[MS-RDPESC]:
Remote Desktop Protocol:
Smart Card Virtual Channel Extension

Revision Summary

Date	Revision History	Revision Class	Comments
06/01/2007	1.0	Major	Updated and revised the technical content.
07/03/2007	1.0.1	Editorial	Revised and edited the technical content.
07/20/2007	1.0.2	Editorial	Revised and edited the technical content.
08/10/2007	1.0.3	Editorial	Revised and edited the technical content.

Date	Revision History	Revision Class	Comments
09/28/2007	1.0.4	Editorial	Revised and edited the technical content.
10/23/2007	1.0.5	Editorial	Revised and edited the technical content.
11/30/2007	2.0	Major	Normative reference.
01/25/2008	2.0.1	Editorial	Revised and edited the technical content.

Table of Contents

1 Introduction

This document specifies an extension (including **virtual channels**) to the Remote Desktop Protocol: File System Virtual Channel Extension for supporting **smart card** reader-like devices.

1.1 Glossary

The following terms are defined in [MS-GLOS]:

ASCII
Device
Device Driver
HRESULT
Interface Definition Language (IDL)
Remote Procedure Call (RPC)
Smart Card
Unicode
Unicode String
Universally Unique Identifier (UUID)

The following terms are specific to this document:

Answer To Reset (ATR): The transmission sent by an ISO-7816–complaint Integrated Circuit Card (as specified in [ISO-7816-3]) to a **smart card reader** in response to an ISO-7816-3–based RESET condition.

Build number: A unique number identifying the version of an application, in this case the **Terminal Services (TS) Client**.

Call Packet: A combination of **IOCTL** and a data structure request from a **protocol client** that corresponds to that **IOCTL**.

Card Type: A string that specifies a specific type of smart card that is recognized by **Smart Cards for Windows**.

Device I/O: **Device** input/output.

Device Name: The friendly, human-readable name of a **device**.

I/O Control Code (IOCTL and IOControlCode): The 32-bit number that specifies the function to execute on the **protocol server**.

Microsoft Terminal Services: A component that allows a user to access applications or data stored on a remote computer over a network connection.

Multi-String: A series of NULL terminated character string ("\0") terminated by final NULL character stored in a contiguous block of memory.

Operating System Version: A uniquely identifiable numbered string that is used to identify a particular operating system.

Protocol Client: An endpoint that initiates a protocol.

Protocol Server: An endpoint that processes the **call packet** from a **protocol client**.

Reader Group Name: The friendly, human-readable name for a Reader Group.

Remote Desktop Protocol (RDP): A multi-channel protocol that allows a user to connect to a computer running **Microsoft Terminal Services**.

Return Packet: An encoded structure containing the result of a **call packet** operation executed on the **protocol client**.

Smart Card Reader: A **device** used as a communication medium between the smart card and a Host; for example, a computer. Also referred to as a Reader.

Smart Card Reader Name: The friendly, human-readable name of the **smart card reader**. Also referred to as a Reader Name.

Smart Cards for Windows: An implementation of the ICC Resource Manager according to [PCSC5].

Static Virtual Channel: The **virtual channel** advertised at session establishment, as part of the RNS_UD_CS_NET data, a part of the Conference Create Request User Data.

TS Client: A **Microsoft Terminal Services** program that initiates a connection.

TS Server: A **Microsoft Terminal Services** program that responds to a request from a **TS client**.

Virtual channel: A communication channel available in a Terminal Server session between an application running at the server and extension module running in the Terminal Server client.

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

1.2 References

1.2.1 Normative References

We conduct frequent surveys of the normative references to assure their continued availability. If you have any issue with finding a normative reference, please contact dochelp@microsoft.com. We will assist you in finding the relevant information. Please check the archive site, http://msdn2.microsoft.com/en-us/library/E4BD6494-06AD-4aed-9823-445E921C9624, as an additional source.

[C706] The Open Group, "DCE 1.1: Remote Procedure Call", C706, August 1997, http://www.opengroup.org/public/pubs/catalog/c706.htm

[ISO-7816-3] International Organization for Standardization, "Identification Cards -- Integrated Circuit Cards -- Part 3: Cards with Contacts -- Electrical Interface and Transmission Protocols", ISO/IEC 7816-3, October 2006, http://www.iso.org/iso/en/CatalogueDetailPage.CatalogueDetail?CSNUMBER=38770

Note There is a charge to download the specification.

[ISO-7816-4] International Organization for Standardization, "Identification Cards -- Integrated Circuit Cards -- Part 4: Organization, Security, and Commands for Interchange", ISO/IEC 7816-4, January 2005, http://www.iso.org/iso/en/CatalogueDetailPage.CatalogueDetail?CSNUMBER=36134

Note There is a charge to download the specification.

[MS-DTYP] Microsoft Corporation, "Windows Data Types", January 2007.

[MS-DCOM] Microsoft Corporation, "Distributed Component Object Model (DCOM) Remote Protocol Specification", March 2007.

[MS-ERREF] Microsoft Corporation, "Windows Error Codes", January 2007.

[MS-GLOS] Microsoft Corporation, "Windows Protocols Master Glossary", March 2007.

[MS-RPCE] Microsoft Corporation, "Remote Procedure Call Protocol Extensions", January 2007.

[MS-RDPEFS] Microsoft Corporation, "Remote Desktop Protocol: File System Virtual Channel Extension", September 2007.

[PCSC3] PC/SC Workgroup, "Interoperability Specification for ICCs and Personal Computer Systems - Part 3: Requirements for PC-Connected Interface Devices", December 1997, http://www.pcscworkgroup.com/specifications/files/p3v10doc.zip

[PCSC5] PC/SC Workgroup, "Interoperability Specification for ICCs and Personal Computer Systems - Part 5: ICC Resource Manager Definition", December 1997, http://www.pcscworkgroup.com/specifications/files/p5v10doc.zip

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

1.2.2 Informative References

There are no informative references for this protocol.

1.3 Protocol Overview (Synopsis)

The following figure illustrates a baseline for terminology related to clients and servers.

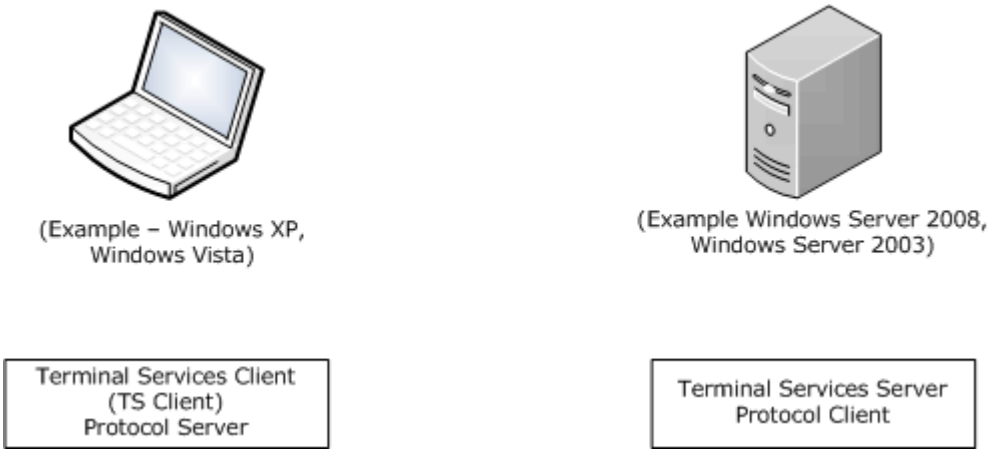


Figure 1: TS and protocol client-server definition

Remote Desktop Protocol (RDP) Device Redirection enables client **devices** (for example, printers, **smart card readers**, drives, audio, serial and parallel ports) to be available to server-side applications, within the context of a single **RDP** session. This protocol is specified in [MS-RDPEFS].

Smart Card Redirection is an asynchronous client/server protocol, an extension (specified in [MS-RDPEFS]) that is designed to remotely execute requests on a client's **Smart Cards for Windows**. These requests would have otherwise been executed on the server. Each request is composed of two

packets: a **call packet** and **return packet**. The **protocol client** (**TS server**) sends a call packet after an initial announcement by the **protocol server** (**TS client**), and will receive a return packet after the request has been completed or an error has occurred. Remote Desktop Protocol (RDP) Device Redirection uses a **static virtual channel** as its transport.

Smart Card Redirection redirects the TS Client–side Smart Cards for Windows. When Smart Card Redirection is in effect, TS Server application smart card subsystem calls (for example, EstablishContext) are automatically remapped to the TS Client–side Smart Cards for Windows, which will then receive the corresponding request. Smart Card Redirection devices are only required to understand one type of **device I/O** request.

The following figure shows a high-level sequence diagram of the protocol for redirected calls. Device Announce and Device Disconnect are handled via the lower-layer protocols.

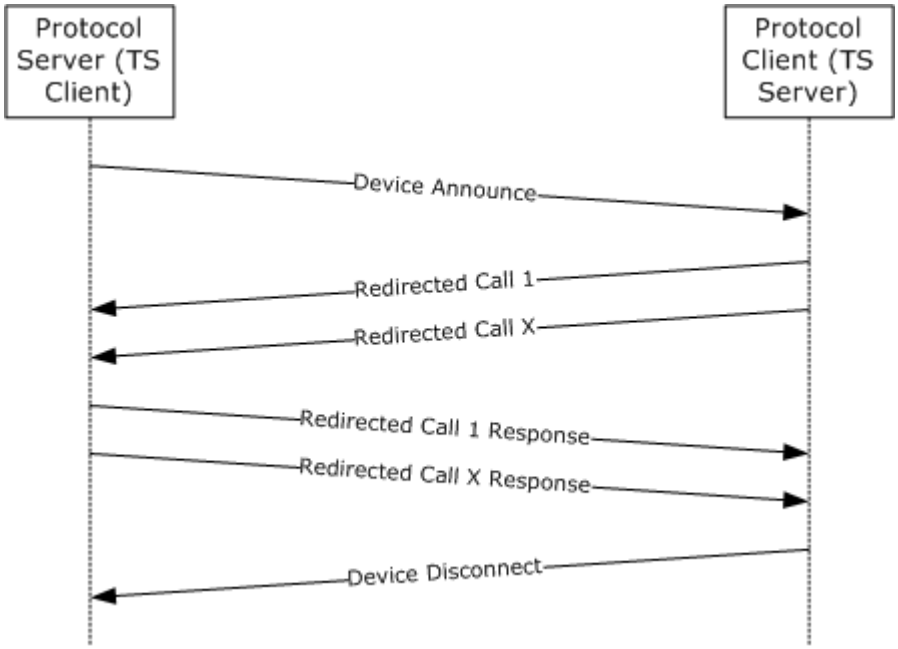


Figure 2: High-level protocol sequence

The following figure specifies how the messages are encoded and routed from a TS client to a TS server. The following numbered list details corresponding actions related to the pictured protocol flow.

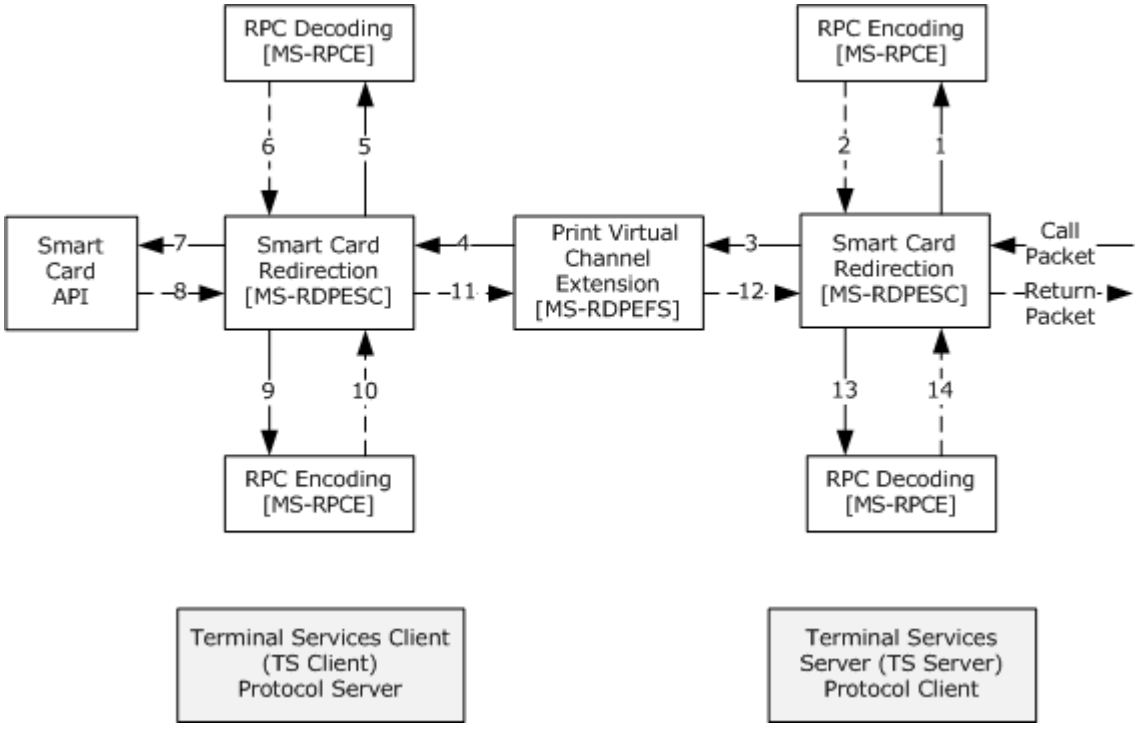


Figure 3: Protocol flow

The input for this protocol (call packet) is a combination of an **I/O control (IOCTL)** and the corresponding structure as specified in section 3.2.5.

1. The call packet structure is encoded as specified in [MS-RPCE] section 2.2.6.
2. The packet, as specified in [MS-RPCE], is returned as a response to 1.
3. The encoded value from 2 is combined with the IOCTL and transported over RDP Device Redirection, as specified in [MS-RDPEFS].
4. On the TS client, Remote Desktop Protocol: File System Virtual Channel Extension will route the packet from 3 to protocol server for the Smart Card Redirection, as specified in [MS-RDPEFS].
5. After Smart Card Redirection receives the message, the encoded structure is decoded, as specified in [MS-RPCE] section 2.2.6.
6. The packet, decoded as specified in [MS-RPCE], is a response to 5.
7. Based on the IOCTL, the structure members are used as input parameters to the Smart Cards for Windows, as specified in [PCSC5].
8. The output parameters including the return code are packaged into the return packet structure for this IOCTL.
9. The return packet structure is encoded as specified in [MS-RPCE] section 2.2.6.
10. Return data, encoded as specified in [MS-RPCE], is a response to 9.

11. The encoded value from 10 is sent to RDP Device Redirection (as specified in [MS-RDPEFS]) as a reply to the call packet from 4.

12. RDP Device Redirection (as specified in [MS-RDPEFS]) routes the reply back to the protocol client.

13. On receipt of packet from 12, the encoded structure is decoded as specified by to [MS-RPCE] section 2.2.6.

14. In response to 13, return data is decoded as specified by [MS-RPCE].

The output from the Smart Card Redirection is the return packet. This data will then be processed by higher layers.

1.4 Relationship to Other Protocols

This protocol extension expands the functionality (as specified in [MS-RDPEFS]) for Smart Cards for Windows API, as specified in [PCSC5]).

1.5 Prerequisites/Preconditions

RDP Device Redirection transport (as specified in [MS-RDPEFS]) must be configured to redirect smart card devices.

1.6 Applicability Statement

This specification applies to redirecting Smart Cards for Windows API-based calls for a Terminal Services client, as specified in [PCSC5].

1.7 Versioning and Capability Negotiation

This document covers versioning issues in the following areas:

- Protocol Versions: Smart Card Redirection supports the following explicit dialects: "SCREDIR_VERSION_XP" and "SCREDIR_VERSION_LONGHORN"

  Multiple versions of the Smart Card Redirection Protocol exist. It was introduced in Remote Desktop Protocol version 5.1 and extended by adding additional calls in Remote Desktop Protocol version 6.0. The version of the protocol is determined on the server by querying the value of the TS client **build number**.

- Capability Negotiation: The Smart Card Redirection protocol does not support negotiation of the dialect to use. Instead, an implementation must be configured with the dialect to use.

  The dialect used is determined by the TS client's build number. The TS server determines the dialect to use by analyzing the client build number on device announce.<1> If the build number is at least 4,034, then SCREDIR_VERSION_LONGHORN is assumed otherwise SCREDIR_VERSION_XP is to be used.

1.8 Vendor-Extensible Fields

This protocol uses **HRESULTs** as defined in [MS-ERREF]. Vendors can define their own HRESULT values, provided they set the C bit (0x20000000) for each vendor-defined value, indicating the value is a customer code.

This protocol uses Win32 error codes. These values are taken from the Windows error number space, as specified in [MS-ERREF]. Vendors SHOULD reuse those values with their indicated meaning. Choosing any other value runs the risk of a collision in the future.

This protocol uses NTSTATUS values as specified in [MS-ERREF]. Vendors are free to choose their own values for this field, provided they set the C bit (0x20000000) for each vendor-defined value, indicating it is a customer code.

IOCTL fields used in this specification are extensible. Vendors MUST implement the corresponding functions.

1.9 Standards Assignments

Parameter	Value	Reference
Remote procedure call (RPC) interface universally unique identifier (UUID)	A35AF600-9CF4-11CD-A076-08002B2BD711	[C706]

2 Messages

The following sections specify how Remote Desktop Protocol: Smart Card Virtual Channel Extension messages are transported, and common data types.

2.1 Transport

All messages MUST be transported over an established RDP Device Extensions (as specified in [MS-RDPEFS]). This protocol uses the device enumerate and announcement messages, as specified in [MS-RDPEFS].

Remote Desktop Protocol: File System Virtual Channel Extension is responsible for choosing a unique Device Id for the DR_SMARTCARD_SUBSYTEM device.

2.2 Common Data Types

All structures in this section MUST be encoded as specified in [MS-RPCE] section 2. Unless otherwise stated, the structure MUST be initialized to zero before use.

2.2.1 Common Structures

The structures defined in the following sections are common among both TS server-generated structures (for more information, see section 2.2.2) and TS client-generated structures (for more information, see section 2.2.3).

2.2.1.1 REDIR_SCARDCONTEXT

REDIR_SCARDCONTEXT represents a context to Smart Cards for Windows on the TS Client.

```
typedef struct _REDIR_SCARDCONTEXT {
  [range(0, 16)] unsigned long cbContext;
  [unique, size_is(cbContext)] byte* pbContext;
} REDIR_SCARDCONTEXT;
```

cbContext: The number of bytes in the **pbContext** field.

pbContext: An array of **cbContext** bytes that contains Smart Cards for Windows context. The data is implementation-specific and MUST NOT be interpreted or changed on the Protocol Server.

2.2.1.2 REDIR_SCARDHANDLE

REDIR_SCARDHANDLE represents a smart card reader handle associated with Smart Cards for Windows context.

```
typedef struct _REDIR_SCARDHANDLE {
  REDIR_SCARDCONTEXT Context;
  [range(0, 16)] signed long cbHandle;
  [size_is(cbHandle)] byte* pbHandle;
} REDIR_SCARDHANDLE;
```

Context: A valid context, as specified in **REDIR_SCARDCONTEXT**.

cbHandle: The number of bytes in the **pbHandle** field.

pbHandle: An array of **cbHandle** bytes that corresponds to a smart card reader handle on the TS Client. The data is implementation-specific and MUST NOT be interpreted or changed on the Protocol Server.

2.2.1.3 Connect_Common

The **Connect_Common** structure contains information common to both versions of the Connect function (for more information, see sections 2.2.2.13 and 2.2.2.14).

```
typedef struct _Connect_Common {
  REDIR_SCARDCONTEXT Context;
  unsigned long dwShareMode;
  unsigned long dwPreferredProtocols;
} Connect_Common;
```

Context: A valid context, as specified in section 2.2.1.1.

dwShareMode: A flag that indicates whether other applications are allowed to form connections to the card. Possible values of this field are specified in section 2.2.6.

dwPreferredProtocols: A bit mask of acceptable protocols for the connection, as specified in section 2.2.5.

2.2.1.4 LocateCards_ATRMask

The **LocateCards_ATRMask** structure contains the information to identify a **card type**.

```
typedef struct _LocateCards_ATRMask {
  [range(0, 36)] unsigned long cbAtr;
  byte rgbAtr[36];
  byte rgbMask[36];
} LocateCards_ATRMask;
```

cbAtr: The number of bytes used in the **rgbAtr** and **rgbMask** fields.

rgbAtr: Values for the card's **Answer To Reset (ATR)** string. This value MUST be formatted as specified in [ISO-7816-3]. Unused bytes MUST be set to 0 and MUST be ignored.

rgbMask: Values for the mask for the card's ATR string. For each bit that MUST not vary between cards of the same type MUST be set to 1. Unused bytes MUST be set to 0 and MUST be ignored.

2.2.1.5 ReaderState_Common_Call

The **ReaderState_Common_Call** structure contains the state of the reader at the time of the call as seen by the caller.

```
typedef struct _ReaderState_Common_Call {
  unsigned long dwCurrentState;
  unsigned long dwEventState;
  [range(0, 36)] unsigned long cbAtr;
  byte rgbAtr[36];
} ReaderState_Common_Call;
```

dwCurrentState: A bitmap that specifies the current reader state according to the TS Client. Possible values are specified in section 2.2.7.

dwEventState: A bitmap that defines the state of the reader after a state change. Possible values are specified in section 2.2.7.

cbAtr: The number of bytes used in the ATR string.

rgbAtr: The value for the card's ATR string. If **cbAtr** is NOT zero, this value MUST be formatted in accordance to [ISO-7816-3]. Unused bytes MUST be set to 0 and MUST be ignored.

2.2.1.6 ReaderStateA

The **ReaderStateA** structure contains information used in calls that only require Smart Cards for Windows context and a **ASCII** string.

```
typedef struct _ReaderStateA {
  [string] const char* szReader;
  ReaderState_Common_Call Common;
} ReaderStateA;
```

szReader: An ASCII string specifying the **reader name**.

Common: A packet that specifies the state of the reader at the time of the call. For information about this packet, see section 2.2.1.5.

2.2.1.7 ReaderStateW

The **ReaderStateW** structure is a **Unicode** representation of the state of a smart card reader.

```
typedef struct _ReaderStateW {
  [string] const wchar_t* szReader;
  ReaderState_Common_Call Common;
} ReaderStateW;
```

szReader: A Unicode string specifying the reader name.

Common: A packet that specifies the state of the reader at the time of the call. For information about this packet, see section 2.2.1.5.

2.2.1.8 SCardIO_Request

The **SCardIO_Request** structure represents the data to be prepended to a Transmit command (for more information, see section 3.1.4.35).

```
typedef struct _SCardIO_Request {
  unsigned long dwProtocol;
  [range(0, 1024)] unsigned long cbExtraBytes;
  [unique, size_is(cbExtraBytes)]
    byte* pbExtraBytes;
} SCardIO_Request;
```

dwProtocol: The protocol in use. Possible values are specified in section 2.2.5.

cbExtraBytes: The number of bytes in the **pbExtraBytes** field.

pbExtraBytes: Request data.

2.2.1.9 ReadCache_Common

The **ReadCache_Common** structure contains information common to both the **ReadCacheA_Call** and **ReadCacheW_Call** structures.

```
typedef struct _ReadCache_Common {
  REDIR_SCARDCONTEXT Context;
  UUID* CardIdentifier;
  unsigned long FreshnessCounter;
  long fPbDataIsNULL;
  unsigned long cbDataLen;
} ReadCache_Common;
```

Context: A valid context, as specified in section 2.2.1.1.

CardIdentifier: A **UUID** that specifies the name of the smart card that the name-value pair is associated.

FreshnessCounter: A value specifying the current revision of the data.

fPbDataIsNULL: A Boolean value specifying whether the caller wants to retrieve the length of the data. It MUST be set to TRUE (0x00000001) if the caller wants only to retrieve the length of the data; otherwise, it MUST be set to FALSE (0x00000000).

cbDataLen: The length of the buffer specified on the server-side. If **cbDataLen** is set to SCARD_AUTOALLOCATE with a value of 0xFFFFFFFF, a buffer of any length can be returned. Otherwise, the returned buffer MUST NOT exceed **cbDataLen** bytes. This field MUST be ignored if **fPbDataIsNULL** is set to TRUE (0x00000001).

2.2.1.10 WriteCache_Common

The **WriteCache_Common** structure contains information common between the **WriteCacheA_Call** and **WriteCacheW_Call** structures.

```
typedef struct _WriteCache_Common {
  REDIR_SCARDCONTEXT Context;
  UUID* CardIdentifier;
  unsigned long FreshnessCounter;
  [range(0, 65536)] unsigned long cbDataLen;
  [unique, size_is(cbDataLen)] byte* pbData;
} WriteCache_Common;
```

Context: A valid context, as specified in section 2.2.1.1.

CardIdentifier: A UUID that identifies the smart card with which the data SHOULD be stored. CardIdentifier MUST be a unique value per the smart card.

FreshnessCounter: A value specifying the current revision of the data.

cbDataLen: The number of bytes in the **pbData** field.

pbData: **cbDataLen** bytes of data to be stored.

2.2.1.11 ReaderState_Return

The **ReaderState_Return** structure specifies state information returned from Smart Cards for Windows.

```
typedef struct _ReaderState_Return {
  unsigned long dwCurrentState;
  unsigned long dwEventState;
  [range(0, 36)] unsigned long cbAtr;
  byte rgbAtr[36];
} ReaderState_Return;
```

dwCurrentState: A bitmap that defines the current state of the reader at the time of the call. Possible values are specified in section 2.2.7.

dwEventState: A bitmap that defines the state of the reader after a state change as seen by Smart Cards for Windows. Possible values are specified in section 2.2.7.

cbAtr: The number of used bytes in **rgbAtr**.

rgbAtr: The values for the card's ATR string. Unused bytes MUST be set to zero and MUST be ignored on receipt.

2.2.2 TS Server-Generated Structures

All structures in this section are sent from the TS Server to the TS Client.

2.2.2.1 EstablishContext_Call

The **EstablishContext_Call** structure is used to specify the scope of Smart Cards for Windows context to be created (for more information, see section 3.1.4.1).

```
typedef struct _EstablishContext_Call {
```

```
  unsigned long dwScope;
} EstablishContext_Call;
```

dwScope: The scope of the context that will be established. The following table shows valid values of this field.

Value	Meaning
SCARD_SCOPE_USER 0x00000000	The context is a user context; any database operations MUST be performed with the domain of the user.
SCARD_SCOPE_SYSTEM 0x00000002	The context is the system context; any database operations MUST be performed within the domain of the system.

2.2.2.2 Context_Call

The **Context_Call** structure contains Smart Cards for Windows context.

```
typedef struct _Context_Call {
  REDIR_SCARDCONTEXT Context;
} Context_Call;
```

Context: A valid context, as specified in section 2.2.1.1.

2.2.2.3 ListReaderGroups_Call

The **ListReaderGroups_Call** structure contains the parameters for the List Readers Groups call (for more information, see sections 3.1.4.5 and 3.1.4.6).

```
typedef struct _ListReaderGroups_Call {
  REDIR_SCARDCONTEXT Context;
  long fmszGroupsIsNULL;
  unsigned long cchGroups;
} ListReaderGroups_Call;
```

Context: A valid context, as specified in section 2.2.1.1.

fmszGroupsIsNULL: A Boolean value specifying whether the caller wants to retrieve just the length of the data. MUST be set to TRUE (0x00000001) if the caller wants only to retrieve the length of the data; otherwise, it MUST be set to FALSE (0x00000000).

cchGroups: The length of the string buffer specified by the caller. If **cchGroups** is set to SCARD_AUTOALLOCATE with a value of 0xFFFFFFFF, a string of any length can be returned. Otherwise, the returned string MUST NOT exceed **cchGroups** characters in length, including any NULL characters. This field MUST be ignored if **fmszGroupsIsNULL** is set to TRUE (0x00000001).

2.2.2.4 ListReaders_Call

The **ListReaders_Call** structure contains the parameters for the List Readers call (for more information, see sections 3.1.4.7 and 3.1.4.8).

```
typedef struct _ListReaders_Call {
  REDIR_SCARDCONTEXT Context;
  [range(0, 65536)] unsigned long cBytes;
  [unique, size_is(cBytes)] const byte* mszGroups;
  long fmszReadersIsNULL;
  unsigned long cchReaders;
} ListReaders_Call;
```

Context: A valid context, as specified in section 2.2.1.1.

cBytes: The length, in bytes, of reader groups specified in **mszGroups**.

mszGroups: The names of the reader groups defined in the system. Reader groups not present on the protocol server MUST be ignored. The value of this is dependent on the context (IOCTL) that it is used.

Value	Meaning
SCARD_IOCTL_LISTREADERSA 0x00090028	ASCII multi-string
SCARD_IOCTL_LISTREADERSW 0x0009002C	Unicode multi-string

fmszReadersIsNULL: A Boolean value specifying whether the caller wants to retrieve the length of the data. MUST be set to TRUE (0x00000001) if the caller wants only to retrieve the length of the data; otherwise, it MUST be set to FALSE (0x00000000).

cchReaders: The length of the string buffer specified by the caller. If **cchReaders** is set to SCARD_AUTOALLOCATE with a value of 0xFFFFFFFF, a string of any length can be returned. Otherwise, the returned string MUST NOT exceed **cchReaders** characters in length, including any NULL characters. This field MUST be ignored if **fmszReadersIsNULL** is set to TRUE (0x00000001).

2.2.2.5 ContextAndStringA_Call

The **ContextAndStringA_Call** structure contains information used in calls that only require a Smart Cards for Windows context and a ASCII string.

```
typedef struct _ContextAndStringA_Call {
  REDIR_SCARDCONTEXT Context;
  [string] const char* sz;
} ContextAndStringA_Call;
```

Context: A valid context, as specified in section 2.2.1.1.

sz: The value of this string depends on the context (based on IOCTL) in which this structure is used.

Value	Meaning
SCARD_IOCTL_INTRODUCEREADERGROUPA 0x00090050	Reader Group Name
SCARD_IOCTL_FORGETREADERGROUPA 0x00090058	Reader Group Name
SCARD_IOCTL_FORGETREADERA 0x00090068	Reader name

2.2.2.6 ContextAndStringW_Call

The **ContextAndStringW_Call** structure contains information used in calls that only require a Smart Cards for Windows context and a Unicode string.

```
typedef struct _ContextAndStringW_Call {
  REDIR_SCARDCONTEXT Context;
  [string] const wchar_t* sz;
} ContextAndStringW_Call;
```

Context: A valid context, as specified in section 2.2.1.1.

sz: The value of this Unicode string depends on the context (based on IOCTL) in which this structure is used.

Value	Meaning
SCARD_IOCTL_INTRODUCEREADERGROUPW 0x00090054	Reader Group Name
SCARD_IOCTL_FORGETREADERGROUPW 0x0009005C	Reader Group Name
SCARD_IOCTL_FORGETREADERW 0x0009006C	Reader name

2.2.2.7 ContextAndTwoStringA_Call

The contents of the **ContextAndTwoStringA_Call** structure are used in those calls that require a valid Smart Cards for Windows context (as specified in section 3.2.5) and two strings (friendly names).

```
typedef struct _ContextAndTwoStringA_Call {
  REDIR_SCARDCONTEXT Context;
  [string] const char* sz1;
  [string] const char* sz2;
} ContextAndTwoStringA_Call;
```

Context: A valid context, as specified in section 2.2.1.1.

sz1: The value of this ASCII string depends on the context (based on IOCTL) in which it is used.

Value	Meaning
SCARD_IOCTL_INTRODUCEREADERA 0x00090060	Reader name
SCARD_IOCTL_ADDREADERTOGROUPA 0x00090070	Reader name
SCARD_IOCTL_REMOVEREADERFROMGROUPA 0x00090078	Reader name

sz2: The value of this ASCII string depends on the context (based on IOCTL) in which it is used.

Value	Meaning
SCARD_IOCTL_INTRODUCEREADERA 0x00090060	Device name
SCARD_IOCTL_ADDREADERTOGROUPA 0x00090070	Reader Group Name
SCARD_IOCTL_REMOVEREADERFROMGROUPA 0x00090078	Reader Group Name

2.2.2.8 ContextAndTwoStringW_Call

The contents of the **ContextAndTwoStringW_Call** structure is used in those calls that require a valid Smart Cards for Windows context (as specified in section 3.2.5) and two strings (friendly names).

```
typedef struct _ContextAndTwoStringW_Call {
  REDIR_SCARDCONTEXT Context;
  [string] const wchar_t* sz1;
  [string] const wchar_t* sz2;
} ContextAndTwoStringW_Call;
```

Context: A valid context, as specified in section 2.2.1.1.

sz1: The value of this Unicode string depends on the context (based on IOCTL) in which it is used.

Value	Meaning
SCARD_IOCTL_INTRODUCEREADERW 0x00090064	Reader name
SCARD_IOCTL_ADDREADERTOGROUPW 0x00090074	Reader name
SCARD_IOCTL_REMOVEREADERFROMGROUPW	Reader name

Value	Meaning
0x0009007C	

sz2: The value of this Unicode string depends on the context (based on IOCTL) in which it is used.

Value	Meaning
SCARD_IOCTL_INTRODUCEREADERW 0x00090064	Device name
SCARD_IOCTL_ADDREADERTOGROUPW 0x00090074	Reader Group Name
SCARD_IOCTL_REMOVEREADERFROMGROUPW 0x0009007C	Reader Group Name

2.2.2.9 LocateCardsA_Call

The parameters of the **LocateCardsA_Call** structure specify the list of smart card readers to search for the specified Card Types. For call information, see section 3.1.4.21.

```
typedef struct _LocateCardsA_Call {
  REDIR_SCARDCONTEXT Context;
  [range(0, 65536)] unsigned long cBytes;
  [size_is(cBytes)] const byte* mszCards;
  [range(0, 10)] unsigned long cReaders;
  [size_is(cReaders)] ReaderStateA* rgReaderStates;
} LocateCardsA_Call;
```

Context: A valid context, as specified in section 2.2.1.1.

cBytes: The number of bytes in the **mszCards** field.

mszCards: An ASCII **multi-string** of card names to locate. Card Names MUST be registered in Smart Cards for Windows. Unknown card types MUST be ignored.

cReaders: The number of Reader state structures.

rgReaderStates: The Reader state information specifying which Readers are searched for the cards listed in **mszCards**.

2.2.2.10 LocateCardsW_Call

The parameters of the **LocateCardsW_Call** structure specify the list of smart card readers to search for the specified Card Types. For more information, see section 3.1.4.22.

```
typedef struct _LocateCardsW_Call {
  REDIR_SCARDCONTEXT Context;
  [range(0, 65536)] unsigned long cBytes;
  [size_is(cBytes)] const byte* mszCards;
  [range(0, 10)] unsigned long cReaders;
  [size_is(cReaders)] ReaderStateW* rgReaderStates;
```

```
} LocateCardsW_Call;
```

Context: A valid context, as specified in section 2.2.1.1.

cBytes: The number of bytes in the **mszCards** field.

mszCards: A Unicode multi-string of card names to locate. Card Names MUST be registered in Smart Cards for Windows. Unknown card types MUST be ignored.

cReaders: The number of Reader state structures.

rgReaderStates: The Reader state information used to locate the cards listed in *mszCards*.

2.2.2.11 GetStatusChangeA_Call

The **GetStatusChangeA_Call** structure provides the state change in the reader as specified in section 3.1.4.23.

```
typedef struct _GetStatusChangeA_Call {
  REDIR_SCARDCONTEXT Context;
  [range(0, 65536)] unsigned long cBytes;
  [size_is(cBytes)] const byte* mszCards;
  [range(0, 10)] unsigned long cReaders;
  [size_is(cReaders)] ReaderStateA* rgReaderStates;
} GetStatusChangeA_Call;
```

Context: A valid context, as specified in section 2.2.1.1.

cBytes: The number of bytes in the **mszCards** field.

mszCards: An ASCII multi-string of card names to locate. Card names MUST be registered in Smart Cards for Windows. Unknown card types MUST be ignored.

cReaders: The number of ReaderStates to track.

rgReaderStates: Smart card readers that the caller is tracking.

2.2.2.12 GetStatusChangeW_Call

The **GetStatusChangeW_Call** structure provides the state change in the Reader as specified in section 3.1.4.24.

```
typedef struct _GetStatusChangeW_Call {
  REDIR_SCARDCONTEXT Context;
  unsigned long dwTimeOut;
  [range(0, 11)] unsigned long cReaders;
  [size_is(cReaders)] ReaderStateW* rgReaderStates;
} GetStatusChangeW_Call;
```

Context: A valid context, as specified in section 2.2.1.1.

dwTimeOut: Maximum amount of time, in milliseconds, to wait for an action. If set to 0xFFFFFFFF (INFINITE), the caller MUST wait until an action occurs.

cReaders: The number of ReaderStates to track.

rgReaderStates: Smart card readers that the caller is tracking.

2.2.2.13 ConnectA_Call

ConnectA_Call opens a connection to the smart card located in the reader identified by a reader name.

```
typedef struct _ConnectA_Call {
  [string] const char* szReader;
  Connect_Common Common;
} ConnectA_Call;
```

szReader: An ASCII string specifying the reader name to connect to.

Common: Additional parameters that are required for the Connect call are specified in section 3.1.4.28. For more information, see section 2.2.1.3.

2.2.2.14 ConnectW_Call

The **ConnectW_Call** structure is used to open a connection to the smart card located in the reader identified by a reader name.

```
typedef struct _ConnectW_Call {
  [string] const wchar_t* szReader;
  Connect_Common Common;
} ConnectW_Call;
```

szReader: A Unicode string specifying the reader name to connect to.

Common: Additional parameters that are required for the Connect call. For more information, see sections 3.1.4.29 and 2.2.1.3.

2.2.2.15 Reconnect_Call

The **Reconnect_Call** structure is used to reopen a connection to the smart card associated with a valid context. For more information, see section 3.1.4.36.

```
typedef struct _Reconnect_Call {
  REDIR_SCARDHANDLE hCard;
  unsigned long dwShareMode;
  unsigned long dwPreferredProtocols;
  unsigned long dwInitialization;
} Reconnect_Call;
```

hCard: A handle, as specified in section 2.2.1.2.

dwShareMode: A flag that indicates whether other applications may form connections to this card. For acceptable values of this field, see section 2.2.6.

dwPreferredProtocols: A bit mask of acceptable protocols for this connection. For specifics on possible values, see section 2.2.5.

dwInitialization: A type of initialization that SHOULD be performed on the card.

Value	Meaning
SCARD_LEAVE_CARD 0x00000000	Do not do anything.
SCARD_RESET_CARD 0x00000001	Reset the smart card.
SCARD_UNPOWER_CARD 0x00000002	Turn off and reset the smart card.

2.2.2.16 HCardAndDisposition_Call

The **HCardAndDisposition_Call** structure defines the action taken on the disposition of a smart card associated with a valid context when a connection is terminated.

```
typedef struct _HCardAndDisposition_Call {
  REDIR_SCARDHANDLE hCard;
  unsigned long dwDisposition;
} HCardAndDisposition_Call;
```

hCard: A handle, as specified in section 2.2.1.2.

dwDisposition: The action to take on the card in the connected reader upon close. This value is ignored on a BeginTransaction message call, as specified in section 3.2.5.3.63.

Value	Meaning
SCARD_LEAVE_CARD 0x00000000	Do not do anything.
SCARD_RESET_CARD 0x00000001	Reset the smart card.
SCARD_UNPOWER_CARD 0x00000002	Turn off and reset the smart card.
SCARD_EJECT_CARD 0x00000003	Eject the smart card.

2.2.2.17 State_Call

The **State_Call** structure defines parameters to the State call (as specified in section 3.1.4.40) for querying the contents of a smart card reader.

```
typedef struct _State_Call {
```

```
  REDIR_SCARDHANDLE hCard;
  long fpbAtrIsNULL;
  unsigned long cbAtrLen;
} State_Call;
```

hCard: A handle, as specified in section 2.2.1.2.

fpbAtrIsNULL: A Boolean value specifying whether the caller wants to retrieve the length of the data. MUST be set to TRUE (0x00000001) if the caller wants only to retrieve the length of the data; otherwise it MUST be set to FALSE (0x00000000). Also, **cbAtrLen** is ignored if this value is TRUE (0x00000001).

Name	Value
FALSE	0x00000000
TRUE	0x00000001

cbAtrLen: The length of the buffer specified on the TS Server side. If **cbAtrLen** is set to SCARD_AUTOALLOCATE with a value of 0xFFFFFFFF, an array of any length can be returned. Otherwise, the returned array MUST NOT exceed **cbAtrLen** bytes in length.

2.2.2.18 Status_Call

Status_Call obtains the status of a connection for a valid smart card reader handle

```
typedef struct _Status_Call {
  REDIR_SCARDHANDLE hCard;
  long fmszReaderNamesIsNULL;
  unsigned long cchReaderLen;
  unsigned long cbAtrLen;
} Status_Call;
```

hCard: A handle, as specified in section 2.2.1.2.

fmszReaderNamesIsNULL: A Boolean value specifying whether the caller wants to retrieve the length of the data. MUST be set to TRUE (0x00000001) if the caller wants only to retrieve the length of the data; otherwise, it MUST be set to FALSE (0x00000000). Also, **cchReaderlen** is ignored if this value is TRUE (0x00000001).

Name	Value
FALSE	0x00000000
TRUE	0x00000001

cchReaderLen: The length of the string buffer specified on the TS Server side. If cchReaderLen is set to SCARD_AUTOALLOCATE with a value of 0xFFFFFFFF, a string of any length can be returned. Otherwise, the returned string MUST NOT exceed **cchReadersLen** characters in length, including any NULL characters. This field MUST be ignored if **fmszReaderNamesIsNULL** is TRUE (0x00000001).

cbAtrLen: Unused. MUST be ignored upon receipt.

2.2.2.19 Transmit_Call

The **Transmit_Call** structure is used to send data to the smart card associated with a valid context.

```
typedef struct _Transmit_Call {
  REDIR_SCARDHANDLE hCard;
  SCardIO_Request ioSendPci;
  [range(0, 66560)] unsigned long cbSendLength;
  [size_is(cbSendLength)] const byte* pbSendBuffer;
  [unique] SCardIO_Request* pioRecvPci;
  long fpbRecvBufferIsNULL;
  unsigned long cbRecvLength;
} Transmit_Call;
```

hCard: A handle, as specified in section 2.2.1.2.

ioSendPci: A packet specifying input header information as specified in section 2.2.1.8.

cbSendLength: The length, in bytes, of the **pbSendBuffer** field.

pbSendBuffer: The data to be written to the card. The format of the data is specific to an individual card. For more information about data formats, see [ISO-7816-4].

pioRecvPci: If non-NULL, this field is an **SCardIO_Request** packet that is set up in the same way as the **ioSendPci** field, and passed as the *pioRecvPci* parameter of the Transmit call. If the value of this is NULL, the caller is not requesting the **pioRecvPci** value to be returned.

fpbRecvBufferIsNULL: A Boolean value specifying whether the caller wants to retrieve the length of the data. MUST be set to TRUE (0x00000001) if the caller wants only to retrieve the length of the data; otherwise, it MUST be set to FALSE (0x00000000).

Name	Value
FALSE	0x00000000
TRUE	0x00000001

cbRecvLength: The maximum size of the buffer to be returned. MUST be ignored if **fpbRecvBufferIsNULL** is set to TRUE (0x00000001).

2.2.2.20 Control_Call

Normally, communication is to the smart card via the reader. However, in some cases, the ability to communicate directly with the smart card reader is requested. The **Control_Call** structure provides the ability to talk to the reader.

```
typedef struct _Control_Call {
  REDIR_SCARDHANDLE hCard;
  unsigned long dwControlCode;
  [range(0, 66560)] unsigned long cbInBufferSize;
  [unique, size_is(cbInBufferSize)]
    const byte* pvInBuffer;
```

```
  long fpvOutBufferIsNULL;
  unsigned long cbOutBufferSize;
} Control_Call;
```

hCard: A handle, as specified in section 2.2.1.2.

dwControlCode: The control code for the operation. These values are specific to the hardware device. This protocol MUST NOT restrict or define any values for this control codes.

cbInBufferSize: The size in bytes of the **pvInBuffer** field.

pvInBuffer: A buffer that contains the data required to perform the operation. This field SHOULD be NULL if the **dwControlCode** field specifies an operation that does not require input data. Otherwise, this data is specific to the function being performed.

fpvOutBufferIsNULL: A Boolean value specifying whether the caller wants to retrieve the length of the data. MUST be set to TRUE (0x00000001) if the caller wants only to retrieve the length of the data; otherwise, it MUST be set to FALSE (0x00000000).

Name	Value
FALSE	0x00000000
TRUE	0x00000001

cbOutBufferSize: The maximum size of the buffer to be returned. This field MUST be ignored if fpvOutBufferIsNULL is set to TRUE (0x00000001).

2.2.2.21 GetAttrib_Call

The **GetAttrib_Call** structure is used to read smart card reader attributes.

```
typedef struct _GetAttrib_Call {
  REDIR_SCARDHANDLE hCard;
  unsigned long dwAttrId;
  long fpbAttrIsNULL;
  unsigned long cbAttrLen;
} GetAttrib_Call;
```

hCard: A handle, as specified in section 2.2.1.2.

dwAttrId: An identifier for the attribute to get. For more information on defined attributes, see [PCSC3].

fpbAttrIsNULL: A Boolean value specifying whether the caller wants to retrieve the length of the data. MUST be set to TRUE (0x00000001) if the caller wants only to retrieve the length of the data; otherwise, it MUST be set to FALSE (0x00000000).

Name	Value
FALSE	0x00000000

Name	Value
TRUE	0x00000001

cbAttrLen: The length of the buffer specified on the TS Server side. If **cbAttrLen** is set to SCARD_AUTOALLOCATE with a value of 0xFFFFFFFF then any buffer length can be returned. Otherwise, the returned buffer MUST NOT exceed **cbAttrLen** bytes in length. This field MUST be ignored if **fpbAttrIsNULL** is set to TRUE (0x00000001).

2.2.2.22 SetAttrib_Call

The **SetAttrib_Call** structure allows users to set smart card reader attributes.

```
typedef struct _SetAttrib_Call {
  REDIR_SCARDHANDLE hCard;
  unsigned long dwAttrId;
  [range(0, 65536)] unsigned long cbAttrLen;
  [size_is(cbAttrLen)] const byte* pbAttr;
} SetAttrib_Call;
```

hCard: A handle, as specified in section 2.2.1.2.

dwAttrId: The identifier of the attribute to set. The values are write-only. For more information on possible values, see [PCSC3].

cbAttrLen: The size, in bytes, of the data corresponding to the **pbAttr** field.

pbAttr: A buffer that contains the attribute whose identifier is supplied in the **dwAttrId** field. The format is specific to the value being set.

2.2.2.23 LocateCardsByATRA_Call

The **LocateCardsByATRA_Call** structure returns information concerning the status of the smart card of interest (ATR).

```
typedef struct _LocateCardsByATRA_Call {
  REDIR_SCARDCONTEXT Context;
  [range(0, 1000)] unsigned long cAtrs;
  [size_is(cAtrs)] LocateCards_ATRMask* rgAtrMasks;
  [range(0, 10)] unsigned long cReaders;
  [size_is(cReaders)] ReaderStateA* rgReaderStates;
} LocateCardsByATRA_Call;
```

Context: A valid context, as specified in section 2.2.2.13.

cAtrs: The number of bytes in the **rgAtrMasks** field.

rgAtrMasks: An array of ATRs to match against currently inserted cards.

cReaders: The number of elements in the **rgReaderStates** field.

rgReaderStates: The states of the readers that the application is monitoring. The states reflects what the application believes is the current states of the readers and might differ from the actual states.

2.2.2.24 LocateCardsByATRW_Call

The **LocateCardsByATRW_Call** structure returns information concerning the status of the smart card of interest (ATR).

```
typedef struct _LocateCardsByATRW_Call {
  REDIR_SCARDCONTEXT Context;
  [range(0, 1000)] unsigned long cAtrs;
  [size_is(cAtrs)] LocateCards_ATRMask* rgAtrMasks;
  [range(0, 10)] unsigned long cReaders;
  [size_is(cReaders)] ReaderStateW* rgReaderStates;
} LocateCardsByATRW_Call;
```

Context: A valid context, as specified in section 2.2.2.14.

cAtrs: The number of bytes in the **rgAtrMasks** field.

rgAtrMasks: An array of ATRs to match against currently inserted cards.

cReaders: The number of elements in the **rgReaderStates** field.

rgReaderStates: The states of the readers that the application is monitoring. The states reflects what the application believes is the current states of the readers and might differ from the actual states.

2.2.2.25 ReadCacheA_Call

The **ReadCacheA_Call** structure is used to obtain the card and reader information from the cache.

```
typedef struct _ReadCacheA_Call {
  [string] char* szLookupName;
  ReadCache_Common Common;
} ReadCacheA_Call;
```

szLookupName: An ASCII string containing the lookup name.

Common: Additional parameters for the Read Cache call (for additional information, see section 3.1.4.42), as specified in section 2.2.1.9.

2.2.2.26 ReadCacheW_Call

The **ReadCacheW_Call** structure is used to obtain the card and reader information from the cache.

```
typedef struct _ReadCacheW_Call {
  [string] wchar_t* szLookupName;
  ReadCache_Common Common;
} ReadCacheW_Call;
```

szLookupName: A Unicode string containing the lookup name.

Common: Additional parameters for the Read Cache call (for additional information, see section 3.1.4.43), as specified in section 2.2.1.9.

2.2.2.27 WriteCacheA_Call

The **WriteCacheA_Call** structure is used to write the card and reader information to the cache.

```
typedef struct _WriteCacheA_Call {
  [string] char* szLookupName;
  WriteCache_Common Common;
} WriteCacheA_Call;
```

szLookupName: An ASCII string containing the lookup name.

Common: Additional parameters for the Write Cache call (for more information, see section 3.1.4.44), as specified in section 2.2.1.10.

2.2.2.28 WriteCacheW_Call

The **WriteCacheW_Call** structure is used to write the card and reader information to the cache.

```
typedef struct _WriteCacheW_Call {
  [string] wchar_t* szLookupName;
  WriteCache_Common Common;
} WriteCacheW_Call;
```

szLookupName: An Unicode string containing the lookup name.

Common: Additional parameters for the Write Cache call (for more information, see section 2.2.1.10.

2.2.2.29 GetTransmitCount_Call

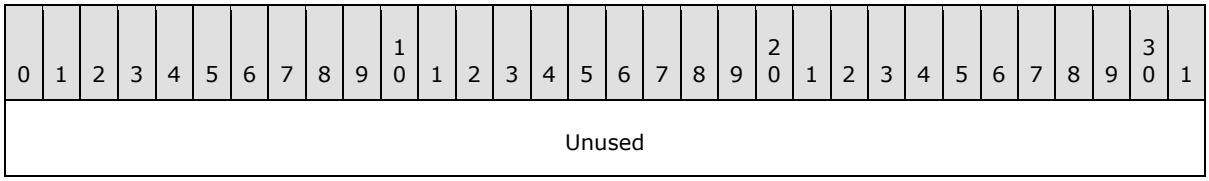
The **GetTransmitCount_Call** structure is used to obtain the number of transmit calls sent to the card since the reader was introduced.

```
typedef struct _GetTransmitCount_Call {
  REDIR_SCARDHANDLE hCard;
} GetTransmitCount_Call;
```

hCard: A handle, as specified in section 2.2.1.2.

2.2.2.30 ScardAccessStartedEvent_Call

ScardAccessStartedEvent_Call is just an uninitialized four-byte buffer that is sent as the IOCTL requires a payload. There is no corresponding serialized structure for this call.



Unused (4 bytes): The field is uninitialized. It SHOULD contain random data and MUST be ignored on receipt.

2.2.3 TS Client-Generated Structures

These structures originate from the client process and compose part of the return packet. If the **ReturnCode** field of the structure is nonzero, all other fields MUST be set to zero and MUST be ignored on receipt.

2.2.3.1 ReadCache_Return

The **ReadCache_Return** structure is used to obtain the data that corresponds to the lookup item requested in ReadCacheA_Call as specified in section 2.2.2.25, or ReadCacheW_Call as specified in section 2.2.2.26. For more call information, see sections 3.1.4.42 and 3.1.4.43.

```
typedef struct _ReadCache_Return {
  long ReturnCode;
  [range(0, 65536)] unsigned long cbDataLen;
  [unique, size_is(cbDataLen)] byte* pbData;
} ReadCache_Return;
```

ReturnCode: HRESULT or Win32 Error codes. Zero indicates success; any other value indicates failure.

cbDataLen: The number of bytes in the **pbData** field.

pbData: The value of the look up item.

2.2.3.2 EstablishContext_Return

The **EstablishContext_Return** structure is used to provide a response to an Establish Context call (for more information, see section 3.1.4.1.)

```
typedef struct _EstablishContext_Return {
  long ReturnCode;
  REDIR_SCARDCONTEXT Context;
} EstablishContext_Return;
```

ReturnCode: HRESULT or Win32 Error code. Zero indicates success; any other value indicates failure.

Context: A valid context, as specified in section 2.2.1.1.

2.2.3.3 Long_Return

The **Long_Return** structure is used for return codes for calls that return only a long value.

```
typedef struct _Long_Return {
  long ReturnCode;
} Long_Return;
```

ReturnCode: HRESULT or Win32 Error code. Zero indicates success; any other value indicates failure.

2.2.3.4 ListReaderGroups_Return and ListReaders_Return

The **ListReaderGroups_Return and ListReaders_Return** structures are used to obtain results for those calls that return a multi-string, in addition to a long return value. For more information, see sections 3.1.4.5, 3.1.4.6, 3.1.4.7, and 3.1.4.8.

```
typedef struct _longAndMultiString_Return {
  long ReturnCode;
  [range(0, 65536)] unsigned long cBytes;
  [unique, size_is(cBytes)] byte* msz;
} ListReaderGroups_Return,
 ListReaders_Return;
```

ReturnCode: HRESULT or Win32 Error code. The value returned from the smart card redirection call.

cBytes: The number of bytes in the **msz** array field.

msz: The meaning of this field is specific to the context (IOCTL) in which it is used:

Value	Meaning
SCARD_IOCTL_LISTREADERSA 0x00090028	ASCII multi-string of readers on the system.
SCARD_IOCTL_LISTREADERSW 0x0009002C	Unicode multi-string of readers on the system.
SCARD_IOCTL_LISTREADERGROUPSA 0x00090020	ASCII multi-string of reader groups on the system.
SCARD_IOCTL_LISTREADERGROUPSW 0x00090024	Unicode multi-string of reader groups on the system.

2.2.3.5 LocateCards_Return and GetStatusChange_Return

The **LocateCards_Return and GetStatusChange_Return** structures are used to obtain the results on those calls that return updated reader state information. (for more information, see sections 3.1.4.21, 3.1.4.22, 3.1.4.23, 3.1.4.24, 3.1.4.25, and 3.1.4.26).

```
typedef struct _LocateCards_Return {
  long ReturnCode;
  [range(0, 10)] unsigned long cReaders;
  [size_is(cReaders)] ReaderState_Return* rgReaderStates;
} LocateCards_Return,
 GetStatusChange_Return;
```

ReturnCode: HRESULT or Win32 Error code. Zero indicates success; any other value indicates failure

cReaders: The number of elements in the **rgReaderStates** field.

rgReaderStates: The current states of the Readers being watched.

2.2.3.6 Control_Return

The **Control_Return** structure is used to obtain information from a **Control_Call** (for more information, see section 3.1.4.37).

```
typedef struct _Control_Return {
  long ReturnCode;
  [range(0, 66560)] unsigned long cbOutBufferSize;
  [unique, size_is(cbOutBufferSize)]
    byte* pvOutBuffer;
} Control_Return;
```

ReturnCode: HRESULT or Win32 Error code. Zero indicates success; any other value indicates failure.

cbOutBufferSize: The number of bytes in the **pvOutBuffer** field.

pvOutBuffer: Contains the return data specific to the value of the **Control_Call** structure.

2.2.3.7 Reconnect_Return

The **Reconnect_Return** structure is used to obtain return information from a Reconnect call (for more information, see section 3.1.4.36).

```
typedef struct _Reconnect_Return {
  long ReturnCode;
  unsigned long dwActiveProtocol;
} Reconnect_Return;
```

ReturnCode: HRESULT or Win32 Error code. Zero indicates success; any other value indicates failure.

dwActiveProtocol: A flag that indicates the established active protocol. For more information on acceptable values, see section 2.2.5 .

2.2.3.8 Connect_Return

The **Connect_Return** structure is used to obtain return information from a Connect call (for more information, see sections 3.1.4.28 and 3.1.4.29).

```
typedef struct _Connect_Return {
  long ReturnCode;
  REDIR_SCARDCONTEXT hCard;
  unsigned long dwActiveProtocol;
} Connect_Return;
```

ReturnCode: HRESULT or Win32 Error code. Zero indicates success; any other value indicates failure.

hCard: A handle, as specified in section 2.2.1.1.

dwActiveProtocol: A value that indicates the active smart card transmission protocol. Possible values are specified in section 2.2.5.

2.2.3.9 State_Return

The **State_Return** structure defines return information about the state of the smart card reader (for more information, see section 3.1.4.40).

```
typedef struct _State_Return {
  long ReturnCode;
  unsigned long dwState;
  unsigned long dwProtocol;
  [range(0, 36)] unsigned long cbAtrLen;
  [unique, size_is(cbAtrLen)] byte* rgAtr;
} State_Return;
```

ReturnCode: HRESULT or Win32 Error code. Zero indicates success; any other value indicates failure.

dwState: The current state of the smart card in the Reader. Possible values are specified in section 2.2.4.

dwProtocol: The current protocol, if any. Possible values are specified in section 2.2.5.

cbAtrLen: The number of bytes in the **rgAtr** field.

rgAtr: A pointer to a buffer that receives the ATR string from the currently inserted card, if available.

2.2.3.10 Status_Return

The **Status_Return** structure defines return information about the status of the smart card reader (for more information, see sections 3.1.4.33 and 3.1.4.34).

```
typedef struct _Status_Return {
  long ReturnCode;
```

```
  [range(0, 65536)] unsigned long cBytes;
  [unique, size_is(cBytes)] byte* mszReaderNames;
  unsigned long dwState;
  unsigned long dwProtocol;
  byte pbAtr[32];
  [range(0, 32)] unsigned long cbAtrLen;
} Status_Return;
```

ReturnCode: HRESULT or Win32 Error code. Zero indicates success; any other value indicates failure.

cBytes: The number of bytes in the **mszReaderNames** field.

mszReaderNames: A multi-string containing the names that the reader is known by. The value of this is dependent on the context (IOCTL) that it is used.

Value	Meaning
SCARD_IOCTL_STATUSA 0x000900C8	ASCII multi-string
SCARD_IOCTL_STATUSW 0x000900CC	Unicode multi-string

dwState: The current state of the smart card in the reader. Possible values are specified in section 2.2.4.

dwProtocol: The current protocol, if any. Possible values are specified in section 2.2.5.

pbAtr: A pointer to a buffer that receives the ATR string from the currently inserted card, if available.

cbAtrLen: The number of bytes in the ATR string.

2.2.3.11 Transmit_Return

The **Transmit_Return** structure defines return information from a smart card after a Transmit call (for more information, see section 3.1.4.35).

```
typedef struct _Transmit_Return {
  long ReturnCode;
  [unique] SCardIO_Request* pioRecvPci;
  [range(0, 66560)] unsigned long cbRecvLength;
  [unique, size_is(cbRecvLength)]
    byte* pbRecvBuffer;
} Transmit_Return;
```

ReturnCode: HRESULT or Win32 Error code. Zero indicates success; any other value indicates failure.

pioRecvPci: The protocol header structure for the instruction, followed by a buffer in which to receive any returned protocol control information (PCI) that is specific to the protocol in use. If this field is NULL, a protocol header MUST NOT be returned.

cbRecvLength: The size, in bytes, of the **pbRecvBuffer** field.

pbRecvBuffer: The data returned from the card.

2.2.3.12 GetAttrib_Return

The **GetAttrib_Return** structure defines attribute information from a smart card reader (for more information, see section 3.1.4.38).

```
typedef struct _GetAttrib_Return {
  long ReturnCode;
  [range(0, 65536)] unsigned long cbAttrLen;
  [unique, size_is(cbAttrLen)] byte* pbAttr;
} GetAttrib_Return;
```

ReturnCode: HRESULT or Win32 Error code. Zero indicates success; any other value indicates failure.

cbAttrLen: The number of bytes in the **pbAttr** field.

pbAttr: A pointer to an array that contains any values returned from the corresponding call.

2.2.3.13 GetTransmitCount_Return

The **GetTransmitCount_Return** structure defines the number of transmit calls that were performed on the smart card reader (for more information, see section 3.1.4.41).

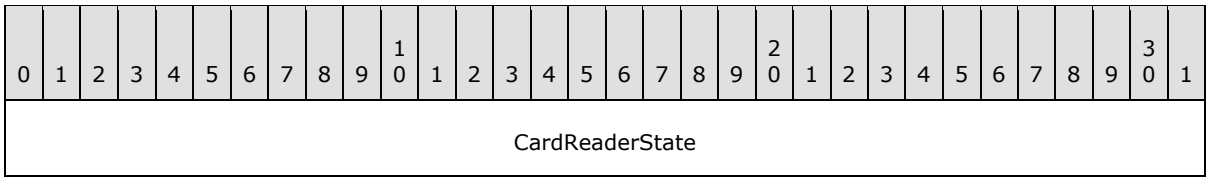
```
typedef struct _GetTransmitCount_Return {
  long ReturnCode;
  unsigned long cTransmitCount;
} GetTransmitCount_Return;
```

ReturnCode: HRESULT or Win32 Error code. Zero indicates success; any other value indicates failure.

cTransmitCount: The field specifies the number of successful Transmit calls (for more information, see section 3.1.4.35) performed on the reader since it was introduced to the system.

2.2.4 Card/Reader State

The following represents the current state of the smart card reader according to Smart Cards for Windows.

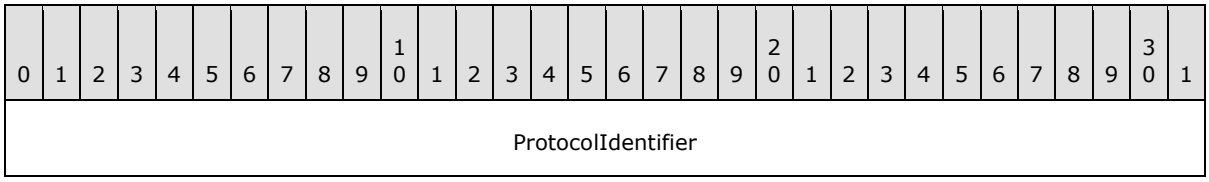


CardReaderState (4 bytes): One of the following values:

Value	Meaning
SCARD_UNKNOWN 0x00000000	The current state of the reader is unknown.
SCARD_ABSENT 0x00000001	There is no card in the reader.
SCARD_PRESENT 0x00000002	There is a card in the reader but it has not been moved into position for use.
SCARD_SWALLOWED 0x00000003	There is a card in the reader in position for use. The card is not powered.
SCARD_POWERED 0x00000004	There is power being applied to the card but the mode of the card is unknown.
SCARD_NEGOTIABLE 0x00000005	The card has been reset and is awaiting PTS negotiation.
SCARD_SPECIFICMODE 0x00000006	The card has been reset and specific communication protocols have been established.

2.2.5 Protocol Identifier

A Protocol Identifier.



ProtocolIdentifier (4 bytes): This field MUST have a value from Table A which is logically OR'ed with a value from Table B.

Table A

Value	Meaning
SCARD_PROTOCOL_UNDEFINED 0x00000000	No transmission protocol is active.
SCARD_PROTOCOL_T0 0x00000001	Transmission protocol 0 (T=0) is active. It is the asynchronous half-duplex character transmission protocol.
SCARD_PROTOCOL_T1	Transmission protocol 1 (T=1) is active. It is the asynchronous

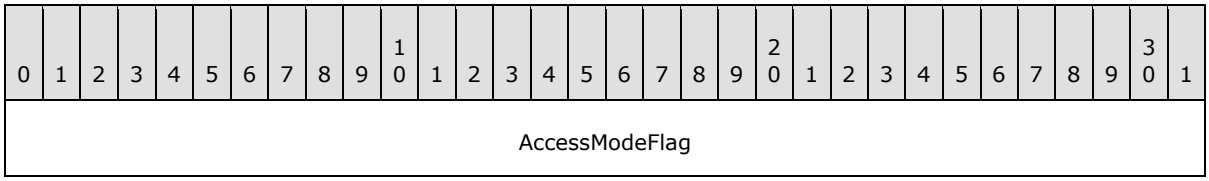
Value	Meaning
0x00000002	half-duplex block transmission protocol.
SCARD_PROTOCOL_Tx 0x00000003	Bitwise OR combination of both of the two International Standards Organization (IS0) transmission protocols SCARD_PROTOCOL_T0 and SCARD_PROTOCOL_T1. This value can be used as a bit mask.
SCARD_PROTOCOL_RAW 0x00010000	Transmission protocol raw is active. The data from the smart card is raw and does not conform to any transmission protocol.

Table B

Value	Meaning
SCARD_PROTOCOL_DEFAULT 0x80000000	A bitwise OR with this value forces the use of the default transmission parameters and card clock frequency.
SCARD_PROTOCOL_OPTIMAL 0x00000000	Optimal transmission parameters and card clock frequency will be used.

2.2.6 Access Mode Flags

Access mode flags provide possible values for applications to connect to the smart card.

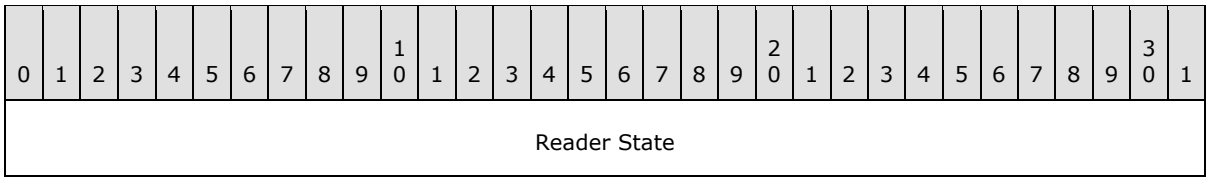


AccessModeFlag (4 bytes): One of the following possible values:

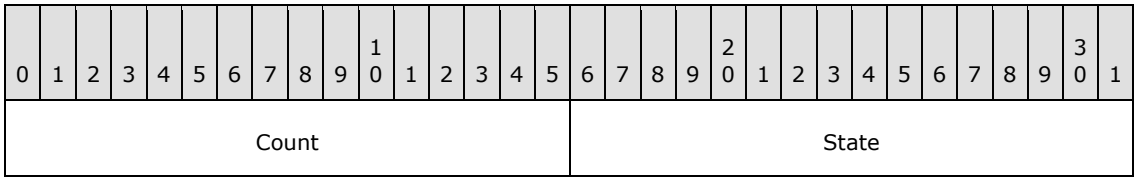
Value	Meaning
SCARD_SHARE_EXCLUSIVE 0x00000001	This application is not willing to share this smart card with other applications.
SCARD_SHARE_SHARED 0x00000002	This application is willing to share this smart card with other applications.
SCARD_SHARE_DIRECT 0x00000003	This application demands direct control of the smart card reader; therefore, it is not available to other applications.

2.2.7 Reader State

The Reader State packet has a sub-structure as shown in the following table.



Reader State (4 bytes): Both the **dwCurrentState** field and the **dwEventState** field, found in the **ReaderState_Common_Call** and **ReaderState_Return** structures, consist of the following two subfields.



Count (2 bytes): The contents of this field depends on the value of the associated reader name. If the reader name (for more information, see sections 2.2.1.6 and 2.2.1.7 for the **szReader** field) is \\?PnP?\Notification then **Count** is a count of the number of readers installed on the system and all bits except SCARD_STATE_CHANGED in **State** MUST be zero. Otherwise, **Count** is a count of the number of times a card has been inserted and/or removed from the smart card reader being monitored.

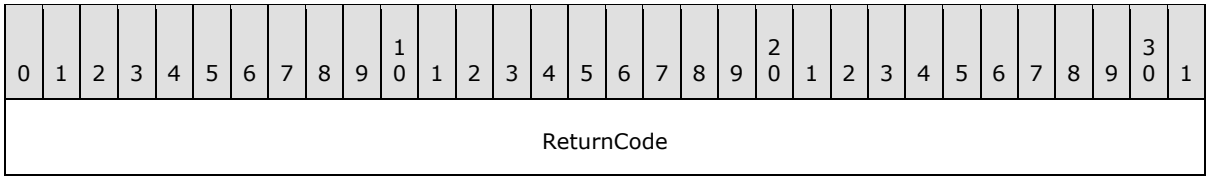
State (2 bytes): The state of a reader. The value MUST be according to the following table.

Value	Meaning
SCARD_STATE_UNAWARE 0x0000	The application requires the current state but does not know it. The use of this value results in an immediate return from state transition monitoring services.
SCARD_STATE_IGNORE 0x0001	The application requested that this Reader be ignored. No other bits are set.
SCARD_STATE_CHANGED 0x0002	There is a difference between the state believed by the application, and the state known by Smart Cards for Windows.
SCARD_STATE_UNKNOWN 0x0004	The reader name is not recognized by Smart Cards for Windows. If this bit is set, both SCARD_STATE_IGNORE and SCARD_STATE_CHANGED MUST be set.
SCARD_STATE_UNAVAILABLE 0x0008	The actual state of this reader is not available. If this bit is set, all of the following bits are clear.
SCARD_STATE_EMPTY 0x0010	There is no card in the reader. If this bit is set, all of the following bits are clear.
SCARD_STATE_PRESENT 0x0020	There is a card in the reader.
SCARD_STATE_ATRMATCH 0x0040	There is a card in the reader with an ATR that matches one of the target cards. If this bit is set, SCARD_STATE_PRESENT also is set.

Value	Meaning
SCARD_STATE_EXCLUSIVE 0x0080	The card in the reader is allocated for exclusive use by another application. If this bit is set, SCARD_STATE_PRESENT also is set.
SCARD_STATE_INUSE 0x0100	The card in the reader is in use by one or more other applications, but can be connected to in shared mode. If this bit is set, SCARD_STATE_PRESENT also is set.
SCARD_STATE_MUTE 0x0200	The card in the reader is unresponsive or is not supported by the reader or software.
SCARD_STATE_UNPOWERED 0x0400	This implies that the card in the reader has not been turned on.

2.2.8 Return Code

The following Smart Cards for Windows-specific return codes MAY be returned by the protocol server to the protocol client and are of the data type unsigned long.



ReturnCode (4 bytes): One of the following return codes:

Value	Meaning
SCARD_S_SUCCESS 0x00000000	No error has occurred.
SCARD_F_INTERNAL_ERROR 0x80100001	An internal consistency check failed.
SCARD_E_CANCELLED 0x80100002	The action was canceled by a Cancel request.
SCARD_E_INVALID_HANDLE 0x80100003	The supplied handle was invalid.
SCARD_E_INVALID_PARAMETER 0x80100004	One or more of the supplied parameters could not be properly interpreted.
SCARD_E_INVALID_TARGET 0x80100005	Registry startup information is missing or invalid.
SCARD_E_NO_MEMORY 0x80100006	Not enough memory available to complete this command.
SCARD_F_WAITED_TOO_LONG 0x80100007	An internal consistency timer has expired.
SCARD_E_INSUFFICIENT_BUFFER 0x80100008L	The data buffer to receive returned data is too small for the returned data.

Value	Meaning
SCARD_E_UNKNOWN_READER 0x80100009	The specified reader name is not recognized.
SCARD_E_TIMEOUT 0x8010000A	The user-specified timeout value has expired.
SCARD_E_SHARING_VIOLATION 0x8010000B	The smart card cannot be accessed because of other connections outstanding.
SCARD_E_NO_SMARTCARD 0x8010000C	The operation requires a smart card, but no smart card is currently in the device.
SCARD_E_UNKNOWN_CARD 0x8010000D	The specified smart card name is not recognized.
SCARD_E_CANT_DISPOSE 0x8010000E	The system could not dispose of the media in the requested manner.
SCARD_E_PROTO_MISMATCH 0x8010000F	The requested protocols are incompatible with the protocol currently in use with the smart card.
SCARD_E_NOT_READY 0x80100010	The reader or smart card is not ready to accept commands.
SCARD_E_INVALID_VALUE 0x80100011	One or more of the supplied parameters values could not be properly interpreted.
SCARD_E_SYSTEM_CANCELLED 0x80100012	The action was canceled by the system, presumably to log off or shut down.
SCARD_F_COMM_ERROR 0x80100013	An internal communications error has been detected.
SCARD_F_UNKNOWN_ERROR 0x80100014	An internal error has been detected, but the source is unknown.
SCARD_E_INVALID_ATR 0x80100015	An ATR obtained from the registry is not a valid ATR string.
SCARD_E_NOT_TRANSACTED 0x80100016	An attempt was made to end a non-existent transaction.
SCARD_E_READER_UNAVAILABLE 0x80100017	The specified reader is not currently available for use.
SCARD_P_SHUTDOWN 0x80100018	The operation has been stopped to allow the server application to exit.
SCARD_E_PCI_TOO_SMALL 0x80100019	The PCI Receive buffer was too small.
SCARD_E_READER_UNSUPPORTED 0x8010001A	The reader device driver does not meet minimal requirements for support.
SCARD_E_DUPLICATE_READER 0x8010001B	The reader device driver did not produce a unique reader name.
SCARD_E_CARD_UNSUPPORTED	The smart card does not meet minimal requirements for

Value	Meaning
0x8010001C	support.
SCARD_E_NO_SERVICE 0x8010001D	Smart Cards for Windows is not running.
SCARD_E_SERVICE_STOPPED 0x8010001E	Smart Cards for Windows has shut down.
SCARD_E_UNEXPECTED 0x8010001F	An unexpected card error has occurred.
SCARD_E_WRITE_TOO_MANY 0x80100028	The smart card does not have enough memory to store the information.
SCARD_E_BAD_SEEK 0x80100029	There was an error trying to set the smart card file object pointer.
SCARD_E_NO_READERS_AVAILABLE 0x8010002E	Cannot find a smart card reader.
SCARD_E_COMM_DATA_LOST 0x8010002F	A communications error with the smart card has been detected. Retry the operation.
SCARD_E_SERVER_TOO_BUSY 0x80100031	Smart Cards for Windows is too busy to complete this operation.
SCARD_W_UNSUPPORTED_CARD 0x80100065	The reader cannot communicate with the smart card, due to ATR configuration conflicts.
SCARD_W_UNRESPONSIVE_CARD 0x80100066	The smart card is not responding to a reset.
SCARD_W_UNPOWERED_CARD 0x80100067	Power has been removed from the smart card, so that further communication is impossible.
SCARD_W_RESET_CARD 0x80100068	The smart card has been reset, so any shared state information is invalid.
SCARD_W_REMOVED_CARD 0x80100069	The smart card has been removed, so that further communication is impossible.
SCARD_W_CACHE_ITEM_NOT_FOUND 0x80100070	The requested item could not be found in the cache.
SCARD_W_CACHE_ITEM_STALE 0x80100071	The requested cache item is too old and was deleted from the cache.
SCARD_W_CACHE_ITEM_TOO_BIG 0x80100072	The new cache item exceeds the maximum per-item size defined for the cache.

3 Protocol Details

The following sections specify details of the Remote Desktop Protocol: Smart Card Virtual Channel Extension, including abstract data models, interface method syntax, and message processing rules.

3.1 Protocol Server Details

3.1.1 Abstract Data Model

This section describes a conceptual model of a 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 provided that their external behavior is consistent with that described in this document.

The protocol server relies on an implementation of Smart Cards for Windows.

The following state MUST be kept by this protocol:

dwDeviceId: The device id assigned by Remote Desktop Protocol: File System Virtual Channel Extension that identifies this protocol.

rgSCardContextList: List of contexts opened by the protocol server.

3.1.2 Timers

No timers are required.

3.1.3 Initialization

Initialization is triggered by the Remote Desktop Protocol: File System Virtual Channel Extension when it enumerates all pre-logon devices. At this time, TS client initialization is performed.

If the TS server **operating system version** is less than 5.1, the device is not announced to the TS server

The **dwDeviceId** field MUST be set to the device Id selected by Remote Desktop Protocol: File System Virtual Channel Extension, and **rgSCardContextList** MUST be set to the empty list.

3.1.4 Message Processing Events and Sequencing Rules

Only messages of type DR_CONTROL_REQ and DR_CONTROL_RSP(as specified in [MS-RDPEFS], sections 2.2.1.4.5 and 2.2.1.5.5 respectively) are valid for this protocol. All other messages MUST be processed according to the Remote Desktop Protocol: File System Virtual Channel Extension.

Only the control codes specified in the IOCTL Processing Rules table below are valid. Invalid packets MUST be dropped without a reply.

Function Number	Value for IoControlCode	IRP_MJ_DEVICE_CONTROL Request	Input Packet, Output Packet
5	0x00090014	SCARD_IOCTL_ESTABLISHCONTEXT	**EstablishContext_Call (section 2.2.2.1)**,

Function Number	Value for IoControlCode	IRP_MJ_DEVICE_CONTROL Request	Input Packet, Output Packet
			EstablishContext_Return (section 2.2.3.2)
6	0x00090018	SCARD_IOCTL_RELEASECONTEXT	Context_Call (section 2.2.2.2), Long_Return (section 2.2.3.3)
7	0x0009001C	SCARD_IOCTL_ISVALIDCONTEXT	**Context_Call** (section 2.2.2.2), **Long_Return** (section 2.2.3.3)
8	0x00090020	SCARD_IOCTL_LISTREADERGROUPSA	ListReaderGroups_Call (section 2.2.2.3), ListReaderGroups_Return (section 2.2.3.4)
9	0x00090024	SCARD_IOCTL_LISTREADERGROUPSW	**ListReaderGroups_Call** (section 2.2.2.3), **ListReaderGroups_Return** (section 2.2.3.4)
10	0x00090028	SCARD_IOCTL_LISTREADERSA	ListReaders_Call (section 2.2.2.4), **ListReaders_Return** (section 2.2.3.4)
11	0x0009002C	SCARD_IOCTL_LISTREADERSW	**ListReaders_Call** (section 2.2.2.4), **ListReaders_Return** (section 2.2.3.4)
20	0x00090050	SCARD_IOCTL_INTRODUCEREADERGROUPA	ContextAndStringA_Call (section 2.2.2.5), **Long_Return** (section 2.2.3.3)
21	0x00090054	SCARD_IOCTL_INTRODUCEREADERGROUPW	ContextAndStringW_Call (section 2.2.2.6), **Long_Return** (section 2.2.3.3)
22	0x00090058	SCARD_IOCTL_FORGETREADERGROUPA	**ContextAndStringA_Call** (section 2.2.2.5), **Long_Return** (section 2.2.3.3)
23	0x0009005C	SCARD_IOCTL_FORGETREADERGROUPW	**ContextAndStringW_Call** (section 2.2.2.6), **Long_Return** (section 2.2.3.3)
24	0x00090060	SCARD_IOCTL_INTRODUCEREADERA	ContextAndTwoStringA_Call (section 2.2.2.7), **Long_Return** (section 2.2.3.3)

Function Number	Value for IoControlCode	IRP_MJ_DEVICE_CONTROL Request	Input Packet, Output Packet
25	0x00090064	SCARD_IOCTL_INTRODUCEREADERW	**ContextAndTwoStringW_Call (section 2.2.2.8)**, **Long_Return** (section 2.2.3.3)
26	0x00090068	SCARD_IOCTL_FORGETREADERA	**ContextAndStringA_Call** (section 2.2.2.5), **Long_Return** (section 2.2.3.3)
27	0x0009006C	SCARD_IOCTL_FORGETREADERW	**ContextAndStringW_Call** (section 2.2.2.6), **Long_Return** (section 2.2.3.3)
28	0x00090070	SCARD_IOCTL_ADDREADERTOGROUPA	**ContextAndTwoStringA_Call** (section 2.2.2.7), **Long_Return** (section 2.2.3.3)
29	0x00090074	SCARD_IOCTL_ADDREADERTOGROUPW	**ContextAndTwoStringW_Call** (section 2.2.2.8), **Long_Return** (section 2.2.3.3)
30	0x00090078	SCARD_IOCTL_REMOVEREADERFROMGROUPA	**ContextAndTwoStringA_Call** (section 2.2.2.7), **Long_Return** (section 2.2.3.3)
31	0x0009007C	SCARD_IOCTL_REMOVEREADERFROMGROUPW	**ContextAndTwoStringW_Call** (section 2.2.2.8), **Long_Return** (section 2.2.3.3)
38	0x00090098	SCARD_IOCTL_LOCATECARDSA	**LocateCardsA_Call (section 2.2.2.9)**, **LocateCards_Return (section 2.2.3.5)**
39	0x0009009C	SCARD_IOCTL_LOCATECARDSW	**LocateCardsW_Call (section 2.2.2.10)**, **LocateCards_Return** (section 2.2.3.5)
40	0x000900A0	SCARD_IOCTL_GETSTATUSCHANGEA	**GetStatusChangeA_Call (section 2.2.2.11)**, **GetStatusChange_Return** (section 2.2.3.5)
41	0x000900A4	SCARD_IOCTL_GETSTATUSCHANGEW	**GetStatusChangeW_Call (section 2.2.2.12)**, **GetStatusChange_Return** (section 2.2.3.5)

Function Number	Value for IoControlCode	IRP_MJ_DEVICE_CONTROL Request	Input Packet, Output Packet
42	0x000900A8	SCARD_IOCTL_CANCEL	**Context_Call** (section 2.2.2.2), **Long_Return** (section 2.2.3.3)
43	0x000900AC	SCARD_IOCTL_CONNECTA	**ConnectA_Call (section 2.2.2.13)**, **Connect_Return (section 2.2.3.8)**
44	0x000900B0	SCARD_IOCTL_CONNECTW	**ConnectW_Call (section 2.2.2.14)**, **Connect_Return** (section 2.2.3.8)
45	0x000900B4	SCARD_IOCTL_RECONNECT	**Reconnect_Call (section 2.2.2.15)**, **Reconnect_Return (section 2.2.3.7)**
46	0x000900B8	SCARD_IOCTL_DISCONNECT	**HCardAndDisposition_Call (section 2.2.2.16)**, **Long_Return** (section 2.2.3.3)
47	0x000900BC	SCARD_IOCTL_BEGINTRANSACTION	**HCardAndDisposition_Call** (section 2.2.2.16), **Long_Return** (section 2.2.3.3)
48	0x000900C0	SCARD_IOCTL_ENDTRANSACTION	**HCardAndDisposition_Call** (section 2.2.2.16), **Long_Return** (section 2.2.3.3)
49	0x000900C4	SCARD_IOCTL_STATE	**State_Call (section 2.2.2.17)**, **State_Return (section 2.2.3.9)**
50	0x000900C8	SCARD_IOCTL_STATUSA	**Status_Call (section 2.2.2.18)**, **Status_Return (section 2.2.3.10)**
51	0x000900CC	SCARD_IOCTL_STATUSW	**Status_Call** (section 2.2.2.18), **Status_Return** (section 2.2.3.10)
52	0x000900D0	SCARD_IOCTL_TRANSMIT	**Transmit_Call (section 2.2.2.19)**, **Transmit_Return (section 2.2.3.11)**
53	0x000900D4	SCARD_IOCTL_CONTROL	**Control_Call (section 2.2.2.20)**, **Control_Return (section 2.2.3.6)**
54	0x000900D8	SCARD_IOCTL_GETATTRIB	**GetAttrib_Call (section 2.2.2.21)**, **GetAttrib_Return (section 2.2.3.12)**

Function Number	Value for IoControlCode	IRP_MJ_DEVICE_CONTROL Request	Input Packet, Output Packet
55	0x000900DC	SCARD_IOCTL_SETATTRIB	**SetAttrib_Call (section 2.2.2.22)**, **Long_Return** (section 2.2.3.3)
56	0x000900E0	SCARD_IOCTL_ACCESSSTARTEDEVENT	ScardAccessStartedEvent_Call (section 2.2.2.30), **Long_Return** (section 2.2.3.3)
58	0x000900E8	SCARD_IOCTL_LOCATECARDSBYATRA	**LocateCardsByATRA_Call (section 2.2.2.23)**, **LocateCards_Return** (section 2.2.3.5)
59	0x000900EC	SCARD_IOCTL_LOCATECARDSBYATRW	**LocateCardsByATRW_Call (section 2.2.2.24)**, **LocateCards_Return** (section 2.2.3.5)
60	0x000900F0	SCARD_IOCTL_READCACHEA	**ReadCacheA_Call (section 2.2.2.25)**, **ReadCache_Return (section 2.2.3.1)**
61	0x000900F4	SCARD_IOCTL_READCACHEW	**ReadCacheW_Call (section 2.2.2.26)**, **ReadCache_Return** (section 2.2.3.1)
62	0x000900F8	SCARD_IOCTL_WRITECACHEA	**WriteCacheA_Call (section 2.2.2.27)**, **Long_Return** (section 2.2.3.3)
63	0x000900FC	SCARD_IOCTL_WRITECACHEW	**WriteCacheW_Call (section 2.2.2.28)**, **Long_Return** (section 2.2.3.3)
64	0x00090100	SCARD_IOCTL_GETTRANSMITCOUNT	**GetTransmitCount_Call (section 2.2.2.29)**, **GetTransmitCount_Return (section 2.2.3.13)**

The TS client MUST be able to process multiple requests simultaneously within the limits of its resources.

Any errors from the Smart Cards for Windows layer MUST be transferred to the TS server and MUST NOT be modified by the TS client. No exceptions are thrown in this protocol.

The following steps MUST be performed on each call packet received:

1. The IoControlCode MUST be present, as specified in the preceding IOCTL Processing Rules table, for the specific protocol version implemented.<2>
2. The input data type is interpreted according to the IOCTL Processing Rules table. The data MUST be decoded as specified in [MS-RPCE] section 2.2.6.

3. Processing MUST be performed according to the corresponding section below. On success MUST return a structure as specified in the IOCTL Processing Rules table above.

4. If the protocol encounters problems decoding the input or encoding the results, the data then RDRDP_DEVICE_IOCOMPLETION.IOStatus will be set to an error from NtStatus.h, the most common of which appear in the following table.

Return value/code	Description
STATUS_NO_MEMORY 0xC0000017	Not enough virtual memory or paging file quota is available to complete the specified operation.
STATUS_UNSUCCESSFUL 0xC0000001	The requested operation was unsuccessful.
STATUS_BUFFER_TOO_SMALL 0xC0000023	The buffer is too small to contain the entry. No information has been written to the buffer.

5. On error, RDPDR_DEVICE_IOCOMPLETION.Parameters.DeviceIOControl.OutputBufferLength, MUST be set to zero and RDPDR_DEVICE_IOCOMPLETION.Parameters.DeviceIOControl.OutputBuffer MUST set to NULL.

6. Otherwise, RDPDR_DEVICE_IOCOMPLETION.IOStatus MUST be set to 0 (STATUS_SUCCESS) and RDPDR_DEVICE_IOCOMPLETION.Parameters.DeviceIOControl.OutputBuffer MUST contain an encoding of the structure (as specified in the preceding Message Processing Events and Sequencing Rules IOCTL Table) as specified in [MS-RPCE] section 2.2.6. RDPDR_DEVICE_IOCOMPLETION.Parameters.DeviceIOControl.OutputBufferLength is the length of data.

7. The return packet is then sent according to Remote Desktop Protocol: File System Virtual Channel Extension.

3.1.4.1 SCARD_IOCTL_ESTABLISHCONTEXT (IOCTL 0x00090014)

Establish Context creates a new Smart Cards for Windows context specified for use in subsequent communication with Smart Cards for Windows.

Return Values: This method sets **EstablishContext_Return**.ReturnCode to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

If the call is successful, **EstablishContext_Return**.Context MUST be added to the rgSCardContextList list maintained by this client.

3.1.4.2 SCARD_IOCTL_RELEASECONTEXT (IOCTL 0x00090018)

Release Context releases a previously established Smart Cards for Windows context as specified in section 3.1.4.1. The context MUST exist in **rgSCardContextList**.

Return Values: This method sets Long_Return.ReturnCode (for more information, see section 2.2.3.3) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

If the call is successful, Context_Call.Context (for more information, see section 2.2.2.2) is removed from rgSCardContextList.

3.1.4.3 SCARD_IOCTL_ISVALIDCONTEXT (IOCTL 0x0009001C)

Is Valid Context checks if a previously established Smart Cards for Windows context from SCARD_IOCTL_ESTABLISHCONTEXT is still valid. For this call to succeed, Context_Call.Context (for more information, see section 2.2.2.2) MUST exist in rgSCardContextList and the Smart Cards for Windows communication channel MUST still be present.

Return Values: This method sets Long_Return.ReturnCode (for more information, see section 2.2.3.3) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.4 SCARD_IOCTL_ACCESSSTARTEDEVENT (IOCTL 0x000900E0)

Access Started Event waits until Smart Cards for Windows is running.

Return Values: This method sets Long_Return.ReturnCode (for more information, see section 2.2.3.3) to SCARD_S_SUCCESS if Smart Cards for Windows is running; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.5 SCARD_IOCTL_LISTREADERGROUPSA (IOCTL 0x00090020)

The ASCII version List Reader Groups returns the reader groups known to Smart Cards for Windows. **ListReaderGroups_Return** is constructed according to **ListReaderGroups_Return and ListReaders_Return** and the information in **ListReaderGroups_Call**.

Return Values: This method sets ListReaderGroups_Return.ReturnCode (for more information, see section 2.2.3.4) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.6 SCARD_IOCTL_LISTREADERGROUPSW (IOCTL 0x00090024)

The Unicode version List Reader Groups returns the reader groups known to Smart Cards for Windows. **ListReaderGroups_Return** is constructed according to **ListReaderGroups_Return and ListReaders_Return** and the information in **ListReaderGroups_Call**.

Return Values: This method sets ListReaderGroups_Return.ReturnCode (for more information, see section 2.2.3.4) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.7 SCARD_IOCTL_LISTREADERSA (IOCTL 0x00090028)

The ASCII version of List Readers returns the smart card readers known to Smart Cards for Windows. **ListReaders_Return** is constructed according to **ListReaderGroups_Return and ListReaders_Return** and **ListReaders_Call**.

Return Values: The method sets ListReaders_Return.ReturnCode (for more information, see section 2.2.3.4) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors

or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.8 SCARD_IOCTL_LISTREADERSW (IOCTL 0x0009002C)

The Unicode version of List Readers returns the smart card readers known to Smart Cards for Windows. **ListReaders_Return** is constructed according to **ListReaderGroups_Return and ListReaders_Return** and **ListReaders_Call**.

Return Values: The method sets ListReaders_Return.ReturnCode (for more information, see section 2.2.3.4) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.9 SCARD_IOCTL_INTRODUCEREADERGROUPA (IOCTL 0x00090050)

The ASCII version of Introduce Reader Group adds the reader group specified in ContextAndStringA_Call.sz (for more information, see section 2.2.2.5) to the list of reader groups known to Smart Cards for Windows.

Return Values: The method sets Long_Return.ReturnCode (for more information, see section 2.2.3.3) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.10 SCARD_IOCTL_INTRODUCEREADERGROUPW (IOCTL 0x00090054)

The Unicode version of Introduce Reader Group adds the reader group specified in ContextAndStringW_Call.sz (for more information, see section 2.2.2.6) to the list of reader groups known to Smart Cards for Windows.

Return Values: The method sets Long_Return.ReturnCode (for more information, see section 2.2.3.3) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.11 SCARD_IOCTL_FORGETREADERGROUPA (IOCTL 0x00090058)

The ASCII version of Forget Reader Group removes the reader group specified in ContextAndStringA_Call.sz (for more inforamtion, see section 2.2.2.5) from the list of reader groups known to the Smart Cards for Windows.

Return Values: The method sets Long_Return.ReturnCode (for more information, see section 2.2.3.3) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.12 SCARD_IOCTL_FORGETREADERGROUPW (IOCTL 0x0009005C)

The Unicode version of Forget Reader Group removes the reader group specified in ContextAndStringW_Call.sz (for more information, see section 2.2.2.6) from the list of reader groups known to Smart Cards for Windows.

Return Values: The method sets Long_Return.ReturnCode (for more information, see section 2.2.3.3) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors

or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.13 SCARD_IOCTL_INTRODUCEREADERA (IOCTL 0x00090060)

The ASCII version of Introduce Reader adds the **device name** specified in ContextAndTwoStringA_Call.sz2 (for more information, see section 2.2.2.7) to the smart card reader specified in ContextAndTwoStringA_Call.sz1.

Return Values: The method sets Long_Return.ReturnCode (for more information, see section 2.2.3.3) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.14 SCARD_IOCTL_INTRODUCEREADERW (IOCTL 0x00090064)

The Unicode version of Introduce Reader adds the device name specified in ContextAndTwoStringW_Call.sz2 (for more information, see section 2.2.2.8) to the smart card reader specified in ContextAndTwoStringW_Call.sz1.

Return Values: The method sets Long_Return.ReturnCode (for more information, see section 2.2.3.3) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.15 SCARD_IOCTL_FORGETREADERA (IOCTL 0x00090068)

The ASCII version of Forget Reader removes the smart card reader specified in ContextAndStringA_Call.sz (for more information, see section 2.2.2.5) from the list of smart card readers known to Smart Cards for Windows.

Return Values: The method sets Long_Return.ReturnCode (for more information, see section 2.2.3.3) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.16 SCARD_IOCTL_FORGETREADERW (IOCTL 0x0009006C)

The Unicode version of Forget Reader removes the smart card reader specified in ContextAndStringW_Call.sz (for more information, see section 2.2.2.6) from the list of smart card readers known to Smart Cards for Windows.

Return Values: The method sets Long_Return.ReturnCode (for more information, see section 2.2.3.3) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.17 SCARD_IOCTL_ADDREADERTOGROUPA (IOCTL 0x00090070)

The ASCII version of Add Reader to Group adds the smart card reader specified in ContextAndTwoStringA_Call.sz2 (for more information, see section 2.2.2.7).

Return Values: The method sets Long_Return.ReturnCode (for more information, see section 2.2.3.3) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors

or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.18 SCARD_IOCTL_ADDREADERTOGROUPW (IOCTL 0x00090074)

The Unicode version of Add Reader to Group adds the smart card reader specified in ContextAndTwoStringW_Call.sz2 (for more information, see section 2.2.2.8).

Return Values: The method sets Long_Return.ReturnCode (for more information, see section 2.2.3.3) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.19 SCARD_IOCTL_REMOVEREADERFROMGROUPA (IOCTL 0x00090078)

The ASCII version of Remove Reader From Group removes the smart card reader specified in ContextAndTwoStringA_Call.sz2 (for more information, see section 2.2.2.7).

Return Values: The method sets Long_Return.ReturnCode (for more information, see section 2.2.3.3) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.20 SCARD_IOCTL_REMOVEREADERFROMGROUPW (IOCTL 0x0009007C)

The Unicode version of Remove Reader From Group removes the smart card reader specified in ContextAndTwoStringW_Call.sz2 (for more information, see section 2.2.2.8).

Return Values: The method sets Long_Return.ReturnCode (for more information, see section 2.2.3.3) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.21 SCARD_IOCTL_LOCATECARDSA (IOCTL 0x00090098)

The ASCII version of Locate Cards searches the readers specified in LocateCardsA_Call.mszCards (for more information, see section 2.2.2.9). Unknown Card Types MUST be ignored. **LocateCards_Return** is constructed according to **LocateCards_Return and GetStatusChange_Return** by using the information in **LocateCardsA_Call**.

Return Values: The method sets LocateCards_Return.ReturnCode (for more information, see section 2.2.3.5) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.22 SCARD_IOCTL_LOCATECARDSW (IOCTL 0x0009009C)

The Unicode version of Locate Cards searches the readers specified in LocateCardsW_Call.mszCards (for more inforamtion, see section 2.2.2.10). Unknown Card Types MUST be ignored. **LocateCards_Return** is constructed according to **LocateCards_Return and GetStatusChange_Return** by using the information in **LocateCardsW_Call**.

Return Values: The method sets **LocateCards_Return**.ReturnCode to SCARD_S_SUCCESS on success; otherwise it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.23 SCARD_IOCTL_GETSTATUSCHANGEA (IOCTL 0x000900A0)

The ASCII version of Get Status Change monitors the smart card readers specified in GetStatusChangeA_Call.rgReaderStates (for more information, see section 2.2.2.11) must correctly represent the state of the Readers as known by Smart Cards for Windows.

Return Values: The method sets **GetStatusChange_Return**.ReturnCode to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.24 SCARD_IOCTL_GETSTATUSCHANGEW (IOCTL 0x000900A4)

The Unicode version of Get Status Change monitors the smart card readers specified in GetStatusChangeW_Call.rgReaderStates (for more information, see section 2.2.2.12) must correctly represent the state of the readers as known by Smart Cards for Windows.

Return Values: The method sets **GetStatusChange_Return**.ReturnCode to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.25 SCARD_IOCTL_LOCATECARDSBYATRA (IOCTL 0x000900E8)

The ASCII version of Locate Cards By ATR searches the Readers specified in LocateCardsByATRA_Call.rgAtrMasks (for more information, see section 2.2.2.23). Unknown card types MUST be ignored. **LocateCards_Return** is constructed according to **LocateCards_Return and GetStatusChange_Return** by using the information in **LocateCardsByATRA_Call**.

Return Values: The method sets LocateCards_Return.ReturnCode (for more information, see section 2.2.3.5) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.26 SCARD_IOCTL_LOCATECARDSBYATRW (IOCTL 0x000900EC)

The Unicode version of Locate Cards By ATR searches the readers specified in LocateCardsByATRW_Call.rgAtrMasks (**LocateCardsByATRW_Call**). Unknown Card Types MUST be ignored. **LocateCards_Return** is constructed according to **LocateCards_Return and GetStatusChange_Return** by using the information in **LocateCardsByATRW_Call**.

Return Values: The method sets LocateCards_Return.ReturnCode (for more information, see section 2.2.3.5) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.27 SCARD_IOCTL_CANCEL (IOCTL 0x000900A8)

The Cancel method will instruct Smart Cards for Windows to call any outstanding calls by using the context specified by Context_Call.Context (for more information, see section 2.2.2.2).

Return Values: The method sets Long_Return.ReturnCode (for more information, see section 2.2.3.3) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.28 SCARD_IOCTL_CONNECTA (IOCTL 0x000900AC)

The ASCII version of Connect establishes a handle to a smart card reader. On success, **Connect_Return** is initialized according to **Control_Return**.

Return Values: The method sets the Connect_Return.ReturnCode (for more information, see section 2.2.3.8) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.29 SCARD_IOCTL_CONNECTW (IOCTL 0x000900B0)

The Unicode version of Connect establishes a smart card reader handle. On success, **Connect_Return** is initialized according to **Control_Return** and the caller is given a handle to execute additional methods on the reader.

Return Values: The method sets the Connect_Return.ReturnCode (for more information, see section 2.2.3.8) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.30 SCARD_IOCTL_DISCONNECT (IOCTL 0x000900B8)

The disconnect method releases a smart card reader handle that was acquired in **ConnectA_Call** or **ConnectW_Call**,using **HCardAndDisposition_Call**.dwDisposition. After a successful call, The smart card reader handle is released and MUST be made available to the system.

Return Values: the method sets **Long_Return**.ReturnCode to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.31 SCARD_IOCTL_BEGINTRANSACTION (IOCTL 0x000900BC)

The Begin Transaction method locks a smart card reader for exclusive access for the specified smart card reader handle. If the caller is unable to receive exclusive access, this call MUST block until the request can be met.

Return Values: the method sets Long_Return.ReturnCode (for more information, see section 2.2.3.3) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.32 SCARD_IOCTL_ENDTRANSACTION (IOCTL 0x000900C0)

The End Transaction method releases a smart card reader after being locked by a previously successful call to Begin Transaction (for more information, see section 3.1.4.31).

Return Values: the method sets Long_Return.ReturnCode (for more information, see section 2.2.3.3) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.33 SCARD_IOCTL_STATUSA (IOCTL 0x000900C8)

The ASCII version of the Status call returns the current state of the smart card reader and any smart card inserted. On success, Status_Return MUST be initialized according to **Status_Return**.

Return Values: the method sets Status_Return.ReturnCode (for more information, see section 2.2.3.10) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.34 SCARD_IOCTL_STATUSW (IOCTL 0x000900CC)

The Unicode version of the Status call returns the current state of the smart card reader and any smart card inserted. On success, Status_Return MUST be initialized according to **Status_Return**.

Return Values: the method sets Status_Return.ReturnCode (for more information, see section 2.2.3.10) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.35 SCARD_IOCTL_TRANSMIT (IOCTL 0x000900D0)

The Transmit function sends a command to a smart card inserted to the smart card reader associated with the smart card reader handle. On success, the command has been successfully sent to the card and the response has been placed in **Transmit_Return**.

Return Values: the method sets Transmit_Return.ReturnCode (for more information, see section 2.2.3.11) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.36 SCARD_IOCTL_RECONNECT (IOCTL 0x000900B4)

The reconnect method re-establishes a smart card reader handle. On success, the handle is valid once again.

Return Values: The method sets Reconnect_Return.ReturnCode (for more information, see section 2.2.3.7) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.37 SCARD_IOCTL_CONTROL (IOCTL 0x000900D4)

The Control function sends a command to a smart card reader associated with the smart card reader handle. On success, the command has been successfully sent to the smart card reader and the response has been placed in **Control_Return**.

Return values: the method sets Control_Return.ReturnCode (for more information, see section 2.2.3.6) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.38 SCARD_IOCTL_GETATTRIB (IOCTL 0x000900D8)

The Get Attribute function requests an attribute of the smart card reader associated with the smart card reader handle. On success, the attribute is copied to **GetAttrib_Return**.

Return values: the method sets GetAttrib_Return.ReturnCode (for more information, see section 2.2.3.12) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.39 SCARD_IOCTL_SETATTRIB (IOCTL 0x000900DC)

The Set Attribute function changes the value of an attribute of the smart card reader associated with the smart card reader handle.

Return values: the method sets Long_Return.ReturnCode (for more information, see section 2.2.3.3) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.40 SCARD_IOCTL_STATE (IOCTL 0x000900C4)

The State method returns the current state of the smart card reader and any smart card inserted. On success, **Status_Return** MUST be initialized as specified in section 2.2.3.10.

Return Values: the method sets State_Return.ReturnCode (for more information, see section 2.2.3.9) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.41 SCARD_IOCTL_GETTRANSMITCOUNT (IOCTL 0x00090100)

The Get Transmit Count retrieves the number of times a successful Transmit method (for more information, see section 3.1.4.35) has been performed on the smart card reader. On success, **GetTrasmitCount_Return** MUST be initialized as specified in section 2.2.3.13.

Return Values: the method sets State_Return.ReturnCode (for more information, see section 2.2.3.9) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.42 SCARD_IOCTL_READCACHEA (IOCTL 0x000900F0)

The ASCII version of Read Cache retrieves cached data for a specific smart card. Data is cached according to the smart card UUID (ReadCacheA_Call.szLookupName; for more information, see section 2.2.2.25), and the freshness of the data (ReadCacheA_Call.Common.FreshnessCounter). All three must match in order for this call to be successful. On success, ReadCache_Return MUST be initialized as specified in section 2.2.3.1.

Return Values: the method sets ReadCache_Return.ReturnCode (for more information, see section 2.2.3.1) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.43 SCARD_IOCTL_READCACHEW (IOCTL 0x000900F4)

The Unicode version of Read Cache retrieves cached data for a specific smart card in a Smart Cards for Windows cache. Data is cached according to the smart card UUID (ReadCacheW_Call.szLookupName; for more information, see section 2.2.2.26), and the freshness of the data (ReadCacheW_Call.Common.FreshnessCounter). All three must match in order for this call to be successful. On success, ReadCache_Return MUST be initialized as specified in section 2.2.3.1.

Return Values: the method sets ReadCache_Return.ReturnCode (for more information, see section 2.2.3.1) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method.

3.1.4.44 SCARD_IOCTL_WRITECACHEA (IOCTL 0x000900F8)

The ASCII version of Write Cache stores data for a specific smart card in a Smart Cards for Windows cache. Data is cached according to the smart card UUID (ReadCacheA_Call.szLookupName; for more information, see section 2.2.2.25), and the freshness of the data (ReadCacheA_Call.Common.FreshnessCounter).

Return Values: the method sets Long_Return.ReturnCode (for more information, see section 2.2.3.3) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method

3.1.4.45 SCARD_IOCTL_WRITECACHEW (IOCTL 0x000900FC)

The Unicode version of Write Cache stores data for a specific smart card in a Smart Cards for Windows cache. Data is cached according to the smart card UUID (ReadCacheA_Call.szLookupName; for more information, see section 2.2.2.25), and the freshness of the data (ReadCacheA_Call.Common.FreshnessCounter).

Return Values: the method sets Long_Return.ReturnCode (for more information, see section 2.2.3.3) to SCARD_S_SUCCESS on success; otherwise, it sets one of the smart card-specific errors or one of the return codes from Winerror.h. No specialized error codes are associated with this method

3.1.5 Timer Events

This protocol has no timer events.

3.1.6 Other Local Events

On protocol termination, the following actions are performed.

For each context in rgSCardContextList, Cancel is called causing all outstanding messages to be processed. After there are no more outstanding messages, Release Context is called on each context and the context MUST be removed from rgSCardContextList.

3.2 Protocol 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 provided that their external behavior is consistent with that described in this document.

The following state MUST be kept by this protocol:

dwDeviceId: device ID of smart card redirection device.

rgOutstandingMessages: Outstanding call packets have not received a return packet.

3.2.2 Timers

No timers are required.

3.2.3 Initialization

Initialization occurs when the protocol server sends a device-announce message according to Remote Desktop Protocol: File System Virtual Channel Extension. At that time, **dwDeviceId** MUST receive the unique device ID announced. The **rgOutstandingMessage** field MUST be set to the empty list.

3.2.4 Higher-Layer Triggered Events

None.

3.2.5 Message Processing Events and Sequencing Rules

3.2.5.1 Sending Outgoing Messages

Messages are constructed according to Remote Desktop Protocol: File System Virtual Channel Extension as a device I/O control message on the redirected device **dwDeviceId**. The call packet MUST follow the format specified in IOCTL Processing Rules. The structure MUST be encoded as specified in [MS-RPCE] section 2. The output buffer length SHOULD be set to 2,048 bytes.

The message is sent to the protocol server by using a transport as specified in [MS-RDPEFS].

3.2.5.2 Processing Incoming Replies

The following steps MUST be applied to each message when they are received.

If IOStatus is STATUS_BUFFER_TOO_SMALL, then the message SHOULD be retransmitted according to Sending Outgoing Messages, doubling the previously requested buffer length.

If IOStatus is zero, the corresponding IoControlCode-specific reply processing MUST be performed.

Otherwise, the call is considered a failure and the error MUST be propagated to the higher layer.

3.2.5.3 Messages

3.2.5.3.1 Sending EstablishContext Message

IoControlCode MUST be set to SCARD_IOCTL_ESTABLISHCONTEXT.

EstablishContext_Call MUST be initialized as specified in section 2.2.2.1.

3.2.5.3.2 Processing EstablishContext Reply

The OutputBuffer MUST be decoded as **EstablishContext_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.3 Sending ReleaseContext Message

IoControlCode MUST be set to SCARD_IOCTL_RELEASECONTEXT.

Context_Call MUST be initialized, as specified in section 2.2.2.2.

3.2.5.3.4 Processing ReleaseContext Reply

The response message MUST be decoded as **Long_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.5 Sending WaitForResourceManager Message

IoControlCode MUST be set to SCARD_IOCTL_ACCESSSTARTEDEVENT.

SCardAccessStartedEvent_Call MUST be initialized as specified in section 2.2.2.30.

3.2.5.3.6 Processing WaitForResourceManager Reply

The OutputBuffer MUST be decoded as **Long_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.7 Sending IntroduceReader (ASCII) Message

IoControlCode MUST be set to SCARD_IOCTL_INTRODUCEREADERA.

ContextAndTwoStringA_Call MUST be initialized as specified in section 2.2.2.7 for a SCARD_IOCTL_INTRODUCEREADERA call.

3.2.5.3.8 Processing IntroduceReader (ASCII) Reply

The OutputBuffer MUST be decoded as **Long_Return**, as specified in [MS-RPCE] section 2.2.6..NET Passport

3.2.5.3.9 Sending IntroduceReader (Unicode) Message

IoControlCode MUST be set to SCARD_IOCTL_INTRODUCEREADERW.

ContextAndTwoStringW_Call MUST be initialized, as specified in section 2.2.2.8, for a SCARD_IOCTL_INTRODUCEREADERW call.

3.2.5.3.10 Processing IntroduceReader (Unicode) Reply

The OutputBuffer MUST be decoded as **Long_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.11 Sending ForgetReader (ASCII) Message

IoControlCode MUST be set to SCARD_IOCTL_FORGETREADERA.

ContextAndStringA_Call MUST be initialized, as specified in section 2.2.2.5, for a SCARD_IOCTL_FORGETREADERA call.

3.2.5.3.12 Processing ForgetReader (ASCII) Reply

The OutputBuffer MUST be decoded as **Long_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.13 Sending ForgetReader (Unicode) Message

IoControlCode MUST be set to SCARD_IOCTL_FORGETREADERW.

ContextAndStringW_Call MUST be initialized, as specified in section 2.2.2.6, for a SCARD_IOCTL_FORGETREADERW call.

3.2.5.3.14 Processing ForgetReader (Unicode) Reply

The OutputBuffer MUST be decoded as **Long_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.15 Sending IntroduceReaderGroup (ASCII) Message

IoControlCode MUST be set to SCARD_IOCTL_INTRODUCEREADERGROUPA.

ContextAndStringA_Call MUST be initialized, as specified in section 2.2.2.5, for a SCARD_IOCTL_INTRODUCEREADERGROUPA call.

3.2.5.3.16 Processing IntroduceReaderGroup (ASCII) Reply

The OutputBuffer MUST be decoded as **Long_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.17 Sending IntroduceReaderGroup (Unicode) Message

IoControlCode MUST be set to SCARD_IOCTL_INTRODUCEREADERGROUPW.

ContextAndStringW_Call MUST be initialized, as specified in section 2.2.2.6, for a SCARD_IOCTL_INTRODUCEREADERGROUPW call.

3.2.5.3.18 Processing IntroduceReaderGroup (Unicode) Reply

The OutputBuffer MUST be decoded as **Long_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.19 Sending ForgetReaderGroup (ASCII) Message

IoControlCode MUST be set to SCARD_IOCTL_FORGETREADERGROUPA.

ContextAndStringA_Call MUST be initialized, as specified in section 2.2.2.5, for a SCARD_IOCTL_FORGETREADERGROUPA call.

3.2.5.3.20 Processing ForgetReaderGroup (ASCII) Reply

The OutputBuffer MUST be decoded as **Long_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.21 Sending ForgetReaderGroup (ASCII) Message

IoControlCode MUST be set to SCARD_IOCTL_FORGETREADERGROUPW.

ContextAndStringW_Call MUST be initialized, as specified in section 2.2.2.6, for a SCARD_IOCTL_FORGETREADERGROUPW call.

3.2.5.3.22 Processing ForgetReaderGroup (Unicode) Reply

The OutputBuffer MUST be decoded as **Long_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.23 Sending AddReaderToGroup (ASCII) Message

IoControlCode MUST be set to SCARD_IOCTL_ADDREADERTOGROUPA.

ContextAndTwoStringA_Call MUST be initialized, as specified in section 2.2.2.7, for a SCARD_IOCTL_ADDREADERTOGROUPA call.

3.2.5.3.24 Processing AddReaderToGroup (ASCII) Reply

The OutputBuffer MUST be decoded as **Long_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.25 Sending AddReaderToGroup (Unicode) Message

IoControlCode MUST be set to SCARD_IOCTL_ADDREADERTOGROUPW.

ContextAndTwoStringW_Call MUST be initialized, as specified in section 2.2.2.8, for a SCARD_IOCTL_ADDREADERTOGROUPW call.

3.2.5.3.26 Processing AddReaderToGroup (Unicode) Reply

The OutputBuffer MUST be decoded as **Long_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.27 Sending RemoveReaderFromGroup (ASCII) Message

IoControlCode MUST be set to SCARD_IOCTL_REMOVEREADERFROMGROUPA.

ContextAndTwoStringA_Call MUST be initialized, as specified in section 2.2.2.7, for a SCARD_IOCTL_REMOVEREADERFROMGROUPA call.

3.2.5.3.28 Processing RemoveReaderFromGroup (ASCII) Reply

The OutputBuffer MUST be decoded as **Long_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.29 Sending RemoveReaderFromGroup (Unicode) Message

IoControlCode MUST be set to SCARD_IOCTL_REMOVEREADERFROMGROUPW.

ContextAndTwoStringW_Call MUST be initialized, as specified in section 2.2.2.8, for a SCARD_IOCTL_REMOVEREADERFROMGROUPW call.

3.2.5.3.30 Processing RemoveReaderFromGroup (Unicode) Reply

The OutputBuffer MUST be decoded as **Long_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.31 Sending ListReaderGroups (ASCII) Message

IoControlCode MUST be set to SCARD_IOCTL_LISTREADERGROUPSA.

ListReaderGroups_Call MUST be initialized, as specified in section 2.2.2.3.

3.2.5.3.32 Processing ListReaderGroups (ASCII) Reply

The OutputBuffer MUST be decoded as **ListReaderGroups_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.33 Sending ListReaderGroups (Unicode) Message

IoControlCode MUST be set to SCARD_IOCTL_LISTREADERGROUPSW.

ListReaderGroups_Call MUST be initialized, as specified in section 2.2.2.3.

3.2.5.3.34 Processing ListReaderGroups (Unicode) Reply

The OutputBuffer MUST be decoded as **ListReaderGroups_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.35 Sending ListReaders (ASCII) Message

IoControlCode MUST be set to SCARD_IOCTL_LISTREADERSA.

ListReaders_Call MUST be initialized, as specified in section 2.2.2.4, for an ASCII call.

3.2.5.3.36 Processing ListReadersReply (ASCII) Reply

The OutputBuffer MUST be decoded as **ListReaders_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.37 Sending ListReaders (Unicode) Message

IoControlCode MUST be set to SCARD_IOCTL_LISTREADERSW.

ListReaders_Call MUST be initialized, as specified in section 2.2.2.4, for an Unicode call.

3.2.5.3.38 Processing ListReadersReply (Unicode) Reply

The OutputBuffer MUST be decoded as **ListReaders_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.39 Sending LocateCards (ASCII) Message

IoControlCode MUST be set to SCARD_IOCTL_LOCATECARDSA.

LocateCardsA_Call MUST be initialized as specified in section 2.2.2.9.

3.2.5.3.40 Processing LocateCards (ASCII) Reply

The OutputBuffer MUST be decoded as **LocateCards_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.41 Sending LocateCards (Unicode) Message

IoControlCode MUST be set to SCARD_IOCTL_LOCATECARDSW.

LocateCardsW_Call MUST be initialized, as specified in section 2.2.2.10.

3.2.5.3.42 Processing LocateCards (Unicode) Reply

The OutputBuffer MUST be decoded as **LocateCards_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.43 Sending GetStatusChange (ASCII) Message

IoControlCode MUST be set to SCARD_IOCTL_GETSTATUSCHANGEA.

GetStatusChangeA_Call MUST be initialized, as specified in section 2.2.2.11.

3.2.5.3.44 Processing GetStatusChange (ASCII) Reply

The OutputBuffer MUST be decoded as **GetStatusChange_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.45 Sending GetStatusChange (Unicode) Message

IoControlCode MUST be set to SCARD_IOCTL_GETSTATUSCHANGEW.

GetStatusChangeW_Call MUST be initialized, as specified in section 2.2.2.12.

3.2.5.3.46 Processing GetStatusChange (Unicode) Reply

The OutputBuffer MUST be decoded as **GetStatusChange_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.47 Sending Cancel Message

IoControlCode MUST be set to SCARD_IOCTL_CANCEL.

Context_Call.Context MUST be initialized, as specified in section 2.2.2.2.

3.2.5.3.48 Processing Cancel Reply

The OutputBuffer MUST be decoded as **Long_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.49 Sending Connect (ASCII) Message

IoControlCode MUST be set to SCARD_IOCTL_CONNECTA.

ConnectA_Call MUST be initialized, as specified in section 2.2.2.13.

3.2.5.3.50 Processing Connect (ASCII) Reply

The OutputBuffer MUST be decoded as **Connect_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.51 Sending Connect (Unicode) Message

IoControlCode MUST be set to SCARD_IOCTL_CONNECTW.

ConnectW_Call MUST be initialized, as specified in section 2.2.2.14.

3.2.5.3.52 Processing Connect (Unicode) Reply

The OutputBuffer MUST be decoded as **Connect_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.53 Sending Reconnect Message

IoControlCode MUST be set to SCARD_IOCTL_RECONNECT.

Reconnect_Call MUST be initialized, as specified in section 2.2.2.15.

3.2.5.3.54 Processing Reconnect Reply

The OutputBuffer MUST be decoded as **Reconnect_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.55 Sending Disconnect Message

IoControlCode MUST be set to SCARD_IOCTL_DISCONNECT.

HCardAndDisposition_Call MUST be initialized, as specified in section 2.2.2.16, for a SCARD_IOCTL_DISCONNECT call.

3.2.5.3.56 Processing Disconnect Reply

The OutputBuffer MUST be decoded as **Long_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.57 Sending Status (ASCII) Message

IoControlCode MUST be set to SCARD_IOCTL_STATUSA.

Status_Call MUST be initialized, as specified in section 2.2.2.18.

3.2.5.3.58 Processing Status (ASCII) Reply

The OutputBuffer MUST be decoded as **Status_Return**, as specified in [MS-RPCE] section 2.2.6, and interpreted as a SCARD_IOCTL_STATUSA return.

3.2.5.3.59 Sending Status (Unicode) Message

IoControlCode MUST be set to SCARD_IOCTL_STATUSW.

Status_Call MUST be initialized, as specified in section 2.2.2.18 .

3.2.5.3.60 Processing Status (Unicode) Reply

The OutputBuffer MUST be decoded as **Status_Return**, as specified in [MS-RPCE] section 2.2.6, and interpreted as a SCARD_IOCTL_STATUSW return.

3.2.5.3.61 Sending State Message

IoControlCode MUST be set to SCARD_IOCTL_STATE.

State_Call MUST be initialized, as specified in section 2.2.2.17, for a SCARD_IOCTL_STATE call.

3.2.5.3.62 Processing State Message Reply

The OutputBuffer MUST be decoded as **State_Return**, as specified in [MS-RPCE] section 2.2.6, and interpreted as a SCARD_IOCTL_STATE return.

3.2.5.3.63 Sending BeginTransaction Message

IoControlCode MUST be set to SCARD_IOCTL_BEGINTRANSACTION.

HCardAndDisposition_Call MUST be initialized, as specified in section 2.2.2.16, for a SCARD_IOCTL_BEGINTRANSACTION call.

3.2.5.3.64 Processing BeginTransaction Reply

The OutputBuffer MUST be decoded as **Long_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.65 Sending EndTransaction Message

IoControlCode MUST be set to SCARD_IOCTL_ENDTRANSACTION.

HCardAndDisposition_Call MUST be initialized, as specified in section 2.2.2.16, for a SCARD_IOCTL_ENDTRANSACTION call.

3.2.5.3.66 Processing EndTransaction Reply

The OutputBuffer MUST be decoded as **Long_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.67 Sending Transmit Message

IoControlCode MUST be set to SCARD_IOCTL_TRANSMIT.

Transmit_Call MUST be initialized as specified in section 2.2.2.19.

3.2.5.3.68 Processing Transmit Reply

The OutputBuffer MUST be decoded as **Transmit_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.69 Sending Control Message

IoControlCode MUST be set to SCARD_IOCTL_CONTROL.

Control_Call MUST be initialized as specified in section 2.2.2.20.

3.2.5.3.70 Processing Control Reply

The OutputBuffer MUST be decoded as **Control_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.71 Sending GetReaderCapabilities Message

IoControlCode MUST be set to SCARD_IOCTL_GETATTRIB.

GetAttrib_Call MUST be initialized as specified in section 2.2.2.21.

3.2.5.3.72 Processing GetReaderCapabilities Reply

The OutputBuffer MUST be decoded as **GetAttrib_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.73 Sending SetReaderCapabilities Message

IoControlCode MUST be set to SCARD_IOCTL_SETATTRIB.

SetAttrib_Call MUST be initialized as specified in section 2.2.2.22.

3.2.5.3.74 Processing SetReaderCapabilities Reply

The OutputBuffer MUST be decoded as **Long_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.75 Sending WaitForResourceManager Message

IoControlCode MUST be set to SCARD_IOCTL_ACCESSSTARTEDEVENT.

ScardAccessStartedEvent_Call MUST be initialized as specified in section 2.2.2.30. This structure MUST not be encoded and MUST be sent as is.

3.2.5.3.76 Processing WaitForResourceManager Reply

The OutputBuffer MUST be decoded as **Long_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.77 Sending LocateCardsByATR (ASCII) Message

IoControlCode MUST be set to SCARD_IOCTL_LOCATECARDSBYATRA.

LocateCardsByATRA_Call MUST be initialized as specified in section 2.2.2.23.

3.2.5.3.78 Processing LocateCardsByATR (Unicode) Reply

The OutputBuffer MUST be decoded as **LocateCards_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.79 Processing LocateCardsByATR (ASCII) Reply

The OutputBuffer MUST be decoded as **LocateCards_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.80 Sending LocateCardsByATR (Unicode) Message

IoControlCode MUST be set to SCARD_IOCTL_LOCATECARDSBYATRW.

LocateCardsByATRW_Call MUST be initialized as specified in section 2.2.2.24.

3.2.5.3.81 Sending ReadCache (ASCII) Message

IoControlCode MUST be set to SCARD_IOCTL_READCACHEA.

ReadCacheA_Call MUST be initialized as specified in section 2.2.2.25.

3.2.5.3.82 Processing ReadCache (ASCII) Reply

The OutputBuffer MUST be decoded as **ReadCache_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.83 Sending ReadCache (Unicode) Message

IoControlCode MUST be set to SCARD_IOCTL_READCACHEW.

ReadCacheW_Call MUST be initialized as specified in section 2.2.2.26.

3.2.5.3.84 Processing ReadCache (Unicode) Reply

The OutputBuffer MUST be decoded as **ReadCache_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.85 Sending WriteCache (ASCII) Message

IoControlCode MUST be set to SCARD_IOCTL_WRITECACHEA.

WriteCacheA_Call MUST be initialized as specified in section 2.2.2.27.

3.2.5.3.86 Processing WriteCache (ASCII) Reply

The OutputBuffer MUST be decoded as **Long_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.87 Sending WriteCache (Unicode) Message

IoControlCode MUST be set to SCARD_IOCTL_WRITECACHEW.

WriteCacheW_Call MUST be initialized as specified in section 2.2.2.28.

3.2.5.3.88 Processing WriteCache (Unicode) Reply

The OutputBuffer MUST be decoded as **Long_Return**, as specified in [MS-RPCE] section 2.2.6.

3.2.5.3.89 Sending GetTransmitCount Message

IoControlCode MUST be set to SCARD_IOCTL_GETTRANSMITCOUNT.

GetTransmitCount_Call MUST be initialized as specified in section 2.2.2.29.

3.2.5.3.90 Processing GetTransmitCount Reply

The OutputBuffer MUST be decoded as **GetTransmitCount_Return**, as specified in of [MS-RPCE] section 2.2.6.

3.2.6 Timer Events

This protocol has no timer events.

3.2.7 Other Local Events

This protocol has no other local events.

4 Protocol Examples

This example shows the messages sent to perform a simple querying of a card in the TS client machine. It assumes that a channel has already been set up on the between the TS client and the TS server. In addition, a PC/SC-compatible resource manager is running on the TS client and there exists a smart card reader with a smart card inserted. The following figure represents the program flow.

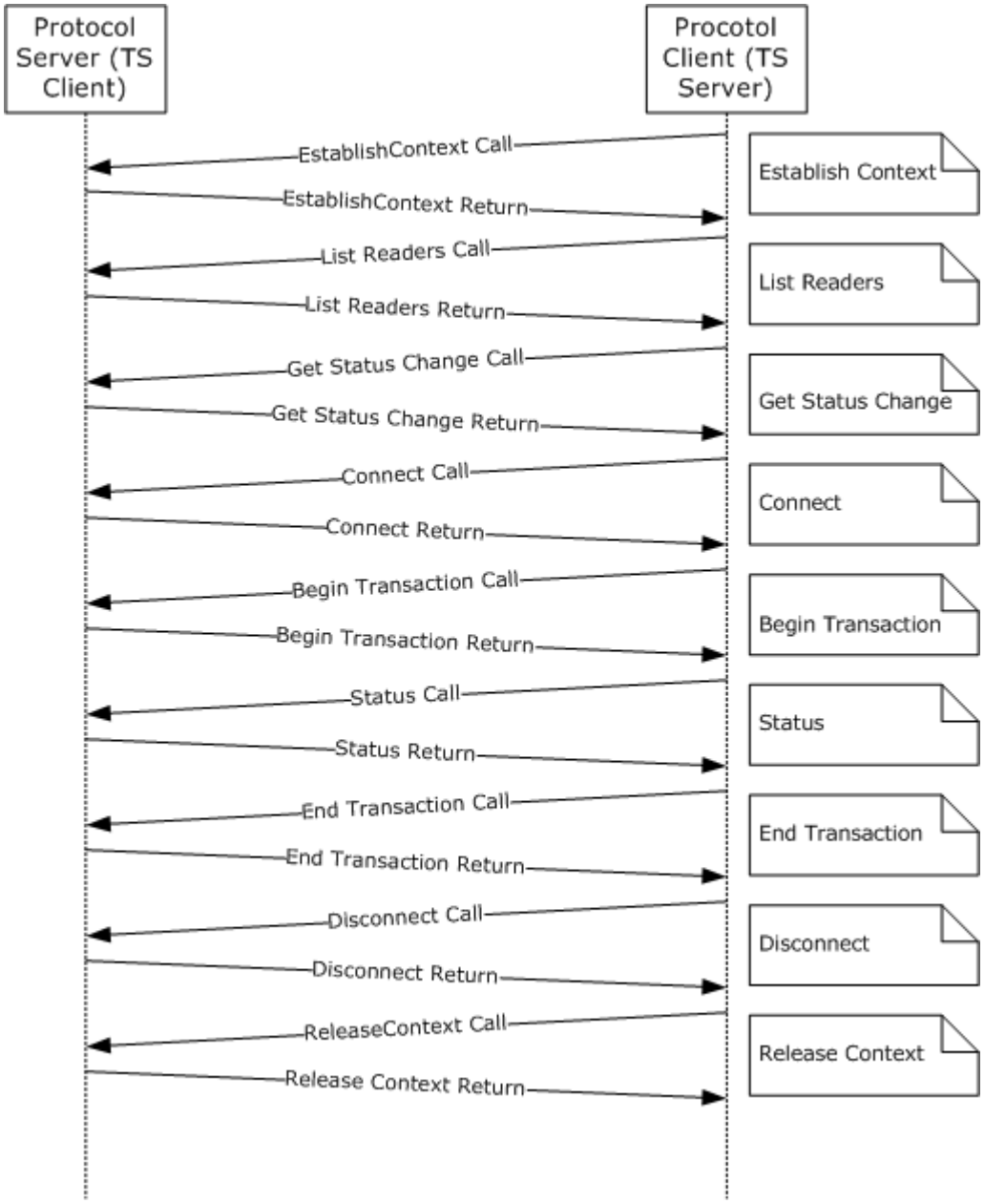


Figure 4: Protocol flow

This representation of the protocol flow is simplified in that there is only one application sending data over this protocol. In an actual implementation there could be multiple outstanding calls at any time.

All packets are constructed as specified in sections 3.2.5 and 3.2.5.3.

4.1 Establish Context Call

```
IoControlCode= SCARD_IOCTL_ESTABLISHCONTEXT
CompletionId = 0
EstablishContext_Call {
dwScope = SCARD_SCOPE_SYSTEM
}
```

4.2 Establish Context Return

```
CompletionId = 0
Status = 0
EstablishContext_Return {
ReturnCode = 0
Context = {cbContext = 4, pbContext = {0x00,0x00,0x01,0xcd} }
}
```

4.3 List Readers Call

```
IoControlCode = SCARD_IOCTL_LISTREADERSW
CompletionId = 0
ListReaders_Call {
Context = {cbContext = 4, pbContext = {0x00,0x00,0x01,0xcd} }
cBytes = 44
mszGroups = L"SCard$DefaultReaders\0\0"
fmszReadersIsNULL = 0
              cchReaders = 0xFFFFFFFF
}
```

4.4 List Readers Return

```
CompletionId = 0
Status = 0
ListReaders_Return {
ReturnCode = 0
cReaders =66
msz = L"Gemplus USB Smart Card Reader 0\0\0"
}
```

4.5 Get Status Change Call

```
IoControlCode = SCARD_IOCTL_GETSTATUSCHANGEW
CompletionId = 0
GetStatusChangeW_Call {
Context = {cbContext = 4, pbContext = {0x00,0x00,0x01,0xcd} }
dwTimeOut = 0
```

```
cReaders =1
rgReaderStates = {
{ szReader = L"Gemplus USB Smart Card Reader 0"
  Common = {
dwCurrentState = SCARD_STATE_UNAWARE
dwEventState = 0
cbAtr = 0
pbAtr = {0}  }
                              }
          }
}
```

4.6 Get Status Change Return

```
Status  = 0
CompletionId = 0
GetStatusChange_Return = {
ReturnCode = 0
cReaders =1
rgReaderStates = {
dwCurrentState = SCARD_STATE_UNAWARE
dwEventState = SCARD_STATE_CHANGED |
     SCARD_STATE_PRESENT | SCARD_STATE_INUSE
cbAtr = 9
rgbAtr = {0x3b, 0x16, 0x94,0x41, 0x73, 0x74,0x72,0x69,
     0x64}
}
}
```

4.7 Connect Call

```
IoControlCode = SCARD_IOCTL_CONNECTW
CompletionId = 0
ConnectW_Call = {
szReader = L"Gemplus USB Smart Card Reader 0"
Common = {
Context = { cbContext = 4, pbContext = {0x00,0x00,0x01,0xcd} }
dwShareMode = SCARD_SHARE_SHARED
dwPreferredProtocols = SCARD_PROTOCOL_T0 | SCARD_PROTOCOL_T1
}
}
```

4.8 Connect Return

```
CompletionId = 0
Status = 0
Connect_Return = {
ReturnCode = 0
hCard = {
Context = { cbContext = 4, pbContext = {0x00,0x00,0x01,0xcd} }
cbHandle = 4
pbHandle = {0x00,0x00,0x01,0xea}{0x00,0x00,0x01,0xea}}
dwActiveProtocol = SCARD_PROTOCOL_T0
```

```
}
```

4.9 Begin Transaction Call

```
IoControlCode = SCARD_IOCTL_BEGINTRANSACTION
CompletionId = 0
HCardAndDisposition_Call = {
hCard = {
Context = { cbContext = 4, pbContext = {0x00,0x00,0x01,0xcd} }
 cbHandle = 4
pbHandle = {0x00,0x00,0x01,0xea}}
dwDisposition = 0
}
```

4.10 Begin Transaction Return

```
CompletionId = 0
Status = 0
Long_Return = {
ReturnCode = 0
}
```

4.11 Status Call

```
IoControlCode = SCARD_IOCTL_STATUSW
CompletionId = 0
Status_Call = {
hCard = {
Context = { cbContext = 4, pbContext = {0x00,0x00,0x01,0xcd} }
 cbHandle = 4
pbHandle = {0x00,0x00,0x01,0xea} }
fmszReaderNamesIsNULL = 0
cchReaderLen = 0xFFFFFFFF
cbAtrLen = 36
}
```

4.12 Status Return

```
CompletionId = 0
IoStatus = 0
Status_Return = {
ReturnCode = 0
cBytes = 66
mszReaderNames = L"Gemplus USB Smart Card Reader 0\0\0"
dwState = SCARD_SPECIFICMODE
dwProtocol = SCARD_PROTOCOL_T0
pbAtr = {0x3b, 0x16, 0x94,0x41, 0x73, 0x74,0x72,0x69,0x64}
cbAtr = 9
}
```

4.13 End Transaction Call

```
IoControlCode = SCARD_IOCTL_ENDTRANSACTION
CompletionId = 0
HCardAndDisposition_Call = {
hCard = {
Context = { cbContext = 4, pbContext = {0x00,0x00,0x01,0xcd} }
cbHandle = 4
pbHandle = {0x00,0x00,0x01,0xea}}
dwDisposition = SCARD_LEAVE_CARD
}
```

4.14 End Transaction Return

```
CompletionId = 0
Status = 0
Long_Return = {
ReturnCode = 0
}
```

4.15 Disconnect Call

```
IoControlCode = SCARD_IOCTL_DISCONNECT
CompletionId = 0
HCardAndDisposition_Call = {
hCard = {
Context = { cbContext = 4, pbContext = {0x00,0x00,0x01,0xcd} }
cbHandle = 4
pbHandle = {0x00,0x00,0x01,0xea}}
dwDisposition = SCARD_RESET_CARD
}
```

4.16 Disconnect Return

```
CompletionId = 0
Status = 0
Long_Return = {
ReturnCode = 0
}
```

4.17 Release Context Call

```
IoControlCode = SCARD_IOCTL_RELEASECONTEXT
CompletionId = 0
Context_Call = {
Context = {cbContext = 4, pbContext = {0x00,0x00,0x01,0xcd} }
}
```

4.18 Release Context Return

```
CompletionId = 0
```

```
Status = 0
Long_Return = {
ReturnCode = 0
}
```

5 Security

This protocol has no security aspects and relies on the underlying transport for any security.

5.1 Security Considerations for Implementers

There are no security considerations for implementers for this protocol.

5.2 Index of Security Parameters

There are no security parameters for this protocol.

6 Appendix A: Full IDL

For ease of implementation, the full **Interface Definition Language (IDL)** is provided below where ms-dtyp.idl is the IDL as specified in [MS-DTYP] Appendix A and ms-dcom.idl is the IDL as specified in [MS-DCOM] Appendix A.

```
import "ms-dtyp.idl";
import "ms-dcom.idl";

[
    uuid(A35AF600-9CF4-11CD-A076-08002B2BD711),
    version(1.0),
    pointer default(unique)
]
interface type scard pack
{

//
// Packing for calls that use the same params
//
typedef struct  REDIR SCARDCONTEXT
{
    [range(0, 16)]                  unsigned long       cbContext;
    [unique] [size_is(cbContext)]   byte               *pbContext;
} REDIR SCARDCONTEXT;

typedef struct  REDIR SCARDHANDLE
{
                          REDIR_SCARDCONTEXT              Context;
    [range(0, 16)]        unsigned long                   cbHandle;
    [size is(cbHandle)]   byte                           *pbHandle;
} REDIR SCARDHANDLE;

typedef struct _long_Return
{
    long                  ReturnCode;
} long Return;

typedef struct  longAndMultiString Return
{
                                        long            ReturnCode;
    [range(0, 65536)]                   unsigned long   cBytes;
    [unique] [size is(cBytes)]          byte           *msz;
} ListReaderGroups Return, ListReaders Return;

typedef struct _Context_Call
{
    REDIR SCARDCONTEXT                          Context;
} Context Call;

typedef struct  ContextAndStringA Call
{
             REDIR_SCARDCONTEXT                         Context;
    [string] const char *                               sz;
} ContextAndStringA Call;

typedef struct  ContextAndStringW Call
{
             REDIR_SCARDCONTEXT                         Context;
    [string] const wchar t *                            sz;
} ContextAndStringW Call;
```

```
typedef struct  ContextAndTwoStringA Call
{
            REDIR_SCARDCONTEXT                          Context;
    [string] const char *                               sz1;
    [string] const char *                               sz2;
} ContextAndTwoStringA Call;

typedef struct _ContextAndTwoStringW_Call
{
            REDIR SCARDCONTEXT                          Context;
    [string] const wchar t *                            sz1;
    [string] const wchar t *                            sz2;
} ContextAndTwoStringW Call;

//
// Call specific packing
//
typedef struct  EstablishContext Call
{
    unsigned long                               dwScope;
} EstablishContext Call;

typedef struct  EstablishContext Return
{
    long                                        ReturnCode;
    REDIR_SCARDCONTEXT                          Context;
} EstablishContext_Return;


typedef struct  ListReaderGroups Call
{
    REDIR_SCARDCONTEXT                          Context;
    long                                        fmszGroupsIsNULL;
    unsigned long                               cchGroups;
} ListReaderGroups Call;


typedef struct _ListReaders_Call
{
                               REDIR SCARDCONTEXT   Context;
    [range(0, 65536)]          unsigned long        cBytes;
    [unique] [size is(cBytes)] const byte          *mszGroups;
                            long                 fmszReadersIsNULL;
                               unsigned long        cchReaders;
} ListReaders Call;

typedef struct  ReaderState Common Call
{
                     unsigned long             dwCurrentState;
                     unsigned long             dwEventState;
    [range(0, 36)]   unsigned long             cbAtr;
                     byte                      rgbAtr[36];
} ReaderState Common Call;

typedef struct _ReaderStateA
{
    [string] const char *                               szReader;
             ReaderState Common Call                    Common;
} ReaderStateA;

typedef struct  ReaderStateW
{
    [string] const wchar_t *                            szReader;
             ReaderState Common Call                    Common;
} ReaderStateW;
```

```
typedef struct _ReaderState_Return
{
                    unsigned long               dwCurrentState;
                    unsigned long               dwEventState;
    [range(0, 36)] unsigned long                cbAtr;
                    byte                        rgbAtr[36];
} ReaderState_Return;

typedef struct  GetStatusChangeA Call
{
                        REDIR SCARDCONTEXT       Context;
    [range(0, 65536)]   unsigned long            cBytes;
    [size_is(cBytes)]   const byte              *mszCards;
    [range(0, 10)]      unsigned long            cReaders;
    [size is(cReaders)] ReaderStateA            *rgReaderStates;
} GetStatusChangeA Call;

typedef struct  LocateCardsA Call {
    REDIR_SCARDCONTEXT                Context;
    [range(0, 65536)] unsigned long    cBytes;
    [size is(cBytes)] const byte *     mszCards;
    [range(0, 10)] unsigned long       cReaders;
    [size is(cReaders)] ReaderStateA * rgReaderStates;
} LocateCardsA_Call;


typedef struct  LocateCardsW Call
{
                        REDIR SCARDCONTEXT       Context;
    [range(0, 65536)]   unsigned long            cBytes;
    [size_is(cBytes)]   const byte              *mszCards;
    [range(0, 10)]      unsigned long            cReaders;
    [size is(cReaders)] ReaderStateW            *rgReaderStates;
} LocateCardsW Call;

typedef struct  LocateCards ATRMask
{
    [range(0, 36)]      unsigned long            cbAtr;
                        byte                     rgbAtr[36];
                        byte                     rgbMask[36];
} LocateCards ATRMask;

typedef struct _LocateCardsByATRA_Call
{
                        REDIR SCARDCONTEXT      Context;
    [range(0, 1000)]    unsigned long           cAtrs;
    [size is(cAtrs)]    LocateCards ATRMask    *rgAtrMasks;
    [range(0, 10)]      unsigned long           cReaders;
    [size_is(cReaders)] ReaderStateA           *rgReaderStates;
} LocateCardsByATRA Call;

typedef struct  LocateCardsByATRW Call
{
                        REDIR_SCARDCONTEXT      Context;
    [range(0, 1000)]    unsigned long           cAtrs;
    [size is(cAtrs)]    LocateCards ATRMask    *rgAtrMasks;
    [range(0, 10)]      unsigned long           cReaders;
    [size is(cReaders)] ReaderStateW           *rgReaderStates;
} LocateCardsByATRW Call;

typedef struct _GetStatusChange_Return
{
                        long                     ReturnCode;
    [range(0, 10)]      unsigned long            cReaders;
```

```
    [size is(cReaders)] ReaderState Return      *rgReaderStates;
} LocateCards_Return, GetStatusChange_Return;

typedef struct  GetStatusChangeW Call
{
                        REDIR SCARDCONTEXT      Context;
                        unsigned long           dwTimeOut;
    [range(0, 11)]      unsigned long           cReaders;
    [size_is(cReaders)] ReaderStateW           *rgReaderStates;
} GetStatusChangeW Call;

typedef struct  Connect Common
{
    REDIR_SCARDCONTEXT                      Context;
    unsigned long                           dwShareMode;
    unsigned long                           dwPreferredProtocols;
} Connect Common;

typedef struct  ConnectA Call
{
    [string] const char *                               szReader;
             Connect Common                             Common;
} ConnectA Call;

typedef struct _ConnectW_Call
{
    [string] const wchar_t *                            szReader;
             Connect Common                             Common;
} ConnectW Call;

typedef struct  Connect Return
{
    long                                        ReturnCode;
    REDIR SCARDHANDLE                           hCard;
    unsigned long                               dwActiveProtocol;
} Connect Return;

typedef struct _Reconnect_Call
{
    REDIR SCARDHANDLE                       hCard;
    unsigned long                           dwShareMode;
    unsigned long                           dwPreferredProtocols;
    unsigned long                           dwInitialization;
} Reconnect_Call;

typedef struct Reconnect Return
{
    long                                        ReturnCode;
    unsigned long                               dwActiveProtocol;
} Reconnect_Return;


typedef struct  HCardAndDisposition Call
{
    REDIR_SCARDHANDLE                           hCard;
    unsigned long                               dwDisposition;
} HCardAndDisposition Call;


typedef struct  State Call
{
    REDIR_SCARDHANDLE                           hCard;
    long                                        fpbAtrIsNULL;
    unsigned long                               cbAtrLen;
    // EDITOR'S NOTE: Can be 0xFFFFFFFF
```

```
} State Call;

typedef struct _State_Return
{
                                    long                ReturnCode;
                                    unsigned long       dwState;
                                    unsigned long       dwProtocol;
    [range(0, 36)]                  unsigned long       cbAtrLen;
    [unique] [size_is(cbAtrLen)]    byte               *rgAtr;
} State Return;


typedef struct  Status Call
{
    REDIR_SCARDHANDLE                       hCard;
    long                                    fmszReaderNamesIsNULL;
    unsigned long                           cchReaderLen;
    unsigned long                           cbAtrLen;
} Status Call;
typedef struct _Status_Return
{
                                long            ReturnCode;
    [range(0, 65536)]           unsigned long   cBytes;
    [unique] [size is(cBytes)]  byte           *mszReaderNames;
                                unsigned long   dwState;
                                unsigned long   dwProtocol;
                                byte            pbAtr[32];
    [range(0, 32)]        unsigned long   cbAtrLen;
} Status Return;


typedef struct _SCardIO_Request
{
                                      unsigned long   dwProtocol;
    [range(0, 1024)]                  unsigned long   cbExtraBytes;
    [unique] [size is(cbExtraBytes)]  byte           *pbExtraBytes;
} SCardIO Request;
typedef struct _Transmit_Call
{
                            REDIR SCARDHANDLE   hCard;
                            SCardIO Request     ioSendPci;
    [range(0, 66560)]       unsigned long       cbSendLength;
    [size_is(cbSendLength)] const byte         *pbSendBuffer;
    [unique]                SCardIO_Request    *pioRecvPci;
                            long                fpbRecvBufferIsNULL;
                            unsigned long       cbRecvLength;
} Transmit Call;
typedef struct  Transmit Return
{
                                     long             ReturnCode;
    [unique]                         SCardIO Request *pioRecvPci;
    [range(0, 66560)]                unsigned long    cbRecvLength;
    [unique] [size is(cbRecvLength)] byte            *pbRecvBuffer;
} Transmit Return;

typedef struct _GetTransmitCount_Call
{
    REDIR SCARDHANDLE   hCard;
} GetTransmitCount Call;

typedef struct  GetTransmitCount Return
{
    long                ReturnCode;
    unsigned long       cTransmitCount;
} GetTransmitCount_Return;
```

```
typedef struct _Control_Call
{
                                REDIR SCARDHANDLE  hCard;
                                unsigned long      dwControlCode;
    [range(0, 66560)]           unsigned long      cbInBufferSize;
    [unique] [size is(cbInBufferSize)]  const byte  *pvInBuffer;
                                long     fpvOutBufferIsNULL;
                                unsigned long      cbOutBufferSize;
} Control Call;

typedef struct  Control Return
{
                                 long           ReturnCode;
    [range(0, 66560)]            unsigned long  cbOutBufferSize;
    [unique] [size is(cbOutBufferSize)] byte     *pvOutBuffer;
} Control Return;

typedef struct  GetAttrib Call
{
    REDIR SCARDHANDLE                hCard;
    unsigned long                    dwAttrId;
    long                             fpbAttrIsNULL;
    unsigned long                    cbAttrLen;
} GetAttrib_Call;

typedef struct _GetAttrib_Return
{
                                   long                ReturnCode;
    [range(0, 65536)]              unsigned long       cbAttrLen;
    [unique] [size is(cbAttrLen)]  byte               *pbAttr;
} GetAttrib_Return;

typedef struct  SetAttrib Call
{
                           REDIR SCARDHANDLE     hCard;
                           unsigned long         dwAttrId;
    [range(0, 65536)]      unsigned long         cbAttrLen;
    [size_is(cbAttrLen)]   const byte           *pbAttr;
} SetAttrib Call;

typedef struct  ReadCache Common
{
    REDIR_SCARDCONTEXT             Context;
    UUID                          *CardIdentifier;
    unsigned long                  FreshnessCounter;
    long                           fPbDataIsNULL;
    unsigned long                  cbDataLen;
} ReadCache_Common;

typedef struct  ReadCacheA Call
{
    [string] char *                          szLookupName;
             ReadCache Common                Common;
} ReadCacheA_Call;

typedef struct  ReadCacheW Call
{
    [string] wchar t *                       szLookupName;
             ReadCache Common                Common;
} ReadCacheW Call;

typedef struct _ReadCache_Return
{
                                   long           ReturnCode;
```

```
    [range(0, 65536)]               unsigned long  cbDataLen;
    [unique] [size_is(cbDataLen)]   byte          *pbData;
} ReadCache_Return;

typedef struct  WriteCache Common
{
                           REDIR SCARDCONTEXT  Context;
                           UUID               *CardIdentifier;
                           unsigned long       FreshnessCounter;
    [range(0, 65536)]      unsigned long       cbDataLen;
    [unique] [size is(cbDataLen)]   byte      *pbData;
} WriteCache Common;

typedef struct _WriteCacheA_Call
{
    [string] char *                szLookupName;
             WriteCache Common     Common;
} WriteCacheA Call;

typedef struct _WriteCacheW_Call
{
    [string] wchar t *             szLookupName;
             WriteCache Common     Common;
} WriteCacheW Call;

}
```

7 Appendix B: Windows Behavior

The information in this specification is applicable to the following versions of Windows:

- Windows XP
- Windows Server 2003
- Windows Vista
- Windows Server 2008

Exceptions, if any, are noted below. Unless otherwise specified, any statement of optional behavior in this specification prescribed using the terms SHOULD or SHOULD NOT implies Windows behavior in accordance with the SHOULD or SHOULD NOT prescription. Unless otherwise specified, the term MAY implies that Windows does not follow the prescription.

<1> Section 1.7: The Windows XP and Windows Server 2003 versions always use SCREDIR_VERSION_XP. Windows Vista and Windows Server 2008 are always SCREDIR_VERSION_LONGHORN.

<2> Section 3.1.4: Windows XP and Windows Server 2003 implement Function Numbers 5 through 58. Windows Vista and Windows Server 2008 implement Function Numbers 5 through 64.

8 Index

M

N

O

P

R

S

T

V

W