

[MS-DRSR-Diff]:

Directory Replication Service (DRS) Remote Protocol

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Revision Summary

Date	Revision History	Revision Class	Comments
3/2/2007	1.0	<u>New</u>	Version 1.0 release
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7/3/2007	1.3	Minor	Added informative reference; minor updates to content.
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1/25/2008	2.0.1	Editorial	Changed language and formatting in the technical content.
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1 Introduction

The Directory Replication Service (DRS) Remote Protocol is an **RPC** protocol for **replication** and management of data in **Active Directory**.

The protocol consists of two RPC interfaces named drsuapi and dsaop. The name of each drsuapi method begins with "IDL_DRS", while the name of each dsaop method begins with "IDL_DSA". This protocol was originally implemented in Windows 2000 Server operating system and is available in all subsequent server releases. It is not available in Windows NT 3.1 operating system, Windows NT 3.51 operating system, or Windows NT 4.0 operating system.

The Windows client operating systems (Windows 2000 operating system, Windows XP operating system, Windows Vista operating system, Windows 7 operating system, Windows 8 operating system, Windows 8.1 operating system, and Windows 10 operating system) can implement a client role for some methods, but cannot implement a server role for any methods. The Windows server operating systems (Windows 2000 Server, Windows Server 2003 operating system, Windows Server 2003 R2 operating system, Windows Server 2008 operating system, Windows Server 2008 R2 operating system, Windows Server 2012 operating system, Windows Server 2012 R2 operating system, and Windows Server 2016 ~~Technical Preview~~ operating system) can implement both client and server roles for all methods. Section 4.1 gives details about the methods for which the Windows client operating systems can implement a client role.

Some functionality exposed by these RPC protocols is also available using the **Lightweight Directory Access Protocol (LDAP)** protocol ([MS-ADTS] section 3.1.1.3); the overlap is described in section 1.4.

The special typographical conventions used in this document are described in section 3.2.

State is included in the state model for this specification only as necessitated by the requirement that a licensee's implementation of Windows server protocols musthas to be capable of receiving messages and responding in the same manner as a Windows server. Behavior is specified in terms of request message received, processing based on current state, resulting state transformation, and response message sent. Unless otherwise specified, all behaviors are required elements of the protocol. Any specified behavior not explicitly qualified with MAY or SHOULD is to be treated as if it were specified as a MUST behavior.

Pervasive Concepts

The following concepts are pervasive throughout this specification.

This specification uses [KNUTH1] section 2.3.4.2 as a reference for the graph-related terms **oriented tree**, root, vertex, arc, initial vertex, and final vertex.

replica: A variable containing a set of objects.

attribute: An identifier for a value or set of values. See also attribute in the Glossary (section 1.1).

object: A set of attributes, each with its associated values. Two attributes of an object have special significance:

- **Identifying attribute:** A designated single-valued attribute appears on every object. The value of this attribute identifies the object. For the set of objects in a replica, the values of the identifying attribute are distinct.
- **Parent-identifying attribute:** A designated single-valued attribute appears on every object. The value of this attribute identifies the **object's** parent. That is, this attribute contains the value of the parent's identifying attribute or a reserved value identifying no object (for more information, see [MS-ADTS] section 3.1.1.1.3). For the set of objects in a replica, the values of this parent-

identifying attribute define an oriented tree with objects as vertices and child-parent references as directed arcs, with the child as an arc's initial vertex and the parent as an arc's final vertex.

Note that an object is a value, not a variable; a **replica** is a variable. The process of adding, modifying, or deleting an object in a replica replaces the entire value of the replica with a new value.

As the term "replica" suggests, it is often the case that two replicas contain "the same objects". In this usage, objects in two replicas are considered "the same" if they have the same value of the identifying attribute and if there is a process in place (that is, replication) to converge the values of the remaining attributes. When the members of a set of replicas are considered to be the same, it is common to say "an object" as a shorthand way of referring to the set of corresponding objects in the replicas.

object class: A set of restrictions on the construction and **update** of objects. An object class must be specified when an object is created. An object class specifies a set of must-have attributes (every object of the class must have at least one value of each) and may-have attributes (every object of the class may have a value of each). An object class also specifies a set of possible superiors (the parent object of an object of the class must have one of these classes). An object class is defined by a classSchema object.

parent object: See "object", above.

child object, children: An object that is not the root of its oriented tree. The children of an object O is the set of all objects whose parent is O .

See [MS-ADTS] section 3.1.1.1.3 for the particular use made of these definitions in this specification.

Sections 1.5, 1.8, 1.9, 2, and 3 of this specification are normative ~~and can contain the terms MAY, SHOULD, MUST, MUST NOT, and SHOULD NOT as defined in [RFC2119]. Sections 1.5 and 1.9 are also normative but do not contain those terms.~~ All other sections and examples in this specification are informative.

1.1 Glossary

~~The~~This document uses the following terms ~~are specific to this document:~~

abstract type: A type used in this specification whose representation need not be standardized for interoperability because the type's use is internal to the specification. See also **concrete type**.

access control list (ACL): A list of access control entries (ACEs) that collectively describe the security rules for authorizing access to some resource; for example, an object or set of objects.

Active Directory: A general-purpose network directory service. **Active Directory** also refers to the Windows implementation of a directory service. **Active Directory** stores information about a variety of **objects** in the network. Importantly, user accounts, computer accounts, groups, and all related credential information used by the Windows implementation of Kerberos are stored in **Active Directory**. **Active Directory** is either deployed as **Active Directory Domain Services (AD DS)** or **Active Directory Lightweight Directory Services (AD LDS)**. [MS-ADTS] describes both forms. For more information, see [MS-AUTHSOD] section 1.1.1.5.2, **Lightweight Directory Access Protocol (LDAP)** versions 2 and 3, Kerberos, and DNS.

Active Directory Domain Services (AD DS): A directory service (DS) implemented by a **domain controller (DC)**. The DS provides a data store for **objects** that is distributed across multiple **DCs**. The **DCs** interoperate as peers to ensure that a local change to an **object** replicates correctly across **DCs**. For more information, see [MS-AUTHSOD] section 1.1.1.5.2 and [MS-ADTS]. For information about product versions, see [MS-ADTS] section 1. See also **Active Directory**.

Active Directory Lightweight Directory Services (AD LDS): A directory service (DS) implemented by a **domain controller (DC)**. The most significant difference between **AD LDS** and **Active Directory Domain Services (AD DS)** is that **AD LDS** does not host **domain naming contexts (domain NCs)**. A server can host multiple **AD LDS DCs**. Each **DC** is an independent **AD LDS** instance, with its own independent state. **AD LDS** can be run as an operating system DS or as a directory service provided by a standalone application (Active Directory Application Mode (ADAM)). For more information, see [MS-ADTS]. See also **Active Directory**.

ancestor object: An **object A** is an ancestor of **object O** if there is a directed path from A to O (in other words, A is on the path from O to the root of the tree containing O).

application naming context (application NC): A specific type of **naming context (NC)**, or an instance of that type, that supports only **full replicas** (no partial replicas). An **application NC** cannot contain security principal objects in Active Directory Domain Services (AD DS), but can contain security principal objects in Active Lightweight Directory Services (AD LDS). A **forest** can have zero or more **application NCs** in either AD DS or AD LDS. An application NC can contain dynamic objects. **Application NCs** do not appear in the **global catalog (GC)**. [The root of an application NC is an object of class domainDNS.](#)

attribute: An identifier for a single or multivalued data element that is associated with a directory **object**. An **object** consists of its **attributes** and their values. For example, cn (common name), street (street address), and mail (email addresses) can all be **attributes** of a **user object**. An **attribute's** schema, including the syntax of its values, is defined in an attributeSchema **object**.

attribute syntax: Specifies the format and range of permissible values of an attribute. The syntax of an attribute is defined by several attributes on the attributeSchema object, as specified in [MS-ADTS] section 3.1.1.2. Attribute syntaxes supported by **Active Directory** include Boolean, Enumeration, Integer, LargeInteger, String(UTC-Time), Object(DS-DN), and String(Unicode).

authentication: The ability of one entity to determine the identity of another entity.

authentication level: A numeric value indicating the level of **authentication** or message protection that **remote procedure call (RPC)** will apply to a specific message exchange. For more information, see [C706] section 13.1.2.1 and [MS-RPCE].

binary large object (BLOB): A collection of binary data stored as a single entity in a database.

binary OID: An **object identifier (OID)** in a Basic Encoding Rules (BER)-encoded binary format, as specified in [ITUX690] section 8.19.

built-in principal: A **security principal** within the built-in domain whose **SID** is identical in every domain.

canonical name: A syntactic transformation of an **Active Directory distinguished name (DN)** into something resembling a path that still identifies an **object** within a **forest**. **DN** "cn=Peter Houston, ou=NTDEV, dc=microsoft, dc=com" translates to the canonical name "microsoft.com/NTDEV/Peter Houston", while the **DN** "dc=microsoft, dc=com" translates to the canonical name "microsoft.com/".

checksum: A value that is the summation of a byte stream. By comparing the checksums computed from a data item at two different times, one can quickly assess whether the data items are identical.

child object, children: An **object** that is not the root of its tree. The children of an **object o** are the set of all **objects** whose parent is o. See section 1 of [MS-ADTS] and section 1 of [MS-DRSR].

class: ~~User-defined binary data that is associated with a key~~[See **object class**.](#)

compression chunk: Portions of replication data that occur when compression is used for that data. Compression chunks are created by dividing the replication data into smaller units that are suitable for the particular algorithm. The chunk size is specific to the compression algorithm being employed.

computer object: An **object** of class computer. A **computer object** is a **security principal object**; the principal is the operating system running on the computer. The shared secret allows the operating system running on the computer to authenticate itself independently of any user running on the system. See **security principal**.

concrete type: A type used in this specification whose representation must be standardized for interoperability. Specific cases include types in the **IDL** definition of an **RPC** interface, types sent over **RPC** but whose representation is unknown to **RPC**, and types stored as byte strings in **directory attributes**.

configuration naming context (config NC): A specific type of **naming context (NC)**, or an instance of that type, that contains configuration information. In **Active Directory**, a single **config NC** is shared among all **domain controllers (DCs)** in the forest. A **config NC** cannot contain security principal objects.

constructed attribute: An attribute whose values are computed from normal attributes (for read) and/or have effects on the values of normal attributes (for write).

container: An **object** in the directory that can serve as the parent for other **objects**. In the absence of schema constraints, all **objects** would be **containers**. The schema allows only **objects** of specific classes to be **containers**.

control access right: An extended access right that can be granted or denied on an **access control list (ACL)**.

critical object: A subset of the **objects** in the default **naming context (NC)**, identified by the attribute `isCriticalSystemObject` having the value `TRUE`. The **objects** that are marked in this way are essential for the operation of a **domain controller (DC)** hosting the **NC**.

crossRef object: An **object** residing in the partitions container of the **config NC** that describes the properties of a **naming context (NC)**, such as its domain naming service name, operational settings, and so on.

cyclic redundancy check (CRC): An algorithm used to produce a **checksum** (a small, fixed number of bits) against a block of data, such as a packet of network traffic or a block of a computer file. The CRC is [a broad class of functions](#) used to detect errors after transmission or storage. A CRC is designed to catch random errors, as opposed to intentional errors. If errors might be introduced by a motivated and intelligent adversary, a cryptographic hash function should be used instead.

default naming context (default NC): When **Active Directory** is operating as **Active Directory Domain Services (AD DS)**, the **default naming context (default NC)** is the **domain naming context (domain NC)** whose full **replica** is hosted by a **domain controller (DC)**, except when the **DC** is a **read-only domain controller (RODC)**, in which case the **default NC** is a filtered partial NC replica. When operating as **AD DS**, [a DC's default NC is the NC of its default NC replica, and](#) the **default NC** contains the **DC's computer object**. When **Active Directory** is operating as **AD LDS**, the **default NC** is the **naming context (NC)** specified by the `msDS-DefaultNamingContext` **attribute** on the **nTDSDSA object** for the **DC**. See **nTDSDSA object**.

deleted-object: An **object** that has been deleted, but remains in storage until a configured amount of time (the deleted-object lifetime) has passed, after which the **object** is transformed to a **recycled-object**. Unlike a **recycled-object** or a **tombstone**, a **deleted-object** maintains virtually all the state of the **object** before deletion, and [may can](#) be undeleted without loss of information. **Deleted-objects** exist only when the **Recycle Bin optional feature** is enabled.

digest: The fixed-length output string from a one-way hash function that takes a variable-length input string and is probabilistically unique for every different input string. Also, a cryptographic checksum of a data (octet) stream.

directory: The database that stores information about objects such as users, groups, computers, printers, and the directory service that makes this information available to users and applications.

~~**directory object:** A **Lightweight Directory Access Protocol (LDAP) object**, as specified in [RFC2251], that is a specialization of an **object**.~~

directory object: An **Active Directory object**, which is a specialization of the "object" concept that is described in [MS-ADTS] section 1 or [MS-DRSR] section 1, Introduction, under Pervasive Concepts. An **Active Directory object** can be identified by the objectGUID **attribute** of a **dsname** according to the matching rules defined in [MS-DRSR] section 5.50, DSNAME. The **parent-identifying attribute** (not exposed as an **LDAP attribute**) is **parent**. **Active Directory objects** are similar to **LDAP entries**, as defined in [RFC2251]; the differences are specified in [MS-ADTS] section 3.1.1.3.1.

directory service agent (DSA): A term from the X.500 **directory** specification [X501] that represents a component that maintains and communicates **directory** information.

distinguished name (DN): In **Lightweight Directory Access Protocol (LDAP)**, an LDAP Distinguished Name, as described in [RFC2251] section 4.1.3. The DN of an object is the DN of its parent, preceded by the RDN of the object. For example: CN=David Thompson, OU=Users, DC=Microsoft, DC=COM. For definitions of CN and OU, see [RFC2256] sections 5.4 and 5.12, respectively.

domain: A set of users and computers sharing a common namespace and management infrastructure. At least one computer member of the set must act as a **domain controller (DC)** and host a member list that identifies all members of the domain, as well as optionally hosting the **Active Directory** service. The domain controller provides **authentication** of members, creating a unit of trust for its members. Each domain has an identifier that is shared among its members. For more information, see [MS-AUTHSOD] section 1.1.1.5 and [MS-ADTS].

domain controller (DC): The service, running on a server, that implements **Active Directory**, or the server hosting this service. The service hosts the data store for **objects** and interoperates with other **DCs** to ensure that a local change to an **object** replicates correctly across all **DCs**. When **Active Directory** is operating as **Active Directory Domain Services (AD DS)**, the **DC** contains **full NC replicas** of the **configuration naming context (config NC)**, **schema naming context (schema NC)**, and one of the **domain NCs** in its **forest**. If the **AD DS DC** is a **global catalog server (GC server)**, it contains **partial NC replicas** of the remaining **domain NCs** in its **forest**. For more information, see [MS-AUTHSOD] section 1.1.1.5.2 and [MS-ADTS]. When **Active Directory** is operating as **Active Directory Lightweight Directory Services (AD LDS)**, several **AD LDS DCs** can run on one server. When **Active Directory** is operating as **AD DS**, only one **AD DS DC** can run on one server. However, several **AD LDS DCs** can coexist with one **AD DS DC** on one server. The **AD LDS DC** contains **full NC replicas** of the **config NC** and the **schema NC** in its **forest**. The domain controller is the server side of Authentication Protocol Domain Support [MS-APDS].

domain name: A **domain name** or a NetBIOS name that identifies a **domain**.

domain naming context (domain NC): A specific type of **naming context (NC)**, or an instance of that type, that represents a **domain**. A **domain NC** can contain security principal objects; no other type of **NC** can contain security principal objects. **Domain NCs** appear in the **global catalog (GC)**. A **domain NC** is hosted by one or more **domain controllers (DCs)** operating as **AD DS**. In **AD DS**, a **forest** has one or more **domain NCs**. A domain NC cannot exist in AD LDS. The root of a **domain NC** is an **object of class** domainDNS; for directory replication [MS-DRSR], see **domainDNS**.

domain security identifier (domain SID): The **SID** of the root **object** of a **domain NC**. The **relative identifier (RID)** portion of the **domain SID** is always zero. Every security principal object in a **domain NC** has an **objectSid** **attribute** equal to the **domain SID** except for the **RID** portion.

domainDNS: A specific **object class**. The root of a **domain NC** or an **application NC** is an **object of class** **domainDNS**. The **DN** of such an **object** takes the form **dc=n1,dc=n2, ... dc=nk**, where each **ni** satisfies the syntactic requirements of a **fully qualified domain name (FQDN) component** (for more information, see [RFC1034]). Such a **DN** corresponds to the **FQDN** **n1.n2.nk**. This is the **FQDN** of the **NC**, and it allows **replicas** of the **NC** to be located by using **DNS**.

DSA GUID: The **objectGUID** of a **DSA object**.

DSA object: See **nTDSDSA object**.

dsname: A tuple that contains between one and three identifiers for an object. The term **dsname** does not stand for anything. The possible identifiers are the object's **GUID** (attribute **objectGuid**), **security identifier (SID)** (attribute **objectSid**), and **distinguished name (DN)** (attribute **distinguishedName**). A **dsname** can appear in a protocol message and as an attribute value (for example, a value of an attribute with syntax **Object(DS-DN)**). Given a **DSName**, an **object** can be identified within a set of **NC replicas** according to the matching rules defined in [MS-DRSR] section 5.49.

dynamic endpoint: A network-specific server address that is requested and assigned at run time. For more information, see [C706].

dynamic object: An object with a time-to-die (attribute **msDS-Entry-Time-To-Die**). The directory service garbage-collects a **dynamic object** immediately after its time-to-die has passed. The constructed attribute **entryTTL** gives a **dynamic object's** current time-to-live, that is, the difference between the current time and **msDS-Entry-Time-To-Die**. For more information, see [RFC2589].

endpoint: A network-specific address of a remote procedure call (RPC) server process for remote procedure calls. The actual name and type of the endpoint depends on the **RPC** protocol sequence that is being used. For example, for RPC over TCP (RPC Protocol Sequence **ncacn_ip_tcp**), an endpoint might be TCP port 1025. For RPC over Server Message Block (RPC Protocol Sequence **ncacn_np**), an endpoint might be the name of a named pipe. For more information, see [C706].

expunge: To permanently remove an object from a **naming context (NC) replica**, without converting it to a **tombstone**.

extended canonical name: Same as a **canonical name**, except that the rightmost forward slash ('/') is replaced with a newline character.

extended operation: A special **replication cycle** in which a client **DC** requests an action on a **FSMO role**; for example, a change in the **FSMO role owner**. **FSMO** role abandon and **FSMO** role transfer are examples of extended operations.

filtered attribute set: The subset of **attributes** that are not replicated to the filtered partial **NC** replica and the filtered **GC** partial **NC** replica. The **filtered attribute set** is part of the state of the **forest** and is used to control the **attributes** that replicate to a **read-only domain controller (RODC)**. The searchFlags **schema attribute** is used to define this set.

flexible single master operation (FSMO): A read or **update** operation on a **naming context (NC)**, such that the operation must be performed on the single designated master **replica** of that **NC**. The master **replica** designation is "flexible" because it can be changed without losing the consistency gained from having a single master. This term, pronounced "fizmo", is never used alone; see also **FSMO role**, **FSMO role owner**, and **FSMO** object.

forest: ~~In the~~For Active Directory directory service, a **forest** is **Domain Services (AD DS)**, a set of **naming contexts (NCs)** consisting of one **schema naming context (schema NC)**, one **configuration naming context (config NC)**, and one or more **domain naming contexts (domain NCs)**, and zero or more **application naming contexts (application NCs)**. Because a set of **NCs** can be arranged into a tree structure, a **forest** is also a set of **containing** one or several trees of **NCs**. For **AD LDS**, a set of **NCs** consisting of one **schema NC**, one **config NC**, and zero or more **application NCs**. (In Microsoft documentation, an **AD LDS forest** is called a "configuration set".)

forest root domain NC: For **Active Directory Domain Services (AD DS)**, the **domain naming context (domain NC)** within a **forest** whose child is the **forest's configuration naming context (config NC)**. The **fully qualified domain name (FQDN)** of the **forest root domain NC** serves as the **forest's** name.

forward link attribute: An **attribute** whose values include **object** references (for example, an **attribute** of syntax Object(DS-DN)). The forward link values can be used to compute the values of a related **attribute**, a back link attribute, on other **objects**. If an **object** o refers to **object** r in **forward link attribute** f, and there exists a back link attribute b corresponding to f, then a back link value referring to o exists in **attribute** b on object r. The relationship between the forward and back link attributes is expressed using the **linkId attribute** on the **attributeSchema objects** representing the two **attributes**. The forward link's **linkId** is an even number, and the back link's **linkId** is the forward link's **linkId** plus one. A **forward link attribute** can exist with no corresponding back link attribute, but not vice-versa. For more information, see [MS-ADTS].

FSMO role: A set of objects that can be updated in only one **naming context (NC)** replica (the FSMO role owner's replica) at any given time. For more information, see [MS-ADTS] section 3.1.1.1.11. See also **FSMO role owner**.

FSMO role object: An **object** in a **directory** that represents a specific **FSMO role**. This **object** is an element of the **FSMO role** and contains the **fsmoRoleOwner** attribute.

FSMO role owner: The **domain controller (DC)** holding the **naming context (NC)** replica in which the **objects** of a **FSMO role** can be updated.

full NC replica: A **naming context (NC) replica** that contains all the **attributes** of the **objects** it contains. A **full replica** accepts originating updates.

fully qualified domain name (FQDN): (1) An unambiguous **domain name** that gives an absolute location in the Domain Name System's (DNS) hierarchy tree, as defined in [RFC1035] section 3.1 and [RFC2181] section 11.

(2) In **Active Directory**, a **fully qualified domain name (FQDN) (1)** that identifies a **domain**.

GC partial attribute set (PAS): The subset of **attributes** that replicate to a GC partial NC replica. A particular **GC partial attribute set (PAS)** is part of the state of the **forest** and is used to control the **attributes** that replicate to **global catalog servers (GC servers)**. The **isMemberOfPartialAttributeSet schema attribute** is used to define this set.

global catalog (GC): A unified partial view of multiple **naming contexts (NCs)** in a distributed partitioned directory. The **Active Directory** directory service **GC** is implemented by **GC servers**. The definition of **global catalog** is specified in [MS-ADTS] section 3.1.1.1.8.

global catalog server (GC server): A **domain controller (DC)** that contains a **naming context (NC) replica** (one full, the rest partial) for each **domain naming context** in the **forest**.

global group: An **Active Directory group** that allows **user objects** from its own **domain** and **global groups** from its own **domain** as members. Also called domain global group. **Universal groups** can contain **global groups**. A **group object** g is a **global group** if and only if **GROUP_TYPE_ACCOUNT_GROUP** is present in g! **groupType**; see [MS-ADTS] section 2.2.12,

"Group Type Flags". A **global group** that is also a security-enabled group is valid for inclusion within ACLs anywhere in the **forest**. If a **domain** is in mixed mode, then a **global group** in that **domain** that is also a security-enabled group allows only **user object** as members. See also domain local group, security-enabled group.

globally unique identifier (GUID): A term used interchangeably with **universally unique identifier (UUID)** in Microsoft protocol technical documents (TDs). Interchanging the usage of these terms does not imply or require a specific algorithm or mechanism to generate the value. Specifically, the use of this term does not imply or require that the algorithms described in [RFC4122] or [C706] must be used for generating the **GUID**. See also **universally unique identifier (UUID)**.

group: A **group object**.

group object: In Active Directory, a group object has an object class group. A group has a forward link attribute member; the values of this attribute either represent elements of the group (for example, objects of class user or computer) or subsets of the group (objects of class group). The representation of group subsets is called "nested group membership". The back link attribute memberOf enables navigation from group members to the groups containing them. Some groups represent groups of security principals and some do not and are, for instance, used to represent email distribution lists.

Interface Definition Language (IDL): The International Standards Organization (ISO) standard language for specifying the interface for remote procedure calls. For more information, see [C706] section 4.

Internet host name: The name of a host as defined in [RFC1123] section 2.1, with the extensions described in [MS-HNDS].

invocation ID: The invocationId **attribute**. An **attribute** of an **nTDSDSA object**. Its value is a unique identifier for a function that maps from **update sequence numbers (USNs)** to **updates** to the **NC replicas** of a **domain controller (DC)**. See also **nTDSDSA object**.

Knowledge Consistency Checker (KCC): An internal Windows component of the **Active Directory** replication that is used to create spanning trees for **domain controller to domain controller** replication and to translate those trees into settings of variables that implement the **replication** topology.

LDAP connection: A TCP connection from a client to a server over which the client sends Lightweight Directory Access Protocol (LDAP) requests and the server sends responses to the client's requests.

Lightweight Directory Access Protocol (LDAP): The primary access protocol for **Active Directory**. Lightweight Directory Access Protocol (LDAP) is an industry-standard protocol, established by the Internet Engineering Task Force (IETF), which allows users to query and update information in a directory service (DS), as described in [MS-ADTS]. The Lightweight Directory Access Protocol can be either version 2 [RFC1777] or version 3 [RFC3377].

lingering object: An **object** that still exists in an **NC replica** even though it has been deleted and garbage-collected from other **replicas**. This occurs, for instance, when a **domain controller (DC)** goes offline for longer than the tombstone lifetime.

link attribute: A **forward link attribute** or a back link attribute.

link value: The value of a **link attribute**.

LinkValueStamplink value stamp: The type of a **stamp** attached to a **link value**.

local domain controller (local DC): A domain controller (DC) on which the current method is executing.

Lost and Found container: A container holding objects in a given **naming context (NC)** that do not have parent objects due to add and remove operations that originated on different **domain controllers (DCs)**. The container is a child of the **NC** root and has RDN CN=LostAndFound in **domain NCs** and CN=LostAndFoundConfig in **config NCs**.

Microsoft Interface Definition Language (MIDL): The Microsoft implementation and extension of the OSF-DCE **Interface Definition Language (IDL)**. **MIDL** can also mean the **Interface Definition Language (IDL)** compiler provided by Microsoft. For more information, see [MS-RPCE].

MSZIP compression algorithm: A compression algorithm specified in [RFC1951] that is used between Windows 2000 **DCs**.

naming context (NC): An **NC** is a set of objects organized as a tree. It is referenced by a DSName. The **DN** of the DSName is the distinguishedName **attribute** of the tree root. The **GUID** of the DSName is the objectGUID **attribute** of the tree root. The **security identifier (SID)** of the DSName, if present, is the objectSid **attribute** of the tree root; for **Active Directory Domain Services (AD DS)**, the **SID** is present if and only if the **NC** is a **domain naming context (domain NC)**. **Active Directory** supports organizing several **NCs** into a tree structure.

NC replica: A variable containing a tree of **objects** whose root **object** is identified by some **naming context (NC)**.

NetBIOS domain name: The name registered by **domain controllers (DCs)** on [1C] records of the NBNS (WINS) server (see section 6.3.4). For details of NetBIOS name registration, see [MS-WPO] sections 7.1.4 and 10.4.

nonreplicated attribute: An attribute whose values are not replicated between **naming context (NC)** replicas. The nonreplicated attributes of an object are, in effect, local variables of the **domain controller (DC)** hosting the **NC** replica containing that object, since changes to these attributes have no effect outside that **DC**.

nTDSDSA object: An **object of class** nTDSDSA that is always located in the **configuration naming context (config NC)**. This **object** represents a **domain controller (DC)** in the **forest**. See [MS-ADTS] section 6.1.1.2.2.1.2.1.1.

NULL GUID: A **GUID** of all zeros.

object: A set of attributes, each with its associated values. ~~Two attributes of an object have special significance: an identifying attribute and a parent identifying attribute. An identifying attribute is a designated single-valued attribute that appears on every object; the value of this attribute identifies the object. For the set of objects in a replica, the values of the identifying attribute are distinct. A parent identifying attribute is a designated single-valued attribute that appears on every object; the value of this attribute identifies the object's parent. That is, this attribute contains the value of the parent's identifying attribute, or a reserved value identifying no object. For the set of objects in a replica, the values of this parent identifying attribute define a tree with objects as vertices and child-parent references as directed edges with the child as an edge's tail and the parent as an edge's head. Note that an object is a value, not a variable; a replica is a variable. The process of adding, modifying, or deleting an object in a replica replaces the entire value of the replica with a new value. As the word replica suggests, it is often the case that two replicas contain "the same objects". In this usage, objects in two replicas are considered the same if they have the same value of the identifying attribute and if there is a process in place (replication) to converge the values of the remaining attributes. When the members of a set of replicas are considered to be the same, it is common to say "an object" as shorthand referring to the set of corresponding objects in the replicas. For more information on objects, see [MS-ADTS] section 1 or [MS-DRSR] section 1.~~

object class: A set of restrictions on the construction and update of objects. An **object class** can specify a set of must-have attributes (every object of the class must have at least one value of

each) and may-have attributes (every object of the class may have a value of each). An **object class** can also specify the allowable classes for the parent object of an object in the class. An **object class** can be defined by single inheritance; an object whose class is defined in this way is a member of all **object classes** used to derive its most specific class. An **object class** is defined in a classSchema object. See section 1 of [MS-ADTS] and section 1 of [MS-DRSR].

object identifier (OID): ~~(1) In the context of an object server, a 64-bit number that uniquely identifies an object.~~

(2) In the Lightweight Directory Access Protocol (LDAP), a sequence of numbers in a format described by [RFC1778]. In many LDAP directory implementations, an OID is the standard internal representation of an attribute. In the directory model used in this specification, the more familiar ldapDisplayName represents an attribute.

object of class x (or x object): An object o such that one of the values of its objectClass attributes is x. For instance, if objectClass contains the value user, o is an object of class user. This is often contracted to "user object".

object reference: An **attribute** value that references an **object**. Reading a reference gives the **distinguished name (DN)** of the **object**.

objectClass: The objectClass **attribute**. The **attribute** on an **object** that holds the object class name of each **object class** of the **object**.

objectGUID: The **attribute** on an **Active Directory** object whose value is a **GUID** that uniquely identifies the object. The **GUID** value of an **object's** objectGUID is assigned when the **object** was created and is immutable thereafter. The integrity of **object references** between **NCs** and of **replication** depends on the integrity of the objectGUID **attribute**. For a description of the general concept of an "object", see [MS-ADTS] section 1. For more detailed information see [MS-ADTS] section 3.1.1.1.3.

objectSid: The objectSid **attribute**. The **attribute** on an **object** whose value is a **SID** that identifies the **object** as a security principal object. The value of an **object's** objectSid is assigned when the security principal object was created and is immutable thereafter unless the **object** moves to another **domain**. The integrity of **authentication** depends on the integrity of the objectSid **attribute**.

opnum: An operation number or numeric identifier that is used to identify a specific remote procedure call (RPC) method or a method in an interface. For more information, see [C706] section 12.5.2.12 or [MS-RPCE].

optional feature: A non-default behavior that modifies the **Active Directory** state model. An **optional feature** is enabled or disabled in a specific scope, such as a **forest** or a **domain**. For more information, refer to [MS-ADTS] section 3.1.1.9.

oriented tree: A directed acyclic graph such that for every vertex v, except one (the root), there is a unique edge whose tail is v. There is no edge whose tail is the root. For more information, see [KNUTH1] section 2.3.4.2.

originating update: An update that is performed to an **NC replica** via any protocol except replication. An **originating update** to an attribute or link value generates a new **stamp** for the attribute or link value.

parent object: An object is either the root of a tree of objects or has a parent. If two objects have the same parent, they must have different values in their **relative distinguished names (RDNs)**. See also, **object** in section 1 of [MS-ADTS] and section 1 of [MS-DRSR].

partial attribute set (PAS): The subset of attributes that replicate to partial **naming context (NC)** replicas. Also, the particular partial attribute set that is part of the state of a forest and that is used to control the attributes that replicate to **global catalog (GC)** servers.

partial NC replica: An **NC replica** that contains a **schema**-specified subset of **attributes** for the **objects** it contains. A **partial NC replica** is not writable—it does not accept **originating updates**. See also **writable NC replica**.

Partitions container: A **child object** of the **configuration naming context (config NC)** root. The **relative distinguished name (RDN)** of the **Partitions container** is "cn=Partitions" and its class is `crossRefContainer` ([MS-ADTS] section 2.30). See also **crossRef object**.

PDC emulator: A **DC** that is designated to track changes made to the accounts of all computers in a **domain**. The **PDC emulator** is the only computer to receive these changes directly and is specialized so as to ensure consistency and to eliminate the potential for conflicting entries in the **Active Directory** database. A **domain** has only one **PDC emulator**.

prefix table: A data structure that is used to translate between an **object identifier (OID)** and a compressed representation for **OIDs**. See [MS-DRSR] section 5.14.

primary domain controller (PDC): A **domain controller (DC)** designated to track changes made to the accounts of all computers on a **domain**. It is the only computer to receive these changes directly, and is specialized so as to ensure consistency and to eliminate the potential for conflicting entries in the **Active Directory** database. A **domain** has only one **PDC**.

primary domain controller (PDC) role owner: The **domain controller (DC)** that hosts the **primary domain controller** emulator FSMO role for a given domain **naming context (NC)**.

principal: See **security principal**.

Privileged Access Management: An optional feature that enables the removal of a link value from the state of a **domain controller (DC)** at a specified date and time.

read permission: The authorization to read an **attribute** of an **object**. For more information, see [MS-ADTS] section 5.1.3.

read-only domain controller (RODC): A **domain controller (DC)** that does not accept **originating updates**. Additionally, an **RODC** does not perform outbound **replication**. An **RODC** cannot be the primary domain controller (PDC) for its domain.

Recycle Bin: An **optional feature** that modifies the state model of object deletions and undeletions, making undeletion of **deleted-objects** possible without loss of the object's attribute values. For more information, see [MS-ADTS] section 3.1.1.9.1.

recycled-object: An **object** that has been deleted, but remains in storage until a configured amount of time (the tombstone lifetime) has passed, after which the **object** is permanently removed from storage. Unlike a **deleted-object**, most of the state of the **object** has been removed, and the **object** **may** no longer be undeleted without loss of information. By keeping the **recycled-object** in existence for the tombstone lifetime, the deleted state of the **object** is able to replicate. **Recycled-objects** exist only when the **Recycle Bin optional feature** is enabled.

relative distinguished name (RDN): The name of an **object** relative to its parent. This is the leftmost attribute-value pair in the **distinguished name (DN)** of an **object**. For example, in the **DN** "cn=Peter Houston, ou=NTDEV, dc=microsoft, dc=com", the **RDN** is "cn=Peter Houston". For more information, see [RFC2251].

relative identifier (RID): The last item in the series of SubAuthority values in a **security identifier (SID)** [SIDD]. It distinguishes one account or group from all other accounts and groups in the domain. No two accounts or groups in any domain share the same RID.

remote procedure call (RPC): A context-dependent term commonly overloaded with three meanings. Note that much of the industry literature concerning RPC technologies uses this term interchangeably for any of the three meanings. Following are the three definitions: (*) The

runtime environment providing remote procedure call facilities. The preferred usage for this meaning is "RPC runtime". (*) The pattern of request and response message exchange between two parties (typically, a client and a server). The preferred usage for this meaning is "RPC exchange". (*) A single message from an exchange as defined in the previous definition. The preferred usage for this term is "RPC message". For more information about RPC, see [C706].

replica: A variable containing a set of objects.

replicated attribute: An **attribute** whose values are replicated to other **NC replicas**. An **attribute** is replicated if its attributeSchema **object** o does not have a value for the systemFlags **attribute**, or if the FLAG_ATTR_NOT_REPLICATED bit (bit 0) of o! systemFlags is zero.

replicated update: An update performed to a **naming context (NC) replica** by the **replication** system, to propagate the effect of an **originating update** at another **NC replica**. The **stamp** assigned during the **originating update** to attribute values or a link value is preserved by **replication**.

replication: The process of propagating the effects of all originating writes to any replica of a **naming context (NC)**, to all replicas of the **NC**. If originating writes cease and replication continues, all replicas converge to a common application-visible state.

replication cycle: Sometimes referred to simply as "cycle". A series of one or more **replication** responses associated with the same **invocationId**, concluding with the return of a new up-to-date vector.

replication epoch: A state variable of a **DC** that changes when a **DC** is no longer compatible for **replication** with its former partners. A server receiving a **replication** request tests the client's **replication epoch** against its own, and refuses the request if the two are not equal.

replication latency: The time lag between a final originating update to a **naming context (NC) replica** and all **NC replicas** reaching a common application-visible state.

RPC protocol sequence: A character string that represents a valid combination of a **remote procedure call (RPC)** protocol, a network layer protocol, and a transport layer protocol, as described in [C706] and [MS-RPCE].

RPC transport: The underlying network services used by the remote procedure call (RPC) runtime for communications between network nodes. For more information, see [C706] section 2.

schema: The set of **attributes** and **object classes** that govern the creation and update of **objects**.

schema naming context (schema NC): A specific type of **naming context (NC)** or an instance of that type. A **forest** has a single **schema NC**, which is replicated to each **domain controller (DC)** in the **forest**. No other **NC replicas** can contain these **objects**. Each **attribute** and class in the **forest's** schema is represented as a corresponding **object** in the **forest's schema NC**. A schema NC cannot contain security principal objects.

secret data: An implementation-specific set of **attributes** on **objects of class** user that contain security-sensitive information about the **security principal**.

security context: A data structure containing authorization information for a particular **security principal** in the form of a collection of **security identifiers (SIDs)**. One **SID** identifies the **principal** specifically, whereas others ~~may~~ represent other capabilities. A server uses the authorization information in a **security context** to check access to requested resources.

security descriptor: A data structure containing the security information associated with a securable **object**. A **security descriptor** identifies an **object's** owner by its **security identifier (SID)**. If access control is configured for the **object**, its **security descriptor**

contains a discretionary access control list (DACL) with **SIDs** for the **security principals** who are allowed or denied access. Applications use this structure to set and query an **object's** security status. The **security descriptor** is used to guard access to an **object** as well as to control which type of auditing takes place when the **object** is accessed. The **security descriptor** format is specified in [MS-DTYP] section 2.4.6; a string representation of **security descriptors**, called SDDL, is specified in [MS-DTYP] section 2.5.1.

security identifier (SID): An identifier for **security principals** in Windows that is used to identify an account or a group. Conceptually, the **SID** is composed of an account authority portion (typically a **domain**) and a smaller integer representing an identity relative to the account authority, termed the **relative identifier (RID)**. The **SID** format is specified in [MS-DTYP] section 2.4.2; a string representation of **SIDs** is specified in [MS-DTYP] section 2.4.2 and [MS-AZOD] section 1.1.1.2.

security principal: A unique entity, also referred to as a principal, that can be authenticated by **Active Directory**. It frequently corresponds to a human user, but also can be a service that offers a resource to other security principals. Other security principals might be a group, which is a set of principals. Groups are supported by **Active Directory**.

security provider: A pluggable security module that is specified by the protocol layer above the **remote procedure call (RPC)** layer, and will cause the **RPC** layer to use this module to secure messages in a communication session with the server. The security provider is sometimes referred to as an **authentication** service. For more information, see [C706] and [MS-RPCE].

server object: A class of **object** in the **configuration naming context (config NC)**. A **server object** can have an **ntdsdsa object** as a child.

service account: A stored set of **attributes** that represent a **principal** that provides a **security context** for services.

service class: The first part of a **service principal name**. See [MS-KILE] section 3.1.5.11.

service principal name (SPN): The name a client uses to identify a service for mutual **authentication**. (For more information, see [RFC1964] section 2.1.1.) An **SPN** consists of either two parts or three parts, each separated by a forward slash ('/'). The first part is the **service class**, the second part is the instance name, and the third part (if present) is the service name. For example, "ldap/dc-01.fabrikam.com/fabrikam.com" is a three-part **SPN** where "ldap" is the service class name, "dc-01.fabrikam.com" is the instance name, and "fabrikam.com" is the service name. See [SPNNAMES] for more information about **SPN** format and composing a unique **SPN**.

session key: A relatively short-lived symmetric key (a cryptographic key negotiated by the client and the server based on a shared secret). A **session key's** lifespan is bounded by the session to which it is associated. A **session key** ~~should~~has to be strong enough to withstand cryptanalysis for the lifespan of the session.

SHA1 hash: A hashing algorithm defined in [FIPS180] that was developed by the National Institute of Standards and Technology (NIST) and the National Security Agency (NSA).

site: A collection of one or more well-connected (reliable and fast) TCP/IP subnets. By defining **sites** (represented by **site objects**) an administrator can optimize both **Active Directory** access and **Active Directory replication** with respect to the physical network. When users log in, **Active Directory** clients find **domain controllers (DCs)** that are in the same **site** as the user, or near the same **site** if there is no **DC** in the **site**. See also **Knowledge Consistency Checker (KCC)**. For more information, see [MS-ADTS].

site object: An **object** of class site, representing a **site**.

stamp: Information that describes an **originating update** by a **domain controller (DC)**. The **stamp** is not the new data value; the **stamp** is information about the update that created the

new data value. A **stamp** is often called metadata, because it is additional information that "talks about" the conventional data values. A **stamp** contains the following pieces of information: the unique identifier of the **DC** that made the **originating update**; a sequence number characterizing the order of this change relative to other changes made at the originating **DC**; a version number identifying the number of times the data value has been modified; and the time when the change occurred.

STATUS code: A 32-bit quantity where zero represents success and nonzero represents failure. The specific failure codes used in this specification are **Windows error codes**.

subordinate reference object (sub-ref object): The **naming context (NC)** root of a parent NC has a list of all the **NC** roots of its child NCs in the subRefs **attribute** ([MS-ADA3] section 2.282). Each entry in this list is a subordinate reference and the **object** named by the entry is denominated a **subordinate reference object**. An **object** is a **subordinate reference object** if and only if it is in such a list. If a server has **replicas** of both an **NC** and its child NC, then the child NC root is the **subordinate reference object**, in the context of the parent NC. If the server does not have a **replica** of the child NC, then another **object**, with distinguishedName ([MS-ADA1] section 2.177) and objectGUID ([MS-ADA3] section 2.44) **attributes** equal to the child NC root, is present in the server and is the **subordinate reference object**.

target object: An object referenced by a forward link value.

tombstone: An object that has been deleted, but remains in storage until a configured amount of time (the tombstone lifetime) has passed, after which the object is permanently removed from storage. By keeping the **tombstone** in existence for the tombstone lifetime, the deleted state of the object is able to replicate. **Tombstones** exist only when the **Recycle Bin optional feature** is not enabled.

Unicode: A character encoding standard developed by the Unicode Consortium that represents almost all of the written languages of the world. The **Unicode** standard [UNICODE5.0.0/2007] provides three forms (UTF-8, UTF-16, and UTF-32) and seven schemes (UTF-8, UTF-16, UTF-16 BE, UTF-16 LE, UTF-32, UTF-32 LE, and UTF-32 BE).

universal group: An **Active Directory group** that allows **user objects, global groups, and universal groups** from anywhere in the **forest** as members. A **group object g** is a **universal group** if and only if GROUP_TYPE_UNIVERSAL_GROUP is present in g! groupType. A security-enabled universal group is valid for inclusion within ACLs anywhere in the **forest**. If a **domain** is in mixed mode, then a **universal group** cannot be created in that **domain**. See also domain local group, security-enabled group.

universally unique identifier (UUID): A 128-bit value. UUIDs can be used for multiple purposes, from tagging objects with an extremely short lifetime, to reliably identifying very persistent objects in cross-process communication such as client and server interfaces, manager entry-point vectors, and **RPC** objects. UUIDs are highly likely to be unique. UUIDs are also known as **globally unique identifiers (GUIDs)** and these terms are used interchangeably in the Microsoft protocol technical documents (TDs). Interchanging the usage of these terms does not imply or require a specific algorithm or mechanism to generate the UUID. Specifically, the use of this term does not imply or require that the algorithms described in [RFC4122] or [C706] must be used for generating the UUID.

update: An add, modify, or delete of one or more objects or attribute values. See **originating update, replicated update**.

update sequence number (USN): A monotonically increasing sequence number used in assigning a stamp to an originating update. For more information, see [MS-ADTS].

up-to-date vector: The representation of an assertion about the presence of **originating updates** from different sources in an **NC replica**. See **replication cycle** and **update sequence number (USN)**.

user object: An object of class user. A user object is a security principal object; the principal is a person or service entity running on the computer. The shared secret allows the person or service entity to authenticate itself, as described in ([MS-AUTHSOD] section 1.1.1.1).

Windows error code: A 32-bit quantity where zero represents success and nonzero represents failure. The specific failure codes are specified in [MS-ERREF].

writable naming context (NC) replica: A **naming context (NC)** replica that accepts originating updates. A **writable NC replica** is always full, but a **full NC replica** is not always writable. Partial replicas are not writable. See also read-only full NC replica.

MAY, SHOULD, MUST, SHOULD NOT, MUST NOT: These terms (in all caps) are used as defined in [RFC2119]. All statements of optional behavior use either MAY, SHOULD, or SHOULD NOT.

1.2 References

Links to a document in the Microsoft Open Specifications library point to the correct section in the most recently published version of the referenced document. However, because individual documents in the library are not updated at the same time, the section numbers in the documents may not match. You can confirm the correct section numbering by checking the Errata.

1.2.1 Normative References

We conduct frequent surveys of the normative references to assure their continued availability. If you have any issue with finding a normative reference, please contact dohelp@microsoft.com. We will assist you in finding the relevant information.

[C706] The Open Group, "DCE 1.1: Remote Procedure Call", C706, August 1997, <https://www2.opengroup.org/ogsys/catalog/c706>

[ISO/IEC 13239] International Organization for Standardization, "Information technology -- Telecommunications and information exchange between systems -- High-level data link control (HDLC) procedures", <http://www.iso.org/iso/en/CatalogueDetailPage.CatalogueDetail?CSNUMBER=37010&ICS1=35&ICS2=100&ICS3=20&showrevision=y&scopelist=CATALOGUE>

[ITUX690] ITU-T, "ASN.1 Encoding Rules: Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER)", Recommendation X.690, July 2002, <http://www.itu.int/ITU-T/studygroups/com17/languages/X.690-0207.pdf>

[MS-ADA1] Microsoft Corporation, "Active Directory Schema Attributes A-L".

[MS-ADA2] Microsoft Corporation, "Active Directory Schema Attributes M".

[MS-ADA3] Microsoft Corporation, "Active Directory Schema Attributes N-Z".

[MS-ADLS] Microsoft Corporation, "Active Directory Lightweight Directory Services Schema".

[MS-ADSC] Microsoft Corporation, "Active Directory Schema Classes".

[MS-ADTS] Microsoft Corporation, "Active Directory Technical Specification".

[MS-DTYP] Microsoft Corporation, "Windows Data Types".

[MS-ERREF] Microsoft Corporation, "Windows Error Codes".

[MS-KILE] Microsoft Corporation, "Kerberos Protocol Extensions".

[MS-LSAD] Microsoft Corporation, "Local Security Authority (Domain Policy) Remote Protocol".

- [MS-NRPC] Microsoft Corporation, "Netlogon Remote Protocol".
- [MS-RPCE] Microsoft Corporation, "Remote Procedure Call Protocol Extensions".
- [MS-SAMR] Microsoft Corporation, "Security Account Manager (SAM) Remote Protocol (Client-to-Server)".
- [MS-SRPL] Microsoft Corporation, "Directory Replication Service (DRS) Protocol Extensions for SMTP".
- [RC4] RSA Data Security, Inc., "The RC4 Encryption Algorithm", <http://www.rsa.com/node.aspx?id=1204>
- [RFC1034] Mockapetris, P., "Domain Names - Concepts and Facilities", STD 13, RFC 1034, November 1987, <http://www.ietf.org/rfc/rfc1034.txt>
- [RFC1321] Rivest, R., "The MD5 Message-Digest Algorithm", RFC 1321, April 1992, <http://www.ietf.org/rfc/rfc1321.txt>
- [RFC1951] Deutsch, P., "DEFLATE Compressed Data Format Specification version 1.3", RFC 1951, May 1996, <http://www.ietf.org/rfc/rfc1951.txt>
- [RFC1964] Linn, J., "The Kerberos Version 5 GSS-API Mechanism", RFC 1964, June 1996, <http://www.rfc-editor.org/rfc/rfc1964.txt>
- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997, <http://www.rfc-editor.org/rfc/rfc2119.txt>
- [RFC2251] Wahl, M., Howes, T., and Kille, S., "Lightweight Directory Access Protocol (v3)", RFC 2251, December 1997, <http://www.ietf.org/rfc/rfc2251.txt>
- [RFC2252] Wahl, M., Coulbeck, A., Howes, T., and Kille, S., "Lightweight Directory Access Protocol (v3): Attribute Syntax Definitions", RFC 2252, December 1997, <http://www.ietf.org/rfc/rfc2252.txt>
- [RFC2253] Wahl, M., Kille, S., and Howe, T., "Lightweight Directory Access Protocol (v3): UTF-8 String Representation of Distinguished Names", RFC 2253, December 1997, <http://www.ietf.org/rfc/rfc2253.txt>
- [RFC2254] Howes, T., "The String Representation of LDAP Search Filters", RFC 2254, December 1997, <http://www.ietf.org/rfc/rfc2254.txt>
- [RFC2821] Klensin, J., "Simple Mail Transfer Protocol", RFC 2821, April 2001, <http://www.ietf.org/rfc/rfc2821.txt>
- [RFC4122] Leach, P., Mealling, M., and Salz, R., "A Universally Unique Identifier (UUID) URN Namespace", RFC 4122, July 2005, <http://www.ietf.org/rfc/rfc4122.txt>

1.2.2 Informative References

- [KNUTH1] Knuth, D., "The Art of Computer Programming: Volume 1/Fundamental Algorithms (Second Edition)", Reading, MA: Addison-Wesley, 1973, ASIN: B000NV8YOA.
- [MS-ADOD] Microsoft Corporation, "Active Directory Protocols Overview".
- [MS-LSAT] Microsoft Corporation, "Local Security Authority (Translation Methods) Remote Protocol".
- [NELSON] Nelson, G., "Systems Programming with Modula-3", Englewood Cliffs, NJ: Prentice Hall, 1991, ISBN: 0135904641.

1.3 Overview

This document specifies the Directory Replication Service (DRS) Remote Protocol, an RPC protocol for replication between **domain controllers** and management of Active Directory. The protocol consists of two RPC interfaces, named drsuapi and dsaop. The name of each drsuapi method begins with "IDL_DRS", while the name of each dsaop method begins with "IDL_DSA".

1.3.1 Methods Categorized by Function

The DRS Remote Protocol contains ~~31~~ methods. ~~These methods that~~ are diverse in function and fall into the following categories:

- Context handle methods: IDL_DRSBind, IDL_DRSUnbind. These methods create and destroy RPC context handles that maintain volatile state used by drsuapi methods. The dsaop methods do not use context handles.
- Replication methods: IDL_DRSGetNCChanges, IDL_DRSReplicaSync, IDL_DRSReplicaVerifyObjects, IDL_DRSGetReplInfo. The IDL_DRSGetNCChanges method replicates **directory** changes from the server to the client. The IDL_DRSReplicaSync and IDL_DRSReplicaVerifyObjects methods cause the server to call IDL_DRSGetNCChanges on the client. The IDL_DRSGetReplInfo method is used to gather information about the replication state of the server.
- Cross-domain move method: IDL_DRSInterDomainMove. This method is used in the server implementation of LDAP Modify **DN** when the DN modification moves an object from one **domain NC** to another.
- Lookups: IDL_DRSVerifyNames, IDL_DRSCrackNames, IDL_DRSGetMemberships, IDL_DRSGetMemberships2. These methods perform specialized directory lookups. They are all used by a DC client; the IDL_DRSCrackNames method is commonly used by a non-DC client.
- DC Locator support methods: IDL_DRSDomainControllerInfo, IDL_DRSQuerySitesByCost. These methods retrieve information about the domain controllers in a **domain** or **forest** and information about the cost of connections between different **sites**.
- Windows NT 4.0 Replication support method: IDL_DRSGetNT4ChangeLog. This method is used in the implementation of Active Directory support for replication to Windows NT 4.0 backup domain controllers (BDCs), specifically in the implementation of moving the **PDC Emulator FSMO role** from one DC to another without triggering a full sync of Windows NT 4.0 BDCs (see [MS-NRPC] section 3.6).
- **Knowledge Consistency Checker (KCC)** support methods: IDL_DRSUpdateRefs, IDL_DRSReplicaAdd, IDL_DRSReplicaDel, IDL_DRSReplicaModify, IDL_DRSExecuteKCC. These methods are used by the KCC ([MS-ADTS] section 6.2) and by administrator tools to manage replication topology.
- Administrator-tool support methods: IDL_DRSAddEntry, IDL_DRSAddSidHistory, IDL_DRSRemoveDsServer, IDL_DRSRemoveDsDomain, IDL_DRSGetObjectExistence, IDL_DSAPrepareScript, IDL_DSAExecuteScript, IDL_DRSWriteSPN, IDL_DRSInitDemotion, IDL_DRSFinishDemotion, IDL_DRSReplicaDemotion, IDL_DRSAddCloneDC. These methods are used by administrator tools to perform various specialized functions.
- msDS-KeyCredentialLink attribute support methods: IDL_DRSWriteNgckKey, IDL_DRSReadNgckKey. These methods are used to create or query the msDS-KeyCredentialLink attribute on a computer account.

The specification of each method in section 4, includes an *Informative summary of behavior* that provides a detailed introduction to the method.

1.3.2 Sequencing Issues

The sequencing issues in this RPC protocol are as follows:

- For server and client initialization, see section 3.6.
- The drsuapi RPC interface is a "context handle"-based RPC interface; [C706] specifies what this means. A client obtains a DRS_HANDLE for a particular DC by calling IDL_DRSBind, then calls any other drsuapi method on that DC, passing the DRS_HANDLE as the first parameter. The client's DRS_HANDLE remains valid for making method calls until the client calls IDL_DRSUnbind, or until the server unilaterally invalidates the DRS_HANDLE (for example, by crashing).

The only state associated with a DRS_HANDLE is the state established by IDL_DRSBind. This state is immutable for as long as the DRS_HANDLE remains valid. Therefore, if a client creates two binding handles to the same DC by using the same parameters to IDL_DRSBind, the server behavior of a drsuapi method is not affected by the client's choice of binding handle passed to the method.

Because the state associated with a DRS_HANDLE is immutable so long as the DRS_HANDLE remains valid, there are no special considerations involved in making concurrent method calls using the same DRS_HANDLE; the client is free to make concurrent method calls.

- Two methods use the "cookie" design pattern. In this pattern, the client sends an initial request containing a designated null value for a certain parameter. The server response contains a value that is opaque to the client or contains the designated null value. If the value is not null, and the response indicates that another client request is required to complete some higher-level operation, the client sends the opaque value returned by the server in the next request rather than sending the designated null value. The exchange of requests and responses continues until some response indicates that the higher-level operation is complete.

The two methods that follow this pattern are:

- IDL_DRSGetNCChanges: In this instance of the "cookie" pattern, the server returns a "cookie" in the response that completes the higher-level operation. The client [maycan](#) use this cookie at the start of the next higher-level operation. The higher-level operation is a complete **replication cycle** that improves the client's **up-to-date vector**. See section 4.1.10.1 for an explanation of replication cycles.
- IDL_DRSGetNT4ChangeLog: In this instance of the "cookie" pattern, the server returns a "cookie" in the response that completes the higher-level operation. The client does not use this cookie at the start of the next higher-level operation. The client supplies the designated null value at the start of the next higher-level operation. The higher-level operation is the retrieval of a complete Windows NT 4.0 change log. See the informative summary of this method in section 4.1.11.3.
- Successfully processing an IDL_DSAPrepareScript request generates a password and stores that password locally on the server. The server returns this password in the IDL_DSAPrepareScript response. When a server is in this state (that is, when it holds the password created by IDL_DSAPrepareScript), it processes an IDL_DSASExecuteScript request that includes this password; otherwise it rejects the request.
- IDL_DRSInitDemotion is called before the other demotion methods: IDL_DRSReplicaDemotion and IDL_DRSFinishDemotion.
- Otherwise, all method requests are independent, apart from their dependencies on the state of the directory. The potential dependencies are varied, and understanding them requires understanding the state model specified in [MS-ADTS] section 3.1.1. Here are some examples:
 - Successfully processing an IDL_DRSSAddEntry request can create a **crossRef object**. When the directory is in this state (that is, when it holds the crossRef object), an

IDL_DRSSRemoveDsDomain request can successfully remove that crossRef object (subject to other conditions specified with IDL_DRSSRemoveDsDomain).

- Successfully processing an IDL_DRSSAddEntry request can create an **nTDSDSA object**. When the directory is in this state (that is, when it holds the nTDSDSA object), an IDL_DRSSRemoveDsServer request can successfully remove that nTDSDSA object.
- Successfully processing an IDL_DRSSReplicaAdd request creates a repsFrom value on a server. When a server is in this state (that is, when it holds the repsFrom value), it has the information needed to make an IDL_DRSSGetNCChanges request on the DC that is specified in IDL_DRSSReplicaAdd.
- Successfully processing an IDL_DRSSUpdateRefs request creates a repsTo value on a server. When a server is in this state (that is, when it holds the repsTo value), it has the information needed to make an IDL_DRSSReplicaSync request on the DC that is specified in IDL_DRSSUpdateRefs.
- Successfully processing an IDL_DRSSRemoveDsDomain request first requires the removal of the metadata for all DCs hosting the domain NC for the domain that is to be removed. This precondition is achieved by the client calling IDL_DRSSRemoveDsServer for each such DC.

State-based sequencing issues also exist between methods specified in this document and LDAP, because LDAP provides another way to change the state of the directory.

- One method, IDL_DRSSGetReplInfo, has a parameter of both input and output, *dwEnumerationContext*. This parameter is defined for the following:
 - *dwInVersion=2*, and
 - *InfoType=DS_REPL_INFO_METADATA_FOR_ATTR_VALUE*, or *DS_REPL_INFO_METADATA_2_FOR_ATTR_VALUE*, or *DS_REPL_INFO_CURSORS_2_FOR_NC*, or *DS_REPL_INFO_CURSORS_3_FOR_NC*.

For the first call to this method for a specific InfoType, the client sets *dwEnumerationContext* in *pmsgIn* to zero. The server returns an implementation-specific value for *dwEnumerationContext* in *pmsgOut*. On subsequent calls to this method with the same InfoType, the client sets the input *dwEnumerationContext* in *pmsgIn* to the last value of that field returned from the server. The purpose of this field is to allow the client to gather all the requested information, but in more than one server call. The final call is identified when the method returns *ERROR_NO_MORE_ITEMS*. See the server implementation section for IDL_DRSSGetReplInfo (4.1.13.3) for exact details.

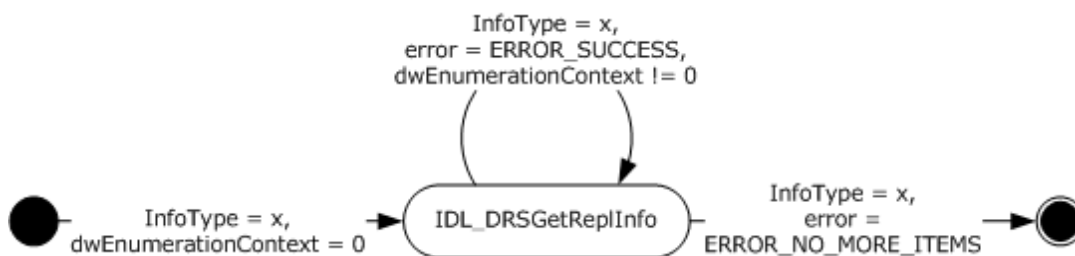


Figure 1: Using dwEnumerationContext

1.3.3 Most Frequently Used Types

The role of the DRS_HANDLE type, described in the previous section (Sequencing Issues), plays a central role in capability negotiation, as explained in the specification of IDL_DRSSBind.

The type that is most central to this protocol is DSNAME. DSNAME is the **concrete type** for the abstract DSNAME specified in [MS-ADTS] section 3.1.1.1.5. A DSNAME identifies an object. Nearly every method in the DRS protocol contains a DSNAME either in its request or its response.

Another basic type in the DRS Remote Protocol is ENTINF. An ENTINF structure contains the DSNAME of an object (or object to be) and a list of **attributes** with associated values—ATTRBLOCK ENTINF and ATTRBLOCK are used in the following ways:

- To communicate some or all of the current state of an object:
 - In the response to an IDL_DRSGetNCChanges request, where multiple ENTINF structures are embedded in a REPLENTINFLIST structure. The request plus the **stamps** on the object determine what information about the object is included in the response.
 - In the response to an IDL_DRSVerifyNames request, which includes an ENTINF structure. The request specifies what information about the object is included in the response.
- To specify the state of an object to be created by a method:
 - In an IDL_DRSSAddEntry request, where the request message is essentially an ENTINF structure but is not declared as such: The DSNAME and the ATTRBLOCK structures are separate top-level fields of the request.
 - In an IDL_DRSInterDomainMove request, where an ENTINF structure specifies the state of the object that is being created in another domain (unlike LDAP Add, with a specified objectGUID).
- To specify the subset of the current state of an object to be returned in a response:
 - In an IDL_DRSVerifyNames request, where an ATTRBLOCK structure specifies attributes but not their values.

1.4 Relationship to Other Protocols

This protocol includes replication that is based on the IP protocol, which is implemented as the IDL_DRSGetNCChanges method (section 4.1.10). Active Directory also supports replication based on the SMTP protocol; SMTP-based replication is specified in [MS-SRPL].

Some of the Active Directory state exposed by this protocol is also exposed by the Active Directory implementation of LDAP; see [MS-ADTS] section 3.1.1.

Some methods in this protocol are exposed, in modified form, via LDAP. The LDAP versions are specified in [MS-ADTS] section 3.1.1.3.

- RootDSE constructed attributes: msDS-ReplAllInboundNeighbors, msDS-ReplConnectionFailures, msDS-ReplLinkFailures, msDS-ReplPendingOps, msDS-ReplAllOutboundNeighbors, msDS-ReplQueueStatistics (these expose some functionality of IDL_DRSGetReplInfo), dnsHostName, dsServiceName, isGlobalCatalogReady, serverName (these expose some functionality of IDL_DRSDomainControllerInfo).
- RootDSE modify operations: becomeDomainMaster, becomeInfrastructureMaster, becomePdc, becomeRidMaster, becomeSchemaMaster, replicateSingleObject, removeLingeringObject. The last two operations expose some functionality of IDL_DRSGetNCChanges.
- Object constructed attributes: canonicalName (this exposes some functionality of IDL_DRSCrackNames), msDS-NCReplInboundNeighbors, msDS-NCReplCursors, msDS-ReplAttributeMetaData, msDS-ReplValueMetaData, msDS-NCReplOutboundNeighbors (these expose some functionality of IDL_DRSGetReplInfo), tokenGroups, tokenGroupsNoGCAcceptable, tokenGroupsGlobalAndUniversal (these expose some functionality of IDL_DRSGetMemberships and IDL_DRSGetMemberships2).

- Controls: LDAP_SERVER_DIRSYNC_OID

The LDAP control LDAP_SERVER_CROSSDOM_MOVE_TARGET_OID is related to IDL_DRSInterDomainMove in that the LDAP client specifies via this control the DC whose IDL_DRSInterDomainMove method should be called (from the LDAP server implementation of Modify DN) to perform the move.

Some methods in this protocol have completely functional equivalents in LDAP:

- The function of IDL_DRSWriteSPN can be performed as an LDAP Modify of the servicePrincipalName attribute.
- The function of creating a crossRef object with IDL_DRSAddEntry can be performed as an LDAP Add of a crossRef object.

1.5 Prerequisites/Preconditions

This protocol is based on RPC and therefore has the prerequisites identified in [MS-RPCE] as common to all RPC interfaces.

Security configuration for usage of RPC is described further in section 2.2.

The Active Directory service must be fully initialized as described in [MS-ADOD] section 2.6.

1.6 Applicability Statement

This protocol is appropriate for replicating (DC-to-DC only) and managing objects in a directory service and for overall management of the directory service.

1.7 Versioning and Capability Negotiation

This document covers versioning issues in the following areas:

- **Supported Transports:** RPC can be implemented on top of TCP and other protocol sequences as described in section 2.1.
- **Protocol Versions:** Each of the protocol interfaces described in this document has a single version number: 4.0 for drsuapi and 1.0 for dsaop.
- **Security and Authentication Methods:** See [MS-RPCE] section 1.7.
- **Capability Negotiation:** This protocol does explicit capability negotiation as described in IDL_DRSBind (section 4.1.3) behavior.

1.8 Vendor-Extensible Fields

This protocol uses Win32 error codes as defined in [MS-ERREF] section 2.2. Vendors SHOULD reuse those values with their indicated meaning. Choosing any other value risks a collision in the future.

This protocol uses NTSTATUS values as defined in [MS-ERREF] section 2.3. Vendors can choose their own values for this field, as long as the C bit (0x20000000) is set, indicating that it is a customer code.

1.9 Standards Assignments

Parameter	Value	Reference
RPC interface UUID for drsuapi	e3514235-4b06-11d1-ab04-	Section 4.1.1 – section

Parameter	Value	Reference
methods	00c04fc2dcd2	4.1.29
RPC interface UUID for dsaop methods	7c44d7d4-31d5-424c-bd5e-2b3e1f323d22	Section 4.2.1 – section 4.2.2

2 Message Transport

The following sections discuss **RPC transport** and security considerations for this protocol. Common data types are defined and discussed in section 5. See section 3 for more details about the organization of this protocol specification.

2.1 RPC Transport

This protocol uses the following **RPC protocol sequence**: RPC over TCP as defined in [MS-RPCE]. A server MAY listen on additional RPC protocol sequences. A client SHOULD attempt to connect using the RPC-over-TCP protocol sequence.<1>

This protocol uses RPC **dynamic endpoints**, as described in [C706] part 4.

Implementations MUST use the UUIDs as specified in section 1.9. The RPC version number is 4.0 for the drsuapi interface and 1.0 for the dsaop interface.

2.2 Protocol Security

This section describes the security mechanisms used for this RPC-based protocol.

2.2.1 General Background

A DC authenticates using its **service account**. In **AD DS**, this is the Local System account on the machine running the DC, represented by the computer object of the machine. In **AD LDS**, a DC's service account is configured by the administrator.

In AD DS, connections for DC-to-DC communications MUST use mutual **authentication** and encryption of protocol traffic. Mutual authentication is provided by Kerberos (see [MS-KILE] section 3.3.1).

In AD LDS, mutual authentication for DC-to-DC communications is not required. When a connection is established, the client uses the GSS Negotiate protocol, which first attempts to use Kerberos, and if Kerberos is unavailable, attempts NTLM (which does not give mutual authentication). If the msDS-RepAuthenticationMode attribute on the **config NC** root equals 2, all DCs in the AD LDS forest require mutual authentication for DC-to-DC communications.

Connections from a non-DC client to a DC do not require mutual authentication. Therefore, NTLM is an acceptable **security provider** in addition to Kerberos.

When a connection is established, the non-DC client uses the GSS Negotiate protocol, which first attempts to use Kerberos and then, if Kerberos is unavailable, attempts NTLM (which does not give mutual authentication).

2.2.2 Service Principal Names for Domain Controllers

In the absence of a trusted naming service, which maps service names to servers providing a given service, the client of a distributed service must authenticate a *service*, not a server. The client produces a **service principal name (SPN)**, which is a name for the service it wants a connection to, and the authentication system verifies that the server is a provider of the named service.

Kerberos verifies the services provided by a server by reading the servicePrincipalName attribute of the server's computer object. The servicePrincipalName attribute contains a set of **Unicode** strings; each string is an SPN. If the client produces an SPN that is not present on the computer object of the server it has requested a connection to, the mutual authentication fails and so does the connection attempt.

Each DC maintains the values of the servicePrincipalName attribute on its own computer object.

For the protocols specified in this document, the SPN produced by a client differs for DC-to-DC communications and non-DC-client-to-DC communications. The specific SPNs produced by a client in each scenario are described in the following sections.

In either DC-to-DC or client-to-DC operations, to allow use of the DRS Remote Protocol when the RPC endpoint mapper has been configured to disallow anonymous clients (see [MS-RPCE] section 3.1.1.1.3), the DC stores an SPN with the following format<2>:

- "RPC/<DSA GUID>.msdcs.<DNS forest name>"

In the preceding SPN description, <DSA GUID> is the **DSA GUID** of the DC and <DNS forest name> is the **FQDNs (2)** of the forest of the DC.

2.2.3 DC-to-DC Operations

This section describes the security and mutual authentication requirements for those DRS Remote Protocol operations that involve DC-to-DC interactions.<3>

2.2.3.1 Security Provider

If mutual authentication is required, a DC client MUST request authentication, specifying the "Kerberos" security provider (RPC_C_AUTHN_GSS_KERBEROS). Regardless of whether mutual authentication is required, a DC client MUST request integrity and encryption of the RPC messages by specifying an **authentication level** (as specified in [MS-RPCE] section 2.2.1.1.8) of "packet privacy" (RPC_C_AUTHN_LEVEL_PKT_PRIVACY).

A DC client MUST authenticate the target DC by constructing an SPN for the service it is using. A DC client constructs an SPN as described in the following section.

2.2.3.2 SPN for a Target DC in AD DS

Two different scenarios are possible when an AD DS DC wants to connect to another DC for a DRS protocol operation:

- A DC wants to connect to a DC in a particular domain.
- A DC wants to connect to a **GC server** (see [MS-ADTS] section 3.1.1.1.10) in the forest.

The scenario determines how the DC constructs an SPN for the service it is using:

- A DC wants to connect to a DC in a particular domain. The DC constructs the following SPN:
 - "<DRS interface GUID>/<DSA GUID>/<DNS domain name>"
- A DC wants to connect to a GC server in the forest. The DC constructs the following SPN:
 - "GC/<DNS hostname>/<DNS forest name>"

In the preceding SPN descriptions:

- "GC" is a literal string that represents a **service class**.
- The forward slash ('/') is the literal separator between parts of the SPN.
- <DRS interface GUID> is the fixed DRS RPC interface **GUID**, which has the well-known value of "E3514235-4B06-11D1-AB04-00C04FC2DCD2".
- <DSA GUID> is the **DSA GUID** of the target DC.

- <DNS domain name> is the FQDN (2) of the domain of the target DC.
- <DNS hostname> is the DNS host name of the target DC.
- <DNS forest name> is the FQDN (2) of the forest of the target DC.

For example, the two SPNs that can be used for a DC named "dc1" with DSA GUID A5FF6869-AB5A-11D2-91E2-08002BA3ED3B in the contoso.com domain and forest are as follows:

- "E3514235-4B06-11D1-AB04-00C04FC2DCD2/A5FF6869-AB5A-11D2-91E2-08002BA3ED3B/contoso.com"
- "GC/dc1.contoso.com/contoso.com"

To allow mutual authentication to occur in DC-to-DC protocol operations, an AD DS **RODC** MUST store the form of SPN that begins with "GC/" as values of the servicePrincipalName attribute of the DC's **computer object**, but not the other form of SPN because that form of SPN is used for outbound replication. Other AD DS DCs MUST store both forms of SPN as values of the servicePrincipalName attribute of the DC's computer object. Additional forms that must be stored for client-to-DC protocol operations are described in section 2.2.4.2.

2.2.3.3 SPN for a Target DC in AD LDS

When an AD LDS DC wants to connect to another DC for a DRS protocol operation, it uses either of the following SPN forms:

- <DRS interface GUID>-ADAM/<DNS hostname>:<LDAP port>
- <DRS interface GUID>-ADAM/<NetBIOS hostname>:<LDAP port>

In the preceding SPN descriptions:

- <DRS interface GUID> is the fixed DRS RPC interface GUID, which has the well-known value of "E3514235-4B06-11D1-AB04-00C04FC2DCD2".
- "-ADAM/" is a literal string.
- <DNS hostname> is the full DNS host name of the target DC.
- <NetBIOS hostname> is the NetBIOS host name of the target DC.
- The colon (':') is the literal separator between the host name and port number.
- <LDAP port> is the LDAP port on which the target DC listens.

If an AD LDS DC runs on a machine joined to an Active Directory domain, and NTDSDSA_OPT_DISABLE_SPN_REGISTRATION is not present in the options attribute of its nTDSDSA object ([MS-ADTS] section 6.1.1.2.2.1.2.1.1), the AD LDS DC MUST store these two forms of SPN as values of the servicePrincipalName attribute of the object (in the external AD DS domain) that corresponds to the **security principal** that the AD LDS service is running as. This action allows mutual authentication to occur in DC-to-DC protocol operations. Additional forms that must be stored for client-to-DC protocol operations are described in section 2.2.4.3.

2.2.4 Client-to-DC Operations

This section describes the security and mutual authentication requirements for those DRS Remote Protocol operations that involve client-to-DC interactions.

2.2.4.1 Security Provider

To request authentication, a client program specifies the "GSS Negotiate" security provider (RPC_C_AUTHN_GSS_NEGOTIATE). Regardless of whether mutual authentication is required, a client MUST request integrity and encryption of the RPC messages by specifying an authentication level of "packet privacy" (RPC_C_AUTHN_LEVEL_PKT_PRIVACY).

To authenticate the target DC, a client program constructs an SPN for the service it is using and negotiates Kerberos as the security provider. A client constructs an SPN as described in the following sections.

2.2.4.2 SPN for a Target DC in AD DS

Three scenarios are possible when a client wants to connect to an AD DS DC for a DRS Remote Protocol operation:

- A client wants to connect to a particular DC by using its host name, regardless of the domain it contains.
- A client wants to connect to a DC in a particular domain.
- A client wants to connect to a GC server (see [MS-ADTS] section 3.1.1.1.10) in the forest.

The scenario determines how the client constructs an SPN for the service it is using:

- A client wants to connect to a particular DC by using its host name, regardless of the domain it contains. The client constructs any of the following three SPNs:
 - "ldap/<NetBIOS hostname>"
 - "ldap/<DNS hostname>"
 - "ldap/<DSA GUID based DNS hostname>"

The SPN that a client constructs depends on the information that the client has available. For example, some clients have only a NetBIOS name for a DC, while others have only an **Internet host name** for a DC.

- A client wants to connect to a DC in a particular domain. The client constructs any of the following three SPNs:
 - "ldap/<DNS hostname>/<NetBIOS domain name>"
 - "ldap/<DNS hostname>/<DNS domain name>"
 - "ldap/<NetBIOS hostname>/<NetBIOS domain name>"<4>

The SPN that a client constructs depends on the information that the client has available. For example, some clients have only a NetBIOS name for a domain, while others have only a fully qualified domain name (FQDN) (2) for a domain.

- A client wants to connect to a GC server in the forest:
 - "GC/<DNS hostname >/<DNS forest name>"

In the preceding SPN descriptions:

- "ldap" and "GC" are literal strings representing service classes.
- The forward slash ('/') is the literal separator between parts of the SPN.

- <NetBIOS hostname> is the NetBIOS host name of the target DC.
- <DNS hostname> is the DNS host name of the target DC.
- <NetBIOS domain name> is the **NetBIOS domain name** of the target DC.
- <DNS domain name> is the FQDN (2) of the domain of the target DC.
- <DSA GUID based DNS hostname> is the DNS host name of the target DC, constructed in the form "<DSA GUID>._msdcs.<DNS forest name>".
- <DNS forest name> is the FQDN (2) of the forest of the target DC or the target GC server.

As an example, the two- and three-part SPNs that can be used for a DC named "dc1" in the contoso.com domain are as follows:

- "ldap/DC1"
- "ldap/dc1.contoso.com"
- "ldap/6B352A21-8622-4F6D-A5A9-45CE9D7A5FB7._msdcs.contoso.com"
- "ldap/dc1.contoso.com/CONTOSO"
- "ldap/dc1.contoso.com/contoso.com"
- "GC/dc1.contoso.com/contoso.com"
- "ldap/DC1/CONTOSO"

To allow mutual authentication to occur in client-to-DC protocol operations, an AD DS DC MUST store these seven forms of SPN as values of the servicePrincipalName attribute of the DC's computer object. The **GC** SPN for client-to-DC is identical to the GC SPN for DC-to-DC. Therefore, when the requirements of this section are added to the requirements of section 2.2.3.2, an AD DS RODC MUST store six, and other AD DS DCs MUST store seven, servicePrincipalName values in all.

2.2.4.3 SPN for a Target DC in AD LDS

When a client wants to connect to an AD LDS DC for a DRS operation, it uses either of the following SPN forms:

- ldap/<DNS hostname>:<LDAP port>
- ldap/<NetBIOS hostname>:<LDAP port>

In the preceding SPN descriptions:

- "ldap" is the literal string representing the service class.
- The forward slash ('/') is the literal separator between parts of the SPN.
- <DNS hostname> is the full DNS host name of the target DC.
- <NetBIOS hostname> is the NetBIOS host name of the target DC.
- The colon (':') is the literal separator between the host name and port number.
- <LDAP port> is the LDAP port on which the target DC listens.

If an AD LDS DC runs on a computer joined to an external Active Directory domain, and NTDSDSA_OPT_DISABLE_SPN_REGISTRATION is not present in the options attribute of its nTDSDSA object in AD LDS (see [MS-ADTS] section 6.1.1.2.2.1.2.1.1), then the AD LDS DC MUST store these

two forms of SPN as values of the servicePrincipalName attribute of the object (in the external AD DS domain) that corresponds to the security principal that the AD LDS service is running as. This action allows mutual authentication to occur in "client-to-AD LDS DC" protocol operations. When the requirements of this section are added to the requirements of section 2.2.3.3, an AD LDS DC that stores SPNs stores four servicePrincipalName values in all.

2.3 Directory Service Schema Elements

This protocol is part of the Active Directory core family of protocols. To be fully compliant with Active Directory, an implementation of this protocol must be used in conjunction with the full Active Directory **schema**, containing all the schema attributes and **classes** specified in [MS-ADA1], [MS-ADA2], [MS-ADA3], [MS-ADLS], and [MS-ADSC].

3 Background to Behavior Specifications

3.1 Document Organization

In this document, information that is relevant to each particular RPC method is grouped with the specification of the behavior for that method. Information that is relevant to a particular RPC method includes: the **IDL** definition of that method, definitions for all types used exclusively by that method, and examples specific to that method.

Most methods specified in this document have no special client considerations. In such cases, the entire specification of the method behavior is the specification of server behavior.

In cases where client behavior is specified, the client behavior in preparing a request is specified in the section immediately preceding the section that specifies server behavior, and the client behavior in processing a response is specified in the section immediately following the section that specifies server behavior. This ordering follows the flow of processing a request.

The behavior specification for some methods is followed immediately by one or more examples that show a request as seen by the server implementation of the method, the corresponding response created by the server implementation of the method, and the effect of server request processing on the state of the directory. Section 3.5.1 specifies the initial state used by all examples.

In cases where a type used in a method request or response is common to several methods, that type is placed in Common Data Types, Variables and Procedures (section 5). This section is arranged alphabetically, and so its table of contents serves as an index. This section is placed after the section that contains method behavior specifications, because typically a reader will reference the common types while reading the method specifications, and not the other way around.

3.2 Typographical Conventions

Sections of this document are not self-contained; they contain both forward and backward references, all of which are hyperlinked. In addition, the following typographical convention is used to indicate the special meaning of certain names:

- Underline, as in instanceType: the name of an attribute or **object class** whose interpretation is specified in the following documents:
 - [MS-ADA1] Attribute names whose initial letter is A through L.
 - [MS-ADA2] Attribute names whose initial letter is M.
 - [MS-ADA3] Attribute names whose initial letter is N through Z.
 - [MS-ADSC] Object class names.
 - [MS-ADLS] Object class names and attribute names for AD LDS.

No special typographical convention is used for names that represent elements of sets; for example, DRS_WRIT_REP. The name of the set type (for example, DRS_OPTIONS) is always clear from context, and the elements of each set type are defined with the set type. Similarly, no special typographical convention is used for names that represent **Windows error codes**; for example, ERROR_INVALID_PARAMETER.

3.3 State Model

3.3.1 Preliminaries

[MS-ADTS] section 3.1.1.1 is a prerequisite to the remainder of this specification.

3.3.2 Transactions

The specifications of client and server method behavior in this document do not mention transaction boundaries because all methods use transactions in a systematic way, as described in the remainder of this section.

In server processing of a normal method, a transaction begins implicitly on the first access to the database that represents the persistent state of the DC, and ends implicitly before a method returns. When a new logical thread of control is created (see Asynchronous Processing in section 3.4.6), the originating thread implicitly ends its transaction before it returns, and the new logical thread of control implicitly begins an unconnected transaction as described above.

If a transaction fails, and the method return would otherwise have been successful, the Windows error code returned by the method is in one of the following sets:

- **Retryable:** ERROR_DS_DRA_BUSY, ERROR_DS_OUT_OF_VERSION_STORE. There is a significant chance that retrying the request will succeed.
- **Implementation limit:** ERROR_DS_MAX_OBJ_SIZE_EXCEEDED. This error is returned when an implementation-specific, fixed size limit is exceeded. Retrying will not succeed, but the system is functioning normally.
- **Resource limit:** ERROR_DISK_FULL, ERROR_NO_SYSTEM_RESOURCES. Retrying will not succeed; an administrator must increase available resources.
- **Corruption:** ERROR_DS_KEY_NOT_UNIQUE, ERROR_DS_OBJ_NOT_FOUND, ERROR_DISK_OPERATION_FAILED. Retrying will not succeed; an administrator must repair the database that represents the persistent state of the DC or restore the database from backup.

If server processing of a normal method performs some updates and then detects an error condition, it terminates the current transaction before returning the error code that describes the error condition. If the transaction termination encounters an error condition, the method does not report the transaction-related error condition. Instead, the method reports the original error condition.

When the specification includes a client preparing a method request or processing a method response, the pattern is similar. When a client that is a DC prepares a method request, it implicitly begins a transaction on the first access to the database that represents the persistent state of the client DC and commits this transaction before sending the request. When a client that is a DC processes a method response, it implicitly begins a transaction on the first access to the database that represents the persistent state of the DC and commits this transaction when processing of the response is complete. A client transaction is never in progress while the client waits for the server to respond to a method request. There is no use of distributed transactions.

3.3.3 Concrete and Abstract Types

This protocol specification involves both concrete and **abstract types**.

A concrete type is a type whose representation must be standardized for interoperability. In this protocol specification, three cases apply:

- Types in the IDL definition of the drsuapi and dsaop RPC interfaces that determine the format of network requests and responses.

- Types that are hand marshaled onto the network, such as types that are sent in drsuapi and dsaop requests and responses as octet strings whose actual structure is hidden from the IDL compiler. The hand marshaling and corresponding hand unmarshaling are performed by the implementation of Active Directory and by clients of the drsuapi and dsaop RPC interfaces.
- Types that are hand marshaled into directory attributes, such as types that are stored in the directory as octet strings. The hand marshaling and corresponding hand unmarshaling are performed by the implementation of Active Directory and by clients of the Active Directory LDAP interface [MS-ADTS] section 3.1.1.3.

Concrete types in the first category are specified by the C / IDL type declaration. Concrete types in the second and third categories are specified pictorially. Some types are in multiple categories and are specified both ways.

All other types in the specification are *abstract*, meaning that their use is internal to the specification. Abstract types are based on the standard mathematical concepts set, sequence, directed graph, and tuple.

This specification introduces the notion of an abstract attribute. An *abstract attribute* is an Active Directory attribute that has an abstract type for use in pseudocode. An abstract attribute can have a specified concrete representation, required for interoperability; in that case, the abstract attribute's type definition specifies the correspondence between information in the abstract type and in the concrete type. This relieves the specification pseudocode from concerns with storage allocation, packing variable-length information into structures, and so on.

Pseudocode deals with a mixture of concrete and abstract types. The notations and conventions for each are specified in section 3.4.

3.4 Pseudocode Language

3.4.1 Naming Conventions

Identifiers for concrete types, structure fields, and constants are used unchanged. The names of concrete types are often uppercase, with underscore characters ('_') to mark the divisions between words.

- Examples: REPS_FROM, DRS_MSG_UPDREFS

Identifiers for object classes and attributes are LDAP display names from [MS-ADA1], [MS-ADA2], [MS-ADA3], and [MS-ADSC]. These identifiers start with a lowercase letter; there are no capitalization conventions for the letters that follow the initial lowercase letter. These identifiers, used in this document to improve the readability of the examples, are equivalent to the ATTRTYP (section 5.14) that actually identifies object classes and attributes. The mapping between ATTRTYP and the schema object representing a class or attribute is specified in [MS-ADTS] section 3.1.1.2.6.

- Examples: repsFrom, nTDSDSA

Identifiers for types and procedures introduced for specification purposes always start with an uppercase letter, and start each word after the first word with an uppercase letter (Pascal case).

- Examples: RepsFrom, ValidateSiteRDN

Identifiers for variables introduced for specification purposes always start with a lowercase letter, and start each word after the first word with an uppercase letter (camel case).

- Examples: dc, vSet

3.4.2 Language Constructs for Concrete Types

Concrete types support structure assignments between types that are not identical. For example:

```
reqV1: DRS_MSG_REPADD_V1
reqV2: DRS_MSG_REPADD_V2

reqV2 := reqV1
```

Such an assignment is shorthand for a field-by-field assignment for fields with the same name in the two structures. The preceding example is equivalent to the following:

```
reqV1: DRS_MSG_REPADD_V1
reqV2: DRS_MSG_REPADD_V2

reqV2.pNC := reqV1.pNC
reqV2.rtSchedule := reqV1.rtSchedule
reqV2.ulOptions := reqV1.ulOptions
```

The ADR built-in function returns the address of a variable. The ADDRESS OF type constructor creates a pointer type. These are needed occasionally when dealing with concrete structures.

Pseudocode does not perform storage allocation for concrete response structures. An implementation is free to allocate any amount of memory sufficient to contain the structures within the response.

3.4.3 Language Constructs for Abstract Types

The language includes the conventional types *Boolean* and *Integer*.

The notation [first .. last] stands for the *subrange* first, first+1, ... , last. The type *byte* is the subrange [0.. 255].

A *sequence* is an indexed collection of variables, called the *elements* of the sequence. The elements all have the same type. The *index type* of a sequence is a zero-based subrange. $S[i]$ denotes the element of the sequence S that corresponds to the value i of the index type. The number of elements in a sequence S is denoted $S.length$. Therefore, the index type of a sequence S is [0 .. $S.length-1$].

A sequence type can be *open* (index type not specified) or *closed* (index type specified):

- type DSNameSeq = sequence of DSName
- type Digest = sequence [0 .. 15] of byte

A fixed-length sequence can be constructed by using the following notation:

- [*first element, second element, ... , last element*]

Therefore:

- $s := []$

sets a sequence-valued variable s to the empty sequence. A sequence of bytes can be written in the more compact string form shown in the following example:

- $s := "\x55\x06\x02"$

A *unicodestring* is a sequence of 16-bit Unicode characters.

If S is a sequence, and $j \geq i$, then $S[i .. j]$ is a new sequence of length $j - i + 1$, whose first element has value $S[i]$, second element has value $S[i + 1]$, ... , and final element has value $S[j]$. The index set of the new sequence is $[0 .. j - i]$. If $j < i$ then $S[i .. j]$ is the empty sequence.

A *tuple* is a set of name-value pairs: $[\text{name}_1: \text{value}_1, \text{name}_2: \text{value}_2, \dots, \text{name}_n: \text{value}_n]$ where name_k is an identifier and value_k is the value bound to that identifier. Tuple types are defined as in the following example:

- type DSName = [dn: DN, guid: GUID, sid: SID]

This example defines DSName as a tuple type with a DN-valued field dn, a GUID-valued field guid, and a SID-valued field sid.

A *tuple constructor* is written as in this example:

- dsName: DSName
- dsName := [dn: "cn=Peter Houston,ou=NTDEV,dc=microsoft,dc=com"]

Fields that are unspecified in a tuple constructor are assigned null values in the resulting tuple.

Access to the named fields of a tuple uses dot notation. Continuing the example:

- d: DN; g: GUID; s: SID
- d := dsName.dn
- g := dsName.guid
- s := dsName.sid

The preceding assignments set the variable d to "cn=Peter Houston,ou=NTDEV,dc=microsoft,dc=com", and variables g and s to null values.

A *tuple deconstructor* can be written anywhere a tuple-valued variable can occur. The preceding assignments are equivalent to the following:

- [dn: d, guid: g, sid: s] := dsName;

The language includes *sets*. If S is a set, $\text{number}(S)$ is the cardinality of the set S .

A fixed-size set can be constructed using the notation:

- {one element, another element, ... , yet another element}

Therefore:

- $S := \{\}$

sets a set-valued variable S to the empty set.

If S is a set, the predicate $x \text{ in } S$ is true if x is a member of S . Therefore, the value of the expression:

- $13 \text{ in } \{1, 2, 3, 5, 7, 11\}$

is false.

If A and B are sets, $A + B$ is the set union of A and B , $A \cap B$ is the set intersection of A and B , and $A - B$ is the set difference of A and B .

The specification uses [KNUTH1] section 2.3.4.2 as a reference for the graph-related terms *directed graph*, *oriented tree*, *vertex*, *arc*, *initial vertex*, and *final vertex*. In pseudocode, graphs are described in terms of their vertex and arc sets, and individual arcs are represented as tuples.

The language supports coercion between abstract and concrete types when the correspondence between the two is clear. For example, if *stringSet* is a set of unicodestring and *stringArrayPtr* is a pointer to an array of pointers to null-terminated Unicode strings, the assignment:

- `stringSet := stringArrayPtr^`

populates the abstract set of strings by copying from the concrete array of strings.

3.4.4 Common Language Constructs

The syntax of standard control structures:

```
if boolean-expr then
  stmts
else
  stmts
endif

if boolean-expr then
  stmts
else if boolean-expr then : disambiguated by indentation
  stmts
endif

foreach var in set-or-sequence-expr
  stmts
endfor

for var := first-value to last-value
  stmts
endfor

while boolean-expr
  stmts
endwhile

return expr

raise expr
```

The keyword **raise** is used to raise an RPC exception. The operand of the **raise** expression specifies the RPC exception to be raised. Details of how an RPC exception is raised are specified in [C706] section 12.6.4.7.

Other constructs used (inspired by Modula-3; for more information, see [NELSON]):

```
: declare a procedure
: with typed args and result
procedure name(arg: type, arg: type, ... , arg: type): type

: declare a procedure
: with call-by-reference args
procedure name(var arg: type, ... , var arg: type): type

: cast a variable or an expression value
: to a different type
loophole(expr, type)
```

```

var: type      : declare a variable with a type
var := expr   : assignment
expr^         : pointer dereferencing
expr.id      : field selection

```

List of infix and prefix operator binding precedence (strongest binding at the top of the list):

```

x.a           : infix dot
f(x) a[i]    : applicative (, [
p^           : postfix ^
+ -          : prefix arithmetics
* / mod ∩    : infix arithmetics; set intersection
+ -          : infix arithmetics; set union and difference
= ≠ < ≤ ≥ > in : infix relations
not          : prefix not
and          : infix and
or           : infix or

```

All infix operators are left-associative, and so, for example:

```
a - b + c
```

means:

```
(a - b) + c
```

Parentheses can be used to override the precedence rules.

The infix Boolean operators "and" and "or" are evaluated left to right, conditionally. The expression "p and q" is true if both p and q are true. If p is false, q is not evaluated. The expression "p or q" is true if at least one of p and q are true. If p is true, q is not evaluated.

3.4.5 Access to Objects and Their Attributes

The specification contains many accesses to specific directory attributes. The specification uses the following concise notation for these accesses to aid readability. If o is a variable that contains a DSName or a DN, then:

```
o!attr
```

... is an access to the attr attribute of the object named by the content of o, performed in the context of the **NC replicas** held by the server. In this notation, the name attr is a constant (like objectGUID), not a variable.

If the form o!attr occurs in an expression context, it denotes a value. There are three possibilities:

- If the attr attribute is not present on o, the value of the expression is the distinguished value null.
- If the attr attribute is present and declared multivalued, the value of the expression is a *set* that contains all the values of attr. If only one value is present, the value of the expression is a set that contains one element, the value.

- If the attr attribute is present and declared single-valued, the value of the expression is the value of attr.

If the form o!attr occurs on the left side of an assignment statement, it is used as a variable. The attr attribute need not already be present on o for this assignment to be well defined. The assignment:

```
o!attr := null
```

... removes the attr attribute from object o.

The distinguished value null is an admissible value for any type that is stored as the value of an attribute. Suppose, for example, that attr is a single-valued integer attribute. If attr is not present on object o, the assignment:

```
i := o!attr
```

... assigns the value null to the integer variable i. There is no ambiguity between this use of null and the use of null as the value of a pointer, because pointer values cannot be stored as the value of an attribute.

The value null can be used in the following ways:

- Tested for equality or inequality.
- Used where a sequence value is expected; it is equivalent to [], the empty sequence.
- Used where a set value is expected; it is equivalent to {}, the empty set.
- Used within a set constructor, where it adds no element to the resulting set.

The value null cannot be used in other expressions involving normal values. Therefore:

```
i: integer
s: set

i := o!attr
s := { o!attr }
if i = null then /* attr not present on object o */
  s := s + o!attr
endif
```

... is a valid pseudocode sequence. If the attr attribute is not present on object o, the branch of the if statement will be executed, and the set s is empty. But the statement:

```
i := o!attr * 2
```

... is a specification error if the attr attribute is not present on object o.

Queries in this specification are expressed in one of the following two forms:

```
rt := select all scope where predicate
```

```
rt := select one scope where predicate
```

In either form of query, *scope* specifies the set of values or objects to be examined, and *predicate* specifies the subset of the scope that is the query result.

Scopes take the form:

```
var from set-of-values-or-objects
```

... where *var* is an identifier to be used in the predicate, and *set-of-values-or-objects* is a set of values or DSNames that designate objects. These sets can be the result of evaluating any expression; for example, they can be the values of local set-valued variables. But usually they are sets of values or objects from the directory; for example, in the following form:

```
var from o!attr
```

... the scope is the set of all values of attribute *attr* on object *o*; by the definition of null, the scope is the empty set if *o!attr* = null.

There are three special forms for scopes that are sets of objects:

```
var from children o
var from subtree o
var from all
```

Here, *o* is a DSName or DN valued variable. The form *children o* denotes the set of children of the object *o* within the **NC** of *o*. This form does not include the object *o* itself. The form *subtree o* denotes the set of all descendants of *o* within the NC of *o*, plus the object *o* itself. The form *all* denotes the set of all objects in all NC replicas held by the server.

The predicate is an arbitrary predicate that uses the scoping identifier (*var*, noted earlier) as a variable. The query is evaluated by binding each value or object (in arbitrary order) to *var*, and then evaluating the predicate. If the predicate is true, the value or object is said to *satisfy* the predicate.

If the query takes the form "select all", the result of the evaluation is the set of all values or objects in the scope that satisfy the predicate. If the scope is a set of values, the type of the result is a set of values; otherwise, the type of the result is a set of DSName.

If the query takes the form "select one", the result of the evaluation is any single value or object that satisfies the predicate, or null if no value or object satisfies the predicate. If more than one result is possible, the result is nondeterministic. If the scope is a set of values, the type of the result is the type of the value; otherwise, the type of the result is DSName.

Here is a query example:

```
rt := select one v from nc!repsTo where
    v.naDsa = pReq^.V1.pszDsaDest or
    v.uuidDsa = pReq^.V1.uuidDsaObjDest
if rt = null then
    /* no matching values */
endif
```

In the "children / subtree / all" forms, as specified, the scope includes normal objects, not **tombstones**. Adding the qualifier "-ts-included" to these forms expands the scope to include both normal objects and tombstones. For example, the expression:

```
select all o from subtree-ts-included nc
```

... returns the set that contains the DSNames of all objects and tombstones in the subtree that is rooted at the DSName **nc**.

3.4.6 Asynchronous Processing

Several methods involve "asynchronous processing" in which a method initiates a separate logical thread of control with some initial state, and then the method execution continues independently. However, all the documented operations are synchronous operations as specified in [MS-RPCE]. No documented operations make use of RPC-defined asynchronous processing.

The phrase "logical thread of control" suggests that asynchronous processing can be implemented in a variety of ways, including message processing (where each message represents a logical thread of control), "heavyweight" processes that have exclusive use of an address space, system-level multi-threading within a single address space, thread pooling, and so on.

A method that uses asynchronous processing always returns its response immediately after initiating the separate logical thread of control; there is never any interaction with the new logical thread of control. The results of the new logical thread of control are visible only through its effects on the database representing the persistent state of the DC. If the server crashes before the new logical thread of control has completed all its documented effects, the new logical thread of control never has any effects.

Asynchronous processing is always performed in the **security context** of the server itself, not the security context of the client. Therefore, all necessary access checks **MUST** be performed before the new logical thread of control is initiated.

This design pattern is indicated by the following text in the pseudocode:

```
Asynchronous Processing: Initiate a logical thread of control  
to process the remainder of this request asynchronously
```

3.5 Conventions for Protocol Examples

3.5.1 Common Configuration

This section specifies the test setup that is used for most of the examples presented in section 4. The behavior of certain methods can be highlighted only by starting from a different state. The example section for such a method specifies the difference between the initial state used for that example and the state given here.

The configuration is a forest with two domains CONTOSO.COM (Forest Root Domain) and ASIA.CONTOSO.COM (Domain NC):

Forest: CONTOSO.COM

- The forest functional level is DS_BEHAVIOR_WIN2003 functional level; therefore only Windows Server 2003 operating system or higher versions of DCs are present in the forest. All DCs are running Windows Server 2003 Enterprise Edition.

Domains:

- CONTOSO.COM (Forest Root Domain NC), whose NetBIOS name is CONTOSO.
- ASIA.CONTOSO.COM (Domain NC), whose NetBIOS name is ASIA.

Sites:

- Default-First-Site-Name
- Default-Second-Site-Name

DCs:

- Domain: CONTOSO.COM
 - CN=DC1, OU=DOMAIN CONTROLLERS, DC=CONTOSO, DC=COM,
 - CN=DC2, OU=DOMAIN CONTROLLERS, DC=CONTOSO, DC=COM,
- Domain: ASIA.CONTOSO.COM
 - CN=DCA1, OU=DOMAIN CONTROLLERS, DC=ASIA, DC=CONTOSO, DC=COM.

Domain-joined computer:

- Domain: CONTOSO.COM
 - CN=M1, CN=COMPUTERS, DC=CONTOSO, DC=COM.

Users added:

- Domain: CONTOSO.COM
 - CN =Kim Akers, CN =Users, DC =CONTOSO, DC =COM,
- Domain: ASIA.CONTOSO.COM
 - CN =Yan Li, CN =Users, DC = ASIA, DC =CONTOSO, DC =COM,

Groups added:

- Domain: CONTOSO.COM
 - CN =GroupA, CN =Users, DC =CONTOSO, DC =COM,
 - objectSid: S-1-5-21-254470460-2440132622-709970653-1114
 - member: null
 - groupType: {GROUP_TYPE_RESOURCE_GROUP, GROUP_TYPE_SECURITY_ENABLED}
 - CN = Administrators, CN =Builtin, DC =CONTOSO, DC =COM
 - objectSid: S-1-5-32-544
 - member: Domain Admins, Enterprise Admins, Local Administrator of DC1
 - groupType: {GROUP_TYPE_BUILTIN_LOCAL_GROUP, GROUP_TYPE_RESOURCE_GROUP, GROUP_TYPE_SECURITY_ENABLED}

3.5.2 Data Display Conventions

The typical (server behavior only) example shows an initial state, a request, a response, and a final state.

The initial and final states highlight the changes for methods that perform updates. If the method is a query, then only the initial state is shown.

States are rendered using the LDP tool. The LDP transcript shown has been edited slightly for clarity. Specifically:

- The "ld" and "&msg" are not shown for each search request. Nor is the "0" that means "typesOnly = false".
- The actual attribute list is shown, in italics, within square brackets. The LDP tool does not show it in the transcript it produces.
- The numeric constant that controls the search scope is replaced by its [RFC2251] name: *baseObject*, *singleLevel*, or *wholeSubtree*.

For example, the string:

```
ldap_search_s(ld, "DC=CONTOSO,DC=COM", 0, "(objectclass=*)", attrList, 0, &msg)
```

in the LDP transcript is changed to:

```
ldap_search_s("DC=CONTOSO,DC=COM", baseObject, "(objectclass=*)", [repsTo])
```

assuming that the search requested that only the *repsTo* attribute be returned.

Requests and responses are rendered by using the Windows debugger in the context of the server (for server behavior) or client (for client behavior), with editing of the transcript for clarity. The following two edits are performed consistently:

- The `DRS_HANDLE` parameter is not shown.
- Where the value of a parameter is a **binary large object (BLOB)**, the value is not shown, but instead expressed as *binary blob*.

3.6 Server and Client Initialization

The server MUST start the RPC service to listen on the incoming RPC. For server configurations, see section 2.1.

3.6.1 AD LDS Specifics

It is possible to run multiple AD LDS DCs on the same computer. All of these AD LDS DCs listen on the same RPC interface ID. So that clients can distinguish between different instances of AD LDS that are running on the same computer, each RPC **endpoint** is annotated (as specified in [C706]) with a string containing the LDAP port number on which the DC listens. For example, if two AD LDS DCs are running on a computer, with one listening on port 389 and the other listening on port 50000, the RPC endpoints of the AD LDS DCs are annotated with "389" and "50000", respectively.

For a client to establish an RPC connection to an AD LDS DC, the client needs to know the name of the computer and the number of the LDAP port on which the AD LDS DC is listening. First, the client establishes a connection to the endpoint mapper service on the computer. Next, the client enumerates all endpoints that are registered for the desired interface ID. Finally, the client selects the endpoint whose annotation equals the LDAP port number of the desired AD LDS DC.

AD DS DCs do not annotate their RPC endpoints. RPC endpoint annotation is not required for AD DS, because it is not possible to run multiple AD DS DCs on a computer.

4 RPC Methods and Their Behavior

The methods for the drsuapi RPC interface are described in section 4.1.

The methods for the dsaop RPC interface are described in section 4.2.

4.1 drsuapi RPC Interface

This section specifies the methods for the drsuapi RPC interface of this protocol and the processing rules for the methods.<5>

Methods in RPC **Opnum** Order

Method	Description
IDL_DRSSBind	Creates a context handle necessary to call any other method in this interface. Opnum: 0
IDL_DRSSUnbind	Destroys a context handle previously created by the IDL_DRSSBind method. Opnum: 1
IDL_DRSSReplicaSync	Triggers replication from another DC. Opnum: 2
IDL_DRSSGetNCChanges	Replicates updates from an NC replica on the server. Opnum: 3
IDL_DRSSUpdateRefs	Adds or deletes a value from the repsTo attribute of a specified NC replica. Opnum: 4
IDL_DRSSReplicaAdd	Adds a replication source reference for the specified NC. Opnum: 5
IDL_DRSSReplicaDel	Deletes a replication source reference for the specified NC. Opnum: 6
IDL_DRSSReplicaModify	Updates the value for repsFrom for the NC replica. Opnum: 7
IDL_DRSSVerifyNames	Resolves a sequence of object identities. Opnum: 8
IDL_DRSSGetMemberships	Retrieves group membership for an object. Opnum: 9
IDL_DRSSInterDomainMove	A helper method used in a cross-NC move LDAP operation. Opnum: 10
IDL_DRSSGetNT4ChangeLog	Returns a sequence of PDC change log entries or the Windows NT 4.0 operating system replication state. Opnum: 11
IDL_DRSSCrackNames	Looks up each of a set of objects in the directory and returns it to the caller in the requested format. Opnum: 12
IDL_DRSSWriteSPN	Updates the set of service principal names (SPNs) on an object. Opnum: 13

Method	Description
IDL_DRSSRemoveDsServer	Removes the representation of a DC from the directory. Opnum: 14
IDL_DRSSRemoveDsDomain	Removes the representation of a domain from the directory. Opnum: 15
IDL_DRSSDomainControllerInfo	Retrieves information about DCs in a given domain. Opnum: 16
IDL_DRSSAddEntry	Adds one or more objects. Opnum: 17
IDL_DRSSExecuteKCC	Validates the replication interconnections of DCs and updates them if necessary. Opnum: 18
IDL_DRSSGetReplInfo	Retrieves the replication state of the server. Opnum: 19
IDL_DRSSAddSidHistory	Adds one or more SIDs to the sIDHistory attribute of a given object. Opnum: 20
IDL_DRSSGetMemberships2	Retrieves group memberships for a sequence of objects. Opnum: 21
IDL_DRSSReplicaVerifyObjects	Verifies the existence of objects in an NC replica. Opnum: 22
IDL_DRSSGetObjectExistence	Helps the client check the consistency of object existence between its replica of an NC and the server's replica of the same NC. Opnum: 23
IDL_DRSSQuerySitesByCost	Determines the communication cost from a "from" site to one or more "to" sites. Opnum: 24
IDL_DRSSInitDemotion	Performs the first phase of the removal of a DC from an AD LDS forest. Opnum: 25
IDL_DRSSReplicaDemotion	Replicates off all changes to the specified NC and moves any FSMOs held to another server. Opnum: 26
IDL_DRSSFinishDemotion	Finishes or cancels the removal of a DC from an AD LDS forest. Opnum: 27
IDL_DRSSAddCloneDC	Creates a new domain controller object by copying attributes from an existing domain controller object. Opnum: 28
IDL_DRSSWriteNgckKey	Composes and updates the msDS-KeyCredentialLink value on an object. Opnum: 29
IDL_DRSSReadNgckKey	Reads and parses the msDS-KeyCredentialLink value on an object. Opnum: 30

For information about the methods for which the Windows client operating systems can implement a client role, see the following behavior note.<6>

The methods will affect only the directory instance that is bound to the current context. If a server has several directory instances installed, the other instances will remain unchanged.

The following considerations apply to the order of method calls. See section 1.3.2 for details.

- IDL_DRSBind must be called before any other method in order to obtain a context handle.
- After the IDL_DRSUnbind method is called, the context handle that was passed to IDL_DRSUnbind cannot be used for other method calls.
- IDL_DRSInitDemotion is called before the other demotion methods.
- All other method calls are independent, apart from their dependencies on the state of the directory.

Because the order of method call is generally nonsequential (except as noted above), the method sections following this section are arranged alphabetically by method name.

4.1.1 IDL_DRSAddEntry (Opnum 17)

The IDL_DRSAddEntry method adds one or more objects.

```
ULONG IDL_DRSAddEntry(  
    [in, ref] DRS_HANDLE hDrs,  
    [in] DWORD dwInVersion,  
    [in, ref, switch_is(dwInVersion)]  
        DRS_MSG_ADDENTRYREQ* pmsgIn,  
    [out, ref] DWORD* pdwOutVersion,  
    [out, ref, switch_is(*pdwOutVersion)]  
        DRS_MSG_ADDENTRYREPLY* pmsgOut  
);
```

hDrs: The RPC context handle that is returned by the IDL_DRSBind method.

dwInVersion: The version of the request message.

pmsgIn: A pointer to the request message.

pdwOutVersion: A pointer to the version of the response message.

pmsgOut: A pointer to the response message.

Return Values: 0 if successful, otherwise a Windows error code.

Exceptions Thrown: This method might throw the following exceptions beyond those thrown by the underlying RPC protocol (as specified in [MS-RPCE]): ERROR_INVALID_HANDLE, ERROR_DS_DRS_EXTENSIONS_CHANGED, ERROR_DS_DIFFERENT_REPL_EPOCHS, and ERROR_INVALID_PARAMETER.

4.1.1.1 Method-Specific Concrete Types

4.1.1.1.1 DRS_MSG_ADDENTRYREQ

The DRS_MSG_ADDENTRYREQ union defines the request messages that are sent to the IDL_DRSAddEntry method.

```
typedef  
    [switch_type(DWORD)]  
    union {
```

```

[case(1)]
    DRS_MSG_ADDENTRYREQ_V1 V1;
[case(2)]
    DRS_MSG_ADDENTRYREQ_V2 V2;
[case(3)]
    DRS_MSG_ADDENTRYREQ_V3 V3;
} DRS_MSG_ADDENTRYREQ;

```

V1: Version 1 request (obsolete).

V2: Version 2 request.

V3: Version 3 request.

4.1.1.1.2 DRS_MSG_ADDENTRYREQ_V1

The DRS_MSG_ADDENTRYREQ_V1 structure defines the request message sent to the IDL_DRSSAddEntry method. This request version is obsolete.<7>

```

typedef struct {
    [ref] DSNAME* pObject;
    ATTRBLOCK AttrBlock;
} DRS_MSG_ADDENTRYREQ_V1;

```

pObject: The identity of the object to add.

AttrBlock: The attributes of the object to add.

4.1.1.1.3 DRS_MSG_ADDENTRYREQ_V2

The DRS_MSG_ADDENTRYREQ_V2 structure defines the request message sent to the IDL_DRSSAddEntry method.

```

typedef struct {
    ENTINFLIST EntInfList;
} DRS_MSG_ADDENTRYREQ_V2;

```

EntInfList: The objects to be added, as specified in section 5.57.

4.1.1.1.4 DRS_MSG_ADDENTRYREQ_V3

The DRS_MSG_ADDENTRYREQ_V3 structure defines the request message sent to the IDL_DRSSAddEntry method.

```

typedef struct {
    ENTINFLIST EntInfList;
    DRS_SecBufferDesc* pClientCreds;
} DRS_MSG_ADDENTRYREQ_V3;

```

EntInfList: The objects to be added.

pClientCreds: The user credentials to authorize the operation.

4.1.1.1.5 DRS_MSG_ADDENTRYREPLY

The DRS_MSG_ADDENTRYREPLY union defines the response messages received from the IDL_DRSSAddEntry method.

```

typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_ADDENTRYREPLY_V1 V1;
    [case(2)]
        DRS_MSG_ADDENTRYREPLY_V2 V2;
    [case(3)]
        DRS_MSG_ADDENTRYREPLY_V3 V3;
} DRS_MSG_ADDENTRYREPLY;

```

V1: Version 1 response (obsolete).

V2: Version 2 response.

V3: Version 3 response.

4.1.1.1.6 DRS_MSG_ADDENTRYREPLY_V1

The DRS_MSG_ADDENTRYREPLY_V1 structure defines the response message received from the IDL_DRSSAddEntry method. This response version is obsolete.<8>

```

typedef struct {
    GUID Guid;
    NT4SID Sid;
    DWORD errCode;
    DWORD dsid;
    DWORD extendedErr;
    DWORD extendedData;
    USHORT problem;
} DRS_MSG_ADDENTRYREPLY_V1;

```

Guid: The objectGUID of the added object.

Sid: The objectSid of the added object.

errCode: 0 if successful or a DIRERR error code (section 4.1.1.1.25) if a fatal error occurred.

dsid: The implementation-specific diagnostic code.

extendedErr: 0, **STATUS code**, or Windows error code.

extendedData: The implementation-specific diagnostic code.

problem: 0 or PROBLEM error code (section 4.1.1.1.26).

4.1.1.1.7 DRS_MSG_ADDENTRYREPLY_V2

The DRS_MSG_ADDENTRYREPLY_V2 structure defines the response message received from the IDL_DRSSAddEntry method.

```

typedef struct {
    [unique] DSNAME* pErrorObject;
    DWORD errCode;
    DWORD dsid;
    DWORD extendedErr;
    DWORD extendedData;
    USHORT problem;
    [range(0,10000)] ULONG cObjectsAdded;
    [size_is(cObjectsAdded)] ADDENTRY_REPLY_INFO* infoList;
}

```

```
} DRS_MSG_ADDENTRYREPLY_V2;
```

pErrorObject: Null, or the identity of the object that was being added when an error occurred.

errCode: 0 if successful, otherwise a DIRERR error code (section 4.1.1.1.25).

dsid: The implementation-specific diagnostic code.

extendedErr: 0, STATUS code, or Windows error code.

extendedData: The implementation-specific diagnostic code.

problem: 0 or PROBLEM error code (section 4.1.1.1.26).

cObjectsAdded: The count of items in the *infoList* array.

infoList: The identities of the added objects. The item order matches the item order of values in the **EntInfList** field in the request structure.

4.1.1.1.8 DRS_MSG_ADDENTRYREPLY_V3

The DRS_MSG_ADDENTRYREPLY_V3 structure defines the response message received from the IDL_DRSSAddEntry method.

```
typedef struct {
    DSNAME* pdsErrObject;
    DWORD dwErrVer;
    [switch_is(dwErrVer)] DRS_ERROR_DATA* pErrData;
    [range(0,10000)] ULONG cObjectsAdded;
    [size_is(cObjectsAdded)] ADDENTRY_REPLY_INFO* infoList;
} DRS_MSG_ADDENTRYREPLY_V3;
```

pdsErrObject: Null, or the identity of the object that was being added when an error occurred.

dwErrVer: MUST be set to 1.

pErrData: Null, or an error that occurred while processing the request.

cObjectsAdded: The count of items in the **infoList** array.

infoList: The identities of the added objects. The item order matches the item order of values in the **EntInfList** field in the request structure.

4.1.1.1.9 ADDENTRY_REPLY_INFO

The ADDENTRY_REPLY_INFO structure defines the identity of an object added by the IDL_DRSSAddEntry method.

```
typedef struct {
    GUID objGuid;
    NT4SID objSid;
} ADDENTRY_REPLY_INFO;
```

objGuid: The objectGUID of the added object.

objSid: The objectSid of the added object.

4.1.1.1.10 DIRERR_DRS_WIRE_V1

The DIRERR_DRS_WIRE_V1 union defines the error that occurred during processing of a request sent to the IDL_DRSSAddEntry method.

```
typedef
[switch_type(DWORD)]
union {
    [case(1)]
    ATRERR_DRS_WIRE_V1 AtrErr;
    [case(2)]
    NAMERR_DRS_WIRE_V1 NamErr;
    [case(3)]
    REFERR_DRS_WIRE_V1 RefErr;
    [case(4)]
    SECERR_DRS_WIRE_V1 SecErr;
    [case(5)]
    SVCERR_DRS_WIRE_V1 SvcErr;
    [case(6)]
    UPDERR_DRS_WIRE_V1 UpdErr;
    [case(7)]
    SYSERR_DRS_WIRE_V1 SysErr;
} DIRERR_DRS_WIRE_V1;
```

AtrErr: Attribute errors.

NamErr: Name resolution error.

RefErr: Referral.

SecErr: Security error.

SvcErr: Service error.

UpdErr: Update error.

SysErr: System error.

4.1.1.1.11 ATRERR_DRS_WIRE_V1

The ATRERR_DRS_WIRE_V1 structure defines attribute errors.

```
typedef struct {
    DSNAME* pObject;
    ULONG count;
    PROBLEMLIST_DRS_WIRE_V1 FirstProblem;
} ATRERR_DRS_WIRE_V1;
```

pObject: The identity of the object being processed when the error occurred.

count: The count of items in the **FirstProblem** linked list.

FirstProblem: The first element in the linked list of attribute errors.

4.1.1.1.12 PROBLEMLIST_DRS_WIRE_V1

The PROBLEMLIST_DRS_WIRE_V1 structure defines an attribute error link entry.

```
typedef struct _PROBLEMLIST_DRS_WIRE_V1 {
    struct _PROBLEMLIST_DRS_WIRE_V1* pNextProblem;
    INTFORMPROB_DRS_WIRE_V1 intprob;
} PROBLEMLIST_DRS_WIRE_V1;
```

pNextProblem: Null, or a pointer to the next item in the list.

intprob: Attribute error description.

4.1.1.1.13 INTFORMPROB_DRS_WIRE_V1

The INTFORMPROB_DRS_WIRE_V1 structure defines an attribute error.

```
typedef struct {
    DWORD dsid;
    DWORD extendedErr;
    DWORD extendedData;
    USHORT problem;
    ATTRTYP type;
    BOOL valReturned;
    ATTRVAL Val;
} INTFORMPROB_DRS_WIRE_V1;
```

dsid: The implementation-specific diagnostic code.

extendedErr: 0, STATUS code, or Windows error code.

extendedData: The implementation-specific diagnostic code.

problem: 0 or PROBLEM error code (section 4.1.1.1.26).

type: The attribute that was being processed when the error occurred.

valReturned: If true, the offending value is returned in the Val member.

Val: The offending value.

4.1.1.1.14 NAMERR_DRS_WIRE_V1

The NAMERR_DRS_WIRE_V1 structure defines a name resolution error.

```
typedef struct {
    DWORD dsid;
    DWORD extendedErr;
    DWORD extendedData;
    USHORT problem;
    DSNAME* pMatched;
} NAMERR_DRS_WIRE_V1;
```

dsid: The implementation-specific diagnostic code.

extendedErr: 0, STATUS code, or Windows error code.

extendedData: The implementation-specific diagnostic code.

problem: 0 or PROBLEM error code (section 4.1.1.1.26).

pMatched: The best match for the supplied object identity.

4.1.1.1.15 REFERR_DRS_WIRE_V1

The REFERR_DRS_WIRE_V1 structure defines a referral to other DCs.

```
typedef struct {
    DWORD dsid;
```

```

    DWORD extendedErr;
    DWORD extendedData;
    CONTREF_DRS_WIRE_V1 Refer;
} REFERR_DRS_WIRE_V1;

```

dsid: The implementation-specific diagnostic code.

extendedErr: 0, STATUS code, or Windows error code.

extendedData: The implementation-specific diagnostic code.

Refer: The DCs to contact to chase the referral.

4.1.1.1.16 NAMERESOP_DRS_WIRE_V1

The NAMERESOP_DRS_WIRE_V1 structure defines the state of name resolution.

```

typedef struct {
    UCHAR nameRes;
    UCHAR unusedPad;
    USHORT nextRDN;
} NAMERESOP_DRS_WIRE_V1;

```

nameRes: MUST be the uppercase ASCII character "S".

unusedPad: Unused. MUST be 0 and ignored.

nextRDN: Unused. MUST be 0 and ignored.

4.1.1.1.17 DSA_ADDRESS_LIST_DRS_WIRE_V1

The DSA_ADDRESS_LIST_DRS_WIRE_V1 structure defines a linked list entry for a referral network name.

```

typedef struct _DSA_ADDRESS_LIST_DRS_WIRE_V1 {
    struct _DSA_ADDRESS_LIST_DRS_WIRE_V1* pNextAddress;
    RPC_UNICODE_STRING* pAddress;
} DSA_ADDRESS_LIST_DRS_WIRE_V1;

```

pNextAddress: Null, or the next element in the linked list.

pAddress: Network name of the DC to which the referral is directed.

4.1.1.1.18 CONTREF_DRS_WIRE_V1

The CONTREF_DRS_WIRE_V1 structure defines a linked list entry for a continuation referral.

```

typedef struct CONTREF_DRS_WIRE_V1 {
    DSNAME* pTarget;
    NAMERESOP_DRS_WIRE_V1 OpState;
    USHORT aliasRDN;
    USHORT RDNsInternal;
    USHORT refType;
    USHORT count;
    DSA_ADDRESS_LIST_DRS_WIRE_V1* pDAL;
    struct CONTREF_DRS_WIRE_V1* pNextContRef;
    BOOL bNewChoice;
    UCHAR choice;
} CONTREF_DRS_WIRE_V1;

```

```
} CONTREF_DRS_WIRE_V1;
```

pTarget: The object to which the referral is directed.

OpState: The operation state.

aliasRDN: Unused. MUST be 0 and ignored.

RDNsInternal: Unused. MUST be 0 and ignored.

refType: The type of referral. This field MUST be one of the following values.

Value	Meaning
CH_REFTYPE_SUPERIOR 0x0000	A referral to a superior DC.
CH_REFTYPE_SUBORDINATE 0x0001	A referral to a subordinate DC (for example, to a child domain).
CH_REFTYPE_NSSR 0x0002	Not in use.
CH_REFTYPE_CROSS 0x0003	A referral to an external crossRef object. See [MS-ADTS] section 6.1.1.2.1.1.1.

count: The count of items in the **pDAL** linked list.

pDAL: A list of network names of the DCs to which the referral is directed.

pNextContRef: Null, or the next item in the linked list.

bNewChoice: True if and only if a new choice is specified.

choice: The choice to use in the continuation referral. This field MUST be one of the following values:

Value	Meaning
SE_CHOICE_BASE_ONLY 0x00	A base search shouldis to be performed.
SE_CHOICE_IMMED_CHLDRN 0x01	A one-level search shouldis to be performed.
SE_CHOICE_WHOLE_SUBTREE 0x02	A subtree search shouldis to be performed.

4.1.1.1.19 SECERR_DRS_WIRE_V1

The SECERR_DRS_WIRE_V1 structure defines a security error.

```
typedef struct {  
    DWORD dsid;  
    DWORD extendedErr;  
    DWORD extendedData;  
    USHORT problem;
```



```
    } SECERR_DRS_WIRE_V1;
```

dsid: The implementation-specific diagnostic code.

extendedErr: 0, STATUS code, or Windows error code.

extendedData: The implementation-specific diagnostic code.

problem: 0 or PROBLEM error code (section 4.1.1.1.26).

4.1.1.1.20 SVCERR_DRS_WIRE_V1

The SVCERR_DRS_WIRE_V1 structure defines a service error.

```
typedef struct {
    DWORD dsid;
    DWORD extendedErr;
    DWORD extendedData;
    USHORT problem;
} SVCERR_DRS_WIRE_V1;
```

dsid: The implementation-specific diagnostic code.

extendedErr: 0, STATUS code, or Windows error code.

extendedData: The implementation-specific diagnostic code.

problem: 0 or PROBLEM error code (section 4.1.1.1.26).

4.1.1.1.21 UPDERR_DRS_WIRE_V1

The UPDERR_DRS_WIRE_V1 structure defines an update error.

```
typedef struct {
    DWORD dsid;
    DWORD extendedErr;
    DWORD extendedData;
    USHORT problem;
} UPDERR_DRS_WIRE_V1;
```

dsid: The implementation-specific diagnostic code.

extendedErr: 0, STATUS code, or Windows error code.

extendedData: The implementation-specific diagnostic code.

problem: 0 or PROBLEM error code (section 4.1.1.1.26).

4.1.1.1.22 SYSERR_DRS_WIRE_V1

The SYSERR_DRS_WIRE_V1 structure defines a system error.

```
typedef struct {
    DWORD dsid;
    DWORD extendedErr;
    DWORD extendedData;
    USHORT problem;
} SYSERR_DRS_WIRE_V1;
```

dsid: The implementation-specific diagnostic code.

extendedErr: 0, STATUS code, or Windows error code.

extendedData: The implementation-specific diagnostic code.

problem: 0 or PROBLEM error code (section 4.1.1.1.26).

4.1.1.1.23 DRS_ERROR_DATA

The DRS_ERROR_DATA union defines the error responses that are received from the IDL_DRSSAddEntry method.

```
typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DRS_ERROR_DATA_V1 V1;
} DRS_ERROR_DATA;
```

V1: Version 1 response.

4.1.1.1.24 DRS_ERROR_DATA_V1

The DRS_ERROR_DATA_V1 structure defines the error response received from the IDL_DRSSAddEntry method.

```
typedef struct {
    DWORD dwRepError;
    DWORD errCode;
    [switch_is(errCode)] DIRERR_DRS_WIRE_V1* pErrInfo;
} DRS_ERROR_DATA_V1;
```

dwRepError: 0 or a Windows error code.

errCode: A DIRERR code (section 4.1.1.1.25) that specifies the error category.

pErrInfo: Category-specific error information.

4.1.1.1.25 DIRERR Codes

The DIRERR codes classify an error that occurs during a search for, or the update of, a **directory object**.

Value and symbolic name	Description
0x00000001 attributeError	Attribute errors.
0x00000002 nameError	Name resolution error.
0x00000003 referralError	Referral.
0x00000004 securityError	Security error.

Value and symbolic name	Description
0x00000005 serviceError	Service error.
0x00000006 updError	Update error.
0x00000007 systemError	System error.

4.1.1.1.26 PROBLEM Error Codes

The PROBLEM error codes describe the problems that can be reported by an update operation.

Value and symbolic name	Description
0x0000000C ENOMEM	Out of memory.
0x00000010 EBUSY	Too busy to proceed.
0x00000016 EINVAL	Invalid parameter.
0x0000001C ENOSPC	Out of storage.
0x000007D1 NA_PROBLEM_NO_OBJECT	Parent object not found in the NC replica.
0x000003E9 PR_PROBLEM_NO_ATTRIBUTE_OR_VAL	Attribute or value not found.
0x000003EA PR_PROBLEM_INVALID_ATT_SYNTAX	Invalid attribute syntax.
0x000003EB PR_PROBLEM_UNDEFINED_ATT_TYPE	Unknown attribute type.
0x000003EC PR_PROBLEM_WRONG_MATCH_OPER	Incorrect matching operation (only applies to match operators in LDAP filters).
0x000003ED PR_PROBLEM_CONSTRAINT_ATT_TYPE	Attribute value violated a schema constraint.
0x000003EE PR_PROBLEM_ATT_OR_VALUE_EXISTS	Attribute or value already exists (multiple values specified for a single-valued attribute OR duplicate value specified for a multi-valued attribute).
0x00000FA1 SE_PROBLEM_INAPPROPRIATE_AUTH	Inappropriate authentication method.
0x00000FA2 SE_PROBLEM_INVALID_CREDENTIALS	Invalid user name or password.

Value and symbolic name	Description
0x0000FA3 SE_PROBLEM_INSUFF_ACCESS_RIGHTS	Access denied.
0x0000FA4 SE_PROBLEM_INVALID_SIGNATURE	Invalid signature.
0x0000FA5 SE_PROBLEM_PROTECTION_REQUIRED	Encrypted connection required.
0x0000FA6 SE_PROBLEM_NO_INFORMATION	Insufficient permissions to generate a referral.
0x00001389 SV_PROBLEM_BUSY	Directory service is busy.
0x0000138A SV_PROBLEM_UNAVAILABLE	Directory service is unavailable.
0x0000138B SV_PROBLEM_WILL_NOT_PERFORM	The requested operation will not be performed.
0x0000138C SV_PROBLEM_CHAINING_REQUIRED	Chaining is required to perform the operation.
0x0000138D SV_PROBLEM_UNABLE_TO_PROCEED	Directory service is unable to proceed with the requested operation.
0x0000138E SV_PROBLEM_INVALID_REFERENCE	Invalid crossRef object.
0x0000138F SV_PROBLEM_TIME_EXCEEDED	Time limit exceeded while processing the operation.
0x00001390 SV_PROBLEM_ADMIN_LIMIT_EXCEEDED	Administrative limit exceeded while processing the operation.
0x00001391 SV_PROBLEM_LOOP_DETECTED	Not in use.
0x00001392 SV_PROBLEM_UNAVAIL_EXTENSION	The requested extended operation is not available.
0x00001393 SV_PROBLEM_OUT_OF_SCOPE	Not in use.
0x00001394 SV_PROBLEM_DIR_ERROR	Generic directory service error.
0x00001771 UP_PROBLEM_NAME_VIOLATION	Naming violation.
0x00001772 UP_PROBLEM_OBJ_CLASS_VIOLATION	Object class violation.
0x00001773 UP_PROBLEM_CANT_ON_NON_LEAF	The operation cannot be performed on an object with child objects .

Value and symbolic name	Description
0x00001774 UP_PROBLEM_CANT_ON_RDN	The operation cannot be performed on an RDN attribute.
0x00001775 UP_PROBLEM_ENTRY_EXISTS	Object already exists.
0x00001776 UP_PROBLEM_AFFECTS_MULT_DSAS	The operation affects multiple DCs.
0x00001777 UP_PROBLEM_CANT_MOD_OBJ_CLASS	The objectClass attribute cannot be modified in this way.

4.1.1.2 Method-Specific Abstract Types and Procedures

4.1.1.2.1 ConstructReplSpn

```
procedure ConstructReplSpn(
  dnsHostName: unicodestring,
  guid: GUID): unicodestring
```

This procedure returns a replication SPN with the given DNS host name (in *dnsHostName*) and GUID (in *guid*). The service class of the resulting SPN is `DRS_SPN_CLASS`. For example, given *dnsHostName* = "dc-01.fabrikam.com" and *guid* being the GUID whose string representation is "{d66e9688-66a5-4a52-8af2-17b110febe0c}", the return value is:

```
E3514235-4B06-11D1-AB04-00C04FC2DCD2/d66e9688-66a5-4a52-8af2-17b110febe0c/dc-01.fabrikam.com
```

4.1.1.2.2 CreateCrossRef

```
procedure CreateCrossRef(
  hDrs: DRS_HANDLE,
  e: ENTINF,
  pmsgOut: ADDRESS OF DRS_MSG_ADDENTRYREPLY,
  ver: DWORD,
  info: ADDRESS OF ADDENTRY_REPLY_INFO): boolean
```

Informative summary of behavior: This procedure creates a crossRef object. If the crossRef object exists already in a disabled state, it will mark the crossRef object as enabled.

```
ulSysFlags, err: DWORD
ncNameV: DSName
trustParentV, rootTrustV, dnsRootV: unicodestring
cr: DSName
prefixTable: PrefixTable

/* Only attributes and classes in the base schema maycan be specified.*/
prefixTable := NewPrefixTable()

ulSysFlags := ENTINF_GetValue(e, systemFlags, prefixTable)
ncNameV := ENTINF_GetValue(e, ncName, prefixTable)

/* Check whether the crossRef object for the given ncName exists. */
cr := select one v from subtree ConfigNC()
```

```

        where v!ncName = ncNameV and crossRef in v!objectClass
if (cr = null) or not (FLAG_CR_NTDS_DOMAIN in ulSysFlags) then
    if FLAG_CR_NTDS_NC in ulSysFlags then
        SetErrorData(SV_PROBLEM_WILL_NOT_PERFORM, serviceError,
            ERROR_DS_MISSING_EXPECTED_ATT, pmsgOut, ver)
        return false
    endif

    /* Add the crossRef object as a regular operation; this is subject
    * to an access check and will succeed only if the server is the
    * Partition Naming Master FSMO role owner. */
    err := PerformAddOperation(e, cr, dc.prefixTable, TRUE)
    if err # 0 then
        /* Pick up the error information from the previous call. */
        SetErrorData(0, 0, 0, pmsgOut, ver)
        return false
    endif

    /* Set the systemFlags because PerformAddOperation does not set it.
    */
    cr!systemFlags := ulSysFlags

    /* Return the objectGUID of the new crossRef object. */
    info^.objGuid := cr.guid;
else
    /* crossRef already exists; enable it. */

    /* The crossRef is expected to be disabled. */
    if cr!enabled = null or cr!enabled = true then
        SetErrorData(SV_PROBLEM_DIR_ERROR,
            serviceError,
            ERROR_DUP_DOMAINNAME,
            pmsgOut, ver)

        return false
    endif

    /* Only allow certain client IP to make the change. */
    if not (ClientIpMatch(hDrs, cr!dnsRoot)) then
        SetErrorData(SE_PROBLEM_INAPPROPRIATE_AUTH, securityError,
            ERROR_DS_INTERNAL_FAILURE, pmsgOut, ver)
        return false
    endif

    /* dnsRoot must be set in the given ENTINF. */
    dnsRootV := ENTINF_GetValue(e, dnsRoot, prefixTable)
    if dnsRootV = null then
        SetErrorData(PR_PROBLEM_NO_ATTRIBUTE_OR_VAL, attributeError,
            ERROR_DS_MISSING_REQUIRED_ATT, pmsgOut, ver)
        return false
    endif

    cr!dnsRoot := dnsRootV

    /* Two more attributes can be set; the rest are ignored. */
    trustParentV := ENTINF_GetValue(e, trustParent, prefixTable)
    if trustParentV # null then
        cr!trustParent := trustParentV
    endif
    rootTrustV := ENTINF_GetValue(e, rootTrust, prefixTable)
    if rootTrustV # null then
        cr!rootTrust := rootTrustV
    endif

    /* Update the systemFlags and enable the crossRef. */
    cr!systemFlags := {FLAG_CR_NTDS_NC, FLAG_CR_NTDS_DOMAIN}
    cr!enabled := null

    /* return the guid of the crossRef object */
    info^.objGuid := cr.guid

```

```

endif

/*The cross ref was created/enabled. Ensure that the respective
sub-ref object is created */
AddSubRef(cr!ncName)

return true

```

4.1.1.2.3 CreateNtdsDsa

```

procedure CreateNtdsDsa(
  hDrs: DRS_HANDLE,
  e: ENTINF,
  entList: ADDRESS OF ENTINFLIST,
  pmsgOut: ADDRESS OF DRS_MSG_ADDENTRYREPLY,
  ver: DWORD,
  info: ADDRESS OF ADDENTRY_REPLY_INFO): boolean

```

Informative summary of behavior: This procedure creates an nTDSDSA object.

```

domainName, domainCR, domain, cr, v,
  partitionsObj, sl, dsaObj: DSName
accessAllowed: boolean
dcfl, err: DWORD
spn: unicodestring
prefixTable: PrefixTable

/* Only attributes and classed in the base schema maycan be specified.*/
prefixTable := NewPrefixTable()

domainName := GetDomainNameFromEntinf(e)

domainCR := select one v from ConfigNC() where v!ncName = domainName
  and crossRef in v!objectClass
  and FLAG_CR_NTDS_DOMAIN in v!systemFlags

domain := select one v from all where v = domainName

if domain ≠ null then
  /* Perform access check. */
  accessAllowed :=
    AccessCheckCAR(domain, DS-Replication-Manage-Topology)
else
  /* Creating the domain crossRef in the same call is
  * allowed. The call will fail if the caller does not have right
  * to create the crossRef object. */
  accessAllowed := IsDomainToBeCreated(entList, domain)
endif

if not accessAllowed then
  SetErrorData(SV_PROBLEM_DIR_ERROR, serviceError,
    ERROR_ACCESS_DENIED, pmsgOut, ver)
  return false
endif

/* Check for the functional level compliance. The functional level
* of a DC cannot be less than the functional level of the forest.

```

```

    * If the DC is not the first DC in its domain, its functional level
    * cannot be less than the functional level of its domain. */
dcfl := ENTINF_GetValue(e, msDS-Behavior-Version, prefixTable)
if dcfl = null then
    dcfl := 0
endif

if domain = DefaultNC() and
    dcfl < DefaultNC()!msDS-Behavior-Version then
    SetErrorData(SV_PROBLEM_WILL_NOT_PERFORM, serviceError,
        ERROR_DS_INCOMPATIBLE_VERSION, pmsgOut, ver)
    return false
endif

partitionsObj := DescendantObject(ConfigNC(), "CN=Partitions,")

if dcfl < partitionsObj!msDS-Behavior-Version then
    SetErrorData(SV_PROBLEM_WILL_NOT_PERFORM, serviceError,
        ERROR_DS_INCOMPATIBLE_VERSION, pmsgOut, ver)
    return false
endif

/* serverReference attribute is not updated here; instead, it is used
 * to find the computer object of the DC so that the replication SPN
 * can be added to the DC's computer object. */
sl := ENTINF_GetValue(e, serverReference, prefixTable)
ENTINF_SetValue(e, serverReference, null, prefixTable)

/* Create the object in the system context; this is necessary to
 * avoid the system-only class constraint defined in the schema.*/
err := PerformAddOperationAsSystem(e, dsaObj, prefixTable)
if err ≠ 0 then
    /* Pick up the error information PerformAddOperationAsSystem set.*/
    SetErrorData(0, 0, 0, pmsgOut, ver)
    return false
endif

/* Find the computer object and update its SPN. */
if sl ≠ null then
    dcObj := select one v from subtree DefaultNC() where v = sl
    spn := ConstructReplSpn(domainCR!dnsHostName, dcObj.guid)
    dcObj!servicePrincipalName := dcObj!servicePrincipalName + {spn}
endif

/* Return the objectGUID of the new nTDSDSA object. */
info^.objGuid := dsaObj.guid

return true

```

4.1.1.2.4 UseCredsForAccessCheck

```

procedure UseCredsForAccessCheck(creds: DRS_SecBufferDesc): DWORD

```

This procedure gets authorization information for a client (using the ClientAuthorizationInfo abstract type, which is a security token) by authenticating the given credentials. Any access checks performed during the remainder of the RPC call are performed against this information.

4.1.1.2.5 IsDomainToBeCreated


```

procedure IsDomainToBeCreated(
    entList: ADDRESS OF ENTINFLIST,
    ncName: DSName): boolean

```

This procedure searches all the ENTINF values in *entList* for any request to create a crossRef object *cr* such that *cr!nCName* = *ncName*. It returns true if such a *cr* is found; otherwise, it returns false.

4.1.1.2.6 GetDomainNameFromEntinf

```

procedure GetDomainNameFromEntinf(e: ENTINF): DSName

```

Informative summary of behavior: This procedure examines the values for the hasMasterNCs attribute found in *e* and returns the domain NC. The hasMasterNCs attribute always contains the dsnames of the **schema NC**, the config NC, and the default domain NC of the DC represented by *e*. The domain NC is identified by a process of elimination.

```

prefixTable: PrefixTable
attr:ATTR
j:DWORD

prefixTable := NewPrefixTable()

/* Scan the ENTINF e to get the attribute for which ATTRTYP is
 * hasMasterNCs.*/
attr := ENTINF_GetAttribute(e, hasMasterNCs, prefixTable)
for j=0 to (attr.AttrVal.valCount-1)
    if (attr.AttrVal.pAVal[j].pVal # SchemaNC()) and
        (attr.AttrVal.pAVal[j].pVal # ConfigNC()) and
            (attr.AttrVal.pAVal[j].valLen > 0) then
                return attr.AttrVal.pAVal[j].pVal^
    end if
endfor

return null

```

4.1.1.2.7 ENTINF_GetAttribute

```

procedure ENTINF_GetAttribute (
    entInf: ENTINF,
    attribute: ATTRTYP,
    prefixTable: PrefixTable
): ATTR

```

Informative summary of behavior: The ENTINF_GetAttribute procedure scans an ENTINF structure and returns the first ATTR structure for the requested *attribute*. The *attribute* parameter is based on *dc.prefixTable*, while the attributes within *entInf* are based on the *prefixTable* parameter.

```

attrType: ATTRTYP
oid : OID
oid := OidFromAttid(dc.prefixTable, attribute)
attrType := MakeAttid(prefixTable, oid)

for each i in [0 .. entInf.AttrBlock.attrCount-1] do
    if (entInf.AttrBlock.pAttr[i].attrTyp = attrType) then
        return entInf.AttrBlock.pAttr[i]
    endif
endfor
return null

```

4.1.1.2.8 SetErrorData

```
procedure SetErrorData(  
    problem: USHORT,  
    errCode: ULONG,  
    extendedError: ULONG,  
    pmsgOut: ADDRESS OF DRS_MSG_ADDENTRYREPLY,  
    version: ULONG)
```

This procedure sets the error message fields of **pmsgOut**: the **problem**, **errCode**, and **extendedErr** fields of *pmsgOut*^.V2 if *version* = 2 or the **pErrData** field of *pmsgOut*^.V3 if *version* = 3. If **problem**, **errCode**, and **extendedError** are all 0, the error information is the result of the last call to PerformAddOperation or PerformAddOperationAsSystem.

4.1.1.2.9 ClientIpMatch

```
procedure ClientIpMatch(  
    hDrs: DRS_HANDLE,  
    dnsRoot: set of unicodestring): boolean
```

This function returns true if the IP address of the client with DRS_HANDLE *hDrs* matches one of the IP addresses of the DNS host names in the set *dnsRoot*.

4.1.1.2.10 PerformModifyEntInf

```
procedure PerformModifyEntInf(  
    hDrs: DRS_HANDLE,  
    e: ENTINF,  
    info: ADDRESS OF ADDEENTRY_REPLY_INFO): boolean
```

This function performs a modify operation on the object *e.pName*^. It enforces all security, schema, and other constraints and follows all processing rules as used by the LDAP modify operation (see [MS-ADTS]). The objectGUID and objectSid of the object being modified are returned in the info output structure. If the operation succeeds, PerformModifyEntInf returns true. If the operation fails for some reason, PerformModifyEntInf sets an appropriate error code (as defined by the LDAP modify operation) in the *info* structure, and returns false.

4.1.1.3 Server Behavior of the IDL_DRSAddEntry Method

Informative summary of behavior: A disabled crossRef object *cr* is one with *cr!Enabled* = false. *Enabling* a disabled crossRef object *cr* means setting *cr!nCName* and *cr!dnsRoot*, and removing *cr!Enabled*.

This method enables, creates, or modifies one or more objects, as requested by the client, in a single transaction. It enables crossRef objects, creates crossRef objects and nTDSDSA objects, and modifies arbitrary objects. The client uses an ENTINF structure to specify the state of each enabled, created, or modified object:

- Enabling a crossRef object: The dnsRoot attribute of a disabled crossRef object contains a set of one or more DNS host names, expressed as Unicode strings. The request to enable a crossRef object succeeds only if the IP address of the client that is making the request matches the IP address of one of the DNS host names in the dnsRoot attribute. When a disabled crossRef object is enabled through this method, the server is not required to be the Domain Naming Master **FSMO role owner**.

The client must specify the nCName and dnsRoot attributes. The trustParent and rootTrust attributes are optional.

- Creating a crossRef object: If the request creates a crossRef object, it succeeds only if the server owns the forest's Domain Naming Master FSMO role. The access check is the same as when a crossRef object is created through LDAP.

The client **must specify** the same attributes that are required during an LDAP Add of a crossRef object, namely the new object's DN, plus all must-have attributes of the crossRef class. See [MS-ADTS] section 6.1.1.2.1.1 for the specification of crossRef objects.

- Creating an nTDSDSA object: Creating an nTDSDSA object is not possible with LDAP. To create an nTDSDSA object, the hasMasterNCs attribute in the request **must have to** identify the forest's schema NC and config NC, and the DC's **default NC**; that is, the domain of the DC corresponding to the new nTDSDSA object. If the default NC exists on the server as the nTDSDSA object is being created by IDL_DRSAddEntry, the client **must have to** have the **control access right DS-Replication-Manage-Topology** on the default NC. Otherwise, the client **must have to** have the right to enable or create the crossRef object that corresponds to the default NC, and **must have to** enable or create this crossRef object in the same IDL_DRSAddEntry request.

The client **must specify** the new object's DN, plus the hasMasterNCs attribute. To create an nTDSDSA object for a functional DC, the request will contain invocationId, dMDLocation, options, msDS-Behavior-Version, and systemFlags. See [MS-ADTS] section 6.1.1.2.2.1.2.1.1 for the specification of nTDSDSA objects.

If the serverReference attribute is given a value in the request, the computer object to which the serverReference attribute points is updated with a new replication SPN.

- Modifying an object: To modify an existing object (other than enabling a crossRef object), the client-supplied ENTINF structure includes ENTINF_REMOTE_MODIFY in the **ulFlags** field and specifies the modified attributes and their values. The client **must have to** have the same rights as those needed to perform the modification via LDAP. The DC enforces the same schema and other constraints on the modification as if performed via LDAP. Performing the modification by using IDL_DRSAddEntry rather than LDAP allows changes to multiple objects to be made in a single transaction.<9>

```

ULONG
IDL_DRSAddEntry(
    [in, ref]   DRS_HANDLE hDrs,
    [in]        DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
                DRS_MSG_ADDENTRYREQ *pmsgIn,
    [out, ref]  DWORD *pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
                DRS_MSG_ADDENTRYREPLY *pmsgOut)

ext: DRS_EXTENSIONS_INT
pEntInflList: ADDRESS OF ENTINFLIST
pClientCreds: ADDRESS OF DRS_SecBufferDesc
objCls : ATTRTYP
ncNameV: DSName
infoList: ADDENTRY_REPLY_INFO
cObjects: ULONG
res: boolean
prefixTable: PrefixTable

ValidateDRSInput(hDrs, 17)

/* Only attributes and classes in the base schema may can be specified.*/
prefixTable := NewPrefixTable()

/* Set the default response version */
pdwOutVersion := 2

if dwInVersion = 1 then /* obsolete */
    pmsgOut^.V1.Guid := 0

```

```

    pmsgOut^.V1.Sid := 0
    pmsgOut^.V1.errCode := 0
    pmsgOut^.V1.dsid := 0
    pmsgOut^.V1.extendedErr := 0
    pmsgOut^.V1.extendedData := 0
    pmsgOut^.V1.problem := 0
else if dwInVersion = 2 then
    pmsgOut^.V2.pErrorObject:= null
    pmsgOut^.V2.errCode := 0
    pmsgOut^.V2.dsid := 0
    pmsgOut^.V2.extendedEr := 0
    pmsgOut^.V2.extendedData := 0
    pmsgOut^.V2.problem := 0
    pmsgOut^.V2.cObjectsAdded := 0
    pmsgOut^.V2.infoList := null
else if dwInVersion = 3 then
    pmsgOut^.V3.pdsErrObject := null
    pmsgOut^.V3.dwErrVer := 0
    pmsgOut^.V3.pErrData := null
    pmsgOut^.V3.ULONG cObjectsAdded := 0
    pmsgOut^.V3.infoList := null
endif

/* Validate parameters. */
if not (dwInVersion in {2,3}) then
    SetErrorData(SV_PROBLEM_UNAVAILABLE, 0, ERROR_DS_UNAVAILABLE,
        pmsgOut, 2)
    return 0
endif

/* If the client supports the version 3 response, use version 3. */
ext := ClientExtensions(hDrs)
if DRS_EXT_ADDENTRYREPLY_V3 in ext.dwFlags then
    pdwOutVersion^ := 3
else
    pdwOutVersion^ := 2
endif

cObjects := 0

if dwInVersion = 2 then
    pEntInfList := pmsgIn^.V2.EntInfList
    pClientCreds := null
else
    pEntInfList := pmsgIn^.V3.EntInfList
    pClientCreds := pmsgIn^.V3.pClientCreds
endif

/* If explicit credentials are given, use them for access checks. */
if pClientCreds # null then
    err := UseCredsForAccessCheck(pClientCreds^)
    if err # 0 then
        return err
    endif
endif

/* Walk through each item in the EntInfList and perform the requested
 * operation. */
e := pEntInfList
while e # null
    if ENTINF_REMOTE_MODIFY in e^.ulFlags then
        if DSAObj(!msDS-Behavior-Version ≥ DS_BEHAVIOR_WIN2008 then
            res := PerformModifyEntInf(
                hDrs, e^.Entinf, ADR(infoList[cObjects]))
            if not res then
                return 0
            endif
        else
            /* Not supported (Win2k3 or older DC). */

```

```

        SetErrorData(SV_PROBLEM_UNAVAILABLE,
                    0,
                    ERROR_DS_UNAVAILABLE,
                    pmsgOut,
                    pdwOutVersion^)
    return 0
endif
else
    objCls := ENTINF_GetValue(e^.Entinf, objectClass, prefixTable)
    if objCls = crossRef then
        /* Create or enable a crossRef object. */
        res := CreateCrossRef(hDrs, e^.Entinf, pmsgOut, pdwOutVersion^,
                            ADR(infoList[cObjects]))
        if not res then
            return 0
        endif
    else if objCls = nTDSDSA then
        /* Create an nTDSDSA object. */
        res := CreateNtdsDsa(hDrs, e^.Entinf, pEntInfList, pmsgOut,
                            pdwOutVersion^, ADR(infoList[cObjects]))
        if not res then
            return 0
        endif
    else
        /* Not supported. */
        SetErrorData(SV_PROBLEM_BUSY, 0, ERROR_DS_DRA_INVALID_PARAMETER,
                    pmsgOut, pdwOutVersion^)
        return 0
    endif
endif

    e := e^.pNextEntInf
    cObjects := cObjects + 1
endwhile

if pdwOutVersion^ = 2 then
    pmsgOut^.V2.cObjectsAdded := cObjects
    pmsgOut^.V2.infoList := infoList
else
    pmsgOut^.V3.cObjectsAdded := cObjects
    pmsgOut^.V3.infoList := infoList
endif

return 0

```

4.1.2 IDL_DRSAddSidHistory (Opnum 20)

The IDL_DRSAddSidHistory method adds one or more SIDs to the SIDHistory attribute of a given object.

```

ULONG IDL_DRSAddSidHistory(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
    DRS_MSG_ADDSIDREQ* pmsgIn,
    [out, ref] DWORD* pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
    DRS_MSG_ADDSIDREPLY* pmsgOut
);

```

hDrs: RPC context handle returned by the IDL_DRSBind method.

dwInVersion: Version of the request message. Must be set to 1, because no other version is supported.

pmsgIn: Pointer to the request message.

pdwOutVersion: Pointer to the version of the response message. The value must be 1, because no other version is supported.

pmsgOut: Pointer to the response message.

Return Values: 0 or one of the following Windows error codes: ERROR_DS_MUST_RUN_ON_DST_DC or ERROR_INVALID_PARAMETER.

Exceptions Thrown: This method might throw the following exceptions beyond those thrown by the underlying RPC protocol (as specified in [MS-RPCE]): ERROR_INVALID_HANDLE, ERROR_DS_DRS_EXTENSIONS_CHANGED, ERROR_DS_DIFFERENT_REPL_EPOCHS, and ERROR_INVALID_PARAMETER.

4.1.2.1 Method-Specific Concrete Types

4.1.2.1.1 DRS_MSG_ADDSIDREQ

The DRS_MSG_ADDSIDREQ union defines the request messages that are sent to the IDL_DRSSAddSidHistory method. Only one version, identified by *dwInVersion* = 1, is currently defined.

```
typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_ADDSIDREQ_V1 V1;
} DRS_MSG_ADDSIDREQ;
```

V1: Version 1 request.

4.1.2.1.2 DRS_MSG_ADDSIDREQ_V1

The DRS_MSG_ADDSIDREQ_V1 structure defines the request message sent to the IDL_DRSSAddSidHistory method.

```
typedef struct {
    DWORD Flags;
    [string] WCHAR* SrcDomain;
    [string] WCHAR* SrcPrincipal;
    [string, ptr] WCHAR* SrcDomainController;
    [range(0,256)] DWORD SrcCredsUserLength;
    [size_is(SrcCredsUserLength)] WCHAR* SrcCredsUser;
    [range(0,256)] DWORD SrcCredsDomainLength;
    [size_is(SrcCredsDomainLength)]
        WCHAR* SrcCredsDomain;
    [range(0,256)] DWORD SrcCredsPasswordLength;
    [size_is(SrcCredsPasswordLength)]
        WCHAR* SrcCredsPassword;
    [string] WCHAR* DstDomain;
    [string] WCHAR* DstPrincipal;
} DRS_MSG_ADDSIDREQ_V1;
```

Flags: A set of zero or more DRS_ADDSID_FLAGS bit flags.

SrcDomain: Name of the domain to query for the SID of **SrcPrincipal**. The domain name can be an FQDN (1) or a NetBIOS name.

SrcPrincipal: Name of a security principal (user, computer, or group) in the source domain. This is the source security principal, whose SIDs will be added to the destination security principal. If **Flags** contains DS_ADDSID_FLAG_PRIVATE_CHK_SECURE, this parameter is not used and is not validated. Otherwise, if **Flags** does not contain DS_ADDSID_FLAG_PRIVATE_DEL_SRC_OBJ, this name is a domain-relative Security Accounts Manager (SAM) name. Otherwise, it is a DN.

SrcDomainController: Name of the primary domain controller (PDC) (or **PDC role owner**) in the source domain. The DC name can be an Internet host name or a NetBIOS name. This parameter is only used when **Flags** contains neither DS_ADDSID_FLAG_PRIVATE_CHK_SECURE nor DS_ADDSID_FLAG_PRIVATE_DEL_SRC_OBJ. If **Flags** contains DS_ADDSID_FLAG_PRIVATE_DEL_SRC_OBJ, this parameter is not used, but it is validated.

SrcCredsUserLength: Count of characters in the **SrcCredsUser** array.

SrcCredsUser: User name for the credentials to be used in the source domain.

SrcCredsDomainLength: Count of characters in the **SrcCredsDomain** array.

SrcCredsDomain: **Domain name** for the credentials to be used in the source domain. The domain name can be an FQDN (1) or a NetBIOS domain name.

SrcCredsPasswordLength: Count of characters in the **SrcCredsPassword** array.

SrcCredsPassword: Password for the credentials to be used in the source domain.

DstDomain: Name of the destination domain in which **DstPrincipal** resides. The domain name can be an FQDN (1) or a NetBIOS name.

DstPrincipal: Name of a security principal (user, computer, or group) in the destination domain. This is the destination **principal**, to which the source principal's SIDs will be added. If **Flags** contains DS_ADDSID_FLAG_PRIVATE_CHK_SECURE, this parameter is not used and is not validated. Otherwise, if **Flags** does not contain DS_ADDSID_FLAG_PRIVATE_DEL_SRC_OBJ, this name is a domain-relative SAM name. Otherwise, it is a DN.

4.1.2.1.3 DRS_MSG_ADDSIDREPLY

The DRS_MSG_ADDSIDREPLY union defines the response messages received from the IDL_DRSAddSidHistory method. Only one version, identified by *pdwOutVersion*[^] = 1, is currently defined.

```
typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_ADDSIDREPLY_V1 v1;
} DRS_MSG_ADDSIDREPLY;
```

V1: Version 1 of the reply packet structure.

4.1.2.1.4 DRS_MSG_ADDSIDREPLY_V1

The DRS_MSG_ADDSIDREPLY_V1 structure defines the response message received from the IDL_DRSAddSidHistory method.

```
typedef struct {
    DWORD dwWin32Error;
} DRS_MSG_ADDSIDREPLY_V1;
```



```
domain: unicodestring): ConnectionCtx
```

Creates a ConnectionCtx for the DC named by *dcname*, associating the credentials of user *username*, password *pwd*, and user-domain domain with the ConnectionCtx. *dcname* **may** be the Internet host name or the NetBIOS name of the DC. If the ConnectionCtx cannot be created, it returns null.

4.1.2.2.4 GenerateFailureAudit

```
procedure GenerateFailureAudit()
```

Generates a failure audit event on the server on which it is called if auditing is enabled. The generated audit event indicates that an operation failed. This procedure does nothing if auditing is not enabled. The content of the audit event is an implementation-specific behavior.

4.1.2.2.5 GenerateSuccessAudit

```
procedure GenerateSuccessAudit()
```

Generates a success audit event on the server on which it is called if auditing is enabled. The generated audit event indicates that an operation succeeded. This procedure does nothing if auditing is not enabled. The content of the audit event is an implementation-specific behavior.

4.1.2.2.6 GenerateSuccessAuditRemotely

```
procedure GenerateSuccessAuditRemotely(ctx: ConnectionCtx): boolean
```

If auditing is enabled on the server associated with *ctx*, the GenerateSuccessAuditRemotely procedure generates a success audit event on that server and returns true. The generated audit event indicates that an operation succeeded. Returns false if auditing is not enabled on that server. The content of the audit event is an implementation-specific behavior. <10>

4.1.2.2.7 GetKeyLength

```
procedure GetKeyLength(hDrs: DRS_HANDLE): integer
```

Returns the key length, in bits, of the encryption used on the *hDrs* connection. Returns 0 if no encryption is in use on the connection.

4.1.2.2.8 FindGC

```
procedure FindGC(): unicodestring
```

Returns the Internet host name of a DC that is a GC server in the forest (see [MS-ADTS] section 6.3.6), or null if such a DC cannot be found.

4.1.2.2.9 GetPDC

```
procedure GetPDC(domainName: unicodestring): unicodestring
```

Returns the Internet host name of the DC that holds the PDC FSMO role for the domain whose name is *domainName* (see [MS-ADTS] section 6.1.5.4), or null if such a DC cannot be found. *domainName* can be either the FQDN (1) or the NetBIOS name of the domain.

4.1.2.2.10 HasAdminRights

```
procedure HasAdminRights(ctx: ConnectionCtx) : boolean
```

Returns true if the credentials associated with *ctx* have administrative rights on the DC associated with *ctx*. Possessing administrative rights is defined as having the ability to write to (that is, change the membership of) the Domain Admins group in the domain that is the default domain NC on the DC associated with *ctx*.

4.1.2.2.11 IsAuditingEnabled

```
procedure IsAuditingEnabled () : boolean
```

Returns true if auditing on the server on which it is called is enabled, and returns false otherwise.

4.1.2.2.12 IsLocalRpcCall

```
procedure IsLocalRpcCall(hDrs: DRS_HANDLE) : boolean
```

Returns true if the RPC call that is being processed on *hDrs* originated from the same computer as the computer that is processing the call.

4.1.2.2.13 IsNT4SP4OrBetter

```
procedure IsNT4SP4OrBetter(ctx: ConnectionCtx) : boolean
```

If the DC named in *ctx* is running Windows NT 4.0 and is not running at least Windows NT 4.0 operating system Service Pack 4 (SP4), this procedure returns false. Otherwise, it returns true.<11>

4.1.2.2.14 IsAuditingGroupPresent

```
procedure IsAuditingGroupPresent(dcname: unicodestring, nETBIOSName: unicodestring) : DWORD
```

Returns ERROR_NO_SUCH_ALIAS if the DC represented by the *dcname* does not have a domain local group whose sAMAccountName is the value of the *nETBIOSName* parameter appended with three dollar signs \$\$\$\$. Otherwise, it returns ERROR_SUCCESS. This group is not present by default and must be created by the administrator of the directory service.

4.1.2.2.15 IsWellKnownDomainRelativeSid

```
procedure IsWellKnownDomainRelativeSid(sid: SID) : boolean
```

Returns true if *sid* consists of the **domain SID** of the server's default domain and of a **RID** (as specified in [MS-DTYP] section 2.4.2) whose value is less than 1000, and returns false otherwise.

4.1.2.2.16 LastRID

```
procedure LastRID(sid: SID) : Rid
```

Extracts and returns the RID from the SID *sid*. See [MS-DTYP] section 2.4.2.

4.1.2.2.17 RemoteQuery

```
procedure RemoteQuery(  
    ctx: ConnectionCtx,  
    query: uncodestring): select-return-value
```

Performs the select statement represented by the string *query* against the server associated with *ctx*, using the credentials associated with *ctx*. Returns the results of the select operation. The return value of this function is the same type as the return value of the select statement performed.

4.1.2.3 Server Behavior of the IDL_DRSAddSidHistory Method

Informative summary of behavior: The IDL_DRSAddSidHistory method adds the SIDs associated with one principal (the source principal) to the sIDHistory attribute of another principal (the destination principal). The source principal's objectSid and any SIDs in the source principal's sIDHistory are added to the destination principal's sIDHistory. This method is called on a DC whose default NC contains the destination principal. If necessary, the destination DC will contact a DC whose default NC contains the source principal as part of executing this method.

This method has three different variants on this behavior, and the caller indicates which variant is desired by specifying a combination of flags in `pmsgIn^.V1.flags`.

- If the DS_ADDSID_FLAG_PRIVATE_CHK_SECURE flag is specified, the first variant is selected. In this variant, the method verifies only that the RPC call is secure. It does not perform any further processing or manipulate the sIDHistory attribute of any object, regardless of other flags that **may** be present.
- If DS_ADDSID_FLAG_PRIVATE_CHK_SECURE is not specified but DS_ADDSID_FLAG_PRIVATE_DEL_SRC_OBJ is specified, the second variant is selected. In this variant, the source and destination principals are in the same domain. The values of the objectSid and sIDHistory attributes of the source principal are added to the destination principal's sIDHistory attribute, and then the source principal is deleted. See [MS-ADTS] section 3.1.1.5.5 for more information about the delete operation. Loosely speaking, the destination principal adopts the source principal as an "alias" and the source principal disappears.
- The third variant is selected by specifying neither DS_ADDSID_FLAG_PRIVATE_CHK_SECURE nor DS_ADDSID_FLAG_PRIVATE_DEL_SRC_OBJ. In this variant, the source and destination principals are in different forests. The values of the source principal's objectSid and sIDHistory attributes are copied into the destination principal's sIDHistory attribute, as in the second variant, but without deleting the source principal. Loosely speaking, the destination principal adopts the source principal as an "alias" while coexisting with the source principal.

The preceding are the only variants supported by the IDL_DRSAddSidHistory method. In particular, the case of source and destination principals in different domains within the same forest is not supported.

```
ULONG  
IDL_DRSAddSidHistory(  
    [in, ref] DRS_HANDLE hDrs,  
    [in] DWORD dwInVersion,  
    [in, ref, switch_is(dwInVersion)] DRS_MSG_ADDSIDREQ *pmsgIn,  
    [out, ref] DWORD *pdwOutVersion,  
    [out, ref, switch_is(*pdwOutVersion)] DRS_MSG_ADDSIDREPLY *pmsgOut)  
  
flags: DRS_ADDSID_FLAGS  
srcPrinc: DSName  
dstPrinc: DSName  
srcPrincInDst: DSName  
srcNc: DSName  
dstNc: DSName
```

```

crSrc: DSName
crDst: DSName
partCtr: DSName
srcDomainController: unicodestring
srcCtx: ConnectionCtx
srcPrincSid: SID
srcPrincSidHistory: set of SID
rt: ULONG

ValidateDRSInput(hDrs, 20)

pdwOutVersion^ := 1
pmsgOut^.V1.dwWin32Error := ERROR_DS_INTERNAL_FAILURE

flags := pmsgIn^.V1.flags
if DS_ADDSID_FLAG_PRIVATE_CHK_SECURE in flags then
    /* First mode of operation: verify connection security.
    * If connecting from off-machine, connection must have 128-bit
    * encryption or better. */
    if (not IsLocalRpcCall(hDrs)) and
        (GetKeyLength(hDrs) < 128) then
        pmsgOut^.V1.dwWin32Error := ERROR_DS_MUST_RUN_ON_DST_DC
        return ERROR_DS_MUST_RUN_ON_DST_DC
    else
        return 0
    endif
endif

/* Currently, only version 1 is supported. The RPC IDL definitions
* for the interface do not allow passing in a version other than 1. */
if dwInVersion ≠ 1 then
    return ERROR_INVALID_PARAMETER
endif

if DS_ADDSID_FLAG_PRIVATE_DEL_SRC_OBJ in flags then
    /* Second mode of operation: add objectSid/sidHistory from source
    * principal to destination principal, then delete source
    * principal. */

    /* Basic parameter validation */
    if (pmsgIn^.V1.SrcDomain ≠ null) or
        (pmsgIn^.V1.DstDomain ≠ null) or
        (pmsgIn^.V1.SrcCredsUserLength ≠ 0) or
        (pmsgIn^.V1.SrcCredsDomainLength ≠ 0) or
        (pmsgIn^.V1.SrcCredsPasswordLength ≠ 0) or
        (pmsgIn^.V1.SrcDomainController = "") or
        (pmsgIn^.V1.SrcPrincipal = null) or
        (pmsgIn^.V1.SrcPrincipal = "") or
        (pmsgIn^.V1.DstPrincipal = null) or
        (pmsgIn^.V1.DstPrincipal = "") then
        pmsgOut^.V1.dwWin32Error := ERROR_DS_INTERNAL_FAILURE
        return ERROR_INVALID_PARAMETER
    endif

    /* In this case, pmsgIn^.V1.SrcPrincipal and .DstPrincipal are
    * DNs. */
    srcPrinc := GetDSNameFromDN(pmsgIn^.V1.SrcPrincipal)
    dstPrinc := GetDSNameFromDN(pmsgIn^.V1.DstPrincipal)
    srcNc := GetObjectNC(srcPrinc)
    dstNc := GetObjectNC(dstPrinc)

    /* Source and destination principals must be in same domain. */
    if srcNc = null or dstNc = null or srcNc ≠ dstNc then
        pmsgOut^.V1.dwWin32Error := ERROR_INVALID_PARAMETER
        return 0
    endif

    /* Destination NC must be this server's default domain NC. */
    if dstNc ≠ DefaultNC() then
        pmsgOut^.V1.dwWin32Error := ERROR_DS_MASTERDSA_REQUIRED

```

```

    return 0
endif

/* Verify that this server has auditing enabled */
if not IsAuditingEnabled () then
    pmsgOut^.V1.dwWin32Error :=
        ERROR_DS_DESTINATION_AUDITING_NOT_ENABLED
    return 0
endif

/* Must have the control access right. */
if not AccessCheckCAR(dstNc, Migrate-SID-History) then
    GenerateFailureAudit()
    pmsgOut^.V1.dwWin32Error := ERROR_DS_INSUFF_ACCESS_RIGHTS
    return 0
endif

/* Destination domain must be in native mode. */
partCtr := DescendantObject(ConfigNC(), "CN=Partitions,")
if partCtr ≠ null
    crDst := select one dd from subtree partCtr where
        (crossRef in dd!objectClass and
         dd!nCName = dstNc)
endif
if partCtr = null or crDst = null then
    pmsgOut^.V1.dwWin32Error := ERROR_DS_INTERNAL_FAILURE
    return 0
else
    if crDst!nTMixedDomain = 1 then
        pmsgOut^.V1.dwWin32Error := ERROR_DS_DST_DOMAIN_NOT_NATIVE
        return 0
    endif
endif

/* Validation of object state. */
if (not ObjExists(srcPrinc)) or
    (not (user in srcPrinc!objectClass or
         group in srcPrinc!objectClass)) or
    (not ObjExists(dstPrinc)) or
    (not (user in dstPrinc!objectClass or
         group in dstPrinc!objectClass)) or
    (srcPrinc = dstPrinc) or
    (IsWellKnownDomainRelativeSid(srcPrinc!objectSid)) or
    (IsWellKnownDomainRelativeSid(dstPrinc!objectSid)) then
    pmsgOut^.V1.dwWin32Error := ERROR_INVALID_PARAMETER
    return 0
endif

/* Check that this machine has rights to delete the source principal. */
if (not AccessCheckObject(srcPrinc, RIGHT_DELETE)) and
    (not AccessCheckObject(srcPrinc.parent, RIGHT_DS_DELETE_CHILD))
    then
        pmsgOut^.V1.dwWin32Error := ERROR_ACCESS_DENIED
        return 0
    endif

/* Save the source principal's principal's SID and SID history and then delete the principal
*/
srcPrincSid := srcPrinc!objectSid
srcPrincSidHistory := srcPrinc!sidHistory
rt = RemoveObj(srcPrinc, false)
if (rt ≠ 0) then
    pmsgOut^.V1.dwWin32Error := rt
    return 0
endif

/* Add source principal's objectSid and sidHistory to
 * destination principal's sidHistory. */
dstPrinc!sidHistory := dstPrinc!sidHistory + {srcPrincSid}
dstPrinc!sidHistory := dstPrinc!sidHistory + srcPrincSidHistory

```

```

    GenerateSuccessAudit()
    return 0
endif

/* Third mode of operation: add objectSid/sIDHistory from source
 * principal to destination principal. Source principal is
 * untouched. */

/* Basic parameter validation. */
if (pmsgIn^.V1.SrcDomain = null) or
   (pmsgIn^.V1.SrcDomain = "") or
   (pmsgIn^.V1.DstDomain = null) or
   (pmsgIn^.V1.DstDomain = "") or
   (pmsgIn^.V1.SrcCredsUserLength > 0 and
    pmsgIn^.V1.SrcCredsUser = null) or
   (pmsgIn^.V1.SrcCredsDomainLength > 0 and
    pmsgIn^.V1.SrcCredsDomain = null) or
   (pmsgIn^.V1.SrcCredsPasswordLength > 0 and
    pmsgIn^.V1.SrcCredsPassword = null) or
   (pmsgIn^.V1.SrcDomainController = "") or
   (pmsgIn^.V1.SrcPrincipal = null) or
   (pmsgIn^.V1.SrcPrincipal = "") or
   (pmsgIn^.V1.DstPrincipal = null) or
   (pmsgIn^.V1.DstPrincipal = "") then
    pmsgOut^.V1.dwWin32Error := ERROR_DS_INTERNAL_FAILURE
    return ERROR_INVALID_PARAMETER
endif

/* Confirm destination domain is in forest of server. */
crDst := select one dd from subtree ConfigNC() where
   (crossRef in dd!objectClass and
    (dd!dnsRoot = pmsgIn^.V1.DstDomain or
     dd!nETBIOSName = pmsgIn^.V1.DstDomain))
if crDst = null then
    pmsgOut^.V1.dwWin32Error :=
        ERROR_DS_DESTINATION_DOMAIN_NOT_IN_FOREST
    return 0
endif

/* Confirm source domain is not in forest of server. */
crSrc := select one ss from subtree ConfigNC() where
   (crossRef in ss!objectClass and
    (ss!dnsRoot = pmsgIn^.V1.SrcDomain or
     ss!nETBIOSName = pmsgIn^.V1.SrcDomain)
    and FLAG_CR_NTDS_NC in ss!systemFlags
    and FLAG_CR_NTDS_DOMAIN in ss!systemFlags)
if crSrc ≠ null then
    pmsgOut^.V1.dwWin32Error := ERROR_DS_SOURCE_DOMAIN_IN_FOREST
    return 0
endif

/* Destination NC must be this server's default domain NC. */
if crDst!nCName ≠ DefaultNC() then
    pmsgOut^.V1.dwWin32Error := ERROR_DS_MASTERDSA_REQUIRED
    return 0
endif

/* Destination domain must be in native mode. */
if crDst!nTMixedDomain = 1 then
    pmsgOut^.V1.dwWin32Error := ERROR_DS_DST_DOMAIN_NOT_NATIVE
    return 0
endif

dstNC := crDst!nCName

/* Verify this server has auditing enabled for destination domain. */
if not IsAuditingEnabled () then
    pmsgOut^.V1.dwWin32Error :=
        ERROR_DS_DESTINATION_AUDITING_NOT_ENABLED

```

```

    return 0
endif

/* Must have the control access right. */
if not AccessCheckCAR(dstNc, Migrate-SID-History) then
    GenerateFailureAudit()
    pmsgOut^.V1.dwWin32Error := ERROR_DS_INSUFF_ACCESS_RIGHTS
    return 0
endif

/* Retrieve destination principal.
 * In this case, pmsgIn^.V1.DstPrincipal is a SAM name. */
dstPrinc := select one o from subtree DefaultNC() where
    (o!sAMAccountName = pmsgIn^.V1.DstPrincipal)
if dstPrinc = null then
    pmsgOut^.V1.dwWin32Error := ERROR_DS_OBJ_NOT_FOUND
    return 0
endif

/* Locate a source DC if one wasn't supplied. Source DC must be
 * the PDC FSMO role owner. */
srcDomainController := pmsgIn^.V1.SrcDomainController
if srcDomainController = null then
    srcDomainController := GetPDC(pmsgIn^.V1.SrcDomain)
else
    if srcDomainController ≠ GetPDC(pmsgIn^.V1.SrcDomain) then
        pmsgOut^.V1.dwWin32Error := ERROR_INVALID_DOMAIN_ROLE
        return 0
    endif
endif
if srcDomainController = null then
    pmsgOut^.V1.dwWin32Error := ERROR_DS_CANT_FIND_DC_FOR_SRC_DOMAIN
    return 0
endif

/* Connect to source DC, using supplied credentials if applicable. */
if (pmsgIn^.V1.SrcCredsUserLength = 0) and
    (pmsgIn^.V1.SrcCredsPasswordLength = 0) and
    (pmsgIn^.V1.SrcCredsDomainLength = 0) then
    srcCtx := ConnectToDC(srcDomainController)
else
    srcCtx := ConnectToDCWithCreds(srcDomainController,
        pmsgIn^.V1.SrcCredsUser, pmsgIn^.V1.SrcCredsPassword,
        pmsgIn^.V1.SrcCredsDomain)
endif

if (srcCtx = null) then
    pmsgOut^.V1.dwWin32Error := ERROR_DS_CANT_FIND_DC_FOR_SRC_DOMAIN
    return 0
endif

/* Confirm client has administrative rights on source DC. */
if not HasAdminRights(srcCtx) then
    pmsgOut^.V1.dwWin32Error := ERROR_DS_INSUFF_ACCESS_RIGHTS
    return 0
endif

/* Retrieve source principal from source DC using the remote connection.
 * In this case, pmsgIn^.V1.SrcPrincipal is a SAM name.
 * Example: If pmsgIn^.V1.SrcPrincipal value is username1 then
 * following query is executed in the source DC:
 * select one o from subtree dc.defaultNC where (o!sAMAccountName = "username1")
 */
srcPrinc := RemoteQuery(srcCtx,
    "select one o from subtree dc.defaultNC where (o!sAMAccountName = "
    + "'" + pmsgIn^.V1.SrcPrincipal + "'" + ")"
    )
if srcPrinc = null then
    pmsgOut^.V1.dwWin32Error := ERROR_DS_OBJ_NOT_FOUND
    return 0

```

```

endif

/* Source principal must be user (which includes computer) or
 * group.*/
if not (group in srcPrinc!objectClass or
        user in srcPrinc!objectClass) then
    pmsgOut^.V1.dwWin32Error := ERROR_DS_SRC_OBJ_NOT_GROUP_OR_USER
    return 0
endif

srcPrincSid := srcPrinc!objectSid
srcPrincSidHistory := srcPrinc!sIDHistory

/* Verify that no principal other than the destination
 * principal exists in the destination forest that contains
 * a SID that matches the source principal. */
if IsGC() or IsAdlds() then
    srcPrincInDst := select one o from subtree DefaultNC() where
        (o ≠ dstPrinc) and
        ((o!objectSid = srcPrincSid) or
         (o!objectSid in srcPrincSidHistory) or
         (srcPrincSid in o!sIDHistory)) or
        ((srcPrincSidHistory ∩ o!sIDHistory) ≠ {}))

    if srcPrincInDst ≠ null then
        pmsgOut^.V1.dwWin32Error := ERROR_DS_SRC_SID_EXISTS_IN_FOREST
        return 0
    endif
else
    /* The current DC is not a GC server.
     * We need to locate a GC server and perform an IDL_DRSCrackNames query against it in order
     for the SID search to be Forest scoped */
    gcDomainController : unicodestring
    hDrsGc: DRS_HANDLE
    crackMsgIn: DRS_MSG_CRACKREQ_V1
    crackOut: DS_NAME_RESULTW

    gcDomainController := FindGC()

    if gcDomainController = null then
        return STATUS_DS_GC_NOT_AVAILABLE
    endif

    /* Bind to GC */
    hDrsGc := BindToDSA(gcDomainController)
    if hDrsGc = null then
        pmsgOut^.V1.dwWin32Error := STATUS_DS_GC_NOT_AVAILABLE
        return 0
    endif

    crackMsgIn.dwFlags := DS_NAME_FLAG_GCVERIFY
    crackMsgIn.formatOffered := DS_STRING_SID_NAME
    crackMsgIn.formatDesired := DS_UNIQUE_ID_NAME
    crackMsgIn.cNames := 1
    crackMsgIn.rpNames[0] := srcPrincSid

    crackNamesErr := IDL_DRSCrackNames(
        hDrsGc,
        dwInVersion,
        crackMsgIn,
        pdwOutVersion,
        ADR(crackOut))

    if crackNamesErr ≠ 0 then
        if crackNamesErr = DS_NAME_ERROR_NOT_UNIQUE then
            pmsgOut^.V1.dwWin32Error := ERROR_DS_SRC_SID_EXISTS_IN_FOREST
            return 0
        elseif crackNamesErr ≠ DS_NAME_ERROR_NOT_FOUND and
            crackNamesErr ≠ DS_NAME_ERROR_DOMAIN_ONLY then

```



```

    pmsgOut^.V1.dwWin32Error := ERROR_DS_INTERNAL_FAILURE
    return 0
endif

if crackOut.rItems # null and
crackOut.rItems[0].pName # dstPrinc!objectGUID then
    pmsgOut^.V1.dwWin32Error := ERROR_DS_SRC_SID_EXISTS_IN_FOREST
    return 0
endif

UnbindFromDSA(hDrsgc)

endif

/* Confirm source domain has auditing enabled and generate an audit
 * event on it. */
if not GenerateSuccessAuditRemotely(srcCtx)
    pmsgOut^.V1.dwWin32Error := ERROR_DS_SOURCE_AUDITING_NOT_ENABLED
    return 0
endif

/* Verify that if source domain is running Windows NT 4.0, it is
 * running at least Service Pack 4 of that operating system. */
if not IsNT4SP4OrBetter(srcCtx)
    pmsgOut^.V1.dwWin32Error := ERROR_DS_SRC_DC_MUST_BE_SP4_OR_GREATER
    return 0
endif

/* Verify that if source domain has a domain local group srcDomainNetBIOSName$$$
 */
if IsAuditingGroupPresent(srcDomainController, pmsgIn^.V1.SrcDomain) = ERROR_NO_SUCH_ALIAS
    pmsgOut^.V1.dwWin32Error := ERROR_NO_SUCH_ALIAS
    return 0
endif

/* Source and destination principals must both be computer, or both
 * be user, or both be group. The order is important: although
 * computer objects are user objects, the case is disallowed where
 * one principal is a computer and the other principal is a user
 * but not a computer. */
if ((computer in srcPrinc!objectClass and
    not computer in dstPrinc!objectClass) or
    (computer in dstPrinc!objectClass and
    not computer in srcPrinc!objectClass)) or
    ((user in srcPrinc!objectClass and
    not user in dstPrinc!objectClass) or
    (user in dstPrinc!objectClass and
    not user in srcPrinc!objectClass)) or
    ((group in srcPrinc!objectClass and
    not group in dstPrinc!objectClass) or
    (group in dstPrinc!objectClass and
    not group in srcPrinc!objectClass)) then
    pmsgOut^.V1.dwWin32Error :=
        ERROR_DS_SRC_AND_DST_OBJECT_CLASS_MISMATCH
    return 0
endif

/* Class-specific object state tests.
 * Note that computer is a subclass of user, so the following test
 * applies to both user and computer objects. */
if user in srcPrinc!objectClass then
    if srcPrinc!userAccountControl ∩ {ADS_UF_NORMAL_ACCOUNT,
        ADS_UF_WORKSTATION_TRUST_ACCOUNT,
        ADS_UF_SERVER_TRUST_ACCOUNT} #
        dstPrinc!userAccountControl ∩ {ADS_UF_NORMAL_ACCOUNT,
        ADS_UF_WORKSTATION_TRUST_ACCOUNT,
        ADS_UF_SERVER_TRUST_ACCOUNT} then
        pmsgOut^.V1.dwWin32Error :=
            ERROR_DS_SRC_AND_DST_OBJECT_CLASS_MISMATCH

```

```

        return 0
    endif

    if group in srcPrinc!objectClass and
        srcPrinc!groupType # dstPrinc!groupType then
        pmsgOut^.V1.dwWin32Error :=
            ERROR_DS_SRC_AND_DST_OBJECT_CLASS_MISMATCH
        return 0
    endif

    /* Check if source principal is built-in principal. */
    if IsBuiltinPrincipal(srcPrinc!objectSid) then
        pmsgOut^.V1.dwWin32Error := ERROR_DS_UNWILLING_TO_PERFORM
        return 0
    endif

    /* If source principal has well-known domain-relative SID
     * make sure final RIDs of source and destination principals
     * are the same. */
    if IsWellKnownDomainRelativeSid(srcPrinc!objectSid) then
        if LastRID(srcPrinc!objectSid) # LastRID(dstPrinc!objectSid)
            pmsgOut^.V1.dwWin32Error := ERROR_DS_UNWILLING_TO_PERFORM
            return 0
        endif
    endif
endif

/* Add source principal's objectSid and sIDHistory to
 * destination principal's sidHistory. */
dstPrinc!sIDHistory := dstPrinc!sIDHistory + {srcPrincSid}
dstPrinc!sIDHistory := dstPrinc!sIDHistory + srcPrincSidHistory
GenerateSuccessAudit()
return 0

```

4.1.2.4 Examples of the IDL_DRSAddSidHistory Method

4.1.2.4.1 Calling IDL_DRSAddSidHistory with DS_ADDSID_FLAG_PRIVATE_CHK_SECURE Flags

This flag is used when the caller wants to check whether an RPC call to DC1 is secure.

4.1.2.4.1.1 Client Request

A client invokes the IDL_DRSAddSidHistory method against DC1 with the following parameters (DRS_HANDLE to DC1 omitted):

- *dwInVersion* = 1
- *pmsgIn* = DRS_MSG_ADDSIDREQ_V1
 - *Flags* = 0x40000000

4.1.2.4.1.2 Server Response

The server returns a code of 0 and the following values:

- *pdwOutVersion* = 1
- *pmsgOut* = DRS_MSG_ADDSIDREPLY_V1
 - *dwWin32Error*: 0

4.1.2.4.1.3 Final State

There are no changes in state.

4.1.2.4.2 Calling IDL_DRSAddSidHistory with DS_ADDSID_FLAG_PRIVATE_DEL_SRC_OBJ Flags

In this example, the user "Kim Akers" has an account in domain DC=contoso, DC=com with a Windows NT 4.0 account name "CONTOSO\kimakers". There is another account in the same domain for the user "Kim Akers" with the Windows NT 4.0 account name "CONTOSO\kimakers1". The domain administrator wants to add a SID of "CONTOSO\Kimakers1" account to the SIDHistory of "CONTOSO\kimakers" and delete "CONTOSO\Kimakers1".

4.1.2.4.2.1 Initial State

Querying the **user object** whose sAMAccountName is kimakers in the domain NC DC=CONTOSO, DC=COM on DC1:

- ldap_search_s("DC=contoso,DC=com", *wholeSubtree*, "(sAMAccountName=kimakers)", [*objectClass, distinguishedName, sAMAccountName, objectSid, SIDHistory*])
- Result <0>: (null)
- Matched DNs:
- Getting 1 entry:
- >> Dn: CN=Kim Akers,CN=Users,DC=contoso,DC=com
 - 4> objectClass: top; person; organizationalPerson; user;
 - 1> distinguishedName: CN=Kim Akers,CN=Users,DC=contoso,DC=com;
 - 1> sAMAccountName: KimAkers;
 - 1> objectSid: S-1-5-21-254470460-2440132622-709970653-1144

Querying the user object whose sAMAccountName is kimakers1 in the domain NC DC=CONTOSO, DC=COM on DC1:

- ldap_search_s("DC=contoso,DC=com", *wholeSubtree*, "(sAMAccountName=kimakers1)", [*objectClass, distinguishedName, sAMAccountName, objectSid, SIDHistory*])
- Result <0>: (null)
- Matched DNs:
- Getting 1 entries:
- >> Dn: CN=Kim Akers1,CN=Users,DC=contoso,DC=com
 - 4> objectClass: top; person; organizationalPerson; user;
 - 1> distinguishedName: CN=Kim Akers1,CN=Users,DC=contoso,DC=com;
 - 1> sAMAccountName: KimAkers1;
 - 1> objectSid: S-1-5-21-254470460-2440132622-709970653-1129;

4.1.2.4.2.2 Client Request

A client invokes the **IDL_DRSAddSidHistory** method against DC1 with the following parameters (DRS_HANDLE to DC1 omitted):

- *dwInVersion* = 1
- *pmsgIn* = DRS_MSG_ADDSIDREQ_V1
 - *Flags* = 0x80000000
 - *SrcPrincipal* = "CN=Kim Akers1,CN=Users,DC=contoso,DC=com"
 - *DstPrincipal* = "CN=Kim Akers,CN=Users,DC=contoso,DC=com"

4.1.2.4.2.3 Server Response

The server returns a code of 0 and the following values:

- *pdwOutVersion* = 1
- *pmsgOut* = DRS_MSG_ADDSIDREPLY_V1
 - *dwWin32Error*: 0

4.1.2.4.2.4 Final State

The **sIDHistory** attribute on the user object whose DN is "Kim Akers,CN=Users,DC=contoso,DC=com" contains one value:

- `ldap_search_s("DC=contoso,DC=com", wholeSubtree, "(sAMAccountName=kimakers)", [objectClass, distinguishedName, sAMAccountName, objectSid, sIDHistory])`
- Result <0>: (null)
- Matched DNs:
- Getting 1 entry:
- >> Dn: CN=Kim Akers,CN=Users,DC=contoso,DC=com
 - 4> objectClass: top; person; organizationalPerson; user;
 - 1> distinguishedName: CN=Kim Akers,CN=Users,DC=contoso,DC=com;
 - 1> sAMAccountName: KimAkers;
 - 1> objectSid: S-1-5-21-254470460-2440132622-709970653-1144;
 - 1> sIDHistory: S-1-5-21-254470460-2440132622-709970653-1129;

The user object whose DN is "Kim Akers1,CN=Users,DC=contoso,DC=com" is deleted:

`ldap_search_s("DC=contoso,DC=com", wholeSubtree, "(sAMAccountName=kimakers1)", [objectClass, distinguishedName, sAMAccountName, objectSid, sIDHistory])`

- Result <0>: (null)
- Matched DNs:
- Getting 0 entries:

4.1.2.4.3 Calling IDL_DRSAddSidHistory with 0 in Flags

The user "Kim Akers" has an account in domain DC=contoso, DC=com with a Windows NT 4.0 account name "CONTOSO\kimakers". The user has another account in a separate forest in domain DC=legacycontoso,DC=com with a Windows NT 4.0 account name "LEGACYCONTOSO\kimakers1".

The domain administrator wants to add the SID of "LEGACYCONTOSO\Kimakers1" account to the sIDHistory of "CONTOSO\kimakers". The administrator's account name in the LEGACYCONTOSO domain is LegacyContosoAdmin with password Passw0rd123. LEGACYCONTOSO is the NetBIOS name for the LEGACYCONTOSO.com domain.

4.1.2.4.3.1 Initial State

Querying the user object whose sAMAccountName is kimakers in the domain NC DC=CONTOSO, DC=COM on DC1:

- `ldap_search_s("DC=contoso,DC=com", wholeSubtree, "(sAMAccountName=kimakers)", [objectClass, distinguishedName, sAMAccountName, objectSid, sIDHistory])`
- Result <0>: (null)
- Matched DNs:
- Getting 1 entry:
- Dn: CN=Kim Akers,CN=Users,DC=contoso,DC=com
 - 4> objectClass: top; person; organizationalPerson; user;
 - 1> distinguishedName: CN=Kim Akers,CN=Users,DC=contoso,DC=com;
 - 1> sAMAccountName: KimAkers
 - 1> objectSid: S-1-5-21-254470460-2440132622-709970653-1144

Querying the user object whose sAMAccountName is kimakers1 in the domain NC DC=LEGACYCONTOSO, DC=COM on DC9:

- `ldap_search_s("DC=legacycontoso,DC=com", wholeSubtree, "(sAMAccountName=kimakers1)", [objectClass, distinguishedName, sAMAccountName, objectSid, sIDHistory])`
- Result <0>: (null)
- Matched DNs:
- Getting 1 entries:
- >> Dn: CN=Kim Akers1,CN=Users,DC=legacycontoso,DC=com
 - 4> objectClass: top; person; organizationalPerson; user;
 - 1> distinguishedName: CN=Kim Akers1,CN=Users,DC=legacycontoso,DC=com;
 - 1> sAMAccountName: KimAkers1;
 - 1> objectSid: S-1-5-21-1137440724-3092688314-3181763971-1153;

4.1.2.4.3.2 Client Request

A client invokes the IDL_DRSAddSidHistory method against DC1 with the following parameters (DRS_HANDLE to DC1 omitted):

- `dwInVersion = 1`
- `pmsgIn = DRS_MSG_ADDSIDREQ_V1`
 - `Flags = 0`

- SrcDomain = "legacycontoso.com"
- SrcPrincipal = "KimAkers1"
- SrcCredsDomain = "legacycontoso"
- SrcCredsDomainLength = 13
- SrcCredsUser = "LegacyContosoAdmin"
- SrcCredsUserLength = 18
- SrcCredsPassword = "Passw0rd123"
- SrcCredsPasswordLength = 11
- DstDomain = "contoso"
- DstPrincipal = "KimAkers"

4.1.2.4.3.3 Server Response

The server returns a code of 0 and the following values:

- *pdwOutVersion* = 1
 - *pmsgOut* = DRS_MSG_ADDSIDREPLY_V1
 - *dwWin32Error*: 0

4.1.2.4.3.4 Final State

The *sIDHistory* attribute on the user object whose DN is "Kim Akers,CN=Users,DC=contoso,DC=com" contains one value:

- `ldap_search_s("DC=contoso,DC=com", wholeSubtree, "(sAMAccountName=kimakers)", [objectClass, distinguishedName, sAMAccountName, objectSid, sIDHistory])`
- Result <0>: (null)
- Matched DNs:
- Getting 1 entry:
- >> Dn: CN=Kim Akers,CN=Users,DC=contoso,DC=com
 - 4> objectClass: top; person; organizationalPerson; user;
 - 1> distinguishedName: CN=Kim Akers,CN=Users,DC=contoso,DC=com;
 - 1> sAMAccountName: KimAkers;
 - 1> objectSid: S-1-5-21-254470460-2440132622-709970653-1144;
 - 1> sIDHistory: S-1-5-21-1137440724-3092688314-3181763971-1153;

In the domain NC DC=LEGACYCONTOSO, DC=COM, the user object whose *sAMAccountName* is *kimakers1* is unchanged:

- `ldap_search_s("DC=legacycontoso,DC=com", wholeSubtree, "(sAMAccountName=kimakers1)", [objectClass, distinguishedName, sAMAccountName, objectSid, sIDHistory])`

- Result <0>: (null)
- Matched DNs:
- Getting 1 entries:
- >> Dn: CN=Kim Akers1,CN=Users,DC=legacycontoso,DC=com
 - 4> objectClass: top; person; organizationalPerson; user;
 - 1> distinguishedName: CN=Kim Akers1,CN=Users,DC=legacycontoso,DC=com;
 - 1> sAMAccountName: KimAkers1;
 - 1> objectSid: S-1-5-21-1137440724-3092688314-3181763971-1153;

4.1.3 IDL_DRSBind (Opnum 0)

The IDL_DRSBind method creates a context handle that is necessary to call any other method in this interface.

```

ULONG IDL_DRSBind(
    [in] handle_t rpc_handle,
    [in, unique] UUID* puuidClientDsa,
    [in, unique] DRS_EXTENSIONS* pextClient,
    [out] DRS_EXTENSIONS** ppextServer,
    [out, ref] DRS_HANDLE* phDrs
);

```

rpc_handle: An RPC binding handle, as specified in [C706].

puuidClientDsa: A pointer to a GUID that identifies the caller.

pextClient: A pointer to client capabilities, for use in version negotiation.

ppextServer: A pointer to a pointer to server capabilities, for use in version negotiation.

phDrs: A pointer to an RPC context handle (as specified in [C706]), which **may** be used in calls to other methods in this interface.

Return Values: 0 if successful, otherwise a Windows error code.

Exceptions Thrown: This method does not throw exceptions beyond those thrown by the underlying RPC protocol.

4.1.3.1 Client Behavior When Sending the IDL_DRSBind Request

~~Note: Some of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it in the Product Behavior appendix.~~

The client uses *puuidClientDsa* to pass an identifier. If the client uses the returned DRS_HANDLE for subsequent calls to the IDL_DRSWriteSPN method, then the client MUST pass NTDSAPI_CLIENT_GUID in *puuidClientDsa*. For any other uses, the server places no constraints on the value of *puuidClientDsa* other than those specified in section 4.1.3.2.<12>

The client uses *pextClient* to pass a properly initialized DRS_EXTENSIONS_INT structure to the server. If the client is a DC, it reads the value of msDS-ReplicationEpoch from its nTDSDSA object and assigns this value to the **dwReplEpoch** field of the DRS_EXTENSIONS_INT structure; otherwise, it sets the

dwReplEpoch field of the `DRS_EXTENSIONS_INT` structure to zero. If the client is a DC, it reads the value of **objectGUID** from the Config NC object and assigns this value to the **ConfigObjGUID** field of the `DRS_EXTENSIONS_INT` structure; otherwise, it sets the **ConfigObjGUID** field of the `DRS_EXTENSIONS_INT` structure to the **NULL GUID** value.

The remaining information in the `DRS_EXTENSIONS_INT` structure must be consistent with the client's capabilities. This information affects the versions of response structures that the server returns in method calls using the `DRS_HANDLE` returned by `IDL_DRSBind`. In descriptions of method calls that use a `DRS_HANDLE`, this handle is sometimes called the client's RPC context. <13>

If a method of this protocol takes a parameter named *dwInVersion*, the client uses that parameter to specify the version of the referent of the next parameter to that method, often named *pmsgIn*. The referent of this parameter is called the method's request. The *dwInVersion* parameter is called the request version. For example, if the client passes *dwInVersion* = 7 to `IDL_DRSGetNCChanges`, the client also passes a `DRS_MSG_GETCHGREQ_V7` request.

If a method of this protocol takes an integer parameter named *pdwOutVersion*, the server uses that parameter to return the version number of the referent of the next parameter to that method, often named *pmsgOut*. The referent of this parameter is called the method's response. The referent of *pdwOutVersion* is called the response version. For example, when the server returns *pdwOutVersion* = 9 from `IDL_DRSGetNCChanges`, the server also returns a `DRS_MSG_GETCHGREPLY_V9` response.

Most methods in this protocol are capable of generating only a certain response version from a certain request version. The following special cases apply:

- `IDL_DRSGetNCChanges` is capable of returning a version 6 response from version 7, version 8, and version 10 requests. However, the `DRS_EXT_GETCHGREPLY_V6` bit must be set in the client's RPC context for the server to generate a version 6 response. Otherwise, the server returns `ERROR_REVISION_MISMATCH`. Note that whenever `IDL_DRSGetNCChanges` is capable of returning a version 6 response, it is also capable of returning a version 7 response, which is a compressed form of a version 6 response. Compression of `IDL_DRSGetNCChanges` responses is not controlled by the state of the client's RPC context; it is controlled on a per-request basis by the client; see `DRS_USE_COMPRESSION` in section 5.41.
- `IDL_DRSGetNCChanges` is capable of returning a version 9 response from version 10 requests. However, the `DRS_EXT_GETCHGREPLY_V9` bit must be set in the client's RPC context for the server to generate a version 9 response. Otherwise, the server returns `ERROR_REVISION_MISMATCH`. Note that whenever `IDL_DRSGetNCChanges` is capable of returning a version 9 response, it is also capable of returning a version 7 response, which is a compressed form of a version 9 response. Compression of `IDL_DRSGetNCChanges` responses is not controlled by the state of the client's RPC context; it is controlled on a per-request basis by the client; see `DRS_USE_COMPRESSION` in section 5.41.
- `IDL_DRSSyncAddEntry` can generate either a version 2 or version 3 response from either a version 2 or version 3 request. The server generates a version 3 response when `DRS_EXT_ADDENTRYREPLY_V3` is set in the client's RPC context; otherwise, the server generates a version 2 response.
- `IDL_DRSDomainControllerInfo` has only one request version; it contains an **InfoLevel** field. The **InfoLevel**, not the *dwInputVersion*, determines the response version. Similarly, `IDL_DRSGetReplInfo` has two request versions, which both contain an **InfoType** field. The **InfoType**, not the *dwInputVersion*, determines the response version.

The following tables describe how the server determines the response version based on the request version, the `DRS_EXTENSIONS_INT` structure specified when creating the `DRS_HANDLE`, and in some cases, the contents of the request message.

`IDL_DRSReplicaSync`

Request version	DRS_EXTENSIONS bit set in client's RPC context	Response version
1	-	-

IDL_DRSGetNCChanges

Request version	DRS_EXTENSIONS bit set in client's RPC context	Response version
4	-	1
5	-	1
7	DRS_EXT_GETCHGREPLY_V6	6
8	DRS_EXT_GETCHGREPLY_V6	6
10	DRS_EXT_GETCHGREPLY_V6	6
10	DRS_EXT_GETCHGREPLY_V9	9
10	DRS_EXT_GETCHGREPLY_V9, DRS_EXT_GETCHGREPLY_V6	9

IDL_DRUpdateRefs

Request version	DRS_EXTENSIONS bit set in client's RPC context	Response version
1	-	-

IDL_DRSReplicaAdd

Request version	DRS_EXTENSIONS bit set in client's RPC context	Response version
1	-	-
2	-	-

IDL_DRSReplicaDel

Request version	DRS_EXTENSIONS bit set in client's RPC context	Response version
1	-	-

IDL_DRSReplicaModify

Request version	DRS_EXTENSIONS bit set in client's RPC context	Response version
1	-	-

IDL_DRSVerifyNames

Request version	DRS_EXTENSIONS bit set in client's RPC context	Response version
1	-	1

IDL_DRSGetMemberships

Request version	DRS_EXTENSIONS bit set in client's RPC context	Response version
1	-	1

IDL_DRSTerminateDomainMove

Request version	DRS_EXTENSIONS bit set in client's RPC context	Response version
2	-	2

IDL_DRSGetNT4ChangeLog

Request version	DRS_EXTENSIONS bit set in client's RPC context	Response version
1	-	1

IDL_DRSCrackNames

Request version	DRS_EXTENSIONS bit set in client's RPC context	Response version
1	-	1

IDL_DRSWriteSPN

Request version	DRS_EXTENSIONS bit set in client's RPC context	Response version
1	-	1

IDL_DRSRemoveDsServer

Request version	DRS_EXTENSIONS bit set in client's RPC context	Response version
1	-	1

IDL_DRSRemoveDsDomain

Request version	DRS_EXTENSIONS bit set in client's RPC context	Response version
1	-	1

IDL_DRSDomainControllerInfo

Request version	DRS_EXTENSIONS bit set in client's RPC context	Response version
1	-	request.InfoLevel ¹

IDL_DRSAddEntry

Request version	DRS_EXTENSIONS bit set in client's RPC context	Response version
2	-	2
3	-	2
2	DRS_EXT_ADDENTRYREPLY_V3	3

Request version	DRS_EXTENSIONS bit set in client's RPC context	Response version
3	DRS_EXT_ADDENTRYREPLY_V3	3

IDL_DRSExecuteKCC

Request version	DRS_EXTENSIONS bit set in client's RPC context	Response version
1	-	1

IDL_DRSGetReplInfo

Request version	DRS_EXTENSIONS bit set in client's RPC context	Response version
1	-	request.InfoType ²
2	-	request.InfoType ²

IDL_DRSAddSidHistory

Request version	DRS_EXTENSIONS bit set in client's RPC context	Response version
1	-	1

IDL_DRSGetMemberships2

Request version	DRS_EXTENSIONS bit set in client's RPC context	Response version
1	-	1

IDL_DRSReplicaVerifyObjects

Request version	DRS_EXTENSIONS bit set in client's RPC context	Response version
1	-	-

IDL_DRSGetObjectExistence

Request version	DRS_EXTENSIONS bit set in client's RPC context	Response version
1	-	1

IDL_DRSQuerySitesByCost

Request version	DRS_EXTENSIONS bit set in client's RPC context	Response version
1	-	1

IDL_DRSInitDemotion

Request version	DRS_EXTENSIONS bit set in client's RPC context	Response version
1	-	1

IDL_DRSReplicaDemotion

Request version	DRS_EXTENSIONS bit set in client's RPC context	Response version
1	-	1

IDL_DRSEnableDemotion

Request version	DRS_EXTENSIONS bit set in client's RPC context	Response version
1	-	1

IDL_DRSEnableCloneDC

Request version	DRS_EXTENSIONS bit set in client's RPC context	Response version
1	-	1

IDL_DRSWriteNgckKey

<u>Request version</u>	<u>DRS_EXTENSIONS bit set in client's RPC context</u>	<u>Response version</u>
<u>1</u>	<u>-</u>	<u>1</u>

IDL_DRSReadNgckKey

<u>Request version</u>	<u>DRS_EXTENSIONS bit set in client's RPC context</u>	<u>Response version</u>
<u>1</u>	<u>-</u>	<u>1</u>

IDL_DSAPrepareScript

Request version	DRS_EXTENSIONS bit set in client's RPC context	Response version
1	-	1

IDL_DSAScheduleScript

Request version	DRS_EXTENSIONS bit set in client's RPC context	Response version
1	-	1

¹ Possible values are 0x1, 0x2, and 0xffffffff (see section 4.1.5).

² Possible values are detailed in section 4.1.13.

4.1.3.2 Server Behavior of the IDL_DRSEnableBind Method

The server returns an error if *puuidClientDsa*[^] is set to the NULL GUID. Otherwise, the server retains the UUID passed as *puuidClientDsa*[^] and the DRS_EXTENSIONS_INT structure passed as *pextClient*[^], and associates them with the RPC context handle, *phDrs*, in an implementation-specific manner.

The server sets *ppextServer* to a DRS_EXTENSIONS_INT structure whose **dwReplEpoch** and **ConfigObjGUID** fields are initialized as described in the previous section (Client Behavior When Sending the IDL_DRSEnableBind Request (section 4.1.3.1)), and whose other fields describe the server. <14> The server associates the information in *ppextServer* with the RPC context handle, *phDrs*, in an implementation-specific manner and then returns a DRS_HANDLE as the referent of *phDrs*.

The following tables specify the capability assertions made by a server that sets bits in the DRS_EXTENSIONS_INT structure returned from IDL_DRSBind. Each row of a table gives a request version (including both *dwInVersion* and the InfoLevel of IDL_DRSDomainControllerInfo and the InfoType of IDL_DRSGetReplInfo) and the DRS_EXTENSIONS_INT bit or bits that the server sets to indicate support for that request. For instance, every server supports a version 1 request to IDL_DRSReplicaSync, but a server does not support a version 5 request to IDL_DRSGetNCChanges unless it has set both the DRS_EXT_GETCHGREQ_V5 and DRS_EXT_RESTORE_USN_OPTIMIZATION bits. For AD LDS, the IDL_DRSDomainControllerInfo method is disabled regardless of the InfoLevel set by the bits.

A server supports version 4 and version 7 requests to IDL_DRSGetNCChanges only via the SMTP replication transport (see [MS-SRPL]). These cases are noted in the relevant table. A server supports all other requests only via the RPC transport.

IDL_DRSReplicaSync

Request version	DRS_EXTENSIONS_INT bit(s)
1	-

IDL_DRSGetNCChanges

Request version	DRS_EXTENSIONS_INT bit(s)
4	SMTP replication transport
5	DRS_EXT_GETCHGREQ_V5 DRS_EXT_RESTORE_USN_OPTIMIZATION
7	SMTP replication transport
8	DRS_EXT_GETCHGREQ_V8 DRS_EXT_RESTORE_USN_OPTIMIZATION
10	DRS_EXT_GETCHGREQ_V10 DRS_EXT_RESTORE_USN_OPTIMIZATION

IDL_DRSUpdateRefs

Request version	DRS_EXTENSIONS_INT bit(s)
1	-

IDL_DRSReplicaAdd

Request version	DRS_EXTENSIONS_INT bit(s)
1	-
2	DRS_EXT_ASYNCREPL

IDL_DRSReplicaDel

Request version	DRS_EXTENSIONS_INT bit(s)
1	-

IDL_DRSReplicaModify

Request version	DRS_EXTENSIONS_INT bit(s)
1	-

IDL_DRSVerifyNames

Request version	DRS_EXTENSIONS_INT bit(s)
1	-

IDL_DRSGetMemberships

Request version	DRS_EXTENSIONS_INT bit(s)
1	-

IDL_DRInterDomainMove

Request version	DRS_EXTENSIONS_INT bit(s)
2	DRS_EXT_MOVEREQ_V2

IDL_DRSGetNT4ChangeLog

Request version	DRS_EXTENSIONS_INT bit(s)
1	-

IDL_DRSCrackNames

Request version	DRS_EXTENSIONS_INT bit(s)
1	-

IDL_DRWriteSPN

Request version	DRS_EXTENSIONS_INT bit(s)
1	-

IDL_DRRemoveDsServer

Request version	DRS_EXTENSIONS_INT bit(s)
1	DRS_EXT_REMOVEAPI

IDL_DRRemoveDsDomain

Request version	DRS_EXTENSIONS_INT bit(s)
1	DRS_EXT_REMOVEAPI

IDL_DRSDomainControllerInfo

Request version	DRS_EXTENSIONS_INT bit(s)
1 InfoLevel = 0x1	DRS_EXT_DCINFO_V1
1 InfoLevel = 0x2	DRS_EXT_DCINFO_V2
1 InfoLevel = 0x3	DRS_EXT_LH_BETA2
1 InfoLevel = 0xffffffff	DRS_EXT_DCINFO_VFFFFFFFF

IDL_DRSSAddEntry

Request version	DRS_EXTENSIONS_INT bit(s)
2	DRS_EXT_ADDENTRY_V2
3	DRS_EXT_NONDOMAIN_NCS

IDL_DRSExecuteKCC

Request version	DRS_EXTENSIONS_INT bit(s)
1	DRS_EXT_KCC_EXECUTE

IDL_DRSSGetReplInfo

Request version	DRS_EXTENSIONS_INT bit(s)
1	-
2	DRS_EXT_GETCHGREQ_V8
2 InfoType = [3..5]	DRS_EXT_POST_BETA3
2 InfoType = 6	DRS_EXT_GETCHGREQ_V8
2 InfoType = [7..10]	DRS_EXT_GETCHGREPLY_V6

IDL_DRSSAddSidHistory

Request version	DRS_EXTENSIONS_INT bit(s)
1	DRS_EXT_ADD_SID_HISTORY

IDL_DRSSGetMemberships2

Request version	DRS_EXTENSIONS_INT bit(s)
1	DRS_EXT_GETMEMBERSHIPS2

IDL_DRSReplicaVerifyObjects

Request version	DRS_EXTENSIONS_INT bit(s)
1	DRS_EXT_WHISTLER_BETA3

IDL_DRSGetObjectExistence

Request version	DRS_EXTENSIONS_INT bit(s)
1	DRS_EXT_WHISTLER_BETA3

IDL_DRSQuerySitesByCost

Request version	DRS_EXTENSIONS_INT bit(s)
1	DRS_EXT_WHISTLER_BETA3

IDL_DRSInitDemotion

Request version	DRS_EXTENSIONS_INT bit(s)
1	DRS_EXT_ADAM

IDL_DRSReplicaDemotion

Request version	DRS_EXTENSIONS_INT bit(s)
1	DRS_EXT_ADAM

IDL_DRSFinishDemotion

Request version	DRS_EXTENSIONS_INT bit(s)
1	DRS_EXT_ADAM

IDL_DSAPrepareScript

Request version	DRS_EXTENSIONS_INT bit(s)
1	-

IDL_DSAExecuteScript

Request version	DRS_EXTENSIONS_INT bit(s)
1	-

4.1.3.3 Client Behavior When Receiving the IDL_DRSBind Response

The client receives a DRS_EXTENSIONS_INT structure from the server as the referent of *ppextServer*.

A server supports only a subset of the possible request versions, including both *dwInVersion* and the *InfoLevel* of *IDL_DRSDomainControllerInfo* and the *InfoType* of *IDL_DRSGetRepInfo*. The server

informs the client of its capabilities via the DRS_EXTENSIONS_INT structure returned from IDL_DRSSBind, as described in Server Behavior of the IDL_DRSSBind Method (section 4.1.3.2).

The client receives a DRS_HANDLE as the referent of *phDrs*.

The client retains the context handle *phDrs*^ for use in method calls on the drsuapi interface. Once a valid handle has been acquired by the client, the handle remains valid until either the server unilaterally breaks the RPC connection (for example, by crashing) or until IDL_DRSSUnbind has been performed.

4.1.3.4 Examples of the IDL_DRSSBind Method

The LDAP Server on DC2.CONTOSO.COM is binding to the directory server DC1.CONTOSO.COM.

4.1.3.4.1 Initial State

Querying the nTDSDSA objects for the **forest** root domain NC DC=CONTOSO, DC=COM for DC1 and DC2 respectively:

- `ldap_search_s("CN=NTDS Settings,CN=DC1,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com", baseObject, "(objectClass=*)", [objectClass, cn, distinguishedName, objectGUID, msDS-Behavior-Version])`
- Result <0>: (null)
- Matched DNs:
- Getting 1 entries:
- >> Dn: CN=NTDS Settings,CN=DC1,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com
 - 3> objectClass: top; applicationSettings; nTDSDSA;
 - 1> cn: NTDS Settings;
 - 1> distinguishedName: CN=NTDS Settings,CN=DC1,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com;
 - 1> objectGUID: c20bc312-4d35-4cc0-9903-b1073368af4a;
 - 1> msDS-Behavior-Version: 2 = (DS_BEHAVIOR_WIN2003);
- `ldap_search_s("CN=NTDS Settings,CN=DC2,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com", baseObject, "(objectClass=*)", [objectClass, cn, distinguishedName, objectGUID, msDS-Behavior-Version])`
- Result <0>: (null)
- Matched DNs:
- Getting 1 entries:
- >> Dn: CN=NTDS Settings,CN=DC2,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com
 - 3> objectClass: top; applicationSettings; nTDSDSA;
 - 1> cn: NTDS Settings;

1> distinguishedName: CN=NTDS Settings, CN=DC2, CN=Servers, CN=Default-First-Site-Name, CN=Sites, CN=Configuration, DC=contoso, DC=com;

1> objectGUID: 6aad8f5a-07cc-403a-9696-9102fe1c320b;

1> msDS-Behavior-Version: 2 = (DS_BEHAVIOR_WIN2003)

4.1.3.4.2 Client Request

~~Note: Some of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it in the Product Behavior appendix.~~

DC2 invokes the IDL_DRSBind method against DC1, with the following parameters (DRS_HANDLE to DC1 omitted):

- *puuidClientDsa* = GUID {6aad8f5a-07cc-403a-9696-9102fe1c320b}
- *pextClient*:
 - *cb*: 0x30
 - *dwFlags*:
 - DRS_EXT_BASE
 - DRS_EXT_ASYNCREPL
 - DRS_EXT_REMOVEAPI
 - DRS_EXT_MOVEREQ_V2
 - DRS_EXT_GETCHG_DEFLATE
 - DRS_EXT_DCINFO_V1
 - DRS_EXT_RESTORE_USN_OPTIMIZATION
 - DRS_EXT_KCC_EXECUTE
 - DRS_EXT_ADDENTRY_V2
 - DRS_EXT_LINKED_VALUE_REPLICATION
 - DRS_EXT_DCINFO_V2
 - DRS_EXT_INSTANCE_TYPE_NOT_REQ_ON_MOD
 - DRS_EXT_CRYPTO_BIND
 - DRS_EXT_GET_REPL_INFO
 - DRS_EXT_STRONG_ENCRYPTION
 - DRS_EXT_DCINFO_VFFFFFFFF
 - DRS_EXT_TRANSITIVE_MEMBERSHIP
 - DRS_EXT_ADD_SID_HISTORY
 - DRS_EXT_POST_BETA3

- DRS_EXT_GETCHGREQ_V5
- DRS_EXT_GET_MEMBERSHIPS2
- DRS_EXT_GETCHGREQ_V6
- DRS_EXT_NONDOMAIN_NCS
- DRS_EXT_GETCHGREQ_V8
- DRS_EXT_GETCHGREPLY_V5
- DRS_EXT_GETCHGREPLY_V6
- DRS_EXT_GETCHGREPLY_V9
- DRS_EXT_WHISTLER_BETA3
- DRS_EXT_W2K3_DEFLATE
- DRS_EXT_GETCHGREQ_V10
- SiteObjGuid: GUID {620954c7-7044-400f-9c0b-5c9154198aa6}
- Pid: 632
- dwReplEpoch:0
- dwFlagsExt: 0
- ConfigObjGUID: NULL GUID

4.1.3.4.3 Server Response

~~Note: Some of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it in the Product Behavior appendix.~~

Return code of 0 (DRS_HANDLE to DC1 omitted) with the following values:

- *ppextServer*:
 - cb: 0x30
 - dwFlags:
 - DRS_EXT_BASE
 - DRS_EXT_ASYNCREPL
 - DRS_EXT_REMOVEAPI
 - DRS_EXT_MOVEREQ_V2
 - DRS_EXT_GETCHG_DEFLATE
 - DRS_EXT_DCINFO_V1
 - DRS_EXT_RESTORE_USN_OPTIMIZATION
 - DRS_EXT_KCC_EXECUTE

- DRS_EXT_ADDENTRY_V2
- DRS_EXT_LINKED_VALUE_REPLICATION
- DRS_EXT_DCINFO_V2
- DRS_EXT_INSTANCE_TYPE_NOT_REQ_ON_MOD
- DRS_EXT_GET_REPL_INFO
- DRS_EXT_STRONG_ENCRYPTION
- DRS_EXT_DCINFO_VFFFFFFFF
- DRS_EXT_TRANSITIVE_MEMBERSHIP
- DRS_EXT_ADD_SID_HISTORY
- DRS_EXT_POST_BETA3
- DRS_EXT_GETCHGREQ_V5
- DRS_EXT_GET_MEMBERSHIPS2
- DRS_EXT_GETCHGREQ_V6
- DRS_EXT_NONDOMAIN_NCS
- DRS_EXT_GETCHGREQ_V8
- DRS_EXT_GETCHGREPLY_V5
- DRS_EXT_GETCHGREPLY_V6
- DRS_EXT_GETCHGREPLY_V9
- DRS_EXT_WHISTLER_BETA3
- DRS_EXT_W2K3_DEFLATE
- DRS_EXT_GETCHGREQ_V10
- SiteObjGuid: GUID {620954c7-7044-400f-9c0b-5c9154198aa6}
- Pid: 632
- dwReplEpoch: 0
- dwFlagsExt: 0
- ConfigObjGUID: NULL GUID

4.1.3.4.4 Final State

No change in state.

4.1.4 IDL_DRSCrackNames (Opnum 12)

The IDL_DRSCrackNames method looks up each of a set of objects in the directory and returns it to the caller in the requested format.

```

ULONG IDL_DRSCrackNames (
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
    DRS_MSG_CRACKREQ* pmsgIn,
    [out, ref] DWORD* pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
    DRS_MSG_CRACKREPLY* pmsgOut
);

```

hDrs: RPC context handle returned by the IDL_DRSSbind method.

dwInVersion: Version of the request message.

pmsgIn: Pointer to the request message.

pdwOutVersion: Pointer to the version of the response message.

pmsgOut: Pointer to the response message.

Return Values: 0 if successful, otherwise a Windows error code.

Exceptions Thrown: This method might throw the following exceptions beyond those thrown by the underlying RPC protocol (as specified in [MS-RPCE]): ERROR_INVALID_HANDLE, ERROR_DS_DS_EXTENSIONS_CHANGED, ERROR_DS_DIFFERENT_REPL_EPOCHS, and ERROR_INVALID_PARAMETER.

4.1.4.1 Method-Specific Concrete Types

4.1.4.1.1 DRS_MSG_CRACKREQ

The DRS_MSG_CRACKREQ union defines the request messages sent to the IDL_DRSCrackNames method. Only one version, identified by *dwInVersion* = 1, is currently defined.

```

typedef
[switch_type(DWORD)]
union {
    [case(1)]
    DRS_MSG_CRACKREQ_V1 V1;
} DRS_MSG_CRACKREQ;

```

V1: Version 1 request.

4.1.4.1.2 DRS_MSG_CRACKREQ_V1

The DRS_MSG_CRACKREQ_V1 structure defines the request message sent to the IDL_DRSCrackNames method.

```

typedef struct {
    ULONG CodePage;
    ULONG LocaleId;
    DWORD dwFlags;
    DWORD formatOffered;
    DWORD formatDesired;
    [range(1,10000)] DWORD cNames;
    [string, size_is(cNames)] WCHAR** rpNames;
} DRS_MSG_CRACKREQ_V1;

```

CodePage: The character set used by the client. This field SHOULD be ignored by the server.

LocaleId: The locale used by the client. This field SHOULD be ignored by the server.

dwFlags: Zero or more of the following bit flags, which are presented in little-endian byte order.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
X	X	X	X	TR	GC	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	FPO	X	X	X	X	X	X	X	

X: Unused. MUST be zero and ignored.

GC (DS_NAME_FLAG_GCVERIFY, 0x00000004): If set, the call fails if the server is not a GC server.

TR (DS_NAME_FLAG_TRUST_REFERRAL, 0x00000008): If set and the lookup fails on the server, referrals are returned to trusted forests where the lookup might succeed.

FPO (DS_NAME_FLAG_PRIVATE_RESOLVE_FPOS, 0x80000000): If set and the named object is a foreign security principal, indicate this by using the status of the lookup operation.

formatOffered: The format of the names in **rpNames**. This may be one of the values from DS_NAME_FORMAT (section 4.1.4.1.3) or one of the following.

Value	Meaning
DS_LIST_SITES 0xFFFFFFFF	Get all sites in the forest.
DS_LIST_SERVERS_IN_SITE 0xFFFFFFFFE	Get all servers in a given site.
DS_LIST_DOMAINS_IN_SITE 0xFFFFFFFFD	Get all domains in a given site.
DS_LIST_SERVERS_FOR_DOMAIN_IN_SITE 0xFFFFFFFFC	Get all DCs of a specified domain in a given site.
DS_LIST_INFO_FOR_SERVER 0xFFFFFFFFB	Get DNS host name and server reference for a given DC.
DS_LIST_ROLES 0xFFFFFFFFA	Get FSMO role owners.
DS_NT4_ACCOUNT_NAME_SANS_DOMAIN 0xFFFFFFFF9	Get value of sAMAccountName attribute.
DS_MAP_SCHEMA_GUID 0xFFFFFFFF8	Get LDAP display name from schema GUID. The given schema GUID <u>should</u> be in the curly braced GUID string format as specified in [MS-DTYP] section 2.3.4.3.
DS_LIST_DOMAINS 0xFFFFFFFF7	Get all domains in the forest.
DS_LIST_NCS 0xFFFFFFFF6	Get all NCs in the forest.

Value	Meaning
DS_ALT_SECURITY_IDENTITIES_NAME 0xFFFFFFFF5	Compares input names against the values of the altSecurityIdentities attribute.
DS_STRING_SID_NAME 0xFFFFFFFF4	String form of SID.
DS_LIST_SERVERS_WITH_DCS_IN_SITE 0xFFFFFFFF3	Get all DCs in a given site.
DS_LIST_GLOBAL_CATALOG_SERVERS 0xFFFFFFFF1	Get all GCs in the forest.
DS_NT4_ACCOUNT_NAME_SANS_DOMAIN_EX 0xFFFFFFFF0	Get value of sAMAccountName attribute; return status DS_NAME_ERROR_NOT_FOUND if account is invalid.
DS_USER_PRINCIPAL_NAME_AND_ALTSECID 0xFFFFFFFFF	Compares input names against the user principal name and the values of the altSecurityIdentities attribute.

formatDesired: Format of the names in the **rItems** field of the DS_NAME_RESULTW structure, which is returned inside the DRS_MSG_CRACKREPLY message. This **may** be one of the values from DS_NAME_FORMAT or one of the following.

Value	Meaning
DS_STRING_SID_NAME 0xFFFFFFFF4	String form of a SID.
DS_USER_PRINCIPAL_NAME_FOR_LOGON 0xFFFFFFFF2	User principal name.

cNames: Count of items in the **rpNames** array.

rpNames: Input names to translate.

4.1.4.1.3 DS_NAME_FORMAT

The DS_NAME_FORMAT enumeration describes the format of a name sent to or received from the IDL_DRSCrackNames method.

```
typedef enum
{
    DS_UNKNOWN_NAME = 0,
    DS_FQDN_1779_NAME = 1,
    DS_NT4_ACCOUNT_NAME = 2,
    DS_DISPLAY_NAME = 3,
    DS_UNIQUE_ID_NAME = 6,
    DS_CANONICAL_NAME = 7,
    DS_USER_PRINCIPAL_NAME = 8,
    DS_CANONICAL_NAME_EX = 9,
    DS_SERVICE_PRINCIPAL_NAME = 10,
    DS_SID_OR_SID_HISTORY_NAME = 11,
    DS_DNS_DOMAIN_NAME = 12
} DS_NAME_FORMAT;
```

DS_UNKNOWN_NAME: The server looks up the name by using the algorithm specified in the LookupUnknownName procedure.

DS_FQDN_1779_NAME: A distinguished name.

DS_NT4_ACCOUNT_NAME: Windows NT 4.0 (and prior) name format. The account name is in the format domain\user and the domain-only name is in the format domain\.

DS_DISPLAY_NAME: A user-friendly display name.

DS_UNIQUE_ID_NAME: Curly braced string representation of an objectGUID. The format of the string representation is specified in [MS-DTYP] section 2.3.4.3.

DS_CANONICAL_NAME: A **canonical name**.

DS_USER_PRINCIPAL_NAME: User principal name.

DS_CANONICAL_NAME_EX: Same as DS_CANONICAL_NAME except that the rightmost forward slash (/) is replaced with a newline character (\n).

DS_SERVICE_PRINCIPAL_NAME: Service principal name (SPN).

DS_SID_OR_SID_HISTORY_NAME: String representation of a SID (as specified in [MS-DTYP] section 2.4.2).

DS_DNS_DOMAIN_NAME: Not supported.

4.1.4.1.4 DS_NAME_RESULT_ITEMW

The DS_NAME_RESULT_ITEMW structure defines the translated name returned by the IDL_DRSCrackNames method.

```
typedef struct {
    DWORD status;
    [string, unique] WCHAR* pDomain;
    [string, unique] WCHAR* pName;
} DS_NAME_RESULT_ITEMW,
 *PDS_NAME_RESULT_ITEMW;
```

status: Status of the crack name operation for the corresponding element of the **rpNames** field in the request. The status is one of the values from the enumeration DS_NAME_ERROR.

pDomain: DNS domain name of the domain in which the named object resides.

pName: Object name in the requested format.

4.1.4.1.5 DS_NAME_RESULTW

The DS_NAME_RESULTW structure defines the translated names returned by the IDL_DRSCrackNames method.

```
typedef struct {
    DWORD cItems;
    [size_is(cItems)] PDS_NAME_RESULT_ITEMW rItems;
} DS_NAME_RESULTW,
 *PDS_NAME_RESULTW;
```

cItems: The count of items in the **rItems** array.

rItems: Translated names that correspond one-to-one with the elements in the **rpNames** field of the request.

4.1.4.1.6 DRS_MSG_CRACKREPLY

The DRS_MSG_CRACKREPLY union defines the response messages received from the IDL_DRSCrackNames method.

```
typedef
[switch_type(DWORD)]
union {
    [case(1)]
    DRS_MSG_CRACKREPLY_V1 V1;
} DRS_MSG_CRACKREPLY;
```

V1: Version 1 reply.

4.1.4.1.7 DRS_MSG_CRACKREPLY_V1

The DRS_MSG_CRACKREPLY_V1 structure defines the response message received from the IDL_DRSCrackNames method.

```
typedef struct {
    DS_NAME_RESULTW* pResult;
} DRS_MSG_CRACKREPLY_V1;
```

pResult: Translated form of the names.

4.1.4.1.8 DS_NAME_ERROR

This section enumerates the possible statuses of a translation operation.

Symbolic name	Description
0 DS_NAME_NO_ERROR	No error occurred during the name translation.
1 DS_NAME_ERROR_RESOLVING	Generic processing error during the name translation.
2 DS_NAME_ERROR_NOT_FOUND	The object with the specified name cannot be found.
3 DS_NAME_ERROR_NOT_UNIQUE	More than one object is located with the specified name.
4 DS_NAME_ERROR_NO_MAPPING	The desired output format cannot be applied to the object with the specified name.
5 DS_NAME_ERROR_DOMAIN_ONLY	Only the domain part of the name was translated.
7 DS_NAME_ERROR_TRUST_REFERRAL	The specified name belongs to a trusted forest, a referral is returned.
0xFFFFFFFF2 DS_NAME_ERROR_IS_SID_HISTORY_UNKNOWN	The specified name matches a value in the sidHistory attribute of an object, but the type of the object is unknown.
0xFFFFFFFF3	Translation was successful. The specified name matches a value in the sidHistory attribute of an object. The

Symbolic name	Description
DS_NAME_ERROR_IS_SID_HISTORY_ALIAS	object's sAMAccountType attribute value is either SAM_NON_SECURITY_ALIAS_OBJECT or SAM_ALIAS_OBJECT as defined in [MS-SAMR] section 2.2.1.9, ACCOUNT_TYPE Values.
0xFFFFFFFF4 DS_NAME_ERROR_IS_SID_HISTORY_GROUP	Translation was successful. The specified name matches a value in the sidHistory attribute of an object. The object's sAMAccountType attribute value is either SAM_GROUP_OBJECT or SAM_NON_SECURITY_GROUP_OBJECT as defined in [MS-SAMR] section 2.2.1.9, ACCOUNT_TYPE Values.
0xFFFFFFFF5 DS_NAME_ERROR_IS_SID_HISTORY_USER	Translation was successful. The specified name matches a value in the sidHistory attribute of an object. The object's sAMAccountType attribute value is SAM_USER_OBJECT or SAM_MACHINE_ACCOUNT or SAM_TRUST_ACCOUNT as defined in [MS-SAMR] section 2.2.1.9, ACCOUNT_TYPE Values.
0xFFFFFFFF6 DS_NAME_ERROR_IS_SID_UNKNOWN	The specified name matches the objectSid attribute of an object, but the type of the object is unknown.
0xFFFFFFFF7 DS_NAME_ERROR_IS_SID_ALIAS	Translation was successful. The specified name matches the objectSid attribute of an object. The object's sAMAccountType attribute value is either SAM_NON_SECURITY_ALIAS_OBJECT or SAM_ALIAS_OBJECT as defined in [MS-SAMR] section 2.2.1.9, ACCOUNT_TYPE Values.
0xFFFFFFFF8 DS_NAME_ERROR_IS_SID_GROUP	Translation was successful. The specified name matches the objectSid attribute of an object. The object's sAMAccountType attribute value is either SAM_GROUP_OBJECT or SAM_NON_SECURITY_GROUP_OBJECT as defined in [MS-SAMR] section 2.2.1.9, ACCOUNT_TYPE Values.
0xFFFFFFFF9 DS_NAME_ERROR_IS_SID_USER	Translation was successful. The specified name matches the objectSid attribute of an object. The object's sAMAccountType attribute value is SAM_USER_OBJECT or SAM_MACHINE_ACCOUNT or SAM_TRUST_ACCOUNT as defined in [MS-SAMR] section 2.2.1.9, ACCOUNT_TYPE Values.
0xFFFFFFFFFA DS_NAME_ERROR_SCHEMA_GUID_CONTROL_RIGHT	Translation was successful. The GUID identifies a control access right.
0xFFFFFFFFFB DS_NAME_ERROR_SCHEMA_GUID_CLASS	Translation was successful. The GUID identifies a classSchema object.
0xFFFFFFFFFC DS_NAME_ERROR_SCHEMA_GUID_ATTR_SET	Translation was successful. The GUID identifies a property set.
0xFFFFFFFFFD DS_NAME_ERROR_SCHEMA_GUID_ATTR	Translation was successful. The GUID identifies an attributeSchema object.
0xFFFFFFFFFE DS_NAME_ERROR_SCHEMA_GUID_NOT_FOUND	The GUID cannot be resolved.
0xFFFFFFFFFF DS_NAME_ERROR_IS_FPO	The object with the specified name is a Foreign Principal Object.

4.1.4.2 Method-Specific Abstract Types and Procedures

4.1.4.2.1 CanonicalNameFromCanonicalNameEx

```
procedure CanonicalNameFromCanonicalNameEx(  
    name: unicodestring): unicodestring
```

This procedure converts *name* from **extended canonical name** format to canonical name format by replacing the last newline character in *name* with a forward slash character. If *name* is not in the correct format, "domain/container/container/.../container\nleaf" (where \n designates a newline character), this procedure returns null.

4.1.4.2.2 DomainDNSNameFromDomain

```
procedure DomainDNSNameFromDomain(domainNC: DSName): unicodestring
```

If the domain NC, whose root has the DSName *domainNC*, is hosted in the forest, this procedure returns the DNS domain name of that domain NC. Otherwise, null is returned.

4.1.4.2.3 DomainFromDomainDNSName

```
procedure DomainFromDomainDNSName(domainName: unicodestring): DSName
```

If the DC hosts an NC replica of the domain NC whose DNS domain name is *domainName*, this procedure returns the DSName of the root of that domain NC. Otherwise, it returns null.

4.1.4.2.4 DomainNameFromCanonicalName

```
procedure DomainNameFromCanonicalName(  
    canonicalName: unicodestring): unicodestring
```

Given a name in canonical format, this procedure extracts and returns the domain FQDN (1). If the input is not in canonical name format, then null is returned. For example, when the input is "example.fabrikam.com/container/username", the returned domain FQDN (1) is "example.fabrikam.com".

4.1.4.2.5 DomainNameFromSid

```
procedure DomainNameFromSid(domainSid: SID): unicodestring
```

Looks up the domain SID *domainSid* among trusted domains and domains in trusted forests. If *domainSid* is the domain SID of a trusted domain, then the name of this domain is returned. If the input is null, then null is returned.

4.1.4.2.6 DomainNameFromUPN

```
procedure DomainNameFromUPN(upn: unicodestring): unicodestring
```

Parses and returns the domain name from a UPN-formatted string *upn*. The domain name is the component after the '@'. For example, when the input is "username@example.fabrikam.com", then "example.fabrikam.com" is returned. If *upn* is not in UPN format, then null is returned.

4.1.4.2.7 DomainNetBIOSNameFromDomain

```
procedure DomainNetBIOSNameFromDomain(domainNC: DSName): unicodestring
```

If the domain NC, whose root has the DSName *domainNC*, is hosted in the forest, this procedure returns the NetBIOS domain name of that domain NC. Otherwise, null is returned.

4.1.4.2.8 DomainSidFromSid

```
procedure DomainSidFromSid(sid: SID): SID
```

Removes the last subauthority from the input security identifier **sid** and returns the resulting security identifier, which is the domain SID. If the input is null, the procedure returns null. See [MS-DTYP] section 2.4.2 for more details on SIDs.

4.1.4.2.9 CrackNames

```
procedure CrackNames(DRS_MSG_CRACKREQ_V1 msgIn, DS_NAME_RESULTW *pmsgOut): ULONG
```

The CrackNames method implements the core functionality of IDL_DRSCrackNames, that is, looking up directory object names that are provided in one format (for example, SPNs) and returning them in a different format (for example, DNs).

```
i: DWORD
rt: set of DSName
serverObj, siteObj, attr, class, er: DSName
guid: GUID

if msgIn.formatOffered in {
    all constants in DS_NAME_FORMAT enumeration,
    DS_NT4_ACCOUNT_NAME_SANS_DOMAIN,
    DS_NT4_ACCOUNT_NAME_SANS_DOMAIN_EX,
    DS_ALT_SECURITY_IDENTITIES_NAME,
    DS_STRING_SID_NAME,
    DS_USER_PRINCIPAL_NAME_AND_ALTSECID} then
    /* Regular name lookup. */
    for i := 0 to msgIn.cNames - 1
        /* Perform the lookup based on the input format. */
        msgOut^.rItems[i] := LookupName(
            msgIn.dwFlags, msgIn.formatOffered, msgIn.formatDesired,
            msgIn.rpNames[i])
    endfor
    msgOut^.cItems = msgIn.cNames
else if msgIn.formatOffered = DS_LIST_ROLES then
    /* Return the list of FSMO role owners. */
    i := 0
    foreach role in {FSMO_SCHEMA, FSMO_DOMAIN_NAMING, FSMO_PDC,
        FSMO_RID, FSMO_INFRASTRUCTURE}
        msgOut^.rItems[i].pName := GetFSMORoleOwner(role).dn
        msgOut^.rItems[i].status := DS_NAME_NO_ERROR
        i := i + 1
    endfor
    msgOut^.cItems := i
else if msgIn.formatOffered = DS_LIST_SITES then
    /* Return the list of known sites. */
    rt := select all o from children
        DescendantObject(ConfigNC(), "CN=Sites,")
        where o!objectCategory = GetDefaultObjectCategory(site)
    i := 0
    foreach siteObj in rt
        msgOut^.rItems[i].pName := siteObj.dn
```

```

        msgOut^.rItems[i].status := DS_NAME_NO_ERROR
        i := i + 1
    endfor
    msgOut^.cItems := i
else if msgIn.formatOffered = DS_LIST_SERVERS_IN_SITE then
    /* Return all DCs in a site named msgIn.rpNames[0]. */
    rt := select all o from subtree msgIn.rpNames[0]
        where o!objectCategory = GetDefaultObjectCategory(server)
    i := 0
    foreach serverObj in rt
        msgOut^.rItems[i].pName := serverObj.dn
        msgOut^.rItems[i].status := DS_NAME_NO_ERROR
        i := i + 1
    endfor
    msgOut^.cItems := i
else if msgIn.formatOffered = DS_LIST_DOMAINS then
    /* Return all known AD domains. */
    rt := select all o from
        subtree DescendantObject(ConfigNC(), "CN=Partitions,")
        where o!objectCategory = GetDefaultObjectCategory(crossRef)
        and FLAG_CR_NTDS_DOMAIN in o!systemFlags
    i := 0
    foreach crObj in rt
        msgOut^.rItems[i].pName := crObj!ncName.dn
        msgOut^.rItems[i].status := DS_NAME_NO_ERROR
        i := i + 1
    endfor
    msgOut^.cItems := i
else if msgIn.formatOffered = DS_LIST_NCS then
    /* Return all known NCs. */
    rt := select all o from
        subtree DescendantObject(ConfigNC(), "CN=Partitions,")
        where o!objectCategory = GetDefaultObjectCategory(crossRef)
    i := 0
    foreach crObj in rt
        msgOut^.rItems[i].pName := crObj!ncName.dn
        msgOut^.rItems[i].status := DS_NAME_NO_ERROR
        i := i + 1
    endfor
    msgOut^.cItems := i
else if msgIn.formatOffered = DS_LIST_DOMAINS_IN_SITE then
    /* Return the list of domains that are hosted by DCs in a site
     * named msgIn.rpNames[0]. */
    /* First find all DCs in a site named msgIn.rpNames[0]. */
    rt := select all o from subtree msgIn.rpNames[0]
        where o!objectCategory = GetDefaultObjectCategory(nTDSDSA)
    /* Gather the list of all domains from DSA object. */
    hostedDomains := null
    foreach dsaObj in rt
        /* Union operation eliminates duplicates. */
        hostedDomains := hostedDomains + dsaObj!hasMasterNCs
    endfor
    i := 0
    foreach domain in hostedDomains
        if domain ≠ SchemaNC() and domain ≠ ConfigNC() then
            msgOut^.rItems[i].pName := domain.dn
            msgOut^.rItems[i].status := DS_NAME_NO_ERROR
            i := i + 1
        endif
    endfor
    msgOut^.cItems := i
else if msgIn.formatOffered = DS_LIST_SERVERS_FOR_DOMAIN_IN_SITE then
    /* Return all DSAs hosting domain msgIn.rpNames[0] in a site named
     * msgIn.rpNames[1]. */
    rt := select all o from subtree msgIn.rpNames[1]
        where o!objectCategory = GetDefaultObjectCategory(nTDSDSA)
        and msgIn.rpNames[0] in o!msDS-hasMasterNCs
    /* Return the list of server objects (parents of DSAs). */
    i := 0
    foreach dsaObj in rt

```

```

serverObj := select one o from subtree ConfigNC() where
    o!objectGUID = dsaObj!parent
msgOut^.rItems[i].pName := serverObj.dn
msgOut^.rItems[i].status := DS_NAME_NO_ERROR
i := i + 1
endfor
msgOut^.cItems := i
else if msgIn.formatOffered = DS_LIST_SERVERS_WITH_DCS_IN_SITE then
/* Return all servers that have DSA objects in a site named
 * msgIn.rpNames[0]. */
rt := select all o from subtree msgIn.rpNames[0]
    where o!objectCategory = GetDefaultObjectCategory(nTDSDSA)
    and o!hasMasterNCs # null
/* Return the list of server objects (parents of DSAs). */
i := 0
foreach dsaObj in rt
    serverObj := select one o from subtree ConfigNC() where
        o!objectGUID = dsaObj!parent
    msgOut^.rItems[i].pName := serverObj.dn
    msgOut^.rItems[i].status := DS_NAME_NO_ERROR
    i := i + 1
endfor
msgOut^.cItems := i
else if msgIn.formatOffered = DS_LIST_INFO_FOR_SERVER then
/* Returns the DSA object, the dnsHostName and the serverReference
 * for the server specified by msgIn.rpNames[0]. */
serverObj := GetDSNameFromDN(msgIn.rpNames[0])
dsaObj := select one o from subtree msgIn.rpNames[0]
    where o!objectCategory = GetDefaultObjectCategory(nTDSDSA)
if dsaObj # null then
/* Ok, looks like a valid server object. */
msgOut^.rItems[0].pName := dsaObj.dn
msgOut^.rItems[0].status := DS_NAME_NO_ERROR
msgOut^.rItems[1].pName := serverObj!dnsHostName
msgOut^.rItems[1].status := DS_NAME_NO_ERROR
msgOut^.rItems[2].pName := serverObj!serverReference
msgOut^.rItems[2].status := DS_NAME_NO_ERROR
msgOut^.cItems := 3
endif
else if msgIn.formatOffered = DS_LIST_GLOBAL_CATALOG_SERVERS then
/* Returns the list of GC servers, including the info which site
 * each GC belongs to. */
rt := select all o from subtree ConfigNC()
    where O!objectCategory = GetDefaultObjectCategory(nTDSDSA)
    and NTDSDSA_OPT_IS_GC in o!options and o!invocationId # null
i := 0
foreach dsaObj in rt
/* server object is the parent of the DSA object. */
serverObj := select one o from subtree ConfigNC() where
    o!objectGUID = dsaObj!parent
/* Site object is the parent of the server object. */
siteObj := select one o from subtree ConfigNC() where
    o!objectGUID = serverObj!parent
msgOut^.rItems[i].pDomain := serverObj!dnsHostName
msgOut^.rItems[i].pName := leftmost RDN of siteObj.dn
msgOut^.rItems[i].status := DS_NAME_NO_ERROR
i := i+1
endfor
msgOut^.cItems := i
else if msgIn.formatOffered = DS_MAP_SCHEMA_GUID then
for i := 0 to msgIn.cNames - 1
/* Map a guid contained in msgIn.rpNames[i] to attribute or class
 * or propertySet.*/
/* Assume no match by default. */
msgOut^.rItems[i].status := DS_NAME_ERROR_SCHEMA_GUID_NOT_FOUND

/* Validate the string guid contained in msgIn.rpNames[i] */
guid := GuidFromString(true, msgIn.rpNames[i])
if guid # null then

```

```

/* First, try to find a matching attribute. */
attr := select one o from subtree SchemaNC()
      where attributeSchema in o!objectClass and
            o!schemaIdGuid = msgIn.rpNames[i]
if attr # null
/* Found a matching attribute object. */
msgOut^.rItems[i].pName := attr!LDAPDisplayName
msgOut^.rItems[i].status := DS_NAME_ERROR_SCHEMA_GUID_ATTR
else
/* Next, try to find a matching class. */
class := select one o from subtree SchemaNC()
       where classSchema in o!objectClass
            o!schemaIdGuid = msgIn.rpNames[i]
if class # null
/* Found a matching class object. */
msgOut^.rItems[i].pName := class!LDAPDisplayName
msgOut^.rItems[i].status := DS_NAME_ERROR_SCHEMA_GUID_CLASS
else
/* Finally, try to find a matching extendedRight object. */
er := select one o from
     subtree DescendantObject(ConfigNC(),
                              "CN=Extended-Rights,")
     where extendedRight in o!objectClass and
           o!rightsGuid = msgIn.rpNames[i]
if er # null
/* Found a matching extendedRight object */
if RIGHT_DS_READ_PROPERTY in er!validAccesses or
   RIGHT_DS_WRITE_PROPERTY in er!validAccesses then
msgOut^.rItems[i].pName := er!displayName
msgOut^.rItems[i].status :=
   DS_NAME_ERROR_SCHEMA_GUID_ATTR_SET
else if RIGHT_DS_CONTROL_ACCESS in er!validAccesses or
   RIGHT_DS_WRITE_PROPERTY_EXTENDED in er!validAccesses
then
msgOut^.rItems[i].pName := er!displayName
msgOut^.rItems[i].status :=
   DS_NAME_ERROR_SCHEMA_GUID_CONTROL_RIGHT
endif
endif
endif
endif
endif
endif
msgOut^.cItems := msgIn.cNames
endif

return ERROR_SUCCESS

```

4.1.4.2.10 LookupName

```

procedure LookupName(
  flags: DWORD,
  formatOffered: DWORD,
  formatDesired: DWORD,
  name: unicodestring): DS_NAME_RESULT_ITEMW

```

Informative summary of behavior: The LookupName procedure performs the lookup of a single *name* in a given input format and produces the output *name* in the given output format.

```

rt: sequence of DSName
obj: DSName
fSidHistory: boolean
result: DS_NAME_RESULT_ITEMW
names: sequence of unicodestring
domainName: unicodestring

```

```

fCanonicalEx: boolean
referredDomain: unicodestring

if formatOffered = DS_UNKNOWN_NAME then
    return LookupUnknownName(flags, name, formatDesired)
endif

domainName := null

if formatOffered = DS_FQDN_1779_NAME then
    rt := LookupAttr(flags, distinguishedName, name)
    domainName := DomainDNSNameFromDomain(RetrieveDCSuffixFromDn(name))
else if formatOffered = DS_NT4_ACCOUNT_NAME then
    rt := LookupAttr(flags, sAMAccountName,
        UserNameFromNT4AccountName(name))
    domainName := DomainNameFromNT4AccountName(name)
else if formatOffered = DS_USER_PRINCIPAL_NAME then
    rt := LookupUPNAndAltSecID(flags, false, name)
    domainName := DomainNameFromUPN(name)
else if formatOffered = DS_CANONICAL_NAME then
    rt := LookupCanonicalName(name)
    domainName := DomainNameFromCanonicalName(name)
else if formatOffered = DS_UNIQUE_ID_NAME then
    rt := select all o from all where o!objectGuid = GuidFromString(true, name)
else if formatOffered = DS_DISPLAY_NAME then
    rt := LookupAttr(flags, displayName, name)
else if formatOffered = DS_SERVICE_PRINCIPAL_NAME then
    rt := LookupSPN(flags, name)
    domainName := GetServiceNameFromSPN(name)
else if formatOffered in {DS_SID_OR_SID_HISTORY_NAME,
    DS_STRING_SID_NAME} then
    rt := LookupSID(flags, SidFromStringSid(name))
    domainName := DomainNameFromSid(DomainSidFromSid(SidFromStringSid(name)))
else if formatOffered = DS_CANONICAL_NAME_EX then
    rt := LookupCanonicalName(CanonicalNameFromCanonicalNameEx(name))
    domainName := DomainNameFromCanonicalName(name)
else if formatOffered in {DS_NT4_ACCOUNT_NAME_SANS_DOMAIN,
    DS_NT4_ACCOUNT_NAME_SANS_DOMAIN_EX} then
    rt := LookupAttr(flags, sAMAccountName, name)
else if formatOffered = DS_ALT_SECURITY_IDENTITIES_NAME then
    rt := LookupAttr(flags, altSecurityIdentities, name)
else if formatOffered = DS_USER_PRINCIPAL_NAME_AND_ALTSECID then
    rt := LookupUPNAndAltSecID(flags, true, name)
    domainName := DomainNameFromUPN(name)
else
    rt := null
endif

result.pName^ := null
result.pDomain^ := null
result.status := DS_NAME_NO_ERROR

if rt = null and domainName ≠ null then
    result.status := DS_NAME_ERROR_DOMAIN_ONLY
    if formatOffered in {DS_NT4_ACCOUNT_NAME, DS_USER_PRINCIPAL_NAME,
        DS_SERVICE_PRINCIPAL_NAME, DS_SID_OR_SID_HISTORY_NAME,
        DS_STRING_SID_NAME, DS_USER_PRINCIPAL_NAME_AND_ALTSECID} then
        if IsDomainNameInTrustedForest(domainName, referredDomain) then
            result.pDomain^ := referredDomain
            if DS_NAME_FLAG_TRUST_REFERRAL in flags then
                result.status := DS_NAME_ERROR_TRUST_REFERRAL
            else
                result.status := DS_NAME_ERROR_DOMAIN_ONLY
            endif
        endif
    endif
    return result
endif

if rt = null then

```



```

    /* No match. */
    result.status := DS_NAME_ERROR_NOT_FOUND
    return result
endif

if rt.length > 1 then
    /* Found more than one matching object. */
    result.status := DS_NAME_ERROR_NOT_UNIQUE
    return result
endif

obj := rt[0]

if formatOffered = DS_NT4_ACCOUNT_NAME_SANS_DOMAIN_EX then
    /* Check that the account is valid. */
    if obj!userAccountControl ∩ {ADS_UF_ACCOUNTDISABLE,
        ADS_UF_TEMP_DUPLICATE_ACCOUNT} ≠ {} then
        result.status := DS_NAME_ERROR_NOT_FOUND
        return result
    endif
endif

if formatOffered = DS_STRING_SID_NAME then
    /* The type of the object needs to be specified in result.status. */
    /* Check if the value came from sidHistory or objectSid. */
    fSidHistory := SidFromStringSid(name) in obj!sidHistory

    if obj!sAMAccountType in {SAM_USER_OBJECT, SAM_MACHINE_ACCOUNT,
        SAM_TRUST_ACCOUNT} then
        if fSidHistory then
            result.status := DS_NAME_ERROR_IS_SID_HISTORY_USER
        else
            result.status := DS_NAME_ERROR_IS_SID_USER
        endif
    else if obj!sAMAccountType in {SAM_NON_SECURITY_GROUP_OBJECT,
        SAM_GROUP_OBJECT} then
        if fSidHistory then
            result.status := DS_NAME_ERROR_IS_SID_HISTORY_GROUP
        else
            result.status := DS_NAME_ERROR_IS_SID_GROUP
        endif
    else if obj!sAMAccountType in {SAM_NON_SECURITY_ALIAS_OBJECT,
        SAM_ALIAS_OBJECT} then
        if fSidHistory then
            result.status := DS_NAME_ERROR_IS_SID_HISTORY_ALIAS
        else
            result.status := DS_NAME_ERROR_IS_SID_ALIAS
        endif
    else
        if fSidHistory then
            result.status := DS_NAME_ERROR_IS_SID_HISTORY_UNKNOWN
        else
            result.status := DS_NAME_ERROR_IS_SID_UNKNOWN
        endif
    endif
endif

/* Found exactly one object. Construct the output name in the
 * desired format. */
names := ConstructOutput(obj, formatDesired)

if formatDesired not in { DS_FQDN_1779_NAME, DS_NT4_ACCOUNT_NAME, DS_DISPLAY_NAME,
    DS_UNIQUE_ID_NAME, DS_CANONICAL_NAME, DS_CANONICAL_NAME_EX, DS_USER_PRINCIPAL_NAME,
    DS_SERVICE_PRINCIPAL_NAME, DS_STRING_SID_NAME, DS_USER_PRINCIPAL_NAME_FOR_LOGON } then
    result.status := DS_NAME_ERROR_RESOLVING
    return result
end if

if names = null and
    foreignSecurityPrincipal in obj!objectClass and

```

```

obj!SID # null and
DS_NAME_FLAG_PRIVATE_RESOLVE_FPOS in flags and
formatDesired in { DS_NT4_ACCOUNT_NAME, DS_DISPLAY_NAME,
  DS_CANONICAL_NAME, DS_CANONICAL_NAME_EX, DS_USER_PRINCIPAL_NAME,
  DS_USER_PRINCIPAL_NAME_FOR_LOGON, DS_SERVICE_PRINCIPAL_NAME} then
/* Found a foreign security principal for which the desired name is not
 * included. Use the LSAT protocol to lookup the name. Note: For any
 * desired format, it can only return either DS_CANONICAL_NAME or
 * DS_CANONICAL_NAME_EX. */
if (formatDesired=DS_CANONICAL_NAME_EX) then
  fCanonicalEx := true
else
  fCanonicalEx := false
endif
result := LookupFPO(fCanonicalEx, obj, result)
return result
endif

if names = null then
  /* Could not construct the required name format. */
  result.status := DS_NAME_ERROR_NO_MAPPING
  return result
endif
if names.length > 1 then
  /* Too many output names. */
  result.status := DS_NAME_ERROR_NOT_UNIQUE
  return result
endif

result.pName^ := names[0]
result.pDomain^ := DomainDNSNameFromDomain(GetObjectNC(obj))
result.status = DS_NAME_NO_ERROR

return result

```

4.1.4.2.11 LookupAttr

```

procedure LookupAttr(
  flags: DWORD,
  att: ATTRTYP,
  attrValue: unicodestring): set of DSName

```

Informative summary of behavior: The LookupAttr procedure is a helper function that looks up an object in an NC replica based on an attributeName=attributeValue criterion. It returns the set of objects that match the criterion.

```

rt: set of DSName

if DS_NAME_FLAG_GCVERIFY in flags or IsGC() then
  rt := select all O from all
    where attrValue in GetAttrVals(O, att, false)
else
  rt := select all O from subtree DefaultNC()
    where attrValue in GetAttrVals(O, att, false)
endif
return rt

```

4.1.4.2.12 LookupCanonicalName

```

procedure LookupCanonicalName(name: unicodestring): DSName

```

Informative summary of behavior: The LookupCanonicalName procedure is a helper function that looks up an object based on its canonical name by walking down the NC replica from the NC root and looking up objects by *name*.

```
curObj: DSName
label: unicodestring

ParseCanonicalName(name, label, name)
curObj := DomainFromDomainDNSName(label)
while name ≠ null and curObj ≠ null
  ParseCanonicalName(name, label, name)
  curObj := select one O from children curObj where O!name=label
  if curObj = null then
    return null
  endif
endwhile
return curObj
```

4.1.4.2.13 GetCanonicalName

```
procedure GetCanonicalName(
  obj: DSName, extended: boolean): unicodestring
```

Informative summary of behavior: The GetCanonicalName function constructs the canonical name of an object by walking up its ancestors to the NC root.

```
result: unicodestring

if obj = GetDomainNC(obj) then
  return DomainDNSNameFromDomain(obj)
endif

/* Recurse into parent, obtain non-extended canonical name. */
result := GetCanonicalName(obj!parent, false)
if extended = true then
  result := result + "\n"
else
  result := result + "/"
endif

result := result + obj!name
return result
```

4.1.4.2.14 LookupSPN

```
procedure LookupSPN(flags: DWORD, name: unicodestring): set of DSName
```

Informative summary of behavior: LookupSPN is a helper function that implements the service principal name (SPN) lookup algorithm.

```
rt: set of DSName
obj: DSName
dcGuid: GUID
```

```

spnMappings: set of unicodestring
mappedSpn: unicodestring

/* First, try to look up the SPN directly. */
rt := LookupAttr(flags, servicePrincipalName, name)
if rt # null then
    return rt
endif

/* Obtain SPN mappings value. */
obj := DescendantObject(ConfigNC(),
    "CN=Directory Service,CN=Windows NT,CN=Services,")
spnMappings := obj!spnMappings
if spnMappings # null
    mappedSpn := MapSPN(name, spnMappings)
    if mappedSpn # null then
        /* try to lookup a mapped SPN */
        rt := LookupAttr(flags, servicePrincipalName, mappedSpn)
        if rt # null then
            return rt
        endif
    endif
endif
/* Try to find replication SPN, which might not be present in our
* NC replicas yet. */
if GetServiceClassFromSPN(name) = DRS_SPN_CLASS and
    GetServiceNameFromSPN(name) =
        DomainNameFromDN(DefaultNC()!distinguishedName) then
    /* Yes, it looks like a replication SPN. Try to find DC by guid. */
    dcGuid := GuidFromString(false, GetInstanceNameFromSPN(name))
    if dcGuid # null then
        /* Find DSA object with this objectGUID value. */
        obj := select one o from subtree ConfigNC()
            where o!objectGUID = dcGuid
        if obj # null then
            /* Get the server object. */
            obj := obj!parent
            if obj # null then
                /* server!serverReference points to the DC's computer
                * object.*/
                rt := {obj!serverReference}
            endif
        endif
    endif
endif
endif
return rt

```

4.1.4.2.15 LookupSID

```

procedure LookupSID(flags: DWORD, sid: SID): set of DSName

```

Informative summary of behavior: The LookupSID procedure is a helper function that implements the SID lookup algorithm.

```

rt1, rt2: set of DSName

rt1 := LookupAttr(flags, objectSid, sid)
rt2 := LookupAttr(flags, SIDHistory, sid)

return rt1 + rt2

```

4.1.4.2.16 LookupUnknownName

```
procedure LookupUnknownName(  
    flags: DWORD,  
    name: unicodestring,  
    formatDesired: DWORD): DS_NAME_RESULT_ITEMW
```

Informative summary of behavior: The server uses LookupUnknownName to look up names of format DS_UNKNOWN_NAME. LookupUnknownName looks up the *name* by trying formats in the specific order listed in the `foreach` statement shown below until a lookup succeeds and produces the output *name* in the given output format.

```
result: DS_NAME_RESULT_ITEMW  
format: DWORD  
  
/* Attempt to resolve in the following formats in this specific  
 * order. */  
foreach format in {DS_FQDN_1779_NAME, DS_USER_PRINCIPAL_NAME,  
                  DS_NT4_ACCOUNT_NAME, DS_CANONICAL_NAME,  
                  DS_UNIQUE_ID_NAME, DS_DISPLAY_NAME,  
                  DS_SERVICE_PRINCIPAL_NAME,  
                  DS_SID_OR_SID_HISTORY_NAME,  
                  DS_CANONICAL_NAME_EX}  
    result := LookupName(flags, format, formatDesired, name)  
    if result.status ≠ DS_NAME_ERROR_NOT_FOUND then  
        return result  
    endif  
endfor  
return result
```

4.1.4.2.17 LookupUPNAndAltSecID

```
procedure LookupUPNAndAltSecID(  
    flags: DWORD,  
    IncludingAltSecID: boolean,  
    name: unicodestring): set of DSName
```

Informative summary of behavior: Returns DSNames of objects, with the given value as a value of userPrincipalName, altSecurityIdentities, or sAMAccountName.

```
rt, rt1, rt2: set of DSName  
  
/* Try lookup by userPrincipalName and altSecurityIdentities  
 * or by only userPrincipalName depending on what is  
 * requested */  
if IncludingAltSecID then  
    rt1 := LookupAttr(flags, userPrincipalName, name)  
    rt2 := LookupAttr(flags, altSecurityIdentities, name)  
    rt := rt1 + rt2  
else  
    rt := LookupAttr(flags, userPrincipalName, name)  
endif  
  
if rt ≠ null then  
    return rt  
endif  
  
/* Finally, attempt to parse the name as simpleName@domain and  
 * search for  
 * sAMAccountName=simpleName. */
```

```

name := UserNameFromUPN(name)
if name ≠ null then
    rt := LookupAttr(flags, sAMAccountName, name)
endif

return rt

```

4.1.4.2.18 LookupFPO

```

procedure LookupFPO(
    fCanonicalEx: boolean,
    obj: DSName,
    result: DS_NAME_RESULT_ITEMW
): DS_NAME_RESULT_ITEMW

```

Informative summary of behavior: LookupFPO is a helper function that attempts to resolve the domain and account name of an object, with an appropriate status value.

```

pReferencedDomain: PLSAPR_REFERENCED_DOMAIN_LIST
TranslatedName: LSAPR_TRANSLATED_NAMES_EX
NtStatus: NTSTATUS

pReferencedDomain := null
TranslatedName := null

NtStatus := TranslateFPOToName(obj, ADR(pReferencedDomain),
                               ADR(TranslatedName))
if (NtStatus = 0x0 and pReferencedDomain ≠ null and TranslatedName ≠ null)
    then
        result.pDomain^ :=
            pReferencedDomains^.Domains[TranslatedName.DomainIndex].Name
        if fCanonicalNameEx then
            result.pName^ := result.pDomain^ + {"\n"} + TranslatedName.Name
        else
            result.pName^ := result.pDomain^ + {"\"} + TranslatedName.Name
        endif
        result.status := DS_NAME_ERROR_IS_FPO
        return result
    else
        result.status := DS_NAME_ERROR_RESOLVING
    endif

/* leave result as-is. */
return result

```

4.1.4.2.19 MapSPN

```

procedure MapSPN(spn: unicodestring,
                spnMappings: set of unicodestring):
    unicodestring

```

The MapSPN procedure performs an SPN mapping operation on *spn* according to the map specified in *spnMappings*, and returns the mapped version of *spn*. The mapping operation is used to change the service class of the SPN. An SPN service class is the first part of an SPN; for example, "ldap" is the service class of the SPN "ldap/fabrikam.com".

Each value of *spnMappings* consists of an alias, followed by an equals sign (=), followed by a comma-separated list of one or more SPN service classes. Thus, each value must be in the following format:

alias=serviceClass1,serviceClass2,serviceClass3,...,serviceClassN

If the service class portion of *spn* corresponds to one of the serviceClassX values in value *v* of *spnMappings*, then the return value of this procedure is the SPN value this is constructed from *spn* by substituting the alias value from *v* as the service class of *spn*. If no mapping is found (that is, if there is no such *v*), or if *spn* is not an SPN, then null is returned.

For example, suppose that *spnMappings* is the following set:

```
{"ldap=ldap,otherldap", "host=alerter,appmgmt,cisvc"}
```

If *spn* is "alerter/fabrikam.com", then the procedure returns "host/fabrikam.com".

4.1.4.2.20 ParseCanonicalName

```
procedure ParseCanonicalName(  
    name: unicodestring,  
    var firstPart: unicodestring,  
    var remainder: unicodestring)
```

The ParseCanonicalName procedure parses the first label from the canonical name string *name* and returns the first label in *firstPart* and the *remainder* of the string in *remainder*. For example, *name* = "container1/container2/leaf" is parsed as *firstPart*:= "container1" and *remainder*:= "container2/leaf". As another example, *name* = "example.fabrikam.com/container/username" is parsed as *firstPart*:= "example.fabrikam.com" and *remainder*:= "container/username". If *name* does not contain a slash character, then it is parsed as *firstPart*:= *name* and *remainder*:= null.

4.1.4.2.21 RetrieveDCSuffixFromDn

```
procedure RetrieveDCSuffixFromDn(dn: unicodestring): unicodestring
```

The RetrieveDCSuffixFromDn procedure parses the distinguished name (DN) syntactically and returns the suffix that consists entirely of the DN components whose attribute type is "DC". For example, given "CN=Administrator,CN=Users,DC=fabrikam,DC=com", this procedure would return "DC=fabrikam,DC=com".

4.1.4.2.22 UserNameFromUPN

```
procedure UserNameFromUPN(upn: unicodestring): unicodestring
```

Parses and returns the user name from a UPN-formatted string *upn*. The user name is the component before the '@'. For example, when the input is "username@example.fabrikam.com", then "username" is returned. If the input is not in UPN format, then null is returned.

4.1.4.2.23 TranslateFPOToName

```
procedure TranslateFPOToName(  
    obj: DSName,  
    ppReferencedDomains: PLSAPR_REFERENCED_DOMAIN_LIST*,  
    pTranslatedNames: PLSAPR_TRANSLATED_NAMES_EX  
): NTSTATUS
```

Informative summary of behavior: The TranslateFPOToName procedure performs an LsarLookupSids2 call ([MS-LSAT] section 3.1.4.10) to translate *obj* to its Windows NT 4.0 account name and domain.

```
hlsaPolicy: LSAPR_HANDLE
```

```

mappedCount: unsigned long
systemName: unicodeString
objectAttributes: LSAPR_OBJECT_ATTRIBUTES
desiredAccess: DWORD
sidEnumBuffer: LSAPR_SID_ENUM_BUFFER
sidInfo: LSAPR_SID_INFORMATION
NtStatus: NTSTATUS

sidEnumBuffer.Entries := 1
sidInfo.Sid := obj!Sid
sidEnumBuffer.SidInfo := ADR(sidInfo)

systemName := ""
objectAttributes.Length := 0
objectAttributes.RootDirectory := null
objectAttributes.ObjectName := null
objectAttributes.attributes := 0
objectAttributes.SecurityDescriptor := null
objectAttributes.SecurityQualityOfService := null
desiredAccess := 0x00000800

NtStatus := LsarOpenPolicy2(systemName, ADR(objectAttributes),
                           desiredAccess, ADR(hlsaPolicy))
if 0x0 = NtStatus then
    NtStatus := LsarLookupSids2(hlsaPolicy, ADR(sidEnumBuffer),
                               ppReferencedDomains, pTranslatedNames,
                               0x1, ADR(mappedCount), 0x0, 0x2)
endif

If hlsaPolicy ≠ null
    LsarClose(ADR(hlsaPolicy))

return NtStatus

```

4.1.4.2.24 ConstructOutput

```

procedure ConstructOutput(
    obj: DSName,
    formatDesired: DWORD): set of unicodestring

```

Informative summary of behavior: ConstructOutput is a helper function that constructs the name of the object in the required output format. Note that the returned set of values **may** be empty or **might** contain more than one value. These situations are handled by the caller function, LookupName (section 4.1.4.2.10).

```

if formatDesired = DS_FQDN_1779_NAME then
    return {obj!distinguishedName}
else if formatDesired = DS_NT4_ACCOUNT_NAME then
    if obj!sAMAccountName ≠ null then
        return {DomainNetBIOSNameFromDomain(GetObjectNC(obj)) + "\" +
                obj!sAMAccountName}
    else if IsDomainOnly(obj) then
        return {DomainNetBIOSNameFromDomain(GetObjectNC(obj)) + "\"}
else if formatDesired = DS_USER_PRINCIPAL_NAME then
    return {obj!userPrincipalName}
else if formatDesired = DS_CANONICAL_NAME then
    return {GetCanonicalName(obj, false)}
else if formatDesired = DS_UNIQUE_ID_NAME then
    return {GuidToString(obj!objectGUID)}
else if formatDesired = DS_DISPLAY_NAME then
    return {obj!displayName}
else if formatDesired = DS_SERVICE_PRINCIPAL_NAME then
    return obj!servicePrincipalName

```



```

else if formatDesired = DS_CANONICAL_NAME_EX then
    return {GetCanonicalName(obj, true)}
else if formatDesired = DS_STRING_SID_NAME then
    return {StringSidFromSid(obj!objectSid)}
else if formatDesired = DS_USER_PRINCIPAL_NAME_FOR_LOGON then
    /* If UPN is set, then return it. */
    if obj!userPrincipalName ≠ null then
        return {obj!userPrincipalName}
    endif
    return {obj!sAMAccountName + "@" +
        DomainDNSNameFromDomain(GetObjectNC(obj))}
endif

/* Otherwise, unknown format. */
return null

```

4.1.4.2.25 IsDomainOnly

Informative summary of behavior: The function determines whether the given DSName is one of the domain NCs present in the forest.

```

procedure IsDomainOnly(obj: DSName): boolean

cr: DSName

/* Confirm that obj is a domainNC in the forest of the server. */
cr := select one domainNC from subtree ConfigNC() where
    (crossRef in domainNC!objectClass and
     domainNC!nCName = obj!distinguishedName)
if cr = null then
    return FALSE
else
    return TRUE
endif

```

4.1.4.3 Server Behavior of the IDL_DRSCrackNames Method

Informative summary of behavior: The IDL_DRSCrackNames method is a generic method that is used to look up information in the directory. The most common usage is looking up directory object names that are provided in one format (for example, SPNs) and returning them in a different format (for example, DNS). One special mode occurs when the input format is not specified, in which case the server tries to "guess" the format of the name by following some heuristics. The method can also be used to look up generic information in the directory, such as the list of sites or the list of servers in a specific site.

```

ULONG
IDL_DRSCrackNames(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)] DRS_MSG_CRACKREQ *pmsgIn,
    [out, ref] DWORD *pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DRS_MSG_CRACKREPLY *pmsgOut)

msgIn: DRS_MSG_CRACKREQ_V1
msgOut: DS_NAME_RESULTW
ULONG result

ValidateDRSInput(hDrs, 12)

pdwOutVersion^ := 1
pmsgOut^.V1.pResult^.cItems := 0

```

```

pmsgOut^.V1.pResult^.rItems := null
if dwInVersion # 1 then
  return ERROR_INVALID_PARAMETER
endif
msgIn := pmsgIn^.V1
if DS_NAME_FLAG_GCVERIFY in msgIn.dwFlags and
  not IsGC() then
  return ERROR_DS_GCVERIFY_ERROR
endif

/* Enable FPO resolution for non-DC callers. */
if ClientUUID(hDrs) = NTDSAPI_CLIENT_GUID then
  msgIn.dwFlags := msgIn.dwFlags + {DS_NAME_FLAG_PRIVATE_RESOLVE_FPOS}
endif

result = CrackNames(pmsgIn^.V1, ADR(msgOut))
if(result = ERROR_SUCCESS) then
  pmsgOut^.V1.pResult := ADR(msgOut)
endif
return result

```

4.1.4.4 Examples of the IDL_DRSCrackNames Method

When user "Kim Akers" logs on to the computer MS1.Contoso.com using her Windows NT 4.0 account name "CONTOSO\kimakers", the domain controller needs to obtain a fully qualified domain name (FQDN) (1) that corresponds to the Windows NT 4.0 account name. The domain controller DC1 calls IDL_DRSCrackNames to translate the Windows NT 4.0 account name to an FQDN (1).

4.1.4.4.1 Initial State

Querying the user object with name KimAkers in the domain NC DC=CONTOSO, DC=COM on DC1:

- ldap_search_s("CN=Kim Akers,CN=Users,DC=contoso,DC=com", *baseObject*, "(objectClass=user)", [*objectClass*, *distinguishedName*, *sAMAccountName*])
- Result <0>: (null)
- Matched DNs:
- Getting 1 entries:
- >> Dn: CN=Kim Akers,CN=Users,DC=contoso,DC=com
 - 4> objectClass: top; person; organizationalPerson; user;
 - 1> distinguishedName: CN=Kim Akers,CN=Users,DC=contoso,DC=com;
 - 1> sAMAccountName: KimAkers

Querying the crossRef object for the domain NC CONTOSO.COM on DC1 by performing the following LDAP search:

- ldap_search_s("CN=CONTOSO,CN=Partitions,CN=Configuration,DC=contoso,DC=com", *baseObject*, "(objectClass=crossRef)", [*objectClass*, *nCName*, *dnsRoot*, *nETBIOSName*])
- Result <0>: (null)
- Matched DNs:
- Getting 1 entries:
- >> Dn: CN=CONTOSO,CN=Partitions,CN=Configuration,DC=contoso,DC=com

- 2> objectClass: top; crossRef;
- 1> nCName: DC=contoso,DC=com;
- 1> dnsRoot: contoso.com;
- 1> nETBIOSName: CONTOSO;

4.1.4.4.2 Client Request

DC1 invokes the IDL_DRSCrackNames method against itself with the following parameters (DRS_HANDLE to DC1 omitted):

- *dwInVersion* = 1
- *pmsgIn* = DRS_MSG_CRACKREQ_V1
 - CodePage = 0x4e4
 - LocaleId = US-EN
 - dwFlags = 0
 - formatOffered = DS_NT4_ACCOUNT_NAME
 - formatDesired = DS_FQDN_1779_NAME
 - cNames: 1
 - rpNames: "CONTOSO\kimakers"

4.1.4.4.3 Server Response

Returns code of 0 and the following values:

- *pdwMessageOut* = 1
 - *pmsgOut* = DRS_MSG_CRACKREPLY_V1
 - pResult: DS_NAME_RESULTW
 - cNames: 1
 - rItems: DS_NAME_RESULT_ITEMW
 - pDomain: "contoso.com"
 - pName: "CN=Kim Akers,CN=Users,DC=contoso,DC=com"
 - status: DS_NAME_NO_ERROR

4.1.4.4.4 Final State

The final state is the same as the initial state; there is no change.

4.1.5 IDL_DRSDomainControllerInfo (Opnum 16)

The IDL_DRSDomainControllerInfo method retrieves information about DCs in a given domain.

```
ULONG IDL_DRSDomainControllerInfo(
    [in, ref] DRS_HANDLE hDrs,
```

```

[in] DWORD dwInVersion,
[in, ref, switch_is(dwInVersion)]
    DRS_MSG_DCINFOREQ* pmsgIn,
[out, ref] DWORD* pdwOutVersion,
[out, ref, switch_is(*pdwOutVersion)]
    DRS_MSG_DCINFOREPLY* pmsgOut
);

```

hDrs: RPC context handle returned by the IDL_DRSSBind method.

dwInVersion: Version of the request message.

pmsgIn: Pointer to the request message.

pdwOutVersion: Pointer to the version of the response message.

pmsgOut: Pointer to the response message.

Return Values: 0 if successful, otherwise a Windows error code.

Exceptions Thrown: This method might throw the following exceptions beyond those thrown by the underlying RPC protocol (as specified in [MS-RPCE]): ERROR_INVALID_HANDLE, ERROR_DS_DRS_EXTENSIONS_CHANGED, ERROR_DS_DIFFERENT_REPL_EPOCHS, and ERROR_INVALID_PARAMETER.

4.1.5.1 Method-Specific Concrete Types

4.1.5.1.1 DRS_MSG_DCINFOREQ

The DRS_MSG_DCINFOREQ union defines the request messages sent to the IDL_DRSSDomainControllerInfo method. Only one version, identified by *dwInVersion* = 1, is currently defined.

```

typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_DCINFOREQ_V1 V1;
} DRS_MSG_DCINFOREQ,
*PDRS_MSG_DCINFOREQ;

```

V1: Version 1 request.

4.1.5.1.2 DRS_MSG_DCINFOREQ_V1

The DRS_MSG_DCINFOREQ_V1 structure defines the request message sent to the IDL_DRSSDomainControllerInfo method.

```

typedef struct {
    [string] WCHAR* Domain;
    DWORD InfoLevel;
} DRS_MSG_DCINFOREQ_V1;

```

Domain: The domain for which the client requests information. The domain can be an FQDN (1) or a NetBIOS domain name.

InfoLevel: The response version requested by the client: 1, 2, 3, or 0xFFFFFFFF. The responses at InfoLevel 1, 2, and 3 all contain information about DCs in the given domain. The information at

InfoLevel 1 is a subset of the information at InfoLevel 2, which is a subset of the information at InfoLevel 3. InfoLevel 3 includes information about the RODCs in the given domain. InfoLevel 0xFFFFFFFF server returns information about the active **LDAP connections**.

4.1.5.1.3 DRS_MSG_DCINFOREPLY

The DRS_MSG_DCINFOREPLY union defines the response messages received from the IDL_DRSDomainControllerInfo method.

```
typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_DCINFOREPLY_V1 V1;
    [case(2)]
        DRS_MSG_DCINFOREPLY_V2 V2;
    [case(3)]
        DRS_MSG_DCINFOREPLY_V3 V3;
    [case(0xFFFFFFFF)]
        DRS_MSG_DCINFOREPLY_VFFFFFFFF VFFFFFFFF;
} DRS_MSG_DCINFOREPLY;
```

V1: Version 1 response.

V2: Version 2 response.

V3: Version 3 response.

VFFFFFFFF: Version 0xFFFFFFFF response.

4.1.5.1.4 DRS_MSG_DCINFOREPLY_V1

The DRS_MSG_DCINFOREPLY_V1 structure defines the response message received from the IDL_DRSDomainControllerInfo method, when the client has requested InfoLevel = 1.

```
typedef struct {
    [range(0,10000)] DWORD cItems;
    [size_is(cItems)] DS_DOMAIN_CONTROLLER_INFO_1W* rItems;
} DRS_MSG_DCINFOREPLY_V1;
```

cItems: Count of items in the **rItems** array.

rItems: DC information.

4.1.5.1.5 DRS_MSG_DCINFOREPLY_V2

The DRS_MSG_DCINFOREPLY_V2 structure defines the response message received from the IDL_DRSDomainControllerInfo method, when the client has requested InfoLevel = 2.

```
typedef struct {
    [range(0,10000)] DWORD cItems;
    [size_is(cItems)] DS_DOMAIN_CONTROLLER_INFO_2W* rItems;
} DRS_MSG_DCINFOREPLY_V2;
```

cItems: Count of items in the **rItems** array.

rItems: DC information.

4.1.5.1.6 DRS_MSG_DCINFOREPLY_V3

The DRS_MSG_DCINFOREPLY_V3 structure defines the response message received from the IDL_DRSDomainControllerInfo method when the client has requested InfoLevel = 3.

```
typedef struct {
    [range(0,10000)] DWORD cItems;
    [size_is(cItems)] DS_DOMAIN_CONTROLLER_INFO_3W* rItems;
} DRS_MSG_DCINFOREPLY_V3;
```

cItems: Count of items in the **rItems** array.

rItems: DC information.

4.1.5.1.7 DRS_MSG_DCINFOREPLY_VFFFFFFFF

The DRS_MSG_DCINFOREPLY_VFFFFFFFF structure defines the response message received from the IDL_DRSDomainControllerInfo method, when the client has requested InfoLevel = 0xFFFFFFFF.

```
typedef struct {
    [range(0,10000)] DWORD cItems;
    [size_is(cItems)] DS_DOMAIN_CONTROLLER_INFO_FFFFFFFFW* rItems;
} DRS_MSG_DCINFOREPLY_VFFFFFFFF;
```

cItems: The count of items in the **rItems** array.

rItems: Information about the active LDAP connections.

4.1.5.1.8 DS_DOMAIN_CONTROLLER_INFO_1W

The DS_DOMAIN_CONTROLLER_INFO_1W structure defines DC information that is returned as a part of the response to an InfoLevel = 1 request. The struct contains information about a single DC in the domain.

```
typedef struct {
    [string, unique] WCHAR* NetbiosName;
    [string, unique] WCHAR* DnsHostName;
    [string, unique] WCHAR* SiteName;
    [string, unique] WCHAR* ComputerObjectName;
    [string, unique] WCHAR* ServerObjectName;
    BOOL fIsPdc;
    BOOL fDsEnabled;
} DS_DOMAIN_CONTROLLER_INFO_1W;
```

NetbiosName: NetBIOS name of the DC.

DnsHostName: DNS host name of the DC.

SiteName: RDN of the site object.

ComputerObjectName: DN of the computer object that corresponds to the DC.

ServerObjectName: DN of the server object that corresponds to the DC.

fIsPdc: True if and only if the DC is the PDC FSMO role owner.

fDsEnabled: A Boolean value that indicates whether or not the machine is a domain controller. This value MUST be TRUE.

4.1.5.1.9 DS_DOMAIN_CONTROLLER_INFO_2W

The DS_DOMAIN_CONTROLLER_INFO_2W structure defines DC information that is returned as a part of the response to an InfoLevel = 2 request. The struct contains information about a single DC in the domain.

```
typedef struct {
    [string, unique] WCHAR* NetbiosName;
    [string, unique] WCHAR* DnsHostName;
    [string, unique] WCHAR* SiteName;
    [string, unique] WCHAR* SiteObjectName;
    [string, unique] WCHAR* ComputerObjectName;
    [string, unique] WCHAR* ServerObjectName;
    [string, unique] WCHAR* NtdsDsaObjectName;
    BOOL fIsPdc;
    BOOL fDsEnabled;
    BOOL fIsGc;
    GUID SiteObjectGuid;
    GUID ComputerObjectGuid;
    GUID ServerObjectGuid;
    GUID NtdsDsaObjectGuid;
} DS_DOMAIN_CONTROLLER_INFO_2W;
```

NetbiosName: NetBIOS name of the DC.

DnsHostName: DNS host name of the DC.

SiteName: RDN of the site object.

SiteObjectName: DN of the site object.

ComputerObjectName: DN of the computer object that corresponds to the DC.

ServerObjectName: DN of the server object that corresponds to the DC.

NtdsDsaObjectName: DN of the nTDSDSA object that corresponds to the DC.

fIsPdc: True if and only if the DC is the PDC FSMO role owner.

fDsEnabled: A Boolean value that indicates whether or not the machine is a domain controller. This value MUST be TRUE.

fIsGc: True if and only if the DC is also a GC.

SiteObjectGuid: The objectGUID attribute of the site object.

ComputerObjectGuid: The objectGUID attribute of the computer object that corresponds to the DC.

ServerObjectGuid: The objectGUID attribute of the server object that corresponds to the DC.

NtdsDsaObjectGuid: The objectGUID attribute of the nTDSDSA object that corresponds to the DC.

4.1.5.1.10 DS_DOMAIN_CONTROLLER_INFO_3W

The DS_DOMAIN_CONTROLLER_INFO_3W structure defines DC information that is returned as a part of the response to an InfoLevel = 3 request. The struct contains information about a single DC in the domain.

```
typedef struct {
    [string, unique] WCHAR* NetbiosName;
    [string, unique] WCHAR* DnsHostName;
    [string, unique] WCHAR* SiteName;
```

```

    [string, unique] WCHAR* SiteObjectName;
    [string, unique] WCHAR* ComputerObjectName;
    [string, unique] WCHAR* ServerObjectName;
    [string, unique] WCHAR* NtdsDsaObjectName;
    BOOL fIsPdc;
    BOOL fDsEnabled;
    BOOL fIsGc;
    BOOL fIsRodc;
    GUID SiteObjectGuid;
    GUID ComputerObjectGuid;
    GUID ServerObjectGuid;
    GUID NtdsDsaObjectGuid;
} DS_DOMAIN_CONTROLLER_INFO_3W;

```

NetbiosName: NetBIOS name of the DC.

DnsHostName: DNS host name of the DC.

SiteName: RDN of the **site object**.

SiteObjectName: DN of the site object.

ComputerObjectName: DN of the computer object that corresponds to the DC.

ServerObjectName: DN of the **server object** that corresponds to the DC.

NtdsDsaObjectName: DN of the nTDSDSA object that corresponds to the DC.

fIsPdc: True if and only if the DC is the PDC FSMO role owner.

fDsEnabled: A Boolean value that indicates whether or not the machine is a domain controller. This value MUST be TRUE.

fIsGc: True if and only if the DC is also a GC.

fIsRodc: True if and only if the DC is an RODC.

SiteObjectGuid: objectGUID of the site object.

ComputerObjectGuid: objectGUID of the computer object that corresponds to the DC.

ServerObjectGuid: objectGUID of the server object that corresponds to the DC.

NtdsDsaObjectGuid: objectGUID of the nTDSDSA object that corresponds to the DC.

4.1.5.1.11 DS_DOMAIN_CONTROLLER_INFO_FFFFFFFFW

The DS_DOMAIN_CONTROLLER_INFO_FFFFFFFFW structure defines DC information that is returned as a part of the response to an InfoLevel = 0xFFFFFFFF request. The struct contains information about a single LDAP connection to the current server.

```

typedef struct {
    DWORD IPAddress;
    DWORD NotificationCount;
    DWORD secTimeConnected;
    DWORD Flags;
    DWORD TotalRequests;
    DWORD Reserved1;
    [string, unique] WCHAR* UserName;
} DS_DOMAIN_CONTROLLER_INFO_FFFFFFFFW;

```


IPAddress: The IPv4 address of the client that established the LDAP connection to the server. If the client is connected with IPv6, this field **MUST** be zero.

NotificationCount: Number of LDAP notifications enabled on the server.

secTimeConnected: Total time in number of seconds that the connection is established.

Flags: Zero or more of the bit flags from LDAP_CONN_PROPERTIES indicating the properties of this connection.

TotalRequests: Total number of LDAP requests made on this LDAP connection.

Reserved1: Unused. **MUST** be 0 and ignored.

UserName: Name of the security principal that established the LDAP connection.

4.1.5.2 Server Behavior of the IDL_DRSDomainControllerInfo Method

Informative summary of behavior: The IDL_DRSDomainControllerInfo method supports four information levels. For levels 1, 2, and 3, the server returns information for the DCs in the domain of the server. For level 0xffffffff, the server returns information about the LDAP connections on the server that are currently open.

Regular read access checks apply to the information that is returned to the caller. Therefore, if the caller does not have **read permission** on data that needs to be returned, this data is not included in the response. See [MS-ADTS] section 3.1.1.4.3 for more information about access check behavior in read operations.

For information about the Windows versions in which information levels were introduced and supported, see the following behavior note.<15>

Note The server behavior of the IDL_DRSDomainControllerInfo method uses the CrackNames procedure defined in section 4.1.4.2.9.

```
ULONG
IDL_DRSDomainControllerInfo(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)] DRS_MSG_DCINFOREQ *pmsgIn,
    [out, ref] DWORD *pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)] DRS_MSG_DCINFOREPLY *pmsgOut)

msgIn: DRS_MSG_DCINFOREQ_V1
infoLevel, i: integer
domainName: unicodestring
dcSet: set of DSName
serversContainer, crObj, dcObj, dsaObj, svrObj, siteObj, obj, v: DSName
lc: DS_DOMAIN_CONTROLLER_INFO_FFFFFFFF
rI1: ADDRESS OF DS_DOMAIN_CONTROLLER_INFO_1W
rI2: ADDRESS OF DS_DOMAIN_CONTROLLER_INFO_2W
rI3: ADDRESS OF DS_DOMAIN_CONTROLLER_INFO_3W
found: boolean
crackMsgIn: DRS_MSG_CRACKREQ_V1
crackOut: DS_NAME_RESULTW
outV: DWORD
userAccountControl: set of integer

ValidateDRSInput(hDrs, 16)

msgIn := pmsgIn^V1
infoLevel := msgIn.InfoLevel
domainName := msgIn.Domain

pdwOutVersion^ := infoLevel
```

```

if infoLevel = 1 then
    pmsgOut^.V1.cItems := 0
    pmsgOut^.V1.rItems := null
else if infoLevel = 2 then
    pmsgOut^.V2.cItems := 0
    pmsgOut^.V2.rItems := null
else if infoLevel = 3 then
    pmsgOut^.V3.cItems := 0
    pmsgOut^.V3.rItems := null
else if infoLevel = 0xFFFFFFFF then
    pmsgOut^.VFFFFFFFF.cItems := 0
    pmsgOut^.VFFFFFFFF.rItems := null
endif

if dwInVersion # 1 then
    return ERROR_INVALID_PARAMETER
endif

if not (infoLevel in {1,2,3,0xFFFFFFFF}) then
    return ERROR_INVALID_PARAMETER
endif

if infoLevel = 0xFFFFFFFF then
    /* Enumerate the LDAP connections. */
    if not IsMemberOfBuiltinAdminGroup() then
        return ERROR_ACCESS_DENIED
    endif

    pmsgOut^.VFFFFFFFF.cItems := number(dc.ldapConnections)

    i := 0
    foreach lc in dc.ldapConnections
        pmsgOut^.VFFFFFFFF.rItems[i].IPAddress := lc.ipAddress
        pmsgOut^.VFFFFFFFF.rItems[i].NotificationCount :=
            lc.notificationCount
        pmsgOut^.VFFFFFFFF.rItems[i].secTimeConnected :=
            lc.secTimeConnected
        pmsgOut^.VFFFFFFFF.rItems[i].Flags := lc.flags
        pmsgOut^.VFFFFFFFF.rItems[i].TotalRequests := lc.totalRequests
        pmsgOut^.VFFFFFFFF.rItems[i].UserName := lc.userName
        pmsgOut^.VFFFFFFFF.rItems[i].Reserved1 := 0

        i := i + 1
    endfor

    return 0
endif

/* Verify that the given domain name matches the default domain NC.
 * First check if it is the nETBiosName or dNSHostName of the default
 * domain NC by searching for the crossRef object. If this doesn't
 * find a match, call IDL_DRSCrackNames to check if the given
 * domain name is a name for the default domain NC. */

crObj := select one v from children
    DescendantObject(ConfigNC(), "CN=Partitions,")
    where
        (v!dnsRoot = domainName or v!nETBiosName = domainName)
        and
        v!nCName = DefaultNC()

found := (crObj # null)

if not found then
    /* Not found; use IDL_DRSCrackNames to resolve the name. */
    crackMsgIn.dwFlags := 0
    crackMsgIn.formatOffered := DS_UNKNOWN_NAME
    crackMsgIn.formatDesired := DS_FQDN_1779_NAME

```

```

crackMsgIn.cNames := 3
crackMsgIn.rpNames[0] := domainName
crackMsgIn.rpNames[1] := domainName + "\"
crackMsgIn.rpNames[2] := domainName + "/"

/* Call IDL_DRSCrackNames as a local procedure. */
CrackNames(crackMsgIn, ADR(crackOut))

i := 0
while i < 3 and not found
  if crackOut.rItems[i].status = DS_NAME_NO_ERROR
    then
      if crackOut.rItems[i].pName = DefaultNC().dn
        then
          found := true
        else
          return ERROR_INVALID_PARAMETER
        endif
      endif
      i := i + 1
    endwhile
  endif

if not found then
  return ERROR_DS_OBJ_NOT_FOUND
endif

/* Enumerate the DCs in the domain. */
if infoLevel = 3 then
  /* client requests to return RODCs too */
  userAccountControl :=
    {ADS_UF_SERVER_TRUST_ACCOUNT, ADS_UF_PARTIAL_SECRETS_ACCOUNT}
else
  userAccountControl := {ADS_UF_SERVER_TRUST_ACCOUNT}
endif

dcSet := select all v from subtree DefaultNC() where
  v!objectCategory = GetDefaultObjectCategory(computer)
  and (userAccountControl ∩ v!userAccountControl ≠ null)

if infoLevel = 1 then
  pmsgOut^.V1.cItems := number(dcSet)

  i := 0
  foreach dcObj in dcSet
    rI1 := ADR(pmsgOut^.V1.rItems[i])

    rI1^.DnsHostName := dcObj!dNSHostName
    rI1^.ComputerObjectName := dcObj.dn
    /* sAMAccountName excluding the "$" at the end. */
    rI1^.NetbiosName := SubString(dcObj!sAMAccountName, 0,
      dcObj!samAccountName.length-1)
    rI1^.fDsEnabled := true

    /* select a server object from the serverReferenceBL, it is
       preferred that the server object has a child object with
       CN "NTDS Settings" */
    svrObj :=
      select one v from all where v.dn in dcObj!serverReferenceBL
        and DescendantObject(v, "CN=NTDS Settings") ≠ null
    if svrObj = null then
      svrObj :=
        select one v from all where v.dn in dcObj!serverReferenceBL
    endif
    if svrObj ≠ null then
      rI1^.ServerObjectName := svrObj.dn
      serversContainer :=
        select one o from all where o!objectGUID = svrObj!parent
      siteObj := serversContainer!parent
      rI1^.SiteObjectName := siteObj.dn
    endif
  endforeach
endif

```

```

        dsaObj := DescendantObject(v, "CN=NTDS Settings,")
        rI1^.fIsPdc := (dsaObj = GetFSMORoleOwner(FSMO_PDC))
    endif
    i := i + 1
endfor
else
    if infoLevel = 2 then
        pmsgOut^.V2.cItems := number(dcSet)

        i := 0
        foreach dcObj in dcSet
            rI2 := ADR(pmsgOut^.V2.rItems[i])

            rI2^.DnsHostName := dcObj!dNSHostName
            rI2^.ComputerObjectName := dcObj.dn
            /* sAMAccountName excluding the "$" at the end. */
            rI2^.NetbiosName := SubString(dcObj!samAccountName, 0,
                dcObj!samAccountName.length-1)
            rI2^.ComputerObjectGUID := dcObj.guid
            rI2^.fDsEnabled := true

            /* select a server object from the serverReferenceBL, it is
            preferred that the server object has a child object with
            CN "NTDS Settings" */
            svrObj :=
                select one v from all where v.dn in dcObj!serverReferenceBL
                    and DescendantObject(v, "CN=NTDS Settings") # null
            if svrObj = null then
                svrObj :=
                    select one v from all where v.dn in dcObj!serverReferenceBL
            endif
            if svrObj # null then
                rI2^.ServerObjectName := svrObj.dn
                rI2^.ServerObjectGuid := svrObj.guid

                serversContainer :=
                    select one o from all where o!objectGUID = svrObj!parent
                siteObj := serversContainer!parent

                rI2^.SiteObjectName := siteObj.dn
                rI2^.SiteObjectGUID := siteObj.guid
                dsaObj := DescendantObject(v, "CN=NTDS Settings,")
                rI2^.NtdsDsaObjectGUID := dsaObj.guid
                rI2^.fIsGc := (NTDSDSA_OPT_IS_GC in dsaObj!options)
                rI2^.fIsPdc := (dsaObj = GetFSMORoleOwner(FSMO_PDC))
            endif
            i := i + 1
        endfor
    else
        /* infoLevel = 3 */
        pmsgOut^.V3.cItems := number(dcSet)

        i := 0
        foreach dcObj in dcSet
            rI3 := ADR(pmsgOut^.V3.rItems[i])

            rI3^.DnsHostName := dcObj!dNSHostName
            rI3^.ComputerObjectName := dcObj.dn
            /* sAMAccountName excluding the "$" at the end. */
            rI3^.NetbiosName := SubString(dcObj!samAccountName, 0,
                dcObj!samAccountName.length-1)
            rI3^.ComputerObjectGUID := dcObj.guid
            rI3^.fDsEnabled := true

            /* select a server object from the serverReferenceBL, it is
            preferred that the server object has a child object with
            CN "NTDS Settings" */
            svrObj :=
                select one v from all where v.dn in dcObj!serverReferenceBL

```

```

        and DescendantObject(v, "CN=NTDS Settings") ≠ null
    if svrObj = null then
        svrObj :=
            select one v from all where v.dn in dcObj!serverReferenceBL
    endif
    if svrObj ≠ null then
        rI3^.ServerObjectName := svrObj.dn
        rI3^.ServerObjectGuid := svrObj.guid

    serversContainer :=
        select one o from all where o!objectGUID = svrObj!parent
    siteObj := serversContainer!parent

    rI3^.SiteObjectName := siteObj.dn
    rI3^.SiteObjectGUID := siteObj.guid
    dsaObj := DescendantObject(v, "CN=NTDS Settings,")
    rI3^.NtdsDsaObjectGUID := dsaObj.guid
    rI3^.fIsGC := (NTDSDSA_OPT_IS_GC in dsaObj!options)
    rI3^.fIsPDC := (dsaObj = GetFSMORoleOwner(FSMO_PDC))
    rI3^.fIsRdc := ((ADS_UF_PARTIAL_SECRETS_ACCOUNT ∩
        dcObj!userAccountControl) ≠ null)
    endif
    i := i + 1
endfor
endif
endif
return 0

```

4.1.5.3 Examples of the IDL_DRSDomainControllerInfo Method

An application running on DC2 invokes the DRSDomainControllerInfo method on DC2 to retrieve the NetBIOS and DNS host names for all DCs in the domain NC CONTOSO.COM.

4.1.5.3.1 Initial State

Querying the crossRef object for the domain NC CONTOSO.COM on DC2 by performing an LDAP search with base scope on the DN 'CN=CONTOSO,CN=Partitions,CN=Configuration,DC=contoso,DC=com':

- Expanding base 'CN=CONTOSO,CN=Partitions,CN=Configuration,DC=contoso,DC=com'...
- Result <0>: (null)
- Matched DNs:
- Getting 1 entries:
- >> Dn: CN=CONTOSO,CN=Partitions,CN=Configuration,DC=contoso,DC=com
 - 2> objectClass: top; crossRef;
 - 1> nCName: DC=contoso,DC=com;
 - 1> dnsRoot: contoso.com;
 - 1> nETBIOSName: CONTOSO;

Querying the DC1 computer object in domain NC DC=CONTOSO, DC=COM by performing an LDAP search with base scope on the DN 'CN=DC1,OU=Domain Controllers,DC=contoso,DC=com':

- Expanding base 'CN=DC1,OU=Domain Controllers,DC=contoso,DC=com'...
- Result <0>: (null)

- Matched DNs:
- Getting 1 entries:
- >> Dn: CN=DC1,OU=Domain Controllers,DC=contoso,DC=com
 - 5> objectClass: top; person; organizationalPerson; user; computer;
 - 1> cn: DC1;
 - 1> distinguishedName: CN=DC1, OU=Domain Controllers, DC=contoso, DC=com;
 - 1> instanceType: 0x4 = (IT_WRITE);
 - 1> whenCreated: 07/10/2006 18:04:35 Pacific Standard Daylight Time;
 - 1> whenChanged: 07/15/2006 19:39:05 Pacific Standard Daylight Time;
 - 1> uSNCreated: 12291;
 - 1> uSNChanged: 24577;
 - 1> name: DC1;
 - 1> objectGUID: ac1993e1-0377-4161-893e-ccd2a98e1bba;
 - 1> userAccountControl: (UF_SERVER_TRUST_ACCOUNT | UF_TRUSTED_FOR_DELEGATION);
 - 1> badPwdCount: 0;
 - 1> codePage: 0;
 - 1> countryCode: 0;
 - 1> badPasswordTime: 01/01/1601 00:00:00 UNC ;
 - 1> lastLogoff: 01/01/1601 00:00:00 UNC ;
 - 1> lastLogon: 07/17/2006 19:47:40 Pacific Standard Daylight Time;
 - 1> localPolicyFlags: 0;
 - 1> pwdLastSet: 07/10/2006 18:04:35 Pacific Standard Daylight Time;
 - 1> primaryGroupID: 516;
 - 1> objectSid: S-1-5-21-254470460-2440132622-709970653-1001;
 - 1> accountExpires: 09/14/30828 02:48:05 UNC ;
 - 1> logonCount: 17;
 - 1> sAMAccountName: DC1\$;
 - 1> sAMAccountType: 805306369;
 - 1> operatingSystem: Windows Server 2003 operating system;
 - 1> operatingSystemVersion: 5.2 (3790);
 - 1> operatingSystemServicePack: Service Pack 1;

- 1> serverReferenceBL: CN=DC1,CN=Servers, CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com;
- 1> dnsHostName: DC1.contoso.com;
- 1> rIDSetReferences: CN=RID Set,CN=DC1,OU=Domain Controllers, DC=contoso, DC=com;
- 15> servicePrincipalName: ldap/DC1.contoso.com/NDNC5.contoso.com; ldap/DC1.contoso.com/NDNC2.contoso.com; ldap/DC1.contoso.com/NDNC1.contoso.com; GC/DC1.contoso.com/contoso.com; HOST/DC1.contoso.com/CONTOSO; HOST/DC1; HOST/DC1.contoso.com; HOST/DC1.contoso.com/contoso.com; E3514235-4B06-11D1-AB04-00C04FC2DCD2/c20bc312-4d35-4cc0-9903-b1073368af4a/contoso.com; ldap/c20bc312-4d35-4cc0-9903-b1073368af4a._msdcs.contoso.com; ldap/DC1.contoso.com/CONTOSO; ldap/DC1; ldap/DC1.contoso.com; ldap/DC1.contoso.com/contoso.com; NtFrs-88f5d2bd-b646-11d2-a6d3-00c04fc9b232/DC1.contoso.com;
- 1> objectCategory: CN=Computer, CN=Schema, CN=Configuration, DC=contoso, DC=com;
- 1> isCriticalSystemObject: TRUE;
- 1> frsComputerReferenceBL: CN=DC1, CN=Domain System Volume (SYSVOL share),CN=File Replication Service,CN=System,DC=contoso,DC=com;
- 1> lastLogonTimestamp: 07/11/2006 04:02:42 Pacific Std Daylight Time;

Querying the DC1 computer object in domain NC DC=CONTOSO, DC=COM by performing an LDAP search with base scope on the DN 'CN=DC2,OU=Domain Controllers,DC=contoso,DC=com':

- Expanding base 'CN=DC2,OU=Domain Controllers,DC=contoso,DC=com'...
- Result <0>: (null)
- Matched DN's:
- Getting 1 entries:
- >> Dn: CN=DC2,OU=Domain Controllers,DC=contoso,DC=com
 - 5> objectClass: top; person; organizationalPerson; user; computer;
 - 1> cn: DC2;
 - 1> distinguishedName: CN=DC2, OU=Domain Controllers, DC=contoso, DC=com;
 - 1> instanceType: 0x4 = (IT_WRITE);
 - 1> whenCreated: 07/10/2006 18:12:01 Pacific Standard Daylight Time;
 - 1> whenChanged: 07/16/2006 13:46:14 Pacific Standard Daylight Time;
 - 1> displayName: DC2\$;
 - 1> uSNCreated: 13711;
 - 1> uSNChanged: 28819;
 - 1> name: DC2;
 - 1> objectGUID: 09697f46-2458-4b26-a4e9-aa36059421c4;
 - 1> userAccountControl: (UF_SERVER_TRUST_ACCOUNT | UF_TRUSTED_FOR_DELEGATION);

- 1> badPwdCount: 0;
- 1> codePage: 0;
- 1> countryCode: 0;
- 1> badPasswordTime: 01/01/1601 00:00:00 UNC ;
- 1> lastLogoff: 01/01/1601 00:00:00 UNC ;
- 1> lastLogon: 07/17/2006 20:38:08 Pacific Standard Daylight Time;
- 1> localPolicyFlags: 0;
- 1> pwdLastSet: 07/10/2006 18:12:02 Pacific Standard Daylight Time;
- 1> primaryGroupID: 516;
- 1> objectSid: S-1-5-21-254470460-2440132622-709970653-1102;
- 1> accountExpires: 09/14/30828 02:48:05 UNC ;
- 1> logonCount: 8;
- 1> sAMAccountName: DC2\$;
- 1> sAMAccountType: 805306369;
- 1> operatingSystem: Windows Server 2003;
- 1> operatingSystemVersion: 5.2 (3790);
- 1> operatingSystemServicePack: Service Pack 1;
- 1> serverReferenceBL: CN=DC2,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com;
- 1> dnsHostName: DC2.contoso.com;
- 1> rIDSetReferences: CN=RID Set,CN=DC2,OU=Domain Controllers, DC=contoso, DC=com;
- 14> servicePrincipalName: ldap/DC2.contoso.com/NDNC5.contoso.com; ldap/DC2.contoso.com/NDNC2.contoso.com; ldap/6aad8f5a-07cc-403a-9696-9102fe1c320b._msdcs.contoso.com; ldap/DC2.contoso.com/CONTOSO; ldap/DC2; ldap/DC2.contoso.com; ldap/DC2.contoso.com/contoso.com; NtFrs-88f5d2bd-b646-11d2-a6d3-00c04fc9b232/DC2.contoso.com; HOST/DC2.contoso.com/CONTOSO; HOST/DC2.contoso.com/contoso.com; C/DC2.contoso.com/contoso.com; E3514235-4B06-11D1-AB04-00C04FC2DCD2/6aad8f5a-07cc-403a-9696-9102fe1c320b/contoso.com;
- HOST/DC2; HOST/DC2.contoso.com;
- 1> objectCategory: CN=Computer, CN=Schema, CN=Configuration, DC=contoso, DC=com;
- 1> isCriticalSystemObject: TRUE;
- 1> frsComputerReferenceBL: CN=DC2,CN=Domain System Volume (SYSVOL share),CN=File Replication Service,CN=System,DC=contoso,DC=com;
- 4> dScorePropagationData: 07/10/2006 18:14:51 Pacific Standard Daylight Time; 07/10/2006 18:14:51 Pacific Standard Time Pacific Daylight Time; 07/10/2006 18:14:51 Pacific Standard Time Pacific Daylight Time; 01/08/1601 07:15:13 Pacific Standard Time Pacific Daylight Time;

- 1 > lastLogonTimestamp: 07/10/2006 19:52:48 Pacific Std Daylight Time;

4.1.5.3.2 Client Request

DC2 invokes the IDL_DRSDomainControllerInfo method against itself with the following parameters (DRS_HANDLE to DC2 is omitted):

- *dwInVersion* = 1
- *pmsgIn* = DRS_MSG_DCINFOREQ_V1
 - Domain = "contoso.com"
 - InfoLevel = 1

4.1.5.3.3 Server Response

Return code of 0 and the following values:

- *pdwOutVersion*^ = 1
- *pmsgOut* = DRS_MSG_DCINFOREPLY_V1
 - cItems: 2
 - rItems[0]: DS_DOMAIN_CONTROLLER_INFO_1W
 - NetbiosName: "DC1"
 - DnsHostName: "DC1.contoso.com"
 - SiteName: "Default-First-Site-Name"
 - ComputerObjectName: "CN=DC1, OU=Domain Controllers,DC=contoso,DC=com"
 - ServerObjectName: "CN=DC1,CN=Servers, CN=Default-First-Site-Name,CN=Sites, CN=Configuration, DC=contoso,DC=com"
 - fIsPdc: 1
 - fDsEnabled: 1
 - rItems[1]: DS_DOMAIN_CONTROLLER_INFO_1W
 - NetbiosName: "DC2"
 - DnsHostName: "DC2.contoso.com"
 - SiteName: "Default-First-Site-Name"
 - ComputerObjectName: "CN=DC2, OU=Domain Controllers,DC=contoso,DC=com"
 - ServerObjectName: "CN=DC2,CN=Servers, CN=Default-First-Site-Name,CN=Sites, CN=Configuration, DC=contoso,DC=com"
 - fIsPdc: 0
 - fDsEnabled: 1

4.1.5.3.4 Final State

The final state is the same as the initial state; there is no change.

4.1.6 IDL_DRSExecuteKCC (Opnum 18)

The IDL_DRSExecuteKCC method validates the replication interconnections of DCs and updates them if necessary.

```
ULONG IDL_DRSExecuteKCC(  
    [in, ref] DRS_HANDLE hDrs,  
    [in] DWORD dwInVersion,  
    [in, ref, switch_is(dwInVersion)]  
        DRS_MSG_KCC_EXECUTE* pmsgIn  
);
```

hDrs: The RPC context handle returned by the IDL_DRSBind method.

dwInVersion: The version of the request message.

pmsgIn: A pointer to the request message.

Return Values: 0 if successful, otherwise a Windows error code.

Exceptions Thrown: This method might throw the following exceptions beyond those thrown by the underlying RPC protocol (as specified in [MS-RPCE]): ERROR_INVALID_HANDLE, ERROR_DS_DRS_EXTENSIONS_CHANGED, ERROR_DS_DIFFERENT_REPL_EPOCHS, and ERROR_INVALID_PARAMETER.

4.1.6.1 Method-Specific Concrete Types

4.1.6.1.1 DRS_MSG_KCC_EXECUTE

The DRS_MSG_KCC_EXECUTE union defines the request messages sent to the IDL_DRSExecuteKCC method. Only one version, identified by *dwInVersion* = 1, is currently defined.

```
typedef  
[switch_type(DWORD)]  
union {  
    [case(1)]  
        DRS_MSG_KCC_EXECUTE_V1 V1;  
} DRS_MSG_KCC_EXECUTE;
```

V1: Version 1 request.

4.1.6.1.2 DRS_MSG_KCC_EXECUTE_V1

The DRS_MSG_KCC_EXECUTE_V1 structure defines the request message sent to the IDL_DRSExecuteKCC method.

```
typedef struct {  
    DWORD dwTaskID;  
    DWORD dwFlags;  
} DRS_MSG_KCC_EXECUTE_V1;
```

dwTaskID: MUST be 0.

dwFlags: Zero or more of the following bit flags, which are presented in little-endian byte order.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
X	X	X	X	X	X	D	A	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

X: Unused. MUST be zero and ignored.

AS (DS_KCC_FLAG_ASYNC_OP, 0x00000001): Request the KCC to run, then return immediately.

DP (DS_KCC_FLAG_DAMPED, 0x00000002): Request the KCC to run unless there is already such a request pending according to implementation-defined rules. Implementations MAY choose to ignore this flag and always request the KCC to run.

4.1.6.2 Method-Specific Abstract Types and Procedures

4.1.6.2.1 ExecuteKCCTasks

```
procedure ExecuteKCCTasks(): ULONG
```

This procedure executes the tasks necessary for maintaining the replication topology between DCs. These tasks include activities such as maintenance of kCCFailedLinks and kCCFailedConnections, maintenance of intrasite and intersite connections, and updates of RODC objects (as appropriate). See [MS-ADTS] section 6.2.2 for a full list of these tasks.

If an error occurs, a Windows error code is returned. If successful, the method returns 0.

4.1.6.3 Server Behavior of the IDL_DRSExecuteKCC Method

Informative summary of behavior: The IDL_DRSExecuteKCC method triggers the execution of tasks that generate and maintain the replication topology between DCs. <16> See [MS-ADTS] section 6.2.2 for more information related to the tasks performed by the KCC upon receipt of an IDL_DRSExecuteKCC request.

```
ULONG
IDL_DRSExecuteKCC(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
    DRS_MSG_KCC_EXECUTE *pmsgIn)

msgIn: DRS_MSG_KCC_EXECUTE_V1

ValidateDRSInput(hDrs, 18)

/* Validate the request version */
if dwInVersion != 1 then
    return ERROR_DS_DRA_INVALID_PARAMETER
endif

msgIn := pmsgIn^V1

if msgIn.dwTaskID != 0 then
    return ERROR_INVALID_PARAMETER
endif

if not AccessCheckCAR(ConfigNC(), DS-Replication-Manage-Topology)
    then
```

```

    return ERROR_DS_DRA_ACCESS_DENIED
endif

if msgIn.dwFlags = DS_KCC_FLAG_ASYNC_OP then
    Asynchronous Processing: Initiate a logical thread of control
    to process the remainder of this request asynchronously
    return 0
endif
return ExecuteKCCTasks()

```

4.1.7 IDL_DRSFinishDemotion (Opnum 27)

The IDL_DRSFinishDemotion method either performs one or more steps toward the complete removal of a DC from an AD LDS forest, or it undoes the effects of the first phase of removal (performed by IDL_DRSInitDemotion). This method is supported by AD LDS only.

```

ULONG IDL_DRSFinishDemotion(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
    DRS_MSG_FINISH_DEMOTIONREQ* pmsgIn,
    [out, ref] DWORD* pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
    DRS_MSG_FINISH_DEMOTIONREPLY* pmsgOut
);

```

hDrs: The RPC context handle returned by the IDL_DRSBind method.

dwInVersion: The version of the request message.

pmsgIn: A pointer to the request message.

pdwOutVersion: A pointer to the version of the response message.

pmsgOut: A pointer to the response message.

Return Values: 0 if successful, otherwise a Windows error code.

Exceptions Thrown: This method might throw the following exceptions beyond those thrown by the underlying RPC protocol (as specified in [MS-RPCE]): ERROR_INVALID_HANDLE, ERROR_DS_DRS_EXTENSIONS_CHANGED, ERROR_DS_DIFFERENT_REPL_EPOCHS, and ERROR_INVALID_PARAMETER.

4.1.7.1 Method-Specific Concrete Types

4.1.7.1.1 DRS_MSG_FINISH_DEMOTIONREQ

The DRS_MSG_FINISH_DEMOTIONREQ union defines the request messages sent to the IDL_DRSFinishDemotion method. Only one version, identified by *dwInVersion* = 1, is currently defined.

```

typedef
[switch_type(DWORD)]
union {
    [case(1)]
    DRS_MSG_FINISH_DEMOTIONREQ_V1 V1;
} DRS_MSG_FINISH_DEMOTIONREQ;

```

V1: Version 1 request. Currently, only one version is defined.


```
} DRS_MSG_FINISH_DEMOTIONREPLY;
```

V1: Version 1 reply.

4.1.7.1.4 DRS_MSG_FINISH_DEMOTIONREPLY_V1

The DRS_MSG_FINISH_DEMOTIONREPLY_V1 structure defines the response message received from the IDL_DRSEFinishDemotion method.

```
typedef struct {  
    DWORD dwOperationsDone;  
    DWORD dwOpFailed;  
    DWORD dwOpError;  
} DRS_MSG_FINISH_DEMOTIONREPLY_V1;
```

dwOperationsDone: The set of operations that were successfully performed. This [maycan](#) include the following values: DS_DEMOTE_ROLLBACK_DEMOTE, DS_DEMOTE_COMMIT_DEMOTE, DS_DEMOTE_DELETE_CSMETA, DS_DEMOTE_UNREGISTER_SCPS, DS_DEMOTE_UNREGISTER_SPNS. This MUST include any value from the input element DRS_MSG_FINISH_DEMOTIONREQ_V1.dwOperations whose corresponding operations (see pseudocode in section 4.1.7.3) succeeded.

dwOpFailed: The set of operations that failed during demotion. This [maycan](#) include the same values as the **dwOperationsDone** field. This MUST include any value from the input element DRS_MSG_FINISH_DEMOTIONREQ_V1.dwOperations whose corresponding operations (see pseudocode in section 4.1.7.3) failed.

dwOpError: The Win32 error code (as specified in [MS-ERREF] section 2.2) of the first failed operation (if any), from the following operations: DS_DEMOTE_ROLLBACK_DEMOTE, DS_DEMOTE_COMMIT_DEMOTE, DS_DEMOTE_DELETE_CSMETA, or DS_DEMOTE_UNREGISTER_SCPS.

4.1.7.2 Method-Specific Abstract Types and Procedures

4.1.7.2.1 RemoveADLDSServer

```
procedure RemoveADLDSServer(): DWORD
```

The RemoveADLDSServer procedure connects to any available replication partner and uses the IDL_DRSERemoveDsServer method to delete the nTDSDSA object that corresponds to this DC. If no replication partner is available, or if a replication partner is available and either no such nTDSDSA object exists or the deletion is successful, RemoveADLDSServer returns ERROR_SUCCESS; otherwise, it returns a Win32 error.

4.1.7.2.2 RemoveADLDSSCP

```
procedure RemoveADLDSSCP(): DWORD
```

The RemoveADLDSSCP procedure connects to an AD DS DC and deletes any serviceConnectionPoint object that was created in AD DS for this AD LDS DC. See [MS-ADTS] section 6.3.8 for more details on AD LDS serviceConnectionPoint objects. If no such serviceConnectionPoint object exists or if the deletion is successful, RemoveADLDSSCP returns ERROR_SUCCESS; otherwise, it returns a Win32 error.

4.1.7.2.3 RemoveADLDSSPNs

```
procedure RemoveADLDSSPNs(szScriptBase: unicodestring): boolean
```

The RemoveADLDSSPNs procedure connects to an AD DS DC and attempts to delete any SPN values registered for the AD LDS DC on the object (in the external AD DS domain) that corresponds to the security principal that the AD LDS service is running as. Sections 2.2.3.2 and 2.2.4.2 specify the SPN values removed by this procedure. If no such SPN values exist or the deletion is successful, RemoveADLDSSPNs returns TRUE; otherwise, it returns FALSE, indicating that a batch file was created in the folder specified by the *szScriptBase* parameter. This batch file contains commands that an administrator can run to clean up the SPNs.

Note When the procedure fails to create a batch file for any reason, RemoveADLDSSPNs returns TRUE.

4.1.7.3 Server Behavior of the IDL_DRSFinishDemotion Method

Informative summary of behavior: The IDL_DRSFinishDemotion method either performs one or more steps toward the complete removal of a DC from an AD LDS forest, or it undoes the effects of the first phase of removal (performed by IDL_DRSInitDemotion).<17>

```
ULONG
IDL_DRSFinishDemotion(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
        DRS_MSG_FINISH_DEMOTIONREQ* pmsgIn,
    [out, ref] DWORD *pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DRS_MSG_FINISH_DEMOTIONREPLY* pmsgOut
)

msgIn: DRS_MSG_FINISH_DEMOTIONREQ_V1
msgOut: DRS_MSG_FINISH_DEMOTIONREPLY_V1
ret: DWORD
res: boolean

ValidateDRSInput(hDrs, 27)

if dwInVersion # 1 then
    return ERROR_INVALID_PARAMETER
endif

if pmsgIn = null then
    return ERROR_INVALID_PARAMETER
endif

msgIn := pmsgIn^.V1
if DS_DEMOTE_OPT_FAIL_ON_UNKNOWN_OP in msgIn.dwOperations then
    /* unknown operation bit is set */
    return ERROR_INVALID_PARAMETER
endif
if DS_DEMOTE_UNREGISTER_SPNS in msgIn.dwOperations
    and msgIn.szScriptBase = null then
    /* szScriptBase must be specified when UNREGISTER_SPN is
    * requested */
    return ERROR_INVALID_PARAMETER
endif
if not IsMemberOfBuiltinAdminGroup() then
    /* only BA is allowed to demote an AD LDS service */
    return ERROR_DS_DRA_ACCESS_DENIED
endif

pdwOutVersion^ := 1
msgOut.dwOperationDone := 0
```

```

msgOut.dwOpFailed := 0
msgOut.dwOpError := ERROR_SUCCESS

if DS_DEMOTE_ROLLBACK_DEMOTE in msgIn.dwOperations then
  /* Begin operations corresponding to dwOperations value of DS_DEMOTE_ROLLBACK_DEMOTE */

  /* undo the effects of IDL_DRSInitDemotion */

  dc.fEnableUpdates := TRUE

  msgOut.dwOperationDone :=
    msgOut.dwOperationDone + {DS_DEMOTE_ROLLBACK_DEMOTE}

  msgOut.dwOpError := ERROR_SUCCESS
  /* no other operations are allowed on rollback */
  /* End operations corresponding to dwOperations value of DS_DEMOTE_ROLLBACK_DEMOTE */
else
  if DS_DEMOTE_COMMIT_DEMOTE in msgIn.dwOperations then
    /* Begin operations corresponding to dwOperations value of DS_DEMOTE_COMMIT_DEMOTE */

    After this call to IDL_DRSFinishDemotion completes, the server should discontinue
    being a DC, which for AD LDS means stopping the MS-DRSR protocol, the MS-DSSP protocol, the
    LDAP protocol, and if they are already enabled also the MS-ADCAP protocol, the WS-Enumeration
    protocol, the WS-Transfer protocol, the MS-WSTIM protocol, the MS-WSDS protocol, and the MS-
    WSPELD protocol. In addition, the state model, constraints and processing rules, and so on,
    in MS-ADTS should also be stopped.

    msgOut.dwOperationDone :=
      msgOut.dwOperationDone + {DS_DEMOTE_COMMIT_DEMOTE}

    msgOut.dwOpError := ERROR_SUCCESS
    /* End operations corresponding to dwOperations value of DS_DEMOTE_COMMIT_DEMOTE */
  endif
  if DS_DEMOTE_DELETE_CSMETA in msgIn.dwOperations then
    /* Begin operations corresponding to dwOperations value of DS_DEMOTE_DELETE_CSMETA */

    ret := RemoveADLDSSTServer()
    if ret = ERROR_SUCCESS then
      msgOut.dwOperationDone :=
        msgOut.dwOperationDone + {DS_DEMOTE_DELETE_CSMETA}
    else
      msgOut.dwOpFailed =
        msgOut.dwOpFailed + {DS_DEMOTE_DELETE_CSMETA}
      if msgOut.dwOpError = ERROR_SUCCESS then
        msgOut.dwOpError := ret
      endif
    endif
    /* End operations corresponding to dwOperations value of DS_DEMOTE_DELETE_CSMETA */
  endif
  if DS_DEMOTE_UNREGISTER_SCPS in msgIn.dwOperations then
    /* Begin operations corresponding to dwOperations value of DS_DEMOTE_UNREGISTER_SCPS */
    ret := RemoveADLDSSTSCP()
    if ret = ERROR_SUCCESS then
      msgOut.dwOperationDone :=
        msgOut.dwOperationDone + {DS_DEMOTE_UNREGISTER_SCPS}
    else
      msgOut.dwOpFailed =
        msgOut.dwOpFailed + {DS_DEMOTE_UNREGISTER_SCPS}
      if msgOut.dwOpError = ERROR_SUCCESS then
        msgOut.dwOpError := ret
      endif
    endif
    /* End operations corresponding to dwOperations value of DS_DEMOTE_UNREGISTER_SCPS */
  endif
  if DS_DEMOTE_UNREGISTER_SPNS in msgIn.dwOperations then
    /* Begin operations corresponding to dwOperations value of DS_DEMOTE_UNREGISTER_SPNS */
    res := RemoveADLDSSTPNs(msgIn.szScriptBase)
    if res = TRUE then
      msgOut.dwOperationDone :=

```



```

        msgOut.dwOperationDone + {DS_DEMOTE_UNREGISTER_SPNS}
    else
        msgOut.dwOpFailed =
            msgOut.dwOpFailed + {DS_DEMOTE_UNREGISTER_SPNS}
    endif
    /* End operations corresponding to dwOperations value of DS_DEMOTE_UNREGISTER_SPNS */
endif
endif
pmsgOut^ := msgOut
pdwMsgOut^ := 1
return ERROR_SUCCESS

```

4.1.8 IDL_DRSGetMemberships (Opnum 9)

The IDL_DRSGetMemberships method retrieves group membership for an object.

```

ULONG IDL_DRSGetMemberships(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
        DRS_MSG_REVMEMB_REQ* pmsgIn,
    [out, ref] DWORD* pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DRS_MSG_REVMEMB_REPLY* pmsgOut
);

```

hDrs: RPC context handle returned by the IDL_DRSBind method.

dwInVersion: Version of the request message.

pmsgIn: Pointer to the request message.

pdwOutVersion: Pointer to the version of the response message.

pmsgOut: Pointer to the response message.

Return Values: 0 if successful, otherwise a Windows error code.

Exceptions Thrown: This method might throw the following exceptions beyond those thrown by the underlying RPC protocol (as specified in [MS-RPCE]): ERROR_INVALID_HANDLE, ERROR_DS_DRS_EXTENSIONS_CHANGED, ERROR_DS_DIFFERENT_REPL_EPOCHS, and ERROR_INVALID_PARAMETER.

4.1.8.1 Method-Specific Concrete Types

4.1.8.1.1 DRS_MSG_REVMEMB_REQ

The DRS_MSG_REVMEMB_REQ union defines the request messages sent to the IDL_DRSGetMemberships method. Only one version, identified by *dwInVersion* = 1, is currently defined.

```

typedef
    [switch_type(DWORD)]
    union {
        [case(1)]
            DRS_MSG_REVMEMB_REQ_V1 V1;
    } DRS_MSG_REVMEMB_REQ;

```

V1: Version 1 request. Currently only one version is defined.

RevMembGetResourceGroups: Transitive membership in all domain-local groups in a given domain, excluding built-in groups.

RevMembGetUniversalGroups: Transitive membership in all **universal groups**, excluding built-in groups.

GroupMembersTransitive: Transitive closure of members of a group based on the information present in the server's NC replicas, including the primary group.

RevMembGlobalGroupsNonTransitive: Non-transitive membership in **global groups**, excluding built-in groups.

4.1.8.1.4 DRS_MSG_REVMEMB_REPLY

The DRS_MSG_REVMEMB_REPLY union defines the response messages received from the IDL_DRSGetMemberships method. Only one version, identified by *pdwOutVersion*[^] = 1, is currently defined.

```
typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_REVMEMB_REPLY_V1 V1;
} DRS_MSG_REVMEMB_REPLY;
```

V1: Version 1 reply.

4.1.8.1.5 DRS_MSG_REVMEMB_REPLY_V1

The DRS_MSG_REVMEMB_REPLY_V1 structure defines the response message received from the IDL_DRSGetMemberships method.

```
typedef struct {
    ULONG errorCode;
    [range(0,10000)] ULONG cDsNames;
    [range(0,10000)] ULONG cSidHistory;
    [size_is(cDsNames,)] DSNAME** ppDsNames;
    [size_is(cDsNames)] DWORD* pAttributes;
    [size_is(cSidHistory,)] NT4SID** ppSidHistory;
} DRS_MSG_REVMEMB_REPLY_V1;
```

errorCode: 0 on success. On failure, this can be one of the following.

Value	Meaning
STATUS_INSUFFICIENT_RESOURCES 0xC000009A	Insufficient system resources exist to complete the request.
STATUS_TOO_MANY_CONTEXT_IDS 0xC000015A	The number of groups is greater than the number that can be returned to the caller.

cDsNames: Count of items in the **ppDsNames** array.

cSidHistory: Count of items in the **ppSidHistory** array.

ppDsNames: The filtered group membership. This list contains the combined membership for all the names specified in ppDsNames field of the input DRS_MSG_REVMEMB_REQ_V1 structure.

pAttributes: Properties of the returned groups. Values are chosen from SE_GROUP values.

ppSidHistory: SID history of the returned groups.

4.1.8.1.6 SE_GROUP Values

Attributes of a security group.

Symbolic name	Value
SE_GROUP_MANDATORY	0x00000001
SE_GROUP_ENABLED_BY_DEFAULT	0x00000002
SE_GROUP_ENABLED	0x00000004

4.1.8.2 Method-Specific Abstract Types and Procedures

4.1.8.2.1 Arc and ArcSet

```
type Arc = [initial: DSName, final: DSName]
type ArcSet = set of Arc
```

4.1.8.2.2 Closure

```
procedure Closure(
  vSet: set of DSName,
  aSet: ArcSet,
  v: DSName): set of DSName
```

The Closure procedure returns the set of vertices that can be reached from vertex v in the directed graph that consists of vertex set $vSet$ and arc set $aSet$. A vertex u can be reached from v if and only if there is a sequence $v[0], v[1], \dots, v[k]$, where $v[0]=v$, $v[k]=u$, and $v[i]$ is in $vSet$ and $[initial:v[i-1], final:v[i]]$ is in $aSet$ for $i=1,2,\dots,k$.

4.1.8.2.3 DomainOf

```
procedure DomainOf(o: DSName): DSName
```

The DomainOf procedure returns the DSName of the domain NC to which the given DSName o belongs. It returns null upon failure.

4.1.8.2.4 GetDSNameOfEnterpriseRODCsGroup

```
procedure GetDSNameOfEnterpriseReadonlyDomainControllerGroup(): DSName
```

This procedure constructs a SID s consisting of the domain SID of the ~~forest~~-root domain-~~NC~~ and the relative identifier (RID) of the Enterprise Read-only Domain Controllers Group (as defined in [MS-ADTS] section 6.1.1.6.14), and returns the **DSName** of the object o for which $o!$ **objectSid** = s . If no such object o exists, this procedure returns null.

4.1.8.2.5 GetDSNameFromPrimaryGroupId

```
procedure GetDSNameFromPrimaryGroupId(rid: Rid): DSName
```

This procedure constructs a SID *s* consisting of the domain SID of the DC's default domain and the given relative identifier **rid**, and returns the DSName of the object *o* for which *o*!objectSid = *s*. If no such object *o* exists, then this procedure will return null.

4.1.8.2.6 IsMatchedGroup

```
procedure IsMatchedGroup(
  w: DSName,
  op: REVERSE_MEMBERSHIP_OPERATION_TYPE,
  limitingDomain: DSName): boolean
```

Informative summary of behavior: The IsMatchedGroup procedure checks whether an object should be included in the result for the specified IDL_DRSGetMemberships operation.

```
limitToDomain, filteroutBuiltin, result: boolean
w: DSName

limitToDomain := (op ≠ RevMembGetUniversalGroups) and
  (limitingDomain ≠ null)

filteroutBuiltin := (op ≠ RevMembGetAliasMembership)

result := (GROUP_TYPE_SECURITY_ENABLED in w!groupType)
  and ((not limitToDomain) or (limitingDomain = DomainOf(w)))
  and ((not filteroutBuiltin) or (not IsBuiltinPrincipal(w.sid)))
  and ((op ≠ RevMembGetGroupsForUser)
    or (w!groupType ∩ {GROUP_TYPE_RESOURCE_GROUP,
      GROUP_TYPE_APP_BASIC_GROUP,
      GROUP_TYPE_APP_QUERY_GROUP} = {}))
  and ((op ≠ RevMembGetAliasMembership)
    or (w!groupType ∩ {GROUP_TYPE_RESOURCE_GROUP,
      GROUP_TYPE_APP_BASIC_GROUP,
      GROUP_TYPE_APP_QUERY_GROUP} ≠ {}))
  and ((op ≠ RevMembGetAccountGroups)
    or (GROUP_TYPE_ACCOUNT_GROUP in w!groupType))
  and ((op ≠ RevMembGetResourceGroups)
    or (GROUP_TYPE_RESOURCE_GROUP in w!groupType))
  and ((op ≠ RevMembGetUniversalGroups)
    or (GROUP_TYPE_UNIVERSAL_GROUP in w!groupType))
  and ((op ≠ RevMembGlobalGroupsNonTransitive)
    or (GROUP_TYPE_ACCOUNT_GROUP in w!groupType))

return result
```

4.1.8.2.7 Neighbors

```
procedure Neighbors(
  vSet: set of DSName,
  aSet: ArcSet,
  v: DSName): set of DSName
```

The Neighbors procedure returns the set of vertices adjacent to vertex *v* in the directed graph that consists of vertex set *vSet* and arc set *aSet*. A vertex *u* is adjacent to *v* if *u* is in *vSet* and [initial:*v*, final:*u*] is in *aSet*. Note that because this is a directed graph, the fact that vertex *u* is adjacent to vertex *v* does not imply that vertex *v* is adjacent to vertex *u*.

4.1.8.3 Server Behavior of the IDL_DRSGetMemberships Method

Informative summary of behavior: The IDL_DRSGetMemberships method constructs a directed graph $G(V,A)$. The vertex set of the graph includes all the objects in the scope of the forest if the server is a GC, or in the scope of the default domain NC otherwise. The arc set of the graph includes all the tuples [initial: u ,final: v] if u is a member of v and both u and v are in the scope. This graph represents the membership relation in the given scope.

For a GroupMembersTransitive request, a reversed graph of G is used because member relation is queried rather than membership. The reversed graph has the same vertex set as G , but the arcs in the arc set are in the opposite direction as those in A .

For other types of requests, a subgraph of G is used. The vertex set of this subgraph consists of only the DSName values of interest for that particular request type, and the arc set is reduced to the arcs that link two vertices in the vertex set of the subgraph.

Starting from the graph, this method computes a set of objects for each DSName in the input parameters. The set could be either transitive closure of the object or the immediate neighbors of the object in the graph, depending on the type of request. The union of these sets is returned as the result.

```
ULONG
IDL_DRSGetMemberships(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)] DRS_MSG_REVMEMB_REQ *pmsgIn,
    [out, ref] DWORD *pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DRS_MSG_REVMEMB_REPLY *pmsgOut)

msgIn: DRS_MSG_REVMEMB_REQ_V1
vSet, wSet, uSet: set of DSName
aSet, aSetR: ArcSet
u,v,w: DSName
op, i: integer
transitive: boolean
t: SID

ValidateDRSInput(hDrs, 9)

pdwOutVersion^ := 1
pmsgOut^.V1.errCode := 0
pmsgOut^.V1.cDsNames := 0
pmsgOut^.V1.cSidHistory := 0
pmsgOut^.V1.ppDsNames := null
pmsgOut^.V1.pAttributes := null
pmsgOut^.V1.ppSidHistory := null

msgIn := pmsgIn^.V1

if dwInVersion # 1 then
    return ERROR_DS_DRA_INVALID_PARAMETER
endif
if not AccessCheckCAR(DefaultNC(), DS-Replication-Get-Changes) then
    return ERROR_DS_DRA_ACCESS_DENIED
endif

op := msgIn.OperationType
if (op = RevMembGetUniversalGroups) and not IsGC() then
    return ERROR_DS_GC_REQUIRED
endif

/* Construct a membership graph. */
/* Vertices */
if IsGC() then
    vSet := select all v from all where true
```

```

else
    vSet := select all v from subtree DefaultNC() where true
Endif

/* Edges */
aSet := {}
aSetR := {}
foreach v in vSet
    foreach u in vSet
        if (u in v!memberOf)
            or (u = GetDSNameFromPrimaryGroupId(v!primaryGroupId)) then
                aSet := aSet + {[initial: v, final: u]}
                aSetR := aSetR + {[initial: u, final: v]}
            endif
        endif
    endforeach
endforeach

/* Calculate GroupMembersTransitive. */
if op = GroupMembersTransitive then
    wSet := {}
    for i := 0 to msgIn.ppDsNames.cDsNames - 1
        u := msgIn.ppDsNames[i]
        if u in vSet then
            wSet := wSet + (Closure(uSet, aSetR, u) - {u})
        endif
    endforeach

    foreach w in wSet
        pmsgOut^.V1.ppDsNames[pmsgOut^.V1.cDsNames] := w
        pmsgOut^.V1.cDsNames := pmsgOut^.V1.cDsNames + 1
    endforeach

    return 0
endif

/* Calculate all other cases (where op ≠ GroupMembersInTransitive).*/
transitive := op in {RevMembGetAccountGroups,
                    RevMembGetResourceGroups,
                    RevMembGetUniversalGroups}

/* Get the initial result set from the graph. */
wSet := {}
for i := 0 to msgIn.ppDsNames.cDsNames - 1
    u := msgIn.ppDsNames[i]
    if u in vSet then
        /* Get the subgraph by applying the predicate IsMatchedGroup
        * on each element in the vertex set, plus u itself. */
        uSet := {u} + select all v from vSet where
            IsMatchedGroup(v, op, msgIn.pLimitingDomain^)
        if transitive then
            wSet := wSet + (Closure(uSet, aSet, u) - {u})
        else
            wSet := wSet + (Neighbors(uSet, aSet, u) - {u})
        endif
        if ((u!userAccountControl & ADS_UF_WORKSTATION_TRUST_ACCOUNT =
            ADS_UF_WORKSTATION_TRUST_ACCOUNT) and
            (u!userAccountControl & ADS_UF_PARTIAL_SECRETS_ACCOUNT =
            ADS_UF_PARTIAL_SECRETS_ACCOUNT))
            wSet := wSet + GetDSNameOfEnterpriseRODCsGroup()
        endif
    endif
endforeach

/* Construct the result message. */
pmsgOut^.V1.cSidHistory := 0
pmsgOut^.V1.cDsNames := 0

foreach w in wSet
    foreach t in w!sIDHistory

```

```

        if not (t in pmsgOut^.V1.ppSidHistory) then
            pmsgOut^.V1.ppSidHistory[pmsgOut^.V1.cSidHistory] := t
            pmsgOut^.V1.cSidHistory := pmsgOut^.V1.cSidHistory + 1
        endif
    endfor

    pmsgOut^.V1.ppDsNames[pmsgOut^.V1.cDsNames] := w

    if (DRS_REVMEMB_FLAG_GET_ATTRIBUTES in msgIn.dwFlags) then
        pmsgOut^.V1.pAttributes[pmsgOut^.V1.cDsNames] :=
            {SE_GROUP_MANDATORY, SE_GROUP_ENABLED_BY_DEFAULT,
             SE_GROUP_ENABLED}
    else
        pmsgOut^.V1.pAttributes[pmsgOut^.V1.cDsNames] := 0
    endif
    pmsgOut^.V1.cDsNames := pmsgOut^.V1.cDsNames + 1
endfor

return 0

```

4.1.9 IDL_DRSGetMemberships2 (Opnum 21)

The IDL_DRSGetMemberships2 method retrieves group memberships for a sequence of objects.

```

ULONG IDL_DRSGetMemberships2(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
        DRS_MSG_GETMEMBERSHIPS2_REQ* pmsgIn,
    [out, ref] DWORD* pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DRS_MSG_GETMEMBERSHIPS2_REPLY* pmsgOut
);

```

hDrs: The RPC context handle returned by the IDL_DRSBind method.

dwInVersion: Version of the request message.

pmsgIn: Pointer to the request message.

pdwOutVersion: Pointer to the version of the response message.

pmsgOut: Pointer to the response message.

Return Values: 0 if successful; otherwise, a Windows error code.

Exceptions Thrown: This method might throw the following exceptions beyond those thrown by the underlying RPC protocol (as specified in [MS-RPCE]): ERROR_INVALID_HANDLE, ERROR_DS_DRS_EXTENSIONS_CHANGED, ERROR_DS_DIFFERENT_REPL_EPOCHS, and ERROR_INVALID_PARAMETER.

4.1.9.1 Method-Specific Concrete Types

4.1.9.1.1 DRS_MSG_GETMEMBERSHIPS2_REQ

The DRS_MSG_GETMEMBERSHIPS2_REQ union defines request messages sent to the IDL_DRSGetMemberships2 method. Only one version, identified by *dwInVersion* = 1, is currently defined.

```
typedef
```



```

[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_GETMEMBERSHIPS2_REQ_V1 V1;
} DRS_MSG_GETMEMBERSHIPS2_REQ;

```

V1: Version 1 request.

4.1.9.1.2 DRS_MSG_GETMEMBERSHIPS2_REQ_V1

The DRS_MSG_GETMEMBERSHIPS2_REQ_V1 structure defines the request message sent to the IDL_DRSGetMemberships2 method.

```

typedef struct {
    [range(1,10000)] ULONG Count;
    [size_is(Count)] DRS_MSG_REVMEMB_REQ_V1* Requests;
} DRS_MSG_GETMEMBERSHIPS2_REQ_V1;

```

Count: Count of items in the **Requests** array.

Requests: Sequence of reverse membership requests.

4.1.9.1.3 DRS_MSG_GETMEMBERSHIPS2_REPLY

The DRS_MSG_GETMEMBERSHIPS2_REPLY union defines response messages received from the IDL_DRSGetMemberships2 method. Only one version, identified by *pdwOutVersion*[^] = 1, is currently defined.

```

typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_GETMEMBERSHIPS2_REPLY_V1 V1;
} DRS_MSG_GETMEMBERSHIPS2_REPLY;

```

V1: Version 1 response.

4.1.9.1.4 DRS_MSG_GETMEMBERSHIPS2_REPLY_V1

The DRS_MSG_GETMEMBERSHIPS2_REPLY_V1 structure defines the response message received from the IDL_DRSGetMemberships2 method.

```

typedef struct {
    [range(0,10000)] ULONG Count;
    [size_is(Count)] DRS_MSG_REVMEMB_REPLY_V1* Replies;
} DRS_MSG_GETMEMBERSHIPS2_REPLY_V1;

```

Count: Count of items in the **Replies** array.

Replies: Sequence of reverse membership replies, in the same order as the **Requests** field of the request message.

4.1.9.2 Server Behavior of the IDL_DRSGetMemberships2 Method

Informative summary of behavior: The IDL_DRSGetMemberships2 method is merely a way to execute a series of IDL_DRSGetMemberships RPC calls via a single RPC request.

```

ULONG
IDL_DRSGetMemberships2(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
        DRS_MSG_GETMEMBERSHIPS2_REQ *pmsgIn,
    [out, ref] DWORD *pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DRS_MSG_GETMEMBERSHIPS2_REPLY *pmsgOut)

error, i: ULONG
dummyVersion: DWORD

ValidateDRSInput(hDrs, 21)

pdwOutVersion^ := 1
pMsgOut^.V1.Count := 0
pMsgOut^.V1.Replies := null

if dwInVersion ≠ 1 then
    return ERROR_DS_DRA_INVALID_PARAMETER
endif

pmsgOut^.V1.Count := pmsgIn^.V1.Count

for i := 0 to pmsgIn^.V1.Count - 1
    /* Call IDL_DRSGetMemberships as a local procedure. */
    error := IDL_DRSGetMemberships(null, 1, ADR(pmsgIn^.V1.Request[i]),
        ADR(dummyVersion), ADR(pmsgOut^.V1.Replies[i]))

    if error ≠ 0 then
        return error
    endif
endfor

return 0

```

4.1.10 IDL_DRSGetNCChanges (Opnum 3)

The IDL_DRSGetNCChanges method replicates updates from an NC replica on the server.

```

ULONG IDL_DRSGetNCChanges(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
        DRS_MSG_GETCHGREQ* pmsgIn,
    [out, ref] DWORD* pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DRS_MSG_GETCHGREPLY* pmsgOut
);

```

hDrs: The RPC context handle returned by the IDL_DRSBind method.

dwInVersion: Version of the request message.

pmsgIn: A pointer to the request message.

pdwOutVersion: A pointer to the version of the response message.

pmsgOut: A pointer to the response message.

Return Values: 0 if successful, otherwise a Windows error code.

Exceptions Thrown: This method might throw the following exceptions beyond those thrown by the underlying RPC protocol (as specified in [MS-RPCE]): ERROR_INVALID_HANDLE, ERROR_DS_DRS_EXTENSIONS_CHANGED, ERROR_DS_DIFFERENT_REPL_EPOCHS, and ERROR_INVALID_PARAMETER.

4.1.10.1 Overview

A client DC sends an IDL_DRSGetNCChanges request (*msgIn*, of a type in the union DRS_MSG_GETCHGREQ) to a server to replicate directory objects in a given NC from the server NC replica to the client NC replica.

The response (*msgOut*, of a type in the union DRS_MSG_GETCHGREPLY) contains a set of updates that the client is to apply to its NC replica. Commonly, this set of updates is too large to send in a single response; in this case, multiple IDL_DRSGetNCChanges requests and responses must be sent before the server sends a response that indicates no additional updates are available.

This sequence of requests and responses is called a replication cycle, or "cycle". A client DC can request an action on a FSMO role (for example, a change in the FSMO role owner) by using a special replication cycle called an extended operation.

4.1.10.1.1 Cycle Start and Finish

There are five types of cycle starts:

1. The client explicitly signals the start of a special single-response cycle when it requests an extended operation. Such cycles always consist of a single response which sets *msgOut.fMoreData* = false.
2. The client explicitly signals the start of a cycle by sending *msgIn.uuidInvocIdSrc* = 0 or *msgIn.usnvecFrom* = 0.
3. The client sends values of *msgIn.uuidInvocIdSrc* and *msgIn.usnvecFrom* that were returned by the server as *msgOut.uuidInvocIdSrc* and *msgOut.usnvecTo* in the final message of some other cycle.
4. The server detects either that *msgIn.uuidInvocIdSrc* ≠ *dc.invocationId* or that *msgIn.uuidInvocIdSrc* and *msgIn.usnvecFrom* were not returned by the server in the final message of some other cycle.
5. The server implementation MAY<18> declare the supplied values of *msgIn.uuidInvocIdSrc* and *msgIn.usnvecFrom* as too stale to use.

If the server starts a new cycle based on items 4 or 5, the server ignores *msgIn.usnvecFrom*, treating it as though it were zero.

The fields *msgOut.usnvecTo* and *msgIn.usnvecFrom* have the same type, USN_VECTOR. The internal format of USN_VECTOR is determined entirely by the server implementation and is subject only to the requirement that *msgIn.usnvecFrom* = 0 represents the start of a cycle. The server MAY<19> use USN_VECTOR to encode the start of a cycle.

Any server response message with *msgOut.fMoreData* = false is the final response in a cycle.

4.1.10.1.2 Cycle Goal

For any cycle that is not an extended operation, the goal of the server is to send updates such that at the conclusion of the cycle, the client NC replica contains all updates that were present in the server NC replica at the start of the cycle. More concretely, if *cycleStartUtd* is the server's *msgIn.pNC^!replUpToDateVector* on receipt of the first request in a cycle where *msgIn.ulExtendedOp*

= 0, then the final response in the cycle MUST contain *msgOut.pUpToDateVecSrc* such that *HasUpdateKnowledge(msgOut.pUpToDateVecSrc^, cycleStartUtd) = true*:

```
procedure HasUpdateKnowledge(  
    utd1: UPTODATE_VECTOR_V2_EXT,  
    utd2: UPTODATE_VECTOR_V2_EXT): boolean  
begin  
    i: integer  
    j: integer  
  
    /* Return true if and only if utd1 asserts the presence of all  
    * updates asserted by utd2. */  
    for i := 0 to utd2.cNumCursors - 1  
        j := select one k from [0 .. utd1.cNumCursors - 1] where  
            utd1.rgCursors[k].uuidDsa = utd2.rgCursors[i].uuidDsa  
        if j = null or utd1.rgCursors[j].usnHighPropUpdate <  
            utd2.rgCursors[i].usnHighPropUpdate then  
            return false  
        endif  
    endfor  
  
    return true  
end HasUpdateKnowledge
```

The server MAY<20> advance the cycle goal on each request such that it includes updates that the server has applied since the first request in the cycle.

The cycle goal includes a cursor *c* for the server DC such that:

- *c.uuidDsa* is the value of the invocationId attribute of the server's nTDSDSA object.
- *c.usnHighPropUpdate* is the highest **USN** such that the server can assert that, including the updates in this response, the client has applied any update with stamp *s* where *s.uuidOriginating* = *c.uuidDsa* and *s.usnOriginating* ≤ *c.usnHighPropUpdate*. If the server has originated no updates in the NC, it MAY<21> set *c.usnHighPropUpdate* to 0.
- *c.timeLastSyncSuccess* is the time at which the server sends the final response.

4.1.10.1.3 Extended Operations

The extended operation specified by *msgIn.ulExtendedOp* is one of the following:

- Request Role (EXOP_FSMO_REQ_ROLE, EXOP_FSMO_REQ_PDC, EXOP_FSMO_RID_REQ_ROLE): Changes the FSMO role owner from the server to the client DC, and then adds all changed objects and **link values** in the FSMO role to the response, including but not limited to the FSMO role owner change.<22>
- Abandon Role (EXOP_FSMO_ABANDON_ROLE): Performs a chained request to the current FSMO role owner to make the server DC the FSMO role owner. This request is sent to help avoid entering a state in which no DC considers itself the owner of the role.<23>
- Allocate RIDs (EXOP_FSMO_REQ_RID_ALLOC): Allocates a new block of RIDs to the client DC.<24>
- Replicate Single Object (EXOP_REPL_OBJ): Adds any changes to the specified object to the response.<25>
- Replicate Single Object including Secret Data (EXOP_REPL_SECRETS): Adds any changes to the specified object to the response. In addition, it also adds the secret attribute values of the

specified object to the response, regardless of whether they have recent changes. See the IsSecretAttribute procedure in section 4.1.10.3.12 for a list of these attributes.<26>

4.1.10.2 Method-Specific Concrete Types

4.1.10.2.1 DRS_MSG_GETCHGREQ

The DRS_MSG_GETCHGREQ union defines request messages that are sent to the IDL_DRSSetNCChanges method. There are no V1, V2, V3, V6, or V9 messages.

```
typedef
[switch_type(DWORD)]
union {
    [case(4)]
        DRS_MSG_GETCHGREQ_V4 V4;
    [case(5)]
        DRS_MSG_GETCHGREQ_V5 V5;
    [case(7)]
        DRS_MSG_GETCHGREQ_V7 V7;
    [case(8)]
        DRS_MSG_GETCHGREQ_V8 V8;
    [case(10)]
        DRS_MSG_GETCHGREQ_V10 V10;
} DRS_MSG_GETCHGREQ;
```

V4: Version 4 request (Windows 2000 operating system SMTP replication [MS-SRPL]).

V5: Version 5 request (Windows 2000 RPC replication).

V7: Version 7 request (Windows Server 2003 SMTP replication [MS-SRPL]).

V8: Version 8 request (Windows Server 2003 RPC replication).

V10: Version 10 request (Windows Server 2008 R2 operating system RPC replication).

4.1.10.2.2 DRS_MSG_GETCHGREQ_V3

The DRS_MSG_GETCHGREQ_V3 structure defines a portion of the request message that is sent to the IDL_DRSSetNCChanges method as part of SMTP replication ([MS-SRPL]). This is not a complete request message; it is embedded in DRS_MSG_GETCHGREQ_V4 and DRS_MSG_GETCHGREQ_V7.<27>

```
typedef struct {
    UUID uuidDsaObjDest;
    UUID uuidInvocIdSrc;
    [ref] DSNAME* pNC;
    USN_VECTOR usnvecFrom;
    [unique] UPTODATE_VECTOR_V1_EXT* pUpToDateVecDestV1;
    [unique] PARTIAL_ATTR_VECTOR_V1_EXT* pPartialAttrVecDestV1;
    SCHEMA_PREFIX_TABLE PrefixTableDest;
    ULONG ulFlags;
    ULONG cMaxObjects;
    ULONG cMaxBytes;
    ULONG ulExtendedOp;
} DRS_MSG_GETCHGREQ_V3;
```

uuidDsaObjDest: DSA GUID of the client DC.

uuidInvocIdSrc: Invocation ID of the server DC.

pNC: NC root of the replica to replicate or the **FSMO role object** for an extended operation.

usnvecFrom: Data that is used to correlate calls to IDL_DRSGetNCChanges.

pUpToDateVecDestV1: Stamp filter describing updates that the client has already applied.

pPartialAttrVecDestV1: A set of one or more attributes whose values are to be replicated to the client's partial replica.

PrefixTableDest: **Prefix table** with which to convert the ATTRTYP values in pPartialAttrVecDestV1 to **OIDs-(2)-.**

ulFlags: A DRS_OPTIONS bit field.

cMaxObjects: An approximate cap on the number of objects to include in the reply.

cMaxBytes: An approximate cap on the number of bytes to include in the reply.

ulExtendedOp: 0 or an EXOP_REQ code (section 4.1.10.2.21).

4.1.10.2.3 DRS_MSG_GETCHGREQ_V4

The DRS_MSG_GETCHGREQ_V4 structure defines the request message sent to the IDL_DRSGetNCChanges method. This message version is a superset of DRS_MSG_GETCHGREQ_V3.<28>

```
typedef struct {
    UUID uuidTransportObj;
    [ref] MTX_ADDR* pmtxReturnAddress;
    DRS_MSG_GETCHGREQ_V3 V3;
} DRS_MSG_GETCHGREQ_V4;
```

uuidTransportObj: The objectGUID of the interSiteTransport object that identifies the transport by which to send the reply.

pmtxReturnAddress: The transport-specific address to which to send the reply.

V3: Version 3 request.

4.1.10.2.4 DRS_MSG_GETCHGREQ_V5

The DRS_MSG_GETCHGREQ_V5 structure defines the request message sent to the IDL_DRSGetNCChanges method.

```
typedef struct {
    UUID uuidDsaObjDest;
    UUID uuidInvocIdSrc;
    [ref] DSNAME* pNC;
    USN_VECTOR usnvecFrom;
    [unique] UPTODATE_VECTOR_V1_EXT* pUpToDateVecDestV1;
    ULONG ulFlags;
    ULONG cMaxObjects;
    ULONG cMaxBytes;
    ULONG ulExtendedOp;
    ULARGE_INTEGER liFsmoInfo;
} DRS_MSG_GETCHGREQ_V5;
```

uuidDsaObjDest: DSA GUID of the client DC.

uuidInvocIdSrc: Invocation ID of the server DC.

pNC: NC root of the replica to replicate or the FSMO role object for an extended operation.

usnvecFrom: Data used to correlate calls to IDL_DRSGetNCChanges.

pUpToDateVecDestV1: Stamp filter that describes updates the client has already applied.

ulFlags: DRS_OPTIONS bit field.

cMaxObjects: Approximate cap on the number of objects to include in the reply.

cMaxBytes: Approximate cap on the number of bytes to include in the reply.

ulExtendedOp: 0 or an extended operation request code (section 4.1.10.2.21).

liFsmoInfo: 0 or a value specific to the requested extended operation.

4.1.10.2.5 DRS_MSG_GETCHGREQ_V7

The DRS_MSG_GETCHGREQ_V7 structure defines the request message sent to the IDL_DRSGetNCChanges method. This message version is a superset of DRS_MSG_GETCHGREQ_V4.<29>

```
typedef struct {
    UUID uuidTransportObj;
    [ref] MTX_ADDR* pmtxReturnAddress;
    DRS_MSG_GETCHGREQ_V3 V3;
    [unique] PARTIAL_ATTR_VECTOR_V1_EXT* pPartialAttrSet;
    [unique] PARTIAL_ATTR_VECTOR_V1_EXT* pPartialAttrSetEx;
    SCHEMA_PREFIX_TABLE PrefixTableDest;
} DRS_MSG_GETCHGREQ_V7;
```

uuidTransportObj: The objectGUID of the interSiteTransport object that identifies the transport by which to send the reply.

pmtxReturnAddress: Transport-specific address to which to send the reply.

V3: Version 3 request.

pPartialAttrSet: A set of one or more attributes whose values are to be replicated to the client's partial replica, or null if the client has a full replica.

pPartialAttrSetEx: A set of one or more attributes whose values are to be added to the client's existing partial replica, or null.

PrefixTableDest: Prefix table with which to convert the ATTRTYP values in **pPartialAttrSet** and **pPartialAttrSetEx** to OIDs ~~(2)~~.

4.1.10.2.6 DRS_MSG_GETCHGREQ_V8

The DRS_MSG_GETCHGREQ_V8 structure defines the request message sent to the IDL_DRSGetNCChanges method. This message version is a superset of DRS_MSG_GETCHGREQ_V5.

```
typedef struct {
    UUID uuidDsaObjDest;
    UUID uuidInvocIdSrc;
    [ref] DSNAME* pNC;
    USN_VECTOR usnvecFrom;
    [unique] UPTODATE_VECTOR_V1_EXT* pUpToDateVecDest;
    ULONG ulFlags;
    ULONG cMaxObjects;
    ULONG cMaxBytes;
```

```

    ULONG ulExtendedOp;
    ULARGE_INTEGER liFsmoInfo;
    [unique] PARTIAL_ATTR_VECTOR_V1_EXT* pPartialAttrSet;
    [unique] PARTIAL_ATTR_VECTOR_V1_EXT* pPartialAttrSetEx;
    SCHEMA_PREFIX_TABLE PrefixTableDest;
} DRS_MSG_GETCHGREQ_V8;

```

uuidDsaObjDest: DSA GUID of the client DC.

uuidInvocIdSrc: Invocation ID of the server DC.

pNC: NC root of the replica to replicate or the FSMO role object for an extended operation.

usnvecFrom: Data used to correlate calls to IDL_DRSGetNCChanges.

pUpToDateVecDest: Stamp filter describing updates the client has already applied.

ulFlags: A DRS_OPTIONS bit field.

cMaxObjects: Approximate cap on the number of objects to include in the reply.

cMaxBytes: Approximate cap on the number of bytes to include in the reply.

ulExtendedOp: 0 or an extended operation request code (section 4.1.10.2.21).

liFsmoInfo: 0 or a value specific to the requested extended operation.

pPartialAttrSet: A set of one or more attributes whose values are to be replicated to the client's partial replica, or null if the client has a full replica.

pPartialAttrSetEx: A set of one or more attributes whose values are to be added to the client's existing partial replica, or null.

PrefixTableDest: Prefix table with which to convert the ATTRTYP values in **pPartialAttrSet** and **pPartialAttrSetEx** to OIDs ~~(2)~~.

4.1.10.2.7 DRS_MSG_GETCHGREQ_V10

The DRS_MSG_GETCHGREQ_V10 structure defines the request message sent to the IDL_DRSGetNCChanges method. This message version is a superset of DRS_MSG_GETCHGREQ_V8.

```

typedef struct {
    UUID uuidDsaObjDest;
    UUID uuidInvocIdSrc;
    [ref] DSNAME* pNC;
    USN_VECTOR usnvecFrom;
    [unique] UPTODATE_VECTOR_V1_EXT* pUpToDateVecDest;
    ULONG ulFlags;
    ULONG cMaxObjects;
    ULONG cMaxBytes;
    ULONG ulExtendedOp;
    ULARGE_INTEGER liFsmoInfo;
    [unique] PARTIAL_ATTR_VECTOR_V1_EXT* pPartialAttrSet;
    [unique] PARTIAL_ATTR_VECTOR_V1_EXT* pPartialAttrSetEx;
    SCHEMA_PREFIX_TABLE PrefixTableDest;
    ULONG ulMoreFlags;
} DRS_MSG_GETCHGREQ_V10;

```

uuidDsaObjDest: DSA GUID of the client DC.

uuidInvocIdSrc: Invocation ID of the server DC.

pNC: NC root of the replica to replicate or the FSMO role object for an extended operation.

usnvecFrom: Data used to correlate calls to IDL_DRSGetNCChanges.

pUpToDateVecDest: Stamp filter describing updates the client has already applied.

ulFlags: A DRS_OPTIONS bit field.

cMaxObjects: Approximate cap on the number of objects to include in the reply.

cMaxBytes: Approximate cap on the number of bytes to include in the reply.

ulExtendedOp: 0 or an extended operation request code (section 4.1.10.2.21).

liFsmoInfo: 0 or a value specific to the requested extended operation.

pPartialAttrSet: A set of one or more attributes whose values are to be replicated to the client's partial replica, or null if the client has a full replica.

pPartialAttrSetEx: A set of one or more attributes whose values are to be added to the client's existing partial replica, or null.

PrefixTableDest: Prefix table with which to convert the ATTRTYP values in **pPartialAttrSet** and **pPartialAttrSetEx** to OIDs ~~(2)~~.

ulMoreFlags: A DRS_MORE_GETCHGREQ_OPTIONS bit field.

4.1.10.2.8 DRS_MSG_GETCHGREPLY

~~Note: Some of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it in the Product Behavior appendix.~~

The DRS_MSG_GETCHGREPLY union defines the response messages received from the IDL_DRSGetNCChanges method. There are no V3, V4, V5, or V8 messages.

```
typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_GETCHGREPLY_V1 V1;
    [case(2)]
        DRS_MSG_GETCHGREPLY_V2 V2;
    [case(6)]
        DRS_MSG_GETCHGREPLY_V6 V6;
    [case(7)]
        DRS_MSG_GETCHGREPLY_V7 V7;
    [case(9)]
        DRS_MSG_GETCHGREPLY_V9 V9;
} DRS_MSG_GETCHGREPLY;
```

- V1:** Version 1 response (Windows 2000).
- V2:** Version 2 response (compressed V1).
- V6:** Version 6 response (Windows Server 2003).
- V7:** Version 7 response (compressed V6 or V9).
- V9:** Version 9 response (V6 with additional link-value metadata).

4.1.10.2.9 DRS_MSG_GETCHGREPLY_V1

The DRS_MSG_GETCHGREPLY_V1 structure defines the response message received from the IDL_DRSGetNCChanges method.

```
typedef struct {
    UUID uuidDsaObjSrc;
    UUID uuidInvocIdSrc;
    [unique] DSNAME* pNC;
    USN_VECTOR usnvecFrom;
    USN_VECTOR usnvecTo;
    [unique] UPTODATE_VECTOR_V1_EXT* pUpToDateVecSrcV1;
    SCHEMA_PREFIX_TABLE PrefixTableSrc;
    ULONG ulExtendedRet;
    ULONG cNumObjects;
    ULONG cNumBytes;
    [unique] REPLENTINFLIST* pObjects;
    BOOL fMoreData;
} DRS_MSG_GETCHGREPLY_V1;
```

uuidDsaObjSrc: DSA GUID of the server DC.

uuidInvocIdSrc: Invocation ID of the server DC.

pNC: The NC root of the replica to replicate or the FSMO role object for an extended operation.

usnvecFrom: Data used to correlate calls to IDL_DRSGetNCChanges.

usnvecTo: Data used to correlate calls to IDL_DRSGetNCChanges.

pUpToDateVecSrcV1: Stamp filter that describes updates the server has already applied.

PrefixTableSrc: Table for translating ATTRTYP values in the response to OIDs ~~(2)~~.

ulExtendedRet: 0 or an EXOP_ERR code (section 4.1.10.2.20).

cNumObjects: Count of items in the **pObjects** linked list.

cNumBytes: Size in bytes of items in or referenced by elements in the **pObjects** linked list.

pObjects: Linked list of object updates that the client applies to its NC replica.

fMoreData: False if and only if this is the last response in a replication cycle.

4.1.10.2.10 DRS_MSG_GETCHGREPLY_V2

The DRS_MSG_GETCHGREPLY_V2 structure defines the compressed DRS_MSG_GETCHGREPLY_V1 message received from the IDL_DRSGetNCChanges method.

```
typedef struct {
    DRS_COMPRESSED_BLOB CompressedV1;
} DRS_MSG_GETCHGREPLY_V2;
```

CompressedV1: Compressed DRS_MSG_GETCHGREPLY_V1 response.

4.1.10.2.11 DRS_MSG_GETCHGREPLY_V6

~~Note: Some of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior~~

notes that pertain to the preliminary product version contain specific references to it in the Product Behavior appendix.

The DRS_MSG_GETCHGREPLY_V6 structure defines the response message received from the IDL_DRSGetNCChanges method. This message version is a superset of DRS_MSG_GETCHGREPLY_V1.

```
typedef struct {
    UUID uuidDsaObjSrc;
    UUID uuidInvocIdSrc;
    [unique] DSNAME* pNC;
    USN_VECTOR usnvecFrom;
    USN_VECTOR usnvecTo;
    [unique] UPTODATE_VECTOR_V2_EXT* pUpToDateVecSrc;
    SCHEMA_PREFIX_TABLE PrefixTableSrc;
    ULONG ulExtendedRet;
    ULONG cNumObjects;
    ULONG cNumBytes;
    [unique] REPLENTINFLIST* pObjects;
    BOOL fMoreData;
    ULONG cNumNcSizeObjects;
    ULONG cNumNcSizeValues;
    [range(0,1048576)] DWORD cNumValues;
    [size_is(cNumValues)] REPLVALINF_V1* rgValues;
    DWORD dwDRSError;
} DRS_MSG_GETCHGREPLY_V6;
```

uuidDsaObjSrc: DSA GUID of the server DC.

uuidInvocIdSrc: Invocation ID of the server DC.

pNC: The NC root of the replica to replicate or the FSMO role object for an extended operation.

usnvecFrom: Data used to correlate calls to IDL_DRSGetNCChanges.

usnvecTo: Data used to correlate calls to IDL_DRSGetNCChanges.

pUpToDateVecSrc: Stamp filter that describes updates the server has already applied.

PrefixTableSrc: Table for translating ATTRTYP values in the response to OIDs ~~(2)~~.

ulExtendedRet: 0 or an extended operation error code (section 4.1.10.2.20).

cNumObjects: Count of items in the **pObjects** linked list.

cNumBytes: Size in bytes of items in or referenced by elements in the **pObjects** linked list.

pObjects: Linked list of object updates that the client applies to its NC replica.

fMoreData: False if and only if this is the last response in a replication cycle.

cNumNcSizeObjects: Estimated number of objects in the server's NC replica.

cNumNcSizeValues: Estimated number of link values in the server's NC replica.

cNumValues: Count of items in the **rgValues** array.

rgValues: Link value updates for the client to apply to its NC replica.

dwDRSError: 0 if successful, otherwise a Windows error code.

4.1.10.2.12 DRS_MSG_GETCHGREPLY_V7

~~Note: Some of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it in the Product Behavior appendix.~~

The **DRS_MSG_GETCHGREPLY_V7** structure defines a compressed **DRS_MSG_GETCHGREPLY_V6** or **DRS_MSG_GETCHGREPLY_V9** message received from the **IDL_DRSSetNCChanges** method.

```
typedef struct {
    DWORD dwCompressedVersion;
    DRS_COMP_ALG_TYPE CompressionAlg;
    DRS_COMPRESSED_BLOB CompressedAny;
} DRS_MSG_GETCHGREPLY_V7;
```

dwCompressedVersion: Version of the response in **CompressedAny**; MUST be set to 6 or 9.

CompressionAlg: Algorithm used to compress the response.

CompressedAny: Compressed **DRS_MSG_GETCHGREPLY_V6** or **DRS_MSG_GETCHGREPLY_V9** response.

4.1.10.2.13 DRS_MSG_GETCHGREPLY_V9

~~Note: All of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it as an aid to the reader.~~

The **DRS_MSG_GETCHGREPLY_V9** structure defines the response message received from the **IDL_DRSSetNCChanges** method. This message version contains all the same elements as a **DRS_MSG_GETCHGREPLY_V6** structure except that the data type of **rgValues** is changed from **REPLVALINF_V1*** to **REPLVALINF_V3***. The data in a **REPLVALINF_V3** structure is a superset of the data in a **REPLVALINF_V1** structure. Therefore, the data in the **DRS_MSG_GETCHGREPLY_V9** structure is a superset of the data in the **DRS_MSG_GETCHGREPLY_V6** structure.

```
typedef struct {
    UUID uuidDsaObjSrc;
    UUID uuidInvocIdSrc;
    [unique] DSNAME* pNC;
    USN_VECTOR usnvecFrom;
    USN_VECTOR usnvecTo;
    [unique] UPTODATE_VECTOR_V2_EXT* pUpToDateVecSrc;
    SCHEMA_PREFIX_TABLE PrefixTableSrc;
    ULONG ulExtendedRet;
    ULONG cNumObjects;
    ULONG cNumBytes;
    [unique] REPLENTINFLIST* pObjects;
    BOOL fMoreData;
    ULONG cNumNcSizeObjects;
    ULONG cNumNcSizeValues;
    [range(0,1048576)] DWORD cNumValues;
    [size_is(cNumValues)] REPLVALINF_V3* rgValues;
    DWORD dwDRSError;
} DRS_MSG_GETCHGREPLY_V9;
```

uuidDsaObjSrc: DSA GUID of the server DC.

uuidInvocIdSrc: Invocation ID of the server DC.

pNC: The NC root of the replica to replicate or the FSMO role object for an extended operation.

usnvecFrom: Data used to correlate calls to IDL_DRSGetNCChanges.

usnvecTo: Data used to correlate calls to IDL_DRSGetNCChanges.

pUpToDateVecSrc: Stamp filter that describes updates the server has already applied.

PrefixTableSrc: Table for translating ATTRTYP values in the response to OIDs ~~(2)~~.

ulExtendedRet: 0 or an extended operation error code (section 4.1.10.2.20).

cNumObjects: Count of items in the **pObjects** linked list.

cNumBytes: Size in bytes of items in or referenced by elements in the **pObjects** linked list.

pObjects: Linked list of object updates that the client applies to its NC replica.

fMoreData: False if and only if this is the last response in a replication cycle.

cNumNcSizeObjects: Estimated number of objects in the server's NC replica.

cNumNcSizeValues: Estimated number of link values in the server's NC replica.

cNumValues: Count of items in the **rgValues** array.

rgValues: Link value updates for the client to apply to its NC replica.

dwDRSError: 0 if successful, otherwise a Windows error code.

4.1.10.2.14 DRS_MSG_GETCHGREPLY_NATIVE

~~Note: All of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it as an aid to the reader.~~

The **DRS_MSG_GETCHGREPLY_NATIVE** structure is an alias for the **DRS_MSG_GETCHGREPLY_V9** data structure.

4.1.10.2.15 DRS_MSG_GETCHGREPLY_NATIVE_VERSION_NUMBER

~~Note: All of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it as an aid to the reader.~~

DRS_MSG_GETCHGREPLY_NATIVE_VERSION_NUMBER is a constant. Its value is 9, and it indicates the message version aliased by **DRS_MSG_GETCHGREPLY_NATIVE**.

4.1.10.2.16 COMPRESSED_DATA

The COMPRESSED_DATA structure defines a sequence of compressed (if **cbDecompressedSize** \neq **cbCompressedSize**) or uncompressed (if **cbDecompressedSize** = **cbCompressedSize**) bytes.

```
typedef struct {
    ULONG cbDecompressedSize;
    ULONG cbCompressedSize;
    BYTE data[];
} COMPRESSED_DATA;
```

cbDecompressedSize: Decompressed size of data.

cbCompressedSize: Compressed size of data.

data: Data stream. The data is padded with zeros, if necessary, so that the block ends on a double word boundary.

4.1.10.2.17 DRS_COMP_ALG_TYPE

The DRS_COMP_ALG_TYPE enumeration is a concrete type for identifying a compression algorithm.

```
typedef enum
{
    DRS_COMP_ALG_NONE = 0,
    DRS_COMP_ALG_UNUSED = 1,
    DRS_COMP_ALG_MSZIP = 2,
    DRS_COMP_ALG_WIN2K3 = 3
} DRS_COMP_ALG_TYPE;
```

DRS_COMP_ALG_NONE: No compression.

DRS_COMP_ALG_UNUSED: Unused. MUST not be used.

DRS_COMP_ALG_MSZIP: MSZIP algorithm.

DRS_COMP_ALG_WIN2K3: Windows Server 2003 compression.

4.1.10.2.18 DRS_COMPRESSED_BLOB

The DRS_COMPRESSED_BLOB structure defines a concrete type that results from marshaling a data structure into a byte stream by using RPC and compressing that byte stream.

```
typedef struct {
    DWORD cbUncompressedSize;
    DWORD cbCompressedSize;
    [size_is(cbCompressedSize)] BYTE* pbCompressedData;
} DRS_COMPRESSED_BLOB;
```

cbUncompressedSize: Size in bytes of the uncompressed byte stream.

cbCompressedSize: Size in bytes of the **pbCompressedData** array.<30>

pbCompressedData: Compressed byte stream.

Padding: Data is padded with zeros, if necessary, so that the block ends on an alignment boundary of LONG.

4.1.10.2.19 ENCRYPTED_PAYLOAD

The ENCRYPTED_PAYLOAD packet is the concrete type for a value of an encrypted attribute.

```
typedef struct {
    UCHAR Salt[16];
    ULONG CheckSum;
    UCHAR EncryptedData[];
} ENCRYPTED_PAYLOAD;
```

0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Salt (16 bytes)																															
...																															
...																															
Checksum																															
EncryptedData (variable)																															
...																															

Salt (16 bytes): A 128-bit randomly generated value.

Checksum (4 bytes): A 32-bit **CRC32 checksum** of the data that is encrypted along with the data.

EncryptedData (variable): A variable-length byte array that represents the encrypted value.

4.1.10.2.20 EXOP_ERR Codes

The following values are error codes for an extended operation request to the IDL_DRSGetNCChanges method.

- EXOP_ERR_SUCCESS** (0x00000001)
- EXOP_ERR_UNKNOWN_OP** (0x00000002)
- EXOP_ERR_FSMO_NOT_OWNER** (0x00000003)
- EXOP_ERR_UPDATE_ERR** (0x00000004)
- EXOP_ERR_EXCEPTION** (0x00000005)
- EXOP_ERR_UNKNOWN_CALLER** (0x00000006)
- EXOP_ERR_RID_ALLOC** (0x00000007)
- EXOP_ERR_FSMO_OWNER_DELETED** (0x00000008)
- EXOP_ERR_FSMO_PENDING_OP** (0x00000009)
- EXOP_ERR_MISMATCH** (0x0000000A)
- EXOP_ERR_COULDNT_CONTACT** (0x0000000B)
- EXOP_ERR_FSMO_REFUSING_ROLES** (0x0000000C)
- EXOP_ERR_DIR_ERROR** (0x0000000D)
- EXOP_ERR_FSMO_MISSING_SETTINGS** (0x0000000E)
- EXOP_ERR_ACCESS_DENIED** (0x0000000F)
- EXOP_ERR_PARAM_ERROR** (0x00000010)

4.1.10.2.21 EXOP_REQ Codes

The following values are request codes for extended operation.

EXOP_FSMO_REQ_ROLE (0x00000001)

EXOP_FSMO_REQ_RID_ALLOC (0x00000002)

EXOP_FSMO_RID_REQ_ROLE (0x00000003)

EXOP_FSMO_REQ_PDC (0x00000004)

EXOP_FSMO_ABANDON_ROLE (0x00000005)

EXOP_REPL_OBJ (0x00000006)

EXOP_REPL_SECRETS (0x00000007)

4.1.10.2.22 PROPERTY_META_DATA

The PROPERTY_META_DATA structure contains attribute and stamp information. For more details, see section 4.1.10.5.9.

The binary portion of the DNBinary value of the msDS-RevealedUsers attribute contains this structure.

```
typedef struct PROPERTY_META_DATA {
    ATTRTYP attrType;
    PROPERTY_META_DATA_EXT propMetadataExt;
} PROPERTY_META_DATA;
```

attrType: Attribute whose value was revealed.

propMetadataExt: Stamp of revealed attribute value.

4.1.10.3 Method-Specific Abstract Types and Procedures

4.1.10.3.1 AbstractLinkValStampFromConcreteLinkValStamp

~~Note: Some of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it in the Product Behavior appendix.~~

```
procedure AbstractLinkValStampFromConcreteLinkValStamp(
    concreteStamp: VALUE_META_DATA_EXT_NATIVE) : LinkValueStamp
```

Informative summary of behavior: The AbstractLinkValStampFromConcreteLinkValStamp procedure converts a **VALUE_META_DATA_EXT_NATIVE** concrete type to a LinkValueStamp.

```
linkValueStamp : LinkValueStamp

linkValueStamp := concreteStamp.MetaData
linkValueStamp.timeCreated := concreteStamp.timeCreated
linkValueStamp.timeExpired := concreteStamp.timeExpired

return linkValueStamp
```


4.1.10.3.2 AbstractPASFromConcretePAS

```
procedure AbstractPASFromConcretePAS(  
    concretePAS: PARTIAL_ATTR_VECTOR_V1_EXT,  
    prefixTable: PrefixTable): sequence of ATTRTYP
```

Informative summary of behavior: The AbstractPASFromConcretePAS procedure translates a concrete PARTIAL_ATTR_VECTOR_V1_EXT to a sequence of ATTRTYP, using *prefixTable* to translate the *concretePAS* entries.

```
abstractPAS: sequence of ATTRTYP  
i: DWORD  
  
for i := 0 to (concretePAS.cAttrs - 1)  
    abstractPAS[i] := LocalAttidFromRemoteAttid(  
        prefixTable, concretePAS.rgPartialAttr[i])  
endfor  
return abstractPAS
```

4.1.10.3.3 AbstractUTDFromConcreteUTD

```
procedure AbstractUTDFromConcreteUTD(  
    concreteUTD: UPTODATE_VECTOR_V2_EXT): sequence of ReplUpToDateVector
```

Informative summary of behavior: The AbstractUTDFromConcreteUTD procedure translates the UPTODATE_VECTOR_V2_EXT structure to the ReplUpToDateVector abstract type.

```
abstractUTD: ReplUpToDateVector  
  
for i := 0 to (concreteUTD.length - 1)  
    abstractUTD[i].uuidDsa := concreteUTD.rgCursors[i].uuidDsa  
    abstractUTD[i].usnHighPropUpdate :=  
        concreteUTD.rgCursors[i].usnHighPropUpdate  
    abstractUTD[i].timeLastSyncSuccess :=  
        concreteUTD.rgCursors[i].timeLastSyncSuccess  
endfor  
  
return concreteUTD
```

4.1.10.3.4 AttributeAndStamp

```
type AttributeAndStamp = [attribute: ATTRTYP, stamp: AttributeStamp]
```

This abstract type encapsulates the ATTRTYP of an attribute (based on *dc.prefixTable*) and its associated AttributeStamp on an object.

4.1.10.3.5 AttributeStampCompare

```
procedure AttributeStampCompare(  
    stamp1: AttributeStamp,  
    stamp2: AttributeStamp): integer
```

Informative summary of behavior: The AttributeStampCompare procedure compares two AttributeStamp values, *stamp1* and *stamp2*. If *stamp1* is greater than *stamp2*, the procedure returns an integer with a value greater than 0. If *stamp1* is equal to *stamp2*, the procedure returns 0. If

stamp1 is less than *stamp2*, then the procedure returns an integer value less than 0. Refer to section 5.11 for details on the comparison of AttributeStamps.

4.1.10.3.6 ConcretePASFromAbstractPAS

```
procedure ConcretePASFromAbstractPAS(  
  abstractPAS: sequence of ATTRTYP) : PARTIAL_ATTR_VECTOR_V1_EXT
```

Informative summary of behavior: The ConcretePASFromAbstractPAS procedure translates a sequence of ATTRTYP to PARTIAL_ATTR_VECTOR_V1_EXT. This translation does not require a prefix table.

```
concretePAS : PARTIAL_ATTR_VECTOR_V1_EXT  
i: DWORD  
  
concretePAS.dwVersion := 1  
concretePAS.dwReserved1 := 0  
concretePAS.cAttrs := abstractPAS.length  
for i := 0 to (abstractPAS.length - 1)  
  concretePAS.rgPartialAttr[i] := abstractPAS[i]  
endfor  
return concretePAS
```

4.1.10.3.7 ConcreteUTDFromAbstractUTD

```
procedure ConcreteUTDFromAbstractUTD(  
  abstractUTD: sequence of ReplUpToDateVector) :  
  UPTODATE_VECTOR_V1_EXT
```

Informative summary of behavior: The ConcreteUTDFromAbstractUTD procedure translates a sequence of abstract ReplUpToDateVector tuples to UPTODATE_VECTOR_V1_EXT.

```
concreteUTD: UPTODATE_VECTOR_V1_EXT  
  
concreteUTD.dwVersion := 1  
concreteUTD.dwReserved1 := 0  
concreteUTD.dwReserved2 := 0  
concreteUTD.cNumCursors := abstractUTD.length  
  
for i := 0 to (abstractUTD.length - 1)  
  concreteUTD.rgCursors[i].uuidDsa := abstractUTD[i].uuidDsa  
  concreteUTD.rgCursors[i].usnHighPropUpdate :=  
    abstractUTD[i].usnHighPropUpdate  
endfor  
  
return concreteUTD
```

4.1.10.3.8 GetNCChangesNativeReply

~~Note: Some of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it in the Product Behavior appendix.~~

```
procedure GetNCChangesNativeReply(  
  replyMessage: DRS_MSG_GETCHGREPLY,  
  version: DWORD) : DRS_MSG_GETCHGREPLY_NATIVE
```

Informative summary of behavior: The GetNCChangesNativeReply procedure transforms a DRS_MSG_GETCHGREPLY of version 1, 6, or 9 to a DRS_MSG_GETCHGREPLY_NATIVE structure. DRS_MSG_GETCHGREPLY_NATIVE is a superset of the data in **DRS_MSG_GETCHGREPLY_V1**, **DRS_MSG_GETCHGREPLY_V6**, and **DRS_MSG_GETCHGREPLY_V9**.

```

msgReplyNative: DRS_MSG_GETCHGREPLY_NATIVE
i: DWORD

if (version = 1) then
    msgReplyNative := 0
    msgReplyNative := replyMessage.V1

    msgReplyNative.pUpToDateVecSrc^.dwVersion := 2
    msgReplyNative.pUpToDateVecSrc^.cNumCursors :=
        replyMessage.V1.pUpToDateVecSrcV1^.cNumCursors
    for i := 0 to (replyMessage.V1.pUpToDateVecSrcV1^.cNumCursors - 1)
        msgReplyNative.pUpToDateVecSrc^.rgCursors[i] :=
            replyMessage.V1.pUpToDateVecSrcV1^.rgCursors[i]
        msgReplyNative.pUpToDateVecSrc^.rgCursors[i].timeLastSyncSuccess := 0
    endfor
else if (version = 6) then
    msgReplyNative := 0
    msgReplyNative := replyMessage.V6
    msgReplyNative.rgValues :=
        ReplValInfNativeListFromReplValInfV1List(replyMessage.V6.rgValues)
else
    msgReplyNative = replyMessage.V9
endif

return msgReplyNative

```

4.1.10.3.9 GetStampsForUpdate

```

procedure GetStampsForUpdate(
    replEntinfList: REPLENTINFLIST,
    prefixTable: PrefixTable): set of AttributeAndStamp

```

Informative summary of behavior: The GetStampsForUpdate procedure retrieves the AttributeStamp associated with an attribute in the REPLENTINFLIST update and constructs a set of AttributeAndStamp tuples.

```

tupleEntry: AttributeAndStamp
attrStamps: set of AttributeStamp
i: DWORD

for i := 0 to (replEntinfList.pMetaDataExt.cNumProps - 1)
    tupleEntry.attribute := LocalAttidFromRemoteAttid(
        prefixTable, replEntinfList.Entinf.AttrBlock.pAttr[i].attrTyp)
    tupleEntry.stamp := AbstractAttrStampFromConcereteAttrStamp(
        replEntinfList.pMetaDataExt.rgMetaData[i])
    attrStamps := attrStamps + {tupleEntry}
endfor
return attrStamps

```

4.1.10.3.10 GetWellKnownObject

```

procedure GetWellKnownObject(
    nc: DSName,

```

```
guid: GUID): DSName
```

Informative summary of behavior: The `GetWellKnownObject` procedure returns the `DSName` of the well-known object with the given `guid` in a specified NC replica.

```
attrVals: set of attribute value
attrVal: DNBinary

attrVals := {nc!wellKnownObjects}
for each attrVal in attrVals do
  if (attrVal.binary = guid) then
    return attrVal.dn
  endif
endfor

return null
```

4.1.10.3.11 IsProtectedObject

```
procedure IsProtectedObject(obj: DSName): boolean
```

The `IsProtectedObject` procedure returns true if *obj* is the `nTDSDSA` object of the DC or an ancestor of the `nTDSDSA` object of the DC. Otherwise, the procedure returns false.

4.1.10.3.12 IsSecretAttribute

```
procedure IsSecretAttribute(attribute : ATTRTYP): boolean
```

The `IsSecretAttribute` procedure returns true if *attribute* is an attribute that contains **secret data**. Otherwise, the procedure returns false.

```
return (attribute in
{currentValue, dBCSPwd, initialAuthIncoming, initialAuthOutgoing,
lmPwdHistory, ntPwdHistory, priorValue, supplementalCredentials,
trustAuthIncoming, trustAuthOutgoing, unicodePwd} )
```

4.1.10.3.13 IsUserIncluded

```
procedure IsUserIncluded(
  userSid: SID
  groupOrAccountSid: SID)
```

The `IsUserIncluded` procedure returns true if *userSid* = *groupOrAccountSid*, or if the object identified by *userSid* is a member of the set returned by `IDL_DRSGetMemberships` (section 4.1.8) with the `GroupMembersTransitive` option applied to the object identified by *groupOrAccountSid*.

4.1.10.3.14 ObjAtts

```
type ObjAtts = [obj: DSName, atts: sequence of ATTRTYP]
```

The ObjAtts abstract type encapsulates the identity of an object (*obj*) and a sequence of ATTRTYP values (*atts*, based on *dc.prefixTable*) for attributes of that object.

4.1.10.3.15 ObjAttVal

```
type ObjAttVal = [obj: DSName; att: ATTRTYP, val: attribute value]
```

The ObjAttVal abstract type encapsulates the identity of an object (*obj*), the ATTRTYP of an attribute of that object (*att*, based on *dc.prefixTable*), and a value of that attribute (*val*).

4.1.10.3.16 PerformModifyDNOperation

```
procedure PerformModifyDNOperation(  
    currentDN: DN,  
    newParentObject: DSName,  
    newRDN: RDN)
```

The PerformModifyDNOperation procedure performs a Modify DN operation on an object with the DN **currentDN** by setting its new parent to **newParentObject** and by setting its new RDN value to **newRDN**. See [MS-ADTS] section 3.1.1.5.4 for more details.

4.1.10.3.17 RemoveAttrVal

```
procedure RemoveAttrVal(  
    obj: DSName,  
    attr: ATTRTYP,  
    attributeValue: attribute value)
```

The RemoveAttrVal procedure removes the value *attributeValue* from the attribute *attr* on the object with DSName *obj*.

4.1.10.3.18 SetAttrStamp

```
procedure SetAttrStamp(  
    obj: DSName,  
    attr: ATTRTYP,  
    stamp: AttributeStamp)
```

The SetAttrStamp procedure sets the AttributeStamp for the attribute *attr* on the object *obj* to *stamp*.

4.1.10.3.19 SetAttrVal

```
procedure SetAttrVal(  
    obj: DSName,  
    attr: ATTRTYP,  
    attributeValue: attribute value)
```

The SetAttrVal procedure sets the value *attributeValue* for the attribute *attr* on the object *obj*.

4.1.10.3.20 SetLinkStamp

```
procedure SetLinkStamp(  
    obj: DSName,  
    attr: ATTRTYP,  
    val: attribute value,  
    stamp: AttributeStamp)
```

The SetLinkStamp procedure sets the LinkValueStamp for the attribute value *val* on the attribute *attr* on the object *obj* to *stamp*.

4.1.10.4 Client Behavior When Sending the IDL_DRSGetNCChanges Request

Informative summary of behavior: The following three tasks can be accomplished by sending an IDL_DRSGetNCChanges request to a server:

1. Replicate objects from the server's NC replica. The ReplicateNCRequestMsg procedure specifies the process of building DRS_MSG_GETCHGREQ to perform this task.
2. Replicate a single object from the server's NC replica. The ReplSingleObjRequestMsg procedure specifies the process of building DRS_MSG_GETCHGREQ to perform this task.
3. Perform extended operations. The PerformExtendedOpRequestMsg procedure specifies the process of building DRS_MSG_GETCHGREQ to perform this task.

After the DC constructs the request message, it sends the message by using the specified transport: SMTP (as specified in [MS-SRPL]) if *rf* ≠ null and if *rf.uuidTransport* is the objectGUID of the interSiteTransport object *t*, where *t!cn* = "SMTP"; otherwise, the IP transport (RPC over TCP).

4.1.10.4.1 ReplicateNCRequestMsg

```
procedure ReplicateNCRequestMsg(  
    hDrs: DRS_HANDLE,  
    version: DWORD,  
    nc: DSName,  
    rf: RepsFrom,  
    ulFlags: ULONG,  
    ulMoreFlags: ULONG,  
    cMaxObjects: ULONG,  
    cMaxBytes: ULONG,  
    var msgRequest: DRS_MSG_GETCHGREQ)
```

Informative summary of behavior: The client sends an IDL_DRSGetNCChanges request to a server to replicate the server's changes in an NC replica. The ReplicateNCRequestMsg procedure specifies how the client constructs the request message for this operation.

The procedure has the following arguments:

- *hDrs*: The DRS_HANDLE that is derived by sending an IDL_DRSBind message to the server.
- *version*: The version number of the input message negotiated between the client and server.
- *nc*: The DSName of the root of the NC replica that is to be replicated.
- *rf*: The RepsFrom that corresponds to the server from which to replicate.
- *ulFlags*: Zero or more of the following bit flags. The client MUST supply the same flags for each request in a given replication cycle, with the exception of DRS_ADD_REF, DRS_GET_ANC, DRS_USE_COMPRESSION, and DRS_GET_NC_SIZE.
 - **DRS_ADD_REF**: Requests that the server add an entry to the repsTo attribute for the client on the root object of the NC replica that is being replicated.
 - **DRS_WRIT_REP**: Indicates that the client contains (or is constructing) a full, **writable NC replica**.
 - **DRS_ASYNC_REP**: Requests that the server send only the root object of the NC replica.

- **DRS_CRITICAL_ONLY**: Signals the server not to send objects *o* where *o*!isCriticalSystemObject is absent or *o*!isCriticalSystemObject is false.
- **DRS_GET_ANC**: Signals the server to send all updates for each **ancestor object** of object *o* before sending updates for object *o*.
- **DRS_GET_NC_SIZE**: Signals the server to set *cNumNcSizeObjects* in *pmsgOut* to an estimate of the number of objects in its NC replica.
- **DRS_FULL_SYNC_PACKET**: Requests that the server send all attributes of the objects in its reply, rather than sending only the updated attributes.
- **DRS_SYNC_FORCED**: Signals the server to honor the request even if its replication has otherwise been disabled.
- **DRS_USE_COMPRESSION**: Requests that the server reply by using one of the compressed reply versions (DRS_MSG_GETCHGREPLY_V2 or DRS_MSG_GETCHGREPLY_V7).
- **DRS_SYNC_PAS**: Indicates replication of additional attributes to the partial replica already present on the client.
- **DRS_SPECIAL_SECRET_PROCESSING**: Requests that the server not ship attribute values of attributes that contain secret data. Servers prior to Windows Server 2008 operating system ignore this flag.
- **DRS_GET_ALL_GROUP_MEMBERSHIP**: Requests that the server ship all group membership. If this flag is not specified, the server ships only universal group membership. Servers prior to Windows Server 2008 ignore this flag.
- **DRS_REF_GCSPN**: Requests that the server add an entry to *repsTo* for the client on the root object of the NC replica that is being replicated. When *repsTo* is set using this flag, the notifying client DC contacts the server DC using the service principal name that begins with "GC" (section 2.2.3.2).
- *ulMoreFlags*: Zero or more of the following bit flags. The client MUST supply the same flags for each request in a given replication cycle, with the exception of DRS_GET_TGT.
 - **DRS_GET_TGT**: Signals the server to send all updates for the **target object** of a link value update before sending the link value update.
- *cMaxObjects*: Recommended limit on the number of objects to include in the reply.
- *cMaxBytes*: Recommended limit on the number of bytes to include in the reply.
- *msgRequest*: The procedure populates corresponding fields in this structure depending on the value that is passed in the *version* parameter.

```

msgIn: DRS_MSG_GETCHGREQ_V10
msgRequest: DRS_MSG_GETCHGREQ
prefixEntry: PrefixTableEntry
partialAttrSetSeq: sequence of DSName
schemaSignature: sequence of BYTE
ncType: ULONG

/* NTDSDSA_OPT_DISABLE_INBOUND_REPL defined in
 * [MS-ADTS] section 6.1.1.2.2.1.2.1.1, "nTDSDSA Object"*/
if NTDSDSA_OPT_DISABLE_INBOUND_REPL in DSAObj()!options and
    not DRS_SYNC_FORCED in ulFlags then
    return ERROR_DS_DRA_SINK_DISABLED
endif

    if IsAddds() and ServerExtensions(hDrs).ConfigObjGUID ≠ NULLGUID and
        ServerExtensions(hDrs).ConfigObjGUID ≠ ConfigNC().GUID then

```

```

        return ERROR_DS_DIFFERENT_REPL_EPOCHS;
    endif

msgIn.ulMoreFlags := ulMoreFlags
msgIn.cMaxObjects := cMaxObjects
msgIn.cMaxBytes := cMaxBytes
msgIn.ulExtendedOp := 0
msgIn.uuidDsaObjDest := dc.serverGuid
msgIn.pNC := ADR(nc)
msgIn.liFsmoInfo := 0

if (ObjExists(nc)) then
    msgIn.pUpToDateVecDest :=
        ConcreteUTDFromAbstractUTD(nc!replUpToDateVector)
else
    msgIn.pUpToDateVecDest := null
endif

/* Fill usnvecFrom and uuidInvocIdSrc fields.
 * usnvecFrom: This field contains the value of the usnVec field in
 * RepsFrom tuple corresponding to the IDL_DRSGetNCChanges server
 * DC, or zeros if no such repsFrom is present.
 * uuidInvocIdSrc: If the usnvecFrom field is not zeros, this field
 * MUST contain the uuidInvocId from the same tuple from which the
 * usnVec field was retrieved. Otherwise, this field contains
 * zeros.*/

if (rf = null) then
    msgIn.usnvecFrom := 0
    msgIn.uuidInvocIdSrc := 0
else
    msgIn.usnvecFrom := rf.usnVec
    msgIn.uuidInvocIdSrc := rf.uuidInvocId
endif

if AmIRODC() then
    if DRS_WRIT_REP in ulFlags then
        return ERROR_DS_DRA_INVALID_PARAMETER
    endif
    ext := ServerExtensions(hDrs)
    if not DRS_EXT_LH_BETA2 in ext.dwFlags and
        msgIn.pNC^ = SchemaNC() then
        ulFlags := ulFlags + {DRS_WRIT_REP}
    endif
endif
ncType = GetNCType(nc)
if not NCT_GC_PARTIAL in ncType then
    ulFlags := ulFlags + {DRS_GET_ALL_GROUP_MEMBERSHIP}
endif
msgIn.ulFlags := ulFlags

if (DRS_WRIT_REP in ulFlags) or
    (not DRS_SYNC_PAS in ulFlags) then
    msgIn.pPartialAttrSetEx := null
else
    msgIn.pPartialAttrSetEx := ConcretePASFromAbstractPAS(rf.pasData)
endif

/* set msgIn.pPartialAttrSet field */
if ObjExists(nc) and nc!partialAttributeSet # null then
    msgIn.pPartialAttrSet := ConcretePASFromAbstractPAS(
        nc!partialAttributeSet)
else
    if (NCT_GC_PARTIAL in ncType and
        NCT_FILTERED_ATTRIBUTE_SET in ncType) then
        msgIn.pPartialAttrSet := FilteredGCPAS()
    else if NCT_FILTERED_ATTRIBUTE_SET in ncType then
        msgIn.pPartialAttrSet := FilteredPAS()
    else if NCT_GC_PARTIAL in ncType then
        msgIn.pPartialAttrSet := GCPAS()
    endif
endif

```



```

else
    msgIn.pPartialAttrSet := null
endif
endif

msgIn.PrefixTableDest = ConcretePTFromAbstractPT(dc.prefixTable)

/* Add schema signature to msgIn.PrefixTableDest */
schemaSignature := SchemaNC(!schemaInfo
prefixEntry.ndx := 0
prefixEntry.prefix.length := schemaSignature.length
prefixEntry.prefix.element := elements of schemaSignature
Append prefixEntry to msgIn.PrefixTableDest.pPrefixEntry
msgIn.PrefixTableDest.PrefixCount :=
    msgIn.PrefixTableDest.PrefixCount + 1

if version = 5 then
    msgRequest.V5 := msgIn
    msgRequest.V5.pUpToDateVecDestV1 := msgIn.pUpToDateVecDest
else if version = 8 then
    msgRequest.V8 := msgIn
else
    msgRequest.V10 := msgIn
endif

```

4.1.10.4.2 ReplSingleObjRequestMsg

```

procedure ReplSingleObjRequestMsg(
    hDrs: DRS_HANDLE,
    version: DWORD,
    nc: DSName,
    object: DSName,
    rf: ReplsFrom,
    ulFlags: ULONG,
    ulMoreFlags: ULONG,
    cMaxObjects: ULONG,
    cMaxBytes: ULONG,
    fWithSecrets: boolean,
    var msgRequest: DRS_MSG_GETCHGREQ): DWORD

```

Informative summary of behavior: The client can send an IDL_DRSGetNCChanges request to the server to replicate changes from a single object. The ReplSingleObjRequestMsg procedure specifies how the request message is constructed for this operation. The arguments for this method are the same as those for the procedure ReplicateNCRequestMsg, with the following exceptions:

- *object*: The DSName of the object that should be replicated.
- *fWithSecrets*: The object's secret attributes should be replicated. Only RODCs need to make, and can make, this request.

The procedure returns a Windows error code if it cannot construct *msgRequest*.

```

msgRequest: DRS_MSG_GETCHGREQ
msgIn: DRS_MSG_GETCHGREQ_V10
ncType: ULONG

/* An NC replica with root of DSName nc shouldmust already exist on the
client */
if (not PartialGCReplicaExists(nc) and
not FullReplicaExists(nc)) then
    return ERROR_DS_DRA_BAD_NC
endif

/* Only RODCs are allowed to request secrets explicitly */
if fWithSecrets and not AmIRODC() then

```

```

    return ERROR_INVALID_PARAMETER
endif

if fWithSecrets then
    msgIn.ulExtendedOp := EXOP_REPL_SECRETS
else
    msgIn.ulExtendedOp := EXOP_REPL_OBJ
endif

if AmIRODC() then
    if DRS_WRIT_REP in ulFlags then
        return ERROR_INVALID_PARAMETER
    endif
    ext := ServerExtensions(hDrs)
    if not DRS_EXT_LH_BETA2 in ext.dwFlags and
        msgIn.pNC^ = SchemaNC() then
        ulFlags := ulFlags + {DRS_WRIT_REP}
    endif
endif

ncType = GetNCType(nc)
if not NCT_GC_PARTIAL in ncType then
    ulFlags := ulFlags + {DRS_GET_ALL_GROUP_MEMBERSHIP}
endif

msgIn.ulFlags := ulFlags
msgIn.ulMoreFlags := ulMoreFlags
msgIn.cMaxObjects := cMaxObjects
msgIn.cMaxBytes := cMaxBytes
msgIn.uuidDsaObjDest := dc.serverGuid
msgIn.pNC := ADR(object)
msgIn.liFsmoInfo := 0
msgIn.pUpToDateVecDest :=
    ConcreteUTDFromAbstractUTD(nc!replUpToDateVector)
msgIn.pPartialAttrSetEx := null

/* set msgIn.pPartialAttrSet field */
if ObjExists(nc) and nc!partialAttributeSet ≠ null then
    msgIn.pPartialAttrSet := ConcretePASFromAbstractPAS(
        nc!partialAttributeSet)
else
    if (NCT_GC_PARTIAL in ncType and
        NCT_FILTERED_ATTRIBUTE_SET in ncType) then
        msgIn.pPartialAttrSet := FilteredGCPAS()
    else if NCT_FILTERED_ATTRIBUTE_SET in ncType then
        msgIn.pPartialAttrSet := FilteredPAS()
    else if NCT_GC_PARTIAL in ncType then
        msgIn.pPartialAttrSet := GCPAS()
    else
        msgIn.pPartialAttrSet := null
    endif
endif

msgIn.PrefixTableDest = ConcretePTFromAbstractPT(dc.prefixTable)

/* Fill usnvecFrom and uuidInvocIdSrc fields.
 * usnvecFrom: This field contains the value of the usnVec field in
 * RepsFrom tuple corresponding to the IDL_DRSGetNCChanges server
 * DC, or zeros if no such repsFrom is present.
 * uuidInvocIdSrc: If the usnvecFrom field is not zeros, this field
 * MUST contain the uuidInvocId from the same tuple from which the
 * usnVec field was retrieved. Otherwise, this field contains
 * zeros.*/

if (rf = null) then
    msgIn.usnvecFrom := 0
    msgIn.uuidInvocIdSrc := 0
else
    msgIn.usnvecFrom := rf.usnVec
    msgIn.uuidInvocIdSrc := rf.uuidInvocId

```

```

endif

if version = 5 then
    msgRequest.V5 := msgIn
    msgRequest.V5.pUpToDateVecDestV1 := msgIn.pUpToDateVecDest
else if version = 8 then
    msgRequest.V8 := msgIn
else
    msgRequest.V10 := msgIn
endif

return 0

```

4.1.10.4.3 PerformExtendedOpRequestMsg

```

procedure PerformExtendedOpRequestMsg (
    hDrs: DRS_HANDLE,
    version: DWORD,
    nc: DSName,
    roleOwnerObject: DSName,
    rf: ReplsFrom,
    ulFlags: ULONG,
    ulMoreFlags: ULONG,
    ulExtendedOp: ULONG,
    cMaxObjects: ULONG,
    cMaxBytes: ULONG,
    var msgRequest: DRS_MSG_GETCHGREQ): DWORD

```

Informative summary of behavior: A client sends an IDL_DRSGetNCChanges request to a server to perform an extended operation. The procedure PerformExtendedOpRequestMsg specifies how the request message is constructed for this operation.

The arguments for this method are the same as those for the procedure ReplicateNCRequestMsg, with the following exceptions:

- *ulExtendedOp*: The requested extended operation. The client MUST supply the same value of this field for each request in a given replication cycle. The possible values are:
 - EXOP_FSMO_REQ_ROLE, for a FSMO role owner transfer.
 - EXOP_FSMO_REQ_RID_ALLOC, for a RID allocation from the RID Master FSMO role owner.
 - EXOP_FSMO_RID_REQ_ROLE, for transfer of the RID Master FSMO role.
 - EXOP_FSMO_REQ_PDC, for transfer of the PDC FSMO role.
 - EXOP_FSMO_ABANDON_ROLE, to request the server to request an extended operation role transfer from the client.
- *roleOwnerObject*: The client sets this value based on the value of *ulExtendedOp*, as per the following table:

ulExtendedOp	roleOwnerObject
EXOP_FSMO_REQ_ROLE	The DSName of the FSMO role object.
EXOP_FSMO_REQ_RID_ALLOC	The value of the rIDManagerReference attribute of DefaultNC().
EXOP_FSMO_RID_REQ_ROLE	The value of the rIDManagerReference attribute of DefaultNC().
EXOP_FSMO_REQ_PDC	DefaultNC().

ulExtendedOp	roleOwnerObject
EXOP_FSMO_ABANDON_ROLE	The DSName of the FSMO role object.

The procedure returns a Windows error code if it not able to construct *msgRequest*.

```

msgIn: DRS_MSG_GETCHGREQ_V10
serverObj: DSName
computerObj: DSName
ridSetReferences: DSName

/* An NC replica with root nc must already exist on the client */
if (not MasterReplicaExists(nc)) then
    return ERROR_DS_DRA_BAD_NC
endif

msgIn.ulFlags := ulFlags
msgIn.ulMoreFlags := ulMoreFlags
msgIn.cMaxObjects := cMaxObjects
msgIn.cMaxBytes := cMaxBytes
msgIn.ulExtendedOp := ulExtendedOp
msgIn.uuidDsaObjDest := dc.serverGuid
msgIn.pNC := ADR(roleOwnerObject)
msgIn.pUpToDateVecDest :=
    ConcreteFromAbstractUTD(nc!replUpToDateVector)
msgIn.pPartialAttrSetEx := null
msgIn.pPartialAttrSet := null
msgIn.PrefixTableDest := 0

if (ulExtendedOp = EXOP_FSMO_REQ_RID_ALLOC) then
    serverObj := DSAObj()!parent
    computerObj := serverObject!serverReference
    ridSetReferences := computerObj!ridSetReferences
    if ((not ridSetReferences = null)
        and (ridSetReferences!isDeleted = false)
        and (not ridSetReferences!rIDNextRid = null)
        and (not ridSetReferences!rIDNextRid = 0)
        and (not ridSetReferences!rIDAllocationPool = null)) then
        msgIn.liFsmoInfo := ridSetReferences!rIDAllocationPool
    else
        msgIn.liFsmoInfo := 0
    endif
else
    msgIn.liFsmoInfo := 0
endif

/* Fill usnvecFrom and uuidInvocIdSrc fields.
 * usnvecFrom: This field contains the value of the usnVec field in
 * ReplsFrom tuple corresponding to the IDL_DRSGetNCChanges server
 * DC, or zeros if no such replsFrom is present.
 * uuidInvocIdSrc: If the usnvecFrom field is not zeros, this field
 * MUST contain the uuidInvocId from the same tuple from which the
 * usnVec field was retrieved. Otherwise, this field contains
 * zeros.*/

if (rf = null) then
    msgIn.usnvecFrom := 0
    msgIn.uuidInvocIdSrc := 0
else
    msgIn.usnvecFrom := rf.usnVec
    msgIn.uuidInvocIdSrc := rf.uuidInvocId
endif

if version = 5 then
    msgRequest.V5 := msgIn
    msgRequest.V5.pUpToDateVecDestV1 := msgIn.pUpToDateVecDest
else if version = 8 then
    msgRequest.V8 := msgIn

```

```

else
    msgRequest.V10 := msgIn
endif

return 0

```

4.1.10.5 Server Behavior of the IDL_DRSGetNCChanges Method

~~Note: Some of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it in the Product Behavior appendix.~~

Informative summary of behavior: The IDL_DRSGetNCChanges method returns a response for a single request in a cycle.

This method is invoked through the drsuapi RPC interface. It is also invoked as a local procedure for requests that are received using the SMTP transport ([MS-SRPL]).

```

ULONG
IDL_DRSGetNCChanges(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
        DRS_MSG_GETCHGREQ *pmsgIn,
    [out, ref] DWORD *pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DRS_MSG_GETCHGREPLY *pmsgOut)

err: ULONG
msgIn: DRS_MSG_GETCHGREQ_V10
ncRoot: DSName
obj: DSName
msgOut: DRS_MSG_GETCHGREPLY_NATIVE
schemaSignature: sequence of BYTE
prefixEntry: PrefixTableEntry
responseSmtpAddress: unicodestring
fullReplicaFlags: set of integer
fullReplicaRequest : boolean

ValidateDRSInput(hDrs, 3)

pdwOutVersion^ := 1
pmsgOut^ := 0

err := TransformInput(hDrs, dwInVersion, pmsgIn^, msgIn,
    pdwOutVersion, responseSmtpAddress)
if err # 0 then
    return err
endif

/* Perform access checks. */
if msgIn.pNC = null then
    return ERROR_DS_DRA_INVALID_PARAMETER
endif
ncRoot := GetObjectNC(msgIn.pNC^)

if ncRoot = null then
    return ERROR_DS_CANT_FIND_EXPECTED_NC
endif

if IsGetNCChangesPermissionGranted(msgIn) == FALSE then
    return ERROR_DRA_ACCESS_DENIED
endif

```

```

/* Validate inputs. */
obj := msgIn.pNC^
if AmILHServer() = false then
    /* Downlevel OS does not understand
       DRS_SPECIAL_SECRET_PROCESSING flags. They just ignore it.
    */
    msgIn.ulFlags := msgIn.ulFlags - {DRS_SPECIAL_SECRET_PROCESSING}
endif

if msgIn.ulExtendedOp = 0 then
    /* Validate normal replication request. */
    if not FullReplicaExists(obj) and not PartialGCReplicaExists(obj)
        then
            return ERROR_DS_CANT_FIND_EXPECTED_NC
        endif
    else
        /* Validate extended operation request. */
        if not ObjExists(obj) then
            return ERROR_DS_CANT_FIND_EXPECTED_NC
        endif
    endif
endif

if AmILHServer() then
    if (msgIn.pPartialAttrSet = null and
        msgIn.pPartialAttrSetEx = null) then
        fullReplicaRequest := true
    else
        fullReplicaRequest := false
    endif
else
    if (DRS_WRITE_REP in msgIn.ulFlags) then
        fullReplicaRequest := true
    else
        fullReplicaRequest := false
    endif
endif

if (fullReplicaRequest) then
    /* Validate Full Replica request. */
    if not IT_WRITE in obj!instanceType then
        return ERROR_DRA_SOURCE_IS_PARTIAL
    endif
    if DRS_SYNC_PAS in msgIn.ulFlags then
        return ERROR_INVALID_PARAMETER
    endif
else
    /* Validate Partial Replica request. */
    if msgIn.pPartialAttrSet = null
        or msgIn.pPartialAttrSet.cAttrs = 0 then
        return ERROR_INVALID_PARAMETER
    endif
    if DRS_SYNC_PAS in msgIn.ulFlags and
        (msgIn.pPartialAttrSetEx = null
         or msgIn.pPartialAttrSetEx.cAttrs = 0) then
        return ERROR_INVALID_PARAMETER
    endif
    if msgIn.PrefixTableDest.PrefixCount = 0 then
        return ERROR_INVALID_PARAMETER
    endif
endif

if IT_NC_GOING in ncRoot!instanceType
    /* NC replica is no longer accepting requests. */
    return ERROR_DRA_NO_REPLICA
endif

if msgIn.uuidInvocIdSrc ≠ DSAObj()!invocationId then
    msgIn.usnvecFrom := 0
endif

```

```

/* Construct response. */
if msgIn.ulExtendedOp = 0 then
    /* Perform normal replication. */
    err := GetReplChanges(hDrs, null, null, msgIn, msgOut)
else
    /* Perform extended operation. Errors are returned in
    * msgOut.ulExtendedErr. */
    ProcessFsmoRoleRequest(hDrs, msgIn, msgOut)
    err := 0
endif
if err = 0 then
    msgOut.pNC := msgIn.pNC
    msgOut.usnvecFrom := msgIn.usnvecFrom
    msgOut.uuidDsaObjSrc := dc.serverGuid
    msgOut.PrefixTableSrc := ConcretePTFromAbstractPT(dc.prefixTable)
    msgOut.uuidInvocIdSrc := DSAObj()!invocationId

    /* Sort msgOut.rgValues into ascending order. */
    SortResponseLinks(msgOut)

    /* Add schema signature to msgOut.PrefixTableSrc. */
    schemaSignature := SchemaNC()!schemaInfo
    prefixEntry.ndx := 0
    prefixEntry.prefix.length := schemaSignature.length
    prefixEntry.prefix.element := elements of schemaSignature
    Append prefixEntry to msgOut.PrefixTableSrc.pPrefixEntry
    msgOut.PrefixTableSrc.PrefixCount :=
        msgOut.PrefixTableSrc.PrefixCount+1

    err := TransformOutput(msgOut, msgIn.ulFlags, pdwOutVersion^,
        pmsgOut)
endif

if responseSmtpAddress ≠ null then
    Send the response using using the SMTP transport to
    responseSmtpAddress
endif

return err

```

4.1.10.5.1 TransformInput

~~Note: Some of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it in the Product Behavior appendix.~~

```

procedure TransformInput(
    hDrs: DRS_HANDLE,
    requestVersion: DWORD,
    requestUnion: DRS_MSG_GETCHGREQ,
    var nativeRequest: DRS_MSG_GETCHGREQ_V10,
    pdwOutVersion: ADDRESS OF DWORD,
    var responseSmtpAddress: unicodestring): ULONG

```

Informative summary of behavior: The TransformInput procedure transforms the received request message into a V10 request, which is a superset of the supported request messages.

```

optionalFeatures: sequence of msDS-OptionalFeature objects /* [MS-ADSC] */
extClient: DRS_EXTENSIONS_INT
extServer: DRS_EXTENSIONS_INT
optionalFeatureBit: integer

```

```

extClient := ClientExtensions(hDrs)
responseSmtpAddress := null

if requestVersion < dc.minimumGetChangesRequestVersion
    return ERROR_REVISION_MISMATCH

if requestVersion = 10
    /* Windows Server 2008 R2 RPC request. */
    nativeRequest := requestUnion.V10
    if DRS_EXT_GETCHGREPLY_V9 in extClient.dwFlags then
        pdwOutVersion^ = 9
    else if DRS_EXT_GETCHGREPLY_V6 in extClient.dwFlags then
        pdwOutVersion^ = 6
    else
        return ERROR_REVISION_MISMATCH
    endif

else if requestVersion = 8
    /* Windows Server 2003 RPC request. */
    nativeRequest := requestUnion.V8
    nativeRequest.ulMoreFlags := 0
    if not DRS_EXT_GETCHGREPLY_V6 in extClient.dwFlags then
        return ERROR_REVISION_MISMATCH
    else
        pdwOutVersion^ := 6
    endif

else if requestVersion = 7 then
    /* Windows Server 2003 SMTP request. */
    responseSmtpAddress := requestUnion.V7.pmtxReturnAddress^.mtx_name
    nativeRequest := requestUnion.V7.V3
    nativeRequest.pUpToDateVecDest :=
        requestUnion.V7.V3.pUpToDateVecDestV1
    nativeRequest.pPartialAttrSet := requestUnion.V7.pPartialAttrSet
    nativeRequest.pPartialAttrSetEx :=
        requestUnion.V7.pPartialAttrSetEx
    nativeRequest.PrefixTableDest := requestUnion.V7.PrefixTableDest
    nativeRequest.ulMoreFlags := 0
    if not DRS_EXT_GETCHGREPLY_V6 in extClient.dwFlags then
        return ERROR_REVISION_MISMATCH
    else
        pdwOutVersion^ := 6
    endif

else if requestVersion = 5 then
    /* Windows 2000 RPC request. */
    nativeRequest := requestUnion.V5
    nativeRequest.pUpToDateVecDest :=
        requestUnion.V5.pUpToDateVecDestV1
    nativeRequest.pPartialAttrSetEx := null
    nativeRequest.PrefixTableDest :=
        ConcretePTFromAbstractPT(dc.prefixTable)
    nativeRequest.ulMoreFlags := 0
    if ({DRS_WRIT_REP} ∩ requestUnion.V5.ulFlags) = null then
        nativeRequest.pPartialAttrSet := GCPAS()
    endif
    pdwOutVersion^ := 1

else if requestVersion = 4 then
    /* Windows 2000 SMTP request. */
    responseSmtpAddress := requestUnion.V4.pmtxReturnAddress^.mtx_name
    nativeRequest := requestUnion.V4.V3
    nativeRequest.pUpToDateVecDest :=
        requestUnion.V4.V3.pUpToDateVecDestV1
    if ({DRS_WRIT_REP} ∩ requestUnion.V4.V3.ulFlags) = null then
        nativeRequest.pPartialAttrSet := GCPAS()
    endif
    nativeRequest.pPartialAttrSetEx := null
    nativeRequest.ulMoreFlags := 0

```



```

    pdwOutVersion^ := 1
else
    /* Unsupported request. */
    return ERROR_REVISION_MISMATCH
endif

if ({DRS_WRIT_REP} ∩ nativeRequest.ulFlags) ≠ null then
    nativeRequest.ulFlags :=
        nativeRequest.ulFlags + {DRS_GET_ALL_GROUP_MEMBERSHIP}
endif

if (responseSntpAddress = null) ≠ (not DRS_MAIL_REP in
    nativeRequest.ulFlags) then
    return ERROR_INVALID_PARAMETER
endif

extServer := ServerExtensions(hDrs)
optionalFeatures := list of msDS-OptionalFeature objects from the
    Optional Features container /* [MS-ADTS] section 6.1.1.2.4.1.3 */

foreach feature in optionalFeatures
    if (GetOptionalFeatureBit(feature!msDS-OptionalFeatureGUID, optionalFeatureBit))
        if (optionalFeatureBit in extServer.dwFlagsEx) and
            optionalFeatureBit not in extClient.dwExtCaps then
            /* Feature is enabled on the server but the client
                is not capable of supporting it */
            return ERROR_REVISION_MISMATCH
        endif
    endif
endif
/* NOTE: The behavior of the server is undefined if */
/* procedure GetOptionalFeatureBit() returns false. */
endfor
return 0

```

4.1.10.5.2 GetReplChanges

~~Note: Some of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it in the Product Behavior appendix.~~

```

procedure GetReplChanges(
    hDrs: DRS_HANDLE,
    searchFilter: LDAPString,
    dirSyncFlags: ULONG,
    msgIn: DRS_MSG_GETCHGREQ_V10,
    var msgOut: DRS_MSG_GETCHGREPLY_NATIVE): ULONG

```

Informative summary of behavior: The GetReplChanges procedure processes an LDAP Search request with LDAP_SERVER_DIRSYNC_OID control or a normal replication request; that is, an IDL_DRSGetNCChanges request that is not a FSMO role request. It adds changed objects and link values to the response, subject to the scope (*msgIn.pNC^*, *msgIn.ulFlags*), filter criteria (*msgIn.pUpToDateVecDest*, *msgIn.ulFlags*, *msgIn.pPartialAttrSet*, *msgIn.pPartialAttrSetEx*, *searchFilter*, *dirSyncFlags*), response limits (*msgIn.cMaxObjects*, *msgIn.cMaxBytes*), and the previous server cookie (*msgIn.usnvecFrom*) in the request. It returns 0 if successful, otherwise a Windows error code.

```

err: ULONG
ncRoot: DSName
pUtd: ADDRESS OF UPTODATE_VECTOR_V1_EXT
scope: set of DSName
attribute: ATTRTYP
partialAttrs: set of ATTRTYP

```

```

partialAttrsEx: set of ATTRTYP
changedObjs: set of ObjAtts
changedLinks: set of ObjAttVal
responseObjs: set of ObjAtts
responseLinks: set of ObjAttVal
anc: ObjAtts
clientDSA : DSName
updRefs: DRS_MSG_UPDREFS_V1 /* See IDL_DRSUpdateRefs structures. */
tgt: DSName

if AmIRODC() then
    return ERROR_DS_DRA_SOURCE_DISABLED
endif

/* check whether outbound replication is disabled */
/* NTDSDSA_OPT_DISABLE_OUTBOUND_REPL defined in
 * [MS-ADTS] section 6.1.1.2.2.1.2.1.1, "nTDSDSA Object" */

if NTDSDSA_OPT_DISABLE_OUTBOUND_REPL in DSAObj(!)options and
    not DRS_SYNC_FORCED in msgIn.ulFlags and
    not dirSyncFlags then
    return ERROR_DS_DRA_SOURCE_DISABLED
endif
ncRoot := GetObjectNC(msgIn.pNC^)

/* Determine stamp filter to apply to the response. */
if DRS_FULL_SYNC_PACKET in msgIn.ulFlags then
    pUtd := null
else
    pUtd := msgIn.pUpToDateVecDest
endif

/* Determine attribute filters to apply to the response. */
if msgIn.pPartialAttrSet = null
    partialAttrs := null
else
    partialAttrs := {}
    foreach id in msgIn.pPartialAttrSet
        attribute := LocalAttidFromRemoteAttid(msgIn.PrefixTableDest, id)
        if (not IT_WRITE in ncRoot!instanceType) and
            (not attribute in ncRoot!partialAttributeSet) then
            return ERROR_DS_DRA_INCOMPATIBLE_PARTIAL_SET
        endif
        partialAttrs := partialAttrs + { attribute }
    endfor
endif
if msgIn.pPartialAttrSetEx = null
    partialAttrsEx := null
else
    partialAttrsEx := {}
    foreach id in msgIn.pPartialAttrSetEx
        attribute := LocalAttidFromRemoteAttid(msgIn.PrefixTableDest, id)
        if (not IT_WRITE in ncRoot!instanceType) and
            (not attribute in ncRoot!partialAttributeSet) then
            return ERROR_DS_DRA_INCOMPATIBLE_PARTIAL_SET
        endif
        partialAttrsEx := partialAttrsEx + { attribute }
    endfor
endif

/* Get nTDSDSA of the client */
clientDSA := select one o from ConfigNC() where
    o!objectGUID = msgIn.uuidDsaObjDest

/* Get the set of all objects that are in scope. */
scope := GetReplScope(msgIn, searchFilter)

/* Get object and link value changes in scope. */
GetChangesInScope(scope, pUtd, msgIn.ulExtendedOp, partialAttrs,
    partialAttrsEx, dirSyncFlags, changedObjs, changedLinks)

```

```

/* Choose subsets of changedObjs and changedLinks to include in this
 * response. Set usnvecTo and fMoreData in out to indicate the
 * subset to return in the next response, if any. */
GetResponseSubset(msgIn, changedObjs, changedLinks, msgOut,
responseObjs, responseLinks)

/* Add responseObjs to response. */
foreach o in responseObjs
  if DRS_GET_ANC in msgIn.ulFlags then
    /* Ancestors predicate: insert any changes to parent before any
     * changes to child. */
    foreach n in Ancestors of o.obj, most distant ancestor first
      anc := select one a from changedObjs where a.obj = n
      if anc ≠ null then
        err := AddObjToResponse(
          hDrs, anc, ncRoot, msgIn.ulFlags, 0, clientDSA, msgOut)
        if err ≠ 0 then
          return err
        endif
      endif
    endfor
  endif
  err := AddObjToResponse(
    hDrs, o, ncRoot, msgIn.ulFlags, 0, clientDSA, msgOut)
  if err ≠ 0 then
    return err
  endif
endfor

/* Add responseLinks to response. */
foreach v in responseLinks
  if DRS_GET_ANC in msgIn.ulFlags then
    /* Ancestors predicate: insert any changes to object before any
     * changes to its link values. */
    anc := select one a from changedObjs where a.obj = v.obj
    if anc ≠ null then
      err := AddObjToResponse(hDrs, anc, ncRoot,
        msgIn.ulFlags, 0, clientDSA, msgOut)
      if err ≠ 0 then
        return err
      endif
    endif
  endif
  if DRS_GET_TGT in msgIn.ulMoreFlags then
    /* Target predicate: insert any changes to the target object
     * before any changes to the link value. */
    tgt := GetDSNameFromAttrVal(v.att, v.val)
    if DRS_GET_ANC in msgIn.ulFlags then
      /* Ancestors predicate: insert any changes to the ancestors of
       * the target before any changes to the target. */
      foreach n in Ancestors of tgt, most distant ancestor first
        anc := select one a from changedObjs where a.obj = n
        if anc ≠ null then
          err := AddObjToResponse(hDrs, anc, ncRoot,
            msgIn.ulFlags, 0, clientDSA, msgOut)
          if err ≠ 0 then
            return err
          endif
        endif
      endfor
    endif
    err := AddObjToResponse(hDrs, tgt, ncRoot,
      msgIn.ulFlags, 0, clientDSA, msgOut)
    if err ≠ 0 then
      return err
    endif
  endif
  AddLinkToResponse(v, msgIn, msgOut)
endfor

```

```

if not msgOut.fMoreData
  msgOut.pUpToDateVecSrc := The cycle goal, as specified in
  section 4.1.10.1.2.
endif

if DRS_GET_NC_SIZE in msgIn.ulFlags then
  msgOut.cNumNcSizeObjects := Approximate number of objects in
  NC replica msgIn.pNC^
  msgOut.cNumNcSizeValues := Approximate number of link values
  with stamps in NC replica msgIn.pNC^
endif

if (DRS_ADD_REF in msgIn.ulFlags and msgIn.uuidDsaObjDest # NULLGUID) then
  /* Client has requested the server to add a repsTo entry. */
  updRefs.uuidDsaDes := msgIn.uuidDsaObjDest
  updRefs.pNC := msgIn.pNC^
  updRefs.pszDsaDest := NetworkAddress of DC corresponding to
  msgIn.uuidDsaObjDest
  updRefs.ulOptions := {DRS_ADD_REF, DRS_ASYNC_OP,
  DRS_GETCHG_CHECK} +
  { msgIn.ulFlags ∩ {DRS_WRIT_REP, DRS_REF_GCSPN}}

  /* Using updRefs, perform repsTo add to the specified NC replica,
  * the result value is a Windows error code or 0.
  err := UpdateRefs(updRefs^.V1)
  if(err # 0) then
    return err
  endif
endif

return 0

```

4.1.10.5.3 GetReplScope

```

procedure GetReplScope(
  msgIn: DRS_MSG_GETCHGREQ_V10,
  searchFilter: LDAPString): set of DSName

```

Informative summary of behavior: The GetReplScope procedure returns the set of objects considered for normal replication or for an LDAP Search request with LDAP_SERVER_DIRSYNC_OID control: the objects in the requested NC replica (*msgIn.pNC^*) or a subset thereof, as indicated by the request flags (*msgIn.ulFlags*) and the search filter (*searchFilter*). If the DRS_ASYNC_REP request flag is specified, the subset includes only the NC root. If the DRS_CRITICAL_ONLY request flag is specified, the subset includes only those objects with isCriticalSystemObject = true and their ancestors.

```

scope: set of DSName
ncRoot: DSName
anc: DSName

ncRoot := GetObjectNC(msgIn.pNC^)

if DRS_ASYNC_REP in msgIn.ulFlags then
  if (ObjectMatchesSearchFilter(ncRoot, searchFilter) = true) then
    scope := {ncRoot}
  endif
else if DRS_CRITICAL_ONLY in msgIn.ulFlags then
  scope := select all o from subtree-ts-included ncRoot where
  o!isCriticalSystemObject = true
  foreach o in scope
    foreach anc in Ancestors of o
      if not anc in scope then
        if (ObjectMatchesSearchFilter(anc, searchFilter) = true) then
          scope := scope + {anc}
        endif
      endif
    endforeach
  endforeach
endif

```

```

        endif
    endif
endfor
else
    scope := select all o from subtree-ts-included ncRoot where true
    foreach o in ncRoot!subRefs
        if (ObjectMatchesSearchFilter(o, searchFilter) = true) then
            scope := scope + {o}
        endif
    endfor
endif
return scope

```

4.1.10.5.4 ObjectMatchesSearchFilter

```

procedure ObjectMatchesSearchFilter (
    o: DSNAME,
    searchFilter: LDAPString) : boolean

```

This procedure returns true if the search filter (*searchFilter*) is null. If the search filter is not null, it returns true if the object whose DSNAME is "o" matches the search filter; otherwise it returns false. See [MS-ADTS] for search filter processing, specifically section 3.1.1.3.1.3.1, Search Filters.

4.1.10.5.5 GetChangesInScope

```

procedure GetChangesInScope(
    scope: set of DSName,
    pUtd: ADDRESS OF UPTODATE_VECTOR_V1_EXT,
    ulExtendedOp: DWORD,
    partialAttrs: set of ATTRTYP,
    partialAttrsEx: set of ATTRTYP,
    dirSyncFlags: ULONG,
    var changedObjs: set of ObjAtts,
    var changedLinks: set of ObjAttVal)

```

Informative summary of behavior: The GetChangesInScope procedure inspects the objects in *scope* and returns the object and link value updates that ~~must beare~~ sent to the client over the course of the replication cycle or as a result of processing LDAP Search request with LDAP_SERVER_DIRSYNC_OID control, as determined by the up-to-date vector (*pUtd*), the extended operation (*ulExtendedOp*), flags (*dirSyncFlags*) associated with the LDAP_SERVER_DIRSYNC_OID control, and the partial replica attribute filters (*partialAttrs* and *partialAttrsEx*).

```

o: DSName
a: ATTRTYP
attrsFound: set of ATTRTYP
attrsReq: set of ATTRTYP
stamp: AttributeStamp
cursor: UPTODATE_CURSOR_V2

/* Get the set of objects in scope with attribute stamps that the
 * client did not have knowledge of at the beginning of this
 * cycle. */
changedObjs := {}
foreach o in scope
    attrsFound := {}
    attrsReq := {}
    foreach a of o's object class
        stamp := AttrStamp(o, a)
        if stamp # null and
            ((ulExtendedOp = EXOP_REPL_SECRETS and IsSecretAttribute(a))
            or not FilterAttribute(o, a, stamp, pUtd,

```

```

        partialAttrs, partialAttrsEx, dirSyncFlags)) then
        attrsFound := attrsFound + {a}
    endif
    if(a = instanceType or a = proxiedObjectName) then
        attrsReq := attrsReq + {a}
    endif
endfor
if attrsFound ≠ {} then
    changedObjs := changedObjs + [obj: o, atts: attrsFound + attrsReq]
else if (IT_NC_HEAD in o!instanceType and pUtd ≠ null)
    stamp := AttrStamp(o, uSNChanged)
    cursor := select one c from pUtd^.rgCursors where c.uuidDsa =
        stamp.uuidOriginating
    if cursor = null or cursor.usnHighPropUpdate < stamp.usnOriginating
    then
        changedObjs := changedObjs + [obj: o, atts: attrsFound + attrsReq]
    endif
endif
endif
endfor

/* Get the set of link values in scope with stamps that the client
 * did not have knowledge of at the beginning of this cycle. */
if (GetForestFunctionalLevel() ≥ 1 or dc.fLinkValueStampEnabled = true) then
    changedLinks := {}
    foreach o in scope
        foreach a in Link Attributes of o's object class
            foreach v in GetAttVals(o, a, true)
                stamp := LinkStamp(o, a, v)
                /* If v was last updated in win2k forest mode
                 * then it does not have LinkValueStamp associated with it.
                 * LinkStamp() returns null in that case and this value will
                 * not be added to changedLinks.
                 */
                if stamp ≠ null
                    and not FilterAttribute(o, a, stamp, pUtd,
                        partialAttrs, partialAttrsEx, dirSyncFlags) then
                        changedLinks := changedLinks + [obj: o, att: a, val: v]
                    endif
                endif
            endfor
        endfor
    endfor
endif
endfor
endif

```

4.1.10.5.6 FilterAttribute

```

procedure FilterAttribute(
    o: DSName,
    attribute: ATTRTYP,
    s: AttributeStamp,
    pUtd: ADDRESS OF UPTODATE_VECTOR_V1_EXT,
    partialAttrs: set of ATTRTYP,
    partialAttrsEx: set of ATTRTYP,
    dirSyncFlags: ULONG): boolean

```

Informative summary of behavior: The FilterAttribute procedure determines whether an update (attribute or link value) that is in scope should be filtered out of the set of changes to send in the replication cycle. The rules are as follows:

- If the client's up-to-date vector *pUtd* asserts that the client has already applied the update with stamps, the update is filtered out, provided that *attribute* is not in the *partialAttrsEx* set. The elements of *partialAttrsEx* are not subject to filtering by the up-to-date vector.
- If *partialAttrs* is not null (indicating the client has a partial replica) and *attribute* is not in *partialAttrs* + *partialAttrsEx*, then the update is filtered out.

- If *partialAttrs* is not null, *attribute* is member, *o* is of class group, and *o* is not a universal group, then the update is filtered out.
- If *attribute* is the naming attribute (that is, cn for **objects of class** container, as shown below) for the object class of *o*, the update is filtered out.
- If LDAP_DIRSYNC_OBJECT_SECURITY is in *dirSyncFlags*, and the client does not have access rights to read the object, all the updates are filtered out except updates to the isDeleted and isRecycled attributes.

```

filtered: boolean
cursor: UPTODATE_CURSOR_V2

filtered := false

if pUtd ≠ null and partialAttrsEx ≠ null
    and not attribute in partialAttrsEx then
    /* Filter updates with stamps that the client's up-to-date vector
    * asserts the client has already applied to its NC replica.
    */
    cursor := select one c from pUtd^.rgCursors where c.uuidDsa =
        s.uuidOriginating
    if cursor ≠ null and cursor.usnHighPropUpdate ≥ s.usnOriginating
        then
        filtered := true
    endif
endif

if not filtered and partialAttrs ≠ null then
    /* Filter updates to attributes that are not in the client's
    * partial replica.
    */
    if not attribute in partialAttrs + partialAttrsEx then
        filtered := true
    endif
endif

if not filtered and partialAttrs ≠ null and attribute = member then
    /* Filter updates to the member attribute from the client's
    * partial replica if the group is not a universal group.
    */
    if group in o!objectClass and
        not GROUP_TYPE_UNIVERSAL_GROUP in o!groupType then
        filtered := true
    endif
endif

if not filtered then
    /* Filter updates to the naming attribute of o. */
    if attribute = o!rdnType then
        filtered := true
    endif
endif

if not filtered then
    /* Filter non replicated attributes of o. */
    if AttrIsNonReplicated(attribute) then
        filtered := true
    endif
endif

if not filtered then
    /* If LDAP_DIRSYNC_OBJECT_SECURITY in dirSyncFlags, and the client does
    not have access rights to read the object, all the updates are filtered
    out except updates to isDeleted and isRecycled attributes. */

    if LDAP_DIRSYNC_OBJECT_SECURITY in dirSyncFlags and
        (AccessCheckObject(o, RIGHT_DS_LIST_OBJECT) = false or

```

```

        AccessCheckObject(o.parent, RIGHT_DS_LIST_CONTENTS) = false) and
        attribute # isDeleted and
        attribute # isRecycled then
            filtered := true
        endif
    endif
    return filtered

```

4.1.10.5.7 GetResponseSubset

~~Note: Some of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it in the Product Behavior appendix.~~

```

procedure GetResponseSubset(
    msgIn: DRS_MSG_GETCHGREQ_V10,
    changedObjs: set of ObjAtts,
    changedLinks: set of ObjAttVal,
    var msgOut: DRS_MSG_GETCHGREPLY_NATIVE,
    var responseObjs: set of ObjAtts,
    var responseLinks: set of ObjAttVal)

```

The GetResponseSubset procedure selects subsets of the changed objects and link values to include in this response. It utilizes the cookie msgIn.usnvecFrom—which is zero or a value returned to the client in a previous response—and the client-requested limits *msgIn.cMaxObjects* and *msgIn.cMaxBytes* to determine the subsets. This procedure then sets msgOut.usnvecTo to a new cookie that the client presents in its next request as msgIn.usnvecFrom.

The server SHOULD<31> choose a subset such that the response will contain no more objects than *msgIn.cMaxObjects* and no more bytes (before any compression is applied) than *msgIn.cMaxBytes*.

It is valid for the response to contain no objects or link values. It is valid for an object or a link value to appear multiple times in a single response, and the object's attribute values or the link values need not be identical. It is valid for an object or a link value to appear both in the current response and in an earlier response in the same cycle, and the object's attribute values or the link values need not be identical.

If the server determines, by using state that is maintained via msgIn.usnvecFrom and msgOut.usnvecTo, that inclusive of what it is sending in this response, it will have sent at least *changedObjs* and *changedLinks* to the client, then it concludes the cycle by returning with msgOut.fMoreData = false. Therefore, if this is the first response message of a cycle, the server only returns with msgOut.fMoreData = false if *responseObjs* = *changedObjs* and *responseLinks* = *changedLinks*.

Subject to resource constraints on the server, if neither *changedObjs* nor *changedLinks* increases during a sequence of calls, the server eventually returns msgOut.fMoreData = false.

4.1.10.5.8 AddObjToResponse

~~Note: Some of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it in the Product Behavior appendix.~~

```

procedure AddObjToResponse(
    hDrs: DRS_HANDLE,
    o: ObjAtts,
    ncRoot: DSName,

```



```

ulFlags: set of integer,
ulExtendedOp: DWORD,
clientDSA: DSName,
var msgOut: DRS_MSG_GETCHGREPLY_NATIVE) : ULONG

```

Informative summary of behavior: The AddObjToResponse procedure constructs a REPLENTINFLIST structure for a changed object and appends it to the response.

```

err: ULONG
re: REPLENTINFLIST
pAttr: ADDRESS OF ATTR
attribute: ATTRTYP
attrObj: DSName
attrVals: sequence of attribute values
i: DWORD
j: DWORD

err := 0
/* Construct a REPLENTINFLIST to represent the changes. */
re := all zeros
re.fIsNcPrefix := (o.obj = ncRoot)
if name in o.attrs and not re.fIsNcPrefix then
    re.pParentGuid := ADR(o.obj!parent)
endif
re.EntInf.pName := ADR(o.obj)
re.EntInf.AttrBlock.pAttrs := array of ATTR of size o.attrs.length
re.EntInf.AttrBlock.attrCount := o.attrs.length
re.pMetaDataExt := PROPERTY_META_DATA_EXT_VECTOR
    with rgMetaData of size o.attrs.length
re.pMetaDataExt^.cNumProps := o.attrs.length
for i := 0 to o.attrs.length - 1
    attribute := o.attrs[i]
    attrObj := SchemaObj(attribute)
    re.pMetaDataExt^.rgMetaData[i] = AttrStamp(o.obj, attribute)
    pAttr := ADR(re.EntInf.AttrBlock.pAttrs[i])
    pAttr^.attrTyp := attribute
    pAttr^.AttrVal.valCount := 0
    if AmILHServer() and
        DRS_SPECIAL_SECRET_PROCESSING in ulFlags and
        IsSecretAttribute(attribute) then
        /* secret attribute, send a null value */
        pAttr^.AttrVal.pAVal = null
        re.pMetaDataExt^.rgMetaData[i].timeChanged = 0
    else if not AmILHServer() and /* W2K3 or lower */
        not DRS_WRIT_REP in ulFlags and /* partial replication */
        IsSecretAttribute(attribute) then
        /* secret attribute in W2K3 or lower servers, send a null value */
        pAttr^.AttrVal.pAVal = null
        re.pMetaDataExt^.rgMetaData[i].timeChanged = 0
    else
        /* not special processing */
        attrVals := GetAttrVals(o, attribute, false)
        pAttr^.AttrVal.pAVal := ARRAY OF ATTRVAL
            WITH SIZE attrVals.length
        for j := 0 to attrVals.length - 1
            /* If attribute is a link value attribute, then add it to the
             * response here only if it does not have a LinkValueStamp
             * associated with it. This can happen if the current forest
             * functional level is DS_BEHAVIOR_WIN2000 or the attribute
             * value attrVals[j] was last updated when the forest
             * functional level was DS_BEHAVIOR_WIN2000. If the
             * attribute value has a LinkValueStamp associated with it,
             * then it will be sent in the response packet by method
             * AddLinkToResponse. Forest functional levels are listed
             * in [MS-ADTS] section 6.1.4.4,
             * "msDS-Behavior-Version: Forest Functional Level".
             */

```

```

        if (attrObj!linkID = null) or
            ((attrObj!linkID ≠ null) and
             (LinkStamp(o.obj, attribute, attrVals[j]) = null) then
                pAttr^.AttrVal.pAVal[j] := ATTRVALFromValue(
                    attrVals[j], Syntax(attribute), dc.prefixTable)
                pAttr^.AttrVal.valCount := pAttr^.AttrVal.valCount + 1
            endif
        endfor /* j := */
    endif
    err := EncryptValuesIfNecessary(hDrs, pAttr^)
    if err ≠ 0 then
        return err
    endif
    /* if secrets are being sent to RODC then log it to revealed
     * list */
    if (EXOP_REPL_SECRETS in ulExtendedOp) then
        UpdateRevealedList(clientDSA, o.obj, attribute)
    endif
endfor /* i := */

/* Add re to the response. */
Add re to the end of the linked list msgOut.pObjects
msgOut.cNumObjects := msgOut.cNumObjects + 1

return err

```

4.1.10.5.9 UpdateRevealedList

```

procedure UpdateRevealedList(
    rodcdsa: DSName,
    revealedObject: DSName,
    attribute: ATTRTYP)

```

Informative summary of behavior: The UpdateRevealedList procedure adds or updates an entry for the attribute *attribute* of the object *revealedObject* on the msDS-RevealedUsers attribute of the computer object that corresponds to the nTDSDSA object *rodcdsa*. The msDS-RevealedUsers attribute is of type DNBinary. The binary portion of the *attribute* value contains a PROPERTY_META_DATA structure in its binary form. The DN portion of *attribute* value contains *revealedObject*.

```

serverObj: DSName
computerObj: DSName
attrSchemaObj: DSName
revealedObjectsNew: set of DNBinary
obj: DNBinary
propMetadata: PROPERTY_META_DATA
propMetadataCurrent: PROPERTY_META_DATA
newRevealedObjectVal: DNBinary

/* Revealed list has entries only for secret attributes */
if not IsSecretAttribute(attribute) then
    return
endif

/* Get the computer object corresponding to nTDSDSA object rodcdsa */
serverObj := rodcdsa!parent
computerObj := serverObj!serverReference

/* filter superseded entries from the msDS-RevealedUsers set */
revealedObjectsNew := {}
foreach obj in computerObj!msDS-RevealedUsers

```

```

propMetadata := loophole(obj.binary, PROPERTY_META_DATA)
if (obj.object_dn # revealedObject) or
  (propMetadata.attrType # attribute) or
  (StampCompare(propMetadata.propMetadataExt,
    AttrStamp(revealedObject, attribute) > 0) then
  revealedObjectsNew := revealedObjectsNew + { obj }
endif
endif
endfor

/* add the new entry to the set */
propMetadataCurrent.attrType := attribute
propMetadataCurrent.propMetadataExt :=
  AttrStamp(revealedObject, attribute)
newRevealedObjectVal.binary :=
  loophole(propMetadataCurrent, sequence of byte)
newRevealedObjectVal.object_dn:= revealedObject
revealedObjectsNew := revealedObjectsNew + { newRevealedObjectVal }

/* set attribute value to new set */
computerObj!msDS-RevealedUsers := revealedObjectsNew

```

4.1.10.5.10 AddLinkToResponse

~~Note: Some of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it in the Product Behavior appendix.~~

```

procedure AddLinkToResponse(
  v: ObjAttVal,
  msgIn: DRS_MSG_GETCHGREQ_V10,
  var msgOut: DRS_MSG_GETCHGREPLY_NATIVE)

```

Informative summary of behavior: The AddLinkToResponse procedure constructs a REPLVALINF_NATIVE structure for a changed link value and appends it to the response.

```

rv: REPLVALINF_NATIVE
rvs: sequence of REPLVALINF_NATIVE
stamp: LinkValueStamp
filterGroups: boolean

filterGroups := true;

if AmILHServer() then
  if DRS_GET_ALL_GROUP_MEMBERSHIP in msgIn.ulFlags then
    filterGroups := false
  endif
else
  if DRS_WRITE_REP in msgIn.ulFlags then
    filterGroups := false
  endif
endif

if filterGroups = true and
  group in v.obj!objectClass and
  not GROUP_TYPE_UNIVERSAL_GROUP in v.obj!groupType and
  v.att = member
/* non-universal group membership is replicated out unless
  explicitly requested */
  return
endif

```

```

/* Construct a REPLVALINF_NATIVE to represent the changes to send. */
rv.pObject = v.obj
rv.attrType := v.att
rv.AVal := ATTRVALFromValue(v.val, Syntax(v.att), dc.prefixTable)
stamp := LinkStamp(v.obj, v.att, v.val)
rv.fIsPresent := stamp.timeDeleted = 0
rv.Metadata := stamp

/* Add rv to the response. */
if msgOut.cNumValues # 0
    Copy elements from msgOut.rgValues to rvs
endif
rvs[msgOut.cNumValues] := rv
msgOut.rgValues := elements of rvs
msgOut.cNumValues := msgOut.cNumValues + 1

```

4.1.10.5.11 EncryptValuesIfNecessary

```

procedure EncryptValuesIfNecessary(
    hDrs: DRS_HANDLE,
    var attr: ATTR) : ULONG

```

Informative summary of behavior: The EncryptValuesIfNecessary procedure encrypts the values of attributes that contain secret data. It performs the encryption by using an MD5 **digest** (as specified in [RFC1321]), a CRC32 checksum (as specified in [ISO/IEC 13239]), and an RC4 stream cipher (as specified in [RC4]). This encryption is in addition to the encryption that is provided by RPC privacy.

```

sessionKey: sequence of BYTE
i: integer
salt: sequence of BYTE
md5Context: MD5_CTX
crc: ULONG
pPayload: ADDRESS OF ENCRYPTED_PAYLOAD

if not IsSecretAttribute(attr.attrTyp) then
    /* No additional encryption necessary. */
    return 0
endif

if not DRS_EXT_STRONG_ENCRYPTION in ClientExtensions(hDrs).dwFlags then
    return SEC_E_ALGORITHM_MISMATCH
endif

/* Get session key associated with the RPC connection. */
sessionKey := session key associated with security context of hDrs,
as specified by [MS-RPCE] section 3.3.1.5.2, "Building and Using a
Security Context", and [MS-KILE] section 3.1.1.2, "Cryptographic
Material"

/* Encrypt each value of this attribute. */
for i := 0 to attr.AttrVal.valCount - 1
    salt := randomly generated 128-bit number

    /* Calculate checksum of the clear value. */
    crc := CRC32 [ISO/IEC 13239] of the attr.AttrVal.pAVal[i].valLen
    bytes starting at attr.AttrVal.pAVal[i].pVal

```

```

/* Compute encryption key. */
MD5Init(md5Context)
MD5Update(md5Context, sessionKey, sessionKey.length)
MD5Update(md5Context, salt, 16)
MD5Final(md5Context)

/* Construct payload, encrypting its contents with the exception of
 * the Salt field. */
pPayload := New ENCRYPTED_PAYLOAD, sized to hold
    attr.AttrVal.pAVal[i].valLen bytes in the EncryptedData field
pPayload^.Salt := salt
pPayload^.Checksum := crc
Copy attr.AttrVal.pAVal[i].valLen bytes from
    attr.AttrVal.pAVal[i].pVal to pPayload^.EncryptedData
Encrypt attr.AttrVal.pAVal[i].valLen + 4 bytes starting at the
    address of pPayload^.Checksum using the RC4 stream cipher
    algorithm [RC4] with encryption key md5Context.digest

/* Replace the clear value with the encrypted value. */
attr.AttrVal.pAVal[i].pVal := pPayload
attr.AttrVal.pAVal[i].valLen := attr.AttrVal.pAVal[i].valLen + 20
endfor

return 0

```

4.1.10.5.12 ProcessFsmoRoleRequest

~~Note: Some of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it in the Product Behavior appendix.~~

```

procedure ProcessFsmoRoleRequest (
    hDrs: DRS_HANDLE,
    msgIn: DRS_MSG_GETCHGREQ_V10,
    var msgOut: DRS_MSG_GETCHGREPLY_NATIVE)

```

Informative summary of behavior: The ProcessFsmoRoleRequest procedure performs the requested FSMO role operation indicated by *msgIn.ulExtendedOp*.

```

fsmoObj: DSName
clientDsaObj: DSName
serverObj: DSName: DSName
rodcObj: DSNAME: DSName
clientComputerObj: DSName
clientRidSetObj: DSName
ownerDsaObj: DSName
scope: set of DSName
ridAllocLoHi: ULONGLONG
ridAllocHi: DWORD
ridReqHi: DWORD
ridAvailLoHi: ULONGLONG
ridAvailLo: DWORD
ridAvailHi: DWORD
changedObjs: set of ObjAtts
changedLinks: set of ObjAttVal

/* Specific error check when at DC functional level Win2K3 */
if (DSAObj())!msDS-Behavior-Version = DS_BEHAVIOR_WIN2003) and

```

```

        (not DRS_WRIT_REP in msgIn.ulFlags) then
        msgOut.ulExtendedRet := EXOP_ERR_PARAM_ERR
        return
    endif

    fsmoObj := msgIn.pNC^
    if not ObjExists(fsmoObj) then
        msgOut.ulExtendedRet := EXOP_ERR_UPDATE_ERR
        return
    endif
    if msgIn.uuidDsaObjDest = null then
        msgOut.ulExtendedRet := EXOP_ERR_UPDATE_ERR
        return
    endif
    clientDsaObj := select one o from ConfigNC()where
        o!objectGUID = msgIn.uuidDsaObjDest
    if clientDsaObj = null then
        msgOut.ulExtendedRet := EXOP_ERR_UNKNOWN_CALLER
        return
    endif

    scope := {}if msgIn.ulExtendedOp in {EXOP_FSMO_REQ_ROLE, EXOP_FSMO_REQ_PDC,
        EXOP_FSMO_RID_REQ_ROLE} then
        /* Change the FSMO role owner from the server to the client. */
        if fsmoObj!fsmoRoleOwner ≠ DSAObj() then
            msgOut.ulExtendedRet := EXOP_ERR_FSMO_NOT_OWNER
            return
        endif

        fsmoObj!fsmoRoleOwner := clientDsaObj
        scope := GetRoleScope(fsmoObj)
    else if msgIn.ulExtendedOp = EXOP_FSMO_ABANDON_ROLE then
        /* Request a change in the FSMO role owner from the current owner
        * to the server. The server will refuse to take the FSMO role if
        it is not a full replica and cannot own FSMO. */
        if AmIRODC() then
            msgOut.ulExtendedRet := EXOP_ERR_FSMO_REFUSING_ROLES
        endif

        if fsmoObj!fsmoRoleOwner ≠ DSAObj() then
            ownerDsaObj := fsmoObj!fsmoRoleOwner
            if not ObjExists(ownerDsaObj) then
                msgOut.ulExtendedRet := EXOP_ERR_UNKNOWN_CALLER
                return
            else if ownerDsaObj!isDeleted = true
                msgOut.ulExtendedRet := EXOP_ERR_OWNER_DELETED
                return
            endif
        endif

        Call IDL_DRSGetNCChanges as a client to the server identified by
        ownerDsaObj to perform a EXOP_FSMO_REQ_ROLE extended
        operation; see the client request generation and response
        processing sections

        if fsmoObj!fsmoRoleOwner ≠ DSAObj() then
            /* Transfer failed. */
            msgOut.ulExtendedRet := EXOP_ERR_COULDNT_CONTACT
            return
        endif
    endif
    else if msgIn.ulExtendedOp = EXOP_FSMO_REQ_RID_ALLOC then
        /* Allocate a block of RIDs for the client DC. */
        if fsmoObj ≠ DefaultNC()!rIDManagerReference then
            msgOut.ulExtendedRet := EXOP_ERR_MISMATCH
            return
        else if fsmoObj!fsmoRoleOwner ≠ DSAObj() then
            msgOut.ulExtendedRet := EXOP_ERR_FSMO_NOT_OWNER
            return
        endif
    endif

```

```

/* Locate or create the RID Set object for the client DC. */
serverObj := clientDsaObj!parent
clientComputerObj := serverObj!serverReference
if clientComputerObj!rIDSetReference = null then
    clientRidSetObj := An implementation defined DSName in the
        default NC such that not ObjExists(clientRidSetObj)
    Create object with DSName clientRidSetObj such that
        rIDSet in clientRidSetObj!objectClass
    /* Windows Behavior: Windows sets clientRidSetObj to be a child
        * of clientComputerObj. */
    clientComputerObj!rIDSetReference := clientRidSetObj
else
    clientRidSetObj := clientComputerObj!rIDSetReference
endif
/* Get the current RID allocation for the client DC. */
ridAllocLoHi := clientRidSetObj!rIDAllocationPool
ridAvailHi := most significant 32 bits of ridAvailLoHi
ridReqHi := most significant 32 bits of msgIn.liFsmoInfo
if ridAllocLoHi = 0 or ridAvailHi = 0 or ridReqHi ≥ ridAvailHi then
    /* The client DC has indeed exhausted its current allocation,
        * according to our records. */

    /* Get the range of RIDs that have not yet been allocated to any
        * DC. */
    ridAvailLoHi := fsmoObj!rIDAvailablePool
    ridAvailLo := least significant 32 bits of ridAvailLoHi
    ridAvailHi := most significant 32 bits of ridAvailLoHi

    /* Select a subset of the unallocated RIDs and allocate them to
        * the client. */
    Assign a value to ridAllocHi according to any implementation-
        defined policy such that ridAvailLo < ridAllocHi < ridAvailHi.
    /* Windows Behavior: By default, Windows sets ridAllocHi to
        * ridAvailLo + 500. */
    ridAllocLoHi := ridAvailLo as least significant 32 bits and
        ridAllocHi as most significant 32 bits
    ridAvailLo := ridAllocHi + 1
    ridAvailLoHi := ridAvailLo as least significant 32 bits and
        ridAvailHi as most significant 32 bits
    fsmoObj!rIDAvailablePool := ridAvailLoHi
    clientRidSetObj!rIDAllocationPool := ridAllocLoHi
    msgOut.liFsmoInfo := ridAllocLoHi
endif

scope := GetRoleScope(fsmoObj) +
    {clientComputerObj, clientRidSetObj}
else if EXOP_REPL_SECRETS in msgIn.ulExtendedOp and
    AmILHServer() then
    /* Request replication of a single object with secret.
        * Secret replication is allowed only if these three conditions
        * hold:
        * 1. Caller is an RODC. An RODC will always be a member of
        *    "Enterprise Read-Only Domain Controllers" (RID 498)
        *    [MS-ADTS] section 6.1.1.6.14.
        * 2. The object is configured to reveal secrets.
        * 3. Outbound secret replication is not disabled.
        */
    serverObj := clientDsaObj!parent
    rodcObj := serverObj!serverReference
    if CheckGroupMembership(
        GetCallerAuthorizationInfo(), SidFromStringSid("S-1-5-22"))
        and RevealSecretsForUserAllowed(rodcObj, fsmoObj)
        and (not NTDSDSA_OPT_DISABLE_OUTBOUND_REPL_SECRET
            in DSAObj!options
            or DRS_SYNC_FORCED in msgIn.ulFlags) then
        scope := {fsmoObj}
    else
        scope := {}
    endif
else if EXOP_REPL_OBJ in msgIn.ulExtendedOp

```

```

if AmLHServer() = true and
    NTDSDSA_OPT_DISABLE_OUTBOUND_REPL_OBJ in DSAObj(!options and
    not DRS_SYNC_FORCED in msgIn.ulFlags then
    /* replication of single object is disabled */
    pmsgOut.dwDRSError := ERROR_DS_DRA_SOURCE_DISABLED
    return
endif

/* Operation is invalid if destination is full replica but this server
 * is not, or if both are partial replicas but this server does not have
 * all the attributes needed by the destination in its PAS. */
if(not FullReplicaExists(GetObjectNC(pMsgIn.NC)msgIn.pNC^)) and
not pMsgInmsgIn.pPartialAttrSet = null)
    msgOut.ulExtendedRet := EXOP_ERR_PARAM_ERR
    return
else if not GetFilteredAttributeSet(()pMsgIn() ∩ msgIn.pPartialAttrSet = {}) then
    msgOut.ulExtendedRet := EXOP_ERR_PARAM_ERR
    return
endif

scope := {fsmoObj}
else
    /* Unrecognized request. */
    msgOut.ulExtendedRet := EXOP_ERR_UNKNOWN_OP
    return
endif

if scope ≠ {} then
    /* Add updates in scope to the response. */
    GetChangesInScope(scope, msgIn.pUpToDateVecDest, msgIn.ulExtendedOp,
        msgIn.pPartialAttrSet, msgIn.pPartialAttrSet,
        0, changedObjs, changedLinks)
    foreach o in changedObjs
        AddObjToResponse(
            hDrs, o, ncRoot, msgIn.ulFlags, msgIn.ulExtendedOp, msgOut)
    endfor
    foreach v in changedLinks
        AddLinkToResponse(v, msgIn, msgOut)
    endfor
endif

msgOut.ulExtendedRet := EXOP_ERR_SUCCESS
return

```

4.1.10.5.13 RevealSecretsPolicy

```

typedef enum
{
    RevealSecretsDeny = 0,
    RevealSecretsAllow = 1,
    RevealSecretsNoPolicy = 2
} RevealSecretsPolicy;

```

4.1.10.5.14 GetRevealSecretsPolicyForUser

```

procedure GetRevealSecretsPolicyForUser(
    rodObj: DSName, userObj: DSName): RevealSecretsPolicy

```

Informative summary of behavior: The GetRevealSecretsPolicyForUser procedure returns the policy that indicates whether the server that holds the secrets of the user object *userObj* is allowed to send those secrets to the RODC identified by the RODC object *rodObj*. If the policy explicitly prohibits the RODC from receiving the secrets, RevealSecretsDenied is returned. If the policy explicitly allows the

RODC to receive the secrets, `RevealSecretsAllow` is returned. In all other cases, `RevealSecretsNoPolicy` is returned.

```
neverRevealObj: DSName
revealObj: DSName
/* An RODC can always cache secrets of its own account
*/
if rodObj = userObj /* see section 5 DSNAME for DSName equality */
  then
    return RevealSecretsAllow
  endif
/* An RODC can always cache secrets of its own
* secondary Kerberos TGT account but not other
* secondary Kerberos TGT accounts.
* See [MS-KILE]
*/
if rodObj!msDS-KrbTgtLink = userObj then
  return RevealSecretsAllow
endif
krbtgts = select o from children DefaultNC() where
  o!msDS-KrbTgtLink ≠ null
foreach krbtgt in krtgts do
  if userObj = krbtgt!msDS-KrbTgtLink then
    return RevealSecretsDeny
  endif
endfor

/* Never reveal secrets of inter-domain
* trust accounts
*/
if userObj!UserAccountControl ∩ {ADS_UF_INTERDOMAIN_TRUST_ACCOUNT}
  ≠ {} then
  return RevealSecretsDeny
endif

/* Never reveal secrets of users reachable from
* rodObj!msDS-NeverRevealGroup
*/
foreach neverRevealObj in rodObj!msDS-NeverRevealGroup
  if IsUserIncluded(
    userObj!objectSid, neverRevealObj!objectSid) then
    return RevealSecretsDeny
  endif
endfor

/* Only reveal secrets of users reachable from
* rodObj!msDS-RevealOnDemandGroup
*/
foreach revealObj in rodObj!msDS-RevealOnDemandGroup
  if IsUserIncluded(
    userObj!objectSid, revealObj!objectSid) then
    return RevealSecretsAllow
  endif
endfor
return RevealSecretsNoPolicy
```

4.1.10.5.15 RevealSecretsForUserAllowed

```
procedure RevealSecretsForUserAllowed(
  rodObj: DSName, userObj: DSName): boolean
```

Informative summary of behavior: The `RevealSecretsForUserAllowed` procedure returns true if a server that holds secrets of the user object `userObj` is allowed to send those secrets to the RODC identified by RODC object `rodObj`.

```

policy: RevealSecretsPolicy
allowed: boolean
policy = GetRevealSecretsPolicyForUser(rodObj, userObj)
if (policy = RevealSecretsDeny) then
    allowed := false
else if (policy = RevealSecretsAllow) then
    allowed := true
else
    allowed := false
endif

return allowed

```

4.1.10.5.16 GetRoleScope

```

procedure GetRoleScope(fsMoObj: DSName): set of DSName

```

Informative summary of behavior: The GetRoleScope procedure returns the set of objects in the FSMO role identified by the FSMO role object *fsMoObj*.

```

scope: set of DSName
partitionsFsMoObj: DSName
schemaFsMoObj: DSName
ridFsMoObj: DSName
pdcFsMoObj: DSName
c: DSName
r: set of DSName

partitionsFsMoObj := select one o from children ConfigNC()
    where o!name = "Partitions"
schemaFsMoObj := SchemaNC()
infrastructureFsMoObj := select one o from children DefaultNC()
    where o!name = "Infrastructure"
ridFsMoObj := DefaultNC()!rIDManagerReference

/* Scope always includes fsMoObj. For the PDC Emulation Role, scope
 * includes only fsMoObj. */
scope := {fsMoObj}

if fsMoObj = partitionsFsMoObj then
    /* Partition Naming Master Role: Add to scope the children of the
     * Partitions container. */
    r := select all o from children partitionsFsMoObj where true
    scope := scope + r
else if fsMoObj = schemaFsMoObj then
    /* Schema Master Role: Set scope to all objects in the Schema
     * NC. */
    scope := select all o from subtree SchemaNC() where true
else if fsMoObj = infrastructureFsMoObj then
    /* Infrastructure Master Role: Add to scope all objects in the
     * subtree rooted at CN=DomainUpdates,CN=System,DefaultNC(). */
    c := select one o from children DefaultNC() where o!name = "System"
    c := select one o from children c where o!name = "DomainUpdates"
    r := select all o from subtree c where true
    scope := scope + r
else if fsMoObj = ridFsMoObj then
    /* RID Allocation Master Role: Add to scope all children of
     * CN=Infrastructure,DefaultNC() that are of class
     * infrastructureUpdate and have a value for the proxiedObjectName
     * attribute. */
    r := select all o from children-ts-included infrastructureFsMoObj

```

```

        where infrastructureUpdate in o!objectClass and
            not o!proxiedObjectName = null
        scope := scope + r
    endif

return scope

```

4.1.10.5.17 SortResponseLinks

~~Note: Some of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it in the Product Behavior appendix.~~

```

procedure SortResponseLinks(var msgOut: DRS_MSG_GETCHGREPLY_NATIVE)

```

The SortResponseLinks procedure sorts the contents of *msgOut.rgValues* in ascending order according to the comparison method CompareLinks():

```

procedure CompareLinks(REPLVALINF_NATIVE val1, REPLVALINF_NATIVE val2): integer
begin
    c: integer
    dsname1: DSName
    dsname2: DSName

    /* Returns 1
       if val1 > val2, 0 if val1 = val2, or -1 if val1 < val2. */

    /* Compare by ascending host object objectGUID. */
    c := result of ANSI C function memcmp()
        applied to val1.pObject^.Guid and val2.pObject^.Guid,
        in little-endian byte order

    /* Then by ascending attribute ID. */
    if c = 0 then
        if val1.attrTyp < val2.attrTyp then
            c := -1
        else if val1.attrTyp > val2.attrType then
            c := 1
        endif
    endif

    /* Then by ascending "is present". */
    if c = 0 then
        if not val1.fIsPresent and val2.fIsPresent then
            c := -1
        else if val1.fIsPresent and not val2.fIsPresent then
            c := 1
        endif
    endif

    /* Then by ascending referenced object objectGUID. */
    if c = 0 then
        dsname1 := Value of val1.AVal.pVal^
        dsname2 := Value of val2.AVal.pVal^

        c := result of ANSI C function memcmp() applied to dsname1.Guid

```

```

        and dsname2.Guid, in little-endian byte order
    endif

    return c
end

```

4.1.10.5.18 ReplValInfV1ListFromReplValInfNativeList

~~Note: All of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it as an aid to the reader.~~

```

procedure ReplValInfV1ListFromReplValInfNativeList(
    replValInfNativeList : REPLVALINF_NATIVE*) : REPLVALINF_V1*

```

Informative summary of behavior: The ReplValInfV1ListFromReplValInfNativeList procedure transforms a list of REPLVALINF_NATIVE structures into a list of **REPLVALINF_V1** structures. Elements in a native structure that do not exist in a V1 structure are omitted from the V1 structure.

```

returnList : list of REPLVALINF_V1
v1 : REPLVALINF_V1

for each e in replValInfNativeList
    /* NOTE: Copy only the fields that exist in a REPLVALINF_V1 structure. */
    v1 := e
    add v1 to returnList
endfor

return returnList

```

4.1.10.5.19 ReplValInfNativeListFromReplValInfV1List

~~Note: All of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it as an aid to the reader.~~

```

procedure ReplValInfNativeListFromReplValInfV1List(
    replValInfV1List : REPLVALINF_V1*) : REPLVALINF_NATIVE*

```

Informative summary of behavior: The ReplValInfNativeListFromReplValInfV1List procedure transforms a list of **REPLVALINF_V1** structures into a list of REPLVALINF_NATIVE structures. Elements in a native structure that do not exist in a V1 structure are initialized to 0 or NULL values.

```

returnList : list of REPLVALINF_NATIVE
native : REPLVALINF_NATIVE

for each v1 in replValInfV1List
    native := 0
    native := v1
    add native to returnList
endfor

return returnList

```

4.1.10.5.20 TransformOutput

~~Note: Some of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it in the Product Behavior appendix.~~

```
procedure TransformOutput(  
    msgOut: DRS_MSG_GETCHGREPLY_NATIVE,  
    flags: DRS_OPTIONS,  
    pdwOutVersion: ADDRESS OF DWORD,  
    pmsgOut: ADDRESS OF DRS_MSG_GETCHGREPLY): ULONG
```

Informative summary of behavior: The TransformOutput procedure transforms the native reply (a superset of all supported reply messages) into the reply version supported by the client, optionally compressing it. The compression algorithms used for the DRS_COMP_ALG_WIN2K3 algorithm type are specified in section 4.1.10.5.21. The compression algorithm used for the DRS_COMP_ALG_MSZIP algorithm type is specified in [RFC1951].

```
pickled: sequence of BYTE  
compressed: sequence of BYTE  
allowedAlgs: set of DRS_COMP_ALG_TYPE  
compressAlg: DRS_COMP_ALG_TYPE  
compress: boolean  
  
/* The SMTP transport [MS-SRPL] performs its own compression. */  
compress := DRS_USE_COMPRESSION in flags  
           and not DRS_MAIL_REP in flags  
  
if pdwOutVersion^ < dc.minimumGetChangesReplyVersion  
    return ERROR_REVISION_MISMATCH  
  
if pdwOutVersion^ = 9 or pdwOutVersion^ = 6 then  
    if pdwOutVersion^ = 9 then  
        /* Convert to V9. */  
        pdwOutVersion^ := 9  
        pmsgOut^.V9 := msgOut  
    else if pdwOutVersion^ = 6 then  
        /* Convert to V6. */  
        pdwOutVersion^ := 6  
        pmsgOut^.V6 := msgOut  
        pmsgOut^.V6.rgValues := ReplValInfV1ListFromReplValInfNativeList(msgOut.rgValues)  
    endif  
  
    if compress then  
        /* Note that the only difference between the compression processing of a V2 and */  
        /* a V7 message is that a V7 message can use the DRS_COMP_ALG_WIN2K3 compression */  
        /* algorithm and a V2 message can not. */  
        /* Return V7 (compressed V6 or V9). */  
        if not DRS_EXT_GETCHGREPLY_V7 in ext.dwFlags then  
            return ERROR_REVISION_MISMATCH  
        endif  
  
        /* Serialize msgOut into a byte stream. */  
        pickled := Pickling of pmsgOut^.V6 or pmsgOut^.V9, as specified by  
            [C311] Part 2, "IDL/NDR Pickles", and  
            [MS-RPCE] sections 2.2.6 and 2.2.7, "Type Serialization  
            Version 1" and "Type Serialization Version 2"  
  
        /* Select a compression algorithm. */  
        allowedAlgs := {DRS_COMP_ALG_NONE, DRS_COMP_ALG_MSZIP}  
        if DRS_EXT_W2K3_DEFLATE in ext.dwFlags then  
            allowedAlgs := allowedAlgs + {DRS_COMP_ALG_WIN2K3}  
        endif  
        compressAlg := One of allowedAlgs, selected by an
```

```

        implementation-defined policy.

/* Compress the serialized msgOut. */
if (compressionAlg = DRS_COMP_ALG_MSZIP) then
    compressed :=
        Compress pickled in accordance
        with [RFC1951].
else
    CompressOrDecompressWin2k3(pickled, compressed, pickled.length, TRUE)
endif
pmsgOut^.V7.dwCompressedVersion := pdwOutVersion^
pmsgOut^.V7.CompressionAlg := compressAlg
pmsgOut^.V7.CompressedAny.cbUncompressedSize := pickled.length
pmsgOut^.V7.CompressedAny.cbCompressedSize := compressed.length
pmsgOut^.V7.CompressedAny.pbCompressedData := bytes in compressed
pdwOutVersion^ := 7
endif
else
/* Return V1 (uncompressed) or V2 (compressed V1). */
/* First, convert to V1. */
pdwOutVersion^ := 1
pmsgOut^.V1 := msgOut
pmsgOut^.V1.pUpToDateVecSrc := Convert msgOut.pUpToDateVecSrc (of
    type UPTODATE_VECTOR_V1_EXT) to UPTODATE_VECTOR_V2_EXT by
    creating a new UPTODATE_VECTOR_V1_EXT with a V1 cursor for each
    V2 cursor, sans the timeLastSyncSuccess field.
/* V1 has the NC size in the ulExtendedRet field. */
if msgOut.cNumNcSizeObjects > 0 then
    pmsgOut^.V1.ulExtendedRet := msgOut.cNumNcSizeObjects
endif

if compress then
/* Serialize msgOut into a byte stream. */
pickled := Pickling of pmsgOut^.V1, as specified by
    [C311] Part 2, "IDL/NDR Pickles" and
    [MS-RPCE] sections 2.2.6 and 2.2.7, "Type Serialization
    Version 1" and "Type Serialization Version 2"

/* Select a compression algorithm. */
allowedAlgs := {DRS_COMP_ALG_NONE, DRS_COMP_ALG_MSZIP}
compressAlg := One of allowedAlgs, selected by an
    implementation-defined policy.

/* Compress the serialized msgOut. */
if (compressionAlg = DRS_COMP_ALG_MSZIP) then
    compressed :=
        Compress pickled in accordance
        with [RFC1951].
else
    CompressOrDecompressWin2k3(pickled, compressed, pickled.length, TRUE)
endif
pdwOutVersion^ := 2
pmsgOut^.V2.CompressedV1.cbUncompressedSize := pickled.length
pmsgOut^.V2.CompressedV1.cbCompressedSize := compressed.length
pmsgOut^.V2.CompressedV1.pbCompressedData := bytes in compressed
endif
endif
endif

return 0

```

4.1.10.5.21 CompressOrDecompressWin2k3

```

procedure CompressOrDecompressWin2k3(
    inputBuffer: sequence of BYTE,
    inputSize: DWORD
    ref outputBuffer: sequence of BYTE,
    comp: BOOLEAN)

```

Informative summary of behavior: The CompressOrDecompressWin2k3 procedure compresses or decompresses data using the compression algorithm LZ77 (section 4.1.10.5.21.1) and the basic encoding algorithm DIRECT2 (section 4.1.10.5.21.2). The procedure has the following parameters:

- *inputBuffer*: A sequence of BYTE containing data to compress or decompress.
- *inputSize*: The DWORD value that indicates the size of *inputBuffer* in bytes.
- *outputBuffer*: A sequence of BYTE that is an empty buffer. Compressed or decompressed data is filled into this buffer.
- *comp*: A Boolean indicating whether to compress (*comp*=TRUE) or decompress (*comp*=FALSE) the *inputBuffer*.

4.1.10.5.21.1 LZ77 Compression Algorithm

The LZ77 compression algorithm is used to analyze input data and determine how to reduce the size of that input data by replacing redundant information with metadata. Sections of the data that are identical to sections of the data that have been encoded are replaced by a small amount of metadata that indicates how to expand those sections again. The encoding algorithm is used to take that combination of data and metadata and serialize it into a stream of bytes that can later be decoded and decompressed.

Compression Algorithm Terminology

The following terms are associated with the compression algorithm. Some of the terms also apply to the DIRECT2 encoding algorithm defined in the next section.

input stream: The sequence of bytes to be compressed.

byte: The basic data element in the input stream.

coding position: The position of the byte in the input stream that is currently being coded (the beginning of the lookahead buffer).

lookahead buffer: The byte sequence from the coding position to the end of the input stream.

window: A buffer that indicates the number of bytes from the coding position backward. A window of size W contains the last W processed bytes.

pointer: Information about the beginning of the match in the window (referred to as "B" in the example later in this section) and its length (referred to as "L" in the example later in this section).

match: The string that is used to find a match of the byte sequence between the lookahead buffer and the window.

Using the Compression Algorithm

To use the LZ77 compression algorithm:

1. Set the coding position to the beginning of the input stream.
2. Find the longest match in the window for the lookahead buffer.
3. Output the P,C pair, where P is the pointer to the match in the window, and C is the first byte in the lookahead buffer that does not match.
4. If the lookahead buffer is not empty, move the coding position (and the window) L+1 bytes forward.
5. Return to step 2.

Compression Process

The compression algorithm searches the window for the longest match with the beginning of the lookahead buffer and then outputs a pointer to that match. Because even a 1-byte match might not be found, the output cannot contain only pointers. The compression algorithm solves this problem by outputting after the pointer the first byte in the lookahead buffer after the match. If no match is found, the algorithm outputs a null-pointer and the byte at the coding position.

Compression Process Example

The following table shows the input stream that is used for this compression example. The bytes in the input, "AABCBBABC", occupy the first nine positions of the stream.

Input stream

Position	1	2	3	4	5	6	7	8	9
Byte	A	A	B	C	B	B	A	B	C

The following table shows the output from the compression process. The table includes the following columns:

Step: Indicates the number of the encoding step. A step in the table finishes every time that the encoding algorithm makes an output. With the compression algorithm, this process happens in each pass through step 3.

Position: Indicates the coding position. The first byte in the input stream has the coding position 1.

Match: Shows the longest match found in the window.

Byte: Shows the first byte in the lookahead buffer after the match.

Output: Presents the output in the format (B,L)C, where (B,L) is the pointer (P) to the match. This gives the following instructions to the decoder: Go back B bytes in the window and copy L bytes to the output. C is the explicit byte.

Note One or more pointers might be included before the explicit byte that is shown in the Byte column. That is, a metadata pointer does not always need to be followed by an explicit byte. An input stream of "ABCABCABC", for example, can be represented as "(0,0)A(0,0)B(0,0)C(3,3)(6,3)" using the (B,L)C notation, with the last two elements being pointers without explicit bytes. The compressed output can be any combination of pointers and explicit bytes.

Compression process output

Step	Position	Match	Byte	Output
1.	1	--	A	(0,0)A
2.	2	A	B	(1,1)B
3.	4	--	C	(0,0)C
4.	5	B	B	(2,1)B
5.	7	A B	C	(5,2)C

The result of compression, conceptually, is the output column—that is, a series of bytes and optional metadata that indicates whether that byte is preceded by some sequence of bytes that is already in the output.

Because representing the metadata itself requires bytes in the output stream, it is inefficient to represent a single byte that has previously been encoded by two bytes of metadata (offset and length). The overhead of the metadata bytes equals or exceeds the cost of outputting the bytes directly. Therefore, the protocol considers sequences of bytes to be a match only if the sequences have three or more bytes in common.

4.1.10.5.21.2 DIRECT2 Encoding Algorithm

The basic notion of the DIRECT2 encoding algorithm is that data appears unchanged in the compressed representation, and metadata is encoded in the same output stream, and in line with, the data.

The key to decoding the compressed data is recognizing what bytes are metadata and what bytes are data. The decoder MUST be able to identify the presence of metadata in the compressed and encoded data stream. Bitmasks are inserted periodically in the byte stream to provide this information to the decoder.

This section describes the bitmasks that enable the decoder to distinguish data from metadata. It also describes the process of encoding the metadata.

Bitmask

To distinguish data from metadata in the compressed byte stream, the data stream begins with a 4-byte bitmask that indicates to the decoder whether the next byte to be processed is data (a "0" value in the bit), or if the next byte (or series of bytes) is metadata (a "1" value in the bit). If a "0" bit is encountered, the next byte in the input stream is the next byte in the output stream. If a "1" bit is encountered, the next byte or series of bytes is metadata that MUST be interpreted further.

For example, a bitmask of 0x01000000 indicates that the first seven bytes are actual data, followed by encoded metadata that starts at the eighth byte. The metadata is followed by 24 additional bytes of data. A bitmask of 0x11200000 indicates that there will be metadata in the 4th, 8th, and 11th elements (note that the actual byte positions in the compressed data *may* be different because metadata elements will range from 2 to 6 bytes in length), with the remaining elements being data bytes.

When the bitmask has been consumed, the next four bytes in the input stream are another bitmask.

The bitmask must also contain a "1" in the bit following the last encoded element, to indicate the end of the compressed data. For example, given a hypothetical 8-bit bitmask, the string "ABCABCDEF" *should be* compressed as (0,0)A(0,0)B(0,0)C(3,3)D(0,0)E(0,0)F. Its bitmask would be b'00010001' (0x11). This would indicate three bytes of data, followed by metadata, followed by an additional 3 bytes, finally terminated with a "1" to indicate the end of the stream.

The final end bit is always necessary, even if an additional bitmask has to be allocated. If the string in the above example was "ABCABCDEF", for example, it would require an additional bitmask. It would begin with the bitmask b'00010000', followed by the compressed data, and followed by another bitmask with a "1" as the next bit to indicate the end of the stream.

Encoding Metadata

In the output stream, actual data bytes are stored unchanged. Bitmasks are stored periodically to indicate whether the next byte or bytes are data or metadata. If the next bit in the bitmask is a "1", the next set of bytes in the input data stream is metadata (unless the last element of data was read, in which case the "1" bit would indicate the end of the stream as noted above). This metadata contains an offset back to the start of the data to be copied to the output stream, and the length of the data to be copied.

To represent the metadata as efficiently as possible, the encoding of that metadata is not fixed in length. The encoding algorithm supports the largest possible floating compression window to increase the probability of finding a large match; the larger the window, the greater the number of bytes that

are needed for the offset. The encoding algorithm also supports the longest possible match; the longer the match length, the greater the number of bytes that are needed to encode the length.

Metadata Offset

The protocol assumes the metadata is two bytes in length. The three low-order bits are used to encode the length. The high-order 13 bits are a first complement of the offset, which is represented as a negative signed value in 2's complement. The offset is only encoded with those 13 bits. This value cannot be extended and defines the maximum size of the compression floating window. For example, the metadata 0x0018 is converted into the offset b'00000000011', and the length b'000'. The offset is '-4', computed by inverting the offset bits, treating the result as a 2's complement, and converting it to an integer.

Match Length

Unlike the metadata offset, the match length is extensible. If the length is less than 10 bytes, it is encoded in the three low-order bits of the 2-byte metadata. Although three bits seems to allow for a maximum length of six (the value b'111' is reserved), because the minimum match is three bytes, these three bits actually allow for the expression of lengths from three to nine. The match length goes from $L = b'000' + 3$ bytes, to $L = b'110' + 3$ bytes. Because smaller lengths are much more common than the larger lengths, the algorithm tries to optimize for smaller lengths. To encode a length between three and nine, we use the three bits that are "in-line" in the 2-byte metadata.

If the length of the match is greater than nine bytes, an initial bit pattern of b'111' is put in the three bits. This does not signify a length of 10 bytes, but instead a length that is greater than or equal to 10, which is included in the low-order nibble of the following byte.

Every other time that the length is greater than nine, an additional byte follows the initial 2-byte metadata. The first time that the additional byte is included, the low-order nibble is used as the additive length. The high-order nibble is "reserved" for the next metadata instance when the length is greater than nine. Therefore, the first time that the decoder encounters a length that is greater than nine, it reads the next byte from the data stream and the low-order nibble is extracted and used to compute the length for this metadata instance. The high-order nibble is remembered and used the next time that the decoder encounters a metadata length that is greater than nine. The third time that a length that is greater than nine is encountered, another extra byte is added after the 2-byte metadata, with the low-order nibble used for this length and the high-order nibble reserved for the fourth length that is greater than nine, and so on.

If the nibble from this "shared" byte is all "1s" (for example, b'1111'), another byte is added after the shared byte to hold more length. In this manner, a length of 24 is encoded as follows:

- b'111' (in the three bits in the original two bytes of metadata), plus
- b'1110' (in the nibble of the "shared" byte) of extended length)
- b'111' means 10 bytes plus b'1110', which is 14, which results in a total of 24.

If the length is more than 24, the next byte is also used in the length calculation. In this manner, a length of 25 is encoded as follows:

- b'111' (in the three bits in the original two bytes of metadata), plus
- b'1111' (in the nibble of the "shared" byte of extended length), plus
- b'00000000' (in the next byte).

This scheme is good for lengths of up to 278 (a length of 10 in the three bits in the original two bytes of metadata, plus a length of 15 in the nibble of the "shared" byte of extended length, plus a length of up to 254 in the extra byte).

A "full" (all b'1') bit pattern (b'111', b'1111', and b'11111111') means that there is more length in the following two bytes.

The final two bytes of length differ from the length information that comes earlier in the metadata. For lengths that are equal to 280 or greater, the length is calculated only from these last two bytes, and is not added to the previous length bits. The value in the last two bytes, a 16-bit integer, is three less than the metadata length. These last two bytes allow for a match length of up to 32,768 bytes + 3 bytes (the minimum match length).

The following table summarizes the length representation in metadata.

Note Length is computed from the bits that are included in the metadata plus the minimum match length of three.

Length representation in metadata

Match length	Length bits in the metadata
24	b'111' (three bits in the original two bytes of metadata) + b'1110' (in the high-order or lower-order nibble, as appropriate, of the shared byte)
25	b'111' (three bits in the original two bytes of metadata) + b'1111' (in the high-order or lower-order nibble, as appropriate, of the shared byte) + b'00000000' (in the next byte)
26	b'111' (three bits in the original two bytes of metadata) + b'1111' (in the high-order or lower-order nibble, as appropriate, of the shared byte) + b'00000001' (in the next byte)
279	b'111' (three bits in the original two bytes of metadata) + b'1111' (in the high-order or lower-order nibble, as appropriate, of the shared byte) + b'11111110' (in the next byte)
280	b'111' (three bits in the original two bytes of metadata) b'1111' (in the high-order or lower-order nibble, as appropriate, of the shared byte) b'11111111' (in the next byte) 0x0115 (in the next two bytes). These two bytes represent a length of 277 + 3 (minimum match length). Note All of the length is included in the final two bytes and is not additive, as were the previous length calculations for lengths that are smaller than 280 bytes.
281	b'111' (three bits in the original two bytes of metadata) b'1111' (in the high-order or lower-order nibble, as appropriate, of the shared byte) b'11111111' (in the next byte) 0x0116 (in the next two bytes). This is 278 + 3 (minimum match length). Note All of the length is included in the final two bytes and is not additive, as were the previous length calculations for lengths that are smaller than 280 bytes.

A "full" bit pattern in that last half word does not mean that more metadata is coming after the last bytes.

The LZ77 compression algorithm produces a well-compressed encoding for small valued lengths, but as the length increases, the encoding becomes less well compressed. A match length of greater than 278 bytes requires a relatively large number of bits: 3+4+8+16. This includes three bits in the original two bytes of metadata, four bits in the nibble in the "shared" byte, eight bits in the next byte, and 16 bits in the final two bytes of metadata.

4.1.10.5.22 GetOptionalFeatureBit

```
procedure GetOptionalFeatureBit(featureGuid: GUID, var bit: integer): boolean
```

Informative summary of behavior: The GetOptionalFeatureBit procedure obtains the *bit* number in the dwFlagsExt and dwExtCaps fields of the DRS_EXTENSIONS_INT structure that corresponds to the **optional feature** identified by *featureGuid*.

```
if (featureGUID = GUID of Recycle Bin optional feature)
  /* [MS-ADTS] section 6.1.1.2.4.1.3.1 */
  bit := DRS_EXT_RECYCLE_BIN
  return true
else
  return false
endif
```

4.1.10.6 Client Behavior When Receiving the IDL_DRSGetNCChanges Response

The client processes an IDL_DRSGetNCChanges response in relation to the current state of its NC replica as detailed in ProcessGetNCChangesReply below. This processing, though sometimes complex, is critical to ensuring that each NC replica arrives at the same abstract state.

4.1.10.6.1 ProcessGetNCChangesReply

~~Note: Some of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it in the Product Behavior appendix.~~

```
procedure ProcessGetNCChangesReply(
  hDrs: DRS_HANDLE,
  rf: RepsFrom,
  msgIn: DRS_MSG_GETCHGREQ_v10,
  dwOutVersion: ULONG,
  msgOut: DRS_MSG_GETCHGREPLY) : ULONG
```

Informative summary of behavior: The ProcessGetNCChangesReply procedure is invoked when an IDL_DRSGetNCChanges response is received over RPC or SMTP, as specified in [MS-SRPL]. Processing of a given response can be separated into five distinct phases: decompression, attribute value decryption, processing object updates, processing link value updates, and updating the "watermark" information.

The arguments to this procedure are as follows:

- *hDrs*: The DRS_HANDLE derived by sending IDL_DRSBind to the server.
- *rf*: RepsFrom for the server.

- *msgIn*: IDL_DRSGetNCChanges request message sent to the server.
- *dwOutVersion*: Version of response message received from the server.
- *msgOut*: Response message received from the server.

```

msgReplyNative: DRS_MSG_GETCHGREPLY_NATIVE
replEntinflList: REPLENTINFLIST
continueProcessing: boolean
writableReplica: boolean
sourcePrefixTable: PrefixTable
attributesAndStamps: set of AttributeAndStamp
linkValueCount: DWORD
clientSchemaSignature: sequence of BYTE
serverSchemaSignature: sequence of BYTE
fServerSchemaMoreRecent: boolean
lastElement: DWORD
ulResult : ULONG

/* Decompress and/or translate the response to a Native response,
 * as necessary. */
if (dwOutVersion = 0x2) or (dwOutVersion = 0x7) then
    msgReplyNative := DecompressReplyMessage(msgOut, dwOutVersion)
else
    msgReplyNative := GetNCChangesNativeReply(msgOut, dwOutVersion)
endif

ulResult := msgReplyNative.dwDRSError

if (ulResult = 0) then

    sourcePrefixTable :=
        AbstractPTFromConcretePT(msgReplyNative.PrefixTableSrc)

    /* Check whether the schema on client and server match. */
    lastElement := sourcePrefixTable.length - 1
    serverSchemaSignature :=
        copy sourcePrefixTable[lastElement].prefix.length bytes of data
        from sourcePrefixTable[lastElement].prefix.elements
    clientSchemaSignature := SchemaNC()!schemaInfo
    if clientSchemaSignature ≠ serverSchemaSignature and
        msgReplyNative.pNC^ ≠ SchemaNC()
    then
        return ERROR_DS_DRA_SCHEMA_MISMATCH
    endif
    Remove sourcePrefixTable[lastElement] from sourcePrefixTable

else
    return ulResult
endif

/* If the source has the Recycle Bin optional feature enabled, then it must
 * be enabled locally, unless the Schema partition is being updating.
 */
if msgReplyNative.pNC^ ≠ SchemaNC() and
    ServerExtensions(hDrs).RB and not IsRecycleBinEnabled()
then
    EnableRecycleBin()
    return ERROR_DS_DRS_EXTENSIONS_CHANGED
endif

/* If the source has the Privileged Access Management optional feature enabled,
 * then it must be enabled locally unless the Schema partition is being updated.
 */
if msgReplyNative.pNC^ ≠ SchemaNC() and
    ServerExtensions(hDrs).GR9 and not IsPrivilegedAccessManagementEnabled()
then
    EnablePrivilegedAccessManagement()

```

```

    return ERROR_DS_DRS_EXTENSIONS_CHANGED
endif

/* Process object updates. */
replEntinfList := msgReplyNative.pObjects^
while (ulResult = 0) and (not replEntinfList = null)
    /* Decrypt any encrypted attribute values. */
    ulResult := DecryptValuesIfNecessary (
        hDrs,
        sourcePrefixTable,
        replEntinfList.Entinf.AttrBlock)

    if (ulResult = 0) then
        attributesAndStamps := GetStampsForUpdate(
            replEntinfList,
            sourcePrefixTable)
        /* Process objects that are moved across an NC. */
        continueProcessing := PrepareCrossNCMove(
            replEntinfList,
            sourcePrefixTable)
    endif
    if continueProcessing and (ulResult = 0) then
        if (DRS_WRIT_REP in msgIn.ulFlags) then
            writableReplica := true
        else
            writableReplica := false
        endif
        continueProcessing := AdjustInstanceTypeAttrVal(
            msgReplyNative.pNC^,
            writableReplica,
            replEntinfList,
            prefixTable)
    endif
    if continueProcessing and (ulResult = 0) then
        if (not ObjExists(replEntinfList.Entinf.pName^)) then
            ulResult := AddObject(
                replEntinfList,
                sourcePrefixTable,
                attributesAndStamps)
        else
            ulResult := UpdateObject(
                replEntinfList,
                sourcePrefixTable,
                attributesAndStamps)
        endif
    endif
    replEntinfList := replEntinfList.pNextEntInf^
endwhile

/* Enable link value updates for outbound replication
 * if inbound link value updates are detected from source. */
if (msgReplyNative.cNumValues > 0) then
    dc.fLinkValueStampEnabled = true
endif

/* Process link value updates. */
linkValueCount := 0
while (ulResult = 0) and (linkValueCount < msgReplyNative.cNumValues)
    ulResult := ProcessLinkValue(
        msgReplyNative.rgValues[linkValueCount],
        msgReplyNative.pNC^,
        prefixTable,
        msgIn.ulFlags,
        msgIn.ulMoreFlags)
    linkValueCount := linkValueCount + 1
endwhile

if (ulResult = ERROR_DS_DRA_MISSING_PARENT) then
    Send IDL_DRSGetNCChanges message again with the same input
    parameters specified in msgIn but this time with msgIn.ulFlags

```

```

    containing DRS_GET_ANC field set. It is an error for this
    condition to occur if (DRS_GET_ANC in msgIn.ulFlags) is true
else if (ulResult = ERROR_DS_DRA_RECYCLED_TARGET) then
    Send IDL_DRSGetNCChanges message again with the same input
    parameters specified in the msgIn but this time with msgIn.ulMoreFlags
    containing DRS_GET_TGT field set.
else if (msgIn.ulExtendedOp = 0) then
    /* Not an extended operation. Update "watermark" information. */
    UpdateRepsFrom(
        rf,
        msgReplyNative,
        dsaServer,
        ulResult)

    if (ulResult = 0) and (msgReplyNative.fMoreData = false) then
        UpdateUTDandPAS(
            msgReplyNative,
            msgIn.partialAttrSetEx^)
    endif
endif

return ulResult

```

4.1.10.6.2 EnableRecycleBin

```

procedure EnableRecycleBin()

```

Informative summary of behavior: The EnableRecycleBin procedure is invoked during inbound replication if the source has the **Recycle Bin optional feature** enabled but the destination does not. It adds a reference to the **object** representing the **Recycle Bin optional feature** to the **msDS-EnabledFeature attribute** of both the **nTDSDSA object** of the destination **DC** and the **Cross-Ref-Container container**. For more details, see [MS-ADTS] sections **3.1.1.9**, **3.1.1.9.1**, and **6.1.1.2.1**.

Asynchronous Processing: Initiate a logical thread of control to process the remainder of this request asynchronously and then return.

```

DSNAME rbObj := select one v from ConfigNC()
                where v!objectGuid = 766ddcd8-acd0-445e-f3b9-a7f9b6744f2a
ConfigNC(!msDS-EnabledFeature :=
    ConfigNC(!msDS-EnabledFeature + {rbObj}
DSAObj(!msDS-EnabledFeature :=
    DSAObj(!msDS-EnabledFeature + {rbObj}
return

```

4.1.10.6.3 EnablePrivilegedAccessManagement

~~Note: All of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it as an aid to the reader.~~

```

procedure EnablePrivilegedAccessManagement()

```

Informative summary of behavior: The EnablePrivilegedAccessManagement procedure is invoked during inbound replication if the source has the **Privileged Access Management** optional feature enabled but the destination does not. It adds a reference to the object representing the Privileged Access Management optional feature to the msDS-EnabledFeature attribute of both the nTDSDSA

object of the destination DC and the Cross-Ref-Container container. For more details, see [MS-ADTS] sections 3.1.1.9, 3.1.1.9.2, and 6.1.1.2.1.

```
Asynchronous Processing: Initiate a logical thread of control
to process the remainder of this request asynchronously
and then return

DSNAME e1Obj := select one v from ConfigNC()
              where v!objectGuid = ec43e873-cce8-4640-b4ab-07ffe4ab5bcd
ConfigNC()!msDS-EnabledFeature :=
  ConfigNC()!msDS-EnabledFeature + {e1Obj}
DSAObj()!msDS-EnabledFeature :=
  DSAObj()!msDS-EnabledFeature + {e1Obj}
return
```

4.1.10.6.4 PrepareCrossNCMove

```
procedure PrepareCrossNCMove(
  replEntinfList: REPLENTINFLIST,
  sourcePrefixTable: PrefixTable): boolean
```

Informative summary of behavior: The PrepareCrossNCMove procedure determines whether the object specified by the *replEntinfList* argument is being moved from one NC to another and, if so, performs preparatory work and/or terminates further processing of *replEntinfList*. The procedure returns true if further processing of **replicated update** in *replEntinfList* must has to be performed. Otherwise, it returns false.

```
proxiedNameAttrVal: ATTRVAL
proxiedNameValue: DNBinary
localProxiedNameValue: DNBinary
proxyEpoch: DWORD
localProxyEpoch: DWORD
proxyObject: DSName
proxyObjectNameValue: DNBinary
isProxy: boolean
objClassVal: ATTRVAL

proxiedNameAttrVal := ENTINF_GetValue(
  replEntinfList.Entinf,
  proxiedObjectName,
  sourcePrefixTable)
if (proxiedNameAttrVal = null) then
  /* Update is not related to cross NC move. Therefore, continue
  processing the replicated update. */
  return true
endif

/* replEntinfList corresponds to an object that has moved across an
* NC /
proxiedNameValue := ValueFromATTRVAL(
  proxiedNameAttrVal, Syntax(proxiedObjectName), sourcePrefixTable)
proxyEpoch := GetProxyEpoch(proxiedNameValue)

/* Check whether the objectClass is infrastructureUpdate. */
objClassVal := ENTINF_GetValue(replEntinfList.Entinf, objectClass,
  sourcePrefixTable)
if LocalAttidFromRemoteAttid(
  sourcePrefixTable, objClassVal.pAVal^.pVal^
  = infrastructureUpdate then
  isProxy := true
```



```

else
    isProxy := false
endif

if not isProxy then
    /* Replicated update is not for an infrastructureUpdate object. */
    proxyObject := replEntinfList.Entinf.pName^
    if (ObjExists(proxyObject)) and
        (not proxyObject!proxiedObjectName = null) then
        localProxyEpoch := GetProxyEpoch(proxyObject!proxiedObjectName)
    else
        localProxyEpoch := 0
    endif
    if (localProxyEpoch > proxyEpoch) then
        /* Local EPOCH value is higher. Don't continue processing the
        * replicated update. */
        return false
    else if (localProxyEpoch < proxyEpoch) and
        (ObjExists(proxyObject)) then
        Expunge(proxyObject)
    endif
else
    proxyObjectNameValue :=
        ValueFromATTRVAL(proxiedNameAttrVal.pVal,
            Syntax(proxiedObjectName),
            sourcePrefixTable)
    proxyObject := proxyObjectNameValue.dn
    if (ObjExists(proxyObject)) then
        localProxiedNameValue = proxyObject!proxiedObjectName
        if (localProxiedNameValue = null) then
            localProxyEpoch := 0
        else
            localProxyEpoch := GetProxyEpoch(localProxiedNameValue)
        endif
        if (localProxyEpoch < proxyEpoch) then
            Expunge(proxyObject)
        endif
    endif
endif
return true /* Continue processing the replicated update. */

```

4.1.10.6.5 AdjustInstanceTypeAttrVal

```

procedure AdjustInstanceTypeAttrVal(
    ncReplicated: DSName,
    writableReplica: DSName,
    var replEntinfList: REPLENTINFLIST,
    prefixTable: PrefixTable) : boolean

```

Informative summary of behavior: The AdjustInstanceTypeAttrVal procedure adjusts the attribute value of instanceType attribute in replEntinfList parameter to an appropriate value that suits the NC replica on the client. The procedure returns true if further processing of replicated update in replEntinfList **musthas to** be performed. Otherwise, it returns false.

```

instanceTypeAttrVal: ATTRVAL
instanceTypeAdjustedAttrVal: ATTRVAL
instanceTypeVal: ULONG
instanceTypeAdjustedVal: ULONG
ncSubRef: DSName

instanceTypeAttrVal := ENTINF_GetValue(replEntinfList.Entinf,
    instanceType, prefixTable)
if (instanceTypeAttrVal = null) then

```

```

/* If instanceType attribute is not present in Entinf
 * then there is no value to adjust. */
return true
endif

instanceTypeVal := ValueFromATTRVAL(
    instanceTypeAttrVal, Syntax(instanceType), prefixTable)

if (IT_NC_HEAD in instanceTypeVal) and
    (not ncReplicated = replEntinfList.Entinf.pName^)
/* If IT_NC_HEAD is set in instanceTypeVal and
 * replEntinfList.Entinf.pName is not the DSName of the root of the
 * NC replica that the client is replicating, then this object is
 * a subordinate reference. Take this opportunity
 * to ensure that ncReplicated!subRefs has an entry for this
 * sub-ref object.
 */
ncSubRef := replEntinfList.Entinf.pName^
if (not ncSubRef in ncReplicated!subRefs) then
    ncReplicated!subRefs := ncReplicated!subRefs + {ncSubRef}
endif
if ObjExists(ncSubRef)
/* Ensure that all sub-ref objects have the flag IT_NC_ABOVE set. */
if not IT_NC_ABOVE in ncSubRef!instanceType then
    ncSubRef!instanceType := ncSubRef!instanceType + {IT_NC_ABOVE}
endif

/* If the sub-ref object corresponds to a locally instantiated
 * child NC, then skip this update as the sub-ref object
 * will be updated when the child NC replicates in.
 */
if PartialGCReplicaExists(ncSubRef) then
    return false /* Skip processing this entry. */
endif
endif

/* If sub-ref object does not exist or exists but the child NC is not
 * locally instantiated, then continue processing this entry to
 * add or update the sub-ref object.
 */
instanceTypeAdjustedVal := instanceTypeVal + {IT_NC_ABOVE,
    IT_UNINSTANT, IT_NC_HEAD}

else
if (not writableReplica) and
    (IT_WRITE in instanceTypeVal) then
/* If the client NC replica is a partial replica then remove the
 * IT_WRITE flag from the instanceTypeVal to mark the object as
 * read-only.
 */
instanceTypeAdjustedVal := instanceTypeVal - {IT_WRITE}
else
instanceTypeAdjustedVal := instanceTypeVal
endif
endif

/* Set or reset instance type bits other than IT_WRITE and
 * IT_NC_HEAD. */
instanceTypeAdjustedVal :=
    SetResetInstanceTypeBits(instanceTypeAdjustedVal)

instanceTypeAdjustedAttrVal := ATTRVALFromValue(
    instanceTypeAdjusted, Syntax(instanceType), prefixTable)

ENTINF_SetValue(replEntinfList.Entinf, instanceType,
    instanceTypeAdjustedAttrVal, prefixTable)

return true

```

4.1.10.6.6 SetResetInstanceTypeBits

```
procedure SetResetInstanceTypeBits(y: DWORD): DWORD
```

The SetResetInstanceTypeBits procedure is an implementation-specific function that MAY<32> set or reset bits in *y* other than IT_WRITE and IT_NC_HEAD. It returns the updated value.

4.1.10.6.7 PerformModifyOperation

```
procedure PerformModifyOperation(  
  data: ENTINF,  
  updateObject: DSNAME,  
  prefixTable: PrefixTable): integer
```

The PerformModifyOperation procedure performs a modify operation with the given ENTINF to modify *updateObject*, an existing object in the directory. For more details, see [MS-ADTS] section 3.1.1.5.3.

This operation modifies the object whose DSNAME is *updateObject*. If the DN in *data.pName.StringName* is not equal to the DN of *updateObject* in *updateObject.StringName*, then let *newParentName* be the DSNAME of the parent object identified in *data.pName.StringName*, let *newRDN* be the RDN identified in *data.pName.StringName*, and call PerformModifyDNOperation(*updateObject!distinguishedName*, *newParentName*, *newRDN*). The PerformModifyDNOperation procedure call **shouldis** NOT **to** be performed as an **originating update**.

For each ATTR **attr** in *data.AttrBlock*, let *attribute* be the ATTRTYP returned by LocalAttridFromRemoteAttrid(*prefixTable*, *attr.attrType*). Then on the object modified by PerformModifyOperation, if the attribute whose ATTRTYP is *attribute* is present, all previous values are removed and replaced with the values *attr.AttrVal.pAVal[0... attr.AttrVal.valCount]*. If the attribute whose ATTRTYP is *attribute* is not present, it is added with the values *attr.AttrVal.pAVal[0... attr.AttrVal.valCount]*.

The PerformModifyOperation procedure is NOT to be performed as an originating update. The AttributeAndStamp values associated with the modified attributes **shouldmust** not be touched by this procedure. For more details about originating updates, see [MS-ADTS] section 3.1.1.1.9.

If the modify operation succeeds, the procedure returns 0. If the modify operation fails, the procedure returns a Windows error code.

4.1.10.6.8 NameObject

```
procedure NameObject(  
  replEntinfList: REPLENTINFLIST,  
  sourcePrefixTable: PrefixTable,  
  nc: DSName,  
  attributesAndStamps: set of AttributeAndStamp): DWORD
```

Informative summary of behavior: The NameObject procedure performs the necessary steps to identify an unused name for an object, whether it is being added new or renamed. This procedure has the following input parameters:

- *replEntinfList*: The replicated update to be applied.
- *sourcePrefixTable*: The prefix table from the server to translate attribute IDs.
- *nc*: The root of the NC replica that is replicated.
- *attributesAndStamps*: The AttributeAndStamp set that corresponds to the replicated update.

The method returns a Windows error code if it encounters an error while updating the object.

```
parentObject: DSNAME
newParentObject: DSNAME

parentObject := select one o from all-ts-included where
(o!objectGUID = replEntinflList.pParentGuid^)
if (parentObject = null) then
/* The client will stop processing the reply message. It will
* resend the IDL_DRSGetNCChanges request with DRS_GET_ANC set in
* ulFlags. It is an error for this condition to occur if the
* request already included DRS_GET_ANC in ulFlags.
*/
return ERROR_DS_DRA_MISSING_PARENT
endif

if (not GetObjectNC(parentObject) = nc) then
/* If parentObject exists in an NC replica other than that
* being replicated, the client stops processing the response.
* This condition indicates that parentObject has moved from one
* NC replica to another and that update has not yet been applied
* to the client NC replica containing parentObject.
* This will be rectified when the client replicates the NC
* replica containing parentObject.
*/
return ERROR_DS_DRA_OBJ_NC_MISMATCH
endif

/* Find an appropriate parent object for the object. If the parent
* object is deleted and if the new object is not a deleted -object
* then FindBestParentObject will return DSName of "Lost and Found
* container". Otherwise, the parent object will remain the same. */
newParentObject := FindBestParentObject(parentObject, replEntinflList,
sourcePrefixTable, nc, attributesAndStamps)

/* Check whether there is a name conflict (see [MS-ADTS] section
* 3.1.1) and resolve it before adding the object. */
newObjectDN := ResolveNameConflict(replEntinflList, newParentObject,
sourcePrefixTable, attributesAndStamps)

/* Set the new DN in the ENTINF. */
Copy the value of newObjectDN to replEntinflList.Entinf.pName^.StringName
and update the value in replEntinflList.Entinf.pName^.structLen and
replEntinflList.Entinf.pName^.NameLen accordingly.

return ERROR_SUCCESS;
```

4.1.10.6.9 AddObject

```
procedure AddObject(
replEntinflList: REPLENTINFLIST,
sourcePrefixTable: PrefixTable,
nc: DSName,
attributesAndStamps: set of AttributeAndStamp): DWORD
```

Informative summary of behavior: The AddObject procedure performs a replicated update by adding an object to the NC replica. This procedure has the following input parameters:

- *replEntinflList*: The replicated update to be applied.
- *sourcePrefixTable*: The prefix table from the server to translate attribute IDs.
- *nc*: The root of the NC replica that is replicated.
- *attributesAndStamps*: The AttributeAndStamp set that corresponds to the replicated update.

The procedure returns a Windows error code if it encounters an error while adding the object.

```
newObject: DSName
dwResult: DWORD
objectClassAttr: ATTRVAL
isDeletedAttr: ATTRVAL
isDeletedValue: boolean
ncNameValue: DSName
ncNameAtt: ATTRVAL
partitionsContainer: DSName
parentObject: DSName

/* Find an appropriate and unused name for the object, updating
 * replEntInfList as appropriate */
dwResult := NameObject(replEntInfList, nc, sourcePrefixTable, attributeAndStamps)

if dwResult ≠ ERROR_SUCCESS then
    return dwResult
endif

/* Check if this is a cross-ref in the partitions container replicating in.*/
objectClassAttr := ENTINF_GetValue(
    replEntInfList.Entinf,
    objectClass,
    sourcePrefixTable)
ncNameAtt := ENTINF_GetValue(
    replEntInfList.Entinf,
    ncName,
    sourcePrefixTable)
ncNameVal := ValueFromATTRVal(ncNameAtt, Syntax(ncNameAtt), sourcePrefixTable)

partitionsContainer:= DescendantObject(ConfigNC(), "CN=Partitions,")
parentObject := replEntInfList.Entinf.pName^ stripped of the first RDN.

if(crossRef in ObjectClassAttr and parentObject = partitionsContainer)
    dwResult := AddSubRef(ncNameVal)
    if dwResult ≠ 0 then
        return dwResult
    endif

    isDeletedAttr := ENTINF_GetValue(
        replEntInfList.Entinf,
        isDeleted,
        sourcePrefixTable)

    if (isDeletedAttr = null) then
        isDeletedValue := false
    else
        isDeletedValue :=
            ValueFromATTRVal(isDeletedAttr, Syntax(isDeleted), sourcePrefixTable)
    endif

    If(isDeleted Value)
        DelSubRef(ncNameVal)
    endif
endif

dwResult := PerformAddOperation(replEntInfList.Entinf, newObject,
    sourcePrefixTable, FALSE)

/* Update attribute stamps. */
if (dwResult = 0) then
    for each e in attributesAndStamps do
        SetAttrStamp(newObject, e.attribute, e.stamp)
    endfor
endif

return dwResult
```

4.1.10.6.10 UpdateObject

```
procedure UpdateObject(  
    replEntinfList: REPLENTINFLIST,  
    sourcePrefixTable: PrefixTable,  
    nc: DSName,  
    attributesAndStamps: set of AttributeAndStamp): DWORD
```

Informative summary of behavior: The UpdateObject procedure performs a replicated update by applying changes on an existing object in an NC replica. This procedure has the following input parameters:

- *replEntinfList*: The replicated update to be applied.
- *sourcePrefixTable*: The prefix table from the server to translate attribute IDs.
- *nc*: The root of the NC replica that is replicated.
- *attributesAndStamps*: The AttributeAndStamp set that corresponds to the replicated update.

The method returns a Windows error code if encounters an error while updating the object.

```
updateObject: DSName  
stampRemote: AttributeStamp  
stampLocal: AttributeStamp  
attribute: ATRTYP  
nameAttrAndStamp: AttributeAndStamp  
attrAndStamp: AttributeAndStamp  
isDeletedAttrAndStamp: AttributeAndStamp  
dwResult: DWORD  
  
updateObject := replEntinfList.Entinf.pName^  
  
/* Determine if attributesAndStamps indicates a rename operation. */  
nameAttrAndStamp := select one e from attributesAndStamps where  
    (e.attribute = name)  
if (nameAttrAndStamp = null) then  
    stampRemote := null  
else  
    stampRemote := nameAttrAndStamp.stamp  
endif  
  
stampLocal := AttrStamp(updateObject, name)  
  
if (not stampRemote = null) and  
    (AttributeStampCompare(stampRemote, stampLocal) > 0) then  
    /* This indicates that replEntinfList provides a more recent  
    * DN for updateObject. It is important to note here that a change  
    * in the name attribute is interpreted as a potential change in  
    * the full DN, not just the RDN. */  
  
    /* The NameObject function will find an appropriate, unused, local  
    * name for the object and modify the replEntInfList appropriately */  
  
    dwResult := NameObject(replEntInfList, sourcePrefixTable,  
        nc, attributeAndStamps)  
    if dwResult ≠ ERROR_SUCCESS then  
        return dwResult  
    endif  
  
    /* Perform modify operation. */  
  
    /* Compare local and remote attribute stamps and update object  
    * attribute only if the changes are more recent than what the  
    * client has seen. */  
    for i := 0 to (replEntinfList.Entinf.AttrBlock.attrCount-1)
```

```

attribute := LocalAttidFromRemoteAttid(
    sourcePrefixTable,
    replEntinfList.Entinf.AttrBlock.pAttr[i].attrTyp);
attrAndStamp := select one e from attributeAndStamps where
    (e.attribute = attribute)
stampRemote := attrAndStamp.stamp
stampLocal := AttrStamp(updateObject, attribute)
if (not stampLocal = null) and
    (AttributeStampCompare(stampRemote, stampLocal) <= 0) then
    /* This indicates the attribute on the object in the client is
    * more up to date. Do not apply the replicated update
    * corresponding to that attribute.
    */
    ENTINF_SetValue(replEntinfList.Entinf, attribute, null,
        sourcePrefixTable)
    attributesAndStamps := attributesAndStamps - {attrAndStamp}
endif
endfor

dwResult := PerformModifyOperation(replEntinfList.Entinf,
    updateObject,
    sourcePrefixTable
)

if dwResult ≠ ERROR_SUCCESS then
    return dwResult
endif

/* Update attribute stamps on the object to those corresponding to
* the replicated updates. */
for each e in attributesAndStamps do
    SetAttrStamp(updateObject, e.attribute, e.stamp)
endfor

if updateObject!isDeleted = true then
    if(crossRef in updateObject!objectClass)
        /* If this is a cross-ref being deleted, then the respective
        * sub-ref object, if any, must also be deleted.*/
        DelSubRef (updateObject!ncName)
    endif
    /* There might be attribute values left on this object that do not
    * conform to the invariants of a tombstone or deleted-object (see
    * MS-ADTS section 3.1.1.5.5). Delete the object again to create an
    * originating change of any such attribute values that need it.
    * This originating change will affect the metadata of updateObject,
    * and can explicitly affect metadata just written to the database
    * in the above SetAttrStamp procedure. */
    dwResult := RemoveObj(updateObject,false)
else
    isDeletedAttrAndStamp := select one e from attributesAndStamps where
        (e.attribute = isDeleted)
    if(isDeletedAttrAndStamp != null and crossRef in updateObject!objectClass)
        /* If this is a cross-ref being undeleted, then we must also undelete
        * the respective sub-ref object. */
        AddSubRef (updateObject!ncName)
    endif
endif

if updateObject!isRecycled = true and IsRecycleBinEnabled() then
    /* There might be attribute values left on this object that do
    * not conform to the invariants of a recycled-object (see MS-ADTS
    * section 3.1.1.5.5). Recycle the object again to create an originating
    * change of any such attribute values that need it. This
    * originating change will affect the metadata of updateObject, and
    * can explicitly affect metadata just written to the database in
    * the above SetAttrStamp procedure. */
    dwResult := RecycleObj(updateObject)
endif

```

```
return dwResult
```

4.1.10.6.11 FindBestParentObject

```
procedure FindBestParentObject(  
    parentObject: DSName,  
    replEntinflList: REPLENTINFLIST,  
    sourcePrefixTable: PrefixTable,  
    nc: DSName,  
    var attributesAndStamps: set of AttributeAndStamp): DSName
```

Informative summary of behavior: Given a desired parent object, the FindBestParentObject procedure validates whether the desired parent object is deleted. If the object that is being updated is not a deleted -object and the desired parent object is deleted, this procedure returns the DSName of the **Lost and Found container**.

Following are the input parameters for this procedure:

- *parentObject*: The DSName of the desired parent object.
- *replEntinflList*: The replicated update that ~~should~~is to be applied.
- *sourcePrefixTable*: The prefix table from the server.
- *nc*: The DSName of the root of the NC replica.
- *attributesAndStamps*: The AttributeAndStamp set that corresponds to the replicated update (can be modified by this procedure).

```
isDeletedAttr: ATTRVAL  
isDeletedValue: boolean  
attrAndStamp: AttributeAndStamp  
  
isDeletedAttr := ENTINF_GetValue(  
    replEntinflList.Entinf,  
    isDeleted,  
    sourcePrefixTable)  
if (isDeletedAttr = null) then  
    isDeletedValue := false  
else  
    isDeletedValue := ValueFromATTRVal(  
        isDeletedAttr, Syntax(isDeleted), sourcePrefixTable)  
endif  
  
if isDeletedValue = false and parentObject!isDeleted = true then  
    /* This indicates that an object was moved/created under  
    * parentObject in one NC replica while parentObject was deleted  
    * in another NC replica. In this case move/add an object under  
    * the "lost and found" container.  
    */  
  
    /* Remove attribute stamp for name so that the update is seen  
    * as an originating update. */  
    attrAndStamp := select one from attributesAndStamps where  
        (e.attribute = name)  
    attributesAndStamps := attributesAndStamps - {attrAndStamp}  
  
    return GetWellKnownObject(nc, GUID_LOSTANDFOUND_CONTAINER_W)  
endif  
  
return parentObject
```


4.1.10.6.12 ResolveNameConflict

```
procedure ResolveNameConflict(  
    replEntinfList: REPLENTINFLIST,  
    parentObject: DSName,  
    var attributesAndStamps: set of AttributeAndStamp): DN
```

Informative summary of behavior: The ResolveNameConflict procedure checks whether there is a name conflict (see [MS-ADTS] section 3.1.1) while applying a replicated update. If there is a name conflict, the procedure changes the desired DN of the object for which the replicated update is applied, or changes the DN of the existing object so that there is no name conflict. Following are the input parameters for this procedure:

replEntinfList: The update to be applied.

parentObject: The DSName of the parent object.

attributesAndStamps: The AttributeAndStamp set that corresponds to the replicated update (can be modified by this procedure).

```
objectRDN: RDN  
objectDN: DN  
rdnValue: unicodestring  
duplicateObject: DSName  
nameAttrStamp: AttributeAndStamp  
guidUpdateObj: GUID  
stampExistingObj: AttributeStamp  
stampUpdateObj: AttributeStamp  
  
objectRDN := leftmost RDN of replEntinfList.Entinf.pName^.StringName  
rdnValue := AttributeValue portion of objectRDN (see [RFC2253])  
objectDN := objectRDN followed by RDNs of  
    parentObject!distinguishedName  
duplicateObject := select one d from children parentObject where  
    (d!name = rdnValue)  
if (not duplicateObject = null) and  
    (not duplicateObject!objectGUID =  
        replEntinfList.Entinf.pName^.Guid^) then  
    /* There already exists a child object (duplicateObject) of  
     * parentObject whose name attribute value will be same as the name  
     * attribute value of the object being renamed/added. */  
    guidUpdateObj := replEntinfList.Entinf.pName^.Guid^  
    nameAttrStamp := select v from attributesAndStamps where  
        (v.attribute = name)  
    stampUpdateObj := nameAttrStamp.stamp  
    stampExistingObj := AttrStamp(duplicateObject, name)  
    if (stampExistingObj.timeChanged > stampUpdateObj.timeChanged)  
        or ((stampExistingObj.timeChanged =  
            stampUpdateObj.timeChanged)  
            and (existingObject!objectGUID > guidUpdateObj)) then  
        /* Rename the replicated object. */  
        newDN = MakeConflictDN(objectDN, guidUpdateObj)  
  
        /* Remove existing attribute stamp for name and add in a new one  
         * so that the update is seen as an originating update. */  
        attributesAndStamps := attributesAndStamps - {nameAttrStamp}  
        nameAttrStamp := originating update stamp  
        /* See MS-ADTS section 3.1.1.1.9 */  
        attributeAndStamps := attributeAndStamps + {nameAttrStamp}  
        return newDN  
    else  
        /* Rename the existing object. */  
        newDN = MakeConflictDN(  
            existingObject!distinguishedName,  
            existingObject!objectGUID)
```

```

    newRDN = The left most RDN of newDN
    PerformModifyDNOperation(existingObject!distinguishedName,
        null, newRDN)
    return objectDN
endif
else
    return objectDN /* No conflict case */
endif

```

4.1.10.6.13 MakeConflictDN

```

procedure MakeConflictDN(oldDN: DN, guid: GUID): DN

```

The MakeConflictDN procedure is used during name conflict resolution. For more details, see section 4.1.10.6.12.

A conflict name for DN *oldDN* and GUID *guid* is the DN *newDN*, such that *newDN* is the same as *oldDN* with the exception of the AttributeValue portion (as specified in [RFC2253]) of the first RDN. This portion is the concatenation of:

- The AttributeValue portion of the first RDN of *oldDN*.
- The Unicode character 0x000A.
- The Unicode string "CNF:".
- The dashed string representation of *guid*.

For example, given *oldDN* = "CN=Engineering,DC=Fabrikam,DC=com" and *guid* = a746b716-0ac0-11d2-b376-0000f87a46c8, *newDN* is "CN=Engineering#CNF:a746b716-0ac0-11d2-b376-0000f87a46c8,DC=Fabrikam,DC=com", where the # represents the Unicode character 0x000A.

The procedure returns *newDN*.

4.1.10.6.14 ProcessLinkValue

~~Note: Some of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it in the Product Behavior appendix.~~

```

procedure ProcessLinkValue(
    replValinf: REPLVALINF_NATIVE,
    nc: DSName,
    sourcePrefixTable: PrefixTable,
    ulFlags: ULONG,
    ulMoreFlags: ULONG): DWORD

```

Informative summary of behavior: The ProcessLinkValue procedure applies the replicated update of a link value. Following are the input parameters for this procedure.

- *replValinf*: The link value replicated update.
- *nc*: The DSName of the root of the NC replica where the replicated update is applied.
- *sourcePrefixTable*: The prefix table from the server.
- *ulFlags*: A DRS_OPTIONS bit field.

- *ulMoreFlags*: A DRS_MORE_GETCHGREQ_OPTIONS bit field.

```

updateObject: DSName
targetObject: DSName
isDeleted: boolean
attribute: ATTRTYP
attributeValue: attribute value
attributeValues: set of attribute value
newAttributeValue: attribute value
localValueStamp: LinkValueStamp
remoteValueStamp: LinkValueStamp

updateObject := replValinf.pObject^

if (not ObjExists(updateObject)) then
  /* The client will stop processing the reply message. It will
  * resend the IDL_DRSGetNCChanges request with DRS_GET_ANC set
  * in ulFlags. It is an error for this condition to occur if the
  * request already included DRS_GET_ANC in ulFlags. */
  return ERROR_DS_DRA_MISSING_PARENT
endif

if (IsRecycleBinEnabled()) then
  isRecycled := updateObject!isRecycled
  if (isRecycled = true) then
    if (DRS_GET_ANC in ulFlags) then
      /* Local object is recycled, and it is up-to-date.
      Replicated update is not applied on a recycled object */
      return 0
    else
      /* Local object is recycled, but it maymight not be up-to-date. */
      return ERROR_DS_DRA_MISSING_PARENT
    endif
  endif
else
  isDeleted := updateObject!isDeleted
  if (isDeleted = true) then
    if (DRS_GET_ANC in ulFlags) then
      /* Local object is deleted, and it is up-to-date.
      Replicated update is not applied on a deleted -object.*/
      return 0
    else
      /* Local object is deleted, but it maymight not be up-to-date. */
      return ERROR_DS_DRA_MISSING_PARENT
    endif
  endif
endif

attribute := replValinf.attrTyp
attributeValues := GetAttrVals(updateObject, attribute, true)
attributeValue := select one k from attributeValues where
  (k = ValueFromATTRVAL(
    sourcePrefixTable, Syntax(attribute), replValInf.pAval))
if (attributeValue = null) then
  localValueStamp := null
else
  /* If attributeValue was last updated when the forest functional
  * level was DS_BEHAVIOR_WIN2000, no LinkValueStamp is
  * associated with attributeValue. In that case the procedure
  * LinkStamp() returns null.
  */
  localValueStamp :=
    LinkStamp(updateObject, attribute, attributeValue)
endif

remoteValueStamp := AbstractLinkValStampFromConcreteLinkValStamp(
  replValinf.Metadata)

if (localValueStamp = null) or

```

```

(LinkValueStampCompare(localValueStamp, remoteValueStamp) < 0)
    then
/* The replicated update is more up to date. Apply that change and
 * modify the stamp. */

newAttributeValue = ValueFromATTRVAL(
    sourcePrefixTable, Syntax(attribute), replValInf.pAval)
targetObject = GetDSNameFromAttrVal( replValInf.attrTyp, replValInf.pAval)
if ((IsRecycleBinEnabled() and targetObject!isRecycled) or
    (not IsRecycleBinEnabled() and targetObject!isDeleted)) then
    if (DRS_GET_TGT in ulMoreFlags) then
        /* nothing to do */
        return 0
    else
        return ERROR_DS_DRA_RECYCLED_TARGET
    endif
if (not attributeValue = null) then
    /* Remove the old attribute value. */
    RemoveAttrVal(updateObject, attribute, attributeValue)
endif

SetAttrVal(updateObject, attribute, newAttributeValue)
/* If the abstract variable timeDeleted associated with the
 * attribute value has a non-zero value, it indicates that the
 * value has been deleted from the NC replica. */
if (replValInf.fIsPresent = false) then
    remoteValueStamp.timeDeleted := current time on the client
else
    remoteValueStamp.timeDeleted := 0
endif
SetLinkStamp(updateObject, attribute, newAttributeValue,
    remoteValueStamp)
endif
return 0

```

4.1.10.6.15 UpdateRepsFrom

~~Note: Some of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it in the Product Behavior appendix.~~

```

procedure UpdateRepsFrom(
    rf: RepsFrom,
    msgReplyNative: DRS_MSG_GETCHGREPLY_NATIVE,
    dsaServer: DSName,
    ulResult: DWORD)

```

Informative summary of behavior: Using the UpdateRepsFrom procedure, the client updates the repsFrom abstract variable after it applies the response message received from the server. Following are the input parameters for this procedure.

- *rf*: The RepsFrom for the server.
- *msgReplyNative*: The IDL_DRSGetNCChanges response from the server.
- *dsaServer*: The DSName of the nTDSDSA object of the server.
- *ulResult*: A Windows error code that indicates whether or not the replicated updates in the response message are applied successfully.

```
rfOld: RepsFrom
```

```

currentTime: DSTIME
nc: DSName

nc := msgReplyNative.pNC^
rfOld := select one v from nc!repsFrom where
    (v.uuidDsa = dsaServer!objectGUID)
if rfOld ≠ null then
    nc!repsFrom := nc!repsFrom - {rfOld} /* remove old entry */
endif

currentTime := current time on the client
rf.timeLastAttempt := currentTime
if (ulResult = 0) then
    rf.consecutiveFailures := 0
    rf.timeLastSuccess := currentTime
    rf.resultLastAttempt := 0
    rf.uuidInvocId := msgReplyNative.uuidInvocIdSrc
    rf.usnVec := msgReplyNative.usnvecTo
    rf.resultLastAttempt := 0
else
    rf.consecutiveFailures := rf.consecutiveFailures + 1
    rf.resultLastAttempt := ulResult
endif

nc!repsFrom := nc!repsFrom + {rfNew}

```

4.1.10.6.16 UpdateUTDandPAS

~~Note: Some of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it in the Product Behavior appendix.~~

```

procedure UpdateUTDandPAS(
    msgReplyNative: DRS_MSG_GETCHGREPLY_NATIVE,
    partialAttrSetEx: PARTIAL_ATTR_VECTOR_V1_EXT,
    nc: DSName)

```

Informative summary of behavior: If the client has applied all replicated updates in the response message of IDL_DRSGetNCChanges from the server, and if the replication cycle is complete, then the client updates the replUpToDateVector and partialAttributeSet abstract attributes, as specified in the UpdateUTDandPAS procedure. This procedure has the following input parameters.

- *msgReplyNative*: The IDL_DRSGetNCChanges response from the server.
- *partialAttrSetEx*: The PARTIAL_ATTR_VECTOR_V1_EXT structure that contains attributes to be added to the partialAttributeSet abstract variable.
- *nc*: The DSName of the root of the NC replica where the replicated update is applied.

```

partialAttrSetAdd: sequence of ATTRTYP
remoteCursor: UPTODATE_CURSOR_V2
localCursor: ReplUpToDateVector
newCursor: ReplUpToDateVector
nc: DSName
i: DWORD
nc := msgReplyNative.pNC^

/* Update partialAttributeSet abstract attribute. */
if (not partialAttrSetEx.cAttrs = 0) then
    partialAttrSetAdd = AbstractPASFromConcretePAS(partialAttrSetEx)

```

```

nc!partialAttributeSet :=
    nc!partialAttributeSet + partialAttrSetAdd
endif

/* Merge replUpToDateVector abstract attribute */
for i := 0 to msgReplyNative.pUpToDateVecSrc^.cNumCursors - 1
    remoteCursor := msgReplyNative.pUpToDateVecSrc^.rgCursors[i]
    localCursor := select one v from nc!replUpToDateVector where
        (v.uuidDsa = remoteCursor.uuidDsa)
    if (localCursor = null) then
        /* An entry for the server does not exist; add it. */
        newCursor.uuidDsa := remoteCursor.uuidDsa
        newCursor.usnHighPropUpdate := remoteCursor.usnHighPropUpdate
        newCursor.timeLastSyncSuccess := remoteCursor.timeLastSyncSuccess
        nc!replUpToDateVector := nc!replUpToDateVector + {newCursor}
    else
        /* Update existing entry for the server. */
        if (localCursor.usnHighPropUpdate <
            remoteCursor.usnHighPropUpdate) then
            newCursor.usnHighPropUpdate := remoteCursor.usnHighPropUpdate
            newCursor.timeLastSyncSuccess :=
                remoteCursor.timeLastSyncSuccess
            newCursor.uuidDsa := remoteCursor.uuidDsa
            nc!replUpToDateVector :=
                nc!replUpToDateVector - {localCursor} + {newCursor}
        endif
    endif
endif
endfor

return

```

4.1.10.6.17 DecryptValuesIfNecessary

```

procedure DecryptValuesIfNecessary(
    hDrs: DRS_HANDLE,
    prefixTable: PrefixTable,
    var attrBlock: ATTRBLOCK): DWORD

```

Informative summary of behavior: The values of several attributes are encrypted by the server and conversely must have to be decrypted by the client before processing object updates. The client decrypts the encrypted data by using MD5 digest (as specified in [RFC1321]), a CRC32 checksum (as specified in [ISO/IEC 13239]), and RC4 stream cipher (as specified in [RC4]). The DecryptValuesIfNecessary procedure specifies the process of attribute value decryption.

Following are the input parameters for this method.

- *hDrs*: The DRS_HANDLE derived by sending IDL_DRSBind to the server.
- *prefixTable*: The prefix table used to translate attribute IDs.
- *attrBlock*: The ATTRBLOCK structure that is derived from the response of the IDL_DRSGetNCChanges message. If *attrBlock* has attribute values that need to be decrypted, then the values are decrypted in place. That is, at the end of the procedure call, the **pVal** field in the ATTRVAL structure refers to the decrypted attribute value.

The procedure returns a Windows error code on failure. Otherwise, it returns 0.

```

localAttid: ATTRTYP
attr: ATTR
pPayload: ADDRESS OF ENCRYPTED_PAYLOAD
salt: sequence of BYTE

```

```

sessionKey: sequence of BYTE
i: integer
j: integer
crcComputed: ULONG
crcReceived: ULONG
md5Context: MD5_CTX

/* Get session key associated with the RPC connection. */
sessionKey := session key associated with security context of hDrs,
  as specified by [MS-RPCE] section 3.3.1.5.2, "Building and Using a
  Security Context", and [MS-KILE] section 3.1.1.2, "Cryptographic
  Material"

for j := 0 to (attrBlock.attrCount - 1)
  attr := attrBlock.pAttr[j]
  localAttid = LocalAttidFromRemoteAttid(prefixTable, attr.attrTyp)
  if IsSecretAttribute(localAttid) then
    /* Decrypt all values of this attribute. */
    for i := 0 to (attr.AttrVal.valCount - 1)
      pPayload := attr.AttrVal.pAVal[i].pVal
      salt := pPayload^.Salt
      /* Compute encryption key. */
      MD5Init(md5Context)
      MD5Update(md5Context, sessionKey, sessionKey.length)
      MD5Update(md5Context, salt, 16)
      MD5Final(md5Context)

      Decrypt (attr.AttrVal.pAVal[i].valLen - 16) bytes starting at
      the address of pPayload^.Checksum using the RC4 stream cipher
      algorithm [RC4] with encryption key md5Context.digest. At the
      end of this operation pPayload^.EncryptedData field contains
      decrypted attribute value.

      /* Calculate checksum of the clear value. */
      crcComputed :=
        CRC32 [ISO/IEC 13239] of the
          (attr.AttrVal.pAVal[i].valLen - 20)
          bytes starting at pPayload^.EncryptedData
      crcReceived := pPayload^.Checksum
      if (not crcComputed = crcReceived) then
        /* Checksums don't match. Stop processing the reply message.
        */
        return SEC_E_ALGORITHM_MISMATCH
      endif

      /* Modify ATTRVAL structure to have decrypted data. */
      attr.AttrVal.pAVal[i].valLen :=
        attr.AttrVal.pAVal[i].valLen - 20
      attr.AttrVal.pAVal[i].pVal := ADR(pPayload^.EncryptedData)
    endfor
  endif
endfor
return 0

```

4.1.10.6.18 DecompressReplyMessage

~~Note: Some of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it in the Product Behavior appendix.~~

```

procedure DecompressReplyMessage(

```

```

msgOut: DRS_MSG_GETCHREPLY,
dwOutVersion: DWORD): DRS_MSG_GETCHGREPLY_NATIVE

```

Informative summary of behavior: Compression subdivides a data stream into sequences of bytes called **compression chunks**. The DecompressReplyMessage procedure decompresses the data stream.

```

pInBuffer: sequence of BYTE
pOutBuffer: sequence of BYTE
cbInBufferCompress: DWORD
cbInBufferDeCompress: DWORD

if (dwOutVersion = 2) or
(dwOutVersion = 7) then
/* decompress data that is compressed.
*/
if (dwOutVersion = 2) then
pInBuffer := msgOut.V2.CompressedV1.pbCompressedData
cbInBufferCompress := msgOut.CompressedV1.cbCompressedSize
cbInBufferDeCompress := msgOut.CompressedV1.cbUncompressedSize
compressionAlg := DRS_COMP_ALG_MSZIP
else if (dwOutVersion = 7) then
pInBuffer := msgOut.V7.CompressedAny.pbCompressedData
cbInBufferCompress := msgOut.V7.CompressedAny.cbCompressedSize
cbInBufferDeCompress :=
msgOut.V7.CompressedAny.cbUncompressedSize
compressionAlg := msgOut.V7.CompressionAlg
endif

DecompressMessage(pInBuffer, cbInBufferCompress, cbOutBufferCompress,
compressionAlg, pOutputBuffer)

/* pOutputBuffer now has the uncompressed data that was derived by
* serializing a DRS_GETCHGREPLY structure at the server.
* Convert the serialized data back to DRS_GETCHGREPLY structure.*/
if dwOutVersion = 2 then
dwOutVersion := 1
else
dwOutVersion := msgOut.V7.dwCompressedVersion
endif
msgOut := Unpickling of data in pOutBuffer of length cbOutBuffer,
as specified by [C311] Part 2, "IDL/NDR Pickles", and
[MS-RPCE] sections 2.2.6 and 2.2.7, "Type Serialization
Version 1" and "Type Serialization Version 2"

endif

return GetNCChangesNativeReply(msgOut, dwOutVersion)

```

4.1.10.6.19 DecompressMessage

```

procedure DecompressMessage(
pInBuffer: sequence of BYTE,
cbInBufferCompress: DWORD,
cbInBufferDeCompress: DWORD,
DRS_COMP_ALG_TYPE: compressionAlg
ref pOutputBuffer: sequence of BYTE)

```

Informative summary of behavior: Compression subdivides a data stream into sequences of bytes called compression chunks. The DecompressMessage procedure decompresses the data stream.

The following table identifies the size of the compression chunk for each algorithm type.

Algorithm	Chunk size
COMP_ALG_NONE	Not applicable
COMP_ALG_MSZIP	32768
COMP_ALG_W2K3	65536

Each compression chunk in the compressed byte sequence is represented by means of a COMPRESSED_DATA structure.

```

pInBlock: ADDRESS OF COMPRESSED_DATA
cbInputProcessed: DWORD
cbDecompressedData: DWORD

if (cbInBufferCompress = cbInBufferDecompress) then
  /* No decompression required here. */
  pOutBuffer := pInBuffer
  cbOutBuffer := cbInBufferDeCompress
else
  cbInputProcessed := 0
  while (cbInputProcessed ≤ cbInBufferCompress)
    pInBlock := ADR(pInputBuffer[cbInputProcessed])
    if (pInBlock^.cbDecompressedSize =
        pInBlock^.cbCompressedSize) then
      pDecompressedData := pInBlock^.data
      cbDecompressedData := pInBlock^.cbDecompressedSize
    else
      if (compressionAlg = DRS_COMP_ALG_MSZIP) then
        pDecompressedData :=
          Decompress pInBlock^.data in accordance
            with [RFC1951].
      else
        pDecompressedData := new sequence of BYTE of length
          pInBlock^.cbDecompressedSize
        CompressOrDecompressWin2k3(pInBlock^.data,
          pInBlock^.cbDecompressedSize,
          pDecompressedData, FALSE)
      endif
      cbDecompressedData := pInBlock^.cbDecompressedSize
    endif
    pOutputBuffer := Append sequence of BYTE pDeCompressedData of
      size cbDecompressedData to sequence of BYTE
      pOutputBuffer
    cbOutputBuffer :=
      cbOutputBuffer + pInBlock^.cbDecompressedSize
    cbInputProcessed := cbInputProcessed +
      pInBlock^.cbCompressedSize
    Round up value in cbInputProcessed such that
      ADR(pInBlock[cbInputProcessed]) align on double word
      boundary.
  endwhile
endif

```

4.1.10.7 Examples of the IDL_DRSGetNCChanges Method - Add User

4.1.10.7.1 Initial State

User "Kim Akers" is created on DC1 with the sAMAccountName "KimAkers"

```
ldap_add_s("CN=Kim Akers,CN=Users,DC=contoso,DC=com", [sAMAccountName])
```

Added {CN=Kim Akers,CN=Users,DC=contoso,DC=com }.

Querying the nTDSDSA objects for the ~~forest~~ root domain NC DC=CONTOSO, DC=COM for DC1:

- `ldap_search_s("CN=NTDS Settings,CN=DC1,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com", baseObject, "(objectClass=*)", [objectClass, cn ... objectGUID])`
- Result <0>: (null)
- Matched DNs:
- Getting 1 entries:
- >> Dn: CN=NTDS Settings,CN=DC1,CN=Servers, CN=Default-First-Site-Name,CN=Sites, CN=Configuration,DC=contoso,DC=com
 - 3> objectClass: top; applicationSettings; nTDSDSA;
 - 1> cn: NTDS Settings;
 - 1> distinguishedName: CN=NTDS Settings,CN=DC1,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com;
 - 1> objectGUID: c20bc312-4d35-4cc0-9903-b1073368af4a;

Querying the user object "CN=Kim Akers, CN=Users, DC=CONTOSO, DC=COM" on DC1:

- `ldap_search_s("CN=Kim Akers,CN=Users,DC=contoso,DC=com", baseObject, "(objectClass=*)", [objectClass, cn ... objectCategory])`
- Result <0>: (null)
- Matched DNs:
- Getting 1 entries:
- >> Dn: CN=Kim Akers,CN=Users,DC=contoso,DC=com
 - 4> objectClass: top; person; organizationalPerson; user;
 - 1> cn: Kim Akers;
 - 1> sn: Dow;
 - 1> givenName: Kim;
 - 1> distinguishedName: CN=Kim Akers,CN=Users,DC=contoso,DC=com;
 - 1> instanceType: 0x4 = (IT_WRITE);
 - 1> whenCreated: 07/17/2006 13:50:32 Pacific Standard Pacific Daylight Time;
 - 1> whenChanged: 07/17/2006 13:50:33 Pacific Standard Pacific Daylight Time;
 - 1> displayName: Kim Akers;
 - 1> uSNCreated: 29345;
 - 1> uSNChanged: 29350;
 - 1> name: Kim Akers;
 - 1> objectGUID: 39ab8618-d3fd-410c-b627-64b65104384d;

- 1> userAccountControl: 0x200 = (UF_NORMAL_ACCOUNT);
- 1> badPwdCount: 0;
- 1> codePage: 0;
- 1> countryCode: 0;
- 1> badPasswordTime: 01/01/1601 00:00:00 UNC ;
- 1> lastLogoff: 01/01/1601 00:00:00 UNC ;
- 1> lastLogon: 01/01/1601 00:00:00 UNC ;
- 1> pwdLastSet: 07/17/2006 13:50:33 Pacific Standard Time Pacific Daylight Time;
- 1> primaryGroupID: 513;
- 1> objectSid: S-1-5-21-254470460-2440132622-709970653-1129;
- 1> accountExpires: 09/14/30828 02:48:05 UNC ;
- 1> logonCount: 0;
- 1> sAMAccountName: KimAkers;
- 1> sAMAccountType: SAM_NORMAL_USER_ACCOUNT;
- 1> userPrincipalName: KimAkers@contoso.com;
- 1> objectCategory: CN=Person,CN=Schema,CN=Configuration,DC=contoso,DC=com;

Querying the repsFrom attribute on the NC root object for domain DC=CONTOSO, DC=COM on DC2:

- ldap_search_s("DC=contoso,DC=com", *baseObject*, "(objectclass=*)",)
- Result <0>: (null)
- Matched DNs:
- Getting 1 entries:
- >> Dn: DC=contoso,DC=com
 - 1> repsFrom: dwVersion = 1, V1.cb: 276, V1.cConsecutiveFailures: 4
 - V1.timeLastSuccess: 12797642625 V1.timeLastAttempt: 12797643058
 - V1.ulResultLastAttempt: 0x2108 V1.cbOtherDraOffset: 216
 - V1.cbOtherDra: 60 V1.ulReplicaFlags: 0x70
 - V1.rtSchedule: <ldap:skipped> V1.usnvec.usnHighObjUpdate: 29322
 - V1.usnvec.usnHighPropUpdate: 29322
 - V1.uuidDsaObj: c20bc312-4d35-4cc0-9903-b1073368af4a
 - V1.uuidInvocId: c20bc312-4d35-4cc0-9903-b1073368af4a
 - V1.uuidTransportObj: 00000000-0000-0000-0000-000000000000
 - V1.mtx_address: c20bc312-4d35-4cc0-9903-b1073368af4a._msdcs.contoso.com

- V1.cbPASDataOffset: 0

Where V1 represents the REPS_FROM structure. V1.mtx_address represents the MTX_ADDR structure stored in the data field of the REPS_FROM structure.

Querying the user object "CN=Kim Akers, CN=Users, DC=CONTOSO, DC=COM" on DC2 returns no entries because the object is not present on DC2.

- ldap_search_s("CN=Kim Akers,CN=Users,DC=contoso,DC=com", *singleLevel*, "(objectclass=*)", *null*)
- Error: Search: No Such Object.
- Matched DNs: CN=Users,DC=contoso,DC=com
- Getting 0 entries:

4.1.10.7.2 Client Request

DC2 invokes the IDL_DRSGetNCChanges method against DC1, with the following parameters (DRS_HANDLE to DC1 omitted):

- *dwInVersion* = 10
- *pmsgIn* = DRS_MSG_GETCHGREQ_V10
 - Destination DSA objGuid: _GUID {6aad8f5a-07cc-403a-9696-9102fe1c320b}
 - Source DSA Invocation ID: _GUID {c20bc312-4d35-4cc0-9903-b1073368af4a}
 - usnvecFrom: USN_VECTOR
 - usnHighObjUpdate : 29322
 - usnHighPropUpdate : 29322
 - pUpToDateVecDest : UPTODATE_VECTOR_V1_EXT
 - DSA Invoc ID: 9876730c-5844-4c94-b0bd-28458be39333, USN: 27359
 - DSA Invoc ID: c20bc312-4d35-4cc0-9903-b1073368af4a, USN: 29335
 - ulFlags:
 - DRS_ASYNC_OP
 - DRS_WRIT_REP
 - DRS_INIT_SYNC
 - DRS_PER_SYNC
 - Max objects to return: 535
 - Max bytes to return: 5357731
 - Extended operation: none
 - Fsmo Info: 0
 - PrefixTableDest : SCHEMA_PREFIX_TABLE
 - ulMoreFlags: 0

4.1.10.7.3 Server Response

~~Note: Some of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it in the Product Behavior appendix.~~

Return code of 0 with the following values:

- *pdwOutVersion*= DRS_MSG_GETCHGREPLY_NATIVE_VERSION_NUMBER
- *pmsgOut* = DRS_MSG_GETCHGREPLY_NATIVE
 - *uuidDsaObjSrc*: _GUID {c20bc312-4d35-4cc0-9903-b1073368af4a}
 - *uuidInvocIdSrc*: _GUID {c20bc312-4d35-4cc0-9903-b1073368af4a}
 - *pNC*: DSNAME DC=CONTOSO,DC=COM
 - *usnvecFrom* : USN_VECTOR
 - *usnHighObjUpdate* : 29322
 - *usnHighPropUpdate* : 29322
 - *usnvecTo*: USN_VECTOR
 - *usnHighObjUpdate* : 29379
 - *usnHighPropUpdate* : 29379
 - *pUpToDateVecSrc* : UPTODATE_VECTOR_V2_EXT
 - DSA Invoc ID: c20bc312-4d35-4cc0-9903-b1073368af4a,
 - *usnHighPropUpdate* : 29379, *timeLastSyncSuccess* : 12797643933
 - *PrefixTableSrc* : SCHEMA_PREFIX_TABLE
 - *pObjects*: REPLENTINFLIST
 - *objectClass*: top; person; organizationalPerson; user;
 - *sn*: Akers;
 - *givenName*: Kim;
 - *instanceType*: 0x4 = (IT_WRITE);
 - *whenCreated*: 07/17/2006 13:50:32 Pacific Standard Daylight Time;
 - *whenChanged*: 07/17/2006 14:05:21 Pacific Standard Daylight Time;
 - *displayName*: Kim Akers;
 - *nTSecurityDescriptor*: *binary data*
 - *objectGUID*: 39ab8618-d3fd-410c-b627-64b65104384d;
 - *codePage*: 0;
 - *countryCode*: 0;

- dBCSPwd: *binary data*
- logonHours: 0
- unicodePwd: *binary data*
- ntPwdHistory: *binary data*
- pwdLastSet: 07/17/2006 13:50:33 Pacific Standard Daylight Time;
- sAMAccountName: KimAkers;
- sAMAccountType: SAM_NORMAL_USER_ACCOUNT;
- userPrincipalName: KimAkers@contoso.com;
- objectCategory: CN=Person, CN=Schema, CN=Configuration, DC=contoso, DC=com;
- rgValues: (null)

4.1.10.7.4 Final State

Querying the repsFrom attribute on the NC root object for the domain DC=CONTOSO, DC=COM on DC2:

- ldap_search_s("DC=contoso,DC=com", *baseObject*, "(objectclass=*)", *repsFrom*)
- Result <0>: (null)
- Matched DNs:
- Getting 1 entries:
- >> Dn: DC=contoso,DC=com
 - 1> repsFrom: dwVersion = 1, V1.cb: 276, V1.cConsecutiveFailures: 0
 - V1.timeLastSuccess: 12797643933 V1.timeLastAttempt: 12797643933
V1.ulResultLastAttempt: 0x0 V1.cbOtherDraOffset: 216
 - V1.cbOtherDra: 60 V1.ulReplicaFlags: 0x70
 - V1.rtSchedule: <ldp:skipped> V1.usnvec.usnHighObjUpdate: 29379
V1.usnvec.usnHighPropUpdate: 29379
 - V1.uuidDsaObj: c20bc312-4d35-4cc0-9903-b1073368af4a
 - V1.uuidInvocId: c20bc312-4d35-4cc0-9903-b1073368af4a V1.uuidTransportObj:
00000000-0000-0000-0000-000000000000 V1.mtx_address: c20bc312-4d35-4cc0-9903-
b1073368af4a._msdcs.contoso.com
 - V1.cbPASDataOffset: 0 V1.PasData: version = -1, size = -1, flag = -1

Querying the user object "CN=Kim Akers, CN=Users, DC=CONTOSO,DC=COM" on DC2, which is now present:

- ldap_search_s("CN=Kim Akers,CN=Users,DC=contoso,DC=com", *baseObject*, "(objectclass=*)", [*objectClass, cn ... objectCategory*])
- Result <0>: (null)
- Matched DNs:

- Getting 1 entries:
- >> Dn: CN=Kim Akers,CN=Users,DC=contoso,DC=com
 - 4> objectClass: top; person; organizationalPerson; user;
 - 1> cn: Kim Akers;
 - 1> sn: Akers;
 - 1> givenName: Kim;
 - 1> distinguishedName: CN=Kim Akers,CN=Users,DC=contoso,DC=com;
 - 1> instanceType: 0x4 = (IT_WRITE);
 - 1> whenCreated: 07/17/2006 13:50:32 Pacific Standard Daylight Time;
 - 1> whenChanged: 07/17/2006 14:05:21 Pacific Standard Daylight Time;
 - 1> displayName: Kim Akers;
 - 1> uSNCreated: 38197;
 - 1> uSNChanged: 38197;
 - 1> name: Kim Akers;
 - 1> objectGUID: 39ab8618-d3fd-410c-b627-64b65104384d;
 - 1> userAccountControl: 0x200 = (UF_NORMAL_ACCOUNT);
 - 1> codePage: 0;
 - 1> countryCode: 0;
 - 1> pwdLastSet: 07/17/2006 13:50:33 Pacific Standard Daylight Time;
 - 1> primaryGroupID: 513;
 - 1> objectSid: S-1-5-21-254470460-2440132622-709970653-1129;
 - 1> accountExpires: 09/14/30828 02:48:05 UNC ;
 - 1> sAMAccountName: KimAkers;
 - 1> sAMAccountType: SAM_NORMAL_USER_ACCOUNT;
 - 1> userPrincipalName: KimAkers@contoso.com;
 - 1> objectCategory: CN=Person, CN=Schema, CN=Configuration, DC=contoso, DC=com;

4.1.10.8 Examples of the IDL_DRSGetNCChanges Method - Add User to a Group

4.1.10.8.1 Initial State

User "Kim Akers" is added to the group ([\[MS-ADSC\] section 2.14.](#)) "GroupA" on DC1.

Querying the repsFrom attribute on the NC root object for the domain DC=CONTOSO, DC=COM on DC2:

- ldap_search_s("DC=contoso,DC=com", *baseObject*, "(objectclass=*)", *repsFrom*)

- Result <0>: (null)
- Matched DNs:
- Getting 1 entries:
- >> Dn: DC=contoso,DC=com
 - 1> repsFrom: dwVersion = 1,
 - V1.cb: 276, V1.cConsecutiveFailures: 3 V1.timeLastSuccess: 12797643933 V1.timeLastAttempt: 12797645671 V1.ulResultLastAttempt: 0x2108 V1.cbOtherDraOffset: 216 V1.cbOtherDra: 60 V1.ulReplicaFlags: 0x70
 - V1.rtSchedule: <ldp:skipped> V1.usnvec.usnHighObjUpdate: 29379 V1.usnvec.usnHighPropUpdate: 29379
 - V1.uuidDsaObj: c20bc312-4d35-4cc0-9903-b1073368af4a V1.uuidInvocId: c20bc312-4d35-4cc0-9903-b1073368af4a V1.uuidTransportObj: 00000000-0000-0000-0000-000000000000 V1.mtx_address: c20bc312-4d35-4cc0-9903-b1073368af4a._msdcs.contoso.com
 - V1.cbPASDataOffset: 0 V1.PasData: version = -1, size = -1, flag = -1 ;

Querying the group object "CN=GroupA, CN=Users, DC=CONTOSO, DC=COM" on DC1:

- ldap_search_s("CN=GroupA, CN=Users, DC=contoso, DC=com", *baseObject*, "(objectclass=*)", [*objectClass, cn ... objectCategory*])
- Result <0>: (null)
- Matched DNs:
- Getting 1 entries:
- >> Dn: CN=GroupA,CN=Users,DC=contoso,DC=com
 - 2> objectClass: top; group;
 - 1> cn: GroupA;
 - 2> member: CN=Kim Akers,CN=Users,DC=contoso,DC=com;
 - 1> distinguishedName: CN=GroupA,CN=Users,DC=contoso,DC=com;
 - 1> instanceType: 0x4 = (IT_WRITE);
 - 1> whenCreated: 07/13/2006 12:25:35 Pacific Standard Daylight Time;
 - 1> whenChanged: 07/17/2006 14:34:12 Pacific Standard Daylight Time;
 - 1> uSNCreated: 16023;
 - 1> uSNChanged: 29387;
 - 1> name: GroupA;
 - 1> objectGUID: 328ab893-b884-4e31-a73c-71740e261715;
 - 1> objectSid: S-1-5-21-254470460-2440132622-709970653-1114;
 - 1> sAMAccountName: GroupA;
 - 1> sAMAccountType: 536870912;

- 1> groupType: 0x80000004 = (GROUP_TYPE_RESOURCE_GROUP | GROUP_TYPE_SECURITY_ENABLED);
- 1> objectCategory: CN=Group,CN=Schema,CN=Configuration,DC=contoso,DC=com;

Querying the **group object** "CN=GroupA, CN=Users, DC=CONTOSO, DC=COM" on DC2, the member attribute value is not returned, as it is currently empty because this group has no members on DC2.

- ldap_search_s("CN=GroupA, CN=Users, DC=contoso, DC=com", *baseObject*, "(objectclass=*)", [*objectClass, cn ... objectCategory*])
- Result <0>: (null)
- Matched DNs:
- Getting 1 entries:
 - >> Dn: CN=GroupA,CN=Users,DC=contoso,DC=com
 - 2> objectClass: top; group;
 - 1> cn: GroupA;
 - 1> distinguishedName: CN=GroupA,CN=Users,DC=contoso,DC=com;
 - 1> instanceType: 0x4 = (IT_WRITE);
 - 1> whenCreated: 07/13/2006 12:25:35 Pacific Standard Daylight Time;
 - 1> whenChanged: 07/13/2006 12:36:03 Pacific Standard Daylight Time;
 - 1> uSNCreated: 26457;
 - 1> uSNChanged: 26543;
 - 1> name: GroupA;
 - 1> objectGUID: 328ab893-b884-4e31-a73c-71740e261715;
 - 1> objectSid: S-1-5-21-254470460-2440132622-709970653-1114;
 - 1> sAMAccountName: GroupA;
 - 1> sAMAccountType: 536870912;
 - 1> groupType: 0x80000004 = (GROUP_TYPE_RESOURCE_GROUP | GROUP_TYPE_SECURITY_ENABLED);
 - 1> objectCategory: CN=Group, CN=Schema, CN=Configuration, DC=contoso, DC=com;

4.1.10.8.2 Client Request

DC2 invokes the method IDL_DRSGetNCChanges against DC1, with the following parameters (DRS_HANDLE to DC1 omitted):

- *dwInVersion* = 10
- *pmsgIn* = DRS_MSG_GETCHGREQ_V10
 - Destination DSA objGuid: _GUID {6aad8f5a-07cc-403a-9696-9102fe1c320b}
 - Source DSA Invocation ID: _GUID {c20bc312-4d35-4cc0-9903-b1073368af4a}

- usnvecFrom: USN_VECTOR
 - usnHighObjUpdate : 29379
 - usnHighPropUpdate : 29379
- pUpToDateVecDest : UPTODATE_VECTOR_V1_EXT
 - DSA Invoc ID: c20bc312-4d35-4cc0-9903-b1073368af4a, USN: 29379
- Flags:
 - DRS_ASYNC_OP
 - DRS_WRIT_REP
 - DRS_INIT_SYNC
 - DRS_PER_SYNC
- Max objects to return: 535
- Max bytes to return: 5357731
- Extended operation: none
- Fsmo Info: 0
- PrefixTableDest : SCHEMA_PREFIX_TABLE
- ulMoreFlags: 0

4.1.10.8.3 Server Response

~~Note: Some of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it in the Product Behavior appendix.~~

Return code of 0 with the following values:

- *pdwOutVersion*= DRS_MSG_GETCHGREPLY_NATIVE_VERSION_NUMBER
- *pmsgOut* = DRS_MSG_GETCHGREPLY_NATIVE
 - *uuidDsaObjSrc*: _GUID {c20bc312-4d35-4cc0-9903-b1073368af4a}
 - *uuidInvocIdSrc*: _GUID {c20bc312-4d35-4cc0-9903-b1073368af4a}
 - *pNC*: DSNAME DC=CONTOSO,DC=COM
 - *usnvecFrom* : USN_VECTOR
 - usnHighObjUpdate : 29379
 - usnHighPropUpdate : 29379
 - *usnvecTo*: USN_VECTOR
 - usnHighObjUpdate : 29389
 - usnHighPropUpdate : 29389

- pUpToDateVecSrc : UPTODATE_VECTOR_V2_EXT
 - DSA Invoc ID: c20bc312-4d35-4cc0-9903-b1073368af4a
 - usnHighPropUpdate : 29389, timeLastSyncSuccess : 12797646597
- PrefixTableSrc : SCHEMA_PREFIX_TABLE
 - pObjects: (null)
- rgValues: REPLVALINF_NATIVE
 - pObject: CN=Kim Akers,CN=Users,DC=contoso,DC=com
 - attrTyp: "member"

4.1.10.8.4 Final State

Querying the repsFrom attribute on the NC root object for the domain DC=CONTOSO, DC=COM on DC2:

- ldap_search_s("DC=contoso,DC=com", *baseObject*, "(objectclass=*)", *repsFrom*)
- Result <0>: (null)
- Matched DNs:
- Getting 1 entries:
- >> Dn: DC=contoso,DC=com
 - 1> repsFrom: dwVersion = 1, V1.cb: 276, V1.cConsecutiveFailures: 0
 - V1.timeLastSuccess: 12797646597 V1.timeLastAttempt: 12797646597
V1.ulResultLastAttempt: 0x0 V1.cbOtherDraOffset: 216
 - V1.cbOtherDra: 60 V1.ulReplicaFlags: 0x70
 - V1.rtSchedule: <ldap:skipped> V1.usnvec.usnHighObjUpdate: 29389
 - V1.usnvec.usnHighPropUpdate: 29389
 - V1.uuidDsaObj: c20bc312-4d35-4cc0-9903-b1073368af4a
 - V1.uuidInvocId: c20bc312-4d35-4cc0-9903-b1073368af4a
 - V1.uuidTransportObj: 00000000-0000-0000-0000-000000000000 V1.mtx_address:
c20bc312-4d35-4cc0-9903-b1073368af4a._msdcs.contoso.com
 - V1.cbPASDataOffset: 0 V1.PasData: version = -1, size = -1, flag = -1 ;

Querying the group object "CN=GroupA, CN=Users, DC=CONTOSO, DC=COM" on DC2:

- ldap_search_s("CN=GroupA,CN=Users,DC=contoso,DC=com", *baseObject*, "(objectclass=*)", [*objectClass*, *cn* ... *objectCategory*])
- Result <0>: (null)
- Matched DNs:
- Getting 1 entries:
- >> Dn: CN=GroupA,CN=Users,DC=contoso,DC=com

- 2> objectClass: top; group;
- 1> cn: GroupA;
- 1> member: CN=Kim Akers,CN=Users,DC=contoso,DC=com
- 1> distinguishedName: CN=GroupA,CN=Users,DC=contoso,DC=com;
- 1> instanceType: 0x4 = (IT_WRITE);
- 1> whenCreated: 07/13/2006 12:25:35 Pacific Standard Daylight Time;
- 1> whenChanged: 07/17/2006 14:49:46 Pacific Standard Daylight Time;
- 1> uSNCreated: 26457;
- 1> uSNChanged: 38218;
- 1> name: GroupA;
- 1> objectGUID: 328ab893-b884-4e31-a73c-71740e261715;
- 1> objectSid: S-1-5-21-254470460-2440132622-709970653-1114;
- 1> sAMAccountName: GroupA;
- 1> sAMAccountType: 536870912;
- 1> groupType: 0x80000004 = (GROUP_TYPE_RESOURCE_GROUP | GROUP_TYPE_SECURITY_ENABLED);
- 1> objectCategory: CN=Group, CN=Schema, CN=Configuration, DC=contoso, DC=com;

4.1.10.9 Examples of the IDL_DRSGetNCChanges Method - Change User Password

4.1.10.9.1 Initial State

User Kim Akers changes the password by pressing CTRL+ALT+DELETE, and the password change is processed by DC1.

Querying the repsFrom attribute on the NC root object for domain DC=CONTOSO, DC=COM on DC2:

- ldap_search_s("DC=contoso,DC=com", *baseObject*, "(objectclass=*)", *repsFrom*)
- Result <0>: (null)
- Matched DNs:
- Getting 1 entries:
- >> Dn: DC=contoso,DC=com
 - 1> repsFrom: dwVersion = 1, V1.cb: 276, V1.cConsecutiveFailures: 4
 - V1.timeLastSuccess: 12797646597 V1.timeLastAttempt: 12797646597
V1.ulResultLastAttempt: 0x2108 V1.cbOtherDraOffset: 216 V1.cbOtherDra: 60
V1.ulReplicaFlags: 0x70
 - V1.rtSchedule: <ldap:skipped> V1.usnvec.usnHighObjUpdate: 29389
V1.usnvec.usnHighPropUpdate: 29389
 - V1.uuidDsaObj: c20bc312-4d35-4cc0-9903-b1073368af4a

- V1.uuidInvocId: c20bc312-4d35-4cc0-9903-b1073368af4a
- V1.uuidTransportObj: 00000000-0000-0000-0000-000000000000 V1.mtx_address: c20bc312-4d35-4cc0-9903-b1073368af4a._msdcs.contoso.com
- V1.cbPASDataOffset: 0 V1.PasData: version = -1, size = -1, flag = -1;

Querying the user object "CN=Kim Akers, CN=Users, DC=CONTOSO,DC=COM" on DC1:

- ldap_search_s("CN=Kim Akers,CN=Users,DC=contoso,DC=com", *baseObject*, "(objectClass=*)", [*objectClass, cn ... objectCategory*])
- Result <0>: (null)
- Matched DN's:
- Getting 1 entries:
- >> Dn: CN=Kim Akers,CN=Users,DC=contoso,DC=com
 - 4> objectClass: top; person; organizationalPerson; user;
 - 1> cn: Kim Akers;
 - 1> sn: Akers;
 - 1> givenName: Kim;
 - 1> distinguishedName: CN=Kim Akers,CN=Users,DC=contoso,DC=com;
 - 1> instanceType: 0x4 = (IT_WRITE);
 - 1> whenCreated: 07/17/2006 13:50:32 Pacific Standard Daylight Time;
 - 1> whenChanged: 07/17/2006 14:58:36 Pacific Standard Daylight Time;
 - 1> displayName: Kim Akers;
 - 1> uSNCreated: 29345;
 - 1> memberOf: CN=GroupA,CN=Users,DC=contoso,DC=com;
 - 1> uSNChanged: 29408;
 - 1> name: Kim Akers;
 - 1> objectGUID: 39ab8618-d3fd-410c-b627-64b65104384d;
 - 1> userAccountControl: 0x200 = (UF_NORMAL_ACCOUNT);
 - 1> badPwdCount: 0;
 - 1> codePage: 0;
 - 1> countryCode: 0;
 - 1> badPasswordTime: 01/01/1601 00:00:00 UNC ;
 - 1> lastLogoff: 01/01/1601 00:00:00 UNC ;
 - 1> lastLogon: 01/01/1601 00:00:00 UNC ;
 - 1> pwdLastSet: 07/17/2006 14:58:36 Pacific Standard Daylight Time;

- 1> primaryGroupID: 513;
- 1> objectSid: S-1-5-21-254470460-2440132622-709970653-1129;
- 1> accountExpires: 09/14/30828 02:48:05 UNC ;
- 1> logonCount: 0;
- 1> sAMAccountName: KimAkers;
- 1> sAMAccountType: 805306368;
- 1> userPrincipalName: KimAkers@contoso.com;
- 1> objectCategory: CN=Person, CN=Schema, CN=Configuration, DC=contoso, DC=com;

Querying the user object "CN=Kim Akers, CN=Users, DC=CONTOSO,DC=COM" on DC2:

- ldap_search_s("CN=Kim Akers,CN=Users,DC=contoso,DC=com", *baseObject*, "(objectclass=*)", [*objectClass, cn ... objectCategory*])
- Result <0>: (null)
- Matched DNs:
- Getting 1 entries:
- >> Dn: CN=Kim Akers,CN=Users,DC=contoso,DC=com
 - 4> objectClass: top; person; organizationalPerson; user;
 - 1> cn: Kim Akers;
 - 1> sn: Akers;
 - 1> givenName: Kim;
 - 1> distinguishedName: CN=Kim Akers,CN=Users,DC=contoso,DC=com;
 - 1> instanceType: 0x4 = (IT_WRITE);
 - 1> whenCreated: 07/17/2006 13:50:32 Pacific Standard Daylight Time;
 - 1> whenChanged: 07/17/2006 14:05:21 Pacific Standard Daylight Time;
 - 1> displayName: Kim Akers;
 - 1> uSNCreated: 38197;
 - 1> memberOf: CN=GroupA,CN=Users,DC=contoso,DC=com;
 - 1> uSNChanged: 38197;
 - 1> name: Kim Akers;
 - 1> objectGUID: 39ab8618-d3fd-410c-b627-64b65104384d;
 - 1> userAccountControl: 0x200 = (UF_NORMAL_ACCOUNT);
 - 1> codePage: 0;
 - 1> countryCode: 0;

- 1> pwdLastSet: 07/17/2006 13:50:33 Pacific Standard Daylight Time;
- 1> primaryGroupID: 513;
- 1> objectSid: S-1-5-21-254470460-2440132622-709970653-1129;
- 1> accountExpires: 09/14/30828 02:48:05 UNC ;
- 1> sAMAccountName: KimAkers;
- 1> sAMAccountType: 805306368;
- 1> userPrincipalName: KimAkers@contoso.com;
- 1> objectCategory: CN=Person, CN=Schema, CN=Configuration, DC=contoso,DC=com;

4.1.10.9.2 Client Request

DC2 invokes the method IDL_DRSGetNCChanges against DC1, with the following parameters (DRS_HANDLE to DC1 omitted):

- *dwInVersion* = 10
- *pmsgIn* = DRS_MSG_GETCHGREQ_V10
 - Destination DSA objGuid: _GUID {6aad8f5a-07cc-403a-9696-9102fe1c320b}
 - Source DSA Invocation ID: _GUID {c20bc312-4d35-4cc0-9903-b1073368af4a}
 - usnvecFrom: USN_VECTOR
 - usnHighPropUpdate : 29389
 - usnHighObjUpdate : 29389
 - pUpToDateVecDest : UPTODATE_VECTOR_V1_EXT
 - DSA Invoc ID: c20bc312-4d35-4cc0-9903-b1073368af4a, USN: 29389
 - Flags:
 - DRS_ASYNC_OP
 - DRS_WRIT_REP
 - DRS_INIT_SYNC
 - DRS_PER_SYNC
 - Max objects to return: 535
 - Max bytes to return: 5357731
 - Extended operation: none
 - Fsmo Info: 0
 - PrefixTableDest : SCHEMA_PREFIX_TABLE
 - ulMoreFlags: 0

4.1.10.9.3 Server Response

~~Note: Some of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it in the Product Behavior appendix.~~

A return code of 0 with the following values:

- *pdwOutVersion*= DRS_MSG_GETCHGREPLY_NATIVE_VERSION_NUMBER
- *pmsgOut* = DRS_MSG_GETCHGREPLY_NATIVE
 - *uuidDsaObjSrc*: _GUID {c20bc312-4d35-4cc0-9903-b1073368af4a}
 - *uuidInvocIdSrc*: _GUID {c20bc312-4d35-4cc0-9903-b1073368af4a}
 - *pNC*: DSNAME DC=CONTOSO,DC=COM
 - *usnvecFrom* : USN_VECTOR
 - *usnHighObjUpdate* : 29389
 - *usnHighPropUpdate* : 29389
 - *usnvecTo* : USN_VECTOR
 - *usnHighObjUpdate* : 29438
 - *usnHighPropUpdate* : 29438
 - *pUpToDateVecSrc* : UPTODATE_VECTOR_V2_EXT
 - DSA Invoc ID: c20bc312-4d35-4cc0-9903-b1073368af4a,
 - *usnHighPropUpdate* : 29438, *timeLastSyncSuccess* : 12797647962
 - *PrefixTableSrc* : SCHEMA_PREFIX_TABLE
 - *pObjects*: REPLENTINFLIST
 - *instanceType*: IT_WRITE
 - *dBSPwd*: *binary data*
 - *unicodePwd*: *binary data*
 - *ntPwdHistory*: *binary data*
 - *pwdLastSet*: 07/17/2006 14:58:36 Pacific Standard Daylight Time
 - *supplementalCredentials*: *binary data*
 - *lmPwdHistory*: *binary data*

4.1.10.9.4 Final State

Querying the *repsFrom* attribute on the NC root object for domain DC=CONTOSO, DC=COM on DC2:

- `ldap_search_s("DC=contoso,DC=com", baseObject, "(objectclass=*)", repsFrom)`
- Result <0>: (null)
- Matched DNs:

- Getting 1 entries:
- >>Dn: DC=contoso,DC=com
 - 1> repsFrom: dwVersion = 1, V1.cb: 276, V1.cConsecutiveFailures: 0
 - V1.timeLastSuccess: 12797647962 V1.timeLastAttempt: 12797647962
V1.ulResultLastAttempt: 0x0 V1.cbOtherDraOffset: 216 V1.cbOtherDra: 60
V1.ulReplicaFlags: 0x70 V1.rtSchedule: <ldp:skipped> V1.usnvec.usnHighObjUpdate:
29438 V1.usnvec.usnHighPropUpdate: 29438 V1.uuidDsaObj: c20bc312-4d35-4cc0-9903-
b1073368af4a
 - V1.uuidInvocId: c20bc312-4d35-4cc0-9903-b1073368af4a
 - V1.uuidTransportObj: 00000000-0000-0000-0000-000000000000 V1.mtx_address:
c20bc312-4d35-4cc0-9903-b1073368af4a._msdcs.contoso.com
 - V1.cbPASDataOffset: 0 V1.PasData: version = -1, size = -1, flag = -1;

Querying the user object "CN=Kim Akers, CN=Users, DC=CONTOSO,DC=COM" on DC2, which has now been updated:

- ldap_search_s("CN=Kim Akers,CN=Users,DC=contoso,DC=com", *baseObject*, "(objectclass=*)", [*objectClass, cn ... objectCategory*])
- Result <0>: (null)
- Matched DNs:
- Getting 1 entries:
- >> Dn: CN=Kim Akers,CN=Users,DC=contoso,DC=com
 - 4> objectClass: top; person; organizationalPerson; user;
 - 1> cn: Kim Akers;
 - 1> sn: Akers;
 - 1> givenName: Kim;
 - 1> distinguishedName: CN=Kim Akers,CN=Users,DC=contoso,DC=com;
 - 1> instanceType: 0x4 = (IT_WRITE);
 - 1> whenCreated: 07/17/2006 13:50:32 Pacific Standard Daylight Time;
 - 1> whenChanged: 07/17/2006 15:12:35 Pacific Standard Daylight Time;
 - 1> displayName: Kim Akers;
 - 1> uSNCreated: 38197;
 - 1> memberOf: CN=GroupA,CN=Users,DC=contoso,DC=com;
 - 1> uSNChanged: 38270;
 - 1> name: Kim Akers;
 - 1> objectGUID: 39ab8618-d3fd-410c-b627-64b65104384d;
 - 1> userAccountControl: 0x200 = (UF_NORMAL_ACCOUNT);

- 1> codePage: 0;
- 1> countryCode: 0;
- 1> pwdLastSet: 07/17/2006 14:58:36 Pacific Standard Daylight Time;
- 1> primaryGroupID: 513;
- 1> objectSid: S-1-5-21-254470460-2440132622-709970653-1129;
- 1> accountExpires: 09/14/30828 02:48:05 UNC ;
- 1> sAMAccountName: KimAkers;
- 1> sAMAccountType: 805306368;
- 1> userPrincipalName: KimAkers@contoso.com;
- 1> objectCategory: CN=Person, CN=Schema, CN=Configuration, DC=contoso, DC=com;

4.1.11 IDL_DRSGetNT4ChangeLog (Opnum 11)

If the server is the PDC emulator FSMO role owner, the IDL_DRSGetNT4ChangeLog method returns either a sequence of PDC change log entries or the NT4 replication state, or both, as requested by the client.

```

ULONG IDL_DRSGetNT4ChangeLog(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
        DRS_MSG_NT4_CHGLOG_REQ* pmsgIn,
    [out, ref] DWORD* pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DRS_MSG_NT4_CHGLOG_REPLY* pmsgOut
);

```

hDrs: The RPC context handle returned by the IDL_DRSBind method.

dwInVersion: The version of the request message.

pmsgIn: A pointer to the request message.

pdwOutVersion: A pointer to the version of the response message.

pmsgOut: A pointer to the response message.

Return Values: 0 or ERROR_MORE_DATA if successful; another Windows error code if a failure occurred.

Exceptions Thrown: This method might throw the following exceptions beyond those thrown by the underlying RPC protocol (as specified in [MS-RPCE]): ERROR_INVALID_HANDLE, ERROR_DS_DRS_EXTENSIONS_CHANGED, ERROR_DS_DIFFERENT_REPL_EPOCHS, and ERROR_INVALID_PARAMETER.

4.1.11.1 Method-Specific Concrete Types

4.1.11.1.1 DRS_MSG_NT4_CHGLOG_REQ


```

[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_NT4_CHGLOG_REPLY_V1 V1;
} DRS_MSG_NT4_CHGLOG_REPLY;

```

V1: The version 1 reply.

4.1.11.1.4 DRS_MSG_NT4_CHGLOG_REPLY_V1

The DRS_MSG_NT4_CHGLOG_REPLY_V1 structure defines the response message received from the IDL_DRSGetNT4ChangeLog method.

```

typedef struct {
    [range(0,10485760)] DWORD cbRestart;
    [range(0,10485760)] DWORD cbLog;
    NT4_REPLICATION_STATE ReplicationState;
    DWORD ActualNtStatus;
    [size_is(cbRestart)] BYTE* pRestart;
    [size_is(cbLog)] BYTE* pLog;
} DRS_MSG_NT4_CHGLOG_REPLY_V1;

```

cbRestart: Zero if **pRestart** = null. Otherwise, the size, in bytes, of **pRestart**^.

cbLog: Zero if **pRestart** = null. Otherwise, the size, in bytes, of **pLog**^.

ReplicationState: The replication state for Windows NT 4.0 DCs.

ActualNtStatus: A STATUS code. See the pseudo-code for interpretation.

pRestart: Null if no entries were returned. Otherwise, a pointer to an opaque value identifying the last entry returned in **pLog**.

pLog: The buffer containing the next entries from the change log.

4.1.11.1.5 NT4_REPLICATION_STATE

The NT4_REPLICATION_STATE structure defines the replication state for Windows NT 4.0 DCs, whose interpretation is specified in [MS-ADTS] section 3.1.1.7.1.

```

typedef struct {
    LARGE_INTEGER SamSerialNumber;
    LARGE_INTEGER SamCreationTime;
    LARGE_INTEGER BuiltinSerialNumber;
    LARGE_INTEGER BuiltinCreationTime;
    LARGE_INTEGER LsaSerialNumber;
    LARGE_INTEGER LsaCreationTime;
} NT4_REPLICATION_STATE;

```

SamSerialNumber: The Windows NT 4.0 replication update sequence number for the SAM database.

SamCreationTime: The time at which the Windows NT 4.0 replication update sequence number for the SAM database was set to 1.

BuiltinSerialNumber: The Windows NT 4.0 replication update sequence number for the built-in database.

BuiltinCreationTime: The time at which the Windows NT 4.0 replication update sequence number for the built-in database was set to 1.

LsaSerialNumber: The Windows NT 4.0 replication update sequence number for the local security authority (LSA) database.

LsaCreationTime: The time at which the Windows NT 4.0 replication update sequence number for the LSA database was set to 1.

4.1.11.2 Method-Specific Abstract Types and Procedures

4.1.11.2.1 IsPDC

```
procedure IsPDC(): boolean
```

Returns true if the DC owns the PDC role for this domain, otherwise false.

4.1.11.2.2 GetWindowsErrorCode

```
procedure GetWindowsErrorCode(ntStatus: DWORD): DWORD
```

Returns the Windows error code corresponding to the specified STATUS code.

4.1.11.3 Server Behavior of the IDL_DRSGetNT4ChangeLog Method

Informative summary of behavior: If the server is the PDC emulator FSMO role owner, it returns either a sequence of PDC change log entries or the NT4 replication state, or both, as requested by the client.

Multiple calls of this method **may** be required to retrieve the entire PDC change log. The client passes `pRestart = null` on the first call in a series of calls; the server returns a sequence of change log entries, including the first, a pointer to an opaque cookie, and a result code. If the server returns no change log entries, it returns null instead of a pointer to a cookie. If the server returns the result code zero, the sequence of change log entries in the response includes the final entry in the log.

The cookie encodes the serial number of the last change log entry returned. If the server returns `ERROR_MORE_DATA`, the final change log entry in the response was not the final entry in the change log. The client can make another call, with `pRestart` pointing to the cookie. The server processes this call identically to a call with `pRestart = null`, except that it returns change log entries starting with the entry following the last previously returned entry, as indicated by the cookie. By making enough calls the client can retrieve the entire change log.

If the client includes a cookie that is either corrupted or identifies a nonexistent change log entry (possibly because the cookie is too old), the server returns `ERROR_INVALID_PARAMETER`. If there are change log entries to return, but the client specifies a bound on the size of the returned change log entries that is too small to hold even a single entry, the server returns `ERROR_INSUFFICIENT_BUFFER`.

The NT4 replication state is a small, fixed-size structure and the server simply copies it into the response.

When the client requests both the PDC change log and the NT4 replication state, the server processes the PDC change log request first. If an error occurs during this processing the server does not process the request for NT4 replication state. If an error occurs while processing the NT4 replication state request, the server returns no indication to the client that the PDC change log request succeeded.

```
ULONG
IDL_DRSGetNT4ChangeLog(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)] DRS_MSG_NT4_CHGLOG_REQ *pmsgIn,
```

```

[out, ref] DWORD *pdwOutVersion,
[out, ref, switch_is(*pdwOutVersion)]
    DRS_MSG_NT4_CHGLOG_REPLY *pmsgOut)

msgIn: DRS_MSG_NT4_CHGLOG_REQ_V1
readStatus, ntStatus: DWORD
sequenceNumber: integer
nextIndexToBeReturned, lastIndexToBeReturned: integer
lastReturnedSerialNumber: LONGLONG
lastReturnedIndex: integer
pChangeLog: ADDRESS OF CHANGE_LOG_ENTRIES

ValidateDRSInput(hDrs, 11)

pdwOutVersion^ := 1
pmsgOut^.V1.cbRestart := 0
pmsgOut^.V1.cbLog := 0
pmsgOut^.V1.ReplicationState.SamSerialNumber := 0
pmsgOut^.V1.ReplicationState.SamCreationTime := 0
pmsgOut^.V1.ReplicationState.BuiltinSerialNumber := 0
pmsgOut^.V1.ReplicationState.BuiltinCreationTime := 0
pmsgOut^.V1.ReplicationState.LsaSerialNumber := 0
pmsgOut^.V1.ReplicationState.LsaCreationTime := 0
pmsgOut^.V1.ActualNtStatus := 0
pmsgOut^.V1.pRestart := null
pmsgOut^.V1.pLog := null

/* Validate the request version */
if dwInVersion # 1 then
    return ERROR_DS_DRA_INVALID_PARAMETER
endif
msgIn := pmsgIn^.V1

/* Access check */
if not AccessCheckCAR(DefaultNC(), DS-Replication-Get-Changes) then
    return ERROR_ACCESS_DENIED
endif

/* The DC must own the PDC role */
if not IsPDC() then
    return ERROR_INVALID_DOMAIN_ROLE
endif

ntStatus := 0
readStatus := 0
if DRS_NT4_CHGLOG_GET_CHANGE_LOG in msgIn.dwFlags then
    /* Return NT4 change log entries. */

    /* Determine the position of the first entry in the change log that
    * needs to be returned. If pRestart = null, this is the first
    * entry of the change log, otherwise it is the entry following the
    * entry identified in the cookie pRestart^ */
    if msgIn.pRestart = null then
        sequenceNumber := 1
        nextIndexToBeReturned := 0
    else
        sequenceNumber :=
            (Sequence number extracted from msgIn.pRestart^) + 1
        lastReturnedSerialNumber :=
            Serial number extracted from msgIn.pRestart^
        lastReturnedIndex := select one i in dc.pdcChangeLog where
            dc.pdcChangeLog[i].SerialNumber = lastReturnedSerialNumber
        if lastReturnedIndex = null then
            /* Cookie is old or corrupted.
            * The STATUS code STATUS_INVALID_PARAMETER corresponds to
            * the Windows error code ERROR_INVALID_PARAMETER. */
            ntStatus := STATUS_INVALID_PARAMETER
        else
            nextIndexToBeReturned := lastReturnedIndex + 1
        endif
    endif

```

```

endif

if ntStatus = 0 and nextIndexToBeReturned ≥ dc.pdcChangeLog.length
    then
        /* No entries to be returned, complete the response message */
        pmsgOut^.V1.pLog := null
        pmsgOut^.V1.cbLog := 0
        pmsgOut^.V1.pRestart := null
        pmsgOut^.V1.cbRestart := 0
    endif

if ntStatus = 0 and
    nextIndexToBeReturned < dc.pdcChangeLog.length then
    /* Entries to be returned. First, determine how many entries fit
    * into the response message */
    lastIndexToBeReturned := the largest integer q such that
        q < dc.pdcChangeLog.length and
        the size in bytes of
            dc.pdcChangeLog[nextIndexToBeReturned .. q]
            is ≤ msgIn.PreferredMaximumLength
    if lastIndexToBeReturned < nextIndexToBeReturned then
        /* Client's PreferredMaximumLength is too small for a single
        * entry, so return no entries.
        * The STATUS code STATUS_BUFFER_TOO_SMALL corresponds to
        * the Windows error code ERROR_INSUFFICIENT_BUFFER. */
        ntStatus := STATUS_BUFFER_TOO_SMALL
    else
        /* Client's PreferredMaximumLength is large enough for one or
        * more entries. Fill in pChangeLog^ from dc.pdcChangeLog */
        pChangeLog^.Size := 0x00000010
        pChangeLog^.Version := 0x00000001
        pChangeLog^.SequenceNumber := sequenceNumber
        pChangeLog^.Flags := 0x00000000
        pChangeLog^.ChangeLogEntries :=
            dc.pdcChangeLog[nextIndexToBeReturned ..
                lastIndexToBeReturned]
        if a fatal error occurred while retrieving dc.pdcChangeLog then
            ntStatus :=
                STATUS code of error that occurred, high-order bit set
        end
    endif
endif
if ntStatus = 0 then
    /* No errors, complete the response message */
    pmsgOut^.V1.pLog := pChangeLog
    pmsgOut^.V1.cbLog := size in bytes of pmsgOut^.V1.pLog^
    /* Construct a new cookie */
    lastReturnedSerialNumber :=
        dc.pdcChangeLog[lastIndexToBeReturned].SerialNumber
    pmsgOut^.V1.pRestart :=
        ADDRESS OF implementation-specific struct
        encapsulating lastReturnedSerialNumber and sequenceNumber
    pmsgOut^.V1.cbRestart := size in bytes of pmsgOut^.V1.pRestart^
    if lastIndexToBeReturned < dc.pdcChangeLog.length - 1 then
        /* There are more entries to be returned.
        * The STATUS code STATUS_MORE_ENTRIES corresponds to
        * the Windows error code ERROR_MORE_DATA. */
        ntStatus := STATUS_MORE_ENTRIES
    endif
endif /* Response complete */
endif /* Entries returned */
endif /* Processed change log request */

/* Save the status code from the previous operation */
readStatus := ntStatus

if ntStatus < 0x80000000 and
    DRS_NT4_CHGLOG_GET_SERIAL_NUMBERS in msgIn.dwFlags then
    /* Return NT4 replication state. */
    pmsgOut^.V1.ReplicationState.SamSerialNumber :=
        dc.nt4ReplicationState.SamNT4ReplicationUSN

```

```

pmsgOut^.V1.ReplicationState.SamCreationTime :=
    dc.nt4ReplicationState.SamCreationTime
pmsgOut^.V1.ReplicationState.BuiltinSerialNumber :=
    dc.nt4ReplicationState.BuiltinNT4ReplicationUSN
pmsgOut^.V1.ReplicationState.BuiltinCreationTime :=
    dc.nt4ReplicationState.BuiltinCreationTime
pmsgOut^.V1.ReplicationState.LsaSerialNumber := 1
pmsgOut^.V1.ReplicationState.LsaCreationTime :=
    current time on the DC
if a fatal error occurred while retrieving NT4 replication state
then
    ntStatus :=
        STATUS code of error that occurred, high-order bit set
end
endif

if ntStatus < 0x80000000 then
    pmsgOut^.V1.ActualStatus := readStatus
else
    pmsgOut^.V1.ActualStatus := ntStatus
endif

return GetWindowsErrorCode(ntStatus)

```

4.1.11.4 Examples of the IDL_DRSGetNT4ChangeLog Method

4.1.11.4.1 Initial State

Domain functional level is DS_BEHAVIOR_WIN2000 and the nTMixedDomain attribute on the domain NC root is 1 (see [MS-ADTS] section 6.1.4.1). The PDC role is held by DC2.

- ldap_search_s("DC=contoso,DC=com", *baseObject*, "(objectClass=*)")
- >> Dn: DC=contoso,DC=com
 - 1> fSMORoleOwner: CN=NTDS Settings, CN=DC2, CN=Servers,

CN=Default-First-Site-Name, CN=Sites, CN=Configuration,

DC=contoso, DC=com;

4.1.11.4.2 Client Request

The PDC role is transferred to DC1, which results in DC1 invoking the IDL_DRSGetNT4ChangeLog method against DC2 with the following parameters (DRS_HANDLE to DC2 omitted):

```

dwMsgVersion = 1
pmsgIn =
    dwFlags: DRS_NT4_CHGLOG_GET_CHANGE_LOG +
             DRS_NT4_CHGLOG_GET_SERIAL_NUMBERS
    PreferredMaximumLength: 0x4000
    cbRestart: 0
    pRestart: null

```

4.1.11.4.3 Server Response

Return code of 0 with the following values:

```

pmsgOut = DRS_MSG_NT4_CHGLOG_REPLY_V1
    cbRestart = 0x10
    cbLog = 0x2d00

```



```

ReplicationState = _NT4_REPLICATION_STATE
  SamSerialNumber = 0x30`00000097
  SamCreationTime = 0x1c6a7a9`792f51f6
  BuiltinSerialNumber = 0x30`00000054
  BuiltinCreationTime = 0x1c6a7a9`792f51f6
  LsaSerialNumber = 0x1
  LsaCreationTime = 0x1c6a832`0a495151
ActualNtStatus = 0
pRestart = "LMEM"
pLog = pointer to actual log (log data omitted)

```

4.1.11.4.4 Final State

The PDC change log entries on DC1 are synchronized with the change log entries on DC2; there is no other change in state.

4.1.12 IDL_DRSGetObjectExistence (Opnum 23)

The IDL_DRSGetObjectExistence method helps the client check the consistency of object existence between its replica of an NC and the server's replica of the same NC. Checking the consistency of object existence means identifying objects that have replicated to both replicas and that exist in one replica but not in the other. For the purposes of this method, an object *exists* within a NC replica if it is either an object or a tombstone.

See IDL_DRSReplicaVerifyObjects for a use of this method.

```

ULONG IDL_DRSGetObjectExistence(
  [in, ref] DRS_HANDLE hDrs,
  [in] DWORD dwInVersion,
  [in, ref, switch_is(dwInVersion)]
  DRS_MSG_EXISTREQ* pmsgIn,
  [out, ref] DWORD* pdwOutVersion,
  [out, ref, switch_is(*pdwOutVersion)]
  DRS_MSG_EXISTREPLY* pmsgOut
);

```

hDrs: The RPC context handle returned by the IDL_DRSBind method.

dwInVersion: The version of the request message.

pmsgIn: A pointer to the request message.

pdwOutVersion: A pointer to the version of the response message.

pmsgOut: A pointer to the response message.

Return Values: 0 if successful, otherwise a Windows error code.

Exceptions Thrown: This method might throw the following exceptions beyond those thrown by the underlying RPC protocol (as specified in [MS-RPCE]): ERROR_INVALID_HANDLE, ERROR_DS_DRS_EXTENSIONS_CHANGED, ERROR_DS_DIFFERENT_REPL_EPOCHS, and ERROR_INVALID_PARAMETER.

4.1.12.1 Method-Specific Concrete Types

4.1.12.1.1 DRS_MSG_EXISTREQ

The DRS_MSG_EXISTREQ union defines request messages sent to the IDL_DRSGetObjectExistence method. Only one version, identified by *dwInVersion* = 1, is currently defined.

```

typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_EXISTREQ_V1 V1;
    } DRS_MSG_EXISTREQ;

```

V1: The version 1 request.

4.1.12.1.2 DRS_MSG_EXISTREQ_V1

The DRS_MSG_EXISTREQ_V1 structure defines the request message sent to the IDL_DRSGetObjectExistence method.

```

typedef struct {
    UUID guidStart;
    DWORD cGuids;
    DSNAME* pNC;
    UPTODATE_VECTOR_V1_EXT* pUpToDateVecCommonV1;
    UCHAR Md5Digest[16];
} DRS_MSG_EXISTREQ_V1;

```

guidStart: The objectGUID of the first object in the client's object sequence.

cGuids: The number of objects in the client's object sequence.

pNC: The NC containing the objects in the sequence.

pUpToDateVecCommonV1: The filter excluding objects from the client's object sequence.

Md5Digest: The digest of the objectGUID values of the objects in the client's object sequence.

4.1.12.1.3 DRS_MSG_EXISTREPLY

The DRS_MSG_EXISTREPLY union defines the response message versions received from the IDL_DRSGetObjectExistence method. Only one version, identified by *pdwOutVersion*[^] = 1, is currently defined.

```

typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_EXISTREPLY_V1 V1;
    } DRS_MSG_EXISTREPLY;

```

V1: The version 1 response.

4.1.12.1.4 DRS_MSG_EXISTREPLY_V1

The DRS_MSG_EXISTREPLY_V1 structure defines the response message received from the IDL_DRSGetObjectExistence method.

```

typedef struct {
    DWORD dwStatusFlags;
    [range(0,10485760)] DWORD cNumGuids;
    [size_is(cNumGuids)] UUID* rgGuids;
} DRS_MSG_EXISTREPLY_V1;

```

dwStatusFlags: 1 if the digests of the object sequences on the client and server are the same, 0 if they are different.

cNumGuids: The number of items in the **rgGuids** array. Zero if **dwStatusFlags** = 0.

rgGuids: The objectGUIDs of the objects in the server's object sequence.

4.1.12.2 Method-Specific Abstract Types and Procedures

The following procedure is used in specifying both the client and server behavior of IDL_DRSGetObjectExistence.

4.1.12.2.1 GuidSequence

Informative summary of behavior: The *candidate set* of objects is the set of all objects and tombstones in the local replica of NC *nc*, excluding objects that have not yet replicated to both the client and server replicas of NC *nc*. The exclusion of objects created too recently is performed using the client-supplied up-to-date vector *utd*.

A *cluster* is any subset of the candidate set such that no object in the candidate set outside the cluster has an objectGUID lying between the objectGUIDs of any two members of the cluster.

The cluster constructed by GuidSequence contains the object in the candidate set with the smallest objectGUID greater than or equal to *startGUID*. The cluster contains as many objects as possible, but no more than *count*.

Both the client and the server use GuidSequence to compute a cluster, create a sorted sequence of objectGUIDs of objects in the cluster, and compute a digest of that sequence.

```
procedure GuidSequence(  
    startGUID: GUID,  
    count: ULONG,  
    nc: DSName,  
    utd: UPTODATE_VECTOR_V1_EXT,  
    var s: sequence of DSName,  
    var digest: sequence [0..15] of byte)
```

The procedure GuidSequence returns the following:

1. A sequence *s* of objectGUIDs from the server's state.
2. An MD5 digest value *digest* that is derived from the sequence *s*.

The first four parameters determine the result sequence *s* as follows:

1. Construct the following set of DSNames:

```
select all o subtree-ts-included nc where  
    StampLessThanOrEqualUTD(AttrStamp(o, whenCreated), utd)
```

2. Construct the GUID sequence *S* that contains the objectGUIDs of members of the set, sorted into ascending order by GUID value.
3. Find the smallest integer *i* such that $S[i] \geq startGUID$. If there is no such *i*, the result sequence *s* is empty, otherwise the result sequence *s* is as follows:

$S[i .. \min(i+count, S.length)-1]$

The result digest is the value of ComputeDigest applied to the result sequence *s*, where ComputeDigest is specified as follows:

```
procedure ComputeDigest(s: sequence of GUID): sequence [0..15] of byte

md5Context : MD5_CTX
MD5Init(md5Context)
  for i := 0 to s.length-1
    MD5Update(md5Context, s[i], 16)
  endfor
MD5Final(md5Context)
return md5Context.digest
```

4.1.12.3 Client Behavior When Sending the IDL_DRSGetObjectExistence Request

Informative summary of behavior: The client uses IDL_DRSGetObjectExistence to check the consistency of object existence between its replica of an NC and another replica of the same NC. Checking the consistency of object existence means identifying objects that have replicated to both replicas, and that exist in one replica but not in the other. For the purposes of this method, an object *exists* within an NC replica if it is either an object or a tombstone.

IDL_DRSGetObjectExistence allows the client to perform this checking in *clusters*, as defined in the informative summary of the GuidSequence procedure (section 4.1.12.2.1).

The inputs to this checking process on the client are as follows:

```
nc: DSName
utdClient, utdServer: UPTODATE_VECTOR_V1_EXT
guidStart: GUID
count: ULONG
```

nc: The NC containing the cluster that the client will check.

utdClient, utdServer: The up-to-date vectors of the client and server for the NC *nc*, respectively. The client can obtain *utdServer* using IDL_DRSGetReplInfo.

guidStart: The lower bound on the smallest objectGUID in the cluster that the client will check.

count: The upper bound on the number of objects in the cluster that the client will check.

Given these inputs, the client creates the request message to IDL_DRSGetObjectExistence as follows:<33>

```
msgIn: DRS_MSG_EXISTREQ_V1
s: sequence
digest: sequence [0..15] of byte

msgIn.pNC := nc
msgIn.pUpToDateVecCommonV1 := MergeUTD(utdClient, utdServer)
GuidSequence(
  guidStart, count, nc, msgIn.pUpToDateVecCommonV1^, s, digest)
msgIn.guidStart := s[0]
msgIn.length := s.length
msgIn.Md5Digest := digest
pmsgIn^.V1 := msgIn
```

4.1.12.4 Server Behavior of the IDL_DRSGetObjectExistence Method

Informative summary of behavior: The server computes a cluster, an objectGUID sequence, and a digest in the same manner as the client, but uses the server's NC replica. If the digest computed by the server equals the digest in the client's request, the server returns dwStatusFlags = 1, otherwise the server returns dwStatusFlags = 0 and the objectGUID sequence.

```
ULONG IDL_DRSGetObjectExistence (
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)] DRS_MSG_EXISTREQ *pmsgIn,
    [out, ref] DWORD *pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DRS_MSG_EXISTREPLY *pmsgOut)

msgIn: DRS_MSG_EXISTREQ_V1
nc: DSName
s: sequence of GUID
digest: sequence [0..15] of byte
msgOut: DRS_MSG_EXISTREPLY_V1
*pdwOutVersion = 1;

ValidateDRSInput(hDrs, 23)

pdwOutVersion^ := 1
pmsgOut^.V1.dwStatusFlags := 0
pmsgOut^.V1.cNumGuids := 0
pmsgOut^.V1.rgGuids := null

if dwInVersion ≠ 0x1 then
    return ERROR_DS_DRA_INVALID_PARAMETER
endif
msgIn := pmsgIn^.V1
nc := msgIn.pNC^
if not MasterReplicaExists(nc) then
    return ERROR_DS_DRA_INVALID_PARAMETER
endif
if msgIn.guidStart = NULLGUID then
    return ERROR_DS_DRA_INVALID_PARAMETER
endif
if not AccessCheckCAR(nc, DS-Replication-Get-Changes) then
    return ERROR_DS_DRA_ACCESS_DENIED
endif
GuidSequence(msgIn.guidStart, msgIn.cGuids, nc,
    msgIn.pUpToDateVecCommonV1^, s, digest)
if msgIn.Md5Digest = digest then
    msgOut.dwStatusFlags := 1
    msgOut.cNumGuids := 0
    msgOut.rgGuids := null
else if
    msgOut.dwStatusFlags := 0
    msgOut.cNumGuids := s.length
    for i := 0 to s.length - 1
        msgOut.rgGuids[i] := s[i]
    endfor
endif
pmsgOut^.V1 := msgOut
return 0
```

4.1.12.5 Client Behavior When Receiving the IDL_DRSGetObjectExistence Response

Informative summary of behavior: If the server response contains dwStatusFlags = 0, the client computes the difference between the client and the server sequences and takes whatever action is required.

4.1.13 IDL_DRSGetReplInfo (Opnum 19)

The IDL_DRSGetReplInfo method retrieves the replication state of the server.

```
ULONG IDL_DRSGetReplInfo(  
    [in, ref] DRS_HANDLE hDrs,  
    [in] DWORD dwInVersion,  
    [in, ref, switch_is(dwInVersion)]  
        DRS_MSG_GETREPLINFO_REQ* pmsgIn,  
    [out, ref] DWORD* pdwOutVersion,  
    [out, ref, switch_is(*pdwOutVersion)]  
        DRS_MSG_GETREPLINFO_REPLY* pmsgOut  
);
```

hDrs: The RPC context handle returned by the IDL_DRSBind method.

dwInVersion: The version of the request message.

pmsgIn: A pointer to the request message.

pdwOutVersion: A pointer to the version of the response message.

pmsgOut: A pointer to the response message.

Return Values: 0 if successful, otherwise a Windows error code.

Exceptions Thrown: This method might throw the following exceptions beyond those thrown by the underlying RPC protocol (as specified in [MS-RPCE]): ERROR_INVALID_HANDLE, ERROR_DS_DRS_EXTENSIONS_CHANGED, ERROR_DS_DIFFERENT_REPL_EPOCHS, and ERROR_INVALID_PARAMETER.

4.1.13.1 Method-Specific Concrete Types

4.1.13.1.1 DRS_MSG_GETREPLINFO_REQ

The DRS_MSG_GETREPLINFO_REQ union defines the request message versions sent to the IDL_DRSGetReplInfo method.

```
typedef  
[switch_type(DWORD)]  
union {  
    [case(1)]  
        DRS_MSG_GETREPLINFO_REQ_V1 V1;  
    [case(2)]  
        DRS_MSG_GETREPLINFO_REQ_V2 V2;  
} DRS_MSG_GETREPLINFO_REQ;
```

V1: Version 1 request.

V2: Version 2 request. The V2 request structure is a superset of the V1 request structure.

4.1.13.1.2 DRS_MSG_GETREPLINFO_REQ_V1

The DRS_MSG_GETREPLINFO_REQ_V1 structure defines a version 1 request message sent to the IDL_DRSGetReplInfo method.

```
typedef struct {  
    DWORD InfoType;  
    [string] LPWSTR pszObjectDN;
```


Value	Meaning
DS_REPL_INFO_NEIGHBORS 0x00000000	Replication state data for each NC and source server pair, for all NC replicas hosted by this DC.
DS_REPL_INFO_CURSORS_FOR_NC 0x00000001	A portion of the replication state for the NC replica of a given NC.
DS_REPL_INFO_METADATA_FOR_OBJ 0x00000002	Stamps for all the replicated attributes of the given object.
DS_REPL_INFO_KCC_DSA_CONNECT_FAILURES 0x00000003	Replication state data regarding connection failures with inbound replication partners.
DS_REPL_INFO_KCC_DSA_LINK_FAILURES 0x00000004	Replication state data regarding link failures with inbound replication partners.
DS_REPL_INFO_PENDING_OPS 0x00000005	Replication tasks that are currently executing or that are queued to execute.
DS_REPL_INFO_METADATA_FOR_ATTR_VALUE 0x00000006	Stamps for a specific link attribute of the given object.
DS_REPL_INFO_CURSORS_2_FOR_NC 0x00000007	A portion of the replication state for the NC replica of a given NC.
DS_REPL_INFO_CURSORS_3_FOR_NC 0x00000008	A portion of the replication state for the NC replica of a given NC.
DS_REPL_INFO_METADATA_2_FOR_OBJ 0x00000009	Stamps for all the replicated attributes of the given object.
DS_REPL_INFO_METADATA_2_FOR_ATTR_VALUE 0x0000000A	Stamps for a specific link attribute of the given object.
DS_REPL_INFO_SERVER_OUTGOING_CALLS 0xFFFFFFFF	A list of all outstanding RPC server call contexts.
DS_REPL_INFO_UPTODATE_VECTOR_V1 0xFFFFFFFFB	The replication state for the NC replica of a given NC.
DS_REPL_INFO_CLIENT_CONTEXTS 0xFFFFFFFFC	A list of all outstanding RPC client contexts.
DS_REPL_INFO_REPSTO 0xFFFFFFFFE	Replication state data for each NC and destination server (which is notified of changes) pair, for all NC replicas hosted by this DC.

4.1.13.1.5 DRS_MSG_GETREPLINFO_REPLY

The DRS_MSG_GETREPLINFO_REPLY union defines response messages received from the IDL_DRSGetReplInfo method.

```
typedef
[switch_type(DWORD)]
union {
    [case(0)]
```



```

    DS_REPL_NEIGHBORSW* pNeighbors;
[case(1)]
    DS_REPL_CURSORS* pCursors;
[case(2)]
    DS_REPL_OBJ_META_DATA* pObjMetaData;
[case(3)]
    DS_REPL_KCC_DSA_FAILURESW* pConnectFailures;
[case(4)]
    DS_REPL_KCC_DSA_FAILURESW* pLinkFailures;
[case(5)]
    DS_REPL_PENDING_OPSW* pPendingOps;
[case(6)]
    DS_REPL_ATTR_VALUE_META_DATA* pAttrValueMetaData;
[case(7)]
    DS_REPL_CURSORS_2* pCursors2;
[case(8)]
    DS_REPL_CURSORS_3W* pCursors3;
[case(9)]
    DS_REPL_OBJ_META_DATA_2* pObjMetaData2;
[case(10)]
    DS_REPL_ATTR_VALUE_META_DATA_2* pAttrValueMetaData2;
[case(0xFFFFFFFFFA)]
    DS_REPL_SERVER_OUTGOING_CALLS* pServerOutgoingCalls;
[case(0xFFFFFFFFFB)]
    UPTODATE_VECTOR_V1_EXT* pUpToDateVec;
[case(0xFFFFFFFFFC)]
    DS_REPL_CLIENT_CONTEXTS* pClientContexts;
[case(0xFFFFFFFFFE)]
    DS_REPL_NEIGHBORSW* pRepsTo;
} DRS_MSG_GETREPLINFO_REPLY;

```

pNeighbors: Neighbor information.

pCursors: Cursors for an NC replica.

pObjMetaData: Attribute stamps.

pConnectFailures: Connection failure data.

pLinkFailures: Link failure data.

pPendingOps: Pending operations in the replication queue.

pAttrValueMetaData: Link value stamps.

pCursors2: Cursors for an NC replica.

pCursors3: Cursors for an NC replica.

pObjMetaData2: Attribute stamps.

pAttrValueMetaData2: Link value stamps.

pServerOutgoingCalls: Outstanding requests from this DC to other DCs.

pUpToDateVec: Cursors for an NC replica.

pClientContexts: Active RPC client connections.

pRepsTo: Neighbor information.

4.1.13.1.6 DS_REPL_NEIGHBORSW

The DS_REPL_NEIGHBORSW structure defines a set of replication neighbors. This structure is a concrete representation of a sequence of RepsFrom or RepsTo values.

```

typedef struct {
    DWORD cNumNeighbors;
    DWORD dwReserved;
    [size_is(cNumNeighbors)] DS_REPL_NEIGHBORW rgNeighbor[];
} DS_REPL_NEIGHBORSW;

```

cNumNeighbors: The count of items in the **rgNeighbor** array.

dwReserved: Unused. MUST be 0 and ignored.

rgNeighbor: A set of replication neighbors.

4.1.13.1.7 DS_REPL_NEIGHBORW

The DS_REPL_NEIGHBORW structure defines a replication neighbor. This structure is a concrete representation of a RepsFrom or RepsTo value.

```

typedef struct {
    [string] LPWSTR pszNamingContext;
    [string] LPWSTR pszSourceDsaDN;
    [string] LPWSTR pszSourceDsaAddress;
    [string] LPWSTR pszAsyncIntersiteTransportDN;
    DWORD dwReplicaFlags;
    DWORD dwReserved;
    UUID uuidNamingContextObjGuid;
    UUID uuidSourceDsaObjGuid;
    UUID uuidSourceDsaInvocationID;
    UUID uuidAsyncIntersiteTransportObjGuid;
    USN usnLastObjChangeSynced;
    USN usnAttributeFilter;
    FILETIME ftimeLastSyncSuccess;
    FILETIME ftimeLastSyncAttempt;
    DWORD dwLastSyncResult;
    DWORD cNumConsecutiveSyncFailures;
} DS_REPL_NEIGHBORW;

```

pszNamingContext: The NC root of the NC replica.

pszSourceDsaDN: The DN of the server DC nTDSDSA object.

pszSourceDsaAddress: The NetworkAddress of the server DC.

pszAsyncIntersiteTransportDN: The DN of the interSiteTransport object corresponding to the transport used to communicate with the server DC.

dwReplicaFlags: The DRS_OPTIONS flags.

dwReserved: Unused. MUST be 0 and ignored.

uuidNamingContextObjGuid: The objectGUID of the NC root.

uuidSourceDsaObjGuid: The DSA GUID of the server DC.

uuidSourceDsaInvocationID: The invocation ID associated with the server DC.

uuidAsyncIntersiteTransportObjGuid: The objectGUID of the interSiteTransport object corresponding to the transport used to communicate with the server DC.

usnLastObjChangeSynced: An implementation-specific value.

usnAttributeFilter: An implementation-specific value.

ftimeLastSyncSuccess: The time of the last successful replication from the server DC.

ftimeLastSyncAttempt: The time of the last attempt to replicate from the server DC.

dwLastSyncResult: 0, or the Windows error code, as specified in [MS-ERREF] section 2.2, resulting from the last sync attempt.

cNumConsecutiveSyncFailures: The number of consecutive failures to replicate from the server DC.

4.1.13.1.8 DS_REPL_CURSORS

The DS_REPL_CURSORS structure defines a set of replication cursors for a given NC replica. This structure is a concrete representation of a sequence of ReplUpToDateVector values.

```
typedef struct {
    DWORD cNumCursors;
    DWORD dwReserved;
    [size_is(cNumCursors)] DS_REPL_CURSOR rgCursor[];
} DS_REPL_CURSORS;
```

cNumCursors: The count of items in the **rgCursor** array.

dwReserved: Unused. MUST be 0 and ignored.

rgCursor: A set of replication cursors.

4.1.13.1.9 DS_REPL_CURSOR

The DS_REPL_CURSOR structure defines a replication cursor for a given NC replica. This structure is a concrete representation of a ReplUpToDateVector value.

```
typedef struct {
    UUID uuidSourceDsaInvocationID;
    USN usnAttributeFilter;
} DS_REPL_CURSOR;
```

uuidSourceDsaInvocationID: The invocation ID of a DC.

usnAttributeFilter: The update sequence number (USN) at which an update was applied on the DC.

4.1.13.1.10 DS_REPL_CURSORS_2

The DS_REPL_CURSORS_2 structure defines a set of replication cursors for a given NC replica. This structure is a concrete representation of a sequence of ReplUpToDateVector values; it is a superset of DS_REPL_CURSORS.

```
typedef struct {
    DWORD cNumCursors;
    DWORD dwEnumerationContext;
    [size_is(cNumCursors)] DS_REPL_CURSOR_2 rgCursor[];
} DS_REPL_CURSORS_2;
```

cNumCursors: The count of items in the **rgCursor** array.

dwEnumerationContext: The value a client uses to populate the **dwEnumerationContext** field of the request on a future call to IDL_DRSGetReplInfo to retrieve additional results. For an informative description of the sequencing issues associated with this field, see section 1.3.2.

rgCursor: A set of replication cursors.

4.1.13.1.11 DS_REPL_CURSOR_2

The DS_REPL_CURSOR_2 structure defines a replication cursor for a given NC replica. This structure is a concrete representation of a ReplUpToDateVector value; it is a superset of DS_REPL_CURSOR.

```
typedef struct {
    UUID uuidSourceDsaInvocationID;
    USN usnAttributeFilter;
    FILETIME ftimeLastSyncSuccess;
} DS_REPL_CURSOR_2;
```

uuidSourceDsaInvocationID: The invocation ID of a DC.

usnAttributeFilter: The USN at which an update was applied on the DC.

ftimeLastSyncSuccess: The time at which the last successful replication occurred from the DC identified by uuidDsa. Used for **replication latency** reporting only.

4.1.13.1.12 DS_REPL_CURSORS_3W

The DS_REPL_CURSORS_3W structure defines a replication cursor for a given NC replica. This structure is a concrete representation of a sequence of ReplUpToDateVector values; it is a superset of DS_REPL_CURSORS_2.

```
typedef struct {
    DWORD cNumCursors;
    DWORD dwEnumerationContext;
    [size_is(cNumCursors)] DS_REPL_CURSOR_3W rgCursor[];
} DS_REPL_CURSORS_3W;
```

cNumCursors: The count of items in the **rgCursor** array.

dwEnumerationContext: The value a client uses to populate the **dwEnumerationContext** field of the request on a future call to IDL_DRSGetReplInfo to retrieve additional results. For an informative description of the sequencing issues associated with this field, see section 1.3.2.

rgCursor: A set of replication cursors.

4.1.13.1.13 DS_REPL_CURSOR_3W

The DS_REPL_CURSOR_3W structure defines a replication cursor for a given NC replica. This structure is a concrete representation of a ReplUpToDateVector value; it is a superset of DS_REPL_CURSOR_2.

```
typedef struct {
    UUID uuidSourceDsaInvocationID;
    USN usnAttributeFilter;
    FILETIME ftimeLastSyncSuccess;
    [string] LPWSTR pszSourceDsaDN;
} DS_REPL_CURSOR_3W;
```

uuidSourceDsaInvocationID: The invocation ID of a DC.

usnAttributeFilter: The USN at which an update was applied on the DC.

ftimeLastSyncSuccess: The time at which the last successful replication occurred from the DC identified by uuidDsa. Used for replication latency reporting only.

pszSourceDsaDN: The DN of the nTDSDSA object with an invocationId of **uuidSourceDsaInvocationID**.

4.1.13.1.14 DS_REPL_OBJ_META_DATA

The DS_REPL_OBJ_META_DATA structure defines a set of attribute stamps for a given object. This structure is a concrete representation of the sequence of AttributeStamp values for all attributes of a given object.

```
typedef struct {
    DWORD cNumEntries;
    DWORD dwReserved;
    [size_is(cNumEntries)] DS_REPL_ATTR_META_DATA rgMetaData[];
} DS_REPL_OBJ_META_DATA;
```

cNumEntries: The count of items in the **rgMetaData** array.

dwReserved: Unused. MUST be 0 and ignored.

rgMetaData: A set of attribute stamps.

4.1.13.1.15 DS_REPL_ATTR_META_DATA

The DS_REPL_ATTR_META_DATA structure defines an attribute stamp for a given object. This structure is a concrete representation of an AttributeStamp.

```
typedef struct {
    [string] LPWSTR pszAttributeName;
    DWORD dwVersion;
    FILETIME ftimeLastOriginatingChange;
    UUID uuidLastOriginatingDsaInvocationID;
    USN usnOriginatingChange;
    USN usnLocalChange;
} DS_REPL_ATTR_META_DATA;
```

pszAttributeName: The LDAPDisplayName of the attribute to which the stamp corresponds.

dwVersion: The stamp version.

ftimeLastOriginatingChange: The date and time at which the last originating update was made.

uuidLastOriginatingDsaInvocationID: The invocation ID of the DC that performed the last originating update.

usnOriginatingChange: The USN assigned to the last originating update by the DC that performed it.

usnLocalChange: An implementation-specific value.

4.1.13.1.16 DS_REPL_OBJ_META_DATA_2

The DS_REPL_OBJ_META_DATA_2 structure defines a set of attribute stamps for a given object. This structure is a concrete representation of the sequence of AttributeStamp values for all attributes of a given object; it is a superset of DS_REPL_OBJ_META_DATA.

```

typedef struct {
    DWORD cNumEntries;
    DWORD dwReserved;
    [size_is(cNumEntries)] DS_REPL_ATTR_META_DATA_2 rgMetaData[];
} DS_REPL_OBJ_META_DATA_2;

```

cNumEntries: The count of items in the **rgMetaData** array.

dwReserved: Unused. MUST be 0 and ignored.

rgMetaData: A set of attribute stamps.

4.1.13.1.17 DS_REPL_ATTR_META_DATA_2

The DS_REPL_ATTR_META_DATA_2 structure defines an attribute stamp for a given object. This structure is a concrete representation of an AttributeStamp; it is a superset of DS_REPL_ATTR_META_DATA.

```

typedef struct {
    [string] LPWSTR pszAttributeName;
    DWORD dwVersion;
    FILETIME ftimeLastOriginatingChange;
    UUID uuidLastOriginatingDsaInvocationID;
    USN usnOriginatingChange;
    USN usnLocalChange;
    [string] LPWSTR pszLastOriginatingDsaDN;
} DS_REPL_ATTR_META_DATA_2;

```

pszAttributeName: The IDAPDisplayName of the attribute to which the stamp corresponds.

dwVersion: The stamp version.

ftimeLastOriginatingChange: The date and time at which the last originating update was made.

uuidLastOriginatingDsaInvocationID: The invocation ID of the DC that performed the last originating update.

usnOriginatingChange: The USN assigned to the last originating update by the DC that performed it.

usnLocalChange: An implementation-specific value.

pszLastOriginatingDsaDN: The DN of the nTDSDSA object with an invocationId of uuidLastOriginatingDsaInvocationID.

4.1.13.1.18 DS_REPL_KCC_DSA_FAILURESW

The DS_REPL_KCC_DSA_FAILURESW structure defines a set of DCs that are in an error state with respect to replication. This structure is a concrete representation of KCCFailedConnections and KCCFailedLinks.

```

typedef struct {
    DWORD cNumEntries;
    DWORD dwReserved;
    [size_is(cNumEntries)] DS_REPL_KCC_DSA_FAILURESW rgDsaFailure[];
} DS_REPL_KCC_DSA_FAILURESW;

```

cNumEntries: The count of items in the **rgDsaFailure** array.

dwReserved: Unused. MUST be 0 and ignored.

rgDsaFailure: An array of DS_REPL_KCC_DSA_FAILUREW structures.

4.1.13.1.19 DS_REPL_KCC_DSA_FAILUREW

The DS_REPL_KCC_DSA_FAILUREW structure defines a DC that is in a replication error state. This structure is a concrete representation of a tuple in a KCCFailedConnections or KCCFailedLinks sequence.

```
typedef struct {
    [string] LPWSTR pszDsaDN;
    UUID uuidDsaObjGuid;
    FILETIME ftimeFirstFailure;
    DWORD cNumFailures;
    DWORD dwLastResult;
} DS_REPL_KCC_DSA_FAILUREW;
```

pszDsaDN: The DN of the nTDSDSA object corresponding to the DC.

uuidDsaObjGuid: The DSA GUID of the DC.

ftimeFirstFailure: The date and time at which the DC entered an error state.

cNumFailures: The number of errors that have occurred.

dwLastResult: The Windows error code, as specified in [MS-ERREF] section 2.2, for the last error.

4.1.13.1.20 DS_REPL_PENDING_OPSW

The DS_REPL_PENDING_OPSW structure defines a sequence of replication operations to be processed by a DC. This structure is a concrete representation of ReplicationQueue.

```
typedef struct {
    FILETIME ftimeCurrentOpStarted;
    DWORD cNumPendingOps;
    [size_is(cNumPendingOps)] DS_REPL_OPW rgPendingOp[];
} DS_REPL_PENDING_OPSW;
```

ftimeCurrentOpStarted: The time when the current operation started.

cNumPendingOps: The number of items in the **rgPendingOp** array.

rgPendingOp: The sequence of replication operations to be performed.

4.1.13.1.21 DS_REPL_OPW

The DS_REPL_OPW structure defines a replication operation to be processed by a DC. This structure is a concrete representation of a tuple in a ReplicationQueue sequence.

```
typedef struct {
    FILETIME ftimeEnqueued;
    ULONG ulSerialNumber;
    ULONG ulPriority;
    DS_REPL_OP_TYPE OpType;
    ULONG ulOptions;
    [string] LPWSTR pszNamingContext;
    [string] LPWSTR pszDsaDN;
    [string] LPWSTR pszDsaAddress;
    UUID uuidNamingContextObjGuid;
```

```

    UUID uuidDsaObjGuid;
} DS_REPL_OPW;

```

ftimeEnqueued: The date and time at which the operation was requested.

ulSerialNumber: The unique ID associated with the operation.

ulPriority: A ULONG specifying the priority value of this operation. Tasks with a higher priority value are executed first. The priority is calculated by the server based on the type of operation and its parameters.

OpType: An integer that indicates the type of operation, as defined in DS_REPL_OP_TYPE (section 5.46).

ulOptions: The DRS_OPTIONS flags.

pszNamingContext: The NC root of the relevant NC replica.

pszDsaDN: The DN of the relevant DC's nTDSDSA object.

pszDsaAddress: The NetworkAddress of the relevant DC.

uuidNamingContextObjGuid: The objectGUID of the NC root of the relevant NC replica.

uuidDsaObjGuid: The DSA GUID of the DC.

4.1.13.1.22 DS_REPL_ATTR_VALUE_META_DATA

The DS_REPL_ATTR_VALUE_META_DATA structure defines a sequence of link value stamps. This structure is a concrete representation of a sequence of LinkValueStamp values.

```

typedef struct {
    DWORD cNumEntries;
    DWORD dwEnumerationContext;
    [size_is(cNumEntries)] DS_REPL_VALUE_META_DATA rgMetaData[];
} DS_REPL_ATTR_VALUE_META_DATA;

```

cNumEntries: The number of items in **rgMetaData** array.

dwEnumerationContext: The value a client uses to populate the **dwEnumerationContext** field of the request on a future call to IDL_DRSGetReplInfo to retrieve additional results. For an informative description of the sequencing issues associated with this field, see section 1.3.2.

rgMetaData: The sequence of link value stamps.

4.1.13.1.23 DS_REPL_VALUE_META_DATA

The DS_REPL_VALUE_META_DATA structure defines a link value stamp. This structure is a concrete representation of a LinkValueStamp.

```

typedef struct {
    [string] LPWSTR pszAttributeName;
    [string] LPWSTR pszObjectDn;
    DWORD cbData;
    [size_is(cbData), ptr] BYTE* pbData;
    FILETIME ftimeDeleted;
    FILETIME ftimeCreated;
    DWORD dwVersion;
    FILETIME ftimeLastOriginatingChange;
    UUID uuidLastOriginatingDsaInvocationID;
} DS_REPL_VALUE_META_DATA;

```



```

    USN usnOriginatingChange;
    USN usnLocalChange;
} DS_REPL_VALUE_META_DATA;

```

pszAttributeName: The IDAPDisplayName of the attribute.

pszObjectDn: The DN of the object.

cbData: The size, in bytes, of the **pbData** array.

pbData: The binary_value portion of the attribute value if the attribute is of syntax Object(DN-Binary), or the string_value portion of the attribute value if the attribute is of syntax Object(DN-String); null otherwise.

ftimeDeleted: The date and time at which the last replicated update was made that deleted the value, or 0 if the value is not currently deleted.

ftimeCreated: The date and time at which the first originating update was made.

dwVersion: The stamp version.

ftimeLastOriginatingChange: The date and time at which the last originating update was made.

uuidLastOriginatingDsaInvocationID: The invocation ID of the DC that performed the last originating update.

usnOriginatingChange: The USN assigned to the last originating update by the DC that performed the update.

usnLocalChange: An implementation-specific value.

4.1.13.1.24 DS_REPL_ATTR_VALUE_META_DATA_2

The DS_REPL_ATTR_VALUE_META_DATA_2 structure defines a sequence of link value stamps. This structure is a concrete representation of a sequence of LinkValueStamp values; it is a superset of DS_REPL_ATTR_VALUE_META_DATA.

```

typedef struct {
    DWORD cNumEntries;
    DWORD dwEnumerationContext;
    [size_is(cNumEntries)] DS_REPL_VALUE_META_DATA_2 rgMetaData[];
} DS_REPL_ATTR_VALUE_META_DATA_2;

```

cNumEntries: The number of items in the **rgMetaData** array.

dwEnumerationContext: The value a client uses to populate the **dwEnumerationContext** field of the request on a future call to IDL_DRSGetReplInfo to retrieve additional results. For an informative description of the sequencing issues associated with this field, see section 1.3.2.

rgMetaData: The sequence of link value stamps.

4.1.13.1.25 DS_REPL_VALUE_META_DATA_2

The DS_REPL_VALUE_META_DATA_2 structure defines a link value stamp. This structure is a concrete representation of LinkValueStamp; it is a superset of DS_REPL_VALUE_META_DATA.

```

typedef struct {
    [string] LPWSTR pszAttributeName;
    [string] LPWSTR pszObjectDn;
} DS_REPL_VALUE_META_DATA_2;

```

```

    DWORD cbData;
    [size_is(cbData), ptr] BYTE* pbData;
    FILETIME ftimeDeleted;
    FILETIME ftimeCreated;
    DWORD dwVersion;
    FILETIME ftimeLastOriginatingChange;
    UUID uuidLastOriginatingDsaInvocationID;
    USN usnOriginatingChange;
    USN usnLocalChange;
    [string] LPWSTR pszLastOriginatingDsaDN;
} DS_REPL_VALUE_META_DATA_2;

```

pszAttributeName: The IDAPDisplayName of the attribute.

pszObjectDn: The DN of the object.

cbData: The size, in bytes, of the **pbData** array.

pbData: The binary_value portion of the attribute value if the attribute is of syntax Object(DN-Binary), or the string_value portion of the attribute value if the attribute is of syntax Object(DN-String); null otherwise.

ftimeDeleted: The date and time at which the last replicated update was made that deleted the value, or 0 if the value is not currently deleted.

ftimeCreated: The date and time at which the first originating update was made.

dwVersion: The stamp version.

ftimeLastOriginatingChange: The date and time at which the last originating update was made.

uuidLastOriginatingDsaInvocationID: The invocation ID of the DC that performed the last originating update.

usnOriginatingChange: The USN assigned to the last originating update by the DC that performed the update.

usnLocalChange: An implementation-specific value.

pszLastOriginatingDsaDN: The DN of the nTDSDSA object with an invocationId of **uuidLastOriginatingDsaInvocationID**.

4.1.13.1.26 DS_REPL_CLIENT_CONTEXTS

The DS_REPL_CLIENT_CONTEXTS structure defines a set of active RPC client connections. This structure is a concrete representation of RPCClientContexts.

```

typedef struct {
    [range(0,10000)] DWORD cNumContexts;
    DWORD dwReserved;
    [size_is(cNumContexts)] DS_REPL_CLIENT_CONTEXT rgContext[];
} DS_REPL_CLIENT_CONTEXTS;

```

cNumContexts: The number of items in the **rgContext** array.

dwReserved: Unused. MUST be 0 and ignored.

rgContext: A set of active RPC client connections.

4.1.13.1.27 DS_REPL_CLIENT_CONTEXT

The DS_REPL_CLIENT_CONTEXT structure defines an active RPC client connection. This structure is a concrete representation of a tuple in an RPCClientContexts sequence.

```
typedef struct {
    ULONGLONG hCtx;
    LONG lReferenceCount;
    BOOL fIsBound;
    UUID uuidClient;
    DSTIME timeLastUsed;
    ULONG IPAddr;
    int pid;
} DS_REPL_CLIENT_CONTEXT;
```

hCtx: The unique ID of the client context.

lReferenceCount: The number of references to the context.

fIsBound: True if and only if the context has not yet been closed by the IDL_DRSUnbind method.

uuidClient: Zeros, or the value pointed to by the *puuidClientDsa* parameter to IDL_DRSBind.

timeLastUsed: The date and time at which this context was last used in an RPC method call.

IPAddr: The IPv4 address of the client. If the client is connected with IPv6, this field MUST be 0.

pid: The process ID specified by the client in the *pextClient* parameter to IDL_DRSBind.

4.1.13.1.28 DS_REPL_SERVER_OUTGOING_CALLS

The DS_REPL_SERVER_OUTGOING_CALLS structure defines a set of outstanding requests from this DC to other DCs. This structure is a concrete representation of RPCOutgoingContexts.

```
typedef struct {
    [range(0,256)] DWORD cNumCalls;
    DWORD dwReserved;
    [size_is(cNumCalls)] DS_REPL_SERVER_OUTGOING_CALL rgCall[];
} DS_REPL_SERVER_OUTGOING_CALLS;
```

cNumCalls: The number of items in the **rgCall** array.

dwReserved: Unused. MUST be 0 and ignored.

rgCall: A set of outstanding requests from this DC to other DCs.

4.1.13.1.29 DS_REPL_SERVER_OUTGOING_CALL

The DS_REPL_SERVER_OUTGOING_CALL structure defines an outstanding request from this DC to another DC. This structure is a concrete representation of a tuple from an RPCOutgoingContexts sequence.

```
typedef struct {
    [string] LPWSTR pszServerName;
    BOOL fIsHandleBound;
    BOOL fIsHandleFromCache;
    BOOL fIsHandleInCache;
    DWORD dwThreadId;
    DWORD dwBindingTimeoutMins;
    DSTIME dstimeCreated;
    DWORD dwCallType;
```

```
} DS_REPL_SERVER_OUTGOING_CALL;
```

pszServerName: The NetworkAddress of the server.

fIsHandleBound: True if and only if the IDL_DRSBind method has completed and the IDL_DRSunbind method has not yet been called.

fIsHandleFromCache: True if and only if the context handle used was retrieved from the cache.

fIsHandleInCache: True if and only if the context handle is still in the cache.

dwThreadId: The thread ID of the thread that is using the context.

dwBindingTimeoutMins: If the context is set to be canceled, the time-out in minutes.

dstimeCreated: The date and time when the context was created.

dwCallType: The call that the client is waiting on. MUST be one of the values in the following table.

Value	Meaning
2	IDL_DRSBind
3	IDL_DRSunbind
4	IDL_DRSReplicaSync
5	IDL_DRSGetNCChanges
6	IDL_DRSUpdateRefs
7	IDL_DRSReplicaAdd
8	IDL_DRSReplicaDel
9	IDL_DRSVerifyNames
10	IDL_DRSGetMemberships
11	IDL_DRSInterDomainMove
12	IDL_DRSGetNT4ChangeLog
13	IDL_DRSCrackNames
14	IDL_DRSAddEntry
15	IDL_DRSGetMemberships2
16	IDL_DRSGetObjectExistence
17	IDL_DRSGetReplInfo
18	IDL_DRSWriteSPN

4.1.13.2 Method-Specific Abstract Types and Procedures

4.1.13.2.1 GetDNFromInvocationID

```
procedure GetDNFromInvocationID(invocationID: GUID): DN
```

Returns the DN of the nTDSDSA object that has the specified invocation ID. If there is no such nTDSDSA object, the results are unconstrained and the resulting behavior of protocol elements that use this returned DN are also unconstrained.

4.1.13.2.2 GetDNFromObjectGuid

```
procedure GetDNFromObjectGuid(guid: GUID): DN
```

Returns the DN of the object with the specified object GUID. This is represented by the following expression.

```
obj := select one o from all where (o!objectGUID = guid)
return obj.dn
```

4.1.13.2.3 GetNCs

```
procedure GetNCs(): set of DSName
```

Returns a set containing the DSNames of all NCs hosted by this server.

4.1.13.2.4 GetUpToDateenessVector

```
procedure GetUpToDateenessVector(nc: DSName): sequence of ReplUpToDateVector
```

Returns a sequence of ReplUpToDateVector (section 5.166), sorted in ascending order by the **uuidDSAAuuidDsa** field. The entries are retrieved from *nc!replUpToDateVector* plus an additional entry with **uuidDSAAuuidDsa** set to the invocation ID of this server, **usnHighPropUpdate** set to rootDSE!highestCommittedUSN, and **timeLastSyncSuccess** set to the current time.

4.1.13.3 Server Behavior of the IDL_DRSGetReplInfo Method

Informative summary of behavior: This method retrieves the replication state information of a DC. Based on the value of the **InfoType** field in the request message, different information is returned, which is summarized in the definition of DS_REPL_INFO in section 4.1.13.1.4.

```
ULONG
IDL_DRSGetReplInfo(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
        DRS_MSG_GETREPLINFO_REQ *pmsgIn,
    [out, ref] DWORD *pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DRS_MSG_GETREPLINFO_REPLY *pmsgOut)
```

```
msgIn: DRS_MSG_GETREPLINFO_REQ_V2
infoType: DWORD
fAccessGranted: boolean
infoTypeValid: boolean
defaultNC: DSName
object: DSName
enumerationContext: DWORD
baseIndex: DWORD
```

```

endIndex: DWORD
ncs: set of DSName
nc: DSName
i, j: DWORD
r: ReplsFrom
q: ReplsTo
pNeighbor: ADDRESS OF DS_REPL_NEIGHBORW
utd: sequence of ReplUpToDateVector
pCursor: ADDRESS OF DS_REPL_CURSOR
pCursor2: ADDRESS OF DS_REPL_CURSOR_2
pCursor3: ADDRESS OF DS_REPL_CURSOR_3W
a: ATTRTYP
attr: ATTRTYP
attrs: set of ATTRTYP
attrsSeq: sequence of ATTRTYP
s: AttributeStamp
stamp: LinkValueStamp
pObjMetaData: ADDRESS OF DS_REPL_OBJ_META_DATA
pObjMetaData2: ADDRESS OF DS_REPL_OBJ_META_DATA_2
values: set of attribute value
valuesSeq: sequence of attribute value
ls: LinkValueStamp
pAttrValueMetaData: ADDRESS OF DS_REPL_ATTR_VALUE_META_DATA
pAttrValueMetaData2: ADDRESS OF DS_REPL_ATTR_VALUE_META_DATA_2
pFailedConnection: ADDRESS OF DS_REPL_KCC_DSA_FAILUREW
pFailedLink: ADDRESS OF DS_REPL_KCC_DSA_FAILUREW
pPendingOp: ADDRESS OF DS_REPL_OPW
pClientContext: ADDRESS OF DS_REPL_CLIENT_CONTEXT
pOutgoingContext: ADDRESS OF DS_REPL_SERVER_OUTGOING_CALL
v: attribute value

```

```

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```

```

if dwInVersion = 1 then
    infoType = pmsgIn^ V1.InfoType
else
    infoType = pmsgIn^ V2.InfoType
endif
pdwOutVersion^ := infoType

```

```

if infoType = DS_REPL_INFO_NEIGHBORS then
    pmsgOut^.pNeighbors := null
else if infoType = DS_REPL_INFO_CURSORS_FOR_NC then
    pmsgOut^.pCursors := null
else if infoType = DS_REPL_INFO_METADATA_FOR_OBJ then
    pmsgOut^.pObjMetaData := null
else if infoType = DS_REPL_INFO_KCC_DSA_CONNECT_FAILURES then
    pmsgOut^.pConnectFailures := null
else if infoType = DS_REPL_INFO_KCC_DSA_LINK_FAILURES then
    pmsgOut^.pLinkFailures := null
else if infoType = DS_REPL_INFO_PENDING_OPS then
    pmsgOut^.pPendingOps := null
else if infoType = DS_REPL_INFO_METADATA_FOR_ATTR_VALUE then
    pmsgOut^.pAttrValueMetaData := null
else if infoType = DS_REPL_INFO_CURSORS_2_FOR_NC then
    pmsgOut^.pCursors2 := null
else if infoType = DS_REPL_INFO_CURSORS_3_FOR_NC then
    pmsgOut^.pCursors3 := null
else if infoType = DS_REPL_INFO_METADATA_2_FOR_OBJ then
    pmsgOut^.pObjMetaData2 := null
else if infoType = DS_REPL_INFO_METADATA_2_FOR_ATTR_VALUE then
    pmsgOut^.pAttrValueMetaData2 := null
else if infoType = DS_REPL_INFO_SERVER_OUTGOING_CALLS then
    pmsgOut^.pServerOutgoingCalls := null
else if infoType = DS_REPL_INFO_UPTODATE_VECTOR_V1 then
    pmsgOut^.pUpToDateVec := null
else if infoType = DS_REPL_INFO_CLIENT_CONTEXTS then
    pmsgOut^.pClientContexts := null
else if infoType = DS_REPL_INFO_REPSTO then
    pmsgOut^.pReplsTo := null

```

```

endif

/* Validate the version of the request message */
if (dwInVersion ≠ 1 and dwInVersion ≠ 2) then
    return ERROR_REVISION_MISMATCH
endif

if dwInVersion = 1 then
    msgIn := pmsgIn^.V1
else
    msgIn := pmsgIn^.V2
endif

/* For some of the request types, paging is supported. For these
 * cases, a starting index into the result set is needed based on
 * what has already been returned in a previous call. Only version 2
 * request messages provide a mechanism for the client to supply the
 * context information from a previous call. */
if dwInVersion = 1 then
    baseIndex := 0
else
    if msgIn.dwEnumerationContext = 0xffffffff then
        /* No more data is available. */
        return ERROR_NO_MORE_ITEMS
    endif
    baseIndex := msgIn.dwEnumerationContext
endif

/* Perform the necessary access checks. */
defaultNC := DefaultNC()
fAccessGranted := false
infoTypeValid := false
object := msgIn.pszObjectDN
if (infoType = DS_REPL_INFO_NEIGHBORS and object ≠ null) then
    infoTypeValid := true
    fAccessGranted :=
        AccessCheckAttr(object, repsFrom, RIGHT_DS_READ_PROPERTY) or
        AccessCheckCAR(object, DS-Replication-Manage-Topology) or
        AccessCheckCAR(object, DS-Replication-Monitor-Topology)
endif
if (infoType = DS_REPL_INFO_NEIGHBORS and object = null) then
    infoTypeValid := true
    fAccessGranted :=
        AccessCheckAttr(defaultNC, repsFrom, RIGHT_DS_READ_PROPERTY) or
        AccessCheckCAR(defaultNC, DS-Replication-Manage-Topology) or
        AccessCheckCAR(defaultNC, DS-Replication-Monitor-Topology)
endif
if (infoType = DS_REPL_INFO_REPSTO and object ≠ null) then
    infoTypeValid := true
    fAccessGranted :=
        AccessCheckAttr(object, repsTo, RIGHT_DS_READ_PROPERTY) or
        AccessCheckCAR(object, DS-Replication-Manage-Topology) or
        AccessCheckCAR(object, DS-Replication-Monitor-Topology)
endif
if (infoType = DS_REPL_INFO_REPSTO and object = null) then
    infoTypeValid := true
    fAccessGranted :=
        AccessCheckAttr(defaultNC, repsTo, RIGHT_DS_READ_PROPERTY) or
        AccessCheckCAR(defaultNC, DS-Replication-Manage-Topology) or
        AccessCheckCAR(defaultNC, DS-Replication-Monitor-Topology)
endif
if (infoType in {DS_REPL_INFO_CURSORS_FOR_NC,
                 DS_REPL_INFO_CURSORS_2_FOR_NC,
                 DS_REPL_INFO_CURSORS_3_FOR_NC,
                 DS_REPL_INFO_UPTODATE_VECTOR_V1}) and
    object ≠ null) then
    infoTypeValid := true
    fAccessGranted :=
        AccessCheckAttr(
            object, replUpToDateVector, RIGHT_DS_READ_PROPERTY) or

```

```

        AccessCheckCAR(object, DS-Replication-Manage-Topology) or
        AccessCheckCAR(object, DS-Replication-Monitor-Topology)
    endif
if infoType in {DS_REPL_INFO_METADATA_FOR_OBJ,
                DS_REPL_INFO_METADATA_2_FOR_OBJ,
                DS_REPL_INFO_METADATA_FOR_ATTR_VALUE,
                DS_REPL_INFO_METADATA_2_FOR_ATTR_VALUE} then
    if object = null then
        return ERROR_INVALID_PARAMETER
    endif
    if not ObjExists(object) then
        if object.dn = null then
            return ERROR_DS_DRA_BAD_DN
        else
            return ERROR_DS_OBJ_NOT_FOUND
        endif
    endif
    infoTypeValid := true
    fAccessGranted :=
        AccessCheckAttr(object,
                        replPropertyMetaData,
                        RIGHT_DS_READ_PROPERTY) or
        AccessCheckCAR(object, DS-Replication-Manage-Topology) or
        AccessCheckCAR(object, DS-Replication-Monitor-Topology)
endif
if infoType in {DS_REPL_INFO_PENDING_OPS,
                DS_REPL_INFO_KCC_DSA_CONNECT_FAILURES,
                DS_REPL_INFO_KCC_DSA_LINK_FAILURES,
                DS_REPL_INFO_CLIENT_CONTEXTS,
                DS_REPL_INFO_SERVER_OUTGOING_CALLS} then
    infoTypeValid := true
    fAccessGranted :=
        AccessCheckCAR(defaultNC, DS-Replication-Manage-Topology) or
        AccessCheckCAR(defaultNC, DS-Replication-Monitor-Topology)
endif

if not infoTypeValid then
    return ERROR_INVALID_PARAMETER
endif

if not fAccessGranted then
    return ERROR_DS_DRA_ACCESS_DENIED
endif

/* Based on the type of information requested, the corresponding
* information is retrieved and the response message constructed */

/* DS_REPL_INFO_NEIGHBORS/DS_REPL_INFO_REPSTO */
if infoType in {DS_REPL_INFO_NEIGHBORS, DS_REPL_INFO_REPSTO}
/* If an object is specified, it must be an NC root. */
    nc := object

    if nc ≠ null then
        ncs := {nc}
    else
        ncs := GetNCs()
    endif

    if infoType = DS_REPL_INFO_NEIGHBORS then
        i := 0
        j := 0
        foreach nc in ncs
            foreach r in nc!repsFrom
                /* The ordering of ncs hosted by the server and the values of
                * repsFrom for each nc is arbitrary but consistent from call
                * to call on a server. */

                /* If a source server GUID is specified, only information for
                * that server is returned. */
                If (msgIn.uuidSourceDsaGuid = NULLGUID or

```



```

        msgIn.uuidSourceDsaGuid = r.uuidDsa) then
    if i >= baseIndex then
        pNeighbor := ADR(pmsgOut^.pNeighbors^.rgNeighbor[j])
        pNeighbor^.pszSourceDsaAddress := r.naDsa
        pNeighbor^.uuidSourceDsaObjGuid := r.uuidDsa
        pNeighbor^.pszSourceDsaDN :=
            GetDNFromObjectGuid(r.uuidDsa)
        pNeighbor^.pszNamingContext := nc!distinguishedName
        /* If a naming context is specified in the request,
         * the uuidNamingContextObjGuid field of the response
         * is set to the NULL GUID. */
        if object # null then
            pNeighbor^.uuidNamingContextObjGuid := NULLGUID
        else
            pNeighbor^.uuidNamingContextObjGuid := nc!objectGUID
        endif
        pNeighbor^.pszAsyncIntersiteTransportDN :=
            GetDNFromObjectGuid(r.uuidTransportObj)
        pNeighbor^.uuidSourceDsaInvocationID := r.uuidInvocId
        pNeighbor^.uuidAsyncIntersiteTransportObjGuid :=
            r.uuidTransportObj
        pNeighbor^.usnLastObjChangeSynced :=
            r.usnVec.usnHighObjUpdate
        pNeighbor^.usnAttributeFilter :=
            r.usnVec.usnHighPropUpdate
        pNeighbor^.ftimeLastSyncSuccess := r.timeLastSuccess
        pNeighbor^.ftimeLastSyncAttempt := r.timeLastAttempt
        pNeighbor^.dwLastSyncResult := r.ulResultLastAttempt
        pNeighbor^.cNumConsecutiveSyncFailures :=
            r.cConsecutiveFailures
        /* Only a subset of the possible DRS_OPTIONS in r.options
         * are preserved in pNeighbor^.dwReplicaFlags.
         * See section 5.169 repsFrom, RepsFrom for more info. */
        pNeighbor^.dwReplicaFlags := {}
        foreach flag in { DRS_WRIT_REP,
                        DRS_INIT_SYNC,
                        DRS_PER_SYNC,
                        DRS_MAIL_REP,
                        DRS_DISABLE_AUTO_SYNC,
                        DRS_DISABLE_PERIODIC_SYNC,
                        DRS_USE_COMPRESSION,
                        DRS_TOWAY_SYNC,
                        DRS_NONGC_RO_REP,
                        DRS_FULL_SYNC_IN_PROGRESS,
                        DRS_FULL_SYNC_PACKET,
                        DRS_REF_GCSPN,
                        DRS_NEVER_SYNCED,
                        DRS_SPECIAL_SECRET_PROCESSING,
                        DRS_PREEMPTED,
                        DRS_NEVER_NOTIFY,
                        DRS_SYNC_PAS}
            if flag in r.options then
                pNeighbor^.dwReplicaFlags := pNeighbor^.dwReplicaFlags + flag
            endif
        endfor
        j := j + 1
    endif
    i := i + 1
endif
endfor
endfor
pmsgOut^.pNeighbors^.cNumNeighbors := j
else
    /* DS_REPL_INFO_REPSTO case. */
    i := 0
    j := 0
    foreach nc in ncs
        foreach q in nc!repsTo
            /* The ordering of ncs hosted by the server and the values of
             * repsTo for each nc is arbitrary but consistent from call

```

```

    * to call on a server. */
if i >= baseIndex then
    pNeighbor := ADR(pmsgOut^.pRepsTo^.rgNeighbor[j])
    pNeighbor^.pszSourceDsaAddress := q.naDsa
    pNeighbor^.ftimeLastSyncSuccess := q.timeLastSuccess
    pNeighbor^.ftimeLastSyncAttempt := q.timeLastAttempt
    pNeighbor^.dwLastSyncResult := q.ulResultLastAttempt
    pNeighbor^.cNumConsecutiveSyncFailures :=
        q.cConsecutiveFailures
    pNeighbor^.uuidSourceDsaObjGuid := q.uuidDsa
    pNeighbor^.pszSourceDsaDN := GetDNFromObjectGuid(q.uuidDsa)
    pNeighbor^.pszNamingContext := nc!distinguishedName
    /* If a naming context is specified in the request,
     * the uuidNamingContextObjGuid field of the response
     * is set to the NULL GUID. */
    if object # null then
        pNeighbor^.uuidNamingContextObjGuid := NULLGUID
    else
        pNeighbor^.uuidNamingContextObjGuid := nc!objectGUID
    endif
    /* Only a subset of the possible DRS_OPTIONS in q.options
     * are preserved in pNeighbor^.dwReplicaFlags.
     * See section 5.170 repsTo, RepsTo for more info. */
    pNeighbor^.dwReplicaFlags := {}
    foreach flag in { DRS_WRIT_REP,
                     DRS_INIT_SYNC,
                     DRS_PER_SYNC,
                     DRS_MAIL_REP,
                     DRS_DISABLE_AUTO_SYNC,
                     DRS_DISABLE_PERIODIC_SYNC,
                     DRS_USE_COMPRESSION,
                     DRS_TWOWAY_SYNC,
                     DRS_NONGC_RO_REP,
                     DRS_FULL_SYNC_IN_PROGRESS,
                     DRS_FULL_SYNC_PACKET,
                     DRS_REF_GCSPN,
                     DRS_NEVER_SYNCED,
                     DRS_SPECIAL_SECRET_PROCESSING,
                     DRS_PREEMPTED,
                     DRS_NEVER_NOTIFY,
                     DRS_SYNC_PAS}
        if flag in q.options then
            pNeighbor^.dwReplicaFlags := pNeighbor^.dwReplicaFlags + flag
        endif
    endforeach
    j := j + 1
endif
i := i + 1
endforeach
pmsgOut^.pRepsTo^.cNumNeighbors := j
endif
endif

/* DS_REPL_INFO_METADATA_FOR_OBJ/DS_REPL_INFO_METADATA_2_FOR_OBJ */
if infoType in {DS_REPL_INFO_METADATA_FOR_OBJ,
                DS_REPL_INFO_METADATA_2_FOR_OBJ} then

    /* Enumerate all the replicated attributes */
    attrsSeq := ReplicatedAttributes()
    i := 0
    j := 0
    while (i < attrsSeq.length)
        attr := attrsSeq[i]
        s := AttrStamp(object, attr)

        if (IsForwardLinkAttribute(attr) and
            dwInVersion = 2 and
            DS_REPL_INFO_FLAG_IMPROVE_LINKED_ATTRS in msgIn.ulFlags)
            then

```

```

ls := null
foreach v in GetAttrVals(object, attr, true)
    stamp := LinkStamp(object, attr, v)
    /* If v was last updated in win2k forest mode
    * then it does not have LinkValueStamp associated with it.
    * LinkStamp() returns null in that case. */
    if stamp # null and LinkValueStampCompare(stamp, ls) > 0 then
        ls := stamp;
    endif
endfor
if s = null then
    s := 0 /* An AttributeStamp with 0 for all fields. */
endif

/* Improve the stamp with the link value stamp. */
s.dwVersion := ls.dwVersion
s.timeChanged := ls.timeChanged
s.uuidOriginating := NULLGUID
s.usnOriginating := ls.usnOriginating
endif

if s # null then
    if i >= baseIndex
        if infoType = DS_REPL_INFO_METADATA_FOR_OBJ then
            pObjMetaData := ADR(pmsgOut^.pObjMetaData^.rgMetaData[j])
            pObjMetaData^.pszAttributeName := attr
            pObjMetaData^.dwVersion := s.dwVersion
            pObjMetaData^.ftimeLastOriginatingChange := s.timeChanged
            pObjMetaData^.uuidLastOriginatingDsaInvocationID :=
                s.uuidOriginating
            pObjMetaData^.usnOriginatingChange := s.usnOriginating
            pObjMetaData^.usnLocalChange :=
                An implementation-specific value that the server
                maintains for replicated attributes
        else
            pObjMetaData2 := ADR(pmsgOut^.pObjMetaData2^.rgMetaData[j])
            pObjMetaData2^.pszAttributeName := attr
            pObjMetaData2^.dwVersion := s.dwVersion
            pObjMetaData2^.ftimeLastOriginatingChange := s.timeChanged
            pObjMetaData2^.uuidLastOriginatingDsaInvocationID :=
                s.uuidOriginating
            pObjMetaData2^.usnOriginatingChange := s.usnOriginating
            pObjMetaData2^.usnLocalChange :=
                An implementation-specific value that the server
                maintains for replicated attributes
            pObjMetaData2^.pszLastOriginatingDsaDN :=
                GetDNFromInvocationID(s.uuidOriginating)
        endif
        j := j + 1
    endif
    i := i + 1
endif
endwhile
if infoType = DS_REPL_INFO_METADATA_FOR_OBJ then
    pmsgOut^.pObjMetaData^.cNumEntries = j
else
    pmsgOut^.pObjMetaData2^.cNumEntries = j
endif
endif

/* DS_REPL_INFO_CURSORS_FOR_NC */
if infoType = DS_REPL_INFO_CURSORS_FOR_NC then

    /* The NC root object must be specified */
    nc := object

    /* Parameter validation */

    if nc = null then
        return ERROR_INVALID_PARAMETER
    endif
endif

```

```

endif

if not FullReplicaExists(nc) and
    not PartialGCReplicaExists(nc) then
    return ERROR_DS_DRA_BAD_NC
endif

utd := GetUpToDatenessVector(nc)
i := baseIndex
j := 0
while i < utd.length
    pCursor := ADR(pmsgOut^.pCursors^.rgCursor[j])
    pCursor^.uuidSourceDsaInvocationID := utd[i].uuidDsa
    pCursor^.usnAttributeFilter := utd[i].usnHighPropUpdate
    i := i + 1
    j := j + 1
endwhile
pmsgOut^.pCursors^.cNumCursors := j
endif

/* DS_REPL_INFO_CURSORS_2_FOR_NC/ DS_REPL_INFO_CURSORS_3_FOR_NC */
if infoType in {DS_REPL_INFO_CURSORS_2_FOR_NC,
    DS_REPL_INFO_CURSORS_3_FOR_NC} then

    /* The NC root object must be specified. */
    nc := object

    /* Parameter validation. */
    if (nc = null) then
        return ERROR_INVALID_PARAMETER
    endif

    if not FullReplicaExists(nc) and
        not PartialGCReplicaExists(nc) then
        return ERROR_DS_DRA_BAD_NC
    endif

    i := baseIndex
    j := 0
    utd := GetUpToDatenessVector(nc)

    /* A maximum of 1000 items will be sent in each call. */
    if utd.length - baseIndex - 1 > 1000 then
        endIndex = baseIndex + 1000
    else
        endIndex = utd.length
    endif

    while i < endIndex
        if infoType = DS_REPL_INFO_CURSORS_2_FOR_NC then
            pCursor2 := ADR(pmsgOut^.pCursors2^.rgCursor[j])
            pCursor2^.uuidSourceDsaInvocationID := utd[i].uuidDsa
            pCursor2^.usnAttributeFilter := utd[i].usnHighPropUpdate
            pCursor2^.ftimeLastSyncSuccess := utd[i].timeLastSyncSuccess
        else
            pCursor3 := ADR(pmsgOut^.pCursor3^.rgCursor[j])
            pCursor3^.uuidSourceDsaInvocationID := utd[i].uuidDsa
            pCursor3^.usnAttributeFilter := utd[i].usnHighPropUpdate
            pCursor3^.ftimeLastSyncSuccess := utd[i].timeLastSyncSuccess
            pCursor3^.pszSourceDsaDN :=
                GetDNFromInvocationID(utd[i].uuidDsa)
        endif
        j := j + 1
        i := i + 1
    endwhile
    if infoType = DS_REPL_INFO_CURSORS_2_FOR_NC then
        pmsgOut^.pCursors2^.cNumCursors := j
    else
        pmsgOut^.pCursor3^.cNumCursors := j
    endif
endif

```

```

if i < utd.length - 1 then
  /* Not all items could be sent back in this call, so save the
   * index of the first item to be sent in the next call. */
  If infoType = DS_REPL_INFO_CURSORS_2_NC then
    pmsgOut^.pCursor2^.dwEnumerationContext := i
  else
    pmsgOut^.pCursors3^.dwEnumerationContext := i
  endif
else
  /* No more data is available. */
  If infoType = DS_REPL_INFO_CURSORS_2_NC then
    pmsgOut^.pCursor2^.dwEnumerationContext := 0xffffffff
  else
    pmsgOut^.pCursors3^.dwEnumerationContext := 0xffffffff
  endif
endif
endif

/* DS_REPL_INFO_UPTODATE_VECTOR_V1 */
if infoType = DS_REPL_INFO_UPTODATE_VECTOR_V1 then

  /* The NC root object must be specified. */
  nc := object

  /* Parameter validation. */

  if (nc = null) then
    return ERROR_INVALID_PARAMETER
  endif

  utd := GetUpToDateVector(nc)
  for i := 0 to utd.length - 1
    pCursor := ADR(pmsgOut^.pUpToDateVec^.rgCursors[i])
    pCursor^.uuidSourceDsaInvocationID := utd[i].uuidDsa
    pCursor^.usnAttributeFilter := utd[i].usnHighPropUpdate
  endfor
  pmsgOut^.pUpToDateVec^.cNumCursors := utd.length
endif

/* DS_REPL_INFO_METADATA_FOR_ATTR_VALUE/
 * DS_REPL_INFO_METADATA_2_FOR_ATTR_VALUE */
if infoType in {DS_REPL_INFO_METADATA_FOR_ATTR_VALUE,
  DS_REPL_INFO_METADATA_2_FOR_ATTR_VALUE} then

  /* If the attribute name is specified it must be a link
   * attribute. */
  attrs := select all a in Link Attributes of object
  if (pmsgIn^.V2.pszAttributeNameValue # null and
    pmsgIn^.V2.pszAttributeNameValue not in attrs) then
    return ERROR_DS_WRONG_LINKED_ATT_SYNTAX
  endif

  /* If the attribute name is not specified, replication state for a
   * link attribute of the object which has a value is returned. */
  if (pmsgIn^.V2.pszAttributeNameValue # null) then
    attr := pmsgIn^.V2.pszAttributeNameValue
  else
    attrsSeq := select all a in attrs where
      GetAttrVals(object, a, true) # null
    attr := attrsSeq[0]
  endif

  if attr # null then
    valuesSeq := GetAttrVals(object, attr, true)

    /* If a start value has been specified, then start at the first
     * occurrence of that value in the sequence of values, otherwise
     * start at the index determined from the enumeration context

```

```

    * which specifies the index of the next value to be returned. */
if (pmsgIn^.V2.pszValueDN # null and
    Syntax(attr) = Object(DS-DN)) then
    i := index of pmsgIn^.V2.pszValueDN in valuesSeq
else
    i := baseIndex
endif

j := 0
while (i < valuesSeq.length and j < 1000)
    ls := LinkStamp(object, attr, valuesSeq[i])
    if infoType = DS_REPL_INFO_METADATA_FOR_ATTR_VALUE then
        pAttrValueMetaData :=
            ADR(pmsgOut^.pAttrValueMetaData^.rgMetadata[j])
        pAttrValueMetaData^.pszAttributeName := attr
        pAttrValueMetaData^.pszObjectDN := object!distinguishedName
        if (Syntax(attr) = Object(DN-Binary) or
            Syntax(attr) = Object(DN-String)) then
            pAttrValueMetaData^.cbData :=
                length of data associated with valuesSeq[i]
            pAttrValueMetaData^.pbData := data associated with
                valuesSeq[i]
        endif
        pAttrValueMetaData^.ftimeCreated := ls.timeCreated
        pAttrValueMetaData^.ftimeDeleted := ls.timeDeleted
        pAttrValueMetaData^.dwVersion := ls.dwVersion
        pAttrValueMetaData^.ftimeLastOriginatingChange :=
            ls.timeChanged
        pAttrValueMetaData^.uuidLastOriginatingDsaInvocationID :=
            ls.uuidOriginating
        pAttrValueMetaData^.usnOriginatingChange := ls.usnOriginating
        pAttrValueMetaData^.usnLocalChange :=
            implementation-specific value maintained for each link
            attribute value
    else
        pAttrValueMetaData2 :=
            ADR(pmsgOut^.pAttrValueMetaData2^.rgMetadata[j])
        pAttrValueMetaData2^.pszAttributeName := attr
        pAttrValueMetaData2^.pszObjectDN := object!distinguishedName
        if (Syntax(attr) = Object(DN-Binary) or
            Syntax(attr) = Object(DN-String)) then
            pAttrValueMetaData2^.cbData :=
                length of data associated with valuesSeq[i]
            pAttrValueMetaData2^.pbData :=
                data associated with valuesSeq[i]
        endif
        pAttrValueMetaData2^.ftimeCreated := ls.timeCreated
        pAttrValueMetaData2^.ftimeDeleted := ls.timeDeleted
        pAttrValueMetaData2^.dwVersion := ls.dwVersion
        pAttrValueMetaData2^.ftimeLastOriginatingChange :=
            ls.timeChanged
        pAttrValueMetaData2^.uuidLastOriginatingDsaInvocationID :=
            ls.uuidOriginating
        pAttrValueMetaData2^.usnOriginatingChange :=
            ls.usnOriginating
        pAttrValueMetaData2^.usnLocalChange :=
            implementation-specific value maintained for each
            link attribute value
        pAttrValueMetaData2^.pszLastOriginatingDsaDN :=
            GetDNFromInvocationID(ls.uuidOriginating)
    endif

    i := i + 1
    j := j + 1
endwhile

if infoType = DS_REPL_INFO_METADATA_FOR_ATTR_VALUE then
    if i < valuesSeq.length - 1 then
        /* Since there are more entries to be returned, save the index
        * of the first value to be returned in the next call. */

```

```

        pmsgOut^.pAttrValueMetaData^.dwEnumerationContext := i
    else
        /* No more data is available. */
        pmsgOut^.pAttrValueMetaData^.dwEnumerationContext :=
            0xffffffff
    endif
    pmsgOut^.pAttrValueMetaData^.cNumEntries = j
else
    if i < valuesSeq.length - 1 then
        /* Since there are more entries to be returned, save the index
        * of the first value to be returned in the next call. */
        pmsgOut^.pAttrValueMetaData2^.dwEnumerationContext := i
    else
        /* No more data is available. */
        pmsgOut^.pAttrValueMetaData2^.dwEnumerationContext :=
            0xffffffff
    endif
    pmsgOut^.pAttrValueMetaData2^.cNumEntries = j
endif
endif
endif

/* DS_REPL_INFO_KCC_DSA_CONNECT_FAILURES */
if infoType = DS_REPL_INFO_KCC_DSA_CONNECT_FAILURES then
    i := 0
    foreach t in dc.kccFailedConnections
        pConnectionFailure :=
            ADR(pmsgOut^.pConnectionFailures^.rgDsaFailure[i])
        pConnectionFailure^.pszDsaDN := t.DsaDN
        pConnectionFailure^.uuidDsaObjGuid := t.UUIDDsa
        pConnectionFailure^.fTimeFirstFailure := t.TimeFirstFailure
        pConnectionFailure^.cNumFailures := t.FailureCount
        pConnectionFailure^.dwLastResult := t.LastResult
        i := i + 1
    endfor
    pmsgOut^.pConnectionFailures^.cNumEntries := i
endif

/* DS_REPL_INFO_KCC_DSA_LINK_FAILURES */
if infoType = DS_REPL_INFO_KCC_DSA_LINK_FAILURES then
    i := 0
    foreach t in dc.kccFailedLinks
        pConnectionLink := ADR(pmsgOut^.pLinkFailures^.rgDsaFailure[i])
        pConnectionLink^.pszDsaDN := t.DsaDN
        pConnectionLink^.uuidDsaObjGuid := t.UUIDDsa
        pConnectionLink^.fTimeFirstFailure := t.TimeFirstFailure
        pConnectionLink^.cNumFailures := t.FailureCount
        pConnectionLink^.dwLastResult := t.LastResult
        i := i + 1
    endfor
    pmsgOut^.pConnectionLinks^.cNumEntries := i
endif

/* DS_REPL_INFO_PENDING_OPS */
if infoType = DS_REPL_INFO_PENDING_OPS then
    i := 0
    foreach t in dc.replicationQueue
        pPendingOp := ADR(pmsgOut^.pPendingOps^.rgPendingOp[i])
        pPendingOp^.fTimeEnqueued := t.TimeEnqueued
        pPendingOp^.ulSerialNumber := t.SerialNumber
        pPendingOp^.ulPriority := t.Priority
        pPendingOp^.OpType := t.OperationType
        pPendingOp^.ulOptions := t.Options
        pPendingOp^.pszNamingContext := t.NamingContext
        pPendingOp^.pszDsaDN := t.DsaDN
        pPendingOp^.pszDsaAddress := t.DsaAddress
        pPendingOp^.uuidNamingContextObjGuid := t.UUIDNC
        pPendingOp^.uuidDsaObjGuid := t.UUIDDsa
        i := i + 1
    endfor

```

```

    pmsgOut^.pPendingOps^.cNumPendingOps := i
    pmsgOut^.pPendingOps^.fTimeCurrentOpStarted := time when current
        operation was started
endif

/* DS_REPL_INFO_CLIENT_CONTEXTS */
if infoType = DS_REPL_INFO_CLIENT_CONTEXTS then
    i := 0
    foreach t in dc.rpcClientContexts
        pClientContext := ADR(pmsgOut^.pClientContexts^.rgContext[i])
        pClientContext^.hCtx := t.BindingContext
        pClientContext^.lReferenceCount := t.RefCount
        pClientContext^.fIsBound := t.IsBound
        pClientContext^.uuidClient := t.UUIDClient
        pClientContext^.timeLastUsed := t.TimeLastUsed
        pClientContext^.IPAddr := t.IPAddress
        pClientContext^.pid := t.PID
        i := i + 1
    endfor
    pmsgOut^.pClientContexts^.cNumContexts := i
endif

/* DS_REPL_INFO_SERVER_OUTGOING_CALLS */
if infoType = DS_REPL_INFO_SERVER_OUTGOING_CALLS then
    i := 0
    foreach t in dc.rpcOutgoingContexts
        pOutgoingContext =
            ADR(pmsgOut^.pServerOutgoingCalls^.rgCall[i])
        pOutgoingContext^.pszServerName := t.ServerName
        pOutgoingContext^.fIsHandleBound := t.IsBound
        pOutgoingContext^.fIsHandleFromCache := t.HandleFromCache
        pOutgoingContext^.fIsHandleInCache := t.HandleInCache
        pOutgoingContext^.dwThreadId := t.ThreadId
        pOutgoingContext^.dwBindingTimeoutMins := t.BindingTimeout
        pOutgoingContext^.dstimeCreated := t.CreateTime
        pOutgoingContext^.dwCallType := t.CallType
        i := i + 1
    endfor
    pmsgOut^.pServerOutgoingCalls^.cNumCalls := i
endif

return 0

```

4.1.13.4 Examples of the IDL_DRSGetReplInfo Method

4.1.13.4.1 Calling IDL_DRSGetReplInfo with infoType DS_REPL_INFO_NEIGHBORS to find replication neighbors for a specified NC

In this example, the domain administrator wants to see which source DCs DC1 receives replication updates from for the domain NC CONTOSO.COM. The domain administrator does so by issuing a request to DC1 with **pszObjectDN** set to the DN of the domain NC.

4.1.13.4.1.1 Initial State

Querying the NC root object for domain NC CONTOSO.COM on DC1:

- ldap_search_s("DC=contoso,DC=com", baseObject, "(objectClass=domainDNS)", [objectClass, repsFrom])
- Getting 1 entry:
- Dn: DC=contoso,DC=com
 - 3> objectClass: top; domain; **domainDNS**;

- 1 > repsFrom: dwVersion: 2 v1.cb: 492 v1.cConsecutive Failures: 0 v1.timeLastSuccess: 12924402382 v1.timeLastAttempt: 12924402382 v1.ulResultLastAttempt: 0 v1.cbOtherDraOffset: 216v1.cbOtherDra: 276v1.ulReplicaFlags: 112 v1.rtSchedule: <skipped> v1.usnvec.usnHighObjUpdate: 19332 v1.usnvec.usnHighPropUpdate: 19332 v1.pszUuidDsaObj: 12626d52-1da7-4a40-a490-987c0880c3fe v1.pszUuidInvocId: 44a2959c-bb0d-4b2e-b106-fd8235288ee4 v1.pszUuidTransportObj: 00000000-0000-0000-0000-000000000000 v1.cbPASDataOffset: 0 v1~PasData: (none) v2~pdsa_rpc_inst v2.pszDSIServer 12626d52-1da7-4a40-a490-987c0880c3fe._msdcs.contoso.com v2.pszDSIAnnotation (null) v2.pszDSIInstance 12626d52-1da7-4a40-a490-987c0880c3fe._msdcs.contoso.com v2.pguidDSIInstance (null);

4.1.13.4.1.2 Client Request

The client invokes the IDL_DRSGetReplInfo (section 4.1.13) method against DC1 with the following parameters (DRS_HANDLE to DC1 omitted):

- *dwInVersion* = 2
- *pmsgIn* = DRS_MSG_GETREPLINFO_REQ_V2
 - InfoType = DS_REPL_INFO_NEIGHBORS
 - pszObjectDN = "DC=contoso,DC=com"
 - uuidSourceDsaObjGuid = 00000000-0000-0000-0000-000000000000
 - ulFlags = 0x0
 - pszAttributeName = (null)
 - pszValueDN = (null)
 - dwEnumerationContext = 0

4.1.13.4.1.3 Server Response

A return code of 0 with the following values:

- *pdwOutVersion* = DS_REPL_INFO_NEIGHBORS
- *pmsgOut* = DS_REPL_NEIGHBORSW
 - cNumNeighbors = 1
 - dwReserved = 0
 - rgNeighbor = DS_REPL_NEIGHBORW[]
 - rgNeighbor[0]
 - pszNamingContext = DC=contoso,dc=com
 - pszSourceDsaDN = CN=NTDS Settings,CN=DC2,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com
 - pszSourceDsaAddress = 12626d52-1da7-4a40-a490-987c0880c3fe._msdcs.contoso.com
 - pszAsyncIntersiteTransportDN = (null)
 - dwReplicaFlags = 0x0

- dwReserved = 0
- uuidNamingContextObjGuid = 00000000-0000-0000-0000-000000000000
- uuidSourceDsaObjGuid = 12626d52-1da7-4a40-a490-987c0880c3fe
- uidSourceDsaInvocationID = 44a2959c-bb0d-4b2e-b106-fd8235288ee4
- uuidAsyncIntersiteTransportObjGuid = 00000000-0000-0000-0000-000000000000
- usnLastObjChangeSynced = 20002
- usnAttributeFilter = 20002
- ftimeLastSyncSuccess.dwLowDateTime = 0x4aaeb00
- ftimeLastSyncSuccess.dwHighDateTime = 0x1cb2ad2
- ftimeLastSyncAttempt.dwLowDateTime = 0x4aaeb00
- ftimeLastSyncAttempt.dwHighDateTime = 0x1cb2ad2
- dwLastSyncResult = 0
- cNumConsecutiveSyncFailures = 0

4.1.13.4.1.4 Final State

The final state is the same as the initial state; there is no change.

4.1.13.4.2 Calling IDL_DRSGetReplInfo with infoType DS_REPL_INFO_NEIGHBORS to find the naming contexts for which a DC receives updates from a replication neighbor

In this example, the domain administrator wants to see the NCs for which DCA1 receives replication updates from DC1. The domain administrator does so by issuing a request to DCA1 with **pszObjectDN** set to null and **uuidSourceDsaObjGuid** set to the DSA GUID of DC1.

4.1.13.4.2.1 Initial State

Querying the nTDSDSA object for DC1 on DCA1:

- ldap_search_s("CN=NTDS Settings,CN=DC1,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com", baseObject, "(objectClass=*)", [objectClass, objectGUID])
- Getting 1 entry:
- >> Dn: CN=NTDS Settings,CN=DC1,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com
 - 3> objectClass: top; applicationSettings; nTDSDSA;
 - 1> objectGUID: 2e235fab-353c-46fc-8afd-437e9d0188b3;

Querying the NC root object for config NC CN=Configuration,DC=contoso,DC=com on DCA1:

- ldap_search_s("CN=Configuration,DC=contoso,DC=com", baseObject, "(objectClass=*)", [objectClass, repsFrom])
- Getting 1 entry:

- >> Dn: CN=Configuration,DC=contoso,DC=com
 - 2> objectClass: top; configuration;
 - 1> repsFrom: dwVersion: 2 v1.cb: 492 v1.cConsecutive Failures: 0 v1.timeLastSuccess: 12924750622 v1.timeLastAttempt: 12924750622 v1.ulResultLastAttempt: 0 v1.cbOtherDraOffset: 216v1.cbOtherDra: 276v1.ulReplicaFlags: 805306448 v1.rtSchedule: <skipped> v1.usnvec.usnHighObjUpdate: 24573 v1.usnvec.usnHighPropUpdate: 24573 v1.pszUuidDsaObj: 2e235fab-353c-46fc-8afd-437e9d0188b3 v1.pszUuidInvocId: 2e235fab-353c-46fc-8afd-437e9d0188b3 v1.pszUuidTransportObj: 00000000-0000-0000-0000-000000000000 v1.cbPASDataOffset: 0 v1~PasData: (none) v2~pdsa_rpc_inst v2.pszDSIServer 2e235fab-353c-46fc-8afd-437e9d0188b3._msdcs.contoso.com v2.pszDSIAnnotation (null) v2.pszDSIIInstance 2e235fab-353c-46fc-8afd-437e9d0188b3._msdcs.contoso.com v2.pguidDSIIInstance (null);

Querying the NC root object for schema NC CN=Schema,CN=Configuration,DC=contoso,DC=com on DCA1:

- ldap_search_s("CN=Schema,CN=Configuration,DC=contoso,DC=com", baseObject, "(objectClass=*)", [objectClass, repsFrom])
- Getting 1 entry:
- >> Dn: CN=Schema,CN=Configuration,DC=contoso,DC=com
 - 2> objectClass: top; dMD;
 - 1> repsFrom: dwVersion: 2 v1.cb: 492 v1.cConsecutive Failures: 0 v1.timeLastSuccess: 12924750622 v1.timeLastAttempt: 12924750622 v1.ulResultLastAttempt: 0 v1.cbOtherDraOffset: 216v1.cbOtherDra: 276v1.ulReplicaFlags: 2952790096 v1.rtSchedule: <skipped> v1.usnvec.usnHighObjUpdate: 24573 v1.usnvec.usnHighPropUpdate: 24573 v1.pszUuidDsaObj: 2e235fab-353c-46fc-8afd-437e9d0188b3 v1.pszUuidInvocId: 2e235fab-353c-46fc-8afd-437e9d0188b3 v1.pszUuidTransportObj: 00000000-0000-0000-0000-000000000000 v1.cbPASDataOffset: 0 v1~PasData: (none) v2~pdsa_rpc_inst v2.pszDSIServer 2e235fab-353c-46fc-8afd-437e9d0188b3._msdcs.contoso.com v2.pszDSIAnnotation (null) v2.pszDSIIInstance 2e235fab-353c-46fc-8afd-437e9d0188b3._msdcs.contoso.com v2.pguidDSIIInstance (null);

Querying the NC root object for NC DC=ForestDnsZones,DC=contoso,DC=com on DCA1:

- ldap_search_s("DC=ForestDnsZones,DC=contoso,DC=com ", baseObject, "(objectClass=*)", [objectClass, repsFrom])
- Getting 1 entry:
- >> Dn: DC=ForestDnsZones,DC=contoso,DC=com
 - 3> objectClass: top; domain; domainDNS;
 - 1> repsFrom: dwVersion: 2 v1.cb: 492 v1.cConsecutive Failures: 0 v1.timeLastSuccess: 12924750622 v1.timeLastAttempt: 12924750622 v1.ulResultLastAttempt: 0 v1.cbOtherDraOffset: 216v1.cbOtherDra: 276v1.ulReplicaFlags: 805306448 v1.rtSchedule: <skipped> v1.usnvec.usnHighObjUpdate: 24573 v1.usnvec.usnHighPropUpdate: 24573 v1.pszUuidDsaObj: 2e235fab-353c-46fc-8afd-437e9d0188b3 v1.pszUuidInvocId: 2e235fab-353c-46fc-8afd-437e9d0188b3 v1.pszUuidTransportObj: 00000000-0000-0000-0000-000000000000 v1.cbPASDataOffset: 0 v1~PasData: (none) v2~pdsa_rpc_inst v2.pszDSIServer 2e235fab-353c-46fc-8afd-437e9d0188b3._msdcs.contoso.com v2.pszDSIAnnotation (null) v2.pszDSIIInstance 2e235fab-353c-46fc-8afd-437e9d0188b3._msdcs.contoso.com v2.pguidDSIIInstance (null);

4.1.13.4.2.2 Client Request

The client invokes the IDL_DRSGetReplInfo (section 4.1.13) method against DCA1 with the following parameters (DRS_HANDLE to DC1 omitted):

- *dwInVersion* = 2
- *pmsgIn* = DRS_MSG_GETREPLINFO_REQ_V2
 - InfoType = DS_REPL_INFO_NEIGHBORS
 - pszObjectDN = (null)
 - uuidSourceDsaObjGuid = 2e235fab-353c-46fc-8afd-437e9d0188b3
 - ulFlags = 0x0
 - pszAttributeName = (null)
 - pszValueDN = (null)
 - dwEnumerationContext = 0

4.1.13.4.2.3 Server Response

A return code of 0 with the following values:

- *pdwOutVersion* = DS_REPL_INFO_NEIGHBORS
- *pmsgOut* = DS_REPL_NEIGHBORSW
 - cNumNeighbors = 3
 - dwReserved = 0
 - rgNeighbor = DS_REPL_NEIGHBORW[]
 - rgNeighbor[0]
 - pszNamingContext = CN=Configuration,DC=contoso,DC=com
 - pszSourceDsaDN = CN=NTDS Settings,CN=DC1,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com
 - pszSourceDsaAddress = 2e235fab-353c-46fc-8afd-437e9d0188b3._msdcs.contoso.com
 - pszAsyncIntersiteTransportDN = (null)
 - dwReplicaFlags = 0x0
 - dwReserved = 0
 - uuidNamingContextObjGuid = 64f4ed75-28b1-42f3-b7c9-6ac234db9a9e
 - uuidSourceDsaObjGuid = 2e235fab-353c-46fc-8afd-437e9d0188b3
 - uidSourceDsaInvocationID = 2e235fab-353c-46fc-8afd-437e9d0188b3
 - uuidAsyncIntersiteTransportObjGuid = 00000000-0000-0000-0000-000000000000
 - usnLastObjChangeSynced = 24523
 - usnAttributeFilter = 24523

- ftimeLastSyncSuccess.dwLowDateTime = 0xf7e80900
- ftimeLastSyncSuccess.dwHighDateTime = 0x1cb2de9
- ftimeLastSyncAttempt.dwLowDateTime = 0xf7e80900
- ftimeLastSyncAttempt.dwHighDateTime = 0x1cb2de9
- dwLastSyncResult = 0
- cNumConsecutiveSyncFailures = 0
- rgNeighbor[1]
 - pszNamingContext = CN=Schema,CN=Configuration,DC=contoso,DC=com
 - pszSourceDsaDN = CN=NTDS Settings,CN=DC1,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com
 - pszSourceDsaAddress = 2e235fab-353c-46fc-8afd-437e9d0188b3._msdcs.contoso.com
 - pszAsyncIntersiteTransportDN = (null)
 - dwReplicaFlags = 0x0
 - dwReserved = 0
 - uuidNamingContextObjGuid = f3ba2060-2d67-43e6-a334-54a8f1ecc78a
 - uuidSourceDsaObjGuid = 2e235fab-353c-46fc-8afd-437e9d0188b3
 - uidSourceDsaInvocationID = 2e235fab-353c-46fc-8afd-437e9d0188b3
 - uuidAsyncIntersiteTransportObjGuid = 00000000-0000-0000-0000-000000000000
 - usnLastObjChangeSynced = 24523
 - usnAttributeFilter = 24523
 - ftimeLastSyncSuccess.dwLowDateTime = 0xf7e80900
 - ftimeLastSyncSuccess.dwHighDateTime = 0x1cb2de9
 - ftimeLastSyncAttempt.dwLowDateTime = 0xf7e80900
 - ftimeLastSyncAttempt.dwHighDateTime = 0x1cb2de9
 - dwLastSyncResult = 0
 - cNumConsecutiveSyncFailures = 0
- rgNeighbor[2]
 - pszNamingContext = DC=ForestDnsZones,DC=contoso,DC=com
 - pszSourceDsaDN = CN=NTDS Settings,CN=DC1,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com
 - pszSourceDsaAddress = 2e235fab-353c-46fc-8afd-437e9d0188b3._msdcs.contoso.com
 - pszAsyncIntersiteTransportDN = (null)
 - dwReplicaFlags = 0x0

- dwReserved = 0
- uuidNamingContextObjGuid = 7fafd728-d866-4cf3-915f-78ff680603d4
- uuidSourceDsaObjGuid = 2e235fab-353c-46fc-8afd-437e9d0188b3
- uidSourceDsaInvocationID = 2e235fab-353c-46fc-8afd-437e9d0188b3
- uuidAsyncIntersiteTransportObjGuid = 00000000-0000-0000-0000-000000000000
- usnLastObjChangeSynced = 24523
- usnAttributeFilter = 24523
- ftimeLastSyncSuccess.dwLowDateTime = 0xf7e80900
- ftimeLastSyncSuccess.dwHighDateTime = 0x1cb2de9
- ftimeLastSyncAttempt.dwLowDateTime = 0xf7e80900
- ftimeLastSyncAttempt.dwHighDateTime = 0x1cb2de9
- dwLastSyncResult = 0
- cNumConsecutiveSyncFailures = 0

4.1.13.4.2.4 Final State

The final state is the same as the initial state; there is no change.

4.1.13.4.3 Calling IDL_DRSGetReplInfo with infoType DS_REPL_INFO_REPSTO to find replication neighbors for a specified NC

In this example, the domain administrator verifies which DCs DC1 sends replication updates to for the domain NC CONTOSO.COM. The domain administrator does this by issuing a request to DC1 with **pszObjectDN** set to the DN of the domain NC.

4.1.13.4.3.1 Initial State

Querying the NC root object for domain NC CONTOSO.COM on DC1:

- ldap_search_s("DC=contoso,DC=com", baseObject, "(objectClass=domainDNS)", [objectClass, repsTo])
- Getting 1 entry:
- >> Dn: DC=contoso,DC=com
 - 3> objectClass: top; domain; domainDNS;
 - 1> repsTo: dwVersion: 2 v1.cb: 492 v1.cConsecutive Failures: 0 v1.timeLastSuccess: 12924828300 v1.timeLastAttempt: 12924828300 v1.ulResultLastAttempt: 0 v1.cbOtherDraOffset: 216v1.cbOtherDra: 276v1.ulReplicaFlags: 16 v1.rtSchedule: <skipped> v1.usnvec.usnHighObjUpdate: 0 v1.usnvec.usnHighPropUpdate: 0 v1.pszUuidDsaObj: 12626d52-1da7-4a40-a490-987c0880c3fe v1.pszUuidInvocId: 00000000-0000-0000-0000-000000000000 v1.pszUuidTransportObj: 00000000-0000-0000-0000-000000000000 v1.cbPASDataOffset: 0 v1~PasData: (none) v2~pdsa_rpc_inst v2.pszDSIServer 12626d52-1da7-4a40-a490-987c0880c3fe._msdcs.contoso.com v2.pszDSIAnnotation (null) v2.pszDSIInstance 12626d52-1da7-4a40-a490-987c0880c3fe._msdcs.contoso.com v2.pguidDSIInstance (null);

4.1.13.4.3.2 Client Request

The client invokes the IDL_DRSGetReplInfo (section 4.1.13) method against DC1 with the following parameters (DRS_HANDLE to DC1 omitted):

- *dwInVersion* = 2
- *pmsgIn* = DRS_MSG_GETREPLINFO_REQ_V2
 - InfoType = DS_REPL_INFO_REPSTO
 - pszObjectDN = DC=contoso,DC=com
 - uuidSourceDsaObjGuid = 00000000-0000-0000-0000-000000000000
 - ulFlags = 0x0
 - pszAttributeName = (null)
 - pszValueDN = (null)
 - dwEnumerationContext = 0

4.1.13.4.3.3 Server Response

A return code of 0 with the following values:

- *pdwOutVersion* = DS_REPL_INFO_REPSTO
- *pmsgOut* = DS_REPL_NEIGHBORSW
 - cNumNeighbors = 1
 - dwReserved = 0
 - rgNeighbor = DS_REPL_NEIGHBORW[]
 - rgNeighbor[0]
 - pszNamingContext = DC=contoso,DC=com
 - pszSourceDsaDN = CN=NTDS Settings,CN=DC2,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com
 - pszSourceDsaAddress = 12626d52-1da7-4a40-a490-987c0880c3fe._msdcs.contoso.com
 - pszAsyncIntersiteTransportDN = (null)
 - dwReplicaFlags = 0x0
 - dwReserved = 0
 - uuidNamingContextObjGuid = 00000000-0000-0000-0000-000000000000
 - uuidSourceDsaObjGuid = 12626d52-1da7-4a40-a490-987c0880c3fe
 - uidSourceDsaInvocationID = 00000000-0000-0000-0000-000000000000
 - uuidAsyncIntersiteTransportObjGuid = 00000000-0000-0000-0000-000000000000
 - usnLastObjChangeSynced = 0

- usnAttributeFilter = 0
- ftimeLastSyncSuccess.dwLowDateTime = 0x6a6bee00
- ftimeLastSyncSuccess.dwHighDateTime = 0x1cb2ea9
- ftimeLastSyncAttempt.dwLowDateTime = 0x6a6bee00
- ftimeLastSyncAttempt.dwHighDateTime = 0x1cb2ea9
- dwLastSyncResult = 0
- cNumConsecutiveSyncFailures = 0

4.1.13.4.3.4 Final State

The final state is the same as the initial state; there is no change.

4.1.13.4.4 Calling IDL_DRSGetReplInfo with infoType DS_REPL_INFO_CURSORS_3_FOR_NC

In this example, the domain administrator wants to view the replication state on DC2 relative to the config NC CN=Configuration,DC=contoso,DC=com. The domain administrator does this by issuing a request to DC1 with **pszObjectDN** set to the DN of the config NC.

4.1.13.4.4.1 Initial State

Querying the NC root object for the config NC CN=Configuration,DC=contoso,DC=com on DC2:

- ldap_search_s("CN=Configuration,DC=contoso,DC=com", baseObject, "(objectClass=configuration)", [objectClass, replUpToDateVector])
- Getting 1 entry:
- >> Dn: CN=Configuration,DC=contoso,DC=com
 - 2> objectClass: top; configuration;
 - 1> replUpToDateVector: dwVersion: 2, dwReserved1: 0, V2.cNumCursors: 2, V2.dwReserved2: 0, rgCursors: {uuidDsa: 2e235fab-353c-46fc-8afd-437e9d0188b3, usnHighPropUpdate: 22378, timeLastSyncSuccess: 07/26/2010 16:00:19}, {uuidDsa: e4dfc4c0-381c-48c9-a563-cb27db448753, usnHighPropUpdate: 18177, timeLastSyncSuccess: 07/26/2010 16:02:32};

4.1.13.4.4.2 Client Request

The client invokes the IDL_DRSGetReplInfo (section 4.1.13) method against DC2 with the following parameters (DRS_HANDLE to DC2 omitted):

- *dwInVersion* = 2
- *pmsgIn* = DRS_MSG_GETREPLINFO_REQ_V2
 - InfoType = DS_REPL_INFO_CURSORS_3_FOR_NC
 - pszObjectDN = CN=Configuration,DC=contoso,dc=com
 - uuidSourceDsaObjGuid = 00000000-0000-0000-0000-000000000000
 - ulFlags = 0x0

- pszAttributeName = (null)
- pszValueDN = (null)
- dwEnumerationContext = 0

4.1.13.4.4.3 Server Response

A return code of 0 with the following values:

- *pdwOutVersion* = DS_REPL_INFO_CURSORS_3_FOR_NC
- *pmsgOut* = DS_REPL_CURSORS_3W
 - cNumCursors = 3
 - dwEnumerationContext = 0xffffffff
 - rgCursor = DS_REPL_CURSOR_3W[]
 - rgCursor[0]
 - usnAttributeFilter = 22378
 - uuidSourceDsaInvocationID = 2e235fab-353c-46fc-8afd-437e9d0188b3
 - ftimeLastSyncSuccess.dwLowDateTime = 0x517f0380
 - ftimeLastSyncSuccess.dwHighDateTime = 0x1cb2d16
 - pszSourceDsaDN = CN=NTDS Settings,CN=DC1,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com
 - rgCursor[1]
 - usnAttributeFilter = 43601
 - uuidSourceDsaInvocationID = 44a2959c-bb0d-4b2e-b106-fd8235288ee4
 - ftimeLastSyncSuccess.dwLowDateTime = 0xaf135000
 - ftimeLastSyncSuccess.dwHighDateTime = 0x1cb2d16
 - pszSourceDsaDN = CN=NTDS Settings,CN=DC2,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com
 - rgCursor[2]
 - usnAttributeFilter = 18177
 - uuidSourceDsaInvocationID = e4dfc4c0-381c-48c9-a563-cb27db448753
 - ftimeLastSyncSuccess.dwLowDateTime = 0xa0c53400
 - ftimeLastSyncSuccess.dwHighDateTime = 0x1cb2d16
 - pszSourceDsaDN = CN=NTDS Settings,CN=DCA1,CN=Servers,CN=Default-Second-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com

4.1.13.4.4.4 Final State

The final state is the same as the initial state; there is no change.

4.1.13.4.5 Calling IDL_DRSGetReplInfo with infoType DS_REPL_INFO_METADATA_2_FOR_OBJ

In this example, the domain administrator wants to view the replication state of the organizational unit OU1 on DC1.

4.1.13.4.5.1 Initial State

Querying OU1 on DC1:

- `ldap_search_s("OU=OU1,DC=contoso,DC=com", baseObject, "(objectClass=*)", [*])`
- Getting 1 entry:
- `>> Dn: OU=OU1,DC=contoso,DC=com`
 - `1> distinguishedName: OU=OU1,DC=contoso,DC=com;`
 - `3> dSCorePropagationData: 7/27/2010 10:20:24 PM Pacific Daylight Time; 7/27/2010 10:20:23 PM Pacific Daylight Time; 0x0 = (), 0x0 = ();`
 - `1> instanceType: 0x4 = (WRITE);`
 - `1> name:OU1;`
 - `1> objectCategory: CN=Organizational-Unit,CN=Schema,CN=Configuration,DC=contoso,DC=com;`
 - `2> objectClass: top; organizationalUnit;`
 - `1> objectGUID: 1a0c2e8f-2747-4e38-80fb-074e2dd3df8c;`
 - `1> ou: OU1;`
 - `1> uSNChanged: 25426;`
 - `1> uSNCreated: 25424;`
 - `1> whenChanged: 7/27/2010 10:20:23 PM Pacific Daylight Time;`
 - `1> whenCreated: 7/27/2010 10:20:23 PM Pacific Daylight Time;`

4.1.13.4.5.2 Client Request

The client invokes the IDL_DRSGetReplInfo (section 4.1.13) method against DC2 with the following parameters (DRS_HANDLE to DC1 omitted):

- `dwInVersion = 2`
- `pmsgIn = DRS_MSG_GETREPLINFO_REQ_V2`
 - `InfoType = DS_REPL_INFO_METADATA_2_FOR_OBJ`
 - `pszObjectDN = OU=OU1,DC=contoso,dc=com`
 - `uuidSourceDsaObjGuid = 00000000-0000-0000-0000-000000000000`
 - `ulFlags = 0x0`
 - `pszAttributeName = (null)`
 - `pszValueDN = (null)`

- dwEnumerationContext = 0

4.1.13.4.5.3 Server Response

A return code of 0 with the following values:

- *pdwOutVersion* = DS_REPL_INFO_METADATA_2_FOR_OBJ
- *pmsgOut* = DS_REPL_OBJ_META_DATA_2
 - cNumEntries = 7
 - dwReserved = 0
 - rgMetaData = DS_REPL_ATTR_META_DATA_2[]
 - rgMetaData[0]
 - pszAttributeName = objectClass
 - dwVersion = 1
 - ftimeLastOriginatingChange.dwLowDateTime = 0x94270580
 - ftimeLastOriginatingChange.dwHighDateTime = 0x1cb2e14
 - uuidLastOriginatingDsaInvocationID = 2e235fab-353c-46fc-8afd-437e9d0188b3
 - usnOriginatingChange = 25424
 - usnLocalChange = 25424
 - pszLastOriginatingDsaDN = CN=NTDS Settings,CN=DC1,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com
 - rgMetaData[1]
 - pszAttributeName = ou
 - dwVersion = 1
 - ftimeLastOriginatingChange.dwLowDateTime = 0x94270580
 - ftimeLastOriginatingChange.dwHighDateTime = 0x1cb2e14
 - uuidLastOriginatingDsaInvocationID = 2e235fab-353c-46fc-8afd-437e9d0188b3
 - usnOriginatingChange = 25424
 - usnLocalChange = 25424
 - pszLastOriginatingDsaDN = CN=NTDS Settings,CN=DC1,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com
 - rgMetaData[2]
 - pszAttributeName = instanceType
 - dwVersion = 1
 - ftimeLastOriginatingChange.dwLowDateTime = 0x94270580
 - ftimeLastOriginatingChange.dwHighDateTime = 0x1cb2e14

- uuidLastOriginatingDsaInvocationID = 2e235fab-353c-46fc-8afd-437e9d0188b3
- usnOriginatingChange = 25424
- usnLocalChange = 25424
- pszLastOriginatingDsaDN = CN=NTDS Settings,CN=DC1,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com
- rgMetaData[3]
 - pszAttributeName = whenCreated
 - dwVersion = 1
 - ftimeLastOriginatingChange.dwLowDateTime = 0x94270580
 - ftimeLastOriginatingChange.dwHighDateTime = 0x1cb2e14
 - uuidLastOriginatingDsaInvocationID = 2e235fab-353c-46fc-8afd-437e9d0188b3
 - usnOriginatingChange = 25424
 - usnLocalChange = 25424
 - pszLastOriginatingDsaDN = CN=NTDS Settings,CN=DC1,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com
- rgMetaData[4]
 - pszAttributeName = nTSecurityDescriptor
 - dwVersion = 2
 - ftimeLastOriginatingChange.dwLowDateTime = 0x94270580
 - ftimeLastOriginatingChange.dwHighDateTime = 0x1cb2e14
 - uuidLastOriginatingDsaInvocationID = 2e235fab-353c-46fc-8afd-437e9d0188b3
 - usnOriginatingChange = 25426
 - usnLocalChange = 25426
 - pszLastOriginatingDsaDN = CN=NTDS Settings,CN=DC1,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com
- rgMetaData[5]
 - pszAttributeName = name
 - dwVersion = 1
 - ftimeLastOriginatingChange.dwLowDateTime = 0x94270580
 - ftimeLastOriginatingChange.dwHighDateTime = 0x1cb2e14
 - uuidLastOriginatingDsaInvocationID = 2e235fab-353c-46fc-8afd-437e9d0188b3
 - usnOriginatingChange = 25424
 - usnLocalChange = 25424

- pszLastOriginatingDsaDN = CN=NTDS Settings,CN=DC1,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com
- rgMetaData[6]
 - pszAttributeName = objectCategory
 - dwVersion = 1
 - ftimeLastOriginatingChange.dwLowDateTime = 0x94270580
 - ftimeLastOriginatingChange.dwHighDateTime = 0x1cb2e14
 - uuidLastOriginatingDsaInvocationID = 2e235fab-353c-46fc-8afd-437e9d0188b3
 - usnOriginatingChange = 25424
 - usnLocalChange = 25424
 - pszLastOriginatingDsaDN = CN=NTDS Settings,CN=DC1,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com

4.1.13.4.5.4 Final State

The final state is the same as the initial state; there is no change.

4.1.13.4.6 Calling IDL_DRSGetReplInfo with infoType DS_REPL_INFO_METADATA_2_FOR_ATTR_VALUE to view the replication metadata for all values of a link value attribute

In this example, the domain administrator requires viewing the replication state of the link value attribute member of the group GroupB on DC2.

4.1.13.4.6.1 Initial State

Querying the GroupB on DC2:

- ldap_search_s("CN=GroupB,CN=Users,DC=contoso,DC=com", baseObject, "(objectClass=group)", [objectClass, member])
- Getting 1 entry:
- >> Dn: CN=GroupB,CN=Users,DC=contoso,DC=com
 - 3> member: CN=GroupC,CN=Users,DC=contoso,DC=com;
CN=GroupA,CN=Users,DC=contoso,DC=com; CN=Kim
Akers,CN=Users,DC=contoso,DC=com;
 - 2> objectClass: top; group;

4.1.13.4.6.2 Client Request

The client invokes the IDL_DRSGetReplInfo (section 4.1.13) method against DC2 with the following parameters (DRS_HANDLE to DC2 omitted):

- *dwInVersion* = 2
- *pmsgIn* = DRS_MSG_GETREPLINFO_REQ_V2
 - InfoType = DS_REPL_INFO_METADATA_2_FOR_ATTR_VALUE

- pszObjectDN = CN=GroupB,CN=Users,DC=contoso,dc=com
- uuidSourceDsaObjGuid = 00000000-0000-0000-0000-000000000000
- ulFlags = 0x0
- pszAttributeName = member
- pszValueDN = (null)
- dwEnumerationContext = 0

4.1.13.4.6.3 Server Response

A return code of 0 with the following values:

- *pdwOutVersion* = DS_REPL_INFO_METADATA_2_FOR_ATTR_VALUE
- *pmsgOut* = DS_REPL_ATTR_VALUE_META_DATA_2
 - cNumEntries = 3
 - dwEnumerationContext = 0xffffffff
 - rgMetaData = DS_REPL_VALUE_META_DATA_2[]
 - rgMetaData[0]
 - pszAttributeName = member
 - pszObjectDn = CN=Kim Akers,CN=Users,DC=contoso,DC=com
 - cbData = 0
 - pbData = null
 - ftimedDeleted.dwLowDateTime = 0x0
 - ftimedDeleted.dwHighDateTime = 0x0
 - ftimedCreated.dwLowDateTime = 0xc3a4dd80
 - ftimedCreated.dwHighDateTime = 0x1cb2ab5
 - dwVersion = 1
 - ftimedLastOriginatingChange.dwLowDateTime = 0xc3a4dd80
 - ftimedLastOriginatingChange.dwHighDateTime = 0x1cb2ab5
 - uuidLastOriginatingDsaInvocationID = 2e235fab-353c-46fc-8afd-437e9d0188b3
 - usnOriginatingChange = 15399
 - usnLocalChange = 19212
 - pszLastOriginatingDsaDN = CN=NTDS Settings,CN=DC1,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com
 - rgMetaData[1]
 - pszAttributeName = member

- pszObjectDn = CN=GroupA,CN=Users,DC=contoso,DC=com
- cbData = 0
- pbData = null
- ftimeDeleted.dwLowDateTime = 0x0
- ftimeDeleted.dwHighDateTime = 0x0
- ftimeCreated.dwLowDateTime = 0x2fb77680
- ftimeCreated.dwHighDateTime = 0x1cb2e13
- dwVersion = 1
- ftimeLastOriginatingChange.dwLowDateTime = 0x2fb77680
- ftimeLastOriginatingChange.dwHighDateTime = 0x1cb2e13
- uuidLastOriginatingDsaInvocationID = 2e235fab-353c-46fc-8afd-437e9d0188b3
- usnOriginatingChange = 25384
- usnLocalChange = 46509
- pszLastOriginatingDsaDN = CN=NTDS Settings,CN=DC1,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com
- rgMetaData[2]
 - pszAttributeName = member
 - pszObjectDn = CN=GroupC,CN=Users,DC=contoso,DC=com
 - cbData = 0
 - pbData = null
 - ftimeDeleted.dwLowDateTime = 0x0
 - ftimeDeleted.dwHighDateTime = 0x0
 - ftimeCreated.dwLowDateTime = 0x2fb77680
 - ftimeCreated.dwHighDateTime = 0x1cb2e13
 - dwVersion = 1
 - ftimeLastOriginatingChange.dwLowDateTime = 0x2fb77680
 - ftimeLastOriginatingChange.dwHighDateTime = 0x1cb2e13
 - uuidLastOriginatingDsaInvocationID = 2e235fab-353c-46fc-8afd-437e9d0188b3
 - usnOriginatingChange = 25385
 - usnLocalChange = 46508
 - pszLastOriginatingDsaDN = CN=NTDS Settings,CN=DC1,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com

4.1.13.4.6.4 Final State

The final state is the same as the initial state; there is no change.

4.1.13.4.7 Calling IDL_DRSGetReplInfo with infoType DS_REPL_INFO_METADATA_2_FOR_ATTR_VALUE to view the replication metadata for a specific value of a link value attribute

In this example, the domain administrator wants to view the replication state of link value attribute member of the group GroupB on DC2. Specifically, the domain administrator is interested in the member value corresponding to Kim Akers' account. The domain administrator does so by issuing a request to DC2 with **pszObjectDN** set to the DN of group B, **pszAttributeName** set to member, and **pszValueDN** set to the DN of Kim Akers' user account.

4.1.13.4.7.1 Initial State

Querying the GroupB on DC2:

- `ldap_search_s("CN=GroupB,CN=Users,DC=contoso,DC=com", baseObject, "(objectClass=group)", [objectClass, member])`
- Getting 1 entry:
- `>> Dn: CN=GroupB,CN=Users,DC=contoso,DC=com`
 - `3> member: CN=GroupC,CN=Users,DC=contoso,DC=com;
CN=GroupA,CN=Users,DC=contoso,DC=com; CN=Kim
Akers,CN=Users,DC=contoso,DC=com;`
 - `2> objectClass: top; group;`

4.1.13.4.7.2 Client Request

The client invokes the IDL_DRSGetReplInfo (section 4.1.13) method against DC2 with the following parameters (DRS_HANDLE to DC2 omitted):

- `dwInVersion = 2`
- `pmsgIn = DRS_MSG_GETREPLINFO_REQ_V2`
 - `InfoType = DS_REPL_INFO_METADATA_2_FOR_ATTR_VALUE`
 - `pszObjectDN = CN=GroupB,CN=Users,DC=contoso,dc=com`
 - `uuidSourceDsaObjGuid = 00000000-0000-0000-0000-000000000000`
 - `ulFlags = 0x0`
 - `pszAttributeName = member`
 - `pszValueDN = CN=Kim Akers,CN=Users,DC=contoso,DC=com`
 - `dwEnumerationContext = 0`

4.1.13.4.7.3 Server Response

A return code of 0 with the following values:

- `pdwOutVersion = DS_REPL_INFO_METADATA_2_FOR_ATTR_VALUE`
- `pmsgOut = DS_REPL_ATTR_VALUE_META_DATA_2`

- `cNumEntries = 1`
- `dwEnumerationContext = 0x1`
- `rgMetaData = DS_REPL_VALUE_META_DATA_2[]`
 - `rgMetaData[0]`
 - `pszAttributeName = member`
 - `pszObjectDn = CN=Kim Akers,CN=Users,DC=contoso,DC=com`
 - `cbData = 0`
 - `pbData = null`
 - `ftimeDeleted.dwLowDateTime = 0x0`
 - `ftimeDeleted.dwHighDateTime = 0x0`
 - `ftimeCreated.dwLowDateTime = 0xc3a4dd80`
 - `ftimeCreated.dwHighDateTime = 0x1cb2ab5`
 - `dwVersion = 1`
 - `ftimeLastOriginatingChange.dwLowDateTime = 0xc3a4dd80`
 - `ftimeLastOriginatingChange.dwHighDateTime = 0x1cb2ab5`
 - `uuidLastOriginatingDsaInvocationID = 2e235fab-353c-46fc-8afd-437e9d0188b3`
 - `usnOriginatingChange = 15399`
 - `usnLocalChange = 19212`
 - `pszLastOriginatingDsaDN = CN=NTDS Settings,CN=DC1,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com`

4.1.13.4.7.4 Final State

The final state is the same as the initial state; there is no change.

4.1.13.4.8 Calling IDL_DRSGetReplInfo with infoType DS_REPL_INFO_KCC_DSA_CONNECT_FAILURES

In this example, the domain administrator verifies whether DC1 has any replication failures.

4.1.13.4.8.1 Initial State

DC2 is a replication neighbor of DC1. DC2 is offline and DC1 is unable to contact DC2 to query its replication state.

4.1.13.4.8.2 Client Request

The client invokes the `IDL_DRSGetReplInfo` (section 4.1.13) method against DC1 with the following parameters (`DRS_HANDLE` to DC1 omitted):

- `dwInVersion = 2`
- `pmsgIn = DRS_MSG_GETREPLINFO_REQ_V2`

- InfoType = DS_REPL_INFO_KCC_DSA_CONNECT_FAILURES
- pszObjectDN = (null)
- uuidSourceDsaObjGuid = 00000000-0000-0000-0000-000000000000
- ulFlags = 0x0
- pszAttributeName = (null)
- pszValueDN = (null)
- dwEnumerationContext = 0

4.1.13.4.8.3 Server Response

A return code of 0 with the following values:

- *pdwOutVersion* = DS_REPL_INFO_KCC_DSA_CONNECT_FAILURES
- *pmsgOut* = DS_REPL_KCC_DSA_FAILURESW
 - *cNumEntries* = 1
 - *dwReserved* = 0
 - *rgDsaFailure* = DS_REPL_KCC_DSA_FAILUREW[]
 - *rgDsaFailure*[0]
 - *pszDsaDN* = CN=NTDS Settings,CN=DC2,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com
 - *uuidDsaObjGuid* = 12626d52-1da7-4a40-a490-987c0880c3fe
 - *ftimeFirstFailure.dwLowDateTime* = 0xcefc4100
 - *ftimeFirstFailure.dwHighDateTime* = 0x1cb2d21
 - *cNumFailures* = 2
 - *dwLastResult* = 1722

4.1.13.4.8.4 Final State

The final state is the same as the initial state (section 4.1.13.4.8.1); there is no change.

4.1.13.4.9 Calling IDL_DRSGetReplInfo with infoType DS_REPL_INFO_PENDING_OPS

In this example, the domain administrator verifies whether DC1 has any pending operations in its replication queue.

4.1.13.4.9.1 Initial State

DC2 is a replication neighbor of DC1. DC1 is syncing updates from DC2.

4.1.13.4.9.2 Client Request

The client invokes the IDL_DRSGetReplInfo (section 4.1.13) method against DC1 with the following parameters (DRS_HANDLE to DC1 omitted):

- *dwInVersion* = 2
 - *pmsgIn* = DRS_MSG_GETREPLINFO_REQ_V2
 - *InfoType* = DS_REPL_INFO_PENDING_OPS
 - *pszObjectDN* = (null)
 - *uuidSourceDsaObjGuid* = 00000000-0000-0000-0000-000000000000
 - *ulFlags* = 0x0
 - *pszAttributeName* = (null)
 - *pszValueDN* = (null)
 - *dwEnumerationContext* = 0

4.1.13.4.9.3 Server Response

A return code of 0 with the following values:

- *pdwOutVersion* = DS_REPL_INFO_PENDING_OPS
- *pmsgOut* = DS_REPL_PENDING_OPSW
 - *ftimeCurrentOpStarted.dwLowDateTime* = 0x2546bc80
 - *ftimeCurrentOpStarted.dwHighDateTime* = 0x1cb2ea7
 - *cNumPendingOps* = 1
 - *rgPendingOp* = DS_REPL_OPW[]
 - *rgPendingOp[0]*
 - *ftimeEnqueued.dwLowDateTime* = 0x2546bc80
 - *ftimeEnqueued.dwHighDateTime* = 0x2546bc80
 - *ulSerialNumber* = 2343
 - *ulPriority* = 250
 - *OpType* = DS_REPL_OP_TYPE_SYNC
 - *ulOptions* = 524291
 - *pszNamingContext* = DC=contoso,DC=com
 - *pszDsaDN* = CN=NTDS Settings,CN=DC2,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com
 - *pszDsaAddress* = 12626d52-1da7-4a40-a490-987c0880c3fe._msdcs.contoso.com
 - *uuidNamingContextObjGuid* = 8f3cea57-61ff-46cb-aa17-6c1683c33020
 - *uuidDsaObjGuid* = 12626d52-1da7-4a40-a490-987c0880c3fe

4.1.13.4.9.4 Final State

The final state is the same as the initial state (section 4.1.13.4.9.1); there is no change.

4.1.14 IDL_DRSInitDemotion (Opnum 25)

The IDL_DRSInitDemotion method performs the first phase of the removal of a DC from an AD LDS forest. This method is supported only by AD LDS.

```
ULONG IDL_DRSInitDemotion(  
    [in, ref] DRS_HANDLE hDrs,  
    [in] DWORD dwInVersion,  
    [in, ref, switch_is(dwInVersion)]  
        DRS_MSG_INIT_DEMOTIONREQ* pmsgIn,  
    [out, ref] DWORD* pdwOutVersion,  
    [out, ref, switch_is(*pdwOutVersion)]  
        DRS_MSG_INIT_DEMOTIONREPLY* pmsgOut  
);
```

hDrs: The RPC context handle returned by the IDL_DRSBind method.

dwInVersion: The version of the request message.

pmsgIn: A pointer to the request message.

pdwOutVersion: A pointer to the version of the response message.

pmsgOut: A pointer to the response message.

Return Values: 0 if successful, otherwise a Windows error code.

Exceptions Thrown: This method might throw the following exceptions beyond those thrown by the underlying RPC protocol (as specified in [MS-RPCE]): ERROR_INVALID_HANDLE, ERROR_DS_DRS_EXTENSIONS_CHANGED, ERROR_DS_DIFFERENT_REPL_EPOCHS, and ERROR_INVALID_PARAMETER.

4.1.14.1 Method-Specific Concrete Types

4.1.14.1.1 DRS_MSG_INIT_DEMOTIONREQ

The DRS_MSG_INIT_DEMOTIONREQ union defines request messages sent to the IDL_DRSInitDemotion method. Only one version, identified by *dwInVersion* = 1, is currently defined.

```
typedef  
[switch_type(DWORD)]  
union {  
    [case(1)]  
        DRS_MSG_INIT_DEMOTIONREQ_V1 v1;  
} DRS_MSG_INIT_DEMOTIONREQ;
```

V1: Version 1 request. Currently, only one version is defined.

4.1.14.1.2 DRS_MSG_INIT_DEMOTIONREQ_V1

The DRS_MSG_INIT_DEMOTIONREQ_V1 structure defines a request message sent to the IDL_DRSInitDemotion method.

```
typedef struct {  
    DWORD dwReserved;  
} DRS_MSG_INIT_DEMOTIONREQ_V1;
```

dwReserved: Unused. MUST be 0.

4.1.14.1.3 DRS_MSG_INIT_DEMOTIONREPLY

The DRS_MSG_INIT_DEMOTIONREPLY union defines the response messages received from the IDL_DRSInitDemotion method. Only one version, identified by *pdwOutVersion*[^] = 1, is currently defined.

```
typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_INIT_DEMOTIONREPLY_V1 V1;
} DRS_MSG_INIT_DEMOTIONREPLY;
```

V1: Version 1 reply.

4.1.14.1.4 DRS_MSG_INIT_DEMOTIONREPLY_V1

The DRS_MSG_INIT_DEMOTIONREPLY_V1 structure defines a response message received from the IDL_DRSInitDemotion method.

```
typedef struct {
    DWORD dwOpError;
} DRS_MSG_INIT_DEMOTIONREPLY_V1;
```

dwOpError: A Win32 error code, as specified in [MS-ERREF] section 2.2.

4.1.14.2 Server Behavior of the IDL_DRSInitDemotion Method

Informative summary of behavior: Performs the first phase of the removal of a DC from an AD LDS forest. This phase consists of disabling both originating and replicated updates to the AD LDS DC.<34>

```
ULONG
IDL_DRSInitDemotion(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
        DRS_MSG_INIT_DEMOTIONREQ* pmsgIn,
    [out, ref] DWORD *pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DRS_MSG_INIT_DEMOTIONREPLY* pmsgOut
)
```

```
msgIn: DRS_MSG_INIT_DEMOTIONREQ_V1
ret: DWORD
```

```
ValidateDRSInput(hDrs, 25)
```

```
pmsgOut^.V1.dwOpError := 0
```

```
if dwInVersion ≠ 1 then
    return ERROR_INVALID_PARAMETER
endif
if pmsgIn = null then
    return ERROR_INVALID_PARAMETER
endif
if pmsgIn^.V1.dwReserved ≠ 0 then
    return ERROR_INVALID_PARAMETER
```

```

endif
msgIn := pmsgIn^.V1
if not IsMemberOfBuiltinAdminGroup() then
    /* only BA is allowed to demote an AD LDS service */
    return ERROR_DS_DRA_ACCESS_DENIED
endif

dc.fEnableUpdates := FALSE

pmsgOut^.V1.dwOpError := ERROR_SUCCESS
pdwOutVersion^ := 1
return ERROR_SUCCESS

```

4.1.15 IDL_DRSInterDomainMove (Opnum 10)

The IDL_DRSInterDomainMove method is a helper method used in a cross-NC move LDAP operation.

```

ULONG IDL_DRSInterDomainMove(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
        DRS_MSG_MOVEREQ* pmsgIn,
    [out, ref] DWORD* pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DRS_MSG_MOVEREREPLY* pmsgOut
);

```

hDrs: The RPC context handle returned by the IDL_DRSBind method.

dwInVersion: The version of the request message.

pmsgIn: A pointer to the request message.

pdwOutVersion: A pointer to the version of the response message.

pmsgOut: A pointer to the response message.

Return Values: 0 if successful, otherwise a Windows error code.

Exceptions Thrown: This method might throw the following exceptions beyond those thrown by the underlying RPC protocol (as specified in [MS-RPCE]): ERROR_INVALID_HANDLE, ERROR_DS_DRS_EXTENSIONS_CHANGED, ERROR_DS_DIFFERENT_REPL_EPOCHS, and ERROR_INVALID_PARAMETER.

4.1.15.1 Method-Specific Concrete Types

4.1.15.1.1 DRS_MSG_MOVEREQ

The DRS_MSG_MOVEREQ union defines the request messages sent to the IDL_DRSInterDomainMove method.

```

typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_MOVEREQ_V1 V1;
    [case(2)]
        DRS_MSG_MOVEREQ_V2 V2;
} DRS_MSG_MOVEREQ;

```

V1: The version 1 request (obsolete).

V2: The version 2 request.

4.1.15.1.2 DRS_MSG_MOVEREQ_V1

The DRS_MSG_MOVEREQ_V1 structure defines a request message sent to the IDL_DRSInterDomainMove method. This request version is obsolete.<35>

```
typedef struct {
    char* pSourceDSA;
    ENTINF* pObject;
    UUID* pParentUUID;
    SCHEMA_PREFIX_TABLE PrefixTable;
    ULONG ulFlags;
} DRS_MSG_MOVEREQ_V1;
```

pSourceDSA: The NetworkAddress of the client DC.

pObject: The object to be moved.

pParentUUID: The objectGUID of the new parent object.

PrefixTable: The prefix table with which to translate the ATTRTYP values in **pObject** to OIDs-(2)-.

ulFlags: Unused. MUST be 0 and ignored.

4.1.15.1.3 DRS_MSG_MOVEREQ_V2

The DRS_MSG_MOVEREQ_V2 structure defines a request message sent to the IDL_DRSInterDomainMove method.

```
typedef struct {
    DSNAME* pSrcDSA;
    ENTINF* pSrcObject;
    DSNAME* pDstName;
    DSNAME* pExpectedTargetNC;
    DRS_SecBufferDesc* pClientCreds;
    SCHEMA_PREFIX_TABLE PrefixTable;
    ULONG ulFlags;
} DRS_MSG_MOVEREQ_V2;
```

pSrcDSA: The client DC nTDSDSA object.

pSrcObject: The object to be moved.

pDstName: The name the object will have in the destination domain.

pExpectedTargetNC: The NC to which **pSrcObject** is being moved.

pClientCreds: The credentials of the user initiating the call.

PrefixTable: The prefix table with which to translate the ATTRTYP values in **pSrcObject** to OIDs-(2)-.

ulFlags: Unused. MUST be 0 and ignored.

4.1.15.1.4 DRS_MSG_MOVEREPLY

The DRS_MSG_MOVEREPLY union defines the response messages received from the IDL_DRSInterDomainMove method.

```
typedef
[switch_type(DWORD)]
union {
    [case(1)]
    DRS_MSG_MOVEREPLY_V1 V1;
    [case(2)]
    DRS_MSG_MOVEREPLY_V2 V2;
} DRS_MSG_MOVEREPLY;
```

V1: The version 1 response (obsolete).

V2: The version 2 response.

4.1.15.1.5 DRS_MSG_MOVEREPLY_V1

The DRS_MSG_MOVEREPLY_V1 structure defines a response message received from the IDL_DRSInterDomainMove method. This response version is obsolete.<36>

```
typedef struct {
    ENTINF** ppResult;
    SCHEMA_PREFIX_TABLE PrefixTable;
    ULONG* pError;
} DRS_MSG_MOVEREPLY_V1;
```

ppResult: The object as it appears following the move operation.

PrefixTable: The prefix table with which to translate the ATTRTYP values in ppResult to OIDs ~~(2)~~.

pError: 0 if successful, or non-zero if a fatal error occurred.

4.1.15.1.6 DRS_MSG_MOVEREPLY_V2

The DRS_MSG_MOVEREPLY_V2 structure defines a response message received from the IDL_DRSInterDomainMove method.

```
typedef struct {
    ULONG win32Error;
    [unique] DSNAME* pAddedName;
} DRS_MSG_MOVEREPLY_V2;
```

win32Error: 0 if successful, or non-zero if a fatal error occurred.

pAddedName: The name of the object in its new domain.

4.1.15.2 Method-Specific Abstract Types and Procedures

4.1.15.2.1 AttrIsBacklink

```
procedure AttrIsBacklink(attr: ATTRTYP): boolean
```

Returns true if the attribute *attr* is a back link, and returns false otherwise.


```
return SchemaObj(attr)!linkID mod 2 = 1
```

4.1.15.2.2 AttrIsConstructed

```
procedure AttrIsConstructed(attr: ATTRTYP): boolean
```

Returns true if the attribute *attr* is a **constructed attribute**, and returns false otherwise.

```
return FLAG_ATTR_IS_CONSTRUCTED in SchemaObj(attr)!systemFlags
```

4.1.15.2.3 AttrIsNonReplicated

```
procedure AttrIsNonReplicated(attr: ATTRTYP): boolean
```

Returns true if the attribute *attr* is a **nonreplicated attribute**, and returns false otherwise.

```
return FLAG_ATTR_NOT_REPLICATED in SchemaObj(attr)!systemFlags
```

4.1.15.2.4 AuthorizationInfoFromClientCredentials

```
procedure AuthorizationInfoFromClientCredentials(  
  credBuffer: DRS_SecBufferDesc,  
  var token: ClientAuthorizationInfo): DWORD
```

Generates a ClientAuthorizationInfo *token* (which is a security token) from client credentials *credBuffer*. See [MS-DTYP] section 2.5.3 for more details. Returns 0 if it succeeds, or a Windows error code if it fails.

4.1.15.2.5 ImpersonateAuthorizationInfo

```
procedure ImpersonateAuthorizationInfo(token: ClientAuthorizationInfo)
```

Impersonates a set of client credentials. This affects the outcome of all subsequent AccessCheckAttr, AccessCheckCAR, AccessCheckObject, AccessCheckWriteToSpnAttribute, and related calls, until RevertToSelf is called.

4.1.15.2.6 IsApplicationNC

```
procedure IsApplicationNC(nc: DSName): boolean
```

Returns true if and only if *nc* is an **application NC**.

4.1.15.2.7 RevertToSelf

```
procedure RevertToSelf()
```

Undoes the effect of ImpersonateAuthorizationInfo. After the RevertToSelf procedure is called, the security context is restored to what it was before ImpersonateAuthorizationInfo was called.

4.1.15.3 Server Behavior of the IDL_DRSInterDomainMove Method

Informative summary of behavior: IDL_DRSInterDomainMove is used during a cross-NC move operation. This is a special object move operation because it involves moving an object from one DC into another. A normal move operation moves the object within one NC on one DC; a cross-NC move involves two DCs. IDL_DRSInterDomainMove is an intermediate step in the cross-NC move operation, which is initiated by an LDAP call. The IDL_DRSInterDomainMove call is done by the "source" DC to the "target" DC in order to move the object with all of its data from one NC replica into another.

Note IDL_DRSInterDomainMove transfers data that is normally not readable by the end user (such as password hashes and other secrets).

During the move, the ENTINF structure that contains the object data is constructed by the source DC and passed to the target DC. The target DC enforces certain constraints, transforms the data according to the processing rules, and then either creates the object in its NC replica or updates the existing object. For more information on cross-NC move operations, see [MS-ADTS] section 3.1.1.5.4.2.

```
ULONG
IDL_DRSInterDomainMove(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
        DRS_MSG_MOVEREQ *pmsgIn,
    [out, ref] DWORD *pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DRS_MSG_MOVEREPLY *pmsgOut)

msgIn: DRS_MSG_MOVEREQ_V2
lastPrefixTableEntry: PrefixTableEntry
prefixTable: PrefixTable
dwErr: DWORD
clientCreds: ClientAuthorizationInfo
callerCreds: ClientAuthorizationInfo
O: ENTINF
existingObj: DSName
attribute: ATTRTYP
proxyEpoch: DWORD

ValidateDRSInput(hDrs, 10)

pdwOutVersion^ := 2
msgOut^.V2.win32error := ERROR_DS_GENERIC_ERROR
msgOut^.V2.pAddedName := null
if dwInVersion # 2 then
    return ERROR_DS_DRA_INVALID_PARAMETER
endif
msgIn := pmsgIn^.V2
if msgIn.pExpectedTargetNC # DefaultNC() then
    return ERROR_DS_DST_NC_MISMATCH
endif
if msgIn.PrefixTable.PrefixCount < 1 then
    return ERROR_SCHEMA_MISMATCH
endif

/* Remember last prefix table entry, and remove it from the prefix
 * table.*/
lastPrefixTableEntry :=
    msgIn.PrefixTable.pPrefixEntry[msgIn.PrefixTable.PrefixCount]
msgIn.PrefixTable.PrefixCount := msgIn.PrefixTable.PrefixCount-1

/* Perform a binary comparison of the OID value from the last
 * prefixTable entry with the schemaInfo attribute on the
 * schema NC.*/
if lastPrefixTableEntry.oid # SchemaNC(!schemaInfo) then
    return ERROR_SCHEMA_MISMATCH
```

```

endif

prefixTable := AbstractPTFromConcretePT(msgIn.PrefixTable)

/* Convert client creds into ClientAuthorizationInfo format. */
dwErr := AuthorizationInfoFromClientCredentials(msgIn.pClientCreds,
        clientCreds)
if dwErr ≠ ERROR_SUCCESS then
    return dwErr
endif

/* Check that the caller (the "source" DC) is actually a DC by
 * checking Enterprise Domain Controllers SID in its token. */
callerCreds := GetCallerAuthorizationInfo()
if not CheckGroupMembership(callerCreds, SidFromStringSid("S-1-5-9"))
    then
    return ERROR_DS_DRA_ACCESS_DENIED
endif

/* Validate input ENTINF. */
O := msgIn.pSrcObject^

if ADS_UF_SERVER_TRUST_ACCOUNT in
    ENTINF_GetValue(
        O, userAccountControl, prefixTable) or
    ADS_UF_INTERDOMAIN_TRUST_ACCOUNT in
    ENTINF_GetValue(
        O, userAccountControl, prefixTable) then
    /* Disallowed to move DC accounts and trust objects. */
    return ERROR_DS_ILLEGAL_XDOM_MOVE_OPERATION
endif
existingObj := select one obj from all where
    (obj!distinguishedName = ENTINF_GetValue(O, distinguishedName,
        prefixTable))
if existingObj ≠ null and
    existingObj!objectGUID ≠
    ENTINF_GetValue(O, objectGUID, prefixTable) then
    /* There's already an object with the same DN but different GUID.*/
    return ERROR_DS_SRC_GUID_MISMATCH
endif

existingObj := select one obj from all where
    (obj!objectGUID = ENTINF_GetValue(O, objectGUID, prefixTable))
if existingObj ≠ null and existingObj!proxiedObjectName ≠
    ENTINF_GetValue(O, proxiedObjectName, prefixTable) then
    /* There's already an object with the same guid,
     * but proxiedObjectName is different - not allowed. */
    return ERROR_DS_EPOCH_MISMATCH
endif

if IsApplicationNC(GetObjectNC(O.pName^)) then
    return ERROR_DS_INTERNAL_FAILURE
endif

/* Scan through the ENTINF and throw away any attributes that are not
 * supposed to be moved. */
foreach attribute in ENTINF_EnumerateAttributes(O, prefixTable)
    if AttrIsBacklink(attribute) or AttrIsNonReplicated(attribute) or
    AttrIsConstructed(attribute) then
    ENTINF_SetValue(O, attribute, null, prefixTable)
    endif
    if attribute in {
        adminCount, badPasswordTime, badPwdCount, creationTime,
        distinguishedName, domainReplica, instanceType,
        isCriticalSystemObject, isDeleted, lastLogoff, lastLogon,
        lastLogonTimestamp, lockoutTime, logonCount, modifiedCount,
        modifiedCountAtLastProm, msDS-Cached-Membership,
        msDS-Cached-Membership-Time-Stamp, msDS-Site-Affinity, nextRid,
        nTSecurityDescriptor, objectCategory, operatorCount,
        primaryGroupID, proxiedObjectName, replPropertyMetaData,

```

```

        revision, rid, sAMAccountType, serverState, subRefs,
        systemFlags, uASCompat, uSNChanged, uSNCreated,
        uSNDALastObjRemoved, uSNLastObjRem, whenChanged, whenCreated}
    then
        ENTINF_SetValue(O, attribute, null, prefixTable)
    endif
endfor

if ENTINF_GetValue(O, userAccountControl, prefixTable) ≠ null then
    /* Reset lockout bit. */
    ENTINF_SetValue(O, userAccountControl,
        ENTINF_GetValue(O, userAccountControl) - {ADS_UF_LOCKOUT},
        prefixTable)
endif

if ENTINF_GetValue(O, pwdLastSet, prefixTable) ≠ null and
    ENTINF_GetValue(O, pwdLastSet, prefixTable) ≠ 0 then
    /* If pwdLastSet is set to non-zero, then change it to -1. */
    ENTINF_SetValue(O, pwdLastSet, (LONGLONG)-1, prefixTable)
endif

/* Append objectSid to sidHistory. */
ENTINF_SetValue(O, sidHistory,
    ENTINF_GetValue(O, sidHistory, prefixTable)
    + {ENTINF_GetValue(O, objectSid, prefixTable)})

/* Compute the new proxiedObjectName value. */
if ENTINF_GetValue(O, proxiedObjectName, prefixTable) ≠ null and
    GetProxyType(ENTINF_GetValue(O, proxiedObjectName)) =
        PROXY_TYPE_MOVED_OBJECT then
    /* There's already a valid proxiedObjectName on the object,
     * so just increment the epoch value. */
    proxyEpoch := GetProxyEpoch(ENTINF_GetValue(O, proxiedObjectName,
        prefixTable))+1
else
    /* No valid proxiedObjectName, so start a new one. */
    proxyEpoch := 1
endif

/* Stamp the new proxiedObjectName value into ENTINF. */
ENTINF_SetValue(O,
    proxiedObjectName,
    MakeProxyValue(msgIn.pSrcNC^,
        PROXY_TYPE_MOVED_OBJECT,
        proxyEpoch),
    prefixTable)

if existingObj ≠ null then
    /* Purge existing object, it is about to be overwritten. */
    Expunge(existingObj)
endif

ImpersonateAuthorizationInfo(clientCreds)
O.pName := msgIn.pDstName
dwErr :=
    PerformAddOperation(
        O,
        msgOut^.V2.pAddedName^,
        AbstractPTFromConcretePT(msgIn.PrefixTable),
        TRUE)

RevertToSelf()
msgOut^.V2.win32error := dwErr
return dwErr

```

4.1.15.4 Examples of the IDL_DRSInterDomainMove Method

In this example, a user is moved from the domain NC ASIA.CONTOSO.COM to the domain NC CONTOSO.COM.

4.1.15.4.1 Initial State

Querying the user object for "Aaron Con" in the domain NC ASIA.CONTOSO.COM on DCA1, prior to the move:

- `ldap_search_s("CN=Aaron Con,CN=Users,DC=asia,DC=contoso,DC=com", singleLevel, "(objectclass=*)", [objectClass, cn, ... objectCategory])`
- Getting 1 entries:
- `>> Dn: CN=Aaron Con,CN=Users,DC=asia,DC=contoso,DC=com`
 - `4> objectClass: top; person; organizationalPerson; user;`
 - `1> cn: Aaron Con;`
 - `1> sn: Con;`
 - `1> givenName: Aaron;`
 - `1> distinguishedName: CN=Aaron Con, CN=Users, DC=asia, DC=contoso, DC=com;`
 - `1> instanceType: 0x4 = (IT_WRITE);`
 - `1> whenCreated: 07/12/2006 17:25:53 Pacific Std Daylight Time;`
 - `1> whenChanged: 07/12/2006 17:25:54 Pacific Std Daylight Time;`
 - `1> displayName: Aaron Con;`
 - `1> uSNCreated: 13798;`
 - `1> uSNChanged: 13803;`
 - `1> name: Aaron Con;`
 - `1> objectGUID: 45a6999f-31eb-40ab-a2e5-906ccd86d5eb;`
 - `1> userAccountControl: 0x200 = (UF_NORMAL_ACCOUNT);`
 - `1> badPwdCount: 0;`
 - `1> codePage: 0;`
 - `1> countryCode: 0;`
 - `1> badPasswordTime: 01/01/1601 00:00:00 UNC ;`
 - `1> lastLogoff: 01/01/1601 00:00:00 UNC ;`
 - `1> lastLogon: 01/01/1601 00:00:00 UNC ;`
 - `1> pwdLastSet: 07/12/2006 17:25:53 Pacific Std Pacific Daylight Time;`
 - `1> primaryGroupID: 513;`
 - `1> objectSid: S-1-5-21-1880045291-2375173688-894673254-1109;`

- 1> accountExpires: 09/14/30828 02:48:05 UNC ;
- 1> logonCount: 0;
- 1> sAMAccountName: aaroncon;
- 1> sAMAccountType: 805306368;
- 1> userPrincipalName: aaroncon@asia.contoso.com;
- 1> objectCategory: CN=Person, CN=Schema, CN=Configuration, DC=contoso, DC=com;

Querying the user object for "Aaron Con" in the domain NC CONTOSO.COM on DC1 prior to the move yields no results, as follows:

- ldap_search_s("CN=Aaron Con,CN=Users,DC=contoso,DC=com", *oneLevel*, "(objectclass=*)", [*objectClass, cn, ... objectCategory*])
- Error: Search: No Such Object.
- Matched DNs: CN=Users,DC=contoso,DC=com
- Getting 0 entries:

4.1.15.4.2 Client Request

An LDAP client invokes the IDL_DRSInterDomainMove method against a DC named DCA1.ASIA.CONTOSO.COM with the following parameters (DRS_HANDLE to DCA1 omitted):

- *dwInVersion* = 2
- *pmsgIn* = DRS_MSG_MOVEREQ_V2
 - pSrcDSA: CN=NTDS Settings,CN=DCA1,CN=Servers, CN=Default-First-Site-Name,CN=Sites, CN=Configuration,DC=contoso,DC=com
 - pSrcObject: ENTINF
 - objectClass: top; person; organizationalPerson; user
 - cn: Aaron Con
 - sn: Con
 - givenName: Aaron
 - instanceType: IT_WRITE
 - whenCreated: 07/12/2006 17:25:53 Pacific Std Time Pacific Daylight Time;
 - whenChanged: 07/12/2006 17:25:54 Pacific Std Time Pacific Daylight Time;
 - displayName: Aaron Con;
 - uSNCreated: 13798;
 - uSNChanged: 13803;
 - objectGUID: 45a6999f-31eb-40ab-a2e5-906ccd86d5eb;
 - userAccountControl: 0x200 = (UF_NORMAL_ACCOUNT);
 - badPwdCount: 0;

- countryCode: 0;
- badPasswordTime: 01/01/1601 00:00:00 UNC ;
- lastLogoff: 01/01/1601 00:00:00 UNC ;
- lastLogon: 01/01/1601 00:00:00 UNC ;
- dBCSPwd: *Binary data*
- unicodePwd: *Binary data*
- supplementalCredentials: *none*
- pwdLastSet: 07/12/2006 17:25:53 Pacific Std Time Pacific Daylight Time;
- primaryGroupID: 513;
- objectSid: S-1-5-21-1880045291-2375173688-894673254-1109;
- accountExpires: 09/14/30828 02:48:05 UNC ;
- logonCount: 0;
- sAMAccountName: aaroncon;
- sAMAccountType: SAM_NORMAL_USER_ACCOUNT;
 - userPrincipalName: aaroncon@asia.contoso.com;
- objectCategory: CN=Person, CN=Schema, CN=Configuration, DC=contoso, DC=com;
- nTSecurityDescriptor: *Binary data*
- replPropertyMetaData: *omitted*
- pDstName: CN=Aaron Con,CN=Users,DC=contoso,DC=com
- pExpectedTargetNC: DC=contoso,DC=com
- pClientCreds: DRS_SecBufferDesc
- PrefixTable: SCHEMA_PREFIX_TABLE
- ulFlags: None

4.1.15.4.3 Server Response

Return code of 0 with the following values:

- *pdwOutVersion* = 2
- *pmsgOut* = DRS_MSG_MOVEREPLY_V2
 - pAddedName: CN=Aaron Con,CN=Users,DC=contoso,DC=com

4.1.15.4.4 Final State

After the move, the user object for "Aaron Con" is not present on domain NC ASIA.CONTOSO.COM, querying DCA1, as follows:

- `ldap_search_s("CN=Aaron Con,CN=Users,DC=asia,DC=contoso,DC=com", singleLevel, "(objectclass=*)", [distinguishedName, objectGUID, userAccountControl, objectSid, sAMAccountName, userPrincipalName])`
- Error: Search: No Such Object.
- Matched DNs: CN=Users,DC=asia,DC=contoso,DC=com
- Getting 0 entries:

After the move, the user object for "Aaron Con" is now present on domain NC CONTOSO.COM, querying DC1:

- `ldap_search_s("CN=Aaron Con,CN=Users, DC=contoso,DC=com", oneLevel, "(objectclass=*)", [cn, distinguishedName ... proxiedObjectName, dScorePropagationData])`
- Matched DNs:
- Getting 1 entries:
- >> Dn: CN=Aaron Con,CN=Users,DC=contoso,DC=com
 - 4> objectClass: top; person; organizationalPerson; user;
 - 1> cn: Aaron Con;
 - 1> sn: Con;
 - 1> givenName: Aaron;
 - 1> distinguishedName: CN=Aaron Con,CN=Users,DC=contoso,DC=com;
 - 1> instanceType: 0x4 = (IT_WRITE);
 - 1> whenCreated: 07/12/2006 17:32:04 Pacific Standard Daylight Time;
 - 1> whenChanged: 07/12/2006 17:32:04 Pacific Standard Daylight Time;
 - 1> displayName: Aaron Con;
 - 1> uSNCreated: 15366;
 - 1> uSNChanged: 15369;
 - 1> name: Aaron Con;
 - 1> objectGUID: 45a6999f-31eb-40ab-a2e5-906ccd86d5eb;
 - 1> userAccountControl: 0x200 = (UF_NORMAL_ACCOUNT);
 - 1> badPwdCount: 0;
 - 1> codePage: 0;
 - 1> countryCode: 0;
 - 1> badPasswordTime: 01/01/1601 00:00:00 UNC ;
 - 1> lastLogoff: 01/01/1601 00:00:00 UNC ;
 - 1> lastLogon: 01/01/1601 00:00:00 UNC ;
 - 1> pwdLastSet: 07/12/2006 17:32:04 Pacific Standard Daylight Time;

- 1> primaryGroupID: 513;
- 1> objectSid: S-1-5-21-254470460-2440132622-709970653-1111;
- 1> accountExpires: 09/14/30828 02:48:05 UNC ;
- 1> logonCount: 0;
- 1> sAMAccountName: aaroncon;
- 1> sAMAccountType: 805306368;
- 1> sIDHistory: S-1-5-21-1880045291-2375173688-894673254-1109;
- 1> userPrincipalName: aaroncon@asia.contoso.com;
- 1> objectCategory: CN=Person, CN=Schema, CN=Configuration, DC=contoso, DC=com;
- 1> proxiedObjectName: B:16:0000000000000001:DC=asia, DC=contoso, DC=com;
- 1> dSCorePropagationData: 07/12/2006 17:32:04 Pacific Standard Daylight Time;
07/12/2006 17:32:04 Pacific Standard Time Pacific Daylight Time; 01/01/1601 01:08:16 UNC
;

4.1.16 IDL_DRSQuerySitesByCost (Opnum 24)

The IDL_DRSQuerySitesByCost method determines the communication cost from a "from" site to one or more "to" sites.

```

ULONG IDL_DRSQuerySitesByCost(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
    DRS_MSG_QUERY_SITESREQ* pmsgIn,
    [out, ref] DWORD* pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
    DRS_MSG_QUERY_SITESREPLY* pmsgOut
);

```

hDrs: The RPC context handle returned by the IDL_DRSBind method.

dwInVersion: The version of the request message.

pmsgIn: A pointer to the request message.

pdwOutVersion: A pointer to the version of the response message.

pmsgOut: A pointer to the response message.

Return Values: 0 if successful, or a Windows error code if a failure occurs.

Exceptions Thrown: This method might throw the following exceptions beyond those thrown by the underlying RPC protocol (as specified in [MS-RPCE]): ERROR_INVALID_HANDLE, ERROR_DS_DRS_EXTENSIONS_CHANGED, ERROR_DS_DIFFERENT_REPL_EPOCHS, and ERROR_INVALID_PARAMETER.

4.1.16.1 Method-Specific Concrete Types

4.1.16.1.1 DRS_MSG_QUERY_SITESREQ

The `DRS_MSG_QUERY_SITESREQ` union defines the request message versions sent to the `IDL_DRSQuerySitesByCost` method. Only one version, identified by `dwInVersion = 1`, is currently defined.

```
typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_QUERY_SITESREQ_V1 V1;
} DRS_MSG_QUERY_SITESREQ;
```

V1: The version 1 request.

4.1.16.1.2 DRS_MSG_QUERY_SITESREQ_V1

The `DRS_MSG_QUERY_SITESREQ_V1` structure defines a request message sent to the `IDL_DRSQuerySitesByCost` method.

```
typedef struct {
    [string] const WCHAR* pwszFromSite;
    [range(1,10000)] DWORD cToSites;
    [string, size_is(cToSites)] WCHAR** rgpszToSites;
    DWORD dwFlags;
} DRS_MSG_QUERY_SITESREQ_V1;
```

pwszFromSite: The RDN of the site object of the "from" site.

cToSites: The number of items in the **rgpszToSites** array (the count of "to" sites).

rgpszToSites: The RDNs of the site objects of the "to" sites.

dwFlags: Unused. MUST be 0 and ignored.

4.1.16.1.3 DRS_MSG_QUERY_SITESREPLY

The `DRS_MSG_QUERY_SITESREPLY` union defines the response messages received from the `IDL_DRSQuerySitesByCost` method.

```
typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_QUERY_SITESREPLY_V1 V1;
} DRS_MSG_QUERY_SITESREPLY;
```

V1: The version 1 response.

4.1.16.1.4 DRS_MSG_QUERY_SITESREPLY_V1

The `DRS_MSG_QUERY_SITESREPLY_V1` structure defines a response message received from the `IDL_DRSQuerySitesByCost` method.

```
typedef struct {
    [range(0,10000)] DWORD cToSites;
    [size_is(cToSites)] DRS_MSG_QUERY_SITESREPLY_ELEMENT_V1* rgCostInfo;
    DWORD dwFlags;
} DRS_MSG_QUERY_SITESREPLY_V1;
```

cToSites: The number of items in the **rgCostInfo** array.

rgCostInfo: The sequence of computed site costs, in the same order as the **rgszToSites** field in the request message.

dwFlags: Unused. MUST be 0 and ignored.

4.1.16.1.5 DRS_MSG_QUERY_SITES_REPLY_ELEMENT_V1

The **DRS_MSG_QUERY_SITES_REPLY_ELEMENT_V1** structure defines the computed cost of communication between two sites.

```
typedef struct {
    DWORD dwErrorCode;
    DWORD dwCost;
} DRS_MSG_QUERY_SITES_REPLY_ELEMENT_V1;
```

dwErrorCode: 0 if this "from-to" computation was successful, or **ERROR_DS_OBJ_NOT_FOUND** if the "to" site does not exist.

dwCost: The communication cost between the "from" site and this "to" site, or **0xFFFFFFFF** if the sites are not connected.

4.1.16.2 Method-Specific Abstract Types and Procedures

4.1.16.2.1 ValidateSiteRDN

```
procedure ValidateSiteRDN(s: uncodestring): boolean
```

Informative summary of behavior: The **ValidateSiteRDN** procedure returns 0 if *s* is a valid RDN for a site object, and returns an appropriate error otherwise. A valid RDN has the following characteristics:

- Is not null.
- Does not have 0 length.
- Does not have a length greater than 64.
- Contains no occurrences of the equal sign (=) or comma (,).

```
if s = null or s.length = 0 then
    return ERROR_DS_DRA_INVALID_PARAMETER
endif
if s.Length > 64 then
    return ERROR_DS_NAME_TOO_LONG
endif
if s contains (=) or s contains (,) then
    return ERROR_DS_DRA_INVALID_PARAMETER
endif
return 0
```

4.1.16.2.2 WeightedArc and WeightedArcSet

```
type WeightedArc = [initial: DSName, final: DSName, cost: integer]
type WeightedArcSet = set of WeightedArc
```

The cost field of a WeightedArc is positive.

4.1.16.2.3 MinWeightPath

```
procedure MinWeightPath(  
    vSet: set of DSName,  
    aSet: WeightedArcSet): WeightedArcSet
```

Returns a WeightedArcSet where, for each WeightedArc *a*:

- *a.initial* and *a.final* are vertices in *vSet*
- *a.final* is reachable from *a.initial* in the graph $G = (vSet, aSet)$
- *a.cost* is the cost of the minimum-cost path in G from *a.initial* to *a.final*.

4.1.16.3 Server Behavior of the IDL_DRSQuerySitesByCost Method

Informative summary of behavior: Given a site *fromSite* and an array of sites *toSites*, the server returns an array that contains the cost from *fromSite* to each element of *toSite*, where the cost is defined as follows.

The server computes a weighted graph $G = (V, A)$. Each vertex in V corresponds to a site object. Each arc in A corresponds to a siteLink object that connects two vertices in V ; the weight of an arc is the value of attribute *cost* on the arc's siteLink object. The cost of a path in the graph is the sum of the arc weights on the path. The cost from one site to another is the minimum-cost path between the two sites.

The model just described corresponds to fully transitive communications between sites: If site *a* communicates with site *b* and site *b* communicates with site *c*, then site *a* communicates with site *c* by routing through *b*. Replication can be configured to restrict transitive communication to sites specified in the same siteLinkBridge object. Suppose there is a siteLink object for site *a* and site *b*, and a siteLink object for site *b* and site *c*, but no siteLink object for site *a* and site *c*. If both of the siteLink objects are specified on the same siteLinkBridge object, site *a* can communicate with site *c* by routing through *b*. If no such siteLinkBridge object exists, site *a* cannot communicate with site *c*.

To calculate the cost when siteLinkBridge objects are used, let *nBridges* be the number of siteLinkBridge objects. For each *k* in the subrange $[0 .. nBridges-1]$, construct a weighted graph $G[k] = (V, A[k])$ using siteLinkBridge object *b[k]*. Graph $G[k]$ has the same vertex set as G , but its arc set $A[k]$ is a subset of A , including only the arcs listed in attribute *siteLinkList* on siteLinkBridge object *b[k]*. Then the cost from site *a* to site *c* is the minimum of the following costs:

1. The cost of the arc, if any, from *a* to *c* in G .
2. For each *k* in the subrange $[0 .. nBridges-1]$, the cost of the minimum cost path, if any, from *a* to *c* in $G[k]$.

Any authenticated user can perform this operation; no access checking is performed.<37>

```
ULONG  
IDL_DRSQuerySitesByCost(  
    [in, ref] DRS_HANDLE hDrs,  
    [in] DWORD dwInVersion,  
    [in, ref, switch_is(dwInVersion)]  
        DRS_MSG_QUERYITESREQ *pmsgIn,  
    [out, ref] DWORD *pdwOutVersion,  
    [out, ref, switch_is(*pdwOutVersion)]  
        DRS_MSG_QUERYITESREPLY *pmsgOut)  
  
msgIn: DRS_MSG_QUERYITESREQ_V1
```

```

vSet, slSet, sbSet : set of DSName
aSet, aSetB, aSetC, aSetD: WeightedArcSet
siteContainer, ipObject, fromSite, toSite: DSName
u, v, sl, sb: DSName
i, c: integer
min: WeightedArc
ul : ULONG

ValidateDRSInput(hDrs, 24)

pdwOutVersion^ := 1
pmsgOut^.V1.cToSites := 0
pmsgOut^.V1.rgCostInfo := null
pmsgOut^.V1.dwFlags := 0

/* Perform input validation,
 * initialize siteContainer, ipObject, fromSite. */
if dwInVersion # 1 then
    return ERROR_DS_DRA_INVALID_PARAMETER
endif
msgIn := pmsgIn^.V1
ul := ValidateSiteRDN(msgIn.pwszFromSite)
if 0 # ul then
    return ul
endif
if msgIn.cToSites > 0 and msgIn.rgszToSites = null then
    return ERROR_INVALID_PARAMETER
endif
for i := 0 to msgIn.cToSites - 1
    ul := ValidateSiteRDN(msgIn.rgszToSites[i])
    if 0 # ul then
        return ul
    endif
endfor
siteContainer := DescendantObject(ConfigNC(), "CN=Sites,")
ipObject := DescendantObject(ConfigNC(),
    "CN=IP,CN=Inter-Site Transports,CN=Sites,")
fromSite := select one v from children siteContainer where
    site in v!objectClass and v!name = msgIn.pwszFromSite
if fromSite = null then
    return ERROR_DS_OBJ_NOT_FOUND
endif

/* Construct the vertex set vSet. */
vSet := select all v from children siteContainer where
    site in v!objectClass
if vSet = {} then
    return ERROR_DS_OBJ_NOT_FOUND
endif

/* Construct the arc set aSet. */
slSet := select all v from children ipObject where
    siteLink in v!objectClass
foreach sl in slSet
    foreach u in sl!siteList
        foreach v in sl!siteList - {u}
            aSet := aSet + {[initial: u, final: v, cost: sl!cost]}
        endfor
    endfor
endfor

/* Construct minimum-cost arc set aSetC.
 * See [MS-ADTS] section 6.1.1.2.2.3.1, "IP Transport Container", for
 * the definition of the NTDSTRANSFORM_OPT_BRIDGES_REQUIRED option. */
if NTDSTRANSFORM_OPT_BRIDGES_REQUIRED in ipObject!options then
    /* Perform construction using siteLinkBridge objects.
     * Initial minimum cost is the cost of a direct arc if any. */
    aSetC := aSet
    sbSet := select all v from children ipObject where
        siteLinkBridge in v!objectclass

```

```

foreach sb in sbSet
  /* Compute the minimum cost using this siteLinkBridge. */
  aSetB := {}
  foreach sl in sb!siteLinkList
    foreach u in sl!siteList
      foreach v in sl!siteList - {u}
        aSetB := aSetB + {[initial: u, final: v, cost: sl!cost]}
      endfor
    endfor
  endfor
  aSetD := MinWeightPath(vSet, aSetB)
  /* Here aSetD contains the minimum cost arc set using this
  * siteLinkBridge. Improve the current minimum cost using
  * aSetD. */
  foreach [initial: u, final: v, cost: c] in aSetD
    min := select one t from aSetC where
      t.initial = u and t.final = v
    if min = null then
      aSetC := aSetC + {[initial: u, final: v, cost: c]}
    else if min.cost > c then
      aSetC := aSetC - {[initial: u, final: v, cost: min.cost]}
      + {[initial: u, final: v, cost: c]}
    endif
  endfor
endfor
else
  /* Fully transitive network, ignore siteLinkBridge objects. */
  aSetC := MinWeightPath(vSet, aSet)
endif

/* Construct result message. */
pdwOutVersion^ := 1
pmsgOut^.V1.cToSites := msgIn.cToSites
pmsgOut^.V1.dwFlags := 0
for i:= 0 to msgIn.cToSites - 1
  toSite := select one v from children siteContainer where
    site in v!objectClass and v!name = msgIn.rgszToSites[i]
  if not (toSite in vSet) then
    pmsgOut^.V1.rgCostInfo[i].dwErrorCode := ERROR_DS_OBJ_NOT_FOUND
    pmsgOut^.V1.rgCostInfo[i].dwCost := 0xffffffff
  else
    min := select one t from aSetC where
      t.initial = fromSite and t.final = toSite
    if min ≠ null then
      pmsgOut^.V1.rgCostInfo[i].dwErrorCode := 0
      pmsgOut^.V1.rgCostInfo[i].dwCost := min.cost
    else
      pmsgOut^.V1.rgCostInfo[i].dwErrorCode = 0
      pmsgOut^.V1.rgCostInfo[i].dwCost := 0xffffffff
    endif
  endif
endif
endfor

return 0

```

4.1.16.4 Examples of IDL_DRSQuerySitesByCost Method

4.1.16.4.1 Nontransitive Communication Using siteLinkBridge

Determines the nontransitive communication cost "from" site DC1 "to" sites DC2, DC3, and DC4. A site graph is displayed in the following figure.

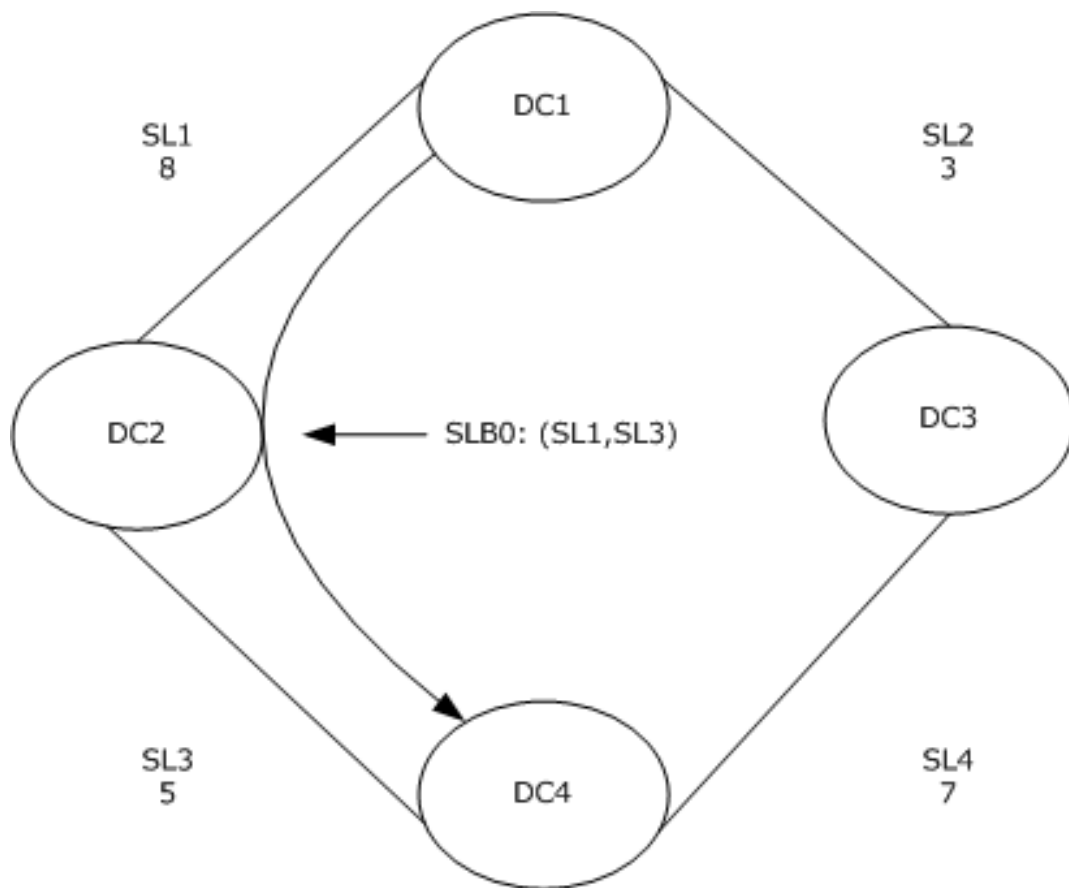


Figure 2: Site graph for a nontransitive network

VERTEX	ARC	ARC WEIGHT
DC1	SL1	8
	SL2	3
	SLB0 (SL1, SL3)	13
DC2	SL1	8
	SL3	5
DC3	SL2	3
	SL4	7
DC4	SL3	7
	SL4	13
	SLB0 (SL1, SL3)	

4.1.16.4.1.1 Initial State

Querying the site object for domain NC CONTOSO.COM by performing an LDAP search with Base DN "CN=Configuration,DC=contoso,DC=com".

- ldap_search_s(ld, "CN=Configuration,DC=contoso,DC=com", 2, "(objectclass=site)", attrList, 0, &msg)
- Result <0>: (null)
- Matched DNs:
- Getting 4 entries:
- >> Dn: CN=DC1,CN=Sites,CN=Configuration,DC=contoso,DC=com
 - 1> cn: DC1;
 - 1> distinguishedName: CN=DC1,CN=Sites,CN=Configuration,DC=contoso,DC=com;
 - 1> instanceType: 0x4 = (WRITE);
 - 1> location: DC1;
 - 1> name: DC1;
 - 1> objectCategory: CN=Site,CN=Schema,CN=Configuration,DC=contoso,DC=com;
 - 2> objectClass: top; site;
 - 1> objectGUID: 3540d101-be2d-4630-b75e-1343c2a39dc8;
 - 1> showInAdvancedViewOnly: TRUE;
 - 1> systemFlags: 0x42000000 = (CONFIG_ALLOW_RENAME | DISALLOW_MOVE_ON_DELETE);
 - 1> uSNChanged: 41007;
 - 1> uSNCreated: 36885;
 - 1> whenChanged: 06/08/2010 19:04:05 Pacific Standard Time;
 - 1> whenCreated: 06/08/2010 13:53:19 Pacific Standard Time;
- >> Dn: CN=DC2,CN=Sites,CN=Configuration,DC=contoso,DC=com
 - 1> cn: DC2;
 - 1> distinguishedName: CN=DC2,CN=Sites,CN=Configuration,DC=contoso,DC=com;
 - 1> dSCorePropagationData: 0x0 = ();
 - 1> instanceType: 0x4 = (WRITE);
 - 1> location: DC2;
 - 1> name: DC2
 - 1> objectCategory: CN=Site,CN=Schema,CN=Configuration,DC=contoso,DC=com;
 - 2> objectClass: top; site;
 - 1> objectGUID: 7dd0525e-f00a-4c1d-9eec-d6df02625a59;
 - 1> showInAdvancedViewOnly: TRUE;
 - 1> systemFlags: 0x42000000 = (CONFIG_ALLOW_RENAME | DISALLOW_MOVE_ON_DELETE);

- 1> uSNChanged: 40991;
- 1> uSNCreated: 40991
- 1> whenChanged: 06/08/2010 18:39:43 Pacific Standard Time;
- 1> whenCreated: 06/08/2010 18:39:43 Pacific Standard Time;
- >> Dn: CN=DC3,CN=Sites,CN=Configuration,DC=contoso,DC=com
 - 1> cn: DC3;
 - 1> distinguishedName: CN=DC3,CN=Sites,CN=Configuration,DC=contoso,DC=com;
 - 1> dSCorePropagationData: 0x0 = ();
 - 1> instanceType: 0x4 = (WRITE);
 - 1> location: DC3;
 - 1> name: DC3;
 - 1> objectCategory: CN=Site,CN=Schema,CN=Configuration,DC=contoso,DC=com;
 - 2> objectClass: top; site;
 - 1> objectGUID: dbdff472-a414-44c2-8206-a619e5eee583;
 - 1> showInAdvancedViewOnly: TRUE;
 - 1> systemFlags: 0x42000000 = (CONFIG_ALLOW_RENAME | DISALLOW_MOVE_ON_DELETE);
 - 1> uSNChanged: 40997;
 - 1> uSNCreated: 40997;
 - 1> whenChanged: 06/08/2010 18:53:31 Pacific Standard Time;
 - 1> whenCreated: 06/08/2010 18:53:31 Pacific Standard Time;
- >> Dn: CN=DC4,CN=Sites,CN=Configuration,DC=contoso,DC=com
 - 1> cn: DC4;
 - 1> distinguishedName: CN=DC4,CN=Sites,CN=Configuration,DC=contoso,DC=com;
 - 1> dSCorePropagationData: 0x0 = ();
 - 1> instanceType: 0x4 = (WRITE);
 - 1> location: DC4;
 - 1> name: DC4;
 - 1> objectCategory: CN=Site,CN=Schema,CN=Configuration,DC=contoso,DC=com;
 - 2> objectClass: top; site;
 - 1> objectGUID: c15325f5-881b-417a-80cf-8e3530885613;
 - 1> showInAdvancedViewOnly: TRUE;
 - 1> systemFlags: 0x42000000 = (CONFIG_ALLOW_RENAME | DISALLOW_MOVE_ON_DELETE);

- 1> uSNChanged: 41002;
- 1> uSNCreated: 41002;
- 1> whenChanged: 06/08/2010 18:59:28 Pacific Standard Time;
- 1> whenCreated: 06/08/2010 18:59:28 Pacific Standard Time;

Querying the siteLink object for domain NC CONTOSO.COM by performing an LDAP search with Base DN "CN=Configuration,DC=contoso,DC=com".

- ldap_search_s(Id, "CN=Configuration,DC=contoso,DC=com", 2, "(objectclass=sitelink)", attrList, 0, &msg)
- Result <0>: (null)
- Matched DNs:
- Getting 4 entries:
- >> Dn: CN=SL1, CN=IP, CN=Inter-Site Transports, CN=Sites, CN=Configuration, DC=contoso, DC=com
 - 1> cn: SL1;
 - 1> cost: 8;
 - 1> distinguishedName: CN=SL1, CN=IP, CN=Inter-Site Transports, CN=Sites, CN=Configuration, DC=contoso, DC=com;
 - 1> instanceType: 0x4 = (WRITE);
 - 1> name: SL1;
 - 1> objectCategory: CN=Site-Link,CN=Schema,CN=Configuration,DC=contoso,DC=com;
 - 2> objectClass: top; siteLink;
 - 1> objectGUID: bd4ba671-90fb-4f4b-ab5d-76c9451d300c;
 - 1> replInterval: 180;
 - 2> siteList : CN=DC2,CN=Sites, CN=Configuration, DC=contoso, DC=com; CN=DC1, CN=Sites, CN=Configuration, DC=contoso, DC=com;
 - 1> systemFlags: 0x40000000 = (CONFIG_ALLOW_RENAME);
 - 1> uSNChanged: 41010;
 - 1> uSNCreated: 36896;
 - 1> whenChanged: 06/08/2010 19:04:37 Pacific Standard Time;
 - 1> whenCreated: 06/08/2010 14:01:17 Pacific Standard Time;
- >> Dn: CN=SL2, CN=IP, CN=Inter-Site Transports, CN=Sites, CN=Configuration, DC=contoso, DC=com
 - 1> cn: SL2;
 - 1> cost: 3;

- 1> distinguishedName: CN=SL2, CN=IP, CN=Inter-Site Transports, CN=Sites, CN=Configuration, DC=contoso, DC=com;
- 1> dScorePropagationData: 0x0 = ();
- 1> instanceType: 0x4 = (WRITE);
- 1> name: SL2;
- 1> objectCategory: CN=Site-Link,CN=Schema,CN=Configuration,DC=contoso,DC=com;
- 2> objectClass: top; siteLink;
- 1> objectGUID: a8906f5f-0c46-4276-87c6-34e60c6c0d63;
- 1> replInterval: 180;
- 2> siteList: CN=DC3, CN=Sites, CN=Configuration, DC=contoso, DC=com; CN=DC1, CN=Sites, CN=Configuration,DC=contoso,DC=com;
- 1> systemFlags: 0x40000000 = (CONFIG_ALLOW_RENAME);
- 1> uSNChanged: 41014;
- 1> uSNCreated: 41014;
- 1> whenChanged: 06/08/2010 19:05:29 Pacific Standard Time;
- 1> whenCreated: 06/08/2010 19:05:29 Pacific Standard Time;
- >> Dn: CN=SL3, CN=IP, CN=Intersite Transports, CN=Sites, CN=Configuration, DC=contoso, DC=com
 - 1> cn: SL3;
 - 1> cost: 5;
 - 1> distinguishedName: CN=SL3, CN=IP, CN=Inter-Site Transports, CN=Sites, CN=Configuration, DC=contoso, DC=com;
 - 1> dScorePropagationData: 0x0 = ();
 - 1> instanceType: 0x4 = (WRITE);
 - 1> name: SL3;
 - 1> objectCategory: CN=Site-Link, CN=Schema, CN=Configuration, DC=contoso, DC=com;
 - 2> objectClass: top; siteLink;
 - 1> objectGUID: 33f2a214-bea7-4061-8ecf-eca598837bc3;
 - 1> replInterval: 180;
 - 2> siteList: CN=DC4,CN=Sites, CN=Configuration, DC=contoso, DC=com; CN=DC2, CN=Sites, CN=Configuration, DC=contoso, DC=com;
 - 1> systemFlags: 0x40000000 = (CONFIG_ALLOW_RENAME);
 - 1> uSNChanged: 41017;
 - 1> uSNCreated: 41017;

- 1> whenChanged: 06/08/2010 19:05:51 Pacific Standard Time;
- 1> whenCreated: 06/08/2010 19:05:51 Pacific Standard Time;
- >> Dn: CN=SL4, CN=IP, CN=Inter-Site Transports, CN=Sites, CN=Configuration, DC=contoso, DC=com
 - 1> cn: SL4;
 - 1> cost: 7;
 - 1> distinguishedName: CN=SL4, CN=IP, CN=Inter-Site Transports, CN=Sites, CN=Configuration, DC=contoso, DC=com;
 - 1> dScorePropagationData: 0x0 = ();
 - 1> instanceType: 0x4 = (WRITE);
 - 1> name: SL4;
 - 1> objectCategory: CN=Site-Link,CN=Schema,CN=Configuration,DC=contoso,DC=com;
 - 2> objectClass: top; siteLink;
 - 1> objectGUID: 3c3e2aa6-03b3-4aab-a0b2-a689a7636619;
 - 1> replInterval: 180;
 - 2> siteList: CN=DC4, CN=Sites, CN=Configuration, DC=contoso, DC=com; CN=DC3, CN=Sites, CN=Configuration, DC=contoso, DC=com;
 - 1> systemFlags: 0x40000000 = (CONFIG_ALLOW_RENAME);
 - 1> uSNChanged: 41020;
 - 1> uSNCreated: 41020;
 - 1> whenChanged: 06/08/2010 19:06:13 Pacific Standard Time;
 - 1> whenCreated: 06/08/2010 19:06:13 Pacific Standard Time;

Querying the siteLinkBridge object for domain NC CONTOSO.COM by performing an LDAP search with Base DN "CN=Configuration,DC=contoso,DC=com".

- ldap_search_s(ld, "CN=Configuration,DC=contoso,DC=com", 2, "(objectclass=sitelinkbridge)", attrList, 0, &msg)
- Result <0>: (null)
- Matched DNs:
- Getting 1 entry:
- >> Dn: CN=SLB0, CN=IP, CN=Inter-Site Transports, CN=Sites, CN=Configuration, DC=contoso, DC=com
 - 1> cn: SLB0;
 - 1> distinguishedName: CN=SLB0, CN=IP, CN=Inter-Site Transports, CN=Sites, CN=Configuration, DC=contoso, DC=com;
 - 1> dScorePropagationData (2): 06/08/2010 17:06:09 Pacific Standard Time; 0x1 = (NEW_SD);

- 1> instanceType: 0x4 = (WRITE);
- 1> name: SLB0;
- 1> objectCategory: CN=Site-Link-Bridge,CN=Schema,CN=Configuration,DC=contoso,DC=com;
- 2> objectClass: top; siteLinkBridge;
- 1> objectGUID: 6ed39e2c-0bb4-4fe7-9cb1-5b4e82d1a5e2;
- 2> siteLinkList: CN=SL1, CN=IP, CN=Inter-Site Transports, CN=Sites, CN=Configuration, DC=contoso,DC=com; CN=SL3, CN=IP, CN=Inter-Site Transports, CN=Sites, CN=Configuration, DC=contoso, DC=com;
- 1> systemFlags: 0x40000000 = (CONFIG_ALLOW_RENAME);
- 1> uSNChanged: 36899;
- 1> uSNCreated: 36899;
- 1> whenChanged: 06/08/2010 14:05:25 Pacific Standard Time;
- 1> whenCreated: 06/08/2010 14:05:25 Pacific Standard Time;

4.1.16.4.1.2 Client Request

A client invokes the IDL_DRSQuerySitesByCost method against Contoso with the following parameters (DRS_HANDLE to DC1 is omitted):

- *dwInVersion* = 1
- *pmsgIn* = DRS_MSG_QUERY_SITESREQ_V1
 - *pwszFromSite* = "DC1"
 - *cToSites* = 3
 - *rgszToSites* = {"DC2", "DC3", "DC4"}
- *dwFlags* = 0

4.1.16.4.1.3 Server Response

- *pdwOutVersion*[^] = 1
- *pmsgOut* = DRS_MSG_QUERY_SITESREPLY_V1
 - *cToSites* = 3
 - *rgCostInfo*[0]: DRS_MSG_QUERY_SITESREPLYELEMENT_V1
 - *dwErrorCode* = 0
 - *dwCost*: = 8
 - *rgCostInfo*[1]: DRS_MSG_QUERY_SITESREPLYELEMENT_V
 - *dwErrorCode* = 0
 - *dwCost*: = 3

- rgCostInfo[2]: DRS_MSG_QUERY_SITES_REPLY_ELEMENT_V1
 - dwErrorCode = 0
 - dwCost: = 13
- dwFlags = 0

4.1.16.4.1.4 Final State

The final state is the same as the initial state; there is no change.

4.1.16.4.2 Transitive Communication

Determines the transitive communication cost from site DC1 to sites DC2, DC3, and DC4. A site graph is displayed in the following figure.

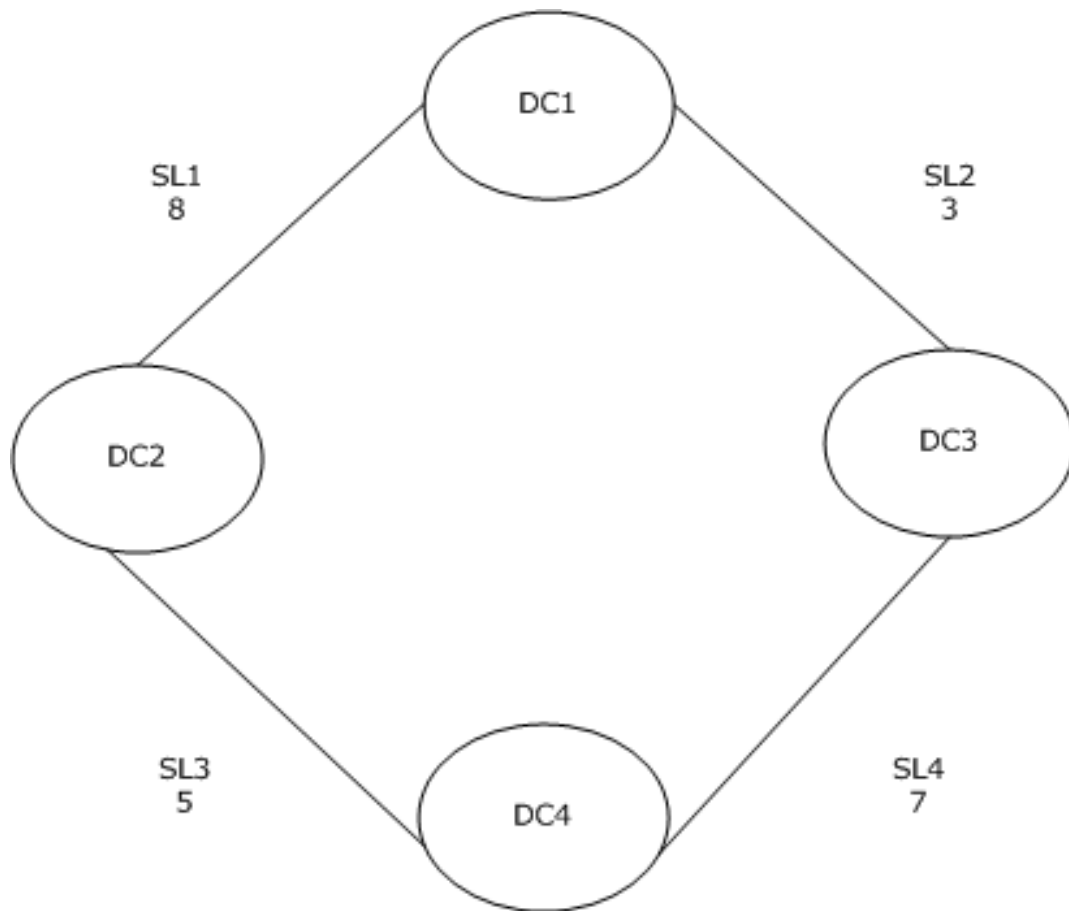


Figure 3: Site graph for a transitive network

VERTEX	ARC	ARC WEIGHT
DC	SL1	8
	SL2	3
DC2	SL1	8
	SL3	5

VERTEX	ARC	ARC WEIGHT
DC3	SL2	3
	SL4	7
DC4	SL3	5
	SL4	7

4.1.16.4.2.1 Initial State

Querying the site object for domain NC CONTOSO.COM by performing an LDAP search with Base DN "CN=Configuration,DC=contoso,DC=com".

- ldap_search_s(ld, "CN=Configuration,DC=contoso,DC=com", 2, "(objectclass=site)", attrList, 0, &msg)
- Result <0>: (null)
- Matched DN;
- Getting 4 entries;
- >> Dn: CN=DC1,CN=Sites,CN=Configuration,DC=contoso,DC=com
 - 1> cn: DC1;
 - 1> distinguishedName: CN=DC1,CN=Sites,CN=Configuration,DC=contoso,DC=com;
 - 1> instanceType: 0x4 = (WRITE);
 - 1> location: DC1;
 - 1> name: DC1;
 - 1> objectCategory: CN=Site,CN=Schema,CN=Configuration,DC=contoso,DC=com;
 - 2> objectClass: top; site;
 - 1> objectGUID: 3540d101-be2d-4630-b75e-1343c2a39dc8;
 - 1> showInAdvancedViewOnly: TRUE;
 - 1> systemFlags: 0x42000000 = (CONFIG_ALLOW_RENAME | DISALLOW_MOVE_ON_DELETE);
 - 1> uSNChanged: 41007;
 - 1> uSNCreated: 36885;
 - 1> whenChanged: 06/08/2010 19:04:05 Pacific Standard Time;
 - 1> whenCreated: 06/08/2010 13:53:19 Pacific Standard Time;
- >> Dn: CN=DC2,CN=Sites,CN=Configuration,DC=contoso,DC=com
 - 1> cn: DC2;
 - 1> distinguishedName: CN=DC2,CN=Sites,CN=Configuration,DC=contoso,DC=com;
 - 1> dScorePropagationData: 0x0 = ();

- 1> instanceType: 0x4 = (WRITE);
- 1> location: DC2;
- 1> name: DC2;
- 1> objectCategory: CN=Site,CN=Schema,CN=Configuration,DC=contoso,DC=com;
- 2> objectClass: top; site;
- 1> objectGUID: 7dd0525e-f00a-4c1d-9eec-d6df02625a59;
- 1> showInAdvancedViewOnly: TRUE;
- 1> systemFlags: 0x42000000 = (CONFIG_ALLOW_RENAME | DISALLOW_MOVE_ON_DELETE);
- 1> uSNChanged: 40991;
- 1> uSNCreated: 40991;
- 1> whenChanged: 06/08/2010 18:39:43 Pacific Standard Time;
- 1> whenCreated: 06/08/2010 18:39:43 Pacific Standard Time;
- >> Dn: CN=DC3,CN=Sites,CN=Configuration,DC=contoso,DC=com
 - 1> cn: DC3;
 - 1> distinguishedName: CN=DC3,CN=Sites,CN=Configuration,DC=contoso,DC=com;
 - 1> dSCorePropagationData: 0x0 = ();
 - 1> instanceType: 0x4 = (WRITE);
 - 1> location: DC3;
 - 1> name: DC3;
 - 1> objectCategory: CN=Site,CN=Schema,CN=Configuration,DC=contoso,DC=com;
 - 2> objectClass: top; site;
 - 1> objectGUID: dbdff472-a414-44c2-8206-a619e5eee583;
 - 1> showInAdvancedViewOnly: TRUE;
 - 1> systemFlags: 0x42000000 = (CONFIG_ALLOW_RENAME | DISALLOW_MOVE_ON_DELETE);
 - 1> uSNChanged: 40997;
 - 1> uSNCreated: 40997;
 - 1> whenChanged: 06/08/2010 18:53:31 Pacific Standard Time;
 - 1> whenCreated: 06/08/2010 18:53:31 Pacific Standard Time;
- >> Dn: CN=DC4,CN=Sites,CN=Configuration,DC=contoso,DC=com
 - > cn: DC4;
 - 1> distinguishedName: CN=DC4,CN=Sites,CN=Configuration,DC=contoso,DC=com;
 - 1> dSCorePropagationData: 0x0 = ();

- 1> instanceType: 0x4 = (WRITE);
- 1> location: DC4;
- 1> name: DC4;
- 1> objectCategory: CN=Site,CN=Schema,CN=Configuration,DC=contoso,DC=com;
- 2> objectClass: top; site;
- 1> objectGUID: c15325f5-881b-417a-80cf-8e3530885613;
- 1> showInAdvancedViewOnly: TRUE;
- 1> systemFlags: 0x42000000 = (CONFIG_ALLOW_RENAME | DISALLOW_MOVE_ON_DELETE);
- 1> uSNChanged: 41002;
- 1> uSNCreated: 41002;
- 1> whenChanged: 06/08/2010 18:59:28 Pacific Standard Time;
- 1> whenCreated: 06/08/2010 18:59:28 Pacific Standard Time;

Querying the siteLink object for domain NC CONTOSO.COM by performing an LDAP search with Base DN "CN=Configuration,DC=contoso,DC=com".

- ldap_search_s(ld, "CN=Configuration,DC=contoso,DC=com", 2, "(objectclass=sitelink)", attrList, 0, &msg)
- Result <0>: (null)
- Matched DNs;
- Getting 4 entries:
- >> Dn: CN=SL1, CN=IP, CN=Inter-Site Transports, CN=Sites, CN=Configuration, DC=contoso, DC=com
 - 1> cn: SL1;
 - 1> cost: 8;
 - 1> distinguishedName: CN=SL1, CN=IP, CN=Inter-Site Transports, CN=Sites, CN=Configuration, DC=contoso, DC=com;
 - 1> instanceType: 0x4 = (WRITE);
 - 1> name: SL1;
 - 1> objectCategory: CN=Site-Link,CN=Schema,CN=Configuration,DC=contoso,DC=com;
 - 2> objectClass: top; siteLink;
 - 1> objectGUID: bd4ba671-90fb-4f4b-ab5d-76c9451d300c;
 - 1> replInterval: 180;
 - 2> siteList : CN=DC2,CN=Sites, CN=Configuration, DC=contoso, DC=com; CN=DC1, CN=Sites, CN=Configuration, DC=contoso, DC=com;
 - 1> systemFlags: 0x40000000 = (CONFIG_ALLOW_RENAME);

- 1> uSNChanged: 41010;
- 1> uSNCreated: 36896;
- 1> whenChanged: 06/08/2010 19:04:37 Pacific Standard Time;
- 1> whenCreated: 06/08/2010 14:01:17 Pacific Standard Time;
- >> Dn: CN=SL2, CN=IP, CN=Inter-Site Transports, CN=Sites, CN=Configuration, DC=contoso, DC=com;
 - 1> cn: SL2;
 - 1> cost: 3;
 - 1> distinguishedName: CN=SL2, CN=IP, CN=Inter-Site Transports, CN=Sites, CN=Configuration, DC=contoso, DC=com;
 - 1> dSCorePropagationData: 0x0 = ();
 - 1> instanceType: 0x4 = (WRITE);
 - 1> name: SL2;
 - 1> objectCategory: CN=Site-Link,CN=Schema,CN=Configuration,DC=contoso,DC=com;
 - 2> objectClass: top; siteLink;
 - 1> objectGUID: a8906f5f-0c46-4276-87c6-34e60c6c0d63;
 - 1> replInterval: 180;
 - 2> siteList: CN=DC3, CN=Sites, CN=Configuration, DC=contoso, DC=com; CN=DC1, CN=Sites, CN=Configuration,DC=contoso,DC=com;
 - 1> systemFlags: 0x40000000 = (CONFIG_ALLOW_RENAME);
 - 1> uSNChanged: 41014;
 - 1> uSNCreated: 41014;
 - 1> whenChanged: 06/08/2010 19:05:29 Pacific Standard Time;
 - 1> whenCreated: 06/08/2010 19:05:29 Pacific Standard Time;
- >> Dn: CN=SL3, CN=IP, CN=Inter-Site Transports, CN=Sites, CN=Configuration, DC=contoso, DC=com
 - 1> cn: SL3;
 - 1> cost: 5;
 - 1> distinguishedName: CN=SL3, CN=IP, CN=Inter-Site Transports, CN=Sites, CN=Configuration, DC=contoso, DC=com;
 - 1> dSCorePropagationData: 0x0 = ();
 - 1> instanceType: 0x4 = (WRITE);
 - 1> name: SL3;
 - 1> objectCategory: CN=Site-Link, CN=Schema, CN=Configuration, DC=contoso, DC=com;

- 2> objectClass: top; siteLink;
- 1> objectGUID: 33f2a214-bea7-4061-8ecf-eca598837bc3;
- 1> replInterval: 180;
- 2> siteList: CN=DC4,CN=Sites, CN=Configuration, DC=contoso, DC=com; CN=DC2, CN=Sites, CN=Configuration, DC=contoso, DC=com;
- 1> systemFlags: 0x40000000 = (CONFIG_ALLOW_RENAME);
- 1> uSNChanged: 41017;
- 1> uSNCreated: 41017;
- 1> whenChanged: 06/08/2010 19:05:51 Pacific Standard Time;
- 1> whenCreated: 06/08/2010 19:05:51 Pacific Standard Time;
- >> Dn: CN=SL4, CN=IP, CN=Inter-Site Transports, CN=Sites, CN=Configuration, DC=contoso, DC=com
 - 1> cn: SL4;
 - 1> cost: 7;
 - 1> distinguishedName: CN=SL4, CN=IP, CN=Inter-Site Transports, CN=Sites, CN=Configuration, DC=contoso, DC=com;
 - 1> dSCorePropagationData: 0x0 = ();
 - 1> instanceType: 0x4 = (WRITE);
 - 1> name: SL4;
 - 1> objectCategory: CN=Site-Link,CN=Schema,CN=Configuration,DC=contoso,DC=com;
 - 2> objectClass: top; siteLink;
 - 1> objectGUID: 3c3e2aa6-03b3-4aab-a0b2-a689a7636619;
 - 1> replInterval: 180;
 - 2> siteList: CN=DC4, CN=Sites, CN=Configuration, DC=contoso, DC=com; CN=DC3, CN=Sites, CN=Configuration, DC=contoso, DC=com;
 - 1> systemFlags: 0x40000000 = (CONFIG_ALLOW_RENAME);
 - 1> uSNChanged: 41020;
 - 1> uSNCreated: 41020;
 - 1> whenChanged: 06/08/2010 19:06:13 Pacific Standard Time;
 - 1> whenCreated: 06/08/2010 19:06:13 Pacific Standard Time;

4.1.16.4.2.2 Client Request

A client invokes the IDL_DRSQuerySitesByCost method against Contoso with the following parameters (DRS_HANDLE to DC1 is omitted):

- *dwInVersion* = 1

- *pmsgIn* = DRS_MSG_QUERY_SITESREQ_V1
 - *pwszFromSite* = "DC1"
 - *cToSites* = 3
 - *rgszToSites* = {"DC2", "DC3", "DC4"}
- *dwFlags* = 0

4.1.16.4.2.3 Server Response

- *pdwOutVersion*[^] = 1
- *pmsgOut* = DRS_MSG_QUERY_SITESREPLY_V1
 - *cToSites* = 3
 - *rgCostInfo*[0]: DRS_MSG_QUERY_SITESREPLYELEMENT_V1
 - *dwErrorCode* = 0
 - *dwCost*: = 8
 - *rgCostInfo*[1]: DRS_MSG_QUERY_SITESREPLYELEMENT_V1
 - *dwErrorCode* = 0
 - *dwCost*: = 3
 - *rgCostInfo*[2]: DRS_MSG_QUERY_SITESREPLYELEMENT_V1
 - *dwErrorCode* = 0
 - *dwCost*: = 10
- *dwFlags* = 0

4.1.16.4.2.4 Final State

The final state is the same as the initial state; there is no change.

4.1.17 IDL_DRSRemoveDsDomain (Opnum 15)

The IDL_DRSRemoveDsDomain method removes the representation (also known as metadata) of a domain from the directory.

```

ULONG IDL_DRSRemoveDsDomain(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
    DRS_MSG_RMDMNREQ* pmsgIn,
    [out, ref] DWORD* pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
    DRS_MSG_RMDMNREPLY* pmsgOut
);

```

hDrs: The RPC context handle returned by the IDL_DRSBind method.

dwInVersion: The version of the request message. This must be set to 1, because this is the only version supported.

pmsgIn: A pointer to the request message.

pdwOutVersion: A pointer to the version of the response message. The value must be 1 because that is the only version supported.

pmsgOut: A pointer to the response message.

Return Values: 0 if successful, or a Windows error code if a failure occurs.

Exceptions Thrown: This method might throw the following exceptions beyond those thrown by the underlying RPC protocol (as specified in [MS-RPCE]): `ERROR_INVALID_HANDLE`, `ERROR_DS_DRS_EXTENSIONS_CHANGED`, `ERROR_DS_DIFFERENT_REPL_EPOCHS`, and `ERROR_INVALID_PARAMETER`.

4.1.17.1 Method-Specific Concrete Types

4.1.17.1.1 DRS_MSG_RMDMNREQ

The `DRS_MSG_RMDMNREQ` union defines the request messages sent to the `IDL_DRSRemoveDsDomain` method. Only one version, identified by `dwInVersion = 1`, is currently defined.

```
typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_RMDMNREQ_V1 V1;
} DRS_MSG_RMDMNREQ;
```

V1: The version 1 request.

4.1.17.1.2 DRS_MSG_RMDMNREQ_V1

The `DRS_MSG_RMDMNREQ_V1` structure defines a request message sent to the `IDL_DRSRemoveDsDomain` method.

```
typedef struct {
    [string] LPWSTR DomainDN;
} DRS_MSG_RMDMNREQ_V1;
```

DomainDN: The DN of the NC root of the domain NC to remove.

4.1.17.1.3 DRS_MSG_RMDMNREPLY

The `DRS_MSG_RMDMNREPLY` union defines the response messages received from the `IDL_DRSRemoveDsDomain` method. Only one version, identified by `pdwOutVersion^ = 1`, is currently defined.

```
typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_RMDMNREPLY_V1 V1;
} DRS_MSG_RMDMNREPLY;
```

V1: The version 1 response.

4.1.17.1.4 DRS_MSG_RMDMNREPLY_V1

The DRS_MSG_RMDMNREPLY_V1 structure defines a response message received from the IDL_DRSSRemoveDsDomain method.

```
typedef struct {
    DWORD Reserved;
} DRS_MSG_RMDMNREPLY_V1;
```

Reserved: Unused. MUST be 0 and ignored.

4.1.17.2 Method-Specific Abstract Types and Procedures

4.1.17.2.1 HasNCReplicated

```
procedure HasNCReplicated(nc: DSName): boolean
```

Returns true if the DC's NC replica of the NC specified by *nc* has replicated at least once with another DC that hosts that NC since the DC was booted; otherwise, returns false.

4.1.17.3 Server Behavior of the IDL_DRSSRemoveDsDomain Method

Informative summary of behavior: Removes the crossRef object that defines a domain NC. Fails if any DC is currently hosting this domain as its default NC, as indicated by the state of that DC's nTDSDSA object. Fails if the server is not the Domain Naming FSMO role owner for the forest.

The removal of the crossRef object signals any DC currently hosting a partial replica of the removed domain NC to remove that replica from its state.

This method undoes the effects of the IDL_DRSSAddEntry method when IDL_DRSSAddEntry is used to create a crossRef object.

The IDL_DRSSRemoveDsServer method removes the state within a forest, including the state on a DC's nTDSDSA object, associated with hosting a domain as a default NC on some DC. Therefore, IDL_DRSSRemoveDsServer can be used to establish a precondition for the success of IDL_DRSSRemoveDsDomain.

```
ULONG
IDL_DRSSRemoveDsDomain(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
        DRS_MSG_RMDMNREQ *pmsgIn,
    [out, ref] DWORD *pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DRS_MSG_RMDMNREPLY *pmsgOut);

domainDN: unicodestring
otherNtdsdsa: DSName
cr: DSName
rt: ULONG

ValidateDRSInput(hDrs, 15)

pdwOutVersion^ := 1
pmsgOut^.V1.Reserved := 0

if dwInVersion ≠ 1 then
    return ERROR_INVALID_PARAMETER
```

```

endif

domainDN := pmsgIn^.V1.DomainDN

if domainDN = null or domainDN = "" then
    return ERROR_INVALID_PARAMETER
endif

/* This function cannot be called on a DC for the domain
 * to be removed. */
if DefaultNC().dn = domainDN then
    return ERROR_DS_ILLEGAL_MOD_OPERATION
endif

/* Make sure no DCs still have NC replicas of this domain NC. */
otherNtdsdsa := select one o from ConfigNC() where
    (nTDSDSA in o!objectClass) and
    (domainDN in o!hasMasterNCs or
     domainDN in o!msDS-hasMasterNCs)
if otherNtdsdsa ≠ null then
    return ERROR_DS_NC_STILL_HAS_DSAS
endif

/* Find the crossRef object for the domain named by domainDN. */
cr := select one o from ConfigNC() where
    (o!ncName = domainDN) and (crossRef in o!objectClass)

if cr = null then
    return ERROR_DS_NO_CROSSREF_FOR_NC
endif

/* Make sure we are the Domain Naming FSMO role owner */
if GetFSMORoleOwner(FSMO_DOMAIN_NAMING) ≠ DSAObj() then
    /* We are not the Domain Naming FSMO role owner */
    return ERROR_DS_OBJ_NOT_FOUND
else
    /* We are the Domain Naming FSMO role owner. If the Config NC
     * has not replicated at least once since startup, our ownership
     * of the NC is not considered to be verified, so exit
     * with an error. */
    if not HasNCReplicated(ConfigNC()) then
        return ERROR_DS_ROLE_NOT_VERIFIED;
    endif
endif

if (not AccessCheckObject(cr, RIGHT_DELETE)) and
    (not AccessCheckObject(cr.parent, RIGHT_DS_DELETE_CHILD)) then
    return ERROR_ACCESS_DENIED
endif

rt:= RemoveObj(cr,false)
if rt ≠ 0 then
    return rt
endif

DelSubRef(cr!ncName)
return 0

```

4.1.18 IDL_DRSRemoveDsServer (Opnum 14)

The IDL_DRSRemoveDsServer method removes the representation (also known as metadata) of a DC from the directory.

```

ULONG IDL_DRSRemoveDsServer(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]

```

```

    DRS_MSG_RMSVRREQ* pmsgIn,
    [out, ref] DWORD* pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
    DRS_MSG_RMSVRREPLY* pmsgOut
);

```

hDrs: The RPC context handle returned by the IDL_DRSSbind method.

dwInVersion: The version of the request message. Must be set to 1 because that is the only version supported.

pmsgIn: A pointer to the request message.

pdwOutVersion: A pointer to the version of the response message. The value must be 1 because that is the only version supported.

pmsgOut: A pointer to the response message.

Return Values: 0 if successful or a Windows error code if a failure occurs.

Exceptions Thrown: This method might throw the following exceptions beyond those thrown by the underlying RPC protocol (as specified in [MS-RPCE]): ERROR_INVALID_HANDLE, ERROR_DS_DRS_EXTENSIONS_CHANGED, ERROR_DS_DIFFERENT_REPL_EPOCHS, and ERROR_INVALID_PARAMETER.

4.1.18.1 Method-Specific Concrete Types

4.1.18.1.1 DRS_MSG_RMSVRREQ

The DRS_MSG_RMSVRREQ union defines the request messages sent to the IDL_DRSSRemoveDsServer method. Only one version, identified by *dwInVersion* = 1, is currently defined.

```

typedef
[switch_type(DWORD)]
union {
    [case(1)]
    DRS_MSG_RMSVRREQ_V1 V1;
} DRS_MSG_RMSVRREQ;

```

V1: The version 1 request.

4.1.18.1.2 DRS_MSG_RMSVRREQ_V1

The DRS_MSG_RMSVRREQ_V1 structure defines a request message sent to the IDL_DRSSRemoveDsServer method.

```

typedef struct {
    [string] LPWSTR ServerDN;
    [string] LPWSTR DomainDN;
    BOOL fCommit;
} DRS_MSG_RMSVRREQ_V1;

```

ServerDN: The DN of the server object of the DC to remove.

DomainDN: The DN of the NC root of the domain that the DC to be removed belongs to. **MayCan** be set to null if the client does not want the server to compute the value of `pmsgOut^.V1.fLastDCInDomain`.

fCommit: True if the DC's metadata should actually be removed from the directory. False if the metadata should not be removed. (This is used by a client that wants to determine the value of `pmsgOut^.V1.fLastDcInDomain` without altering the directory.)

4.1.18.1.3 DRS_MSG_RMSVRREPLY

The `DRS_MSG_RMSVRREPLY` union defines the response messages received from the `IDL_DRSSRemoveDsServer` method.

```
typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_RMSVRREPLY_V1 V1;
} DRS_MSG_RMSVRREPLY;
```

V1: The version 1 response.

4.1.18.1.4 DRS_MSG_RMSVRREPLY_V1

The `DRS_MSG_RMSVRREPLY_V1` structure defines a response message received from the `IDL_DRSSRemoveDsServer` method. Only one version, identified by `pdwOutVersion^ = 1`, is currently defined.

```
typedef struct {
    BOOL fLastDcInDomain;
} DRS_MSG_RMSVRREPLY_V1;
```

fLastDcInDomain: True if the DC is the last DC in its domain, and `pmsgIn^.V1.DomainDN` was set to the DN of the NC root of the domain to which the DC belongs. Otherwise, false.

4.1.18.2 Server Behavior of the IDL_DRSSRemoveDsServer Method

Informative summary of behavior: Removes the metadata defining a DC, which consists of the tree of objects rooted at the DC's `nTDSDSA` object as well as the `rIDSet` objects and DRS SPNs associated with the DC's computer object. This method is typically used when a DC is demoted. As part of the demotion process, the DC being demoted calls this method on another DC (either in the same domain, if such a DC exists, or in the parent domain, if there are no other DCs in the same domain but there is a parent domain) to remove the metadata of the DC being demoted from the forest. Alternatively, if a DC is removed from the domain without being properly demoted (for example, if the DC suffers a fatal hardware failure), a client **maycan** make this call to remove the metadata of the now-nonexistent DC. When `pmsgIn^.V1.DomainDN` is specified, this method also computes whether the DC is the last replica of its default domain NC.

The behavior of this method has two variants. If `pmsgIn^.V1.fCommit` is false, the method is read-only with regard to abstract state; that is, it does not make any changes to the directory contents. In this mode, the main purpose of the method is to compute `pmsgOut^.V1.fLastDcInDomain` (and so there is little point to calling the method in this mode without setting `pmsgIn^.V1.DomainDN`). For example, prior to removing the DC's metadata, a client application might try to determine whether any DCs would be left in the domain, so that it can warn the user if the user is removing the last DC in the domain.

When `pmsgIn^.V1.fCommit` is true, the second variant of the behavior is performed. In this mode, the method actually removes the DC metadata. *The* `pmsgOut^.V1.fLastDcInDomain` value is also computed in this mode (provided that `pmsgIn^.V1.DomainDN` was passed in). This method undoes the effects of the `IDL_DRSSAddEntry` method when `IDL_DRSSAddEntry` is used to create an `nTDSDSA`

object. The removal of the DC's metadata signals other DCs in the forest that this particular DC no longer exists.

```
ULONG
IDL_DRSSRemoveDsServer(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
        DRS_MSG_RMSVRREQ *pmsgIn,
    [out, ref] DWORD *pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DRS_MSG_RMSVRREPLY *pmsgOut);

serverDn: unicodestring
domainDn: unicodestring
server: DSName
ntdsdsa: DSName
otherNtdsdsa: DSName
spnsToRemove: set of unicodestring
computerDn: unicodestring
computer: DSName
objectsToDelete: set of DSName
rt: ULONG
RODCKrbtgtAcct: DSName
accountList: set of DSName
ValidateDRSInput(hDrs, 14)

serverDn := pmsgIn^.V1.ServerDN
domainDn := pmsgIn^.V1.DomainDN

pdwOutVersion^ := 1
pmsgOut^.V1.fLastDcInDomain = false

/* Basic parameter validation */
if dwInVersion ≠ 1 then
    return ERROR_INVALID_PARAMETER
endif

if serverDn = null or serverDn = "" then
    return ERROR_INVALID_PARAMETER
endif

/* Note that DomainDN maycan be null, but it cannot be empty. */
if domainDn = "" then
    return ERROR_INVALID_PARAMETER
endif

/* Compute fLastDcInDomain if domainDn is non-null. */
if domainDn ≠ null then
    otherNtdsdsa := select one o from subtree ConfigNC() where
        (o!objectCategory = nTDSDSA)
        and
        (domainDn in o!hasMasterNCs or domainDn in o!msDS-hasMasterNCs)
        and
        (o ≠ ntdsdsa)
    if otherNtdsdsa = null then
        pmsgOut^.V1.fLastDcInDomain = true
    else
        pmsgOut^.V1.fLastDcInDomain = false
    endif
endif

/* If nothing to commit, processing is complete. */
if not pmsgIn^.V1.fCommit then
    return 0
endif

ntdsdsa := DescendantObject([dn: serverDn], "CN=NTDS Settings,")
if ntdsdsa = null then
```



```

endifor

if not AccessCheckAttr(computer, servicePrincipalName,
    RIGHT_DS_WRITE_PROPERTY) then
    return ERROR_ACCESS_DENIED
endif

computer!servicePrincipalName :=
    computer!servicePrincipalName - spnsToRemove
endif

return 0

```

4.1.19 IDL_DRSReplicaAdd (Opnum 5)

The IDL_DRSReplicaAdd method adds a replication source reference for the specified NC.

```

ULONG IDL_DRSReplicaAdd(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwVersion,
    [in, ref, switch_is(dwVersion)]
    DRS_MSG_REPADD* pmsgAdd
);

```

hDrs: The RPC context handle returned by the IDL_DRSBind method.

dwVersion: The version of the request message.

pmsgAdd: A pointer to the request message.

Return Values: 0 if successful, otherwise a Windows error code.

Exceptions Thrown: This method might throw the following exceptions beyond those thrown by the underlying RPC protocol (as specified in [MS-RPCE]): ERROR_INVALID_HANDLE, ERROR_DS_DRS_EXTENSIONS_CHANGED, ERROR_DS_DIFFERENT_REPL_EPOCHS, and ERROR_INVALID_PARAMETER.

4.1.19.1 Method-Specific Concrete Types

4.1.19.1.1 DRS_MSG_REPADD

The DRS_MSG_REPADD union defines request messages that are sent to the IDL_DRSReplicaAdd method.

```

typedef
[switch_type(DWORD)]
union {
    [case(1)]
    DRS_MSG_REPADD_V1 V1;
    [case(2)]
    DRS_MSG_REPADD_V2 V2;
} DRS_MSG_REPADD;

```

V1: The version 1 request.

V2: The version 2 request (a superset of V1).

4.1.19.1.2 DRS_MSG_REPADD_V1

The DRS_MSG_REPADD_V1 structure defines a request message sent to the IDL_DRSReplicaAdd method.

```
typedef struct {
    [ref] DSNAME* pNC;
    [ref,] [string] char* pszDsaSrc;
    REPLTIMES rtSchedule;
    ULONG ulOptions;
} DRS_MSG_REPADD_V1;
```

pNC: The NC root of the NC to replicate.

pszDsaSrc: The transport-specific NetworkAddress of the DC from which to replicate updates.

rtSchedule: The schedule used to perform periodic replication.

ulOptions: Zero or more DRS_OPTIONS flags.

4.1.19.1.3 DRS_MSG_REPADD_V2

The DRS_MSG_REPADD_V2 structure defines a request message sent to the IDL_DRSReplicaAdd method. This request version is a superset of V1.

```
typedef struct {
    [ref] DSNAME* pNC;
    [unique] DSNAME* pSourceDsaDN;
    [unique] DSNAME* pTransportDN;
    [ref,] [string] char* pszSourceDsaAddress;
    REPLTIMES rtSchedule;
    ULONG ulOptions;
} DRS_MSG_REPADD_V2;
```

pNC: The NC root of the NC to replicate.

pSourceDsaDN: The nTDSDSA object for the DC from which to replicate changes.

pTransportDN: The interSiteTransport object that identifies the network transport over which replication ~~should~~ be performed.

pszSourceDsaAddress: The transport-specific NetworkAddress of the DC from which to replicate updates.

rtSchedule: The schedule used to perform periodic replication.

ulOptions: Zero or more DRS_OPTIONS flags.

4.1.19.2 Server Behavior of the IDL_DRSReplicaAdd Method

Informative summary of behavior: The server adds a value to the repsFrom of the specified NC replica. If ulOptions contains DRS_ASYNC_OP, the server processes the request asynchronously. The client can be an administrative client or another DC. The client includes DRS_WRIT_REP in ulOptions if the specified NC replica is writable at the server. The client includes DRS_NONGC_RO_REP and DRS_SPECIAL_SECRET_PROCESSING in ulOptions if the specified NC replica is a read-only full replica on a read-only DC. The server adds a value to repsFrom, and the value has replicaFlags derived from ulOptions (see below), serverAddress equal to pszSourceDsaAddress (pszDsaSrc if V1), and schedule equal to rtSchedule. If ulOptions contains DRS_ASYNC_REP but not DRS_MAIL_REP or DRS_NEVER_NOTIFY, the server sends a request to the DC specified by pszSourceDsaAddress to add a value to the repsTo of the specified NC replica by calling IDL_DRSUpdateRefs. Finally, the server begins a replication cycle by sending an IDL_DRSGetNCChanges request.

```

ULONG
IDL_DRSReplicaAdd(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwVersion,
    [in, ref, switch_is(dwVersion)] DRS_MSG_REPADD *pmsgAdd);

options: DRS_OPTIONS
nc: DSName
partitionsObj: DSName
cr: DSName
rf: RepsFrom
msgIn: DRS_MSG_REPADD_V2
updRefs: DRS_MSG_UPDREFS /* See IDL_DRSUpdateRefs structures. */
hDrsSrc: DRS_HANDLE
msgRequest: DRS_MSG_GETCHGREQ
msgOut: DRS_MSG_GETCHGREPLY
outVersion: DWORD
cMaxObjects: ULONG
cMaxBytes: ULONG
versionRequestMsg: DWORD
err: ULONG

ValidateDRSInput(hDrs, 5)

/* Validate the version */
if dwVersion ≠ 1 and dwVersion ≠ 2 then
    return ERROR_DS_DRA_INVALID_PARAMETER
endif
if dwVersion = 1 then
    msgIn := pmsgAdd^.V1
    msgIn.pszSourceDsaAddress = pmsgAdd^.V1.pszDsaSrc
else
    msgIn := pmsgAdd^.V2
endif

if msgIn.pNC = null
    or msgIn.pszSourceDsaAddress = null
    or msgIn.pszSourceDsaAddress = "" then
    return ERROR_DS_DRA_INVALID_PARAMETER
endif

options := msgIn.ulOptions
nc := msgIn.pNC^

partitionsObj :=
    select one o from children ConfigNC() where o!name = "Partitions"
cr := select o from children partitionsObj where o!nCName = nc
if cr = null then
    return ERROR_DS_DRA_BAD_NC
endif

if options - {DRS_ASYNC_OP, DRS_CRITICAL_ONLY, DRS_ASYNC_REP,
    DRS_WRIT_REP, DRS_INIT_SYNC, DRS_PER_SYNC, DRS_MAIL_REP,
    DRS_NONGC_RO_REP, DRS_SPECIAL_SECRET_PROCESSING, DRS_DISABLE_AUTO_SYNC,
    DRS_DISABLE_PERIODIC_SYNC, DRS_USE_COMPRESSION, DRS_NEVER_NOTIFY,
    DRS_TWOWAY_SYNC} ≠ {} then
    return ERROR_DS_DRA_INVALID_PARAMETER
endif

if AmIRODC() and DRS_WRIT_REP in options then
    return ERROR_DS_DRA_INVALID_PARAMETER
endif

if AmIRODC() and DRS_MAIL_REP in options then
    return ERROR_DS_DRA_INVALID_PARAMETER
endif

if DRS_MAIL_REP in options and not DRS_ASYNC_REP in options then
    return ERROR_DS_DRA_INVALID_PARAMETER

```

```

endif

if ObjExists(nc) then
    if not AccessCheckCAR(nc, DS-Replication-Manage-Topology) then
        return ERROR_DS_DRA_ACCESS_DENIED
    endif
else
    if not AccessCheckCAR(DefaultNC(), DS-Replication-Manage-Topology)
        then
        return ERROR_DS_DRA_ACCESS_DENIED
    endif
endif

if DRS_ASYNC_OP in options then
    Asynchronous Processing: Initiate a logical thread of control
    to process the remainder of this request asynchronously
    return 0
endif

if ObjExists(nc) then
    if (IT_WRITE in nc!instanceType) ≠ (DRS_WRIT_REP in options) then
        return ERROR_DS_DRA_BAD_INSTANCE_TYPE
    endif
    /* Disallow addition if server already replicates from this
    * source */
    if (select one v from nc!repsFrom
        where v.serverAddress = msgIn.pszSourceDsaAddress) ≠ null
        then
        return ERROR_DS_DRA_DN_EXISTS
    endif
endif

if DRS_ASYNC_REP in options then
    if msgIn.pSourceDsaDN = null
        or not ObjExists(msgIn.pSourceDsaDN^)
        then
        return ERROR_DS_DRA_INVALID_PARAMETER
    endif
endif

if DRS_MAIL_REP in options then
    if msgIn.pTransportDN = null
        or not ObjExists(msgIn.pTransportDN^)
        then
        return ERROR_DS_DRA_INVALID_PARAMETER
    endif
endif

/* Construct RepsFrom value. */
if msgIn.pSourceDsaDN ≠ null then
    rf.uuidDsa := msgIn.pSourceDsaDN!objectGUID
endif
if msgIn.pTransportDN ≠ null then
    rf.uuidTransportObj := msgIn.pTransportDN!objectGUID
endif
rf.replicaFlags := msgIn.ulOptions ∩ {DRS_DISABLE_AUTO_SYNC,
    DRS_DISABLE_PERIODIC_SYNC, DRS_INIT_SYNC, DRS_MAIL_REP,
    DRS_NEVER_NOTIFY, DRS_PER_SYNC, DRS_TWOWAY_SYNC,
    DRS_USE_COMPRESSION, DRS_WRIT_REP, DRS_NONGC_RO_REP,
    DRS_SPECIAL_SECRET_PROCESSING }
rf.schedule := msgIn.rtSchedule^
rf.serverAddress := msgIn.pszSourceDsaAddress^
rf.timeLastAttempt := current time

nc!repsFrom := nc!repsFrom + {rf}
if msgIn.ulOptions ∩ {DRS_ASYNC_REP, DRS_NEVER_NOTIFY, DRS_MAIL_REP}
    = {DRS_ASYNC_REP} then
    /* Enable replication notifications by requesting the server DC
    * to add a repsTo for this DC. */
    updRefs.pNC^ := ADR(nc)

```

```

updRefs.pszDsaDest := NetworkAddress of this DC
updRefs.uuidDsaObjDest := dc.serverGuid
updRefs.ulOptions := {DRS_ASYNC_OP, DRS_ADD_REF, DRS_DEL_REF}
if DRS_WRIT_REP in msgIn.ulOptions then
    updRefs.ulOptions := updRefs.ulOptions + {DRS_WRIT_REP}
endif

hDrsSrc := BindToDSA(msgIn.pSourceDsaDN)
if hDrsSrc ≠ null then
    ret := IDL_DRSUpdateRefs(hDrsSrc, 1, ADR(updRefs))
    UnbindFromDSA(hDrsSrc)
endif

endif

/* Perform a replication cycle as a client of IDL_DRSGetNCChanges. */
versionRequestMsg := The version number of the input message negotiated between the
client and server (section 4.1.10.4.1).
cMaxObjects := Implementation-specific value.
cMaxBytes := Implementation-specific value.

/* Form the first request */
ReplicateNCRequestMsg(
    hDrsSrc,
    versionRequestMsg,
    nc,
    rf,
    options,
    cMaxObjects,
    cMaxBytes,
    ADDR(msgRequest))

err := IDL_DRSGetNCChanges(
    hDrsSrc,
    versionRequestMsg,
    msgRequest,
    ADDR(outVersion),
    ADDR(msgOut))

if err = 0
    and not DRS_MAIL_REP in msgIn.ulOptions
then

    Wait for the response, process it (section 4.1.10.6), send the next request, etc.
    until the replication cycle is complete.

    If there are any failures from this replication attempt, err should beis assigned an
    appropriate error value.

endif

return err

```

4.1.20 IDL_DRSReplicaDel (Opnum 6)

The IDL_DRSReplicaDel method deletes a replication source reference for the specified NC.

```

ULONG IDL_DRSReplicaDel(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwVersion,
    [in, ref, switch_is(dwVersion)]
    DRS_MSG_REPDEL* pmsgDel
);

```


hDrs: The RPC context handle returned by IDL_DRSSBind.

dwVersion: The version of the request message.

pmsgDel: A pointer to the request message.

Return Values: 0 if successful, otherwise a Windows error code.

Exceptions Thrown: This method might throw the following exceptions beyond those thrown by the underlying RPC protocol (as specified in [MS-RPCE]): ERROR_INVALID_HANDLE, ERROR_DS_DRS_EXTENSIONS_CHANGED, ERROR_DS_DIFFERENT_REPL_EPOCHS, and ERROR_INVALID_PARAMETER.

4.1.20.1 Method-Specific Concrete Types

4.1.20.1.1 DRS_MSG_REPDEL

The DRS_MSG_REPDEL union defines the request messages sent to the IDL_DRSReplicaDel method. Only one version, identified by *dwVersion* = 1, is currently defined.

```
typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_REPDEL_V1 V1;
} DRS_MSG_REPDEL;
```

V1: The version 1 request.

4.1.20.1.2 DRS_MSG_REPDEL_V1

The DRS_MSG_REPDEL_V1 structure defines a request message sent to the IDL_DRSReplicaDel method.

```
typedef struct {
    [ref] DSNAME* pNC;
    [string] char* pszDsaSrc;
    ULONG ulOptions;
} DRS_MSG_REPDEL_V1;
```

pNC: A pointer to DSName of the root of an NC replica on the server.

pszDsaSrc: The transport-specific NetworkAddress of a DC.

ulOptions: The DRS_OPTIONS flags.

4.1.20.2 Server Behavior of the IDL_DRSReplicaDel Method

Informative summary of behavior: When DRS_NO_SOURCE is not specified, the server removes a value from the repsFrom of the specified NC replica. If ulOptions contains DRS_ASYNC_OP, the server processes the request asynchronously. The client **must** include DRS_WRIT_REP in ulOptions if the specified NC replica is a writable replica. The server removes the value from repsFrom whose serverAddress matches pszDsaSrc. If ulOptions does not contain DRS_LOCAL_ONLY, the server sends a request to the DC specified by pszDsaSrc to remove this DC from the values in repsTo of the specified NC replica by calling IDL_DRSUpdateRefs.

When DRS_NO_SOURCE is specified, the server **expunges** the NC replica and all its children. This operation returns an error and the expunge does not occur if the repsFrom or repsTo attributes are present on the NC replica. However, if ulOptions contains DRS_REF_OK, it is permitted for repsTo to be present. If ulOptions contains DRS_ASYNC_OP, the server processes the request asynchronously. The client **must** include DRS_WRIT_REP in ulOptions if the specified NC replica is writable. If ulOptions contains DRS_ASYNC_REP, the server expunges the objects asynchronously.

```

ULONG
IDL_DRSReplicaDel(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwVersion,
    [in, ref, switch_is(dwVersion)] DRS_MSG_REPDEL *pmsgDel);

options: DRS_OPTIONS
nc: DSName
cr: DSName
srcDSA: DSName
hDrsSrc: DRS_HANDLE
rf: RepsFrom
msgIn: DRS_MSG_REPDEL_V1
updRefs: DRS_MSG_UPDREFS /* See IDL_DRSUpdateRefs structures. */
rt: ULONG

ValidateDRSInput(hDrs, 6)

msgIn := pmsgDel^.V1

/* Validate the NC */
if msgIn.pNC = null then
    return ERROR_DS_DRA_INVALID_PARAMETER
endif

nc := msgIn.pNC^

if not ObjExists(nc) then
    return ERROR_DS_DRA_BAD_NC
endif

if not AccessCheckCAR(nc, DS-Replication-Manage-Topology) then
    return ERROR_DS_DRA_ACCESS_DENIED
endif

options := msgIn.ulOptions

/* Any request that includes invalid options is rejected. */
if options - {DRS_ASYNC_OP, DRS_WRIT_REP, DRS_MAIL_REP, DRS_ASYNC_REP,
    DRS_IGNORE_ERROR, DRS_LOCAL_ONLY, DRS_NO_SOURCE, DRS_REF_OK} ≠ {} then
    return ERROR_DS_DRA_INVALID_PARAMETER
endif

if DRS_NO_SOURCE in options then
    /* Expunging local copy of an NC. */

    /* Do not permit removal of nonroot or uninstantiated NCs. */
    if (IT_NC_HEAD not in nc!instanceType or
        IT_UNINSTANT in nc!instanceType) then
        return ERROR_DS_DRA_BAD_NC
    endif

    /* NC must not replicate from any other DC. */
    if (select one v from nc!repsFrom where (true)) ≠ null then
        return ERROR_DS_DRA_INVALID_PARAMETER
    endif

    /* NC should must not replicate to any other DC. */
    if (select one v from nc!repsTo where (true)) ≠ null
        and (not DRS_REF_OK in options) then
        return ERROR_DS_DRA_OBJ_IS_REP_SOURCE
    endif

```

```

endif

/* Do not permit removal of important NCs. */
if IT_WRITE in nc!instanceType
    and (nc = DefaultNC()
        or nc = ConfigNC()
        or nc = SchemaNC()) then
    return ERROR_DS_DRA_INVALID_PARAMETER
endif

if DRS_ASYNC_REP in options then
    Asynchronous Processing: Initiate a logical thread of control
    to process the remainder of this request asynchronously
    return 0
endif

/* Expunge the subtree rooted at dn and pertaining to the same NC.
 * If the subtree includes a sub-ref object for a locally instantiated NC,
 * remove the IT_NC_ABOVE flag from the sub-ref object instanceType
 * attribute.
 */
foreach o in (select all v from subtree nc where GetObjectNC(v) = nc)
    if(IT_NC_HEAD in o!instanceType and
        IT_UNINSTANT not in o!instanceType) then
        o!instanceType = o!instanceType - {IT_NC_ABOVE}
    else
        Expunge(o)
    endif
endfor

/* If the root of the NC being expunged is a sub-ref object itself, then it
 * may need to be preserved.
 */

/* Check whether there is still a crossref object for the given nc. */
cr := select one v from subtree ConfigNC()
    where v!ncName = nc and crossRef in v!objectClass

if(cr == NULL)
    if(IT_NC_ABOVE in nc!instanceType) then
        nc!instanceType = {IT_NC_ABOVE, IT_UNINSTANT, IT_NC_HEAD}
    endif
    rt := RemoveObj(nc, false)
    if rt ≠ 0 then
        return rt
    endif
else
    if(IT_NC_ABOVE in nc!instanceType) then
        nc!instanceType = {IT_NC_ABOVE, IT_UNINSTANT, IT_NC_HEAD}
    else
        Expunge(nc)
    endif
endif

return 0

else /* not DRS_NO_SOURCE in options */
    /* Removing a single source from repsFrom, but leaving NC replica
    * on DC. */

    if msgIn.pszDsaSrc = null or
    msgIn.pszDsaSrc^ = "" or
    (IsAdlds() and
    GetDSNameFromNetworkAddress(msgIn.pszDsaSrc^) = null) then
        return ERROR_DS_DRA_INVALID_PARAMETER
    endif

    if DRS_ASYNC_OP in options then
        Asynchronous Processing: Initiate a logical thread of control

```

```

        to process the remainder of this request asynchronously
        return 0
    endif

    rf := select one v from nc!repsFrom
        where (v.serverAddress = msgIn.pszDsaSrc)
    if rf = null then
        return ERROR_DS_DRA_NO_REPLICA
    endif
    nc!repsFrom := nc!repsFrom - {rf}

    if (not DRS_LOCAL_ONLY in options)
        and (not DRS_MAIL_REP in rf.options) then
        /* Disable replication notifications by requesting the server DC
        * specified by msgIn.pszDsaSrc to remove this DC
        * from its repsTo. */
        updRefs.pNC^ := ADR(nc)
        updRefs.pszDsaDest := NetworkAddress of this DC
        updRefs.uuidDsaDest := dc.serverGuid
        updRefs.ulOptions := {DRS_ASYNC_OP, DRS_DEL_REF}
        if DRS_WRIT_REP in msgIn.ulOptions then
            updRefs.ulOptions := updRefs.ulOptions + {DRS_WRIT_REP}
        endif
        srcDSA := GetDSNameFromNetworkAddr(msgIn.pszDsaSrc)
        hDrsSrc := BindToDSA(srcDSA)
        if hDrsSrc ≠ null then
            ret := IDL_DRSUpdateRefs(hDrsSrc, 1, ADR(updRefs))
            UnbindFromDSA(hDrsSrc)
        endif
    endif

    endif
    return 0
endif

```

4.1.21 IDL_DRSReplicaDemotion (Opnum 26)

The IDL_DRSReplicaDemotion method replicates off all changes to the specified NC and moves any FSMOs held to another server.

```

ULONG IDL_DRSReplicaDemotion(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
    DRS_MSG_REPLICA_DEMOTIONREQ* pmsgIn,
    [out, ref] DWORD* pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
    DRS_MSG_REPLICA_DEMOTIONREPLY* pmsgOut
);

```

hDrs: The RPC context handle returned by the IDL_DRSBind method.

dwInVersion: The version of the request message.

pmsgIn: A pointer to the request message.

pdwOutVersion: A pointer to the version of the response message.

pmsgOut: A pointer to the response message.

Return Values: 0 if successful, otherwise a Windows error code.

Exceptions Thrown: This method might throw the following exceptions beyond those thrown by the underlying RPC protocol (as specified in [MS-RPCE]): ERROR_INVALID_HANDLE,


```
} DRS_MSG_REPLICA_DEMOTIONREPLY;
```

V1: The version 1 reply.

4.1.21.1.4 DRS_MSG_REPLICA_DEMOTIONREPLY_V1

The DRS_MSG_REPLICA_DEMOTIONREPLY_V1 structure defines a response message received from the IDL_DRSReplicaDemotion method.

```
typedef struct {  
    DWORD dwOpError;  
} DRS_MSG_REPLICA_DEMOTIONREPLY_V1;
```

dwOpError: The Win32 error code, as specified in [MS-ERREF] section 2.2.

4.1.21.2 Method-Specific Abstract Types and Procedures

4.1.21.2.1 ReplicationPartners()

```
procedure ReplicationPartners(nc: DSNAME): sequence of DSNAME
```

The DC D executing this procedure hosts a portion of forest F. This procedure computes the set of all DCs in F that host the specified NC, excluding D. It returns this set as a sequence in an arbitrary order.

4.1.21.2.2 AbandonAllFSMORoles()

~~Note: Some of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it in the Product Behavior appendix.~~

```
procedure AbandonAllFSMORoles(nc: DSNAME): DWORD
```

The AbandonAllFSMORoles procedure abandons any FSMO roles represented in the supplied NC that are held by this DC. The new holder of the FSMO roles is arbitrary. AbandonAllFSMORoles returns a Win32 error value.

```
targetDSAs: sequence of DSNAME  
fsmoContainer: DSNAME  
ret: DWORD  
bGivenAway: boolean  
i: integer  
hDRS: DRS_HANDLE  
  
msgReq: DRS_MSG_GETCHGREQ_V10  
msgUpd: DRS_MSG_GETCHGREPLY_NATIVE  
if nc = ConfigNC() then  
    /* check domain naming FSMO role */  
    fsmoContainer := DescendantObject(ConfigNC(), "CN=Partitions,")  
else if nc = SchemaNC() then  
    /* check schema master FSMO role */  
    fsmoContainer := SchemaNC()  
else  
    /* application NCs don't hold FSMOs */  
    return ERROR_SUCCESS  
endif
```

```

/* check if we hold the fsmo */
if fsmoContainer!fsmoRoleOwner # DSAObj() then
  /* we do not own the role! All's well */
  return ERROR_SUCCESS
endif
/* yes, we own the role! Let's give it away */
bGivenAway := false
targetDSAs := ReplicationPartners(nc)
i := 0
while not bGivenAway
  if i ≥ targetDSAs.length then
    /* no more replication partners that would take our FSMO! */
    return ERROR_DS_UNABLE_TO_SURRENDER_ROLES
  endif
  hDRS := BindToDSA(targetDSAs[i])
  if hDRS # null then
    /* the targetDSA appears to be up. Let's try to transfer the
     * role */
    /* Perform an IDL_DRSGetNCChanges(EXOP_FSMO_ABANDON_ROLE) call */
    msgReq.uuidDsaObjDest := dc.serverGuid
    msgReq.pNC := ADDR(fsmoContainer)
    msgReq.ulFlags := DRS_WRIT_REP
    msgReq.ulExtendedOp := EXOP_FSMO_ABANDON_ROLE
    ret :=
      IDL_DRSGetNCChanges(hDRS, 8, ADDR(msgReq), 6, ADDR(msgUpd))
    if ret = ERROR_SUCCESS then
      /* successfully given away */
      bGivenAway := true
    endif
    UnbindFromDSA(hDRS)
  endif
  i := i + 1
endwhile
/* if execution got here, the role was given away */
return ERROR_SUCCESS

```

4.1.21.2.3 ReplicateOffChanges()

```

procedure ReplicateOffChanges(nc: DSNAME): DWORD

```

The ReplicateOffChanges procedure replicates all local changes in the NC to a randomly selected replication partner.

```

targetDSAs: sequence of DSNAME
ret: DWORD
bReplicated: boolean
i: integer
msgSyncReq: DRS_MSG_REPSYNC_V1
msgAddReq: DRS_MSG_REPADD_V2
hDRS: DRS_HANDLE

bReplicated := false
targetDSAs := ReplicationPartners(nc)
i := 0
while not bReplicated
  if i ≥ targetDSAs.length then
    /* no more replication partners that host the NC! */
    return ERROR_DS_CANT_FIND_DSA_OBJ
  endif
  hDRS := BindToDSA(targetDSAs[i])
  if hDRS # null then
    /* the targetDSA appears to be up. Let's try to replicate to
     * it */
    /* Invoke IDL_DRSReplicaSync to get changes from us */

```

```

msgSyncReq.pszDsaSrc := NetworkAddress of targetDSA
msgSyncReq.uuidDsaSrc := dc.serverGuid
msgSyncReq.pNC := ADDR(nc)
msgSyncReq.ulOptions := DRS_WRIT_REP
ret := IDL_DRSReplicaSync(hDRS, 1,ADR(msgSyncReq))
if ret = ERROR_DS_DRA_NO_REPLICA then
  /* the targetDSA does not currently have replication agreement
  (repsFrom) with this DC. Tell it to add one */
  msgAddReq.pNC := ADDR(nc)
  msgAddReq.pszSourceDsaAddress := NetworkAddress of this DC
  msgAddReq.ulOptions := DRS_WRIT_REP
  msgAddReq.pSourceDsaDN := null
  msgAddReq.pTransportDN := null
  ret := IDL_DRSReplicaAdd(hDRS, 2,ADR(msgAddReq))
endif
UnbindFromDSA(hDRS)
if ret = ERROR_SUCCESS then
  /* success! */
  bReplicated := true
endif
endif
i := i + 1
endwhile
/* if execution got here, then the changes were successfully replicated off */
return ERROR_SUCCESS

```

4.1.21.3 Server Behavior of the IDL_DRSReplicaDemotion Method

Informative summary of behavior: For a given NC, the IDL_DRSReplicaDemotion method replicates out any changes that had not previously been replicated out. It also abandons any NC-specific FSMO roles that are owned by this DC. This function accomplishes nothing when the DC being demoted is the last DC in the forest.

```

ULONG
IDL_DRSReplicaDemotion(
  [in, ref] DRS_HANDLE hDrs,
  [in] DWORD dwInVersion,
  [in, ref, switch_is(dwInVersion)]
  DRS_MSG_REPLICA_DEMOTIONREQ* pmsgIn,
  [out, ref] DWORD *pdwOutVersion,
  [out, ref, switch_is(*pdwOutVersion)]
  DRS_MSG_REPLICA_DEMOTIONREPLY* pmsgOut
)

msgIn: DRS_MSG_REPLICA_DEMOTIONREQ_V1
ret: DWORD
nc: DSNAME

ValidateDRSInput(hDrs, 26)

pdwOutVersion^ := 1
pmsgOut^.V1.dwOpError := ERROR_DS_CODE_INCONSISTENCY

if dwInVersion ≠ 1 then
  return ERROR_INVALID_PARAMETER
endif
msgIn := pmsgIn^.V1
if msgIn.pNC = null or
  msgIn.dwFlags ≠ DS_REPLICA_DEMOTE_TRY_ALL_SRCS then
  return ERROR_INVALID_PARAMETER
endif

if not IsMemberOfBuiltinAdminGroup() then
  /* only BA is allowed to demote an AD LDS service */
  return ERROR_DS_DRA_ACCESS_DENIED

```



```

endif

nc := msgIn.pNC^
ret := AbandonAllFSMORoles(nc)
if ret = ERROR_SUCCESS then
    ret := ReplicateOffChanges(nc)
endif

if ret = ERROR_SUCCESS then
    /* mark instanceType as going and not coming */
    nc!instanceType := nc!instanceType + {IT_NC_GOING} - {IT_NC_COMING}
    /* remove any repsFrom */
    nc!repsFrom := null
endif

pmsgOut^.V1.dwOpError := ret
pdwMsgOut^ := 1
return ERROR_SUCCESS

```

4.1.22 IDL_DRSReplicaModify (Opnum 7)

The IDL_DRSReplicaModify method updates the value for repsFrom for the NC replica.

```

ULONG IDL_DRSReplicaModify(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwVersion,
    [in, ref, switch_is(dwVersion)]
    DRS_MSG_REPMOD* pmsgMod
);

```

hDrs: The RPC context handle returned by IDL_DRSBind.

dwVersion: The version of the request message.

pmsgMod: A pointer to the request message.

Return Values: 0 if successful, or a Windows error code if a failure occurs.

Exceptions Thrown: This method might throw the following exceptions beyond those thrown by the underlying RPC protocol (as specified in [MS-RPCE]): ERROR_INVALID_HANDLE, ERROR_DS_DRS_EXTENSIONS_CHANGED, ERROR_DS_DIFFERENT_REPL_EPOCHS, and ERROR_INVALID_PARAMETER.

4.1.22.1 Method-Specific Concrete Types

4.1.22.1.1 DRS_MSG_REPMOD

The DRS_MSG_REPMOD union defines the request messages for the IDL_DRSReplicaModify method. Only one version, identified by *dwVersion* = 1, is currently defined.

```

typedef
[switch_type(DWORD)]
union {
    [case(1)]
    DRS_MSG_REPMOD_V1 V1;
} DRS_MSG_REPMOD;

```

V1: The version 1 request.


```

options: DRS_OPTIONS
nc: DSName
rf: RepsFrom
msgIn: DRS_MSG_REPMOD_V1

ValidateDRSInput(hDrs, 7)

msgIn := pmsgMod^.V1

/* Validate input parameters */
if msgIn.pNC = null
  or msgIn.pNC^ = ""
  or (msgIn.pszSourceDRA = null
    and msgIn.uuidSourceDRA = null)
  or (DRS_UPDATE_ADDRESS in msgIn.ulModifyFields
    and (msgIn.pszSourceDRA = null
      or msgIn.pszSourceDRA = ""))
  or (DRS_UPDATE_SCHEDULE in msgIn.ulModifyFields
    and msgIn.rtSchedule = null)
  or msgIn.ulModifyFields = 0
  or msgIn.ulModifyFields -
    {DRS_UPDATE_ADDRESS, DRS_UPDATE_SCHEDULE, DRS_UPDATE_FLAGS}
    ≠ {}
  or msgIn.ulOptions - {DRS_ASYNC_OP} ≠ {} then
  return ERROR_DS_DRA_INVALID_PARAMETER
endif

/* Validate the specified NC */
options := msgIn.ulOptions
nc := msgIn.pNC^

if not ObjExists(nc) then
  return ERROR_DS_DRA_BAD_NC
endif

if not AccessCheckCAR(nc, DS-Replication-Manage-Topology) then
  return ERROR_DS_DRA_ACCESS_DENIED
endif

if DRS_ASYNC_OP in options then
  Asynchronous Processing: Initiate a logical thread of control
  to process the remainder of this request asynchronously
  return 0
endif

/* Find the specified repsFrom. */
if (msgIn.uuidSourceDRA ≠ null ) then
  rf := select one v from nc!repsFrom
  where (v.uuidDsa = msgIn.uuidSourceDRA)
else
  rf := select one v from nc!repsFrom
  where (v.serverAddress = msgIn.pszSourceDRA)
end if

if rf = null then
  return ERROR_DS_DRA_NO_REPLICA
endif

/* Update the specified repsFrom. */
nc!repsFrom := nc!repsFrom - {rf}
if DRS_UPDATE_ADDRESS in msgIn.ulModifyFields then
  rf.serverAddress := msgIn.pszSourceDRA
endif
if DRS_UPDATE_SCHEDULE in msgIn.ulModifyFields then
  rf.schedule := msgIn.rtSchedule
endif
if DRS_UPDATE_FLAGS in msgIn.ulModifyFields then
  rf.replicaFlags := msgIn.ulReplicaFlags
endif

```

```

nc!repsFrom := nc!repsFrom + {rf}

return 0

```

4.1.23 IDL_DRSReplicaSync (Opnum 2)

The IDL_DRSReplicaSync method triggers replication from another DC.

```

ULONG IDL_DRSReplicaSync(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwVersion,
    [in, ref, switch_is(dwVersion)]
        DRS_MSG_REPSYNC* pmsgSync
);

```

hDrs: The RPC context handle returned by the IDL_DRSBind method.

dwVersion: The version of the request message.

pmsgSync: A pointer to the request message.

Return Values: 0 if successful, otherwise a Windows error code.

Exceptions Thrown: This method might throw the following exceptions beyond those thrown by the underlying RPC protocol (as specified in [MS-RPCE]): ERROR_INVALID_HANDLE, ERROR_DS_DRS_EXTENSIONS_CHANGED, ERROR_DS_DIFFERENT_REPL_EPOCHS, and ERROR_INVALID_PARAMETER.

4.1.23.1 Method-Specific Concrete Types

4.1.23.1.1 DRS_MSG_REPSYNC

The DRS_MSG_REPSYNC union defines the request messages sent to the IDL_DRSReplicaSync method. Only one version, identified by *dwVersion* = 1, is currently defined.

```

typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_REPSYNC_V1 V1;
} DRS_MSG_REPSYNC;

```

V1: The version 1 request.

4.1.23.1.2 DRS_MSG_REPSYNC_V1

The DRS_MSG_REPSYNC_V1 structure defines a request message sent to the IDL_DRSReplicaSync method.

```

typedef struct {
    [ref] DSNAME* pNC;
    UUID uuidDsaSrc;
    [unique, string] char* pszDsaSrc;
    ULONG ulOptions;
} DRS_MSG_REPSYNC_V1;

```

pNC: A pointer to DSName of the root of an NC replica on the server.

uuidDsaSrc: The DSA GUID.

pszDsaSrc: The transport-specific NetworkAddress of a DC.

ulOptions: The DRS_OPTIONS flags.

4.1.23.2 Server Behavior of the IDL_DRSReplicaSync Method

Informative summary of behavior: The server starts or resumes a replication cycle by sending an IDL_DRSGetNCChanges request to the specified DC. If ulOptions contains DRS_ASYNC_OP, the server performs this operation asynchronously.

```
ULONG
IDL_DRSReplicaSync(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwVersion,
    [in, ref, switch_is(dwVersion)]
        DRS_MSG_REPSYNC *pmsgSync);

options: DRS_OPTIONS
nc: DSName
rf: sequence of RepsFrom
msgIn: DRS_MSG_REPSYNC_V1
err: ULONG

ValidateDRSInput(hDrs, 2)

/* Validate the version */
if dwVersion ≠ 1 then
    return ERROR_DS_DRA_INVALID_PARAMETER
endif
msgIn := pmsgSync^.V1

/* Validate input params */
options := msgIn.ulOptions
if msgIn.pNC = null
    or (not DRS_SYNC_ALL in options /* See product behavior note below.*/
        and msgIn.uuidDsaSrc = null
        and msgIn.pszDsaSrc = null) then
    return ERROR_DS_DRA_INVALID_PARAMETER
endif

/* Validate the specified NC. */
nc := msgIn.pNC^
if not ObjExists(nc) then
    return ERROR_DS_DRA_BAD_NC
endif

if (DRS_SYNC_BYNAME in options and msgIn.pszDsaSrc = null)
    or (not DRS_SYNC_BYNAME in options and msgIn.uuidDsaSrc = null)
    or (not DRS_SYNC_BYNAME in options and msgIn.uuidDsaSrc = NULLGUID) then
    return ERROR_DS_DRA_INVALID_PARAMETER
endif

if AccessCheckCAR(nc, DS-Replication-Synchronize) then
    return ERROR_DS_DRA_ACCESS_DENIED
endif

if DRS_ASYNC_OP in options then
    Asynchronous Processing: Initiate a logical thread of control
    to process the remainder of this request asynchronously
    return 0
endif

rf := select all v in nc!repsFrom
```

```

        where DRS_SYNC_ALL in options
            or (DRS_SYNC_BYNAME in options
                and v.naDsa = msgIn.pszDsaSrc)
            or (not DRS_SYNC_BYNAME in options
                and v.uuidDsa = msgIn.uuidDsaSrc)
    if rf = null then
        return ERROR_DS_DRA_NO_REPLICA
    endif

    foreach r in rf
        msgRequest: DRS_MSG_GETCHGREQ
        cMaxObjects: ULONG
        cMaxBytes: ULONG
        versionRequestMsg: DWORD
        outVersion: DWORD
        msgOut: DRS_MSG_GETCHGREPLY

        versionRequestMsg := The version number of the input message negotiated between the
            client and server (section 4.1.10.4.1).
        cMaxObjects := Implementation-specific value.
        cMaxBytes := Implementation-specific value.

        if DRS_UPDATE_NOTIFICATION in options
            and not DRS_TWOWAY_SYNC in options
            and DRS_NEVER_NOTIFY in r.V2.ulReplicaFlags then
                return ERROR_DS_DRA_NO_REPLICA
            endif

        /* Replicate nc from the DC specified by r.uuidDsa. */

        ReplicateNCRequestMsg(
            hDrs,
            versionRequestMsg,
            nc,
            r,
            options,
            cMaxObjects,
            cMaxBytes,
            ADDR(msgRequest))
        err := IDL_DRSGetNCChanges(
            hDrsSrc,
            versionRequestMsg,
            msgRequest,
            ADDR(outVersion),
            ADDR(msgOut))

        if err = 0
            and not DRS_MAIL_REP in msgIn.ulOptions
            then

                Wait for the response, process it (section 4.1.10.6), send the next request,
                etc., until the replication cycle is complete.

                If there are any failures from this replication attempt, assign an
                appropriate error value to err, and then break out of the for loop.

        endif
    endfor

    return err

```

For information about Windows support for the DRS_SYNC_ALL flag, see the product behavior note in section 5.41.

4.1.24 IDL_DRSReplicaVerifyObjects (Opnum 22)

The IDL_DRSReplicaVerifyObjects method verifies the existence of objects in an NC replica by comparing against a replica of the same NC on a reference DC, optionally deleting any objects that do not exist on the reference DC.

```
ULONG IDL_DRSReplicaVerifyObjects(  
    [in, ref] DRS_HANDLE hDrs,  
    [in] DWORD dwVersion,  
    [in, ref, switch_is(dwVersion)]  
        DRS_MSG_REPVERIFYOBJ* pmsgVerify  
);
```

hDrs: The RPC context handle returned by the IDL_DRSBind method.

dwVersion: The version of the request message.

pmsgVerify: A pointer to the request message.

Return Values: 0 if successful, otherwise a Windows error code.

Exceptions Thrown: This method might throw the following exceptions beyond those thrown by the underlying RPC protocol (as specified in [MS-RPCE]): ERROR_INVALID_HANDLE, ERROR_DS_DRS_EXTENSIONS_CHANGED, ERROR_DS_DIFFERENT_REPL_EPOCHS, and ERROR_INVALID_PARAMETER.

4.1.24.1 Method-Specific Concrete Types

4.1.24.1.1 DRS_MSG_REPVERIFYOBJ

The DRS_MSG_REPVERIFYOBJ union defines the request messages sent to the IDL_DRSReplicaVerifyObjects method. Only one version, identified by *dwVersion* = 1, is currently defined.

```
typedef  
[switch_type(DWORD)]  
union {  
    [case(1)]  
        DRS_MSG_REPVERIFYOBJ_V1 V1;  
} DRS_MSG_REPVERIFYOBJ;
```

V1: The version 1 request.

4.1.24.1.2 DRS_MSG_REPVERIFYOBJ_V1

The DRS_MSG_REPVERIFYOBJ_V1 structure defines a request message sent to the IDL_DRSReplicaVerifyObjects method.

```
typedef struct {  
    [ref] DSNAME* pNC;  
    UUID uuidDsaSrc;  
    ULONG ulOptions;  
} DRS_MSG_REPVERIFYOBJ_V1;
```

pNC: The NC to verify.

uuidDsaSrc: The objectGUID of the nTDSDSA object for the reference DC.

ulOptions: 0 to expunge each object that is not verified, or 1 to log an event that identifies each such object.

4.1.24.2 Method-Specific Abstract Types and Procedures

4.1.24.2.1 GetRemoteUTD

```
procedure GetRemoteUTD(  
  dsa: DSName,  
  nc: DSName,  
  var uTDFec: UPTODATE_VECTOR_V1_EXT  
): ULONG
```

The GetRemoteUTD procedure uses the IDL_DRSGetReplInfo method to remotely retrieve the UPTODATE_VECTOR_V1_EXT for the NC with the DSName *nc* from the DC whose nTDSDSA object has the DSName *dsa*. The procedure returns either an implementation-specific value from the client implementation of the IDL_DRSGetReplInfo method, or the value returned by the remote server's IDL_DRSGetReplInfo method.

4.1.24.2.2 ObjectExistsAtDC

```
procedure ObjectExistsAtDC(o: DSName, dsa: DSName): boolean
```

The ObjectExistsAtDC procedure checks that the object *o* exists on the DC whose nTDSDSA object has the DSName *dsa* by verifying that the DC holds an object *o'* whose objectGUID value is equal to that of object *o*. If the object exists, the procedure returns true; otherwise, the procedure returns false.

4.1.24.3 Server Behavior of the IDL_DRSReplicaVerifyObjects Method

Informative summary of behavior: Let *N* be the NC pNC[^], and let the reference DC be the DC corresponding to the nTDSDSA object uuidDsaSrc.

For the purposes of this method, an object *exists* within an NC replica if it is either an object or a tombstone.

Let *S* be the set of objects that exists in *N* at the server running IDL_DRSReplicaVerifyObjects at the time IDL_DRSReplicaVerifyObjects begins processing. Let the set *S'* be *S* minus the members of *S* that have never existed in *N* at the reference DC when IDL_DRSReplicaVerifyObjects begins processing. The members of (*S* - *S'*) **must-beare** objects recently added to *N* on the server, since otherwise they would have replicated to the reference DC. The set *S'* is computable using the replUpToDateVector for *N* at the server and at the reference DC.

For each object *o* in *S'* that does not exist in *N* at the reference DC while IDL_DRSReplicaVerifyObjects is processing, either expunge *o* at the server (if ulOptions = 0) or log an administrator-visible event at the server (if ulOptions = 1).

If an object goes out of existence in *N* at the reference DC during processing of IDL_DRSReplicaVerifyObjects, then there is no requirement on whether IDL_DRSReplicaVerifyObjects should or should not expunge or log the object at the server.

```
ULONG IDL_DRSReplicaVerifyObjects(  
  [in, ref] DRS_HANDLE hDrs,  
  [in] DWORD dwVersion,  
  [in, ref, switch_is(dwVersion)]  
  DRS_MSG_REPVERIFYOBJ *pmsgVerify)  
  
err: ULONG  
msgIn: DRS_MSG_REPVERIFYOBJ_V1
```



```

nc, refDsa, o: DSName
uTDServer, uTDRef, uTDMerge: UPTODATE_VECTOR_V1_EXT
sPrime: set of DSName

ValidateDRSInput(hDrs, 22)

/* Perform input validation and access check */
if dwVersion ≠ 0x1 then
    return ERROR_DS_DRA_INVALID_PARAMETER
endif
msgIn := pmsgVerify^.V1
if msgIn.pNC = null or
    msgIn.uuidDsaSrc = NULLGUID then
    return ERROR_DS_DRA_INVALID_PARAMETER
endif
nc := msgIn.pNC^
if not FullReplicaExists(nc) and
    not PartialGCReplicaExists(nc) then
    return ERROR_DS_DRA_BAD_NC
endif
if not AccessCheckCAR(nc, DS-Replication-Manage-Topology) then
    return ERROR_DS_DRA_ACCESS_DENIED
endif
refDsa := select one object o from subtree ConfigNC() where
    o!objectGUID = msgIn.uuidDsaSrc and nTDSDSA in o!objectClass
if refDsa = null then
    return ERROR_DS_DRA_INVALID_PARAMETER
endif

/* Compute the set S' */
uTDServer := nc!replUpToDateVector
err := GetRemoteUTD(refDsa, nc, uTDRef)
if err ≠ 0 then
    return err
endif
uTDMerge := MergeUTD(uTDServer, uTDRef)

sPrime := select all objects o from subtree-ts-included nc where
    StampLessThanOrEqualUTD(AttrStamp(o, whenCreated), uTDMerge)

/* Process the set S' */
for each o in sPrime
    if not ObjectExistsAtDC(o, refDSA) then
        if msgIn.ulOptions = 0 then
            Expunge(o)
        else if msgIn.ulOptions = 1 then
            Log a message: o exists on server but does not exist on refDsa
        endif
    endif
endfor

return 0

```

Windows behavior about the for loop is specified in the following citation: <38>

4.1.24.4 Examples of the IDL_DRSReplicaVerifyObjects Method

A client that has bound to DC1 is removing all **lingering objects** on this directory server with respect to DC2.

4.1.24.4.1 Initial State

A client has bound to DC1.CONTOSO.COM using the IDL_DRSBind method and received a DRS_HANDLE to DC1.

Consider the following objects under the Users container, "CN=Users,DC=CONTOSO,DC=COM", listed by their DSName:

Users at DC1	Users at DC2	Notes
<GUID=f5ef2f4b-a3db-464c-8403-b27aa00b0d5d>;<SID=S-1-5-21-1583212203-607051668-819563750-1107>;CN=Kim Akers,CN=Users,DC=CONTOSO,DC=COM	<GUID=f5ef2f4b-a3db-464c-8403-b27aa00b0d5d>;<SID=S-1-5-21-1583212203-607051668-819563750-1107>;CN=Kim Akers,CN=Users,DC=CONTOSO,DC=COM	Objects are identical.
<GUID=89430510-48eb-4e68-aeb1-98a9471f1938>;<SID=S-1-5-21-1583212203-607051668-819563750-1111>;CN=Josh Bailey,CN=Users,DC=CONTOSO,DC=COM		"Josh Bailey" was created on DC1 and has not been replicated to DC2 yet.
<GUID=833a118e-035f-4702-b67e-9e7c1ada2f57>;<SID=S-1-5-21-1583212203-607051668-819563750-1108>;CN= Eva Corets,CN=Users,DC=CONTOSO,DC=COM		"Eva Corets" is a lingering object on DC1.
<GUID=3cb4b6cf-f220-472a-bd2f-5f1399232ca6>;<SID=S-1-5-21-1583212203-607051668-819563750-1109>;CN= Jim Daly,CN=Users,DC=CONTOSO,DC=COM	<GUID=3cb4b6cf-f220-472a-bd2f-5f1399232ca6>;<SID=S-1-5-21-1583212203-607051668-819563750-1109>;CN= Jim Daly,CN=Users,DC=CONTOSO,DC=COM	The mail attribute of "Jim Daly" has been modified on DC1 but this change has not replicated to DC2 yet.
	<GUID=46c1b351-da31-49f2-8437-8d82df024972>;<SID=S-1-5-21-1583212203-607051668-819563750-1604>;CN=Ebru Ersan,CN=Users,DC=CONTOSO,DC=COM	"Ebru Ersan" was created on DC2 and has not been replicated to DC1 yet.
	<GUID=8df1f9bb-7551-46c3-b9c2-c905e9463542>;<SID=S-1-5-21-1583212203-607051668-819563750-1110>;CN= Kari Furse,CN=Users,DC=CONTOSO,DC=COM	"Kari Furse" is a lingering object on DC2.

Relevant entries of the DS_REPL_ATTR_META_DATA structure for each object listed above are also captured below to further demonstrate the differences between DC1 and DC2.

Relevant metadata entries for "CN=Kim Akers,CN=Users,DC=CONTOSO,DC=COM" at DC1:

usnLocalChange	uuidLastOriginatingDsaInvocationID	usnOriginatingChange	ftimeLastOriginatingChange	dwVersion	pszAttribute Name
13964	4875e25f-11a9-4c70-abf4-5fb39529f84b	13964	5/21/2010 18:08:30	1	whenCreated

Relevant metadata entries for "CN=Josh Bailey,CN=Users,DC=CONTOSO,DC=COM" at DC1:

usnLocalChange	uuidLastOriginatingDsaInvocationID	usnOriginatingChange	fTimeLastOriginatingChange	dwVersion	pszAttributeNames
14112	4875e25f-11a9-4c70-abf4-5fb39529f84b	14112	5/21/2010 19:11:09	1	whenCreated

Relevant metadata entries for "CN=Eva Corets,CN=Users,DC=CONTOSO,DC=COM" at DC1:

usnLocalChange	uuidLastOriginatingDsaInvocationID	usnOriginatingChange	fTimeLastOriginatingChange	dwVersion	pszAttributeNames
9071	4875e25f-11a9-4c70-abf4-5fb39529f84b	9071	1/15/2009 11:05:42	1	whenCreated

Relevant metadata entries for "CN=Jim Daly,CN=Users,DC=CONTOSO,DC=COM" at DC1:

usnLocalChange	uuidLastOriginatingDsaInvocationID	usnOriginatingChange	fTimeLastOriginatingChange	dwVersion	pszAttributeNames
14085	4875e25f-11a9-4c70-abf4-5fb39529f84b	14085	5/21/2010 19:06:32	1	whenCreated
14118	4875e25f-11a9-4c70-abf4-5fb39529f84b	14118	5/21/2010 19:12:51	1	mail

Relevant metadata entries for "CN=Kim Akers,CN=Users,DC=CONTOSO,DC=COM" at DC2:

usnLocalChange	uuidLastOriginatingDsaInvocationID	usnOriginatingChange	fTimeLastOriginatingChange	dwVersion	pszAttributeNames
12324	4875e25f-11a9-4c70-abf4-5fb39529f84b	13964	5/21/2010 18:08:30	1	whenCreated

Relevant metadata entries for "CN=Jim Daly,CN=Users,DC=CONTOSO,DC=COM" at DC2:

usnLocalChange	uuidLastOriginatingDsaInvocationID	usnOriginatingChange	fTimeLastOriginatingChange	dwVersion	pszAttributeNames
12432	4875e25f-11a9-4c70-abf4-5fb39529f84b	14085	5/21/2010 19:06:32	1	whenCreated

Relevant metadata entries for "CN=Ebru Ersan,CN=Users,DC=CONTOSO,DC=COM" at DC2:

usnLocalChange	uuidLastOriginatingDsaInvocationID	usnOriginatingChange	fTimeLastOriginatingChange	dwVersion	pszAttributeNames
12451	7526f625-51db-4022-8150-59c0286efd82	12451	5/21/2010 19:19:14	1	whenCreated

Relevant metadata entries for "CN=Kari Furse,CN=Users,DC=CONTOSO,DC=COM" at DC2:

usnLocalChange	uuidLastOriginatingDsaInvocationID	usnOriginatingChange	fTimeLastOriginatingChange	dwVersion	pszAttributeNames
441	4875e25f-11a9-4c70-abf4-5fb39529f84b	5099	11/1/2008 04:29:47	1	whenCreated

The UPTODATE_VECTOR_V1_EXT structures on DC1 and DC2 are also needed for the IDL_DRSReplicaVerifyObjects method:

- On DC1:
 - dwVersion:** 1
 - dwReserved1:** 0
 - cNumCursors:** 2
 - dwReserved2:** 0
 - rgCursors:** An array of UPTODATE_CURSOR_V1:
 - First entry:
 - uuidDsa:** 4875e25f-11a9-4c70-abf4-5fb39529f84b
 - usnHighPropUpdate:** 14621
 - Second entry:
 - uuidDsa:** 7526f625-51db-4022-8150-59c0286efd82
 - usnHighPropUpdate:** 12448
- On DC2:
 - dwVersion:** 1
 - dwReserved1:** 0
 - cNumCursors:** 2
 - dwReserved2:** 0
 - rgCursors:** An array of UPTODATE_CURSOR_V1:
 - First entry:
 - uuidDsa:** 4875e25f-11a9-4c70-abf4-5fb39529f84b
 - usnHighPropUpdate:** 14107
 - Second entry:
 - uuidDsa:** 7526f625-51db-4022-8150-59c0286efd82
 - usnHighPropUpdate:** 12992
 - Finally, also relevant to IDL_DRSReplicaVerifyObjects is the nTDSDSA object for DC2 as seen on DC1:
 - Dn: CN=NTDS Settings,CN=DC2,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=CONTOSO,DC=COM
 - 3> objectClass: top; applicationSettings; nTDSDSA;
 - 1> cn: NTDS Settings;
 - 1> distinguishedName: CN=NTDS Settings,CN=DC2,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=CONTOSO,DC=COM;

- 1 > objectGUID: e845e047-3850-4a82-8811-a0b9250863c6;

4.1.24.4.2 Client Request

A client invokes the IDL_DRSReplicaVerifyObjects method on DC1 with the following parameters (DRS_HANDLE to DC1 omitted):

- *dwVersion*: 1
- *pmsgVerify*:

pNC: Pointer to the DSName structure for DC=CONTOSO,DC=COM

uuidDsaSrc: e845e047-3850-4a82-8811-a0b9250863c6

ulOptions: 0

4.1.24.4.3 Server Response

The server returns a code of 0.

4.1.24.4.4 Final State

The IDL_DRSReplicaVerifyObjects method has removed all lingering objects on DC1 (but not on DC2). The following table compares the Users container on DC1 and DC2 after the IDL_DRSReplicaVerifyObjects method has been successfully returned.

Users at DC1	Users at DC2	Notes
<GUID=f5ef2f4b-a3db-464c-8403-b27aa00b0d5d>; <SID=S-1-5-21-1583212203-607051668-819563750-1107>; CN=Kim Akers, CN=Users,DC=CONTOSO,DC=COM	<GUID=f5ef2f4b-a3db-464c-8403-b27aa00b0d5d>; <SID=S-1-5-21-1583212203-607051668-819563750-1107>; CN=Kim Akers, CN=Users,DC=CONTOSO,DC=COM	Objects are identical.
GUID=89430510-48eb-4e68-aeb1-98a9471f1938>; <SID=S-1-5-21-1583212203-607051668-819563750-1111>; CN=Josh Bailey, CN=Users,DC=CONTOSO,DC=COM		"Josh Bailey" was created on DC1 and has not been replicated to DC2 yet.
		"Eva Corets" was a lingering object on DC1 and has been expunged.
<GUID=3cb4b6cf-f220-472a-bd2f-5f1399232ca6>; <SID=S-1-5-21-1583212203-607051668-819563750-1109>; CN= Jim Daly, CN=Users,DC=CONTOSO,DC=COM	<GUID=3cb4b6cf-f220-472a-bd2f-5f1399232ca6>; <SID=S-1-5-21-1583212203-607051668-819563750-1109>; CN= Jim Daly, CN=Users,DC=CONTOSO,DC=COM	The mail attribute of "Jim Daly" has been modified on DC1 but this change has not replicated to DC2 yet.
	<GUID=46c1b351-da31-49f2-8437-8d82df024972>; <SID=S-1-5-21-1583212203-607051668-819563750-1604>;	"Ebru Ersan" was created on DC2 and

Users at DC1	Users at DC2	Notes
	CN=Ebru Ersan,CN=Users,DC=CONTOSO,DC=COM	has not been replicated to DC1 yet.
	<GUID=8df1f9bb-7551-46c3-b9c2-c905e9463542>;<SID=S-1-5-21-1583212203-607051668-819563750-1110>; CN= Kari Furse,CN=Users,DC=CONTOSO,DC=COM	"Kari Furse" is a lingering object on DC2.

4.1.25 IDL_DRSUnbind (Opnum 1)

The IDL_DRSUnbind method destroys a context handle previously created by the IDL_DRSBind method.

```
ULONG IDL_DRSUnbind(
    [in, out, ref] DRS_HANDLE* phDrs
);
```

phDrs: A pointer to the RPC context handle returned by the IDL_DRSBind method. The value is set to null on return.

Return Values: 0 if successful, or a Windows error code if a failure occurs.

Exceptions Thrown: This method might throw the following exception beyond those thrown by the underlying RPC protocol (as specified in [MS-RPCE]): ERROR_INVALID_HANDLE.

4.1.25.1 Server Behavior of the IDL_DRSUnbind Method

Informative summary of behavior: The server releases any resources associated with the context handle, making the context handle unusable by the client. The server sets *phDrs* to null.

```
ULONG
IDL_DRSUnbind(
    [in, out, ref] DRS_HANDLE *phDrs)

ValidateDRSInput(hDrs, 1)

phDrs^ := null
return 0
```

4.1.26 IDL_DRSUpdateRefs (Opnum 4)

The IDL_DRSUpdateRefs method adds or deletes a value from the repsTo of a specified NC replica.

```
ULONG IDL_DRSUpdateRefs(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwVersion,
    [in, ref, switch_is(dwVersion)]
    DRS_MSG_UPDREFS* pmsgUpdRefs
);
```

hDrs: The RPC context handle returned by the IDL_DRSBind method.

dwVersion: The version of the request message.

pmsgUpdRefs: A pointer to the request message.

Return Values: 0 if successful, otherwise a Windows error code.

Exceptions Thrown: This method might throw the following exceptions beyond those thrown by the underlying RPC protocol (as specified in [MS-RPCE]): `ERROR_INVALID_HANDLE`, `ERROR_DS_DRS_EXTENSIONS_CHANGED`, `ERROR_DS_DIFFERENT_REPL_EPOCHS`, and `ERROR_INVALID_PARAMETER`.

4.1.26.1 Method-Specific Concrete Types

4.1.26.1.1 DRS_MSG_UPDREFS

The `DRS_MSG_UPDREFS` union defines the request message versions sent to the `IDL_DRSUpdateRefs` method. Only one version, identified by `dwVersion = 1`, is currently defined.

```
typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_UPDREFS_V1 V1;
} DRS_MSG_UPDREFS;
```

V1: The version 1 request.

4.1.26.1.2 DRS_MSG_UPDREFS_V1

The `DRS_MSG_UPDREFS_V1` structure defines a request message sent to the `IDL_DRSUpdateRefs` method.

```
typedef struct {
    [ref] DSNAME* pNC;
    [ref, _] [string] char* pszDsaDest;
    UUID uuidDsaObjDest;
    ULONG ulOptions;
} DRS_MSG_UPDREFS_V1;
```

pNC: A pointer to the DSNAME of the root of an NC replica on the server.

pszDsaDest: The transport-specific NetworkAddress of a DC.

uuidDsaObjDest: The DSA GUID.

ulOptions: The `DRS_OPTIONS` that control the update.

4.1.26.2 Server Behavior of the `IDL_DRSUpdateRefs` Method

Informative summary of behavior: If `ulOptions` contains `DRS_ADD_REF`, the server adds a value to the `repsTo` of the specified NC replica; if `ulOptions` contains `DRS_DEL_REF`, the server deletes a value. If these options are combined, the Delete operation is done before the Add operation; if a corresponding value does not already exist, this is the same as if `ulOptions` contained `DRS_ADD_REF` but not `DRS_DEL_REF`. The client includes `DRS_WRIT_REP` in `ulOptions` if the specified NC replica is writable. The client specifies both **pszDsaDest** and **uuidDsaObjDest** to identify the value to be added or removed. If `ulOptions` contains `DRS_ASYNC_OP`, the server processes the request asynchronously. If

the server adds a value to `repsTo`, the value has `ulReplicaFlags` equal to `ulOptions & {DRS_WRIT_REP}`.

```
ULONG IDL_DRSUpdateRefs(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwVersion,
    [in, ref, switch_is(dwVersion)] DRS_MSG_UPDREFS *pmsgUpdRefs);

msgIn: DRS_MSG_UPDREFS_V1
options: DRS_OPTIONS
err: DWORD
nc: DSName

ValidateDRSInput(hDrs, 4)

if dwVersion ≠ 1 then
    return ERROR_DS_DRA_INVALID_PARAMETER
endif
msgIn := pmsgUpdRefs^.V1
options := msgIn.ulOptions

if msgIn.pNC = null or
    (msgIn.pszDsaDest = null) or
    (msgIn.uuidDsaObjDest = null) or
    (options & {DRS_ADD_REF, DRS_DEL_REF} = null)
    return ERROR_DS_DRA_INVALID_PARAMETER
endif
nc := msgIn.pNC^

if (options - {DRS_ASYNC_OP, DRS_GETCHG_CHECK, DRS_WRIT_REP, DRS_DEL_REF, DRS_ADD_REF,
DRS_REF_GCSPN} ≠ 0) then
    return ERROR_DS_DRA_INVALID_PARAMETER

if ((DRS_WRIT_REP in options) and not (IT_WRITE in nc!instanceType)) or
    not ObjExists(nc) then
    return ERROR_DS_DRA_BAD_NC
endif

if not AccessCheckCAR(nc, DS-Replication-Manage-Topology) then
    return ERROR_DS_DRA_ACCESS_DENIED
endif

/* Perform repsTo value add, delete, or combination of add/delete to the specified NC
replica,
* the result value is a Windows error code or 0
result := UpdateRefs(pmsgIn^.V1)
if(result ≠ ERROR_SUCCESS) then
    return result
endif

/* If DRS_GETCHG_CHECK is specified, ERROR_DS_DRA_REF_NOT_FOUND and
* ERROR_DS_DRA_REF_ALREADY_EXISTS are ignored. */
if DRS_GETCHG_CHECK in options and
(err = ERROR_DS_DRA_REF_NOT_FOUND or err = ERROR_DS_DRA_REF_ALREADY_EXISTS) then
    err := 0
endif

return err
```

4.1.26.3 Examples of the IDL_DRSUpdateRefs Method

4.1.26.3.1 Adding a repsTo Entry

This example shows how to add a new **repsTo** entry by calling `IDL_DRSUpdateRefs` (section 4.1.26) with the `DRS_ADD_REF` parameter.

4.1.26.3.1.1 Initial State

The `repsTo` attribute on the NC root object for domain NC CONTOSO.COM on DC1 does not contain a value:

```
ldap_search_s("DC=CONTOSO,DC=COM", baseObject, "(objectclass=*)", [repsTo])
```

Result <0>: (null)

Matched DNs:

Getting 1 entry:

```
>> Dn: DC=CONTOSO,DC=COM
```

4.1.26.3.1.2 Client Request

DC2 invokes the `IDL_DRSUpdateRefs` method against DC1, with the following parameters (`DRS_HANDLE` to DC1 omitted):

- `dwVersion = 1`
- `pmsgUpdRefs = 0x0006fe08` ; Pointer to the following structure:
- `pNC`: Pointer to the DSNAME structure for `DC=CONTOSO,DC=COM`
- `pszDsaDest`: "5fe84f18-3765-4ca3-b895-47802a7ab74f._msdcs.CONTOSO.COM"
- `uuidDsaObjDest`: 5fe84f18-3765-4ca3-b895-47802a7ab74f
- `ulOptions`: `DRS_WRIT_REP | DRS_ADD_REF`

4.1.26.3.1.3 Server Response

Return code of 0.

4.1.26.3.1.4 Final State

The `repsTo` attribute on the NC root object for domain NC CONTOSO.COM on DC1 contains one value:

```
ldap_search_s("DC=CONTOSO,DC=COM", baseObject, "(objectclass=*)", [repsTo])
```

Result <0>: (null)

Matched DNs:

Getting 1 entry:

```
>> Dn: DC=CONTOSO,DC=COM
```

```
1> repsTo: dwVersion = 2,
```

- `V2.cb`: 592, `V2.cConsecutiveFailures`: 0, `V2.timeLastSuccess`: 12924245513,
- `V2.timeLastAttempt`: 0, `V2.ulResultLastAttempt`: 0,
- `V2.cbOtherDraOffset`: 216,
- `V2.cbOtherDra`: 376, `V2.ulReplicaFlags`: 16, `V2.rtSchedule`: <ldp:skipped>,
- `V2.usnvec.usnHighObjUpdate`: 0, `V2.usnvec.usnHighPropUpdate`: 0,

- V2.uuidDsaObj: 5fe84f18-3765-4ca3-b895-47802a7ab74f
- V2.uuidInvocId: 00000000-0000-0000-0000-000000000000
- V2.uuidTransportObj: 00000000-0000-0000-0000-000000000000
- V2.cbPASDataOffset: 0
- V2~PasData: (none)
- v2~pdsa_rpc_inst
- v2.pszDSIServer 5fe84f18-3765-4ca3-b895-47802a7ab74f._msdcs.CONTOSO.COM
- v2.pszDSIAnnotation (null)
- v2.pszDSIInstance 5fe84f18-3765-4ca3-b895-47802a7ab74f._msdcs.CONTOSO.COM
- v2.pguidDSIInstance (null);

4.1.26.3.2 Replacing a repsTo Entry

This example shows how to semantically update an existing **repsTo** entry by calling `IDL_DRSUpdateRefs` with the `DRS_ADD_REF` and `DRS_DEL_REF` parameters.

4.1.26.3.2.1 Initial State

The ldap search

```
ldap_search_s(ld, "DC=CONTOSO,DC=com", 0, "(objectclass=*)",[repsTo])
```

returns

Getting 1 entry:

```
>> Dn: DC=CONTOSO,DC=COM
```

```
repsTo (2): dwVersion = 2
```

- v2.cb: 592, v2.cConsecutive Failures: 0, v2.timeLastSuccess: 12924315918,
- V2.timeLastAttempt: 12924315918, V2.ulResultLastAttempt:0,
- V2.cbOtherDraOffset: 216,
- V2.cbOtherDra: 376, V2.ulReplicaFlags: 16, V2.rtSchedule: <ldp:skipped>,
- V2.usnvec.usnHighObjUpdate: 0, v2.usnvec.usnHighPropUpdate:0
- V2.pszUuidDsaObj: 5fe84f18-3765-4ca3-b895-47802a7ab74f
- V2.pszUuidInvocId: 00000000-0000-0000-0000-000000000000
- V2.pszUuidTransportObj: 00000000-0000-0000-0000-000000000000
- V2.cbPASDataOffset: 0 v2~PasData: (none)
- V2~pdsa_rpc_inst
- V2.pszDSIServer 5fe84f18-3765-4ca3-b895-47802a7ab74f._msdcs.CONTOSO.COM
- V2.pszDSIAnnotation (null)

- V2.pszDSIIInstance 5fe84f18-3765-4ca3-b895-47802a7ab74f._msdcs.CONTOSO.COM
- V2.pguidDSIIInstance (null)

4.1.26.3.2.2 Client Request

A client invokes the IDL_DRSUpdateRefs (section 4.1.26) method against DC1 with the following parameters (DRS_HANDLE to DC1 omitted).

- *dwVersion* = 1
- *pmsgUpdRefs* = 0x0006fe08 ; Pointer to the following structure:
 - *pNC*: Pointer to the DSNAME structure for DC=CONTOSO,DC=COM
 - *pszDsaDest* : "5fe84f18-3765-4ca3-b895-47802a7ab74f._msdcs.contoso.com"
 - *uuidDsaObjDest*: _GUID { 5fe84f18-3765-4ca3-b895-47802a7ab74f }
 - *ulOptions*: DRS_WRIT_REP | DRS_DEL_REF | DRS_ADD_REF

4.1.26.3.2.3 Server Response

Return code of 0.

4.1.26.3.2.4 Final State

The ldap search

```
ldap_search_s(ld, "DC=CONTOSO,DC=com", 0, "(objectclass=*)",[repsTo])
```

returns

Getting 1 entry:

```
>> Dn: DC=CONTOSO,DC=COM
```

```
repsTo (2): dwVersion = 2,
```

- v2.cb: 592, v2.cConsecutive Failures: 0, v2.timeLastSuccess: 12924320155
- V2.timeLastAttempt: 0, V2.ulResultLastAttempt: 0,
- V2.cbOtherDraOffset: 216,
- V2.cbOtherDra: 376, V2.ulReplicaFlags: 16, V2.rtSchedule: <ldp:skipped>,
- V2.usnvec.usnHighObjUpdate: 0, v2.usnvec.usnHighPropUpdate:0
- V2.pszUuidDsaObj: 5fe84f18-3765-4ca3-b895-47802a7ab74f
- V2.pszUuidInvocId: 00000000-0000-0000-0000-000000000000
- V2.pszUuidTransportObj: 00000000-0000-0000-0000-000000000000
- V2.cbPASDataOffset: 0 v2~PasData: (none)
- v2~pdsa_rpc_inst
- v2.pszDSIServer 5fe84f18-3765-4ca3-b895-47802a7ab74f._msdcs.CONTOSO.COM
- v2.pszDSIAnnotation (null)

- v2.pszDSIInstance 5fe84f18-3765-4ca3-b895-47802a7ab74f._msdcs.CONTOSO.COM
- v2.pguidDSIInstance (null);

4.1.27 IDL_DRSVerifyNames (Opnum 8)

The IDL_DRSVerifyNames method resolves a sequence of object identities.

```
ULONG IDL_DRSVerifyNames(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
        DRS_MSG_VERIFYREQ* pmsgIn,
    [out, ref] DWORD* pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DRS_MSG_VERIFYREPLY* pmsgOut
);
```

hDrs: The RPC context handle returned by the IDL_DRSBind method.

dwInVersion: The version of the request message.

pmsgIn: A pointer to the request message.

pdwOutVersion: A pointer to the version of the response message.

pmsgOut: A pointer to the response message.

Return Values: 0 if successful, otherwise a Windows error code.

Exceptions Thrown: This method might throw the following exceptions beyond those thrown by the underlying RPC protocol (as specified in [MS-RPCE]): ERROR_INVALID_HANDLE, ERROR_DS_DRS_EXTENSIONS_CHANGED, ERROR_DS_DIFFERENT_REPL_EPOCHS, and ERROR_INVALID_PARAMETER.

4.1.27.1 Method-Specific Concrete Types

4.1.27.1.1 DRS_MSG_VERIFYREQ

The DRS_MSG_VERIFYREQ union defines the request messages sent to the IDL_DRSVerifyNames method. Only one version, identified by *dwInVersion* = 1, is currently defined.

```
typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_VERIFYREQ_V1 V1;
} DRS_MSG_VERIFYREQ;
```

V1: The version 1 request.

4.1.27.1.2 DRS_MSG_VERIFYREQ_V1

The DRS_MSG_VERIFYREQ_V1 structure defines a request message sent to the IDL_DRSVerifyNames method.

```
typedef struct {
    DWORD dwFlags;
```

```

[range(1,10000)] DWORD cNames;
[size_is(cNames)] DSNAME** rpNames;
ATTRBLOCK RequiredAttrs;
SCHEMA_PREFIX_TABLE PrefixTable;
} DRS_MSG_VERIFYREQ_V1;

```

dwFlags: The type of name to be verified; MUST have one of the following values:

Value	Meaning
DRS_VERIFY_DSNAME 0x00000000	Verify DSName values.
DRS_VERIFY_SIDS 0x00000001	Verify objectSid values.
DRS_VERIFY_SAM_ACCOUNT_NAMES 0x00000002	Verify sAMAccountName values.
DRS_VERIFY_FPOS 0x00000003	Verify foreign principal object names.

cNames: The number of items in the **rpNames** array.

rpNames: An array of pointers to DSNames that need to be verified.

RequiredAttrs: The list of attributes to be retrieved for each name that is verified.

PrefixTable: The prefix table used to translate ATTRTYP values in **RequiredAttrs** to OID values.

4.1.27.1.3 DRS_MSG_VERIFYREPLY

The DRS_MSG_VERIFYREPLY union defines the response messages received from the IDL_DRSVerifyNames method. Only one version, identified by *pdwOutVersion*[^] = 1, is currently defined.

```

typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_VERIFYREPLY_V1 V1;
} DRS_MSG_VERIFYREPLY;

```

V1: The version 1 reply.

4.1.27.1.4 DRS_MSG_VERIFYREPLY_V1

The DRS_MSG_VERIFYREPLY_V1 structure defines a response message received from the IDL_DRSVerifyNames method.

```

typedef struct {
    DWORD error;
    [range(0,10000)] DWORD cNames;
    [size_is(cNames)] ENTINF* rpEntInf;
    SCHEMA_PREFIX_TABLE PrefixTable;
} DRS_MSG_VERIFYREPLY_V1;

```

error: Unused. MUST be 0 and ignored.

cNames: The number of items in the **rpEntInf** array.

rpEntInf: An array of ENTINF structures that contain the attributes requested in the **RequestAttrsRequiredAttrs** field of the input DRS_MSG_VERIFYREQ_V1 structure if the corresponding name is verified.

PrefixTable: The prefix table used to translate ATTRTYP values in the response to OIDs ~~(2)~~.

4.1.27.2 Server Behavior of the IDL_DRSVerifyNames Method

Informative summary of behavior: The server resolves each of a sequence of object names and returns its **DSName** and the values of zero or more of its attributes. The type of the input object name is indicated by the **dwFlags** field in the request. The IDL_DRSVerifyNames method verifies the names of both deleted and normal objects.

```
ULONG
IDL_DRSVerifyNames(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
        DRS_MSG_VERIFYREQ *pmsgIn,
    [out, ref] DWORD *pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DRS_MSG_VERIFYREPLY *pmsgOut);

msgIn: DRS_MSG_VERIFYREQ_V1
msgOut: DRS_MSG_VERIFYREPLY_V1
nc, d: DSName
o: sequence of DSName
i, j, k: int
domainName, username: unicodestring
done: boolean
attribute: ATTRTYP
FilterPAS: PARTIAL_ATTR_VECTOR_V1_EXT
GCPas: PARTIAL_ATTR_VECTOR_V1_EXT
referredDomain: unicodestring

ValidateDRSInput(hDrs, 8)

pdwOutVersion^ := 1
pmsgOut^.V1.error := 0
pmsgOut^.V1.cNames := 0
pmsgOut^.V1.rpEntInf := null
pmsgOut^.V1.PrefixTable.PrefixCount := 0
pmsgOut^.V1.PrefixTable.pPrefixEntry := null

/* Perform input validation and access check */
if dwInVersion ≠ 0x1 then
    return ERROR_DS_DRA_INVALID_PARAMETER
endif
msgIn := pmsgIn^.V1
if msgIn.dwFlags ≠ DRS_VERIFY_DSNames and
    msgIn.dwFlags ≠ DRS_VERIFY_SAM_ACCOUNT_NAMES and
    msgIn.dwFlags ≠ DRS_VERIFY_SIDS and
    msgIn.dwFlags ≠ DRS_VERIFY_FPOS then
    return ERROR_DS_DRA_INVALID_PARAMETER
endif
if msgIn.cNames > 0 and msgIn.rpNames = null then
    return ERROR_DS_DRA_INVALID_PARAMETER
endif
if (msgIn.dwFlags = DRS_VERIFY_SIDS or
    msgIn.dwFlags = DRS_VERIFY_SAM_ACCOUNT_NAMES or
    msgIn.dwFlags = DRS_VERIFY_FPOS) and
    not IsGC() then
    return ERROR_DS_GC_REQUIRED
```

```

endif
if msgIn.dwFlags = DRS_VERIFY_DSNAMEs and not IsGC() then
  for i := 0 to msgIn.cNames-1
    if DefaultNC() ≠ GetObjectNC(msgIn.rpNames[i]^) then
      return ERROR_DS_GC_REQUIRED
    endif
  endfor
endif

/* Compute output */
msgOut.PrefixTable := dc.prefixTable
for i := 0 to msgIn.cNames - 1
  d := msgIn.rpNames[i]
  o := null
  done := false

  if msgIn.dwFlags = DRS_VERIFY_SAM_ACCOUNT_NAMES then
    domainName := DomainNameFromNT4AccountName(d.dn)
    username := UserNameFromNT4AccountName(d.dn)

    if domainName ≠ null and username ≠ null and
      IsDomainNameInTrustedForest(domainName, referredDomain) then
      /* Provide a hint as to which forest this name could be coming
      * from. Note that 0xFFFF0009 is a hardcoded attribute ID
      * recognized by clients of this method. This attribute ID does
      * not correspond to any attribute defined in the schema. */
      msgOut.rpEntInf[i].pName := null
      msgOut.rpEntInf[i].AttrBlock.AttrCount := 1
      msgOut.rpEntInf[i].AttrBlock.pAttr[0].AttrTyp := 0xFFFF0009
      msgOut.rpEntInf[i].AttrBlock.pAttr[0].AttrVal.valCount := 1
      msgOut.rpEntInf[i].AttrBlock.pAttr[0].AttrVal.pAVal[0].valLen
      := Length in characters of domainName, excluding any
      terminating null
      msgOut.rpEntInf[i].AttrBlock.pAttr[0].AttrVal.pAVal[0].pAVal :=
      referredDomain
      done := true
    endif
  endif

  if not done
    /* locate object or objects in question */
    if msgIn.dwFlags = DRS_VERIFY_DSNAMEs then
      if ObjExists(d) then
        o := {d}
      endif
    else if msgIn.dwFlags = DRS_VERIFY_SIDS then
      o := select all v from all-ts-included
        where v!objectSid = d.sid and
        foreignSecurityPrincipal not in v!objectClass
    else if msgIn.dwFlags = DRS_VERIFY_SAM_ACCOUNT_NAMES then
      if domainName ≠ null and username ≠ null then
        nc := select one v from all
          where v!NETBIOSName = domainName and GetObjectNC(v) = v
          /* The following query returns both normal objects
          and tombstones */
        o := select all v from subtree-ts-included nc where
          v!SAMAccountName = username
      else
        o := select all v from all-ts-included
          where v!userPrincipalName =
          d.dn
      endif
    else if msgIn.dwFlags = DRS_VERIFY_FPOS then
      o := select all v from all-ts-included
        where v!objectSid = d.sid
        and foreignSecurityPrincipal in v!objectClass
    endif

    /* Compute returned info and get requested attributes */
    if o.length = 1 and AccessCheckCAR(GetObjectNC(o[0]), DS-Replication-Get-Changes) then

```

```

msgOut.rpEntInf[i].pName = o[0]!distinguishedName
if MasterReplicaExists(GetObjectNC(o[0])) then
    msgOut.rpEntInf[i].ulFlags := ENTINF_FROM_MASTER
else
    msgOut.rpEntInf[i].ulFlags := 0
endif
msgOut.rpEntInf[i].AttrBlock.AttrCount :=
    msgIn.RequiredAttrs.AttrCount

FilterPas := FilteredPAS()
GCPas := GCPAS()

for j := 0 to msgIn.RequiredAttrs.AttrCount - 1

    if AmILHServer() then
        if (not (msgIn.RequiredAttrs.pAttr[j].AttrType in FilterPas
            &&
            msgIn.RequiredAttrs.pAttr[j].AttrType in GCPas))
        then
            /* skip requested attributes not part of both FilterPAS
            and GCPas */
            msgOut.rpEntInf[i] := null
            continue;
        endif
    else
        /* pre-LH server */
        if (not (msgIn.RequiredAttrs.pAttr[j].AttrType in GCPas))
        then
            /* skip requested attributes not part of GCPas */
            msgOut.rpEntInf[i] := null
            continue;
        endif
    endif

    attribute := LocalAttidFromRemoteAttid(
        msgIn.PrefixTable,
        msgIn.RequiredAttrs.pAttr[j].attrTyp)
    msgOut.rpEntInf[i].AttrBlock.pAttr[j].attrTyp := attribute
    k := 0
    foreach val in GetAttrVals(o, attribute, false)
        msgOut.rpEntInf[i].AttrBlock.pAttr[j].AttrVal.pAVal :=
            ADR(ATTRVALFromValue(val,
                Syntax(attribute),
                dc.prefixTable))
        msgOut.rpEntInf[i].AttrBlock.pAttr[j].AttrVal.valCount :=
            k + 1
    endfor
endfor
else
    msgOut.rpEntInf[i] := null
endif
endif
endfor /* i := */

pmsgOut^.V1 := msgOut
return 0

```

4.1.27.3 Examples of the IDL_DRSVerifyNames Method

4.1.27.3.1 Initial State

Querying the user object JaneDow on DC=CONTOSO, DC=COM

- `ldap_search_s("CN=JaneDow,CN=Users,DC=contoso,DC=com", baseObject, "(objectClass=*)", [objectGUID, objectSid, sAMAccountName, sAMAccountType])`

- Getting 1 entries:
- >> Dn: CN=JaneDow,CN=Users,DC=contoso,DC=com
 - 1> objectGUID: 772cf177-00f8-45ed-9c72-5e5206bead02;
 - 1> objectSid: S-1-5-21-3263199975-614030967-162443871-1603;
 - 1> sAMAccountName: JaneDow;
 - 1> sAMAccountType: SAM_NORMAL_USER_ACCOUNT;

4.1.27.3.2 Client Request

To get a user's SID, DC2 invokes the IDL_DRSVerifyNames method against DC1 with the following parameters (DRS_HANDLE to DC1 omitted):

- *dwInVersion* = 1
- *pmsgIn* = DRS_MSG_VERIFYREQ_V1
 - *dwFlags*: 2
 - *cNames*: 1
 - *rpNames*: DSNAME
 - *StringName*: "CN=Jane Dow,CN=Users,DC=contoso,DC=com"
 - *RequiredAttrs*: ATTRBLOCK
 - *attrCount*: 3
 - *pAttr*: ATTR
 - *sAMAccountType*
 - *objectSid*
 - *sAMAccountName*

4.1.27.3.3 Server Response

The server responds with a return code of 0 and the following values:

- *pMsgOut* = DRS_MSG_VERIFYREPLY_V1
 - *cNames*: 1
 - *rpEntInf*: ENTINF
 - *pName*: DSNAME
 - *Guid*: GUID {772cf177-00f8-45ed-9c72-5e5206bead02}
 - *SID*: S-1-5-21-3263199975-614030967-162443871-1603
 - *String Name*: "CN=Jane Dow,CN=Users,DC=contoso,DC=com"
 - *ulFlags*: ENTINF_FROM_MASTER
 - *AttrBlock*: ATTRBLOCK

- sAMAccountType: 0x30000000
- objectSid: S-1-5-21-3263199975-614030967-162443871-1603
- sAMAccountName: JaneDow
- PrefixTable: SCHEMA_PREFIX_TABLE

4.1.27.3.4 Final State

No change in state.

4.1.28 IDL_DRSWriteSPN (Opnum 13)

The IDL_DRSWriteSPN method updates the set of SPNs on an object.

```

ULONG IDL_DRSWriteSPN(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
        DRS_MSG_SPNREQ* pmsgIn,
    [out, ref] DWORD* pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DRS_MSG_SPNREPLY* pmsgOut
);

```

hDrs: The RPC context handle returned by the IDL_DRSBind method.

dwInVersion: The version of the request message. Must be set to 1, because that is the only version supported.

pmsgIn: A pointer to the request message.

pdwOutVersion: A pointer to the version of the response message. The value must be 1 because that is the only version supported.

pmsgOut: A pointer to the response message.

Return Values: 0 if successful, or a Windows error code if a failure occurs.

Exceptions Thrown: This method might throw the following exceptions beyond those thrown by the underlying RPC protocol (as specified in [MS-RPCE]): ERROR_INVALID_HANDLE, ERROR_DS_DRS_EXTENSIONS_CHANGED, ERROR_DS_DIFFERENT_REPL_EPOCHS, and ERROR_INVALID_PARAMETER.

4.1.28.1 Method-Specific Concrete Types

4.1.28.1.1 DRS_MSG_SPNREQ

The DRS_MSG_SPNREQ union defines the request messages sent to the IDL_DRSWriteSPN method. Only one version, identified by *dwInVersion* = 1, is currently defined.

```

typedef
    [switch_type(DWORD)]
    union {
        [case(1)]
            DRS_MSG_SPNREQ_V1 V1;
    } DRS_MSG_SPNREQ;

```

V1: The version 1 request.

4.1.28.1.2 DRS_MSG_SPNREQ_V1

The DRS_MSG_SPNREQ_V1 structure defines a request message sent to the IDL_DRSWriteSPN method.

```
typedef struct {
    DWORD operation;
    DWORD flags;
    [string] const WCHAR* pwszAccount;
    [range(0,10000)] DWORD cSPN;
    [string, size_is(cSPN)] const WCHAR** rpwszSPN;
} DRS_MSG_SPNREQ_V1;
```

operation: The SPN operation to perform. MUST be one of the DS_SPN_OPERATION values.

flags: Unused. MUST be 0 and ignored.

pwszAccount: The DN of the object to modify.

cSPN: The number of items in the **rpwszSPN** array.

rpwszSPN: The SPN values.

4.1.28.1.3 DRS_MSG_SPNREPLY

The DRS_MSG_SPNREPLY union defines the response messages received from the IDL_DRSWriteSPN method. Only one version, identified by *pdwOutVersion*[^] = 1, is currently defined.

```
typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_SPNREPLY_V1 V1;
} DRS_MSG_SPNREPLY;
```

V1: The version 1 response.

4.1.28.1.4 DRS_MSG_SPNREPLY_V1

The DRS_MSG_SPNREPLY_V1 structure defines a response message received from the IDL_DRSWriteSPN method.

```
typedef struct {
    DWORD retVal;
} DRS_MSG_SPNREPLY_V1;
```

retVal: 0, or a Windows error code.

4.1.28.1.5 DS_SPN_OPERATION

The DS_SPN_OPERATION type indicates the operation to perform.

This type is declared as follows:

```
typedef DWORD DS_SPN_OPERATION;
```

It must be one of the following values.

Value	Meaning
DS_SPN_ADD_SPN_OP (0x00000000)	Adds the specified values to the existing set of SPNs.
DS_SPN_REPLACE_SPN_OP (0x00000001)	Removes all the existing SPNs, then adds the specified values. If the set of specified values is empty (cSPN is zero), no values are added.
DS_SPN_DELETE_SPN_OP (0x00000002)	Removes all the existing SPNs.

4.1.28.2 Method-Specific Abstract Types and Procedures

4.1.28.2.1 ExecuteWriteSPNRemotely

```
procedure ExecuteWriteSPNRemotely(  
    DWORD dwInVersion,  
    DRS_MSG_SPNREQ *pmsgIn,  
    DWORD *pdwOutVersion,  
    DRS_MSG_SPNREPLY *pmsgOut): ULONG
```

This procedure is executed only on an RODC. It finds a DC that holds a **full NC replica** of the domain NC of the RODC, performs the IDL_DRSWriteSPN RPC method call with the given parameters against the DC in the client's security context, and returns the value returned by that RPC call.

4.1.28.3 Server Behavior of the IDL_DRSWriteSPN Method

Informative summary of behavior: The IDL_DRSWriteSPN method updates the servicePrincipalName attribute of an object. The values of this multivalued attribute are called service principal names (SPNs). The IDL_DRSWriteSPN method does one of three things:

- Adds a non-empty set of SPNs to the object's servicePrincipalName. If a member of the set is already present on the object's servicePrincipalName, it is ignored.
- Removes all current values from the object's servicePrincipalName, then adds a (possibly empty) set of SPNs to the object's servicePrincipalName.
- Removes a non-empty set of SPNs from the object's servicePrincipalName. If a member of the set is not present on the object's servicePrincipalName, it is ignored.

The effect of this method can be achieved by an LDAP Modify operation to the servicePrincipalName attribute of an object. Some manipulations of the servicePrincipalName attribute that cannot be performed using this method can be performed using LDAP Modify. For example, an LDAP Modify can remove one specific SPN from the servicePrincipalName attribute while adding another SPN to the servicePrincipalName attribute in the same transaction; IDL_DRSWriteSPN cannot do this.

```
ULONG  
IDL_DRSwriteSPN(  
    [in, ref] DRS_HANDLE hDrs,  
    [in] DWORD dwInVersion,
```

```

[in, ref, switch_is(dwInVersion)]
    DRS_MSG_SPNREQ *pmsgIn,
[out, ref] DWORD *pdwOutVersion,
[out, ref, switch_is(*pdwOutVersion)]
    DRS_MSG_SPNREPLY *pmsgOut);

accountDN: unicodestring
account: DSName
err: DWORD
operation: DS_SPN_OPERATION
cSPN: integer
spnSet: set of unicodestring
instanceName: unicodestring

ValidateDRSInput(hDrs, 13)

pdwOutVersion^ := 1
pmsgOut^.V1.retVal := 0

/* Input parameter validation */
if dwInVersion # 1 then
    pmsgOut^.V1.retVal := ERROR_INVALID_PARAMETER
    return ERROR_INVALID_PARAMETER
endif

/* Input parameter validation */
if ClientUUID(hDrs) # NTDSAPI_CLIENT_GUID
    pmsgOut^.V1.retVal := ERROR_INVALID_PARAMETER
    return ERROR_INVALID_PARAMETER
endif

/* RODCs do not perform originating updates */
if AmIRODC() then
    return ExecuteWriteSPNRemotely(dwInVersion,
        pmsgIn, pdwOutVersion, pmsgOut);
endif

accountDN := pmsgIn^.V1.pwszAccount
operation := pmsgIn^.V1.operation
cSPN := pmsgIn^.V1.cSPN
spnSet := pmsgIn^.V1.rpwszSPN

if accountDN = null or accountDN = "" then
    pmsgOut^.V1.retVal := ERROR_INVALID_PARAMETER
    return ERROR_INVALID_PARAMETER
endif

if not operation in [DS_SPN_ADD_SPN_OP .. DS_SPN_DELETE_SPN_OP] then
    pmsgOut^.V1.retVal := ERROR_INVALID_FUNCTION
    return ERROR_INVALID_FUNCTION
endif

/* DS_SPN_REPLACE_SPN_OP permits 0 SPNs to be specified (meaning
 * "delete all SPNs"). Other operations require >=1 SPNs to be
 * specified. */
if (operation # DS_SPN_REPLACE_SPN_OP) and (cSPN = 0) then
    pmsgOut^.V1.retVal := ERROR_INVALID_PARAMETER
    return ERROR_INVALID_PARAMETER
endif

/* The empty string is an invalid SPN. */
foreach spn in spnSet
    if spn = null or spn = "" then
        pmsgOut^.V1.retVal := ERROR_INVALID_PARAMETER
        return ERROR_INVALID_PARAMETER
    endif
endfor

account := GetDSNameFromDN(accountDN);
if not ObjExists(account) then

```

```

    pmsgOut^.Vl.retVal := ERROR_DS_OBJ_NOT_FOUND
    return ERROR_DS_OBJ_NOT_FOUND
endif

/* Perform access checks */
err = AccessCheckWriteToSpnAttribute(account, spnSet)
if err # ERROR_SUCCESS then
    pmsgOut^.Vl.retVal := err
    return err
endif

if (operation = DS_SPN_DELETE_SPN_OP) then
    /* Remove specified SPNs */
    foreach spn in spnSet
        if spn in account!servicePrincipalName then
            account!servicePrincipalName :=
                account!servicePrincipalName - {spn}
        endif
    endfor
    return 0
endif

if (operation = DS_SPN_ADD_SPN_OP) then
    /* Add specified SPNs */
    foreach spn in spnSet
        account!servicePrincipalName :=
            account!servicePrincipalName + {spn}
    endfor
    return 0
endif

/* Must be DS_SPN_REPLACE_SPN_OP.
 * Remove all existing SPNs, then add in the specified SPNs. */
account!servicePrincipalName := {null}
foreach spn in spnSet
    account!servicePrincipalName :=
        account!servicePrincipalName + {spn}
endfor
return 0

```

4.1.29 IDL_DRSSAddCloneDC (Opnum 28)

The IDL_DRSSAddCloneDC method is used to create a new DC object by copying attributes from an existing DC object.

```

ULONG IDL_DRSSAddCloneDC (
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
        DRS_MSG_ADDCLONEDCREQ* pmsgIn,
    [out, ref] DWORD* pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DRS_MSG_ADDCLONEDCREPLY* pmsgOut
);

```

hDrs: The RPC context handle returned by the IDL_DRSSBind method.

dwInVersion: The version of the request message.

pmsgIn: A pointer to the request message.

pdwOutVersion: A pointer to the version of the response message.

pmsgOut: A pointer to the response message.

Return Values: 0 if successful, otherwise a Windows error code.

Exceptions Thrown: This method might throw the following exceptions beyond those thrown by the underlying RPC protocol (as specified in [MS-RPCE]): ERROR_INVALID_HANDLE, ERROR_DS_DRS_EXTENSIONS_CHANGED, and ERROR_INVALID_PARAMETER.

4.1.29.1 Method-Specific Concrete Types

4.1.29.1.1 DRS_MSG_ADDCLONEDCREQ

The DRS_MSG_ADDCLONEDCREQ union defines the request messages sent to the IDL_DRSSAddCloneDC method.

```
typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_ADDCLONEDCREQ_V1 V1;
} DRS_MSG_ADDCLONEDCREQ;
```

V1: The version 1 request.

4.1.29.1.2 DRS_MSG_ADDCLONEDCREQ_V1

The DRS_MSG_ADDCLONEDCREQ_V1 structure defines a request message sent to the IDL_DRSSAddCloneDC method.

```
typedef struct {
    [string] const WCHAR* pwszCloneDCName;
    [string] const WCHAR* pwszSite;
} DRS_MSG_ADDCLONEDCREQ_V1;
```

pwszCloneDCName: The new DC name.

pwszSite: The RDN of the site the new DC will be placed into.

4.1.29.1.3 DRS_MSG_ADDCLONEDCREPLY

The DRS_MSG_ADDCLONEDCREPLY union defines the response messages received from the IDL_DRSSAddCloneDC method.

```
typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_ADDCLONEDCREPLY_V1 V1;
} DRS_MSG_ADDCLONEDCREPLY;
```

V1: The version 1 response.

4.1.29.1.4 DRS_MSG_ADDCLONEDCREPLY_V1

The DRS_MSG_ADDCLONEDCREPLY_V1 structure defines a response message received from the IDL_DRSSAddCloneDC method.

```
typedef struct {
```

```

    [string] WCHAR* pwszCloneDCName;
    [string] WCHAR* pwszSite;
    [range(0,1024)] DWORD cPasswordLength;
    [size_is(cPasswordLength)] WCHAR* pwsNewDCAccountPassword;
} DRS_MSG_ADDCLONEDCREPLY_V1;

```

pwszCloneDCName: The new DC's name.

pwszSite: The site containing the new DC.

cPasswordLength: The length of the **pwsNewDCAccountPassword** member.

pwsNewDCAccountPassword: The password of the new DC account.

4.1.29.2 Method-Specific Abstract Types and Procedures

4.1.29.2.1 GetKeyLength

```

procedure GetKeyLength(hDrs: DRS_HANDLE): integer

```

Returns the key length, in bits, of the encryption used on the *hDrs* connection. Returns 0 if no encryption is in use on the connection.

4.1.29.2.2 DNMap

```

type DNMap : Map {originalObj : DSName} to {newObj : DSName}

```

A map from one DN to another DN.

4.1.29.2.3 DCInfo

This abstract type stores information about a domain controller.

```

typedef struct {
    string Name;
    string dnsHostName;
    SID Sid;
} DCInfo;

```

Name: The DC's name.

dnsHostName: The DC's DNS host name.

Sid: The DC's SID.

4.1.29.2.4 TranslationInfo

Represents translation from the original domain controller to the new domain controller.

```

typedef struct {
    DCInfo OriginalDC;
    DCInfo NewDC;
    DNMap objMap;
} TranslationInfo;

```

originalDC: The original DC's information.

newDC: The new DC's information.

objMap: The map of the original DC-related DNs to the new DC-related DN.

4.1.29.2.5 ReplaceName

```
ReplaceName(stringValue : string, originalName : string, newName : string) : string
```

Replaces all occurrences of *originalName* in *stringValue* with *newName*, and returns the resulting string.

4.1.29.2.6 ReplaceSIDInSecurityDescriptor

```
ReplaceSIDInSecurityDescriptor(sd : SECURITY_DESCRIPTOR, originalSid : SID, newSid : SID) : SECURITY_DESCRIPTOR
```

Creates a copy of **security descriptor** *sd*, replaces all occurrences of *originalSid* with *newSid* in the security descriptor, and returns the new security descriptor.

4.1.29.2.7 GetPrincipalSid

```
GetPrincipalSid(clientCreds : ClientAuthorizationInfo) : SID
```

Returns the user-SID part of the *clientCreds* abstract type.

4.1.29.2.8 GenerateNewKrbTgtAcct

```
GenerateNewKrbTgtAcct() : DSName
```

Generates a Kerb Tgt user account in the **local domain controller (local DC)** using the same steps as [MS-ADTS] section 3.1.1.3.4.1.23. The following steps are performed by this abstract procedure:

- Creates a new user object.
- Selects a value in the range [1 .. 65535] that is not currently present as a value of the msDS-SecondaryKrbTgtNumber attribute on any object in this domain, and assigns the value to the msDS-SecondaryKrbTgtNumber attribute of the created object. If no such value exists, the result is the error *other* / *ERROR_NO_SYSTEM_RESOURCES*.
- The selected value for msDS-SecondaryKrbTgtNumber is appended (in decimal form) to the string "krbtgt", and the resulting string is assigned to the sAMAccountName attribute on the created object.
- The userAccountControl bits ADS_UF_ACCOUNT_DISABLE and ADS_UF_DONT_EXPIRE_PASSWD are set on the object's userAccountControl attribute.
- The object's account password is set to a randomly generated value that satisfies all criteria in [MS-SAMR] section 3.1.1.7.2 and is processed as described in [MS-SAMR] section 3.1.1.8.5.
- Returns the DSName of the created object.

4.1.29.2.9 DuplicateObject

```
Procedure DuplicateObject (  
    originalObj : DSName,  
    newObjParent : DSName,  
    newObjRdn : string,
```

```
tlInfo : TranslationInfo) : DSName
```

Informative summary of behavior: This procedure creates a new object by copying data from an existing object. When copying data, it replaces any reference to the original DC in the object data with a reference to the new DC. The new object is created under *newObjectParent* and its RDN is set to *newObjRdn*.

```
Procedure DuplicateObject (
    originalObj : DSName,
    newObjParent : DSName,
    newObjRdn : string,
    tlInfo : TranslationInfo) : DSName

newObj : DSName
forwardLinkAttribute : string
referenceObj : DSName

newObj!distinguishedName := newObjRdn + ',' +
    newObjParent!distinguishedName

foreach attribute in originalObj!attr
    if attribute in {
        objectClass, objectCategory, userAccountControl,
        hasMasterNCs, msDS-hasMasterNCs, dMDLocation, msDS-HasDomainNCs,
        options, systemFlags, showInAdvancedViewOnly,
        msDS-NeverRevealGroup, msDS-RevealOnDemandGroup,
        msDS-RevealedUsers, managedBy, msDS-Behavior-Version,
        msDS-HasDomainNCs, msDS-hasFullReplicaNCs, enabledConnection,
        fromServer} then
        newObj!attribute := originalObj!attribute
    else if attribute in {sAMAccountName, dnsHostName} then
        newObj!attribute.Value := ReplaceName(originalObj!attribute.Value,
            tlInfo.originalDC.Name, tlInfo.newDC.Name)
    else if attribute in {serverReference, msDS-KrbTgtLink,
        msDFSR-ComputerReference} then
        /* replace reference to original DC-related object with new
        DC object using objMap*/
        newObj!attribute.Value :=
            tlInfo.objMap[originalObj!distinguishedName]
    else if attribute = servicePrincipalName then
        foreach servicePrincipalName in originalDC!servicePrincipalName
            newServicePrincipalName : string
            newServicePrincipalName := servicePrincipalName
            if newServicePrincipalName contains tlInfo.OriginalDC.Name then
                newServicePrincipalName :=
                    ReplaceName(newServicePrincipalName,
                        tlInfo.OriginalDC.Name,
                        tlInfo.NewDC.Name)
            newObj!servicePrincipalName :=
                newObj!servicePrincipalName +
                {newServicePrincipalName}
            else if newServicePrincipalName
                contains(tlInfo.originalDC.dnsHostName) then
                newServicePrincipalName :=
                    ReplaceName(newServicePrincipalName,
                        tlInfo.OriginalDC.dnsHostName,
                        tlInfo.newDC.dnsHostName)
            newObj!servicePrincipalName :=
                newObj!servicePrincipalName +
                {newServicePrincipalName}
            endif
        endfor
    else if attribute = invocationId then
        newObj!invocationId := a random guid
    else if attribute = nTSecurityDescriptor then
        if tlInfo.newDC.Sid ≠ null then
            newObj!nTSecurityDescriptor := ReplaceSIDInSecurityDescriptor (
```

```

        originalDC!NTSecurityDescriptor, tlInfo.originalDC.Sid,
        tlInfo.newDC.Sid)
    endif
endif
endfor

/* If a back link points to the original DC object, update the forward
link in the referenced object
*/
foreach attribute in originalObj!Attributes
    if attribute in {memberOf, msDS-NC-RO-Replica-Locations-BL} then
        if attribute = isMemberOf then
            forwardLinkAttribute := member
        else if attribute = msDS-NC-RO-Replica-Locations-BL then
            forwardLinkAttribute := msDS-NC-RO-Replica-Locations
        endif
        if tlInfo.objMap.Keys.exists(originalObj!attribute) then
            referenceObj := tlInfo.objMap[originalObj!attribute]
        else
            referenceObj := select o from all
                where o!distinguishedName = originalObj!attribute
            endif
            referenceObj!forwardLinkAttribute := newObj
        endif
    endif
endfor
return newObj

```

4.1.29.3 Server Behavior of the IDL_DRSAddCloneDC Method

Informative summary of behavior: The IDL_DRSAddCloneDC method is used to create a new domain controller (DC) by duplicating the states of the original DC. The states of a DC are composed of computer, server, NTDS settings, FRS, DFSR, and connection objects that are maintained for each DC. When duplicating an object, this RPC method replaces all references to the original DC with corresponding objects of the new DC. The caller must have the control access right DS-Clone-Domain-Controller on the default NC. When called, this RPC method:

1. Validates that the caller has permission to perform the operation.
2. Creates new account and other objects for the new domain controller account by copying information from the existing domain controller.
3. Returns the name, site, and password for the new domain controller to the client.

```

ULONG
IDL_DRSAddCloneDC(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
        DRS_MSG_ADDCLONEDCREQ *pmsgIn,
    [out, ref] DWORD *pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DRS_MSG_ADDCLONEDCREPLY *pmsgOut)

msgIn: DRS_MSG_ADDCLONEDCREQ_V1
clientCreds: ClientAuthorizationInfo
tlInfo: TranslationInfo
callerSid: SID
isRodc: boolean

computerObj: DSName
originalDCSrvObj: DSName
originalDCSiteObj: DSName
originalDCServersObj: DSName
originalDSAObj: DSName

```

```

newDCComputerObj: DSName
newDCSiteObj: DSName
newDCServersObj: DSName
newDCServerObj: DSName
newDSAObj: DSName

ValidateDRSInput(hDrs, 28)

pdwOutVersion^ := 1
pmsgOut^.V1.pwszCloneDCName := null
pmsgOut^.V1.pwszSite := null
pmsgOut^.V1.cPasswordLength := 0
pmsgOut^.V1.pwsNewDCAccountPassword := null
if dwInVersion # 1 then
    return ERROR_DS_DRA_INVALID_PARAMETER
endif
msgIn := pmsgIn^.V1

if GetKeyLength(hDrs) < 128 then
    return ERROR_DS_STRONG_AUTH_REQUIRED
endif

if not AccessCheckCAR(DefaultNC(), DS-Clone-Domain-Controller) then
    return ERROR_DS_DRA_ACCESS_DENIED
endif

/* Check that the caller (the "source" DC) is actually a DC by
 * checking Enterprise Domain Controllers or Enterprise Read-Only Domain
 * Controllers SID in its token. */
clientCreds := GetCallerAuthorizationInfo()
if not CheckGroupMembership(clientCreds, SidFromStringSid("S-1-5-9")) then
    if not CheckGroupMembership(clientCreds, SidFromStringSid("S-1-5-498"))
    then
        return ERROR_DS_DRA_ACCESS_DENIED
    else
        isRodc := true
    endif
endif

/* The DC must own the PDC role */
if GetFSMORoleOwner(FSMO_PDC) # DSAObj() then
    return ERROR_INVALID_DOMAIN_ROLE
endif

callerSid := GetPrincipalSid(clientCreds)

/* get the original DC computer object */
computerObj := select one obj from all where
    (obj!objectSid = callerSid)

tlInfo.OriginalDC.Name := computerObj!sAMAccountName.Remove('$')

/* generate cloned DC name if not specified */
if (msgIn.pwszCloneDCName = null)
    found : boolean
    newDCName : string

    /* Generate new name by appending '-CL' and 4 digits to the original
     * DC name */
    found := false
    For suffix = 0000 to 9999 do
        newDCName := tlInfo.OriginalDC.Name[0 .. 8] + '-CL' + suffix

        if not exists(
            select o from all where o!sAMAccountName = (newDCName + '$')
        ) then
            found := true
            break
        endif
    endfor
endif

```

```

        endfor
        if not found then
            return ERROR_DS_UNWILLING_TO_PERFORM
        endif
        tlInfo.newDC.Name := newDCName
    else
        tlInfo.newDC.Name := msgIn.pwszClonedDCName
    endif

    tlInfo.OriginalDC.Sid := computerObj!objectSid
    tlInfo.OriginalDC.dnsHostName := computerObj!dnsHostName

    if isRdc then
        newKrbTgtAcct : DSName
        newKrbTgtAcct := GenerateNewKrbTgtAcct()
        tlInfo.objMap[computerObj!msDS-KrbTgtLink] := newKrbTgtAcct
    endif

    /* Duplicate original DC computer object */
    newDCComputerObj := DuplicateObject(computerObj, computerObj!parent,
        "cn=" + tlInfo.newDC.Name, tlInfo)
    tlInfo.objMap[computerObj!distinguishedName] :=
        newDCComputerObj!distinguishedName
    tlInfo.NewDC.Sid := newDCComputerObj!objectSid
    tlInfo.NewDC.dnsHostName := newDCComputerObj!dnsHostName

    /* Get the original DC server object */
    originalDCSrvObj := select one v from ConfigNC()
        where v.dn in computerObj!serverReferenceBL
    originalDCServersObj := originalDCSrvObj!parent
    originalDCSiteObj := originalDCSrvObj!parent

    /* use the specified site for the new DC.
    * use the original DC site if the site is not specified */
    if (msgIn.pwszSite ≠ null) then
        siteContainer: DSName
        siteContainer := DescendantObject(ConfigNC(), "CN=Sites,")
        newDCSiteObj := select one v from siteContainer!children
            where v!name = msgIn.pwszSite
        if newDCSiteObj = null
            return ERROR_NO_SUCH_SITE
        endif
    else
        newDCSiteObj := originalDCSiteObj
    endif
    newDCServersObj := DescendantObject(newDCSiteObj, "CN=Servers")

    /* Duplicate the original DC servers object if the servers object is not
    * present in the new DC site */
    if not exists newDCServersObj then
        newDCServersObj := DuplicateObject(originalDCServersObj,
            newDCSiteObj, "CN=Servers", tlInfo)
    endif
    tlInfo.objMap[originalDCServersObj!distinguishedName] :=
        newDCServersObj!distinguishedName

    /* Duplicate the server object */
    newDCServerObj := DescendantObject(newDCServersObj,
        "CN=" + tlInfo.newDC.Name)

    if not exists newDCServerObj then
        newDCServerObj := DuplicateObject(originalDCSrvObj, newDCServersObj,
            "CN=" + tlInfo.newDC.Name, tlInfo)
    endif
    tlInfo.objMap[originalDCSrvObj!distinguishedName] :=
        newDCServerObj!distinguishedName

    /* Duplicate the NTDS settings object */
    originalDSAObj := DescendantObject(originalDCSrvObj,
        "CN=NTDS Settings")

```

```

newDSAObj := DuplicateObject(originalDSAObj, newDCServerObj,
    "CN=NTDS Settings", tlInfo)
tlInfo.ObjMap[originalDSAObj!distinguishedName] :=
    newDSAObj!distinguishedName

if isRodc then
    newConnObj: DSName
    topologyObj: DSName
    originalDFSRObj: DSName
    newDFSRObj: DSName
    frsSysvolObj: DSName
    originalFRSObj: DSName
    newfrsObj : DSName

    foreach obj in originalDSAObj!children where
        obj!objectClass = "ntdsConnection"
            newConnObj := DuplicateObject(obj, newDSAObj,
                "CN=" + tlInfo.newDC.Name, tlInfo)
            objMap[obj!distinguishedName] := newConnObj!distinguishedName
    endfor

    /* Duplicate DFSR topology object */
    topologyObj := DescendantObject(DefaultNC(),
        "CN=Topology,CN=Domain System Volume,CN=DFSR-GlobalSettings,CN=System")
    originalDFSRObj := DescendantObject(topologyObj,
        "CN=" + tlInfo.OriginalDC.Name)

    if originalDFSRObj # null then
        newDFSRObj = DuplicateObject(originalDFSRObj, topologyObj,
            "CN="+ tlInfo.newDC.Name, tlInfo)
    endIf

    /* Duplicate FRS object */
    frsSysvolObj = DescendantObject(DefaultNC(),
        "CN=Domain System Volume (SYSVOL share),CN=File Replication Service,CN=System")
    originalFRSObj = DescendantObject(frsSysvolObj,
        "CN=" + tlInfo.OriginalDC.Name)
    if originalFRSObj # null then
        newfrsObj = DuplicateObject(originalFRSObj, frsSysVolObj,
            "CN=" + tlInfo.newDC.Name, tlInfo)
    endIf
endif

pmsgOut^.V1.pwszCloneDCName := tlInfo.newDC.Name
pmsgOut^.V1.cPasswordLength := 120
pmsgOut^.V1.pwsNewDCAccountPassword:= a 120-byte sequence of randomly
    generated characters between ASCII 32 (space) and ASCII 122 ('z')
pmsgOut^.V1.pwszSite := newDCSiteObj!name

return 0

```

4.1.29.4 Examples of the IDL_DRSAddCloneDC Method

DC1 invokes the IDL_DRSAddCloneDC method on the PDC to create a cloned domain controller account "DC1Clone1" in the CONTOSO.COM domain NC.

4.1.29.4.1 Initial State

Querying the DC1 computer object in domain NC DC=CONTOSO, DC=COM by performing an LDAP search with base scope on the DN "CN=DC1,OU=Domain Controllers,DC=contoso,DC=com":

- Expanding base 'CN=DC1,OU=Domain Controllers,DC=contoso,DC=com'...
- Result <0>: (null)

- Matched DNs:
- Getting 1 entries:
- >> Dn: CN=DC1,OU=Domain Controllers,DC=contoso,DC=com
 - 5> objectClass: top; person; organizationalPerson; user; computer;
 - 1> cn: DC1;
 - 1> distinguishedName: CN=DC1, OU=Domain Controllers, DC=contoso, DC=com;
 - 1> instanceType: 0x4 = (IT_WRITE);
 - 1> whenCreated: 07/10/2006 18:04:35 Pacific Standard Daylight Time;
 - 1> whenChanged: 07/15/2006 19:39:05 Pacific Standard Daylight Time;
 - 1> uSNCreated: 12291;
 - 1> uSNChanged: 24577;
 - 1> name: DC1;
 - 1> objectGUID: ac1993e1-0377-4161-893e-ccd2a98e1bba;
 - 1> userAccountControl: (UF_SERVER_TRUST_ACCOUNT | UF_TRUSTED_FOR_DELEGATION);
 - 1> badPwdCount: 0;
 - 1> codePage: 0;
 - 1> countryCode: 0;
 - 1> badPasswordTime: 01/01/1601 00:00:00 UNC ;
 - 1> lastLogoff: 01/01/1601 00:00:00 UNC ;
 - 1> lastLogon: 07/17/2006 19:47:40 Pacific Standard Daylight Time;
 - 1> localPolicyFlags: 0;
 - 1> pwdLastSet: 07/10/2006 18:04:35 Pacific Standard Daylight Time;
 - 1> primaryGroupID: 516;
 - 1> objectSid: S-1-5-21-254470460-2440132622-709970653-1001;
 - 1> accountExpires: 09/14/30828 02:48:05 UNC ;
 - 1> logonCount: 17;
 - 1> sAMAccountName: DC1\$;
 - 1> sAMAccountType: 805306369;
 - 1> operatingSystem: Windows Server® 2003 operating system;
 - 1> operatingSystemVersion: 5.2 (3790);
 - 1> operatingSystemServicePack: Service Pack 1;

- 1> serverReferenceBL: CN=DC1,CN=Servers, CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com;
- 1> dNSHostName: DC1.contoso.com;
- 1> rIDSetReferences: CN=RID Set,CN=DC1,OU=Domain Controllers, DC=contoso, DC=com;
- 15> servicePrincipalName: ldap/DC1.contoso.com/NDNC5.contoso.com; ldap/DC1.contoso.com/NDNC2.contoso.com; ldap/DC1.contoso.com/NDNC1.contoso.com; GC/DC1.contoso.com/contoso.com; HOST/DC1.contoso.com/CONTOSO; HOST/DC1; HOST/DC1.contoso.com; HOST/DC1.contoso.com/contoso.com; E3514235-4B06-11D1-AB04-00C04FC2DCD2/c20bc312-4d35-4cc0-9903-b1073368af4a/contoso.com; ldap/c20bc312-4d35-4cc0-9903-b1073368af4a._msdcs.contoso.com; ldap/DC1.contoso.com/CONTOSO; ldap/DC1; ldap/DC1.contoso.com; ldap/DC1.contoso.com/contoso.com; NtFrs-88f5d2bd-b646-11d2-a6d3-00c04fc9b232/DC1.contoso.com;
- 1> objectCategory: CN=Computer, CN=Schema, CN=Configuration, DC=contoso, DC=com;
- 1> isCriticalSystemObject: TRUE;
- 1> frsComputerReferenceBL: CN=DC1, CN=Domain System Volume (SYSVOL share),CN=File Replication Service,CN=System,DC=contoso,DC=com;
- 1> lastLogonTimestamp: 07/11/2006 04:02:42 Pacific Std Daylight Time;

Querying the DC1 configuration objects in config NC CN=Configuration, DC=CONTOSO, DC=COM by performing an LDAP search with subtree scope on the DN "CN=DC1, CN=DC1,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com":

- ldap_search_s(ldap, "CN=ALPHA10,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com", 2, "(objectClass=*)", attrList, 0, &msg)
- Getting 5 entries:
- >>Dn: CN=DC1,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com
 - 1> cn: DC1;
 - 1> distinguishedName: CN=DC1,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com;
 - 1> dNSHostName: DC1.mohkhan-TEST10.nttest.microsoft.com;
 - 1> dSCorePropagationData: 0x0 = ();
 - 1> instanceType: 0x4 = (WRITE);
 - 1> name: DC1;
 - 1> objectCategory: CN=Server,CN=Schema,CN=Configuration,DC=contoso,DC=com;
 - 2> objectClass: top; server;
 - 1> objectGUID: 75568225-7ec6-4d83-a72d-82d19c0799c5;
 - 1> serverReference: CN=DC1,OU=Domain Controllers,DC=contoso,DC=com;
 - 1> showInAdvancedViewOnly: TRUE;

- 1> systemFlags: 0x52000000 = (CONFIG_ALLOW_RENAME | CONFIG_ALLOW_LIMITED_MOVE | DISALLOW_MOVE_ON_DELETE);
- 1> uSNChanged: 7763;
- 1> uSNCreated: 7747;
- 1> whenChanged: 7/21/2011 2:51:29 PM Pacific Daylight Time;
- 1> whenCreated: 7/21/2011 2:18:57 PM Pacific Daylight Time;
- >> Dn: CN=NTDS Settings,CN=DC1,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com
 - 1> cn: NTDS Settings;
 - 1> distinguishedName: CN=NTDS Settings,CN=DC1,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com;
 - 1> dMDLocation: CN=Schema,CN=Configuration,DC=contoso,DC=com;
 - 1> dSCorePropagationData: 0x0 = ();
 - 3> hasMasterNCs: CN=Schema,CN=Configuration,DC=contoso,DC=com; CN=Configuration,DC=contoso,DC=com; DC=contoso,DC=com;
 - 1> instanceType: 0x4 = (WRITE);
 - 1> invocationId: 64ef4da2-e442-4d8b-98d9-933609051bec;
 - 1> msDS-Behavior-Version: 5;
 - 1> msDS-HasDomainNCs: DC=contoso,DC=com;
 - 3> msDS-HasInstantiatedNCs:
 - B:8:0000000D:CN=Schema,CN=Configuration,DC=contoso,DC=com;
 - B:8:0000000D:CN=Configuration,DC=contoso,DC=com;
 - B:8:00000005:DC=contoso,DC=com;
 - 3> msDS-hasMasterNCs: N=Schema,CN=Configuration,DC=contoso,DC=com; CN=Configuration,DC=contoso,DC=com; DC=contoso,DC=com;
 - 1> name: NTDS Settings;
 - 1> objectCategory: CN=NTDS-DSA,CN=Schema,CN=Configuration,DC=contoso,DC=com;
 - 3> objectClass: top; applicationSettings; nTDSDSA;
 - 1> objectGUID: 64ef4da2-e442-4d8b-98d9-933609051bec;
 - 1> options: 0x1 = (IS_GC);
 - 1> serverReferenceBL: CN=DC1,CN=Domain System Volume (SYSVOL share),CN=File Replication Service,CN=System,DC=contoso,DC=com;
 - 1> showInAdvancedViewOnly: TRUE;
 - 1> systemFlags: 0x2000000 = (DISALLOW_MOVE_ON_DELETE);
 - 1> uSNChanged: 7777;
 - 1> uSNCreated: 7755;

- 1> whenChanged: 7/21/2011 2:51:29 PM Pacific Daylight Time;
- 1> whenCreated: 7/21/2011 2:18:57 PM Pacific Daylight Time;
- >> Dn: CN=a00d8e30-9afb-47de-80e3-06f53ffd88bd,CN=NTDS Settings,CN=DC1,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com
 - 1> cn: a00d8e30-9afb-47de-80e3-06f53ffd88bd;
 - 1> distinguishedName: CN=a00d8e30-9afb-47de-80e3-06f53ffd88bd,CN=NTDS Settings,CN=DC1,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com;
 - 1> dSCorePropagationData: 0x0 = ();
 - 1> enabledConnection: TRUE;
 - 1> fromServer: CN=NTDS Settings,CN=DC2,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=contoso,DC=com;
 - 1> instanceType: 0x4 = (WRITE);
 - 3> mS-DS-ReplicatesNCREason:
 - B:8:00000008:CN=Schema,CN=Configuration,DC=contoso,DC=com;
 - B:8:00000008:DC=contoso,DC=com;
 - B:8:00000008:CN=Configuration,DC=contoso,DC=com;
 - 3> name: a00d8e30-9afb-47de-80e3-06f53ffd88bd;
 - 1> objectCategory: CN=NTDS-Connection,CN=Schema,CN=Configuration,DC=contoso,DC=com;
 - 3> objectClass: top; leaf; nTDSConnection;
 - 1> objectGUID: 9a3269e9-8bae-4bc2-a201-865d1b4785c6;
 - 1> options: 0x1 = (IS_GENERATED);
 - 1> schedule: Size: 188, Bandwidth: 0, NumberOfSchedules: 1, Schedules[0].Type: 0, Schedules[0].Offset: 20 1000.1000.1000.1000.... 0.1000.1000.1000.1000.1000.1000.1000.1000.1000. ;
 - 1> showInAdvancedViewOnly: TRUE;
 - 1> systemFlags: 0x60000000 = (CONFIG_ALLOW_RENAME | CONFIG_ALLOW_MOVE);
 - 1> uSNChanged: 41448;
 - 1> uSNCreated: 12337;
 - 1> whenChanged: 7/22/2011 3:25:14 PM Pacific Daylight Time;
 - 1> whenCreated: 7/21/2011 2:54:55 PM Pacific Daylight Time;

4.1.29.4.2 Client Request

DC1 invokes the IDL_DRSAddClonedDC method against the PDC with the following parameters (DRS_HANDLE is omitted):

- *dwInVersion* = 1

- *pmsgIn* = DRS_MSG_ADDCLONEDCREQ_V1
 - *pwszCloneDCName* = "DC1Clone1"
 - *pwszSite* = Site1
 - Here Site1 is an existing site.

4.1.29.4.3 Server Response

Return code of 0 and the following values:

- *pdwOutVersion*^ = 1
- *pmsgOut* = DRS_MSG_ADDCLONEDCREPLY_V1
 - *pwszCloneDCname*: DC1Clone1
 - *pwszSite*: Site1
 - *cPasswordLength*: 120
 - *pwsNewDCAccountPassword*: "a;adoba01>...4ei1283-0"

4.1.29.4.4 Final State

After the clone operation, objects for a new domain controller "DC1Clone1" are present in the CONTOSO.COM domain, querying the PDC as follows:

- Expanding base 'CN=DC1CLONE1,OU=Domain Controllers,DC=contoso,DC=com'...
- Result <0>: (null)
- Matched DNs:
- Getting 1 entries:
- >> Dn: CN=DC1CLONE1,OU=Domain Controllers,DC=contoso,DC=com
 - 5> objectClass: top; person; organizationalPerson; user; computer;
 - 1> cn: DC1CLONE1;
 - 1> distinguishedName: CN=DC1CLONE1, OU=Domain Controllers, DC=contoso, DC=com;
 - 1> instanceType: 0x4 = (IT_WRITE);
 - 1> whenCreated: 07/27/2011 18:04:35 Pacific Standard Daylight Time;
 - 1> whenChanged: 07/27/2011 19:39:05 Pacific Standard Daylight Time;
 - 1> uSNCreated: 12291;
 - 1> uSNChanged: 24577;
 - 1> name: DC1CLONE1;
 - 1> objectGUID: b6734e82-727f-49e9-a1f5-f08ad23cb3ff;
 - 1> userAccountControl: (UF_SERVER_TRUST_ACCOUNT | UF_TRUSTED_FOR_DELEGATION);
 - 1> codePage: 0;

- 1> countryCode: 0;
- 1> localPolicyFlags: 0;
- 1> pwdLastSet: 07/10/2006 18:04:35 Pacific Standard Daylight Time;
- 1> primaryGroupID: 516;
- 1> objectSid: S-1-5-21-254470460-2440132622-709970653-1051;
- 1> accountExpires: 09/14/30828 02:48:05 UNC ;
- 1> sAMAccountName: DC1CLONE1\$;
- 1> sAMAccountType: 805306369;
- 1> serverReferenceBL: CN=DC1CLONE1,CN=Servers,
CN=Site1,CN=Sites,CN=Configuration,DC=contoso,DC=com;
- 1> dNSHostName: DC1CLONE1.contoso.com;
- 15> servicePrincipalName: ldap/DC1CLONE1.contoso.com/NDNC5.contoso.com;
ldap/DC1CLONE1.contoso.com/NDNC2.contoso.com;
ldap/DC1CLONE1.contoso.com/NDNC1.contoso.com;
GC/DC1CLONE1.contoso.com/contoso.com; HOST/DC1CLONE1.contoso.com/CONTOSO;
HOST/DC1CLONE1; HOST/DC1CLONE1.contoso.com;
HOST/DC1CLONE1.contoso.com/contoso.com; E3514235-4B06-11D1-AB04-
00C04FC2DCD2/c20bc312-4d35-4cc0-9903-b1073368af4a/contoso.com; ldap/c20bc312-
4d35-4cc0-9903-b1073368af4a._msdcs.contoso.com;
ldap/DC1CLONE1.contoso.com/CONTOSO; ldap/DC1CLONE1; ldap/DC1CLONE1.contoso.com;
ldap/DC1CLONE1.contoso.com/contoso.com; NtFrs-88f5d2bd-b646-11d2-a6d3-
00c04fc9b232/DC1CLONE1.contoso.com;
- 1> objectCategory: CN=Computer, CN=Schema, CN=Configuration, DC=contoso, DC=com;
- 1> isCriticalSystemObject: TRUE;
- 1> frsComputerReferenceBL: CN=DC1CLONE1, CN=Domain System Volume (SYSVOL
share),CN=File Replication Service,CN=System,DC=contoso,DC=com;

Querying the DC1CLONE1 configuration objects in config NC CN=Configuration, DC=CONTOSO, DC=COM by performing an LDAP search with subtree scope on the DN "CN=DC1CLONE1, CN=DC1CLONE1,CN=Servers,CN=Site1,CN=Sites,CN=Configuration,DC=contoso,DC=com":

- ldap_search_s(ld,
"CN=ALPHA10,CN=Servers,CN=Site1,CN=Sites,CN=Configuration,DC=contoso,DC=com", 2,
"(objectClass=*)", attrList, 0, &msg)
- Getting 5 entries:
- >>Dn: CN=DC1CLONE1,CN=Servers,CN=Site1,CN=Sites,CN=Configuration,DC=contoso,DC=com
 - 1> cn: DC1CLONE1;
 - 1> distinguishedName:
CN=DC1CLONE1,CN=Servers,CN=Site1,CN=Sites,CN=Configuration,DC=contoso,DC=com;
 - 1> dNSHostName: DC1CLONE1.mohkhan-TEST10.nttest.microsoft.com;
 - 1> dSCorePropagationData: 0x0 = ();
 - 1> instanceType: 0x4 = (WRITE);

- 1> name: DC1CLONE1;
- 1> objectCategory: CN=Server,CN=Schema,CN=Configuration,DC=contoso,DC=com;
- 2> objectClass: top; server;
- 1> objectGUID: 9d308291-d1c8-41cd-a32b-8aa62746a9b9;
- 1> serverReference: CN=DC1CLONE1,OU=Domain Controllers,DC=contoso,DC=com;
- 1> showInAdvancedViewOnly: TRUE;
- 1> systemFlags: 0x52000000 = (CONFIG_ALLOW_RENAME | CONFIG_ALLOW_LIMITED_MOVE | DISALLOW_MOVE_ON_DELETE);
- 1> uSNChanged: 17763;
- 1> uSNCreated: 17747;
- 1> whenChanged: 7/21/2011 12:51:29 PM Pacific Daylight Time;
- 1> whenCreated: 7/21/2011 12:18:57 PM Pacific Daylight Time;
- >> Dn: CN=NTDS Settings,CN=DC1CLONE1,CN=Servers,CN=Site1,CN=Sites,CN=Configuration,DC=contoso,DC=com
 - 1> cn: NTDS Settings;
 - 1> distinguishedName: CN=NTDS Settings,CN=DC1CLONE1,CN=Servers,CN=Site1,CN=Sites,CN=Configuration,DC=contoso,DC=com;
 - 1 > dMDLocation: CN=Schema,CN=Configuration,DC=contoso,DC=com;
 - 1> dScorePropagationData: 0x0 = ();
 - 3> hasMasterNCs: CN=Schema,CN=Configuration,DC=contoso,DC=com; CN=Configuration,DC=contoso,DC=com; DC=contoso,DC=com;
 - 1> instanceType: 0x4 = (WRITE);
 - 1> invocationId: 5a2a4503-ffad-4884-a420-a0fafbc0efbe;
 - 1> msDS-Behavior-Version: 5;
 - 1> msDS-HasDomainNCs: DC=contoso,DC=com;
 - 3> msDS-HasInstantiatedNCs: B:8:0000000D:CN=Schema,CN=Configuration,DC=contoso,DC=com; B:8:0000000D:CN=Configuration,DC=contoso,DC=com; B:8:00000005:DC=contoso,DC=com;
 - 3> msDS-hasMasterNCs: N=Schema,CN=Configuration,DC=contoso,DC=com; CN=Configuration,DC=contoso,DC=com; DC=contoso,DC=com;
 - 1> name: NTDS Settings;
 - 1> objectCategory: CN=NTDS-DSA,CN=Schema,CN=Configuration,DC=contoso,DC=com;
 - 3> objectClass: top; applicationSettings; nTDSDSA;

- 1> objectGUID: cbd9c90a-0758-4cf2-987e-fa44768ab78d;
- 1> options: 0x1 = (IS_GC);
- 1> serverReferenceBL: CN=DC1CLONE1,CN=Domain System Volume (SYSVOL share),CN=File Replication Service,CN=System,DC=contoso,DC=com;
- 1> showInAdvancedViewOnly: TRUE;
- 1> systemFlags: 0x2000000 = (DISALLOW_MOVE_ON_DELETE);
- 1> uSNChanged: 17777;
- 1> uSNCreated: 17755;
- 1> whenChanged: 7/21/2011 12:51:29 PM Pacific Daylight Time;
- 1> whenCreated: 7/21/2011 12:18:57 PM Pacific Daylight Time;

4.1.30 IDL_DRSWriteNgcKey (Opnum 29)

The IDL_DRSWriteNgcKey method composes and updates the msDS-KeyCredentialLink value on an object.

```

ULONG IDL_DRSWriteNgcKey(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
        DRS_MSG_WRITENGCKEYREQ* pmsgIn,
    [out, ref] DWORD* pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DRS_MSG_WRITENGCKEYREPLY* pmsgOut
);

```

hDrs: The RPC context handle returned by the IDL_DRSBind method.

dwInVersion: The version of the request message. Must be set to 1, because that is the only version supported.

pmsgIn: A pointer to the request message.

pdwOutVersion: A pointer to the version of the response message. The value must be 1 because that is the only version supported.

pmsgOut: A pointer to the response message.

Return Values: 0 if successful, or a Windows error code if a failure occurs.

Exceptions Thrown: This method might throw the following exceptions beyond those thrown by the underlying RPC protocol (as specified in [MS-RPCE]): ERROR_INVALID_HANDLE, ERROR_DS_DRS_EXTENSIONS_CHANGED, and ERROR_INVALID_PARAMETER.

4.1.30.1 Method-Specific Concrete Types

4.1.30.1.1 DRS_MSG_WRITENGCKEYREQ

The DRS_MSG_WRITENGCKEYREQ union defines the request messages sent to the IDL_DRSWriteNgcKey method. Only one version, identified by *dwInVersion* = 1, is currently defined.

```

typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_WRITENGCKEYREQ_V1 V1;
} DRS_MSG_WRITENGCKEYREQ;

```

V1: The version 1 request.

4.1.30.1.2 DRS_MSG_WRITENGCKEYREQ_V1

The DRS_MSG_WRITENGCKEYREQ_V1 structure defines a request message sent to the IDL_DRSWriteNgcKey method.

```

typedef struct _DRS_MSG_WRITENGCKEYREQ_V1{
    [string] const WCHAR* pwszAccount;
    [range(0,0xFFFF)] DWORD cNgcKey;
    [size_is(cNgcKey)] UCHAR * pNgcKey;
} DRS_MSG_WRITENGCKEYREQ_V1;

```

pwszAccount: The DN of the object to modify.

cNgcKey: The number of bytes in the pNgcKey array.

pNgcKey: The NGC key value.

4.1.30.1.3 DRS_MSG_WRITENGCKEYREPLY

The DRS_MSG_WRITENGCKEYREPLY union defines the response messages received from the IDL_DRSWriteNgcKey method. Only one version, identified by $pdwOutVersion^{\wedge} = 1$, is currently defined.

```

typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_WRITENGCKEYREPLY_V1 V1;
} DRS_MSG_WRITENGCKEYREPLY;

```

V1: The version 1 response.

4.1.30.1.4 DRS_MSG_WRITENGCKEYREPLY_V1

The DRS_MSG_WRITENGCKEYREPLY_V1 structure defines a response message received from the IDL_DRSWriteNgcKey method.

```

typedef struct _DRS_MSG_WRITENGCKEYREPLY_V1{
    DWORD retVal;
} DRS_MSG_WRITENGCKEYREPLY_V1;

```

retVal: 0, or a Windows error code.

4.1.30.2 Method-Specific Abstract Types and Procedures

4.1.30.2.1 AccessCheckWriteToKeyCredentialLinkAttribute

```

procedure AccessCheckWriteToKeyCredentialLinkAttribute (
    obj: DSName,
    newValue: boolean) : ULONG

```

The `AccessCheckWriteToKeyCredentialLinkAttribute` procedure performs an access check to determine if the client security context, which MUST be retrieved using the method described in [MS-RPCE] section 3.3.3.4.3, has the right to modify the `msDS-KeyCredentialLink` attribute of object `obj` taking into consideration both regular and extended write property rights.

```

if AccessCheckAttr(obj,
    msDS-KeyCredentialLink,
    RIGHT_DS_WRITE_PROPERTY) then
    return ERROR_SUCCESS
else
    if AccessCheckAttr(obj,
        msDS-KeyCredentialLink,
        RIGHT_DS_WRITE_PROPERTY_EXTENDED) then
        /* Extended write access permits the attribute to be written */
        * provided certain constraints are met. */

        isSelf: boolean
        existingValue: boolean

        if (!(computer in obj!objectClass))
            return ERROR_DS_INSUFF_ACCESS_RIGHTS
        endif

        if (obj!ObjectSid = ClientAuthorizationInfo!UserSid)
            isSelf := true
        else
            isSelf := false
        endif

        if (obj!msDS-KeyCredentialLink = NULL)
            existingValue := false
        else
            existingValue := true
        endif

        if (!isSelf && newValue)
            return ERROR_DS_INSUFF_ACCESS_RIGHTS
        endif

        if (newValue && existingValue)
            return ERROR_DS_INSUFF_ACCESS_RIGHTS
        endif
        return ERROR_SUCCESS
    endif
endif

```

4.1.30.2.2 ComposeKeyCredentialLinkForComputer

```

procedure ComposeKeyCredentialLinkForComputer (
    obj: DSName,
    keyValue: array of UCHAR) : DNBinary

```

The `ComposeKeyCredentialLinkForComputer` procedure builds a `DNBinary` for an `msDS-KeyCredentialLink`. Note that the following pseudocode uses the `KEYCREDENTIALLINK_BLOB` and `KEYCREDENTIALLINK_ENTRY` structures and related constants ([MS-ADTS] section 2.2.20).

```

keyDNBinary : DNBinary
keyBinary: array of UCHAR
keyBlob: KEYCREDENTIALLINK_BLOB

```



```

keyEntry: KEYCREDENTIALLINK_ENTRY
hashOffset: DWORD
hashValueOffset: DWORD
now: DSTIME

now := Current time as DSTIME

keyBlob!Version := KEY_CREDENTIAL_LINK_VERSION_2

// Write the header
keyBinary := keyBlob

// Add KeyID
keyEntry!Length := 32
keyEntry!Identifier := KeyID
keyEntry!Value := SHA256(keyValue)

keyBinary := keyBinary + keyEntry

// Add KeyHash
keyEntry!Length := 32
keyEntry!Identifier := KeyHash
keyEntry!Value := 32-byte array of UCHAR

// Store the location of the hash
hashOffset := length(keyBinary)

keyBinary := keyBinary + keyEntry

// Store the location where the hash data starts
hashValueOffset := length(keyBinary)

// Add KeyMaterial
keyEntry!Length = length(keyValue)
keyEntry!Identifier = KeyMaterial
keyEntry!Value = keyValue

keyBinary := keyBinary + keyEntry

// Add KeyUsage
keyEntry!Length := 1
keyEntry!Identifier := KeyUsage
keyEntry!Value := 1

keyBinary := keyBinary + keyEntry

// Add KeySource
keyEntry!Length := 1
keyEntry!Identifier := KeySource
keyEntry!Value := 0

keyBinary := keyBinary + keyEntry

// Add KeyApproximateLastLogonTimeStamp
keyEntry!Length := sizeof(DSTIME)
keyEntry!Identifier := KeyApproximateLastLogonTimeStamp
keyEntry!Value := now

keyBinary := keyBinary + keyEntry

// Add KeyCreationTime
keyEntry!Length := sizeof(DSTIME)
keyEntry!Identifier := KeyCreationTime
keyEntry!Value := now

keyBinary := keyBinary + keyEntry

// Compute and store the KeyHash value now that all subsequent fields are present
keyEntry := keyBinary + hashOffset
keyEntry!Value := SHA256(keyBinary[hashValueOffset .. (length(keyBinary)-1)])

```

```

keyDNBinary!DN := obj
keyDNBinary!Binary := keyBinary
return keyDNBinary

```

4.1.30.3 Server Behavior of the IDL_DRSWriteNgcKey Method

Informative summary of behavior: The IDL_DRSWriteNgcKey method sets the msDS-KeyCredentialLink attribute of an object. The IDL_DRSWriteNgcKey method replaces any existing msDS-KeyCredentialLink attributes on the object with a new value. In this new value, the DN portion is the portion set to the account and the binary portion is set to a KEYCREDENTIALLINK_BLOB with the following KEYCREDENTIALLINK_ENTRY entries set. (See [MS-ADTS] section 2.2.20 for structures and constants.)

- KeyID – Value set to a SHA256 hash of the pNgcKey.
- KeyHash – Value set as defined in [MS-ADTS] section 2.2.20.5.
- KeyMaterial – Value set to the pNgcKey array.
- KeyUsage – Value set to KEY_USAGE_NGC.
- KeySource – Value set to KEY_SOURCE_AD.
- KeyApproximateLastLogonTimeStamp – Value set to the current time.
- KeyCreationTime – Value set to the current time.

The effect of this method can be achieved by an LDAP Modify operation to the msDS-KeyCredentialLink attribute of an object.

```

ULONG IDL_DRSWriteNgcKey(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
        DRS_MSG_WRITENGCKEYREQ* pmsgIn,
    [out, ref] DWORD* pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DRS_MSG_WRITENGCKEYREPLY* pmsgOut);

accountDN: unicodestring
account: DSName
keyValue : array of UCHAR
err: DWORD
key: DNBinary

ValidateDRSInput(hDrs, 29)

pdwOutVersion^ := 1
pmsgOut^.V1.retVal := 0

/* Input parameter validation */
if dwInVersion ≠ 1 then
    pmsgOut^.V1.retVal := ERROR_INVALID_PARAMETER
    return ERROR_INVALID_PARAMETER
endif

/* Input parameter validation */
if ClientUUID(hDrs) ≠ NTDSAPI_CLIENT_GUID
    pmsgOut^.V1.retVal := ERROR_INVALID_PARAMETER
    return ERROR_INVALID_PARAMETER
endif

accountDN := pmsgIn^.V1.pwszAccount
keyValue := pmsgIn^.V1.pNgcKey

```

```

if accountDN = null or accountDN = "" then
    pmsgOut^.Vl.retVal := ERROR_INVALID_PARAMETER
    return ERROR_INVALID_PARAMETER
endif

account := GetDSNameFromDN(accountDN);
if not ObjExists(account) then
    pmsgOut^.Vl.retVal := ERROR_DS_OBJ_NOT_FOUND
    return ERROR_DS_OBJ_NOT_FOUND
endif

/* Perform access checks */
err = AccessCheckWriteToKeyCredentialLinkAttribute(account, true)
if err ≠ ERROR_SUCCESS then
    pmsgOut^.Vl.retVal := err
    return err
endif
key := ComposeKeyCredentialLinkForComputer(account, keyValue);
account!msDS-KeyCredentialLink := key

return 0

```

4.1.31 IDL_DRSReadNgcKey (Opnum 30)

The IDL_DRSReadNgcKey method reads and parses the msDS-KeyCredentialLink value on an object.

```

ULONG IDL_DRSReadNgcKey(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
        DRS_MSG_READNGCKEYREQ* pmsgIn,
    [out, ref] DWORD* pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DRS_MSG_READNGCKEYREPLY* pmsgOut
);

```

hDrs: The RPC context handle returned by the IDL_DRSBind method.

dwInVersion: The version of the request message. Must be set to 1, because that is the only version supported.

pmsgIn: A pointer to the request message.

pdwOutVersion: A pointer to the version of the response message. The value must be 1 because that is the only version supported.

pmsgOut: A pointer to the response message.

Return Values: 0 if successful, or a Windows error code if a failure occurs.

Exceptions Thrown: This method might throw the following exceptions beyond those thrown by the underlying RPC protocol (as specified in [MS-RPCE]): ERROR_INVALID_HANDLE, ERROR_DS_DRS_EXTENSIONS_CHANGED, and ERROR_INVALID_PARAMETER.

4.1.31.1 Method-Specific Concrete Types

4.1.31.1.1 DRS_MSG_READNGCKEYREQ

The DRS_MSG_READNGCKEYREQ union defines the request messages sent to the IDL_DRSReadNgcKey method. Only one version, identified by *dwInVersion* = 1, is currently defined.

```

typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_READNGCKEYREQ_V1 V1;
} DRS_MSG_READNGCKEYREQ;

```

V1: The version 1 request.

4.1.31.1.2 DRS_MSG_READNGCKEYREQ_V1

The `DRS_MSG_READNGCKEYREQ_V1` structure defines a request message sent to the `IDL_DRSReadNgcKey` method.

```

typedef struct _DRS_MSG_READNGCKEYREQ_V1{
    [string] const WCHAR* pwszAccount;
} DRS_MSG_READNGCKEYREQ_V1;

```

pwszAccount: The DN of the object to read.

4.1.31.1.3 DRS_MSG_READNGCKEYREPLY

The `DRS_MSG_READNGCKEYREPLY` union defines the response messages received from the `IDL_DRSReadNgcKey` method. Only one version, identified by `pdwOutVersion^ = 1`, is currently defined.

```

typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_READNGCKEYREPLY_V1 V1;
} DRS_MSG_READNGCKEYREPLY;

```

V1: The version 1 response.

4.1.31.1.4 DRS_MSG_READNGCKEYREPLY_V1

The `DRS_MSG_READNGCKEYREPLY_V1` structure defines a response message received from the `IDL_DRSReadNgcKey` method.

```

typedef struct _DRS_MSG_READNGCKEYREPLY_V1{
    DWORD retVal;
    [range(0,0xFFFF)] DWORD cNgcKey;
    [size_is(cNgcKey)] UCHAR * pNgcKey;
} DRS_MSG_READNGCKEYREPLY_V1;

```

retVal: Zero, or a Windows error code.

cNgcKey: The number of bytes in the **pNgcKey** array.

pNgcKey: The NGC key value.

4.1.31.2 Server Behavior of the `IDL_DRSReadNgcKey` Method

Informative summary of behavior: The `IDL_DRSReadNgcKey` method reads the `msDS-KeyCredentialLink` attribute values of an object, attempts to parse the `msDS-KeyCredentialLink`

attribute on the object and returns the KeyMaterial field ([MS-ADTS] section 2.2.20.5) from the first entry that is successfully parsed. The order in which the values are parsed is implementation specific. Note that the following pseudocode uses the KEYCREDENTIALLINK_BLOB and KEYCREDENTIALLINK_ENTRY structures and related constants ([MS-ADTS] section 2.2.20).

```

ULONG IDL_DRSReadNgcKey(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
        DRS_MSG_READNGCKEYREQ* pmsgIn,
    [out, ref] DWORD* pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DRS_MSG_READNGCKEYREPLY* pmsgOut);

accountDN: unicodestring
account: DSName
keyValue : array of UCHAR
err: DWORD
key: DNBinary
keyBinary: array of BYTE
keyBlob: KEYCREDENTIALLINK_BLOB
keyEntry: KEYCREDENTIALLINK_ENTRY
offset: DWORD

ValidateDRSInput(hDrs, 30)

pdwOutVersion^ := 1
pmsgOut^.V1.retVal := 0

/* Input parameter validation */
if dwInVersion != 1 then
    pmsgOut^.V1.retVal := ERROR_INVALID_PARAMETER
    return ERROR_INVALID_PARAMETER
endif

/* Input parameter validation */
if ClientUUID(hDrs) != NTDSAPI_CLIENT_GUID
    pmsgOut^.V1.retVal := ERROR_INVALID_PARAMETER
    return ERROR_INVALID_PARAMETER
endif

accountDN := pmsgIn^.V1.pwszAccount

if accountDN = null or accountDN = "" then
    pmsgOut^.V1.retVal := ERROR_INVALID_PARAMETER
    return ERROR_INVALID_PARAMETER
endif

account := GetDSNameFromDN(accountDN);
if not ObjExists(account) then
    pmsgOut^.V1.retVal := ERROR_DS_OBJ_NOT_FOUND
    return ERROR_DS_OBJ_NOT_FOUND
endif

/* Perform access checks */
if (!AccessCheckAttr(account,
    msDS-KeyCredentialLink,
    RIGHT_DS_READ_PROPERTY)) then
    return ERROR_DS_INSUFF_ACCESS_RIGHTS
endif
keyValue := NULL

foreach (key in obj!msDS-KeyCredentialLink)
    keyBinary := key!Binary
    offset := 0
    keyBlob := keyBinary
    offset := offset + sizeof(keyBlob)

```

```

if (keyBlob!Version != KEY_CREDENTIAL_LINK_VERSION_2)
    continue
endif

while (offset < length(keyBinary))
    keyEntry := keyBinary[offset]
    offset :=
        offset +
        sizeof(keyEntry!Length) +
        sizeof(keyEntry!Identifier) +
        keyEntry!Length

    if (keyEntry!Identifier = KeyMaterial)
        keyValue := keyEntry!Value
        break
    endif
endwhile
if (keyValue != NULL)
    break
endif
endifor

if (keyValue == NULL)
    return ERROR_DS_OBJ_NOT_FOUND
endif

pmsgOut^.V1.pNgcKey := keyValue
pmsgOut^.V1.cNgcKey := length(keyValue)
return 0

```

4.2 dsaop RPC Interface

This section specifies the methods for the dsaop RPC interface of the DRS Remote Protocol, in addition to the processing rules. This interface is available only when msDS-UpdateScript contains a valid value, where the validation criterion is implementation-specific.

Methods in RPC Opnum Order

Method	Description
IDL_DSAPrepareScript	Prepares the DC to run a maintenance script. Opnum: 0
IDL_DSAAExecuteScript	Executes a maintenance script. Opnum: 1

For information on the order of method calls, see section 1.3.2.

All methods MUST NOT throw exceptions.

4.2.1 IDL_DSAPrepareScript (Opnum 0)

The IDL_DSAPrepareScript method prepares the DC to run a maintenance script.

```

ULONG IDL_DSAPrepareScript(
    [in] handle_t hRpc,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
    DSA_MSG_PREPARE_SCRIPT_REQ* pmsgIn,
    [out, ref] DWORD* pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
    DSA_MSG_PREPARE_SCRIPT_REPLY* pmsgOut
)

```

);

hRpc: The RPC binding handle, as specified in [C706].

dwInVersion: The version of the request message.

pmsgIn: A pointer to the request message.

pdwOutVersion: A pointer to the version of the response message.

pmsgOut: A pointer to the response message.

Return Values: 0 if successful, or a Windows error code if a failure occurs.

4.2.1.1 Method-Specific Concrete Types

4.2.1.1.1 DSA_MSG_PREPARE_SCRIPT_REQ

The DSA_MSG_PREPARE_SCRIPT_REQ union defines the request messages sent to the IDL_DSAPrepareScript method.

```
typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DSA_MSG_PREPARE_SCRIPT_REQ_V1 V1;
} DSA_MSG_PREPARE_SCRIPT_REQ;
```

V1: The version 1 request.

4.2.1.1.2 DSA_MSG_PREPARE_SCRIPT_REQ_V1

The DSA_MSG_PREPARE_SCRIPT_REQ_V1 structure defines a request message sent to the IDL_DSAPrepareScript method.

```
typedef struct {
    DWORD Reserved;
} DSA_MSG_PREPARE_SCRIPT_REQ_V1;
```

Reserved: Unused. MUST be 0 and ignored.

4.2.1.1.3 DSA_MSG_PREPARE_SCRIPT_REPLY

The DSA_MSG_PREPARE_SCRIPT_REPLY union defines the response messages received from the IDL_DSAPrepareScript method.

```
typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DSA_MSG_PREPARE_SCRIPT_REPLY_V1 V1;
} DSA_MSG_PREPARE_SCRIPT_REPLY;
```

V1: The version 1 response.

4.2.1.1.4 DSA_MSG_PREPARE_SCRIPT_REPLY_V1

The `DSA_MSG_PREPARE_SCRIPT_REPLY_V1` structure defines a response message received from the `IDL_DSAPrepareScript` method.

```
typedef struct {
    DWORD dwOperationStatus;
    [string] LPWSTR pwErrorMessage;
    [range(0,1024)] DWORD cbPassword;
    [size_is(cbPassword)] BYTE* pbPassword;
    [range(0,10485760)] DWORD cbHashBody;
    [size_is(cbHashBody)] BYTE* pbHashBody;
    [range(0,10485760)] DWORD cbHashSignature;
    [size_is(cbHashSignature)] BYTE* pbHashSignature;
} DSA_MSG_PREPARE_SCRIPT_REPLY_V1;
```

dwOperationStatus: 0 if successful, or a Windows error code if a fatal error occurred.

pwErrorMessage: Null if successful, or a description of an error if a fatal error occurred.

cbPassword: The count, in bytes, of the **pbPassword** array.

pbPassword: The password.

cbHashBody: The count, in bytes, of the **pbHashBody** array.

pbHashBody: The hash of the script value.

cbHashSignature: The count, in bytes, of the **pbHashSignature** array.

pbHashSignature: The script signature.

4.2.1.2 Method-Specific Abstract Types and Procedures

4.2.1.2.1 GetKeyLengthHandleT

```
procedure GetKeyLengthHandleT(hRpc: handle_t): integer
```

Returns the key length, in bits, of the encryption used on the *hRpc* connection. Returns 0 if no encryption is in use on the connection.

4.2.1.2.2 PrepareScriptInProgress

```
procedure PrepareScriptInProgress(): boolean
```

Returns true if an instance of the `IDL_DSAPrepareScript()` method is already executing, and false otherwise.

4.2.1.2.3 PrepareScriptVerifyScript

```
procedure PrepareScriptVerifyScript(pc: DSName): boolean
```

Executes an NC Rename(*pc!*msDS-UpdateScript, false), as specified in [MS-ADTS] section 3.1.1.12. Returns true if the return value of NC Rename is 0 and false otherwise.

4.2.1.2.4 PrepareScriptHashBody

```
procedure PrepareScriptHashBody(pc: DSName): sequence of BYTE
```


Returns a **SHA1 hash** of the value of `pc!msDS-UpdateScript`.

4.2.1.2.5 PrepareScriptHashSignature

```
procedure PrepareScriptHashSignature(pc: DSName): sequence of BYTE
```

Returns a SHA1 hash of the value formed by appending the GUID {0916C8E3-3431-4586-AF77-44BD3B16F961} to the value of `pc!msDS-UpdateScript`.

4.2.1.2.6 PrepareScriptGeneratePassword

```
procedure PrepareScriptGeneratePassword(): sequence of BYTE
```

Returns a randomly generated password for use in a subsequent call to `IDL_DSASExecuteScript`.

4.2.1.3 Server Behavior of the IDL_DSAPrepareScript Method

Informative summary of behavior: The `IDL_DSAPrepareScript` method prepares for a subsequent call to `IDL_DSASExecuteScript`. The **partitions container** that is a child object of the root of the configuration NC is altered as follows:

- The value of `msDS-UpdateScript` is validated.
- If valid, a password is generated and stored in the value for `msDS-ExecuteScriptPassword`.

The password, a hash of the value stored in `msDS-UpdateScript`, and a hash of that same value with the GUID {0916C8E3-3431-4586-AF77-44BD3B16F961} appended are returned to the client. The returned password value is later passed back by the client in a call to `IDL_DSASExecuteScript` as a form of authorization.

```
ULONG
IDL_DSAPrepareScript(
    [in] handle_t hRpc,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
        DSA_MSG_PREPARE_SCRIPT_REQ *pmsgIn,
    [out, ref] DWORD *pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DSA_MSG_PREPARE_SCRIPT_REPLY *pmsgOut);

pc: DSName
msgIn: DSA_MSG_PREPARE_SCRIPT_REQ_V1
byteseq: sequence of BYTE

/* Returned message will be version 1 */
pdwOutVersion^ := 1
pmsgOut^V1.dwOperationStatus := ERROR_DS_INTERNAL_FAILURE
pmsgOut^V1.pwErrorMessage := null
pmsgOut^V1.cbPassword := 0
pmsgOut^V1.pbPassword := null
pmsgOut^V1.cbHashBody := 0
pmsgOut^V1.pbHashBody := null
pmsgOut^V1.cbHashSignature := 0
pmsgOut^V1.pbHashSignature := null

/* Validate the version */
if dwInVersion ≠ 1 then
    return ERROR_INVALID_PARAMETER
endif
msgIn := pmsgIn^V1
```

```

/* Validate input params */
if msgIn.Reserved ≠ 0 then
    return ERROR_INVALID_PARAMETER
endif

/* Only 1 instance of this call can be running. */
if PrepareScriptInProgress() then
    pmsgOut^.V1.dwOperationStatus := ERROR_ACCESS_DENIED
    pmsgOut^.V1.pwErrMsg := human-readable description of the error
    return 0
endif

/* Locate the Partitions container directly beneath ConfigNC */
pc := DescendantObject(ConfigNC(), "CN=Partitions,")

/* Forest functionality level must be Win2K3 or above */
if pc!msDS-Behavior-Version = null or
    pc!msDS-Behavior-Version < DS_BEHAVIOR_WIN2003 then
    return ERROR_DS_NOT_SUPPORTED
endif

/* Security checks */
if not AccessCheckAttr(
    pc, msDS-UpdateScript, RIGHT_DS_WRITE_PROPERTY) then
    pmsgOut^.V1.dwOperationStatus := ERROR_DS_AUTHORIZATION_FAILED
    pmsgOut^.V1.pwErrMsg := human-readable description of the error
    return 0
endif

if not AccessCheckCAR(pc, DS-Execute-Intentions-Script) then
    pmsgOut^.V1.dwOperationStatus := ERROR_DS_AUTHORIZATION_FAILED
    pmsgOut^.V1.pwErrMsg := human-readable description of the error
    return 0
endif

if GetKeyLengthHandleT(hRpc) < 128 then
    pmsgOut^.V1.dwOperationStatus := ERROR_DS_STRONG_AUTH_REQUIRED
    pmsgOut^.V1.pwErrMsg := human-readable description of the error
    return 0
endif

/* Validate stored script */
if not PrepareScriptVerifyScript(pc) then
    pmsgOut^.V1.dwOperationStatus := ERROR_DS_INVALID_SCRIPT
    pmsgOut^.V1.pwErrMsg := human-readable description of the error
    return 0
endif

/* Generate and return password for subsequent call to
 * IDL_DSASExecuteScript() */
pc!msDS-ExecuteScriptPassword := PrepareScriptGeneratePassword()

/* Return password and hashes */
byteseq := pc!msDS-ExecuteScriptPassword
pmsgOut^.V1.pbPassword := byteseq
pmsgOut^.V1.cbPassword := byteseq.length

byteseq := PrepareScriptHashBody(pc)
pmsgOut^.V1.pbHashBody := byteseq
pmsgOut^.V1.cbHashBody := byteseq.length

byteseq := PrepareScriptHashSignature(pc)
pmsgOut^.V1.pbHashSignature := byteseq
pmsgOut^.V1.cbHashSignature := byteseq.length

pmsgOut^.V1.dwOperationStatus := 0
return 0

```

4.2.2 IDL_DSAExecuteScript (Opnum 1)

The IDL_DSAExecuteScript method executes a maintenance script.

```
ULONG IDL_DSAExecuteScript(  
    [in] handle_t hRpc,  
    [in] DWORD dwInVersion,  
    [in, ref, switch_is(dwInVersion)]  
        DSA_MSG_EXECUTE_SCRIPT_REQ* pmsgIn,  
    [out, ref] DWORD* pdwOutVersion,  
    [out, ref, switch_is(*pdwOutVersion)]  
        DSA_MSG_EXECUTE_SCRIPT_REPLY* pmsgOut  
);
```

hRpc: The RPC binding handle, as specified in [C706].

dwInVersion: The version of the request message.

pmsgIn: A pointer to the request message.

pdwOutVersion: A pointer to the version of the response message.

pmsgOut: A pointer to the response message.

Return Values: 0 if successful, or a Windows error code if a failure occurs.

4.2.2.1 Method-Specific Concrete Types

4.2.2.1.1 DSA_MSG_EXECUTE_SCRIPT_REQ

The DSA_MSG_EXECUTE_SCRIPT_REQ union defines the request messages sent to the IDL_DSAExecuteScript method.

```
typedef  
[switch_type(DWORD)]  
union {  
    [case(1)]  
        DSA_MSG_EXECUTE_SCRIPT_REQ_V1 V1;  
} DSA_MSG_EXECUTE_SCRIPT_REQ;
```

V1: The version 1 request.

4.2.2.1.2 DSA_MSG_EXECUTE_SCRIPT_REQ_V1

The DSA_MSG_EXECUTE_SCRIPT_REQ_V1 structure defines a request message sent to the IDL_DSAExecuteScript method.

```
typedef struct {  
    DWORD Flags;  
    [range(1,1024)] DWORD cbPassword;  
    [size_is(cbPassword)] BYTE* pbPassword;  
} DSA_MSG_EXECUTE_SCRIPT_REQ_V1;
```

Flags: Unused. MUST be 0 and ignored.

cbPassword: The count, in bytes, of the **pbPassword** array.

pbPassword: The password.

4.2.2.1.3 DSA_MSG_EXECUTE_SCRIPT_REPLY

The DSA_MSG_EXECUTE_SCRIPT_REPLY union defines the response messages received from the IDL_DSASExecuteScript method.

```
typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DSA_MSG_EXECUTE_SCRIPT_REPLY_V1 V1;
} DSA_MSG_EXECUTE_SCRIPT_REPLY;
```

V1: The version 1 request.

4.2.2.1.4 DSA_MSG_EXECUTE_SCRIPT_REPLY_V1

The DSA_MSG_EXECUTE_SCRIPT_REPLY_V1 structure defines a response message received from the IDL_DSASExecuteScript method.

```
typedef struct {
    DWORD dwOperationStatus;
    [string] LPWSTR pwErrorMessage;
} DSA_MSG_EXECUTE_SCRIPT_REPLY_V1;
```

dwOperationStatus: 0 if successful, or a Windows error code if a fatal error occurred.

pwErrorMessage: Null if successful, or a description of the error if a fatal error occurred.

4.2.2.2 Method-Specific Abstract Types and Procedures

4.2.2.2.1 ExecuteScriptInProgress

```
procedure ExecuteScriptInProgress(): boolean
```

Returns true if an instance of the IDL_DSASExecuteScript method is already executing, and false otherwise.

4.2.2.2.2 ExecuteScript

```
procedure ExecuteScript(pc: DSName): ULONG
```

Executes an NC Rename(*pc!*msDS-UpdateScript, true), as specified in [MS-ADTS] section 3.1.1.12. Returns the return value of the NC Rename.

4.2.2.3 Server Behavior of the IDL_DSASExecuteScript Method

Informative summary of behavior: The value of the attribute msDS-UpdateScript is executed as a transacted sequence of updates. The RPC call is not authenticated using normal means (that is, it can be performed by an anonymous caller). However, the password value passed by the caller must have to match the password that was obtained by a prior call to the IDL_DSASPrepareScript method on the same DC.

```
ULONG
IDL_DSASExecuteScript(
    [in] handle_t hRpc,
```

```

[in] DWORD dwInVersion,
[in, ref, switch_is(dwInVersion)]
    DSA_MSG_EXECUTE_SCRIPT_REQ *pmsgIn,
[out, ref] DWORD *pdwOutVersion,
[out, ref, switch_is(*pdwOutVersion)]
    DSA_MSG_EXECUTE_SCRIPT_REPLY *pmsgOut);

pc: DSName
msgIn: DSA_MSG_EXECUTE_SCRIPT_REQ_V1

/* returned message is version 1 */
pdwOutVersion^ := 1

pmsgOut^.V1.dwOperationStatus := ERROR_DS_INTERNAL_FAILURE
pmsgOut^.V1.pwErrorMessage := null

/* Validate the version */
if dwInVersion # 1 then
    return ERROR_INVALID_PARAMETER
endif
msgIn := pmsgIn^.V1

/* Only 1 instance of this call can be running. */
if ExecuteScriptInProgress() then
    pmsgOut^.V1.dwOperationStatus := ERROR_ACCESS_DENIED
    pmsgOut^.V1.pwErrorMessage := human-readable description of the error
    return 0
endif

pc := DescendantObject(ConfigNC(), "CN=Partitions,")

/* Forest functionality level must be Win2K3 or above */
if pc!msDS-Behavior-Version = null or
    pc!msDS-Behavior-Version < DS_BEHAVIOR_WIN2003 then
    return ERROR_DS_NOT_SUPPORTED
endif

/* Passwords match? */
if pc!msDS-ExecuteScriptPassword # msgIn.pbPassword then
    pmsgOut^.V1.dwOperationStatus := ERROR_DS_AUTHORIZATION_FAILED
    pmsgOut^.V1.pwErrorMessage := human-readable description of the error
    return 0
endif

/* Execute and delete the script. */
pmsgOut^.V1.dwOperationStatus := ExecuteScript(pc)
if pmsgOut^.V1.dwOperationStatus = 0 then
    /* Script executed successfully. Remove the script value */
    pc!msDS-UpdateScript := null
else
    pmsgOut^.V1.pwErrorMessage := human-readable description of the error
endif

return 0

```

5 Common Data Types, Variables, and Procedures

This section contains types that are used by two or more drsuapi or dsaop methods, or types that are used in this specification but normatively specified in other specifications. It also contains types and procedures used only within the specification. This section is arranged in order by type or procedure name.

The specification of message syntax in this section is normative for syntax only. The behavior descriptions for types representing messages are informative. Consult the behavior description for each method that uses a type for the normative specification of behavior related to that type.

"Hand-marshaled" types are types passed as BLOBs through RPC and types stored as BLOBs in the directory. Any type that is "hand-marshaled" is specified pictorially in this section to emphasize the layout of any multibyte quantities it contains. The layout is always little-endian. If a type is both "hand-marshaled" and marshaled by RPC, then an IDL specification of the type is given in addition to the pictorial specification.

This specification uses the definitions of RPC base types. Additional data types used in this protocol are specified in this section.

Note that values of some types are marshaled by RPC as structures in some cases and as little-endian byte arrays in other cases. An example is DSName, which *may can* be marshaled as a DSName *pObject field of an ENTINF, or as a UCHAR *pVal field of an ATTRVAL. Where such cases exist, the structure is defined both in **MIDL** syntax and in a byte diagram, and the byte array cases are clearly identified so that big-endian architectures can perform the necessary byte swapping. (For example, see ATTRVAL conversions.)

5.1 AbstractPTFromConcretePT

```
procedure AbstractPTFromConcretePT(  
    concretePrefixTable: SCHEMA_PREFIX_TABLE): PrefixTable
```

Informative summary of behavior: The AbstractPTFromConcretePT procedure translates the SCHEMA_PREFIX_TABLE structure to an abstract PrefixTable.

```
prefixTable: PrefixTable  
schemaSignature: sequence of BYTE  
i: DWORD  
  
for i := 0 to (concretePrefixTable.PrefixCount - 1)  
    prefixTable[i].prefixString :=  
        concretePrefixTable.pPrefixTableEntry[i].prefix  
    prefixTable[i].prefixIndex :=  
        concretePrefixTable.pPrefixTableEntry[i].ndx  
endfor  
  
return concretePrefixTable
```

5.2 AccessCheckAttr

```
procedure AccessCheckAttr(  
    dsName: DSName, attr: ATTRTYP, right: Right): boolean
```

The AccessCheckAttr procedure returns true if *dsName* identifies an object within an NC replica hosted by the server, and if the client's security context, which **MUST** be retrieved using the method described in [MS-RPCE] section 3.3.3.4.3, has the access indicated by the access right **right** to the

attribute **attr** on that object according to the algorithm specified in [MS-DTYP] section 2.5.3.2. The procedure returns false otherwise.

See [MS-ADTS] section 5.1.3 for the specification of this procedure.

See [MS-ADTS] section 5.1.3.2 for the list of symbolic names for access rights (for example, RIGHT_DS_WRITE_PROPERTY) and the numeric value of each.

5.3 AccessCheckCAR

```
procedure AccessCheckCAR(dsName: DSName; right: Right): boolean
```

The AccessCheckCAR procedure returns true if *dsName* identifies an object within an NC replica hosted by the server, and if the client's security context, which MUST be retrieved using the method described in [MS-RPCE] section 3.3.3.4.3, has the access indicated by the control access right **right** on that object according to the algorithm specified in [MS-DTYP] section 2.5.3.2. It returns false otherwise.

See [MS-ADTS] section 5.1.3 for the specification of this procedure.

See [MS-ADTS] section 5.1.3.2.1 for the list of symbolic names for control access rights (for example, DS-Replication-Manage-Topology) and the numeric value of each.

5.4 AccessCheckObject

```
procedure AccessCheckObject(dsName: DSName, right: Right): boolean
```

The AccessCheckObject procedure returns true if *dsName* identifies an object within an NC replica hosted by the server, and if the client's security context, which MUST be retrieved using the method described in [MS-RPCE] section 3.3.3.4.3, has the access indicated by the access right **right** on that object according to the algorithm specified in [MS-DTYP] section 2.5.3.2. The procedure returns false otherwise.

See [MS-ADTS] section 5.1.3 for the specification of this procedure.

See [MS-ADTS] section 5.1.3.2 for the list of symbolic names for access rights (for example, RIGHT_DS_DELETE_CHILD) and the numeric value of each.

5.5 AccessCheckWriteToSpnAttribute

```
procedure AccessCheckWriteToSpnAttribute(  
  obj: DSName, spnSet: set of unicodestring) : boolean
```

The AccessCheckWriteToSpnAttribute procedure performs an access check to determine if the client security context, which MUST be retrieved using the method described in [MS-RPCE] section 3.3.3.4.3, has the right to modify the servicePrincipalName attribute of object *obj* with the SPN values specified in *spnSet*, taking into consideration both regular and extended write property rights.

```
if AccessCheckAttr(obj,  
  servicePrincipalName,  
  RIGHT_DS_WRITE_PROPERTY) then  
  return ERROR_SUCCESS  
else  
  if AccessCheckAttr(obj,  
    servicePrincipalName,  
    RIGHT_DS_WRITE_PROPERTY_EXTENDED) then
```

```

/* Extended write access permits the attribute to be written */
/* provided the proposed SPNs meet certain constraints. */

foreach spn in spnSet
  if not Is2PartSPN(spn) then
    if (Is3PartSPN(spn) and IsDCAccount(obj)) then

      /* Three part SPNs are permitted for DC computer accounts */
      /* However, in addition to the constraints on 2 part SPNs, */
      /* the service name must meet additional constraints */

      serviceName := GetServiceNameFromSPN(spn)
      if not IsValidServiceName(obj, serviceName)
        return ERROR_DS_INVALID_ATTRIBUTE_SYNTAX
      endif
    else
      return ERROR_DS_INVALID_ATTRIBUTE_SYNTAX
    endif
  endif

  instanceName := GetInstanceNameFromSPN(spn)
  if (instanceName # obj!dNSHostName) and
    (not instanceName + "$" = obj!sAMAccountName) and
    (not instanceName in obj!msDS-AdditionalDnsHostName) and
    (not instanceName + "$" in
      obj!msDS-AdditionalSamAccountName) then
    /* If this is a DC computer account */
    /* the instance name may be a GUID based dns host name */
    if IsDCAccount(obj) then
      if not IsGUIDBasedDNSName(obj, instanceName) then
        return ERROR_DS_INVALID_ATTRIBUTE_SYNTAX
      endif
    else
      return ERROR_DS_INVALID_ATTRIBUTE_SYNTAX
    endif
  endif
endif
return ERROR_SUCCESS
endif

return ERROR_DS_INSUFF_ACCESS_RIGHTS
endif

```

5.6 AddSubRef

```

procedure AddSubRef(childNC: DSName): DWORD

```

Informative summary of behavior: This procedure creates a **sub-ref object** to the NC named by *childNC*, if appropriate.

```

parentNC, parentObj: DSName
srAtt: ENTINF
err: DWORD

err:= 0

/* Find the parent NC */
parentNC := GetObjectNC(ChildNC)

/* If the parent NC is not instantiated locally, return */
if not FullReplicaExists(parentNC) and
  not PartialGCReplicaExists(parentNC) then
  return err
endif
/* If child does not exist, create it */

```



```

if !ObjExists(childNC) then
  /* Create a subordinate reference object */
  ENTINF_SetValue(srAtt, instanceType,
    {IT_NC_HEAD | IT_UNINSTANT | IT_NC_ABOVE}, dc.prefixTable)
  ENTINF_SetValue(srAtt, objectClass, top, prefixTable)
  ENTINF_SetValue(srAtt, objectCategory, SchemaObj(top), dc.prefixTable)
  ENTINF_SetValue(srAtt, distinguishedName, childNC, prefixTable)
  err := PerformAddOperation(srAtt, childNC, dc.prefixTable, TRUE)
  if(err != 0)
    return err
  endif
else
  if (childNC!isDeleted)
    /*The cross-ref is being undeleted. Undelete the sub-ref object also.*/
    UndeleteObject(childNC)
  endif
endif

/* Ensure that the subordinate reference object is listed in the parent's
  subRefs attribute*/
if (not childNC in parentNC!subRefs) then
  parentNC!subRefs := parentNC!subRefs + {childNC}
endif
return err

```

5.7 AmIRODC

```

procedure AmIRODC() : boolean

```

The AmIRODC procedure returns true if the DC is an RODC.

```

return DSAObj()!objectCategory = SchemaObj(nTDSDSARO)

```

5.8 AmILHServer

```

procedure AmILHServer() : boolean

```

The AmILHServer procedure returns true if the local machine is Windows Server 2008 operating system or later.

```

/* DS_BEHAVIOR_WIN2008 defined in [MS-ADTS]
 * section 6.1.4.2, "msDS-Behavior-Version: DC Functional Level" */
return DSAObj()!msDS-Behavior-Version ≥ DS_BEHAVIOR_WIN2008

```

5.9 ATTR

The ATTR structure defines a concrete type for the identity and values of an attribute.

```

typedef struct {
  ATTRTYP attrTyp;
  ATTRVALBLOCK AttrVal;
} ATTR;

```

attrTyp: An attribute.

AttrVal: The sequence of values for this attribute.

5.10 ATTRBLOCK

The ATTRBLOCK structure defines a concrete type for a set of attributes and their values.

```
typedef struct {
    [range(0,1048576)] ULONG attrCount;
    [size_is(attrCount)] ATTR* pAttr;
} ATTRBLOCK;
```

attrCount: The number of items in the pAttr array.

pAttr: An array of attributes and their values.

5.11 AttributeStamp

AttributeStamp is an abstract type that contains information about the last originating update to an attribute. It is a tuple of the following:

- **dwVersion:** A 32-bit integer. Set to 1 when a value for the attribute is set for the first time. On each subsequent originating update, if the current value of **dwVersion** is less than 0xFFFFFFFF, then increment it by 1; otherwise set it to 0.
- **timeChanged:** The date and time at which the last originating update was made.
- **uuidOriginating:** The invocation ID of the DC that performed the last originating update.
- **usnOriginating:** The USN assigned to the last originating update by the DC that performed it.

Comparisons

Version Comparison: The following procedure is used for comparing the **dwVersion** fields of two **AttributeStamps**:

```
procedure CompareVersions(x: DWORD, y: DWORD): int
```

Informative summary of behavior: This procedure compares two **dwVersions** and returns an integer that is used in AttributeStamp following comparisons.

```
if x = y then
    return 0
elseif x > 0x7FFFFFFF then
    if y = (x - 0x80000000) then
        return 1
    elseif (y < (x - 0x7FFFFFFF)) or (x < y) then
        return -1
    else
        return 1
endif
elseif x < 0x7FFFFFFF then
    if y = (x + 0x80000000) then
        return -1
    elseif (x < y) and (y < (x - 0x7FFFFFFF)) then
        return -1
    else
        return 1
```

```

endif
else
if y = 0xFFFFFFFF then
return -1
elseif x < y then
return -1
else
return 1
endif
endif

```

AttributeStamp Comparison: Given two **AttributeStamps** x and y , let d be the result of the procedure CompareVersions(x .dwVersion, y .dwVersion).

x is said to be equal to y if any of the following is true:

- x is null and y is null
- $d = 0$ and x .timeChanged = y .timeChanged and x .uuidOriginating = y .uuidOriginating

x is said to be greater than y if any of the following is true:

- x is not null and y is null
- $d > 0$
- $d = 0$ and x .timeChanged > y .timeChanged
- $d = 0$ and x .timeChanged = y .timeChanged and x .uuidOriginating > y .uuidOriginating

x is said to be less than y if any of the following is true:

- x is null and y is not null
- $d < 0$
- $d = 0$ and x .timeChanged < y .timeChanged
- $d = 0$ and x .timeChanged = y .timeChanged and x .uuidOriginating < y .uuidOriginating

Conversions

A value x of type **AttributeStamp** [may](#) be converted to and from its wire format y of type PROPERTY_META_DATA_EXT by associating the values of fields in x with the values of the like-named fields in y .

5.12 AttributeSyntax

AttributeSyntax is an abstract type that represents an LDAP **attribute syntax**. The valid values are the names from the LDAP Syntax Name column of the table in section 5.16.2, for example, "Object(DS-DN)" and "Object(DN-Binary)".

5.13 AttrStamp

```

procedure AttrStamp(o: DSName, attr: ATTRTYP) : AttributeStamp

```

The AttrStamp procedure returns the AttributeStamp for the attribute whose ATTRTYP is *attr* on the object whose DSName is *o*.

5.14 ATTRTYP

ATTRTYP is a concrete type for a compact representation of an OID ~~(2)~~.

This type is declared as follows:

```
typedef ULONG ATTRTYP;
```

Section 5.16.4 specifies the procedures that map between ATTRTYP and OID ~~(2)~~ with the aid of a SCHEMA_PREFIX_TABLE.

5.15 AttrtypFromSchemaObj

```
procedure AttrtypFromSchemaObj(o: DSName): ATTRTYP
```

Given the dsname *o* of an attributeSchema or classSchema object, the AttrtypFromSchemaObj procedure returns the ATTRTYP that identifies this schema object on this DC.

```
if o!msDS-IntId ≠ null then
  return o!msDS-IntId
endif
if attributeSchema in o!objectClass then
  return MakeAttid(dc.prefixTable, o!attributeID)
else
  return MakeAttid(dc.prefixTable, o!governsID)
endif
```

5.16 ATTRVAL

The ATTRVAL structure defines a concrete type for the value of a single attribute.

```
typedef struct {
  [range(0,26214400)] ULONG valLen;
  [size_is(valLen)] UCHAR* pVal;
} ATTRVAL;
```

valLen: The size, in bytes, of the **pVal** array.

pVal: The value of the attribute. The encoding of the attribute varies by syntax, as described in the following sections.

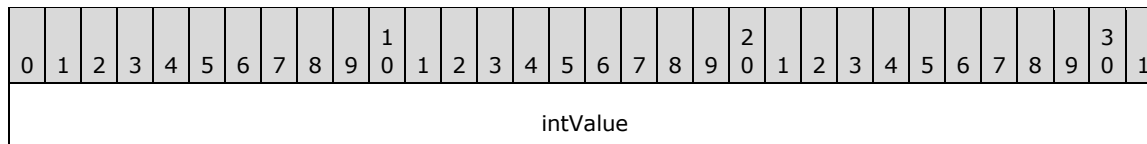
5.16.1 Concrete Value Representations

This section defines types used for concrete value representations. In addition to the types described here, the following types are also used for concrete value representations:

- ATTRTYP (section 5.14)
- DSNAME (section 5.50)
- DSTIME (section 5.51)
- SYNTAX_ADDRESS (section 5.191)
- SYNTAX_DISTNAME_BINARY (section 5.192)

5.16.1.1 INT32

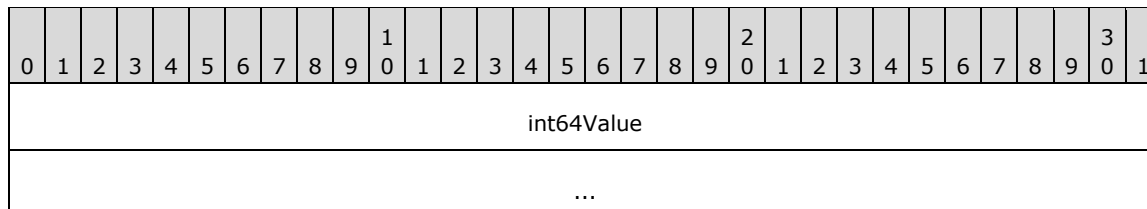
The INT32 type is a 4-byte integer in little-endian form. See [MS-DTYP] section 2.2.22 for its definition.



intValue (4 bytes): A 32-bit signed number in little-endian byte order.

5.16.1.2 INT64

The INT64 type is an 8-byte integer in little-endian form. See [MS-DTYP] section 2.2.23 for its definition.



int64Value (8 bytes): A 64-bit signed number in little-endian byte order.

5.16.1.3 OctetString

The OctetString represents an array of bytes. The number of bytes in the array equals the valLen field of the ATTRVAL structure.

5.16.1.4 String8

The String8 type is an array of ASCII characters. Each character is encoded as a single byte. The number of bytes in the array equals the valLen field of the ATTRVAL structure.

5.16.1.5 String16

The String16 type is an array of Unicode characters. Each Unicode character is encoded as 2 bytes. The number of bytes in the array equals the valLen field of the ATTRVAL structure.

The byte ordering is little-endian.

5.16.1.6 SECURITY_DESCRIPTOR

The SECURITY_DESCRIPTOR structure is an NT security descriptor in self-relative format, as specified in [MS-DTYP] section 2.4.6.

The data is stored in little-endian byte order.

5.16.1.7 SID

The **SID** type is an NT security identifier (SID) structure, as specified in [MS-DTYP] section 2.4.2.

The data is stored in little-endian byte order.

5.16.2 Abstract Value Representations

The abstract data model utilizes a representation of data values that is used by LDAP, minus the BER encoding. Several of these syntaxes are adopted from [RFC2252].

The following table lists all the supported syntaxes and how they are represented in the model. Some syntaxes share an OID ~~(2)z~~, so the syntaxes in the table are identified by name, not OID ~~(2)z~~.

LDAP syntax name (OID)	[RFC2252] name	Reference section in [RFC2252] or in this document
Boolean (2.2.5.8)	Boolean	[RFC2252] section 6.4
Enumeration (2.5.5.9)	INTEGER	[RFC2252] section 6.16
Integer (2.5.5.9)	INTEGER	[RFC2252] section 6.16
LargeInteger (2.5.5.16)	INTEGER	[RFC2252] section 6.16
Object(Presentation-Address) (2.5.5.13)	Presentation Address	[RFC2252] section 6.28
Object(Replica-Link) (2.5.5.10)	Binary	[RFC2252] section 6.2
String(IA5) (2.5.5.5)	IA5 String	[RFC2252] section 6.15
String(Numeric) (2.5.5.6)	Numeric String	[RFC2252] section 6.23
String(Object-Identifier) (2.5.5.2)	OID	[RFC2252] section 6.25
String(Octet) (2.5.5.10)	Binary	[RFC2252] section 6.2
String(Printable) (2.5.5.5)	Printable String	[RFC2252] section 6.29
String(Unicode) (2.5.5.12)	Directory String	[RFC2252] section 6.10
String(UTC-Time) (2.5.5.11)	UTC Time	[RFC2252] section 6.31
String(Generalized-Time) (2.5.5.11)	Generalized Time	[RFC2252] section 6.14
Object(DS-DN) (2.5.5.1)	-	Section 5.16.2.1
Object(DN-String) (2.5.5.14)	-	Section 5.16.2.2
Object(DN-Binary) (2.5.5.7)	-	Section 5.16.2.3
Object(Access-Point) (2.5.5.14)	-	Section 5.16.2.4
Object(OR-Name) (2.5.5.7)	-	Section 5.16.2.5
String(NT-Sec-Desc) (2.5.5.15)	-	Section 5.16.2.6
String(SID) (2.5.5.17)	-	Section 5.16.2.7
String(Teletex) (2.5.5.4)	-	Section 5.16.2.8

The LDAP syntaxes that are not defined in [RFC2252] are described in the following sections.

5.16.2.1 Object(DS-DN)

A value with the Object(DS-DN) syntax is a UTF-8 string in the following format:

```
<GUID=guid_value>;<SID=sid_value>;dn
```

where:

- *guid_value* is the value of the object's objectGUID attribute.
- *sid_value* is the value of the object's objectSid attribute in its binary format (as specified in [MS-DTYP] section 2.4.2).
- *dn* is the string representation of a DN (as specified by [RFC2252] section 6.9, and further specified by [RFC2253]).

For reference to objects that do not have an objectSid, the format is as follows:

<GUID=*guid_value*>;*dn*

where *guid_value* and *dn* have the same meaning as in the previous case.

5.16.2.2 Object(DN-String)

A value with the Object(DN-String) syntax is a UTF-8 string in the following format:

S:*char_count*:*string_value*:*object_DN*

where:

- S is a string literal that MUST be present.
- Each : is a string literal that MUST be present.
- *char_count* is the number of characters in the *string_value* string.
- *object_DN* is an **object reference** in the format of Object(DS-DN).

5.16.2.3 Object(DN-Binary)

A value with the Object(DN-Binary) syntax is a UTF-8 string in the following format:

B:*char_count*:*binary_value*:*object_DN*

where:

- B is a string literal that MUST be present.
- Each : is a string literal that MUST be present.
- *char_count* is the number of hexadecimal digits in *binary_value*.
- *binary_value* is the hexadecimal representation of a binary value.
- *object_DN* is an object reference in the format of Object(DS-DN).

5.16.2.4 Object(Access-Point)

A value with the Object(Access-Point) syntax is a UTF-8 string in the following format:

presentation_address#X500:*object_DN*

where:

- #X500 is a string literal that MUST be present.
- : is a string literal that MUST be present.

- *presentation_address* is a value encoded in the Object(Presentation-Address) syntax.
- *object_DN* is an object reference in the format of Object(DS-DN).

5.16.2.5 Object(OR-Name)

A value with the Object(OR-Name) syntax is a UTF-8 string in the following format:

object_DN

where: *object_DN* is an object reference in the format of Object(DS-DN).

5.16.2.6 String(NT-Sec-Desc)

A value with the String(NT-Sec-Desc) syntax contains a Windows security descriptor in self-relative binary form. The binary form is that of a SECURITY_DESCRIPTOR structure and is documented in [MS-DTYP] section 2.4.6.

5.16.2.7 String(Sid)

A value with the String(Sid) syntax is a Windows SID in binary form. The binary form is that of a SID structure and is specified in [MS-DTYP] section 2.4.2.

5.16.2.8 String(Teletex)

A value with the String(Teletex) syntax is a UTF-8 string restricted to characters with values between 0x20 and 0x7e, inclusive.

5.16.3 Converting Between Abstract and Concrete Value Representations

The type ATTRVAL is an encoding that several methods use to send individual directory attribute values across the network. When an attribute has multiple values, and all those values need to be sent, this is performed by sending multiple ATTRVALs.

An ATTRVAL that encodes an OID ~~(2)~~ requires a prefix table for decoding. In some cases, the prefix table accompanies the ATTRVAL in the same RPC request or response. In other cases, a predefined prefix table is sufficient. The process of creating the ATTRVAL for an OID ~~(2)~~ can add an entry to the prefix table that will accompany the ATTRVAL.

The abstract directory model specified in [MS-ADTS] section 3.1.1 represents individual attribute values in the form used by LDAP (see [RFC2252]), minus the BER encoding. In short, values are represented as strings in a variety of formats. The abstract type Value is used to represent an attribute value in the model. Section 5.16.2 specifies the abstract representation for each LDAP syntax.

Therefore, this specification requires procedures that convert between the concrete ATTRVAL encoding and the abstract Value encoding, creating a prefix table while creating the ATTRVAL, and reading a prefix table while decoding the ATTRVAL. These procedures have the following signatures:

```
procedure ATTRVALFromValue(
    v: Value, s: AttributeSyntax, var t: PrefixTable) : ATTRVAL

procedure ValueFromATTRVAL(
    a: ATTRVAL, s: AttributeSyntax, t: PrefixTable) : Value
```

where:

- *s* is an LDAP attribute syntax from the table in section 5.16.2.
- *t* is an abstract PrefixTable object, representing a prefix table.

ATTRVALFromValue mutates its input PrefixTable object *t*; ValueFromATTRVAL does not.

Apart from the prefix table complication, these two procedures are straightforward given the two value representations. These procedures obey the mappings shown in the following table for converting between abstract and concrete value representations.

LDAP syntax name	Encoding of ATTRVAL payload
Boolean (2.2.5.8)	INT32
Enumeration (2.5.5.9)	INT32
Integer (2.5.5.9)	INT32
LargeInteger (2.5.5.16)	INT64
Object(Presentation-Address) (2.5.5.13)	SYNTAX_ADDRESS
Object(Replica-Link) (2.5.5.10)	OctetString
String(IA5) (2.5.5.5)	String8
String(Numeric) (2.5.5.6)	String8
String(Object-Identifier) (2.5.5.2)	ATTRTYP
String(Octet) (2.5.5.10)	OctetString
String(Printable) (2.5.5.5)	String8
String(Unicode) (2.5.5.12)	String16
String(UTC-Time) (2.5.5.11)	DSTIME
String(Generalized-Time) (2.5.5.11)	DSTIME
Object(DS-DN) (2.5.5.1)	DSName
Object(DN-String) (2.5.5.14)	SYNTAX_DISTNAME_BINARY
Object(DN-Binary) (2.5.5.7)	SYNTAX_DISTNAME_BINARY
Object(Access-Point) (2.5.5.14)	SYNTAX_DISTNAME_BINARY
Object(OR-Name) (2.5.5.7)	SYNTAX_DISTNAME_BINARY
String(NT-Sec-Desc) (2.5.5.15)	SECURITY_DESCRIPTOR
String(SID) (2.5.5.17)	SID
String(Teletex) (2.5.5.4)	String8

Since the preceding procedures require a prefix table, a procedure to produce a prefix table is also required, as follows:

```
procedure NewPrefixTable() : PrefixTable
```

The special case value conversion between ATTRTYP and OID is provided by the following two procedures:

```
procedure MakeAttid(t: PrefixTable, o: OID) : ATTRTYP
procedure OidFromAttid(t: PrefixTable, attr: ATTRTYP) : OID
```

These three procedures, specified in section 5.16.4, describe the algorithm for converting values of type OID to and from their ATTRVAL payload representation using a PrefixTable.

The conversion between an abstract Value representation and a concrete ATTRVAL representation is specified in the following sections, which are organized by abstract value type. In the examples shown:

- **LDAP Value** represents the LDAP value.
- **valLen** represents the value in the **valLen** field of the ATTRVAL structure.
- **payload** represents the data in the payload (the referent of pVal in the ATTRVAL structure).

Because prefix tables are communicated over the wire, the ConcretePTFromAbstractPT and AbstractPTFromConcretePT procedures are defined to convert between the abstract PrefixTable and the concrete SCHEMA_PREFIX_TABLE.

5.16.3.1 Boolean

The Boolean LDAP attribute value FALSE corresponds to an INT32 with value 0. The Boolean LDAP attribute value TRUE corresponds to an INT32 with a nonzero value. INT32 is in little-endian format. The valLen field of ATTRVAL equals 4.

Example:

```
LDAP value: TRUE
INT32 value 0x1

valLen: 4.

payload:
01 00 00 00          ....
```

5.16.3.2 Enumeration and Integer

The Enumeration and the Integer LDAP syntax types are represented in the same manner. The LDAP representation of the integer as a string expressed in base-10 notation corresponds to an INT32, which is in little-endian format. The valLen field of ATTRVAL equals 4.

Example:

```
LDAP value: 5
INT32 value: 0x5

valLen: 4,

payload:
05 00 00 00          ....
```

5.16.3.3 LargeInteger

The LDAP representation of the integer as a string expressed in base-10 notation corresponds to an INT64, which is in little-endian format. The valLen field of ATTRVAL equals 8.

Example:

```
LDAP value: 12605
INT64 value: Hexadecimal 0x313d

valLen: 8,

payload:

3d 31 00 00 00 00 00 00          =1.....
```

5.16.3.4 Object(Presentation-Address)

To convert from the LDAP representation to the SYNTAX_ADDRESS representation, the UTF-8 encoded string is converted to a UCS-16 encoded Unicode string. The resulting string is not null-terminated. The dataLen field of SYNTAX_ADDRESS equals the length of the Unicode string in bytes, plus 4. The valLen field of ATTRVAL equals the dataLen field of SYNTAX_ADDRESS.

Example:

```
LDAP value: 12345 (Unicode string encoded as UTF-8)

This represents the following SYNTAX_ADDRESS struct:

+0x000 dataLen      : 0xe
+0x004 uVal         : L"12345"

valLen: 14

payload:

0e 00 00 00 31 00 32 00 33 00 34 00 35 00      ....1.2.3.4.5.
```

5.16.3.5 Object(Replica-Link) String (Octet)

The representation used in LDAP syntax and encoding of the ATTRVAL payload is the same. Therefore, the payload is set to the same value. The valLen field of ATTRVAL equals the length of the byte array.

5.16.3.6 String(IA5) String(Printable) String(Numeric) String(Teletex)

The representation used in LDAP syntax and encoding of the ATTRVAL payload is the same. Therefore, the payload is set to the same value. The string is not null-terminated. The valLen field of ATTRVAL equals the number of bytes in the string.

Example:

```
LDAP value: 123456789
This represents an ASCII string "123456789"
```

valLen: 9

```
payload:
31 32 33 34 35 36 37 38 39          123456789
```

5.16.3.7 String(Unicode)

To convert from the LDAP representation to the Unicode syntax representation, the UTF-8 encoded string is converted to a UCS-16 encoded String16. Each Unicode character is in little-endian format. The resulting string is not null-terminated. The valLength field of ATTRVAL equals the total number of bytes in the Unicode string.

Example:

```
LDAP value: Administrator (Unicode string encoded in UTF-8)
valLen: 26

payload:
41 00 64 00 6d 00 69 00 6e 00 69 00 73 00 74 00  A.d.m.i.n.i.s.t.
72 00 61 00 74 00 6f 00 72 00                   r.a.t.o.r.
```

5.16.3.8 String(Object-Identifier)

Conversion from the LDAP representation to ATTRTYP is performed via the MakeAttid function. The length of the valLen field in ATTRVAL equals 4.

Conversion from ATTRTYP to LDAP representation is performed by the OidFromAttid procedure.

Example:

```
LDAP value: 2.5.6.5
This corresponds to ATTRTYP value: 0x00010005.

valLen: 4
payload:
05 00 01 00          ....
```

5.16.3.9 String(UTC-Time) and String(Generalized-Time)

For both the String(UTC-Time) and String(Generalized-Time) LDAP syntaxes, the time expressed in the LDAP value corresponds to DSTIME. It is in little-endian format. The valLen field of ATTRVAL equals 8.

```
LDAP value: 20060609211106.0Z (06/09/2006 14:11:06 PST).
This corresponds to DSTIME value: 0x2fa9a74ea
valLen: 8,

payload:
ea 74 9a fa 02 00 00 00          .t.....
```

5.16.3.10 Object(DS-DN)

The LDAP representation of Object(DS-DN) is defined in section 5.16.2.1. This corresponds to DSName as follows:

The *dn* part of the LDAP representation is converted to a UCS-16 encoded Unicode string. Then, the *attributeValue* component (defined in [RFC2253]) of each RDN in the DN is canonicalized according to the following rules:

- The first leading space, if any, is escaped as a backslash (\) followed by a space.
- Any carriage return or line-feed characters are escaped as a backslash followed by the 2-digit hexadecimal value of that character, as specified in [RFC2253] section 2.4.
- Any of the following characters—number sign (#), plus sign (+), comma (,), semicolon (;), quotation mark ("), left angle bracket (<), equal sign (=), right angle bracket (>), and backslash (\)—are escaped as a backslash followed by the character.
- The trailing space, if any, is escaped as a backslash followed by a space.

The resulting string (including a terminating null character) is inserted into the *StringName* field of the DSNAME. The length of the string, in Unicode characters, is inserted into the *NameLen* field. The length of the string in the *NameLen* field does not include the terminating null character. The value of *guid_value* in LDAP representation is expressed as a GUID and inserted into the *Guid* field of the DSNAME structure. If the *sid_value* is present, it is copied into the *Sid* field of the DSNAME and the *SidLen* field is set to the length, in bytes, of the SID. If the *sid_value* part is not present, then the *SidLen* field is set to 0. The *valLen* field of ATTRVAL equals the length of the DSNAME structure. All the multibyte quantities in the DSNAME are stored in little-endian format.

Example:

```
LDAP Value: <GUID=3ceab4a1-fc47-4a71-8195-454faa6423a3>;
<SID=0105000000000051500000089598d33d3c56b6894e1f2e6f4010000>;CN=Administrator,OU=Users,DC=test,DC=com
```

This corresponds to the following DSNAME:

```
+0x000 structLen      : 0x8a
+0x004 SidLen         : 0x1c
+0x008 Guid           : 3ceab4a1-fc47-4a71-8195-454faa6423a3
+0x018 Sid            : S-1-5-21-864901513-1751893459-3874677140-500
+0x034 NameLen        : 0x28
+0x038 StringName     : L"CN=Administrator,OU=Users,DC=test,DC=com"
```

valLen: 138,

payload:

```
8a 00 00 00 1c 00 00 00 a1 b4 ea 3c 47 fc 71 4a .....<G.qJ
81 95 45 4f aa 64 23 a3 01 05 00 00 00 00 05 ..EO.d#.....
15 00 00 00 89 59 8d 33 d3 c5 6b 68 94 e1 f2 e6 .....Y.3.kh...
f4 01 00 00 28 00 00 00 43 00 4e 00 3d 00 41 00 ....(.C.N=.A.
64 00 6d 00 69 00 6e 00 69 00 73 00 74 00 72 00 d.m.i.n.i.s.t.r.
61 00 74 00 6f 00 72 00 2c 00 4f 00 55 00 3d 00 a.t.o.r.,.O.U.=.
55 00 73 00 65 00 72 00 73 00 2c 00 44 00 43 00 U.s.e.r.s.,.D.C.
3d 00 74 00 65 00 73 00 74 00 2c 00 44 00 43 00 =.t.e.s.t.,.D.C.
3d 00 63 00 6f 00 6d 00 00 00 .....=.c.o.m...
```

5.16.3.11 Object(DN-Binary)

The LDAP representation of the attribute value corresponds to SYNTAX_DISTNAME_BINARY. The *object_DN* portion of the LDAP representation is treated as if it were in Object(DS-DN) syntax and converted to the DSNAME syntax representation, as explained in section 5.16.2.3. The *binary_value* portion of the LDAP representation is converted to the binary value (an array of bytes) and stored in

the byteVal field of the SYNTAX_ADDRESS structure. The dataLen field of SYNTAX_ADDRESS is set to the length of the array, in bytes, plus 4, where 4 is the length of the dataLen field.

Padding is added between the DSNAME and SYNTAX_ADDRESS structures so that the length of DSNAME plus padding modulo 4 equals 0. The padding is an array of bytes, each byte of value 0. The valLen field of ATTRVAL equals the length of the DSNAME structure, plus the number of bytes added for padding, plus the length of the SYNTAX_ADDRESS structure.

All the multibyte quantities in the DSNAME and SYNTAX_ADDRESS structures are stored in little-endian format.

Example where padding is required because DSNAME is not 4-byte aligned:

```
LDAP value:
B:8:00000005:<GUID=2d8b0ce6-aa32-4f31-a6e8-88343e6244a5>;<SID=010100001cd509a018459359>;DC=test,DC=com

Representation of data as SYNTAX_DISTNAME_BINARY:

+0x000 Name          : DSNAME
  +0x000 structLen   : 0x56
  +0x004 SidLen      : 0xc
  +0x008 Guid        : 2d8b0ce6-aa32-4f31-a6e8-88343e6244a5
  +0x018 Sid         : S-1-483723680-1502823704
  +0x034 NameLen     : 0xe
  +0x038 StringName  : "DC=test,DC=com"
+0x058 Data          : SYNTAX_ADDRESS
  +0x000 dataLen     : 8
  +0x004 byteVal     : 00 00 00 05

valLength: 96

payload:

56 00 00 00 0c 00 00 00 e6 0c 8b 2d 32 aa 31 4f V.....-2.10
a6 e8 88 34 3e 62 44 a5 01 01 00 00 1c d5 09 a0 ...4>bD.....
18 45 93 59 00 00 00 00 00 00 00 00 00 00 00 00 .E.Y.....
00 00 00 00 0e 00 00 00 44 00 43 00 3d 00 74 00 .....D.C.=.t.
65 00 73 00 74 00 2c 00 44 00 43 00 3d 00 63 00 e.s.t.,.D.C.=.c.
6f 00 6d 00 00 00 00 00 08 00 00 00 00 00 00 05 o.m.....
```

Example where padding is not required because DSNAME is 4-byte aligned:

```
LDAP value:
B:8:0000000D:<GUID= ff432fe0-8c94-43cf-915c-286b197b0164>;<SID=010100001a180dba5ec27614>;DC=test1,DC=test,DC=com.

Representation of data as SYNTAX_DISTNAME_BINARY:

+0x000 Name          : DSNAME
  +0x000 structLen   : 0x68
  +0x004 SidLen      : 0xc
  +0x008 Guid        : ff432fe0-8c94-43cf-915c-286b197b0164
  +0x018 Sid         : S-1-437783994-343327326
  +0x034 NameLen     : 0x17
  +0x038 StringName  : "DC=test1,DC=test,DC=com"
+0x068 Data          : SYNTAX_ADDRESS
  +0x000 dataLen     : 0x74003d
  +0x004 byteVal     : 00 00 00 0d

68 00 00 00 0c 00 00 00 e0 2f 43 ff 94 8c cf 43 h...../C....C
91 5c 28 6b 19 7b 01 64 01 01 00 00 1a 18 0d ba .\{k.{.d.....
5e c2 76 14 00 00 00 00 00 00 00 00 00 00 00 00 ^.v.....
00 00 00 00 17 00 00 00 44 00 43 00 3d 00 74 00 .....D.C.=.t.
```

```

65 00 73 00 74 00 31 00 2c 00 44 00 43 00 3d 00 e.s.t.1.,.D.C.=.
74 00 65 00 73 00 74 00 2c 00 44 00 43 00 3d 00 t.e.s.t.,.D.C.=.
63 00 6f 00 6d 00 00 00 08 00 00 00 00 00 0d c.o.m.....

```

5.16.3.12 Object(DN-String)

The LDAP representation of the attribute value corresponds to SYNTAX_DISTNAME_BINARY. The *object_DN* portion of the LDAP representation is treated as if it were in Object(DS-DN) syntax and converted to the DSNAME representation, as explained in section 5.16.2.2. The result is stored in the Name field of that structure. The *string_value* portion of the LDAP representation is converted to a UCS-16 encoded Unicode string and stored in the byteVal field of the SYNTAX_ADDRESS structure. The dataLen field of SYNTAX_ADDRESS is set to the length of the string, in bytes, plus 4, where 4 is the length of the dataLen field. Enough padding is added between the DSNAME and SYNTAX_ADDRESS structures such that the length of DSNAME plus padding modulo 4 equals 0. The padding is an array of bytes of value 0. The valLen field of ATTRVAL equals the length of the DSNAME structure, plus the number of bytes added for padding, plus the length of the SYNTAX_ADDRESS structure. All the multibyte quantities in the DSNAME and SYNTAX_ADDRESS structures are stored in little-endian format.

Example:

```

LDAP value:
S:7:Unicode:<GUID=2d8b0ce6-aa32-4f31-a6e8-
88343e6244a5>;<SID=010100001cd509a018459359>;DC=test,DC=com

```

```

This represents data as SYNTAX_DISTNAME_BINARY
(note the structure SYNTAX_ADDRESS is 4-byte aligned):

```

```

+0x000 Name          : DSNAME
+0x000 structLen    : 0x56
+0x004 SidLen       : 0xc
+0x008 Guid         : 2d8b0ce6-aa32-4f31-a6e8-88343e6244a5
+0x018 Sid          : S-1-483723680-1502823704
+0x034 NameLen      : 0xe
+0x038 StringName   : "DC=test,DC=com"
+0x058 Data         : SYNTAX_ADDRESS
+0x000 dataLen      : 0x12
+0x004 uVal         : "Unicode"

```

```
valLength: 106
```

```
payload:
```

```

56 00 00 00 0c 00 00 00 e6 0c 8b 2d 32 aa 31 4f V.....-2.10
a6 e8 88 34 3e 62 44 a5 01 01 00 00 1c d5 09 a0 ...4>bD.....
18 45 93 59 00 00 00 00 00 00 00 00 00 00 00 00 .E.Y.....
00 00 00 00 0e 00 00 00 44 00 43 00 3d 00 74 00 .....D.C.=.t.
65 00 73 00 74 00 2c 00 44 00 43 00 3d 00 63 00 e.s.t.,.D.C.=.c.
6f 00 6d 00 00 00 00 00 12 00 00 00 55 00 6e 00 o.m.....U.n.
69 00 63 00 6f 00 64 00 65 00 i.c.o.d.e.

```

5.16.3.13 Object(OR-Name)

The LDAP representation of the attribute value corresponds to SYNTAX_DISTNAME_BINARY. The *object_DN* of the LDAP representation is treated as if it were in Object(DS-DN) syntax and converted to the DSNAME syntax representation, as explained in section 5.16.2.5.

5.16.3.14 Object(Access-Point)

The LDAP representation of the attribute value corresponds to SYNTAX_DISTNAME_BINARY. The *object_DN* portion of the LDAP representation is treated as if it were in Object(DS-DN) syntax and converted to the DSNAME syntax representation, as explained in section 5.16.2.4. The *presentation_address* portion of the LDAP representation is treated as if it were in the Object(Presentation-Address) syntax and converted to the SYNTAX_ADDRESS representation. All the multibyte quantities in the DSNAME and SYNTAX_ADDRESS structures are stored in little-endian format.

5.16.3.15 String(Sid)

The representation used in LDAP syntax and encoding of ATTRVAL payload is the same. Therefore the payload is set to the same value. The valLen field of ATTRVAL equals the number of bytes in the payload. It is always 28. All the multibyte quantities in the SID structure are stored in little-endian format.

Example:

```
LDAP Value: 01050000000000051500000089598d33d3c56b6894e1f2e6f4010000
valLen: 28
payload:
01 05 00 00 00 00 05 15 00 00 00 89 59 8d 33 .....Y.3
d3 c5 6b 68 94 e1 f2 e6 f4 01 00 00 ..kh.....
```

5.16.3.16 String(NT-Sec-Desc)

The representation used in LDAP syntax and encoding of ATTRVAL payload is the same. Therefore the payload is set to the same value. The valLen field of ATTRVAL equals the number of bytes in the payload. All the multibyte quantities in the security descriptor structure are stored in little-endian format.

```
LDAP value: (binary blob, represented in hex format here)
0100048c70000000800000000000000001400000004005c0003000000050028000001000001000000531a72ab2f1ed
011981900aa0040529b01010000000000050a00000000121800ff010f000102000000000005200000002002000000
1214009400020001010000000000050b000000010200001cd509a01845935900020000010200001cd509a01845935
900020000
```

This represents the following self-relative security descriptor value:

```
SD Revision: 1
SD Control: 0x8c04
    SE_DACL_PRESENT
    SE_DACL_AUTO_INHERITED
    SE_SACL_AUTO_INHERITED
    SE_SELF_RELATIVE
Owner: S-1-483723680-1502823704-512
Group: S-1-483723680-1502823704-512
DACL:
    Revision      4
    Size          92 bytes
    # Aces       3
    Ace[0]
        Ace Type: 0x5 - ACCESS_ALLOWED_OBJECT_ACE_TYPE
        Ace Size: 40 bytes
        Ace Flags: 0x0
        Object Ace Mask: 0x00000100
        CTRL_DS_CONTROL_ACCESS
```



```

Object Ace Flags: 0x1
    ACE_OBJECT_TYPE_PRESENT
Object Ace Type:
    Change Password-ab721a53-1e2f-11d0-9819-00aa0040529b
Object Ace Sid:  NT AUTHORITY\SELF [S-1-5-10]
Ace[1]
    Ace Type:  0x0 - ACCESS_ALLOWED_ACE_TYPE
    Ace Size:  24 bytes
    Ace Flags: 0x12
        CONTAINER_INHERIT_ACE
        INHERITED_ACE
    Ace Mask:  0x000f01ff
        DELETE
        READ_CONTROL
        WRITE_DAC
        WRITE_OWNER
        ACTRL_DS_CREATE_CHILD
        ACTRL_DS_DELETE_CHILD
        ACTRL_DS_LIST
        ACTRL_DS_SELF
        ACTRL_DS_READ_PROP
        ACTRL_DS_WRITE_PROP
        ACTRL_DS_DELETE_TREE
        ACTRL_DS_LIST_OBJECT
        ACTRL_DS_CONTROL_ACCESS
    Ace Sid:  BUILTIN\Administrators [S-1-5-32-544]
Ace[2]
    Ace Type:  0x0 - ACCESS_ALLOWED_ACE_TYPE
    Ace Size:  20 bytes
    Ace Flags: 0x12
        CONTAINER_INHERIT_ACE
        INHERITED_ACE
    Ace Mask:  0x00020094
        READ_CONTROL
        ACTRL_DS_LIST
        ACTRL_DS_READ_PROP
        ACTRL_DS_LIST_OBJECT
    Ace Sid:  NT AUTHORITY\Authenticated Users [S-1-5-11]

```

valLen: 144

payload:

```

01 00 04 8c 70 00 00 00 80 00 00 00 00 00 00 00  ....p.....
14 00 00 00 04 00 5c 00 03 00 00 00 05 00 28 00  .....\.....(
00 01 00 00 01 00 00 00 53 1a 72 ab 2f 1e d0 11  .....S.r./...
98 19 00 aa 00 40 52 9b 01 01 00 00 00 00 00 05  ....@R.....
0a 00 00 00 00 12 18 00 ff 01 0f 00 01 02 00 00  .....
00 00 00 05 20 00 00 00 20 02 00 00 00 12 14 00  ....
94 00 02 00 01 01 00 00 00 00 00 05 0b 00 00 00  .....
01 02 00 00 1c d5 09 a0 18 45 93 59 00 02 00 00  .....E.Y....
01 02 00 00 1c d5 09 a0 18 45 93 59 00 02 00 00  .....E.Y....

```

5.16.4 ATTRTYP-to-OID Conversion

This section describes the prefix mapping mechanism that allows the one-to-one mapping between OIDs (2) and a 32-bit integer (ATTRTYP).

An OID (2) can be represented in the binary form, with a BER encoding scheme. The standard BER encoding of an object identifier (2) consists of three components, because the end-of-contents component is not present. Only the third component (contents octets) is used here; other components are omitted.

Note The BER encoding of an OID (2) is described in [ITUX690] section 8.19. To avoid ambiguity, the non-encoded form of the OID (2) is referred to as the original form in this section.

The prefix of an OID-(2) is the **binary OID**, excluding the last one or two bytes. If the number following the final period (.) in the original form of the OID (2) is less than 128, only the last byte is excluded; otherwise, the last two bytes are excluded.

A **PrefixTable** is a sequence of tuples defined as follows.

```
type PrefixTable = sequence of [  
    prefixString: uncodestring,  
    prefixIndex: integer  
]
```

where:

- *prefixString* is the prefix of an OID-(2).
- *prefixIndex* is an integer in the range [0 .. 0x0000ffff].

The integer *prefixIndex* is called the prefix index of *prefixString*. To allow one-to-one mappings between the prefix strings and the prefix indexes in the table, each *prefixString* MUST occur at most once in the table, and each *prefixIndex* MUST occur at most once in the table.

An ATTRTYP is a 32-bit, unsigned integer. If *attr* is an ATTRTYP, define *attr.upperWord* to be the most significant 16 bits, and *attr.lowerWord* to be the least significant 16 bits.

The following types and helper procedures are used for mapping between OIDs (2) and ATTRTYP.

```
procedure ToBinary(st: uncodestring) : sequence of BYTE
```

Converts a string to a binary OID representation. For example, "\x55\x06" is the binary OID \x55\x06.

```
procedure CatBinary(o: sequence of BYTE, b: BYTE) : sequence of BYTE
```

Concatenates a byte onto a binary OID. For example, \x02 concatenated onto \x55\x06 is \x55\x06\x02.

```
procedure ToStringOID(o: sequence of BYTE) : uncodestring
```

Converts a binary OID to its string representation, as described in [ITUX690] section 8.19; returns null if the conversion fails. For example, the binary OID \x55\x06\x02 is converted to the OID (2) string "2.5.6.2".

```
procedure ToBinaryOID(s: uncodestring) : sequence of BYTE
```

Converts an OID-(2) string representation to a binary OID, as described in [ITUX690] section 8.19; returns null if the conversion fails. For example, the OID-(2) string "2.5.6.2" is converted to the binary form \x55\x06\x02.

```
procedure ToByte(i: integer) : BYTE
```

Converts an integer into a byte representation, truncating to the least significant digits, if needed. For example, 2 converts to \x02.

```
procedure SubBinary(b: sequence of BYTE,  
  start: integer, end: integer) : sequence of BYTE
```

Returns the sequence [*start* .. *end*] of bytes in *b*.

```
procedure AddPrefixTableEntry(var t: PrefixTable, o: sequence of BYTE)
```

Sets *t*[*t.length*].*prefixString* to *o*. Generates a random number between 0 and 65535 that is unique in the values of *prefixIndex* in *t*, and sets *t*[*t.length*].*prefixIndex* to the generated random number. Increases *t.length* by one.

```
procedure ToInteger(s: unicodestring) : integer
```

Converts a string to its integer representation. For example, "127" is 127. Strings with non-numeric characters are not defined for this procedure.

The following procedures are used for mapping between object identifiers ~~(2)~~ and ATTRTYP representations.

```
procedure MakeAttid(var t: PrefixTable, o: OID): ATTRTYP
```

Informative summary of behavior: This procedure converts an OID ~~(2)~~ to a corresponding ATTRTYP representation.

```
  lastValueString: unicodestring  
  lastValue, lowerWord: integer  
  binaryOID, oidPrefix: sequence of BYTE  
  attr: ATTRTYP  
  pos: integer  
  
  /* get the last value in the original OID: the value  
   * after the last '.'*/  
  lastValueString := SubString(o,  
                                FindCharRev(o, o.length, '.'),  
                                o.length)  
  lastValue := ToInteger(lastValueString)  
  
  /* convert the dotted form of OID into a BER encoded binary  
   * format. The BER encoding of OID is described in section  
   * 8.19 of [ITUX690]*/  
  binaryOID := ToBinaryOid(o)  
  
  /* get the prefix of the OID*/  
  if lastValue < 128 then  
    oidPrefix := SubBinary(binaryOID, 0, binaryOID.length - 2)  
  else  
    oidPrefix := SubBinary(binaryOID, 0, binaryOID.length - 3)  
  endif  
  
  /* search the prefix in the prefix table, if none found, add  
   * one entry for the new prefix.*/
```

```

fToAdd := true
for i := 0 to t.length
  if ToBinary(t[i].prefixString) = oidPrefix then
    fToAdd := false
    pos := i
  endif
endfor

if fToAdd then
  pos := t.length
  AddPrefixTableEntry(t, oidPrefix)
endif

/*compose the attid*/
lowerWord := lastValue mod 16384
if lastValue ≥ 16384 then
  /*mark it so that it is known to not be the whole lastValue*/
  lowerWord := lowerWord + 32768
endif
upperWord := t[pos].prefixIndex
attr := upperWord * 65536 + lowerWord

return attr

procedure OidFromAttid(t: PrefixTable, attr: ATTRTYP): OID

```

Informative summary of behavior: This procedure converts an ATTRTYP representation to a corresponding OID ~~(2)~~.

```

i, upperWord, lowerWord: integer
binaryOID: sequence of BYTE

binaryOID = null

/* separate the ATTRTYP into two parts*/
upperWord := attr / 65536
lowerWord := attr mod 65536

/* search in the prefix table to find the upperWord, if found,
 * construct the binary OID by appending lowerWord to the end of
 * found prefix.*/
for i := 0 to t.length
  if t[i].prefixIndex = upperWord then
    if lowerWord < 128 then
      binaryOID := CatBinary(ToBinary(t[i].prefixString),
        ToByte(lowerWord))
    else
      if lowerWord ≥ 32768 then
        lowerWord := lowerWord - 32768
      endif
      binaryOID := CatBinary(ToBinary(t[i].prefixString),
        ToByte(((lowerWord / 128) mod 128) + 128))
      binaryOID := CatBinary(binaryOID, ToByte(lowerWord mod 128))
    endif
  endif
endfor
if binaryOID = null then
  return null
else
  return ToStringOID(binaryOID)
endif

procedure NewPrefixTable( ): PrefixTable

```

This procedure creates a new **PrefixTable**, inserts the following tuples into the table, and returns the table as the result.

prefixString	Length of prefixString	prefixIndex
"\x55\x4"	2	0
"\x55\x6"	2	1
"\x2A\x86\x48\x86\xF7\x14\x01\x02"	8	2
"\x2A\x86\x48\x86\xF7\x14\x01\x03"	8	3
"\x60\x86\x48\x01\x65\x02\x02\x01"	8	4
"\x60\x86\x48\x01\x65\x02\x02\x03"	8	5
"\x60\x86\x48\x01\x65\x02\x01\x05"	8	6
"\x60\x86\x48\x01\x65\x02\x01\x04"	8	7
"\x55\x5"	2	8
"\x2A\x86\x48\x86\xF7\x14\x01\x04"	8	9
"\x2A\x86\x48\x86\xF7\x14\x01\x05"	8	10
"\x09\x92\x26\x89\x93\xF2\x2C\x64"	8	19
"\x60\x86\x48\x01\x86\xF8\x42\x03"	8	20
"\x09\x92\x26\x89\x93\xF2\x2C\x64\x01"	9	21
"\x60\x86\x48\x01\x86\xF8\x42\x03\x01"	9	22
"\x2A\x86\x48\x86\xF7\x14\x01\x05\xB6\x58"	10	23
"\x55\x15"	2	24
"\x55\x12"	2	25
"\x55\x14"	2	26

The following examples show the correspondence between OID and ATTRTYP by using the **PrefixTable** returned by the procedure NewPrefixTable.

```

OID: 2.5.4.6 (countryName attribute)
Binary: \x55\x04\x06
Prefix string: "\x55\x04"
Prefix index: 0
ATTRTYP: 0x00000006

OID: 2.5.6.2 (country class)
Binary: \x55\x06\x02
Prefix string: "\x55\x06"
Prefix index: 1
ATTRTYP: 0x00010002

OID: 1.2.840.113556.1.2.1 (instanceType attribute)
Binary: \x2A\x86\x48\x86\xF7\x14\x01\x02\x01
Prefix string: "\x2A\x86\x48\x86\xF7\x14\x01\x02"
Prefix index: 2
ATTRTYP: 0x00020001

```

```

OID: 1.2.840.113556.1.3.23 (container class)
Binary: \x2A\x86\x48\x86\xF7\x14\x01\x03\x17
Prefix string: "\x2A\x86\x48\x86\xF7\x14\x01\x03"
Prefix index: 3
ATTRTYP: 0x00030017

OID: 2.5.5.1 (attribute syntax: distinguished name)
Binary: \x55\x5\x1
Prefix string: "\x55\x5"
Prefix index: 8
ATTRTYP: 0x00080001

OID: 1.2.840.113556.1.4.1 (RDN attribute)
Binary: \x2A\x86\x48\x86\xF7\x14\x01\x04\x01
Prefix string: "\x2A\x86\x48\x86\xF7\x14\x01\x04"
Prefix index: 9
ATTRTYP: 0x00090001

OID: 1.2.840.113556.1.5.1 (securityObject class)
Binary: \x2A\x86\x48\x86\xF7\x14\x01\x05\x01
Prefix string: "\x2A\x86\x48\x86\xF7\x14\x01\x05"
Prefix index: 10
ATTRTYP: 0x000a0001

OID: 0.9.2342.19200300.100.1.1 (uid attribute)
Binary: \x09\x92\x26\x89\x93\xF2\x2C\x64\x01\x01
Prefix string: "\x09\x92\x26\x89\x93\xF2\x2C\x64\x01"
Prefix index: 21
ATTRTYP: 0x00150001

OID: 2.16.840.1.113730.3.1.1 (carLicense attribute)
Binary: \x60\x86\x48\x01\x86\xF8\x42\x03\x01\x01
Prefix string: "\x60\x86\x48\x01\x86\xF8\x42\x03\x01"
Prefix index: 22
ATTRTYP: 0x00160001

OID: 1.2.840.113556.1.5.7000.53 (crossRefContainer class)
Binary: \x2A\x86\x48\x86\xF7\x14\x01\x05\xB6\x58\x35
Prefix string: "\x2A\x86\x48\x86\xF7\x14\x01\x05\xB6\x58"
Prefix index: 23
ATTRTYP: 0x00170035

OID: 2.5.21.2 (ditContentRules attribute)
Binary: \x55\x15\x02
Prefix string: "\x55\x15"
Prefix index: 24
ATTRTYP: 0x00180002

OID: 2.5.18.1 (createTimeStamp attribute)
Binary: \x55\x12\x01
Prefix string: "\x55\x12"
Prefix index: 25
ATTRTYP: 0x00190001

OID: 2.5.20.1 (subSchema class)
Binary: \x55\x14\x01
Prefix string: "\x55\x14"
Prefix index: 26
ATTRTYP: 0x001a0001

```

5.17 ATTRVALBLOCK

The ATTRVALBLOCK structure defines a concrete type for a sequence of attribute values.

```

typedef struct {
    [range(0,10485760)] ULONG valCount;
    [size_is(valCount)] ATTRVAL* pAVal;

```

```
} ATTRVALBLOCK;
```

valCount: The number of items in the pAVal array.

pAVal: The sequence of attribute values.

5.18 ATTRVALFromValue

```
procedure ATTRVALFromValue(v: Value,  
                           s: Syntax,  
                           var t: PrefixTable) : ATTRVAL
```

The ATTRVALFromValue procedure converts a value in the abstract Value encoding *v* of syntax *s* into a concrete ATTRVAL, using the prefix table represented by *t*. This procedure **may** mutate the supplied prefix table.

See section 5.16.3 for the specification of this procedure.

5.19 BindToDSA()

```
procedure BindToDSA(dsa: DSNAME): DRS_HANDLE
```

The BindToDSA procedure establishes an RPC connection to the target DC represented by its **DSA object**. It also performs the IDL_DRSSbind call. It returns the RPC handle on success or null on failure.

5.20 BOOL

A concrete type for a Boolean value, as specified in [MS-DTYP] section 2.2.3.

5.21 BYTE

A concrete type for a single byte, as specified in [MS-DTYP] section 2.2.6.

5.22 CHANGE_LOG_ENTRIES

CHANGE_LOG_ENTRIES is a concrete type, normatively specified in [MS-ADTS] section 3.1.1.7.3; the type of the pmsgOut.V1.pLog field of the IDL_DRSSGetNT4ChangeLog response. The following five fields within this type are used in specifying IDL_DRSSGetNT4ChangeLog server behavior:

Size: MUST be 0x00000010.

Version: MUST be 0x00000001.

SequenceNumber: The sequence number for the buffer. MUST be set to 0x00000001 in a response to an IDL_DRSSGetNT4ChangeLog request with pmsgIn.V1.pRestart = null. The value of pmsgOut.V1.pRestart in any IDL_DRSSGetNT4ChangeLog response MUST encapsulate SequenceNumber. In a response to an IDL_DRSSGetNT4ChangeLog request with pmsgIn.V1.pRestart ≠ null, SequenceNumber is the value encapsulated in pmsgIn.V1.pRestart, plus one.

Flags: MUST be 0x00000000.

ChangeLogEntries: A pointer to an array of CHANGELOG_ENTRY.

5.23 CHANGELOG_ENTRY

CHANGELOG_ENTRY is a concrete type that is defined in [MS-NRPC] section 3.5.4.6.4, with more information in [MS-ADTS] section 3.1.1.7.1.2. The abstract variable `dc.pdcChangeLog` is a sequence of CHANGELOG_ENTRY. The following two fields within this type are used in specifying IDL_DRSGetNT4ChangeLog server behavior:

ChangeLogEntrySize: A DWORD containing the size, in bytes, of the CHANGELOG_ENTRY structure.

SerialNumber: A LARGE_INTEGER containing the serial number of the update represented in this CHANGELOG_ENTRY.

5.24 CheckGroupMembership

```
procedure CheckGroupMembership(  
    token: ClientAuthorizationInfo,  
    groupSid: SID): boolean
```

The CheckGroupMembership procedure returns true only if the user represented by *token* is a member of the group whose SID is *groupSid*. For more details, see [MS-DTYP] section 2.5.3.

5.25 ClientAuthorizationInfo

ClientAuthorizationInfo is an abstract type that represents a client's security context that contains authorization information for a client.

5.26 ClientExtensions

```
procedure ClientExtensions(hDrs: DRS_HANDLE): DRS_EXTENSIONS_INT
```

The ClientExtensions server procedure gets the client extensions presented in the IDL_DRSSBind call that created *hDrs*. Any fields not specified by the client in the *pextClient* parameter to IDL_DRSSBind (such that *pextClient*[^].*cb* is less than the offset of the end of the field of DRS_EXTENSIONS_INT) are set to 0.

5.27 ClientUUID

```
procedure ClientUUID(hDrs: DRS_HANDLE): UUID
```

The ClientUUID procedure returns the GUID that identifies the caller presented in the IDL_DRSSBind call that created *hDrs*.

5.28 ConcretePTFromAbstractPT

```
procedure ConcretePTFromAbstractPT(  
    prefixTable: PrefixTable): SCHEMA_PREFIX_TABLE
```

Informative summary of behavior: The ConcretePTFromAbstractPT procedure translates abstract PrefixTable to a SCHEMA_PREFIX_TABLE structure.

```
prefixCount: ULONG  
concretePrefixTable: SCHEMA_PREFIX_TABLE
```



```

schemaSignature: sequence of BYTE

prefixCount := prefixTable.length
concretePrefixTable.PrefixCount := prefixCount
for i := 0 to (prefixTable.length - 1)
    concretePrefixTable.pPrefixTableEntry[i].prefix :=
        prefixTable[i].prefixString
    concretePrefixTable.pPrefixTableEntry[i].ndx :=
        prefixTable[i].prefixIndex
endfor

return concretePrefixTable

```

5.29 ConfigNC

```

procedure ConfigNC(): DSName

```

The ConfigNC procedure returns the dsname of dc.configNC.

5.30 dc, DC

A global variable that represents the state of a DC, as defined in [MS-ADTS] section 3.1.1.1.9, and the type of that variable. That definition is repeated here for convenience:

```

type DC = [
    serverGuid: GUID,
    invocationId: GUID,
    usn: 64-bit integer,
    prefixTable: PrefixTable,
    defaultNC: domain NC replica,
    configNC: config NC replica,
    schemaNC: schema NC replica,
    partialDomainNCs: set of partial domain NC replica,
    appNCs: set of application NC replica,
    pdcChangeLog: PdcChangeLog,
    nt4ReplicationState: NT4ReplicationState,
    ldapConnections: LDAPConnections,
    replicationQueue: ReplicationQueue,
    kccFailedConnections: KCCFailedConnections,
    kccFailedLinks: KCCFailedLinks,
    rpcClientContexts: RPCClientContexts,
    rpcOutgoingContexts: RPCOutgoingContexts,
    flinkValueStampEnabled: boolean,

```

```

nt4EmulatorEnabled: boolean,
fEnableUpdates: boolean,
minimumGetChangesReplyVersion: integer,
minimumGetChangesRequestVersion: integer
]

```

The *IdapConnections*, *replicationQueue*, *kccFailedConnections*, *kccFailedLinks*, *rpcClientContexts*, and *rpcOutgoingContexts* fields are volatile state. Each volatile field is set to the empty sequence on server startup. The other fields are persistent state, updated by using transactions.

The variable *dc* is the only global variable in this specification. It contains the state of the server:

```
dc: DC
```

5.31 DefaultNC

```
procedure DefaultNC(): DSName
```

The *DefaultNC* procedure returns the *dsname* of the *dc.defaultNC*.

5.32 DelSubRef

```
procedure DelSubRef(childNC: DSName)
```

Informative summary of behavior: This procedure deletes a sub-ref object for the NC *childNC*, if it exists.

```

parentNC: DSName
rt: ULONG

/* If the sub-ref object is not instantiated, delete it */
if(IT_UNINSTANT in childNC!instanceType)
then
    rt:=RemoveObj(childNC, false)
    /* Ignore rt because there are no possible errors returned by RemoveObj
    while deleting a subref object. RemoveObj always returns success in this
    procedure */

else
    /* Otherwise, just prevent continuation referrals from being
    * generated by removing childNC from the parent's subRefs list.
    */
    parentNC := GetObjectNC(ChildNC)
    parentNC!subRefs := parentNC!subRefs - {childNC}
endif

```

5.33 DescendantObject

```

procedure DescendantObject(
    ancestor: DSName, rdns: unicodestring): DSName

```

The `DescendantObject` procedure constructs a DN string by concatenating `rdns` and `ancestor.dn`, and then verifies the existence of the descendant object. It returns the `DSName` if the descendant exists, and null otherwise.

5.34 DomainNameFromDN

```
procedure DomainNameFromDN(  
    dn: unicodestring): unicodestring
```

The `DomainNameFromDN` procedure returns the fully qualified domain name (FQDN) (1) of the `crossRef` object identified by `dn`, or null if no matching `crossRef` object exists.

5.35 DN

DN is an abstract type that is a *unicodestring* (section 3.4.3) that contains a DN of the form specified in [RFC2253].

5.36 DNBinary

DNBinary is an abstract type that represents the concrete type `SYNTAX_DISTNAME_BINARY`. It consists of the following tuple:

```
type DNBinary = [dn: DSName, binary: sequence of BYTE]
```

5.37 DomainNameFromNT4AccountName

```
procedure DomainNameFromNT4AccountName(  
    nt4AccountName: unicodestring): unicodestring
```

If `nt4AccountName` is a name in Windows NT 4.0 operating system account name format, that is, two components separated by a backslash (for example, "DOMAIN\username"), the `DomainNameFromNT4AccountName` procedure returns the first component (the domain name, or "DOMAIN" in this example). If the `nt4AccountName` is not in this format, null is returned.

5.38 DRS_EXTENSIONS

The `DRS_EXTENSIONS` structure defines a concrete type for capabilities information used in version negotiation.

```
typedef struct {  
    [range(1,10000)] DWORD cb;  
    [size_is(cb)] BYTE rgb[];  
} DRS_EXTENSIONS;
```

cb: The size, in bytes, of the **rgb** array.

rgb: To RPC, this field is a string of **cb** bytes. It is interpreted by the client and the server as the first **cb** bytes of a `DRS_EXTENSIONS_INT` structure that follow the **cb** field of that structure. The fields of the `DRS_EXTENSIONS_INT` structure are in little-endian byte order. Since both `DRS_EXTENSIONS` and `DRS_EXTENSIONS_INT` begin with a **DWORD cb**, a field in `DRS_EXTENSIONS_INT` is at the same offset in `DRS_EXTENSIONS` as it is in `DRS_EXTENSIONS_INT`.

5.39 DRS_EXTENSIONS_INT

Note: Some of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it in the Product Behavior appendix.

The DRS_EXTENSIONS_INT structure is a concrete type for structured capabilities information used in version negotiation.

0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
cb																															
dwFlags																															
SiteObjGuid (16 bytes)																															
...																															
...																															
Pid																															
dwReplEpoch																															
dwFlagsExt																															
ConfigObjGUID (16 bytes)																															
...																															
...																															
dwExtCaps																															

cb (4 bytes): The count of bytes in the fields **dwFlags** through **dwExtCaps**, inclusive. <39><40><41> This field allows the DRS_EXTENSIONS_INT structure to be extended by including new fields at the end of the structure.

dwFlags (4 bytes): The **dwFlags** field contains individual bit flags that describe the capabilities of the DC that produced the DRS_EXTENSIONS_INT structure. <42>

The following table lists the bit flags, which are presented in little-endian byte order.

0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	
A	U	D	D	M	R	A	B	S	G	C	I	D	L	A	K	A	G	G	G	P	S	T	D	R	R	G	D	W	G	G	G	
E	O	C	F	V	M	S	A	E	R	B	N	C	V	E	E	N	C	M	C	B	H	M	C	3	R	C	F	B	R	R	C	

BAS (DRS_EXT_BASE, 0x00000001): Unused. SHOULD be 1 and MUST be ignored.

- AS (DRS_EXT_ASYNCREPL, 0x00000002):** If present, signifies that the DC supports DRS_MSG_REPADD_V2.
- RM (DRS_EXT_REMOVEAPI, 0x00000004):** If present, signifies that the DC supports IDL_DRSCRemoveDsServer and IDL_DRSCRemoveDsDomain.
- MV (DRS_EXT_MOVEREQ_V2, 0x00000008):** If present, signifies that the DC supports DRS_MSG_MOVEREQ_V2.
- DF (DRS_EXT_GETCHG_DEFLATE, 0x00000010):** If present, signifies that the DC supports DRS_MSG_GETCHGREPLY_V2.
- DC (DRS_EXT_DCINFO_V1, 0x00000020):** If present, signifies that the DC supports IDL_DRSDomainControllerInfo.
- UO (DRS_EXT_RESTORE_USN_OPTIMIZATION, 0x00000040):** Unused. SHOULD be 1 and MUST be ignored.
- AE (DRS_EXT_ADDENTRY, 0x00000080):** If present, signifies that the DC supports IDL_DRSCAddEntry.
- KE (DRS_EXT_KCC_EXECUTE, 0x00000100):** If present, signifies that the DC supports IDL_DRSCExecuteKCC.
- AE2 (DRS_EXT_ADDENTRY_V2, 0x00000200):** If present, signifies that the DC supports DRS_MSG_ADDENTRYREQ_V2.
- LVR (DRS_EXT_LINKED_VALUE_REPLICATION, 0x00000400):** If present, signifies that the DC supports link value replication, and this support is enabled.
- DC2 (DRS_EXT_DCINFO_V2, 0x00000800):** If present, signifies that the DC supports DRS_MSG_DCINFOREPLY_V2.
- INR (DRS_EXT_INSTANCE_TYPE_NOT_REQ_ON_MOD, 0x00001000):** Unused. SHOULD be 1 and MUST be ignored.
- CB (DRS_EXT_CRYPTO_BIND, 0x00002000):** A client-only flag. If present, it indicates that the security provider used for the connection supports **session keys** through RPC (example, Kerberos connections with mutual authentication enable RPC to expose session keys, but NTLM connections do not enable RPC to expose session keys).
- GRI (DRS_EXT_GET_REPL_INFO, 0x00004000):** If present, signifies that the DC supports IDL_DRSCGetReplInfo.
- SE (DRS_EXT_STRONG_ENCRYPTION, 0x00008000):** If present, signifies that the DC supports additional 128-bit encryption for passwords over the wire. DCs MUST NOT replicate passwords to other DCs that do not support this extension.
- DCF (DRS_EXT_DCINFO_VFFFFFFFF, 0x00010000):** If present, signifies that the DC supports DRS_MSG_DCINFOREPLY_VFFFFFFFF.
- TM (DRS_EXT_TRANSITIVE_MEMBERSHIP, 0x00020000):** If present, signifies that the DC supports IDL_DRSCGetMemberships.
- SH (DRS_EXT_ADD_SID_HISTORY, 0x00040000):** If present, signifies that the DC supports IDL_DRSCAddSidHistory.
- PB3 (DRS_EXT_POST_BETA3, 0x00080000):** Unused. SHOULD be 1 and MUST be ignored.
- GC5 (DRS_EXT_GETCHGREQ_V5, 0x00100000):** If present, signifies that the DC supports DRS_MSG_GETCHGREQ_V5.

This type is declared as follows:

```
typedef unsigned long DRS_OPTIONS;
```

It is a bit field, presented in little-endian byte order, that contains the following values.

Seven elements of the set are interpreted differently by different methods; such elements have multiple symbolic names.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
M	P	I	W	A	A	G	A	F	S	N	G	G	C	T	A	I	S	S	N	R	S	S	F	F	G	S	N	U	D	D	S	P
R	S	S	R	L	R	C	S	S	N	R	S	A	O	S	S	S	S	S	S	R	S	U	S	S	P	P	N	U	D	D	S	P
			L	L		/	/	/	/	/	/				R	R																
			D	D		U	N	S	F	R	L				I	N																
			R	R		N					O				E																	

X: Unused. MUST be zero and ignored.

AS (DRS_ASYNC_OP, 0x00000001): Perform the operation asynchronously.

GC (DRS_GETCHG_CHECK, 0x00000002): Treat ERROR_DS_DRA_REF_NOT_FOUND and ERROR_DS_DRA_REF_ALREADY_EXISTS as success for calls to IDL_DRSUpdateRefs (section 4.1.26).

UN (DRS_UPDATE_NOTIFICATION, 0x00000002): Identifies a call to IDL_DRSReplicaSync that was generated due to a replication notification. See [MS-ADTS] section 3.1.1.5.1.6 for more details on replication notifications. This flag is ignored by the server.

AR (DRS_ADD_REF, 0x00000004): Register a client DC for notifications of updates to the NC replica.

ALL (DRS_SYNC_ALL, 0x00000008): Replicate from all server DCs.

DR (DRS_DEL_REF, 0x00000008): Deregister a client DC from notifications of updates to the NC replica.

WR (DRS_WRIT_REP, 0x00000010): Replicate a writable replica, not a read-only partial replica or read-only full replica.

IS (DRS_INIT_SYNC, 0x00000020): Perform replication at startup.

PS (DRS_PER_SYNC, 0x00000040): Perform replication periodically.

MR (DRS_MAIL_REP, 0x00000080): Perform replication using SMTP as a transport.

ASR (DRS_ASYNC_REP, 0x00000100): Populate the NC replica asynchronously.

IE (DRS_IGNORE_ERROR, 0x00000100): Ignore errors.

TS (DRS_TWOWAY_SYNC, 0x00000200): Inform the server DC to replicate from the client DC.

CO (DRS_CRITICAL_ONLY, 0x00000400): Replicate only **system-critical objects**.

GA (DRS_GET_ANC, 0x00000800): Include updates to ancestor objects before updates to their descendants.

GS (DRS_GET_NC_SIZE, 0x00001000): Get the approximate size of the server NC replica.

LO (DRS_LOCAL_ONLY, 0x00001000): Perform the operation locally without contacting any other DC.

NRR (DRS_NONGC_RO_REP, 0x00002000): Replicate a read-only full replica. Not a writable or partial replica.

SN (DRS_SYNC_BYNAME, 0x00004000): Choose the source server by network name.

RF (DRS_REF_OK, 0x00004000): Allow the NC replica to be removed even if other DCs use this DC as a replication server DC.

FS (DRS_FULL_SYNC_NOW, 0x00008000): Replicate all updates in the replication cycle, even those that would normally be filtered.

NS (DRS_NO_SOURCE, 0x00008000): The NC replica has no server DCs.

FSI (DRS_FULL_SYNC_IN_PROGRESS, 0x00010000): When the flag DRS_FULL_SYNC_NOW is received in a call to IDL_DRSReplicaSync, the flag DRS_FULL_SYNC_IN_PROGRESS is sent in the associated calls to IDL_DRSGetNCChanges until the replication cycle completes. This flag is ignored by the server.

FSP (DRS_FULL_SYNC_PACKET, 0x00020000): Replicate all updates in the replication request, even those that would normally be filtered.

SQ (DRS_SYNC_REQUEUE, 0x00040000): This flag is specific to the Microsoft client implementation of IDL_DRSGetNCChanges. It is used to identify whether the call was placed in the replicationQueue more than once due to implementation-specific errors. This flag is ignored by the server.

SU (DRS_SYNC_URGENT, 0x00080000): Perform the requested replication immediately; do not wait for any timeouts or delays. For information about urgent replication, see [MS-ADTS] section 3.1.1.5.1.7.

RG (DRS_REF_GCSPN, 0x00100000): Requests that the server add an entry to repsTo for the client on the root object of the NC replica that is being replicated. When repsTo is set using this flag, the notifying client DC contacts the server DC using the service principal name that begins with "GC" (section 2.2.3.2).

ND (DRS_NO_DISCARD, 0x00100000): This flag is specific to the Microsoft implementation. It identifies when the client DC shouldis to call the requested IDL_DRSReplicaSync method individually, without overlapping other outstanding calls to IDL_DRSReplicaSync. This flag is ignored by the server.

NSY (DRS_NEVER_SYNCED, 0x00200000): There is no successfully completed replication from this source server.

SS (DRS_SPECIAL_SECRET_PROCESSING, 0x00400000): Do not replicate attribute values of attributes that contain secret data.

ISN (DRS_INIT_SYNC_NOW, 0x00800000): Perform initial replication now.

PE (DRS_PREEMPTED, 0x01000000): The replication attempt is preempted by a higher priority replication request.

SF (DRS_SYNC_FORCED, 0x02000000): Force replication, even if the replication system is otherwise disabled.

DAS (DRS_DISABLE_AUTO_SYNC, 0x04000000): Disable replication induced by update notifications.

DPS (DRS_DISABLE_PERIODIC_SYNC, 0x08000000): Disable periodic replication.

X: Unused. MUST be zero and ignored.

TYP: **MayCan** be one of the following values:

Value	Meaning
SECBUFFER_EMPTY 0x00000000	A placeholder in the buffer array. The caller can supply several such entries in the array, and the security package can return data in them.
SECBUFFER_DATA 0x00000001	Used for common data. The security package can read this data and write it, for example, to encrypt some or all of it.
SECBUFFER_TOKEN 0x00000002	This buffer is used to indicate the security token portion of the message. This is read-only for input parameters or read/write for output parameters.
SECBUFFER_PKG_PARAMS 0x00000003	These are transport-to-package-specific parameters. For example, the Netware redirector maycan supply the server object identifier, while DCE RPC can supply an association UUID, and so on.
SECBUFFER_MISSING 0x00000004	The security package uses this value to indicate the number of missing bytes in a particular message. The pvBuffer member is ignored in this type.
SECBUFFER_EXTRA 0x00000005	The security package uses this value to indicate the number of extra or unprocessed bytes in a message.
SECBUFFER_STREAM_TRAILER 0x00000006	Indicates a protocol-specific trailer for a particular record.
SECBUFFER_STREAM_HEADER 0x00000007	Indicates a protocol-specific header for a particular record.

RO (SECBUFFER_READONLY, 0x80000000): The buffer is read-only. This flag is intended for sending header data to the security package for checksumming. The package can read this buffer but cannot modify it.

pvBuffer: Authentication data.

5.44 DRS_SecBufferDesc

DRS_SecBufferDesc is a Generic Security Service (GSS) Kerberos authentication token, as specified in [RFC1964].

```
typedef struct {
    unsigned long ulVersion;
    [range(0,10000)] unsigned long cBuffers;
    [size_is(cBuffers)] DRS_SecBuffer* Buffers;
} DRS_SecBufferDesc;
```

ulVersion: MUST be 0.

cBuffers: The number of items in the Buffers array.

Buffers: Buffers that contain authentication data.

5.45 DRS_SPN_CLASS

A *unicodestring* constant (section 3.4.3) that is used as the service class in the SPN for a DC. It has the value "E3514235-4B06-11D1-AB04-00C04FC2DCD2".

5.46 DS_REPL_OP_TYPE

DS_REPL_OP_TYPE is a concrete type for the replication operation type.

```
typedef enum
{
    DS_REPL_OP_TYPE_SYNC = 0x00000000,
    DS_REPL_OP_TYPE_ADD = 0x00000001,
    DS_REPL_OP_TYPE_DELETE = 0x00000002,
    DS_REPL_OP_TYPE_MODIFY = 0x00000003,
    DS_REPL_OP_TYPE_UPDATE_REFS = 0x00000004
} DS_REPL_OP_TYPE;
```

DS_REPL_OP_TYPE_SYNC: Sync NC replica from server DC.

DS_REPL_OP_TYPE_ADD: Add NC replica server DC.

DS_REPL_OP_TYPE_DELETE: Remove NC replica server DC.

DS_REPL_OP_TYPE_MODIFY: Modify NC replica server DC.

DS_REPL_OP_TYPE_UPDATE_REFS: Update NC replica client DC.

5.47 DSAObj

```
procedure DSAObj(): DSName
```

The DSAObj procedure returns the dsname of the DC's nTDSDSA object.

```
return select one o from children ConfigNC()
       where o!objectGUID = dc.serverGUID
```

5.48 DSA_RPC_INST

The DSA_RPC_INST structure is a concrete type that represents a DC.

```
typedef struct _DSA_RPC_INST {
    DWORD cb;
    DWORD cbpszServerOffset;
    DWORD cbpszAnnotationOffset;
    DWORD cbpszInstanceOffset;
    DWORD cbpguidInstanceOffset;
} DSA_RPC_INST,
*PDSA_RPC_INST;
```

cb: The total number of bytes in the DSA_RPC_INST structure.

cbpszServerOffset: The offset from the start of the DSA_RPC_INST structure to a location that specifies the start of the server name of this instance.

cbpszAnnotationOffset: The offset from the start of the DSA_RPC_INST structure to a location that specifies the start of the annotation of this instance.

cbpszInstanceOffset: The offset from the start of the DSA_RPC_INST structure to a location that specifies the start of the NetworkAddress (section 5.133134) of this instance.

cbpguidInstanceOffset: The offset from the start of the DSA_RPC_INST structure to a location that specifies the start of the GUID for the instance.

5.49 DSName

DSName is an abstract type for representing a dsname. It corresponds to the concrete representation DSNAME. It consists of a tuple that identifies an object in the directory. This tuple is discussed in [MS-ADTS] section 3.1.1.1.5. For this document, the fields of the tuple are defined as follows:

```
type DSName = [dn: StringName , guid: GUID, sid: Sid]
```

The *dn* field corresponds to the **StringName** field of the DSNAME structure and contains the DN of the object.

The *guid* field corresponds to the **Guid** field of the DSNAME structure and contains the value of the object's objectGUID attribute.

The *sid* field corresponds to the **Sid** field of the DSNAME structure. If the object possesses an objectSid attribute, it contains the value of the object's objectSid attribute. If the object does not possess an objectSid attribute, the field is null.

5.50 DSNAME

DSNAME is a concrete type for representing a DSName, identifying a directory object using the values of one or more of its LDAP attributes: objectGUID, objectSid, or distinguishedName.

```
typedef struct {
    unsigned long structLen;
    unsigned long SidLen;
    GUID Guid;
    NT4SID Sid;
    unsigned long NameLen;
    [range(0, 10485761),] [size_is(NameLen + 1)]
    WCHAR StringName[];
} DSNAME;
```

structLen: The length, in bytes, of the entire data structure.

SidLen: The number of bytes in the Sid field used to represent the object's objectSid attribute value. Zero indicates that the DSNAME does not identify the objectSid value of the directory object.

Guid: The value of the object's objectGUID attribute specified as a GUID structure, which is defined in [MS-DTYP] section 2.3.4. If the values for all fields in the GUID structure are zero, this indicates that the DSNAME does not identify the objectGUID value of the directory object.

Sid: The value of the object's objectSid attribute, its security identifier, specified as a **SID** structure, which is defined in [MS-DTYP] section 2.4.2. The size of this field is exactly 28 bytes, regardless of the value of **SidLen**, which specifies how many bytes in this field are used. Note that this is smaller than the theoretical size limit of a **SID**, which is 68 bytes. While Windows publishes a general SID format, Windows never uses that format in its full generality. 28 bytes is sufficient for a Windows SID.

NameLen: The number of characters in the **StringName** field, not including the terminating null character, used to represent the object's distinguishedName attribute value. Zero indicates that the DSNAME does not identify the distinguishedName value of the directory object.

StringName: A null-terminated Unicode value of the object's distinguishedName attribute, as specified in [MS-ADTS] section 3.1.1.1.4. This field always contains at least one character: the terminating null character. Each Unicode value is encoded as 2 bytes. The byte ordering is little-endian.<49>

The following table shows an alternative representation of this structure.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
structLen																															
SidLen																															
Guid.Data1																															
Guid.Data2																Guid.Data3															
Guid.Data4...																															
...Guid.Data4																															
Sid...																															
...Sid...																															
...Sid...																															
...Sid...																															
...Sid...																															
...Sid...																															
...Sid...																															
...Sid																															
NameLen																															
StringName (Variable Length) ...																															

Note All fields have little-endian byte ordering.

5.50.1 DSNAME Equality

When comparing DSNAME elements for equality, an implementation must be aware that multiple attributes may be specified. DSNAME values x and y are equal only if one of the following conditions holds:

- x.Guid is not zeros and y.Guid is not zeros and x.Guid = y.Guid
- All of the following are true:
 - x.Guid is zeros or y.Guid is zeros.
 - x.StringLen ≠ 0.
 - The number of RDNs in x is the same as in y.
 - For each RDN x_i in x and RDN y_i in y (see [RFC2253]):
 - AttributeType of x_i = AttributeType of y_i .
 - AttributeValue of x_i = AttributeValue of y_i , without regard to case differences, Hiragana and Katakana character differences, and nonspacing characters.
- All of the following are true:
 - x.Guid is zeros.
 - y.Guid is zeros.
 - x.StringLen = 0.
 - y.StringLen = 0.
 - x.SidLen ≠ 0.
 - x.SidLen = y.SidLen.
 - x.Sid and y.Sid contain identical values in the first x.SidLen array items.

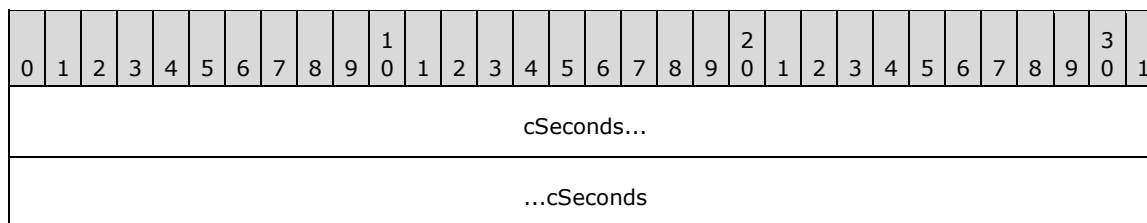
5.51 DSTIME

DSTIME is a concrete type for time expressed as the number of seconds since January 1, 1601, 12:00:00 A.M.

This type is declared as follows:

```
typedef LONGLONG DSTIME;
```

The following diagram shows an alternative representation of this type.



Note Byte ordering is little-endian.

5.52 DWORD

A concrete type for a 32-bit, unsigned integer, as specified in [MS-DTYP] section 2.2.9.

5.55 ENTINF_SetValue

```
procedure ENTINF_SetValue (  
    var entInf: ENTINF,  
    attribute: ATTRTYP,  
    attrVal: ATTRVAL,  
    prefixTable: PrefixTable)
```

The ENTINF_SetValue procedure updates an attribute value within the ENTINF. If *attrVal* is null, then the attribute is removed from the list (if it exists). If the value is non-null, then the attribute value is updated or added to the list (when a value is not already present). The *attribute* and *attrVal* parameters are based on *dc.prefixTable*, while the attributes within *entInf* are based on the *prefixTable* parameter.

5.56 ENTINF_EnumerateAttributes

```
procedure ENTINF_EnumerateAttributes(  
    e: ENTINF,  
    prefixTable: PrefixTable): set of ATTRTYP
```

The ENTINF_EnumerateAttributes procedure returns the list of attributes (based on *dc.prefixTable*) that are present in the ENTINF *e*. Attributes within *e* are based on the *prefixTable* parameter.

5.57 ENTINFLIST

ENTINFLIST is a concrete type for a list of ENTINF entries.

```
typedef struct ENTINFLIST {  
    struct ENTINFLIST* pNextEntInf;  
    ENTINF Entinf;  
} ENTINFLIST;
```

pNextEntInf: The next ENTINFLIST in the sequence, or null.

Entinf: An ENTINF entry.

5.58 Expunge

```
procedure Expunge(obj: DSName)
```

The Expunge procedure physically removes an object whose DSName is *obj* from the directory, without enforcing referential integrity constraints. The object is immediately removed without undergoing conversion to a tombstone.

5.59 FILETIME

FILETIME is a concrete type for a time, as specified in [MS-DTYP] section 2.3.3.

5.60 FilteredGCPAS

```
procedure FilteredGCPAS() : PARTIAL_ATTR_VECTOR_V1_EXT^
```

Informative summary of behavior: The FilteredGCPAS procedure returns a reference to an instance of structure PARTIAL_ATTR_VECTOR_V1_EXT that contains the list of attributes that **maycan** be present, based on the schema, on a filtered GC replica.

```

attrSetSeq: sequence of DSName
filteredAttributeSet: sequence of ATTRTYP
pPartialAttrVector: PARTIAL_ATTR_VECTOR_V1_EXT^
attrId: ATTRTYP
i, j:int

attrSetSeq := select o from subtree SchemaNC() where
                (attributeSchema in o!objectClass) and
                (o!isMemberOfPartialAttributeSet = true)

filteredAttributeSet := GetFilteredAttributeSet()

pPartialAttrVector = new PARTIAL_ATTR_VECTOR_V1_EXT sized to hold
                (attrSetSeq.length - filteredAttributeSet.length) entries in
                its rgPartialAttr field
pPartialAttrVector^.dwVersion := 1
-
j := 0
for i := 0 to attrSetSeq.length-1
    attrId = AttrtypFromSchemaObj(attrSetSeq[i]);
    if (not attrId in filteredAttributeSet) then
        /* attribute is not in the filtered list */
        pPartialAttrVector^.rgPartialAttr[j] := attrId
        j := j + 1
    endif
endfor
pPartialAttrVector^.cattrs := j

return pPartialAttrVector^

```

5.61 FilteredPAS

```

procedure FilteredPAS() : PARTIAL_ATTR_VECTOR_V1_EXT

```

Informative summary of behavior: The FilteredPAS procedure returns a reference to an instance of structure PARTIAL_ATTR_VECTOR_V1_EXT that contains the list of attributes that **maycan** be present, based on the schema, on a filtered NC replica.

```

attrSetSeq: sequence of DSName
filteredAttributeSet: sequence of ATTRTYP
pPartialAttrVector: PARTIAL_ATTR_VECTOR_V1_EXT^
attrId: ATTRTYP
i, j: int

attrSetSeq := select o from subtree SchemaNC() where
                (attributeSchema in o!objectClass) and
                (o!systemFlags &
                {FLAG_ATTR_NOT_REPLICATED,
                FLAG_ATTR_IS_CONSTRUCTED} = null)

filteredAttributeSet := GetFilteredAttributeSet()

pPartialAttrVector = new PARTIAL_ATTR_VECTOR_V1_EXT sized to hold
                (attrSetSeq.length - filteredAttributeSet.length) entries in
                its rgPartialAttr field
pPartialAttrVector^.dwVersion := 1
for i := 0 to attrSetSeq.length-1
    attrId = AttrtypFromSchemaObj(attrSetSeq [i]);
    if (not attrId in filteredAttributeSet = null) then
        /* attribute is not in the filtered list */

```


Version (4 bytes): The version of the data structure. The only supported version of the data structure is 1.

RecordCount (4 bytes): The number of records present in the data structure.

Records (variable): Variable-length records that each contain a specific type of data about the forest trust relationship.

Note Records are not necessarily aligned to 32-bit boundaries. Each record starts at the next byte after the previous record ends.

Each record is represented as described in section 5.64.1.

Note All fields have little-endian byte ordering.

5.64.1 Record

Each Record is represented in the following manner.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
RecordLen																															
Flags																															
Timestamp																															
...																															
RecordType																ForestTrustData (variable)															
...																															

RecordLen (4 bytes): The length, in bytes, of the entire record.

Flags (4 bytes): Individual bit flags that control how the forest trust information in this record can be used.

If **RecordType** = 0 or 1, the **Flags** field can have one or more of the following bits, which are presented in little-endian byte order.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
X	X	X	X	X	TDC	TDA	TDN	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

X: Unused. Must be zero and ignored.

TDN (LSA_TLN_DISABLED_NEW, 0x00000001): The entry is not yet enabled.

TDA (LSA_TLN_DISABLED_ADMIN, 0x00000002): The entry is disabled by the administrator.

TDC (LSA_TLN_DISABLED_CONFLICT, 0x00000004): The entry is disabled due to a conflict with another trusted domain.

If **RecordType** = 2, the **Flags** field can have one or more of the following bits, which are presented in little-endian byte order.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
X	X	X	X	N D C	N D A	S D C	S D A	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

X: Unused. MUST be zero and ignored.

SDA (LSA_SID_DISABLED_ADMIN, 0x00000001): The entry is disabled for SID-based matches by the administrator.

SDC (LSA_SID_DISABLED_CONFLICT, 0x00000002): The entry is disabled due to a SID conflict with another trusted domain.

NDA (LSA_NB_DISABLED_ADMIN, 0x00000004): The entry is disabled for NetBIOS name-based matches by the administrator.

NDC (LSA_NB_DISABLED_CONFLICT, 0x00000008): The entry is disabled due to a NetBIOS domain name conflict with another trusted domain.

For RecordType = 2, NETBIOS_DISABLED_MASK is defined as a mask on the lower 4 bits of the **Flags** field.

For all record types, LSA_FTRECORD_DISABLED_REASONS is defined as a mask on the lower 16 bits of the **Flags** field. Unused bits covered by the mask are reserved for future use.

Timestamp (8 bytes): A FILETIME (section 5.59) that contains the time when this entry was created.

RecordType (1 byte): An 8-bit value that specifies the type of record contained in this specific entry. The allowed values are specified in section 5.65.

ForestTrustData (variable): A variable length, type-specific record, depending on the RecordType value, that contains the specific type of data about the forest trust relationship.

Important The type-specific ForestTrustData record is not necessarily aligned to a 32-bit boundary. Each record starts at the byte following the **RecordType** field.

There are three different type-specific records. Depending on the value of the **RecordType** field, the structure of the type-specific record differs as described below.

- If RecordType = 0 or RecordType = 1, then the type-specific record is represented in the following manner.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
NameLen																															
Name (variable length)...																															

NameLen: The length, in bytes, of the **Name** field.

Name: The top-level name of the trusted forest, in UTF-8 format.

- If RecordType = 2, then the type-specific record is represented in the following manner. Note that the record contains the following structures one after another. It is important to note that none of the data shown below is necessarily aligned to 32-bit boundaries.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
SidLen																															
Sid (variable length)...																															
DnsNameLen																															
DnsName (variable length)...																															
NetbiosNameLen																															
NetbiosName (variable length)...																															

SidLen: The length, in bytes, of the **Sid** field.

Sid: The SID of a domain in the trusted forest, specified as a SID structure, which is defined in [MS-DTYP] section 2.4.2.

DnsNameLen: The length, in bytes, of the **DnsName** field.

DnsName: The FQDN (1) of a domain in the trusted forest, in UTF-8 format.

NetbiosNameLen: The length, in bytes, of the **NetbiosName** field.

NetbiosName: The NetBIOS name of a domain in the trusted forest, in UTF-8 format.

- If RecordType is not one of the preceding values, then the type-specific record is represented in the following manner.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
BinaryDataLen																															
BinaryData (variable length)...																															

BinaryDataLen: The length, in bytes, of the **BinaryData** field.

BinaryData: Trusted forest data.

5.64.2 Determining If a Name Is in a Trusted Forest

This section describes procedures that use the forest trust information contained in the msDS-TrustForestTrustInfo attribute to determine if a given domain is in a trusted forest.

The procedures described in this section use the following data structures.

```
struct {
    ULONG RecordCount;
```

```

        PX_FOREST_TRUST_RECORD *Entries;
    } X_FOREST_TRUST_INFORMATION;

    struct {
        ULONG Flags;
        FOREST_TRUST_RECORD_TYPE ForestTrustType;
        LARGE_INTEGER Time;
        union {
            LPWSTR TopLevelName;
            X_FOREST_TRUST_DOMAIN_INFO DomainInfo;
            X_FOREST_TRUST_BINARY_DATA Data;
        } ForestTrustData;
    } X_FOREST_TRUST_RECORD, *PX_FOREST_TRUST_RECORD;

    struct {
        SID *Sid;
        LPWSTR DnsName;
        LPWSTR NetbiosName;
    } X_FOREST_TRUST_DOMAIN_INFO;

    struct {
        ULONG Length;
        BYTE *Buffer;
    } X_FOREST_TRUST_BINARY_DATA;

```

The `X_FOREST_TRUST_INFORMATION` structure previously defined is used by the procedure to determine if a given domain is in a trusted forest. To unmarshal the content of the `msDS-TrustForestTrustInfo` attribute into this structure, the `UnmarshalForestTrustInfo` procedure described below can be used.

```

procedure ExtractString(
    buffer: sequence of BYTE,
    index: DWORD, size: DWORD): unicodestring;

```

The sequence [*index* .. *index* + *size*] of bytes in *buffer* is interpreted as a UTF-8 string, and a corresponding *unicodestring* (section 3.4.3) is returned.

```

procedure ExtractSid(
    buffer: sequence of BYTE,
    index: DWORD, size: DWORD): SID;

```

The sequence [*index* .. *index* + *size*] of bytes in *buffer* is converted into a SID structure and returned.

```

procedure ExtractBinary(
    buffer: sequence of BYTE,
    index: DWORD, size: DWORD): sequence of BYTE;

```

The sequence [*index* .. *index* + *size*] of bytes in *buffer* is returned.

```

procedure UnmarshalForestTrustInfo
    (inputBuffer: sequence of BYTE,
     var forestTrustInfo: X_FOREST_TRUST_INFORMATION): boolean

```

Informative summary of behavior: The `UnmarshalForestTrustInfo` procedure unmarshals the byte stream *inputBuffer*, which holds the content of a `msDS-TrustForestTrustInfo` attribute that contains

forest trust information, as described in FOREST_TRUST_INFORMATION, into the forestTrustInfo structure.

```
index: DWORD
pdwVersion: ADDRESS OF DWORD
pdwRecordCount: ADDRESS OF DWORD
i: DWORD
pwdRecordLength: ADDRESS OF DWORD
pTrustRecord: ADDRESS OF X_FOREST_TRUST_RECORD
pulTime: ADDRESS OF ULONGLONG
pType: ADDRESS OF BYTE
pSid: ADDRESS OF SID
pString: ADDRESS OF unicodestring
pdwSize: ADDRESS OF DWORD

index := 0

pdwVersion := ADR(inputBuffer[index])
if pdwVersion^ ≠ 1 then
    return false
endif

index := index + 4

pdwRecordCount := ADR(inputBuffer[index])
forestTrustInfo.RecordCount := pdwRecordCount^
index := index + 4

/* Extract each record */
for i:= 0 to pdwRecordCount^

    /* First 4 bytes of the record is the length */
    pdwRecordLength := ADR(inputBuffer[index])
    index := index + 4

    pTrustRecord := forestTrustInfo.Entries[i]

    /* Next 4 bytes of the record are the flags */
    pdwFlags := ADR(inputBuffer[index])
    pTrustRecord^.Flags := pdwFlags^
    index := index + 4

    /* Next 8 bytes of the record represent the Time field */
    pulTime := ADR(inputBuffer[index])
    pTrustRecord^.Time := pulTime^
    index := index + 8

    /* Next byte represents trust type */
    pType := ADR(inputBuffer[index])
    pTrustRecord^.ForestTrustType := pType^
    index := index + 1

    if (pTrustRecord^.ForestTrustType = ForestTrustTopLevelName or
        pTrustRecord^.ForestTrustType = ForestTrustTopLevelNameEx)
        then

            /* Next 4 bytes represent the size of the top level name */
            pdwSize := ADR(inputBuffer[index])
            index := index + 4

            /* Extract the top level name; index is at the start of name */
            pTrustRecord^.TopLevelName :=
                ExtractString(inputBuffer, index, pdwSize^)
            index := index + pdwSize^
        else
            if (pTrustRecord^.ForestTrustType = ForestTrustDomainInfo)
                then
                    /* Next 4 bytes represent the size of the sid */
```



```

pdwSize := ADR(inputBuffer[index])
index := index + 4

/* Extract the sid; index is at the start of sid */
pTrustRecord^.DomainInfo.Sid :=
    ExtractSid(inputBuffer, index, pdwSize^)
index := index + pdwSize^

/* Next 4 bytes represent the size of the dns domain name */
pdwSize := ADR(inputBuffer[index])
index := index + 4

/* Extract the dns domain name; index is at start of name */
pTrustRecord^.DomainInfo.DnsName :=
    ExtractString(inputBuffer, index, pdwSize^)
index := index + pdwSize^

/* Next 4 bytes represent the size of the netbios
 * domain name */
pdwSize := ADR(inputBuffer[index])
index := index + 4

/* Extract the netbios domain name; index is at the start
 * of name */
pTrustRecord^.DomainInfo.NetbiosName :=
    ExtractString(inputBuffer, index, pdwSize^)
index := index + pdwSize^
else
/* Next 4 bytes represent the size of the binary data */
pdwSize := ADR(inputBuffer[index])
pTrustRecord^.Data.Length := pdwSize^
index := index + 4

/* Extract the binary data; index is at the start of data */
pTrustRecord^.Data.Buffer :=
    ExtractBinary(inputbuffer, index, pdwSize^)
index := index + pdwSize^
endif

endif

/* index is now at the beginning of the next record */
endifor

return true

```

The following procedures are used to determine if a given domain *name*, SID, or UPN is in a trusted forest. Since they make use of forest trust information data stored in objects in the NC replica of the forest root domain **NC** (see FOREST_TRUST_INFORMATION), these functions only work on GC servers or DCs in the forest root domain **NC**.

```

procedure IsDomainNameInTrustedForest(name: uncodestring,
    referredDomain: uncodestring): boolean

```

Informative summary of behavior: The IsDomainNameInTrustedForest procedure determines if the domain with the name given by *name* is in a trusted forest. The input *name* may can be a DNS or a NetBIOS name.

```

if IsDomainDnsNameInTrustedForest(name, referredDomain) then
    return true
endif

```

```

if IsDomainNetbiosNameInTrustedForest(name, referredDomain) then
    return true
endif

return false

procedure IsDomainSidInTrustedForest(sid: SID): boolean

```

Informative summary of behavior: The IsDomainSidInTrustedForest procedure determines if the domain with the SID given by *sid* is in a trusted forest.

```

tdos: set of DSName
f: X_FOREST_TRUST_INFORMATION
b: boolean

tdos := select all o in Children ForestRootDomainNC() where
    trustedDomain in o!objectClass and
    o!trustAttributes & 0x00000008 ≠ 0 and
    o!msDS-TrustForestTrustInfo ≠ null

foreach o in tdos
    if not UnmarshalForestTrustInfo(o!msDS-TrustForestTrustInfo, f)
        then
            return false
        else
            foreach e in f.Entries
                if (e.ForestTrustType = ForestTrustDomainInfo and
                    e.DomainInfo.Sid = sid and
                    LSA_FTRECORD_DISABLED_REASONS not in e.Flags) then

                    b := true
                    foreach g in f.Entries
                        if (g.ForestTrustType = ForestTrustTopLevelNameEx and
                            LSA_FTRECORD_DISABLED_REASONS not in g.Flags and
                            (g.TopLevelName = e.DomainInfo.DnsName or
                                IsSubdomainOf(e.DomainInfo.DnsName, g.TopLevelName))) then
                            b := false
                            break
                        endif
                    endfor

                    if b then
                        return true
                    endif
                endif
            endfor
        endif
    endfor
    return false

procedure IsUPNInTrustedForest(upn: uncodestring): boolean

```

Informative summary of behavior: The IsUPNInTrustedForest procedure determines if the domain containing the account with the UPN given by *upn* is in a trusted forest.

```

interpret upn as being in the format "username@domainName"
return IsNamespaceInTrustedDomain(domainName, trustedForestName)

```

The IsDomainNameInTrustedForest procedure uses the following helper procedures to determine if a domain is in a trusted forest.

```

procedure IsSubdomainOf(subdomainName: uncodestring,
    superiordomainName: uncodestring): boolean

```

The `IsSubdomainOf` procedure takes a pair of domain names and returns true if *subdomainName* is a subdomain of *superiordomainName* as described in [RFC1034] section 3.1, and false otherwise.

```

procedure ForestTrustOwnsName(f: X_FOREST_TRUST_INFORMATION, name: uncodestring): boolean

```

```

    /* if the name matches or is a subdomain of one in the exclusion list, the
    * forest does not own this name */
    foreach e in f.Entries
        if (e.ForestTrustType = ForestTrustTopLevelNameEx and
            (e.TopLevelName = name or
             IsSubdomainOf(name, e.TopLevelName))) then
            return false
        endif
    endfor

```

```

    /* if a suffix of the name is in the inclusion list and is
    * not disabled, the forest owns this name */
    foreach e in f.Entries
        if (e.ForestTrustType = ForestTrustTopLevelName and
            LSA_FTRECORD_DISABLED_REASONS not in e.Flags and
            (e.TopLevelName = name or
             IsSubdomainOf(name, e.TopLevelName))) then
            return true
        endif
    endfor

```

```

    return false

```

```

procedure IsDomainDnsNameInTrustedForest(name: uncodestring,
    var referredDomain: uncodestring) : boolean

```

```

    tdos: set of DSName
    f: X_FOREST_TRUST_INFORMATION

```

```

    /* Get all the objects that represent trusted domains */
    tdos := select all o in Children ForestRootDomainNC() where
        trustedDomain in o!objectClass and
        o!trustAttributes & 0x00000008 ≠ 0 and
        o!msDS-TrustForestTrustInfo ≠ null

```

```

    foreach o in tdos
        if not UnmarshalForestTrustInfo(o!msDS-TrustForestTrustInfo, f)
            then
                return false
            else
                foreach e in f.Entries
                    if (e.ForestTrustType = ForestTrustDomainInfo and
                        e.DomainInfo.DnsName = name and
                        LSA_SID_DISABLED_ADMIN not in e.Flags and
                        LSA_SID_DISABLED_CONFLICT not in e.Flags and
                        ForestTrustOwnsName(f, e.DomainInfo.DnsName) then
                        referredDomain := o!trustPartner
                        return true
                    endif
                endfor
            endif
        endfor
    endfor

```

```

    return false

```

```

procedure IsDomainNetbiosNameInTrustedForest
    (name: uncodestring, var referredDomain: uncodestring): boolean

```

```

tdos: set of DSName
f: X_FOREST_TRUST_INFORMATION

/* Get all the objects that represent trusted domains */
tdos := select all o in Children ForestRootDomainNC() where
    trustedDomain in o!objectClass and
    o!trustAttributes & 0x00000008 ≠ 0 and
    o!msDS-TrustForestTrustInfo ≠ null

foreach o in tdos
    if not UnmarshalForestTrustInfo(o!msDS-TrustForestTrustInfo, f)
        then
            return false
        else
            foreach e in f.Entries
                if (e.ForestTrustType = ForestTrustDomainInfo and
                    e.DomainInfo.NetbiosName = name and
                    NETBIOS_DISABLED_MASK not in e.Flags and
                    ForestTrustOwnsName(f, e.DomainInfo.DnsName) then
                    referredDomain := o!trustPartner
                    return true
                endif
            endfor
        endif
    endif
endfor

return false

```

The IsUPNInTrustedForest procedure uses the following helper procedure to determine if a UPN is in a trusted forest.

```

procedure IsNamespaceInTrustedDomain
    (name: unicodestring, var trustedForestName: unicodestring): boolean

    tdos: set of DSName
    f: X_FOREST_TRUST_INFORMATION
    b: boolean
    dnsParent: unicodestring
    parents: set of unicodestring

    /* if name is A.B.C, parents has the values A.B.C, B.C, and C */
    parents := DNS parents of name

    foreach dnsParent in parents
        /* Get all the objects that represent trusted domains */
        tdos := select all o in Children ForestRootDomainNC() where
            trustedDomain in o!objectClass and
            o!trustAttributes & 0x00000008 ≠ 0 and
            o!msDS-TrustForestTrustInfo ≠ null

        foreach o in tdos
            if not UnmarshalForestTrustInfo(o!msDS-TrustForestTrustInfo, f)
                then
                    return false
            else
                foreach e in f.Entries
                    if (e.ForestTrustType = ForestTrustTopLevelName and
                        e.TopLevelName = dnsParent and
                        LSA_FTRECORD_DISABLED_REASONS not in e.Flags) then

                        b := true
                        foreach g in f.Entries
                            if (g.ForestTrustType = ForestTrustTopLevelNameEx and
                                LSA_FTRECORD_DISABLED_REASONS not in g.Flags and
                                (g.TopLevelName = dnsParent or

```

```

        IsSubdomainOf(dnsParent, g.TopLevelName))) then
            b := false
            break
        endif
    endfor

    if (b) then
        trustedForestName := o!trustPartner
        return true
    endif
endif
endfor
endif
endfor
endfor

return false

```

5.65 FOREST_TRUST_RECORD_TYPE

FOREST_TRUST_RECORD_TYPE is a concrete type for specifying the type of record contained in a forest trust information (FOREST_TRUST_INFORMATION) entry. The allowed values are specified by the following enumerated list.

```

typedef enum
{
    ForestTrustTopLevelName = 0,
    ForestTrustTopLevelNameEx = 1,
    ForestTrustDomainInfo = 2
} FOREST_TRUST_RECORD_TYPE;

```

5.66 ForestRootDomainNC

```

procedure ForestRootDomainNC(): DSName

```

The ForestRootDomainNC procedure returns the DSName of the **forest root domain NC**.

5.67 FullReplicaExists

```

procedure FullReplicaExists(nc : DSName) : boolean

```

The FullReplicaExists procedure returns true if the NC replica with root *nc* is a full replica.

```

if not ObjExists(nc) then
    return false
endif
return nc in (DSAObj()!msDS-hasMasterNCs +
             DSAObj()!msDS-hasFullReplicaNCs)

```

5.68 GCPAS

```

procedure GCPAS() : PARTIAL_ATTR_VECTOR_V1_EXT

```

Informative summary of behavior: The GCPAS procedure returns a reference to an instance of the PARTIAL_ATTR_VECTOR_V1_EXT structure, which contains the list of attributes that may can be present, based on the schema, on a GC NC replica.

```
partialAttrSetSeq: sequence of DSName
pPartialAttrVector: PARTIAL_ATTR_VECTOR_V1_EXT^

partialAttrSetSeq := select o from subtree SchemaNC() where
    (o!isMemberOfPartialAttributeSet = true)
pPartialAttrVector = new PARTIAL_ATTR_VECTOR_V1_EXT sized to hold
    partialAttrSetSeq.length entries in its rgPartialAttr
    field
pPartialAttrVector^.dwVersion := 1
pPartialAttrVector^.cAttrs := partialAttrSetSeq.length
for i := 0 to partialAttrSetSeq.length-1
    pPartialAttrVector^.rgPartialAttr[i] :=
        AttrtypFromSchemaObj(partialAttrSetSeq[i])
endfor

return pPartialAttrVector
```

5.69 GetFilteredAttributeSet

```
procedure GetFilteredAttributeSet() : sequence of ATTRTYP
```

Informative summary of behavior: The GetFilteredAttributeSet procedure returns a sequence of ATTRTYP that represents the list of attributes that may not cannot be present on a filtered NC replica

```
filteredAttrSet: sequence of ATTRTYP
filteredAttrSetObjSeq: sequence of DSName
i: int

filteredAttrSetObjSeq := select o from subtree SchemaNC() where
    (fRODCFilteredAttribute in o!searchFlags) and
    (not FLAG_ATTR_REQ_PARTIAL_SET_MEMBER in
        o!systemFlags) and
    (not o!systemOnly = true) and
    (not AttrtypFromSchemaObj(o) in
        {currentValue, dBCSPwd, unicodePwd,
          ntPwdHistory, priorValue,
          supplementalCredentials, trustAuthIncoming,
          trustAuthOutgoing, lmPwdHistory,
          initialAuthIncoming, initialAuthOutgoing,
          msDS-ExecuteScriptPassword, displayName,
          codePage, creationTime, lockoutDuration,
          lockOutObservationWindow, logonHours,
          lockoutThreshold, maxPwdAge, minPwdAge,
          minPwdLength, netbiosName, pwdProperties,
          pwdHistoryLength, pwdLastSet,
          securityIdentifier, trustDirection,
          trustPartner, trustPosixOffset, trustType,
          rid, domainReplica, accountExpires,
          ntMixedDomain, OperatingSystem,
          OperationSystemVersion,
          operatingSystemServicePack, fsmoRoleOwner,
          trustAttributes, trustParent, flatName,
          sidHistory, dnsHostName, lockoutTime,
          servicePrincipalName, isCriticalSystemObject,
          msDS-TrustForestTrustInfo, msDS-SPNSuffixes,
          msDS-AdditionalDnsHostName, msDS-
          AdditionalSamAccountName, msDS-
          AllowedToDelegateTo, msDS-KrbTgtLink, msDS-
          AuthenticatedAtDC, msDS-
          SupportedEncryptionTypes})
```

```

for i := 0 to filteredAttrSetObjSeq.length-1
  filteredAttrSet[i]:=
    AttrtypFromSchemaObj(filteredAttrSetObjSeq [i])
endfor

return filteredAttrSet

```

5.70 GetNCType

```

procedure GetNCType(nc: DSName) : ULONG

```

Informative summary of behavior: The GetNCType procedure returns the type of the NC replica.

```

ncType: ULONG

ncType = 0;

if not AmIRODC() then
  if not nc = ConfigNC() and
    not nc = SchemaNC() and
    not nc = DefaultNC() and
    IsApplicationNC(nc) = false then
    /* the NC replica correspond to a GC partition */
    ncType := ncType + {NCT_GC_PARTIAL}
  endif
else if
  if nc = ConfigNC() or
    nc = DefaultNC() or
    ApplicationNC(nc) = true then
    ncType := ncType + {NCT_FILTERED_ATTRIBUTE_SET,
      NCT_SPECIAL_SECRET_PROCESSING }
  else if nc = SchemaNC() then
    ncType := 0
  else
    ncType := ncType + {NCT_FILTERED_ATTRIBUTE_SET,
      NCT_GC_PARTIAL}
  endif
endif
return ncType

```

5.71 GetAttrVals

```

procedure GetAttrVals(
  o: DSName,
  att: ATTRTYP,
  includeDeletedLinks: boolean): set of attribute value

```

The GetAttrVals procedure constructs a set V that contains each value of the attribute *att* from object *o*.

If *att* is not a link attribute, the value of *includeDeletedLinks* is ignored. If *att* is a link attribute and *includeDeletedLinks* = false, the set includes only those values *v* of *att* such that LinkStamp(*o*, *att*, *v*).timeDeleted = 0. If *att* is a link attribute and *includeDeletedLinks* = true, the set contains all values *v* of *att*, even those such that LinkStamp(*o*, *att*, *v*).timeDeleted ≠ 0.

If the V is empty, null is returned. Otherwise, V is returned.

5.72 GetCallerAuthorizationInfo

```
procedure GetCallerAuthorizationInfo(): ClientAuthorizationInfo
```

The GetCallerAuthorizationInfo procedure returns the ClientAuthorizationInfo (a security token) of the current caller. For more details, see [MS-DTYP] section 2.5.3.

5.73 GetDefaultObjectCategory

```
procedure GetDefaultObjectCategory(class: ATTRTYP): DSName
```

The GetDefaultObjectCategory procedure returns the defaultObjectCategory value for the object class *class*.

```
classObj: DSName  
classObj := SchemaObj(class)  
return classObj!defaultObjectCategory
```

5.74 GetDomainNC

```
procedure GetDomainNC(o: DSName): DSName
```

The GetDomainNC procedure returns one of the following:

- The DSName of the NC in which the object whose DSName is *o* is located if *o* is in an application partition.
- The DSName of the NC that is the root for the domain where *o* is located if *o* is in a domain partition.
- NULL if the NC is not found or it is not of the DN form specified in [RFC2253].

5.75 GetDSNameFromAttrVal

```
procedure GetDSNameFromAttrVal(attrTyp: ATTRTYP, attrVal: ATTRVAL): DSName
```

The GetDSNameFromAttrVal procedure extracts the DSName from the ATTRVAL *attrVal* based on its syntax, which is determined from the ATTRTYP *attrTyp*. If the syntax is not one of Object(DS-DN), Object(DN-String), or Object(DN-Binary), this procedure returns a null DSName.

5.76 GetDSNameFromDN

```
procedure GetDSNameFromDN(dn: uncodestring): DSName
```

The GetDSNameFromDN procedure produces a DSName from *dn*. Let *d* represent the returned DSName. It is the case that *d.dn* = *dn*. If there is an object *o* in an NC replica hosted by the server such that *o!*distinguishedName = *dn*, then *d.guid* = *o!*objectGUID; otherwise, all fields of *d.guid* are zero. Furthermore, if *o!*objectSid ≠ null, then *d.sid* = *o!*objectSid; otherwise *d.sid* = null.

5.77 GetDSNameFromNetworkAddress

```
procedure GetDSNameFromNetworkAddress(n: NetworkAddress): DSName
```

The `GetDSNameFromNetworkAddress` procedure produces a `DSName` from the `NetworkAddress` n . If n is an FQDN (1) such that, for a DSA object d , there is a server object s such that $d!$ parent = s and $s!$ dnsHostName = n , then return the `DSName` of d . If n is in the format `<DC-name>:<DC-identifier>` as described in section 5.134, return the `DSName` of the DC's DSA object. Otherwise return `NULL`.

5.78 GetForestFunctionalLevel

```
procedure GetForestFunctionalLevel(): integer
```

The `GetForestFunctionalLevel` procedure returns the forest functional level (see [MS-ADTS] section 6.1.4.4).

```
partitionsContainer: DSName
partitionsContainer:= DescendantObject(ConfigNC(), "CN=Partitions,")
if partitionsContainer!msDS-Behavior-Version = null then
    return DS_BEHAVIOR_WIN2000
else
    return partitionsContainer!msDS-Behavior-Version
endif
```

5.79 GetFSMORoleOwner

```
procedure GetFSMORoleOwner(role: integer): DSName
```

The `GetFSMORoleOwner` procedure returns the `DSName` of the `nTDSDSA` object of the DC that owns the FSMO role specified by *role*. The following table lists the valid values for *role*.

Symbolic constant	Value
FSMO_SCHEMA	1
FSMO_DOMAIN_NAMING	2
FSMO_PDC	3
FSMO_RID	4
FSMO_INFRASTRUCTURE	5

5.80 GetInstanceNameFromSPN

```
procedure GetInstanceNameFromSPN(spn: unicodestring): unicodestring
```

The `GetInstanceNameFromSPN` procedure syntactically extracts and returns the instance name from a two-part or three-part SPN. The instance name is the second part of the SPN. For example, `dc-01.fabrikam.com` is the instance name in the two-part SPN `"ldap/dc-01.fabrikam.com"` and in the three-part SPN `"ldap/dc-01.fabrikam.com/fabrikam.com"`.

AG (GROUP_TYPE_ACCOUNT_GROUP, 0x00000002): The account group type.

RG (GROUP_TYPE_RESOURCE_GROUP, 0x00000004): The resource group type.

UG (GROUP_TYPE_UNIVERSAL_GROUP, 0x00000008): The universal group type.

BG (GROUP_TYPE_APP_BASIC_GROUP, 0x00000010): The application basic group type.

QG (GROUP_TYPE_APP_QUERY_GROUP, 0x00000020): The application query group type.

SE (GROUP_TYPE_SECURITY_ENABLED, 0x80000000): The group is security-enabled.

5.87 GUID

A concrete type, as specified in [C706] and [MS-DTYP] section 2.3.4.

The type GUID has a well-defined null value, which is called the NULL GUID. The constant NULLGUID is equal to this value.

When comparing two GUID values, each GUID value is treated as an octet string in little-endian byte order.

Two GUID values *g1* and *g2* are equal if they are octet-for-octet identical.

Value *g1* is less than value *g2* only if there exists an *N* (where *N* is less than the size of the GUID type in octets) such that octets 0...*N*-1 of *g1* and *g2* are identical, and octet *N* of *g1* is less than octet *N* of *g2*.

Value *g1* is greater than value *g2* only if there exists an *N* (where *N* is less than the size of the GUID type in octets) such that octets 0...*N*-1 of *g1* and *g2* are identical, and octet *N* of *g1* is greater than octet *N* of *g2*.

5.88 GuidFromString

```
procedure GuidFromString(BracedFormat: boolean,  
    strGuid: unicodestring): GUID
```

The `GuidFromString` procedure converts the string representation of a GUID specified in *strGuid* (for example, "{12AA5F43-C776-4D63-B347-1175DF806200}" or "12aa5f43-c776-4d63-b347-1175df806200") to a binary GUID. When *BracedFormat* is true, to be a valid string representation of a GUID, *strGuid* MUST be in the curly braced GUID string format as defined in [MS-DTYP] section 2.3.4.3. When *BraceFormat* is false, to be a valid string representation of a GUID, *strGuid* MUST be in the string GUID format as defined in [RFC4122]. If *strGuid* is not a valid string representation of a GUID, null is returned.

5.89 GuidToString

```
procedure GuidToString(guid: GUID): unicodestring
```

The `GuidToString` procedure converts *guid* to the concatenation of "{", the string representation defined in [RFC4122] section 3, and "}"; for example, {12aa5f43-c776-4d63-b347-1175df806200}.

5.90 handle_t

`handle_t` is a concrete type for an RPC binding handle, as specified in [C706] section 4.2.9.7 and [MS-DTYP] section 2.1.3.

5.96 IsDomainNameInTrustedForest

```
procedure IsDomainNameInTrustedForest(name: unicodestring,  
    var referredDomain: unicodestring) : boolean
```

The `IsDomainNameInTrustedForest` procedure returns true if the domain identified by *name* is in a forest trusted by the caller's forest, as determined by the `FOREST_TRUST_INFORMATION` state of the caller's forest, and false otherwise. The *name* parameter can be either an FQDN (1) or a NetBIOS name of a domain. If the `IsDomainNameInTrustedForest` procedure returns true, the *referredDomain* parameter value will be set to the FQDN (1) of the root domain of the forest of the domain specified by the *name* parameter. If the `IsDomainNameInTrustedForest` procedure returns false, the value of the *referredDomain* parameter remains unchanged.

See section 5.64 for the specification of this procedure.

5.97 IsDomainSidInTrustedForest

```
procedure IsDomainSidInTrustedForest(sid: SID): boolean
```

The `IsDomainSidInTrustedForest` procedure returns true if the domain identified by *sid* is in a forest trusted by the caller's forest, as determined by the `FOREST_TRUST_INFORMATION` state of the caller's forest, and false otherwise. The *sid* parameter is the SID of a domain.

See section 5.64.2 for the specification of this procedure.

5.98 IsDCAccount

```
procedure IsDCAccount(o: DSName): boolean
```

The `IsDCAccount` procedure returns true if the object represents the computer account of a DC.

5.99 IsForwardLinkAttribute

```
procedure IsForwardLinkAttribute (att:ATTRTYP): Boolean
```

The `IsForwardLinkAttribute` procedure returns true if the given `ATTRTYP` represents a **forward link attribute**. Forward link attribute is defined in [MS-ADTS] section 3.1.1.1.6.

5.100 IsGC

```
procedure IsGC(): boolean
```

The `IsGC` procedure returns true if the DC on which it is called is a global catalog server as defined in [MS-ADTS] section 3.1.1.1.10 or is in a forest that contains only one domain. Otherwise, the procedure returns false.

5.101 IsGetNCChangesPermissionGranted

```
procedure IsGetNCChangesPermissionGranted(  
    msgIn: DRS_MSG_GETCHGREQ_V10) : boolean
```

Informative summary of behavior: The `IsGetNCChangesPermissionGranted` procedure returns true if the source DC has permission to replicate objects and its attributes from the NC replica, as defined in `msgIn`.

```
ncRoot: DSName
clientDsaObj: DSName
serverObj: DSName
cachedAt: DSName
cachedUser: DSName
fRevealSecret: boolean
fRevealFilteredSet: boolean

ncRoot := GetObjectNC(msgIn.pNC^)
if not AccessCheckCAR(ncRoot, Ds-Replication-Get-Changes) then
    return false
endif

fRevealSecret := true

if IsRevealSecretRequest(msgIn) then
    if AccessCheckCAR(ncRoot, Ds-Replication-Get-Changes-All) = false
        then
            if (msgIn.ulExtendedOp = EXOP_REPL_SECRETS) then
                clientDsaObj := select one o from ConfigNC()where
                    o!objectGUID = msgIn.uuidDsaObjDest
                serverObj := clientDsaObj!parent
                cachedAt := serverObj!serverReference
                cachedUser := msgIn.pNC^
                fRevealSecret := RevealSecretsForUserAllowed(
                    cachedAt, cachedUser)
            else
                fRevealSecret := false
            endif
        endif
    endif

fRevealFilteredSet := true
if IsRevealFilteredAttr(msgIn) then
    if (AccessCheckCAR(ncRoot, Ds-Replication-Get-Changes-All) = false
        and
        AccessCheckCAR(ncRoot, Ds-Replication-Get-Changes-In-Filtered-Set)
        = false) then
        fRevealFilteredSet := false
    endif
endif

if (fRevealSecret = false) or (fRevealFilteredSet = false)
    return false
else
    return true
endif
```

5.102 IsGUIDBasedDNSName

```
procedure IsGUIDBasedDNSName(o: DSName, instanceName: uncodestring):
    boolean
```

The `IsGUIDBasedDNSName` procedure returns true if *instanceName* is the DNS host name of the DC, identified by *o*, constructed in the form "<DSA GUID>._msdcs.<DNS forest name>".

5.103 IsMemberOfBuiltinAdminGroup

```
procedure IsMemberOfBuiltinAdminGroup(): boolean
```

The `IsMemberOfBuiltinAdminGroup` procedure returns true if the client security context, which MUST be retrieved using the method described in [MS-RPCE] section 3.3.3.4.3, is a member of the `BUILTIN\Administrators` group, and false if it is not. The `BUILTIN\Administrators` group is the group with the SID `S-1-5-32-544`. [MS-SAMR] section 3.1.4.2 describes the accounts included in the built-in `Administrators` group by default.

5.104 `IsRecycleBinEnabled`

```
procedure IsRecycleBinEnabled(): boolean
```

Informative summary of behavior: The `IsRecycledBinEnabled` procedure returns true if the **Recycle Bin optional feature** is enabled. Otherwise, it returns false. For more details, see [MS-ADTS] sections **3.1.1.9**, **3.1.1.9.1**, and **6.1.1.2.1**

```
recycleBinFeatureGuid: GUID
scope: DSNAME
recycleBinFeatureGuid := {766ddcd8-acd0-445e-f3b9-a7f9b6744f2a}
scope := DSName of the nTDSDSA object
return IsOptionalFeatureEnabled (scope, recycleBinFeatureGuid)
```

5.105 `IsRevealFilteredAttribute`

```
procedure IsRevealFilteredAttribute(
    DRS_MSG_GETCHGREQ_V10 msgIn) : boolean
```

Informative summary of behavior: The `IsRevealFilteredAttribute` procedure returns true if the source DC is requesting attributes in the filtered set.

```
filteredAttrSet: sequence of ATTRTYP
i: int

filteredAttrSet := GetFilteredAttributeSet()

for i := 0 to msgIn.pPartialAttrSet.cAttrs - 1
    if msgIn.pPartialAttrSet.rgPartialAttr[i] in
        filteredAttrSet then
        return true;
    endif
endfor

for i := 0 to msgIn.pPartialAttrSetEx.cAttrs - 1
    if msgIn.pPartialAttrSetEx.rgPartialAttr[i] in
        filteredAttrSet then
        return true;
    endif
endfor

return false;
```

5.106 `IsPrivilegedAccessManagementEnabled`

~~Note: All of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it as an aid to the reader.~~

```
procedure IsPrivilegedAccessManagementEnabled(): boolean
```

Informative summary of behavior: The IsPrivilegedAccessManagementEnabled procedure returns true if the Privileged Access Management optional feature is enabled. Otherwise, it returns false. For more information, see [MS-ADTS] sections 3.1.1.9, 3.1.1.9.2, and 6.1.1.2.1.

```
privilegedAccessManagementFeatureGuid: GUID
scope: DSNAME
privilegedAccessManagementFeatureGuid := {ec43e873-cce8-4640-b4ab-07ffe4ab5bcd}
scope := DSName of the nTDSDSA object
return IsOptionalFeatureEnabled (scope, privilegedAccessManagementFeatureGuid)
```

5.107 IsRevealSecretRequest

```
procedure IsRevealSecretRequest(DRS_MSG_GETCHGREQ_V10 msgIn)
: boolean
```

Informative summary of behavior: The IsRevealSecretRequest procedure returns true if the source DC is requesting secret attributes.

```
if AmILHServer() = false then
  if (DRS_WRITE_REP in msgIn.ulFlags) then
    return true
  else
    return false
  endif
endif

/* if source DC is requesting FSMO related operation then it is same
as a reveal secret request */
if (msgIn.ulExtendedOp = EXOP_FSMO_REQ_ROLE or
  msgIn.ulExtendedOp = EXOP_FSMO_REQ_RID_ALLOC or
  msgIn.ulExtendedOp = EXOP_FSMO_REQ_RID_REQ_ROLE or
  msgIn.ulExtendedOp = EXOP_FSMO_REQ_PDC or
  msgIn.ulExtendedOp = EXOP_FSMO_ABANDON_ROLE) then
  return true
endif

/* if source DC is requesting for special secrets processing then it
implies that it is not requesting for secrets */
if ((DRS_SPECIAL_SECRET_PROCESSING) ∩ msgIn.ulFlags) then
  return false
endif

if (msgIn.ulExtendedOp = EXOP_REPL_SECRETS or
  msgIn.pAttributeSet = null then /* requesting all attributes that
includes secrets*/
  return true
endif

for i := 0 to msgIn.pPartialAttrSet.cAttrs - 1
  if IsSecretAttribute(msgIn.pPartialAttrSet.rgPartialAttr[i]) then
    return true;
  endif
endfor

for i := 0 to msgIn.pPartialAttrSetEx.cAttrs - 1
  if IsSecretAttribute(msgIn.pPartialAttrSetEx.rgPartialAttr[i]) then
    return true;
  endif
endfor

return false;
```


5.108 IsServerExtensionsChanged

```
procedure IsServerExtensionsChanged(  
    ServerExtensions: DRS_EXTENSIONS_INT): boolean;
```

The `IsServerExtensionsChanged` procedure returns true if the supplied extensions are different from the current server extensions. Otherwise, it returns false.

5.109 IsUPNInTrustedForest

```
procedure IsUPNInTrustedForest(upn: unicodestring): boolean
```

The `IsUPNInTrustedForest` procedure returns true if the domain containing the account identified by `upn` is in a forest trusted by the caller's forest, as determined by the `FOREST_TRUST_INFORMATION` state of the caller's forest, and false otherwise. The `upn` parameter is the UPN of an account in a domain.

See section 5.64 for the specification of this procedure.

5.110 IsValidServiceName

```
procedure IsValidServiceName(o: DSName, serviceName: unicodestring):  
    boolean
```

The `IsValidServiceName` procedure returns true if the name `serviceName` is a valid service name in an SPN for the DC represented by computer object `o`.

A valid service name can be one of the following:

1. For GC SPNs, the service name must be the DNS forest name.
2. For other classes of SPNs, the service name must be either the DNS domain name of the DC's default domain or the DNS domain name of an application NC hosted by the DC.

5.111 KCCFailedConnections

`KCCFailedConnections` is an abstract type consisting of a sequence of tuples, one tuple for each DC for which the connection attempt failed. Each tuple contains the following fields:

- **DsaDN:** A *unicodestring* (section 3.4.3) that contains the DN of the nTDSDSA object that corresponds to the DC.
- **UIIDDsa:** A GUID that contains the DSA GUID of the DC.
- **TimeFirstFailure:** A FILETIME that contains the time when the KCC noticed the first failure while contacting the DC.
- **FailureCount:** An integer that contains the total number of failures the KCC encountered while contacting the DC.
- **LastResult:** A DWORD that contains a Windows error code, as specified in [MS-ERREF] section 2.2, that indicates the reason for the last failure.

The global variable `dc` for a DC has an associated field `dc.kccFailedConnections`, which maintains the DC's `KCCFailedConnections` state.

5.112 KCCFailedLinks

KCCFailedLinks is an abstract type that consists of a sequence of tuples, one tuple for each neighboring DC for which a connection attempt failed.

The fields of the tuple are the same as the fields of the KCCFailedConnections tuple.

The global variable dc for a DC has an associated field dc.kccFailedLinks, which maintains the DC's KCCFailedLinks state.

5.113 LARGE_INTEGER

A concrete type for a 64-bit signed integer, as specified in [MS-DTYP] section 2.3.5.

5.114 LDAP_CONN_PROPERTIES

LDAP_CONN_PROPERTIES is a concrete type that contains bit flags that identify properties of an LDAP connection. The bit flags are presented below in little-endian byte order.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
M	S	N	G	G	U	S	B	X	X	X	X	X	X	S	S	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
D	P	G	S	C	D	S	N							L	G																
5	L	O	S		P	L	D							N	N																

X: Unused. MUST be zero and ignored.

BND (0x00000001): A bind has been performed on this LDAP connection.

SSL (0x00000002): The LDAP connection corresponds to a Secure Sockets Layer (SSL) connection.

UDP (0x00000004): The LDAP connection corresponds to a User Datagram Protocol (UDP) connection.

GC (0x00000008): The LDAP connection was made through the GC port.

GSS (0x00000010): The Generic Security Services Application Programming Interface (GSS-API) security package was used for authentication.

NGO (0x00000020): The Simple and Protected GSS-API Negotiation (SPNEGO) security package was used for authentication.

SPL (0x00000040): The LDAP bind corresponds to LDAP simple bind.

MD5 (0x00000080): The Digest-MD5 security package was used for authentication.

SGN (0x00000100): Signing is enabled on the LDAP connection.

SL (0x00000200): Sealing is enabled on the LDAP connection.

5.115 LDAP_SERVER_DIRSYNC_OID LDAP Search Control

This section describes LDAP_SERVER_DIRSYNC_OID control processing. See [MS-ADTS] section 3.1.1.3.4.1.3 for more details.

5.115.1 Abstract Types

5.115.1.1 AttributeList

```
Type AttributeList = [next: AttributeList,  
                    value: AttributeListElement]
```

AttributeList is an abstract type that contains information about the attributes of an object. It is a tuple of the following:

next: The next tuple.

value: An attribute type and its value(s).

5.115.1.2 AttributeListElement

```
Type AttributeListElement = [type: LDAPString,  
                             vals: AttributeVals]
```

AttributeListElement is an abstract type that contains information about an attribute of an object. It is a tuple of the following:

type: Attribute type.

vals: Attribute values.

5.115.1.3 AttributeVals

```
Type AttributeVals = [next: AttributeVals,  
                    value: LDAPString]
```

AttributeVals is an abstract type that contains information about the value(s) of an attribute. It is a tuple of the following:

next: The next tuple.

value: An attribute value.

5.115.1.4 Control

```
Type Control = [controlType: LDAPString, criticality: BOOL,  
               controlValue: LDAPString]
```

Control is an abstract type that contains information about an LDAP control. It is a tuple of the following:

controlType: LDAP control OID.

criticality: LDAP control criticality.

controlValue: LDAP control value.

5.115.1.5 DirSyncControlValue

```
Type DirSyncControlValue = [flags: ULONG, size: ULONG, cookie: LDAPString]
```

DirSyncControlValue is an abstract type that contains information about the LDAP_SERVER_DIRSYNC_OID control value. It is a tuple of the following:

flags: Flags, as described in [MS-ADTS] section 3.1.1.3.4.1.3.

size: In the request control value, this field indicates the maximum number of bytes expected in the reply. In the reply control value, it is set to 0.

cookie: A cookie value.

5.115.1.6 DirSyncSearchArg

```
Type DirSyncSearchArg = [pObject: LDAPString, pFilter: LDAPString,  
pSelection: ATTRBLOCK, sizeLimit: ULONG]
```

DirSyncSearchArg is an abstract type that contains information about the LDAP search request. It is a tuple of the following:

pObject: The LDAP search base object DN.

pFilter: The string representation, as defined in [RFC2254], of the LDAP search filter.

pSelection: The attribute selection info in the LDAP search request.

sizeLimit: The size limit in the LDAP search request.

5.115.1.7 LDAPString

```
Type LDAPString = [length: ULONG, value: * UCHAR]
```

LDAPString is an abstract type that contains information about a string of unsigned characters. It is a tuple of the following:

length: The number of unsigned characters in **value**.

value: The string of unsigned characters that may contain null characters.

5.115.1.8 SearchResultEntry

```
Type SearchResultEntry = [objectName: LDAPString,  
attributes: AttributeList]
```

SearchResultEntry is an abstract type that contains information about a search result entry. It is a tuple of the following:

objectName: The object DN.

attributes: The list of the attributes of object.

5.115.1.9 SearchResultEntryList

```
Type SearchResultEntryList = [next: SearchResultEntryList,
```

```
entry: SearchResultEntry]
```

SearchResultEntryList is an abstract type that contains information about search result entries. It is a tuple of the following:

next: The next tuple.

entry: An entry in the search result.

5.115.2 Concrete Types

5.115.2.1 Cookie

The Cookie structure is a concrete type that contains information about the cookie in the LDAP_SERVER_DIRSYNC_OID control value.

```
typedef struct {
    UCHAR signature[4];
    ULONG version;
    FILETIME creationTime;
    ULONGLONG reserved;
    ULONG utdVectorSize;
    USN_VECTOR usnVector;
    UUID uuidSourceDsaInvocationID;
    UCHAR utdVector[variable];
} Cookie;
```

signature: Cookie signature.

version: The version number.

creationTime: The creation time.

reserved: Unused.

utdVectorSize: The up-to-date vector size.

usnVector: The USN vector.

uuidSourceDsaInvocationID: The invocation ID (a UUID) of the source DSA.

utdVector: The up-to-date vector.

5.115.3 ProcessDirSyncSearchRequest

~~Note: Some of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it in the Product Behavior appendix.~~

```
ProcessDirSyncSearchRequest (
    [in] searchArg: DirSyncSearchArg,
    [in] dirSyncControlValue: DirSyncControlValue,
    [out] searchResultEntryList: SearchResultEntryList,
    [out] dirSyncResponseControl: Control
) : ULONG
```

Informative summary of behavior: The ProcessDirSyncSearchRequest procedure processes an LDAP search request with an LDAP_SERVER_DIRSYNC_OID control. It creates a list of search result entries and the LDAP_SERVER_DIRSYNC_OID response control.

```
err: ULONG
msgIn: DRS_MSG_GETCHGREQ_V10
msgOut: DRS_MSG_GETCHGREPLY_NATIVE
filter: LDAPString
replFlags: ULONG

/* Transform the LDAP search request with LDAP_SERVER_DIRSYNC_OID control to
   a replication GetChanges request. */

err := DirSyncReqToGetChgReq(searchArg, dirSyncControlValue, msgIn)
if err # 0 then
    return err
endif

replFlags := dirSyncControlValue.flags

/* Perform access checks unless client has specified object-level security */

if not (LDAP_DIRSYNC_OBJECT_SECURITY in replFlags) then
    err := SecurityCheckForChanges(msgIn)
    if err # 0 then
        return err
    endif
endif

filter := searchArg.pfilter
/* Perform normal replication (Get replication changes). */

err := GetReplChanges(null, filter, replFlags, msgIn, msgOut)
if err # 0 then
    return err
endif

/* Transform the replication GetChanges reply to reply for the LDAP search
   request with LDAP_SERVER_DIRSYNC_OID control. */

err := GetChgReplyToSearchResult(msgOut, searchResultEntryList,
                                dirSyncResponseControl)

if err # 0 then
    return err
endif

return 0 /* success */
```

5.115.4 DirSyncReqToGetChgReq

```
procedure DirSyncReqToGetChgReq(
    [in] searchArg: DirSyncSearchArg,
    [in] dirSyncControlValue: DirSyncControlValue,
    [out] nativeRequest: DRS_MSG_GETCHGREQ_V10
): ULONG
```

Informative summary of behavior: The DirSyncReqToGetChgReq procedure transforms the received LDAP search request with an LDAP_SERVER_DIRSYNC_OID control message into a DRS_MSG_GETCHGREQ_V10 request.

```
baseObjectDsName: DSNAME
replFlags: ULONG
ulSizeLimit: ULONG
ulMaxBytes: ULONG
```

```

errCode: ULONG

/* Validate input */
/* If the base of the search is not the root of an NC,
   return unwillingToPerform */

baseObjectDsName := GetDSNameFromDN (searchArg.pObject)
if baseObjectDsName ≠ GetObjectNC(baseObjectDsName) then
   return unwillingToPerform
endif

nativeRequest.pNC := baseObjectDsName
nativeRequest.ulFlags := 0

nativeRequest.ulMoreFlags := 0

replFlags := dirSyncControlValue.flags
if (LDAP_DIRSYNC_ANCESTORS_FIRST_ORDER in replFlags) then
   nativeRequest.ulFlags := nativeRequest.ulFlags + {DRS_GET_ANC}
endif

ulSizeLimit := 1000
if (searchArg.sizeLimit) then
   ulSizeLimit := min(searchArg.sizeLimit, ulSizeLimit)
endif

nativeRequest.cMaxObjects = max (ulSizeLimit, 100)

ulMaxBytes := dirSyncControlValue.size
if (ulMaxBytes = 0) then
   ulMaxBytes := 1024*1024
endif
nativeRequest.cMaxBytes := ulMaxBytes

cookie := dirSyncControlValue.cookie
errCode := GetUsnUtdVectorFromCookie (cookie, nativeRequest)
if (errCode ≠ 0) then
   return errCode
endif

/* Handle attribute selection */
copy the list of required attributes, if present, from searchArg.pSelection
to nativeRequest.pPartialAttrSet

return 0 /* success */

```

5.115.5 GetChgReplyToSearchResult

~~Note: Some of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it in the Product Behavior appendix.~~

```

procedure GetChgReplyToSearchResult (
   [in] chgReply: DRS_MSG_GETCHGREPLY_NATIVE,
   [out] searchResultEntryList: SearchResultEntryList,
   [out] dirSyncResponseControl: Control)

```

Informative summary of behavior: The GetChgReplyToSearchResult procedure generates a list of search result entries (*searchResultEntryList*) and an LDAP_SERVER_DIRSYNC_OID response control (*dirSyncResponseControl*) from a DRS_MSG_GETCHGREPLY_NATIVE structure.

The arguments to this procedure are as follows:

- *chgReply*: A DRS_MSG_GETCHGREPLY_NATIVE message generated by the GetReplChanges function.
- *searchResultEntryList*: A list of search result entries.
- *dirSyncResponseControl*: The control that is sent back to the client.

```

objCount: ULONG
valCount: ULONG
replEntinfList: REPLENTINFLIST
responseControlValue: DirSyncControlValue
objectGuid: GUID
attrType: ATTRTYP
minCookieLength: ULONG
utdVectorSize: ULONG

objCount := chgReply.cNumObjects
valCount := chgReply.cNumValues

/* Process object updates. */

replEntinfList := chgReply.pObjects
while (not replEntinfList = null)
    TransformEntinfToSearchEntry(replEntinfList.Entinf,
                                searchResultEntryList.entry

    Add objectGUID attribute with value =
        replEntinfList.Entinf.pName.Guid to
        searchResultEntryList.entry

    Add parentGUID attribute with value =
        replEntinfList.pParentGuid to
        searchResultEntryList.entry

    replEntinfList := replEntinfList.pNextEntInf
    searchResultEntryList := searchResultEntryList.next
endwhile

/* Process value updates. */

foreach distinct object GUID objectGuid, referred by replValInf,
in chgReply.rgValues

    TransformReplValInfNativeListToSearchEntry(
        replValInf.pObject, chgReply, searchResultEntryList.entry)

    Add objectGUID attribute with value =
        replValInf.pObject.Guid to
        searchResultEntryList.entry

    searchResultEntryList := searchResultEntryList.next
endfor

/* Construct LDAP_SERVER_DIRSYNC_OID response control */

```



```

dirSyncResponseControl.value.controlType := LDAP_SERVER_DIRSYNC_OID
dirSyncResponseControl.value.criticality := false

responseControlValue := GetResponseDirSyncControlValue (chgReply)
dirSyncResponseControl.value.controlValue :=
    BER encoding of the responseControlValue

return

```

5.115.6 TransformEntinfToSearchEntry

```

procedure TransformEntinfToSearchEntry (
    [in] entinf: ENTINF
    [out] searchResultEntry: SearchResultEntry
)

```

Informative summary of behavior: The TransformEntinfToSearchEntry procedure transforms an ENTINF structure (*entinf*) into a SearchResultEntry structure (*searchResultEntry*).

```

attrList: AttributeList
attrVals: AttributeVals

TransformDSNameToLdapDN (entinf.pName, searchResultEntry.objectName)

attrList := searchResultEntry.attributes

foreach i in [0 .. entInf.AttrBlock.attrCount -1] do

    attrList.value.type := LDAPDisplayNameFromAttrTyp (
        entInf.AttrBlock.pAttr[i].attrTyp)

    attrVals := attrList.value.vals

    foreach j in [0 .. entInf.AttrBlock.pAttr[i].AttrVal.valCount -1] do

        attrVals.value := ValueFromATTRVAL(
            entInf.AttrBlock.pAttr[i].AttrVal.pAVal[j],
            Syntax(entInf.AttrBlock.pAttr[i].attrTyp),
            dc.prefixTable)
        attrVals := attrVals.next
    endfor
    attrList := attrList.next
endfor

return

```

5.115.7 TransformReplValInfNativeListToSearchEntry

~~Note: Some of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior~~

notes that pertain to the preliminary product version contain specific references to it in the Product Behavior appendix.

```
procedure TransformReplValInfNativeListToSearchEntry (  
    [in] o: DSNAME,  
    [in] chgReply: DRS_MSG_GETCHGREPLY_NATIVE,  
    [out] searchResultEntry: SEARCH_RESULT_ENRTY  
)
```

Informative summary of behavior: The TransformReplValInfNativeListToSearchEntry procedure transforms, for object *o*, the attribute values in the REPLVALINF_NATIVE list (*chgReply.rgValues*) to an AttributeList structure in *searchResultEntry*.

```
attrList: AttributeList  
attrVals: AttributeVals  
attributeType: ATTRTYP  
  
TransformDSNameToLdapDN (o, searchResultEntry.objectName)  
  
attrList := searchResultEntry.attributes  
  
foreach distinct attribute attrType of the object o in  
chgReply.rgValues  
  
    attrList.value.type := LDAPDisplayNameFromAttrTyp (attrType)  
    attrVals := attrList.value.vals  
  
    foreach attribute value replAttrVal of the attribute attrType  
of the object o in chgReply.rgValues  
  
        attrVals.value := ValueFromATTRVAL(replAttrVal,  
                                            attrType,  
                                            dc.prefixTable)  
        attrVals := attrVals.next  
    endfor  
  
    attrList := attrList.next  
endfor  
  
return
```

5.115.8 TransformDSNameToLdapDN

```
procedure TransformDSNameToLdapDN (  
    [in] dsName: DSNAME  
    [out] dn: LDAPString  
)
```

Informative summary of behavior: The TransformDSNameToLdapDN procedure transforms a DSNAME to an LDAPString DN.

```
dn.length := dsName.NameLen
```

```
dn.value := dsName.StringName
```

```
return
```

5.115.9 LDAPDisplayNameFromAttrTyp

```
Procedure LDAPDisplayNameFromAttrTyp (  
    [in] attrTyp: ATTRTYP  
    ) : LDAPString
```

Informative summary of behavior: The LDAPDisplayNameFromAttrTyp procedure transforms an attribute type (ATTRTYP) to an attribute name that is used by the LDAP clients.

```
oid : OID  
attributeDisplayName: LDAPString  
attrObj: DSName  
  
oid := OidFromAttid(dc.prefixTable, attrTyp)  
attrObj := select o from subtree SchemaNC() where  
    (attributeSchema in o!objectClass) and  
    (o!attributeID = oid)  
attrDisplayname := attrObj!LDAPDisplayName  
  
return attrDisplayName
```

5.115.10 GetResponseDirSyncControlValue

~~Note: Some of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it in the Product Behavior appendix.~~

```
procedure GetResponseDirSyncControlValue (  
    [in] chgReply: DRS_MSG_GETCHGREPLY_NATIVE  
    ) : DirSyncControlValue
```

Informative summary of behavior: The GetResponseDirSyncControlValue procedure creates an LDAP_SERVER_DIRSYNC_OID control value, to be returned in the response LDAP_SERVER_DIRSYNC_OID control, from a DRS_MSG_GETCHGREPLY_NATIVE structure (*chgReply*).

The arguments to this procedure are as follows:

- *chgReply*: A DRS_MSG_GETCHGREPLY_NATIVE message generated by the GetReplChanges function.

```
replControlValue: DirSyncControlValue  
minCookieLength: ULONG  
utdVectorSize: ULONG  
pUpToDateVecSrcV1: UPTODATE_VECTOR_V1_EXT  
  
/* Construct LDAP_SERVER_DIRSYNC_OID response control value */
```

```

replControlValue.flag := chgReply.fMoreData
replControlValue.size := 0 /* must be ignored by the client */

/* minimum possible cookie size in bytes; that is, the size of a cookie
when a UTD vector is not present in the cookie. */

minCookieLength := 17*4

pUpToDateVecSrcV1 := If necessary, convert chgReply.pUpToDateVecSrc (of
type UPTODATE_VECTOR_V2_EXT) to UPTODATE_VECTOR_V1_EXT by
creating a new UPTODATE_VECTOR_V1_EXT with a UPTODATE_CURSOR_V1
cursor for each UPTODATE_CURSOR_V2 cursor, ignoring the
timeLastSyncSuccess field in UPTODATE_CURSOR_V2.

utdVectorSize := 16 /* offsetof(UPTODATE_VECTOR_V1,rgCursors[0]) */
+ (pUpToDateVecSrcV1.V1.cNumCursors *
sizeof(UPTODATE_CURSOR_V1))

replControlValue.cookie.length := minCookieLength + utdVectorSize
replControlValue.cookie.value.signature := "SDSM"
replControlValue.cookie.value.version := 3
replControlValue.cookie.value.creationTime := current system time
replControlValue.cookie.value.utdVectorSize := utdVectorSize
replControlValue.cookie.value.usnVector := chgReply.usnvecTo
replControlValue.cookie.value.uuidSourceDsaInvocationID :=
chgReply.uuidInvocIdSrc
copy utdVectorSize bytes from pUpToDateVecSrcV1 to
replControlValue.cookie.value.utdVector

return replControlValue

```

5.115.11 GetUsnUtdVectorFromCookie

```

procedure GetUsnUtdVectorFromCookie(
[in] replCookie: LDAPString,
[in/out] nativeRequest: DRS_MSG_GETCHGREQ_V10
): ULONG

```

Informative summary of behavior: The GetUsnUtdVectorFromCookie procedure extracts the USN vector and the UTD vector from an LDAP_SERVER_DIRSYNC_OID control value (*replCookie*) and sets the USN vector **from** (*nativeRequest.usnvecFrom*) and UTD vector **destination** (*nativeRequest.pUpToDateVecDest*).

```

utdVectorSize: ULONG
minCookieLength: ULONG
/* minimum possible cookie size in bytes; that is, the size of a cookie
when a UTD vector is not present in the cookie. */

minCookieLength := 17*4

/* Validate cookie, and extract USN and UTD vectors. */
If (replCookie.length ≠ 0) then
  If (replCookie.length < minCookieLength)
    or
    (replCookie.value.signature ≠ "SDSM")
    or
    (replCookie.value.version ≠ 3)

```

```

        return protocolError
    endif

    utdVectorSize := replCookie.value.utdVectorSize
    if (utdVectorSize < sizeof(UPTODATE_VECTOR_V1_EXT)
        or
        replCookie.length < minCookieLength +
            utdVectorSize) then
        utdVectorSize := 0
    endif

    if (replCookie.value.uuidSourceDsaInvocationId =
        DSAObj(!invocationId) then
        nativeRequest.usnvecFrom := replCookie.value.usnVector
    endif

    if (utdVectorSize > 0) then
        Copy utdVectorSize bytes from replCookie.value.utdVector
        to nativeRequest.pUpToDateVecDest

        /* some more validation */
        if (nativeRequest.pUpToDateVecDest.dwVersion # 1
            or
            16 /* (offsetof(UPTODATE_VECTOR,V1.rgCursors[0]) */
            + (nativeRequest.pUpToDateVecDest.V1.cNumCursors
            * sizeof(UPTODATE_CURSOR_V1))) # utdVectorSize
            or
            replCookie.length # minCookieLength
            + utdVectorSize) then
            return protocolError
        endif
    Endif
endif

return 0 /* success */

```

5.115.12 SecurityCheckForChanges

```

procedure SecurityCheckForChanges(
    [in] msgIn: DRS_MSG_GETCHGREQ_V10
): ULONG

```

Informative summary of behavior: The SecurityCheckForChanges procedure checks whether an LDAP_SERVER_DIRSYNC_OID control client has access rights to read the changes in an NC (*msgIn.pNC*).

```

if AccessCheckCAR(msgIn.pNC, Ds-Replication-Get-Changes) = false then
    return insufficientAccessRights
endif

if msgIn.pPartialAttrSet.cAttrs # 0 and
    IsFilteredAttributePresent(msgIn.pPartialAttrSet) = true and
    AccessCheckCAR(msgIn.pNC,
        Ds-Replication-Get-Changes-In-Filtered-Set) = false and
    AccessCheckCAR(msgIn.pNC,
        Ds-Replication-Get-Changes-All) = false
then
    return insufficientAccessRights
endif

return 0 /* success */

```

5.115.13 IsFilteredAttributePresent

```
procedure IsFilteredAttributePresent(  
    [in] attrVec: PARTIAL_ATTR_VECTOR_V1_EXT  
    ) : boolean
```

Informative summary of behavior: The IsFilteredAttributePresent procedure returns true if an attribute from the filtered set is present in *attrVec*; otherwise, it returns false.

```
filteredAttrSet: sequence of ATTRTYP  
i: int  
  
filteredAttrSet := GetFilteredAttributeSet()  
  
for i := 0 to attrVec.cAttrs - 1  
    if attrVec.rgPartialAttr[i] in filteredAttrSet then  
        return true  
    endif  
endfor  
  
return false
```

5.116 LDAPConnections

LDAPConnections is an abstract type for the LDAP connections associated with a DC. It is a sequence of tuples, one tuple per LDAP connection currently open. Each tuple contains the following fields:

- **iPAddress:** A DWORD that contains the IPv4 address of the client machine that established the connection.
- **notificationCount:** An integer that contains the number of LDAP notifications enabled on the connection.
- **secTimeConnected:** An integer that contains the time, in seconds, that the connection has been open.
- **flags:** A DWORD that contains the LDAP_CONN_PROPERTIES bit flags that identify properties of the connection.
- **totalRequests:** An integer that contains the total number of LDAP requests processed on the connection.
- **userName:** A *unicodestring* (section 3.4.3) that contains the name of the security principal that opened the connection.
- **fschemaUpgradeInProgress:** A Boolean that specifies certain constraint validations are skipped when adding, updating, or removing directory objects on the opened connection. The skipped constraint validations are documented in the applicable constraint sections in [MS-ADTS].

The global variable *dc* for a DC has an associated field *dc.ldapConnections*, which maintains the DC's LDAPConnections state.

5.117 LinkStamp

```
procedure LinkStamp(  
    o: DSName;
```

```
att: ATTRTYP;  
val: attribute value): LinkValueStamp
```

The LinkStamp procedure returns the LinkValueStamp associated with the last update to add or remove value *val* from the forward link attribute *att* of object *o*. If *val* was last updated when the forest functional level was DS_BEHAVIOR_WIN2000 (see [MS-ADTS] section 6.1.4.4), no LinkValueStamp is associated with *val*, and LinkStamp returns null.

5.118 LinkValueStamp

~~Note: Some of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it in the Product Behavior appendix.~~

LinkValueStamp is an abstract type that denotes information about the last update to a link value of an object. It is a tuple that consists of all the fields in AttributeStamp, plus the following additional fields:

- **timeCreated:** The date and time at which the first originating update was made.
- **timeDeleted:** The date and time at which the last replicated update was made that deleted the value, or 0 if the value is not currently deleted.
- **timeExpired:** The date and time at which the value ~~should~~must be removed from the state of the DC.

Comparisons

Values of LinkValueStamp are partially ordered. Let *d* be the result of *x.dwVersion* - *y.dwVersion*, cast as a 32-bit integer. Then given two stamps *x* and *y*, *x* is said to be greater than *y* if any of the following is true:

- *x* is not null and *y* is null
- *x.timeCreated* > *y.timeCreated*
- *x.timeCreated* = *y.timeCreated* and *d* > 0
- *x.timeCreated* = *y.timeCreated* and *d* = 0 and *x.timeChanged* > *y.timeChanged*
- *x.timeCreated* = *y.timeCreated* and *d* = 0 and *x.timeChanged* = *y.timeChanged* and *x.uuidOriginating* > *y.uuidOriginating*

Conversions

A value *x* of type LinkValueStamp ~~may~~can be converted to and from its wire format *y* of type PROPERTY_META_DATA_EXT by associating the values of fields in *x* with the values of the like-named fields in *y* and *y.Metadata*.

Note The value of *timeDeleted* does not appear in the wire format. On the wire, the PROPERTY_META_DATA_EXT value always appears as a value of the *Metadata* field of a REPLVALINF_V1 or REPLVALINF_V3 structure. Given value *x* of type LinkValueStamp and value *z* of type REPLVALINF_V1 or REPLVALINF_V3, *z.isPresent* is TRUE if *x.timeDeleted* is 0 and FALSE if *x.timeDeleted* is nonzero.

Note The value of *timeExpired* does not appear in the REPLVALINF_V1 wire format. In cases where the REPLVALINF_V1 wire format is used, the value of *timeExpired* is not returned to the caller.

5.119 LinkValueStampCompare

```
procedure LinkValueStampCompare(  
    LinkValueStamp stamp1,  
    LinkValueStamp stamp2): integer
```

Informative summary of behavior: The LinkValueStampCompare procedure compares two LinkValueStamps, *stamp1* and *stamp2*. If *stamp1* > *stamp2* then the procedure returns an integer with a value greater than 0. If *stamp1* = *stamp2* then the procedure returns 0. If *stamp1* < *stamp2* then the procedure returns an integer value less than 0.

```
d: integer  
  
d := 0  
  
if stamp1.dwVersion ≠ 0 and stamp2.dwVersion = 0 then  
    d := 1  
else if stamp1.dwVersion = 0 and stamp2.dwVersion ≠ 0 then  
    d := -1  
endif  
  
if d = 0 then  
    if stamp1.timeCreated > stamp2.timeCreated then  
        d := 1  
    else if stamp1.timeCreated < stamp2.timeCreated then  
        d := -1  
    endif  
endif  
  
if d = 0 then  
    /* The value of d will be the result of stamp1.dwVersion -  
    * stamp2.dwVersion, cast as a 32-bit integer. For example, if  
    * stamp1.dwVersion is 1 and stamp2.dwVersion is 3, d is -2. If  
    * stamp1.dwVersion is 5 and stamp2.dwVersion is 0xFFFFFFFF,  
    * d is 11.  
    */  
    d := stamp1.dwVersion - stamp2.dwVersion  
endif  
  
if d = 0 then  
    if stamp1.timeChanged > stamp2.timeChanged then  
        d := 1  
    else if stamp1.timeChanged < stamp2.timeChanged then  
        d := -1  
    endif  
endif  
  
if d = 0 then  
    if stamp1.uuidOriginating > stamp2.uuidOriginating then  
        d := 1  
    else if stamp1.uuidOriginating < stamp2.uuidOriginating then  
        d := -1  
    endif  
endif  
  
return d
```

5.120 LocalAttidFromRemoteAttid

```
procedure LocalAttidFromRemoteAttid(  
    remotePT: PrefixTable,  
    remoteAttid : ATRTYP) : ATRTYP
```


Informative summary of behavior: The LocalAttidFromRemoteAttid procedure converts the attribute ID *remoteAttid* based on the prefix table *remotePT* to an attribute ID based on *dc.prefixTable*.

```
oid : OID  
  
oid := OidFromAttid(remotePT, remoteAttid)  
return MakeAttid(dc.prefixTable, oid)
```

5.121 LONG

A concrete type for a 32-bit, signed integer, as specified in [MS-DTYP] section 2.2.27.

5.122 LONGLONG

A concrete type for a 64-bit, signed integer, as specified in [MS-DTYP] section 2.2.28.

5.123 LPWSTR

A concrete type for a pointer to a string of double-byte Unicode characters, as specified in [MS-DTYP] section 2.2.36.

5.124 MakeAttid

```
procedure MakeAttid(var t: PrefixTable, o: OID) : ATTRTYP
```

The MakeAttid procedure translates an abstract OID *o* to a concrete ATTRTYP, using the prefix table specified by *t*. This procedure [may](#) mutate the supplied prefix table. See section 5.16.4 for the specification of this procedure.

5.125 MakeProxyValue

```
procedure MakeProxyValue(  
  dnPart: DSName,  
  proxyType: DWORD,  
  proxyEpoch: DWORD): DNBinary
```

The MakeProxyValue procedure constructs and returns a value in the proxiedObjectName format (section 5.157) from the provided parts. Let *d* be the returned DNBinary. *d.dn* equals *dnPart* and *d.binary* is constructed from *proxyType* and *proxyEpoch*.

5.126 MasterReplicaExists

```
procedure MasterReplicaExists(nc : DSName) : boolean
```

The MasterReplicaExists procedure returns true only if the NC replica with root *nc* is a writable NC replica.

```
If not ObjExists(nc) then  
  return false  
endif  
return nc in DSAObj()!msDS-hasMasterNCs
```

5.127 MD5_CTX

MD5_CTX is an abstract type defined in [RFC1321].

5.128 MD5Final

```
procedure MD5Final(var context: MD5_CTX)
```

The MD5Final procedure performs the MD5Final algorithm, as specified in [RFC1321].

5.129 MD5Init

```
procedure MD5Init(var context: MD5_CTX)
```

The MD5Init procedure performs the MD5Init algorithm, as specified in [RFC1321].

5.130 MD5Update

```
procedure MD5Update(  
  var context: MD5_CTX,  
  input: sequence of BYTE,  
  inputLen: integer)
```

The MD5Update procedure performs the MD5Update algorithm, as specified in [RFC1321].

5.131 MergeUTD

```
procedure MergeUTD(  
  utd1: UPTODATE_VECTOR_V1_EXT,  
  utd2: UPTODATE_VECTOR_V1_EXT): UPTODATE_VECTOR_V1_EXT
```

Informative summary of behavior: The client does not want to include objects in the inconsistency-detection process that have not yet replicated. To meet this goal, it uses the MergeUTD procedure to compute an UPTODATE_VECTOR_V1_EXT that has minimal pairwise values for each uuidDsa.

MergeUTD is specified by the following normative semantics:

For every uuidDsa that is in both *utd1* and *utd2*, add the uuidDsa to the returned UPTODATE_VECTOR_V1_EXT with a corresponding USN value such that the USN is the smaller of the USNs corresponding to the uuidDsa in *utd1* and *utd2*.

5.132 MTX_ADDR

The MTX_ADDR structure defines a concrete type for the network name of a DC.

```
typedef struct {  
  [range(1,256)] unsigned long mtx_namelen;  
  [size_is(mtx_namelen)] char mtx_name[];  
} MTX_ADDR;
```

mtx_namelen: A 32-bit, unsigned integer that specifies the number of bytes in **mtx_name**, including a terminating null character.

mtx_name: The UTF-8 encoding of a NetworkAddress.

The following table shows an alternative representation of this structure.

0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
mtx_namelen																															
mtx_name (variable length) ...																															

5.133 NCType Bits

Bit flags, presented in little-endian byte order, describing **NCType**.

0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
X	X	X	X	X	F	G	S	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
					P	P	P																								

X: Unused. MUST be zero and ignored.

SP (NCT_SPECIAL_SECRET_PROCESSING, 0x00000001): The NC replica requests special secret processing while replicating objects.

GP (NCT_GC_PARTIAL, 0x00000002): Objects in the NC replica can only have attributes that are specified in the **GC partial attribute set**.

FP (NCT_FILTERED_ATTRIBUTE_SET, 0x00000004): Objects in the NC replica do not have attributes defined in the **filtered attribute set**.

5.134 NetworkAddress

NetworkAddress is an abstract type for the transport-specific address of a DC represented as a string. For the SMTP transport, the address is an SMTP address (as specified in [RFC2821] and [MS-SRPL]). For the RPC transport in AD DS, the NetworkAddress is a fully qualified DNS name corresponding to the DC.

For the RPC transport in AD LDS, the NetworkAddress is a UTF-8 string in the following format:

- <DC-name>:<DC-identifier>

In the preceding format:

- <DC-name> is an IP address in the UTF-8 format, a fully qualified DNS name, or a NetBIOS name.
- <DC-identifier> is either a GUID or an integer. The GUID corresponds to the objectGUID attribute of the DC's nTDSDSA object. The integer is the **ldapPort** attribute of the DC's nTDSDSA object.
- The colon (":") is the literal separator between the DC-name and the DC-identifier.

A NetworkAddress is stored as an **mtx_name** within an **MTX_ADDR** structure or in a location that is pointed to by the **cbpszInstanceOffset** member of the **DSA_RPC_INST** structure, which in turn is stored within a **REPS_TO** structure. The concrete representation of NetworkAddress in these concrete structures is the same as the abstract representation described above.

5.135 NewPrefixTable

```
procedure NewPrefixTable() : PrefixTable
```

The NewPrefixTable procedure creates a new PrefixTable that contains a set of default prefixes. See section 5.16.4 for the specification of this procedure.

5.136 Nt4ReplicationState

Nt4ReplicationState is an abstract type for the replication state for Windows NT 4.0 BDCs. It is a tuple that contains the following fields:

- **SamNT4ReplicationUSN:** A USN that records the replication update sequence number for SAM database updates that are relevant to the Windows NT 4.0 replication protocol. Relevant updates are described in [MS-ADTS] section 3.1.1.7.2.2.
- **SamCreationTime:** A FILETIME at which the Windows NT 4.0 replication update sequence number for the SAM database was set to 1.
- **BuiltinNT4ReplicationUSN:** A USN that records the replication update sequence number for built-in database updates that are relevant to the Windows NT 4.0 replication protocol. The built-in database contains the objects for built-in principals.
- **BuiltinCreationTime:** A FILETIME at which the replication update sequence number for the built-in database was set to 1.

The global variable dc for a DC has an associated field dc.nt4ReplicationState. When a DC owns the PDC FSMO role, this field contains its Nt4ReplicationState. [MS-ADTS] section 3.1.1.7.1.1 describes how the components of dc.nt4ReplicationState are maintained and used to support replication via the Windows NT 4.0 replication mechanism. As an implementation-specific behavior, other DCs may maintain the dc.nt4ReplicationState field as well.

5.137 NT4SID

The NT4SID structure defines a concrete type for a SID.

```
typedef struct {  
    char Data[28];  
} NT4SID;
```

Data: Bytes that make up a SID structure, as specified in [MS-DTYP] section 2.4.2, in little-endian byte order.

5.138 NTSAPI_CLIENT_GUID

NTDSAPI_CLIENT_GUID is a value of type GUID that is defined as {e24d201a-4fd6-11d1-a3da-0000f875ae0d}.

5.139 NTDSTRANSPORT_OPT Values

The valid system flags used on directory objects are specified in [MS-ADTS] section 6.1.1.2.2.3.1.

5.140 NULLGUID

NULLGUID is a value of type GUID that is entirely zero, that is, {00000000-0000-0000-0000-000000000000}. This is a constant representation of the NULL GUID value.

5.141 ObjExists

```
procedure ObjExists(dsName: DSName): boolean
```

The ObjExists procedure returns true if *dsName* identifies an object in some NC replica hosted by the server.

```
rt: DSName
rt:= select one v from all where v = dsName
if (rt = null) then
  return false
else
  return true
endif
```

5.142 OID

OID is an abstract type for representing values of type String(Object-Identifier). Values of this type are a dotted decimal *unicodestring* (section 3.4.3), for example, "1.2.840.113556.1.4.159".

5.143 OID_t

The OID_t structure defines a concrete type for an OID or a prefix of an OID; it is a component of type PrefixTableEntry.

```
typedef struct {
  [range(0,10000)] unsigned int length;
  [size_is(length)] BYTE* elements;
} OID_t;
```

length: The size, in bytes, of the elements array.

elements: An array of bytes that constitute an OID or a prefix of an OID.

5.144 OidFromAttid

```
procedure OidFromAttid(t: PrefixTable, attr: ATTRTYP) : OID
```

The OidFromAttid procedure translates a concrete ATTRTYP *attr* to an abstract OID, using the prefix table specified by *t*. See section 5.16.4 for the specification of this procedure.

5.145 parent

parent is an abstract attribute that is present on every object, as specified in [MS-ADTS] section 3.1.1.1.3. This attribute is part of the state model but is not exposed in the Active Directory schema.

5.146 PARTIAL_ATTR_VECTOR_V1_EXT

The PARTIAL_ATTR_VECTOR_V1_EXT structure defines a concrete type for a set of attributes to be replicated to a given partial replica.

```
typedef struct {
    DWORD dwVersion;
    DWORD dwReserved1;
    [range(1,1048576)] DWORD cAttrs;
    [size_is(cAttrs)] ATTRTYP rgPartialAttr[];
} PARTIAL_ATTR_VECTOR_V1_EXT;
```

dwVersion: The version of this structure; MUST be 1.

dwReserved1: Unused. MUST be 0 and ignored.

cAttrs: The number of attributes in the rgPartialAttr array.

rgPartialAttr: The attributes in the set.

5.147 partialAttributeSet

The abstract, nonreplicated, single-valued attribute partialAttributeSet is an optional attribute on the NC root of every partial replica.

The abstract type set of ATTRTYP simplifies the specification of methods that read and write the attribute partialAttributeSet. Reading the attribute partialAttributeSet returns a single value, which is of type set of ATTRTYP. Each element in the set is an attribute that is in the subset of attributes replicated to the partial replica.

5.148 PartialGCReplicaExists

```
procedure PartialGCReplicaExists(nc : DSName) : boolean
```

The PartialGCReplicaExists procedure returns true if the NC replica with root *nc* is a **partial NC replica**.

```
if not ObjExists(nc) then
    return false
endif
return nc in DSAObj()!hasPartialReplicaNCs
```

5.149 PAS_DATA

PAS_DATA is a concrete type for a list of attributes in a **partial attribute set**.

0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
version																															
size																															
flag																															

pas (variable)
...

version (4 bytes): The version of the structure; MUST be 1.

size (4 bytes): The size of the entire structure.

flag (4 bytes): Unused. MUST be 0 and ignored.

pas (variable): A PARTIAL_ATTR_VECTOR_V1_EXT structure, which specifies the additional attributes being requested as part of a PAS cycle.

5.150 PdcChangeLog

PdcChangeLog is an abstract type for a sequence of CHANGELOG_ENTRY objects. The change log is used to support replication of certain Active Directory changes to Windows NT 4.0 BDCs, and is specified in [MS-ADTS] section 3.1.1.7.

The global variable dc for a DC has an associated field dc.pdcChangeLog. When a DC owns the PDC FSMO role, this field contains its change log. As an implementation-specific behavior, other DCs **may** maintain the dc.pdcChangeLog field as well.

5.151 PerformAddOperation

```
procedure PerformAddOperation(
  data: ENTINF,
  var newObjectName: DSName,
  prefixTable: PrefixTable,
  boolean: fAsOriginating): integer
```

The PerformAddOperation procedure performs an add operation with the given ENTINF to create a new object in the directory. For more details, see [MS-ADTS] section 3.1.1.5.2.

The resulting object has the DSNAME *data.pName*.

For each ATTR **attr** in *data.AttrBlock*, let *attribute* be the ATTRTYP returned by LocalAttidFromRemoteAttid(*prefixTable*, attr.attrType). Then the object created by PerformAddOperation has an attribute whose ATTRTYP is *attribute* and that has the values attr.AttrVal.pAVal[0... attr.AttrVal.valCount].

If $data.ulFlags \cap \{ENTINF_DYNAMIC_OBJECT\} = \{ENTINF_DYNAMIC_OBJECT\}$, the resulting object is created as a dynamic object.

If *fAsOriginating* is true, then add the object as an originating update. See [MS-ADTS] section 3.1.1.1.9.

If the add operation succeeds, the DSName of the created object is returned in *newObjectName* and the procedure returns 0. If the add operation fails, the procedure returns a Windows error code.

5.152 PerformAddOperationAsSystem

```
procedure PerformAddOperationAsSystem(
  data: ENTINF,
  prefixTable: PrefixTable,
  var newObjectName: DSNAME): integer
```

The PerformAddOperationAsSystem procedure is identical to PerformAddOperation, except that the add operation is performed as the system. When an operation is performed as the system, all access checks are bypassed and schema constraints are not enforced.

5.153 PrefixTable

PrefixTable is an abstract type for a prefix table. See section 5.16.4 for the specification of this type.

5.154 PrefixTableEntry

The PrefixTableEntry structure defines a concrete type for mapping a range of ATTRTYP values to and from OIDs. It is a component of the type SCHEMA_PREFIX_TABLE.

```
typedef struct {
    unsigned long ndx;
    OID_t prefix;
} PrefixTableEntry;
```

ndx: The index assigned to the prefix.

prefix: An OID or a prefix of an OID.

5.155 PROPERTY_META_DATA_EXT

The PROPERTY_META_DATA_EXT structure defines a concrete type for the stamp of the last originating update to an attribute.

```
typedef struct {
    DWORD dwVersion;
    DSTIME timeChanged;
    UUID uuidDsaOriginating;
    USN usnOriginating;
} PROPERTY_META_DATA_EXT;
```

dwVersion: The version of the attribute values, starting at 1 and increasing by one with each originating update.

timeChanged: The time at which the originating update was performed.

uuidDsaOriginating: The invocationId of the DC that performed the originating update.

usnOriginating: The USN of the DC assigned to the originating update.

5.156 PROPERTY_META_DATA_EXT_VECTOR

The PROPERTY_META_DATA_EXT_VECTOR structure defines a concrete type for a sequence of attribute stamps.

```
typedef struct {
    [range(0,1048576)] DWORD cNumProps;
    [size_is(cNumProps)] PROPERTY_META_DATA_EXT rgMetaData[];
} PROPERTY_META_DATA_EXT_VECTOR;
```

cNumProps: The number of items in the **rgMetaData** array.

rgMetaData: An array of attribute stamps.

5.157 proxiedObjectName Value Format

Values of the proxiedObjectName attribute are of DNBinary type. The binary portion is composed of two DWORDs, which are stored in big-endian format. The first DWORD contains the "proxy type" value. The following table lists the valid values for the first DWORD.

Symbolic name	Value	Meaning
PROXY_TYPE_MOVED_OBJECT	0x0	An object that was cross-NC moved.
PROXY_TYPE_PROXY	0x1	Used by the reference update task. For more details, see [MS-ADTS] section 3.1.1.6.2.

The second DWORD is the "proxy epoch" value, which is a DWORD counter value that is used by the cross-NC move operation.

5.158 RDN

RDN is an abstract type for representing the relative distinguished name (RDN) (as specified in [RFC2253]).

5.159 rdnType

rdnType is an abstract attribute present on every object. The rdnType of an object is the RDN attribute of the object, that is, an ATTRTYP that identifies the attributeSchema object of the RDN attribute. rdnType is not represented in the schema and does not replicate in the normal way.

On an originating Add, the new object's rdnType is derived from the most specific structural object class of the new object.

On a replicated Add, rdnType is derived as follows:

- If the forest functional level is less than DS_BEHAVIOR_WIN2003, rdnType is derived from the objectClass of the object, which replicates.
- If the forest functional level is DS_BEHAVIOR_WIN2003 or greater, rdnType is derived from the DN of the object, which replicates.

5.160 RecycleObj

```
procedure RecycleObj(o: DSName)
```

The RecycleObj procedure transforms, as described in [MS-ADTS] section 3.1.1.5.5, the object whose DSName is *o* into a **recycled-object**. All appropriate attributes (possibly including distinguishedName) are changed or removed from the object to conform to the invariants of [MS-ADTS] section 3.1.1.5.5. Any changes that need to be made to the object are performed as an originating update, except for changes required to remove linked attribute values, which are simply removed from the directory. Attributes and values that already conform to the invariants are not changed. See [MS-ADTS] section 3.1.1.1.9 for more details on originating updates.

5.161 RemoveObj

```
procedure RemoveObj(o: DSName,treeDeletion: boolean): ULONG
```

The RemoveObj procedure performs a delete operation on the **object** whose DSName is *o*. If the value of parameter *treeDeletion* is true, then the tree-delete variation of the operation is performed. As described in [MS-ADTS] section 3.1.1.5.5, the delete operation transforms the targeted **object** into a **deleted-object** or a **tombstone**, depending on the state of the **Recycle Bin optional feature**. The tree-delete operation performs, as described in [MS-ADTS] section 3.1.1.5.5.7.3, a delete operation on all **objects** in the subtree rooted at the **target object**. All appropriate **attributes** (possibly including **distinguishedName**) are changed or removed from the deleted -objects to conform to the invariants of [MS-ADTS] section 3.1.1.5.5. Any changes that need to be made to the **objects** are performed as an **originating update**, except for changes required to remove linked **attribute** values, which are simply removed from the **directory**. **Attributes** and values that already conform to the invariants are not changed. See [MS-ADTS] section 3.1.1.1.9 for more details on **originating updates**. If the delete operation succeeds, 0 is returned. Otherwise, this procedure returns an error code, as specified in [MS-ADTS] section 3.1.1.5.5, that indicates the reason for the failure.

5.162 REPLENTINFLIST

The REPLENTINFLIST structure defines a concrete type for updates to one or more attributes of a given object.

```
typedef struct REPLENTINFLIST {
    struct REPLENTINFLIST* pNextEntInf;
    ENTINF Entinf;
    BOOL fIsNCPrefix;
    UUID* pParentGuid;
    PROPERTY_META_DATA_EXT_VECTOR* pMetaDataExt;
} REPLENTINFLIST;
```

pNextEntInf: The next REPLENTINFLIST in the sequence, or null.

Entinf: The object and its updated attributes.

fIsNCPrefix: TRUE only if the object is an NC root.

pParentGuid: The value of the objectGUID attribute of the parent of the object, or null if not known or not specified.

pMetaDataExt: The stamps for the attributes specified in Entinf.AttrBlock. Entinf.AttrBlock and pMetaDataExt.rgMetaData are parallel arrays. For a given integer *i* in [0 .. Entinf.AttrBlock.attrCount], the stamp for the attribute described by Entinf.AttrBlock.pAttr^[*i*] is pMetaDataExt^.rgMetaData[*i*].

5.163 ReplicatedAttributes

```
procedure ReplicatedAttributes(): Set of ATTRTYP
```

The ReplicatedAttributes procedure returns the set of ATTRTYP of all attributes in the schema excluding nonreplicated attributes. See [MS-ADTS] section 3.1.1.2.3 for more details on nonreplicated attributes.

5.164 ReplicationQueue

ReplicationQueue is an abstract type for queued pending replication operations. It is a sequence of tuples, one tuple for each queued replication operation that is pending. Each tuple contains the following fields:

- **TimeEnqueued:** A FILETIME that contains the time when the operation was enqueued.
- **SerialNumber:** A ULONG that contains a unique identifier associated with the operation.
- **Priority:** A ULONG that contains the priority of the operation. Tasks with a higher priority value are executed first. The priority is calculated by the server based on the type of operation and its parameters.
- **OperationType:** An integer that indicates the type of operation, as defined in DS_REPL_OP_TYPE.
- **Options:** A DRS_OPTIONS that contains options associated with the replication operation.
- **NamingContext:** A *unicodestring* (section 3.4.3) that contains the NC root of the NC replica associated with the operation.
- **DsaDN:** A *unicodestring* (section 3.4.3) that contains the DN of the nTDSDSA object of the DC associated with the operation.
- **DsaAddress:** A *unicodestring* (section 3.4.3) that contains the network address of the DC associated with the operation.
- **UUIDNC:** A GUID that contains the objectGUID of the NC root of the NC replica associated with the operation.
- **UUIDDsa:** A GUID that contains the DSA GUID of the DC associated with the operation.

The global variable `dc` for a DC has an associated field `dc.replicationQueue`, which maintains the DC's `ReplicationQueue` state.

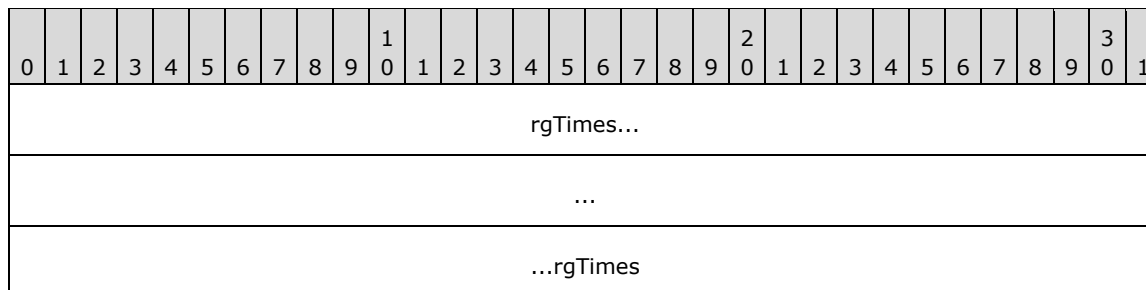
5.165 REPLTIMES

The `REPLTIMES` structure defines a concrete type for times at which periodic replication occurs.

```
typedef struct {
    UCHAR rgTimes[84];
} REPLTIMES;
```

rgTimes: A byte array of length 84 that is used to set periodic replication times. Each bit in this byte array represents a 15-minute period for which replication can be scheduled within a one-week period. The replication schedule begins on Sunday 12:00:00 AM UTC. Each byte in the array represents a two-hour period of a week in ascending order, starting Sunday 12:00:00 AM UTC. The most significant bit of a byte represents the earliest 15-minute period in the two-hour period, and the rest of the bits in the byte represent their respective 15-minute periods in this order.

The following diagram shows an alternative representation of this structure.



5.166 replUpToDateVector, ReplUpToDateVector

The nonreplicated attribute replUpToDateVector is an optional attribute on the NC root of every NC replica.

The abstract type ReplUpToDateVector simplifies the specification of methods that read and write the replUpToDateVector attribute. Reading the replUpToDateVector attribute produces one or more ReplUpToDateVector values.

The ReplUpToDateVector type is a tuple with the following fields:

- **uuidDsa:** The invocation ID of the DC that assigned usnHighPropUpdate.
- **usnHighPropUpdate:** A USN at which an update was applied on the DC identified by uuidDsa.
- **timeLastSyncSuccess:** The time at which the last successful replication occurred from the DC identified by uuidDsa; for replication latency reporting only.

Given an NC replica *r*, if *c* is an element of *r*!replUpToDateVector, then all updates made by *c*.uuidDsa with USN ≤ *c*.usnHighPropUpdate have been applied to *r*.

5.167 REPLVALINF_V1

~~Note: Some of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it in the Product Behavior appendix.~~

The REPLVALINF_V1 structure defines a concrete type for the identity and stamp of a link value.

```
typedef struct {
    DSNAME* pObject;
    ATTRTYP attrTyp;
    ATTRVAL Aval;
    BOOL fIsPresent;
    VALUE_META_DATA_EXT_V1 MetaData;
} REPLVALINF_V1;
```

pObject: Identifies the object with the attribute that contains the link value.

attrTyp: An attribute that contains the link value.

Aval: The link value.

fIsPresent: FALSE if and only if the link value has been removed from the attribute.

MetaData: The stamp associated with the link value.

5.168 REPLVALINF_V3

~~Note: All of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it as an aid to the reader.~~

The REPLVALINF_V3 structure defines a concrete type for the identity and stamp of a link value. This structure contains all the same elements as a **REPLVALINF_V1** structure except that the data type of MetaData is changed from **VALUE_META_DATA_EXT_V1** to **VALUE_META_DATA_EXT_V3**.

Because **VALUE_META_DATA_EXT_V3** is a superset of **VALUE_META_DATA_EXT_V1**, this structure is a superset of the **REPLVALINF_V1** structure.

```
typedef struct {
    DSNAME* pObject;
    ATTRTYP attrTyp;
    ATTRVAL Aval;
    BOOL fIsPresent;
    VALUE_META_DATA_EXT_V3 MetaData;
} REPLVALINF_V3;
```

pObject: Identifies the object with the attribute that contains the link value.

attrTyp: An attribute that contains the link value.

Aval: The link value.

fIsPresent: FALSE if and only if the link value has been removed from the attribute.

MetaData: The stamp associated with the link value.

5.169 REPLVALINF_NATIVE

~~Note: All of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it as an aid to the reader.~~

The REPLVALINF_NATIVE structure is an alias for the **REPLVALINF_V3** data structure.

5.170 REPS_FROM

The nonreplicated, multivalued attribute repsFrom is an optional attribute on the root object of every NC replica. It is stored with the structure of the REPS_FROM concrete type, which is represented by the following diagram.

Note In the following field descriptions, the source DC refers to the DC identified by the uuidDsaObj.

0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
dwVersion																															
dwReserved0																															
cb																															
cConsecutiveFailures																															
timeLastSuccess																															
...																															
timeLastAttempt																															

...
ulResultLastAttempt
cbOtherDraOffset
cbOtherDra
ulReplicaFlags
rtSchedule (84 bytes)
...
...
dwReserved1
usnVec (24 bytes)
...
...
uuidDsaObj (16 bytes)
...
...
uuidInvocId (16 bytes)
...
...
uuidTransportObj (16 bytes)
...
...
dwReserved
cbPasDataOffset
data (variable)
...

dwVersion (4 bytes): The version of this structure. The value must be 1 or 2. <50>

dwReserved0 (4 bytes): Unused. MUST be 0 and ignored.

cb (4 bytes): The total number of bytes in the REPS_FROM structure.

cConsecutiveFailures (4 bytes): An unsigned long that contains the number of consecutive failures that have occurred while replicating from the source DC.

timeLastSuccess (8 bytes): A DSTIME that contains the time of the last successful replication cycle with the source DC.

timeLastAttempt (8 bytes): A DSTIME that contains the time of the last replication attempt with the source DC.

ulResultLastAttempt (4 bytes): A Win32 error code, as specified in [MS-ERREF] section 2.2, that represents the result of the last replication attempt with the source DC.

cbOtherDraOffset (4 bytes): The offset from the start of the structure to a location in the data field, specifying the start of a structure that contains a NetworkAddress for the source DC. If **dwVersion** is 1, it is an MTX_ADDR structure. If **dwVersion** is 2, it is a DSA_RPC_INST structure.

cbOtherDra (4 bytes): The size of the structure pointed to by **cbOtherDraOffset**.

ulReplicaFlags (4 bytes): A ULONG. This field contains a set of DRS_OPTIONS that are applicable when replicating from the source DC.

rtSchedule (84 bytes): A REPLTIMES structure. If periodic replication is enabled (ulReplicaFlags contains DRS_PER_SYNC), this field identifies the 15-minute intervals within each week when a replication cycle is initiated with the source DC.

dwReserved1 (4 bytes): Unused. MUST be 0 and ignored.

usnVec (24 bytes): A USN_VECTOR structure. This holds 0 or the usnvecTo field from the response to the last IDL_DRSGetNCChanges replication request sent to the source DC.

uuidDsaObj (16 bytes): A GUID that is the DSA GUID of the source DC.

uuidInvocId (16 bytes): A GUID that contains the invocation ID of the source DC.

uuidTransportObj (16 bytes): A GUID that contains the objectGUID of the interSiteTransport object that corresponds to the transport used for communication with the source DC.

dwReserved (4 bytes): Unused. MUST be 0 and ignored.

cbPasDataOffset (4 bytes): The offset from the start of the structure to a location in the data field, specifying the start of a PAS_DATA structure.

data (variable): The storage for the rest of the structure. The structures pointed to by **cbOtherDraOffset** and **cbPasDataOffset** are packed into this field and can be referenced using the offsets.

5.171 REPS_TO

The nonreplicated, multivalued attribute `repsTo` is an optional attribute on the root object of every NC replica. It is stored with the structure of the `REPS_TO` concrete type, which is represented by the following diagram.

This structure is used for both `repsTo` values and `repsFrom` values. Many of the fields are unused in `repsTo` values, and some of the field names are misleading (for example, **timeLastSuccess**).

0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
dwVersion																															
dwReserved0																															
cb																															
cConsecutiveFailures																															
timeLastSuccess																															
...																															
timeLastAttempt																															
...																															
ulResultLastAttempt																															
cbOtherDraOffset																															
cbOtherDra																															
ulReplicaFlags																															
rtSchedule (84 bytes)																															
...																															
...																															
dwReserved1																															
usnVec (24 bytes)																															
...																															
...																															
uuidDsaObj (16 bytes)																															
...																															
...																															
uuidInvocId (16 bytes)																															
...																															

...
uuidTransportObj (16 bytes)
...
...
dwReserved
cbPasDataOffset
data (variable)
...

dwVersion (4 bytes): The version of this structure. The value must be 1 or 2. <51>

dwReserved0 (4 bytes): Unused. MUST be 0 and ignored.

cb (4 bytes): The total number of bytes in the REPS_TO structure.

cConsecutiveFailures (4 bytes): An unsigned long that contains the number of unsuccessful consecutive attempts to send a replication notification to the DC identified by uuidDsaObj.

timeLastSuccess (8 bytes): A DSTIME structure that contains the time when the last successful replication notification to the DC identified by uuidDsaObj was sent, or 0 if no replication notification has been sent successfully.

timeLastAttempt (8 bytes): A DSTIME structure that contains the last time when an attempt was made to send a replication notification to the DC identified by uuidDsaObj, or 0 if no attempt has been made.

ulResultLastAttempt (4 bytes): An unsigned long that contains the result of the last attempt to send a replication notification to the DC identified by uuidDsaObj. It has a value of 0 if the last notification was sent successfully or a Windows error code (as specified in [MS-ERREF] section 2.2) otherwise.

cbOtherDraOffset (4 bytes): The offset from the start of the structure to a location in the data field, specifying the start of a structure that contains a NetworkAddress. If **dwVersion** is 1, it is an MTX_ADDR structure. If **dwVersion** is 2, it is a DSA_RPC_INST structure.

cbOtherDra (4 bytes): The size of the structure pointed to by **cbOtherDraOffset**.

ulReplicaFlags (4 bytes): A ULONG. This set contains DRS_WRIT_REP (section 5.41) if this replica is writable. This set never contains any other elements.

rtSchedule (84 bytes): A REPLTIMES structure. Not used.

dwReserved1 (4 bytes): Unused. MUST be 0 and ignored.

usnVec (24 bytes): A USN_VECTOR structure. Not used.

uuidDsaObj (16 bytes): A GUID. A DSA GUID that identifies a DC.

uuidInvocId (16 bytes): A GUID. Not used.

uuidTransportObj (16 bytes): A GUID. Not used.

dwReserved (4 bytes): Unused. MUST be 0 and ignored.

cbPasDataOffset (4 bytes): Not used.

data (variable): The storage for the rest of the structure. The structure pointed to by **cbOtherDraOffset** is packed into this field and can be referenced using the offset.

5.172 repsFrom, RepsFrom

The nonreplicated, multivalued attribute `repsFrom` is an optional attribute on the root object of every NC replica. It is stored with the structure `REPS_FROM`.

The abstract type `RepsFrom` simplifies the specification of methods that read and write the attribute `repsFrom`. Reading the attribute `repsFrom` produces one or more `RepsFrom` values using the conversions from `REPS_FROM` specified below. Writing a `RepsFrom` value to the attribute `repsFrom` stores a `REPS_FROM` using the reverse conversion.

The type `RepsFrom` is a tuple with the following fields:

naDsa: A `NetworkAddress` that corresponds to `cbOtherDraOffset` and `cbOtherDra` in `REPS_FROM`. This is a `NetworkAddress` of the DC.

uuidDsa: A GUID that corresponds to `uuidDsaObj` in `REPS_FROM`. This is the DSA GUID of the DC.

options: A `ULONG` that corresponds to `ulReplicaFlags` in `REPS_FROM`. This set contains one or more of the following values chosen from `DRS_OPTIONS`:

- `DRS_WRIT_REP`: The replica is a full (read/write) replica of the NC.
- `DRS_INIT_SYNC`: The replica must be replicated from the DC identified by `uuidDsa` when the DC hosting this replica is started.
- `DRS_PER_SYNC`: Periodically replicate the NC replica from the DC identified by `uuidDsa`, as defined by the periodic replication schedule.
- `DRS_MAIL_REP`: Replicate the NC replica from the DC identified by `uuidDsa` via SMTP (see [MS-SRPL]).
- `DRS_DISABLE_AUTO_SYNC`: Disable notification-based replication of the NC replica from the DC identified by `uuidDsa`.
- `DRS_DISABLE_PERIODIC_SYNC`: Disable periodic replication of the NC replica from the DC identified by `uuidDsa`.
- `DRS_USE_COMPRESSION`: Replication response messages sent along this communication path **should** be compressed.
- `DRS_TWOWAY_SYNC`: At the end of a replication cycle, replication **should** be triggered in the opposite direction.

The following additional values are preserved if they are present when reading **ulReplicaFlags**, but are otherwise ignored by the protocol:

- `DRS_NONGC_RO_REP`: Replicate a read-only full replica. Not a writable or partial replica.
- `DRS_FULL_SYNC_IN_PROGRESS`: When the flag `DRS_FULL_SYNC_NOW` is received in a call to `IDL_DRSReplicaSync`, the flag `DRS_FULL_SYNC_IN_PROGRESS` is sent in the associated calls to `IDL_DRSGetNCChanges` until the replication cycle completes. This flag is ignored by the server.

- **DRS_FULL_SYNC_PACKET:** Replicate all updates in the replication request, even those that would normally be filtered.
- **DRS_REF_GCSPN:** Requests that the server add an entry to `repsTo` for the client on the root object of the NC replica that is being replicated. When `repsTo` is set using this flag, the notifying client DC contacts the server DC using the service principal name that begins with "GC" (section 2.2.3.2).
- **DRS_NEVER_SYNCED:** There is no successfully completed replication from this source server.
- **DRS_SPECIAL_SECRET_PROCESSING:** Do not replicate attribute values of attributes that contain secret data.
- **DRS_PREEMPTED:** The replication attempt is preempted by a higher priority replication request.
- **DRS_NEVER_NOTIFY:** Do not send update notifications.
- **DRS_SYNC_PAS:** Expand the partial attribute set of the partial replica.

schedule: A `REPLTIMES` that corresponds to `rtSchedule` in `REPS_FROM`. This contains the periodic replication schedule.

uuidInvocId: A GUID that contains the invocation ID of the source DC.

usnVec: A `USN_VECTOR` that corresponds to the `usnVec` in `REPS_FROM`. This holds 0 or the `usnVecTo` field from the response to the last `IDL_DRSGetNCChanges` replication request sent to the DC identified by `uuidDsa`.

uuidTransport: A GUID that corresponds to `uuidTransportObj` in `REPS_FROM`. This is the `objectGUID` of the `interSiteTransport` object that corresponds to the transport used for communication with the DC identified by `uuidDsa`.

consecutiveFailures: A `DWORD` that corresponds to `cConsecutiveFailures` in `REPS_FROM`. It is the number of consecutive failures during replication from the DC identified by `uuidDsa`.

timeLastSuccess: A `DWORD` that corresponds to `timeLastSuccess` in `REPS_FROM`. It is the time of the last successful replication from the DC identified by `uuidDsa`.

timeLastAttempt: A `DWORD` that corresponds to `timeLastAttempt` in `REPS_FROM`. It is the time of the last replication attempt with the DC identified by `uuidDsa`.

resultLastAttempt: The result of the last replication attempt with the DC identified by `uuidDsa`.

pasData: A `PAS_DATA` value that corresponds to **cbPasDataOffset** in `REPS_FROM`. Contains the list of attributes (being added to the partial attribute set for the NC on this DC) that are being requested from the DC identified by `uuidDsa` as part of a PAS replication cycle.

When converting a `RepsFrom` to a `REPS_FROM`, assign zeros to all unused fields of `REPS_FROM`. If `naDsa` is an empty string, set `cbOtherDra` to 0 and `cbOtherDraOffset` to 0. If `pasData.pas.cAttrs` is 0, set `cbPasDataOffset` to 0.

5.173 `repsTo`, `RepsTo`

The nonreplicated, multivalued attribute `repsTo` is an optional attribute on the root object of every NC replica. It is stored as the structure `REPS_TO`.

The abstract type `RepsTo` simplifies the specification of methods that read and write the attribute `repsTo`. Reading the attribute `repsTo` produces one or more `RepsTo` values using the conversions from

REPS_TO specified below. Writing a RepsTo value to the attribute repsTo stores a REPS_TO using the reverse conversion.

The type RepsTo is a tuple with the following fields:

naDsa: A NetworkAddress that corresponds to cbOtherDraOffset and cbOtherDra in REPS_TO. This is the NetworkAddress of a DC.

uuidDsa: A GUID that corresponds to uuidDsaObj in REPS_TO. This is the DSA GUID of the target DC.

options: Bit flags chosen from DRS_OPTIONS that correspond to ulReplicaFlags in REPS_TO. This set contains the DRS_WRIT_REP value if this replica is writable.

The following additional values are preserved if they are present when reading ulReplicaFlags, but are otherwise ignored by the protocol:

- DRS_INIT_SYNC: The replica must be replicated from the DC identified by uuidDsa when the DC hosting this replica is started.
- DRS_PER_SYNC: Periodically replicate the NC replica from the DC identified by uuidDsa, as defined by the periodic replication schedule.
- DRS_MAIL_REP: Replicate the NC replica from the DC identified by uuidDsa via SMTP (see [MS-SRPL]).
- DRS_DISABLE_AUTO_SYNC: Disable notification-based replication of the NC replica from the DC identified by uuidDsa.
- DRS_DISABLE_PERIODIC_SYNC: Disable periodic replication of the NC replica from the DC identified by uuidDsa.
- DRS_USE_COMPRESSION: Replication response messages sent along this communication path **should** be compressed.
- DRS_TWOWAY_SYNC: At the end of a replication cycle, replication **should** be triggered in the opposite direction.
- DRS_NONGC_RO_REP: Replicate a read-only full replica. Not a writable or partial replica.
- DRS_FULL_SYNC_IN_PROGRESS: When the flag DRS_FULL_SYNC_NOW is received in a call to IDL_DRSReplicaSync, the flag DRS_FULL_SYNC_IN_PROGRESS is sent in the associated calls to IDL_DRSGetNCChanges until the replication cycle completes. This flag is ignored by the server.
- DRS_FULL_SYNC_PACKET: Replicate all updates in the replication request, even those that would normally be filtered.
- DRS_REF_GCSPN: Requests that the server add an entry to repsTo for the client on the root object of the NC replica that is being replicated. When repsTo is set using this flag, the notifying client DC contacts the server DC using the service principal name that begins with "GC" (section 2.2.3.2).
- DRS_NEVER_SYNCED: There is no successfully completed replication from this source server.
- DRS_SPECIAL_SECRET_PROCESSING: Do not replicate attribute values of attributes that contain secret data.
- DRS_PREEMPTED: The replication attempt is preempted by a higher priority replication request.
- DRS_NEVER_NOTIFY: Do not send update notifications.
- DRS_SYNC_PAS: Expand the partial attribute set of the partial replica.

resultLastAttempt: A DWORD that corresponds to ulResultLastAttempt in REPS_TO. Contains the result of the last attempt to send a replication notification to the DC identified by uuidDsa. It has a value of 0 if the last notification was sent successfully and a Windows error code otherwise.

consecutiveFailures: A DWORD that corresponds to cConsecutiveFailures in REPS_TO. Contains the number of unsuccessful consecutive attempts to send a replication notification to the DC identified by uuidDsa.

timeLastAttempt: A DSTIME that corresponds to timeLastAttempt in REPS_TO. Contains the last time when an attempt was made to send a replication notification to the DC identified by uuidDsa, or 0 if no attempt has been made.

timeLastSuccess: A DSTIME that corresponds to timeLastSuccess in REPS_TO. Contains the time when the last successful replication notification to the DC identified by uuidDsa was sent, or 0 if no replication notification has been successfully sent.

When converting a RepsTo to a REPS_TO, assign zeros to all unused fields of REPS_TO. If naDsa is an empty string, set cbOtherDra to 0 and cbOtherDraOffset to 0.

5.174 Rid

Rid is an abstract type that consists of an integer that represents the relative identifier (RID) component of a SID, as specified in [MS-DTYP] section 2.4.2.

5.175 Right

Right is an abstract type that represents an access right (for example, RIGHT_DS_WRITE_PROPERTY) or a control access right (for example, DS-Replication-Manage-Topology) on an object. The complete set of access right values is specified in [MS-ADTS] section 5.1.3.2, and the complete set of control access right values is specified in [MS-ADTS] section 5.1.3.2.1.

Note Since access rights and control access rights are non-overlapping sets, there is no ambiguity in having one type represent rights of both kinds.

5.176 RIGHT Values

The valid access rights used in **ACLs** in security descriptors are defined in [MS-ADTS] section 5.1.3.2.

5.177 RPCClientContexts

RPCClientContexts is an abstract type that is a sequence of tuples, one tuple per RPC context for an incoming RPC session to the DC. Each tuple contains the following fields:

- **BindingContext:** A ULONGLONG that contains a unique identifier for the context.
- **RefCount:** An integer that is used to reference count the number of references to the context.
- **IsBound:** A Boolean value that is true if IDL_DRSUnbind has not yet been called on the RPC context represented by this tuple, and false otherwise.
- **UUIDClient:** A GUID that contains the value that was passed in as the puuidClientDsa argument of IDL_DRSSBind while establishing the context.
- **TimeLastUsed:** A FILETIME that contains the last time a session corresponding to the context was used in an RPC method call.
- **IPAddress:** A DWORD that contains the IPv4 address of the client associated with the context.

- **PID:** An integer that contains the process ID passed in by the client as the `pextClient` argument of `IDL_DRSSBind` while establishing the context.

The global variable `dc` for a DC has an associated field `dc.rpcClientContexts`, which maintains the DC's `RPCClientContexts` state.

5.178 `RPCOutgoingContexts`

`RPCOutgoingContexts` is an abstract type that is a sequence of tuples, one tuple per RPC context for an outgoing RPC session from the DC. Each tuple contains the following fields:

- **ServerName:** A *unicodestring* (section 3.4.3) that contains the host name of the server.
- **IsBound:** A Boolean value that is true if `IDL_DRSSUnbind` has not yet been called on the RPC context represented by this tuple, and false otherwise.
- **HandleFromCache:** A Boolean value that is true if the context handle was retrieved from the cache, and false otherwise.
- **HandleInCache:** A Boolean value that is true if the context handle is still in the cache, and false otherwise.
- **ThreadId:** An integer that contains the thread ID of the thread that is using the context.
- **BindingTimeOut:** An integer. If the context is set to be canceled, then this field contains the time-out, in minutes.
- **CreateTime:** A `DSTIME` value that contains the time when the context was created.
- **CallType:** An integer that indicates the type of RPC call that the DC is waiting on. See `DS_REPL_SERVER_OUTGOING_CALL` for possible values.

The global variable `dc` for a DC has an associated field `dc.rpcOutgoingContexts`, which maintains the DC's `RPCOutgoingContexts` state.

5.179 `sAMAccountType` Values

`sAMAccountType` values describe information about various account type objects. See [MS-SAMR] section 2.2.1.9 for descriptions of these values.

Symbolic name	Value
<code>SAM_GROUP_OBJECT</code>	0x10000000
<code>SAM_NON_SECURITY_GROUP_OBJECT</code>	0x10000001
<code>SAM_ALIAS_OBJECT</code>	0x20000000
<code>SAM_NON_SECURITY_ALIAS_OBJECT</code>	0x20000001
<code>SAM_USER_OBJECT</code>	0x30000000
<code>SAM_MACHINE_ACCOUNT</code>	0x30000001
<code>SAM_TRUST_ACCOUNT</code>	0x30000002

Only the values used by this protocol are contained in this table.

5.180 SCHEMA_PREFIX_TABLE

The SCHEMA_PREFIX_TABLE structure defines the concrete type for a table to map ATTRTYP values to and from OIDs.

```
typedef struct {
    [range(0,1048576)] DWORD PrefixCount;
    [size_is(PrefixCount)] PrefixTableEntry* pPrefixEntry;
} SCHEMA_PREFIX_TABLE;
```

PrefixCount: The number of items in the **pPrefixEntry** array.

pPrefixEntry: An array of PrefixTableEntry items in the table.

5.181 SchemaNC

```
procedure SchemaNC(): DSName
```

The SchemaNC procedure returns the DSName of dc.schemaNC.

5.182 SchemaObj

```
procedure SchemaObj(att: ATTRTYP): DSName
```

Given the ATTRTYP *att* of an attributeSchema or classSchema object on this DC, the SchemaObj procedure returns the dsname of the attributeSchema or the classSchema object.

```
return select one o from children SchemaNC()
where AttrtypFromSchemaObj(o) = att
```

5.183 ServerExtensions

```
procedure ServerExtensions(hDrs: DRS_HANDLE): DRS_EXTENSIONS_INT
```

The ServerExtensions procedure returns the server extensions presented in the IDL_DRSBind call that created *hDrs*. Any fields not specified by the server in the *ppextServer* parameter of IDL_DRSBind are set to 0.

5.184 SID

A concrete type for the Windows NT operating system **SID** structure, as specified in [MS-DTYP] section 2.4.2.

5.185 SidFromStringSid

```
procedure SidFromStringSid(stringSID: unicodestring): SID
```

The SidFromStringSid procedure converts the string representation of a SID specified in *stringSID* (for example, S-1-5-3) to the SID type, as specified in [MS-DTYP] section 2.4.2. See [MS-DTYP] section 2.4.2.1 for the string representation of a SID.

5.186 StampLessThanOrEqualToUTD

```
procedure StampLessThanOrEqualToUTD(  
    stamp: AttributeStamp,  
    utd: UPTODATE_VECTOR_V1_EXT) : boolean
```

Informative summary of behavior: The StampLessThanOrEqualToUTD procedure is used to determine if an attribute has already replicated (or should have already replicated).

```
i: integer  
  
for i := 0 to utd.cNumCursors - 1  
    if utd.rgCursors[i].uuidDsa = stamp.uuidOriginating) and  
        (utd.rgCursors[i].usn >= stamp.usnOriginating) then  
        return true  
    endif  
endfor  
return false
```

5.187 StartsWith

```
procedure StartsWith(s: unicodestring, p: unicodestring): boolean
```

The StartsWith procedure returns true if the string *p* is a prefix of string *s* and returns false otherwise.

5.188 StringSidFromSid

```
procedure StringSidFromSid(sid: SID): unicodestring
```

The StringSidFromSid procedure converts a binary SID specified in *sid* to the string representation of a SID (for example, S-1-5-3). See [MS-DTYP] section 2.4.2.1 for the string representation of a SID.

5.189 SubString

```
procedure SubString(  
    s: unicodestring, start: integer, length: integer): unicodestring
```

The SubString procedure returns the portion of *s* beginning at the zero-based index *start* and containing *length* characters. If *start* is less than zero or greater than *s.length-1*, returns null. If *length* + *start* is greater than *s.length*, then *length* is treated as if it equals *s.length - start*.

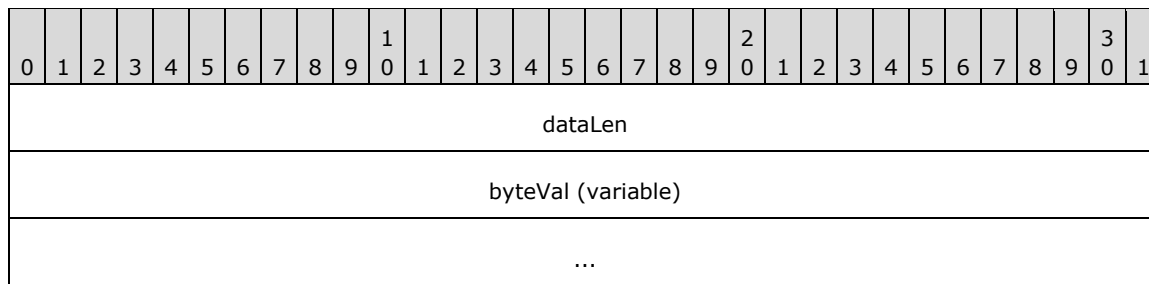
5.190 Syntax

```
procedure Syntax(attr: ATTRTYP): AttributeSyntax
```

The Syntax procedure returns the syntax of the attribute *attr*.

5.191 SYNTAX_ADDRESS

The SYNTAX_ADDRESS packet is the concrete type for a sequence of bytes or Unicode characters.



dataLen (4 bytes): The size of the entire structure (including this field), in bytes.

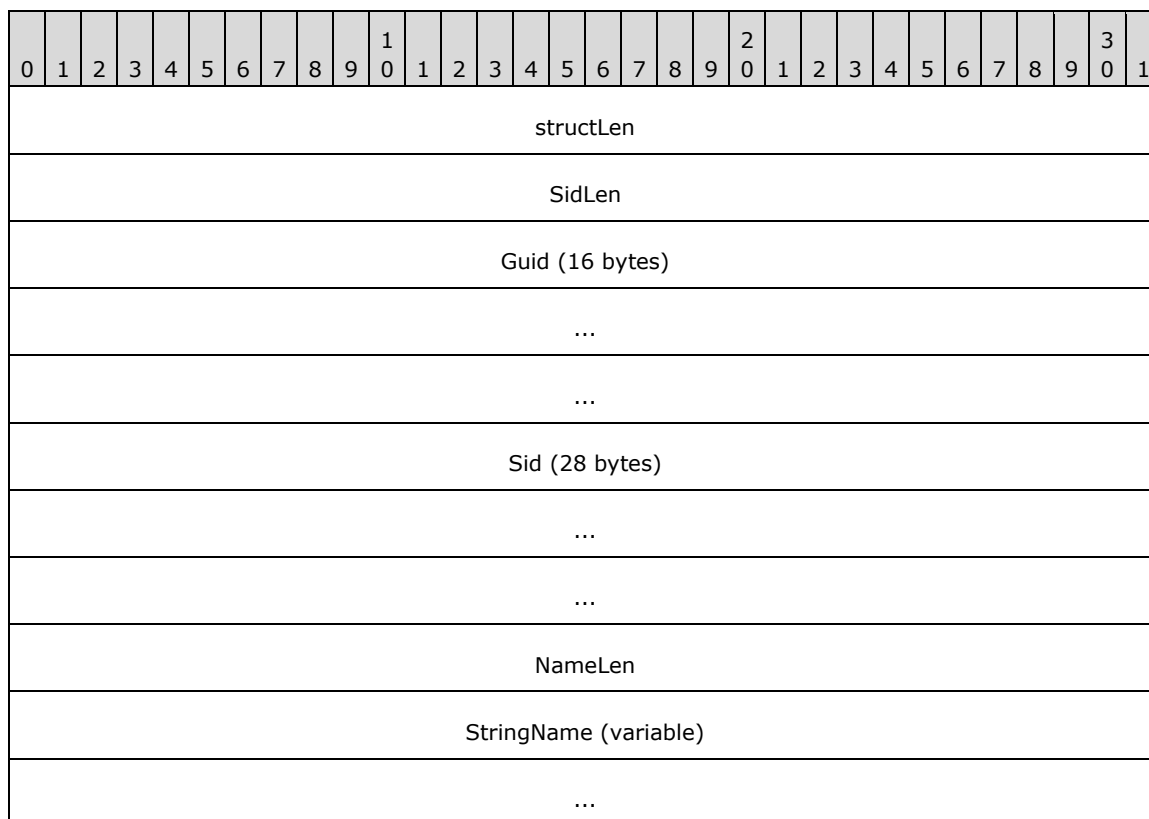
byteVal (variable): The byte or character data.

The following structure definition shows an alternative representation of this data type.

```
typedef struct {
    DWORD dataLen;
    union {
        BYTE byteVal[];
        wchar_t uVal[];
    };
} SYNTAX_ADDRESS;
```

5.192 SYNTAX_DISTNAME_BINARY

The SYNTAX_DISTNAME_BINARY packet is the concrete type for a combination of a DSNAME and a binary or character data buffer.



Padding (variable)
...
dataLen
byteVal (variable)
...

structLen (4 bytes): The length of the structure, in bytes, up to and including the field StringName.

SidLen (4 bytes): The number of bytes in the Sid field used to represent the object's objectSid attribute value. Zero indicates that the SYNTAX_DISTNAME_BINARY does not identify the objectSid value of the directory object.

Guid (16 bytes): The value of the object's objectGUID attribute specified as a GUID structure, which is defined in [MS-DTYP] section 2.3.4. If the values for all fields in the GUID structure are zero, this indicates that the SYNTAX_DISTNAME_BINARY does not identify the objectGUID value of the directory object.

Sid (28 bytes): The value of the object's objectSid attribute, its security identifier specified as a SID structure, which is defined in [MS-DTYP] section 2.4.2. The size of this field is exactly 28 bytes, regardless of the value of SidLen, which specifies how many bytes in this field are used.

NameLen (4 bytes): The number of characters in the StringName field, not including the terminating null character, used to represent the object's distinguishedName attribute value. Zero indicates that the SYNTAX_DISTNAME_BINARY does not identify the distinguishedName value of the directory object.

StringName (variable): The null-terminated Unicode value of the object's distinguishedName attribute, as specified in [MS-ADTS] section 3.1.1.1.4. This field always contains at least one character: the terminating null character. Each Unicode value is encoded as 2 bytes. The byte ordering is little-endian.

Padding (variable): The padding (bytes with value zero) to align the field dataLen at a double word boundary.

dataLen (4 bytes): The length of the remaining structure, including this field, in bytes.

byteVal (variable): An array of bytes.

Note All fields have little-endian byte ordering.

The following structure definition shows an alternative representation of this data type.

```
typedef struct {
    DSNAME Name;
    SYNTAX_ADDRESS Data;
} SYNTAX_DISTNAME_BINARY;
```

5.193 systemFlags Values

The valid system flags used on directory objects are defined in [MS-ADTS] section 2.2.10.

5.194 UCHAR

A concrete type, as defined in [MS-DTYP] section 2.2.45. A UCHAR is an 8-bit, unsigned quantity.

5.195 ULARGE_INTEGER

ULARGE_INTEGER is a concrete type for a 64-bit, unsigned integer.

```
typedef struct {
    ULONGLONG QuadPart;
} ULARGE_INTEGER;
```

5.196 ULONG

A concrete type for a 32-bit, unsigned integer, as specified in [MS-DTYP] section 2.2.51.

5.197 ULONGLONG

A concrete type for a 64-bit, unsigned integer, as specified in [MS-DTYP] section 2.2.55.

5.198 UndeleteObject

```
procedure UndeleteObject(
    obj: DSNAME,
    attributesAndStamps: set of AttributeAndStamp)
```

For each *attStamp* in *attributesAndStamps*, the *UndeleteObject* procedure performs an originating update to *obj* such that the value(s) of *attStamp.attribute* do not change, but *AttrStamp(obj, attStamp.attribute).dwVersion > attStamp.stamp.dwVersion*. The effect of this update to *obj* is such that this DC's values for these attributes replicate out to other DCs and overwrite the updates with stamps in *attributesAndStamps*.

5.199 UnbindFromDSA()

```
procedure UnbindFromDSA(hDRS: DRS_HANDLE)
```

The *UnbindFromDSA* procedure closes the RPC connection that was established by the *BindToDSA* procedure.

5.200 UpdateRefs

```
procedure UpdateRefs(DRS_MSG_UPDREFS_V1 msgIn): ULONG
```

The *UpdateRefs* method implements the core functionality of *IDL_DRSUpdateRefs*, that is, adds or deletes a value from the *repsTo* of a specified NC replica.

```
err: DWORD
nc: DSName
rt: RepsTo
nc := msgIn.pNC^

/* If ulOptions contains DRS_ASYNC_OP, the server processes the request asynchronously.
if DRS_ASYNC_OP in msgIn.ulOptions then
    Asynchronous Processing: Initiate a logical thread of control
```

```

    to process the remainder of this request asynchronously
    return ERROR_SUCCESS
endif

/* If DRS_DEL_REF is specified, the return value is that associated with the DRS_DEL_REF
if DRS_DEL_REF in msgIn.ulOptions then
    rt := select one v from nc!repsTo where
        (v.naDsa = msgIn.pszDsaDest or
         v.uuidDsa = msgIn.uuidDsaObjDest)
    if rt = null then
        err := ERROR_DS_DRA_REF_NOT_FOUND
    else
        nc!repsTo := nc!repsTo - {rt}
        err := ERROR_SUCCESS
    endif
endif

/* If DRS_ADD_REF and DRS_DEL_REF are both specified, the return
* value is that associated with the DRS_ADD_REF. */
if DRS_ADD_REF in msgIn.ulOptions then
    rt := select one v from nc!repsTo where
        (v.naDsa = msgIn.pszDsaDest or
         v.uuidDsa = msgIn.uuidDsaObjDest)
    if rt = null then
        rt.naDsa := msgIn.pszDsaDest
        rt.uuidDsa := msgIn.uuidDsaObjDest
        rt.options := msgIn.ulOptions ∩ {DRS_WRIT_REF}
        rt.timeLastAttempt := 0
        rt.timeLastSuccess := current time
        rt.consecutiveFailures := 0
        rt.resultLastAttempt := 0
        nc!repsTo := nc!repsTo + {rt}
        err := ERROR_SUCCESS
    else
        err := ERROR_DS_DRA_REF_ALREADY_EXISTS
    endif
endif
return err

```

5.201 UPTODATE_CURSOR_V1

The UPTODATE_CURSOR_V1 structure is a concrete type for the replication state relative to a given DC.

```

typedef struct {
    UUID uuidDsa;
    USN usnHighPropUpdate;
} UPTODATE_CURSOR_V1;

```

uuidDsa: The invocationId of the DC performing the update.

usnHighPropUpdate: The USN of the update on the updating DC.

A cursor *c* with *c.uuidDsa* = *x* and *c.usnHighPropUpdate* = *y* indicates a replication state that includes all changes originated by DC *x* at USN less than or equal to *y*.

5.202 UPTODATE_CURSOR_V2

The UPTODATE_CURSOR_V2 structure defines a concrete type for the replication state relative to a given DC.

```

typedef struct {

```

```

    UUID uuidDsa;
    USN usnHighPropUpdate;
    DSTIME timeLastSyncSuccess;
} UPTODATE_CURSOR_V2;

```

uuidDsa: The invocationId of the DC performing the update.

usnHighPropUpdate: The USN of the update on the updating DC.

timeLastSyncSuccess: The time at which the last successful replication occurred from the DC identified by **uuidDsa**; for replication latency reporting only.

A cursor *c* with *c.uuidDsa* = *x* and *c.usnHighPropUpdate* = *y* indicates a replication state that includes all changes originated by DC *x* at USN less than or equal to *y*.

5.203 UPTODATE_VECTOR_V1_EXT

The UPTODATE_VECTOR_V1_EXT structure defines a concrete type for the replication state relative to a set of DCs.

```

typedef struct {
    DWORD dwVersion;
    DWORD dwReserved1;
    [range(0,1048576)] DWORD cNumCursors;
    DWORD dwReserved2;
    [size_is(cNumCursors)] UPTODATE_CURSOR_V1 rgCursors[];
} UPTODATE_VECTOR_V1_EXT;

```

dwVersion: The version of this structure; MUST be 1.

dwReserved1: Unused. MUST be 0 and ignored.

cNumCursors: The number of items in the **rgCursors** array.

dwReserved2: Unused. MUST be 0 and ignored.

rgCursors: An array of UPTODATE_CURSOR_V1. The items in this field MUST be sorted in increasing order of the **uuidDsa** field.

5.204 UPTODATE_VECTOR_V2_EXT

The UPTODATE_VECTOR_V2_EXT structure defines a concrete type for the replication state relative to a set of DCs.

```

typedef struct {
    DWORD dwVersion;
    DWORD dwReserved1;
    [range(0,1048576)] DWORD cNumCursors;
    DWORD dwReserved2;
    [size_is(cNumCursors)] UPTODATE_CURSOR_V2 rgCursors[];
} UPTODATE_VECTOR_V2_EXT;

```

dwVersion: The version of this structure; MUST be 2.

dwReserved1: Unused. MUST be 0 and ignored.

cNumCursors: The number of items in the **rgCursors** array.

dwReserved2: Unused. MUST be 0 and ignored.

rgCursors: An array of UPTODATE_CURSOR_V2. The items in this field MUST be sorted in increasing order of the **uuidDsa** field.

5.205 userAccountControl Bits

The userAccountControl bits are bit flags that describe various qualities of a security account. The bit flags are presented below in little-endian byte order.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31		
X	X	X	L O	X	X	A D	X	X	X	S T	W T	I D	X	N A	D A	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	P S	X	X

X: Unused. MUST be zero and ignored.

AD (ADS_UF_ACCOUNTDISABLE, 0x00000002): The account is disabled.

LO (ADS_UF_LOCKOUT, 0x00000010): The account is temporarily locked out.

DA (ADS_UF_TEMP_DUPLICATE_ACCOUNT, 0x00000100): This is an account for a user whose primary account is in another domain.

NA (ADS_UF_NORMAL_ACCOUNT, 0x00000200): The default account type that represents a typical user.

ID (ADS_UF_INTERDOMAIN_TRUST_ACCOUNT, 0x00000800): The account for a domain-to-domain trust.

WT (ADS_UF_WORKSTATION_ACCOUNT, 0x00001000): The computer account for a computer that is a member of this domain.

ST (ADS_UF_SERVER_TRUST_ACCOUNT, 0x00002000): The computer account for a DC.

PS (ADS_UF_PARTIAL_SECRETS_ACCOUNT, 0x04000000): The computer account for an RODC.

5.206 UserNameFromNT4AccountName

```
procedure UserNameFromNT4AccountName(  
    nt4AccountName: unicodestring): unicodestring
```

If *nt4AccountName* is a name in Windows NT 4.0 account name format, that is, two components separated by a backslash (for example, "DOMAIN\username"), the `UserNameFromNT4AccountName` procedure returns the second component (the user name, or "username" in this example). If the *nt4AccountName* is not in this format, null is returned.

5.207 USHORT

A concrete type for a 16-bit, unsigned integer, as specified in [MS-DTYP] section 2.2.58.

5.208 USN

USN is a concrete type for the variable *usn* specified in [MS-ADTS] section 3.1.1.1.9 and present in the dc global variable.

This type is declared as follows:

```
typedef LONGLONG USN;
```

5.209 USN_VECTOR

The USN_VECTOR structure defines a concrete type for the cookie (section 1.3.2) used to pass state between calls to IDL_DRSGetNCChanges.

```
typedef struct {
    USN usnHighObjUpdate;
    USN usnReserved;
    USN usnHighPropUpdate;
} USN_VECTOR;
```

usnHighObjUpdate: A USN.

usnReserved: A USN.

usnHighPropUpdate: A USN.

The USN_VECTOR type, as shown, is used in the DRS IDL. However, only the size of USN_VECTOR (24 bytes) and the representation of its null value (24 zero bytes) are standardized for interoperability.

5.210 UUID

UUID is a type that is equivalent to the GUID type.

5.211 ValidateDRSDemotionInput

```
procedure ValidateDRSDemotionInput(hDrs: DRS_HANDLE, opnum: integer)
```

Informative summary of behavior: The ValidateDRSDemotionInput procedure performs certain checks based on the input and throws an exception, if needed.

The server MUST raise an ERROR_INVALID_PARAMETER exception when *opnum* = 25 and *IsAdlds()* == false.

The server SHOULD raise an ERROR_INVALID_PARAMETER exception when *opnum* = 26 and *IsAdlds()* == false.<52>

The server MUST raise an ERROR_INVALID_PARAMETER exception when *opnum* = 27 and *IsAdlds()* == false.

5.212 ValidateDRSInput

```
procedure ValidateDRSInput(hDrs: DRS_HANDLE, opnum: integer)
```

Informative summary of behavior: The ValidateDRSInput procedure performs certain checks based on the input and throws an exception, if needed.

```
if opnum = 0 then
    return
endif
```

```

if (hDrs = null) then
    raise ERROR_INVALID_HANDLE exception
endif

if (ClientUUID(hDrs) # NTDSAPI_CLIENT_GUID) and
    (IsServerExtensionsChanged(ServerExtensions(hDrs)) and
    opnum # 1
then
    raise ERROR_DS_DRS_EXTENSIONS_CHANGED exception
endif

if (ClientUUID(hDrs) # NTDSAPI_CLIENT_GUID) and
    (ClientExtensions(hDrs).dwReplEpoch # DSAObj(!msDS-ReplicationEpoch) and
    opnum # 1
then
    raise ERROR_DS_DIFFERENT_REPL_EPOCHS exception
endif

if IsAdlds() and
    (opnum = 9 or /*IDL_DRSGetMemberships*/
    opnum = 10 or /*IDL_DRSInterDomainMove*/
    opnum = 11 or /*IDL_DRSGetNT4ChangeLog*/
    opnum = 13 or /*IDL_DRSWriteSPN*/
    opnum = 15 or /*IDL_DRSRemoveDsDomain*/
    opnum = 16 or /*IDL_DRSDomainControllerInfo*/
    opnum = 20 or /*IDL_DRSAddSidHistory*/
    opnum = 21 or /*IDL_DRSGetMemberships2*/
    opnum = 24 /*IDL_DRSQuerySitesByCost*/)
then
    raise ERROR_INVALID_PARAMETER exception
endif

if AmIRODC() and
    (opnum = 3 or /*IDL_DRSGetNCChanges*/
    opnum = 10 or /*IDL_DRSInterDomainMove*/
    opnum = 11 or /*IDL_DRSGetNT4ChangeLog*/
    opnum = 14 or /*IDL_DRSRemoveDsServer*/
    opnum = 15 or /*IDL_DRSRemoveDsDomain*/
    opnum = 17 or /*IDL_DRSAddEntry*/
    opnum = 20 /*IDL_DRSAddSidHistory*/)
then
    raise ERROR_INVALID_PARAMETER exception
endif

ValidateDRSDemotionInput(hDrs, opnum)

```

5.213 Value

Value is an abstract type for attribute values used for abstract value representation (see section 5.16.2).

5.214 VALUE_META_DATA_EXT_V1

The VALUE_META_DATA_EXT_V1 structure defines a concrete type for the stamp of a link value.

```

typedef struct {
    DSTIME timeCreated;
    PROPERTY_META_DATA_EXT MetaData;
} VALUE_META_DATA_EXT_V1;

```

timeCreated: The date and time at which the first originating update was made.

MetaData: The remainder of the stamp; has the same PROPERTY_META_DATA_EXT type as used for the stamp of an attribute.

5.215 VALUE_META_DATA_EXT_V3

~~Note: All of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it as an aid to the reader.~~

The VALUE_META_DATA_EXT_V3 structure defines a concrete type for the stamp of a link value. This structure is a superset of the VALUE_META_DATA_EXT_V1 structure.

```
typedef struct {
    DSTIME timeCreated;
    PROPERTY_META_DATA_EXT MetaData;
    DWORD unused1;
    DWORD unused2;
    DWORD unused3;
    DSTIME timeExpired;
} VALUE_META_DATA_EXT_V3;
```

timeCreated: The date and time at which the first originating update was made.

MetaData: The remainder of the stamp; has the same PROPERTY_META_DATA_EXT type as used for the stamp of an attribute.

~~**timeCreated:** The date and time at which the first originating update was made.~~

unused1: Unused. MUST be 0 and ignored

unused2: Unused. MUST be 0 and ignored

unused3: Unused. MUST be 0 and ignored

timeExpired: The date and time at which the link value ~~should~~must be removed from the state of the DC.

5.216 VALUE_META_DATA_EXT_NATIVE

~~Note: All of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it as an aid to the reader.~~

The VALUE_META_DATA_EXT_NATIVE structure is an alias for the **VALUE_META_DATA_EXT_V3** data structure.

5.217 ValueFromATTRVAL

```
procedure ValueFromATTRVAL(
    a: ATTRVAL, s: Syntax, t: PrefixTable) : Value
```

The ValueFromATTRVAL procedure converts a value of syntax *s* expressed as a concrete ATTRVAL *a* into the abstract Value encoding, using the prefix table represented by *t*.

See section 5.16.3 for the specification of this procedure.

5.218 WCHAR

A concrete type, as specified in [MS-DTYP] section 2.2.60. A WCHAR is a 16-bit, unsigned integer in little-endian byte order that is used to store a double-byte Unicode character. A WCHAR * is a pointer to a null-terminated Unicode string.

6 Security

6.1 Security Considerations for Implementers

General security considerations for this protocol are specified in section 2.2. Security considerations for an individual method are specified in the subsection of section 4 that describes the behavior of that method.

6.2 Index of Security Parameters

Security parameter	Section
SPNs for DC-to-DC authentication	Section 2.2.3.2
SPNs for client-to-DC authentication	Section 2.2.4.2

7 Appendix A: Full IDL

For ease of implementation, the full IDL is provided below, where "ms-dtyp.idl" refers to the IDL found in [MS-DTYP] Appendix A.

```
import "ms-dtyp.idl";
[
    uuid (e3514235-4b06-11d1-ab04-00c04fc2dcd2), version(4.0),
    pointer_default (unique)
]
interface drsuapi
{

typedef LONGLONG DSTIME;

typedef [context_handle] void * DRS_HANDLE;

typedef struct {
    char Data[28];
} NT4SID;

typedef struct {
    unsigned long structLen;
    unsigned long SidLen;
    GUID Guid;
    NT4SID Sid;
    unsigned long NameLen;
    [range(0, 10485761)] [size_is(NameLen + 1)] WCHAR StringName[];
} DSNAME;

typedef LONGLONG USN;

typedef struct {
    USN usnHighObjUpdate;
    USN usnReserved;
    USN usnHighPropUpdate;
} USN_VECTOR;

typedef struct {
    UUID uuidDsa;
    USN usnHighPropUpdate;
} UPTODATE_CURSOR_V1;

typedef struct {
    DWORD dwVersion;
    DWORD dwReserved1;
    [range(0,1048576)] DWORD cNumCursors;
    DWORD dwReserved2;
    [size_is(cNumCursors)] UPTODATE_CURSOR_V1 rgCursors[];
} UPTODATE_VECTOR_V1_EXT;

typedef struct {
    [range(0,10000)] unsigned int length;
    [size_is(length)] BYTE *elements;
} OID_t;

typedef struct {
    unsigned long ndx;
    OID_t prefix;
} PrefixTableEntry;

typedef struct {
    [range(0,1048576)] DWORD PrefixCount;
    [size_is(PrefixCount)] PrefixTableEntry *pPrefixEntry;
} SCHEMA_PREFIX_TABLE;

typedef ULONG ATTRTYP;
```

```

typedef struct {
    DWORD dwVersion;
    DWORD dwReserved1;
    [range(1,1048576)] DWORD cAttrs;
    [size_is(cAttrs)] ATTRTYP rgPartialAttr[];
} PARTIAL_ATTR_VECTOR_V1_EXT;

typedef struct {
    [range(1,256)] unsigned long mtx_namelen;
    [size_is(mtx_namelen)] char mtx_name[];
} MTX_ADDR;

typedef struct {
    [range(0,26214400)] ULONG valLen;
    [size_is(valLen)] UCHAR *pVal;
} ATTRVAL;

typedef struct {
    [range(0, 10485760)] ULONG valCount;
    [size_is(valCount)] ATTRVAL *pAVal;
} ATTRVALBLOCK;

typedef struct {
    ATTRTYP attrTyp;
    ATTRVALBLOCK AttrVal;
} ATTR;

typedef struct {
    [range(0, 1048576)] ULONG attrCount;
    [size_is(attrCount)] ATTR *pAttr;
} ATTRBLOCK;

typedef struct {
    DSNAME *pName;
    unsigned long ulFlags;
    ATTRBLOCK AttrBlock;
} ENTINF;

typedef struct {
    DWORD dwVersion;
    DSTIME timeChanged;
    UUID uuidDsaOriginating;
    USN usnOriginating;
} PROPERTY_META_DATA_EXT;

typedef struct {
    [range(0,1048576)] DWORD cNumProps;
    [size_is(cNumProps)] PROPERTY_META_DATA_EXT rgMetaData[];
} PROPERTY_META_DATA_EXT_VECTOR;

typedef struct REPLENTINFLIST {
    struct REPLENTINFLIST * pNextEntInf;
    ENTINF Entinf;
    BOOL fIsNCPrefix;
    UUID* pParentGuid;
    PROPERTY_META_DATA_EXT_VECTOR* pMetaDataExt;
} REPLENTINFLIST;

typedef struct {
    UUID uuidDsa;
    USN usnHighPropUpdate;
    DSTIME timeLastSyncSuccess;
} UPTODATE_CURSOR_V2;

typedef struct {
    DWORD dwVersion;
    DWORD dwReserved1;
    [range(0,1048576)] DWORD cNumCursors;
    DWORD dwReserved2;
}

```

```

    [size_is(cNumCursors)] UPTODATE_CURSOR_V2 rgCursors[];
} UPTODATE_VECTOR_V2_EXT;

typedef struct {
    DSTIME timeCreated;
    PROPERTY_META_DATA_EXT MetaData;
} VALUE_META_DATA_EXT_V1;

typedef struct {
    DSTIME timeCreated;
    PROPERTY_META_DATA_EXT MetaData;
    DWORD unused1;
    DWORD unused2;
    DWORD unused3;
    DSTIME timeExpired;
} VALUE_META_DATA_EXT_V3;

typedef struct {
    DSNAME *pObject;
    ATTRTYP attrTyp;
    ATTRVAL Aval;
    BOOL fIsPresent;
    VALUE_META_DATA_EXT_V1 MetaData;
} REPLVALINF_V1;

typedef struct {
    DSNAME *pObject;
    ATTRTYP attrTyp;
    ATTRVAL Aval;
    BOOL fIsPresent;
    VALUE_META_DATA_EXT_V3 MetaData;
} REPLVALINF_V3;

typedef struct {
    UCHAR rgTimes[84];
} REPLTIMES;

typedef struct {
    DWORD status;
    [string,unique] WCHAR *pDomain;
    [string,unique] WCHAR *pName;
} DS_NAME_RESULT_ITEMW, *PDS_NAME_RESULT_ITEMW;

typedef struct {
    DWORD cItems;
    [size_is(cItems)] PDS_NAME_RESULT_ITEMW rItems;
} DS_NAME_RESULTW, *PDS_NAME_RESULTW;

typedef struct {
    [string,unique] WCHAR *NetbiosName;
    [string,unique] WCHAR *DnsHostName;
    [string,unique] WCHAR *SiteName;
    [string,unique] WCHAR *ComputerObjectName;
    [string,unique] WCHAR *ServerObjectName;
    BOOL fIsPdc;
    BOOL fDsEnabled;
} DS_DOMAIN_CONTROLLER_INFO_1W;

typedef struct {
    [string,unique] WCHAR *NetbiosName;
    [string,unique] WCHAR *DnsHostName;
    [string,unique] WCHAR *SiteName;
    [string,unique] WCHAR *SiteObjectName;
    [string,unique] WCHAR *ComputerObjectName;
    [string,unique] WCHAR *ServerObjectName;
    [string,unique] WCHAR *NtdsDsaObjectName;
    BOOL fIsPdc;
    BOOL fDsEnabled;
    BOOL fIsGc;
    GUID SiteObjectGuid;
}

```

```

    GUID ComputerObjectGuid;
    GUID ServerObjectGuid;
    GUID NtdsDsaObjectGuid;
} DS_DOMAIN_CONTROLLER_INFO_2W;

typedef struct {
    [string, unique] WCHAR* NetbiosName;
    [string, unique] WCHAR* DnsHostName;
    [string, unique] WCHAR* SiteName;
    [string, unique] WCHAR* SiteObjectName;
    [string, unique] WCHAR* ComputerObjectName;
    [string, unique] WCHAR* ServerObjectName;
    [string, unique] WCHAR* NtdsDsaObjectName;
    BOOL fIsPdc;
    BOOL fDsEnabled;
    BOOL fIsGc;
    BOOL fIsRdc;
    GUID SiteObjectGuid;
    GUID ComputerObjectGuid;
    GUID ServerObjectGuid;
    GUID NtdsDsaObjectGuid;
} DS_DOMAIN_CONTROLLER_INFO_3W;

typedef struct {
    DWORD IPAddress;
    DWORD NotificationCount;
    DWORD secTimeConnected;
    DWORD Flags;
    DWORD TotalRequests;
    DWORD Reserved1;
    [string,unique] WCHAR *UserName;
} DS_DOMAIN_CONTROLLER_INFO_FFFFFFFFW;

typedef struct ENTINFLIST {
    struct ENTINFLIST *pNextEntInf;
    ENTINF Entinf;
} ENTINFLIST;

typedef struct {
    DWORD dsid;
    DWORD extendedErr;
    DWORD extendedData;
    USHORT problem;
    ATTRTYP type;
    BOOL valReturned;
    ATTRVAL Val;
} INTFORMPROB_DRS_WIRE_V1;

typedef struct _PROBLEMLIST_DRS_WIRE_V1 {
    struct _PROBLEMLIST_DRS_WIRE_V1 *pNextProblem;
    INTFORMPROB_DRS_WIRE_V1 intprob;
} PROBLEMLIST_DRS_WIRE_V1;

typedef struct {
    DSNAME *pObject;
    ULONG count;
    PROBLEMLIST_DRS_WIRE_V1 FirstProblem;
} ATRERR_DRS_WIRE_V1;

typedef struct {
    DWORD dsid;
    DWORD extendedErr;
    DWORD extendedData;
    USHORT problem;
    DSNAME *pMatched;
} NAMERR_DRS_WIRE_V1;

typedef struct {
    UCHAR nameRes;
    UCHAR unusedPad;
}

```

```

    USHORT nextRDN;
} NAMERESOP_DRS_WIRE_V1;

typedef struct _DSA_ADDRESS_LIST_DRS_WIRE_V1 {
    struct _DSA_ADDRESS_LIST_DRS_WIRE_V1 *pNextAddress;
    RPC_UNICODE_STRING *pAddress;
} DSA_ADDRESS_LIST_DRS_WIRE_V1;

typedef struct CONTREF_DRS_WIRE_V1 {
    DSNAME *pTarget;
    NAMERESOP_DRS_WIRE_V1 OpState;
    USHORT aliasRDN;
    USHORT RDNsInternal;
    USHORT refType;
    USHORT count;
    DSA_ADDRESS_LIST_DRS_WIRE_V1 *pDAL;
    struct CONTREF_DRS_WIRE_V1 *pNextContRef;
    BOOL bNewChoice;
    UCHAR choice;
} CONTREF_DRS_WIRE_V1;

typedef struct {
    DWORD dsid;
    DWORD extendedErr;
    DWORD extendedData;
    CONTREF_DRS_WIRE_V1 Refer;
} REFERR_DRS_WIRE_V1;

typedef struct {
    DWORD dsid;
    DWORD extendedErr;
    DWORD extendedData;
    USHORT problem;
} SECERR_DRS_WIRE_V1;

typedef struct {
    DWORD dsid;
    DWORD extendedErr;
    DWORD extendedData;
    USHORT problem;
} SVCERR_DRS_WIRE_V1;

typedef struct {
    DWORD dsid;
    DWORD extendedErr;
    DWORD extendedData;
    USHORT problem;
} UPDERR_DRS_WIRE_V1;

typedef struct {
    DWORD dsid;
    DWORD extendedErr;
    DWORD extendedData;
    USHORT problem;
} SYSERR_DRS_WIRE_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] ATRERR_DRS_WIRE_V1 AtrErr;
    [case(2)] NAMEERR_DRS_WIRE_V1 NamErr;
    [case(3)] REFERR_DRS_WIRE_V1 RefErr;
    [case(4)] SECERR_DRS_WIRE_V1 SecErr;
    [case(5)] SVCERR_DRS_WIRE_V1 SvcErr;
    [case(6)] UPDERR_DRS_WIRE_V1 UpdErr;
    [case(7)] SYSERR_DRS_WIRE_V1 SysErr;
} DIRERR_DRS_WIRE_V1;

typedef struct {
    [string] LPWSTR pszNamingContext;
    [string] LPWSTR pszSourceDsaDN;
    [string] LPWSTR pszSourceDsaAddress;
}

```



```

    [string] LPWSTR pszAsyncIntersiteTransportDN;
    DWORD dwReplicaFlags;
    DWORD dwReserved;
    UUID uuidNamingContextObjGuid;
    UUID uuidSourceDsaObjGuid;
    UUID uuidSourceDsaInvocationID;
    UUID uuidAsyncIntersiteTransportObjGuid;
    USN usnLastObjChangeSynced;
    USN usnAttributeFilter;
    FILETIME ftimeLastSyncSuccess;
    FILETIME ftimeLastSyncAttempt;
    DWORD dwLastSyncResult;
    DWORD cNumConsecutiveSyncFailures;
} DS_REPL_NEIGHBORW;

typedef struct {
    DWORD cNumNeighbors;
    DWORD dwReserved;
    [size_is(cNumNeighbors)] DS_REPL_NEIGHBORW rgNeighbor[];
} DS_REPL_NEIGHBORSW;

typedef struct {
    UUID uuidSourceDsaInvocationID;
    USN usnAttributeFilter;
} DS_REPL_CURSOR;

typedef struct {
    DWORD cNumCursors;
    DWORD dwReserved;
    [size_is(cNumCursors)] DS_REPL_CURSOR rgCursor[];
} DS_REPL_CURSORS;

typedef struct {
    [string] LPWSTR pszAttributeName;
    DWORD dwVersion;
    FILETIME ftimeLastOriginatingChange;
    UUID uuidLastOriginatingDsaInvocationID;
    USN usnOriginatingChange;
    USN usnLocalChange;
} DS_REPL_ATTR_META_DATA;

typedef struct {
    [string] LPWSTR pszDsaDN;
    UUID uuidDsaObjGuid;
    FILETIME ftimeFirstFailure;
    DWORD cNumFailures;
    DWORD dwLastResult;
} DS_REPL_KCC_DSA_FAILUREW;

typedef struct {
    DWORD cNumEntries;
    DWORD dwReserved;
    [size_is(cNumEntries)] DS_REPL_KCC_DSA_FAILUREW rgDsaFailure[];
} DS_REPL_KCC_DSA_FAILURESW;

typedef struct {
    DWORD cNumEntries;
    DWORD dwReserved;
    [size_is(cNumEntries)] DS_REPL_ATTR_META_DATA rgMetaData[];
} DS_REPL_OBJ_META_DATA;

typedef enum {
    DS_REPL_OP_TYPE_SYNC = 0,
    DS_REPL_OP_TYPE_ADD,
    DS_REPL_OP_TYPE_DELETE,
    DS_REPL_OP_TYPE_MODIFY,
    DS_REPL_OP_TYPE_UPDATE_REFS
} DS_REPL_OP_TYPE;

typedef struct {

```

```

    FILETIME ftimeEnqueued;
    ULONG ulSerialNumber;
    ULONG ulPriority;
    DS_REPL_OP_TYPE OpType;
    ULONG ulOptions;
    [string] LPWSTR pszNamingContext;
    [string] LPWSTR pszDsaDN;
    [string] LPWSTR pszDsaAddress;
    UUID uuidNamingContextObjGuid;
    UUID uuidDsaObjGuid;
} DS_REPL_OPW;

typedef struct {
    FILETIME ftimeCurrentOpStarted;
    DWORD cNumPendingOps;
    [size_is(cNumPendingOps)] DS_REPL_OPW rgPendingOp[];
} DS_REPL_PENDING_OPSW;

typedef struct {
    [string] LPWSTR pszAttributeName;
    [string] LPWSTR pszObjectDn;
    DWORD cbData;
    [size_is(cbData), ptr] BYTE *pbData;
    FILETIME ftimeDeleted;
    FILETIME ftimeCreated;
    DWORD dwVersion;
    FILETIME ftimeLastOriginatingChange;
    UUID uuidLastOriginatingDsaInvocationID;
    USN usnOriginatingChange;
    USN usnLocalChange;
} DS_REPL_VALUE_META_DATA;

typedef struct {
    DWORD cNumEntries;
    DWORD dwEnumerationContext;
    [size_is(cNumEntries)] DS_REPL_VALUE_META_DATA rgMetaData[];
} DS_REPL_ATTR_VALUE_META_DATA;

typedef struct {
    UUID uuidSourceDsaInvocationID;
    USN usnAttributeFilter;
    FILETIME ftimeLastSyncSuccess;
} DS_REPL_CURSOR_2;

typedef struct {
    DWORD cNumCursors;
    DWORD dwEnumerationContext;
    [size_is(cNumCursors)] DS_REPL_CURSOR_2 rgCursor[];
} DS_REPL_CURSORS_2;

typedef struct {
    UUID uuidSourceDsaInvocationID;
    USN usnAttributeFilter;
    FILETIME ftimeLastSyncSuccess;
    [string] LPWSTR pszSourceDsaDN;
} DS_REPL_CURSOR_3W;

typedef struct {
    DWORD cNumCursors;
    DWORD dwEnumerationContext;
    [size_is(cNumCursors)] DS_REPL_CURSOR_3W rgCursor[];
} DS_REPL_CURSORS_3W;

typedef struct {
    [string] LPWSTR pszAttributeName;
    DWORD dwVersion;
    FILETIME ftimeLastOriginatingChange;
    UUID uuidLastOriginatingDsaInvocationID;
    USN usnOriginatingChange;
    USN usnLocalChange;
}

```

```

    [string] LPWSTR pszLastOriginatingDsaDN;
} DS_REPL_ATTR_META_DATA_2;

typedef struct {
    DWORD cNumEntries;
    DWORD dwReserved;
    [size_is(cNumEntries)] DS_REPL_ATTR_META_DATA_2 rgMetaData[];
} DS_REPL_OBJ_META_DATA_2;

typedef struct {
    [string] LPWSTR pszAttributeName;
    [string] LPWSTR pszObjectDn;
    DWORD cbData;
    [size_is(cbData), ptr] BYTE *pbData;
    FILETIME ftimeDeleted;
    FILETIME ftimeCreated;
    DWORD dwVersion;
    FILETIME ftimeLastOriginatingChange;
    UUID uuidLastOriginatingDsaInvocationID;
    USN usnOriginatingChange;
    USN usnLocalChange;
    [string] LPWSTR pszLastOriginatingDsaDN;
} DS_REPL_VALUE_META_DATA_2;

typedef struct {
    DWORD cNumEntries;
    DWORD dwEnumerationContext;
    [size_is(cNumEntries)] DS_REPL_VALUE_META_DATA_2 rgMetaData[];
} DS_REPL_ATTR_VALUE_META_DATA_2;

typedef struct {
    [range(1,10000)] DWORD cb;
    [size_is(cb)] BYTE rgb[];
} DRS_EXTENSIONS;

typedef struct {
    UUID uuidDsaObjDest;
    UUID uuidInvocIdSrc;
    [ref] DSNAME *pNC;
    USN_VECTOR usnvecFrom;
    [unique] UPTODATE_VECTOR_V1_EXT *pUpToDateVecDestV1;
    [unique] PARTIAL_ATTR_VECTOR_V1_EXT *pPartialAttrVecDestV1;
    SCHEMA_PREFIX_TABLE PrefixTableDest;
    ULONG ulFlags;
    ULONG cMaxObjects;
    ULONG cMaxBytes;
    ULONG ulExtendedOp;
} DRS_MSG_GETCHGREQ_V3;

typedef struct {
    UUID uuidTransportObj;
    [ref] MTX_ADDR *pmtxReturnAddress;
    DRS_MSG_GETCHGREQ_V3 V3;
} DRS_MSG_GETCHGREQ_V4;

typedef struct {
    UUID uuidTransportObj;
    [ref] MTX_ADDR *pmtxReturnAddress;
    DRS_MSG_GETCHGREQ_V3 V3;
    [unique] PARTIAL_ATTR_VECTOR_V1_EXT *pPartialAttrSet;
    [unique] PARTIAL_ATTR_VECTOR_V1_EXT *pPartialAttrSetEx;
    SCHEMA_PREFIX_TABLE PrefixTableDest;
} DRS_MSG_GETCHGREQ_V7;

typedef struct {
    UUID uuidDsaObjSrc;
    UUID uuidInvocIdSrc;
    [unique] DSNAME *pNC;
    USN_VECTOR usnvecFrom;
    USN_VECTOR usnvecTo;

```

```

    [unique] UPTODATE_VECTOR_V1_EXT *pUpToDateVecSrcV1;
    SCHEMA_PREFIX_TABLE PrefixTableSrc;
    ULONG ulExtendedRet;
    ULONG cNumObjects;
    ULONG cNumBytes;
    [unique] REPLENTINFLIST* pObjects;
    BOOL fMoreData;
} DRS_MSG_GETCHGREPLY_V1;

typedef struct {
    UUID uuidDsaObjSrc;
    UUID uuidInvocIdSrc;
    [unique] DSNAME *pNC;
    USN_VECTOR usnvecFrom;
    USN_VECTOR usnvecTo;
    [unique] UPTODATE_VECTOR_V2_EXT *pUpToDateVecSrc;
    SCHEMA_PREFIX_TABLE PrefixTableSrc;
    ULONG ulExtendedRet;
    ULONG cNumObjects;
    ULONG cNumBytes;
    [unique] REPLENTINFLIST *pObjects;
    BOOL fMoreData;
    ULONG cNumNcSizeObjects;
    ULONG cNumNcSizeValues;
    [range(0,1048576)] DWORD cNumValues;
    [size_is(cNumValues)] REPLVALINF_V1 *rgValues;
    DWORD dwDRSError;
} DRS_MSG_GETCHGREPLY_V6;

typedef struct {
    UUID uuidDsaObjSrc;
    UUID uuidInvocIdSrc;
    [unique] DSNAME *pNC;
    USN_VECTOR usnvecFrom;
    USN_VECTOR usnvecTo;
    [unique] UPTODATE_VECTOR_V2_EXT *pUpToDateVecSrc;
    SCHEMA_PREFIX_TABLE PrefixTableSrc;
    ULONG ulExtendedRet;
    ULONG cNumObjects;
    ULONG cNumBytes;
    [unique] REPLENTINFLIST *pObjects;
    BOOL fMoreData;
    ULONG cNumNcSizeObjects;
    ULONG cNumNcSizeValues;
    [range(0,1048576)] DWORD cNumValues;
    [size_is(cNumValues)] REPLVALINF_V3 *rgValues;
    DWORD dwDRSError;
} DRS_MSG_GETCHGREPLY_V9;

typedef struct {
    DWORD cbUncompressedSize;
    DWORD cbCompressedSize;
    [size_is(cbCompressedSize)] BYTE *pbCompressedData;
} DRS_COMPRESSED_BLOB;

typedef struct {
    UUID uuidDsaObjDest;
    UUID uuidInvocIdSrc;
    [ref] DSNAME *pNC;
    USN_VECTOR usnvecFrom;
    [unique] UPTODATE_VECTOR_V1_EXT *pUpToDateVecDestV1;
    ULONG ulFlags;
    ULONG cMaxObjects;
    ULONG cMaxBytes;
    ULONG ulExtendedOp;
    ULARGE_INTEGER liFsmoInfo;
} DRS_MSG_GETCHGREQ_V5;

typedef struct {
    UUID uuidDsaObjDest;

```

```

        UUID uuidInvocIdSrc;
        [ref] DSNAME *pNC;
        USN_VECTOR usnvecFrom;
        [unique] UPTODATE_VECTOR_V1_EXT *pUpToDateVecDest;
        ULONG ulFlags;
        ULONG cMaxObjects;
        ULONG cMaxBytes;
        ULONG ulExtendedOp;
        ULARGE_INTEGER liFsmoInfo;
        [unique] PARTIAL_ATTR_VECTOR_V1_EXT *pPartialAttrSet;
        [unique] PARTIAL_ATTR_VECTOR_V1_EXT *pPartialAttrSetEx;
        SCHEMA_PREFIX_TABLE PrefixTableDest;
    } DRS_MSG_GETCHGREQ_V8;

typedef struct {
    UUID uuidDsaObjDest;
    UUID uuidInvocIdSrc;
    [ref] DSNAME *pNC;
    USN_VECTOR usnvecFrom;
    [unique] UPTODATE_VECTOR_V1_EXT *pUpToDateVecDest;
    ULONG ulFlags;
    ULONG cMaxObjects;
    ULONG cMaxBytes;
    ULONG ulExtendedOp;
    ULARGE_INTEGER liFsmoInfo;
    [unique] PARTIAL_ATTR_VECTOR_V1_EXT *pPartialAttrSet;
    [unique] PARTIAL_ATTR_VECTOR_V1_EXT *pPartialAttrSetEx;
    SCHEMA_PREFIX_TABLE PrefixTableDest;
    ULONG ulMoreFlags;
} DRS_MSG_GETCHGREQ_V10;

typedef [switch_type(DWORD)] union {
    [case(4)] DRS_MSG_GETCHGREQ_V4 V4;
    [case(5)] DRS_MSG_GETCHGREQ_V5 V5;
    [case(7)] DRS_MSG_GETCHGREQ_V7 V7;
    [case(8)] DRS_MSG_GETCHGREQ_V8 V8;
    [case(10)] DRS_MSG_GETCHGREQ_V10 V10;
} DRS_MSG_GETCHGREQ;

typedef struct {
    DRS_COMPRESSED_BLOB CompressedV1;
} DRS_MSG_GETCHGREPLY_V2;

typedef enum {
    DRS_COMP_ALG_NONE = 0,
    DRS_COMP_ALG_UNUSED = 1,
    DRS_COMP_ALG_MSZIP = 2,
    DRS_COMP_ALG_WIN2K3 = 3
} DRS_COMP_ALG_TYPE;

typedef struct {
    DWORD dwCompressedVersion;
    DRS_COMP_ALG_TYPE CompressionAlg;
    DRS_COMPRESSED_BLOB CompressedAny;
} DRS_MSG_GETCHGREPLY_V7;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_GETCHGREPLY_V1 V1;
    [case(2)] DRS_MSG_GETCHGREPLY_V2 V2;
    [case(6)] DRS_MSG_GETCHGREPLY_V6 V6;
    [case(7)] DRS_MSG_GETCHGREPLY_V7 V7;
    [case(9)] DRS_MSG_GETCHGREPLY_V9 V9;
} DRS_MSG_GETCHGREPLY;

typedef struct {
    [ref] DSNAME *pNC;
    UUID uuidDsaSrc;
    [unique] [string] char *pszDsaSrc;
    ULONG ulOptions;

```

```

} DRS_MSG_REPSYNC_V1;

typedef [switch_type(DWORD)] union
{
    [case(1)] DRS_MSG_REPSYNC_V1 V1;
} DRS_MSG_REPSYNC;

typedef struct {
    [ref] DSNAME *pNC;
    [ref] [string] char *pszDsaDest;
    UUID uuidDsaObjDest;
    ULONG ulOptions;
} DRS_MSG_UPDREFS_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_UPDREFS_V1 V1;
} DRS_MSG_UPDREFS;

typedef struct {
    [ref] DSNAME *pNC;
    [ref] [string] char *pszDsaSrc;
    REPLTIMES rtSchedule;
    ULONG ulOptions;
} DRS_MSG_REPADD_V1;

typedef struct {
    [ref] DSNAME *pNC;
    [unique] DSNAME *pSourceDsaDN;
    [unique] DSNAME *pTransportDN;
    [ref] [string] char *pszSourceDsaAddress;
    REPLTIMES rtSchedule;
    ULONG ulOptions;
} DRS_MSG_REPADD_V2;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_REPADD_V1 V1;
    [case(2)] DRS_MSG_REPADD_V2 V2;
} DRS_MSG_REPADD;

typedef struct {
    [ref] DSNAME *pNC;
    [string] char *pszDsaSrc;
    ULONG ulOptions;
} DRS_MSG_REPDEL_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_REPDEL_V1 V1;
} DRS_MSG_REPDEL;

typedef struct {
    [ref] DSNAME *pNC;
    UUID uuidSourceDRA;
    [unique, string] char *pszSourceDRA;
    REPLTIMES rtSchedule;
    ULONG ulReplicaFlags;
    ULONG ulModifyFields;
    ULONG ulOptions;
} DRS_MSG_REPMOD_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_REPMOD_V1 V1;
} DRS_MSG_REPMOD;

typedef struct {
    DWORD dwFlags;
    [range(1,10000)] DWORD cNames;
    [size_is(cNames)] DSNAME **rpNames;
    ATTRBLOCK RequiredAttrs;
    SCHEMA_PREFIX_TABLE PrefixTable;
} DRS_MSG_VERIFYREQ_V1;

```

```

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_VERIFYREQ_V1 V1;
} DRS_MSG_VERIFYREQ;

typedef struct {
    DWORD error;
    [range(0,10000)] DWORD cNames;
    [size_is(cNames)] ENTINF *rpEntInf;
    SCHEMA_PREFIX_TABLE PrefixTable;
} DRS_MSG_VERIFYREPLY_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_VERIFYREPLY_V1 V1;
} DRS_MSG_VERIFYREPLY;

typedef enum {
    RevMembGetGroupsForUser=1,
    RevMembGetAliasMembership,
    RevMembGetAccountGroups,
    RevMembGetResourceGroups,
    RevMembGetUniversalGroups,
    GroupMembersTransitive,
    RevMembGlobalGroupsNonTransitive
} REVERSE_MEMBERSHIP_OPERATION_TYPE;

typedef struct {
    [range(1,10000)] ULONG cDsNames;
    [size_is(cDsNames,)] DSNAME **ppDsNames;
    DWORD dwFlags;
    [range(1,7)] REVERSE_MEMBERSHIP_OPERATION_TYPE OperationType;
    DSNAME *pLimitingDomain;
} DRS_MSG_REVMEMB_REQ_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_REVMEMB_REQ_V1 V1;
} DRS_MSG_REVMEMB_REQ;

typedef struct {
    ULONG errCode;
    [range(0,10000)] ULONG cDsNames;
    [range(0,10000)] ULONG cSidHistory;
    [size_is(cDsNames,)] DSNAME **ppDsNames;
    [size_is(cDsNames)] DWORD *pAttributes;
    [size_is(cSidHistory,)] NT4SID **ppSidHistory;
} DRS_MSG_REVMEMB_REPLY_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_REVMEMB_REPLY_V1 V1;
} DRS_MSG_REVMEMB_REPLY;

typedef struct {
    char *pSourceDSA;
    ENTINF *pObject;
    UUID *pParentUUID;
    SCHEMA_PREFIX_TABLE PrefixTable;
    ULONG ulFlags;
} DRS_MSG_MOVEREQ_V1;

typedef struct {
    [range(0,10000)] unsigned long cbBuffer;
    unsigned long BufferType;
    [size_is(cbBuffer)] BYTE *pvBuffer;
} DRS_SecBuffer;

typedef struct {
    unsigned long ulVersion;
    [range(0,10000)] unsigned long cBuffers;
    [size_is(cBuffers)] DRS_SecBuffer *Buffers;
} DRS_SecBufferDesc;

```

```

typedef struct {
    DSNAME *pSrcDSA;
    ENTINF *pSrcObject;
    DSNAME *pDstName;
    DSNAME *pExpectedTargetNC;
    DRS_SecBufferDesc *pClientCreds;
    SCHEMA_PREFIX_TABLE PrefixTable;
    ULONG ulFlags;
} DRS_MSG_MOVEREQ_V2;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_MOVEREQ_V1 V1;
    [case(2)] DRS_MSG_MOVEREQ_V2 V2;
} DRS_MSG_MOVEREQ;

typedef struct {
    ENTINF **ppResult;
    SCHEMA_PREFIX_TABLE PrefixTable;
    ULONG *pError;
} DRS_MSG_MOVEREPLY_V1;

typedef struct {
    ULONG win32Error;
    [unique] DSNAME *pAddedName;
} DRS_MSG_MOVEREPLY_V2;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_MOVEREPLY_V1 V1;
    [case(2)] DRS_MSG_MOVEREPLY_V2 V2;
} DRS_MSG_MOVEREPLY;

typedef struct {
    ULONG CodePage;
    ULONG LocaleId;
    DWORD dwFlags;
    DWORD formatOffered;
    DWORD formatDesired;
    [range(1,10000)] DWORD cNames;
    [string, size_is(cNames)] WCHAR **rpNames;
} DRS_MSG_CRACKREQ_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_CRACKREQ_V1 V1;
} DRS_MSG_CRACKREQ;

typedef struct {
    DS_NAME_RESULTW *pResult;
} DRS_MSG_CRACKREPLY_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_CRACKREPLY_V1 V1;
} DRS_MSG_CRACKREPLY;

typedef struct {
    DWORD dwFlags;
    DWORD PreferredMaximumLength;
    [range(0,10485760)] DWORD cbRestart;
    [size_is(cbRestart)] BYTE *pRestart;
} DRS_MSG_NT4_CHGLOG_REQ_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_NT4_CHGLOG_REQ_V1 V1;
} DRS_MSG_NT4_CHGLOG_REQ;

typedef struct {
    LARGE_INTEGER SamSerialNumber;
    LARGE_INTEGER SamCreationTime;
    LARGE_INTEGER BuiltinSerialNumber;
    LARGE_INTEGER BuiltinCreationTime;
}

```



```

        LARGE_INTEGER LsaSerialNumber;
        LARGE_INTEGER LsaCreationTime;
    } NT4_REPLICATION_STATE;

typedef struct {
    [range(0,10485760)] DWORD cbRestart;
    [range(0,10485760)] DWORD cbLog;
    NT4_REPLICATION_STATE ReplicationState;
    DWORD ActualNtStatus;
    [size_is(cbRestart)] BYTE *pRestart;
    [size_is(cbLog)] BYTE *pLog;
} DRS_MSG_NT4_CHGLOG_REPLY_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_NT4_CHGLOG_REPLY_V1 V1;
} DRS_MSG_NT4_CHGLOG_REPLY;

typedef struct {
    DWORD operation;
    DWORD flags;
    [string] const WCHAR *pwszAccount;
    [range(0,10000)] DWORD cSPN;
    [string, size_is(cSPN)] const WCHAR **rpwszSPN;
} DRS_MSG_SPNREQ_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_SPNREQ_V1 V1;
} DRS_MSG_SPNREQ;

typedef struct {
    DWORD retVal;
} DRS_MSG_SPNREPLY_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_SPNREPLY_V1 V1;
} DRS_MSG_SPNREPLY;

typedef struct {
    [string] LPWSTR ServerDN;
    [string] LPWSTR DomainDN;
    BOOL fCommit;
} DRS_MSG_RMSVRREQ_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_RMSVRREQ_V1 V1;
} DRS_MSG_RMSVRREQ;

typedef struct {
    BOOL fLastDcInDomain;
} DRS_MSG_RMSVRREPLY_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_RMSVRREPLY_V1 V1;
} DRS_MSG_RMSVRREPLY;

typedef struct {
    [string] LPWSTR DomainDN;
} DRS_MSG_RMDMNREQ_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_RMDMNREQ_V1 V1;
} DRS_MSG_RMDMNREQ;

typedef struct {
    DWORD Reserved;
} DRS_MSG_RMDMNREPLY_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_RMDMNREPLY_V1 V1;
} DRS_MSG_RMDMNREPLY;

```

```

typedef struct {
    [string] WCHAR *Domain;
    DWORD InfoLevel;
} DRS_MSG_DCINFOREQ_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_DCINFOREQ_V1 V1;
} DRS_MSG_DCINFOREQ, *PDRS_MSG_DCINFOREQ;

typedef struct {
    [range(0,10000)] DWORD cItems;
    [size_is(cItems)] DS_DOMAIN_CONTROLLER_INFO_1W *rItems;
} DRS_MSG_DCINFOREPLY_V1;

typedef struct {
    [range(0,10000)] DWORD cItems;
    [size_is(cItems)] DS_DOMAIN_CONTROLLER_INFO_2W *rItems;
} DRS_MSG_DCINFOREPLY_V2;

typedef struct {
    [range(0,10000)] DWORD cItems;
    [size_is(cItems)] DS_DOMAIN_CONTROLLER_INFO_3W* rItems;
} DRS_MSG_DCINFOREPLY_V3;

typedef struct {
    [range(0,10000)] DWORD cItems;
    [size_is(cItems)] DS_DOMAIN_CONTROLLER_INFO_FFFFFFFFW *rItems;
} DRS_MSG_DCINFOREPLY_VFFFFFFFF;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_DCINFOREPLY_V1 V1;
    [case(2)] DRS_MSG_DCINFOREPLY_V2 V2;
    [case(3)] DRS_MSG_DCINFOREPLY_V3 V3;
    [case(0xFFFFFFFF)] DRS_MSG_DCINFOREPLY_VFFFFFFFF VFFFFFFFF;
} DRS_MSG_DCINFOREPLY;

typedef struct {
    [ref] DSNAME *pObject;
    ATTRBLOCK AttrBlock;
} DRS_MSG_ADDENTRYREQ_V1;

typedef struct {
    ENTINFLIST EntInfList;
} DRS_MSG_ADDENTRYREQ_V2;

typedef struct {
    ENTINFLIST EntInfList;
    DRS_SecBufferDesc *pClientCreds;
} DRS_MSG_ADDENTRYREQ_V3;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_ADDENTRYREQ_V1 V1;
    [case(2)] DRS_MSG_ADDENTRYREQ_V2 V2;
    [case(3)] DRS_MSG_ADDENTRYREQ_V3 V3;
} DRS_MSG_ADDENTRYREQ;

typedef struct {
    GUID Guid;
    NT4SID Sid;
    DWORD errCode;
    DWORD dsid;
    DWORD extendedErr;
    DWORD extendedData;
    USHORT problem;
} DRS_MSG_ADDENTRYREPLY_V1;

typedef struct {
    GUID objGuid;
    NT4SID objSid;

```

```

} ADDENTRY_REPLY_INFO;

typedef struct {
    [unique] DSNAME *pErrorObject;
    DWORD errCode;
    DWORD dsid;
    DWORD extendedErr;
    DWORD extendedData;
    USHORT problem;
    [range(0,10000)] ULONG cObjectsAdded;
    [size_is(cObjectsAdded)] ADDENTRY_REPLY_INFO *infoList;
} DRS_MSG_ADDENTRYREPLY_V2;

typedef struct {
    DWORD dwRepError;
    DWORD errCode;
    [switch_is(errCode)] DIRERR_DRS_WIRE_V1 *pErrInfo;
} DRS_ERROR_DATA_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_ERROR_DATA_V1 V1;
} DRS_ERROR_DATA;

typedef struct {
    DSNAME *pdsErrObject;
    DWORD dwErrVer;
    [switch_is(dwErrVer)] DRS_ERROR_DATA *pErrData;
    [range(0,10000)] ULONG cObjectsAdded;
    [size_is(cObjectsAdded)] ADDENTRY_REPLY_INFO *infoList;
} DRS_MSG_ADDENTRYREPLY_V3;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_ADDENTRYREPLY_V1 V1;
    [case(2)] DRS_MSG_ADDENTRYREPLY_V2 V2;
    [case(3)] DRS_MSG_ADDENTRYREPLY_V3 V3;
} DRS_MSG_ADDENTRYREPLY;

typedef struct {
    DWORD dwTaskID;
    DWORD dwFlags;
} DRS_MSG_KCC_EXECUTE_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_KCC_EXECUTE_V1 V1;
} DRS_MSG_KCC_EXECUTE;

typedef struct {
    ULONGLONG hCtx;
    LONG lReferenceCount;
    BOOL fIsBound;
    UUID uuidClient;
    DSTIME timeLastUsed;
    ULONG IPAddr;
    int pid;
} DS_REPL_CLIENT_CONTEXT;

typedef struct {
    [range(0,10000)] DWORD cNumContexts;
    DWORD dwReserved;
    [size_is(cNumContexts)] DS_REPL_CLIENT_CONTEXT rgContext[];
} DS_REPL_CLIENT_CONTEXTS;

typedef struct {
    [string] LPWSTR pszServerName;
    BOOL fIsHandleBound;
    BOOL fIsHandleFromCache;
    BOOL fIsHandleInCache;
    DWORD dwThreadId;
    DWORD dwBindingTimeoutMins;
    DSTIME dstimeCreated;
}

```

```

    DWORD dwCallType;
} DS_REPL_SERVER_OUTGOING_CALL;

typedef struct {
    [range(0, 256)] DWORD cNumCalls;
    DWORD dwReserved;
    [size_is(cNumCalls)] DS_REPL_SERVER_OUTGOING_CALL rgCall[];
} DS_REPL_SERVER_OUTGOING_CALLS;

typedef struct {
    DWORD InfoType;
    [string] LPWSTR pszObjectDN;
    UUID uuidSourceDsaObjGuid;
} DRS_MSG_GETREPLINFO_REQ_V1;

typedef struct {
    DWORD InfoType;
    [string] LPWSTR pszObjectDN;
    UUID uuidSourceDsaObjGuid;
    DWORD ulFlags;
    [string] LPWSTR pszAttributeName;
    [string] LPWSTR pszValueDN;
    DWORD dwEnumerationContext;
} DRS_MSG_GETREPLINFO_REQ_V2;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_GETREPLINFO_REQ_V1 V1;
    [case(2)] DRS_MSG_GETREPLINFO_REQ_V2 V2;
} DRS_MSG_GETREPLINFO_REQ;

typedef [switch_type(DWORD)] union {
    [case(0)] DS_REPL_NEIGHBORSW *pNeighbors;
    [case(1)] DS_REPL_CURSORS *pCursors;
    [case(2)] DS_REPL_OBJ_META_DATA *pObjMetaData;
    [case(3)] DS_REPL_KCC_DSA_FAILURESW *pConnectFailures;
    [case(4)] DS_REPL_KCC_DSA_FAILURESW *pLinkFailures;
    [case(5)] DS_REPL_PENDING_OPSW *pPendingOps;
    [case(6)] DS_REPL_ATTR_VALUE_META_DATA *pAttrValueMetaData;
    [case(7)] DS_REPL_CURSORS_2 *pCursors2;
    [case(8)] DS_REPL_CURSORS_3W *pCursors3;
    [case(9)] DS_REPL_OBJ_META_DATA_2 *pObjMetaData2;
    [case(10)] DS_REPL_ATTR_VALUE_META_DATA_2 *pAttrValueMetaData2;
    [case(0xFFFFFFFFFA)]
        DS_REPL_SERVER_OUTGOING_CALLS *pServerOutgoingCalls;
    [case(0xFFFFFFFFFB)] UPTODATE_VECTOR_V1_EXT *pUpToDateVec;
    [case(0xFFFFFFFFFC)] DS_REPL_CLIENT_CONTEXTS *pClientContexts;
    [case(0xFFFFFFFFFE)] DS_REPL_NEIGHBORSW *pRepsTo;
} DRS_MSG_GETREPLINFO_REPLY;

typedef struct {
    DWORD Flags;
    [string] WCHAR *SrcDomain;
    [string] WCHAR *SrcPrincipal;
    [string, ptr] WCHAR *SrcDomainController;
    [range(0,256)] DWORD SrcCredsUserLength;
    [size_is(SrcCredsUserLength)] WCHAR *SrcCredsUser;
    [range(0,256)] DWORD SrcCredsDomainLength;
    [size_is(SrcCredsDomainLength)] WCHAR *SrcCredsDomain;
    [range(0,256)] DWORD SrcCredsPasswordLength;
    [size_is(SrcCredsPasswordLength)] WCHAR *SrcCredsPassword;
    [string] WCHAR *DstDomain;
    [string] WCHAR *DstPrincipal;
} DRS_MSG_ADDSIDREQ_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_ADDSIDREQ_V1 V1;
} DRS_MSG_ADDSIDREQ;

typedef struct {
    DWORD dwWin32Error;

```

```

} DRS_MSG_ADDSIDREPLY_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_ADDSIDREPLY_V1 V1;
} DRS_MSG_ADDSIDREPLY;

typedef struct {
    [range(1, 10000)] ULONG Count;
    [size_is(Count)] DRS_MSG_REVMEMB_REQ_V1 *Requests;
} DRS_MSG_GETMEMBERSHIPS2_REQ_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_GETMEMBERSHIPS2_REQ_V1 V1;
} DRS_MSG_GETMEMBERSHIPS2_REQ;

typedef struct {
    [range(0, 10000)] ULONG Count;
    [size_is(Count)] DRS_MSG_REVMEMB_REPLY_V1 *Replies;
} DRS_MSG_GETMEMBERSHIPS2_REPLY_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_GETMEMBERSHIPS2_REPLY_V1 V1;
} DRS_MSG_GETMEMBERSHIPS2_REPLY;

typedef struct {
    [ref] DSNAME *pNC;
    UUID uuidDsaSrc;
    ULONG ulOptions;
} DRS_MSG_REPVERIFYOBJ_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_REPVERIFYOBJ_V1 V1;
} DRS_MSG_REPVERIFYOBJ;

typedef struct {
    UUID guidStart;
    DWORD cGuids;
    DSNAME *pNC;
    UPTODATE_VECTOR_V1_EXT *pUpToDateVecCommonV1;
    UCHAR Md5Digest[16];
} DRS_MSG_EXISTREQ_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_EXISTREQ_V1 V1;
} DRS_MSG_EXISTREQ;

typedef struct {
    DWORD dwStatusFlags;
    [range(0,10485760)] DWORD cNumGuids;
    [size_is(cNumGuids)] UUID *rgGuids;
} DRS_MSG_EXISTREPLY_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_EXISTREPLY_V1 V1;
} DRS_MSG_EXISTREPLY;

typedef struct {
    [string] const WCHAR *pwszFromSite;
    [range(1,10000)] DWORD cToSites;
    [string, size_is(cToSites)] WCHAR **rgszToSites;
    DWORD dwFlags;
} DRS_MSG_QUERYsitesREQ_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_QUERYsitesREQ_V1 V1;
} DRS_MSG_QUERYsitesREQ;

typedef struct {
    DWORD dwErrorCode;
    DWORD dwCost;

```

```

} DRS_MSG_QUERY_SITES_REPLY_ELEMENT_V1;

typedef struct {
    [range(0,10000)] DWORD cToSites;
    [size_is(cToSites)] DRS_MSG_QUERY_SITES_REPLY_ELEMENT_V1 *rgCostInfo;
    DWORD dwFlags;
} DRS_MSG_QUERY_SITES_REPLY_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_QUERY_SITES_REPLY_V1 V1;
} DRS_MSG_QUERY_SITES_REPLY;

typedef struct {
    DWORD dwReserved;
} DRS_MSG_INIT_DEMOTIONREQ_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_INIT_DEMOTIONREQ_V1 V1;
} DRS_MSG_INIT_DEMOTIONREQ;

typedef struct {
    DWORD dwOpError;
} DRS_MSG_INIT_DEMOTIONREPLY_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_INIT_DEMOTIONREPLY_V1 V1;
} DRS_MSG_INIT_DEMOTIONREPLY;

typedef struct {
    DWORD dwFlags;
    UUID uuidHelperDest;
    [ref] DSNAME* pNC;
} DRS_MSG_REPLICA_DEMOTIONREQ_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_REPLICA_DEMOTIONREQ_V1 V1;
} DRS_MSG_REPLICA_DEMOTIONREQ;

typedef struct {
    DWORD dwOpError;
} DRS_MSG_REPLICA_DEMOTIONREPLY_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_REPLICA_DEMOTIONREPLY_V1 V1;
} DRS_MSG_REPLICA_DEMOTIONREPLY;

typedef struct {
    DWORD dwOperations;
    UUID uuidHelperDest;
    [string] LPWSTR szScriptBase;
} DRS_MSG_FINISH_DEMOTIONREQ_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_FINISH_DEMOTIONREQ_V1 V1;
} DRS_MSG_FINISH_DEMOTIONREQ;

typedef struct {
    DWORD dwOperationsDone;
    DWORD dwOpFailed;
    DWORD dwOpError;
} DRS_MSG_FINISH_DEMOTIONREPLY_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_FINISH_DEMOTIONREPLY_V1 V1;
} DRS_MSG_FINISH_DEMOTIONREPLY;

typedef struct {
    [string] const WCHAR *pwszCloneDCName;
    [string] const WCHAR *pwszSite;
} DRS_MSG_ADDCLONEDCREQ_V1;

```

```

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_ADDCLONEDCREQ_V1 V1;
} DRS_MSG_ADDCLONEDCREQ;

typedef struct {
    [string] WCHAR *pwszCloneDCName;
    [string] WCHAR *pwszSite;
    [range(0,1024)] DWORD cPasswordLength;
    [size_is(cPasswordLength)] WCHAR *pwsNewDCAccountPassword;
} DRS_MSG_ADDCLONEDCREPLY_V1;

typedef [switch_type(DWORD)] union {
    [case(1)] DRS_MSG_ADDCLONEDCREPLY_V1 V1;
} DRS_MSG_ADDCLONEDCREPLY;

typedef struct _DRS_MSG_WRITENGCKEYREQ_V1{
    [string] const WCHAR* pwszAccount;
    [range(0,0xFFFF)] DWORD cNgcKey;
    [size_is(cNgcKey)] UCHAR * pNgcKey;
} DRS_MSG_WRITENGCKEYREQ_V1;

typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_WRITENGCKEYREQ_V1 V1;
} DRS_MSG_WRITENGCKEYREQ;

typedef struct _DRS_MSG_WRITENGCKEYREPLY_V1{
    DWORD retVal;
} DRS_MSG_WRITENGCKEYREPLY_V1;

typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_WRITENGCKEYREPLY_V1 V1;
} DRS_MSG_WRITENGCKEYREPLY;

typedef struct _DRS_MSG_READNGCKEYREQ_V1{
    [string] const WCHAR* pwszAccount;
} DRS_MSG_READNGCKEYREQ_V1;

typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_READNGCKEYREQ_V1 V1;
} DRS_MSG_READNGCKEYREQ;

typedef struct _DRS_MSG_READNGCKEYREPLY_V1{
    DWORD retVal;
    [range(0,0xFFFF)] DWORD cNgcKey;
    [size_is(cNgcKey)] UCHAR * pNgcKey;
} DRS_MSG_READNGCKEYREPLY_V1;

typedef
[switch_type(DWORD)]
union {
    [case(1)]
        DRS_MSG_READNGCKEYREPLY_V1 V1;
} DRS_MSG_READNGCKEYREPLY;

// opnum 0
ULONG

```

```

IDL_DRSBind(
    [in] handle_t rpc_handle,
    [in, unique] UUID *puuidClientDsa,
    [in, unique] DRS_EXTENSIONS *pextClient,
    [out] DRS_EXTENSIONS **ppextServer,
    [out, ref] DRS_HANDLE *phDrs);

// opnum 1
ULONG
IDL_DRSUnbind(
    [in, out, ref] DRS_HANDLE *phDrs);

// opnum 2
ULONG
IDL_DRSReplicaSync(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwVersion,
    [in, ref, switch_is(dwVersion)] DRS_MSG_REPSYNC *pmsgSync);

// opnum 3
ULONG
IDL_DRSGetNCChanges(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)] DRS_MSG_GETCHGREQ *pmsgIn,
    [out, ref] DWORD *pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DRS_MSG_GETCHGREPLY *pmsgOut);

// opnum 4
ULONG
IDL_DRSUpdateRefs(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwVersion,
    [in, ref, switch_is(dwVersion)] DRS_MSG_UPDREFS *pmsgUpdRefs);

// opnum 5
ULONG
IDL_DRSReplicaAdd(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwVersion,
    [in, ref, switch_is(dwVersion)] DRS_MSG_REPADD *pmsgAdd);

// opnum 6
ULONG
IDL_DRSReplicaDel(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwVersion,
    [in, ref, switch_is(dwVersion)] DRS_MSG_REPDEL *pmsgDel);

// opnum 7
ULONG
IDL_DRSReplicaModify(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwVersion,
    [in, ref, switch_is(dwVersion)] DRS_MSG_REPMOD *pmsgMod);

// opnum 8
ULONG
IDL_DRSVerifyNames(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)] DRS_MSG_VERIFYREQ *pmsgIn,
    [out, ref] DWORD *pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DRS_MSG_VERIFYREPLY *pmsgOut);

// opnum 9
ULONG
IDL_DRSGetMemberships(

```



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[in, ref] DRS_HANDLE hDrs,
[in] DWORD dwInVersion,
[in, ref, switch_is(dwInVersion)] DRS_MSG_REVMEMB_REQ *pmsgIn,
[out, ref] DWORD *pdwOutVersion,
[out, ref, switch_is(*pdwOutVersion)]
    DRS_MSG_REVMEMB_REPLY *pmsgOut);

// opnum 10
ULONG
IDL_DRSSInterDomainMove(
[in, ref] DRS_HANDLE hDrs,
[in] DWORD dwInVersion,
[in, ref, switch_is(dwInVersion)] DRS_MSG_MOVEREQ *pmsgIn,
[out, ref] DWORD *pdwOutVersion,
[out, ref, switch_is(*pdwOutVersion)] DRS_MSG_MOVE_REPLY *pmsgOut);

// opnum 11
ULONG
IDL_DRSGetNT4ChangeLog(
[in, ref] DRS_HANDLE hDrs,
[in] DWORD dwInVersion,
[in, ref, switch_is(dwInVersion)] DRS_MSG_NT4_CHGLOG_REQ *pmsgIn,
[out, ref] DWORD *pdwOutVersion,
[out, ref, switch_is(*pdwOutVersion)]
    DRS_MSG_NT4_CHGLOG_REPLY *pmsgOut);

// opnum 12
ULONG
IDL_DRSCrackNames(
[in, ref] DRS_HANDLE hDrs,
[in] DWORD dwInVersion,
[in, ref, switch_is(dwInVersion)] DRS_MSG_CRACKREQ *pmsgIn,
[out, ref] DWORD *pdwOutVersion,
[out, ref, switch_is(*pdwOutVersion)]
    DRS_MSG_CRACKREPLY *pmsgOut);

// opnum 13
ULONG
IDL_DRSSwriteSPN(
[in, ref] DRS_HANDLE hDrs,
[in] DWORD dwInVersion,
[in, ref, switch_is(dwInVersion)] DRS_MSG_SPNREQ *pmsgIn,
[out, ref] DWORD *pdwOutVersion,
[out, ref, switch_is(*pdwOutVersion)] DRS_MSG_SPNREPLY *pmsgOut);

// opnum 14
ULONG
IDL_DRSSRemoveDsServer(
[in, ref] DRS_HANDLE hDrs,
[in] DWORD dwInVersion,
[in, ref, switch_is(dwInVersion)] DRS_MSG_RMSVRREQ *pmsgIn,
[out, ref] DWORD *pdwOutVersion,
[out, ref, switch_is(*pdwOutVersion)]
    DRS_MSG_RMSVRREPLY *pmsgOut);

// opnum 15
ULONG
IDL_DRSSRemoveDsDomain(
[in, ref] DRS_HANDLE hDrs,
[in] DWORD dwInVersion,
[in, ref, switch_is(dwInVersion)] DRS_MSG_RMDMNREQ *pmsgIn,
[out, ref] DWORD *pdwOutVersion,
[out, ref, switch_is(*pdwOutVersion)]
    DRS_MSG_RMDMNREPLY *pmsgOut);

// opnum 16
ULONG
IDL_DRSSDomainControllerInfo(
[in, ref] DRS_HANDLE hDrs,
[in] DWORD dwInVersion,

```

```

[in, ref, switch_is(dwInVersion)] DRS_MSG_DCINFOREQ *pmsgIn,
[out, ref] DWORD *pdwOutVersion,
[out, ref, switch_is(*pdwOutVersion)]
    DRS_MSG_DCINFOREPLY *pmsgOut);

// opnum 17
ULONG
IDL_DRAddEntry(
[in, ref] DRS_HANDLE hDrs,
[in] DWORD dwInVersion,
[in, ref, switch_is(dwInVersion)] DRS_MSG_ADDENTRYREQ *pmsgIn,
[out, ref] DWORD *pdwOutVersion,
[out, ref, switch_is(*pdwOutVersion)]
    DRS_MSG_ADDENTRYREPLY *pmsgOut);

// opnum 18
ULONG
IDL_DRSExecuteKCC(
[in, ref] DRS_HANDLE hDrs,
[in] DWORD dwInVersion,
[in, ref, switch_is(dwInVersion)] DRS_MSG_KCC_EXECUTE *pmsgIn);

// opnum 19
ULONG
IDL_DRGetReplInfo(
[in, ref] DRS_HANDLE hDrs,
[in] DWORD dwInVersion,
[in, ref, switch_is(dwInVersion)] DRS_MSG_GETREPLINFO_REQ *pmsgIn,
[out, ref] DWORD *pdwOutVersion,
[out, ref, switch_is(*pdwOutVersion)]
    DRS_MSG_GETREPLINFO_REPLY *pmsgOut);

// opnum 20
ULONG
IDL_DRAddSidHistory(
[in, ref] DRS_HANDLE hDrs,
[in] DWORD dwInVersion,
[in, ref, switch_is(dwInVersion)] DRS_MSG_ADDSIDREQ *pmsgIn,
[out, ref] DWORD *pdwOutVersion,
[out, ref, switch_is(*pdwOutVersion)]
    DRS_MSG_ADDSIDREPLY *pmsgOut);

// opnum 21
ULONG
IDL_DRGetMemberships2(
[in, ref] DRS_HANDLE hDrs,
[in] DWORD dwInVersion,
[in, ref, switch_is(dwInVersion)]
    DRS_MSG_GETMEMBERSHIPS2_REQ *pmsgIn,
[out, ref] DWORD *pdwOutVersion,
[out, ref, switch_is(*pdwOutVersion)]
    DRS_MSG_GETMEMBERSHIPS2_REPLY *pmsgOut);

// opnum 22
ULONG
IDL_DRSTransferObjects(
[in, ref] DRS_HANDLE hDrs,
[in] DWORD dwVersion,
[in, ref, switch_is(dwVersion)] DRS_MSG_REPVERIFYOBJ *pmsgVerify);

// opnum 23
ULONG
IDL_DRGetObjectExistence(
[in, ref] DRS_HANDLE hDrs,
[in] DWORD dwInVersion,
[in, ref, switch_is(dwInVersion)] DRS_MSG_EXISTREQ *pmsgIn,
[out, ref] DWORD *pdwOutVersion,
[out, ref, switch_is(*pdwOutVersion)]
    DRS_MSG_EXISTREPLY *pmsgOut);

```

```

// opnum 24
ULONG
IDL_DRSQuerySitesByCost(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)] DRS_MSG_QUERY_SITESREQ *pmsgIn,
    [out, ref] DWORD *pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DRS_MSG_QUERY_SITESREPLY *pmsgOut);

// opnum 25
ULONG
IDL_DRSInitDemotion(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
        DRS_MSG_INIT_DEMOTIONREQ* pmsgIn,
    [out, ref] DWORD* pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DRS_MSG_INIT_DEMOTIONREPLY* pmsgOut);

// opnum 26
ULONG
IDL_DRSReplicaDemotion(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
        DRS_MSG_REPLICA_DEMOTIONREQ* pmsgIn,
    [out, ref] DWORD* pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DRS_MSG_REPLICA_DEMOTIONREPLY* pmsgOut);

// opnum 27
ULONG
IDL_DRSFinishDemotion(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
        DRS_MSG_FINISH_DEMOTIONREQ* pmsgIn,
    [out, ref] DWORD* pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DRS_MSG_FINISH_DEMOTIONREPLY* pmsgOut);

// opnum 28
ULONG
IDL_DRSAddClonedDC (
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
        DRS_MSG_ADDCLONEDCREQ* pmsgIn,
    [out, ref] DWORD * pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DRS_MSG_ADDCLONEDCREPLY* pmsgOut
);

// opnum 29
ULONG
IDL_DRSWriteNgcKey(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
        DRS_MSG_WRITENGCKEYREQ* pmsgIn,
    [out, ref] DWORD* pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DRS_MSG_WRITENGCKEYREPLY* pmsgOut
);

// opnum 30
ULONG

```

```

IDL_DRSReadNgcKey(
    [in, ref] DRS_HANDLE hDrs,
    [in] DWORD dwInVersion,
    [in, ref, switch_is(dwInVersion)]
        DRS_MSG_READNGCKEYREQ* pmsgIn,
    [out, ref] DWORD* pdwOutVersion,
    [out, ref, switch_is(*pdwOutVersion)]
        DRS_MSG_READNGCKEYREPLY* pmsgOut
);
}

// This is the "real" ntdscript interface.
[
    uuid(7c44d7d4-31d5-424c-bd5e-2b3elf323d22), version(1.0),
    pointer_default (unique)
]
interface dsaop
{
    typedef struct {
        DWORD Flags;
        [range(1,1024)] DWORD cbPassword;
        [size_is(cbPassword)] BYTE *pbPassword;
    } DSA_MSG_EXECUTE_SCRIPT_REQ_V1;

    typedef [switch_type(DWORD)] union {
        [case(1)] DSA_MSG_EXECUTE_SCRIPT_REQ_V1 V1;
    } DSA_MSG_EXECUTE_SCRIPT_REQ;

    typedef struct {
        DWORD dwOperationStatus;
        [string] LPWSTR pwErrMessage;
    } DSA_MSG_EXECUTE_SCRIPT_REPLY_V1;

    typedef [switch_type(DWORD)] union {
        [case(1)] DSA_MSG_EXECUTE_SCRIPT_REPLY_V1 V1;
    } DSA_MSG_EXECUTE_SCRIPT_REPLY;

    typedef struct {
        DWORD Reserved;
    } DSA_MSG_PREPARE_SCRIPT_REQ_V1;

    typedef [switch_type(DWORD)] union {
        [case(1)] DSA_MSG_PREPARE_SCRIPT_REQ_V1 V1;
    } DSA_MSG_PREPARE_SCRIPT_REQ;

    typedef struct {
        DWORD dwOperationStatus;
        [string] LPWSTR pwErrMessage;
        [range(0,1024)] DWORD cbPassword;
        [size_is(cbPassword)] BYTE *pbPassword;
        [range(0,10485760)] DWORD cbHashBody;
        [size_is(cbHashBody)] BYTE *pbHashBody;
        [range(0,10485760)] DWORD cbHashSignature;
        [size_is(cbHashSignature)] BYTE *pbHashSignature;
    } DSA_MSG_PREPARE_SCRIPT_REPLY_V1;

    typedef [switch_type(DWORD)] union {
        [case(1)] DSA_MSG_PREPARE_SCRIPT_REPLY_V1 V1;
    } DSA_MSG_PREPARE_SCRIPT_REPLY;

    // opnum 0
    ULONG
    IDL_DSAPrepareScript(
        [in] handle_t hRpc,
        [in] DWORD dwInVersion,
        [in, ref, switch_is(dwInVersion)]
            DSA_MSG_PREPARE_SCRIPT_REQ *pmsgIn,

```

```
[out, ref] DWORD *pdwOutVersion,  
[out, ref, switch_is(*pdwOutVersion)]  
    DSA_MSG_PREPARE_SCRIPT_REPLY *pmsgOut);  
  
// opnum 1  
ULONG  
IDL_DSASExecuteScript(  
    [in] handle_t hRpc,  
    [in] DWORD dwInVersion,  
    [in, ref, switch_is(dwInVersion)]  
        DSA_MSG_EXECUTE_SCRIPT_REQ *pmsgIn,  
    [out, ref] DWORD *pdwOutVersion,  
    [out, ref, switch_is(*pdwOutVersion)]  
        DSA_MSG_EXECUTE_SCRIPT_REPLY *pmsgOut);  
  
}
```

8 Appendix B: Product Behavior

The information in this specification is applicable to the following Microsoft products or supplemental software. References to product versions include released service packs.

~~Note: Some of the information in this section is subject to change because it applies to a preliminary product version, and thus may differ from the final version of the software when released. All behavior notes that pertain to the preliminary product version contain specific references to it as an aid to the reader.~~

- Windows 2000 operating system
- Windows 2000 Server operating system
- Windows XP operating system
- Windows Server 2003 operating system
- Windows Server 2003 R2 operating system
- Active Directory Application Mode (ADAM)
- Windows Vista operating system
- Windows Server 2008 operating system
- Active Directory Lightweight Directory Services (AD LDS) for Windows Vista
- Windows 7 operating system
- Windows Server 2008 R2 operating system
- Active Directory Lightweight Directory Services (AD LDS) for Windows 7
- Windows 8 operating system
- Windows Server 2012 operating system
- Active Directory Lightweight Directory Services (AD LDS) for Windows 8 operating system
- Windows 8.1 operating system
- Windows Server 2012 R2 operating system
- Active Directory Lightweight Directory Services (AD LDS) for Windows 8.1 operating system
- Windows 10 operating system
- Windows Server 2016 ~~Technical Preview~~ operating system
- Active Directory Lightweight Directory Services (AD LDS) for Windows 10 operating system

Exceptions, if any, are noted below. If a service pack or Quick Fix Engineering (QFE) number appears with the product version, behavior changed in that service pack or QFE. The new behavior also applies to subsequent service packs of the product unless otherwise specified. If a product edition appears with the product version, behavior is different in that product edition.

Unless otherwise specified, any statement of optional behavior in this specification that is prescribed using the terms SHOULD or SHOULD NOT implies product behavior in accordance with the SHOULD or SHOULD NOT prescription. Unless otherwise specified, the term MAY implies that the product does not follow the prescription.

<1> Section 2.1: Windows servers listen only on the RPC-over-TCP protocol sequence. Windows clients attempt to connect using only the RPC-over-TCP protocol sequence.

<2> Section 2.2.2: Windows 2000 Server, Windows Server 2003, Windows Server 2003 R2, Windows Server 2008, and Windows Server 2008 R2 AD DS DCs do not store the "RPC" SPN.

<3> Section 2.2.3: Windows implements DC-to-DC interaction with an SPN with service class "E3514235-4B06-11D1-AB04-00C04FC2DCD2". See DRS_SPN_CLASS.

<4> Section 2.2.4.2: SPN "ldap/<NetBIOS hostname>/<NetBIOS domain name>" is available in Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1, Windows Server 2012 R2, Windows 10, and Windows Server 2016 **Technical Preview**.

<5> Section 4.1: All IDL methods and their associated concrete types have existed in the drsuapi RPC interface since Windows 2000 except those listed in the following table. All IDL methods and their associated concrete types continue to exist in this interface in subsequent versions of Windows according to the applicability list at the beginning of this section.

Data type or IDL method	Section	Windows version introduced
DRS_MSG_GETCHGREQ_V7 support	4.1.10.2.5	Windows Server 2003
DRS_MSG_GETREPLINFO_REQ_V2	4.1.13.1.3	Windows Server 2003
DRS_MSG_DCINFOREPLY_V3	4.1.5.1.6	Windows Server 2008
DS_DOMAIN_CONTROLLER_INFO_3W	4.1.5.1.10	Windows Server 2008
DRS_MSG_GETCHGREQ_V8 support	4.1.10.2.6	Windows Server 2003
DRS_MSG_GETCHGREQ_V10 support	4.1.10.2.7	Windows Server 2008 R2
DRS_MSG_GETCHGREPLY_V6 support	4.1.10.2.11	Windows Server 2003
DRS_MSG_GETCHGREPLY_V7 support	4.1.10.2.12	Windows Server 2003
DRS_MSG_GETCHGREPLY_V9 support	4.1.10.2.13	Windows Server 2016 Technical Preview
DRS_MSG_ADDENTRYREQ_V3 support	4.1.1.1.4	Windows Server 2003
DRS_MSG_ADDENTRYREPLY_V3 support	4.1.1.1.8	Windows Server 2003
IDL_DRSSGetObjectExistence	4.1.12	Windows Server 2003
IDL_DRSSReplicaVerifyObjects	4.1.24	Windows Server 2003
IDL_DRSSFinishDemotion	4.1.7	Windows Server 2008
IDL_DRSSInitDemotion	4.1.14	Windows Server 2008
IDL_DRSSReplicaDemotion	4.1.21	Windows Server 2008
IDL_DRSSAddCloneDC	4.1.29	Windows Server 2012
IDL_DRSSWriteNgcKey	4.1.30	Windows Server 2016 Technical Preview
IDL_DRSSReadNgcKey	4.1.31	Windows Server 2016 Technical Preview

<6> Section 4.1: The following table identifies the methods for which the Windows client operating systems (Windows 2000, Windows XP, Windows Vista, Windows 7, Windows 8, Windows 8.1, and Windows 10) can implement a client role.

Method	Windows client operating systems can implement a client role
IDL_DRSSBind Opnum: 0	Yes
IDL_DRSSUnbind Opnum: 1	Yes
IDL_DRSSReplicaSync Opnum: 2	Yes
IDL_DRSSGetNCChanges Opnum: 3	No
IDL_DRSSUpdateRefs Opnum: 4	Yes
IDL_DRSSReplicaAdd Opnum: 5	Yes
IDL_DRSSReplicaDel Opnum: 6	Yes
IDL_DRSSReplicaModify Opnum: 7	Yes
IDL_DRSSVerifyNames Opnum: 8	No
IDL_DRSSGetMemberships Opnum: 9	No
IDL_DRSSInterDomainMove Opnum: 10	No
IDL_DRSSGetNT4ChangeLog Opnum: 11	No
IDL_DRSSCrackNames Opnum: 12	Yes
IDL_DRSSWriteSPN Opnum: 13	Yes
IDL_DRSSRemoveDsServer Opnum: 14	Yes
IDL_DRSSRemoveDsDomain Opnum: 15	Yes
IDL_DRSSDomainControllerInfo Opnum: 16	Yes
IDL_DRSSAddEntry Opnum: 17	No
IDL_DRSSExecuteKCC Opnum: 18	Yes

Method	Windows client operating systems can implement a client role
IDL_DRSGetReplInfo Opnum: 19	Yes
IDL_DRSSAddSidHistory Opnum: 20	Yes
IDL_DRSGetMemberships2 Opnum: 21	No
IDL_DRSSReplicaVerifyObjects Opnum: 22	Yes
IDL_DRSSGetObjectExistence Opnum: 23	No
IDL_DRSSQuerySitesByCost Opnum: 24	Yes
IDL_DRSSInitDemotion Opnum: 25	Yes
IDL_DRSSReplicaDemotion Opnum: 26	Yes
IDL_DRSSFinishDemotion Opnum: 27	Yes
IDL_DRSSAddCloneDC Opnum: 28	No
IDL_DRSSWriteNgcKey Opnum: 29	Yes
IDL_DRSSReadNgcKey Opnum: 30	Yes

<7> Section 4.1.1.1.2: Though this request version appears in the IDL, Windows DCs do not support it. It was never supported in a released version of Windows Server operating system.

<8> Section 4.1.1.1.6: Though this response version appears in the IDL, Windows DCs do not support it.

<9> Section 4.1.1.3: This operation is only supported by AD LDS and AD DS in Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, and Windows Server 2016 ~~Technical Preview~~.

<10> Section 4.1.2.2.6: The function determines whether auditing is enabled on the server by querying the LSA information policy on the server associated with *ctx* and by confirming that the information policy is set to generate both success and failure audits for the "account management" audit category. To achieve this, the *LsarOpenPolicy2*, *LsarQueryInformationPolicy*, and *LsarClose* messages in [MS-LSAD] are used ([MS-LSAD] sections 3.1.4.4.1, 3.1.4.4.4, and 3.1.4.9.4). The **srcDomainController** variable in the *IDL_DRSSAddSidHistory* method is used as the *SystemName* parameter to *LsarOpenPolicy2*, and the *DesiredAccess* parameter to *LsarOpenPolicy2* is set to (POLICY_VIEW_AUDIT_INFORMATION + POLICY_VIEW_LOCAL_INFORMATION). On success, the *PolicyHandle* acquired from the *LsarOpenPolicy2* message is passed to *LsarQueryInformationPolicy*

with `PolicyAuditEventsInformation` as the information class. The check to determine whether success and failure audits are enabled for "account management" is achieved by performing the following evaluation:

```
PolicyInformation^.PolicyAuditEventsInfo.EventAuditingOptions[6] 0
{ POLICY_AUDIT_EVENT_SUCCESS, POLICY_AUDIT_EVENT_FAILURE } =
{ POLICY_AUDIT_EVENT_SUCCESS, POLICY_AUDIT_EVENT_FAILURE }
```

where `PolicyInformation` is the result from the `LsarQueryInformationPolicy` message. `PolicyHandle` is then closed by using the `LsarClose` message.

The function generates an audit on the DC associated with `ctx` by adding the source principal (`pmsgIn^.V1.SrcPrincipal`, where `pmsgIn` is a parameter to the `IDL_DRSAddSidHistory` method, which in turn calls this method) to the group `srcDomainFlatName$$$` on the DC associated with `ctx`, where `srcDomainFlatName` is the NetBIOS name of the domain to which the source principal belongs. After adding the principal to the group, it then removes the principal from the group, leaving the group in its original state but having generated an audit event as a side effect of manipulating the group's membership.

<11> Section 4.1.2.2.13: This test is implemented in two steps. First, it is determined if the DC associated with `ctx` is running at least Windows 2000. This is determined by whether a `SamrConnect5` or `SamrConnect4` API call (as specified in [MS-SAMR]) to the DC is successful. If it is, the DC is running at least Windows 2000, and the function returns true.

Otherwise, the DC is considered to be running Windows NT 4.0 operating system. The function then connects to the registry service on the DC named in `ctx` and queries the value of the "CSDVersion" registry value on the "HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows NT\CurrentVersion" registry key. If the value is not equal to any of the following strings, the function returns true; otherwise, it returns false:

- Service Pack 0
- Service Pack 1
- Service Pack 2
- Service Pack 3

If the registry service on the DC could not be contacted, or if the registry key or registry value does not exist, the function returns false.

<12> Section 4.1.3.1: Windows non-DC client callers always pass `NTDSAPI_CLIENT_GUID` in `puuidClientDsa`. If a Windows DC client caller uses the returned `DRS_HANDLE` for subsequent calls to the `IDL_DRSWriteSPN` method, then the client **MUST pass** `NTDSAPI_CLIENT_GUID` in `puuidClientDsa`. In any other cases, Windows DC client callers pass `DC!serverGuid` in `puuidClientDsa`.

<13> Section 4.1.3.1: Windows non-DC client callers always set the **dwFlags** field of the `DRS_EXTENSIONS_INT` structure to zero. Windows non-DC client callers always set the **SiteObjGuid** field of the `DRS_EXTENSIONS_INT` structure to the NULL GUID value. Windows non-DC client callers always set the **Pid** field of the `DRS_EXTENSIONS_INT` structure to an implementation-specific, client-local process identifier (PID).

Windows non-DC clients do not include the following fields in the `DRS_EXTENSIONS_INT` structure. In addition, the following fields are included by Windows DC clients only if the clients are running the corresponding versions of Windows.

Field	Included by
ConfigObjGUID	Windows DC clients running Windows Server 2003 R2 (AD LDS only), Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, and Windows Server 2016 Technical Preview.
dwFlagsExt	Windows DC clients running Windows Server 2003 R2 (AD LDS only), Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, and Windows Server 2016 Technical Preview.
dwExtCaps	Windows DC clients running Windows Server 2012 R2 <u>and Windows Server 2016.</u>

<14> Section 4.1.3.2: The **ConfigObjGUID** and **dwFlagsExt** fields in the DRS_EXTENSIONS_INT structure are included only by servers running Windows Server 2003 R2 (AD LDS only), Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, or Windows Server 2016 ~~Technical Preview.~~

<15> Section 4.1.5.2: All of the information levels listed in section 4.1.5.2 have existed in the drsuapi RPC interface since Windows 2000, except as noted in the following table.

Infolevel	Introduced in Windows version
3	Windows Server 2008

<16> Section 4.1.6.3: The Windows implementation of this method puts the KCC execution requests in a local-machine work queue. If DS_KCC_FLAG_DAMPED is specified in the call to IDL_DRSExecuteKCC and there is already a request pending, the execution request is not added to the queue in order to reduce redundant requests.

<17> Section 4.1.7.3: The Windows implementation of the IDL_DRSFinishDemotion method causes the underlying RPC protocol [MS-RPCE] to throw an RPC_S_INVALID_TAG exception when returning ERROR_INVALID_PARAMETER.

<18> Section 4.1.10.1.1: The Windows implementation never declares msgIn.uuidInvocIdSrc and msgIn.usnvecFrom that are otherwise valid to be stale.

<19> Section 4.1.10.1.1: The internal format of USN_VECTOR identifies the start of a cycle.

<20> Section 4.1.10.1.2: The goal is advanced on each request of a cycle.

<21> Section 4.1.10.1.2: *c.usnHighPropUpdate* is never set to 0.

<22> Section 4.1.10.1.3: The Request Role extended operation is supported by Windows 2000 Server, Windows Server 2003, Windows Server 2003 R2, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, and Windows Server 2016 ~~Technical Preview.~~

<23> Section 4.1.10.1.3: The Abandon Role extended operation is supported by Windows 2000 Server, Windows Server 2003, Windows Server 2003 R2, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, and Windows Server 2016 ~~Technical Preview.~~

<24> Section 4.1.10.1.3: The Allocate RIDs extended operation is supported by Windows 2000 Server, Windows Server 2003, Windows Server 2003 R2, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, and Windows Server 2016 ~~Technical Preview.~~

<25> Section 4.1.10.1.3: The Replicate Single Object extended operation is supported by Windows Server 2003, Windows Server 2003 R2, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, and Windows Server 2016 ~~Technical Preview~~.

<26> Section 4.1.10.1.3: The Replicate Single Object including Secret Data extended operation is supported by Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, and Windows Server 2016 ~~Technical Preview~~.

<27> Section 4.1.10.2.2: Though this request version appears in the IDL, Windows DCs never send this request version by means of RPC. It exists solely to support SMTP replication (see [MS-SRPL]).

<28> Section 4.1.10.2.3: Although this request version appears in the IDL, Windows DCs never send this request version using RPC. It exists solely to support SMTP replication ([MS-SRPL]).

<29> Section 4.1.10.2.5: Though this request version appears in the IDL, Windows DCs never send this request version using RPC. It exists solely to support SMTP replication ([MS-SRPL]).

<30> Section 4.1.10.2.18: Windows Server 2003, Windows Server 2003 R2, Windows Server 2008, and Windows Server 2008 R2 enforce the following range for the **cbCompressedSize** member: "[range(1,10485760)]".

<31> Section 4.1.10.5.7: The server tests the response against the limits after adding each object and link to the response, unless the object is a parent object that is being included because of the Ancestors predicate (see the GetReplChanges method). If the test shows that the response has exceeded one of the limits, the server stops adding to the response. The server ~~may~~ return more objects or bytes than the limits.

<32> Section 4.1.10.6.6: Windows DCs assign the remainder of the bits in values of *o!*instanceType for a given object *o* as follows:

- IT_UNINSTANT: Set if and only if *o* is an NC root and its NC replica is not present on the DC.
- IT_NC_ABOVE: Set if and only if *o* is an NC root and the DC has an NC replica with NC root *p* such that *p* is the parent of *o*.
- IT_NC_COMING: Set if and only if *o* is an NC root and the DC has not yet completed the first replication cycle for that NC replica.
- IT_NC_GOING: Set if and only if *o* is an NC root and the DC is in the process of removing its replica of the NC.

<33> Section 4.1.12.3: Windows uses count = 1000.

<34> Section 4.1.14.2: The Windows implementation of the **IDL_DRSInitDemotion** method causes the underlying RPC protocol (as specified in [MS-RPCE]) to throw an RPC_S_INVALID_TAG exception when returning ERROR_ACCESS_DENIED.

<35> Section 4.1.15.1.2: Although this request version appears in the IDL, Windows DCs do not support it. It was never supported in a released version of Windows Server.

<36> Section 4.1.15.1.5: Although this response version appears in the IDL, Windows DCs do not support it.

<37> Section 4.1.16.3: The server returns the error ERROR_DS_GENERIC_ERROR if the Intersite Messaging Service is not running on the server.

<38> Section 4.1.24.3: The Windows implementation of the for loop uses IDL_DRSGetObjectExistence to determine if object *o* exists at *refDsa*, and logs a message to the Windows Event Log.

<39> Section 5.39: In Windows 2000 Server, the **cb** field contains the count of bytes in the fields **dwFlags** through **Pid**, inclusive, which is the size of the structure in that version minus the 4 bytes of the **cb** field.

<40> Section 5.39: In AD DS and AD LDS servers running Windows Server 2003, and in AD DS servers running Windows Server 2003 R2, the **cb** field contains the count of bytes in the fields **dwFlags** through **dwReplEpoch**, inclusive, which is the size of the structure in those versions minus the 4 bytes of the **cb** field.

<41> Section 5.39: In Windows Server 2003 R2 (AD LDS only), Windows Server 2008, Windows Server 2008 R2, and Windows Server 2012, the **cb** field contains the count of bytes in the fields **dwFlags** through **ConfigObjGUID**, inclusive, which is the size of the structure in those versions minus the 4 bytes of the **cb** field.

<42> Section 5.39: Client callers set dwFlags to zero.

<43> Section 5.39: This field contains the process ID of the client.

<44> Section 5.39: The **dwReplEpoch** field in the DRS_EXTENSIONS_INT structure is included only by servers running Windows Server 2003, Windows Server 2003 R2, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, or Windows Server 2016 ~~Technical Preview~~.

<45> Section 5.39: The **ConfigObjGUID** and **dwFlagsExt** fields in the DRS_EXTENSIONS_INT structure are included only by AD DS servers running Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, or Windows Server 2016 ~~Technical Preview~~ and by AD LDS servers running Windows Server 2003 R2, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, or Windows Server 2016 ~~Technical Preview~~.

<46> Section 5.39: The **ConfigObjGUID** and **dwFlagsExt** fields in the DRS_EXTENSIONS_INT structure are included only by AD DS servers running Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, or Windows Server 2016 ~~Technical Preview~~ and by AD LDS servers running Windows Server 2003 R2, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, or Windows Server 2016 ~~Technical Preview~~.

<47> Section 5.39: The **dwExtCaps** field in the DRS_EXTENSIONS_INT structure is included only by AD DS ~~servers running Windows Server 2012 R2, and by~~ AD LDS servers running Windows Server 2012 R2 ~~and Windows Server 2016~~.

<48> Section 5.41: All the DRS_OPTIONS listed in section 5.41 have existed in the drsuapi RPC interface since Windows 2000 except those listed in the following table.

Flag	Windows version introduced
DRS_SYNC_PAS	Windows Server 2003

This flag is ignored inbound on the operating systems previous to its introduction.

All the DRS_OPTIONS listed in section 5.41 continue to exist in this interface in subsequent versions of Windows according to the applicability list at the beginning of this section, except those listed in the following table.

Flag	Windows version deprecated
DRS_SYNC_ALL	Windows Server 2012

This flag ~~should~~is not ~~to~~ be used on the operating system from which it was removed or on subsequent versions of the operating system. If this flag is used on a deprecated platform, the error code ERROR_DS_DRA_INVALID_PARAMETER will be returned.

The following pseudocode specifies how to unmask the flags that are unsupported for each operating system.

```
msgReq.ulFlags &= msgReq.ulFlags & allowedFlagsForSpecificOS
```

<49> Section 5.50: No range is supported on any member of DSNAME in Windows 2000 Server. A range of 0 to 10485760 is supported on the **NameLen** member of DSNAME in Windows Server 2003 and Windows Server 2003 R2. A range of 0 to 10485761 is supported on the **StringName** member of DSNAME in Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, and Windows Server 2016 ~~Technical Preview~~.

<50> Section 5.170: Windows 2000 Server, Windows Server 2003, and Windows Server 2003 R2 AD DS DCs have a value of 1 in the dwVersion field. Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, and Windows Server 2016 ~~Technical Preview~~ AD DS DCs have a value of 2 in the dwVersion field. Windows Server 2003 R2, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, and Windows Server 2016 ~~Technical Preview~~ AD LDS DCs have a value of 2 in the **dwVersion** field.

<51> Section 5.171: Windows 2000 Server, Windows Server 2003, and Windows Server 2003 R2 AD DS DCs have a value of 1 in the dwVersion field. Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, and Windows Server 2016 ~~Technical Preview~~ AD DS DCs have a value of 2 in the **dwVersion** field. Windows Server 2003 R2, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, and Windows Server 2016 ~~Technical Preview~~ AD LDS DCs have a value of 2 in the **dwVersion** field.

<52> Section 5.211: Windows Server 2008 and Windows Server 2008 R2 do not raise an ERROR_INVALID_PARAMETER exception when *opnum*==26 and *IsAdlds()* == false. Instead, the method **IDL_DRSReplicaDemotion (section 4.1.21)** executes, and the effects vary depending on the NC specified in *pmsgIn.V1.pNC*.

If *pmsgIn.V1.pNC* contains the **DSNAME** of the default NC, then:

- The return code from **IDL_DRSReplicaDemotion** is ERROR_SUCCESS.
- Only the FSMO roles contained within the domain NC, as described in [MS-ADTS] section 3.1.1.1.11, FSMO Roles, are transferred to a replication partner.
- *pmsgIn.V1.pNC!repsFrom* values are not removed.

If *pmsgIn.V1.pNC* contains the **DSNAME** of the config NC, then:

- The return code from **IDL_DRSReplicaDemotion** is ERROR_INVALID_DOMAINNAME.
- No FSMO roles are transferred.
- *pmsgIn.V1.pNC!repsFrom* values are not removed.

If *pmsgIn.V1.pNC* contains the **DSNAME** of the schema NC, then:

- The return code from **IDL_DRSReplicaDemotion** is ERROR_INVALID_DOMAINNAME.
- No FSMO roles are transferred.
- *pmsgIn.V1.pNC!repsFrom* values are not removed.

If *pmsgIn.V1.pNC* contains the **DSNAME** of a domain NC and *pmsgIn.V1.pNC!instanceType* does not contain IT_WRITE, then:

- The return code from **IDL_DRSReplicaDemotion** is ERROR_NO_SUCH_DOMAIN.

- No FSMO roles are transferred.
- *pmsgIn.V1.pNC!repsFrom* values are not removed.

If *pmsgIn.V1.pNC* contains the **DSNAME** of an application NC, then:

- The return code from **IDL_DRSReplicaDemotion** is ERROR_NO_SUCH_DOMAIN.
- No FSMO roles are transferred.
- *pmsgIn.V1.pNC!repsFrom* values are not removed.

9 Change Tracking

~~No table of This section identifies changes is available. The that were made to this document is either new or has had no changes since its the last release. Changes are classified as New, Major, Minor, Editorial, or No change.~~

~~The revision class **New** means that a new document is being released.~~

~~The revision class **Major** means that the technical content in the document was significantly revised. Major changes affect protocol interoperability or implementation. Examples of major changes are:~~

- ~~▪ A document revision that incorporates changes to interoperability requirements or functionality.~~
- ~~▪ The removal of a document from the documentation set.~~

~~The revision class **Minor** means that the meaning of the technical content was clarified. Minor changes do not affect protocol interoperability or implementation. Examples of minor changes are updates to clarify ambiguity at the sentence, paragraph, or table level.~~

~~The revision class **Editorial** means that the formatting in the technical content was changed. Editorial changes apply to grammatical, formatting, and style issues.~~

~~The revision class **No change** means that no new technical changes were introduced. Minor editorial and formatting changes may have been made, but the technical content of the document is identical to the last released version.~~

~~Major and minor changes can be described further using the following change types:~~

- ~~▪ New content added.~~
- ~~▪ Content updated.~~
- ~~▪ Content removed.~~
- ~~▪ New product behavior note added.~~
- ~~▪ Product behavior note updated.~~
- ~~▪ Product behavior note removed.~~
- ~~▪ New protocol syntax added.~~
- ~~▪ Protocol syntax updated.~~
- ~~▪ Protocol syntax removed.~~
- ~~▪ New content added due to protocol revision.~~
- ~~▪ Content updated due to protocol revision.~~
- ~~▪ Content removed due to protocol revision.~~
- ~~▪ New protocol syntax added due to protocol revision.~~
- ~~▪ Protocol syntax updated due to protocol revision.~~
- ~~▪ Protocol syntax removed due to protocol revision.~~
- ~~▪ Obsolete document removed.~~

~~Editorial changes are always classified with the change type **Editorially updated**.~~

Some important terms used in the change type descriptions are defined as follows:

- **Protocol syntax** refers to data elements (such as packets, structures, enumerations, and methods) as well as interfaces.
- **Protocol revision** refers to changes made to a protocol that affect the bits that are sent over the wire.

The changes made to this document are listed in the following table. For more information, please contact dochelp@microsoft.com.

Section	Tracking number (if applicable) and description	Major change (Y or N)	Change type
1.3.1 Methods Categorized by Function	5357 : Included the msDS-KeyCredentialLink attribute support methods: IDL_DRSWriteNgcKey , IDL_DRSReadNgcKey in the list of methods that the DRS Remote Protocol contains.	Y	Content update.
4.1.3.1 Client Behavior When Sending the IDL_DRSBind Request	Updated product behavior note for this version of Windows Server.	Y	Product behavior note updated.
4.1.3.1 Client Behavior When Sending the IDL_DRSBind Request	5358 : Included tables of request version to response version for the IDL_DRSWriteNgcKey and IDL_DRSReadNgcKey methods.	Y	Content update.
4.1.10.5.12 ProcessFsmoRoleRequest	Updated the use of pMsgIn in the procedure implementation to match the procedure's signature (msgIn: DRS_MSG_GETCHGREQ_V10) and the use of NC to match the pNC member of DRS_MSG_GETCHGREQ_V10.	Y	Content update.
4.1.18.2 Server Behavior of the IDL_DRSRemoveDsServer Method	72818 : Added pseudo code to clean up read-only domain controllers in the IDL_DRSRemoveDsServer implementation.	Y	Content update.
4.1.27.1.4 DRS_MSG_VERIFYREPLY_V1	73072 : Updated RequestAttrs to RequiredAttrs in the rpEntInf array definition.	Y	Content update.
5.39 DRS_EXTENSIONS_INT	Updated product behavior note for this version of Windows Server.	Y	Product behavior note updated.

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