

# [MC-NETCEX-Diff]: .NET Context Exchange Protocol

---

## Intellectual Property Rights Notice for Open Specifications Documentation

- **Technical Documentation.** Microsoft publishes Open Specifications documentation (“this documentation”) for protocols, file formats, data portability, computer languages, and standards as well as overviews of the interaction among each of these technologies support. Additionally, overview documents cover inter-protocol relationships and interactions.
- **Copyrights.** This documentation is covered by Microsoft copyrights. Regardless of any other terms that are contained in the terms of use for the Microsoft website that hosts this documentation, you maycan make copies of it in order to develop implementations of the technologies that are described in the Open Specifications this documentation and maycan distribute portions of it in your implementations using that use these technologies or in your documentation as necessary to properly document the implementation. You maycan also distribute in your implementation, with or without modification, any schema, IDL's schemas, IDLs, or code samples that are included in the documentation. This permission also applies to any documents that are referenced in the Open Specifications- documentation.
- **No Trade Secrets.** Microsoft does not claim any trade secret rights in this documentation.
- **Patents.** Microsoft has patents that maymight cover your implementations of the technologies described in the Open Specifications- documentation. Neither this notice nor Microsoft's delivery of the this documentation grants any licenses under those patents or any other Microsoft patents. However, a given Open Specification may Specifications document might be covered by the Microsoft Open Specifications Promise or the Microsoft Community Promise. If you would prefer a written license, or if the technologies described in the Open Specifications this documentation are not covered by the Open Specifications Promise or Community Promise, as applicable, patent licenses are available by contacting [iplg@microsoft.com](mailto:iplg@microsoft.com).
- **Trademarks.** The names of companies and products contained in this documentation maymight be covered by trademarks or similar intellectual property rights. This notice does not grant any licenses under those rights. For a list of Microsoft trademarks, visit [www.microsoft.com/trademarks](http://www.microsoft.com/trademarks).
- **Fictitious Names.** The example companies, organizations, products, domain names, e-mail email addresses, logos, people, places, and events that are depicted in this documentation are fictitious. No association with any real company, organization, product, domain name, email address, logo, person, place, or event is intended or should be inferred.

**Reservation of Rights.** All other rights are reserved, and this notice does not grant any rights other than as specifically described above, whether by implication, estoppel, or otherwise.

**Tools.** The Open Specifications documentation does not require the use of Microsoft programming tools or programming environments in order for you to develop an implementation. If you have access to Microsoft programming tools and environments, you are free to take advantage of them. Certain Open Specifications documents are intended for use in conjunction with publicly available standard standards specifications and network programming art, and assumes, as such, assume that the reader either is familiar with the aforementioned material or has immediate access to it.

## Revision Summary

Date	Revision History	Revision Class	Comments
4/8/2008	0.1	<u>New</u>	Version 0.1 release
5/16/2008	0.1.1	Editorial	Changed language and formatting in the technical content.
6/20/2008	0.1.2	Editorial	Changed language and formatting in the technical content.
7/25/2008	0.1.3	Editorial	Changed language and formatting in the technical content.
8/29/2008	0.1.4	Editorial	Changed language and formatting in the technical content.
10/24/2008	0.1.5	Editorial	Changed language and formatting in the technical content.
12/5/2008	0.1.6	Editorial	Changed language and formatting in the technical content.
1/16/2009	0.1.7	Editorial	Changed language and formatting in the technical content.
2/27/2009	1.0	Major	Updated and revised the technical content.
4/10/2009	1.0.1	Editorial	Changed language and formatting in the technical content.
5/22/2009	1.0.2	Editorial	Changed language and formatting in the technical content.
7/2/2009	1.0.3	Editorial	Changed language and formatting in the technical content.
8/14/2009	1.0.4	Editorial	Changed language and formatting in the technical content.
9/25/2009	1.1	Minor	Clarified the meaning of the technical content.
11/6/2009	1.1.1	Editorial	Changed language and formatting in the technical content.
12/18/2009	1.1.2	Editorial	Changed language and formatting in the technical content.
1/29/2010	1.2	Minor	Clarified the meaning of the technical content.
3/12/2010	1.2.1	Editorial	Changed language and formatting in the technical content.
4/23/2010	1.2.2	Editorial	Changed language and formatting in the technical content.
6/4/2010	1.2.3	Editorial	Changed language and formatting in the technical content.
7/16/2010	2.0	Major	Updated and revised the technical content.
8/27/2010	2.0	None	No changes to the meaning, language, or formatting of the technical content.
10/8/2010	2.0	None	No changes to the meaning, language, or formatting of the technical content.
11/19/2010	2.0	None	No changes to the meaning, language, or formatting of the technical content.
1/7/2011	2.0	None	No changes to the meaning, language, or formatting of the technical content.
2/11/2011	2.0	None	No changes to the meaning, language, or formatting of the technical content.
3/25/2011	2.0	None	No changes to the meaning, language, or formatting of the technical content.

Date	Revision History	Revision Class	Comments
5/6/2011	2.0	None	No changes to the meaning, language, or formatting of the technical content.
6/17/2011	2.1	Minor	Clarified the meaning of the technical content.
9/23/2011	2.1	None	No changes to the meaning, language, or formatting of the technical content.
12/16/2011	3.0	Major	Updated and revised the technical content.
3/30/2012	3.0	None	No changes to the meaning, language, or formatting of the technical content.
7/12/2012	3.0	None	No changes to the meaning, language, or formatting of the technical content.
10/25/2012	3.0	None	No changes to the meaning, language, or formatting of the technical content.
1/31/2013	3.0	None	No changes to the meaning, language, or formatting of the technical content.
8/8/2013	3.0	None	No changes to the meaning, language, or formatting of the technical content.
11/14/2013	3.0	None	No changes to the meaning, language, or formatting of the technical content.
2/13/2014	3.0	None	No changes to the meaning, language, or formatting of the technical content.
5/15/2014	3.0	None	No changes to the meaning, language, or formatting of the technical content.
6/30/2015	4.0	Major	Significantly changed the technical content.
10/16/2015	4.0	<del>No Change</del> None	No changes to the meaning, language, or formatting of the technical content.

# Table of Contents

<b>1</b>	<b>Introduction .....</b>	<b>6</b>
1.1	Glossary .....	6
1.2	References .....	7
1.2.1	Normative References .....	7
1.2.2	Informative References .....	8
1.3	Overview .....	8
1.4	Relationship to Other Protocols .....	12
1.5	Prerequisites/Preconditions .....	12
1.6	Applicability Statement .....	12
1.7	Versioning and Capability Negotiation .....	12
1.8	Vendor-Extensible Fields .....	13
1.9	Standards Assignments.....	13
<b>2</b>	<b>Messages.....</b>	<b>14</b>
2.1	Transport.....	14
2.2	Message Syntax.....	14
2.2.1	CONTEXT_XML .....	15
2.2.2	CALLBACK_CONTEXT_XML.....	16
2.2.3	CONTEXT_NV .....	17
2.2.4	HTTP Client Message Header .....	17
2.2.5	HTTP Server Message Header.....	17
2.2.6	Server Context Establishing Message .....	18
2.2.7	Context Participating Message.....	18
<b>3</b>	<b>Protocol Details .....</b>	<b>19</b>
3.1	Context Exchange Client Role Details.....	19
3.1.1	Abstract Data Model.....	19
3.1.1.1	IDLE State .....	20
3.1.1.2	WAIT_CORRELATED_SM State.....	20
3.1.1.3	WAIT_SM State .....	20
3.1.1.4	ENDED State .....	21
3.1.2	Timers .....	21
3.1.3	Initialization.....	21
3.1.4	Higher-Layer Triggered Events .....	21
3.1.4.1	SEND_CM .....	21
3.1.4.2	TERMINATE.....	22
3.1.5	Message Processing Events and Sequencing Rules .....	22
3.1.5.1	RECEIVE_SM .....	22
3.1.6	Timer Events.....	23
3.1.7	Other Local Events.....	23
3.2	Context Exchange Server Role Details .....	23
3.2.1	Abstract Data Model.....	23
3.2.1.1	WAIT_CM State .....	24
3.2.1.2	ENDED State .....	24
3.2.2	Timers .....	24
3.2.3	Initialization.....	24
3.2.4	Higher-Layer Triggered Events .....	24
3.2.4.1	TERMINATE.....	24
3.2.5	Message Processing Events and Sequencing Rules .....	25
3.2.5.1	RECEIVE_CM .....	25
3.2.6	Timer Events.....	26
3.2.7	Other Local Events.....	26
3.3	Callback Context Exchange Client Role Details .....	27
3.3.1	Abstract Data Model.....	27
3.3.1.1	WAIT_SM State .....	27

3.3.1.2	ENDED State .....	27
3.3.2	Timers .....	27
3.3.3	Initialization .....	28
3.3.4	Higher-Layer Triggered Events .....	28
3.3.4.1	TERMINATE .....	28
3.3.5	Message Processing Events and Sequencing Rules .....	28
3.3.5.1	SEND_CM .....	28
3.3.5.2	RECEIVE_SM .....	28
3.3.6	Timer Events.....	29
3.3.7	Other Local Events.....	29
3.4	Callback Context Exchange Server Role Details .....	29
3.4.1	Abstract Data Model .....	29
3.4.1.1	WAIT_CM State .....	30
3.4.1.2	ENDED State .....	30
3.4.2	Timers .....	30
3.4.3	Initialization .....	30
3.4.4	Higher-Layer Triggered Events .....	31
3.4.4.1	TERMINATE .....	31
3.4.5	Message Processing Events and Sequencing Rules .....	31
3.4.5.1	RECEIVE_CM .....	31
3.4.5.2	SEND_SM .....	31
3.4.6	Timer Events.....	32
3.4.7	Other Local Events.....	32
<b>4</b>	<b>Protocol Examples .....</b>	<b>33</b>
4.1	Using the .NET Context Exchange Protocol with SOAP 1.2 .....	33
4.1.1	Establishing Context Using SOAP 1.2.....	33
4.1.2	Subsequent Context Participating Messages Using SOAP 1.2 .....	34
4.1.3	Continue Using Context Using SOAP 1.2 .....	35
4.1.4	Establish a Callback Context .....	35
4.1.5	Subsequent Callback Messages .....	36
4.2	Using the .NET Context Exchange Protocol with HTTP .....	36
4.2.1	Establishing Context Using HTTP.....	36
4.2.2	Subsequent Context Participating Messages Using HTTP .....	37
4.2.3	Continue Using the Context Using HTTP.....	38
4.3	Processing an Unrecognized Context Using SOAP 1.2.....	38
4.4	Processing an Unrecognized Context Using HTTP.....	39
<b>5</b>	<b>Security .....</b>	<b>40</b>
5.1	Security Considerations for Implementers .....	40
5.2	Index of Security Parameters .....	40
<b>6</b>	<b>Appendix A: Product Behavior .....</b>	<b>41</b>
<b>7</b>	<b>Change Tracking.....</b>	<b>42</b>
<b>8</b>	<b>Index.....</b>	<b>43</b>

# 1 Introduction

This document specifies the .NET Context Exchange Protocol, which specifies a message syntax for identifying context that is shared between a client and a server, and a protocol for establishing that context.

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:~~

**base64 encoding:** A binary-to-text encoding scheme whereby an arbitrary sequence of bytes is converted to a sequence of printable ASCII characters, as described in [RFC4648].

**callback context:** The **context** that is required for a **server** to make callbacks to a **client**. A callback context consists of an **endpoint reference** for a **client endpoint** with an optional **context identifier**.

**client:** A computer on which the remote procedure call (RPC) client is executing.

**Client Context Initiating Message:** A **client message** that requests a server to establish a **context**.

**client message:** A message that is sent from a **client** to a **server**.

**connection:** A time-bounded association between two **endpoints** that allows the two **endpoints** to exchange messages.

**context:** An abstract concept that represents an association between a resource and a set of messages that are exchanged between a **client** and a **server**. A context is uniquely identified by a **context identifier**.

**context identifier:** A GUID that identifies a **context**.

**Context Participating Message:** A **client message** or a **server message** that is one of a set of messages associated with a context.

**endpoint:** A communication port that is exposed by an application server for a specific shared service and to which messages can be addressed.

**endpoint reference (EPR):** A resource that conveys the information that is needed to address an **endpoint**.

**server:** A computer on which the remote procedure call (RPC) server is executing.

**Server Context Establishing Message:** A **server message** that establishes a new context and is correlated to a **Client Context Initiating Message**.

**server message:** A message that is sent from a **server** to a **client**.

**SOAP:** A lightweight protocol for exchanging structured information in a decentralized, distributed environment. **SOAP** uses XML technologies to define an extensible messaging framework, which provides a message construct that can be exchanged over a variety of underlying protocols. The framework has been designed to be independent of any particular programming model and

other implementation-specific semantics. SOAP 1.2 supersedes SOAP 1.1. See [SOAP1.2-1/2003].

**SOAP envelope:** A container for **SOAP message** information and the root element of a **SOAP** document. See [SOAP1.2-1/2007] section 5.1 for more information.

**SOAP fault:** A container for error and status information within a **SOAP message**. See [SOAP1.2-1/2007] section 5.4 for more information.

**SOAP header:** A mechanism for implementing extensions to a **SOAP message** in a decentralized manner without prior agreement between the communicating parties. See [SOAP1.2-1/2007] section 5.2 for more information.

**SOAP message:** An XML document consisting of a mandatory **SOAP envelope**, an optional **SOAP header**, and a mandatory SOAP body. See [SOAP1.2-1/2007] section 5 for more information.

**UTF-8:** A byte-oriented standard for encoding Unicode characters, defined in the Unicode standard. Unless specified otherwise, this term refers to the UTF-8 encoding form specified in [UNICODE5.0.0/2007] section 3.9.

**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 dochelp@microsoft.com. We will assist you in finding the relevant information.

[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>

[RFC2234] Crocker, D. and Overell, P., "Augmented BNF for Syntax Specifications: ABNF", RFC 2234, November 1997, <http://www.ietf.org/rfc/rfc2234.txt>

[RFC2616] Fielding, R., Gettys, J., Mogul, J., et al., "Hypertext Transfer Protocol -- HTTP/1.1", RFC 2616, June 1999, <http://www.rfc-editor.org/rfc/rfc2616.txt>

[RFC3548] Josefsson, S., Ed., "The Base16, Base32, and Base64 Data Encodings", RFC 3548, July 2003, <http://www.rfc-editor.org/rfc/rfc3548.txt>

[RFC3629] Yergeau, F., "UTF-8, A Transformation Format of ISO 10646", STD 63, RFC 3629, November 2003, <http://www.ietf.org/rfc/rfc3629.txt>

[SOAP1.1] Box, D., Ehnebuske, D., Kakivaya, G., et al., "Simple Object Access Protocol (SOAP) 1.1", May 2000, <http://www.w3.org/TR/2000/NOTE-SOAP-20000508/>

[SOAP1.2-1/2007] Gudgin, M., Hadley, M., Mendelsohn, N., et al., "SOAP Version 1.2 Part 1: Messaging Framework (Second Edition)", W3C Recommendation 27, April 2007, <http://www.w3.org/TR/2007/REC-soap12-part1-20070427/>

[W3C-XSD] World Wide Web Consortium, "XML Schema Part 2: Datatypes Second Edition", October 2004, <http://www.w3.org/TR/2004/REC-xmlschema-2-20041028>

[WSA] Gudgin, M., Hadley, M., and Rogers, T., "Web Services Addressing 1.0 - Core", W3C Recommendation, May 2006, <http://www.w3.org/TR/2006/REC-ws-addr-core-20060509/>

[XML1.0] Bray, T., Paoli, J., Sperberg-McQueen, C.M., and Maler, E., "Extensible Markup Language (XML) 1.0 (Second Edition)", W3C Recommendation, October 2000, <http://www.w3.org/TR/2000/REC-xml-20001006>

## 1.2.2 Informative References

[RFC2109] Kristol, D., and Montulli, L., "HTTP State Management Mechanism", RFC 2109, February 1997, <http://www.rfc-editor.org/rfc/rfc2109.txt>

[RFC2965] Kristol, D. and Montulli, L., "HTTP State Management Mechanism", RFC 2965, October 2000, <http://www.ietf.org/rfc/rfc2965.txt>

[RFC4346] Dierks, T., and Rescorla, E., "The Transport Layer Security (TLS) Protocol Version 1.1", RFC 4346, April 2006, <http://www.ietf.org/rfc/rfc4346.txt>

[WSS1] Nadalin, A., Kaler, C., Hallam-Baker, P., et al., "Web Services Security: SOAP Message Security 1.0 (WS-Security 2004)", March 2004, <http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-soap-message-security-1.0.pdf>

## 1.3 Overview

The .NET Context Exchange Protocol specifies a message syntax for identifying **context** that is shared between a **client** and a **server** independent of **connection** usage, and a protocol for establishing that context. For example, in some scenarios, the connection between a client and a server is sufficient for the server to relate the **client messages** to specific resources; a chat application can define a conversation resource and relate chat messages to a conversation by associating the conversation with chat messages that arrive over a particular connection.

It is typical, however, for a set of client messages to be associated with a resource that is independent of a connection. For example, a **SOAP**-based shopping application can define a shopping cart resource and relate client messages to the shopping cart even if the first few messages arrive on one connection and the remaining messages arrive on a different connection. The .NET Context Exchange Protocol facilitates this more general connection-independent case.

The .NET Context Exchange Protocol can be used in one of two modes: stateless or stateful. In stateless mode, a client and server use the message syntax specified in section 2.2; however, the interpretation of this syntax is defined by the client and server implementations. In stateful mode, the client and server ~~must~~ interpret the message syntax as specified in section 3. Unless explicitly mentioned, this document discusses the .NET Context Exchange Protocol in stateful mode.

This protocol specifies two roles for context exchange: a client role and a server role. The server role is responsible for creating **context identifiers** in response to client requests and associating context identifiers with resources. For example, a shopping service ~~may~~can create a context identifier with the following (property name, property value) pair.

Property name	Property value
shoppingCartId	1a1913b1-cb24-4d94-91d2-cf414a569481

~~It may then store~~After that, it stores a shopping cart resource by using the value of the shoppingCartId as a key.

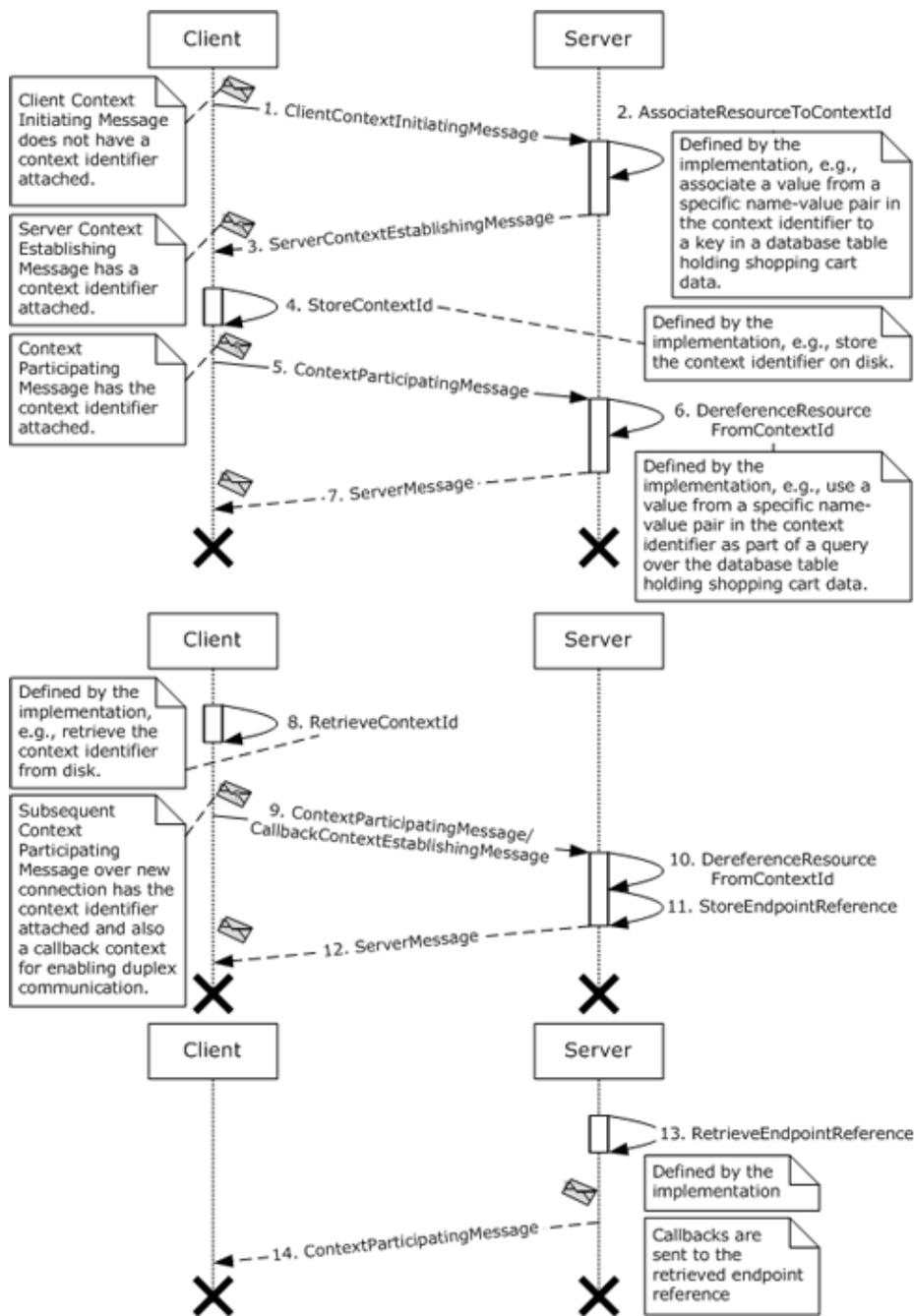
The client role initiates communication with the server role, captures the context identifier that is sent from the server role, and attaches the context identifier to all subsequent client messages that are related to the resources in question. For example, a client shopping application [may can](#) use the previously mentioned shopping service to create a shopping cart resource using the .NET Context Exchange Protocol. The client stores the context identifier that is generated by the server and attaches it to each message that is intended to manipulate the shopping cart.

The protocol also specifies two roles for **callback context** exchange: a client role and a server role. <1> The initial communication of the client role with the server role ~~may specify~~**specifies** a callback context to enable duplex communication. The callback context consists of an **endpoint reference** that specifies the address of the client **endpoint**. The endpoint reference ~~may optionally can~~ contain a context identifier that is associated with resources by the client. For example, a customer of a shopping service [may can](#) create a context identifier with the following (property name, property value) pair.

Property name	Property value
customerId	9b0e43f0-e783-4cb9-8343-106d677c4ed7

Note that the roles for context exchange and callback context exchange compose. For example, the entity acting as the client role for context exchange [may can](#) also act as the client role for callback context exchange.

The following figure describes the typical use of the .NET Context Exchange Protocol.



**Figure 1: Typical use of the .NET Context Exchange Protocol**

Each message that is exchanged between client and server is an application-specific message. This protocol is a header-based protocol that composes into client and server messages:

1. The client sends a **Client Context Initiating Message** to the server. The server recognizes this message as a Client Context Initiating Message because it does not have a context identifier attached.
2. The server creates a resource (for example, a shopping cart) and a new context identifier. It then associates the resource with the new context identifier.

3. The server returns a **Server Context Establishing Message** to the client with the newly created context identifier attached.
4. The client stores the attached context identifier so that it can be retrieved even if the client process is restarted.
5. The client sends the server a **Context Participating Message** with the context identifier attached. This message is intended to manipulate the resource that is created in step 2. For example, it may be intended to add an item to the shopping cart.
6. The server dereferences the resource using the context identifier. For example, it may use the property value of the property named "shoppingCartId" in the predicate of a database query to retrieve the shopping cart. ~~It may then act~~After that, it acts on the resource according to the message it received.
7. The server sends a response back to the client.
8. At some point later on a different connection, the client retrieves the context identifier that it stored earlier in step 4.
9. The client then sends the server a Context Participating Message that has the context identifier attached. This message is intended to manipulate the resource that was created in step 2. For example, it may be intended to purchase the items in the shopping cart.

The message that is sent by the client is also a Callback Context Establishing Message that has a callback context attached. This allows the server to engage in a duplex conversation with the client. For example, it allows the server to notify the client when the purchased items have shipped.

10. The server dereferences the resource from the context identifier, as described in step 6.
11. The server stores the endpoint reference that is sent in the callback context from the client.
12. The server sends a response back to the client. For example, the server acknowledges that the items in the shopping cart have been purchased.
13. At some point later on a different connection, the server retrieves the endpoint reference that it stored earlier in step 11.
14. The server sends a Context Participating Message to the endpoint reference from the callback context. For example, it notifies the specific customer that purchased items have been shipped.

These examples and the examples in section 4 of this document demonstrate sending a context identifier from a server to a client in a Server Context Establishing Message. This protocol does not require a client and server to exchange a context identifier by using a Client Context Initiating Message and a Server Context Establishing Message. A client and server may agree on a context identifier without this initial exchange. The protocol that is specified in section 3 allows the client to acquire a context identifier by using a Client Context Initiating Message and a Server Context Establishing Message; then subsequently, to send Context Participating Messages.

Alternatively, this protocol allows an implementation-specific context exchange mechanism to be leveraged to initialize the protocol with a context identifier. This context identifier can then be attached to subsequent Context Participating Messages.

Similarly, the callback context need not be established using a Callback Context Establishing Message, but could instead be established through an implementation-specific callback context exchange mechanism.

## 1.4 Relationship to Other Protocols

The .NET Context Exchange Protocol can be used with HTTP [RFC2616] or SOAP-formatted messages [SOAP1.2-1/2007] [SOAP1.1]. The following figure shows a protocol stack.

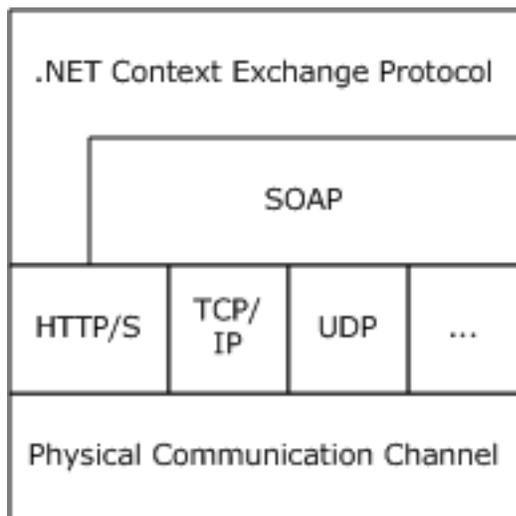


Figure 2: Protocol stack for the .NET Context Exchange Protocol

## 1.5 Prerequisites/Preconditions

The .NET Context Exchange Protocol requires that the client role can communicate with a server role so that client messages and server messages can be exchanged.

The .NET Context Exchange Protocol requires an underlying protocol in which a **server message** can be correlated to a unique client message.

## 1.6 Applicability Statement

The .NET Context Exchange Protocol is applicable to scenarios where a client and server application requires a set of client messages to be associated with a resource independent of a connection. The client and server application use this protocol to share context.

## 1.7 Versioning and Capability Negotiation

This document covers versioning issues in the following areas:

- **Supported Transports:** This protocol can be implemented by using transports that support sending HTTP [RFC2616] or SOAP messages, as discussed in section 2.1.
- **Protocol Versions:** When this protocol is implemented by using SOAP, it requires the use of SOAP messaging version 1.1 [SOAP1.1] or SOAP messaging 1.2 [SOAP1.2-1/2007]. When this protocol is implemented by using HTTP, it requires the use of HTTP version 1.1.
- **Capability Negotiation:** The .NET Context Exchange Protocol does not support negotiation of the version to use. Instead, an implementation ~~must be~~ is configured to process only messages as described in section 2.1.

## 1.8 Vendor-Extensible Fields

Vendors and implementers MAY extend the protocol by including additional attributes [XML1.0] on the CONTEXT\_XML element or its child Property element. The interpretation of these attributes is defined by the implementation. For example, an extension MAY be used to:

- Convey lifetime information for a particular context identifier.
- Convey metadata about the applicability of the context identifier.

Similarly, vendors and implementers MAY extend the protocol by including additional attributes [XML1.0] on the CALLBACK\_CONTEXT\_XML element. The interpretation of these attributes is defined by the implementation.

## 1.9 Standards Assignments

There are no standards assignments for this protocol.

## 2 Messages

### 2.1 Transport

The .NET Context Exchange Protocol can be used over any transport protocol that supports transmitting messages that are specified by the following protocols:

- HTTP 1.1 [RFC2616]
- SOAP 1.1 [SOAP1.1]
- SOAP 1.2 [SOAP1.2-1/2007]

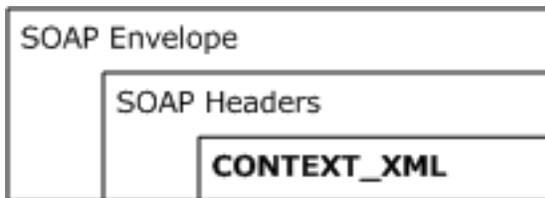
This specification uses the term SOAP to mean either SOAP 1.1 or SOAP 1.2. Where the differences between the two versions of SOAP are significant, either SOAP 1.1 or SOAP 1.2 is referenced.

An implementation of the .NET Context Exchange Protocol MUST support the processing of messages that are specified by HTTP 1.1 or either of the SOAP versions. This section specifies the format of .NET Context Exchange Protocol messages using the message formats of both HTTP 1.1 and SOAP.

### 2.2 Message Syntax

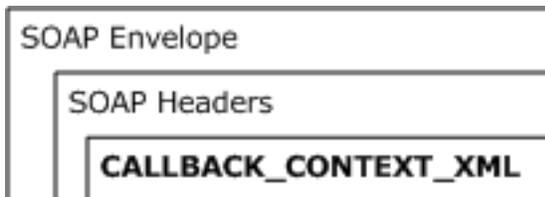
This section specifies the messages that are used by the .NET Context Exchange Protocol and their relationship to HTTP 1.1 [RFC2616] and SOAP.

When used with SOAP, the .NET Context Exchange Protocol uses a CONTEXT\_XML element as a **SOAP header** using the SOAP extensibility model, specified in [SOAP1.2-1/2007] section 3, to form a Server Context Establishing Message or a Context Participating Message. The following figure shows the containment of CONTEXT\_XML in a **SOAP envelope**.



**Figure 3: Context Participating Message or Server Context Establishing Message using SOAP**

The .NET Context Exchange Protocol uses CALLBACK\_CONTEXT\_XML as a SOAP header using the SOAP extensibility model, specified in [SOAP1.2-1/2007] section 3, to form a Callback Context Establishing Message. The following figure shows the containment of CALLBACK\_CONTEXT\_XML in a SOAP envelope.



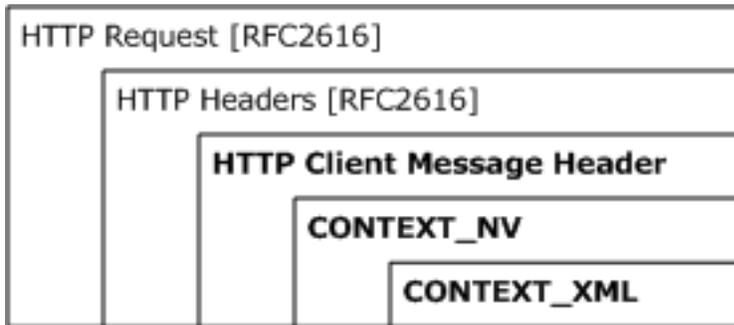
**Figure 4: Callback Context Establishing Message using SOAP**

When used with HTTP 1.1, the .NET Context Exchange Protocol uses:

- An HTTP Client Message Header as an HTTP header in an HTTP request message to form a Context Participating Message; or

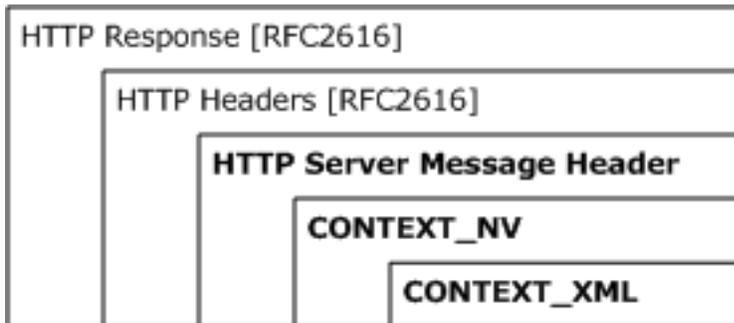
- An HTTP Server Message Header as an HTTP header in an HTTP response message to form a Server Context Establishing Message.

The next figure shows the containment of message structures, which are defined in section 2, within an HTTP request message.



**Figure 5: Client Context Participating Message using HTTP 1.1**

The following figure shows the containment of message structures, which are defined in section 2, within an HTTP response message.



**Figure 6: Server Context Establishing Message using HTTP 1.1**

### 2.2.1 CONTEXT\_XML

CONTEXT\_XML is an XML element [XML1.0] that represents a context identifier, as specified by the following XML schema [W3C-XSD].

```

<xs:schema
  targetNamespace="http://schemas.microsoft.com/ws/2006/05/context"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
>
  <xs:element name="Context">
    <xs:complexType>
      <xs:sequence minOccurs="0" maxOccurs="unbounded">
        <xs:element name="Property">
          <xs:complexType>
            <xs:simpleContent>
              <xs:extension base="xs:string">
                <xs:attribute name="name">
                  <xs:simpleType>
                    <xs:restriction base="xs:string">
                      <xs:pattern value="[A-Za-z\.\-\_]+"/>
                    </xs:restriction>
                  </xs:simpleType>
                </xs:attribute>
                <xs:anyAttribute namespace="##any"/>
              </xs:extension>
            </xs:simpleContent>
          </xs:complexType>
        </xs:element>
      </xs:sequence>
    </xs:complexType>
  </xs:element>
</xs:schema>
  
```

```

        </xs:extension>
    </xs:simpleContent>
</xs:complexType>
</xs:element>
</xs:sequence>
<xs:anyAttribute namespace="##any"/>
</xs:complexType>
</xs:element>
</xs:schema>

```

For a context identifier and a CONTEXT\_XML element to be isomorphic, all the following statements MUST be true:

- The number of Property XML elements in the CONTEXT\_XML element is equal to the number of (property name, property value) pairs in the context identifier.
- No two Property XML elements, when inside the CONTEXT\_XML element, have the same value as the name XML attribute.
- For each Property XML element that is inside the CONTEXT\_XML element, there is exactly one (property name, property value) pair in the context identifier so that:
  - The Property name is equal to the value of the name XML attribute of the Property XML element, and
  - The Property value is equal to the value of the content of the Property XML element.

### 2.2.2 CALLBACK\_CONTEXT\_XML

CALLBACK\_CONTEXT\_XML is an XML element [XML1.0] that represents a callback context, as specified by the following XML schema [W3C-XSD].

```

<xs:schema
  targetNamespace="http://schemas.microsoft.com/ws/2008/02/context"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  xmlns:wsa="http://www.w3.org/2005/08/addressing"
>
  <xs:element name="CallbackContext">
    <xs:complexType>
      <xs:sequence minOccurs="1" maxOccurs="1">
        <xs:element name="CallbackEndpointReference" type="wsa:EndpointReferenceType">
        </xs:sequence>
        <xs:anyAttribute namespace="##any"/>
      </xs:complexType>
    </xs:element>
  </xs:schema>

```

To specify a context identifier as part of the callback context, a CONTEXT\_XML element MUST be included as a reference parameter of the endpoint reference that is specified by the CallbackEndpointReference element.

For a callback context and a CALLBACK\_CONTEXT\_XML element to be isomorphic, the following statement MUST be true:

- The CallbackEndpointReference element in the CALLBACK\_CONTEXT\_XML element is an XML Infoset representation of the endpoint reference from the callback context as defined by [WSA].

### 2.2.3 CONTEXT\_NV

CONTEXT\_NV specifies a literal that results from resolving the following context\_nv Augmented Backus-Naur Form (ABNF) rule [RFC2234].

```
context-nv      = %x57.73.63.43.6F.6E.74.65.78.74      ; WscContext
                  lws "=" lws
                  %x22 context-v %x22
context-v       = *base64
base64          = %x30-39 / %x41-5A / %x61-7A / %x2B / %x2F / %x3D
lws              = *(%x0D.0A / %x09 / %x20)           ; CRLF, space, or tab
```

For a context identifier and a CONTEXT\_NV literal to be isomorphic, the value of context-v MUST be a **base64** [RFC3548] encoding of a **UTF-8** encoding [RFC3629] of a CONTEXT\_XML element that is isomorphic to the context identifier.

### 2.2.4 HTTP Client Message Header

The HTTP Client Message Header is an HTTP header [RFC2616] that results from resolving the following client\_context\_header ABNF rule [RFC2234].

```
client_context_header = lws "Cookie" lws ":"
                       *(any-nv ";" ) lws
                       context-nv
                       lws *(";" any-nv)
any-nv                 = lws token lws "=" lws (token / quoted-string) lws
lws                    = *(%x0D.0A / %x09 / %x20)           ; CRLF, space, or tab
```

This is a new header which does not have any relation with the "Cookie" header as described in [RFC2109] and [RFC2965].

The rules token and quoted-string of this grammar are specified in [RFC2616] section 2.2.

The context\_nv rule MUST resolve to a CONTEXT\_NV literal.

For a context identifier and an HTTP Client Message Header to be isomorphic, the context\_nv rule MUST resolve to a value that is isomorphic to the context identifier, as specified in CONTEXT\_NV.

### 2.2.5 HTTP Server Message Header

The HTTP Server Message Header is an HTTP header [RFC2616] that results from resolving the following server\_context\_header ABNF rule [RFC2234].

```
server_context_header = lws "Set-Cookie" lws ":"
                       *(any-nv ";" ) lws
                       context-nv
                       lws *(";" any-nv)
any-nv                 = lws token lws "=" lws (token / quoted-string) lws
lws                    = *(%x0D.0A / %x09 / %x20)           ; CRLF, space, or tab
```

This is a new header which does not have any relation with the "Set-Cookie" header as described in [RFC2109].

The rules token and quoted-string of this grammar are specified in [RFC2616] section 2.2.

The context\_nv rule MUST resolve to a CONTEXT\_NV literal.

For a context identifier and an HTTP Server Message Header to be isomorphic, the context\_nv rule MUST resolve to a value that is isomorphic to the context identifier, as specified in CONTEXT\_NV.

### **2.2.6 Server Context Establishing Message**

The Server Context Establishing Message MUST be either:

- A server message that is an HTTP response message [RFC2616] that contains an HTTP Server Message Header.
- A server message that is a SOAP envelope that contains a CONTEXT\_XML element as a SOAP header.

### **2.2.7 Context Participating Message**

The Context Participating Message MUST be either:

- A client message that is an HTTP request message [RFC2616] that contains an HTTP Client Message Header.
- A client message that is a SOAP envelope that contains a CONTEXT\_XML element as a SOAP header.

## 3 Protocol Details

### 3.1 Context Exchange Client Role Details

In this section, "client role" refers to the client role for context exchange.

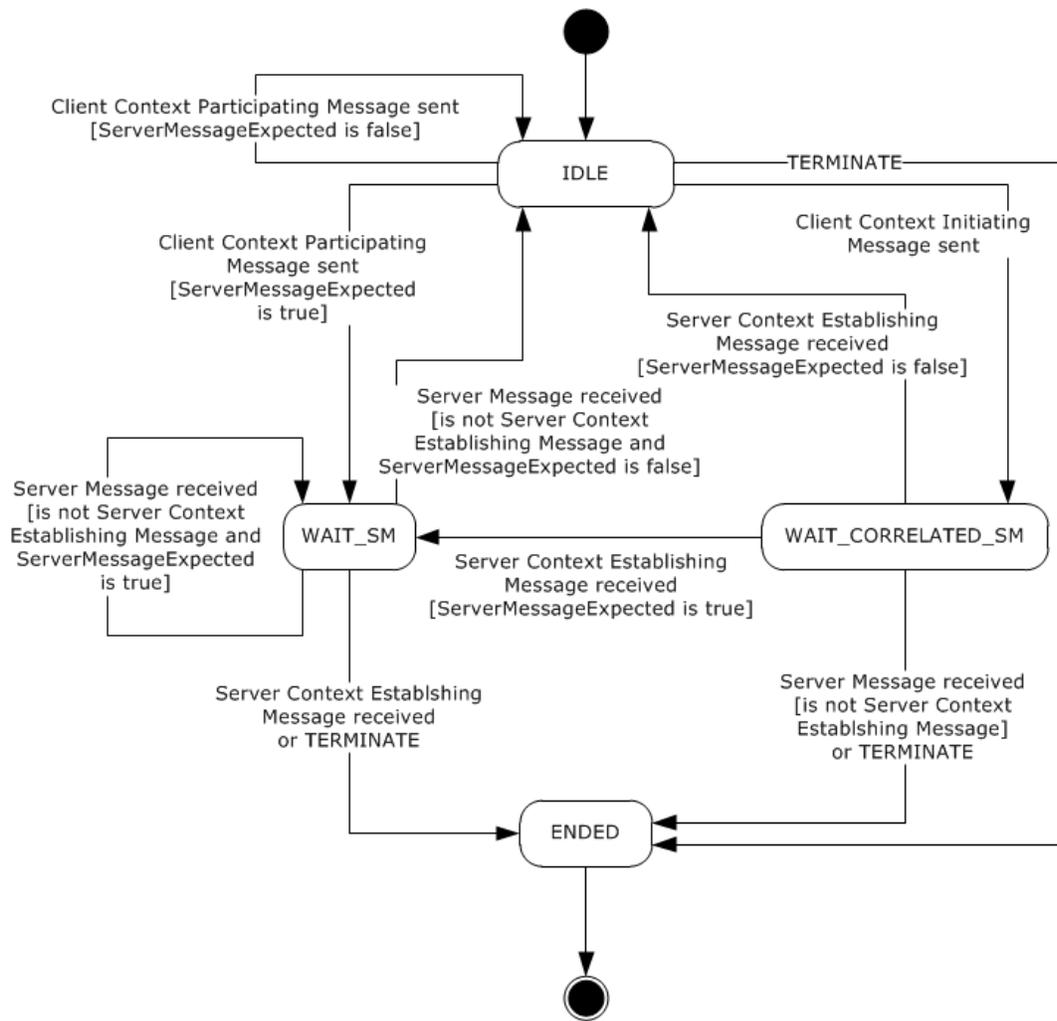
#### 3.1.1 Abstract Data Model

This section describes a conceptual model of possible data organization that an implementation maintains to participate in this protocol. The described organization is provided to facilitate the explanation of how the protocol behaves. This document does not mandate that implementations adhere to this model as long as their external behavior is consistent with the behavior that is described in this document.

The client role **MUST** maintain the following data elements:

- **Context Identifier Store:** A data element that is capable of holding an instance of a context identifier or an empty value.
- **State:** An enumeration that identifies the current state of the client role with the following possible values:
  - IDLE
  - WAIT\_CORRELATED\_SM
  - WAIT\_SM
  - ENDED

The following figure shows the relationship between the client role states.



**Figure 7: State diagram for the client role**

### 3.1.1.1 IDLE State

IDLE is the initial state. The following events are processed in this state:

- SEND\_CM
- TERMINATE

### 3.1.1.2 WAIT\_CORRELATED\_SM State

The following events are processed in the WAIT\_CORRELATED\_SM state:

- RECEIVE\_SM
- TERMINATE

### 3.1.1.3 WAIT\_SM State

The following events are processed in the WAIT\_SM state:

- RECEIVE\_SM
- TERMINATE

#### 3.1.1.4 ENDED State

The ENDED state is the final state.

#### 3.1.2 Timers

None.

#### 3.1.3 Initialization

When the client role is initialized:

- The **State** field MUST be set to IDLE.
- The **Context Identifier Store** field MUST be set to a value that is obtained from an implementation-specific source.

#### 3.1.4 Higher-Layer Triggered Events

##### 3.1.4.1 SEND\_CM

The SEND\_CM event MUST be signaled by the higher-layer business logic with the following arguments:

- The Client Message argument.
- The Protocol argument with two possible values: HTTP or SOAP.
- The ServerMessageExpected argument with two possible values: true or false.

If the SEND\_CM event is signaled, the client role implementation MUST perform the following actions:

- If the **Context Identifier Store** contains an empty value:
  - Send the client message to the server role by using the underlying transport protocol.
  - Set the **State** field to WAIT\_CORRELATED\_SM.
- Otherwise:
  - Transform the client message to a Context Participating Message by performing the following steps:
    - If the Protocol value is HTTP and the client message is an HTTP request message [RFC2616]:
      - Create an HTTP Client Message Header that is isomorphic with the value of the **Context Identifier Store**.
      - Add the HTTP Client Message Header to the client message.
    - Else if the Protocol value is SOAP and the client message is a SOAP envelope:
      - Create a CONTEXT\_XML element that is isomorphic with the value of the **Context Identifier Store**.

- Add the CONTEXT\_XML element to the client message as a SOAP header.
- Otherwise:
  - Return an implementation-specific failure result to the higher-layer business logic.
- Send the Context Participating Message to the server role by using the underlying transport protocol.
- If the ServerMessageExpected value is true:
  - Set the **State** field to WAIT\_SM.

### 3.1.4.2 TERMINATE

The TERMINATE event MUST be signaled by the higher-layer business logic.

If the TERMINATE event is signaled, the client role implementation MUST perform the following action:

- Set the **State** field to ENDED.

## 3.1.5 Message Processing Events and Sequencing Rules

### 3.1.5.1 RECEIVE\_SM

The RECEIVE\_SM event MUST be signaled by the underlying transport protocol with the following arguments:

- The Server Message argument.
- The Protocol argument with two possible values: HTTP or SOAP.
- The ServerMessageExpected argument with two possible values: true or false.

If the RECEIVE\_SM event is signaled, the client role implementation MUST perform the following actions:

- If the **State** field is WAIT\_CORRELATED\_SM:
  - If the server message is a Server Context Establishing Message:
    - Create the context identifier from the Server Context Establishing Message by performing the following steps:
      - If the Protocol value is HTTP and the server message contains an HTTP Server Message Header:
        - Create a context identifier that is isomorphic with the HTTP Server Message Header from the server message.
      - Else if the Protocol value is SOAP and the server message contains a SOAP header that matches a CONTEXT\_XML element:
        - Create a context identifier that is isomorphic with the SOAP header from the server message that matches a CONTEXT\_XML element.
    - Otherwise:
      - Set the **State** field to ENDED.

- Return an implementation-specific failure result to the higher-layer business logic.
  - Set the **Context Identifier Store** field to the value of the created context identifier.
  - Provide the server message to the higher-layer business logic.
- Otherwise:
  - Set the **State** field to ENDED.
  - Return an implementation-specific failure result to the higher-layer business logic.
- Otherwise:
  - If the server message is a Server Context Establishing Message:
    - Set the **State** field to ENDED.
    - Return an implementation-specific failure result to the higher-layer business logic.
  - Otherwise:
    - Provide the server message to the higher-layer business logic.
- If the ServerMessageExpected value is true:
  - Set the **State** field to WAIT\_SM.
- Otherwise:
  - Set the **State** field to IDLE.

### 3.1.6 Timer Events

None.

### 3.1.7 Other Local Events

None.

## 3.2 Context Exchange Server Role Details

In this section "server role" refers to the server role for context exchange.

### 3.2.1 Abstract Data Model

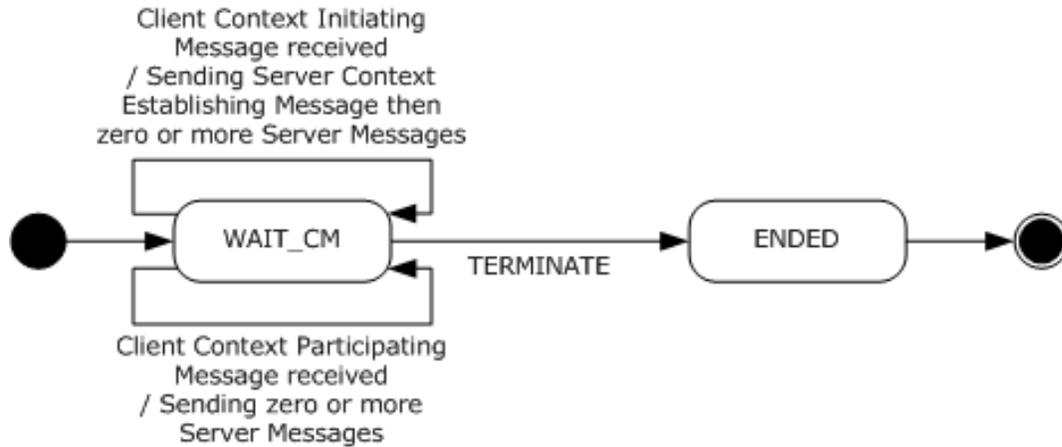
This section describes a conceptual model of possible data organization that an implementation maintains to participate in this protocol. The described organization is provided to facilitate the explanation of how the protocol behaves. This document does not mandate that implementations adhere to this model as long as their external behavior is consistent with the behavior that is described in this document.

The server role MUST maintain the following data elements:

- **Context Identifier Store:** A data element that is capable of holding an instance of a context identifier or an empty value.
- **State:** An enumeration that identifies the current state of the server role with the following possible values:

- WAIT\_CM
- ENDED

The following figure shows the relationship between server role states.



**Figure 8: State diagram for the server role**

### 3.2.1.1 WAIT\_CM State

The WAIT\_CM state is the initial state. The following events are processed in the WAIT\_CM state:

- RECEIVE\_CM
- TERMINATE

### 3.2.1.2 ENDED State

The ENDED state is the final state.

### 3.2.2 Timers

None.

### 3.2.3 Initialization

When the server role is initialized:

- The **State** field MUST be set to WAIT\_CM.
- The **Context Identifier Store** field MUST be set to a value that is obtained from an implementation-specific source.

### 3.2.4 Higher-Layer Triggered Events

#### 3.2.4.1 TERMINATE

The TERMINATE event MUST be signaled by the higher-layer business logic.

If the TERMINATE event is signaled, the server role implementation MUST perform the following action:

- Set the **State** field to ENDED.

### 3.2.5 Message Processing Events and Sequencing Rules

#### 3.2.5.1 RECEIVE\_CM

The RECEIVE\_CM event MUST be signaled by the underlying transport protocol with the following arguments:

- The Client Message argument.
- The Protocol argument with two possible values: HTTP or SOAP.

If the RECEIVE\_CM event is signaled, the server role implementation MUST perform the following actions:

- Initialize the NEW\_CONTEXT Boolean local data element to false.
- If the client message is a Context Participating Message:
  - Create the context identifier from the Context Participating Message by performing the following steps:
    - If the Protocol value is HTTP and the client message is an HTTP request message [RFC2616]:
      - Create a context identifier that is isomorphic with the HTTP Client Message Header from the client message.
    - Else if the Protocol value is SOAP and the server message is a SOAP envelope:
      - Create a context identifier that is isomorphic with the SOAP header from the client message that matches the CONTEXT\_XML element.
    - Otherwise:
      - Return an implementation-specific failure result to the higher-layer business logic.
  - Invoke a function in the higher-layer business logic that accepts the created context identifier and the value from the **Context Identifier Store** field; and returns one of three values: PARTICIPATE, NEW, or FAIL.
  - If the value that is returned from the higher-layer business logic is PARTICIPATE:
    - Provide the client message to the higher-layer business logic.
    - Set NEW\_CONTEXT to false.
  - Else if the value that is returned from the higher-layer business logic is NEW:
    - Set the **Context Identifier Store** field to an empty value.
    - Set NEW\_CONTEXT to true.
  - Otherwise:
    - Return an implementation-specific failure result to the higher-layer business logic.

- Otherwise:
  - Set NEW\_CONTEXT to true.
- If NEW\_CONTEXT is true:
  - If the **Context Identifier Store** field is empty:
    - Invoke a function in the higher-layer business logic that returns a context identifier.
    - Invoke a function in the higher-layer business logic that accepts the client message and returns a correlated server message using a correlation mechanism that is supplied by the underlying transport protocol.
    - Transform the server message to a Server Context Establishing Message by performing the following steps:
      - If the Protocol value is HTTP and the server message is an HTTP response message [RFC2616]:
        - Create an HTTP Server Message Header that is isomorphic with the context identifier.
        - Add the HTTP Server Message Header to the server message [RFC2616].
      - Else if the Protocol value is SOAP and the server message is a SOAP envelope:
        - Create a CONTEXT\_XML element that is isomorphic with the context identifier.
        - Add the CONTEXT\_XML element to the server message as a SOAP header.
      - Otherwise:
        - Return an implementation-specific failure result to the higher-layer business logic.
    - Send the Server Context Establishing Message to the client role by using the underlying transport protocol.
    - Set the **Context Identifier Store** field to the value of the context identifier that is returned by higher-layer business logic.
  - Otherwise:
    - Return an implementation-specific failure result to the higher-layer business logic.
- Invoke a function in the higher-layer business logic that accepts the client message and returns a (possibly empty) collection of correlated server messages by using a correlation mechanism that is supplied by the underlying transport protocol.
- For each server message in the collection of the server messages:
  - Send the server message to the client role by using the underlying transport protocol.

### 3.2.6 Timer Events

None.

### 3.2.7 Other Local Events

None.

### 3.3 Callback Context Exchange Client Role Details

In this section, "client role" refers to the client role for callback context exchange.

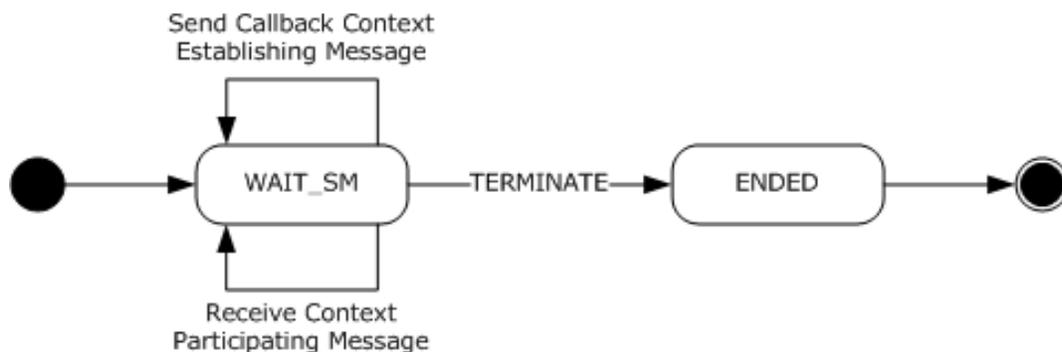
#### 3.3.1 Abstract Data Model

This section describes a conceptual model of possible data organization that an implementation maintains to participate in this protocol. The described organization is provided to facilitate the explanation of how the protocol behaves. This document does not mandate that implementations adhere to this model as long as their external behavior is consistent with the behavior that is described in this document.

The client role MUST maintain the following data elements:

- **Context Identifier Store:** A data element that is capable of holding an instance of a context identifier or an empty value.
- **State:** An enumeration that identifies the current state of the client role with the following possible values:
  - WAIT\_SM
  - ENDED

The following figure shows the relationship between the client role states.



**Figure 9: State diagram for the callback context exchange client role**

##### 3.3.1.1 WAIT\_SM State

The WAIT\_SM state is the initial state. The following events are processed in the WAIT\_SM state:

- SEND\_CM
- RECEIVE\_SM
- TERMINATE

##### 3.3.1.2 ENDED State

The ENDED state is the final state.

#### 3.3.2 Timers

There are no timers specified for the client role.

### 3.3.3 Initialization

When the client role is initialized:

- The **State** field MUST be set to WAIT\_SM.
- The **Context Identifier Store** field MUST be set to a value that is obtained from an implementation-specific source.

### 3.3.4 Higher-Layer Triggered Events

#### 3.3.4.1 TERMINATE

The TERMINATE event MUST be signaled by the higher-layer business logic.

If the TERMINATE event is signaled, the client role implementation MUST perform the following actions:

- Set the **State** field to ENDED.

### 3.3.5 Message Processing Events and Sequencing Rules

#### 3.3.5.1 SEND\_CM

The SEND\_CM event MUST be signaled by the higher-layer business logic with the following arguments:

- The Client Message argument.
- The Callback Context argument.

If the SEND\_CM event is signaled, the client role implementation MUST perform the following actions:

- Transform the client message to a Callback Context Establishing Message by performing the following steps:
  - If the client message is a SOAP envelope:
    - Create a CALLBACK\_CONTEXT\_XML element that is isomorphic with the callback context.
    - Add the CALLBACK\_CONTEXT\_XML element to the client message as a SOAP header.
  - Otherwise:
    - Return an implementation-specific failure result to the higher-layer business logic.
- Send the Callback Context Establishing Message to the server role by using the underlying transport protocol.
- If the callback context specifies a context identifier:
  - Set the **Context Identifier Store** field to the value of the context identifier.

#### 3.3.5.2 RECEIVE\_SM

The RECEIVE\_SM event MUST be signaled by the underlying transport protocol with the following arguments:

- The Server Message argument.

If the RECEIVE\_SM event is signaled, the client role implementation MUST perform the following actions:

- If the server message is a Context Participating Message:
  - Create the context identifier from the Context Participating Message by performing the following steps:
    - If the server message is a SOAP envelope:
      - Create a context identifier that is isomorphic with the SOAP header from the server message that matches the CONTEXT\_XML element.
    - Otherwise:
      - Return an implementation-specific failure result to the higher-layer business logic.
  - Invoke a function in the higher-layer business logic that accepts the created context identifier and the value from the **Context Identifier Store** field and returns one of two values: PARTICIPATE or FAIL.
  - If the value that is returned from the higher-layer business logic is PARTICIPATE:
    - Provide the client message to the higher-layer business logic.
  - Otherwise:
    - Return an implementation-specific failure result to the higher-layer business logic.
- Invoke a function in the higher-layer business logic that accepts the server message and returns a (possibly empty) collection of correlated client messages using a correlation mechanism that is supplied by the underlying transport protocol.
- For each client message in the collection of the client messages:
  - Send the client message to the server role by using the underlying transport protocol.

### 3.3.6 Timer Events

None.

### 3.3.7 Other Local Events

None.

## 3.4 Callback Context Exchange Server Role Details

In this section, "server role" refers to the server role for the callback context exchange.

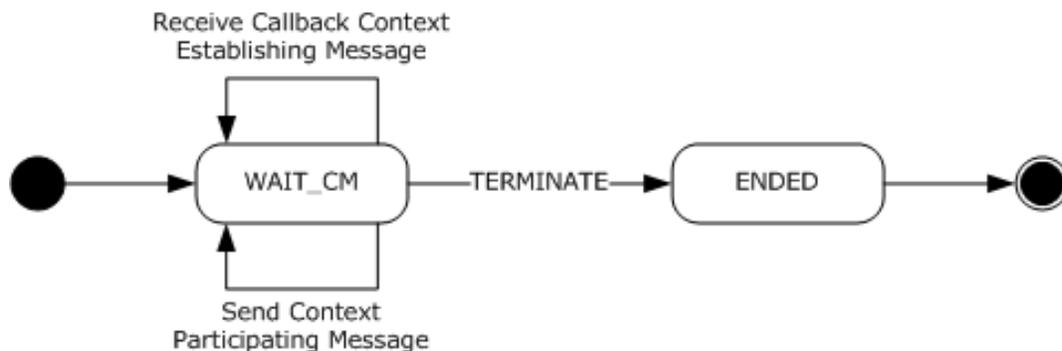
### 3.4.1 Abstract Data Model

This section describes a conceptual model of possible data organization that an implementation maintains to participate in this protocol. The described organization is provided to facilitate the explanation of how the protocol behaves. This document does not mandate that implementations adhere to this model as long as their external behavior is consistent with the behavior that is described in this document.

The server role MUST maintain the following data elements:

- **Endpoint Reference Store:** A data element that is capable of holding an instance of an endpoint reference or an empty value.
- **State:** An enumeration that identifies the current state of the server role with the following possible values:
  - WAIT\_CM
  - ENDED

The following figure shows the relationship between server role states.



**Figure 10: State diagram for the callback context exchange server role**

#### 3.4.1.1 WAIT\_CM State

The WAIT\_CM state is the initial state. The following events are processed in the WAIT\_CM state:

- RECEIVE\_CM
- SEND\_SM
- TERMINATE

#### 3.4.1.2 ENDED State

The ENDED state is the final state.

#### 3.4.2 Timers

None.

#### 3.4.3 Initialization

When the server role is initialized:

- The **State** field MUST be set to WAIT\_CM.
- The **Endpoint Reference Store** field MUST be set to a value that is obtained from an implementation-specific source.

## 3.4.4 Higher-Layer Triggered Events

### 3.4.4.1 TERMINATE

The TERMINATE event MUST be signaled by the higher-layer business logic.

If the TERMINATE event is signaled, the server role implementation MUST perform the following actions:

- Set the **State** field to ENDED.

## 3.4.5 Message Processing Events and Sequencing Rules

### 3.4.5.1 RECEIVE\_CM

The RECEIVE\_CM event MUST be signaled by the underlying transport protocol with the following arguments:

- The Client Message argument.

If the RECEIVE\_CM event is signaled, the server role implementation MUST perform the following actions:

- If the client message is a Callback Context Establishing Message:
  - If the client message contains a SOAP header that matches a CALLBACK\_CONTEXT\_XML element:
    - Create a callback context that is isomorphic with the SOAP header from the client message that matches the CALLBACK\_CONTEXT\_XML element.
    - Set the **Endpoint Reference Store** field to the value of the endpoint reference from the created callback context.
- Provide the client message to the higher-layer business logic.

### 3.4.5.2 SEND\_SM

The SEND\_SM event MUST be signaled by the underlying transport protocol with the following argument:

- The Server Message argument.

If the SEND\_SM event is signaled, the server role implementation MUST perform the following actions:

- If the server message is a **SOAP message**:
  - If the **Endpoint Reference Store** field is not empty:
    - Send the server message to the endpoint reference that is stored in the **Endpoint Reference Store** field by using the process that is specified in [WSA] section 3.3.
  - Otherwise:
    - Return an implementation-specific failure result to the higher-layer business logic.
- Otherwise:
  - Return an implementation-specific failure result to the higher-layer business logic.

### **3.4.6 Timer Events**

None.

### **3.4.7 Other Local Events**

None.

## 4 Protocol Examples

The following sections describe common scenarios to illustrate typical use of the .NET Context Exchange Protocol:

- Using the .NET Context Exchange Protocol with SOAP 1.2 [SOAP1.2-1/2007].
- Using the .NET Context Exchange Protocol with HTTP [RFC2616].
- Processing an Unrecognized Context Using SOAP 1.2 [SOAP1.2-1/2007].

These examples assume that the client role can establish a connection with the server role by using a transport protocol that supports exchanging HTTP or SOAP messages.

### 4.1 Using the .NET Context Exchange Protocol with SOAP 1.2

This scenario shows how a client establishes a context with a server that associates Context Participating Messages to a shopping cart resource. The scenario also shows how the client reestablishes that context after the original connection with the server is closed. Finally the scenario shows how the client establishes a callback context with the server.

The scenario starts after the client connects to the server by using a transport protocol that supports the exchange of SOAP messages.

All messages that are exchanged in this scenario use [SOAP1.2-1/2007].

#### 4.1.1 Establishing Context Using SOAP 1.2

A client establishes context with a server by sending the server a Client Context Initiating Message. This message is a SOAP message [SOAP1.2-1/2007] that does not contain CONTEXT\_XML as a SOAP header.

```
<s:Envelope xmlns:s="http://www.w3.org/2003/05/soap-envelope" xmlns:a="http://www.w3.org/2005/08/addressing">
  <s:Header>
    <a:Action
      s:mustUnderstand="1">http://machine1.example.org/Sample/IShoppingCart/Create</a:Action>
    <a:MessageID>urn:uuid:04133e99-4c4f-4433-b2de-4aca4132e78f</a:MessageID>

    <a:ReplyTo>
      <a:Address>http://www.w3.org/2005/08/addressing/anonymous</a:Address>
    </a:ReplyTo>
    <a:To s:mustUnderstand="1">http://machine2.example.org/ShoppingCart</a:To>
  </s:Header>
  <s:Body>
    <Create xmlns="http://machine1.example.org/Sample">
      <customerId>571</customerId>
    </Create>
  </s:Body>
</s:Envelope>
```

When the server receives this message, it invokes a business logic function according to its rules for processing SOAP messages ([SOAP1.2-1/2007] section 2.6). This function creates a new shopping cart resource, associates it with a new context identifier, and creates a response message. The context identifier has a single pair (property name, property value).

Property name	Property value
instanceId	1a1913b1-cb24-4d94-91d2-cf414a569481

The server then transforms the response message into a Server Context Establishing Message by adding a SOAP header and sends it to the client. This header is a CONTEXT\_XML element that is isomorphic to the context identifier that is associated with the shopping cart.

```
<s:Envelope xmlns:s="http://www.w3.org/2003/05/soap-envelope" xmlns:a="http://www.w3.org/2005/08/addressing">
  <s:Header>
    <a:Action
      s:mustUnderstand="1">http://machine1.example.org/Sample/IShoppingCart/CreateResponse</a:Action>
    <a:RelatesTo>urn:uuid:04133e99-4c4f-4433-b2de-4aca4132e78f</a:RelatesTo>
    <Context xmlns="http://schemas.microsoft.com/ws/2006/05/context">
      <Property name="instanceId">1a1913b1-cb24-4d94-91d2-cf414a569481</Property>
    </Context>
  </s:Header>
  <s:Body>
    <CreateResponse xmlns="http://machine1.example.org/Sample"/>
  </s:Body>
</s:Envelope>
```

When the client receives the Server Context Establishing Message, it creates a context identifier that is isomorphic to the CONTEXT\_XML element from the SOAP message and stores it.

#### 4.1.2 Subsequent Context Participating Messages Using SOAP 1.2

After the context is established as described in section 4.1.1, the client sends SOAP messages [SOAP1.2-1/2007] that are intended to manipulate the associated shopping cart. All these messages are Context Participating Messages with a CONTEXT\_XML element that is isomorphic to the client's stored context identifier, as shown in the following example.

```
<s:Envelope xmlns:s="http://www.w3.org/2003/05/soap-envelope"
  xmlns:a="http://www.w3.org/2005/08/addressing">
  <s:Header>
    <a:Action
      s:mustUnderstand="1">http://machine1.example.org/Sample/IShoppingCart/AddItem</a:Action>
    <a:MessageID>urn:uuid:a807e1f4-2096-40f3-9c6c-bbc3f45bc509</a:MessageID>
    <a:ReplyTo>
      <a:Address>http://www.w3.org/2005/08/addressing/anonymous</a:Address>
    </a:ReplyTo>
    <Context xmlns="http://schemas.microsoft.com/ws/2006/05/context">
      <Property name="instanceId">1a1913b1-cb24-4d94-91d2-cf414a569481</Property>
    </Context>
    <a:To s:mustUnderstand="1">http://machine2.example.org /ShoppingCart</a:To>
  </s:Header>
  <s:Body>
    <AddItem xmlns="http://machine1.example.org /Sample">
      <item>scarf</item>
    </AddItem>
  </s:Body>
</s:Envelope>
```

When the server receives each message, it creates a context identifier that is isomorphic to the CONTEXT\_XML element from the SOAP message and invokes a business logic function according to its rules for processing SOAP messages. This function determines that a shopping cart exists for the

provided context identifier and performs the appropriate action on the shopping cart by using the content of the SOAP message.

The client then closes the connection to the server.

### 4.1.3 Continue Using Context Using SOAP 1.2

To continue using the context that is associated with the shopping cart that was created in section 4.1.1, the client connects to the server by using a transport protocol that supports the exchange of SOAP messages [SOAP1.2-1/2007]. It then sends Context Participating Messages to the server. The creation, transmission, and processing of these messages is as described in section 4.1.2.

### 4.1.4 Establish a Callback Context

To enable duplex communication with the server, the client sends another Context Participating Message to the server (as in section 4.1.2) that is also a Callback Context Establishing Message.

The client invokes a business logic function that creates a new customer resource and associates it with a new context identifier. The context identifier has a single pair (property name, property value).

Property name	Property value
instanceId	c4b4e186-a5eb-4a8c-9f64-f8bb099e84eb

The client adds a CALLBACK\_CONTEXT\_XML element as a SOAP header to the message to specify the endpoint reference to which to send callback messages ~~should be sent~~. The endpoint reference also contains a context identifier for the client.

```
<s:Envelope xmlns:s="http://www.w3.org/2003/05/soap-envelope"
xmlns:a="http://www.w3.org/2005/08/addressing">
  <s:Header>
    <a:Action
s:mustUnderstand="1">http://machine1.example.org/Sample/IShoppingCart/Purchase</a:Action>
    <a:MessageID>urn:uuid:31d9ce06-a90b-4d81-9a0b-b1b8eaf67b28</a:MessageID>
    <a:ReplyTo>
    <a:Address>http://www.w3.org/2005/08/addressing/anonymous</a:Address>
    </a:ReplyTo>
    <Context xmlns="http://schemas.microsoft.com/ws/2006/05/context">
    <Property name="instanceId">1a1913b1-cb24-4d94-91d2-cf414a569481</Property>
    </Context>
    <CallbackContext xmlns="http://schemas.microsoft.com/ws/2008/02/context">
    <CallbackEndpointReference>
    <a:Address>http://machine3.example.org</a:Address>
    <a:ReferenceParameters>
    <Context xmlns="http://schemas.microsoft.com/ws/2006/05/context">
    <Property name="instanceId">c4b4e186-a5eb-4a8c-9f64-f8bb099e84eb</Property>
    </Context>
    <a:ReferenceParameters>
    </CallbackEndpointReference>
    </CallbackContext>
    <a:To s:mustUnderstand="1">http://machine2.example.org/ShoppingCart</a:To>
  </s:Header>
  <s:Body>
    <Purchase xmlns="http://machine1.example.org/Sample">
    <customerId>571</customerId>
    </Purchase>
  </s:Body>
</s:Envelope>
```

When the server receives the Server Context Establishing Message, it creates an endpoint reference that is isomorphic to the endpoint reference in the CALLBACK\_CONTEXT\_XML element from the SOAP message and stores it.

The client then closes the connection with the server.

#### 4.1.5 Subsequent Callback Messages

After the callback context is established as described in section 4.1.4, the client connects to the server by using a transport protocol that supports exchanging SOAP messages as specified in [SOAP1.2-1/2007]. The server then sends a SOAP message that is intended for the associated customer. The server sends this message to the endpoint reference that was stored when the callback context was established. The context identifier for the customer is as described in WS-Addressing [WSA].

```
<s:Envelope xmlns:s="http://www.w3.org/2003/05/soap-envelope"
xmlns:a="http://www.w3.org/2005/08/addressing">
  <s:Header>
    <a:Action
s:mustUnderstand="1">http://machine1.example.org/Sample/INotifyCustomer/ShippedItems</a:Action>
    <a:MessageID>urn:uuid:323d365c-e69a-4d9e-99f1-3c2a57490926</a:MessageID>
    <a:ReplyTo>
      <a:Address>http://www.w3.org/2005/08/addressing/anonymous</a:Address>
    </a:ReplyTo>
    <Context xmlns="http://schemas.microsoft.com/ws/2006/05/context">
      <Property name="instanceId">c4b4e186-a5eb-4a8c-9f64-f8bb099e84eb</Property>
    </Context>
    <a:To s:mustUnderstand="1">http://machine3.example.org</a:To>
  </s:Header>
  <s:Body>
    <ShippedItems xmlns="http://machine1.example.org/Sample">
      <item>scarf</item>
    </ShippedItems>
  </s:Body>
</s:Envelope>
```

When the client receives the message, it creates a context identifier that is isomorphic to the CONTEXT\_XML element from the SOAP message and invokes a business logic function according to its rules for processing SOAP messages. This function determines that the customer exists for the provided context identifier and performs the appropriate action on the customer instance by using the content of the SOAP message.

## 4.2 Using the .NET Context Exchange Protocol with HTTP

This scenario shows how a client establishes a context with a server that associates a Context Participating Message to a shopping cart resource and how the client reestablishes that context after the original connection with the server is closed.

All messages that are exchanged in this scenario use HTTP [RFC2616]. This scenario starts after the client has connected to the server by using a transport that supports HTTP.

### 4.2.1 Establishing Context Using HTTP

A client establishes context with a server by sending the server a Client Context Initiating Message. This message is an HTTP request message [RFC2616] that does not contain an HTTP Client Message Header.

```
POST /ShoppingCart/ HTTP/1.1
```

```
Content-Type: application/xml; charset=utf-8
Host: machine2.example.org
Content-Length: 87
Expect: 100-continue
Connection: Keep-Alive
```

```
<Create xmlns="http://machine1.example.org/Sample"><customerId>15</customerId></Create>
```

When the server receives this message, it invokes a business logic function according to its rules for processing HTTP messages. This function creates a new shopping cart resource, associates it with a new context identifier, and creates a response message. The context identifier has a single pair (property name, property value).

Property name	Property value
instanceId	0b29289f-45b0-4d37-9c40-6a481945477a

The server then transforms the response message into a Server Context Establishing Message by adding an HTTP Server Message Header and sends it to the client. This header is isomorphic to the context identifier that is associated with the shopping cart.

```
HTTP/1.1 200 OK
Content-Length: 60
Content-Type: application/xml; charset=utf-8
Server: Microsoft-HTTPAPI/2.0
Set-Cookie: WscContext="77u/PENvbnRleHQgeG1sbnM9Imh0dHA6Ly9zY2h1bWFzLm1pY3Jvc29mdC5jb20vd3MvMjAwNi8wNS9jb250ZXh0Ij48UHJvcGVydHkgbW50ZGFuY2VJZCI+ODIxOWQ2NjItYTZMi00YzA4LWFjZWItNzZiN2ZmYWYzNTAyPC9Qcm9wZXJ0eT48L0NvbnRleHQ+";Path=/ShoppingCart/
Date: Thu, 21 Feb 2008 22:01:38 GMT
```

```
<CreateResponse xmlns="http://machine1.example.org/Sample"/>
```

When the client receives the Server Context Establishing Message, it creates a context identifier that is isomorphic to the HTTP Server Message Header and stores it.

## 4.2.2 Subsequent Context Participating Messages Using HTTP

After the context is established as described in section 4.2.1, the client sends HTTP messages [RFC2616] that are intended to manipulate the associated shopping cart. All these messages are Context Participating Messages with an HTTP Client Message Header that is isomorphic to the client's stored context identifier, as shown in the following example.

```
POST /ShoppingCart/AddItem HTTP/1.1
Content-Type: application/xml; charset=utf-8
Cookie: WscContext="77u/PENvbnRleHQgeG1sbnM9Imh0dHA6Ly9zY2h1bWFzLm1pY3Jvc29mdC5jb20vd3MvMjAwNi8wNS9jb250ZXh0Ij48UHJvcGVydHkgbW50ZGFuY2VJZCI+ODIxOWQ2NjItYTZMi00YzA4LWFjZWItNzZiN2ZmYWYzNTAyPC9Qcm9wZXJ0eT48L0NvbnRleHQ+"
Host: machine2.example.org
Content-Length: 80
Expect: 100-continue

<AddItem xmlns="http://machine1.example.org/Sample"><item>scarf</item></AddItem>
```

When the server receives each message, it creates a context identifier that is isomorphic to the HTTP Client Message Header and invokes a business logic function according to its rules for processing HTTP messages. This function determines that a shopping cart exists for the provided context identifier and performs the appropriate action on the shopping cart based on the content of the HTTP message.

The client then closes the connection to the server.

### 4.2.3 Continue Using the Context Using HTTP

To continue using the context that is associated with the shopping cart that was created in section 4.2.1, the client connects to the server by using a transport that supports HTTP [RFC2616]; it then sends Context Participating Messages to the server. The creation, transmission, and processing of these messages is as described in section 4.2.2.

### 4.3 Processing an Unrecognized Context Using SOAP 1.2

A client sends a SOAP message [SOAP1.2-1/2007] that is intended to manipulate a particular shopping cart. This message is a Context Participating Message with a CONTEXT\_XML element that is isomorphic to the stored context identifier of the client, as shown in the following example.

```
<s:Envelope xmlns:s="http://www.w3.org/2003/05/soap-envelope"
xmlns:a="http://www.w3.org/2005/08/addressing">
  <s:Header>
    <a:Action
s:mustUnderstand="1">http://machine1.example.org/Sample/IShoppingCart/AddItem</a:Action>
    <a:MessageID>urn:uuid:5730ae92-2bc3-4576-95bc-ae0ddf4a2be7</a:MessageID>
    <a:ReplyTo>
    <a:Address>http://www.w3.org/2005/08/addressing/anonymous</a:Address>
    </a:ReplyTo>
    <Context xmlns="http://schemas.microsoft.com/ws/2006/05/context">
    <Property name="instanceId">7da72d4e-41da-467d-bfbb-d66fa8cb5ab9</Property>
    </Context>
    <a:To s:mustUnderstand="1">http://machine2.example.org/ShoppingCart</a:To>
  </s:Header>
  <s:Body>
    <AddItem xmlns="http://machine1.example.org/Sample">
    <item>toque</item>
    </AddItem>
  </s:Body>
</s:Envelope>
```

When the server receives this message, it creates a context identifier that is isomorphic to the CONTEXT\_XML element from the SOAP message. It invokes a business logic function according to its rules for processing SOAP messages. This function determines that a shopping cart does not exist for the provided context identifier, creates a **SOAP fault** message, and sends it to the client. An example SOAP fault message follows.

```
<s:Envelope xmlns:s="http://www.w3.org/2003/05/soap-envelope"
xmlns:a="http://www.w3.org/2005/08/addressing">
  <s:Header>
    <a:Action s:mustUnderstand="1">http://schemas.microsoft.com/net/2005/12/windowscommuni
cationfoundation/dispatcher/fault</a:Action>
    <a:RelatesTo>urn:uuid:5730ae92-2bc3-4576-95bc-ae0ddf4a2be7</a:RelatesTo>
  </s:Header>
  <s:Body>
    <s:Fault>
    <s:Code>
    <s:Value>s:Receiver</s:Value>
    <s:Subcode>
    <s:Value xmlns:a="http://schemas.microsoft.com/net/2005/12/windowscommunicationfoundat
```

```
ion/dispatcher">a:InternalServiceFault</s:Value>
</s:Subcode>
</s:Code>
<s:Reason>
<s:Text xml:lang="en-US">The server was unable to process the request
due to an internal error. For more information about the error, either
turn on IncludeExceptionDetailInFaults (either from
ServiceBehaviorAttribute or from the <serviceDebug> configuration
behavior) on the server in order to send the exception information back
to the client, or turn on tracing as per the Microsoft .NET Framework
3.0 SDK documentation and inspect the server trace logs.</s:Text>
</s:Reason>
</s:Fault>
</s:Body>
</s:Envelope>
```

#### 4.4 Processing an Unrecognized Context Using HTTP

A client sends an HTTP message, as specified in [RFC2616], that is intended to manipulate a particular shopping cart. This message is a Context Participating Message with an HTTP Client Message Header that is isomorphic to the stored context identifier of the client, as shown in the following example.

```
POST /ShoppingCart/AddItem HTTP/1.1
Content-Type: application/xml; charset=utf-8
Cookie: WscContext="77u/PENvbnRleHQgeG1sbnM9Imh0dHA6Ly9zY2h1bWFzLm1pY3Jvc
29mdC5jb20vd3MvMjAwNi8wNS9jb250ZXh0Ij48UHJvcGVydHkgbmFtZT0iaW5zdGFuY2VJZC
I+ODIxOWQ2NjItYTZMi00YzA4LWFjZWItNzZiN2ZmYWYzNTAyPC9Qcm9wZXJ0eT48LONvbnR
leHQ+"
Host: machine2.example.org
Expect: 100-continue
```

When the server receives this message, it creates a context identifier that is isomorphic to the HTTP Client Message Header and invokes a business logic function according to its rules for processing HTTP messages. This function determines that a shopping cart does not exist for the provided context identifier, and sends an HTTP 500 "Internal Server Error" to the client.

```
HTTP/1.1 500 Internal Server Error
Content-Length: 734
Content-Type: text/xml; charset=utf-8
Server: Microsoft-IIS/7.5
X-Powered-By: ASP.NET
```

## 5 Security

### 5.1 Security Considerations for Implementers

If the context information in the HTTP Message and SOAP Headers is not secured, it can be intercepted, tampered with, and sent to the server with malicious intent. The following mechanisms are recommended to make sure that the context information is not tampered while in transit:

1. While using the .NET Context Exchange Protocol over HTTP 1.1 [RFC2616], **send** HTTP Client Message Headers and HTTP Server Message Headers ~~should be sent~~ over a secure channel using the Transport Layer Security Protocol [RFC4346].
2. While using the .NET Context Exchange protocol over SOAP, **send** the CONTEXT\_XML and CALLBACK\_CONTEXT\_XML SOAP Headers ~~should be sent~~ over a secure channel using the Transport Layer Security Protocol [RFC4346] or secured using WS-\* security mechanisms, such as [WSS1].

### 5.2 Index of Security Parameters

None.

## 6 Appendix A: 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.

This document specifies version-specific details in the Microsoft .NET Framework. For information about which versions of .NET Framework are available in each released Windows product or as supplemental software, see [MS-NETOD] section 4.

- Microsoft .NET Framework 3.5
- Microsoft .NET Framework 4.0
- Microsoft .NET Framework 4.5
- Microsoft .NET Framework 4.6

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 1.3: The .NET Framework 3.5 implements only the client and server roles for context exchange. It does not implement the client and server roles for callback context exchange.

.NET Framework 4.0, .NET Framework 4.5, and .NET Framework 4.6 implement the client and server roles for both context exchange and callback context exchange.

## 7 Change Tracking

No table of changes is available. The document is either new or has had no changes since its last release.

## 8 Index

### A

Abstract data model  
    callback context exchange client role 27  
    callback context exchange server role 29  
    context exchange client role 19  
    context exchange server role 23  
Applicability 12

### C

CALLBACK\_CONTEXT\_XML message 16  
Capability negotiation 12  
Change tracking 42  
Client role - callback context exchange  
    abstract data model 27  
    higher-layer triggered events 28  
    initialization 28  
    local events 29  
    message processing  
        RECEIVE\_SM 28  
        SEND\_CM 28  
    overview 27  
    sequencing rules  
        RECEIVE\_SM 28  
        SEND\_CM 28  
    timer events 29  
    timers 27  
Client role - context exchange  
    abstract data model 19  
    higher-layer triggered events 21  
    initialization 21  
    local events 23  
    message processing - RECEIVE\_SM 22  
    overview 19  
    sequencing rules - RECEIVE\_SM 22  
    timer events 23  
    timers 21  
Context Participating Message message 18  
CONTEXT\_NV message 17  
CONTEXT\_XML message 15

### D

Data model - abstract  
    callback context exchange client role 27  
    callback context exchange server role 29  
    context exchange client role 19  
    context exchange server role 23

### E

Examples - overview 33

### F

Fields - vendor-extensible 13

### G

Glossary 6

## H

### Higher-layer triggered events

- callback context exchange client role 28
  - callback context exchange server role 31
  - context exchange client role 21
  - context exchange server role 24
- HTTP Client Message Header message 17  
HTTP Server Message Header message 17

## I

- Implementer - security considerations 40  
Index of security parameters 40  
Informative references 8  
Initialization
  - callback context exchange client role 28
  - callback context exchange server role 30
  - context exchange client role 21
  - context exchange server role 24Introduction 6

## L

### Local events

- callback context exchange client role 29
- callback context exchange server role 32
- context exchange client role 23
- context exchange server role 26

## M

### Message processing

- callback context exchange client role
  - RECEIVE\_SM 28
  - SEND\_CM 28
- callback context exchange server role
  - RECEIVE\_CM 31
  - SEND\_SM 31
- context exchange client role - RECEIVE\_SM 22
- context exchange server role - RECEIVE\_CM 25

### Messages

- CALLBACK\_CONTEXT\_XML 16
- Context Participating Message 18
- CONTEXT\_NV 17
- CONTEXT\_XML 15
- HTTP Client Message Header 17
- HTTP Server Message Header 17
- Server Context Establishing Message 18
- syntax 14
- transport 14

## N

- Normative references 7

## O

- Overview (synopsis) 8

## P

- Parameters - security index 40  
Preconditions 12

Prerequisites 12  
Product behavior 41

## R

References 7  
  informative 8  
  normative 7  
Relationship to other protocols 12

## S

Security  
  implementer considerations 40  
  parameter index 40  
Sequencing rules  
  callback context exchange client role  
    RECEIVE\_SM 28  
    SEND\_CM 28  
  callback context exchange server role  
    RECEIVE\_CM 31  
    SEND\_SM 31  
  context exchange client role - RECEIVE\_SM 22  
  context exchange server role - RECEIVE\_CM 25  
Server Context Establishing Message message 18  
Server role - callback context exchange  
  abstract data model 29  
  higher-layer triggered events 31  
  initialization 30  
  local events 32  
  message processing  
    RECEIVE\_CM 31  
    SEND\_SM 31  
  overview 29  
  sequencing rules  
    RECEIVE\_CM 31  
    SEND\_SM 31  
  timer events 32  
  timers 30  
Server role - context exchange  
  abstract data model 23  
  higher-layer triggered events 24  
  initialization 24  
  local events 26  
  message processing - RECEIVE\_CM 25  
  overview 23  
  sequencing rules - RECEIVE\_CM 25  
  timer events 26  
  timers 24  
Standards assignments 13  
Syntax 14

## T

Timer events  
  callback context exchange client role 29  
  callback context exchange server role 32  
  context exchange client role 23  
  context exchange server role 26  
Timers  
  callback context exchange client role 27  
  callback context exchange server role 30  
  context exchange client role 21  
  context exchange server role 24  
Tracking changes 42

Transport 14  
Triggered events - higher-layer  
  callback context exchange client role 28  
  callback context exchange server role 31  
  context exchange client role 21  
  context exchange server role 24

## **V**

Vendor-extensible fields 13  
Versioning 12