

## [MS-RDPEI]:

# Remote Desktop Protocol: Input 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).

## Revision Summary

| Date       | Revision History | Revision Class | Comments   |
|------------|------------------|----------------|--|
| 12/16/2011 | 1.0              | New            | Released new document.   |
| 3/30/2012  | 1.0              | None           | No changes to the meaning, language, or formatting of the technical content. |
| 7/12/2012  | 2.0              | Major          | Significantly changed the technical content.                                 |
| 10/25/2012 | 3.0              | Major          | Significantly changed the technical content.                                 |
| 1/31/2013  | 3.0              | None           | No changes to the meaning, language, or formatting of the technical content. |
| 8/8/2013   | 3.1              | Minor          | Clarified the meaning of the technical content.                              |
| 11/14/2013 | 4.0              | Major          | Significantly changed the technical content.                                 |
| 2/13/2014  | 4.0              | None           | No changes to the meaning, language, or formatting of the technical content. |
| 5/15/2014  | 4.0              | None           | No changes to the meaning, language, or formatting of the technical content. |
| 6/30/2015  | 5.0              | Major          | Significantly changed the technical content.                                 |
| 10/16/2015 | 5.0              | None           | No changes to the meaning, language, or formatting of the technical content. |
| 7/14/2016  | 5.0              | None           | No changes to the meaning, language, or formatting of the technical content. |
| 6/1/2017   | 5.0              | None           | No changes to the meaning, language, or formatting of the technical content. |

# Table of Contents

|             |  |           |
|-------------|--|-----------|
| <b>1</b>    | <b>Introduction .....</b>                            | <b>5</b>  |
| 1.1         | Glossary .....                                       | 5         |
| 1.2         | References .....                                     | 5         |
| 1.2.1       | Normative References .....                           | 5         |
| 1.2.2       | Informative References .....                         | 5         |
| 1.3         | Overview .....                                       | 6         |
| 1.4         | Relationship to Other Protocols .....                | 7         |
| 1.5         | Prerequisites/Preconditions .....                    | 7         |
| 1.6         | Applicability Statement .....                        | 7         |
| 1.7         | Versioning and Capability Negotiation .....          | 7         |
| 1.8         | Vendor-Extensible Fields .....                       | 7         |
| 1.9         | Standards Assignments.....                           | 7         |
| <b>2</b>    | <b>Messages.....</b>                                 | <b>8</b>  |
| 2.1         | Transport .....                                      | 8         |
| 2.2         | Message Syntax .....                                 | 8         |
| 2.2.1       | Namespaces .....                                     | 8         |
| 2.2.2       | Common Data Types.....                               | 8         |
| 2.2.2.1     | TWO_BYTE_UNSIGNED_INTEGER .....                      | 8         |
| 2.2.2.2     | TWO_BYTE_SIGNED_INTEGER.....                         | 8         |
| 2.2.2.3     | FOUR_BYTE_UNSIGNED_INTEGER .....                     | 9         |
| 2.2.2.4     | FOUR_BYTE_SIGNED_INTEGER .....                       | 10        |
| 2.2.2.5     | EIGHT_BYTE_UNSIGNED_INTEGER .....                    | 11        |
| 2.2.2.6     | RDPINPUT_HEADER.....                                 | 12        |
| 2.2.3       | Input Messages .....                                 | 13        |
| 2.2.3.1     | RDPINPUT_SC_READY_PDU .....                          | 13        |
| 2.2.3.2     | RDPINPUT_CS_READY_PDU .....                          | 14        |
| 2.2.3.3     | RDPINPUT_TOUCH_EVENT_PDU.....                        | 15        |
| 2.2.3.3.1   | RDPINPUT_TOUCH_FRAME .....                           | 15        |
| 2.2.3.3.1.1 | RDPINPUT_TOUCH_CONTACT .....                         | 16        |
| 2.2.3.4     | RDPINPUT_SUSPEND_INPUT_PDU.....                      | 19        |
| 2.2.3.5     | RDPINPUT_RESUME_INPUT_PDU .....                      | 19        |
| 2.2.3.6     | RDPINPUT_DISMISS_HOVERING_TOUCH_CONTACT_PDU .....    | 19        |
| 2.2.3.7     | RDPINPUT_PEN_EVENT_PDU .....                         | 20        |
| 2.2.3.7.1   | RDPINPUT_PEN_FRAME.....                              | 20        |
| 2.2.3.7.1.1 | RDPINPUT_PEN_CONTACT .....                           | 21        |
| 2.3         | Directory Service Schema Elements .....              | 24        |
| <b>3</b>    | <b>Protocol Details .....</b>                        | <b>25</b> |
| 3.1         | Common Details .....                                 | 25        |
| 3.1.1       | Abstract Data Model.....                             | 25        |
| 3.1.1.1     | Touch Contact State Transitions.....                 | 25        |
| 3.1.2       | Timers .....   | 26        |
| 3.1.3       | Initialization .....                                 | 26        |
| 3.1.4       | Higher-Layer Triggered Events .....                  | 26        |
| 3.1.5       | Message Processing Events and Sequencing Rules ..... | 26        |
| 3.1.5.1     | Processing an Input Message.....                     | 26        |
| 3.1.6       | Timer Events.....                                    | 26        |
| 3.1.7       | Other Local Events.....                              | 26        |
| 3.2         | Server Details.....                                  | 26        |
| 3.2.1       | Abstract Data Model.....                             | 26        |
| 3.2.2       | Timers .....   | 26        |
| 3.2.3       | Initialization .....                                 | 27        |
| 3.2.4       | Higher-Layer Triggered Events .....                  | 27        |
| 3.2.5       | Message Processing Events and Sequencing Rules ..... | 27        |

|          |  |           |
|----------|--|-----------|
| 3.2.5.1  | Sending an RDPINPUT_SC_READY_PDU Message .....                             | 27        |
| 3.2.5.2  | Processing an RDPINPUT_CS_READY_PDU Message .....                          | 27        |
| 3.2.5.3  | Processing an RDPINPUT_TOUCH_EVENT_PDU Message .....                       | 27        |
| 3.2.5.4  | Sending an RDPINPUT_SUSPEND_INPUT_PDU message.....                         | 27        |
| 3.2.5.5  | Sending an RDPINPUT_RESUME_INPUT_PDU Message.....                          | 28        |
| 3.2.5.6  | Processing an RDPINPUT_DISMISS_HOVERING_TOUCH_CONTACT_PDU<br>Message ..... | 28        |
| 3.2.5.7  | Processing an RDPINPUT_PEN_EVENT_PDU Message .....                         | 28        |
| 3.2.6    | Timer Events.....  | 28        |
| 3.2.7    | Other Local Events.....  | 28        |
| 3.3      | Client Details .....   | 28        |
| 3.3.1    | Abstract Data Model.....   | 28        |
| 3.3.1.1  | Input Transmission Suspended .....   | 29        |
| 3.3.1.2  | Pen Input Allowed .....  | 29        |
| 3.3.2    | Timers .....   | 29        |
| 3.3.3    | Initialization.....  | 29        |
| 3.3.4    | Higher-Layer Triggered Events .....  | 29        |
| 3.3.5    | Message Processing Events and Sequencing Rules .....                       | 29        |
| 3.3.5.1  | Processing an RDPINPUT_SC_READY_PDU message .....                          | 29        |
| 3.3.5.2  | Sending an RDPINPUT_CS_READY_PDU message .....                             | 29        |
| 3.3.5.3  | Sending an RDPINPUT_TOUCH_EVENT_PDU message.....                           | 30        |
| 3.3.5.4  | Processing an RDPINPUT_SUSPEND_INPUT_PDU message .....                     | 30        |
| 3.3.5.5  | Processing an RDPINPUT_RESUME_INPUT_PDU message.....                       | 30        |
| 3.3.5.6  | Sending an RDPINPUT_DISMISS_HOVERING_TOUCH_CONTACT_PDU message<br>.....    | 30        |
| 3.3.5.7  | Sending an RDPINPUT_PEN_EVENT_PDU message .....                            | 30        |
| 3.3.6    | Timer Events.....  | 31        |
| 3.3.7    | Other Local Events.....  | 31        |
| <b>4</b> | <b>Protocol Examples .....</b>   | <b>32</b> |
| 4.1      | Touch Contact Geometry Examples .....                                      | 32        |
| 4.1.1    | Touch Contact Oriented at 0 Degrees .....                                  | 32        |
| 4.1.2    | Touch Contact Oriented at 45 Degrees .....                                 | 33        |
| 4.1.3    | Touch Contact Oriented at 90 Degrees .....                                 | 33        |
| 4.1.4    | Touch Contact Oriented at 315 Degrees .....                                | 34        |
| <b>5</b> | <b>Security.....</b>   | <b>35</b> |
| 5.1      | Security Considerations for Implementers .....                             | 35        |
| 5.2      | Index of Security Parameters .....   | 35        |
| <b>6</b> | <b>Appendix A: Product Behavior .....</b>                                  | <b>36</b> |
| <b>7</b> | <b>Change Tracking.....</b>  | <b>37</b> |
| <b>8</b> | <b>Index.....</b>  | <b>38</b> |

# 1 Introduction

The Remote Desktop Protocol: Input Virtual Channel Extension applies to the Remote Desktop Protocol: Basic Connectivity and Graphics Remoting, as specified in [MS-RDPBCGR] sections 1 to 5. The input protocol defined in section 2.2 is used to remote multitouch and pen input from a **terminal server** client to a terminal server. The multitouch and pen input is generated at the client by a physical or virtual digitizer, encoded, and then sent on the wire to the server. After this input is received and decoded by the server, it is injected into the session associated with the remote user, effectively remoting the multitouch and pen input generated at the client.

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:

**ANSI character:** An 8-bit Windows-1252 character set unit.

**little-endian:** Multiple-byte values that are byte-ordered with the least significant byte stored in the memory location with the lowest address.

**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.

**terminal server:** A computer on which terminal services is running.

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

## 1.2 References

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

### 1.2.1 Normative References

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

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

[MS-RDPEDYC] Microsoft Corporation, "[Remote Desktop Protocol: Dynamic Channel Virtual Channel Extension](#)".

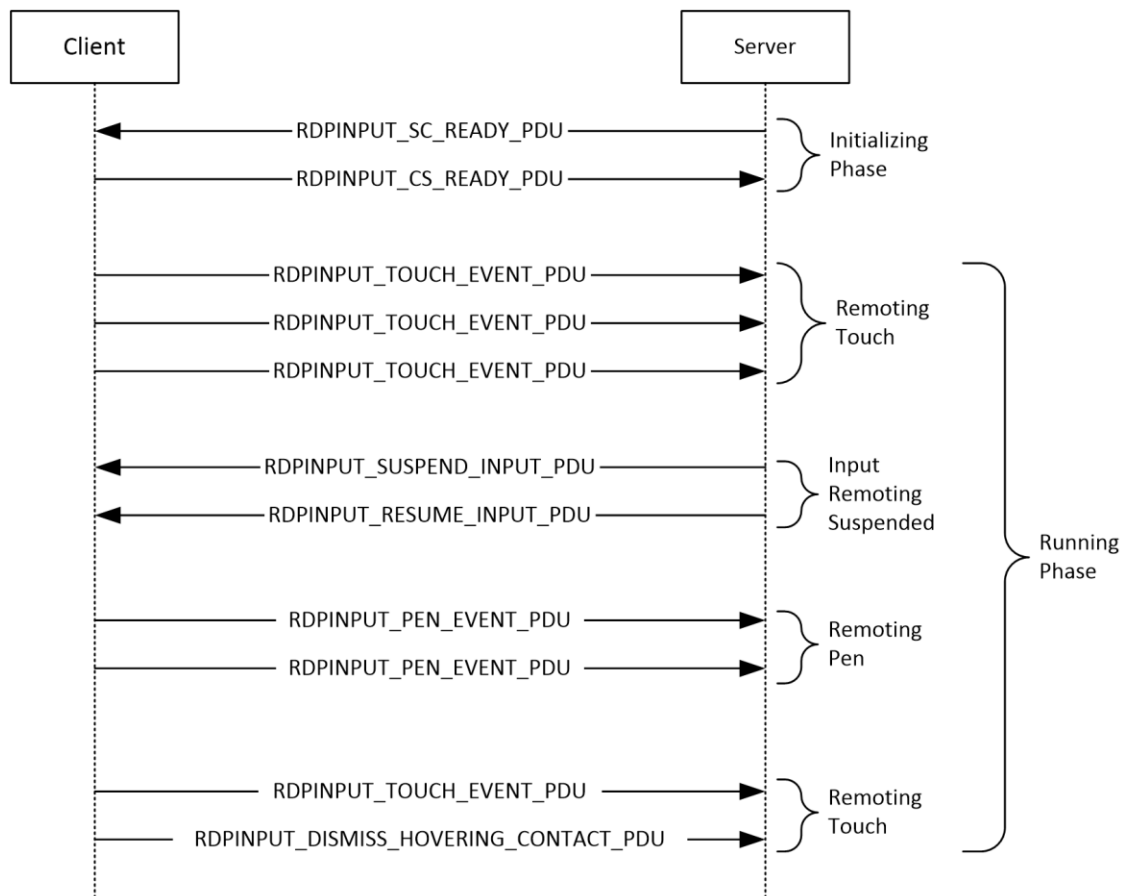
[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997, <http://www.rfc-editor.org/rfc/rfc2119.txt>

### 1.2.2 Informative References

None.

### 1.3 Overview

An example message flow encapsulating all of the Input Messages, described in section 2.2.3, and protocol phases is presented in the following figure.



**Figure 1: Messages exchanged by the input protocol endpoints**

The input protocol is divided into two distinct phases:

- Initializing Phase
- Running Phase

The Initializing Phase occurs at the start of the connection. During this phase, the server and client exchange the [RDPINPUT\\_SC\\_READY\\_PDU \(section 2.2.3.1\)](#) and [RDPINPUT\\_CS\\_READY\\_PDU \(section 2.2.3.2\)](#) messages. The server initiates this exchange when the dynamic virtual channel (sections 1.4 and 2.1) over which the input messages will flow has been opened.

Once both endpoints are ready, the Running Phase is entered. During this phase, the client sends touch or pen frames to the server encapsulated in the [RDPINPUT\\_TOUCH\\_EVENT\\_PDU \(section 2.2.3.3\)](#) or [RDPINPUT\\_PEN\\_EVENT\\_PDU \(section 2.2.3.7\)](#) message. The server decodes these frames and injects them into the user's session.

During the Running Phase, the server can request that the client suspend the transmission of input messages by sending the [RDPINPUT\\_SUSPEND\\_INPUT\\_PDU \(section 2.2.3.4\)](#) message to the client. To request that the client resume the transmission of input messages, the server can send the [RDPINPUT\\_RESUME\\_INPUT\\_PDU \(section 2.2.3.5\)](#) message to the client.

To transition touch contacts in the "hovering" state to the "out of range" state (section [3.1.1.1](#)), the client can send the [RDPINPUT\\_DISMISS\\_HOVERING\\_TOUCH\\_CONTACT\\_PDU \(section 2.2.3.6\)](#) message to the server. This message effectively allows individual contacts (in the hovering state) to be transitioned to the out of range state without requiring the construction and transmission of a touch frame from client to server. If the contact specified in the **RDPINPUT\_DISMISS\_HOVERING\_TOUCH\_CONTACT\_PDU** message does not exist on the server, then the message is simply ignored.

#### **1.4 Relationship to Other Protocols**

The Remote Desktop Protocol: Input Virtual Channel Extension is embedded in a dynamic virtual channel transport, as specified in [\[MS-RDPEDYC\]](#) sections 1 to 3.

#### **1.5 Prerequisites/Preconditions**

The Remote Desktop Protocol: Input Virtual Channel Extension operates only after the dynamic virtual channel transport is fully established. If the dynamic virtual channel transport is terminated, the Remote Desktop Protocol: Input Virtual Channel Extension is also terminated. The protocol is terminated by closing the underlying virtual channel. For details about closing the dynamic virtual channel, see [\[MS-RDPEDYC\]](#) section 3.2.5.2.

#### **1.6 Applicability Statement**

The Remote Desktop Protocol: Input Virtual Channel Extension is applicable in scenarios where the transfer of multitouch or pen input frames (generated by a physical or virtual digitizer) is required from a **terminal server** client to a terminal server.

#### **1.7 Versioning and Capability Negotiation**

None.

#### **1.8 Vendor-Extensible Fields**

None.

#### **1.9 Standards Assignments**

None.

## 2 Messages

### 2.1 Transport

The Remote Desktop Protocol: Input Virtual Channel Extension is designed to operate over a dynamic virtual channel, as specified in [MS-RDPEDYC] sections 1 to 3. The dynamic virtual channel name is the null-terminated **ANSI character** string "Microsoft::Windows::RDS::Input". The usage of channel names in the context of opening a dynamic virtual channel is specified in [MS-RDPEDYC] section 2.2.2.1. The "Microsoft::Windows::RDS::Input" dynamic virtual channel SHOULD NOT be opened by the client if a touch digitizer is not present.

### 2.2 Message Syntax

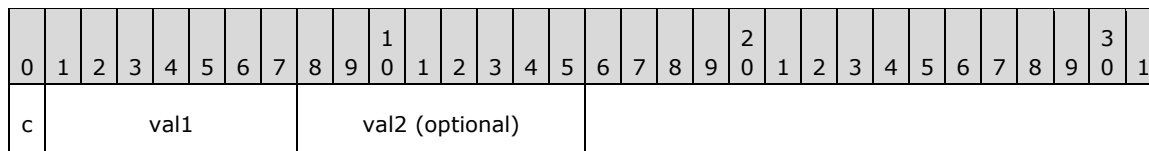
The following sections specify the Remote Desktop Protocol: Input Virtual Channel Extension message syntax. All multiple-byte fields within a message MUST be marshaled in **little-endian** byte order, unless otherwise specified.

#### 2.2.1 Namespaces

#### 2.2.2 Common Data Types

##### 2.2.2.1 TWO\_BYTE\_UNSIGNED\_INTEGER

The **TWO\_BYTE\_UNSIGNED\_INTEGER** structure is used to encode a value in the range 0x0000 to 0x7FFF by using a variable number of bytes. For example, 0x1A1B is encoded as { 0x9A, 0x1B }. The most significant bit of the first byte encodes the number of bytes in the structure.



**c (1 bit):** A 1-bit unsigned integer field containing an encoded representation of the number of bytes in this structure.

| Value             | Meaning   |
|-------------------|---|
| ONE_BYTE_VAL<br>0 | Implies that the optional <b>val2</b> field is not present. Hence, the structure is 1 byte in size. |
| TWO_BYTE_VAL<br>1 | Implies that the optional <b>val2</b> field is present. Hence, the structure is 2 bytes in size.    |

**val1 (7 bits):** A 7-bit unsigned integer field containing the most significant 7 bits of the value represented by this structure.

**val2 (1 byte, optional):** An 8-bit unsigned integer containing the least significant bits of the value represented by this structure.

##### 2.2.2.2 TWO\_BYTE\_SIGNED\_INTEGER

The **TWO\_BYTE\_SIGNED\_INTEGER** structure is used to encode a value in the range -0x3FFF to 0x3FFF by using a variable number of bytes. For example, -0x1A1B is encoded as { 0xDA, 0x1B },



and -0x0002 is encoded as { 0x42 }. The most significant bits of the first byte encode the number of bytes in the structure and the sign.

|   |   |      |   |   |   |   |   |                 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|------|---|---|---|---|---|-----------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 2    | 3 | 4 | 5 | 6 | 7 | 8               | 9 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | 1 |
| c | s | val1 |   |   |   |   |   | val2 (optional) |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

**c (1 bit):** A 1-bit unsigned integer field containing an encoded representation of the number of bytes in this structure.

| Value             | Meaning   |
|-------------------|---|
| ONE_BYTE_VAL<br>0 | Implies that the optional <b>val2</b> field is not present. Hence, the structure is 1 byte in size. |
| TWO_BYTE_VAL<br>1 | Implies that the optional <b>val2</b> field is present. Hence, the structure is 2 bytes in size.    |

**s (1 bit):** A 1-bit unsigned integer field containing an encoded representation of whether the value is positive or negative.

| Value             | Meaning   |
|-------------------|---|
| POSITIVE_VAL<br>0 | Implies that the value represented by this structure is positive. |
| NEGATIVE_VAL<br>1 | Implies that the value represented by this structure is negative. |

**val1 (6 bits):** A 6-bit unsigned integer field containing the most significant 6 bits of the value represented by this structure.

**val2 (1 byte, optional):** An 8-bit unsigned integer containing the least significant bits of the value represented by this structure.

### 2.2.2.3 FOUR\_BYTE\_UNSIGNED\_INTEGER

The **FOUR\_BYTE\_UNSIGNED\_INTEGER** structure is used to encode a value in the range 0x00000000 to 0x3FFFFFFF by using a variable number of bytes. For example, 0x001A1B1C is encoded as {0x9A, 0x1B, 0x1C}. The two most significant bits of the first byte encode the number of bytes in the structure.

|   |      |   |   |   |   |   |                 |   |   |   |   |   |                 |   |   |   |   |   |                 |   |   |   |   |   |   |   |   |   |   |   |   |
|---|------|---|---|---|---|---|-----------------|---|---|---|---|---|-----------------|---|---|---|---|---|-----------------|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1    | 2 | 3 | 4 | 5 | 6 | 7               | 8 | 9 | 0 | 1 | 2 | 3               | 4 | 5 | 6 | 7 | 8 | 9               | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | 1 |
| c | val1 |   |   |   |   |   | val2 (optional) |   |   |   |   |   | val3 (optional) |   |   |   |   |   | val4 (optional) |   |   |   |   |   |   |   |   |   |   |   |   |

**c (2 bits):** A 2-bit unsigned integer field containing an encoded representation of the number of bytes in this structure.

| Value             | Meaning   |
|-------------------|---|
| ONE_BYTE_VAL<br>0 | Implies that the optional <b>val2</b> , <b>val3</b> , and <b>val4</b> fields are not present. Hence, the structure is 1 byte in size. |

| Value               | Meaning   |
|---------------------|---|
| TWO_BYTE_VAL<br>1   | Implies that the optional <b>val2</b> field is present, while the optional <b>val3</b> and <b>val4</b> fields are not present. Hence, the structure is 2 bytes in size. |
| THREE_BYTE_VAL<br>2 | Implies that the optional <b>val2</b> and <b>val3</b> fields are present, while the optional <b>val4</b> field is not present. Hence, the structure is 3 bytes in size. |
| FOUR_BYTE_VAL<br>3  | Implies that the optional <b>val2</b> , <b>val3</b> , and <b>val4</b> fields are all present. Hence, the structure is 4 bytes in size.                                  |

**val1 (6 bits):** A 6-bit unsigned integer field containing the most significant 6 bits of the value represented by this structure.

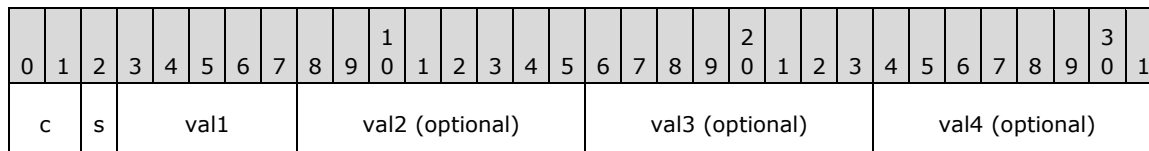
**val2 (1 byte, optional):** An 8-bit unsigned integer containing the second most significant bits of the value represented by this structure.

**val3 (1 byte, optional):** An 8-bit unsigned integer containing the third most significant bits of the value represented by this structure.

**val4 (1 byte, optional):** An 8-bit unsigned integer containing the least significant bits of the value represented by this structure.

#### 2.2.2.4 FOUR\_BYTE\_SIGNED\_INTEGER

The **FOUR\_BYTE\_SIGNED\_INTEGER** structure is used to encode a value in the range -0x1FFFFFFF to 0x1FFFFFFF by using a variable number of bytes. For example, -0x001A1B1C is encoded as {0xBA, 0x1B, 0x1C}, and -0x00000002 is encoded as {0x22}. The three most significant bits of the first byte encode the number of bytes in the structure and the sign.



**c (2 bits):** A 2-bit unsigned integer field containing an encoded representation of the number of bytes in this structure.

| Value               | Meaning   |
|---------------------|---|
| ONE_BYTE_VAL<br>0   | Implies that the optional <b>val2</b> , <b>val3</b> , and <b>val4</b> fields are not present. Hence, the structure is 1 byte in size.                                   |
| TWO_BYTE_VAL<br>1   | Implies that the optional <b>val2</b> field is present, while the optional <b>val3</b> and <b>val4</b> fields are not present. Hence, the structure is 2 bytes in size. |
| THREE_BYTE_VAL<br>2 | Implies that the optional <b>val2</b> and <b>val3</b> fields are present, while the optional <b>val4</b> field is not present. Hence, the structure is 3 bytes in size. |
| FOUR_BYTE_VAL<br>3  | Implies that the optional <b>val2</b> , <b>val3</b> , and <b>val4</b> fields are all present. Hence, the structure is 4 bytes in size.                                  |

**s (1 bit):** A 1-bit unsigned integer field containing an encoded representation of whether the value is positive or negative.

| Value             | Meaning   |
|-------------------|---|
| POSITIVE_VAL<br>0 | Implies that the value represented by this structure is positive. |
| NEGATIVE_VAL<br>1 | Implies that the value represented by this structure is negative. |

**val1 (5 bits):** A 5-bit unsigned integer field containing the most significant 5 bits of the value represented by this structure.

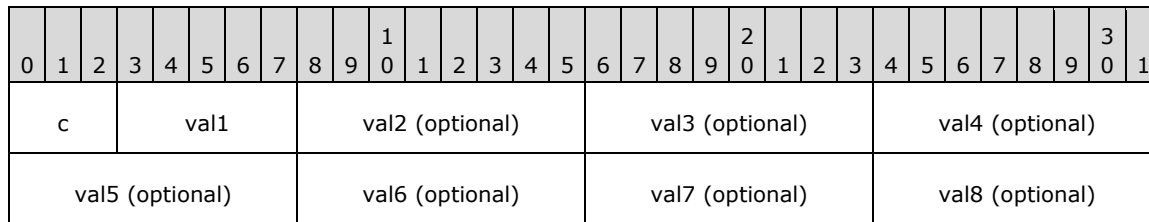
**val2 (1 byte, optional):** An 8-bit unsigned integer containing the second most significant bits of the value represented by this structure.

**val3 (1 byte, optional):** An 8-bit unsigned integer containing the third most significant bits of the value represented by this structure.

**val4 (1 byte, optional):** An 8-bit unsigned integer containing the least significant bits of the value represented by this structure.

### 2.2.2.5 EIGHT\_BYTE\_UNSIGNED\_INTEGER

The **EIGHT\_BYTE\_UNSIGNED\_INTEGER** structure is used to encode a value in the range 0x0000000000000000 to 0xFFFFFFFFFFFFFFFF by using a variable number of bytes. For example, 0x001A1B1C1D1E1F2A is encoded as {0xDA, 0x1B, 0x1C, 0x1D, 0x1E, 0x1F, 0x2A}. The three most significant bits of the first byte encode the number of bytes in the structure.



**c (3 bits):** A 3-bit unsigned integer field containing an encoded representation of the number of bytes in this structure.

| Value               | Meaning   |
|---------------------|---|
| ONE_BYTE_VAL<br>0   | Implies that the optional <b>val2</b> , <b>val3</b> , <b>val4</b> , <b>val5</b> , <b>val6</b> , <b>val7</b> and <b>val8</b> fields are not present. Hence, the structure is 1 byte in size.   |
| TWO_BYTE_VAL<br>1   | Implies that the optional <b>val2</b> field is present, while the optional <b>val3</b> , <b>val4</b> , <b>val5</b> , <b>val6</b> , <b>val7</b> and <b>val8</b> fields are not present. Hence, the structure is 2 bytes in size.           |
| THREE_BYTE_VAL<br>2 | Implies that the optional <b>val2</b> and <b>val3</b> fields are present, while the optional <b>val4</b> , <b>val5</b> , <b>val6</b> , <b>val7</b> and <b>val8</b> fields are not present. Hence, the structure is 3 bytes in size.       |
| FOUR_BYTE_VAL<br>3  | Implies that the optional <b>val2</b> , <b>val3</b> , and <b>val4</b> fields are all present, while the optional <b>val5</b> , <b>val6</b> , <b>val7</b> and <b>val8</b> fields are not present. Hence, the structure is 4 bytes in size. |
| FIVE_BYTE_VAL<br>4  | Implies that the optional <b>val2</b> , <b>val3</b> , <b>val4</b> and <b>val5</b> fields are all present, while the optional <b>val6</b> , <b>val7</b> and <b>val8</b> fields are not present. Hence, the structure is 5 bytes in size.   |
| SIX_BYTE_VAL        | Implies that the optional <b>val2</b> , <b>val3</b> , <b>val4</b> , <b>val5</b> and <b>val6</b> fields are all present, while   |

| Value               | Meaning   |
|---------------------|---|
| 5                   | the optional <b>val7</b> and <b>val8</b> fields are not present. Hence, the structure is 6 bytes in size.   |
| SEVEN_BYTE_VAL<br>6 | Implies that the optional <b>val2</b> , <b>val3</b> , <b>val4</b> , <b>val5</b> , <b>val6</b> and <b>val7</b> fields are all present, while the optional <b>val8</b> field is not present. Hence, the structure is 7 bytes in size. |
| EIGHT_BYTE_VAL<br>7 | Implies that the optional <b>val2</b> , <b>val3</b> , <b>val4</b> , <b>val5</b> , <b>val6</b> , <b>val7</b> and <b>val8</b> fields are all present. Hence, the structure is 8 bytes in size.  |

**val1 (5 bits):** A 5-bit unsigned integer field containing the most significant 5 bits of the value represented by this structure.

**val2 (1 byte, optional):** An 8-bit unsigned integer containing the second most significant bits of the value represented by this structure.

**val3 (1 byte, optional):** An 8-bit unsigned integer containing the third most significant bits of the value represented by this structure.

**val4 (1 byte, optional):** An 8-bit unsigned integer containing the fourth most significant bits of the value represented by this structure.

**val5 (1 byte, optional):** An 8-bit unsigned integer containing the fifth most significant bits of the value represented by this structure.

**val6 (1 byte, optional):** An 8-bit unsigned integer containing the sixth most significant bits of the value represented by this structure.

**val7 (1 byte, optional):** An 8-bit unsigned integer containing the seventh most significant bits of the value represented by this structure.

**val8 (1 byte, optional):** An 8-bit unsigned integer containing the least significant bits of the value represented by this structure.

### 2.2.2.6 RDPINPUT\_HEADER

The **RDPINPUT\_HEADER** structure is included in all input event **PDU**s and is used to identify the input event type and to specify the length of the 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 |
| eventId |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    | pduLength |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| ...     |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |           |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |

**eventId (2 bytes):** A 16-bit unsigned integer that identifies the type of the input event PDU.

| Value                      | Meaning  |
|----------------------------|--|
| EVENTID_SC_READY<br>0x0001 | <a href="#">RDPINPUT_SC_READY_PDU (section 2.2.3.1).</a> |
| EVENTID_CS_READY<br>0x0002 | <a href="#">RDPINPUT_CS_READY_PDU (section 2.2.3.2).</a> |

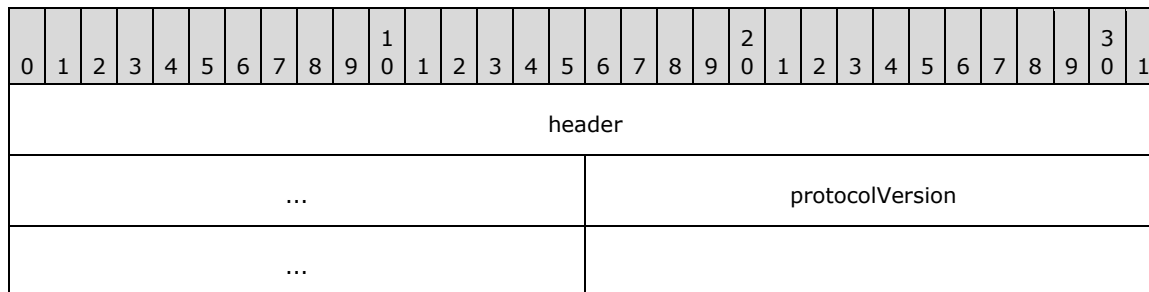
| Value  | Meaning  |
|--|--|
| EVENTID_TOUCH<br>0x0003                          | <a href="#">RDPINPUT_TOUCH_EVENT_PDU (section 2.2.3.3).</a>                    |
| EVENTID_SUSPEND_INPUT<br>0x0004                  | <a href="#">RDPINPUT_SUSPEND_INPUT_PDU (section 2.2.3.4).</a>                  |
| EVENTID_RESUME_INPUT<br>0x0005                   | <a href="#">RDPINPUT_RESUME_INPUT_PDU (section 2.2.3.5).</a>                   |
| EVENTID_DISMISS_HOVERING_TOUCH_CONTACT<br>0x0006 | <a href="#">RDPINPUT_DISMISS_HOVERING_TOUCH_CONTACT_PDU (section 2.2.3.6).</a> |
| EVENTID_PEN<br>0x0008                            | <a href="#">RDPINPUT_PEN_EVENT_PDU (section 2.2.3.7).</a>                      |

**pduLength (4 bytes):** A 32-bit unsigned integer that specifies the length of the input event PDU in bytes. This value **MUST** include the length of the **RDPINPUT\_HEADER** (6 bytes).

## 2.2.3 Input Messages

### 2.2.3.1 RDPINPUT\_SC\_READY\_PDU

The **RDPINPUT\_SC\_READY\_PDU** message is sent by the server endpoint and is used to indicate readiness to commence with input remoting transactions.



**header (6 bytes):** An [RDPINPUT\\_HEADER \(section 2.2.2.6\)](#) structure. The **eventId** field **MUST** be set to EVENTID\_SC\_READY (0x0001).

**protocolVersion (4 bytes):** A 32-bit unsigned integer that specifies the input protocol version supported by the server.

| Value                                | Meaning   |
|--------------------------------------|---|
| RDPINPUT_PROTOCOL_V100<br>0x00010000 | Version 1.0.0 of the RDP input remoting protocol. This version only supports the remoting of multitouch frames.         |
| RDPINPUT_PROTOCOL_V101<br>0x00010001 | Version 1.0.1 of the RDP input remoting protocol. This version only supports the remoting of multitouch frames.         |
| RDPINPUT_PROTOCOL_V200<br>0x00020000 | Version 2.0.0 of the RDP input remoting protocol. This version supports the remoting of both multitouch and pen frames. |

### 2.2.3.2 RDPINPUT\_CS\_READY\_PDU

The **RDPINPUT\_CS\_READY\_PDU** message is sent by the client endpoint and is used to indicate readiness to commence with input remoting transactions.

|        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0      | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | 1 | 2 | 3 | 4 | 5 | 6                | 7 | 8 | 9 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | 1 |
| header |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| ...    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | flags            |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| ...    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | protocolVersion  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| ...    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | maxTouchContacts |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

**header (6 bytes):** An [RDPINPUT\\_HEADER \(section 2.2.2.6\)](#) structure. The **eventId** field MUST be set to EVENTID\_CS\_READY (0x0002).

**flags (4 bytes):** A 32-bit unsigned integer that specifies touch initialization flags.

| Flag  | Meaning   |
|---|---|
| READY_FLAGS_SHOW_TOUCH_VISUALS<br>0x00000001          | Touch gesture and contact visuals SHOULD be rendered by the server in the remote session.   |
| READY_FLAGS_DISABLE_TIMESTAMP_INJECTION<br>0x00000002 | The client does not support touch frame timestamp remoting. The server MUST ignore any values specified in the <b>frameOffset</b> field of the <a href="#">RDPINPUT_TOUCH_FRAME (section 2.2.3.3.1)</a> structure and the <b>encodeTime</b> field of the <a href="#">RDPINPUT_TOUCH_EVENT_PDU (section 2.2.3.3)</a> message.<br><br>This flag SHOULD NOT be sent to a server that only supports version 1.0.0 of the input remoting protocol. The server-supported version is specified in the <b>protocolVersion</b> field of the <a href="#">RDPINPUT_SC_READY_PDU (section 2.2.3.1)</a> message. |

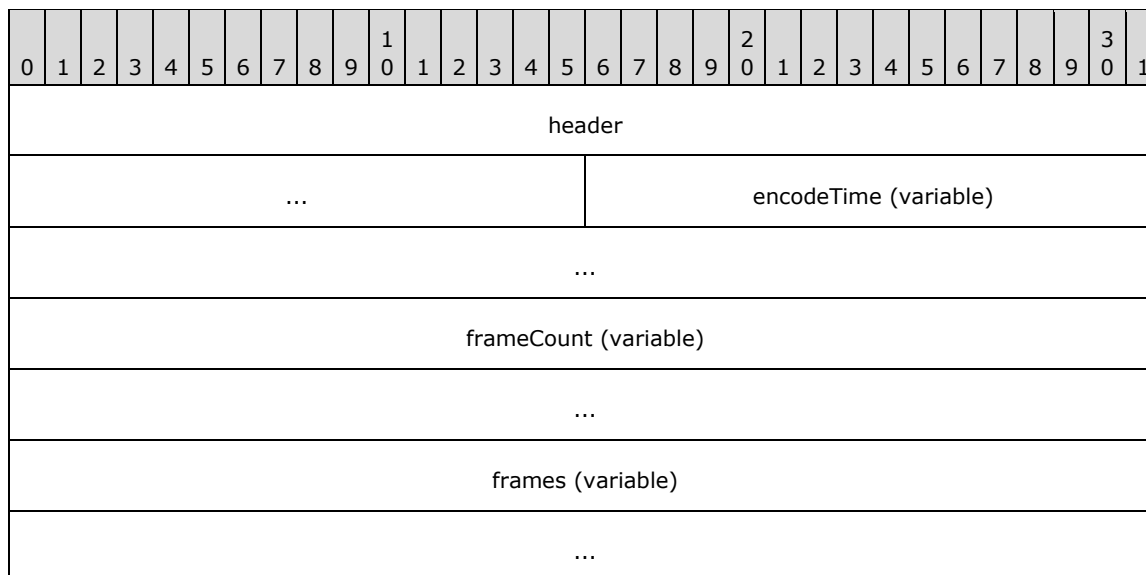
**protocolVersion (4 bytes):** A 32-bit unsigned integer that specifies the input protocol version supported by the client.

| Value                                | Meaning   |
|--------------------------------------|---|
| RDPINPUT_PROTOCOL_V100<br>0x00010000 | Version 1.0.0 of the RDP input remoting protocol. This version only supports the remoting of multitouch frames.         |
| RDPINPUT_PROTOCOL_V101<br>0x00010001 | Version 1.0.1 of the RDP input remoting protocol. This version only supports the remoting of multitouch frames.         |
| RDPINPUT_PROTOCOL_V200<br>0x00020000 | Version 2.0.0 of the RDP input remoting protocol. This version supports the remoting of both multitouch and pen frames. |

**maxTouchContacts (2 bytes):** A 16-bit unsigned integer that specifies the maximum number of simultaneous touch contacts supported by the client.

### 2.2.3.3 RDPINPUT\_TOUCH\_EVENT\_PDU

The **RDPINPUT\_TOUCH\_EVENT\_PDU** message is sent by the client endpoint and is used to remote a collection of touch frames.



**header (6 bytes):** An RDPINPUT\_HEADER (section [2.2.2.6](#)) structure. The **eventId** field MUST be set to EVENTID\_TOUCH (0x0003).

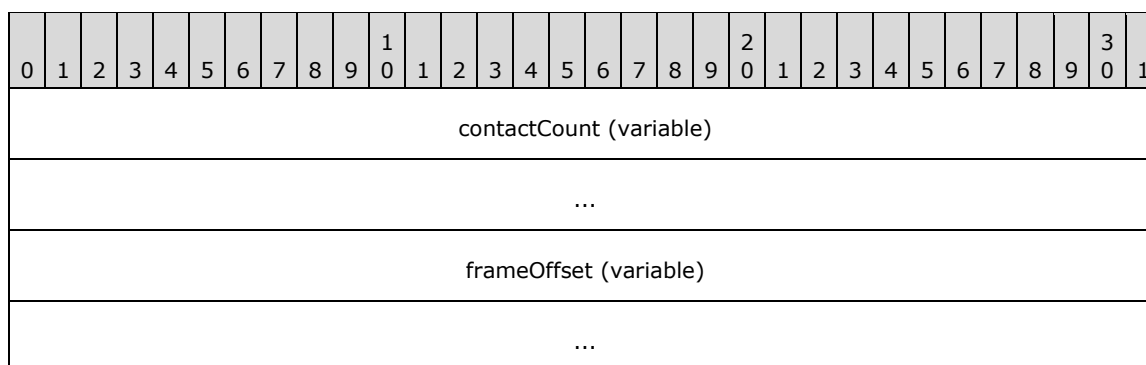
**encodeTime (variable):** A FOUR\_BYTE\_UNSIGNED\_INTEGER (section [2.2.2.3](#)) structure that specifies the time that has elapsed (in milliseconds) from when the oldest touch frame was generated to when it was encoded for transmission by the client.

**frameCount (variable):** A TWO\_BYTE\_UNSIGNED\_INTEGER (section [2.2.2.1](#)) structure that specifies the number of RDPINPUT\_TOUCH\_FRAME (section [2.2.3.3.1](#)) structures in the **frames** field.

**frames (variable):** An array of **RDPINPUT\_TOUCH\_FRAME** structures ordered from the oldest in time to the most recent in time. The number of structures in this array is specified by the **frameCount** field.

#### 2.2.3.3.1 RDPINPUT\_TOUCH\_FRAME

The **RDPINPUT\_TOUCH\_FRAME** structure encapsulates a collection of RDPINPUT\_TOUCH\_CONTACT (section [2.2.3.3.1.1](#)) structures that are part of the same logical touch frame.



|                     |
|---------------------|
| contacts (variable) |
| ...                 |

**contactCount (variable):** A TWO\_BYTE\_UNSIGNED\_INTEGER (section [2.2.2.1](#)) structure that specifies the number of **RDPINPUT\_TOUCH\_CONTACT** structures in the **contacts** field.

**frameOffset (variable):** An EIGHT\_BYTE\_UNSIGNED\_INTEGER (section [2.2.2.5](#)) structure that specifies the time offset from the previous frame (in microseconds). If this is the first frame being transmitted then this field **MUST** be set to zero.

**contacts (variable):** An array of **RDPINPUT\_TOUCH\_CONTACT** structures. The number of structures in this array is specified by the **contactCount** field.

### 2.2.3.3.1.1 RDPINPUT\_TOUCH\_CONTACT

The **RDPINPUT\_TOUCH\_CONTACT** structure describes the characteristics of a contact that is encapsulated in an RDPINPUT\_TOUCH\_FRAME (section [2.2.3.3.1](#)) structure.

| 0                           | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10                       | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |  |  |  |  |  |
|-----------------------------|---|---|---|---|---|---|---|---|---|--------------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|--|--|--|--|--|
| contactId                   |   |   |   |   |   |   |   |   |   | fieldsPresent (variable) |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| ...                         |   |   |   |   |   |   |   |   |   |                          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| x (variable)                |   |   |   |   |   |   |   |   |   |                          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| ...                         |   |   |   |   |   |   |   |   |   |                          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| y (variable)                |   |   |   |   |   |   |   |   |   |                          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| ...                         |   |   |   |   |   |   |   |   |   |                          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| contactFlags (variable)     |   |   |   |   |   |   |   |   |   |                          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| ...                         |   |   |   |   |   |   |   |   |   |                          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| contactRectLeft (variable)  |   |   |   |   |   |   |   |   |   |                          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| ...                         |   |   |   |   |   |   |   |   |   |                          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| contactRectTop (variable)   |   |   |   |   |   |   |   |   |   |                          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| ...                         |   |   |   |   |   |   |   |   |   |                          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| contactRectRight (variable) |   |   |   |   |   |   |   |   |   |                          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| ...                         |   |   |   |   |   |   |   |   |   |                          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |



|                              |
|------------------------------|
| contactRectBottom (variable) |
| ...                          |
| orientation (variable)       |
| ...                          |
| pressure (variable)          |
| ...                          |

**contactId (1 byte):** An 8-bit unsigned integer that specifies the ID assigned to the contact.

**fieldsPresent (variable):** A TWO\_BYTE\_UNSIGNED\_INTEGER (section [2.2.2.1](#)) structure that specifies the presence of the optional **contactRectLeft**, **contactRectTop**, **contactRectRight**, **contactRectBottom**, **orientation**, and **pressure** fields.

| Flag  | Meaning  |
|---|--|
| TOUCH_CONTACT_CONTACTRECT_PRESENT<br>0x0001 | The optional <b>contactRectLeft</b> , <b>contactRectTop</b> , <b>contactRectRight</b> , and <b>contactRectBottom</b> fields are all present. |
| TOUCH_CONTACT_ORIENTATION_PRESENT<br>0x0002 | The optional <b>orientation</b> field is present.  |
| TOUCH_CONTACT_PRESSURE_PRESENT<br>0x0004    | The optional <b>pressure</b> field is present.   |

**x (variable):** A FOUR\_BYTE\_SIGNED\_INTEGER (section [2.2.2.4](#)) structure that specifies the X-coordinate (relative to the virtual-desktop origin) of the contact.

**y (variable):** A **FOUR\_BYTE\_SIGNED\_INTEGER** structure that specifies the Y-coordinate (relative to the virtual-desktop origin) of the contact.

**contactFlags (variable):** A FOUR\_BYTE\_UNSIGNED\_INTEGER (section [2.2.2.3](#)) structure that specifies the current state of the contact.

| Flag                             | Meaning  |
|----------------------------------|--|
| CONTACT_FLAG_DOWN<br>0x0001      | The contact transitioned to the engaged state (made contact).    |
| CONTACT_FLAG_UPDATE<br>0x0002    | Contact update.  |
| CONTACT_FLAG_UP<br>0x0004        | The contact transitioned from the engaged state (broke contact). |
| CONTACT_FLAG_INRANGE<br>0x0008   | The contact has not departed and is still in range.              |
| CONTACT_FLAG_INCONTACT<br>0x0010 | The contact is in the engaged state.                             |

| Flag                            | Meaning                        |
|---------------------------------|--------------------------------|
| CONTACT_FLAG_CANCELED<br>0x0020 | The contact has been canceled. |

This field MUST contain one of the following combinations of the contact state flags and MUST NOT contain any other combination:

- UP
- UP | CANCELED
- UPDATE
- UPDATE | CANCELED
- DOWN | INRANGE | INCONTACT
- UPDATE | INRANGE | INCONTACT
- UP | INRANGE
- UPDATE | INRANGE

The figure "Lifetime of a touch or pen contact" in section [3.1.1.1](#) describes the states through which a contact involved in a touch transaction can transition.

**contactRectLeft (variable):** An optional [TWO\\_BYTE\\_SIGNED\\_INTEGER \(section 2.2.2.2\)](#) structure that specifies the leftmost bound (relative to the contact point specified by the **x** and **y** fields) of the exclusive rectangle describing the geometry of the contact. This rectangle MUST be rotated counter-clockwise by the angle specified in the **orientation** field to yield the actual contact geometry. The presence of the **contactRectLeft** field is indicated by the TOUCH\_CONTACT\_CONTACTRECT\_PRESENT (0x0001) flag in the **fieldsPresent** field.

**contactRectTop (variable):** An optional **TWO\_BYTE\_SIGNED\_INTEGER** structure that specifies the upper bound (relative to the contact point specified by the **x** and **y** fields) of the exclusive rectangle describing the geometry of the contact. This rectangle MUST be rotated counter-clockwise by the angle specified in the **orientation** field to yield the actual contact geometry. The presence of the **contactRectTop** field is indicated by the TOUCH\_CONTACT\_CONTACTRECT\_PRESENT (0x0001) flag in the **fieldsPresent** field.

**contactRectRight (variable):** An optional **TWO\_BYTE\_SIGNED\_INTEGER** structure that specifies the rightmost bound (relative to the contact point specified by the **x** and **y** fields) of the exclusive rectangle describing the geometry of the contact. This rectangle MUST be rotated counter-clockwise by the angle specified in the **orientation** field to yield the actual contact geometry. The presence of the **contactRectRight** field is indicated by the TOUCH\_CONTACT\_CONTACTRECT\_PRESENT (0x0001) flag in the **fieldsPresent** field.

**contactRectBottom (variable):** An optional **TWO\_BYTE\_SIGNED\_INTEGER** structure that specifies the lower bound (relative to the contact point specified by the **x** and **y** fields) of the exclusive rectangle describing the geometry of the contact. This rectangle MUST be rotated counter-clockwise by the angle specified in the **orientation** field to yield the actual contact geometry. The presence of the **contactRectBottom** field is indicated by the TOUCH\_CONTACT\_CONTACTRECT\_PRESENT (0x0001) flag in the **fieldsPresent** field.

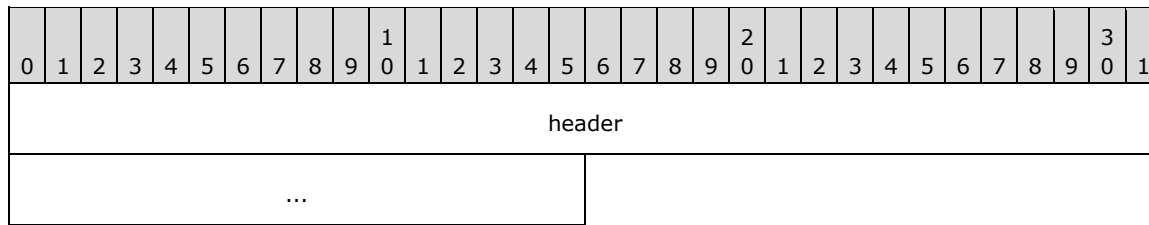
**orientation (variable):** An optional **FOUR\_BYTE\_UNSIGNED\_INTEGER** structure that specifies the angle through which the contact rectangle (specified in the **contactRectLeft**, **contactRectTop**, **contactRectRight** and **contactRectBottom** fields) MUST be rotated to yield the actual contact geometry. This value MUST be in the range 0x00000000 to 0x00000167 (359), inclusive, where 0x00000000 indicates a touch contact aligned with the y-axis and pointing from

bottom to top; increasing values indicate degrees of rotation in a counter-clockwise direction. The presence of the **orientation** field is indicated by the TOUCH\_CONTACT\_ORIENTATION\_PRESENT (0x0002) flag in the **fieldsPresent** field. If the **orientation** field is not present the angle of rotation MUST be assumed to be zero degrees.

**pressure (variable):** An optional **FOUR\_BYTE\_UNSIGNED\_INTEGER** structure that specifies the contact pressure. This value MUST be normalized in the range 0x00000000 to 0x00000400 (1024), inclusive. The presence of this field is indicated by the TOUCH\_CONTACT\_PRESSURE\_PRESENT (0x0004) flag in the **fieldsPresent** field.

#### 2.2.3.4 RDPINPUT\_SUSPEND\_INPUT\_PDU

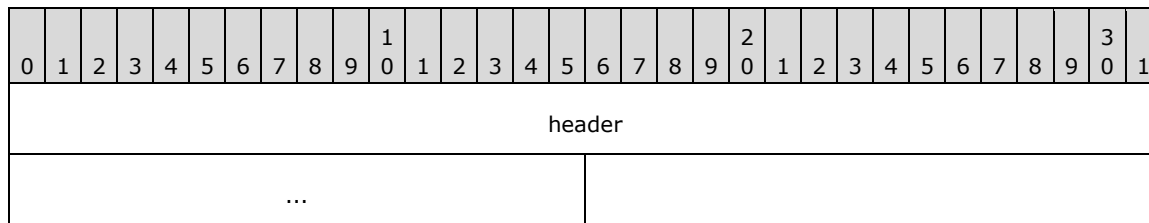
The **RDPINPUT\_SUSPEND\_INPUT\_PDU** message is sent by the server endpoint and is used to instruct the client to suspend the transmission of the [RDPINPUT\\_TOUCH\\_EVENT\\_PDU \(section 2.2.3.3\)](#) message.



**header (6 bytes):** An [RDPINPUT\\_HEADER \(section 2.2.2.6\)](#) structure. The **eventId** field MUST be set to EVENTID\_SUSPEND\_INPUT (0x0004).

#### 2.2.3.5 RDPINPUT\_RESUME\_INPUT\_PDU

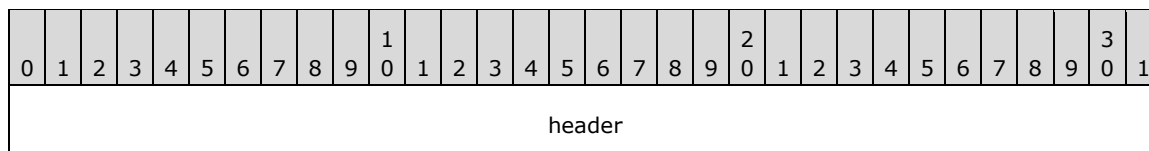
The **RDPINPUT\_RESUME\_INPUT\_PDU** message is sent by the server endpoint and is used to instruct the client to resume the transmission of the [RDPINPUT\\_TOUCH\\_EVENT\\_PDU \(section 2.2.3.3\)](#) message.



**header (6 bytes):** An [RDPINPUT\\_HEADER \(section 2.2.2.6\)](#) structure. The **eventId** field MUST be set to EVENTID\_RESUME\_INPUT (0x0005).

#### 2.2.3.6 RDPINPUT\_DISMISS\_HOVERING\_TOUCH\_CONTACT\_PDU

The **RDPINPUT\_DISMISS\_HOVERING\_TOUCH\_CONTACT\_PDU** message is sent by the client endpoint to instruct the server to transition a contact in the "hovering" state to the "out of range" state (section [3.1.1.1](#)).



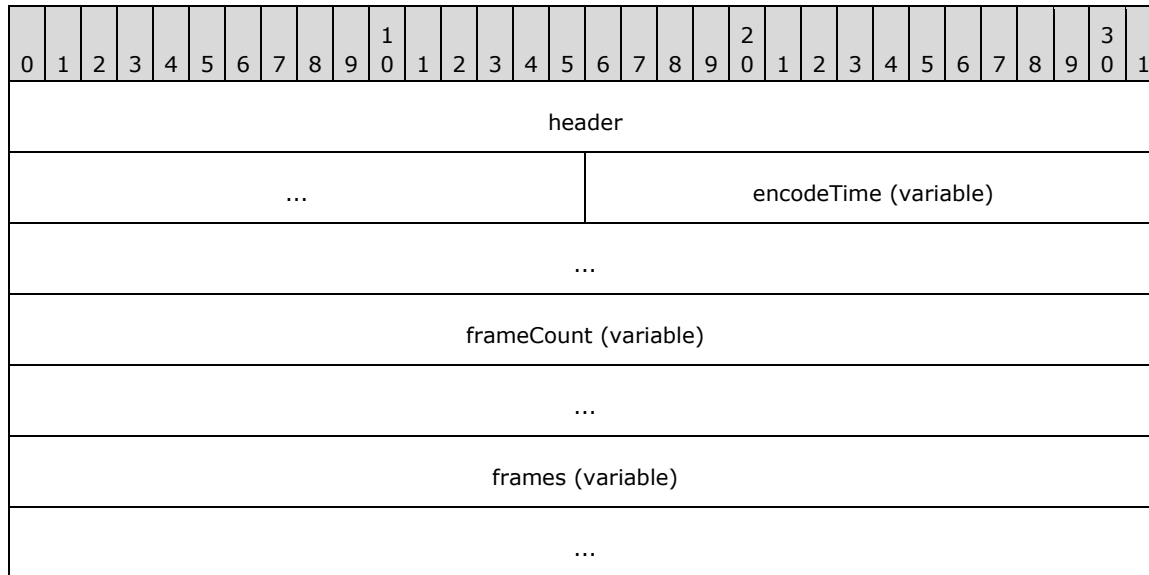
|     |           |
|-----|-----------|
| ... | contactId |
|-----|-----------|

**header (6 bytes):** An [RDPINPUT\\_HEADER \(section 2.2.2.6\)](#) structure. The **eventId** field MUST be set to EVENTID\_DISMISS\_HOVERING\_TOUCH\_CONTACT (0x0006).

**contactId (1 byte):** An 8-bit unsigned integer that specifies the ID assigned to the contact. This value MUST be in the range 0x00 to 0xFF (inclusive).

### 2.2.3.7 RDPINPUT\_PEN\_EVENT\_PDU

The **RDPINPUT\_PEN\_EVENT\_PDU** message is sent by the client endpoint and is used to remote a collection of pen frames.



**header (6 bytes):** An [RDPINPUT\\_HEADER \(section 2.2.2.6\)](#) structure. The **eventId** field MUST be set to EVENTID\_PEN (0x0008).

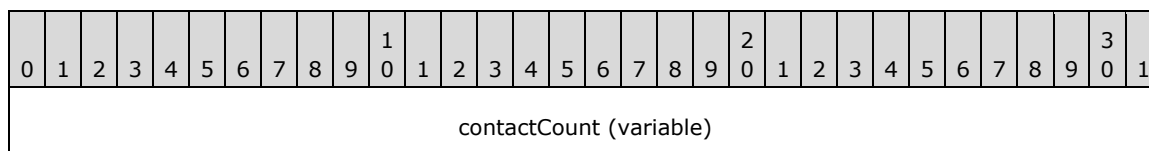
**encodeTime (variable):** A [FOUR\\_BYTE\\_UNSIGNED\\_INTEGER \(section 2.2.2.3\)](#) structure that specifies the time that has elapsed (in milliseconds) from when the oldest pen frame was generated to when it was encoded for transmission by the client.

**frameCount (variable):** A [TWO\\_BYTE\\_UNSIGNED\\_INTEGER \(section 2.2.2.1\)](#) structure that specifies the number of [RDPINPUT\\_PEN\\_FRAME \(section 2.2.3.7.1\)](#) structures in the frames field.

**frames (variable):** An array of [RDPINPUT\\_PEN\\_FRAME](#) structures ordered from the oldest in time to the most recent in time. The number of structures in this array is specified by the **frameCount** field.

#### 2.2.3.7.1 RDPINPUT\_PEN\_FRAME

The **RDPINPUT\_PEN\_FRAME** structure encapsulates a collection of [RDPINPUT\\_PEN\\_CONTACT \(section 2.2.3.7.1.1\)](#) structures that are part of the same logical pen frame.



|                        |
|------------------------|
| ...                    |
| frameOffset (variable) |
| ...                    |
| contacts (variable)    |
| ...                    |

**contactCount (variable):** A [TWO BYTE UNSIGNED INTEGER \(section 2.2.2.1\)](#) structure that specifies the number of **RDPINPUT\_PEN\_CONTACT** structures in the **contacts** field.

**frameOffset (variable):** An [EIGHT BYTE UNSIGNED INTEGER \(section 2.2.2.5\)](#) structure that specifies the time offset from the previous frame (in microseconds). If this is the first frame being transmitted, then this field **MUST** be set to zero.

**contacts (variable):** An array of **RDPINPUT\_PEN\_CONTACT** structures. The number of structures in this array is specified by the **contactCount** field.

### 2.2.3.7.1.1 RDPINPUT\_PEN\_CONTACT

The **RDPINPUT\_PEN\_CONTACT** structure describes the characteristics of a contact that is encapsulated in an [RDPINPUT\\_PEN\\_FRAME \(section 2.2.3.7.1\)](#) structure.

|                         |   |   |   |   |   |   |   |   |   |                          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|-------------------------|---|---|---|---|---|---|---|---|---|--------------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 0                       | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10                       | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| contactId               |   |   |   |   |   |   |   |   |   | fieldsPresent (variable) |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| ...                     |   |   |   |   |   |   |   |   |   |                          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| x (variable)            |   |   |   |   |   |   |   |   |   |                          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| ...                     |   |   |   |   |   |   |   |   |   |                          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| y (variable)            |   |   |   |   |   |   |   |   |   |                          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| ...                     |   |   |   |   |   |   |   |   |   |                          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| contactFlags (variable) |   |   |   |   |   |   |   |   |   |                          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| ...                     |   |   |   |   |   |   |   |   |   |                          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| penFlags (variable)     |   |   |   |   |   |   |   |   |   |                          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| ...                     |   |   |   |   |   |   |   |   |   |                          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| pressure (variable)     |   |   |   |   |   |   |   |   |   |                          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |

|                     |
|---------------------|
| ...                 |
| rotation (variable) |
| ...                 |
| tiltX (variable)    |
| ...                 |
| tiltY (variable)    |
| ...                 |

**contactId (1 byte):** An 8-bit unsigned integer that specifies the ID assigned to the contact.

**fieldsPresent (variable):** A [TWO BYTE UNSIGNED INTEGER \(section 2.2.2.1\)](#) structure that specifies the presence of the optional **penFlags**, **pressure**, **rotation**, **tiltX**, and **tiltY** fields.

| Flag                                   | Meaning  |
|--|--|
| PEN_CONTACT_PENFLAGS_PRESENT<br>0x0001 | The optional <b>penFlags</b> field is present. |
| PEN_CONTACT_PRESSURE_PRESENT<br>0x0002 | The optional <b>pressure</b> field is present. |
| PEN_CONTACT_ROTATION_PRESENT<br>0x0004 | The optional <b>rotation</b> field is present. |
| PEN_CONTACT_TILTX_PRESENT<br>0x0008    | The optional <b>tiltX</b> field is present.    |
| PEN_CONTACT_TILTY_PRESENT<br>0x0010    | The optional <b>tiltY</b> field is present.    |

**x (variable):** A [FOUR BYTE SIGNED INTEGER \(section 2.2.2.4\)](#) structure that specifies the x-coordinate (relative to the virtual-desktop origin) of the contact.

**y (variable):** A [FOUR\\_BYTE\\_SIGNED\\_INTEGER](#) structure that specifies the y-coordinate (relative to the virtual-desktop origin) of the contact.

**contactFlags (variable):** A [FOUR\\_BYTE\\_UNSIGNED\\_INTEGER \(section 2.2.2.3\)](#) structure that specifies the current state of the contact.

| Flag                          | Meaning  |
|-------------------------------|--|
| CONTACT_FLAG_DOWN<br>0x0001   | The contact transitioned to the engaged state (made contact).    |
| CONTACT_FLAG_UPDATE<br>0x0002 | Contact update.  |
| CONTACT_FLAG_UP               | The contact transitioned from the engaged state (broke contact). |

| Flag                             | Meaning   |
|----------------------------------|---|
| 0x0004                           |   |
| CONTACT_FLAG_INRANGE<br>0x0008   | The contact has not departed and is still in range. |
| CONTACT_FLAG_INCONTACT<br>0x0010 | The contact is in the engaged state.                |
| CONTACT_FLAG_CANCELED<br>0x0020  | The contact has been canceled.                      |

This field **MUST** contain one of the following combinations of the contact state flags and **MUST NOT** contain any other combination:

- UP
- UP | CANCELED
- UPDATE
- UPDATE | CANCELED
- DOWN | INRANGE | INCONTACT
- UPDATE | INRANGE | INCONTACT
- UP | INRANGE
- UPDATE | INRANGE

The figure "Lifetime of a touch or pen contact" in section [3.1.1.1](#) describes the states through which a contact involved in a pen transaction can transition.

**penFlags (variable):** A **FOUR\_BYTE\_UNSIGNED\_INTEGER** structure that specifies the current state of the pen..

| Flag                              | Meaning   |
|-----------------------------------|---|
| PEN_FLAG_BARREL_PRESSED<br>0x0001 | Indicates that the barrel button is in the pressed state. |
| PEN_FLAG_ERASER_PRESSED<br>0x0002 | Indicates that the eraser button is in the pressed state. |
| PEN_FLAG_INVERTED<br>0x0004       | Indicates that the pen is inverted.                       |

The presence of this field is indicated by the PEN\_CONTACT\_PENFLAGS\_PRESENT (0x0001) flag in the **fieldsPresent** field.

**pressure (variable):** An optional **FOUR\_BYTE\_UNSIGNED\_INTEGER** structure that specifies the pressure applied to the pen. This value **MUST** be normalized in the range 0x00000000 to 0x00000400 (1024), inclusive. The presence of this field is indicated by the PEN\_CONTACT\_PRESSURE\_PRESENT (0x0002) flag in the **fieldsPresent** field.

**rotation (variable):** An optional **TWO\_BYTE\_UNSIGNED\_INTEGER** structure that specifies the clockwise rotation (or twist) of the pen. This value **MUST** be in the range 0x00000000 to

0x00000167 (359), inclusive. The presence of this field is indicated by the PEN\_CONTACT\_ROTATION\_PRESENT (0x0004) flag in the **fieldsPresent** field.

**tiltX (variable):** An optional **TWO\_BYTE\_SIGNED\_INTEGER** structure that specifies the angle of tilt of the pen along the x-axis. This value MUST be in the range -0x0000005A (-90) to 0x0000005A (90), inclusive: a positive value indicates a tilt to the right. The presence of this field is indicated by the PEN\_CONTACT\_TILTX\_PRESENT (0x0008) flag in the **fieldsPresent** field.

**tiltY (variable):** An optional **TWO\_BYTE\_SIGNED\_INTEGER** structure that specifies the angle of tilt of the pen along the y-axis. This value MUST be in the range -0x0000005A (-90) to 0x0000005A (90), inclusive: a positive value indicates a tilt toward the user. The presence of this field is indicated by the PEN\_CONTACT\_TILTY\_PRESENT (0x0010) flag in the **fieldsPresent** field.

### 2.3 Directory Service Schema Elements

None.



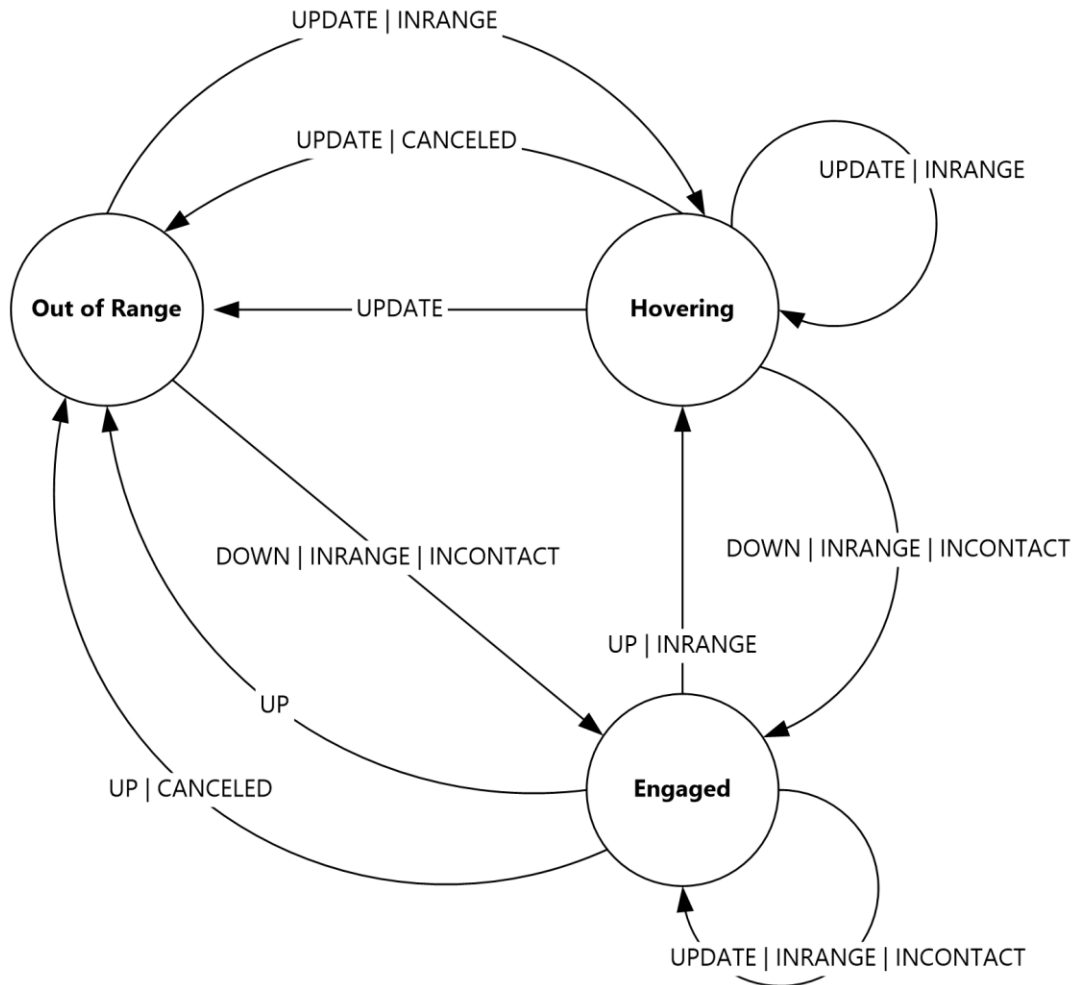
### 3 Protocol Details

#### 3.1 Common Details

##### 3.1.1 Abstract Data Model

###### 3.1.1.1 Touch Contact State Transitions

The following finite state machine diagram describes the states through which a contact involved in a touch or pen transaction can transition during its lifetime.



**Figure 2: Lifetime of a touch or pen contact**

A contact transitions through three main states:

- Out of Range
- Hovering

- Engaged

When a contact is in the "hovering" or "engaged" state, it is referred to as being "active". "Hovering" contacts are in range of the digitizer, while "engaged" contacts are in range of the digitizer and in contact with the digitizer surface. The Remote Desktop Protocol: Input Virtual Channel Extension remotes only active contacts and contacts that are transitioning to the "out of range" state; see section [2.2.3.3.1.1](#) for an enumeration of valid state flags combinations.

When transitioning from the "engaged" state to the "hovering" state, or from the "engaged" state to the "out of range" state, the contact position cannot change; it is only allowed to change after the transition has taken place.

### **3.1.2 Timers**

None.

### **3.1.3 Initialization**

None.

### **3.1.4 Higher-Layer Triggered Events**

None.

### **3.1.5 Message Processing Events and Sequencing Rules**

#### **3.1.5.1 Processing an Input Message**

All input messages are prefaced by the [RDPINPUT\\_HEADER \(section 2.2.2.6\)](#) structure.

When an input message is processed, the **eventId** field in the header MUST first be examined to determine if the message is within the subset of expected messages. If the message is not expected, it SHOULD be ignored.

If the message is in the correct sequence, the **pduLength** field MUST be examined to make sure that it is consistent with the amount of data read from the "Microsoft::Windows::RDS::Input" dynamic virtual channel (section [2.1](#)). If this is not the case, the message SHOULD be ignored.

#### **3.1.6 Timer Events**

None.

#### **3.1.7 Other Local Events**

None.

## **3.2 Server Details**

### **3.2.1 Abstract Data Model**

None.

## 3.2.2 Timers

None.

## 3.2.3 Initialization

The server MUST send the [RDPINPUT\\_SC\\_READY\\_PDU \(section 2.2.3.1\)](#) message to the client, as specified in section [3.2.5.1](#), to initiate the process of remoting touch input frames.

## 3.2.4 Higher-Layer Triggered Events

None.

## 3.2.5 Message Processing Events and Sequencing Rules

### 3.2.5.1 Sending an RDPINPUT\_SC\_READY\_PDU Message

The structure and fields of the **RDPINPUT\_SC\_READY\_PDU** message are specified in section [2.2.3.1](#).

If the server does not support touch injection, then it MUST NOT send this **PDU** to the client. The **protocolVersion** field SHOULD be set to at least RDPINPUT\_PROTOCOL\_V200 (0x00020000) if the server supports the injection of pen input using the [RDPINPUT\\_PEN\\_EVENT\\_PDU \(section 2.2.3.7\)](#) message.

### 3.2.5.2 Processing an RDPINPUT\_CS\_READY\_PDU Message

The structure and fields of the **RDPINPUT\_CS\_READY\_PDU** message are specified in section [2.2.3.2](#).

The **header** field MUST be processed as specified in section [3.1.5.1](#). If the message is valid, the server SHOULD use the value specified by the client in the **maxTouchContacts** field to initialize the touch injection subsystem.

### 3.2.5.3 Processing an RDPINPUT\_TOUCH\_EVENT\_PDU Message

The structure and fields of the **RDPINPUT\_TOUCH\_EVENT\_PDU** message are specified in section [2.2.3.3](#).

The **header** field MUST be processed as specified in section [3.1.5.1](#). If the message is valid, the server MUST iterate over each [RDPINPUT\\_TOUCH\\_FRAME \(section 2.2.3.3.1\)](#) structure encapsulated in the **RDPINPUT\_TOUCH\_EVENT\_PDU** message, decode each [RDPINPUT\\_TOUCH\\_CONTACT \(section 2.2.3.3.1.1\)](#) structure in the frame, and then inject the frame contacts into the user session.

If any of the contacts does not conform to the finite state machine described in section [3.1.1.1](#), the touch transaction SHOULD be canceled in the session, and all subsequent frames associated with the transaction SHOULD be ignored until a new touch transaction is initiated at the client.

### 3.2.5.4 Sending an RDPINPUT\_SUSPEND\_INPUT\_PDU message

The structure and fields of the **RDPINPUT\_SUSPEND\_INPUT\_PDU** message are specified in section [2.2.3.4](#).

To request that the client resume the transmission of input messages, the server MUST send the [RDPINPUT\\_RESUME\\_INPUT\\_PDU \(section 2.2.3.5\)](#) message to the client, as specified in section [3.2.5.5](#).

### 3.2.5.5 Sending an RDPINPUT\_RESUME\_INPUT\_PDU Message

The structure and fields of the **RDPINPUT\_RESUME\_INPUT\_PDU** message are specified in section [2.2.3.5](#).

The RDPINPUT\_RESUME\_INPUT\_PDU (section 2.2.3.5) message SHOULD be sent only if the transmission of input messages was suspended by using the [RDPINPUT\\_SUSPEND\\_INPUT\\_PDU \(section 2.2.3.4\)](#) message, as specified in section [3.2.5.4](#).

### 3.2.5.6 Processing an RDPINPUT\_DISMISS\_HOVERING\_TOUCH\_CONTACT\_PDU Message

The structure and fields of the **RDPINPUT\_DISMISS\_HOVERING\_TOUCH\_CONTACT\_PDU** message are specified in section [2.2.3.6](#).

The **header** field MUST be processed as specified in section [3.1.5.1](#). If the message is valid, the server MUST transition the contact specified by the **contactId** field to the "out of range" state if it is in the hovering state. If no contact with the specified contact ID exists, or if the contact is in the engaged state, then no action MUST be taken.

### 3.2.5.7 Processing an RDPINPUT\_PEN\_EVENT\_PDU Message

The structure and fields of the **RDPINPUT\_PEN\_EVENT\_PDU** message are specified in section [2.2.3.7](#).

The **header** field MUST be processed as specified in section [3.1.5.1](#). If the message is valid, the server MUST iterate over each [RDPINPUT\\_PEN\\_FRAME \(section 2.2.3.7.1\)](#) structure encapsulated in the **RDPINPUT\_PEN\_EVENT\_PDU** message, decode each [RDPINPUT\\_PEN\\_CONTACT \(section 2.2.3.7.1.1\)](#) structure in the frame, and then inject the frame contacts into the user session.

If any of the contacts does not conform to the finite state machine described in section [3.1.1.1](#), the pen transaction SHOULD be canceled in the session, and all subsequent frames associated with the transaction SHOULD be ignored until a new pen transaction is initiated at the client.

## 3.2.6 Timer Events

None.

## 3.2.7 Other Local Events

None.

## 3.3 Client 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 that 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 that described in this document.

### 3.3.1.1 Input Transmission Suspended

The **Input Transmission Suspended** abstract data model (ADM) element contains a Boolean value that indicates whether the capture, encoding, and transmission of touch and pen frames on the client have been suspended. This value is toggled by the receipt of the [RDPINPUT\\_SUSPEND\\_INPUT\\_PDU \(section 2.2.3.4\)](#) message, as specified in section [3.3.5.4](#), and the [RDPINPUT\\_RESUME\\_INPUT\\_PDU \(section 2.2.3.5\)](#) message, as specified in section [3.3.5.5](#).

### 3.3.1.2 Pen Input Allowed

The **Pen Input Allowed** abstract data model (ADM) element contains a Boolean value that indicates whether the server supports the injection of pen input using the [RDPINPUT\\_PEN\\_EVENT\\_PDU \(section 2.2.3.7\)](#) message. This value is set by the client when processing the [RDPINPUT\\_SC\\_READY\\_PDU \(section 2.2.3.1\)](#) message, as specified in section [3.3.5.1](#).

### 3.3.2 Timers

None.

### 3.3.3 Initialization

The client SHOULD NOT open the "Microsoft::Windows::RDS::Input" virtual channel transport (section [2.1](#)) if a physical or virtual touch digitizer is not attached to the system.

### 3.3.4 Higher-Layer Triggered Events

None.

### 3.3.5 Message Processing Events and Sequencing Rules

#### 3.3.5.1 Processing an RDPINPUT\_SC\_READY\_PDU message

The structure and fields of the **RDPINPUT\_SC\_READY\_PDU** message are specified in section [2.2.3.1](#).

The **header** field MUST be processed as specified in section [3.1.5.1](#). If the message is valid, the client SHOULD respond by sending the [RDPINPUT\\_CS\\_READY\\_PDU \(section 2.2.3.2\)](#) message to the server, as specified in section [3.3.5.2](#). If the **protocolVersion** field of the **RDPINPUT\_SC\_READY\_PDU** message is set to at least RDPINPUT\_PROTOCOL\_V200 (0x00020000), then the client SHOULD set the **Pen Input Allowed** (section [3.3.1.2](#)) ADM element to TRUE.

After sending the **RDPINPUT\_CS\_READY\_PDU** message to the server, the client SHOULD start remoting multitouch and pen input frames by sending the [RDPINPUT\\_TOUCH\\_EVENT\\_PDU \(section 2.2.3.3\)](#) and [RDPINPUT\\_PEN\\_EVENT\\_PDU \(section 2.2.3.7\)](#) messages to the server, as specified in sections [3.3.5.3](#) and [3.3.5.7](#), respectively.

#### 3.3.5.2 Sending an RDPINPUT\_CS\_READY\_PDU message

The structure and fields of the **RDPINPUT\_CS\_READY\_PDU** message are specified in section [2.2.3.2](#).

The client MUST populate the **maxTouchContacts** field to indicate the maximum number of touch contacts that can be active at any given point in time. This value is the sum of the maximum active contacts supported by each touch digitizer attached to the client.

### 3.3.5.3 Sending an RDPINPUT\_TOUCH\_EVENT\_PDU message

The structure and fields of the **RDPINPUT\_TOUCH\_EVENT\_PDU** message are specified in section [2.2.3.3](#).

Each RDPINPUT\_TOUCH\_EVENT\_PDU (section 2.2.3.3) message contains an array of [RDPINPUT\\_TOUCH\\_FRAME \(section 2.2.3.3.1\)](#) structures, and each frame contains an array of [RDPINPUT\\_TOUCH\\_CONTACT \(section 2.2.3.3.1.1\)](#) structures. Every **RDPINPUT\_TOUCH\_CONTACT** structure represents the state and attributes of an active contact; see section [3.1.1.1](#) for a description of permissible touch contact state transitions.

Every touch frame received by the client from a touch digitizer MUST be encoded as an **RDPINPUT\_TOUCH\_FRAME** structure, the contacts being encoded as **RDPINPUT\_TOUCH\_CONTACT** structures. The number of encoded frames depends on the rate at which the digitizer generates touch frames. Once the touch frames have been encoded, they MUST be encapsulated in an **RDPINPUT\_TOUCH\_EVENT\_PDU** message.

### 3.3.5.4 Processing an RDPINPUT\_SUSPEND\_INPUT\_PDU message

The structure and fields of the **RDPINPUT\_SUSPEND\_INPUT\_PDU** message are specified in section [2.2.3.4](#).

The **header** field MUST be processed as specified in section [3.1.5.1](#). If the message is valid, the client MUST set the **Input Transmission Suspended** (section [3.3.1.1](#)) ADM element to TRUE and MUST suspend the transmission of input messages to the server. If the **Input Transmission Suspended** ADM element is already set to TRUE, the client SHOULD ignore this message.

### 3.3.5.5 Processing an RDPINPUT\_RESUME\_INPUT\_PDU message

The structure and fields of the **RDPINPUT\_RESUME\_INPUT\_PDU** message are specified in section [2.2.3.5](#).

The **header** field MUST be processed as specified in section [3.1.5.1](#). If the message is valid, the client SHOULD set the **Input Transmission Suspended** (section [3.3.1.1](#)) ADM element to FALSE and MUST resume the transmission of input messages to the server. If the **Input Transmission Suspended** ADM element is already set to FALSE, the client SHOULD ignore this message.

### 3.3.5.6 Sending an RDPINPUT\_DISMISS\_HOVERING\_TOUCH\_CONTACT\_PDU message

The structure and fields of the **RDPINPUT\_DISMISS\_HOVERING\_TOUCH\_CONTACT\_PDU** message are specified in section [2.2.3.6](#).

The **contactId** field MUST be initialized with the ID of a valid hovering contact that has to be transitioned to the "out of range" state.

### 3.3.5.7 Sending an RDPINPUT\_PEN\_EVENT\_PDU message

The structure and fields of the **RDPINPUT\_PEN\_EVENT\_PDU** message are specified in section [2.2.3.7](#).

Each RDPINPUT\_PEN\_EVENT\_PDU (section 2.2.3.7) message contains an array of [RDPINPUT\\_PEN\\_FRAME \(section 2.2.3.7.1\)](#) structures, and each frame contains an array of [RDPINPUT\\_PEN\\_CONTACT \(section 2.2.3.7.1.1\)](#) structures. Every **RDPINPUT\_PEN\_CONTACT** structure represents the state and attributes of an active contact; see section [3.1.1.1](#) for a description of permissible pen contact state transitions.

Every pen frame received by the client from a pen digitizer MUST be encoded as an **RDPINPUT\_PEN\_FRAME** structure, the contacts being encoded as **RDPINPUT\_PEN\_CONTACT** structures. The number of encoded frames depends on the rate at which the digitizer generates pen frames. Once the pen frames have been encoded, they MUST be encapsulated in an **RDPINPUT\_PEN\_EVENT\_PDU** message.

### **3.3.6 Timer Events**

None.

### **3.3.7 Other Local Events**

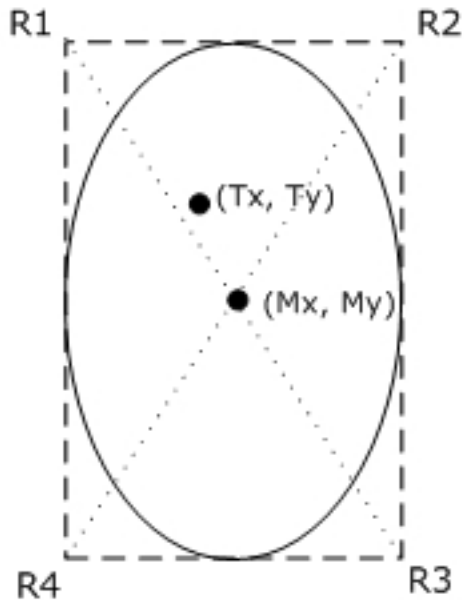
None.

## 4 Protocol Examples

### 4.1 Touch Contact Geometry Examples

The examples in sections [4.1.1](#) through to [4.1.4](#) present illustrations of touch contacts orientated at 0, 45, 90 and 315 degrees respectively. Based on the orientation of the contact, the contact geometry is rotated so that the height of the contact rectangle is parallel to the y-axis and the width parallel to the x-axis.

#### 4.1.1 Touch Contact Oriented at 0 Degrees



In this case, the `x`, `y`, contact rectangle, and orientation of the [RDPINPUT TOUCH CONTACT \(section 2.2.3.3.1.1\)](#) structure are populated by using the following values:

**x** = Tx

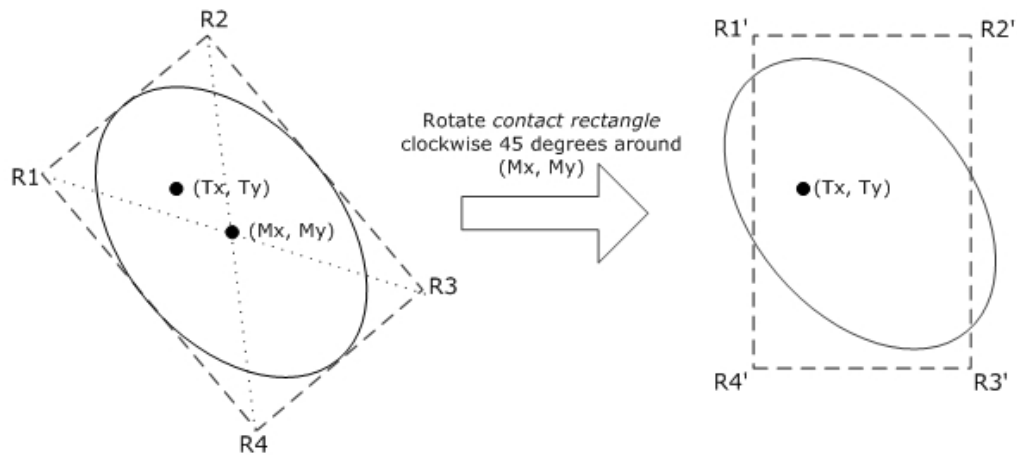
**y** = Ty

**contact rectangle** = (R1, R2, R3, R4)

**orientation** = 0 degrees



### 4.1.2 Touch Contact Oriented at 45 Degrees



In this case, the  $x$ ,  $y$ , contact rectangle, and orientation fields of the [RDPINPUT TOUCH CONTACT \(section 2.2.3.3.1.1\)](#) structure are populated by using the following values:

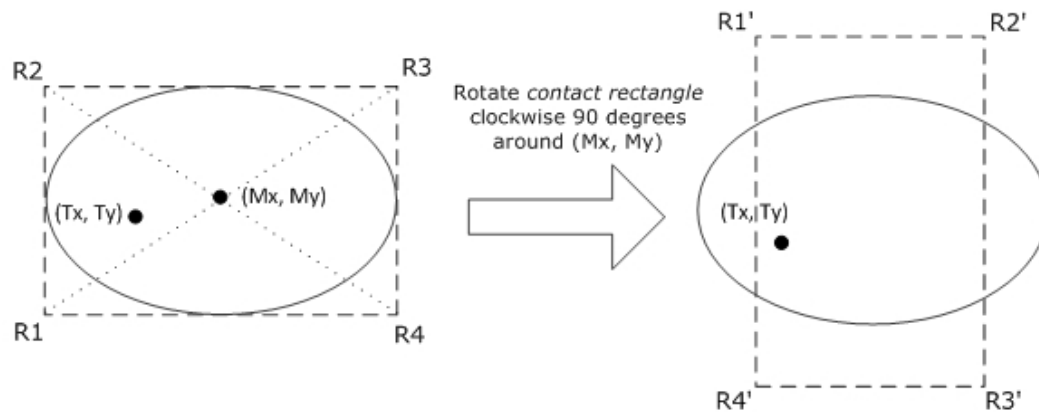
**x** = Tx

**y** = Ty

**contact rectangle** = (R1', R2', R3', R4')

**orientation** = 45 degrees

### 4.1.3 Touch Contact Oriented at 90 Degrees



In this case, the  $x$ ,  $y$ , contact rectangle, and orientation fields of the [RDPINPUT TOUCH CONTACT \(section 2.2.3.3.1.1\)](#) structure are populated by using the following values:

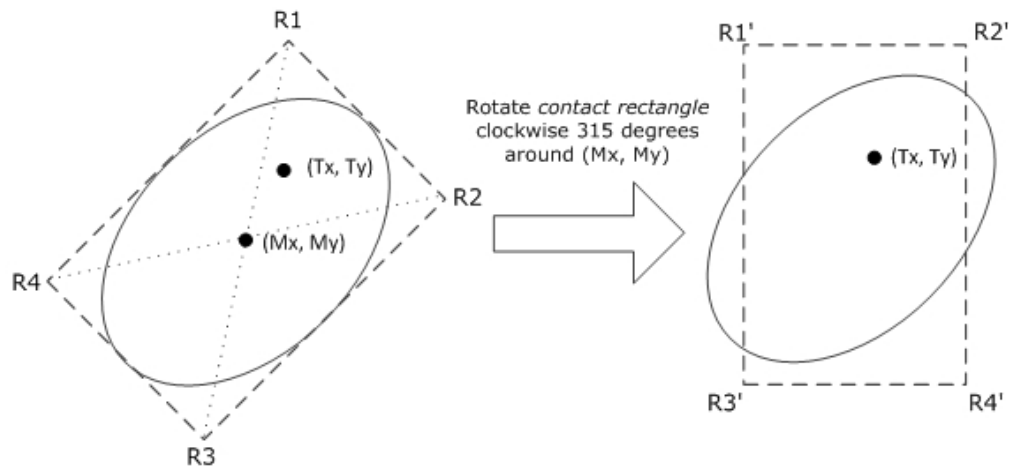
**x** = Tx

**y** = Ty

**contact rectangle** = (R1', R2', R3', R4')

**orientation** = 90 degrees

#### 4.1.4 Touch Contact Oriented at 315 Degrees



In this case, the `x`, `y`, contact rectangle, and orientation fields of the [RDPINPUT TOUCH CONTACT \(section 2.2.3.3.1.1\)](#) structure are populated by using the following values:

**x** = Tx

**y** = Ty

**contactRect** = (R1', R2', R3', R4')

**orientation** = 315 degrees

## **5 Security**

### **5.1 Security Considerations for Implementers**

None.

### **5.2 Index of Security Parameters**

None.

## 6 Appendix A: Product Behavior

The information in this specification is applicable to the following Microsoft products or supplemental software. References to product versions include released service packs.

- 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

Exceptions, if any, are noted below. If a service pack or Quick Fix Engineering (QFE) number appears with the product version, behavior changed in that service pack or QFE. The new behavior also applies to subsequent service packs of the product unless otherwise specified. If a product edition appears with the product version, behavior is different in that product edition.

Unless otherwise specified, any statement of optional behavior in this specification that is prescribed using the terms "SHOULD" or "SHOULD NOT" implies product behavior in accordance with the SHOULD or SHOULD NOT prescription. Unless otherwise specified, the term "MAY" implies that the product does not follow the prescription.

## 7 Change Tracking

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

## 8 Index

### A

Abstract data model  
[client](#) 28  
[touch contact state transitions](#) 25  
[touch remoting suspended](#) 29  
[server](#) 26  
[touch contact state transitions](#) 25  
[Applicability](#) 7

### C

[Capability negotiation](#) 7  
[Change tracking](#) 37  
Client  
[abstract data model](#) 28  
[touch contact state transitions](#) 25  
[touch remoting suspended](#) 29  
higher-layer triggered events ([section 3.1.4](#) 26, [section 3.3.4](#) 29)  
initialization ([section 3.1.3](#) 26, [section 3.3.3](#) 29)  
message processing events  
[processing input message](#) 26  
[processing RDPINPUT\\_READY\\_PDU message](#) 29  
[processing RDPINPUT\\_RESUME\\_PDU message](#) 30  
[processing RDPINPUT\\_SUSPEND\\_PDU message](#) 30  
[sending RDPINPUT\\_READY\\_PDU message](#) 29  
sending RDPINPUT\_TOUCH\_PDU message ([section 3.3.5.1](#) 29, [section 3.3.5.3](#) 30)  
other local events ([section 3.1.7](#) 26, [section 3.3.7](#) 31)  
sequencing rules  
[processing input message](#) 26  
[processing RDPINPUT\\_READY\\_PDU message](#) 29  
[processing RDPINPUT\\_RESUME\\_PDU message](#) 30  
[processing RDPINPUT\\_SUSPEND\\_PDU message](#) 30  
[sending RDPINPUT\\_READY\\_PDU message](#) 29  
sending RDPINPUT\_TOUCH\_PDU message ([section 3.3.5.1](#) 29, [section 3.3.5.3](#) 30)  
timer events ([section 3.1.6](#) 26, [section 3.3.6](#) 31)  
timers ([section 3.1.2](#) 26, [section 3.3.2](#) 29)

### D

Data model - abstract  
[client](#) 28  
[touch contact state transitions](#) 25  
[touch remoting suspended](#) 29  
[server](#) 26  
[touch contact state transitions](#) 25  
[Directory service schema elements](#) 24

### E

[Elements - directory service schema](#) 24

### F

[Fields - vendor-extensible](#) 7

### G

[Glossary](#) 5

### H

Higher-layer triggered events  
client ([section 3.1.4](#) 26, [section 3.3.4](#) 29)  
server ([section 3.1.4](#) 26, [section 3.2.4](#) 27)

### I

[Implementer - security considerations](#) 35  
[Index of security parameters](#) 35  
[Informative references](#) 5  
Initialization  
client ([section 3.1.3](#) 26, [section 3.3.3](#) 29)  
server ([section 3.1.3](#) 26, [section 3.2.3](#) 27)  
[Introduction](#) 5

### M

Message processing events  
client  
[processing input message](#) 26  
[processing RDPINPUT\\_READY\\_PDU message](#) 29  
[processing RDPINPUT\\_RESUME\\_PDU message](#) 30  
[processing RDPINPUT\\_SUSPEND\\_PDU message](#) 30  
[sending RDPINPUT\\_READY\\_PDU message](#) 29  
sending RDPINPUT\_TOUCH\_PDU message ([section 3.3.5.1](#) 29, [section 3.3.5.3](#) 30)  
server  
[processing input message](#) 26  
[processing RDPINPUT\\_READY\\_PDU message](#) 27  
processing RDPINPUT\_TOUCH\_PDU message ([section 3.2.5.1](#) 27, [section 3.2.5.3](#) 27)  
[sending RDPINPUT\\_READY\\_PDU message](#) 27  
[sending RDPINPUT\\_RESUME\\_PDU message](#) 28  
[sending RDPINPUT\\_SUSPEND\\_PDU message](#) 27  
Messages  
[syntax](#) 8  
[transport](#) 8

### N

[Normative references](#) 5

### O

Other local events  
client ([section 3.1.7](#) 26, [section 3.3.7](#) 31)  
server ([section 3.1.7](#) 26, [section 3.2.7](#) 28)  
Overview (synopsis) ([section 1.3](#) 6, [section 1.6](#) 7)

### P

[Parameters - security index](#) 35  
[Preconditions](#) 7  
[Prerequisites](#) 7  
[Product behavior](#) 36

## R

[References](#) 5  
    [informative](#) 5  
    [normative](#) 5  
[Relationship to other protocols](#) 7

## S

[Schema elements - directory service](#) 24  
Security  
    [implementer considerations](#) 35  
    [parameter index](#) 35  
Sequencing rules  
    client  
        [processing input message](#) 26  
        [processing RDPINPUT\\_READY\\_PDU message](#) 29  
        [processing RDPINPUT\\_RESUME\\_PDU message](#) 30  
        [processing RDPINPUT\\_SUSPEND\\_PDU message](#) 30  
        [sending RDPINPUT\\_READY\\_PDU message](#) 29  
        [sending RDPINPUT\\_TOUCH\\_PDU message](#)  
        ([section 3.3.5.1](#) 29, [section 3.3.5.3](#) 30)  
    server  
        [processing input message](#) 26  
        [processing RDPINPUT\\_READY\\_PDU message](#) 27  
        [processing RDPINPUT\\_TOUCH\\_PDU message](#)  
        ([section 3.2.5.1](#) 27, [section 3.2.5.3](#) 27)  
        [sending RDPINPUT\\_READY\\_PDU message](#) 27  
        [sending RDPINPUT\\_RESUME\\_PDU message](#) 28  
        [sending RDPINPUT\\_SUSPEND\\_PDU message](#) 27  
Server  
    [abstract data model](#) 26  
    [touch contact state transitions](#) 25  
    higher-layer triggered events ([section 3.1.4](#) 26,  
    [section 3.2.4](#) 27)  
    initialization ([section 3.1.3](#) 26, [section 3.2.3](#) 27)  
    message processing events  
        [processing input message](#) 26  
        [processing RDPINPUT\\_READY\\_PDU message](#) 27  
        [processing RDPINPUT\\_TOUCH\\_PDU message](#)  
        ([section 3.2.5.1](#) 27, [section 3.2.5.3](#) 27)  
        [sending RDPINPUT\\_READY\\_PDU message](#) 27  
        [sending RDPINPUT\\_RESUME\\_PDU message](#) 28  
        [sending RDPINPUT\\_SUSPEND\\_PDU message](#) 27  
    other local events ([section 3.1.7](#) 26, [section 3.2.7](#)  
    28)  
    sequencing rules  
        [processing input message](#) 26  
        [processing RDPINPUT\\_READY\\_PDU message](#) 27  
        [processing RDPINPUT\\_TOUCH\\_PDU message](#)  
        ([section 3.2.5.1](#) 27, [section 3.2.5.3](#) 27)  
        [sending RDPINPUT\\_READY\\_PDU message](#) 27  
        [sending RDPINPUT\\_RESUME\\_PDU message](#) 28  
        [sending RDPINPUT\\_SUSPEND\\_PDU message](#) 27  
    timer events ([section 3.1.6](#) 26, [section 3.2.6](#) 28)  
    timers ([section 3.1.2](#) 26, [section 3.2.2](#) 26)  
[Standards assignments](#) 7  
[Syntax](#) 8

## T

Timer events  
    client ([section 3.1.6](#) 26, [section 3.3.6](#) 31)  
    server ([section 3.1.6](#) 26, [section 3.2.6](#) 28)

## Timers

    client ([section 3.1.2](#) 26, [section 3.3.2](#) 29)  
    server ([section 3.1.2](#) 26, [section 3.2.2](#) 26)  
[Tracking changes](#) 37  
[Transport](#) 8  
Triggered events - higher-layer  
    client ([section 3.1.4](#) 26, [section 3.3.4](#) 29)  
    server ([section 3.1.4](#) 26, [section 3.2.4](#) 27)

## V

[Vendor-extensible fields](#) 7  
[Versioning](#) 7