

## [MS-RDPERP-Diff]:

# Remote Desktop Protocol: Remote Programs Virtual Channel Extension

---

### 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 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 can make copies of it in order to develop implementations of the technologies that are described in this documentation and can distribute portions of it in your implementations that use these technologies or in your documentation as necessary to properly document the implementation. You can also distribute in your implementation, with or without modification, any 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 might cover your implementations of the technologies described in the Open Specifications documentation. Neither this notice nor Microsoft's delivery of this documentation grants any licenses under those patents or any other Microsoft patents. However, a given Open 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 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).
- **License Programs.** To see all of the protocols in scope under a specific license program and the associated patents, visit the [Patent Map](#).
- **Trademarks.** The names of companies and products contained in this documentation might 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, 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 standards specifications and network programming art and, as such, assume that the reader either is familiar with the aforementioned material or has immediate access to it.

**Support.** For questions and support, please contact [dochelp@microsoft.com](mailto:dochelp@microsoft.com).

**Preliminary Documentation.** This Open Specification provides documentation relevant to this technology. This document covers all past and current releases of this technology and should be considered final documentation with respect to all of these releases. Microsoft updates this technology with new releases from time to time. When Microsoft is working on updates or new releases of this

technology it updates this documentation prior to the final commercial release of the relevant updates. As a result, this document covers not only current and past releases of this technology, but also prerelease versions of this technology.

All preliminary content is formatted with a non-black text color so it can be easily identified. Preliminary text and other content that was not present in previous releases is further identified with underlines, and newly deleted text is identified with strikethroughs.

Because this documentation may change between the preliminary and final updated versions of this technology, there are risks in relying on preliminary documentation. Those risks include but are not limited to additional development obligations and costs. Because preliminary documentation is not yet final and is subject to change, you rely on it at your own risk.

PREVIEW

## Revision Summary

Date	Comments
03/11/2024	Released Preview Document.

PREVIEW

# Table of Contents

<b>1</b>	<b>Introduction .....</b>	<b>10</b>
1.1	Glossary .....	10
1.2	References .....	11
1.2.1	(Updated Section) Normative References .....	11
1.2.2	Informative References .....	12
1.3	Overview .....	12
1.3.1	Relationship to the Remote Desktop Protocol: Basic Connectivity and Graphics Remoting Specification .....	13
1.3.2	Message Flows .....	13
1.3.2.1	RAIL Session Connection .....	13
1.3.2.2	RAIL Session Disconnection and Reconnection .....	14
1.3.2.3	RAIL Server/Client Synchronization .....	14
1.3.2.4	RAIL Virtual Channel Messages .....	15
1.3.2.5	RAIL Local Move/Resize .....	15
1.3.3	Enhanced RemoteApp .....	16
1.3.4	Window Resize Margins .....	17
1.4	Relationship to Other Protocols .....	17
1.5	Prerequisites/Preconditions .....	17
1.6	Applicability Statement .....	17
1.7	Versioning and Capability Negotiation .....	18
1.8	Vendor-Extensible Fields .....	18
1.9	Standards Assignments .....	18
<b>2</b>	<b>Messages .....</b>	<b>19</b>
2.1	Transport .....	19
2.2	Message Syntax .....	19
2.2.1	Updates to the Remote Desktop Protocol: Basic Connectivity and Graphics Remoting Specification .....	19
2.2.1.1	Capability Sets .....	19
2.2.1.1.1	Remote Programs Capability Set .....	19
2.2.1.1.2	Window List Capability Set .....	21
2.2.1.2	Common Structures .....	22
2.2.1.2.1	Unicode String (UNICODE_STRING) .....	22
2.2.1.2.2	Rectangle (TS_RECTANGLE_16) .....	22
2.2.1.2.3	Icon Info (TS_ICON_INFO) .....	22
2.2.1.2.4	Cached Icon Info (TS_CACHED_ICON_INFO) .....	23
2.2.1.3	Windowing Alternate Secondary Drawing Orders .....	24
2.2.1.3.1	Window Information .....	24
2.2.1.3.1.1	Common Header (TS_WINDOW_ORDER_HEADER) .....	24
2.2.1.3.1.2	Orders .....	24
2.2.1.3.1.2.1	New or Existing Window .....	24
2.2.1.3.1.2.2	Window Icon .....	32
2.2.1.3.1.2.3	Cached Icon .....	33
2.2.1.3.1.2.4	Deleted Window .....	33
2.2.1.3.2	Notification Icon Information .....	34
2.2.1.3.2.1	Common Header (TS_NOTIFYICON_ORDER_HEADER) .....	34
2.2.1.3.2.2	Orders .....	34
2.2.1.3.2.2.1	New or Existing Notification Icons .....	35
2.2.1.3.2.2.2	Deleted Notification Icons .....	37
2.2.1.3.2.2.3	Notification Icon Balloon Tooltip (TS_NOTIFY_ICON_INFOTIP) .....	37
2.2.1.3.3	Desktop Information .....	38
2.2.1.3.3.1	Common Header (TS_DESKTOP_ORDER_HEADER) .....	38
2.2.1.3.3.2	Orders .....	39
2.2.1.3.3.2.1	Actively Monitored Desktop .....	39
2.2.1.3.3.2.2	Non-Monitored Desktop .....	40
2.2.2	Static Virtual Channel Protocol .....	40

2.2.2.1	Common Header (TS_RAIL_PDU_HEADER) .....	40
2.2.2.2	Initialization Messages .....	42
2.2.2.2.1	Handshake PDU (TS_RAIL_ORDER_HANDSHAKE) .....	42
2.2.2.2.2	Client Information PDU (TS_RAIL_ORDER_CLIENTSTATUS) .....	43
2.2.2.2.3	(Updated Section) HandshakeEx PDU (TS_RAIL_ORDER_HANDSHAKE_EX) .....	44
2.2.2.3	Program Launching Messages .....	45
2.2.2.3.1	Client Execute PDU (TS_RAIL_ORDER_EXEC) .....	45
2.2.2.3.2	Server Execute Result PDU (TS_RAIL_ORDER_EXEC_RESULT) .....	47
2.2.2.4	Local Client System Parameters Update Messages .....	48
2.2.2.4.1	(Updated Section) Client System Parameters Update PDU (TS_RAIL_ORDER_SYSPARAM) .....	48
2.2.2.4.2	High Contrast System Information Structure (TS_HIGHCONTRAST) .....	53
2.2.2.4.3	Filter Keys System Information Structure (TS_FILTERKEYS) .....	54
2.2.2.4.4	Toggle Keys System Information Structure (TS_TOGGLEKEYS) .....	55
2.2.2.4.5	Sticky Keys System Information Structure (TS_STICKYKEYS) .....	56
2.2.2.4.6	(Added Section) Accent Color System Information Structure (TS_ACCENTCOLOR) .....	57
2.2.2.5	Server System Parameters Update Messages .....	60
2.2.2.5.1	Server System Parameters Update PDU (TS_RAIL_ORDER_SYSPARAM) .....	60
2.2.2.6	Local Client Event Messages .....	60
2.2.2.6.1	Client Activate PDU (TS_RAIL_ORDER_ACTIVATE) .....	60
2.2.2.6.2	Client System Menu PDU (TS_RAIL_ORDER_SYSMENU) .....	61
2.2.2.6.3	Client System Command PDU (TS_RAIL_ORDER_SYSCOMMAND) .....	61
2.2.2.6.4	Client Notify Event PDU (TS_RAIL_ORDER_NOTIFY_EVENT) .....	62
2.2.2.6.5	Client Get Application ID PDU (TS_RAIL_ORDER_GET_APPID_REQ) .....	64
2.2.2.7	Window Move Messages .....	64
2.2.2.7.1	Server Min Max Info PDU (TS_RAIL_ORDER_MINMAXINFO) .....	64
2.2.2.7.2	Server Move/Size Start PDU (TS_RAIL_ORDER_LOCALMOVESIZE) .....	65
2.2.2.7.3	Server Move/Size End PDU (TS_RAIL_ORDER_LOCALMOVESIZE) .....	68
2.2.2.7.4	Client Window Move PDU (TS_RAIL_ORDER_WINDOWMOVE) .....	69
2.2.2.7.5	Client Window Snap PDU (TS_RAIL_ORDER_SNAP_ARRANGE) .....	69
2.2.2.8	Server Application ID Response .....	70
2.2.2.8.1	Server Get Application ID Response PDU (TS_RAIL_ORDER_GET_APPID_RESP) .....	70
2.2.2.8.2	Server Get Application ID Extended Response PDU (TS_RAIL_ORDER_GET_APPID_RESP_EX) .....	71
2.2.2.9	Language Bar Messages .....	72
2.2.2.9.1	Language Bar Information PDU (TS_RAIL_ORDER_LANGBARINFO) .....	72
2.2.2.10	Language Sync Messages .....	73
2.2.2.10.1	Language Profile Information PDU (TS_RAIL_ORDER_LANGUAGEIMEINFO) .....	73
2.2.2.10.1.1	Globally Unique Identifier (GUID) .....	75
2.2.2.10.2	Compartment Status Information PDU (TS_RAIL_ORDER_COMPARTMENTINFO_BODY) .....	76
2.2.2.11	Z-Order Sync Messages .....	78
2.2.2.11.1	Server Z-Order Sync Information PDU (TS_RAIL_ORDER_ZORDER_SYNC) .....	78
2.2.2.12	Window Cloak State Sync Messages .....	78
2.2.2.12.1	Window Cloak State Change PDU (TS_RAIL_ORDER_CLOAK) .....	78
2.2.2.13	Power Display Request Messages .....	79
2.2.2.13.1	Power Display Request PDU (TS_RAIL_ORDER_POWER_DISPLAY_REQUEST) .....	79
2.2.2.14	Server Taskbar State Messages .....	80
2.2.2.14.1	Taskbar Tab Info PDU (TS_RAIL_ORDER_TASKBARINFO) .....	80
2.2.2.15	Accessibility Messages .....	81
2.2.2.15.1	Text Scale Information PDU (TS_RAIL_ORDER_TEXTSCALEINFO) .....	81
2.2.2.15.2	Caret Blink Information PDU (TS_RAIL_ORDER_CARETBLINKINFO) .....	82

<b>3</b>	<b>Protocol Details .....</b>	<b>83</b>
3.1	Common Details .....	83
3.1.1	Abstract Data Model .....	83
3.1.1.1	Server State Machine .....	83
3.1.1.2	Icon Cache Support .....	85
3.1.2	Timers .....	85
3.1.3	Initialization .....	85
3.1.4	Higher-Layer Triggered Events .....	85
3.1.5	Message Processing Events and Sequencing Rules .....	85
3.1.5.1	Constructing Handshake PDU .....	85
3.1.5.2	Processing Handshake PDU .....	85
3.1.6	Timer Events .....	86
3.1.7	Other Local Events .....	86
3.2	Client Details .....	86
3.2.1	Abstract Data Model .....	86
3.2.1.1	Windowing Support Level .....	86
3.2.1.2	Marker Window ID .....	86
3.2.2	Timers .....	86
3.2.3	Initialization .....	86
3.2.4	Higher-Layer Triggered Events .....	86
3.2.5	Message Processing Events and Sequencing Rules .....	86
3.2.5.1	Updates to RDP Core Protocol .....	87
3.2.5.1.1	Constructing Client MCS Connect Initial PDU .....	87
3.2.5.1.2	Processing Server MCS Connect Response PDU .....	87
3.2.5.1.3	Constructing Client Info PDU .....	87
3.2.5.1.4	Constructing Confirm Active PDU .....	87
3.2.5.1.5	Processing Demand Active PDU .....	87
3.2.5.1.6	Processing Window Information Orders .....	88
3.2.5.1.7	Processing Notification Icon Orders .....	89
3.2.5.1.8	Processing Desktop Information Orders .....	89
3.2.5.2	Static Virtual Channel Protocol .....	90
3.2.5.2.1	Initialization Messages .....	90
3.2.5.2.1.1	Sending Client Information PDU .....	90
3.2.5.2.1.2	Processing HandshakeEx PDU .....	90
3.2.5.2.2	Program Launching Messages .....	90
3.2.5.2.2.1	Sending Execute PDU .....	90
3.2.5.2.2.2	Processing Execute Result PDU .....	90
3.2.5.2.3	Local Client System Parameters Update Messages .....	90
3.2.5.2.3.1	Sending System Parameters Update PDU .....	90
3.2.5.2.4	Server System Parameters Update Messages .....	90
3.2.5.2.4.1	Processing Server System Parameters Update PDU .....	90
3.2.5.2.5	Local Client Event Messages .....	90
3.2.5.2.5.1	Sending Activate PDU .....	91
3.2.5.2.5.2	Sending System Menu PDU .....	91
3.2.5.2.5.3	Sending System Command PDU .....	91
3.2.5.2.5.4	Sending Notify Event PDU .....	91
3.2.5.2.6	Language Bar Information PDUs .....	91
3.2.5.2.6.1	Sending Language Bar Information PDU .....	91
3.2.5.2.6.2	Processing Language Bar Information PDU .....	92
3.2.5.2.7	Window Move Messages .....	92
3.2.5.2.7.1	Processing Min Max Info PDU .....	92
3.2.5.2.7.2	Processing Move/Size Start PDU .....	92
3.2.5.2.7.3	Sending Window Move PDU .....	92
3.2.5.2.7.4	Processing Move/Size End PDU .....	92
3.2.5.2.7.5	Sending Window Snap PDU .....	93
3.2.5.2.8	Application ID Messages .....	93
3.2.5.2.8.1	Sending Client Get Application ID PDU .....	93

3.2.5.2.8.2	Processing Server Get Application ID Response PDU.....	93
3.2.5.2.8.3	Processing Server Get Application ID Extended Response PDU.....	93
3.2.5.2.9	Z-Order Sync Messages.....	93
3.2.5.2.9.1	Sending Z-Order Sync Support Flag .....	93
3.2.5.2.9.2	Processing Z-Order Sync Information PDU .....	93
3.2.5.2.10	Window Cloak State Sync Messages.....	94
3.2.5.2.10.1	Sending Window Cloak State Change PDU.....	94
3.2.5.2.10.2	Processing Window Cloak State Change PDU .....	94
3.2.5.2.11	Power Display Request Messages.....	94
3.2.5.2.11.1	Processing Power Display Request PDU .....	94
3.2.5.2.12	Server Taskbar State Messages.....	94
3.2.5.2.12.1	Processing Taskbar Tab Info PDU .....	94
3.2.5.2.13	Accessibility Messages.....	94
3.2.5.2.13.1	Sending Text Scale Information PDU .....	94
3.2.5.2.13.2	Sending Caret Blink Information PDU .....	95
3.2.6	Timer Events.....	95
3.2.7	Other Local Events.....	95
3.3	Server Details.....	95
3.3.1	Abstract Data Model.....	95
3.3.1.1	Client Local Move/Size Ability Store.....	95
3.3.1.2	Windowing Support Level.....	95
3.3.1.3	Marker Window.....	95
3.3.2	Timers .....	96
3.3.3	Initialization.....	96
3.3.4	Higher-Layer Triggered Events .....	96
3.3.5	Message Processing Events and Sequencing Rules .....	96
3.3.5.1	Updates to RDP Core Protocol.....	96
3.3.5.1.1	Processing Client MCS Connect Initial PDU.....	96
3.3.5.1.2	Constructing Server MCS Connect Response PDU .....	96
3.3.5.1.3	Processing Client Info PDU.....	96
3.3.5.1.4	Constructing Demand Active PDU .....	96
3.3.5.1.5	Processing Confirm Active PDU.....	97
3.3.5.1.6	Constructing Window Information Orders .....	97
3.3.5.1.7	Constructing Notification Icon Orders .....	98
3.3.5.1.8	Constructing Desktop Information Orders .....	98
3.3.5.2	Static Virtual Channel Protocol.....	99
3.3.5.2.1	Initialization Messages .....	99
3.3.5.2.1.1	Processing Client Information PDU .....	99
3.3.5.2.1.2	Sending HandshakeEx PDU .....	99
3.3.5.2.2	Program Launching Messages .....	100
3.3.5.2.2.1	Processing Execute PDU.....	100
3.3.5.2.2.2	Sending Execute Result PDU .....	100
3.3.5.2.3	Local Client System Parameters Update Messages .....	100
3.3.5.2.3.1	Processing System Parameters Update PDU .....	100
3.3.5.2.4	Server System Parameters Update Messages.....	100
3.3.5.2.4.1	Sending Server System Parameters Update PDU.....	100
3.3.5.2.5	Local Client Event Messages .....	100
3.3.5.2.5.1	Processing Activate PDU .....	100
3.3.5.2.5.2	Processing System Menu PDU.....	100
3.3.5.2.5.3	Processing System Command PDU .....	100
3.3.5.2.5.4	Processing Notify Event PDU .....	100
3.3.5.2.5.5	Processing Language Bar Information PDU .....	101
3.3.5.2.6	Window Move Messages .....	101
3.3.5.2.6.1	Sending Min Max Info PDU .....	101
3.3.5.2.6.2	Sending Move/Size Start PDU .....	101
3.3.5.2.6.3	Processing Window Move PDU .....	101
3.3.5.2.6.4	Sending Move/Size End PDU.....	101

3.3.5.2.6.5	Processing Window Snap PDU.....	101
3.3.5.2.7	Application ID Messages.....	102
3.3.5.2.7.1	Processing the Get Application ID PDU.....	102
3.3.5.2.7.2	Sending the Get Application ID Response PDU.....	102
3.3.5.2.8	Z-Order Sync Messages.....	102
3.3.5.2.8.1	Processing Z-Order Sync Support Flag.....	102
3.3.5.2.8.2	Sending Z-Order Sync Information PDU.....	102
3.3.5.2.9	Window Cloak State Sync Messages.....	102
3.3.5.2.9.1	Processing Window Cloak State Change PDU .....	102
3.3.5.2.9.2	Sending Window Cloak State Change PDU.....	102
3.3.5.2.10	Power Display Request Messages.....	102
3.3.5.2.10.1	Sending Power Display Request PDU .....	103
3.3.5.2.11	Server Taskbar State Messages.....	103
3.3.5.2.11.1	Sending Taskbar Tab Info PDU .....	103
3.3.5.2.12	Accessibility Messages.....	103
3.3.5.2.12.1	Processing Text Scale Information PDU.....	103
3.3.5.2.12.2	Processing Caret Blink Information PDU.....	103
3.3.6	Timer Events.....	103
3.3.7	Other Local Events.....	103
3.3.7.1	Sending Language Bar Information PDU.....	103
3.3.7.2	Sending Language Profile Information PDU.....	103
3.3.7.3	Sending Compartment Status Information PDU.....	104
<b>4</b>	<b>Protocol Examples.....</b>	<b>105</b>
4.1	Updates to the RDP Core Protocol .....	105
4.1.1	Windowing Alternate Secondary Drawing Orders .....	105
4.1.1.1	New or Existing Windows .....	105
4.1.1.2	Deleted Window.....	105
4.1.1.3	New or Existing Notification Icons .....	106
4.1.1.4	Deleted Notification Icons .....	107
4.1.1.5	Actively Monitored Desktop .....	107
4.1.1.6	Non-Monitored Desktop .....	107
4.2	Initialization Messages.....	107
4.2.1	TS_RAIL_ORDER_HANDSHAKE.....	107
4.2.2	TS_RAIL_ORDER_CLIENTSTATUS .....	108
4.3	Launching Messages.....	108
4.3.1	TS_RAIL_ORDER_EXEC .....	108
4.3.2	TS_RAIL_ORDER_EXEC_RESULT.....	109
4.4	Local Client System Parameters Update Messages.....	109
4.4.1	TS_RAIL_ORDER_SYSPARAM .....	109
4.5	Local Client Event Messages .....	109
4.5.1	TS_RAIL_ORDER_ACTIVATE.....	109
4.5.2	TS_RAIL_ORDER_SYSMENU .....	109
4.5.3	TS_RAIL_ORDER_SYSCOMMAND .....	110
4.5.4	TS_RAIL_ORDER_NOTIFY_EVENT .....	110
4.5.5	TS_RAIL_ORDER_LANGBARINFO .....	110
4.5.6	TS_RAIL_ORDER_GET_APPID_REQ.....	110
4.5.7	TS_RAIL_ORDER_GET_APPID_RESP.....	111
4.6	Window Move Messages.....	111
4.6.1	TS_RAIL_ORDER_WINDOWMOVE .....	111
4.6.2	TS_RAIL_ORDER_LOCALMOVESIZE.....	111
4.6.3	TS_RAIL_ORDER_MINMAXINFO.....	112
4.7	Z-Order Sync Messages .....	112
4.7.1	TS_RAIL_ORDER_ZORDER_SYNC .....	112
4.8	Power Display Request Messages .....	112
4.8.1	TS_RAIL_ORDER_POWER_DISPLAY_REQUEST .....	112
<b>5</b>	<b>Security.....</b>	<b>113</b>



5.1	Security Considerations for Implementers .....	113
5.2	Index of Security Parameters .....	113
<b>6</b>	<b>(Updated Section) Appendix A: Product Behavior.....</b>	<b>114</b>

PREVIEW

# 1 Introduction

Remote Programs, also known as remote applications integrated locally (RAIL), is a Remote Desktop Protocol (RDP) feature (as specified in the Remote Desktop Protocol: Basic Connectivity and Graphics Remoting Specification [MS-RDPBCGR]) that presents a remote application (running remotely on a RAIL server) as a local user application (running on the RAIL client machine). RAIL extends the core RDP protocol to deliver this seamless windows experience.

Sections 1.5, 1.8, 1.9, 2, and 3 of this specification are normative. All other sections and examples in this specification are informative.

## 1.1 Glossary

This document uses the following terms:

**Application Desktop Toolbar:** A window (anchored to an edge of the screen) that is similar to the taskbar and that typically contains buttons that give the user quick access to other applications and windows.

**balloon tooltip:** A tooltip displayed inside a balloon-shaped window. It usually has an icon, a title, and the tooltip text.

**caret:** A blinking line, block, or bitmap in the client area of a window. The caret typically indicates the location at which text or graphics will be inserted.

**client area:** The area of the desktop that is available for a window or notification icon to paint on.

**desktop switch:** The act of switching from one user desktop to another, or to the Windows Secure Desktop.

**display-required power request:** A power request that indicates whether the display of the device should remain in the powered-on state even if there is no user input for an extended period.

**Filter Keys:** An accessibility feature that allows configuration of keyboard input characteristics such as acceptance delay, repeat rate, and bounce rate, to filter out accidental keypresses.

**Input Method Editor (IME):** An application that is used to enter characters in written Asian languages by using a standard 101-key keyboard. An IME consists of both an engine that converts keystrokes into phonetic and ideographic characters and a dictionary of commonly used ideographic words.

**marker window:** A server-side window that is not remoted to the client and is used to manage the activation of RAIL windows.

**notification icon:** An icon placed in the notification area.

**protocol data unit (PDU):** Information that is delivered as a unit among peer entities of a network and that may contain control information, address information, or data. For more information on remote procedure call (RPC)-specific PDUs, see [C706] section 12.

**RAIL notification icon:** An icon placed in the notification area of the client machine by the remote applications integrated locally (RAIL) client.

**RAIL window:** A local client window that mimics a remote application window.

**remote application:** An application running on a remote server.

**remote applications integrated locally (RAIL):** A software component that enables remoting of individual windows and notification icons.

**screen coordinates:** Coordinates relative to the top-left corner of the screen, which has the coordinates (0,0).

**Snap:** A window management feature in Windows that resizes a window to fill a portion (usually one half or one quarter) of the screen when the user drags the window title bar to the edge or corner of the screen, uses a keyboard shortcut, or selects the window from the Snap Assist interface. When the window is moved away from the edge of the screen, it returns to its previous size.

**Sticky Keys:** An accessibility feature that allows users to enter key combinations by pressing modifier keys (SHIFT, CTRL, or ALT) and then other keys in sequence, rather than at the same time.

**system command:** A message that is sent to a window or notification icon via its system menu, or via a keyboard shortcut. Common system commands include minimize, maximize, move, and so on.

**System menu:** See window menu.

**tabbed application:** A feature of Windows, introduced in Windows 7, that allows a multiple-document interface (MDI) or tabbed-document interface (TDI) application to display a separate tab on its taskbar group flyout for each document it manages.

**taskbar:** A window, anchored to an edge of the screen, that contains the Start button and buttons for all open programs.

**text scale:** A setting that controls the size of text in Windows.

**Toggle Keys:** An accessibility feature that causes the computer to emit audible tones when CAPS LOCK, NUM LOCK, or SCROLL LOCK are switched on or off.

**tooltip:** A window displaying text that is created when the mouse is moved over a window or notification icon.

**Unicode character:** Unless otherwise specified, a 16-bit UTF-16 code unit.

**window coordinates:** Coordinates relative to the top-left corner of the window.

**window visible region:** The portion of the window that is not obscured by other user interface elements.

**z-order:** The rendering order of an object on a z axis.

**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 (Updated Section) 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.

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

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

[MS-RDPBCGR] Microsoft Corporation, "Remote Desktop Protocol: Basic Connectivity and Graphics Remoting".

[MS-RDPEGDI] Microsoft Corporation, "Remote Desktop Protocol: Graphics Device Interface (GDI) Acceleration Extensions".

[MS-RDPEAFX] Microsoft Corporation, "Remote Desktop Protocol: Graphics Pipeline Extension".

[MSDN-MUI] Microsoft Corporation, "Language Identifier Constants and Strings", <https://docs.microsoft.com/en-us/windows/win32/intl/language-identifier-constants-and-strings>

[MSDN-STPFLAG] Microsoft Corporation, "STPFLAG enumeration", [https://docs.microsoft.com/en-us/windows/desktop/api/shobjidl\\_core/ne-shobjidl\\_core-stpflag](https://docs.microsoft.com/en-us/windows/desktop/api/shobjidl_core/ne-shobjidl_core-stpflag)

[MSFT-DIL] Microsoft Corporation, "Default Input Locales", [https://docs.microsoft.com/en-us/previous-versions/windows/it-pro/windows-vista/cc766503\(v=ws.10\)](https://docs.microsoft.com/en-us/previous-versions/windows/it-pro/windows-vista/cc766503(v=ws.10))

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997, <https://www.rfc-editor.org/rfc/rfc2119>

### 1.2.2 Informative References

[MSDN-CREATEWINEX] Microsoft Corporation, "CreateWindowEx function", <http://msdn.microsoft.com/en-us/library/ms632680.aspx>

[MSDN-HIGHCONTRAST] Microsoft Corporation, "HIGHCONTRAST", <http://msdn.microsoft.com/en-us/library/ms695609.aspx>

[MSDN-SHELLNOTIFY] Microsoft Corporation, "Shell\_NotifyIcon function", <http://msdn.microsoft.com/en-us/library/bb762159.aspx>

[MSDN-SysParamsInfo] Microsoft Corporation, "SystemParametersInfo function", [http://msdn.microsoft.com/en-us/library/ms724947\(VS.85\).aspx](http://msdn.microsoft.com/en-us/library/ms724947(VS.85).aspx)

[MSDN-VIRTUALSCR] Microsoft Corporation, "The Virtual Screen", [http://msdn.microsoft.com/en-us/library/dd145136\(VS.85\).aspx](http://msdn.microsoft.com/en-us/library/dd145136(VS.85).aspx)

[MSDN-WINFEATURE] Microsoft Corporation, "Window Features", <http://msdn.microsoft.com/en-us/library/ms632599.aspx>

[MSDN-WINSTYLE] Microsoft Corporation, "Window Styles", <http://msdn.microsoft.com/en-us/library/ms632600.aspx>

### 1.3 Overview

Remote Programs, also known as remote applications integrated locally (RAIL), is an RDP feature (as specified in the Remote Desktop Protocol: Basic Connectivity and Graphics Remoting Specification [MS-RDPBCGR]) that presents a remote application (running remotely on a RAIL server) as a local user application (running on the RAIL client machine). RAIL extends the core RDP protocol to deliver this seamless experience. Support for RAIL is optional in RDP, and it is negotiated as part of the capability negotiation process.

The RAIL client, running on the user's local machine, creates one local window or notification icon for every window or notification icon running on the RAIL server. These local windows/icons, called RAIL

windows/icons, exactly mimic the appearance of their corresponding remote windows/icons, which are created by remote applications running on the RAIL server. All local user input to the RAIL windows/icons is captured by the RAIL client and redirected to the server. All display updates to the remote windows/icons on the RAIL server are captured by the server and redirected to the client

RAIL relies on the core RDP protocol for basic connection establishment, connection security, local input redirection to server, and drawing order updates from server to client (as specified in the Remote Desktop Protocol: Basic Connectivity and Graphics Remoting Specification). In addition, RAIL adds the following extensions to the RDP protocol:

- Extensions to the RDP core protocol to send drawing orders from the server to the client describing individual windows and notification icons. This enables the RAIL client to mimic their geometry in RAIL windows/icons.
- Virtual channel messages from client to server containing client information, system parameters information, and RAIL-specific commands, such as remote program launch.
- Virtual channel updates from server to client containing responses to client messages, server system parameters information, or information regarding other RAIL-specific features such as local move/resize (specified in section 1.3.2.5).
- Certain classes of user input are not directly received by the RAIL window/icon as keyboard or mouse input. Examples include right-clicking the window's taskbar icon; key combinations to minimize, maximize, or restore all windows; and all user interactions with notification icons. These interactions are posted to the RAIL window/icon as non-keyboard or non-mouse messages, and, hence, cannot be sent over the core RDP channel. The client sends these interactions to the server as RAIL Virtual Channel messages.
- A virtual channel message from the server to the client that indicates the ID of the server-side marker window.

### **1.3.1 Relationship to the Remote Desktop Protocol: Basic Connectivity and Graphics Remoting Specification**

Remote applications integrated locally (RAIL) protocol messages travel over two separate RDP channels:

- Window information orders from server to client are encapsulated in Alternate Secondary Drawing Orders (as specified in [MS-RDPEGDI] section 2.2.2.1.3.1.1).
- All other RAIL-specific messages travel over a static virtual channel, called the RAIL virtual channel, that is created by the Remote Desktop Protocol: Basic Connectivity and Graphics Remoting during connection establishment (as specified in [MS-RDPBCGR] sections 1.3.3 and 2.2.1).

### **1.3.2 Message Flows**

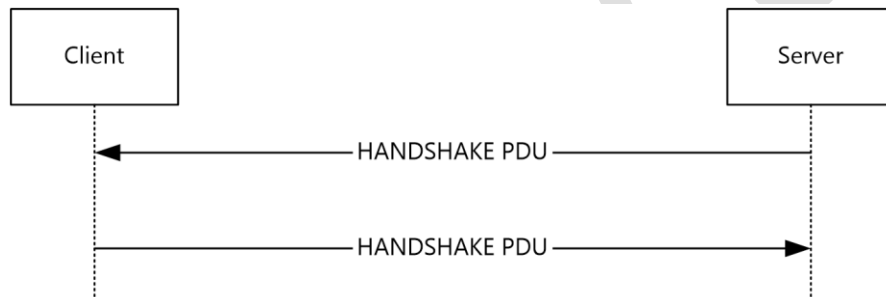
#### **1.3.2.1 RAIL Session Connection**

RAIL connection establishment follows the Remote Desktop Protocol: Basic Connectivity and Graphics Remoting connection establishment sequence (as specified in [MS-RDPBCGR] section 1.3.1.1). RAIL-specific information during connection establishment is outlined as follows:

- The client creates and initializes a static virtual channel to be used for RAIL protocol messages. Information regarding this channel is sent to the server in the Client MCS Connect Initial PDU with GCC Conference Create Request (as specified in [MS-RDPBCGR] section 2.2.1.3).

- The Client Info PDU (as specified in [MS-RDPBCGR] section 2.2.1.11) indicates the client's request to establish a RAIL connection.
- The **Alternate Shell** field of the Client Info PDU, as specified in [MS-RDPBCGR] section 2.2.1.11, is NOT used to communicate the initial application started in the session. Instead, the initial application information is communicated to the server via the Client Execute PDU.
- The client can set the INFO\_HIDEF\_RAIL\_SUPPORTED flag of the Client Info PDU (as specified in [MS-RDPBCGR] section 2.2.1.11.1.1) to request an Enhanced RemoteApp session. If the server does not support Enhanced RemoteApp, it should fall back to a standard RemoteApp session.
- If the server supports RAIL, the Demand Active PDU has to contain the Remote Programs Capability Set and Window List Capability Set to indicate that it supports RAIL.
- The client sends corresponding Remote Programs Capability Set and Window Capability Set in the Confirm Active PDU.
- If, in the Demand Active PDU, the server does not indicate that it supports RAIL, the client requests a disconnection according to the Remote Desktop Protocol: Basic Connectivity and Graphics Remoting ([MS-RDPBCGR] section 1.3.1.4.1). Likewise, if the client does not indicate that it supports RAIL in the Confirm Active PDU, the server disconnects the client (see [MS-RDPBCGR] section 1.3.1.4.2).

After the RDP connection is established, a RAIL client and server exchange Handshake PDUs over the RAIL Virtual Channel to indicate that each is ready for data on the virtual channel. The server should send a HandshakeEx PDU instead of a Handshake PDU if the client and server both indicate support for it in the Remote Programs Capability Set, or if Enhanced RemoteApp is in use. The client must respond with a Handshake PDU.



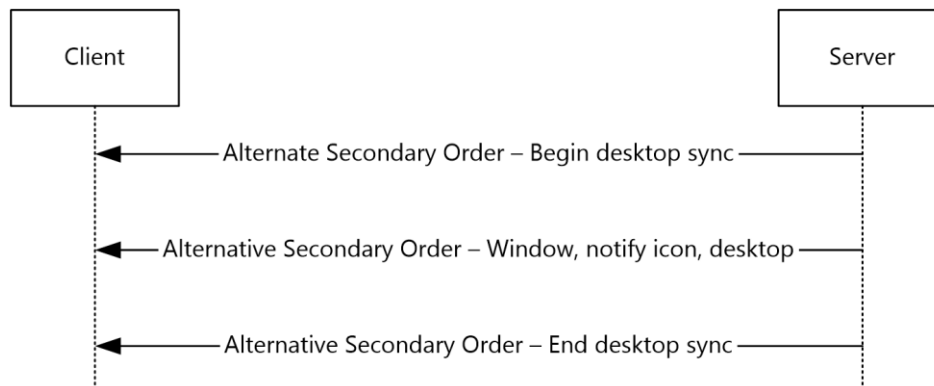
**Figure 1: Handshake PDU**

### 1.3.2.2 RAIL Session Disconnection and Reconnection

RAIL Session Disconnection and RAIL Session Reconnection follow the corresponding Remote Desktop Protocol: Basic Connectivity and Graphics Remoting sequences, as specified in [MS-RDPBCGR] section 1.3.1.4 (Disconnection Sequences) and [MS-RDPBCGR] section 1.3.1.5 (Automatic Reconnection).

### 1.3.2.3 RAIL Server/Client Synchronization

A RAIL server synchronizes with the RAIL client over the RDP channel upon connection establishment or when a desktop switch occurs.



**Figure 2: RAIL protocol client synchronization**

The synchronization begins with a Desktop Information Order with the WINDOW\_ORDER\_FIELD\_DESKTOP\_ARC\_BEGAN(0x00000008) flag set in the **Hdr** field (section 2.2.1.3.3.2.2). Upon receipt of this order, the client clears all previously received information from the server. This order is followed by any number of Windowing Alternate Secondary Drawing Orders describing windows, notification icons, and desktop. Finally, the server sends a Desktop Information Order with the WINDOW\_ORDER\_FIELD\_DESKTOP\_ARC\_COMPLETED (0x00000004) flag set to signal the end of synchronization data (section 2.2.1.3.3.2.1).

After the initial synchronization, Windowing Alternate Secondary Drawing Orders flow from server to client whenever a change occurs in a window, notification icon, or desktop state.

If the server is not capable of monitoring the desktop (for example, secure desktop), it sends a Desktop Information Order with the WINDOW\_ORDER\_FIELD\_DESKTOP\_NONE (0x00000001) flag set in the **Hdr** field (section 2.2.1.3.3.2.2). Upon receipt of this order, the client clears out all previously received information from the server.

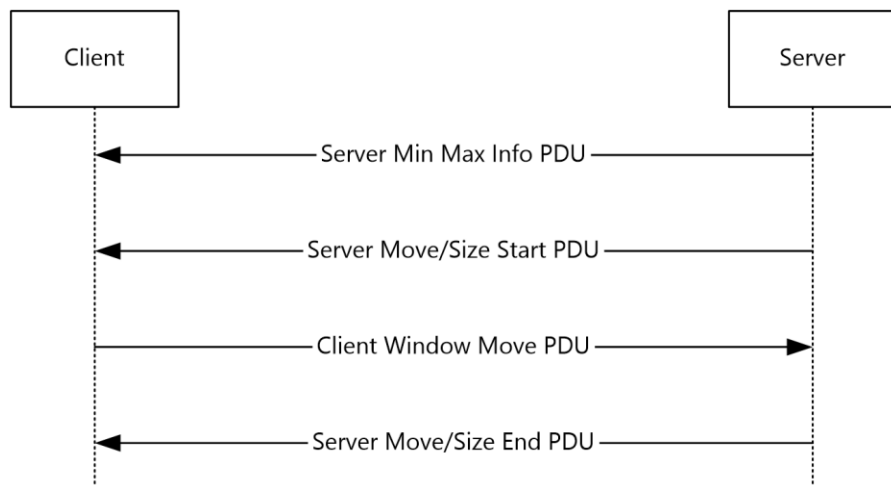
### 1.3.2.4 RAIL Virtual Channel Messages

Client/server or server/client messages can flow over the RAIL anytime after the virtual channel handshake sequence (section 2.2.2.2.1). The client sends the Client Information PDU and the Client System Parameters Update PDU immediately after the handshake to inform the server of its state and system parameters. If the client includes the TS\_RAIL\_CLIENTSTATUS\_ZORDER\_SYNC (0x00000004) flag in the Client Information PDU, then the server creates the marker window (section 3.3.1.3) and sends the ID of this window to the client using the Z-Order Sync Information PDU (section 2.2.2.11.1). If the client includes the TS\_RAIL\_CLIENTSTATUS\_WINDOW\_RESIZE\_MARGIN\_SUPPORTED (0x00000010) flag in the Client Information PDU, then the server sends the dimensions of the window resize margins in the Window Information PDU (section 2.2.1.3.1). If the client includes the TS\_RAIL\_CLIENTSTATUS\_APPBAR\_REMOTING\_SUPPORTED (0x00000040) flag in the Client Information PDU, then the server sends the registration state and edge messages for application desktop toolbars in the Window Information PDU (section 2.2.1.3.1). The server sends the Server System Parameters Update PDU immediately after the handshake to inform the client of its system parameters. All other virtual channel messages are generated in response to events on the client or server. If the client includes the TS\_RAIL\_CLIENTSTATUS\_POWER\_DISPLAY\_REQUEST\_SUPPORTED (0x00000080) flag in the Client Information PDU, then the server sends display-required power requests to the client using the Power Display Request PDU (section 2.2.2.13.1).

### 1.3.2.5 RAIL Local Move/Resize

Local move/resize features are RAIL options designed to optimize bandwidth in certain situations where RAIL windows are moved or resized by the user. A RAIL client indicates to the RAIL server

whether it supports local move/resize through the Client Capabilities PDU (section 2.2.2.2.2), sent after the Virtual Channel handshake sequence. RAIL servers do not have to explicitly report move/size support to the client.



**Figure 3: RAIL local move/resize operation**

Local move/resize is based on the following logic:

1. When the server detects that a window is beginning to be moved or resized, it sends a Server Min Max Info PDU (section 2.2.2.7.1) to the client with the window extents. This is followed by a Server Move/Size Start PDU (section 2.2.2.7.2).
2. If the client supports local move/resize, it injects a mouse button-down at the position indicated by the move/size PDU (if the move/size was initiated via mouse) or posts a command to the window (if the move/size was initiated via keyboard) to initiate move/resize of the window by the local window manager.
3. At the same time, the client lets the local Window Manager handle all keyboard and mouse events for the RAIL window, instead of redirecting to the server, to ensure that the move/size is entirely happening locally.
4. Finally, when the user is done with the move/resize, the local RAIL window receives this notification and forwards a mouse button-up to the server to end move/size on the server. For keyboard-based moves and all resize operations, the client also sends a Client Window Move PDU (section 2.2.2.7.4) to the server to inform the server of the window's new position and size. (For mouse-based moves, the mouse button-up is sufficient to inform the window's final position).
5. When the server detects that move/size has ended, it sends a Server Move/Size End PDU (section 2.2.2.7.3) with the final window position and size. The client can adjust its local RAIL window if necessary using this information.

### 1.3.3 Enhanced RemoteApp

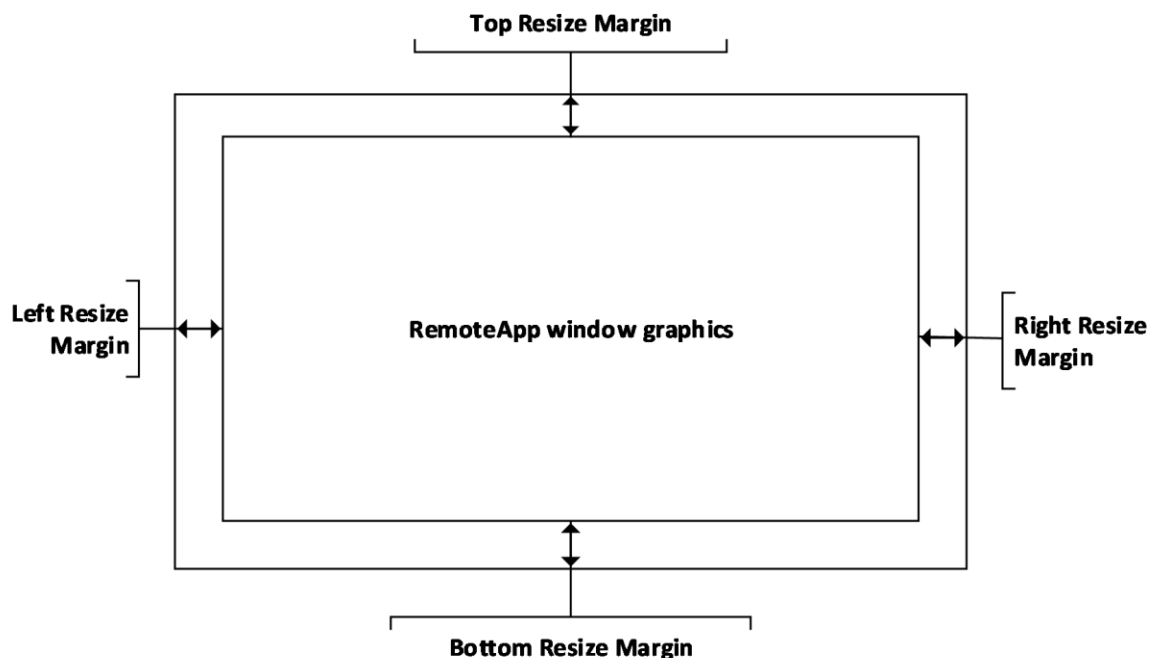
Enhanced RemoteApp is a graphics presentation mode supported by RDP 8.1 that leverages the Remote Desktop Protocol: Graphics Pipeline Extension ([MS-RDPEGFX] section 1.3) to remote only the contents of the windows running in a RAIL session (see [MS-RDPEGFX] section 1.5 for implementation requirements). This implies that the desktop background is not remotored and a client that supports Enhanced RemoteApp will always have access to the complete contents of a RAIL window, even if the window is obscured on the server.



### 1.3.4 Window Resize Margins

Window resize margins are supported by RDP 10.2. The dimensions of these margins are defined by the server and are to be used by the client to create a transparent hit-testable region around the RemoteApp window graphics. Any mouse, pen, or touch input within these margins is to be sent to the server.

Window resize margins must be used to extend the window geometry and are not included in the boundaries of the window sent in the Window Information Order (section 2.2.1.3.1.2.1).



**Figure 4: Window Resize Margins**

### 1.4 Relationship to Other Protocols

RAIL extends the Remote Desktop Protocol: Basic Connectivity and Graphics Remoting Specification [MS-RDPBCGR].

### 1.5 Prerequisites/Preconditions

The Remote Programs Extensions for Remote Desktop Protocol has the assumption to operate in a fully operational RDP connection. A fully operational RDP connection is a connection that has passed the Connection Finalization phase, as specified in [MS-RDPBCGR] section 1.3.1.1.

The RAIL server endpoint expects that the Channel PDU Header ([MS-RDPBCGR] section 2.2.6.1.1) is visible for all data that flows over the RAIL virtual channel (sections 1.3.1 and 2.2.2). To ensure that this condition is met, the CHANNEL\_FLAG\_SHOW\_PROTOCOL (0x00000010) flag has to be set in the **flags** field of the Channel PDU Header.

### 1.6 Applicability Statement

The Remote Desktop Protocol: Remote Programs Virtual Channel Extension applies only to RDP 6.0 and later.

## 1.7 Versioning and Capability Negotiation

Versioning: RAIL is supported in RDP 6.0 and later clients only. The RDP version is negotiated as a part of the Remote Desktop Protocol: Basic Connectivity and Graphics Remoting (as specified in [MS-RDPBCGR] section 1.7). Capability: RAIL-specific capabilities for Remote Programs and Window List are negotiated via the Demand Active and Confirm Active PDUs of the server and client, respectively (as specified in [MS-RDPBCGR] section 2.2.1.13).

## 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 runs the risk of a collision in the future.

## 1.9 Standards Assignments

The Remote Desktop Protocol: Remote Programs Virtual Channel Extension does not use any assigned standards.

## 2 Messages

The following sections specify how Remote Desktop Protocol: Remote Programs Virtual Channel Extension messages are transported and Remote Desktop Protocol: Remote Programs Virtual Channel Extension message syntax.

This protocol references commonly used data types as defined in [MS-DTYP].

### 2.1 Transport

The Remote Desktop Protocol: Remote Programs Virtual Channel Extension messages are passed between the client and server, embedded within an RDP connection, as described in section 1.3.1 for an overview.

The protocol uses the TCP connection created by the Remote Desktop Protocol: Basic Connectivity and Graphics Remoting (as specified in [MS-RDPBCGR] section 2.1) and does not establish any transport connections.

### 2.2 Message Syntax

#### 2.2.1 Updates to the Remote Desktop Protocol: Basic Connectivity and Graphics Remoting Specification

Support for RAIL is indicated by the client and server during the connection establishment phase of the Remote Desktop Protocol: Basic Connectivity and Graphics Remoting [MS-RDPBCGR], as described in section 1.3.2.1 for an overview of how the RAIL connection is established.

The Remote Desktop Protocol: Basic Connectivity and Graphics Remoting has also been extended to support windowing-specific drawing orders for RAIL scenarios. These orders, called Windowing Alternate Secondary Drawing Orders, describe state for windows, notification icons, and desktop-related information on the server. The following sections outline the capability sets and drawing orders that make up the Remote Desktop Protocol: Basic Connectivity and Graphics Remoting extensions for RAIL.

##### 2.2.1.1 Capability Sets

A RAIL server and client indicate support for RAIL by exchanging two capability sets during the capabilities negotiation phase of RDP connection establishment. These sets are outlined in the following sections.

###### 2.2.1.1.1 Remote Programs Capability Set

The Remote Programs Capability Set is sent by the server in the Demand Active PDU and by the client in the Confirm Active PDU, as specified in [MS-RDPBCGR] section 2.2.1.13. It indicates that the client and server are capable of communicating RAIL PDUs over the RAIL static virtual channel.

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
CapabilitySetType																LengthCapability															
RailSupportLevel																															

**CapabilitySetType (2 bytes):** An unsigned 16-bit integer. The type of the capability set. This field MUST be set to 0x0017 (CAPSTYPE\_RAIL).

**LengthCapability (2 bytes):** An unsigned 16-bit integer. The combined length of the **CapabilitySetType**, **LengthCapability**, and **RailSupportLevel** fields, in bytes.

**RailSupportLevel (4 bytes):** A 4-byte bit field specifying support for Remote Programs and the Docked Language Bar for Remote Programs.<1>

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
S	L	H	I	C	M	K	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Where the bits are defined as:

Value	Description
S TS_RAIL_LEVEL_SUPPORTED	Set to 1 if the client/server is capable of supporting Remote Programs; set to 0 otherwise.
L TS_RAIL_LEVEL_DOCKED_LANGBAR_SUPPORTED	Set to 1 if the client/server is capable of supporting Docked Language Bar for Remote Programs; set to 0 otherwise. This flag MUST be set to 0 if TS_RAIL_LEVEL_SUPPORTED is 0.
H TS_RAIL_LEVEL_SHELL_INTEGRATION_SUPPORTED	Set to 1 if the client/server is capable of supporting extended shell integration like tabbed windows and overlay icons for Remote Programs; set to 0 otherwise. This flag MUST be set to 0 if TS_RAIL_LEVEL_SUPPORTED is 0.
I TS_RAIL_LEVEL_LANGUAGE_IME_SYNC_SUPPORTED	Set to 1 if the client/server is capable of supporting syncing language/IME changes for Remote Programs; set to 0 otherwise. This flag MUST be set to 0 if TS_RAIL_LEVEL_SUPPORTED is 0.
C TS_RAIL_LEVEL_SERVER_TO_CLIENT_IME_SYNC_SUPPORTED	Set to 1 if the client/server is capable of supporting syncing IME changes originating at the server for Remote Programs; set to 0 otherwise. This flag MUST be set to 0 if TS_RAIL_LEVEL_SUPPORTED is 0.
M TS_RAIL_LEVEL_HIDE_MINIMIZED_APPS_SUPPORTED	Set to 1 if the client/server supports hiding minimized windows of Remote Programs on the server; set to 0 otherwise. This flag MUST be set to 0 if TS_RAIL_LEVEL_SUPPORTED is 0.
K TS_RAIL_LEVEL_WINDOW_CLOAKING_SUPPORTED	Set to 1 if the client/server supports syncing per-window cloak state changes originating on the client for Remote Programs; set to 0 otherwise. This flag MUST be set to 0 if TS_RAIL_LEVEL_SUPPORTED is 0.
E TS_RAIL_LEVEL_HANDSHAKE_EX_SUPPORTED	Set to 1 if the client/server supports the HandshakeEx PDU (section 2.2.2.3); set to 0 otherwise. This flag MUST be set to 0 if TS_RAIL_LEVEL_SUPPORTED is 0.

### 2.2.1.1.2 Window List Capability Set

The Window List Capability Set is sent by the server in the Demand Active PDU and by the client in the Confirm Active PDU, as specified in [MS-RDPBCGR] section 2.2.1.13. It indicates that the client and server are capable of communicating Windowing Alternate Secondary Drawing Orders as extensions to the core RDP protocol drawing orders (see section 2.2.1.3).

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
CapabilitySetType																LengthCapability															
WndSupportLevel																															
NumIconCaches										NumIconCacheEntries																					

**CapabilitySetType (2 bytes):** An unsigned 16-bit integer. The type of capability set. This field MUST be set to 0x0018 (CAPSTYPE\_WINDOW).

**LengthCapability (2 bytes):** An unsigned 16-bit integer. Specifies the combined length of the **CapabilitySetType**, **LengthCapability**, **WndSupportLevel**, **NumIconCaches**, and **NumIconCacheEntries** fields, in bytes.

**WndSupportLevel (4 bytes):** An unsigned 32-bit integer. The windowing support level. This field MUST be set to one of the following values. <2>

Value	Meaning
TS_WINDOW_LEVEL_NOT_SUPPORTED 0x00000000	The client or server is not capable of supporting Windowing Alternate Secondary Drawing Orders.
TS_WINDOW_LEVEL_SUPPORTED 0x00000001	The client or server is capable of supporting Windowing Alternate Secondary Drawing Orders.
TS_WINDOW_LEVEL_SUPPORTED_EX 0x00000002	The client or server is capable of supporting Windowing Alternate Secondary Drawing Orders and the following flags: <ul style="list-style-type: none"><li>WINDOW_ORDER_FIELD_CLIENTAREASIZE</li><li>WINDOW_ORDER_FIELD_RPCCONTENT</li><li>WINDOW_ORDER_FIELD_ROOTPARENT</li></ul>

**NumIconCaches (1 byte):** An unsigned 8-bit integer. The number of icon caches requested by the server (Demand Active PDU) or supported by the client (Confirm Active PDU).

The server maintains an icon cache and refers to it to avoid sending duplicate icon information (see section 2.2.1.3.1.2.3). The client also maintains an icon cache and refers to it when the server sends across a Cached Icon Window Information Order.

**NumIconCacheEntries (2 bytes):** An unsigned 16-bit integer. The number of entries within each icon cache requested by the server (Demand Active PDU) or supported by the client (Confirm Active PDU).

The server maintains an icon cache and refers to it to avoid sending duplicate icon information (see section 2.2.1.3.1.2.3). The client also maintains an icon cache and refers to it when the server sends across a Cached Icon Window Information Order.

2.2.1.2 Common Structures

2.2.1.2.1 Unicode String (UNICODE\_STRING)

The UNICODE\_STRING packet is used to pack a variable-length Unicode string.

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
CbString																String (variable)															
...																															

**CbString (2 bytes):** An unsigned 16-bit integer. The number of bytes in the **String** field. If CbString is zero (0), then the **String** field is absent. The maximum allowed value for **CbString** depends on the context in which the string is used.

**String (variable):** Optional and of variable length. A non-null-terminated Unicode character string. The number of characters in the string is equal to the value of **CbString** divided by 2.

2.2.1.2.2 Rectangle (TS\_RECTANGLE\_16)

The TS\_RECTANGLE\_16 structure describes a rectangle by using its top-left and bottom-right coordinates. The units depend on the context in which this structure is used.

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
Left																Top															
Right																Bottom															

**Left (2 bytes):** An unsigned 16-bit integer. The x-coordinate of the rectangle's top-left corner.

**Top (2 bytes):** An unsigned 16-bit integer. The y-coordinate of the rectangle's top-left corner.

**Right (2 bytes):** An unsigned 16-bit integer. The x-coordinate of the rectangle's bottom-right corner.

**Bottom (2 bytes):** An unsigned 16-bit integer. The y-coordinate of the rectangle's bottom-right corner.

2.2.1.2.3 Icon Info (TS\_ICON\_INFO)

The TS\_ICON\_INFO packet describes an icon.

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
CacheEntry																CacheId								Bpp							
Width																Height															

CbColorTable (optional)	CbBitsMask
CbBitsColor	BitsMask (variable)
...	
ColorTable (variable)	
...	
BitsColor (variable)	
...	

**CacheEntry (2 bytes):** An unsigned 16-bit integer. The index within an icon cache at which this icon MUST be stored at the client. The index is unique within a given **CacheId** (see following description). The maximum value of **CacheEntry** is negotiated between server and client through the **NumIconCacheEntries** field of the Window List Capability Set during the connection establishment phase.

**CacheId (1 byte):** An unsigned 8-bit integer. The index of the icon cache at which this icon MUST be stored at the client. If the value is 0xFFFF, the icon SHOULD NOT be cached. The **CacheId** is unique within a remote session.

The maximum value of **CacheId** is negotiated between server and client through the **NumIconCaches** field of the Window List Capability Set while establishing the connection.

**Bpp (1 byte):** An unsigned 8-bit integer. The color depth of the icon. Valid values are as follows:

1, 4, 8, 16, 24, 32.

**Width (2 bytes):** An unsigned 16-bit integer. The width, in pixels, of the icon.

**Height (2 bytes):** An unsigned 16-bit integer. The height, in pixels, of the icon.

**CbColorTable (2 bytes):** An unsigned 16-bit integer. The size, in bytes, of the color table data. This field is ONLY present if the **bits per pixel (Bpp)** value is 1, 4, or 8.

**CbBitsMask (2 bytes):** An unsigned 16-bit integer. The size, in bytes, of the icon's one-bit color-depth mask image.

**CbBitsColor (2 bytes):** An unsigned 16-bit integer. The size, in bytes, of the icon's color image.

**BitsMask (variable):** The image data for the 1-bpp bitmap. The length, in bytes, of this field is equal to the value of **CbBitsMask**. This field is optional.

**ColorTable (variable):** The image data for the color bitmap. The length, in bytes, of this field is equal to the value of **CbColorTable**. This field is only present if the **Bpp** value is 1, 4, or 8.

**BitsColor (variable):** The image data for the icon's color image. The length, in bytes, of this field is equal to the value of **CbBitsColor**. This field is optional.

#### 2.2.1.2.4 Cached Icon Info (TS\_CACHED\_ICON\_INFO)

The TS\_CACHED\_ICON\_INFO packet describes a cached icon.

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
CacheEntry																CacheId															

**CacheEntry (2 bytes):** An unsigned 16-bit integer. The index within an icon cache at the client that refers to the cached icon. This value MUST have been previously specified by the server in the **Icon Info** structure (section 2.2.1.2.3) of a **Window Information Order** (section 2.2.1.3.1) or **Icon** structure of a New or Existing Notification Icon (section 2.2.1.3.2.2.1).

**CacheId (1 byte):** An unsigned 8-bit integer. The index of the icon cache containing the cached icon. This value MUST have been previously specified by the server in the **Icon Info** structure of a **Window Information Order** or **Icon** structure of a New or Existing Notification Icon.

### 2.2.1.3 Windowing Alternate Secondary Drawing Orders

#### 2.2.1.3.1 Window Information

Window Information Orders specify the state of windows on the server.

##### 2.2.1.3.1.1 Common Header (TS\_WINDOW\_ORDER\_HEADER)

The TS\_WINDOW\_ORDER\_HEADER packet contains information common to every Windowing Alternate Secondary Drawing Order describing a window.

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1						
Header								OrderSize															FieldsPresentFlags														
																						...								WindowId							
																						...															

**Header (1 byte):** An unsigned 8-bit integer. An Alternate Secondary Order Header, as specified in [MS-RDPEGLI] section 2.2.2.2.1.3.1.1. The embedded **orderType** field MUST be set to 0x0B (TS\_ALTSEC\_WINDOW).

**OrderSize (2 bytes):** An unsigned 16-bit integer. The size of the entire packet, in bytes.

**FieldsPresentFlags (4 bytes):** An unsigned 32-bit integer. The flags indicating which fields are present in the packet. See Orders.

**WindowId (4 bytes):** An unsigned 32-bit integer. The ID of the window being described in the drawing order. It is generated by the server and is unique for every window in the session.

##### 2.2.1.3.1.2 Orders

###### 2.2.1.3.1.2.1 New or Existing Window

A Window Information Order is generated by the server whenever a new window is created on the server or when a property on a new or existing window is updated. The window metrics sent in this order are illustrated in the "An illustration of the window metrics sent in the Window Information Order" figure in section 3.3.5.1.6.





...	NumWindowRects (optional)	WindowRects (variable)	
...			
VisibleOffsetX (optional)			
VisibleOffsetY (optional)			
NumVisibilityRects (optional)		VisibilityRects (variable)	
...			
OverlayDescription (variable)			
...			
TaskbarButton (optional)	EnforceServerZOrder (optional)	AppBarState (optional)	AppBarEdge (optional)

**Hdr (11 bytes):** Eleven bytes. Common Window AltSec Order header, TS\_WINDOW\_ORDER\_HEADER. The **FieldsPresentFlags** field of the header MUST conform to the values defined as follows.

Value	Meaning
0x01000000 WINDOW_ORDER_TYPE_WINDOW	Indicates a Windowing Alternate Secondary Drawing Order describing a window. This flag MUST be set.
0x10000000 WINDOW_ORDER_STATE_NEW	Indicates that the Windowing Alternate Secondary Drawing Order contains information for a new window. If this flag is not set, the order contains information for an existing window.
0x00000002 WINDOW_ORDER_FIELD_OWNER	Indicates that the <b>OwnerWindowId</b> field is present.
0x00000008 WINDOW_ORDER_FIELD_STYLE	Indicates that the <b>Style</b> and <b>ExtendedStyle</b> fields are present.
0x00000010 WINDOW_ORDER_FIELD_SHOW	Indicates that the <b>ShowState</b> field is present.
0x00000004 WINDOW_ORDER_FIELD_TITLE	Indicates that the <b>TitleInfo</b> field is present.
0x00004000 WINDOW_ORDER_FIELD_CLIENTAREAOFFSET	Indicates that the <b>ClientOffsetX</b> and <b>ClientOffsetY</b> fields are present.
0x00010000 WINDOW_ORDER_FIELD_CLIENTAREASIZE	Indicates that the <b>ClientAreaWidth</b> and <b>ClientAreaHeight</b> fields are present.<3>
0x00000080 WINDOW_ORDER_FIELD_RESIZE_MARGIN_X	Indicates that the <b>WindowLeftResizeMargin</b> and <b>WindowRightResizeMargin</b> fields are present.

Value	Meaning
0x08000000 WINDOW_ORDER_FIELD_RESIZE_MARGIN_Y	Indicates that the <b>WindowTopResizeMargin</b> and <b>WindowBottomResizeMargin</b> fields are present.
0x00020000 WINDOW_ORDER_FIELD_RPCCONTENT	Indicates that the <b>RPContent</b> field is present. <4>
0x00040000 WINDOW_ORDER_FIELD_ROOTPARENT	Indicates that the <b>RootParentHandle</b> field is present. <5>
0x00008000 WINDOW_ORDER_FIELD_WNDOFFSET	Indicates that the <b>WindowOffsetX</b> and <b>WindowOffsetY</b> fields are present.
0x00008000 WINDOW_ORDER_FIELD_CLIENTDELTA	Indicates that the <b>WindowClientDeltaX</b> and <b>WindowClientDeltaY</b> fields are present.
0x00000400 WINDOW_ORDER_FIELD_WND_SIZE	Indicates that the <b>WindowWidth</b> and <b>WindowHeight</b> fields are present.
0x00000100 WINDOW_ORDER_FIELD_WNDRECTS	Indicates that the <b>NumWindowRects</b> and <b>WindowRects</b> fields are present.
0x00001000 WINDOW_ORDER_FIELD_VISOFFSET	Indicates that the <b>VisibleOffsetX</b> and <b>VisibleOffsetY</b> fields are present.
0x00000200 WINDOW_ORDER_FIELD_VISIBILITY	Indicates that the <b>NumVisibilityRects</b> and <b>VisibilityRects</b> fields are present.
0x00400000 WINDOW_ORDER_FIELD_OVERLAY_DESCRIPTION	Indicates that the <b>OverlayDescription</b> field is present.
0x00200000 WINDOW_ORDER_FIELD_ICON_OVERLAY_NULL	Indicates that a taskbar overlay icon previously set by the window has been removed.
0x00800000 WINDOW_ORDER_FIELD_TASKBAR_BUTTON	Indicates that the <b>TaskbarButton</b> field is present.
0x00080000 WINDOW_ORDER_FIELD_ENFORCE_SERVER_ZORDER	Indicates that the <b>EnforceServerZOrder</b> field is present.
0x00000040 WINDOW_ORDER_FIELD_APPBAR_STATE	Indicates that the <b>AppBarState</b> field is present.
0x00000001 WINDOW_ORDER_FIELD_APPBAR_EDGE	Indicates that the <b>AppBarEdge</b> field is present.

**OwnerWindowId (4 bytes):** An unsigned 32-bit integer. The ID of the window on the server that is the owner of the window specified in WindowId field of **Hdr**. For more information on owned windows, see [MSDN-WINFEATURE]. This field is present if and only if the WINDOW\_ORDER\_FIELD\_OWNER flag is set in the **FieldsPresentFlags** field of TS\_WINDOW\_ORDER\_HEADER.

**Style (4 bytes):** An unsigned 32-bit integer. Describes the window's current style. Window styles determine the appearance and behavior of a window. For more information, see [MSDN-WINSTYLE]. This field is present if and only if the WINDOW\_ORDER\_FIELD\_STYLE flag is set in the **FieldsPresentFlags** field of the TS\_WINDOW\_ORDER\_HEADER.

**ExtendedStyle (4 bytes):** An unsigned 32-bit integer. Extended window style information. For more information about extended window styles, see [MSDN-CREATEWINEX].

This field is present if and only if the WINDOW\_ORDER\_FIELD\_STYLE flag is set in the **FieldsPresentFlags** field of TS\_WINDOW\_ORDER\_HEADER.

**ShowState (1 byte):** An unsigned 8-bit integer. Describes the show state of the window.

This field is present if and only if the WINDOW\_ORDER\_FIELD\_SHOW flag is set in the **FieldsPresentFlags** field of TS\_WINDOW\_ORDER\_HEADER.

The field MUST be one of the following values.

Value	Meaning
0x00	Do not show the window.
0x02	Show the window minimized.
0x03	Show the window maximized.
0x05	Show the window in its current size and position.

**TitleInfo (variable):** UNICODE\_STRING. Variable length. Contains the window's title string. This string is not guaranteed to be null-terminated. The maximum value for the **CbString** field of UNICODE\_STRING is 520 bytes. This structure is present only if the WINDOW\_ORDER\_FIELD\_TITLE flag is set in the **FieldsPresentFlags** field of TS\_WINDOW\_ORDER\_HEADER.

**ClientOffsetX (4 bytes):** A 32-bit signed integer. The X (horizontal) offset from the top-left corner of the screen to the top-left corner of the window's client area, expressed in screen coordinates.

This field is present only if the WINDOW\_ORDER\_FIELD\_CLIENTAREAOFFSET flag is set in the **FieldsPresentFlags** field of TS\_WINDOW\_ORDER\_HEADER.

**ClientOffsetY (4 bytes):** A 32-bit signed integer. The Y (vertical) offset from the top-left corner of the screen to the top-left corner of the window's client area, expressed in screen coordinates.

This field is present only if the WINDOW\_ORDER\_FIELD\_CLIENTAREAOFFSET flag is set in the **FieldsPresentFlags** field of TS\_WINDOW\_ORDER\_HEADER.

**ClientAreaWidth (4 bytes):** An unsigned 32-bit integer specifying the width of the client area rectangle of the target window.

This field only appears if the **WndSupportLevel** field of the Window List Capability Set message is set to TS\_WINDOW\_LEVEL\_SUPPORTED\_EX (as specified in section 2.2.1.1.2) and the WINDOW\_ORDER\_FIELD\_CLIENTAREASIZE flag is set in the **FieldsPresentFlags** field of the TS\_WINDOW\_ORDER\_HEADER packet (section 2.2.1.3.1.1).

**ClientAreaHeight (4 bytes):** An unsigned 32-bit integer specifying the height of the client area rectangle of the target window.

This field only appears if the **WndSupportLevel** field of the Window List Capability Set message is set to TS\_WINDOW\_LEVEL\_SUPPORTED\_EX (as specified in section 2.2.1.1.2) and the **Hdr** field has the WINDOW\_ORDER\_FIELD\_CLIENTAREASIZE flag is set in the **FieldsPresentFlags** field of the TS\_WINDOW\_ORDER\_HEADER packet (section 2.2.1.3.1.1).

**WindowLeftResizeMargin (4 bytes):** An unsigned 32-bit integer specifying the width of the transparent hit-testable margin along the left edge of the window. Any mouse, pen, or touch input within this margin SHOULD be sent to the server.

This field is present only if the `WINDOW_ORDER_FIELD_RESIZE_MARGIN_X` flag is set in the **FieldsPresentFlags** field of `TS_WINDOW_ORDER_HEADER`.

Resize margins SHOULD be used to extend the window geometry (defined by the **WindowOffsetX**, **WindowOffsetY**, **WindowWidth** and **WindowHeight** fields) and are not included in the window boundaries.

**WindowRightResizeMargin (4 bytes):** An unsigned 32-bit integer specifying the width of the transparent hit-testable margin along the right edge of the window. Any mouse, pen or touch input within this margin SHOULD be sent to the server.

This field is present only if the `WINDOW_ORDER_FIELD_RESIZE_MARGIN_X` flag is set in the **FieldsPresentFlags** field of `TS_WINDOW_ORDER_HEADER`.

Resize margins SHOULD be used to extend the window geometry (defined by the **WindowOffsetX**, **WindowOffsetY**, **WindowWidth** and **WindowHeight** fields) and are not included in the window boundaries.

**WindowTopResizeMargin (4 bytes):** An unsigned 32-bit integer specifying the height of the transparent hit-testable margin along the top edge of the window. Any mouse, pen or touch input within this margin SHOULD be sent to the server.

This field is present only if the `WINDOW_ORDER_FIELD_RESIZE_MARGIN_Y` flag is set in the **FieldsPresentFlags** field of `TS_WINDOW_ORDER_HEADER`.

Resize margins SHOULD be used to extend the window geometry (defined by the **WindowOffsetX**, **WindowOffsetY**, **WindowWidth** and **WindowHeight** fields) and are not included in the window boundaries.

**WindowBottomResizeMargin (4 bytes):** An unsigned 32-bit integer specifying the height of the transparent hit-testable margin along the bottom edge of the window. Any mouse, pen or touch input within this margin SHOULD be sent to the server.

This field is present only if the `WINDOW_ORDER_FIELD_RESIZE_MARGIN_Y` flag is set in the **FieldsPresentFlags** field of `TS_WINDOW_ORDER_HEADER`.

Resize margins SHOULD be used to extend the window geometry (defined by the **WindowOffsetX**, **WindowOffsetY**, **WindowWidth** and **WindowHeight** fields) and are not included in the window boundaries.

**RPContent (1 byte):** An unsigned BYTE that MUST be set to one of the following possible values.

Value	Meaning
0x00	The window is not used by a render plug-in to do client-side rendering.
0x01	The window is used by a render plug-in to do client-side rendering.

This field only appears if the **WndSupportLevel** field of the Window List Capability Set message is set to `TS_WINDOW_LEVEL_SUPPORTED_EX` (as specified in section 2.2.1.1.2) and the **Hdr** field has the `WINDOW_ORDER_FIELD_RPCONTENT` flag is set in the **FieldsPresentFlags** field of the `TS_WINDOW_ORDER_HEADER` packet (section 2.2.1.3.1.1).

**RootParentHandle (4 bytes):** An unsigned 32-bit integer specifying the server-side target window's top-level parent window handle. A Top-Level parent window is the window immediately below "desktop" in the window hierarchy. If the target window is a top-level window, the window handle of the target window is sent.

This field only appears if the **WndSupportLevel** field of the Window List Capability Set message is set to `TS_WINDOW_LEVEL_SUPPORTED_EX` (as specified in section 2.2.1.1.2) and the **Hdr** field

has the WINDOW\_ORDER\_FIELD\_ROOTPARENT flag is set in the **FieldsPresentFlags** field of the TS\_WINDOW\_ORDER\_HEADER packet (section 2.2.1.3.1.1).

**WindowOffsetX (4 bytes):** A 32-bit signed integer. The X (horizontal) offset from the top-left corner of the primary monitor to the top-left corner of the window, expressed in screen coordinates.

This field is present only if the WINDOW\_ORDER\_FIELD\_WNDOFFSET flag is set in the **FieldsPresentFlags** field of TS\_WINDOW\_ORDER\_HEADER.

**WindowOffsetY (4 bytes):** A 32-bit signed integer. The Y (vertical) offset from the top-left corner of the primary monitor to the top-left corner of the window, expressed in screen coordinates.

This field is present only if the WINDOW\_ORDER\_FIELD\_WNDOFFSET flag is set in the **FieldsPresentFlags** field of TS\_WINDOW\_ORDER\_HEADER.

**WindowClientDeltaX (4 bytes):** A 32-bit signed integer. The X (horizontal) delta between the top-left corner of the window and the window's client area.

This field is present only if the WINDOW\_ORDER\_FIELD\_CLIENTDELTA flag is set in the **FieldsPresentFlags** field of TS\_WINDOW\_ORDER\_HEADER.

**WindowClientDeltaY (4 bytes):** A 32-bit signed integer. The Y (vertical) delta between the top-left corner of the window and the window's client area.

This field is present only if the WINDOW\_ORDER\_FIELD\_CLIENTDELTA flag is set in the **FieldsPresentFlags** field of TS\_WINDOW\_ORDER\_HEADER.

**WindowWidth (4 bytes):** An unsigned 32-bit integer. The window width, in screen coordinates.

This field is present only if the WINDOW\_ORDER\_FIELD\_WND\_SIZE flag is set in the **FieldsPresentFlags** field of TS\_WINDOW\_ORDER\_HEADER.

**WindowHeight (4 bytes):** An unsigned 32-bit integer. The window height, in screen coordinates.

This field is present only if the WINDOW\_ORDER\_FIELD\_WND\_SIZE flag is set in the **FieldsPresentFlags** field of TS\_WINDOW\_ORDER\_HEADER.

**NumWindowRects (2 bytes):** An unsigned 16-bit integer. A count of rectangles describing the window geometry.

This field is present only if the WINDOW\_ORDER\_FIELD\_WNDRECTS flag is set in the **FieldsPresentFlags** field of TS\_WINDOW\_ORDER\_HEADER.

**WindowRects (variable):** An array of TS\_RECTANGLE\_16 structures, **NumWindowRects** wide, describing the window geometry. All coordinates are window coordinates.

This field is present only if the **NumWindowRects** field is greater than 0 and the WINDOW\_ORDER\_FIELD\_WNDRECTS flag is set in the **FieldsPresentFlags** field of TS\_WINDOW\_ORDER\_HEADER.

**VisibleOffsetX (4 bytes):** A 32-bit signed integer. The X (horizontal) offset from the top-left corner of the screen to the top-left corner of the window visible region's bounding rectangle, expressed in screen coordinates.<6>

This field is present only if the WINDOW\_ORDER\_FIELD\_VISOFFSET flag is set in the **FieldsPresentFlags** field of TS\_WINDOW\_ORDER\_HEADER.

**VisibleOffsetY (4 bytes):** A 32-bit signed integer. The Y (vertical) offset from the top-left corner of the screen to the top-left corner of the window visible region's bounding rectangle, expressed in screen coordinates.<7>

This field is present only if the WINDOW\_ORDER\_FIELD\_VISOFFSET flag is set in the **FieldsPresentFlags** field of TS\_WINDOW\_ORDER\_HEADER.

**NumVisibilityRects (2 bytes):** An unsigned 16-bit integer. A count of rectangles describing the window visible region.

This field is present only if the WINDOW\_ORDER\_FIELD\_VISIBILITY flag is set in the **FieldsPresentFlags** field of TS\_WINDOW\_ORDER\_HEADER.

**VisibilityRects (variable):** An array of TS\_RECTANGLE\_16 structures, **NumVisibilityRects** wide, describing the window visible region. All coordinates are window coordinates.

This field is present only if the value of the **NumVisibilityRects** field is greater than 0 and the WINDOW\_ORDER\_FIELD\_VISIBILITY flag is set in the **FieldsPresentFlags** field of TS\_WINDOW\_ORDER\_HEADER.

**OverlayDescription (variable, optional):** A variable length UNICODE\_STRING (section 2.2.1.2.1) that contains the description text for the window's overlay icon (see sections 2.2.1.3.1.2.2 and 2.2.1.3.1.2.3).

This field is present only if the WINDOW\_ORDER\_FIELD\_OVERLAY\_DESCRIPTION flag is set in the **FieldsPresentFlags** field of TS\_WINDOW\_ORDER\_HEADER.

**TaskbarButton (1 byte, optional):** An 8-bit unsigned integer. If this field is set to 0x00, then the client SHOULD add a tab to the taskbar button group for the window, if supported by the operating system, instead of adding a new taskbar button for the window. If this field is set to 0x01, then the client SHOULD remove the tab from the taskbar button group for the window.

Windows share a taskbar button group if they have matching Application IDs, as specified by the **Server Get Application ID Response PDU** (section 2.2.2.8.1).

This field is present only if the WINDOW\_ORDER\_FIELD\_TASKBAR\_BUTTON flag is set in the **FieldsPresentFlags** field of TS\_WINDOW\_ORDER\_HEADER.

**EnforceServerZOrder (1 byte, optional):** An 8-bit unsigned integer. If this field is set to 0x01, then the client SHOULD order this window, and all other windows in the Z-order list (in the **Actively Monitored Desktop** packet, as specified in section 2.2.1.3.3.2.1) that also have the field set consecutively per the Z-order hierarchy. The client SHOULD NOT attempt to reorder these windows with respect to each other, or to move any window between the windows in this group.

If this field is set to 0x00, then no special Z-order handling is required.

This field is present only if the WINDOW\_ORDER\_FIELD\_ENFORCE\_SERVER\_ZORDER flag is set in the **FieldsPresentFlags** field of TS\_WINDOW\_ORDER\_HEADER.

**AppBarState (1 byte, optional):** An 8-bit unsigned integer. If this field is set to 0x01, then the window SHOULD be registered as an application desktop toolbar. If this field is set to 0x00, then the application desktop toolbar SHOULD be deregistered.

This field is present only if the WINDOW\_ORDER\_FIELD\_APPBAR\_STATE flag is set in the **FieldsPresentFlags** field of TS\_WINDOW\_ORDER\_HEADER.

**AppBarEdge (1 byte, optional):** An 8-bit unsigned integer. The value of this field indicates the edge to which the application desktop toolbar SHOULD be anchored. This field MUST be set to one of the following possible values.

Value	Meaning
0x00	Anchor to the left edge.

Value	Meaning
0x01	Anchor to the top edge.
0x02	Anchor to the right edge.
0x03	Anchor to the bottom edge.

This field is present only if the WINDOW\_ORDER\_FIELD\_APPBAR\_EDGE flag is set in the **FieldsPresentFlags** field of TS\_WINDOW\_ORDER\_HEADER.

### 2.2.1.3.1.2.2 Window Icon

The Window Icon packet is a Window Information Order generated by the server when a new or existing window sets or updates its associated icon.

Icons are created by combining two bitmaps of the same size. The mask bitmap is always 1 bpp, although the color depth of the color bitmap can vary. The color bitmap can have an associated color table.

The Window Icon order SHOULD NOT be sent if the client specified the TS\_RAIL\_CLIENTSTATUS\_SUPPRESS\_ICON\_ORDERS flag in the Client Information PDU (section 2.2.2.2.2).

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1	
Hdr																																
...																																
...																				IconInfo (variable)												
...																																

**Hdr (11 bytes):** Eleven bytes. A TS\_WINDOW\_ORDER\_HEADER structure. The **FieldsPresentFlags** field of the header MUST be constructed using the following values.

Value	Meaning
0x01000000 WINDOW_ORDER_TYPE_WINDOW	Indicates a Windowing Alternate Secondary Drawing Order that describes a window. This flag MUST be set.
0x10000000 WINDOW_ORDER_STATE_NEW	Indicates that the Windowing Alternate Secondary Drawing Order contains information for a new window. If this flag is not set, the order contains information for an existing window.
0x40000000 WINDOW_ORDER_ICON	Indicates that the order contains icon information for the window. This flag MUST be set.
0x00002000 WINDOW_ORDER_FIELD_ICON_BIG	Indicates that the large version of the icon is being sent. If this flag is not present, the icon is a small icon. <8>
0x00100000 WINDOW_ORDER_FIELD_ICON_OVERLAY	Indicates that the overlay icon for the window is being sent. If this flag is not present, the icon is an application icon.

**IconInfo (variable):** Variable length. TS\_ICON\_INFO structure. Describes the window's icon.



2.2.1.3.1.2.3 Cached Icon

The **Cached Icon** Window Information Order is generated by the server when a new or existing window sets or updates the icon in its title bar or in the Alt-Tab dialog box. If the icon information was transmitted by the server in a previous Window Information Order or Notification Icon Information Order in the same session, and the icon was cacheable (that is, the server specified a CacheEntry and CacheId for the icon), the server reports the icon cache entries to avoid sending duplicate information.

The Cached Icon packet SHOULD NOT be sent if the client specified the TS\_RAIL\_CLIENTSTATUS\_SUPPRESS\_ICON\_ORDERS flag in the Client Information PDU (section 2.2.2.2.2).

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
Hdr																															
...																															
...																								CachedIcon							
...																															

**Hdr (11 bytes):** Eleven bytes. A **TS\_WINDOW\_ORDER\_HEADER** (section 2.2.1.3.1.1) structure. The **FieldsPresentFlags** field of the header MUST conform to the values defined as follows.

Value	Description
0x01000000 WINDOW_ORDER_TYPE_WINDOW	Indicates a Windowing Alternate Secondary Drawing Order that describes a window. This flag MUST be set.
0x10000000 WINDOW_ORDER_STATE_NEW	Indicates that the Windowing Alternate Secondary Drawing Order contains information for a new window. If this flag is not set, the order contains information for an existing window.
0x80000000 WINDOW_ORDER_CACHEDICON	Indicates that the order contains cached icon information for the window. This flag MUST be set.
0x00002000 WINDOW_ORDER_FIELD_ICON_BIG	Indicates that the large version of the icon is being referred to. If this flag is not present, the icon is a small icon. <9>
0x00100000 WINDOW_ORDER_FIELD_ICON_OVERLAY	Indicates that the overlay icon for the window is being referred to. If this flag is not present, the icon is an application icon.

**CachedIcon (3 bytes):** Three bytes. **TS\_CACHED\_ICON\_INFO** (section 2.2.1.2.4) structure. Describes a cached icon on the client.

2.2.1.3.1.2.4 Deleted Window

The Deleted Window Information Order is generated by the server whenever an existing window is destroyed on the server.

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
Hdr																															

...
...

**Hdr (11 bytes):** Eleven bytes. A TS\_WINDOW\_ORDER\_HEADER structure. The **FieldsPresentFlags** field of the header **MUST** be constructed using the following values.

Value	Meaning
0x01000000 WINDOW_ORDER_TYPE_WINDOW	Indicates a Windowing Alternate Secondary Drawing Order describing a window. This flag <b>MUST</b> be set.
0x20000000 WINDOW_ORDER_STATE_DELETED	Indicates that the window is deleted. If this flag is set, the order <b>MUST NOT</b> contain any other information.

### 2.2.1.3.2 Notification Icon Information

Notification Icon Information orders specify the state of the notification icon on the server.

#### 2.2.1.3.2.1 Common Header (TS\_NOTIFYICON\_ORDER\_HEADER)

The TS\_NOTIFYICON\_ORDER\_HEADER packet contains information common to every Windowing Alternate Secondary Drawing Order specifying a notification icon.

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
Header									OrderSize													FieldsPresentFlags									
									...													WindowId									
									...													NotifyIconId									
									...																						

**Header (1 byte):** An unsigned 8-bit integer. An Alternate Secondary Order Header, as specified in [MS-RDPEGDI] section 2.2.2.2.1.3.1.1. The embedded **orderType** field **MUST** be set to 0x0B (TS\_ALTSEC\_WINDOW).

**OrderSize (2 bytes):** An unsigned 16-bit integer. The size, in bytes, of the entire packet.

**FieldsPresentFlags (4 bytes):** An unsigned 32-bit integer. The flags indicating which fields are present in the packet. See New or Existing Notification Icons.

**WindowId (4 bytes):** An unsigned 32-bit integer. The ID of the window owning the notification icon specified in the drawing order. The ID is generated by the server and is unique for every window in the session.

**NotifyIconId (4 bytes):** An unsigned 32-bit integer. The ID of the notification icon specified in the drawing order. The ID is generated by the application that owns the notification icon and **SHOULD** be unique for every notification icon owned by the application.

#### 2.2.1.3.2.2 Orders

2.2.1.3.2.2.1 New or Existing Notification Icons

The Notification Icon Information Order packet is generated by the server whenever a new notification icon is created on the server or when an existing notification icon is updated.

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								
Hdr (15 bytes)																																							
...																																							
...																																							
...																								Version (optional)															
...																								ToolTip (variable)															
...																																							
InfoTip (variable)																																							
...																																							
State (optional)																																							
Icon (variable)																																							
...																																							
CachedIcon (optional)																																							

**Hdr (15 bytes):** A TS\_NOTIFYICON\_ORDER\_HEADER structure. Common AltSec Order header. The **FieldsPresentFlags** field of the header MUST conform to the values defined as follows.

Value	Meaning
WINDOW_ORDER_TYPE_NOTIFY 0x02000000	Indicates a Windowing Alternate Secondary Drawing Order specifying a notification icon. This flag MUST be set.
WINDOW_ORDER_STATE_NEW 0x10000000	Indicates that the Windowing Alternate Secondary Drawing Order contains information for a new notification icon. If this flag is set, one of the <b>Icon</b> and <b>CachedIcon</b> fields MUST be present. If this flag is not set, the Windowing Alternate Secondary Drawing Order contains information for an existing notification icon.
WINDOW_ORDER_FIELD_NOTIFY_VERSION 0x00000008	Indicates that the <b>Version</b> field is present.
WINDOW_ORDER_FIELD_NOTIFY_TIP 0x00000001	Indicates that the <b>ToolTip</b> field is present.
WINDOW_ORDER_FIELD_NOTIFY_INFO_TIP	Indicates that the <b>InfoTip</b> field is present.

Value	Meaning
0x00000002	
WINDOW_ORDER_FIELD_NOTIFY_STATE 0x00000004	Indicates that the <b>State</b> field is present.
WINDOW_ORDER_ICON 0x40000000	Indicates that the <b>Icon</b> field is present. Either the <b>Icon</b> or the <b>CachedIcon</b> field SHOULD be present, but not both.
WINDOW_ORDER_CACHED_ICON 0x80000000	Indicates that the <b>CachedIcon</b> field is present. Either the <b>Icon</b> or the <b>CachedIcon</b> field SHOULD be present, but not both. <10>

**Version (4 bytes):** An unsigned 32-bit integer. Specifies the behavior of the notification icons. This field is present only if the WINDOW\_ORDER\_FIELD\_NOTIFY\_VERSION flag is set in the **FieldsPresentFlags** field of TS\_NOTIFYICON\_ORDER\_HEADER. This field MUST be set to one of the following values.

Value	Meaning
0	Use this value for applications designed for Windows NT 4.0 operating system.
3	Use the Windows 2000 operating system notification icons behavior. Use this value for applications designed for Windows 2000 and Windows XP operating system.
4	Use the current behavior. Use this value for applications designed for Windows Vista operating system and Windows 7 operating system.

For more information about notification icons, see [MSDN-SHELLNOTIFY], the Remarks section.

**ToolTip (variable):** Variable length. UNICODE\_STRING. Specifies the text of the notification icon tooltip. This structure is present only if the WINDOW\_ORDER\_FIELD\_NOTIFY\_TIP flag is set in the **FieldsPresentFlags** field of TS\_NOTIFYICON\_ORDER\_HEADER.

**InfoTip (variable):** Variable length. A TS\_NOTIFY\_ICON\_INFOTIP structure. Specifies the notification icon's balloon tooltip. This field SHOULD NOT be present for icons that follow Windows 95 operating system behavior (Version = 0). This structure is present only if the WINDOW\_ORDER\_FIELD\_NOTIFY\_INFO\_TIP flag is set in the **FieldsPresentFlags** field of TS\_NOTIFYICON\_ORDER\_HEADER.

**State (4 bytes):** Unsigned 32-bit integer. Specifies the state of the notification icon. This field SHOULD NOT be present for icons that follow Windows 95 behavior (Version = 0).

This field is present only if the WINDOW\_ORDER\_FIELD\_NOTIFY\_STATE flag is set in the **FieldsPresentFlags** field of TS\_NOTIFYICON\_ORDER\_HEADER.

Value	Meaning
1	The notification icon is hidden.

**Icon (variable):** Variable length. A TS\_ICON\_INFO structure. Specifies the notification icon's image. This structure is present only if the WINDOW\_ORDER\_ICON flag is set in the **FieldsPresentFlags** field of TS\_NOTIFYICON\_ORDER\_HEADER.

A Notification Icon Order MUST NOT contain both an **Icon** field and a **CachedIcon** field. If the WINDOW\_ORDER\_STATE\_NEW flag is set, either the **Icon** field or the **CachedIcon** field MUST be present.

**CachedIcon (3 bytes):** Three bytes. A TS\_CACHED\_ICON\_INFO structure. Specifies the notification icon as a cached icon on the client.

This structure is present only if the WINDOW\_ORDER\_CACHEDICON flag is set in the **FieldsPresentFlags** field of TS\_NOTIFYICON\_ORDER\_HEADER. Only one of **Icon** and **CachedIcon** fields SHOULD be present in the Notification Icon Order. If the WINDOW\_ORDER\_STATE\_NEW flag is set, only one of these fields MUST be present.

2.2.1.3.2.2 Deleted Notification Icons

The server generates a Notification Icon Information (section 2.2.1.3.2) order packet whenever an existing notification icon is deleted on the server.

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
Hdr (15 bytes)																															
...																															
...																															
...																															

**Hdr (15 bytes):** A TS\_NOTIFYICON\_ORDER\_HEADER (section 2.2.1.3.2.1) structure. The **FieldsPresentFlags** field of the header MUST be constructed using the following values.

Value	Meaning
0x02000000 WINDOW_ORDER_TYPE_NOTIFY	Indicates an order specifying a notification icon. This flag MUST be set.
0x20000000 WINDOW_ORDER_STATE_DELETED	Indicates that the window is deleted. This flag MUST be set, and the order MUST NOT contain any other information.

2.2.1.3.2.2.3 Notification Icon Balloon Tooltip (TS\_NOTIFY\_ICON\_INFOTIP)

The TS\_NOTIFY\_ICON\_INFOTIP structure specifies the balloon tooltip of a notification icon.

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
Timeout																															
InfoFlags																															
InfoTipText (variable)																															
...																															
Title (variable)																															

...
-----

**Timeout (4 bytes):** An unsigned 32-bit integer. The timeout in milliseconds for the notification icon’s balloon tooltip. After the specified timeout, the tooltip SHOULD be destroyed. <11>

**InfoFlags (4 bytes):** An unsigned 32-bit integer. The flags that can be set to add an icon to a balloon tooltip. It is placed to the left of the title. If the **InfoTipText** field length is zero-length, the icon is not shown.

Value	Meaning
NIIF_NONE 0x00000000	Do not show an icon.
NIIF_INFO 0x00000001	Show an informational icon next to the balloon tooltip text.
NIIF_WARNING 0x00000002	Show a warning icon next to the balloon tooltip text.
NIIF_ERROR 0x00000003	Show an error icon next to the balloon tooltip text.
NIIF_NOSOUND 0x00000010	Do not play an associated sound.
NIIF_LARGE_ICON 0x00000020	Show the large version of the icon.

**InfoTipText (variable):** Variable length. A UNICODE\_STRING specifying the text of the balloon tooltip. The maximum length of the tooltip text string is 510 bytes.

**Title (variable):** Variable length. A UNICODE\_STRING specifying the title of the balloon tooltip. The maximum length of the tooltip title string is 126 bytes.

### 2.2.1.3.3 Desktop Information

Desktop Information Orders specify the state of the desktop on the server.

#### 2.2.1.3.3.1 Common Header (TS\_DESKTOP\_ORDER\_HEADER)

The TS\_DESKTOP\_ORDER\_HEADER packet contains information common to every order specifying the desktop.

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
Header								OrderSize																FieldsPresentFlags							
...																															

**Header (1 byte):** An unsigned 8-bit integer. An Alternate Secondary Order Header, as specified in [MS-RDPEGLI] section 2.2.2.1.3.1.1. The embedded **orderType** field MUST be set to 0x0B (TS\_ALTSEC\_WINDOW).

**OrderSize (2 bytes):** An unsigned 16-bit integer. The size of the entire packet in bytes.

**FieldsPresentFlags (4 bytes):** An unsigned 32-bit integer. The flags indicating which fields are present in the packet. See **Actively Monitored Desktop** for values and use.

2.2.1.3.3.2 Orders

2.2.1.3.3.2.1 Actively Monitored Desktop

The Actively Monitored Desktop packet contains information about the actively monitored desktop.

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
Hdr																															
...																								ActiveWindowId (optional)							
...																								NumWindowIds (optional)							
WindowIds (variable)																															
...																															

**Hdr (7 bytes):** Seven bytes. A TS\_DESKTOP\_ORDER\_HEADER header. The **FieldsPresentFlags** field of the header **MUST** be constructed using the following values.

Value	Meaning
0x04000000 WINDOW_ORDER_TYPE_DESKTOP	Indicates an order specifying a desktop. This flag <b>MUST</b> be set.
0x00000002 WINDOW_ORDER_FIELD_DESKTOP_HOOKED	Indicates that the server will be sending information for the server's current input desktop.
0x00000008 WINDOW_ORDER_FIELD_DESKTOP_ARC_BEGAN	Indicates that the server is beginning to synchronize information with the client after the client has auto-reconnected or the server has just begun monitoring a new desktop. If this flag is set, the WINDOW_ORDER_FIELD_DESKTOP_HOOKED flag <b>MUST</b> also be set.
0x00000004 WINDOW_ORDER_FIELD_DESKTOP_ARC_COMPLETED	Indicates that the server has finished synchronizing data after the client has auto-reconnected or the server has just begun monitoring a new desktop. The client <b>SHOULD</b> assume that any window or shell notification icon not received during the synchronization is discarded. This flag <b>MUST</b> only be combined with the WINDOW_ORDER_TYPE_DESKTOP flag.
0x00000020 WINDOW_ORDER_FIELD_DESKTOP_ACTIVEWND	Indicates that the <b>ActiveWindowId</b> field is present.
0x00000010 WINDOW_ORDER_FIELD_DESKTOP_ZORDER	Indicates that the <b>NumWindowIds</b> field is present. If the <b>NumWindowIds</b> field has a value greater than 0, the <b>WindowIds</b> field <b>MUST</b> also be present.

**ActiveWindowId (4 bytes):** Optional. An unsigned 32-bit integer. The ID of the currently active window on the server. This field is present if and only if the WINDOW\_ORDER\_FIELD\_DESKTOP\_ACTIVEWND flag is set in the **FieldsPresentFlags** field of the TS\_DESKTOP\_ORDER\_HEADER packet (section 2.2.1.3.3.1).

**NumWindowIds (1 byte):** Optional. An unsigned 8-bit integer. The number of top-level windows on the server. This field is present if and only if the WINDOW\_ORDER\_FIELD\_DESKTOP\_ZORDER flag is set in the **FieldsPresentFlags** field of the TS\_DESKTOP\_ORDER\_HEADER packet (section 2.2.1.3.3.1).

**WindowIds (variable):** Variable length. An array of 4-byte window IDs, corresponding to the IDs of the top-level windows on the server, ordered by their Z-order on the server. The number of window IDs in the array is equal to the value of the **NumWindowIds** field.

This field is present if and only if the **NumWindowIds** field is greater than 0 and the WINDOW\_ORDER\_FIELD\_DESKTOP\_ZORDER flag is set in the **FieldsPresentFlags** field of the TS\_DESKTOP\_ORDER\_HEADER packet (section 2.2.1.3.3.1).

### 2.2.1.3.3.2.2 Non-Monitored Desktop

The Non-Monitored Desktop packet is generated by the server when it is not actively monitoring the current desktop on the server.

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
Hdr																															
...																															

**Hdr (7 bytes):** Seven bytes. A TS\_DESKTOP\_ORDER\_HEADER header. The **FieldsPresentFlags** field of the header MUST be constructed using the following values.

Value	Meaning
0x04000000 WINDOW_ORDER_TYPE_DESKTOP	Indicates an order specifying a desktop. This flag MUST be set.
0x00000001 WINDOW_ORDER_FIELD_DESKTOP_NONE	Indicates that the server will not be sending information for the server's current input desktop. This flag MUST be set.

## 2.2.2 Static Virtual Channel Protocol

The RAIL Static Virtual Channel (named "RAIL") is responsible for communicating non-RDP specific data between the RAIL client and server. The following sections outline the messages that are transmitted over the virtual channel.

### 2.2.2.1 Common Header (TS\_RAIL\_PDU\_HEADER)

The **TS\_RAIL\_PDU\_HEADER** packet contains information common to every RAIL Virtual Channel PDU.



0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
orderType																orderLength															

**orderType (2 bytes):** An unsigned 16-bit integer. The type of the Virtual Channel message; MUST be set to one of the following values.

Value	Meaning
TS_RAIL_ORDER_EXEC 0x0001	Indicates a Client Execute PDU from client to server.
TS_RAIL_ORDER_ACTIVATE 0x0002	Indicates a Client Activate PDU from client to server.
TS_RAIL_ORDER_SYSPARAM 0x0003	Indicates a Client System Parameters Update PDU from client to server or a Server System Parameters Update PDU from server to client.
TS_RAIL_ORDER_SYSCOMMAND 0x0004	Indicates a Client System Command PDU from client to server.
TS_RAIL_ORDER_HANDSHAKE 0x0005	Indicates a bi-directional Handshake PDU.
TS_RAIL_ORDER_NOTIFY_EVENT 0x0006	Indicates a Client Notify Event PDU from client to server.
TS_RAIL_ORDER_WINDOWMOVE 0x0008	Indicates a Client Window Move PDU from client to server.
TS_RAIL_ORDER_LOCALMOVESIZE 0x0009	Indicates a Server Move/Size Start PDU and a Server Move/Size End PDU from server to client.
TS_RAIL_ORDER_MINMAXINFO 0x000a	Indicates a Server Min Max Info PDU from server to client.
TS_RAIL_ORDER_CLIENTSTATUS 0x000b	Indicates a Client Information PDU from client to server.
TS_RAIL_ORDER_SYSMENU 0x000c	Indicates a Client System Menu PDU from client to server.
TS_RAIL_ORDER_LANGBARINFO 0x000d	Indicates a Server Language Bar Information PDU from server to client, or a Client Language Bar Information PDU from client to server.
TS_RAIL_ORDER_EXEC_RESULT 0x0080	Indicates a Server Execute Result PDU from server to client.
TS_RAIL_ORDER_GET_APPID_REQ 0x000E	Indicates a Client Get Application ID PDU from client to server.
TS_RAIL_ORDER_GET_APPID_RESP 0x000F	Indicates a Server Get Application ID Response PDU from server to client.

Value	Meaning
TS_RAIL_ORDER_TASKBARINFO 0x0010	Indicates a <b>Taskbar Tab Info PDU</b> (section 2.2.2.14.1) from server to client.
TS_RAIL_ORDER_LANGUAGEIMEINFO 0x0011	Indicates a Language Profile Information PDU from client to server
TS_RAIL_ORDER_COMPARTMENTINFO 0x0012	Indicates a bi-directional Compartment Status Information PDU.
TS_RAIL_ORDER_HANDSHAKE_EX 0x0013	Indicates a HandshakeEx PDU from server to client.
TS_RAIL_ORDER_ZORDER_SYNC 0x0014	Indicates a Server Z-Order Sync Information PDU from server to client.
TS_RAIL_ORDER_CLOAK 0x0015	Indicates a Window Cloak State Change PDU from client to server.
TS_RAIL_ORDER_POWER_DISPLAY_REQUEST 0x0016	Indicates a <b>Power Display Request PDU</b> (section 2.2.2.13.1) from server to client.
TS_RAIL_ORDER_SNAP_ARRANGE 0x0017	Indicates a <b>Client Window Snap PDU</b> (section 2.2.2.7.5) from client to server.
TS_RAIL_ORDER_GET_APPID_RESP_EX 0x0018	Indicates a <b>Server Get Application ID Extended Response PDU</b> (section 2.2.2.8.2) from server to client.
TS_RAIL_ORDER_TEXTSCALEINFO 0x0019	Indicates a <b>Text Scale Information PDU</b> (section 2.2.2.15.1) from client to server.
TS_RAIL_ORDER_CARETBLINKINFO 0x001A	Indicates a <b>Caret Blink Information PDU</b> (section 2.2.2.15.2) from client to server.

**orderLength (2 bytes):** An unsigned 16-bit integer. The length of the Virtual Channel PDU, in bytes.

## 2.2.2.2 Initialization Messages

Initialization messages are exchanged between client and server at the start of a RAIL session.

### 2.2.2.2.1 Handshake PDU (TS\_RAIL\_ORDER\_HANDSHAKE)

The Handshake PDU is exchanged between the server and the client to establish that both endpoints are ready to begin RAIL mode. The server sends the Handshake PDU and the client responds with the Handshake PDU.

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
header																															
buildNumber																															

**header (4 bytes):** A TS\_RAIL\_PDU\_HEADER structure. The **orderType** field of the header MUST be set to 0x0005 (TS\_RAIL\_ORDER\_HANDSHAKE).

**buildNumber (4 bytes):** An unsigned 32-bit integer. The build or version of the sending party.

#### 2.2.2.2.2 Client Information PDU (TS\_RAIL\_ORDER\_CLIENTSTATUS)

The Client Information PDU is sent from client to server and contains information about RAIL client state and features supported by the client.

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
header																															
Flags																															

**header (4 bytes):** A TS\_RAIL\_PDU\_HEADER structure. The **orderType** field of header MUST be set to 0x000b (TS\_RAIL\_ORDER\_CLIENTSTATUS).

**Flags (4 bytes):** An unsigned 32-bit integer. RAIL features that are supported by the client; MUST be set to one or more of the following feature flags, or zero if none of the features are supported.

Value	Meaning
TS_RAIL_CLIENTSTATUS_ALLOWLOCALMOVESIZE 0x00000001	Indicates that the client supports the local move/size RAIL feature.
TS_RAIL_CLIENTSTATUS_AUTORECONNECT 0x00000002	Indicates that the client is auto-reconnecting to the server after an unexpected disconnect of the session.
TS_RAIL_CLIENTSTATUS_ZORDER_SYNC 0x00000004	Indicates that the client supports Z-order sync using the Z-Order Sync Information PDU (section 2.2.2.11.1).
TS_RAIL_CLIENTSTATUS_WINDOW_RESIZE_MARGIN_SUPPORTED 0x00000010	Indicates that the client supports resize margins using the Window Information PDU (section 2.2.1.3.1).
TS_RAIL_CLIENTSTATUS_HIGH_DPI_ICONS_SUPPORTED 0x00000020	Indicates that the client supports icons up to 96×96 pixels in size in the Window Icon PDU (section 2.2.1.3.1.2.2). If this flag is not present, icon dimensions are limited to 32×32 pixels.
TS_RAIL_CLIENTSTATUS_APPBAR_REMOTING_SUPPORTED 0x00000040	Indicates that the client supports application desktop toolbar remoting using the Window Information PDU (section 2.2.1.3.1).
TS_RAIL_CLIENTSTATUS_POWER_DISPLAY_REQUEST_SUPPORTED 0x00000080	Indicates that the client supports display-required power requests sent using the Power Display Request PDU (section 2.2.2.13.1).
TS_RAIL_CLIENTSTATUS_BIDIRECTIONAL_CLOAK_SUPPORTED 0x00000200	Indicates that the client is capable of processing Window Cloak State Change PDUs (section 2.2.2.12.1) sent by the server.
TS_RAIL_CLIENTSTATUS_SUPPRESS_ICON_ORDERS	Indicates that window icons SHOULD NOT be sent to the client using the

Value	Meaning
0x00000400	Window Icon (section 2.2.1.3.1.2.2) and Cached Icon (section 2.2.1.3.1.2.3) orders. This flag is intended to improve performance for clients that do not display window icons. Clients MUST still process icon PDUs as older server implementations may not support this flag.

### 2.2.2.2.3 (Updated Section) HandshakeEx PDU (TS\_RAIL\_ORDER\_HANDSHAKE\_EX)

The **HandshakeEx PDU** (instead of the Handshake PDU) is sent from the server to the client if both the client and the server specified support for it by including the TS\_RAIL\_LEVEL\_HANDSHAKE\_EX\_SUPPORTED flag in the **Remote Programs Capability Set** (section 2.2.1.1.1). This PDU is also sent by the server in an Enhanced RemoteApp session to signal that it is ready to begin Enhanced RemoteApp mode. The server sends the **HandshakeEx PDU**, and the client responds with the **Handshake PDU** (section 2.2.2.2.1).

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
header																															
buildNumber																															
railHandshakeFlags																															

**header (4 bytes):** A **TS\_RAIL\_PDU\_HEADER** (section 2.2.2.1) structure. The **orderType** field of the header MUST be set to 0x0013 (TS\_RAIL\_ORDER\_HANDSHAKE\_EX).

**buildNumber (4 bytes):** An unsigned 32-bit integer. The build or version of the sending party.

**railHandshakeFlags (4 bytes):** An unsigned 32-bit integer. Flags for setting up RAIL session parameters.

Flag	Meaning
TS_RAIL_ORDER_HANDSHAKEEX_FLAGS_HIDEF 0x00000001	Indicates that Enhanced RemoteApp (section 1.3.3) is supported. This implies support for the Remote Desktop Protocol: Graphics Pipeline Extension ([MS-RDPEGFX] section 1.5), specifically the <b>RDPGFX_MAP_SURFACE_TO_WINDOW_PDU</b> ([MS-RDPEGFX] section 2.2.2.20) message.
TS_RAIL_ORDER_HANDSHAKE_EX_FLAGS_EXTENDED_SPI_SUPPORTED 0x00000002	Indicates that additional system parameter flags are supported in the <b>Client System Parameters Update PDU</b> (section 2.2.2.4.1).
TS_RAIL_ORDER_HANDSHAKE_EX_FLAGS_SNAP_ARRANGE_SUPPORTED 0x00000004	Indicates that the server supports the <b>Client Window Snap PDU</b> (section 2.2.2.7.5).

Flag	Meaning
TS_RAIL_ORDER_HANDSHAKE_EX_FLAGS_TEXT_SCALE_SUPPORTED 0x00000008	Indicates that the server supports the <b>Text Scale Information PDU</b> (section 2.2.2.15.1).
TS_RAIL_ORDER_HANDSHAKE_EX_FLAGS_CARET_BLINK_SUPPORTED 0x00000010	Indicates that the server supports the <b>Caret Blink Information PDU</b> (section 2.2.2.15.2).
TS_RAIL_ORDER_HANDSHAKE_EX_FLAGS_EXTENDED_SPI_2_SUPPORTED 0x00000020	Indicates that more additional system parameter flags are supported in the <b>Client System Parameters Update PDU</b> (section 2.2.2.4.1).
TS_RAIL_ORDER_HANDSHAKE_EX_FLAGS_EXTENDED_SPI_3_SUPPORTED 0x00000040	Indicates that more additional system parameter flags are supported in the <b>Client System Parameters Update PDU</b> (section 2.2.2.4.1).

2.2.2.3 Program Launching Messages

2.2.2.3.1 Client Execute PDU (TS\_RAIL\_ORDER\_EXEC)

The Client Execute PDU is sent from a client to a server to request that a remote application launch on the server.

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
header																															
Flags																ExeOrFileLength															
WorkingDirLength																ArgumentsLen															
ExeOrFile (variable)																															
...																															
WorkingDir (variable)																															
...																															
Arguments (variable)																															
...																															

**header (4 bytes):** A TS\_RAIL\_PDU\_HEADER structure. The **orderType** field of the header MUST be set to 0x0001 (TS\_RAIL\_ORDER\_EXEC).

**Flags (2 bytes):** An unsigned 16-bit integer. Specifies a bit field of flags that indicate modifications to the Client Execute PDU fields.

<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>	<b>15</b>
A	B	C	D	E	0	0	0	0	0	0	0	0	0	0	0

Where the bits are defined as:

Value	Description
A TS_RAIL_EXEC_FLAG_EXPAND_WORKINGDIRECTORY	The environment variables in the <b>WorkingDir</b> field MUST be expanded on the server.
B TS_RAIL_EXEC_FLAG_TRANSLATE_FILES	The drive letters in the file path MUST be converted to corresponding mapped drives on the server. This flag MUST NOT be set if the TS_RAIL_EXEC_FLAG_FILE (0x0004) flag is not set.
C TS_RAIL_EXEC_FLAG_FILE	If this flag is set, the <b>ExeOrFile</b> field refers to a file path. If it is not set, the <b>ExeOrFile</b> field refers to an executable.
D TS_RAIL_EXEC_FLAG_EXPAND_ARGUMENTS	The environment variables in the <b>Arguments</b> field MUST be expanded on the server.
E TS_RAIL_EXEC_FLAG_APP_USER_MODEL_ID	If this flag is set, the <b>ExeOrFile</b> field refers to an application user model ID. If it is not set, the <b>ExeOrFile</b> field refers to a file path. This flag MUST be ignored if the TS_RAIL_EXEC_FLAG_FILE (0x0004) flag is set. An application user model ID is a string that uniquely identifies an application, regardless of where the application is installed on the operating system. The string can be used to identify Windows Store applications as well as desktop applications.

**ExeOrFileLength (2 bytes):** An unsigned 16-bit integer. Specifies the length of the **ExeOrFile** field in bytes. The length MUST be nonzero. The maximum length is 520 bytes.

**WorkingDirLength (2 bytes):** An unsigned 16-bit integer. Specifies the length of the **WorkingDir** field, in bytes. The minimum length is 0, and the maximum length is 520 bytes.

**ArgumentsLen (2 bytes):** An unsigned 16-bit integer. Specifies the length of the **Arguments** field, in bytes. The minimum length is 0, and the maximum length is 16,000 bytes.<12>

**ExeOrFile (variable):** A non-null-terminated string of Unicode characters. Variable length. Specifies the executable, file path, or application user model ID to be launched on the server. This field MUST be present. The maximum length of this field, including file path translations (see TS\_RAIL\_EXEC\_FLAG\_TRANSLATE\_FILES mask of **Flags** field), is 520 bytes.

**WorkingDir (variable):** Optional non-null-terminated string of Unicode characters. Variable length. Specifies the working directory of the launched **ExeOrFile** field. If the **WorkingDirLength** field is 0, this field MUST NOT be present; otherwise, it MUST be present. The maximum length of this field, including expanded environment variables (see TS\_RAIL\_EXEC\_FLAG\_EXPAND\_WORKINGDIRECTORY mask of **Flags** field), is 520 bytes.

**Arguments (variable):** Optional non-null-terminated string of Unicode characters. Variable length. Specifies the arguments to the **ExeOrFile** field. If the **ArgumentsLen** field is 0, this field MUST NOT be present; otherwise, it MUST be present. The maximum length of this field, including expanded environment variables (see TS\_RAIL\_EXEC\_FLAG\_EXPAND\_ARGUMENTS mask of **Flags** field), is 16,000 bytes.

### 2.2.2.3.2 Server Execute Result PDU (TS\_RAIL\_ORDER\_EXEC\_RESULT)

The Server Execute Result PDU is sent from server to client in response to a Client Execute PDU request, and contains the result of the server's attempt to launch the requested executable.

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
header																															
Flags																ExecResult															
RawResult																															
Padding																ExeOrFileLength															
ExeOrFile (variable)																															
...																															

**header (4 bytes):** A TS\_RAIL\_PDU\_HEADER structure. The **orderType** field of the header MUST be set to TS\_RAIL\_ORDER\_EXEC\_RESULT (0x0080).

**Flags (2 bytes):** An unsigned 16-bit integer. Identical to the Flags field of the Client Execute PDU. The server sets this field to enable the client to match the Client Execute PDU with the Server Execute Result PDU.

**ExecResult (2 bytes):** An unsigned 16-bit integer. The result of the Client Execute PDU. This field MUST be set to one of the following values.

Value	Meaning
RAIL_EXEC_S_OK 0x0000	The Client Execute request was successful and the requested application or file has been launched.
RAIL_EXEC_E_HOOK_NOT_LOADED 0x0001	The Client Execute request could not be satisfied because the server is not monitoring the current input desktop.
RAIL_EXEC_E_DECODE_FAILED 0x0002	The Execute request could not be satisfied because the request PDU was malformed.
RAIL_EXEC_E_NOT_IN_ALLOWLIST 0x0003	The Client Execute request could not be satisfied because the requested application was blocked by policy from being launched on the server.
RAIL_EXEC_E_FILE_NOT_FOUND 0x0005	The Client Execute request could not be satisfied because the application or file path could not be found.
RAIL_EXEC_E_FAIL 0x0006	The Client Execute request could not be satisfied because an unspecified error occurred on the server.
RAIL_EXEC_E_SESSION_LOCKED 0x0007	The Client Execute request could not be satisfied because the remote session is locked.

**RawResult (4 bytes):** An unsigned 32-bit integer. Contains an operating system-specific return code for the result of the Client Execute request.<13>

**Padding (2 bytes):** An unsigned 16-bit integer. Not used.

**ExeOrFileLength (2 bytes):** An unsigned 16-bit integer. Specifies the length of the **ExeOrFile** field in bytes. The length **MUST** be nonzero. The maximum length is 520 bytes.

**ExeOrFile (variable):** The executable or file that was attempted to be launched. This field is copied from the **ExeOrFile** field of the Client Execute PDU. The server sets this field to enable the client to match the Client Execute PDU with the Server Execute Result PDU.

## 2.2.2.4 Local Client System Parameters Update Messages

### 2.2.2.4.1 (Updated Section) Client System Parameters Update PDU (TS\_RAIL\_ORDER\_SYSPARAM)

The Client System Parameters Update PDU is sent from the client to the server to synchronize system parameters on the server with those on the client.

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
header																															
SystemParam																															
Body (variable)																															
...																															

**header (4 bytes):** A TS\_RAIL\_PDU\_HEADER structure. The **orderType** field of header **MUST** be set to TS\_RAIL\_ORDER\_SYSPARAM(0x0003).

**SystemParam (4 bytes):** An unsigned 32-bit integer. The type of system parameter being transmitted. The field **MUST** be set to one of the following values.

Value	Meaning
SPI_SETDRAGFULLWINDOWS 0x00000025	The system parameter for full-window drag.
SPI_SETKEYBOARDCUES 0x0000100B	The system parameter to determine whether menu access keys are always underlined.
SPI_SETKEYBOARDPREF 0x00000045	The system parameter specifying a preference for the keyboard instead of the mouse.
SPI_SETWORKAREA 0x0000002F	The system parameter to set the size of the work area. The work area is the portion of the screen not obscured by the system taskbar or by application desktop toolbars.
RAIL_SPI_DISPLAYCHANGE 0x0000F001	The system parameter for display resolution.
SPI_SETMOUSEBUTTONSWAP 0x00000021	The system parameter to swap or restore the meaning of the left and right mouse buttons.



Value	Meaning
RAIL_SPI_TASKBARPOS 0x0000F000	The system parameter to indicate the size of the client taskbar.
SPI_SETHIGHCONTRAST 0x00000043	The system parameter to set the parameters of the HighContrast accessibility feature.
SPI_SETCARETWIDTH 0x00002007	The system parameter to set the caret width used for text entry controls. This flag SHOULD NOT be sent if the server did not advertise the EXTENDED_SPI_SUPPORTED flag in the <b>HandshakeEx PDU</b> (section 2.2.2.2.3).
SPI_SETSTICKYKEYS 0x0000003B	The system parameter to set the parameters of the Sticky Keys accessibility feature. This flag SHOULD NOT be sent if the server did not advertise the EXTENDED_SPI_SUPPORTED flag in the <b>HandshakeEx PDU</b> .
SPI_SETTOGGLEKEYS 0x00000035	The system parameter to set the parameters of the Toggle Keys accessibility feature. This flag SHOULD NOT be sent if the server did not advertise the EXTENDED_SPI_SUPPORTED flag in the <b>HandshakeEx PDU</b> .
SPI_SETFILTERKEYS 0x00000033	The system parameter to set the parameters of the Filter Keys accessibility feature. This flag SHOULD NOT be sent if the server did not advertise the EXTENDED_SPI_SUPPORTED flag in the <b>HandshakeEx PDU</b> .
RAIL_SPI_DISPLAY_ANIMATIONS_ENABLED 0x0000F002	The system parameter indicating whether animations are enabled for the system user interface. This flag SHOULD NOT be sent if the server did not advertise the EXTENDED_SPI_2_SUPPORTED flag in the <b>HandshakeEx PDU</b> .
RAIL_SPI_DISPLAY_ADVANCED_EFFECTS_ENABLED 0x0000F003	The system parameter indicating whether the system Transparency effects setting is enabled. This flag SHOULD NOT be sent if the server did not advertise the EXTENDED_SPI_2_SUPPORTED flag in the <b>HandshakeEx PDU</b> .
RAIL_SPI_DISPLAY_AUTO_HIDE_SCROLLBARS 0x0000F004	The system parameter indicating whether the user has specified that scrollbars should be automatically hidden when not being interacted with. This flag SHOULD NOT be sent if the server did not advertise the EXTENDED_SPI_2_SUPPORTED flag in the <b>HandshakeEx PDU</b> .
RAIL_SPI_DISPLAY_MESSAGE_DURATION 0x0000F005	The system parameter indicating the length of time a message is displayed for the app view in seconds. This flag SHOULD NOT be sent if the server did not advertise the EXTENDED_SPI_2_SUPPORTED flag in the <b>HandshakeEx PDU</b> .
RAIL_SPI_CLOSED_CAPTION_FONT_COLOR 0x0000F006	The system parameter indicating the font color for closed-caption text. Valid properties are described by the ClosedCaptionColor enumeration. This flag SHOULD NOT be sent if the server did not advertise the EXTENDED_SPI_2_SUPPORTED flag in the <b>HandshakeEx PDU</b> .

Value	Meaning
RAIL_SPI_CLOSED_CAPTION_FONT_OPACITY 0x0000F007	The system parameter indicating the font opacity for closed-caption text. Valid properties are described by the ClosedCaptionOpacity enumeration. This flag SHOULD NOT be sent if the server did not advertise the EXTENDED_SPI_2_SUPPORTED flag in the <b>HandshakeEx PDU</b> .
RAIL_SPI_CLOSED_CAPTION_FONT_SIZE 0x0000F008	The system parameter indicating the font size for closed-caption text. Valid properties are described by the ClosedCaptionSize enumeration. This flag SHOULD NOT be sent if the server did not advertise the EXTENDED_SPI_2_SUPPORTED flag in the <b>HandshakeEx PDU</b> .
RAIL_SPI_CLOSED_CAPTION_FONT_STYLE 0x0000F009	The system parameter indicating the font style for closed-caption text. Valid properties are described by the ClosedCaptionStyle enumeration. This flag SHOULD NOT be sent if the server did not advertise the EXTENDED_SPI_2_SUPPORTED flag in the <b>HandshakeEx PDU</b> .
RAIL_SPI_CLOSED_CAPTION_FONT_EDGE_EFFECT 0x0000F00A	The system parameter indicating the font effect for close-caption text. Valid properties are described by the ClosedCaptionEdgeEffect enumeration. This flag SHOULD NOT be sent if the server did not advertise the EXTENDED_SPI_2_SUPPORTED flag in the <b>HandshakeEx PDU</b> .
RAIL_SPI_CLOSED_CAPTION_BACKGROUND_COLOR 0x0000F00B	The system parameter indicating the background color of lines of closed-caption text. Valid properties are described by the ClosedCaptionColor enumeration. This flag SHOULD NOT be sent if the server did not advertise the EXTENDED_SPI_2_SUPPORTED flag in the <b>HandshakeEx PDU</b> .
RAIL_SPI_CLOSED_CAPTION_BACKGROUND_OPACITY 0x0000F00C	The system parameter indicating the background opacity of lines of closed-caption text. Valid properties are described by the ClosedCaptionOpacity enumeration. This flag SHOULD NOT be sent if the server did not advertise the EXTENDED_SPI_2_SUPPORTED flag in the <b>HandshakeEx PDU</b> .
RAIL_SPI_CLOSED_CAPTION_REGION_COLOR 0x0000F00D	The system parameter indicating the region color for closed-caption text. Valid properties are described by the ClosedCaptionColor enumeration. This flag SHOULD NOT be sent if the server did not advertise the EXTENDED_SPI_2_SUPPORTED flag in the <b>HandshakeEx PDU</b> .
RAIL_SPI_CLOSED_CAPTION_REGION_OPACITY 0x0000F00E	The system parameter indicating the region opacity for closed-caption text. Valid properties are described by the ClosedCaptionOpacity enumeration. This flag SHOULD NOT be sent if the server did not advertise the EXTENDED_SPI_2_SUPPORTED flag in the <b>HandshakeEx PDU</b> .
RAIL_SPI_ACCENT_COLOR 0x0000F00F	The system parameter that indicates the system accent color for emphasizing important elements in

Value	Meaning
	the user interface and indicates the state of an interactive object or control. This flag SHOULD NOT be sent if the server did not advertise the EXTENDED_SPI_3_SUPPORTED flag in the HandshakeEx PDU.
RAIL_SPI_SYSTEM_USES_LIGHT_THEME 0x0000F010	The system parameter that indicates whether the system uses light mode by default. This flag SHOULD NOT be sent if the server did not advertise the EXTENDED_SPI_3_SUPPORTED flag in the HandshakeEx PDU.
RAIL_SPI_APPS_USE_LIGHT_THEME 0x0000F011	The system parameter that indicates whether applications use light mode by default. This flag SHOULD NOT be sent if the server did not advertise the EXTENDED_SPI_3_SUPPORTED flag in the HandshakeEx PDU.

**Body (variable):** The contents of this field depend on the **SystemParam** field. The following table outlines the valid values of the **SystemParam** field (Value column) and corresponding values of the **Body** field (Meaning column).

Value	Meaning
SPI_SETDRAGFULLWINDOWS 0x0025	Size of Body field: 1 byte. 0 (FALSE): Full Window Drag is disabled. Nonzero (TRUE): Full Window Drag is enabled.
SPI_SETKEYBOARDUCUES 0x100B	Size of Body field: 1 byte. 0 (FALSE): Menu Access Keys are underlined only when the menu is activated by the keyboard. Nonzero (TRUE): Menu Access Keys are always underlined.
SPI_SETKEYBOARDPREF 0x0045	Size of Body field: 1 byte. 0 (FALSE): The user does not prefer the keyboard over mouse. Nonzero (TRUE): The user prefers the keyboard over mouse. This causes applications to display keyboard interfaces that would otherwise be hidden.
SPI_SETMOUSEBUTTONSWAP 0x0021	Size of Body field: 1 byte. 0 (FALSE): Restores the meaning of the left and right mouse buttons to their original meanings. Nonzero (TRUE): Swaps the meaning of the left and right mouse buttons.
SPI_SETWORKAREA 0x002F	Size of Body field: 8 bytes. The body is a TS_RECTANGLE_16 structure that defines the work area in virtual screen coordinates. In a system with multiple display monitors, the work area is that of the monitor that contains the specified rectangle. For more information about virtual screen coordinates, see [MSDN-VIRTUALSCR].
RAIL_SPI_DISPLAYCHANGE 0xF001	Size of Body field: 8 bytes. The body is a TS_RECTANGLE_16 structure that indicates the new display resolution in virtual

Value	Meaning
	screen coordinates. For more information about virtual screen coordinates, see [MSDN-VIRTUALSCR].
RAIL_SPI_TASKBARPOS 0xF000	Size of Body field: 8 bytes. The body is a TS_RECTANGLE_16 structure that indicates the size of the client taskbar.
SPI_SETHIGHCONTRAST 0x0043	Size of Body field: Variable number of bytes. The body is a TS_HIGHCONTRAST structure.
SPI_SETCARETWIDTH 0x00002007	Size of Body field: 4 bytes. The body is an unsigned 32-bit integer that indicates the width of the caret. The minimum allowed value is 0x00000001.
SPI_SETSTICKYKEYS 0x0000003B	Size of Body field: 4 bytes. The body is a TS_STICKYKEYS structure.
SPI_SETTOGGLEKEYS 0x00000035	Size of Body field: 4 bytes. The body is a TS_TOGGLEKEYS structure.
SPI_SETFILTERKEYS 0x00000033	Size of Body field: 20 bytes. The body is a TS_FILTERKEYS structure.
RAIL_SPI_DISPLAY_ANIMATIONS_ENABLED 0x0000F002	Size of Body field: 1 byte. 0 (FALSE): Animations are disabled for the user interface. Nonzero (TRUE): Animations are enabled for the user interface.
RAIL_SPI_DISPLAY_ADVANCED_EFFECTS_ENABLED 0x0000F003	Size of Body field: 1 byte. 0 (FALSE): Transparency UI effects are disabled. Nonzero (TRUE): Transparency UI effects are enabled.
RAIL_SPI_DISPLAY_AUTO_HIDE_SCROLLBARS 0x0000F004	Size of Body field: 1 byte. 0 (FALSE): Scroll bars are not automatically hidden when not being interacted with. Nonzero (TRUE): Scroll bars are automatically hidden when not being interacted with.
RAIL_SPI_DISPLAY_MESSAGE_DURATION 0x0000F005	Size of Body field: 4 bytes. The body is an unsigned 32-bit integer that indicates the duration of a message is displayed for the app view, in seconds.
RAIL_SPI_CLOSED_CAPTION_FONT_COLOR 0x0000F006	Size of Body field: 1 byte. The body is a byte that indicates the font color for closed-caption text, as described by the ClosedCaptionColor enumeration.
RAIL_SPI_CLOSED_CAPTION_FONT_OPACITY 0x0000F007	Size of Body field: 1 byte. The body is a byte that indicates the font opacity for closed-caption text, as described by the ClosedCaptionOpacity enumeration.
RAIL_SPI_CLOSED_CAPTION_FONT_SIZE 0x0000F008	Size of Body field: 1 byte.

Value	Meaning
	The body is a byte that indicates the font size for closed-caption text, as described by the ClosedCaptionSize enumeration.
RAIL_SPI_CLOSED_CAPTION_FONT_STYLE 0x0000F009	Size of Body field: 1 byte. The body is a byte that indicates the font style for closed-caption text, as described by the ClosedCaptionStyle enumeration.
RAIL_SPI_CLOSED_CAPTION_FONT_EDGE_EFFECT 0x0000F00A	Size of Body field: 1 byte. The body is a byte that indicates the font effect for closed-caption text, as described by the ClosedCaptionEdgeEffect enumeration.
RAIL_SPI_CLOSED_CAPTION_BACKGROUND_COLOR 0x0000F00B	Size of Body field: 1 byte. The body is a byte that indicates the background color of lines of closed-caption text, as described by the ClosedCaptionColor enumeration.
RAIL_SPI_CLOSED_CAPTION_BACKGROUND_OPACITY 0x0000F00C	Size of Body field: 1 byte. The body is a byte that indicates the background opacity of lines of closed-caption text, as described by the ClosedCaptionOpacity enumeration.
RAIL_SPI_CLOSED_CAPTION_REGION_COLOR 0x0000F00D	Size of Body field: 1 byte. The body is a byte that indicates the region color for closed-caption text, as described by the ClosedCaptionColor enumeration.
RAIL_SPI_CLOSED_CAPTION_REGION_OPACITY 0x0000F00E	Size of Body field: 1 byte. The body is a byte that indicates the region opacity for closed-caption text, as described by the ClosedCaptionOpacity enumeration.
RAIL_SPI_ACCENT_COLOR 0x0000F00F	Size of Body field: Variable number of bytes. The body is a TS_ACCENTCOLOR structure.
RAIL_SPI_SYSTEM_USES_LIGHT_THEME 0x0000F010	Size of Body field: 4 bytes. 0 (FALSE): System uses dark mode by default. 1 (TRUE): System uses light mode by default.
RAIL_SPI_APPS_USE_LIGHT_THEME 0x0000F011	Size of Body field: 4 bytes. 0 (FALSE): Applications use dark mode by default. 1 (TRUE): Applications use light mode by default.

#### 2.2.2.4.2 High Contrast System Information Structure (TS\_HIGHCONTRAST)

The TS\_HIGHCONTRAST packet defines parameters for the high-contrast accessibility feature.

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
Flags																															

ColorSchemeLength
ColorScheme (variable)
...

**Flags (4 bytes):** An unsigned 32-bit integer that is read by the server and used to set the High Contrast parameters.<14>

Flag	Meaning
HCF_HIGHCONTRASTON 0x00000001	The High Contrast feature is enabled.
HCF_AVAILABLE 0x00000002	The High Contrast feature is available.
HCF_HOTKEYACTIVE 0x00000004	The user can turn the High Contrast feature on or off by using the hotkey (left SHIFT + left ALT + PRINT SCREEN).
HCF_CONFIRMHOTKEY 0x00000008	The user will be prompted with a confirmation dialog before the High Contrast feature is enabled using the hotkey.
HCF_HOTKEYSOUND 0x00000010	A sound is played whenever the High Contrast feature is turned on or off using the hotkey.

**ColorSchemeLength (4 bytes):** An unsigned 32-bit integer. The length, in bytes, of the ColorScheme field.

**ColorScheme (variable):** UNICODE\_STRING. Variable length. The Windows-specific name of the High Contrast Color Scheme, specified as a null-terminated UNICODE\_STRING.<15>

### 2.2.2.4.3 Filter Keys System Information Structure (TS\_FILTERKEYS)

The **TS\_FILTERKEYS** packet defines parameters for the Filter Keys accessibility feature.

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
Flags																															
WaitTime																															
DelayTime																															
RepeatTime																															
BounceTime																															

**Flags (4 bytes):** An unsigned 32-bit integer that is read by the server and used to set the Filter Keys parameters.

Flag	Meaning
FKF_FILTERKEYSON 0x00000001	The Filter Keys feature is enabled.
FKF_AVAILABLE 0x00000002	The Filter Keys feature is available.
FKF_HOTKEYACTIVE 0x00000004	The user can turn the Filter Keys feature on or off by using the default hotkey (holding right SHIFT for 8 seconds).
FKF_CONFIRMHOTKEY 0x00000008	The user will be prompted with a confirmation dialog before the Filter Keys feature is enabled using the hotkey.
FKF_HOTKEYSOUND 0x00000010	A sound is played whenever the Filter Keys feature is turned on or off using the hotkey.
FKF_INDICATOR 0x00000020	A visual indicator is displayed when the Filter Keys feature is enabled.
FKF_CLICKON 0x00000040	A click sound is played whenever a key is pressed or accepted.

**WaitTime (4 bytes):** An unsigned 32-bit integer. The length of time, in milliseconds, that a user has to hold down a key before it is accepted by the computer.

**DelayTime (4 bytes):** An unsigned 32-bit integer. The length of time, in milliseconds, that the user has to hold down a key before it begins to repeat.

**RepeatTime (4 bytes):** An unsigned 32-bit integer. The length of time, in milliseconds, between each repetition of the keystroke.

**BounceTime (4 bytes):** An unsigned 32-bit integer. The length of time, in milliseconds, that has to elapse after releasing a key before a subsequent press of the same key is accepted.

#### 2.2.2.4.4 Toggle Keys System Information Structure (TS\_TOGGLEKEYS)

The **TS\_TOGGLEKEYS** packet defines parameters for the Toggle Keys accessibility feature.

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
Flags																															

**Flags (4 bytes):** An unsigned 32-bit integer that is read by the server and used to set the Toggle Keys parameters.

Flag	Meaning
TKF_TOGGLEKEYSON 0x00000001	The Toggle Keys feature is enabled.
TKF_AVAILABLE 0x00000002	The Toggle Keys feature is available.
TKF_HOTKEYACTIVE 0x00000004	The user can turn the Toggle Keys feature on or off by using the hotkey (holding NUM LOCK for 8 seconds).

Flag	Meaning
TKF_CONFIRMHOTKEY 0x00000008	The user will be prompted with a confirmation dialog before the Toggle Keys feature is enabled using the hotkey.
TKF_HOTKEYSOUND 0x00000010	A sound is played whenever the Toggle Keys feature is turned on or off using the hotkey.

#### 2.2.2.4.5 Sticky Keys System Information Structure (TS\_STICKYKEYS)

The **TS\_STICKYKEYS** packet defines parameters for the Sticky Keys accessibility feature.

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
Flags																															

**Flags (4 bytes):** An unsigned 32-bit integer that is read by the server and used to set the Sticky Keys parameters.

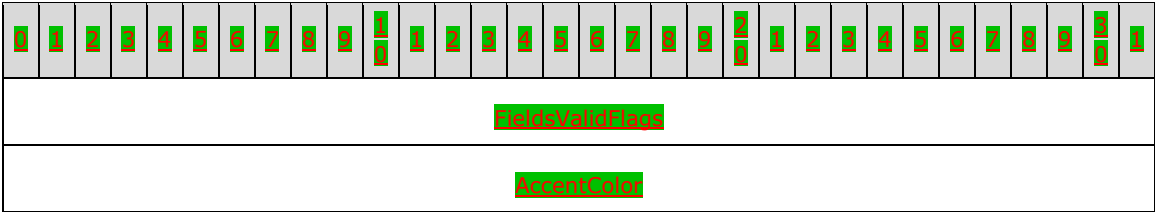
Flag	Meaning
SKF_STICKYKEYSON 0x00000001	The Sticky Keys feature is enabled.
SKF_AVAILABLE 0x00000002	The Sticky Keys feature is available.
SKF_HOTKEYACTIVE 0x00000004	The user can turn the Sticky Keys feature on or off by using the hotkey (pressing the SHIFT key five times).
SKF_CONFIRMHOTKEY 0x00000008	The user will be prompted with a confirmation dialog before the Sticky Keys feature is enabled using the hotkey.
SKF_HOTKEYSOUND 0x00000010	A sound is played whenever the Sticky Keys feature is turned on or off using the hotkey.
SKF_INDICATOR 0x00000020	A visual indicator is displayed when the Sticky Keys feature is enabled.
SKF_AUDIBLEFEEDBACK 0x00000040	A sound is played whenever a modifier key is latched, locked, or released.
SKF_TRISTATE 0x00000080	Pressing a modifier key twice in a row will lock the key down until the user presses it a third time.
SKF_TWOKEYSOFF 0x00000100	Releasing a modifier key that has been pressed in combination with another key will turn off the Sticky Keys feature.
SKF_LSHIFTLOCKED 0x00010000	The left SHIFT key is locked.
SKF_RSHIFTLOCKED 0x00020000	The right SHIFT key is locked.



Flag	Meaning
SKF_LCTLLOCKED 0x00040000	The left CTRL key is locked.
SKF_RCTLLOCKED 0x00080000	The right CTRL key is locked.
SKF_LALTLOCKED 0x00100000	The left ALT key is locked.
SKF_RALTLOCKED 0x00200000	The right ALT key is locked.
SKF_LWINLOCKED 0x00400000	The left WINDOWS key is locked.
SKF_RWINLOCKED 0x00800000	The right WINDOWS key is locked.
SKF_LSHIFTLATCHED 0x01000000	The left SHIFT key is latched.
SKF_RSHIFTLATCHED 0x02000000	The right SHIFT key is latched.
SKF_LCTLATCHED 0x04000000	The left CTRL key is latched.
SKF_RCTLATCHED 0x08000000	The right CTRL key is latched.
SKF_LALTATCHED 0x10000000	The left ALT key is latched.
SKF_RALTATCHED 0x20000000	The right ALT key is latched.
SKF_LWINLATCHED 0x40000000	The left WINDOWS key is latched.
SKF_RWINLATCHED 0x80000000	The right WINDOWS key is latched.

2.2.2.4.6 (Added Section) Accent Color System Information Structure  
[TS\_ACCENTCOLOR]

The TS\_ACCENTCOLOR structure defines parameters for the accent color accessibility feature.



ColorizationColor
ColorizationColorBalance
ColorizationAfterglow
ColorizationAfterglowBalance
ColorizationBlurBalance
ColorizationClassAttribute
ColorPrevalence
EnableWindowColorization
AccentColorMenu
StartColorMenu
AccentPaletteLength
AccentPalette (variable)

**FieldsValidFlags (4 bytes):** An unsigned, 32-bit integer that is read by the server and used to indicate what fields in the rest of the **TS\_ACCENTCOLOR** structure are valid.

Flag	Meaning
RACE_ACCENT_COLOR 0x00000001	The <b>AccentColor</b> field is valid.
RACE_COLORIZATION_COLOR 0x00000002	The <b>ColorizationColor</b> field is valid.
RACE_COLORIZATION_COLOR_BALANCE 0x00000004	The <b>ColorizationColorBalance</b> field is valid.
RACE_COLORIZATION_AFTERGLOW 0x00000008	The <b>ColorizationAfterglow</b> field is valid.
RACE_COLORIZATION_AFTERGLOW_BALANCE 0x00000010	The <b>ColorizationAfterglowBalance</b> field is valid.
RACE_COLORIZATION_BLUR_BALANCE 0x00000020	The <b>ColorizationBlurBalance</b> field is valid.

Flag	Meaning
RACE_COLORIZATION_GLASS_ATTRIBUTE 0x00000040	The <b>ColorizationGlassAttribute</b> field is valid.
RACE_COLOR_PREVALENCE 0x00000080	The <b>ColorPrevalence</b> field is valid.
RACE_ENABLE_WINDOW_COLORIZATION 0x00000100	The <b>EnableWindowColorization</b> field is valid.
RACE_ACCENT_COLOR_MENU 0x00000200	The <b>AccentColorMenu</b> field is valid.
RACE_ACCENT_PALETTE 0x00000800	The <b>AccentPaletteLength</b> and <b>AccentPalette</b> fields are valid.

**AccentColor (4 bytes):** An unsigned, 32-bit integer. The Windows-specific name of the registry value under HKEY\_CURRENT\_USER\Software\Microsoft\Windows\DWM.

**ColorizationColor (4 bytes):** An unsigned, 32-bit integer. The Windows-specific name of the registry value under HKEY\_CURRENT\_USER\Software\Microsoft\Windows\DWM.

**ColorizationColorBalance (4 bytes):** An unsigned, 32-bit integer. The Windows-specific name of the registry value under HKEY\_CURRENT\_USER\Software\Microsoft\Windows\DWM.

**ColorizationAfterglow (4 bytes):** An unsigned, 32-bit integer. The Windows-specific name of the registry value under HKEY\_CURRENT\_USER\Software\Microsoft\Windows\DWM.

**ColorizationAfterglowBalance (4 bytes):** An unsigned, 32-bit integer. The Windows-specific name of the registry value under HKEY\_CURRENT\_USER\Software\Microsoft\Windows\DWM.

**ColorizationBlurBalance (4 bytes):** An unsigned, 32-bit integer. The Windows-specific name of the registry value under HKEY\_CURRENT\_USER\Software\Microsoft\Windows\DWM.

**ColorizationGlassAttribute (4 bytes):** An unsigned, 32-bit integer. The Windows-specific name of the registry value under HKEY\_CURRENT\_USER\Software\Microsoft\Windows\DWM.

**ColorPrevalence (4 bytes):** An unsigned, 32-bit integer. The Windows-specific name of the registry value under HKEY\_CURRENT\_USER\Software\Microsoft\Windows\DWM.

**EnableWindowColorization (4 bytes):** An unsigned, 32-bit integer. The Windows-specific name of the registry value under HKEY\_CURRENT\_USER\Software\Microsoft\Windows\DWM.

**AccentColorMenu (4 bytes):** An unsigned, 32-bit integer. The Windows-specific name of the registry value under HKEY\_CURRENT\_USER\Software\Microsoft\Windows\CurrentVersion\Explorer\Accent.

**StartColorMenu (4 bytes):** An unsigned, 32-bit integer. The Windows-specific name of the registry value under HKEY\_CURRENT\_USER\Software\Microsoft\Windows\CurrentVersion\Explorer\Accent.

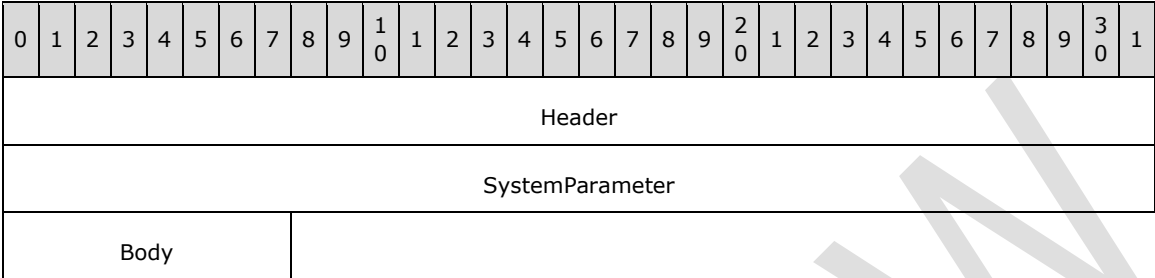
**AccentPaletteLength (4 bytes):** An unsigned, 32-bit integer. The length, in bytes, of the **AccentPalette** field.

**AccentPalette (variable):** An unsigned, 32-bit integer. The Windows-specific name of the registry value under HKEY\_CURRENT\_USER\Software\Microsoft\Windows\CurrentVersion\Explorer\Accent.

2.2.2.5 Server System Parameters Update Messages

2.2.2.5.1 Server System Parameters Update PDU (TS\_RAIL\_ORDER\_SYSPARAM)

The Server System Parameters Update PDU is sent from the server to client to synchronize system parameters on the client with those on the server.



**Header (4 bytes):** A TS\_RAIL\_PDU\_HEADER structure. The **orderType** field of header MUST be set to 0x03 (TS\_RAIL\_ORDER\_SYSPARAM).

**SystemParameter (4 bytes):** An unsigned 32-bit integer. The type of system parameter being transmitted. This field MUST be set to one of the following values.

Value	Meaning
SPI_SETSCREENSAVEACTIVE 0x00000011	The system parameter indicating whether the screen saver is enabled.
SPI_SETSCREENSAVESECURE 0x00000077	The system parameter indicating whether the desktop is to be locked after switching out of screen saver mode (that is, after the screen saver starts due to inactivity, then stops due to activity).<16>

**Body (1 byte):** The content of this field depends on the SystemParameter field. The following table outlines the valid values of the SystemParameter field (Value column) and corresponding values of the Body field (Meaning column).

Value	Meaning
SPI_SETSCREENSAVEACTIVE 0x00000011	Size of Body field: 1 byte. 0 (FALSE): Screen saver is not enabled. Nonzero (TRUE): Screen Saver is enabled.
SPI_SETSCREENSAVESECURE 0x00000077	Size of Body field: 1 byte. 0 (FALSE): Do not lock the desktop when switching out of screen saver mode. Nonzero (TRUE): Lock the desktop when switching out of screen saver mode.

2.2.2.6 Local Client Event Messages

These messages are generated by the client whenever a window or notification icon event occurs on the client side that is not communicated via the RDP channel.

2.2.2.6.1 Client Activate PDU (TS\_RAIL\_ORDER\_ACTIVATE)

The Client Activate PDU is sent from client to server when a local RAIL window on the client is activated or deactivated.

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
Hdr																															
WindowId																															
Enabled																															

**Hdr (4 bytes):** A TS\_RAIL\_PDU\_HEADER structure. The **orderType** field of the header MUST be set to TS\_RAIL\_ORDER\_ACTIVATE (0x0002).

**WindowId (4 bytes):** An unsigned 32-bit integer. The ID of the associated window on the server that is to be activated or deactivated.

**Enabled (1 byte):** An unsigned 8-bit integer. Indicates whether the window is to be activated (value = nonzero) or deactivated (value = 0).

#### 2.2.2.6.2 Client System Menu PDU (TS\_RAIL\_ORDER\_SYSMENU)

The Client System Menu PDU packet is sent from the client to the server when a local RAIL window on the client receives a command to display its System menu. This command is forwarded to the server via the System menu PDU.

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
Hdr																															
WindowId																															
Left																Top															

**Hdr (4 bytes):** A TS\_RAIL\_PDU\_HEADER header. The **orderType** field of the header MUST be set to TS\_RAIL\_ORDER\_SYSMENU (0x000C).

**WindowId (4 bytes):** An unsigned 32-bit integer. The ID of the window on the server that SHOULD display its System menu.

**Left (2 bytes):** A 16-bit signed integer. The x-coordinate of the top-left corner at which the System menu SHOULD be displayed. Specified in screen coordinates.

**Top (2 bytes):** A 16-bit signed integer. The y-coordinate of the top-left corner at which the System menu SHOULD be displayed. Specified in screen coordinates.

#### 2.2.2.6.3 Client System Command PDU (TS\_RAIL\_ORDER\_SYSCOMMAND)

The Client System Command PDU packet is sent from the client to the server when a local RAIL window on the client receives a command to perform an action on the window, such as minimize or maximize. This command is forwarded to the server via the System Command PDU.

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
Hdr																															
WindowId																															
Command																															

**Hdr (4 bytes):** A TS\_RAIL\_PDU\_HEADER header. The **orderType** field of the header **MUST** be set to TS\_RAIL\_ORDER\_SYSCOMMAND (0x0004).

**WindowId (4 bytes):** An unsigned 32-bit integer. The ID of the window on the server to activate or deactivate.

**Command (2 bytes):** An unsigned 16-bit integer. Specifies the type of command. The field **MUST** be one of the following values.

Value	Meaning
SC_SIZE 0xF000	Resize the window.
SC_MOVE 0xF010	Move the window.
SC_MINIMIZE 0xF020	Minimize the window.
SC_MAXIMIZE 0xF030	Maximize the window.
SC_CLOSE 0xF060	Close the window.
SC_KEYMENU 0xF100	The ALT + SPACE key combination was pressed; display the window's system menu.
SC_RESTORE 0xF120	Restore the window to its original shape and size.
SC_DEFAULT 0xF160	Perform the default action of the window's system menu.

#### 2.2.2.6.4 Client Notify Event PDU (TS\_RAIL\_ORDER\_NOTIFY\_EVENT)

The Client Notify Event PDU packet is sent from a client to a server when a local RAIL Notification Icon on the client receives a keyboard or mouse message from the user. This notification is forwarded to the server via the Notify Event PDU.

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
Hdr																															

WindowId
NotifyIconId
Message

**Hdr (4 bytes):** A TS\_RAIL\_PDU\_HEADER header. The **orderType** field of the header MUST be set to TS\_RAIL\_ORDER\_NOTIFY\_EVENT (0x0006).

**WindowId (4 bytes):** An unsigned 32-bit integer. The ID of the associated window on the server that owns the notification icon being specified in the PDU.

**NotifyIconId (4 bytes):** An unsigned 32-bit integer. The ID of the associated notification icon on the server that SHOULD receive the keyboard or mouse interaction.

**Message (4 bytes):** An unsigned 32-bit integer. The message being sent to the notification icon on the server.

Value	Meaning
WM_LBUTTONDOWN 0x00000201	The user pressed the left mouse button in the client area of the notification icon.
WM_LBUTTONUP 0x00000202	The user released the left mouse button while the cursor was in the client area of the notification icon.
WM_RBUTTONDOWN 0x00000204	The user pressed the right mouse button in the client area of the notification icon.
WM_RBUTTONUP 0x00000205	The user released the right mouse button while the cursor was in the client area of the notification icon.
WM_CONTEXTMENU 0x0000007B	The user selected a notification icon's shortcut menu with the keyboard. This message is sent only for notification icons that follow Windows 2000 behavior (see <b>Version</b> field in section 2.2.1.3.2.2.1).
WM_LBUTTONDBLCLK 0x00000203	The user double-clicked the left mouse button in the client area of the notification icon.
WM_RBUTTONDBLCLK 0x00000206	The user double-clicked the right mouse button in the client area of the notification icon.
NIN_SELECT 0x00000400	The user selected a notification icon with the mouse and activated it with the ENTER key. This message is sent only for notification icons that follow Windows 2000 behavior (see <b>Version</b> field in section 2.2.1.3.2.2.1).
NIN_KEYSELECT 0x00000401	The user selected a notification icon with the keyboard and activated it with the SPACEBAR or ENTER key. This message is sent only for notification icons that follow Windows 2000 behavior (see <b>Version</b> field in section 2.2.1.3.2.2.1).
NIN_BALLOONSHOW 0x00000402	The user passed the mouse pointer over an icon with which a balloon tooltip is associated (see <b>InfoTip</b> field in section 2.2.1.3.2.2.1), and the balloon tooltip was shown. This message is sent only for notification icons that follow Windows 2000 behavior (see <b>Version</b> field in section 2.2.1.3.2.2.1).
NIN_BALLOONHIDE 0x00000403	The icon's balloon tooltip disappeared because, for example, the icon was deleted. This message is not sent if the balloon is dismissed because of a timeout or mouse click by the user. This message is sent only for notification

Value	Meaning
	icons that follow Windows 2000 behavior (see <b>Version</b> field in section 2.2.1.3.2.2.1).
NIN_BALLOONTIMEOUT 0x00000404	The icon's balloon tooltip was dismissed because of a timeout. This message is sent only for notification icons that follow Windows 2000 behavior (see <b>Version</b> field in section 2.2.1.3.2.2.1).
NIN_BALLOONUSERCLICK 0x00000405	User dismissed the balloon by clicking the mouse. This message is sent only for notification icons that follow Windows 2000 behavior (see <b>Version</b> field in section 2.2.1.3.2.2.1).

#### 2.2.2.6.5 Client Get Application ID PDU (TS\_RAIL\_ORDER\_GET\_APPID\_REQ)

The Client Get Application ID PDU is sent from a client to a server. This PDU requests information from the server about the Application ID that the window SHOULD<17> have on the client.

The server MAY ignore this PDU.

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
Hdr																															
WindowId																															

**Hdr (4 bytes):** A TS\_RAIL\_PDU\_HEADER header. The **orderType** field of the header MUST be set to TS\_RAIL\_ORDER\_GET\_APPID\_REQ (0x000E).

**WindowId (4 bytes):** An unsigned 32-bit integer specifying the ID of the associated window on the server that requires needs an Application ID.

### 2.2.2.7 Window Move Messages

#### 2.2.2.7.1 Server Min Max Info PDU (TS\_RAIL\_ORDER\_MINMAXINFO)

The Server Min Max Info PDU is sent from a server to a client when a window move or resize on the server is being initiated. This PDU contains information about the minimum and maximum extents to which the window can be moved or sized.

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
Hdr																															
WindowId																															
MaxWidth																MaxHeight															
MaxPosX																MaxPosY															
MinTrackWidth																MinTrackHeight															



MaxTrackWidth	MaxTrackHeight
---------------	----------------

**Hdr (4 bytes):** A TS\_RAIL\_PDU\_HEADER header. The **orderType** field of the header MUST be set to TS\_RAIL\_ORDER\_MINMAXINFO (0x000A).

**WindowId (4 bytes):** An unsigned 32-bit integer. The ID of the window on the server that is being moved or resized.

**MaxWidth (2 bytes):** A signed 16-bit integer. The width of the maximized window.

**MaxHeight (2 bytes):** A signed 16-bit integer. The height of the maximized window.

**MaxPosX (2 bytes):** A signed 16-bit integer. The x-coordinate of the top-left corner of the maximized window.

**MaxPosY (2 bytes):** A signed 16-bit integer. The y-coordinate of the top-left corner of the maximized window.

**MinTrackWidth (2 bytes):** A signed 16-bit integer. The minimum width to which the window can be resized.

**MinTrackHeight (2 bytes):** A signed 16-bit integer. The minimum height to which the window can be resized.

**MaxTrackWidth (2 bytes):** A signed 16-bit integer. The maximum width to which the window can be resized.

**MaxTrackHeight (2 bytes):** A signed 16-bit integer. The maximum height to which the window can be resized.

**2.2.2.7.2 Server Move/Size Start PDU (TS\_RAIL\_ORDER\_LOCALMOVESIZE)**

The Server Move/Size Start PDU packet is sent by the server when a window on the server is beginning a move or resize. The client uses this information to initiate a local move or resize of the corresponding local window.

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
Hdr																															
WindowId																															
IsMoveSizeStart																MoveSizeType															
PosX																PosY															

**Hdr (4 bytes):** A TS\_RAIL\_PDU\_HEADER header. The **orderType** field of the header MUST be set to TS\_RAIL\_ORDER\_LOCALMOVESIZE (0x0009).

**WindowId (4 bytes):** An unsigned 32-bit integer. The ID of the window on the server that is being moved or resized.

**IsMoveSizeStart (2 bytes):** An unsigned 16-bit integer. Indicates that the move/size is beginning; MUST be set to a nonzero value.

**MoveSizeType (2 bytes):** An unsigned 16-bit integer. Indicates the type of the move/size. This value determines the meaning of the fields **PosX** and **PosY**.

Value	Meaning
RAIL_WMSZ_LEFT 0x0001	The left edge of the window is being sized.
RAIL_WMSZ_RIGHT 0x0002	The right edge of the window is being sized.
RAIL_WMSZ_TOP 0x0003	The top edge of the window is being sized.
RAIL_WMSZ_TOPLEFT 0x0004	The top-left corner of the window is being sized.
RAIL_WMSZ_TOPRIGHT 0x0005	The top-right corner of the window is being sized.
RAIL_WMSZ_BOTTOM 0x0006	The bottom edge of the window is being sized.
RAIL_WMSZ_BOTTOMLEFT 0x0007	The bottom-left corner of the window is being sized.
RAIL_WMSZ_BOTTOMRIGHT 0x0008	The bottom-right corner of the window is being sized.
RAIL_WMSZ_MOVE 0x0009	The window is being moved by using the mouse.
RAIL_WMSZ_KEYMOVE 0x000A	The window is being moved by using the keyboard.
RAIL_WMSZ_KEYSIZE 0x000B	The window is being resized by using the keyboard.

**PosX (2 bytes):** A signed 16-bit integer. The meaning of this field depends upon the value of the **MoveSizeType** field.

Value	Meaning
RAIL_WMSZ_LEFT 0x0001	The x-coordinate of the last mouse button-down.
RAIL_WMSZ_RIGHT 0x0002	The x-coordinate of the last mouse button-down.
RAIL_WMSZ_TOP 0x0003	The x-coordinate of the last mouse button-down.
RAIL_WMSZ_TOPLEFT 0x0004	The x-coordinate of the last mouse button-down.
RAIL_WMSZ_TOPRIGHT 0x0005	The x-coordinate of the last mouse button-down.

Value	Meaning
RAIL_WMSZ_BOTTOM 0x0006	The x-coordinate of the last mouse button-down.
RAIL_WMSZ_BOTTOMLEFT 0x0007	The x-coordinate of the last mouse button-down.
RAIL_WMSZ_BOTTOMRIGHT 0x0008	The x-coordinate of the last mouse button-down.
RAIL_WMSZ_MOVE 0x0009	The horizontal offset between the window's top-left edge and the current mouse position.
RAIL_WMSZ_KEYMOVE 0x000A	The x-coordinate of the last mouse button-down.
RAIL_WMSZ_KEYSIZE 0x000B	The x-coordinate of the last mouse button-down.

**PosY (2 bytes):** A signed 16-bit integer. The meaning of this field depends on the value of the **MoveSizeType** field.

Value	Meaning
RAIL_WMSZ_LEFT 0x0001	The y-coordinate of the last mouse button-down.
RAIL_WMSZ_RIGHT 0x0002	The y-coordinate of the last mouse button-down.
RAIL_WMSZ_TOP 0x0003	The y-coordinate of the last mouse button-down.
RAIL_WMSZ_TOPLEFT 0x0004	The y-coordinate of the last mouse button-down.
RAIL_WMSZ_TOPRIGHT 0x0005	The y-coordinate of the last mouse button-down.
RAIL_WMSZ_BOTTOM 0x0006	The y-coordinate of the last mouse button-down.
RAIL_WMSZ_BOTTOMLEFT 0x0007	The y-coordinate of the last mouse button-down.
RAIL_WMSZ_BOTTOMRIGHT 0x0008	The y-coordinate of the last mouse button-down.
RAIL_WMSZ_MOVE 0x0009	The vertical offset between the window's top-left edge and the current mouse position.
RAIL_WMSZ_KEYMOVE 0x000A	The y-coordinate of the last mouse button-down.
RAIL_WMSZ_KEYSIZE 0x000B	The y-coordinate of the last mouse button-down.

### 2.2.2.7.3 Server Move/Size End PDU (TS\_RAIL\_ORDER\_LOCALMOVESIZE)

The Server Move/Size End PDU is sent by the server when a window on the server is completing a move or resize. The client uses this information to end a local move/resize of the corresponding local window.

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
Hdr																															
WindowId																															
IsMoveSizeStart																MoveSizeType															
TopLeftX																TopLeftY															

**Hdr (4 bytes):** A TS\_RAIL\_PDU\_HEADER header. The **orderType** field of the header MUST be set to TS\_RAIL\_ORDER\_LOCALMOVESIZE (0x0009).

**WindowId (4 bytes):** An unsigned 32-bit integer. The ID of the window on the server that is being moved or resized.

**IsMoveSizeStart (2 bytes):** An unsigned 16-bit integer. Indicates the move or resize is ending. This field MUST be set to 0.

**MoveSizeType (2 bytes):** An unsigned 16-bit integer. Indicates the type of the move/size.

Value	Meaning
RAIL_WMSZ_LEFT 0x0001	The left edge of the window is being sized.
RAIL_WMSZ_RIGHT 0x0002	The right edge of the window is being sized.
RAIL_WMSZ_TOP 0x0003	The top edge of the window is being sized.
RAIL_WMSZ_TOPLEFT 0x0004	The top-left corner of the window is being sized.
RAIL_WMSZ_TOPRIGHT 0x0005	The top-right corner of the window is being sized.
RAIL_WMSZ_BOTTOM 0x0006	The bottom edge of the window is being sized.
RAIL_WMSZ_BOTTOMLEFT 0x0007	The bottom-left corner of the window is being sized.
RAIL_WMSZ_BOTTOMRIGHT 0x0008	The bottom-right corner of the window is being sized.
RAIL_WMSZ_MOVE	The window is being moved by using the mouse.

Value	Meaning
0x0009	
RAIL_WMSZ_KEYMOVE 0x000A	The window is being moved by using the keyboard.
RAIL_WMSZ_KEYSIZE 0x000B	The window is being resized by using the keyboard.

**TopLeftX (2 bytes):** A signed 16-bit integer. The x-coordinate of the moved or resized window's top-left corner.

**TopLeftY (2 bytes):** A signed 16-bit integer. The y-coordinate of the moved or resized window's top-left corner.

#### 2.2.2.7.4 Client Window Move PDU (TS\_RAIL\_ORDER\_WINDOWMOVE)

The Client Window Move PDU packet is sent from the client to the server when a local window is ending a move or resize. The client communicates the locally moved or resized window's position to the server by using this packet. The server uses this information to reposition its window.

Window positions sent using this packet SHOULD include hit-testable margins (see section 3.2.5.1.6).

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
Hdr																															
WindowId																															
Left																Top															
Right																Bottom															

**Hdr (4 bytes):** A TS\_RAIL\_PDU\_HEADER header. The **orderType** field of the header MUST be set to TS\_RAIL\_ORDER\_WINDOWMOVE (0x0008).

**WindowId (4 bytes):** An unsigned 32-bit integer. The ID of the window on the server corresponding to the local window that was moved or resized.

**Left (2 bytes):** A signed 16-bit integer. The x-coordinate of the top-left corner of the window's new position.

**Top (2 bytes):** A signed 16-bit integer. The y-coordinate of the top-left corner of the window's new position.

**Right (2 bytes):** A signed 16-bit integer. The x-coordinate of the bottom-right corner of the window's new position.

**Bottom (2 bytes):** A signed 16-bit integer. The y-coordinate of the bottom-right corner of the window's new position.

#### 2.2.2.7.5 Client Window Snap PDU (TS\_RAIL\_ORDER\_SNAP\_ARRANGE)

The **Client Window Snap PDU** packet is sent from the client to the server when a local window is repositioned by the local window manager due to the use of a window arrangement feature, such as

Snap or Snap Assist. The client communicates the new position of the local window to the server by sending this packet. The server uses this information to reposition the corresponding window using an equivalent window arrangement feature. This packet is only sent if the server has advertised support for the Window Snap feature in the **HandshakeEx PDU** (section 2.2.2.3); otherwise, a **Client Window Move PDU** (section 2.2.2.7.4) is sent instead.

Window positions sent using this packet SHOULD include hit-testable margins (see section 3.2.5.1.6).

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
Hdr																															
WindowId																															
Left																Top															
Right																Bottom															

**Hdr (4 bytes):** A **TS\_RAIL\_PDU\_HEADER** header. The **orderType** field of the header MUST be set to **TS\_RAIL\_ORDER\_SNAP\_ARRANGE** (0x0017).

**WindowId (4 bytes):** An unsigned 32-bit integer. The ID of the window on the server corresponding to the local window that was snapped.

**Left (2 bytes):** A signed 16-bit integer. The x-coordinate of the top-left corner of the window's new position.

**Top (2 bytes):** A signed 16-bit integer. The y-coordinate of the top-left corner of the window's new position.

**Right (2 bytes):** A signed 16-bit integer. The x-coordinate of the bottom-right corner of the window's new position.

**Bottom (2 bytes):** A signed 16-bit integer. The y-coordinate of the bottom-right corner of the window's new position.

## 2.2.2.8 Server Application ID Response

### 2.2.2.8.1 Server Get Application ID Response PDU (TS\_RAIL\_ORDER\_GET\_APPID\_RESP)

The **Server Get Application ID Response PDU** is sent from a server to a client as a response to a **Client Get Application ID PDU** (section 2.2.2.6.5).

This PDU specifies the Application ID that the specified window SHOULD<18> have on the client. The client MAY ignore this PDU.

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
Hdr																															
WindowId																															

ApplicationId (520 bytes)
...
...

**Hdr (4 bytes):** A **TS\_RAIL\_PDU\_HEADER** (section 2.2.2.1) header. The **orderType** field of the header MUST be set to TS\_RAIL\_ORDER\_GET\_APPID\_RESP (0x000F).

**WindowId (4 bytes):** An unsigned 32-bit integer specifying the ID of the associated window on the server whose Application ID is being sent to the client.

**ApplicationId (520 bytes):** A null-terminated string of Unicode characters specifying the Application ID that the Client SHOULD associate with its window, if it supports using the Application ID for identifying and grouping windows.

#### 2.2.2.8.2 Server Get Application ID Extended Response PDU (TS\_RAIL\_ORDER\_GET\_APPID\_RESP\_EX)

The **Server Get Application ID Extended Response PDU** is sent from a server to a client as a response to a **Client Get Application ID PDU** (section 2.2.2.6.5).

This PDU specifies the Application ID that the specified window SHOULD have on the client. The client MAY ignore this PDU.

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
Hdr																															
WindowId																															
ApplicationId (520 bytes)																															
...																															
...																															
...																															
ProcessId																															
ProcessImageName (520 bytes)																															
...																															
...																															
...																															

**Hdr (4 bytes):** A **TS\_RAIL\_PDU\_HEADER** (section 2.2.2.1) header. The **orderType** field of the header MUST be set to TS\_RAIL\_ORDER\_GET\_APPID\_RESP\_EX (0x0018).

**WindowId (4 bytes):** An unsigned 32-bit integer specifying the ID of the associated window on the server whose Application ID is being sent to the client.

**ApplicationId (520 bytes):** A null-terminated string of Unicode characters specifying the Application ID that the Client SHOULD associate with its window, if it supports using the Application ID for identifying and grouping windows.

**ProcessId (4 bytes):** An unsigned 32-bit integer specifying the ID of the process associated with the window on the server whose Application ID is being sent to the client.

**ProcessImageName (520 bytes):** A null-terminated string of Unicode characters specifying the image name of the process associated with the window on the server whose Application ID is being sent to the client.

## 2.2.2.9 Language Bar Messages

### 2.2.2.9.1 Language Bar Information PDU (TS\_RAIL\_ORDER\_LANGBARINFO)

The Language Bar Information PDU is used to set the language bar status. It is sent from a client to a server or a server to a client, but only when both support the Language Bar docking capability (TS\_RAIL\_LEVEL\_DOCKED\_LANGBAR\_SUPPORTED). This PDU contains information about the language bar status.

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
Hdr																															
LanguageBarStatus																															

**Hdr (4 bytes):** A TS\_RAIL\_PDU\_HEADER (section 2.2.2.1) header. The **orderType** field of the header MUST be set to TS\_RAIL\_ORDER\_LANGBARINFO (0x000D).

**LanguageBarStatus (4 bytes):** An unsigned 32-bit integer. The possible values are indicated in the table below. The server sends the **LanguageBarStatus** it retrieves from the local language bar:

Value	Meaning
TF_SFT_SHOWNORMAL 0x00000001	Display the language bar as a floating window. This constant cannot be combined with the TF_SFT_DOCK, TF_SFT_MINIMIZED, TF_SFT_HIDDEN, or TF_SFT_DESKBAND constants.
TF_SFT_DOCK 0x00000002	Dock the language bar in its own task pane. This constant cannot be combined with the TF_SFT_SHOWNORMAL, TF_SFT_MINIMIZED, TF_SFT_HIDDEN, or TF_SFT_DESKBAND constants.<20>
TF_SFT_MINIMIZED 0x00000004	Display the language bar as a single icon in the system tray. This constant cannot be combined with the TF_SFT_SHOWNORMAL, TF_SFT_DOCK, TF_SFT_HIDDEN, or TF_SFT_DESKBAND constants.
TF_SFT_HIDDEN 0x00000008	Hide the language bar. This constant cannot be combined with the TF_SFT_SHOWNORMAL, TF_SFT_DOCK, TF_SFT_MINIMIZED, or TF_SFT_DESKBAND constants.
TF_SFT_NOTTRANSPARENCY 0x00000010	Make the language bar opaque.



Value	Meaning
TF_SFT_LOWTRANSPARENCY 0x00000020	Make the language bar partially transparent.<21>
TF_SFT_HIGHTRANSPARENCY 0x00000040	Make the language bar highly transparent.<22>
TF_SFT_LABELS 0x00000080	Display text labels next to language bar icons.
TF_SFT_NOLABELS 0x00000100	Hide language bar icon text labels.
TF_SFT_EXTRAICONSONMINIMIZED 0x00000200	Display text service icons on the taskbar when the language bar is minimized.
TF_SFT_NOEXTRAICONSONMINIMIZED 0x00000400	Hide text service icons on the taskbar when the language bar is minimized.
TF_SFT_DESKBAND 0x00000800	Dock the language bar in the system task bar. This constant cannot be combined with the TF_SFT_SHOWNORMAL, TF_SFT_DOCK, TF_SFT_MINIMIZED, or TF_SFT_HIDDEN constants.<23>

### 2.2.2.10 Language Sync Messages

#### 2.2.2.10.1 Language Profile Information PDU (TS\_RAIL\_ORDER\_LANGUAGEIMEINFO)

The Language Profile Information PDU is used to send the current active language profile of the client to the server. It is only sent when both client and server support this capability (TS\_RAIL\_LEVEL\_LANGUAGE\_IME\_SYNC\_SUPPORTED). This PDU contains information about the current active language profile.

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
Hdr																															
ProfileType																															
LanguageID																LanguageProfileCLSID (16 bytes)															
...																															
...																															
...																															
...																ProfileGUID (16 bytes)															

...	
...	
...	
...	KeyboardLayout
...	

**Hdr (4 bytes):** A TS\_RAIL\_PDU\_HEADER header. The **orderType** field of the header MUST be set to TS\_RAIL\_ORDER\_LANGUAGEIMEINFO (0x0011).

**ProfileType (4 bytes):** An unsigned 4-byte integer that identifies the profile type of the language. The value SHOULD be either TF\_PROFILETYPE\_INPUTPROCESSOR (0x0001) or TF\_PROFILETYPE\_KEYBOARDLAYOUT (0x0002).

Value	Meaning
TF_PROFILETYPE_INPUTPROCESSOR 0x00000001	Indicates that the profile type is an input processor.
TF_PROFILETYPE_KEYBOARDLAYOUT 0x00000002	Indicates that the profile type is a keyboard layout.

**LanguageID (2 bytes):** An unsigned 2-byte integer. This is the language identifier that identifies both the language and the country/region. For a list of language identifiers, see [MSDN-MUI].

**LanguageProfileCLSID (16 bytes):** A globally unique identifier (section 2.2.2.10.1.1) that uniquely identifies the text service of the client. This field MUST be set to GUID\_NULL if the **ProfileType** field is set to TF\_PROFILETYPE\_KEYBOARDLAYOUT (0x0002).

Value	Meaning
GUID_NULL {0x00000000, 0x0000, 0x0000, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00}	Indicates that there is no input processor.
GUID_MSIME_JPN {0x03B5835F, 0xF03C, 0x411B, 0x9C, 0xE2, 0xAA, 0x23, 0xE1, 0x17, 0x1E, 0x36}	Indicates that the input processor is Japanese.
GUID_MSIME_KOR {0xA028AE76, 0x01B1, 0x46C2, 0x99, 0xC4, 0xAC, 0xD9, 0x85, 0x8A, 0xE0, 0x2}	Indicates that the input processor is Korean.
GUID_CHSIME {0x81D4E9C9, 0x1D3B, 0x41BC, 0x9E, 0x6C, 0x4B, 0x40, 0xBF, 0x79, 0xE3, 0x5E}	Indicates that the input processor is Chinese Simplified.
GUID_CHTIME {0x531FDEBF, 0x9B4C, 0x4A43, 0xA2, 0xAA, 0x96, 0x0E, 0x8F, 0xCD, 0xC7, 0x32}	Indicates that the input processor is Chinese (Taiwanese).

**ProfileGUID (16 bytes):** A globally unique identifier (section 2.2.2.10.1.1) that uniquely identifies the language profile of the client. This field **MUST** be set to GUID\_NULL if the **ProfileType** field is set to TF\_PROFILETYPE\_KEYBOARDLAYOUT (0x0002).

Value	Meaning
GUID_NULL {0x00000000, 0x0000, 0x0000, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00}	Indicates that there is no profile.
GUID_PROFILE_NEWPHONETIC {0xB2F9C502, 0x1742, 0x11D4, 0x97, 0x90, 0x00, 0x80, 0xC8, 0x82, 0x68, 0x7E}	Indicates that the profile is new phonetic.
GUID_PROFILE_CHANGJIE {0x4BDF9F03, 0xC7D3, 0x11D4, 0xB2, 0xAB, 0x00, 0x80, 0xC8, 0x82, 0x68, 0x7E}	Indicates that the profile is ChangJie.
GUID_PROFILE_QUICK {0x6024B45F, 0x5C54, 0x11D4, 0xB9, 0x21, 0x00, 0x80, 0xC8, 0x82, 0x68, 0x7E}	Indicates that the profile is Quick type.
GUID_PROFILE_CANTONESE {0x0AEC109C, 0x7E96, 0x11D4, 0xB2, 0xEF, 0x00, 0x80, 0xC8, 0x82, 0x68, 0x7E}	Indicates that the profile is Cantonese.
GUID_PROFILE_PINYIN {0xF3BA9077, 0x6C7E, 0x11D4, 0x97, 0xFA, 0x00, 0x80, 0xC8, 0x82, 0x68, 0x7E}	Indicates that the profile is PinYin.
GUID_PROFILE_SIMPLEFAST {0xFA550B04, 0x5AD7, 0x411F, 0xA5, 0xAC, 0xCA, 0x03, 0x8E, 0xC5, 0x15, 0xD7}	Indicates that the profile is SimpleFast.
GUID_GUID_PROFILE_MSIME_JPN {0xA76C93D9, 0x5523, 0x4E90, 0xAA, 0xFA, 0x4D, 0xB1, 0x12, 0xF9, 0xAC, 0x76}	Indicates that the profile is Microsoft Japanese IME.
GUID_PROFILE_MSIME_KOR {0xB5FE1F02, 0xD5F2, 0x4445, 0x9C, 0x03, 0xC5, 0x68, 0xF2, 0x3C, 0x99, 0xA1}	Indicates that the profile is Microsoft Korean IME.

**KeyboardLayout (4 bytes):** An unsigned 4-byte integer. The active input locale identifier, also known as the "HKL" (for example, 0x00010409 identifies a "United States-Dvorak" keyboard layout, while 0x00020418 is a "Romanian (Programmers)" keyboard layout). For a list of input locale identifiers, see [MSFT-DIL].

2.2.2.10.1.1 Globally Unique Identifier (GUID)

The GUID structure contains 128 bits that represent a globally unique identifier that can be used to provide a distinctive reference number, as defined in [MS-DTYP] section 2.3.4.

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
codecGUID1																															
codecGUID2																codecGUID3															

codecGUID4	codecGUID5	codecGUID6	codecGUID7
codecGUID8	codecGUID9	codecGUID10	codecGUID11

**codecGUID1 (4 bytes):** A 32-bit, unsigned integer. The first GUID component.

**codecGUID2 (2 bytes):** A 16-bit, unsigned integer. The second GUID component.

**codecGUID3 (2 bytes):** A 16-bit, unsigned integer. The third GUID component.

**codecGUID4 (1 byte):** An 8-bit, unsigned integer. The fourth GUID component.

**codecGUID5 (1 byte):** An 8-bit, unsigned integer. The fifth GUID component.

**codecGUID6 (1 byte):** An 8-bit, unsigned integer. The sixth GUID component.

**codecGUID7 (1 byte):** An 8-bit, unsigned integer. The seventh GUID component.

**codecGUID8 (1 byte):** An 8-bit, unsigned integer. The eighth GUID component.

**codecGUID9 (1 byte):** An 8-bit, unsigned integer. The ninth GUID component.

**codecGUID10 (1 byte):** An 8-bit, unsigned integer. The tenth GUID component.

**codecGUID11 (1 byte):** An 8-bit, unsigned integer. The eleventh GUID component.

#### 2.2.2.10.2 Compartment Status Information PDU (TS\_RAIL\_ORDER\_COMPARTMENTINFO\_BODY)

The Compartment Status Information PDU is used to send the current input method editor (IME) status information. It is sent from a client to the server, or from a server to the client, but only when client and server both support this capability (TS\_RAIL\_LEVEL\_LANGUAGE\_IME\_SYNC\_SUPPORTED). This PDU is used to send the current compartment values of the client or server and is sent only if the current language profile type is TF\_PROFILETYPE\_INPUTPROCESSOR (0x0001).

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
Hdr																															
ImeState																															
ImeConvMode																															
ImeSentenceMode																															
KANAMode																															

**Hdr (4 bytes):** A TS\_RAIL\_PDU\_HEADER header. The **orderType** field of the header MUST be set to TS\_RAIL\_ORDER\_COMPARTMENTINFO (0x0012).

**ImeState (4 bytes):** A 32-bit, unsigned integer. Indicates the open or closed state of the IME.

Value	Meaning
IME_STATE_CLOSED	The IME state is closed.

Value	Meaning
0x00000000	
IME_STATE_OPEN 0x00000001	The IME state is open.

**ImeConvMode (4 bytes):** A 32-bit, unsigned integer. Indicates the IME conversion mode.

Value	Meaning
IME_CMODE_NATIVE 0x00000001	The input mode is native. If not set, the input mode is alphanumeric.
IME_CMODE_KATAKANA 0x00000002	The input mode is Katakana. If not set, the input mode is Hiragana.
IME_CMODE_FULLSHAPE 0x00000008	The input mode is full-width. If not set, the input mode is half-width.
IME_CMODE_ROMAN 0x00000010	The input mode is Roman.
IME_CMODE_CHARCODE 0x00000020	Character-code input is in effect.
IME_CMODE_HANJACONVERT 0x00000040	Hanja conversion mode is in effect.
IME_CMODE_SOFTKBD 0x00000080	A soft (on-screen) keyboard is being used.
IME_CMODE_NOCONVERSION 0x00000100	IME conversion is inactive (that is, the IME is closed).
IME_CMODE_EUDC 0x00000200	End-User Defined Character (EUDC) conversion mode is in effect.
IME_CMODE_SYMBOL 0x00000400	Symbol conversion mode is in effect.
IME_CMODE_FIXED 0x00000800	Fixed conversion mode is in effect.

**ImeSentenceMode (4 bytes):** An unsigned 4-byte integer that identifies the sentence mode of the IME.

Flag	Meaning
IME_SMODE_NONE 0x00000000	Indicates that the IME uses no information for sentence.
IME_SMODE_PLURALCLAUSE 0x00000001	Indicates that the IME uses plural clause information to carry out conversion processing.
IME_SMODE_SINGLECONVERT 0x00000002	Indicates that the IME carries out conversion processing in single-character mode.

Flag	Meaning
IME_SMODE_AUTOMATIC 0x00000004	Indicates that the IME carries conversion processing in automatic mode.
IME_SMODE_PHRASEPREDICT 0x00000008	Indicates that the IME uses phrase information to predict the next character.
IME_SMODE_CONVERSATION 0x00000010	Indicates that the IME uses conversation mode. This is useful for chat applications.

**KANAMode (4 bytes):** An unsigned 4-byte integer that identifies whether the input mode is Romaji or KANA for Japanese text processors. The value is 0x0000 for all non-Japanese text processors.

Value	Meaning
KANA_MODE_OFF 0x00000000	Indicates that the KANA input mode is off.
KANA_MODE_ON 0x00000001	Indicates that the KANA input mode is activated.

## 2.2.2.11 Z-Order Sync Messages

### 2.2.2.11.1 Server Z-Order Sync Information PDU (TS\_RAIL\_ORDER\_ZORDER\_SYNC)

The Z-Order Sync Information PDU is sent from the server to the client if the client has advertised support for Z-order sync in the Client Information PDU (section 2.2.2.2.2).

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
Hdr																															
WindowIdMarker																															

**Hdr (4 bytes):** A TS\_RAIL\_PDU\_HEADER structure. The **orderType** field of the header MUST be set to TS\_RAIL\_ORDER\_ZORDER\_SYNC (0x0014).

**WindowIdMarker (4 bytes):** An unsigned 32-bit integer. Indicates the ID of the marker window (section 3.3.1.3), which is used to manage the activation of RAIL windows as specified in section 3.2.5.2.9.2.

## 2.2.2.12 Window Cloak State Sync Messages

### 2.2.2.12.1 Window Cloak State Change PDU (TS\_RAIL\_ORDER\_CLOAK)

Windows are either in a cloaked or uncloaked state. Changes in the cloak state of a RAIL window on the client, or a remoted window on the server, are communicated by Window Cloak State Change PDU.

The client sends the Window Cloak State Change PDU if both the client and server support syncing per-window cloak state (indicated by the TS\_RAIL\_LEVEL\_WINDOW\_CLOAKING\_SUPPORTED flag in the Remote Programs Capability Set (section 2.2.1.1.1)). The server uses this information to sync the cloak state to the associated window on the server.

The server sends the Window Cloak State Change PDU if the client is capable of processing this PDU (indicated by the TS\_RAIL\_CLIENTSTATUS\_BIDIRECTIONAL\_CLOAK\_SUPPORTED flag in the Client Information PDU (section 2.2.2.2.2)). The client uses this information to sync the cloak state to the associated window on the client.

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
Hdr																															
WindowId																															
Cloaked																															

**Hdr (4 bytes):** A TS\_RAIL\_PDU\_HEADER structure. The **orderType** field of the header MUST be set to TS\_RAIL\_ORDER\_CLOAK (0x0015).

**WindowId (4 bytes):** An unsigned 32-bit integer. The ID of the window that is to be cloaked or uncloaked.

**Cloaked (1 byte):** An unsigned 8-bit integer that indicates whether the window SHOULD be cloaked or uncloaked.

Value	Meaning
0x00	The window SHOULD be uncloaked.
0x01	The window SHOULD be cloaked.

### 2.2.2.13 Power Display Request Messages

#### 2.2.2.13.1 Power Display Request PDU (TS\_RAIL\_ORDER\_POWER\_DISPLAY\_REQUEST)

The Power Display Request PDU is sent from the server to the client if the client has advertised support for display-required power request sync in the Client Information PDU (section 2.2.2.2.2).

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
Hdr																															
Active																															

**Hdr (4 bytes):** A TS\_RAIL\_PDU\_HEADER structure. The **orderType** field of the header MUST be set to TS\_RAIL\_ORDER\_POWER\_DISPLAY\_REQUEST (0x0016).

**Active (4 bytes):** A 32-bit, unsigned integer. Indicates the active or inactive state of the display-required power request.

Value	Meaning
0x00000000	The display-required power request state is inactive, which means the display of the device SHOULD enter the powered-off state if there is no user input for an extended period.
0x00000001	The display-required power request state is active, which means the display of the device should remain in the powered-on state even if there is no user input for an extended period.

## 2.2.2.14 Server Taskbar State Messages

### 2.2.2.14.1 Taskbar Tab Info PDU (TS\_RAIL\_ORDER\_TASKBARINFO)

The Taskbar Tab Info PDU is sent from the server to the client when a remote tabbed application adds, removes, or changes the state of a taskbar tab. It is sent only when the client advertises support for the extended shell integration capability (TS\_RAIL\_LEVEL\_SHELL\_INTEGRATION\_SUPPORTED).

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
header																															
TaskbarMessage																															
WindowIdTab																															
Body																															

**header (4 bytes):** A TS\_RAIL\_PDU\_HEADER structure. The **orderType** field of the header MUST be set to TS\_RAIL\_ORDER\_TASKBARINFO (0x0010).

**TaskbarMessage (4 bytes):** An unsigned 32-bit integer. Contains the type of tabbed application event that occurred in the remote session. This field MUST be set to one of the following values.

Value	Meaning
RAIL_TASKBAR_MSG_TAB_REGISTER 0x00000001	A remote application added a window to its tab group.
RAIL_TASKBAR_MSG_TAB_UNREGISTER 0x00000002	A remote application removed a window from its tab group.
RAIL_TASKBAR_MSG_TAB_ORDER 0x00000003	The position of a window in the tab group order for a remote application has changed. This message SHOULD be sent immediately after a RAIL_TASKBAR_MSG_TAB_REGISTER message.
RAIL_TASKBAR_MSG_TAB_ACTIVE 0x00000004	The active (selected) tab of a remote application tab group has changed.



Value	Meaning
RAIL_TASKBAR_MSG_TAB_PROPERTIES 0x00000005	The properties of a tab in a remote application tab group have changed.

**WindowIdTab (4 bytes):** An unsigned 32-bit integer. The window ID of the remote application window whose tab group state is changing.

**Body (4 bytes):** The contents of this field depend on the **TaskbarMessage** field. The following table outlines the valid values of the **TaskbarMessage** field and the corresponding values of the **Body** field.

Value	Meaning
RAIL_TASKBAR_MSG_TAB_REGISTER 0x00000001	The window ID of the window that is being added to the taskbar tab group owned by <b>WindowIdTab</b> .
RAIL_TASKBAR_MSG_TAB_UNREGISTER 0x00000002	Not used. The <b>Body</b> field MUST still be present but SHOULD be set to zero.
RAIL_TASKBAR_MSG_TAB_ORDER 0x00000003	The window ID that the tab owned by <b>WindowIdTab</b> SHOULD be placed immediately before in its tab group. If this value is zero, the tab SHOULD be placed at the end of its tab group.
RAIL_TASKBAR_MSG_TAB_ACTIVE 0x00000004	The window ID corresponding to the tab that SHOULD be set active in the tab group owned by <b>WindowIdTab</b> .
RAIL_TASKBAR_MSG_TAB_PROPERTIES 0x00000005	The properties of the tab corresponding to <b>WindowIdTab</b> that are to be set. Valid properties are described by the [MSDN-STPFLAG] enumeration.

## 2.2.2.15 Accessibility Messages

### 2.2.2.15.1 Text Scale Information PDU (TS\_RAIL\_ORDER\_TEXTSCALEINFO)

The Text Scale Information PDU is sent from the client to the server during the connection establishment phase and when the client system's text scale factor is changed. The client communicates the new text scale factor to the server by sending this packet. The server uses this information to change the system text size setting. This packet is only sent if the server has advertised support for the Text Scale Information PDU in the HandshakeEx PDU (section 2.2.2.2.3); otherwise, this packet will not be sent.

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
Hdr																															
TextScaleFactor																															

**Hdr (4 bytes):** A TS\_RAIL\_PDU\_HEADER structure (section 2.2.2.1). The **orderType** field of the header MUST be set to TS\_RAIL\_ORDER\_TEXTSCALEINFO (0x0019).

**TextScaleFactor (4 bytes):** A 32-bit integer. Indicates the text scale factor ranged between 100 and 225, inclusive.

### 2.2.2.15.2 Caret Blink Information PDU (TS\_RAIL\_ORDER\_CARETBLINKINFO)

The Caret Blink Information PDU is sent from the client to the server during the connection establishment phase and when the client system's caret blink rate is changed. The client communicates the new caret blink rate to the server by sending this packet. The server uses this information to change the system caret blink rate. This packet is only sent if the server has advertised support for the Caret Blink Information in the HandshakeEx PDU (section 2.2.2.2.3); otherwise, this packet will not be sent.

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
Hdr																															
CaretBlinkRate																															

**Hdr (4 bytes):** A TS\_RAIL\_PDU\_HEADER structure (section 2.2.2.1). The **orderType** field of the header MUST be set to TS\_RAIL\_ORDER\_CARETBLINKINFO (0x001A).

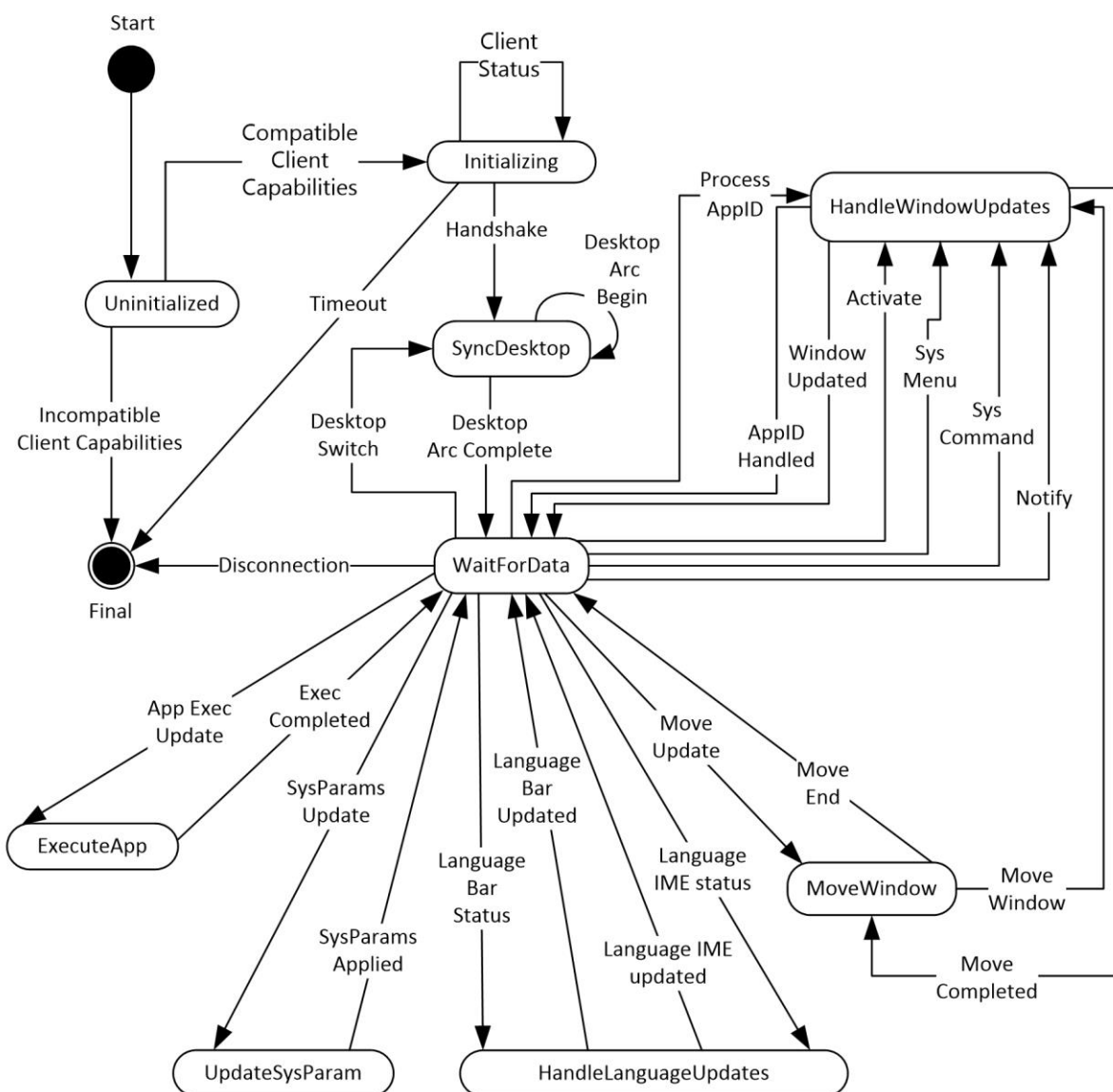
**CaretBlinkRate (4 bytes):** An unsigned 32-bit integer. Indicates the caret blink time to the specified number of milliseconds. The blink time is the elapsed time, in milliseconds, required to invert the pixels of the caret. A value of **INFINITE** (0xFFFFFFFF) indicates that the caret SHOULD NOT blink.

## 3 Protocol Details

### 3.1 Common Details

#### 3.1.1 Abstract Data Model

##### 3.1.1.1 Server State Machine



**Figure 5: Server State Machine Diagram**

State	Description
Uninitialized	This is the initial state of the server. In this state, the server waits for the Remote Programs Capability Set (section 2.2.1.1.1) and the Window List Capability

State	Description
	Set (section 2.2.1.1.2) from the client. On receiving these capability sets, the server processes them as specified in section 3.3.5.1.5. If the server finds compatible settings, it transitions to the Initializing state. Otherwise, the connection is terminated (see [MS-RDPBCGR] section 1.3.1.4.2).
Initializing	In this state, the server examines the Handshake PDU (section 2.2.2.2.1) and the Client Information PDU (section 2.2.2.2.2). On receiving these, the server processes the Handshake PDU as specified in section 3.1.5.2 and the Client Information PDU as specified in section 3.3.5.2.1.1, and transitions to the SyncDesktop state. If the server does not receive the Handshake PDU within a specified time, it can disconnect the connection (see section 3.1.2).
SyncDesktop	In this state, the server syncs its desktop with that of the client. The server transitions to this state either during the RAIL connection synchronization (see section 1.3.2.3) or on detection of a desktop switch (see section 3.3.5.1.8). After completion of the desktop sync (as specified in section 3.3.5.1.8), the server transitions to the WaitForData state.
WaitForData	In this state, the server waits for all non-initialization messages received on the static virtual channel (see section 3.3.5.2). On receiving a Client Execute PDU (section 2.2.2.3.1), the server transitions to the ExecuteApp state. On receiving a Client System Parameters Update PDU (section 2.2.2.4.1), the server transitions to the UpdateSysParam state. On receiving a Language Bar Information PDU (section 2.2.2.9.1), the server transitions to the UpdateLanguageBar state. On receiving a Client Window Move PDU (section 2.2.2.7.4), the server transitions to the MoveWindow state. On receiving a Client Activate PDU (section 2.2.2.6.1), a Client System Menu PDU (section 2.2.2.6.2), a Client System Command PDU (section 2.2.2.6.3), a Client Notify Event PDU (section 2.2.2.6.4), or a Client Get Application ID PDU (section 2.2.2.6.5), the server transitions to the HandleWindowUpdates state. On detecting a desktop switch, the server transitions to the SyncDesktop state.
ExecuteApp	In this state, the server processes the Client Execute PDU, as specified in section 3.3.5.2.2.1, and sends the Server Execute Result PDU (section 2.2.2.3.2), as specified in section 3.3.5.2.2.2. The server then transitions back to the WaitForData state.
UpdateSysParam	In this state, the server processes the Client System Parameters Update PDU, as specified in section 3.3.5.2.3.1, and transitions back to the WaitForData state.
UpdateLanguageBar	In this state, the server processes the Language Bar Information PDU, as specified in section 3.3.5.2.5.5, and transitions back to the WaitForData state.
MoveWindow	In this state, the server processes the Client Window Move PDU, as specified in section 3.3.5.2.6.3. If the window ID is valid, the server transitions to the HandleWindowUpdates state. Once the window is moved, the server transitions back to the MoveWindow state. If applicable, the server also sends a Server Move/Size End PDU (section 2.2.2.7.3) to the client, as specified in section 3.3.5.2.6.4. After all processing is complete, the server transitions back to the WaitForData state.
HandleWindowUpdates	In this state, the server processes local client events relevant to individual windows: the Client Activate PDU, as specified in section 3.3.5.2.5.1; the Client System Menu PDU, as specified in section 3.3.5.2.5.2; the Client System Command PDU, as specified in section 3.3.5.2.5.3; and the Client Notify Event PDU, as specified in section 3.3.5.2.5.4. The server also processes the Client Get Application ID PDU, as specified in section 3.3.5.2.7.1, and sends the Server Get Application ID Response PDU (section 2.2.2.8.1), as specified in section 3.3.5.2.7.2. After all processing is complete, the server transitions back to the WaitForData state.

### 3.1.1.2 Icon Cache Support

If the implementation supports icon caching, then the following state is negotiated between the client and server as part of the Window List Capability Set order (section 2.2.1.1.2), and thereafter maintained on both client and server.

**NumIconCaches:** the number of discrete caches for icons maintained on client and server.

**NumIconCacheEntries:** the number of entries allocated in each icon cache.

Once an icon cache capability is established, individual entries in the cache are identified by a Cached Icon Info packet (section 2.2.1.2.4), containing a pair of index values designating the specific icon cache and the entry within that cache.

### 3.1.2 Timers

A handshake timer MAY<24> be used by the client and/or server to wait for the Handshake PDU from the sending party.

### 3.1.3 Initialization

The static virtual channel between the client and the server MUST be established before protocol operations can commence (see section 1.3.2.1 for an overview).

The Handshake PDU (as specified in section 2.2.2.2.1) is exchanged between the server and the client to establish that both endpoints are ready to begin RAIL mode.

The Client Information PDU (as specified in section 2.2.2.2.2) is sent from a client to a server and contains information about RAIL client state and features supported by the client.

### 3.1.4 Higher-Layer Triggered Events

No higher-layer triggered events are used.

### 3.1.5 Message Processing Events and Sequencing Rules

The following sections describe construction and processing of common messages.

#### 3.1.5.1 Constructing Handshake PDU

The Handshake PDU is constructed during initialization of the remote applications integrated locally (RAIL) virtual channel. The buildNumber field SHOULD be initialized to the build or version of the sending party. This PDU (or alternatively the HandshakeEx PDU (section 2.2.2.2.3) if the sending party is the server) MUST be sent before any other PDU on the virtual channel.

#### 3.1.5.2 Processing Handshake PDU

The receiving party SHOULD check the **buildNumber** field to verify compatibility of the receiver with the sender.<25>

The receiving party MUST NOT process any other virtual channel PDUs unless either the Handshake PDU or (if the receiving party is the client) the HandshakeEx PDU (section 2.2.2.2.3) has been received.

### 3.1.6 Timer Events

Upon the expiration of the handshake timer (as specified in section 3.1.2), the receiving party SHOULD drop the connection.

### 3.1.7 Other Local Events

No additional events are used.

## 3.2 Client Details

### 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 what is described in this document.

Note: It is possible to implement the following conceptual data by using a variety of techniques as long as the implementation produces external behavior that is consistent with what is described in this document.

#### 3.2.1.1 Windowing Support Level

The windowing support level determines whether the server is capable of supporting Windowing Alternate Secondary Drawing Orders and the following flags: WINDOW\_ORDER\_FIELD\_CLIENTAREASIZE, WINDOW\_ORDER\_FIELD\_RPCCONTENT, and WINDOW\_ORDER\_FIELD\_ROOTPARENT. This is communicated to the client by the **WndSupportLevel** field, as part of the Window List Capability Set (section 2.2.1.1.2).

#### 3.2.1.2 Marker Window ID

An ID that uniquely identifies the marker window (section 3.3.1.3) created by the server. The ID of this window is sent to the client in the Z-Order Sync Information PDU (section 2.2.2.11.1).

### 3.2.2 Timers

No timers are used.

### 3.2.3 Initialization

None.

### 3.2.4 Higher-Layer Triggered Events

There are no higher-layer triggered events.

### 3.2.5 Message Processing Events and Sequencing Rules

The following sections describe construction and processing of client messages.

### 3.2.5.1 Updates to RDP Core Protocol

#### 3.2.5.1.1 Constructing Client MCS Connect Initial PDU

The Client MCS Connect Initial PDU is constructed by the client during the connection establishment phase, as specified in [MS-RDPBCGR] section 3.2.5.3.3.

For remote applications integrated locally (RAIL) clients, the **clientNetworkData** field (as specified in [MS-RDPBCGR] section 2.2.1.3) MUST be present and MUST contain a CHANNEL\_DEF structure in channelDefArray for the RAIL virtual channel. This informs the server that the client wants to use a static virtual channel for communicating RAIL virtual channel messages.<26>

#### 3.2.5.1.2 Processing Server MCS Connect Response PDU

This PDU is sent by the server in response to the Client MCS Connect Initial PDU. It is processed by the client, as specified in [MS-RDPBCGR] section 3.2.5.3.4.

#### 3.2.5.1.3 Constructing Client Info PDU

The Client Info PDU (as specified in [MS-RDPBCGR] section 2.2.1.11) is constructed by the client during the connection establishment phase (as specified in [MS-RDPBCGR] section 3.2.5.3.11).

For remote applications integrated locally (RAIL) clients, the **flags** field of the Info Packet (as specified in [MS-RDPBCGR] section 2.2.1.11.1.1) MUST have the INFO\_RAIL (0x00008000) flag set. This informs the server that the client wants to create a RAIL session.

If the client supports Enhanced RemoteApp, the **flags** field SHOULD also have the INFO\_HIDEF\_RAIL\_SUPPORTED (0x02000000) flag set. This flag requests that the server create a RAIL session in Enhanced RemoteApp mode. Setting this flag does not guarantee that Enhanced RemoteApp will be enabled since the server may not support this mode.

#### 3.2.5.1.4 Constructing Confirm Active PDU

The Confirm Active PDU is constructed by the client in response to the Demand Active PDU, as specified in [MS-RDPBCGR] section 3.2.5.3.13.2.

Remote applications integrated locally (RAIL) clients MUST populate this PDU with two RAIL-specific capabilities in the **capabilitySets** field of the TS\_CONFIRM\_ACTIVE\_PDU ([MS-RDPBCGR] section 2.2.1.13.2.1) structure: the Remote Programs Capability Set, as specified in section 2.2.1.1.1, and the Window List Capability Set, as specified in section 2.2.1.1.2.

The NumIconCaches and NumIconCacheEntries of the Window List Capability Set SHOULD be reported as the minimum of the corresponding values supported by the client, and those reported by the server in the Demand Active PDU. The values MUST not exceed those reported by the server in the Demand Active PDU.

#### 3.2.5.1.5 Processing Demand Active PDU

The Demand Active PDU is processed by the client during the connection establishment phase, as specified in [MS-RDPBCGR] section 3.2.5.3.13.1.

Remote applications integrated locally (RAIL) clients MUST verify that this PDU contains two RAIL-specific capabilities in the **capabilitySets** field of the TS\_DEMAND\_ACTIVE\_PDU ([MS-RDPBCGR] section 2.2.1.13.1.1) structure: the Remote Programs Capability Set, as specified in section 2.2.1.1.1, and the Window List Capability Set, as specified in section 2.2.1.1.2. If it does not contain these capability sets, or if the RailSupportLevel of the Remote Programs Capability Set is not set to at least TS\_RAIL\_LEVEL\_SUPPORTED, or the WndSupportLevel of the Window List Capability Set is TS\_WINDOW\_LEVEL\_NOT\_SUPPORTED (0), the client MUST drop the connection.

The client SHOULD use the NumIconCaches and NumIconCacheEntries of the Window List Capability Set to determine the values of NumIconCaches and NumIconCacheEntries reported by it in the Confirm Active PDU, as specified in section 3.2.5.1.4.

### 3.2.5.1.6 Processing Window Information Orders

Window Information Orders (section 2.2.1.3.1) inform the client of the following types of window events on the server:

- Creation of a new window.
- Updates on window properties for a new or existing window.
- Updates on icons for a new or existing window.
- Deletion of an existing window.
- Registration of a new or existing window as an application desktop toolbar.
- Deregistration of an existing application desktop toolbar.
- Updates on the edge to which the application desktop toolbar window is anchored.

Upon receipt of a Window Information Order for a new window (the **FieldsPresentFlags** field of the **Hdr** contains the WINDOW\_ORDER\_STATE\_NEW (0x10000000) flag, as specified in section 2.2.1.3.1.2.1), the client SHOULD create a new RAIL window locally. The client SHOULD store an association of the **WindowId** reported in the **Hdr** field with the local RAIL window.

Upon receipt of a Window Information Order for an existing window (the **FieldsPresentFlags** field of **Hdr** does not contain the WINDOW\_ORDER\_STATE\_NEW (0x10000000) flag, as specified in section 2.2.1.3.1.2.1), the client SHOULD locate the local RAIL window that corresponds to the **WindowId** reported in the **Hdr** field and apply the specified updates to the RAIL window. If no such window can be found, the client SHOULD ignore the order.

Upon receipt of a Window Information Order for an icon or cached icon, as specified in sections 2.2.1.3.1.2.2 and 2.2.1.3.1.2.3, the client SHOULD locate the local RAIL window that corresponds to the **WindowId** reported in the **Hdr** field and apply the icon updates to the RAIL window. If no such window can be found, the client SHOULD ignore the order.

Upon receipt of a Window Information Order for a deleted window, as specified in section 2.2.1.3.1.2.4, the client SHOULD locate the local RAIL window that corresponds to the **WindowId** reported in the **Hdr** field and destroy it. If no such window can be found, the client SHOULD ignore the order.

Upon receipt of a Window Information Order for the registration of a window as an application desktop toolbar, the client SHOULD locate the local RAIL window that corresponds to the **WindowId** reported in the **Hdr** field and register it as an application desktop toolbar. If no such window can be found, the client SHOULD ignore the order.

Upon receipt of a Window Information Order for the deregistration of an application desktop toolbar window, the client SHOULD locate the local RAIL window that corresponds to the **WindowId** reported in the **Hdr** field and deregister the application desktop toolbar window. If no such window can be found, the client SHOULD ignore the order.

The boundaries of the window (defined by the **WindowOffsetX**, **WindowOffsetY**, **WindowWidth** and **WindowHeight** fields) only include the visible area of the window, and do not include any optional transparent hit-testable window margins ("resize margins"). However, the Client Window Move PDU (section 2.2.2.7.4) and Client Window Snap PDU (section 2.2.2.7.5) do include resize margins in the window boundaries. For this reason, clients SHOULD NOT expect the window boundaries reported in the Window Information Order (section 2.2.1.3.1.2.1) to match boundaries



previously sent in a Window Move/Snap PDU. This applies even if margins were not sent in the Window Information Order.<27>

Upon receipt of a Window Information Order for the edge of an application desktop toolbar window, the client SHOULD locate the local RAIL window that corresponds to the **WindowId** reported in the **Hdr** field and update the edge to which the window is anchored. If no such window can be found, the client SHOULD ignore the order.

### 3.2.5.1.7 Processing Notification Icon Orders

Notification Icon Information Orders (section 2.2.1.3.2) inform the client of the following types of notification icon events on the server:

- Creation of a new notification icon.
- Updates on properties for a new or existing notification icon.
- Deletion of an existing notification icon.

Upon receipt of a Notification Icon Order for a new notification icon (the **FieldsPresentFlags** field of **Hdr** contains the WINDOW\_ORDER\_STATE\_NEW (0x10000000) flag, as specified in section 2.2.1.3.2.2.1), the client SHOULD create a new RAIL notification icon locally. The client SHOULD store an association of the **WindowId** and **NotifyIconId** reported in the **Hdr** field with the local notification icon.

Upon receipt of a notification icon Order for an existing notification icon (the FieldsPresentFlags field of **Hdr** does not contain the WINDOW\_ORDER\_STATE\_NEW (0x10000000) flag, as specified in section 2.2.1.3.2.2.1), the client SHOULD locate the RAIL notification icon that corresponds to the WindowId and NotifyIconId reported in the **Hdr** field, and then apply the specified updates to the RAIL notification icon. If no such icon can be found, the client SHOULD ignore the Order.

Upon receipt of a notification icon Order for a deleted icon, as specified in section 2.2.1.3.2.2.2, the client SHOULD locate the local RAIL notify icon that corresponds to the WindowId and NotifyIconId reported in the **Hdr** field and destroy it. If no such icon can be found, the client SHOULD ignore the Order.

### 3.2.5.1.8 Processing Desktop Information Orders

Desktop Information Orders inform the client of events on the server that are not confined to a single window or notification icon. Processing of these orders is indicated as follows:

- Upon receipt of a Desktop Information Order, as specified in section 2.2.1.3.3.2.1, with the WINDOW\_ORDER\_FIELD\_DESKTOP\_ARC\_BEGAN (0x00000008) and the WINDOW\_ORDER\_FIELD\_DESKTOP\_HOOKED (0x00000002) flags set in the **Hdr** field, the client SHOULD discard all of the existing RAIL windows and Notify Icons and prepare for Window Orders (see sections 2.2.1.3.1.2.1 and 2.2.1.3.1.2.4) and Notify Icon Orders (see sections 2.2.1.3.1.2.2 and 2.2.1.3.1.2.3) from the server.
- Upon receipt of a Desktop Information Order for a **Non-Monitored Desktop** packet, as specified in section 2.2.1.3.3.2.2, the client SHOULD discard all of the existing RAIL windows and Notify Icons.
- Upon receipt of a Desktop Information Order with the WINDOW\_ORDER\_FIELD\_DESKTOP\_HOOKED (0x00000002) flag set in the **Hdr** field, the client SHOULD prepare for Window and Notify Icon Orders from the server.
- Upon receipt of a Desktop Information Order with the **NumWindowIds** and **WindowIds** fields present, the client SHOULD apply the specified Z-order of the server's windows to its local RAIL windows.

- Upon receipt of a Desktop Information Order with the **ActiveWindowId** field present, the client SHOULD activate the corresponding local RAIL window.

### 3.2.5.2 Static Virtual Channel Protocol

#### 3.2.5.2.1 Initialization Messages

##### 3.2.5.2.1.1 Sending Client Information PDU

The client information PDU is initialized as specified in section 2.2.2.2.2.

##### 3.2.5.2.1.2 Processing HandshakeEx PDU

The client SHOULD check the **buildNumber** field to verify compatibility of the receiver with the sender. <28>

If the TS\_RAIL\_ORDER\_HANDSHAKEEX\_FLAGS\_HIDEF (0x00000001) flag in the **railHandshakeFlags** field is set, the remote session is running in Enhanced RemoteApp mode, and the client SHOULD handle the RDPGFX\_MAP\_SURFACE\_TO\_WINDOW\_PDU ([MS-RDPEGFX] section 2.2.2.20) message. If this flag is not set, the session is not running in Enhanced RemoteApp mode, even if the client requested it in the Client Info PDU (as specified in section 3.2.5.1.3). In this scenario, the client SHOULD NOT expect to receive Enhanced RemoteApp messages.

The client MUST NOT process any other virtual channel PDUs unless either the HandshakeEx PDU (section 2.2.2.2.3) or the Handshake PDU (section 2.2.2.2.1) has been received.

#### 3.2.5.2.2 Program Launching Messages

##### 3.2.5.2.2.1 Sending Execute PDU

As specified in section 2.2.2.3.1, the client SHOULD store the execute request to match execute requests with Execute Result PDUs from the server. For Server Execute Result PDU, see section 2.2.2.3.2.

##### 3.2.5.2.2.2 Processing Execute Result PDU

The client SHOULD match the Execute Result PDU with a previously sent Execute PDU and report the results to the user.

#### 3.2.5.2.3 Local Client System Parameters Update Messages

##### 3.2.5.2.3.1 Sending System Parameters Update PDU

Initialized as specified in section 2.2.2.4.1, this PDU SHOULD be sent at the start of every remote applications integrated locally (RAIL) connection or reconnection and when a system parameter on the client changes its value.

#### 3.2.5.2.4 Server System Parameters Update Messages

##### 3.2.5.2.4.1 Processing Server System Parameters Update PDU

On receipt of this PDU, the client SHOULD update its system parameters to those reported by the server. This helps to maintain consistency between local client and remote server settings, which is an important aspect of the seamless experience.

#### 3.2.5.2.5 Local Client Event Messages

Local Client Event Messages are Virtual Channel PDUs sent from the client to the server specifying user interactions with RAIL windows and notifications that cannot be captured and sent over the regular RDP channel.

#### 3.2.5.2.5.1 Sending Activate PDU

The Activate PDU is sent by the client when a RAIL window is activated by a means other than clicking it, such as by pressing ALT+TAB.

**Note** Mouse clicks on the RAIL window are forwarded to the server via the RDP core protocol. The PDU is initialized as specified in section 2.2.2.6.1.

The **WindowId** field SHOULD be initialized to the ID of an existing window on the server that is associated with the local RAIL window being activated. The RAIL client SHOULD create this association during processing of the Window Information Order for new windows, as specified in section 2.2.1.3.1.2.1.

#### 3.2.5.2.5.2 Sending System Menu PDU

The System Menu PDU is sent by the client when a RAIL window receives a command to display its system menu by a means other than clicking it, such as by right-clicking the taskbar icon for the window.

**Note** Mouse clicks in the RAIL window are forwarded to the server via the RDP core protocol. The PDU is initialized as specified in section 2.2.2.6.2.

The **WindowId** field SHOULD be initialized to the ID of an existing window on the server that is associated with the local RAIL window. The RAIL client SHOULD create this association during processing of the Window Information Order for new windows, as specified in section 2.2.1.3.1.2.1.

#### 3.2.5.2.5.3 Sending System Command PDU

The System Command PDU is sent by the client when a RAIL window receives a system command by a means other than clicking it (for example, by pressing the Windows logo key+M to minimize the window, by clicking the Show Desktop button in the taskbar, or by selecting the system menu by pressing ALT+SPACE).

**Note** Mouse clicks in the RAIL window are forwarded to the server via the RDP core protocol. The PDU is initialized as specified in section 2.2.2.6.3.

The **WindowId** field SHOULD be initialized to the ID of an existing window on the server that is associated with the local RAIL window. The RAIL client SHOULD create this association during processing of the Window Information Order for new windows, as specified in section 2.2.1.3.1.2.1.

#### 3.2.5.2.5.4 Sending Notify Event PDU

The Notify Event PDU is sent by the client when a remote applications integrated locally (RAIL) notification icon receives any user interaction via the keyboard or mouse. The PDU is initialized as specified in section 2.2.2.6.4.

The **WindowId** and **NotifyIconId** fields SHOULD be initialized to the ID of an existing Window and notification icon (respectively) on the server and associated with the local RAIL notification icon. The RAIL client SHOULD create this association during processing of the Notification Icon Information Order for new notification icons, as specified in section 2.2.1.3.2.2.1.

#### 3.2.5.2.6 Language Bar Information PDUs

##### 3.2.5.2.6.1 Sending Language Bar Information PDU

After initialization (as specified in section 2.2.2.9.1), this PDU SHOULD be sent from a client to a server just after sending the RAIL handshake (see section 2.2.2.2.1). This enables the server synchronize its language bar state with the client's.

This PDU MUST NOT be sent if the server does not support the Docked Language Bar RAIL capability (TS\_RAIL\_LEVEL\_DOCKED\_LANGBAR\_SUPPORTED).

### 3.2.5.2.6.2 Processing Language Bar Information PDU

Upon receipt of this PDU, the client SHOULD update the status of its language using the Language Bar Information PDU.

### 3.2.5.2.7 Window Move Messages

Window Move Messages are generated by the server and client to enable the local move/size feature of RAIL.

#### 3.2.5.2.7.1 Processing Min Max Info PDU

On receipt of the Min Max Info PDU, if the client supports local move/size, it SHOULD locate the local RAIL window that corresponds to the **WindowId** field and apply the specified window extents (**MaxWidth**, **MaxHeight**, **MaxPosX**, **MaxPosY**, **MinTrackWidth**, **MinTrackHeight**, **MaxTrackWidth**, and **MaxTrackHeight** fields) to it.

If no such RAIL window can be found, the client SHOULD ignore this PDU.

If the client does not support local move/size, it SHOULD ignore this PDU.

#### 3.2.5.2.7.2 Processing Move/Size Start PDU

On receipt of the Move/Size Start PDU, if the client supports local move/size features, it SHOULD locate the local RAIL window that corresponds to the **WindowId** field and initiate a move/size of the local RAIL window by using the local Window Manager based on the **MoveSizeType** field. The client SHOULD also suppress forwarding of keyboard/mouse events to the server to maintain a local-only move/size of the RAIL window.

If no RAIL window can be found corresponding to **WindowId**, the client SHOULD ignore this PDU.

If the client does not support local move/size, it SHOULD ignore this PDU.

#### 3.2.5.2.7.3 Sending Window Move PDU

If the client supports local move/size, it SHOULD send the Window Move PDU upon receiving a notification from the local window manager that a local move/size of a RAIL window has ended. The PDU is sent for keyboard-based moves and all resizes, and it is initialized as specified in section 2.2.2.7.4.

The **WindowId** field SHOULD be initialized to the ID of an existing window on the server that is associated with the local RAIL window. The RAIL client SHOULD create this association during processing of the Window Information Order for new windows, as specified in section 2.2.1.3.1.2.1.

If the client suppressed forwarding of keyboard/mouse events to the server during processing of the Move/Size Start PDU, it MUST resume the forwarding of these events to the server to allow the server to detect a move/size end of the remote window.

#### 3.2.5.2.7.4 Processing Move/Size End PDU

Upon receipt of the Move/Size End PDU, if the client supports local move/size features, it SHOULD locate the local RAIL window that corresponds to the **WindowId** field and move it to the coordinates specified by the **TopLeftX** and **TopLeftY** fields. This ensures synchronization between the final positions of the corresponding moved/resized windows on the server and client.

If no RAIL window can be found corresponding to **WindowId**, the client SHOULD ignore this PDU.

If the client does not support local move/size, it SHOULD ignore this PDU.

### 3.2.5.2.7.5 Sending Window Snap PDU

If the server advertises support for window snapping in the **HandshakeEx PDU** (section 2.2.2.2.3) structure (using the TS\_RAIL\_ORDER\_HANDSHAKE\_EX\_FLAGS\_SNAP\_ARRANGE\_SUPPORTED flag, as specified in the **HandshakeEx PDU**), the client SHOULD send the **Window Snap PDU** (section 2.2.2.7.5) when it receives a notification from the local window manager that a local RAIL window has been moved, and is able to determine that the move occurred due to the use of Snap or an equivalent feature.

If the server does not support window snapping or if the client is unable to detect what feature caused the local RAIL window to be moved, it SHOULD send the **Window Move PDU** (section 2.2.2.7.4) instead.

If the client sends the **Window Snap PDU** in response to a local RAIL window being snapped, it SHOULD NOT send a **Window Move PDU** for the same event.

### 3.2.5.2.8 Application ID Messages

#### 3.2.5.2.8.1 Sending Client Get Application ID PDU

After being initialized as specified in section 2.2.2.6.5, this PDU MAY be sent from a client to a server after receiving a Window Information Order containing the WINDOW\_ORDER\_STATE\_NEW (0x10000000) flag.

#### 3.2.5.2.8.2 Processing Server Get Application ID Response PDU

Upon receipt of this PDU, the client SHOULD<29> update the Application ID string of the Window matching the Windows ID received from the server.

#### 3.2.5.2.8.3 Processing Server Get Application ID Extended Response PDU

Upon receipt of this PDU, the client SHOULD<30> update the Application ID string of the Window matching the Windows ID received from the server. The client SHOULD also cache the ID and the image name of the process that hosts the corresponding window on the server.

### 3.2.5.2.9 Z-Order Sync Messages

#### 3.2.5.2.9.1 Sending Z-Order Sync Support Flag

The client advertises support for Z-order sync by including the TS\_RAIL\_CLIENTSTATUS\_ZORDER\_SYNC (0x00000004) flag in the Client Information PDU (section 2.2.2.2.2).

#### 3.2.5.2.9.2 Processing Z-Order Sync Information PDU

When the client receives the Z-Order Sync Information PDU, the ID of the marker window MUST be stored in the Marker Window ID (section 3.2.1.2) store.

If a client-side window that is not remoted from the server (referred to as "Window A") is activated, then the client SHOULD instruct the server to activate the marker window by sending the Client Activate PDU (section 2.2.2.6.1) to the server with the **Enabled** field set to zero.

Furthermore, if the server instructs the client to activate a RAIL window (referred to as "Window B"), the client SHOULD check the position of Window B with respect to the marker window in the **WindowIds** field of the Actively Monitored Desktop (section 2.2.1.3.3.2.1). Window B SHOULD only be activated if it appears before the marker window in the **WindowIds** field of the Actively Monitored Desktop Order.

### 3.2.5.2.10 Window Cloak State Sync Messages

#### 3.2.5.2.10.1 Sending Window Cloak State Change PDU

The Window Cloak State Change PDU (section 2.2.2.12.1) SHOULD be sent by the client when a RAIL window is cloaked or uncloaked on the client (for example, in the case of a virtual desktop feature, when the user switches desktops). A cloaked window MUST be present on the client, but MUST be invisible to the user and MUST NOT receive mouse, pen, or touch input. This PDU ensures that cloaked state is synchronized between client and server.

The PDU is initialized as specified in section 2.2.2.12.1. The **WindowId** field SHOULD be initialized to the ID of an existing window on the server that is associated with the local RAIL window. The RAIL client SHOULD create this association during processing of the Window Information Order for new windows, as specified in section 2.2.1.3.1.2.1.

#### 3.2.5.2.10.2 Processing Window Cloak State Change PDU

On receipt of this PDU the client SHOULD cloak or uncloak the RAIL window with the ID specified by the **WindowId** field. The action of cloaking or uncloaking is specified by the **Cloaked** field. The client SHOULD NOT send a Window Cloak State Change PDU back to the server as a result of processing this PDU.

If no RAIL window can be found corresponding to **WindowId**, the client SHOULD ignore this PDU.

### 3.2.5.2.11 Power Display Request Messages

#### 3.2.5.2.11.1 Processing Power Display Request PDU

On receipt of this PDU, the client SHOULD update its display-required power request status. If the Active field is set to 0x00000001, then the display on the client device SHOULD remain in the powered-on state even if there is no user input for an extended period.

### 3.2.5.2.12 Server Taskbar State Messages

#### 3.2.5.2.12.1 Processing Taskbar Tab Info PDU

On receipt of this PDU, the client SHOULD update the local window manager to reflect the new tab group state of the tabbed application. If the local window manager does not expose the necessary features to make use of window tabs, the client MAY ignore this PDU.

### 3.2.5.2.13 Accessibility Messages

#### 3.2.5.2.13.1 Sending Text Scale Information PDU

If the server advertises support for the Text Scale Information PDU in the HandshakeEx PDU (section 2.2.2.2.3) structure (using the TS\_RAIL\_ORDER\_HANDSHAKE\_EX\_FLAGS\_TEXT\_SCALE\_SUPPORTED

flag), the client SHOULD send the **Text Scale Information PDU** (section 2.2.2.15.1) during the connection establishment phase and when the text scale factor of the client system is changed.

### 3.2.5.2.13.2 Sending Caret Blink Information PDU

If the server advertises support for Caret Blink Information in the HandshakeEx PDU (section 2.2.2.2.3) structure (using the TS\_RAIL\_ORDER\_HANDSHAKE\_EX\_FLAGS\_CARET\_BLINK\_SUPPORTED flag), the client SHOULD send the **Caret Blink Information PDU** (section 2.2.2.15.2) during the connection establishment phase and when the caret blink rate of the client system is changed.

## 3.2.6 Timer Events

None.

## 3.2.7 Other Local Events

None.

## 3.3 Server Details

### 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 what is described in this document.

Note: It is possible to implement the following conceptual data by using a variety of techniques as long as the implementation produces external behavior that is consistent with what is described in this document.

#### 3.3.1.1 Client Local Move/Size Ability Store

The Client Local Move/Size Ability store determines whether the client has the ability to support Local Move/Size in RAIL. This is communicated to the server by the TS\_RAIL\_CLIENTSTATUS\_ALLOWLOCALMOVESIZE flag as part of Client Information PDU (see section 2.2.2.2.2).

#### 3.3.1.2 Windowing Support Level

The windowing support level determines whether the client is capable of supporting Windowing Alternate Secondary Drawing Orders and the following flags: WINDOW\_ORDER\_FIELD\_CLIENTAREASIZE, WINDOW\_ORDER\_FIELD\_RPCONTENT, and WINDOW\_ORDER\_FIELD\_ROOTPARENT. This is communicated to the server by the **WndSupportLevel** field, as part of the Window List Capability Set (section 2.2.1.1.2).

#### 3.3.1.3 Marker Window

The marker window is a server-side window that is not remotized to the client and is used to manage the activation of RAIL windows. This window is destroyed if the client does not advertise support for Z-order sync in the Client Information PDU (section 2.2.2.2.2).

### 3.3.2 Timers

No timers are used.

### 3.3.3 Initialization

None.

### 3.3.4 Higher-Layer Triggered Events

No higher-layer triggered events are used.

### 3.3.5 Message Processing Events and Sequencing Rules

#### 3.3.5.1 Updates to RDP Core Protocol

##### 3.3.5.1.1 Processing Client MCS Connect Initial PDU

The Client MCS Connect Initial PDU is processed by the server during the connection establishment phase, as specified in [MS-RDPBCGR].

##### 3.3.5.1.2 Constructing Server MCS Connect Response PDU

This PDU is sent by the server in response to the Client MCS Connect Initial PDU, as specified in [MS-RDPBCGR].

##### 3.3.5.1.3 Processing Client Info PDU

The Client Info PDU is processed by the server during the connection establishment phase, as specified in [MS-RDPBCGR].

If the flags field of the Info Packet (as specified in [MS-RDPBCGR] section 2.2.1.11.1.1) has the INFO\_RAIL (0x00008000) flag set, it indicates that the client wants to start a remote applications integrated locally (RAIL) connection. If the server supports RAIL, it SHOULD indicate this by using the Demand Active PDU (see section 3.3.5.1.4).

If the **flags** field of the Info Packet has the INFO\_HIDEF\_RAIL\_SUPPORTED (0x02000000) flag set, it indicates that the client has requested that the RAIL session be created in Enhanced RemoteApp mode. If the server supports Enhanced RemoteApp mode this mode SHOULD be enabled, and upon initialization of the RAIL virtual channel the HandshakeEx PDU (section 2.2.2.2.3) MUST be sent with the TS\_RAIL\_ORDER\_HANDSHAKEEX\_FLAGS\_HIDEF (0x00000001) flag set (section 3.3.5.2.1.2). If the INFO\_HIDEF\_RAIL\_SUPPORTED flag is not set, the server MUST NOT enable Enhanced RemoteApp.

##### 3.3.5.1.4 Constructing Demand Active PDU

The Demand Active PDU is constructed by the server during the connection establishment phase, as specified in [MS-RDPBCGR] section 3.3.5.3.13.1.

If the client has requested support for remote applications integrated locally (RAIL) in the Client Info PDU (as specified in [MS-RDPBCGR] section 2.2.1.11), and the server supports RAIL, the server MUST specify two RAIL-specific capabilities in the **capabilitySets** field of the TS\_DEMAND\_ACTIVE\_PDU ([MS-RDPBCGR] section 2.2.1.13.1.1) structure: the Remote Programs Capability Set (section 2.2.1.1.1) and the Window List Capability Set (section 2.2.1.1.2).



The server MUST specify the number of icon caches supported by using the NumIconCaches and NumIconCacheEntries of the Window List Capability Set.

#### 3.3.5.1.5 Processing Confirm Active PDU

The Confirm Active PDU is processed by the server, as specified in [MS-RDPBCGR] section 3.3.5.3.13.2.

If the client has requested support for remote applications integrated locally (RAIL) in the Client Info PDU (see section 3.2.5.1.3), and the server has indicated support for RAIL in the Demand Active PDU (see section 3.3.5.1.4), the server MUST verify that this PDU contains two RAIL-specific capabilities in the **capabilitySets** field of the TS\_CONFIRM\_ACTIVE\_PDU ([MS-RDPBCGR] section 2.2.1.13.2.1) structure: the Remote Programs Capability Set (section 2.2.1.1.1) and the Window List Capability Set (section 2.2.1.1.2). If it does not contain these capability sets, or the RailSupportLevel of the Remote Programs Capability Set is not set to at least TS\_RAIL\_LEVEL\_SUPPORTED, or the WndSupportLevel of the Window List Capability Set is TS\_WINDOW\_LEVEL\_NOT\_SUPPORTED (0), the server MUST drop the connection.

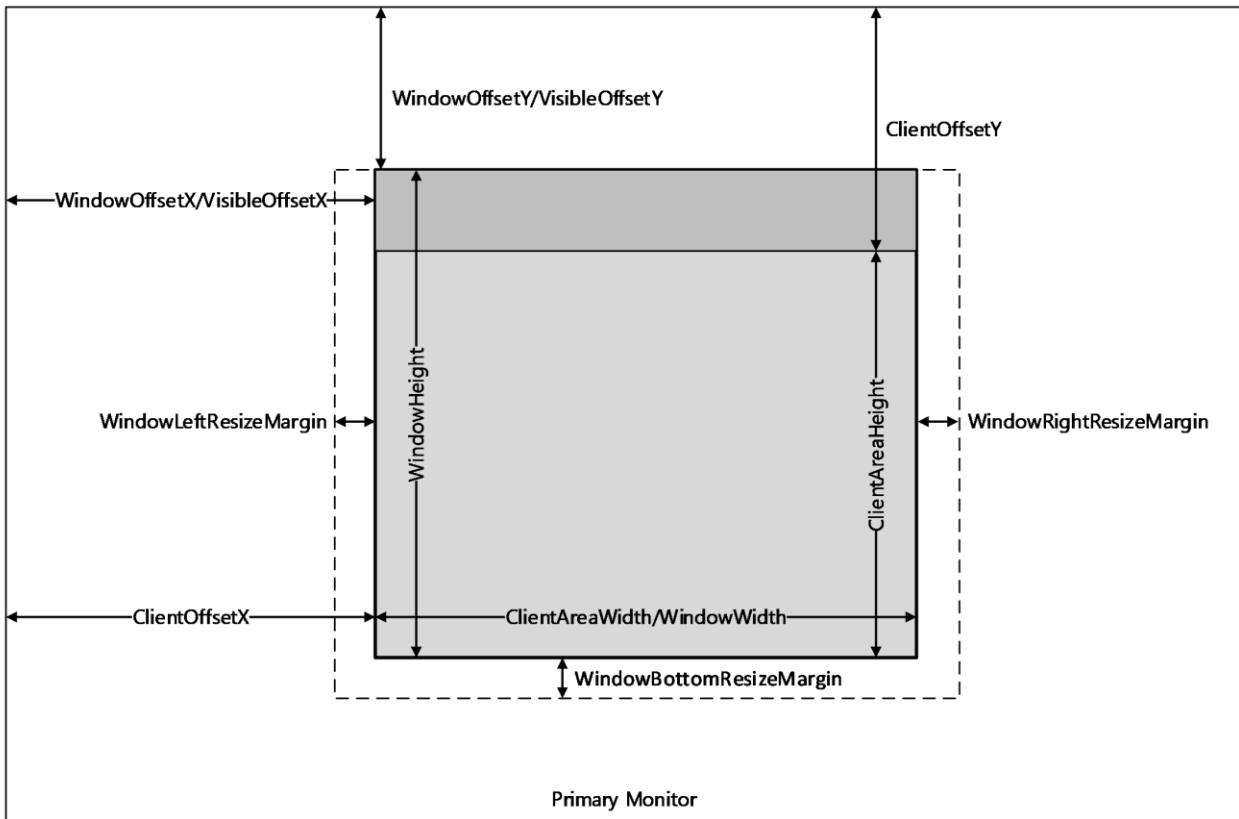
The server MUST verify that the NumIconCaches and NumIconCacheEntries of the Window List Capability Set do not exceed the corresponding entries set by the server in the Demand Active PDU. <31> The server MUST also update its icon cache limits to those reported in NumIconCaches and NumIconCacheEntries.

#### 3.3.5.1.6 Constructing Window Information Orders

The server generates Window Information Orders to inform the client of the following types of window events on the server:

- Creation of a new window.
- Updates on window properties for a new or existing window.
- Updates on icons for a new or existing window.
- Deletion of an existing window.
- Registration of a new or existing window as an application desktop toolbar.
- Deregistration of an existing application desktop toolbar.

The Window Information Orders are constructed as specified in section 2.2.1.3.1.



**Figure 6: An illustration of the window metrics sent in the Window Information Order**

Window icon orders SHOULD NOT be sent to the client if the `TS_RAIL_CLIENTSTATUS_SUPPRESS_ICON_ORDERS` flag was specified in the Client Information PDU (section 2.2.2.2.2). Notification icon orders are not affected by this flag.

### 3.3.5.1.7 Constructing Notification Icon Orders

The server generates Notification Icon Information Orders to inform the client of the following types of notification icon events on the server.

- Creation of a new notification icon.
- Updates on properties for a new or existing notification icon.
- Deletion of an existing notification icon.

The Notification Icon Orders are constructed as specified in section 2.2.1.3.2.

### 3.3.5.1.8 Constructing Desktop Information Orders

Desktop Information Orders are generated by the server to inform the client of events on the server that are not confined to a single window or notification icon. These events include the following:

- A client connects to the server that is actively monitoring a desktop. The server generates the following events in order:
  1. A Desktop Information Order (see section 2.2.1.3.3.2.1) with the `WINDOW_ORDER_FIELD_DESKTOP_ARC_BEGAN` (0x00000008) and the

WINDOW\_ORDER\_FIELD\_DESKTOP\_HOOKED (0x00000002) flags set in the **Hdr** field to indicate that the synchronization has begun.

2. After all orders specifying windows, icons, and the desktop are sent, the server generates a Desktop Information Order with the WINDOW\_ORDER\_FIELD\_DESKTOP\_ARC\_COMPLETED (0x00000004) flag set to signal the end of synchronization data.
- A desktop switch occurred on the server causing the server to stop monitoring the current desktop and (optionally) start monitoring the new desktop. This is indicated by generating the following events in order.
    1. A Desktop Information Order for the **Non-Monitored Desktop** packet (see section 2.2.1.3.3.2.2).
    2. A Desktop Information Order with the WINDOW\_ORDER\_FIELD\_DESKTOP\_HOOKED (0x00000002) flag set in the **Hdr** field. If the server is unable to monitor the new desktop, the server SHOULD NOT send this order.
  - The number and/or Z-order of top-level windows on the server changes. This is indicated by generating a Desktop Information Order with the **NumWindowIds** and **WindowIds** fields present.
  - The active window on the server changes. This is indicated by generating a Desktop Information Order with the **ActiveWindowId** field present.

### 3.3.5.2 Static Virtual Channel Protocol

#### 3.3.5.2.1 Initialization Messages

##### 3.3.5.2.1.1 Processing Client Information PDU

If the **Flags** field of the PDU contains the TS\_RAIL\_CLIENTSTATUS\_ALLOWLOCALMOVESIZE (0x00000001) flag, the client supports Local Move/Size. If the server also supports Local Move/Size, it SHOULD record this fact and SHOULD send Move Messages to the client window when appropriate (see section 2.2.2.7.4).

If the **Flags** field of the PDU contains the TS\_RAIL\_CLIENTSTATUS\_ZORDER\_SYNC (0x00000004) flag, the client supports Z-order sync. On receiving this flag, the server SHOULD create the marker window (section 3.3.1.3) and send the ID of this window to the client using the Z-Order Sync Information PDU (section 2.2.2.11.1).

If the **Flags** field of the PDU contains the TS\_RAIL\_CLIENTSTATUS\_POWER\_DISPLAY\_REQUEST\_SUPPORTED (0x00000080) flag, the client supports setting the display-required power request. On receiving this flag, the server SHOULD monitor the state of its display-required power request and send it to the client using the Power Display Request PDU (section 2.2.2.13.1).

##### 3.3.5.2.1.2 Sending HandshakeEx PDU

The HandshakeEx PDU MUST be constructed as specified in section 2.2.2.2.3.

If Enhanced RemoteApp has been enabled for the current RAIL session (section 3.3.5.1.3), the server MUST set the TS\_RAIL\_ORDER\_HANDSHAKEEX\_FLAGS\_HIDEF (0x00000001) flag. If it has not been enabled, the server MUST NOT set this flag.

If Enhanced RemoteApp is not enabled, and support for the HandshakeEx PDU was not indicated in the Remote Programs Capability Set (section 2.2.1.1.1), the server MUST send the Handshake PDU (section 3.1.5.1) instead of the HandshakeEx PDU.

### 3.3.5.2.2 Program Launching Messages

#### 3.3.5.2.2.1 Processing Execute PDU

Upon receipt of this PDU, the server MUST start the application specified in the PDU on the server. The PDU is processed as specified in 2.2.2.3.2.

#### 3.3.5.2.2.2 Sending Execute Result PDU

This PDU is sent in response to an Execute PDU from the client and is initialized as specified in section 2.2.2.3.2.

### 3.3.5.2.3 Local Client System Parameters Update Messages

#### 3.3.5.2.3.1 Processing System Parameters Update PDU

Upon receipt of this PDU, the server SHOULD set its system parameters to those reported by the client. This helps applications running remotely to behave consistently with local user settings, which is an important aspect of the seamless experience.

### 3.3.5.2.4 Server System Parameters Update Messages

#### 3.3.5.2.4.1 Sending Server System Parameters Update PDU

This PDU is initialized as specified in section 2.2.2.5.1. This PDU SHOULD be sent at the start of every remote applications integrated locally (RAIL) connection/reconnection, and when a system parameter on the server changes its value.

### 3.3.5.2.5 Local Client Event Messages

#### 3.3.5.2.5.1 Processing Activate PDU

Upon receipt of this PDU, the server SHOULD activate or deactivate the remote window whose ID is specified by **WindowId** and whose activation state is specified by the **Enabled** field.

If no such window exists, the server SHOULD ignore the PDU.

#### 3.3.5.2.5.2 Processing System Menu PDU

On receipt of this PDU, the server SHOULD post a command to the remote window whose ID is specified by **WindowId** to display its system menu at the coordinates specified by the **Left** and **Top** fields.

If no such window exists, the server SHOULD ignore the PDU.

#### 3.3.5.2.5.3 Processing System Command PDU

Upon receipt of this PDU, the server SHOULD post the system command specified by the **Command** field to the remote window whose ID is specified by **WindowId**.

If no such window exists, the server SHOULD ignore the PDU.

#### 3.3.5.2.5.4 Processing Notify Event PDU

Upon receipt of this PDU, the server SHOULD post the message specified by the **Message** field to the remote notification icon specified by the **WindowId** and **NotifyIconId** fields.

If no such notify icon exists, the server SHOULD ignore the PDU.

#### **3.3.5.2.5.5 Processing Language Bar Information PDU**

Upon receipt of this PDU, the server MUST first send the status of its language bar to the client using the Language Bar Information PDU. The server MUST then adjust the server-side language bar to match the client's language bar status by making it either float or be docked.

#### **3.3.5.2.6 Window Move Messages**

The Window Move messages are generated by the server and client to enable the Local Move/Size feature of RAIL.

##### **3.3.5.2.6.1 Sending Min Max Info PDU**

This PDU is sent by the server when a user attempts to move or resize a local RAIL window and when the corresponding keyboard input or mouse input forwarded to the server causes the corresponding remote window to begin to move or resize. It is initialized as specified in section 2.2.2.7.1.

This PDU SHOULD be sent if the client and server both support local move/size features.

##### **3.3.5.2.6.2 Sending Move/Size Start PDU**

This PDU is sent by the server when a user attempts to move or resize a local RAIL window (for example, by dragging the window title with the mouse or resizing the window borders with the mouse), and the corresponding keyboard input or mouse input forwarded to the server causes the corresponding remote window to begin the move or resize. It is initialized as specified in section 2.2.2.7.2.

This PDU SHOULD be sent if the client and server both support local move/size features. It SHOULD be sent immediately after the Min Max Info PDU (see section 2.2.2.7.1).

##### **3.3.5.2.6.3 Processing Window Move PDU**

On receipt of the Client Window Move PDU section 2.2.2.7.4, the server SHOULD move the remote window specified by the WindowId field to the coordinates specified by the Left, Top, Right, and Bottom fields.

If no such Window exists, the server SHOULD ignore the PDU.

##### **3.3.5.2.6.4 Sending Move/Size End PDU**

This PDU is sent by the server when a user completes a move or resize of a local RAIL window (for example, by releasing the mouse button), and the corresponding keyboard input or mouse input forwarded to the server causes the corresponding remote window to complete the move or resize. It is initialized as specified in section 2.2.2.7.3.

This PDU SHOULD be sent if the client and server both support local move/size features.

##### **3.3.5.2.6.5 Processing Window Snap PDU**

On receipt of the **Client Window Snap PDU** (section 2.2.2.7.5), the server SHOULD move the remote window specified by the **WindowId** field to the coordinates specified by the **Left**, **Top**, **Right**, and **Bottom** fields. When moving the window, the server SHOULD use a feature such as Snap that can restore the window's size when it is unsnapped. If no such feature is available, the server SHOULD NOT advertise support for this PDU.

In all other respects, this PDU is equivalent to the **Window Move PDU** (section 2.2.2.7.4) and SHOULD be handled the same way.

### 3.3.5.2.7 Application ID Messages

#### 3.3.5.2.7.1 Processing the Get Application ID PDU

Upon receipt of the Get Application ID PDU, the server MAY<32> retrieve the Application ID of the window whose window ID is specified in the PDU.

If no such window exists, the server SHOULD ignore the PDU.

#### 3.3.5.2.7.2 Sending the Get Application ID Response PDU

The Get Application ID Response PDU is sent in response to a Get Application ID PDU from the client and is initialized as specified in section 2.2.2.8.1.

### 3.3.5.2.8 Z-Order Sync Messages

#### 3.3.5.2.8.1 Processing Z-Order Sync Support Flag

On processing the TS\_RAIL\_CLIENTSTATUS\_ZORDER\_SYNC (0x00000004) flag in the Client Information PDU (section 2.2.2.2.2), the server SHOULD create the marker window (section 3.3.1.3) and send the ID of this window to the client in the Z-Order Sync Information PDU (section 2.2.2.11.1). If the client does not advertise support for Z-order sync, then the server MUST destroy the marker window, if it exists.

#### 3.3.5.2.8.2 Sending Z-Order Sync Information PDU

The server SHOULD send the ID of the marker window to the client in the Z-Order Sync Information PDU (section 2.2.2.11.1).

### 3.3.5.2.9 Window Cloak State Sync Messages

#### 3.3.5.2.9.1 Processing Window Cloak State Change PDU

Upon receipt of the Windows Cloak State Change PDU (section 2.2.2.12.1), the server SHOULD cloak or uncloak the remote window whose ID is specified by **WindowId** as specified by the **Cloaked** field. The server SHOULD NOT send a Deleted Window Information Order as a result of processing this PDU. The server MUST NOT send a Window Cloak State Change PDU back to the client as a result of processing this PDU.

If no such window exists, the server SHOULD ignore the PDU.

#### 3.3.5.2.9.2 Sending Window Cloak State Change PDU

The Window Cloak State Change PDU (section 2.2.2.12.1) SHOULD be sent by the server when a remotized window is cloaked or uncloaked (unless the cloak or uncloak occurred as a result of processing a Window Cloak State Change PDU sent by the client). This PDU MUST be initialized as specified in section 2.2.2.12.1.

If the client does not support processing the Window Cloak State Change PDU, the server SHOULD send a Deleted Window Information Order (section 2.2.1.3.1.2.4) when a window is cloaked, and a Window Information Order (section 2.2.1.3.1.2.1) when a window is uncloaked.

### 3.3.5.2.10 Power Display Request Messages

### **3.3.5.2.10.1 Sending Power Display Request PDU**

If the state of its display-required power request changes in the remote session, then the server SHOULD send the new state to the client in the Power Display Request PDU (section 2.2.2.13.1).

### **3.3.5.2.11 Server Taskbar State Messages**

#### **3.3.5.2.11.1 Sending Taskbar Tab Info PDU**

The server SHOULD send the Taskbar Tab Info PDU (section 2.2.2.14.1) whenever it determines that the state of a tabbed application's taskbar tab group has changed. However, the server SHOULD NOT send the PDU if it does not support tabbed applications, or if the client has not advertised support for extended shell integration in the Remote Programs Capability Set (section 2.2.1.1.1).

If the client has connected to an existing session, the server SHOULD re-sync the taskbar tab state of its tabbed applications to the client by sending RAIL\_TASKBAR\_MSG\_TAB\_REGISTER, RAIL\_TASKBAR\_MSG\_TAB\_ORDER, and RAIL\_TASKBAR\_MSG\_TAB\_PROPERTIES messages for each window in each tabbed application in the session.

### **3.3.5.2.12 Accessibility Messages**

#### **3.3.5.2.12.1 Processing Text Scale Information PDU**

On receipt of the Text Scale Information PDU (section 2.2.2.15.1), the server SHOULD use this information to change the system text scale setting. If no such feature is available, the server SHOULD NOT advertise support for this PDU.

#### **3.3.5.2.12.2 Processing Caret Blink Information PDU**

On receipt of the Caret Blink Information PDU (section 2.2.2.15.2), the server SHOULD use this information to change the caret blink rate. If no such feature is available, the server SHOULD NOT advertise support for this PDU.

### **3.3.6 Timer Events**

No timer events are used.

### **3.3.7 Other Local Events**

#### **3.3.7.1 Sending Language Bar Information PDU**

Upon receiving a notification from the server-side language bar indicating that its status was updated, the server MUST then send the updated status of its language bar to the client using the Language Bar Information PDU. This enables the client to stay in sync with the server.

#### **3.3.7.2 Sending Language Profile Information PDU**

Upon receiving a notification from the client-side text services framework that the current active language profile has changed, the client MUST then send the new active language profile information to the server using the Language Profile Information PDU (section 2.2.2.10.1). This enables the server to stay in sync with the current active language of the client.

Upon receiving this PDU from the client, the server SHOULD change the current server-side active language profile, by using the information sent by the client. This ensures that the server uses the same active language profile as the one being used by the client.

### 3.3.7.3 Sending Compartment Status Information PDU

Upon receiving a notification from the text services framework that the current input method editor (IME) compartments has changed, the client **MUST** then send the new compartment information to the server using the Compartment Status Information PDU (section 2.2.2.10.2). This enables the server to stay in sync with the current compartment mode of the client.

Similarly, the server is also to send the compartment values to the client if it receives a notification from the server's text services framework.

Upon receiving this PDU from the client or server, the IME compartment status is set to the values passed in the PDU.



## 4 Protocol Examples

The following sections describe several operations as used in common scenarios to illustrate the function of the Remote Desktop Protocol: Remote Programs Virtual Channel Extension.

### 4.1 Updates to the RDP Core Protocol

#### 4.1.1 Windowing Alternate Secondary Drawing Orders

##### 4.1.1.1 New or Existing Windows

The following is a network capture of a Window Information Order, sent when a new window is created on the server or when a property on a new or existing window is updated (as specified in 2.2.1.3.1.2.1).

```
00000000 2e 81 00 9e df 08 19 58 01 12 00 00 00 00 00 00 .....X.....
00000010 00 cf 14 00 01 00 00 05 1a 00 46 00 69 00 6c 00 .....F.i.l.
00000020 65 00 20 00 45 00 78 00 70 00 6c 00 6f 00 72 00 e. .E.x.p.l.o.r.
00000030 65 00 72 00 1b 01 00 00 34 01 00 00 07 00 00 00 e.r.....4.....
00000040 07 00 00 00 00 00 00 00 07 00 00 00 8d 00 00 00 .....
00000050 9a 00 00 00 8e 00 00 00 9a 00 00 00 e6 05 00 00 .....
00000060 42 03 00 00 01 00 00 00 00 00 e6 05 42 03 8d 00 B.....B...
00000070 00 00 9a 00 00 00 01 00 00 00 00 00 e6 05 42 03 .....B...

2e -> TS_WINDOW_ORDER_HEADER::Header (1 Byte)
81 00 -> TS_WINDOW_ORDER_HEADER::OrderSize (2 Bytes)
9e df 08 19 -> TS_WINDOW_ORDER_HEADER::FieldsPresentFlags (4 Bytes)
58 01 12 00 -> TS_WINDOW_ORDER_HEADER::WindowId (4 Bytes)
00 00 00 00 -> OwnerWindowId
00 00 cf 14 -> Style
00 01 00 00 -> ExtendedStyle
05 -> ShowState
1a 00 46 00 69 00 6c 00 65 00 20 00 45 00 78 00 70 00 6c 00 6f 00 72 00
65 00 72 00 -> TitleInfo (File Explorer)
1b 01 00 00 -> ClientOffsetX (283)
34 01 00 00 -> ClientOffsetY (308)
07 00 00 00 -> WindowLeftResizeMargin (7)
07 00 00 00 -> WindowRightResizeMargin (7)
00 00 00 00 -> WindowTopResizeMargin (0)
07 00 00 00 -> WindowBottomResizeMargin (7)
8d 00 00 00 -> WindowOffsetX (141)
9a 00 00 00 -> WindowOffsetY (154)
8e 00 00 00 -> WindowClientDeltaX (142)
9a 00 00 00 -> WindowClientDeltaY (154)
e6 05 00 00 -> WindowWidth (1510)
42 03 00 00 -> WindowHeight (834)
01 00 -> NumWindowRects (1)
00 00 00 00 e6 05 42 03 -> WindowRects (0,0,1510,834)
8d 00 00 00 -> VisibleOffsetX (141)
9a 00 00 00 -> VisibleOffsetY (154)
01 00 -> NumVisibilityRects (1)
00 00 00 00 e6 05 42 03 -> VisibilityRects (0,0,1510,834)
```

##### 4.1.1.2 Deleted Window

The following is a network capture of a Window Information Order, sent when an existing window is destroyed on the server (as specified in 2.2.1.3.1.2.4).

```
00000000 2e 0b 00 00 00 00 21 24 00 03 00.....!$...
```

```

2e -> TS_WINDOW_ORDER_HEADER::Header (1 Byte)
0b 00 -> TS_WINDOW_ORDER_HEADER::OrderSize (2 Bytes)
00 00 00 21 -> TS_WINDOW_ORDER_HEADER::FieldsPresentFlags (4 Bytes)
(WINDOW_ORDER_TYPE_WINDOW | WINDOW_ORDER_STATE_DELETED )
24 00 03 00 -> TS_WINDOW_ORDER_HEADER::WindowId (4 Bytes)

```

#### 4.1.1.3 New or Existing Notification Icons

The following is a network capture of a Notification Icon Information Order, sent when a new notification icon is created on the server (as specified in 2.2.1.3.2.2.1).

```

00000000 2e 9d 04 01 00 00 52 8e 00 01 00 d2 9c 00 00 40 .....R.....@
00000010 00 2a 20 0e 20 43 00 6f 00 6d 00 6d 00 75 00 6e .* . C.o.m.m.u.n
00000020 00 69 00 63 00 61 00 74 00 6f 00 72 00 20 00 2d .i.c.a.t.o.r. -
00000030 00 20 00 4e 00 6f 00 74 00 20 00 73 00 69 00 67 . .N.o.t. .s.i.g
00000040 00 6e 00 65 00 64 00 20 00 69 00 6e 00 0e 20 2c .n.e.d. .i.n. ,
00000050 20 00 00 02 20 10 00 10 00 40 00 00 04 fe 03 00 . . . .@.....
00000060 00 fc 01 00 00 fc 01 00 00 c0 01 00 00 80 00 00 .....
00000070 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00000080 00 00 00 00 00 00 00 00 00 00 00 00 00 80 00 00 .....
00000090 00 80 01 00 00 f0 3f 00 00 f8 7f 00 00 00 00 00 .....?.....
000000a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000000b0 00 00 00 00 00 00 00 00 18 36 80 18 1e 38 7f .....6...8.
000000c0 9c 19 35 96 ef 1a 3c b5 fe 1e 3e ad ee 15 34 8c ..5...<...>...4.
000000d0 8d 14 30 77 1b 00 00 00 00 00 00 00 00 00 00 ..0w.....
000000e0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000000f0 00 00 00 00 1c 38 85 17 1a 34 87 c6 17 31 9d .....8...4...1.
00000100 ff 0d 2c af ff 15 39 cd ff 1a 42 e3 ff 22 49 e0 ,,...9...B..."I.
00000110 fc 17 39 a4 c1 13 30 78 1b 00 00 00 00 00 00 ..9...0x.....
.....(more icon data)

2e -> TS_NOTIFYICON_ORDER_HEADER::Header(1 Byte)
9d 04 -> TS_NOTIFYICON_ORDER_HEADER::OrderSize(2 Bytes)
01 00 00 52 -> TS_NOTIFYICON_ORDER_HEADER::FieldsPresentFlags (4 Bytes)
WINDOW_ORDER_TYPE_NOTIFY | WINDOW_ORDER_FIELD_NOTIFY_TIP |
WINDOW_ORDER_STATE_NEW | WINDOW_ORDER_ICON)
8e 00 01 00 -> TS_NOTIFYICON_ORDER_HEADER::WindowId
d2 9c 00 00 -> TS_NOTIFYICON_ORDER_HEADER::NotifyIconId
0000000f 40
00000010 00 57 00 69 00 6e 00 64 00 6f 00 77 00 73 00 20
00000020 00 54 00 61 00 73 00 6b 00 20 00 4d 00 61 00 6e
00000030 00 61 00 67 00 65 00 72 00 00 00 02 10 10 00 10
00000040 00 6e 00 65 00 64 00 20 00 69 00 6e 00 0e 20 2c -> ToolTip (Communicator - Not
signed in )
00000050 20 00 00 02 20 10 00 10 00 40 00 00 04 fe 03 00 . . . .@.....
00000060 00 fc 01 00 00 fc 01 00 00 c0 01 00 00 80 00 00 .....
00000070 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00000080 00 00 00 00 00 00 00 00 00 00 00 00 00 80 00 00 .....
00000090 00 80 01 00 00 f0 3f 00 00 f8 7f 00 00 00 00 00 .....?.....
000000a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000000b0 00 00 00 00 00 00 00 00 18 36 80 18 1e 38 7f .....6...8.
000000c0 9c 19 35 96 ef 1a 3c b5 fe 1e 3e ad ee 15 34 8c ..5...<...>...4.
000000d0 8d 14 30 77 1b 00 00 00 00 00 00 00 00 00 00 ..0w.....
000000e0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
000000f0 00 00 00 00 1c 38 85 17 1a 34 87 c6 17 31 9d .....8...4...1.
00000100 ff 0d 2c af ff 15 39 cd ff 1a 42 e3 ff 22 49 e0 ,,...9...B..."I.
00000110 fc 17 39 a4 c1 13 30 78 1b 00 00 00 00 00 00 ..9...0x..... -> Icon
.....(more icon data)

```

**Note** The icon data is significantly large and accounts for the remainder of the order. For the sake of brevity, the icon information in the remaining bytes of the **orderSize** field has been truncated in this example.

#### 4.1.1.4 Deleted Notification Icons

The following is a network capture of a Notification Icon Information Order, sent when an existing notification icon is deleted on the server (as specified in 2.2.1.3.2.2).

```
00000000 2e 0f 00 01 00 00 62 f4 01 03 00 00 00 00 00 .y....B.....
2e -> TS_NOTIFYICON_ORDER_HEADER::Header(1 Byte)
0f 00 -> TS_NOTIFYICON_ORDER_HEADER::OrderSize(2 Bytes)
01 00 00 62 -> TS_NOTIFYICON_ORDER_HEADER::FieldsPresentFlags (4 Bytes)
    WINDOW_ORDER_TYPE_NOTIFY | WINDOW_ORDER_STATE_DELETED |
    WINDOW_ORDER_FIELD_NOTIFY_TIP | WINDOW_ORDER_ICON)
f4 01 03 00 -> TS_NOTIFYICON_ORDER_HEADER::WindowId
00 00 00 00 -> TS_NOTIFYICON_ORDER_HEADER::NotifyIconId
```

#### 4.1.1.5 Actively Monitored Desktop

The following is a network capture of an Actively Monitored Desktop packet (as specified in 2.2.1.3.3.2.1).

```
00000000 2e 14 00 30 00 00 04 a0 00 01 00 02 a0 00 01 00 ...0.....
2e -> TS_DESKTOP_ORDER_HEADER::Header
14 00 -> TS_DESKTOP_ORDER_HEADER::OrderSize
30 00 00 04 -> TS_DESKTOP_ORDER_HEADER::FieldsPresentFlags (0x4000030)
    (WINDOW_ORDER_TYPE_DESKTOP | WINDOW_ORDER_FIELD_DESKTOP_ZORDER
    WINDOW_ORDER_FIELD_DESKTOP_ACTIVEWND )
a0 00 01 00 -> ActiveWindowId
02 -> NumWindowIds
66 00 02 00
a0 00 01 00 -> WindowIds
```

#### 4.1.1.6 Non-Monitored Desktop

The following is a network capture of a **Non-Monitored Desktop** packet (as specified in 2.2.1.3.3.2.2).

```
00000000 2e 07 00 01 00 00 04 .....@.....
2e -> TS_DESKTOP_ORDER_HEADER::Header
07 00 -> TS_DESKTOP_ORDER_HEADER::OrderSize
01 00 00 04 -> TS_DESKTOP_ORDER_HEADER::FieldsPresentFlags
    (WINDOW_ORDER_TYPE_DESKTOP | WINDOW_ORDER_FIELD_DESKTOP_NONE)
```

## 4.2 Initialization Messages

### 4.2.1 TS\_RAIL\_ORDER\_HANDSHAKE

The following are network captures of the Handshake PDU (TS\_RAIL\_ORDER\_HANDSHAKE, as specified in 2.2.2.2.1).

## Server to Client

```
00000000 05 00 08 00 71 17 00 00          ....q...
05 00 -> TS_RAIL_PDU_HEADER::orderType = TS_RAIL_ORDER_HANDSHAKE (5) (2 Bytes)
08 00 -> TS_RAIL_PDU_HEADER::orderLength  = 8                      (2 Bytes)
71 17 00 00 -> buildNumber                                (4 Bytes)
```

## Client to Server

```
00000000 05 00 08 00 71 17 00 00          ....q...
05 00 -> TS_RAIL_PDU_HEADER::orderType = TS_RAIL_ORDER_HANDSHAKE (5) (2 Bytes)
08 00 -> TS_RAIL_PDU_HEADER::orderLength  = 8                      (2 Bytes)
71 17 00 00 -> buildNumber                                (4 Bytes)
```

### 4.2.2 TS\_RAIL\_ORDER\_CLIENTSTATUS

The following is a network capture of the Client Caps PDU (TS\_RAIL\_ORDER\_CLIENTSTATUS, as specified in 2.2.2.2.2).

```
00000000 0b 00 08 00 01 00 00 00          .....
0b 00 -> TS_RAIL_PDU_HEADER::orderType = TS_RAIL_ORDER_CLIENTSTATUS (11) (2 Bytes)
08 00 -> TS_RAIL_PDU_HEADER::orderLength  = 8                      (2 Bytes)
01 00 00 00 -> Flags                                (4 Bytes)
```

## 4.3 Launching Messages

### 4.3.1 TS\_RAIL\_ORDER\_EXEC

The following is a network capture of the Client Execute PDU (TS\_RAIL\_ORDER\_EXEC, as specified in 2.2.2.3.1).

```
00000000 01 00 5e 00 08 00 14 00 26 00 18 00 7c 00 7c 00 ..^.....&...|.
00000010 69 00 65 00 78 00 70 00 6c 00 6f 00 72 00 65 00 i.e.x.p.l.o.r.e.
00000020 66 00 3a 00 5c 00 77 00 69 00 6e 00 64 00 6f 00 f...\w.i.n.d.o.
00000030 77 00 73 00 5c 00 73 00 79 00 73 00 74 00 65 00 w.s.\s.y.s.t.e.
00000040 6d 00 33 00 32 00 77 00 77 00 77 00 2e 00 62 00 m.3.2.w.w...b.
00000050 69 00 6e 00 67 00 2e 00 63 00 6f 00 6d 00 00 00 i.n.g...c.o.m...

Header:
01 00 -> TS_RAIL_PDU_HEADER::orderType = TS_RAIL_ORDER_EXEC (1) (2 Bytes)
5e 00 -> TS_RAIL_PDU_HEADER::orderLength  = 94                      (2 Bytes)
08 00 -> Flags                          : TS_RAIL_EXEC_FLAG_EXPAND_ARGUMENTS (2 Bytes)
14 00 -> ExeOrFileLength   : 0x14                      (2 Bytes)
26 00 -> WorkingDirLength  : 0x26                      (2 Bytes)
18 00 -> ArgumentsLen     : 0x18                      (2 Bytes)
7c 00 7c 00 69 00 65 00 78 00 70 00 6c 00 6f 00 72 00 65 00 -> ExeOrFile : ||iexplore (20
Bytes)
66 00 3a 00 5c 00 77 00 69 00 6e 00 64 00 6f 00 77 00 73 00 5c 00 73 00 79 00 73 00 74 00 65
00 6d 00 33 00 32 00 -> WorkingDir: f:\windows\system32 (38 bytes)
77 00 77 00 77 00 2e 00 62 00 69 00 6e 00 67 00 2e 00 63 00 6f 00 6d 00 -> Arguments (24
bytes)
```

### 4.3.2 TS\_RAIL\_ORDER\_EXEC\_RESULT

The following is a network capture of the Server Execute Result PDU (TS\_RAIL\_ORDER\_EXEC\_RESULT, as specified in 2.2.2.3.2).

```
00000000 80 00 24 00 08 00 03 00 15 00 00 00 00 14 00 ..$.~.....
00000010 7c 00 7c 00 57 00 72 00 6f 00 6e 00 67 00 41 00 |.|.W.r.o.n.g.A.
00000020 70 00 70 00                                     p.p.

80 00 -> TS_RAIL_PDU_HEADER::orderType = TS_RAIL_ORDER_EXEC_RESULT(128) (2 Bytes)
24 00 -> TS_RAIL_PDU_HEADER::orderLength = 36 (2 Bytes)
08 00 -> Flags : TS_RAIL_EXEC_FLAG_EXPAND_ARGUMENTS (2 Bytes)
03 00 -> ExecResult : 3 (2 Bytes)
15 00 00 00 -> RawResult : 0x15 (4 Bytes)
00 00 -> Padding : 0 (2 Bytes)
14 00 -> ExeOrFileLength : 0x14 (2 Bytes)
7c 00 7c 00 57 00 72 00 6f 00 6e 00 67 00 41 00
70 00 70 00 : ExeOrFile : ||WrongApp (20 Bytes)
```

## 4.4 Local Client System Parameters Update Messages

### 4.4.1 TS\_RAIL\_ORDER\_SYSPARAM

The following are network captures of the Client System Parameters Update PDU (TS\_RAIL\_ORDER\_SYSPARAM, as specified in 2.2.2.4.1).

```
00000000 03 00 12 00 43 00 00 00 7e 00 00 00 02 00 00 00 ....C...~.....
00000010 00 00 ..

03 00 -> TS_RAIL_PDU_HEADER::orderType = TS_RAIL_ORDER_SYSPARAM(3) (2 Bytes)
12 00 -> TS_RAIL_PDU_HEADER::orderLength = 18 (2 Bytes)
43 00 00 00 -> SystemParam: SPI_SETHIGHCONTRAST (4 Bytes)
7e 00 00 00 -> TS_HIGHCONTRAST::Flags: 0x7e (4 Bytes)
02 00 00 00 -> TS_HIGHCONTRAST::ColorSchemeLength: 2 (4 Bytes)
00 00 -> TS_HIGHCONTRAST::ColorScheme: 0 (2 Bytes)
```

## 4.5 Local Client Event Messages

### 4.5.1 TS\_RAIL\_ORDER\_ACTIVATE

The following is a network capture of the Client Activate PDU (TS\_RAIL\_ORDER\_ACTIVATE, as specified in 2.2.2.6.1).

```
00000000 02 00 09 00 4e 01 01 00 01 ....N....

02 00 -> TS_RAIL_PDU_HEADER::orderType = TS_RAIL_ORDER_ACTIVATE(2) (2 Bytes)
09 00 -> TS_RAIL_PDU_HEADER::orderLength = 9 (2 Bytes)
4e 01 01 00 -> WindowId: 0x1014e (4 Bytes)
01 -> Enabled (1 Byte)
```

### 4.5.2 TS\_RAIL\_ORDER\_SYSMENU

The following is a network capture of the Client System Menu PDU (TS\_RAIL\_ORDER\_SYSMENU, as specified in 2.2.2.6.2).

```

00000000 0c 00 0c 00 22 01 09 00 a4 ff 4a 02          ....".....J.

0c 00 -> TS_RAIL_PDU_HEADER::orderType = TS_RAIL_ORDER_SYSMENU(12) (2 Bytes)
0c 00 -> TS_RAIL_PDU_HEADER::orderLength = 12 (2 Bytes)
22 01 09 00 -> WindowId:: 0x90122 (4 Bytes)
a4 ff -> Left (2 Bytes)
4a 02 -> Top (2 Bytes)

```

### 4.5.3 TS\_RAIL\_ORDER\_SYSCOMMAND

The following is a network capture of the Client System Command PDU (TS\_RAIL\_ORDER\_SYSCOMMAND, as specified in 2.2.2.6.3).

```

00000000 04 00 0a 00 52 00 02 00 20 f0          ....R...

04 00 -> TS_RAIL_PDU_HEADER::orderType = TS_RAIL_ORDER_SYSCOMMAND(4) (2 Bytes)
0a 00 -> TS_RAIL_PDU_HEADER::orderLength = 10 (2 Bytes)
52 00 02 00 -> WindowId:: 0x20052 (4 Bytes)
20 f0 -> Command (2 Bytes)

```

### 4.5.4 TS\_RAIL\_ORDER\_NOTIFY\_EVENT

The following is a network capture of the Client Notify Event PDU (TS\_RAIL\_ORDER\_NOTIFY\_EVENT, as specified in 2.2.2.6.4).

```

00000000 06 00 10 00 aa 01 02 00 02 00 00 00 04 02 00 00 .....

06 00 -> TS_RAIL_PDU_HEADER::orderType = TS_RAIL_ORDER_NOTIFY_EVENT(6) (2 Bytes)
10 00 -> TS_RAIL_PDU_HEADER::orderLength = 16 (2 Bytes)
aa 01 02 00 -> WindowId (4 Bytes)
02 00 00 00 -> NotifyIconId (4 Bytes)
04 02 00 00 -> Message (4 Bytes)

```

### 4.5.5 TS\_RAIL\_ORDER\_LANGBARINFO

The following is a network capture of the Language Bar Information PDU (TS\_RAIL\_ORDER\_LANGBARINFO, as specified in 2.2.2.9.1).

```

0d 00 -> TS_RAIL_PDU_HEADER::orderType = TS_RAIL_ORDER_LANGBARINFO (13) (2 Bytes)
08 00 -> TS_RAIL_PDU_HEADER::orderLength = 8 (2 Bytes)
01 00 00 00 -> LanguageBarStatus:: 0x00000001 (4 Bytes)

```

### 4.5.6 TS\_RAIL\_ORDER\_GET\_APPID\_REQ

The following is a network capture of the Client Get Application ID PDU (TS\_RAIL\_ORDER\_GET\_APPID\_REQ, as specified in section 2.2.2.6.5).

```

00000000 0e 00 08 00 52 00 02 00          ....R...

0e 00 -> TS_RAIL_PDU_HEADER::orderType = TS_RAIL_ORDER_GET_APPID_REQ (14) (2 Bytes)
08 00 -> TS_RAIL_PDU_HEADER::orderLength = 8 (2 Bytes)
52 00 02 00 -> WindowId:: 0x20052 (4 Bytes)

```

## 4.5.7 TS\_RAIL\_ORDER\_GET\_APPID\_RESP

The following is a network capture of the Server Get Application ID Response PDU (TS\_RAIL\_ORDER\_GET\_APPID\_RESP, as specified in section 2.2.2.8.1).

```
00000000 0F 00 08 02 52 00 02 00 6d 00 69 00 63 00 72 00 ....R...m.i.c.r.
00000010 6f 00 73 00 6f 00 66 00 74 00 2e 00 77 00 69 00 o.s.o.f.t...w.i.
00000020 6e 00 64 00 6f 00 77 00 73 00 2e 00 6e 00 6f 00 n.d.o.w.s...n.o.
00000030 74 00 65 00 70 00 61 00 64 00 00 00 00 00 00 00 t.e.p.a.d.....
                                00000040 00 ...
00000200 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....

0F 00 -> TS_RAIL_PDU_HEADER::orderType = TS_RAIL_ORDER_GET_APPID_RESP (15) (2 Bytes)
08 02 -> TS_RAIL_PDU_HEADER::orderLength = 520 (2 Bytes)
52 00 02 00 -> WindowId:: 0x20052 (4 Bytes)
6d 00 69 00 63 00 72 00 6f 00 73 00 6f 00 66 00 74 00 2e 00 77 00 69 00 6e 00 64 00
6f 00 77 00 73 00 2e 00 6e 00 6f 00 74 00 65 00 70 00 61 00 64 00 00 ... -> ApplicationId::
microsoft.windows.notepad (512 Bytes)
```

## 4.6 Window Move Messages

### 4.6.1 TS\_RAIL\_ORDER\_WINDOWMOVE

The following is a network capture of the Client Window Move PDU (TS\_RAIL\_ORDER\_WINDOWMOVE, as specified in 2.2.2.7.4).

```
00000000 08 00 10 00 20 00 02 00 09 03 00 01 db 05 88 01 ....

08 00 -> TS_RAIL_PDU_HEADER::orderType = TS_RAIL_ORDER_WINDOWMOVE (8) (2 Bytes)
10 00 -> TS_RAIL_PDU_HEADER::orderLength = 16 (2 Bytes)
20 00 02 00 -> WindowId (4 Bytes)
09 03 -> Left (2 Bytes)
00 01 -> Top (2 Bytes)
db 05 -> Right (2 Bytes)
88 01 -> Bottom (2 Bytes)
```

### 4.6.2 TS\_RAIL\_ORDER\_LOCALMOVESIZE

The following is a network capture of the Server Move/Size Start PDU (TS\_RAIL\_ORDER\_LOCALMOVESIZE, as specified in 2.2.2.7.2).

```
00000000 09 00 10 00 94 00 01 00 01 00 08 00 2c 05 e9 03 .....

09 00 -> TS_RAIL_PDU_HEADER::orderType = TS_RAIL_ORDER_LOCALMOVESIZE (9) (2 Bytes)
10 00 -> TS_RAIL_PDU_HEADER::orderLength = 16 (2 Bytes)
94 00 01 00 -> WindowId (4 Bytes)
01 00 -> IsMoveSizeStart (2 Bytes)
08 00 -> MoveSizeType (2 Bytes)
2c 05 -> PosX (2 Bytes)
e9 03 -> PosY (2 Bytes)
```

### 4.6.3 TS\_RAIL\_ORDER\_MINMAXINFO

The following is a network capture of the Server Min Max Info PDU (TS\_RAIL\_ORDER\_MINMAXINFO, as specified in 2.2.2.7.1).

```
*00000000 0a 00 18 00 94 00 01 00 48 06 b8 04 00 00 00 00 .....H.....
*00000010 70 00 1b 00 4c 06 bc 04                               p...L...

0a 00 -> TS_RAIL_PDU_HEADER::orderType = TS_RAIL_ORDER_MINMAXINFO(10) (2 Bytes)
18 00 -> TS_RAIL_PDU_HEADER::orderLength = 24 (2 Bytes)
94 00 01 00 -> WindowId (4 Bytes)
48 06 -> MaxWidth (2 Bytes)
b8 04 -> MaxHeight (2 Bytes)
00 00 -> MaxPosX (2 Bytes)
00 00 -> MaxPosY (2 Bytes)
70 00 -> MinTrackWidth (2 Bytes)
1b 00 -> MinTrackHeight (2 Bytes)
4c 06 -> MaxTrackWidth (2 Bytes)
bc 04 -> MaxTrackHeight (2 Bytes)
```

## 4.7 Z-Order Sync Messages

### 4.7.1 TS\_RAIL\_ORDER\_ZORDER\_SYNC

The following is a network capture of the Server Z-Order Sync Information PDU (TS\_RAIL\_ORDER\_ZORDER\_SYNC, as specified in section 2.2.2.11.1).

```
14 00 -> TS_RAIL_PDU_HEADER::orderType = TS_RAIL_ORDER_ZORDER_SYNC (20) (2 Bytes)
08 00 -> TS_RAIL_PDU_HEADER::orderLength = 8 (2 Bytes)
10 05 40 00 -> WindowIdMarker (4 Bytes)
```

## 4.8 Power Display Request Messages

### 4.8.1 TS\_RAIL\_ORDER\_POWER\_DISPLAY\_REQUEST

The following is a network capture of the Server Power Display Request PDU (TS\_RAIL\_ORDER\_POWER\_DISPLAY\_REQUEST, as specified in section 2.2.2.13.1).

```
16 00 -> TS_RAIL_PDU_HEADER::orderType = TS_RAIL_ORDER_POWER_DISPLAY_REQUEST (22) (2 Bytes)
08 00 -> TS_RAIL_PDU_HEADER::orderLength = 8 (2 Bytes)
01 00 00 00 -> Active:: 0x00000001 (4 Bytes)
```



## 5 Security

The following sections specify security considerations for implementers of the Remote Desktop Protocol: Remote Programs Virtual Channel Extension.

### 5.1 Security Considerations for Implementers

There are no security considerations for Remote Desktop Protocol: Remote Programs Virtual Channel Extension messages because all traffic is secured by the underlying Remote Desktop Protocol core protocol. For an overview of the implemented security-related mechanisms, see [MS-RDPBCGR] section 5.

### 5.2 Index of Security Parameters

There are no security parameters in the Remote Desktop Protocol: Remote Programs Virtual Channel Extension.

## 6 (Updated Section) Appendix A: Product Behavior

The information in this specification is applicable to the following Microsoft products or supplemental software. References to product versions include updates to those products.

- Windows Vista operating system
- Windows Server 2008 operating system
- Windows 7 operating system
- Windows Server 2008 R2 operating system
- Windows 8 operating system
- Windows Server 2012 operating system
- Windows 8.1 operating system
- Windows Server 2012 R2 operating system
- Windows 10 operating system
- Windows Server 2016 operating system
- Windows Server operating system
- Windows Server 2019 operating system
- Windows Server 2022 operating system
- Windows 11 operating system

### ▪ Windows Server 2025 operating system

Exceptions, if any, are noted in this section. If an update version, service pack or Knowledge Base (KB) number appears with a product name, the behavior changed in that update. The new behavior also applies to subsequent updates 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 2.2.1.1.1: Microsoft implementations set TS\_RAIL\_LEVEL\_SUPPORTED to 1 in the following versions of Windows: Windows Server 2008, Windows Server 2008 R2 operating system, Windows Server 2012, Windows 7 Enterprise, Windows 7 Enterprise N, Windows 7 Ultimate, Windows 7 Ultimate N, and Windows 8.

Microsoft implementations set TS\_RAIL\_LEVEL\_DOCKED\_LANGBAR\_SUPPORTED to 1 in the following versions of Windows: Windows Server 2008 R2, Windows Server 2012, Windows 7 Enterprise, Windows 7 Enterprise N, Windows 7 Ultimate, Windows 7 Ultimate N, and Windows 8.

Microsoft implementations set TS\_RAIL\_LEVEL\_SUPPORTED to 0 on other versions when that capability is sent and the server does not support Remote Programs.

<2> Section 2.2.1.1.2: Windows sends the TS\_WINDOW\_LEVEL\_SUPPORTED\_EX value to the client; only Windows Vista and Windows Server 2008 send the TS\_WINDOW\_LEVEL\_SUPPORTED value to the client.

- <3> Section 2.2.1.3.1.2.1: Windows does not set this flag in any server implementation.
- <4> Section 2.2.1.3.1.2.1: Windows does not set this flag in any server implementation.
- <5> Section 2.2.1.3.1.2.1: Windows does not set this flag in any server implementation.
- <6> Section 2.2.1.3.1.2.1: Only Windows Vista, Windows Server 2008, Windows 7, and Windows Server 2008 R2 distinguish between window offsets and window visible region offsets. This means that for those products **VisibleOffsetX** is not guaranteed to be equal to **WindowOffsetX**.
- <7> Section 2.2.1.3.1.2.1: Only Windows Vista, Windows Server 2008, Windows 7, and Windows Server 2008 R2 distinguish between window offsets and window visible region offsets. This means that for those products **VisibleOffsetY** is not guaranteed to be equal to **WindowOffsetY**.
- <8> Section 2.2.1.3.1.2.2: Windows applications display large icons in elements such as the Alt-Tab dialog box and on the desktop, and place small icons in elements such as the window's title bar and taskbar buttons.
- <9> Section 2.2.1.3.1.2.3: Windows applications display large icons in elements such as the Alt-Tab dialog box and on the desktop, and place small icons in elements such as the window's title bar and taskbar buttons.
- <10> Section 2.2.1.3.2.2.1: The WINDOW\_ORDER\_CACHED\_ICON flag is not set in Windows 7, Windows Server 2008 R2, Windows 8, and Windows Server 2012 implementations.
- <11> Section 2.2.1.3.2.2.3: Microsoft implementations set minimum value to 10000 (10 seconds) and the maximum value to 30000 (30 seconds).
- <12> Section 2.2.2.3.1: The length of the **ArgumentsLen** field is set to a maximum of 16,000 bytes, except in Windows Vista and Windows Server 2008 R2 where the maximum is set to 520 bytes.
- <13> Section 2.2.2.3.2: This contains a Win32 error code. For more information, see [MS-ERREF].
- <14> Section 2.2.2.4.2: Sets the High-Contrast parameters using the Win32 API. For more information, see [MSDN-HIGHCONTRAST].
- <15> Section 2.2.2.4.2: Uses the Windows-specific name of the color scheme.
- <16> Section 2.2.2.5.1: This system parameter is supported in Windows. For more information, see ([MSDN-SysParamsInfo]).
- <17> Section 2.2.2.6.5: Only Windows Vista and Windows Server 2008 do not use the Application ID string to identify and group windows.
- <18> Section 2.2.2.8.1: Only Windows Vista and Windows Server 2008 do not use the Application ID string to identify and group windows.
- <19> Section 2.2.2.8.2: Only Windows Vista and Windows Server 2008 do not use the Application ID string to identify and group windows.
- <20> Section 2.2.2.9.1: This option is not available on Windows Vista and Windows Server 2008.
- <21> Section 2.2.2.9.1: This option is not available on Windows Vista and Windows Server 2008.
- <22> Section 2.2.2.9.1: This option is available on Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, Windows Server 2016, and Windows Server 2019 only.
- <23> Section 2.2.2.9.1: This option is available on Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, Windows Server 2016, and Windows Server 2019 only.
- <24> Section 3.1.2: Microsoft implementations use 30 seconds as the time-out value.

<25> Section 3.1.5.2: Windows implementations ignore any incompatibility resulting from checking the **buildNumber** field between the sender and the receiver.

<26> Section 3.2.5.1.1: Windows implementations use RAIL as the name of the virtual channel.

<27> Section 3.2.5.1.6: Windows 10 v1607 operating system, Windows Server 2016, Windows 10 v1703 operating system, Windows 10 v1709 operating system, Windows 10 v1803 operating system, Windows 10 v1809 operating system, Windows Server 2019, and Windows 10 v1903 operating system only send transparent hit-testable margins for resizable windows.

<28> Section 3.2.5.2.1.2: Windows implementations ignore any incompatibility resulting from checking the **buildNumber** field between the sender and the receiver.

<29> Section 3.2.5.2.8.2: Only Windows Vista and Windows Server 2008 do not use the Application ID string to identify and group windows.

<30> Section 3.2.5.2.8.3: Only Windows Vista and Windows Server 2008 do not use the Application ID string to identify and group windows.

<31> Section 3.3.5.1.5: In Windows implementations the **NumIconCaches** and **NumCacheEntries** fields for each cache are set to 0 if the values in the Windows List Capability Sets exceed the corresponding entries set in the server cache.

<32> Section 3.3.5.2.7.1: Only Windows Vista and Windows Server 2008 do not use the Application ID string to identify and group windows.