

# [MS-SMB]: Server Message Block (SMB) Protocol

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# 1 Introduction

The Server Message Block (SMB) Version 1.0 Protocol defines extensions to the Common Internet File System (CIFS) Protocol, which is specified in [\[MS-CIFS\]](#). Unless specifically extended or overridden in this document, all specifications and behaviors that are described for Windows NT operating system clients and servers in [\[MS-CIFS\]](#) apply to the Windows client and server implementations covered in this document. The list of Windows client and server implementations covered in this document is provided in section [6](#).

Unless otherwise noted, this document only provides the extensions made to the CIFS Protocol relative to the specification in [\[MS-CIFS\]](#). The extended CIFS Protocol is known as the Server Message Block (SMB) Version 1.0 Protocol. Both this document and [\[MS-CIFS\]](#) are required in order to create a complete implementation of the Server Message Block (SMB) Version 1.0 Protocol.

This document also defines Windows behavior with respect to optional behavior that is described in the specifications of the SMB extensions.

Sections 1.8, 2, and 3 of this specification are normative and can contain the terms MAY, SHOULD, MUST, MUST NOT, and SHOULD NOT as defined in RFC 2119. Sections 1.5 and 1.9 are also normative but cannot contain those terms. All other sections and examples in this specification are informative.

## 1.1 Glossary

The following terms are defined in [\[MS-GLOS\]](#):

- @GMT Token**
- 8.3 name**
- Coordinated Universal Time (UTC)**
- Copychunk Resume Key**
- discretionary access control list (DACL)**
- Distributed File System (DFS)**
- domain**
- Fid**
- file allocation table (FAT)**
- FileId (1)**
- file system control (FSCTL)**
- guest account**
- Information Level**
- Key Distribution Center (KDC)**
- little-endian**
- message mode**
- named pipe**
- network byte order**
- NT file system (NTFS)**
- oplock break**
- opportunistic lock (oplock)**
- original equipment manufacturer (OEM) character**
- process identifier (PID)**
- raw read (on a named pipe)**
- reparse point**
- security context**
- security descriptor**

**security identifier (SID)**  
**security principal name (SPN)**  
**Server Message Block (SMB)**  
**session**  
**shadow copy**  
**share**  
**share connect**  
**SMB connection**  
**SMB dialect**  
**SMB session**  
**snapshot**  
**stream**  
**system access control list (SACL)**  
**Transmission Control Protocol (TCP)**  
**Unicode**  
**Unicode string**  
**volume identifier (VolumeId)**

The following terms are defined in [\[MS-CIFS\]](#):

**byte mode**  
**Common Internet File System (CIFS)**  
**deprecated**  
**input/output control (IOCTL)**  
**obsolescent**  
**SMB command**  
**SMB message**  
**tree connect**

The following terms are specific to this document:

**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

References to Microsoft Open Specifications documentation do not include a publishing year because links are to the latest version of the documents, which are updated frequently. References to other documents include a publishing year when one is available.

A reference marked "(Archived)" means that the reference document was either retired and is no longer being maintained or was replaced with a new document that provides current implementation details. We archive our documents online [\[Windows Protocol\]](#).

### 1.2.1 Normative References

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

[IANAPORT] IANA, "Port Numbers", November 2006, <http://www.iana.org/assignments/port-numbers>

- [MS-CIFS] Microsoft Corporation, "[Common Internet File System \(CIFS\) Protocol](#)".
- [MS-DFSC] Microsoft Corporation, "[Distributed File System \(DFS\): Referral Protocol](#)".
- [MS-DTYP] Microsoft Corporation, "[Windows Data Types](#)".
- [MS-EFSR] Microsoft Corporation, "[Encrypting File System Remote \(EFSRPC\) Protocol](#)".
- [MS-FSA] Microsoft Corporation, "[File System Algorithms](#)".
- [MS-FSCC] Microsoft Corporation, "[File System Control Codes](#)".
- [MS-KILE] Microsoft Corporation, "[Kerberos Protocol Extensions](#)".
- [MS-NLMP] Microsoft Corporation, "[NT LAN Manager \(NTLM\) Authentication Protocol](#)".
- [MS-RAP] Microsoft Corporation, "[Remote Administration Protocol](#)".
- [MS-SRVS] Microsoft Corporation, "[Server Service Remote Protocol](#)".
- [RFC1321] Rivest, R., "The MD5 Message-Digest Algorithm", RFC 1321, April 1992, <http://www.ietf.org/rfc/rfc1321.txt>
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- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997, <http://www.rfc-editor.org/rfc/rfc2119.txt>
- [RFC2743] Linn, J., "Generic Security Service Application Program Interface Version 2, Update 1", RFC 2743, January 2000, <http://www.ietf.org/rfc/rfc2743.txt>
- [RFC4178] Zhu, L., Leach, P., Jaganathan, K., and Ingersoll, W., "The Simple and Protected Generic Security Service Application Program Interface (GSS-API) Negotiation Mechanism", RFC 4178, October 2005, <http://www.ietf.org/rfc/rfc4178.txt>

## 1.2.2 Informative References

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- [MS-AUTHSOD] Microsoft Corporation, "[Authentication Services Protocols Overview](#)".
- [MS-BRWS] Microsoft Corporation, "[Common Internet File System \(CIFS\) Browser Protocol](#)".
- [MS-BRWSA] Microsoft Corporation, "[Common Internet File System \(CIFS\) Browser Auxiliary Protocol](#)".
- [MS-DFSNM] Microsoft Corporation, "[Distributed File System \(DFS\): Namespace Management Protocol](#)".
- [MS-ERREF] Microsoft Corporation, "[Windows Error Codes](#)".
- [MS-GLOS] Microsoft Corporation, "[Windows Protocols Master Glossary](#)".
- [MS-MAIL] Microsoft Corporation, "[Remote Mailslot Protocol](#)".
- [MS-RPCE] Microsoft Corporation, "[Remote Procedure Call Protocol Extensions](#)".

[MS-SMB2] Microsoft Corporation, "[Server Message Block \(SMB\) Protocol Versions 2 and 3](#)".

[MS-WKST] Microsoft Corporation, "[Workstation Service Remote Protocol](#)".

[MS-WPO] Microsoft Corporation, "[Windows Protocols Overview](#)".

[MSBRWSE] Thompson IV, D. and McLaughlin, R., "MS Windows NT Browser",  
<https://www.microsoft.com/technet/archive/winntas/deploy/prodspecs/ntbrowse.msp>

[MSDFS] Microsoft Corporation, "How DFS Works", March 2003, <http://technet.microsoft.com/en-us/library/cc782417%28WS.10%29.aspx>

[MSDN-IMPERS] Microsoft Corporation, "Impersonation" <http://msdn.microsoft.com/en-us/library/ms691341.aspx>

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[NETBEUI] IBM Corporation, "LAN Technical Reference: 802.2 and NetBIOS APIs", 1986,  
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[RFC1001] Network Working Group, "Protocol Standard for a NetBIOS Service on a TCP/UDP Transport: Concepts and Methods", STD 19, RFC 1001, March 1987,  
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[http://networks.cs.ucdavis.edu/~zhuk/research/sans/documents/CIFS-TR-1p00\\_FINAL.pdf](http://networks.cs.ucdavis.edu/~zhuk/research/sans/documents/CIFS-TR-1p00_FINAL.pdf)

### 1.3 Overview

Client systems use the Common Internet File System (CIFS) Protocol to request file and print services from server systems over a network. CIFS is a stateful protocol, in which clients establish a **session** with a server and use that session to make a variety of requests to access files, printers, and inter-process communication (IPC) mechanisms, such as **named pipes**. CIFS imposes state to maintain an authentication context, cryptographic operations, file semantics, such as locking, and similar features. A detailed overview of how the CIFS Protocol functions is provided in [\[MS-CIFS\]](#) section 2.

The Server Message Block (SMB) Version 1.0 Protocol extends the CIFS Protocol with additional security, file, and disk management support. These extensions do not alter the basic message sequencing of the CIFS Protocol but introduce new flags, extended requests and responses, and new **Information Levels**. All of these extensions follow a request/response pattern in which the client initiates all of the requests. The base protocol allows for one exception to this pattern--**oplock breaks**--as specified in [\[MS-CIFS\]](#) section 3.2.5.42.

This document defines the SMB Version 1.0 Protocol extensions to CIFS, which provide support for the following features:

- New authentication methods, including Kerberos. The Negotiate and Session Setup commands have been enhanced to carry opaque security tokens to support mechanisms that are compatible with the Generic Security Services (GSS).
- Enumeration and access to previous versions of files. A new subcommand that uses a file system control (**FSCTL**) allows the client to query the server for the presence of older versions of files. If the server implements a file system with versioning, then this can be exposed to clients.
- Client requests for server-side data movement operations between files without requiring the data to be read by the client and then written back to the server. As specified in [MS-CIFS], to copy a file on the server requires the client to read all of the data from the server and then write the data back to the server. The SMB Version 1.0 Protocol introduces a method by which such an operation can be done entirely on the server without consuming network resources.
- **SMB connections** that use Direct TCP for the SMB transport. The CIFS Protocol supports the use of NBT for connections, as specified in [MS-CIFS] section 2.1.1.2. The SMB Version 1.0 Protocol includes a method to connect directly over **TCP** (see [RFC793]) without involving NetBIOS (see [RFC1001] and [RFC1002]). Information about NetBIOS is specified in [NETBEUI].
- Support for retrieving extended information in response to **share connect** and file open operations. Certain server functionality and indicators (such as the need for the client to cache the contents of a **share** ) are new in the SMB Version 1.0 Protocol and are returned to the client through these extensions to existing commands.
- Additional **SMB commands** for the setting and querying of quotas by user. Provided the server supports quotas, the client can constrain the file system capacity consumed by the files of users.

Many of these capabilities are exposed in enhancements to the [SMB\\_COM\\_NEGOTIATE](#) (section 2.2.4.5) and [SMB\\_COM\\_SESSION\\_SETUP\\_ANDX](#) (section 2.2.4.6) command requests and responses.

## 1.4 Relationship to Other Protocols

The extensions to the CIFS protocol rely on the Simple and Protected Generic Security Service Application Program Interface Negotiation Mechanism (SPNEGO), as described in [MS-AUTHSOD] section 2.1.2.3.1 and specified in [RFC4178], for authentication, which in turn relies on Kerberos, as specified in [MS-KILE], and/or the NT LAN Manager (NTLM), as specified in [MS-NLMP], challenge/response authentication protocol.

The Server Message Block (SMB) Version 2 Protocol is a new version of **SMB**. For more information about the SMB Version 2 Protocol, see [MS-SMB2]. This specification does not require implementation of the SMB Version 2 Protocol.

The following protocols extend this specification to provide additional functionality:

- The Distributed File System (DFS): Namespace Referral Protocol, as specified in [MS-DFSC]. For more information, see [MSDFS]. For management of **DFS**, see [MS-DFSNM].

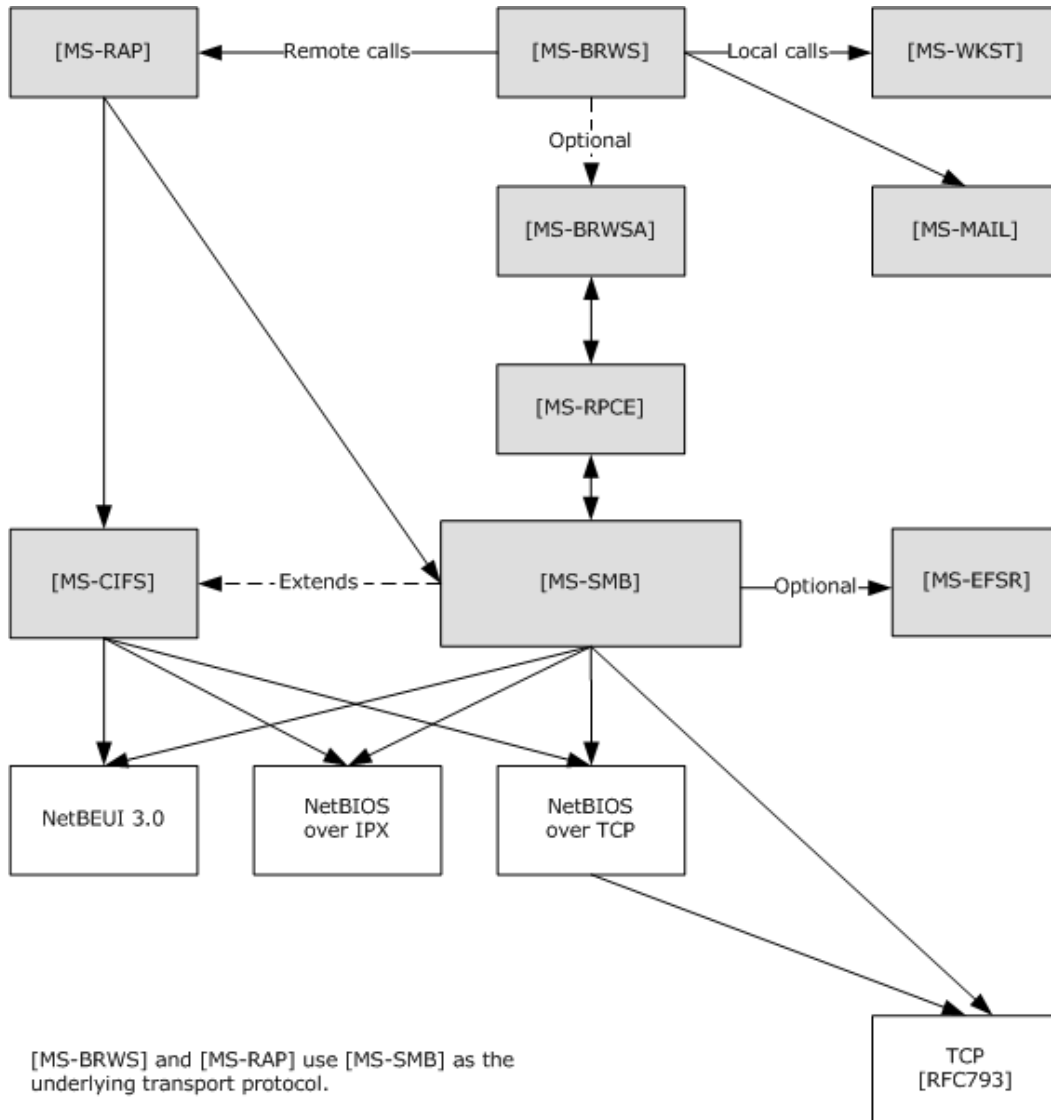
The following protocols can use the SMB Version 1.0 Protocol as a transport:

- The Remote Procedure Call (RPC) Protocol Extensions. Note that when named pipes are used, this protocol requires the SMB Protocol. For more information, see [MS-RPCE].
- The Remote Mailslot Protocol. This protocol can use the SMB Version 1.0 Protocol as a transport but supports other transports as well. For more information, see [MS-MAIL].

- The CIFS Browser Protocol. This protocol uses the Remote Mailslot Protocol and the RAP as transport protocols, which in turn can use this specification. It does not use this specification directly, but is included here for completeness. For more information, see [\[MS-BRWS\]](#) and [\[MSBRWSE\]](#).

The SMB protocol server, upon request from an underlying object store, optionally invokes the Encrypting File System Remote (EFSRPC) protocol when a user attempts to open or create a new encrypted file. For more information, see [\[MS-FSA\]](#) and [\[MS-EFSR\]](#).

The following diagram illustrates the relationship amongst the protocols.



**Figure 1: Relationships to other protocols**

## 1.5 Prerequisites/Preconditions

The SMB Version 1.0 Protocol assumes the availability of the following resources:

- An underlying transport protocol that supports reliable, in-order message delivery.
- An underlying object store on the server, such as a file system, exposing file, named pipe, or printer objects.

## 1.6 Applicability Statement

The extensions specified in this document are applicable to environments in which the security characteristics of the base protocol, as specified in [\[MS-CIFS\]](#), are insufficient. In particular, these extensions provide for enhanced message integrity and stronger authentication mechanisms.

The extensions are applicable to an environment that requires tighter data retention policies. In particular, through the use of previous version capabilities, the extensions allow access to versions of a file that have been changed or deleted when the server supports this capability. This feature is applicable to environments that require more stringent data retention policies that include maintaining access to previous versions of files.

## 1.7 Versioning and Capability Negotiation

This document covers versioning issues in the following areas:

- **Supported Transports:** The extensions in this document add additional transports, as defined in section [2.1](#).
- **Security and Authentication Methods:** The extensions in this document add additional authentication methods, as specified in section [3.2.4.2](#).
- **Capability Negotiation:** The extensions in this document use capability negotiation, as specified in [\[MS-CIFS\]](#) sections [1.7](#), [2.2.4.52](#), [2.2.4.53](#), and [3.3.1.2](#).

**SMB dialect** negotiation is handled as specified in [\[MS-CIFS\]](#) sections [1.7](#) and [3.2.4.2](#). The extensions specified in this document introduce no new dialects and apply only to connections that have negotiated the **NT LAN Manager** dialect, as identified by the "NT LM 0.12" dialect identification string. The extensions specified in this document are detected via the following methods:

- They can be returned in the **Capabilities** field, as specified in [\[MS-CIFS\]](#) section 2.2.4.52. Specific new capability options are defined in this document.
- They can be supplied or returned in the **Flags** and **Flags2** fields of the SMB header, as specified in [\[MS-CIFS\]](#) sections [2.2.3.1](#).
- A server can return an error code (STATUS\_NOT\_SUPPORTED) when a client request is sent to a server for a new feature that is not supported.

A client written to support these extensions cannot require that the target server implement these extensions to successfully connect. Thus, a server that does not implement an extension is still accessible by a client that implements that extension, although the relevant new features might not be available. The one exception is that a client offers the capability to be configured to require the new security features to create a more secure environment so that the client could be restricted from connecting successfully to servers that do not implement these features.

Negotiation of the use of the Generic Security Service Application Program Interface (GSS API) for authentication is specified in section [3.2.4.2.4](#). The GSS API is specified in [\[RFC2743\]](#).



## 1.8 Vendor-Extensible Fields

The CAP\_UNIX capability bit is specified in order to allow third-party implementers to collaborate on the definition of a specific set of extensions. SMB\_COM\_TRANSACTION2 Information Levels in the range 0x200 to 0x3E0 (inclusive) are reserved for these extensions. <1>

## 1.9 Standards Assignments

In addition to any standards assignments specified in [\[MS-CIFS\]](#), the Direct TCP Transport, as specified in section [2.2](#), makes use of the following assignment:

Parameter	TCP port value	Reference
Microsoft-DS	445 (0x01BD)	<a href="#">[IANAPORT]</a>

**SMB** transports can have assigned port numbers or other assigned values. See the documentation for the specific transport for more information.

## 2 Messages

An SMB Version 1.0 Protocol implementation MUST implement CIFS, as specified by section [2](#) of the [\[MS-CIFS\]](#) specification.

### 2.1 Transport

In addition to the transport protocols listed in section [2.1](#) of [\[MS-CIFS\]](#), the extended version of the protocol supports the use of TCP as a transport layer. Hereafter, the special TCP-related characteristics that are employed in the application of SMB over TCP are known as the Direct TCP transport. [<2>](#)

The extended version of the SMB Version 1.0 Protocol can use Direct TCP over either IPv4 or IPv6 as a reliable stream-oriented transport for **SMB messages**. No NetBIOS layer is provided or used. TCP provides a full, duplex, sequenced, and reliable transport for the connection. When using TCP as the reliable connection-oriented transport, the extended version of the SMB Version 1.0 Protocol makes no higher-level attempts to ensure sequenced delivery of messages between a client and server. The TCP transport has mechanisms to detect failures of either the client node or the server node, and to deliver such an indication to the client or server software so that it can clean up the state.

When using Direct TCP as the SMB transport, the implementer MUST establish a TCP connection from an SMB client to a TCP port on the server. The TCP source port used by the SMB client can be of any TCP port value. The SMB server SHOULD listen for connections on port 445. This port number has been registered with the Internet Assigned Numbers Authority (IANA) and has been officially assigned for Microsoft-DS. [<3>](#)

When using Direct TCP as the SMB transport, the implementer MUST prepend a 4-byte Direct TCP transport packet header to each SMB message. This transport header MUST be formatted as a byte of zero (8 zero bits) followed by 3 bytes that indicate the length of the SMB message that is encapsulated. The body of the SMB packet follows as a variable-length payload. A Direct TCP transport packet has the following structure (in **network byte order**).

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31					
Zero										Stream Protocol Length																										
SMB Message (variable)																																				
...																																				

**Zero (1 byte):** The first byte of the Direct TCP transport packet header MUST be zero (0x00).

**Stream Protocol Length (3 bytes):** The length, in bytes, of the SMB message. This length is formatted as a 3-byte integer in network byte order. The length field does not include the 4-byte Direct TCP transport header; rather, it is only the length of the enclosed SMB message. For SMB messages, if this value exceeds 0x1FFFF, the server SHOULD [<4>](#) disconnect the connection.

**SMB Message (variable):** The body of the SMB packet. The length of an SMB message varies based on the SMB command represented by the message.

## 2.2 Message Syntax

A client exchanges messages with a server to access resources on the server. These messages are called SMB messages or SMBs. Every SMB message has a common format, as defined in [\[MS-CIFS\]](#) section 2.2.

All SMB messages MUST begin with a fixed-length SMB header (as specified in [\[MS-CIFS\]](#), section [2.2.1](#)). The header contains a command field that indicates the operation code that the client requests or to which the server responds. An SMB message is of variable length. The actual length depends on the SMB command field (and consequent appended data structures) and whether the SMB message is a client request or a server response.

Unless otherwise indicated, numeric fields are integers of the specified byte length.

Unless otherwise specified, multibyte fields (that is, 16-bit, 32-bit, and 64-bit fields) in an SMB message MUST be transmitted in **little-endian** byte order (least significant byte first).

Unless otherwise noted, fields marked as Reserved SHOULD be set to zero when being sent and MUST be ignored upon receipt. Unless otherwise noted, unused or reserved bits in bit fields SHOULD be set to zero when being sent and MUST be ignored upon receipt.

When an error occurs, unless otherwise noted in this specification, an SMB server SHOULD return an Error Response message. An Error Response message is comprised of a complete SMB header, along with an empty parameter and data portion. [<5>](#)

### 2.2.1 Common Data Type Extensions

#### 2.2.1.1 Character Sequences

##### 2.2.1.1.1 Pathname Extensions

In addition to the specification in [\[MS-CIFS\]](#) section 2.2.1.1.2, pathnames include the following extension:

- Previous Version Tokens -- Support for this feature is optional. [<6>](#)

Pathnames are allowed to contain a previous version token (or **@GMT token**), as a directory element in a path. A previous version token indicates that the pathname is a request to access the previous version (or **shadow copy**) of the file or directory at a particular point in time. This feature is available on any path-based operation (for example, SMB\_COM\_NT\_CREATE\_ANDX). A pathname MUST NOT contain more than one previous version token.

For example, requesting a previous version of the file `\\server\mydocs\reviews\feb01.doc` at 2:44:00 P.M. on March30, 2001 **UTC** is specified in the following format:

```
\\server\mydocs\reviews\@GMT-2001.03.30-14.44.00\feb01.doc
```

The same technique can be used to build a path that represents a previous version of a directory as opposed to a file.

For example, requesting a previous version of the directory `\\server\mydocs\reviews` at 2:44:00 PM on 3/30/01 UTC can be specified in either of the following formats:

A token appearing as an intermediate path component:

```
\\server\mydocs\@GMT-2001.03.30-14.44.00\reviews
```

A token appearing as a final path component:

```
\\server\mydocs\reviews\@GMT-2001.03.30-14.44.00
```

In addition, it is possible to request an enumeration of available previous version timestamps (or **snapshots**) of a file or directory. While the NT\_TRANSACT\_IOCTL subcommand can be used with the FSCTL\_SRV\_ENUMERATE\_SNAPSHOTS FSCTL code to enumerate available previous version timestamps using a valid **Fid** (section [2.2.7.2.1](#)), these extensions also present a path-based method to access this functionality. The TRANS2\_FIND\_FIRST2 subcommand's SMB\_FIND\_FILE\_BOTH\_DIRECTORY\_INFO Information Level (section [2.2.6.1](#)) has been extended to allow a special previous version wildcard token, @GMT-\*

For example, requesting an enumeration of available previous version timestamps of the examples, discussed earlier in this section, can be specified in the following ways:

```
\\server\mydocs\reviews\@GMT-*\feb01.doc  
\\server\mydocs\@GMT-*\reviews  
\\server\mydocs\reviews\@GMT-*
```

## 2.2.1.2 File Attributes

### 2.2.1.2.1 Extended File Attribute (SMB\_EXT\_FILE\_ATTR) Extensions

The list of extended file attributes valid in 32-bit attribute values, as specified in [\[MS-CIFS\]](#) section 2.2.1.2.3, has been extended to include the following attributes:

- ATTR\_SPARSE
- ATTR\_REPARSE\_POINT
- ATTR\_OFFLINE
- ATTR\_NOT\_CONTENT\_INDEXED
- ATTR\_ENCRYPTED

The following table lists all possible values. Unless otherwise noted, any combination of these values is acceptable.

Name & bitmask	Extension	Meaning
ATTR_READONLY 0x00000001	No	File is read-only. Applications cannot write or delete the file.
ATTR_HIDDEN 0x00000002	No	File is hidden. It is not to be included in an ordinary directory enumeration.
ATTR_SYSTEM 0x00000004	No	File is part of or is used exclusively by the operating system.
ATTR_DIRECTORY	No	File is a directory.

Name & bitmask	Extension	Meaning
0x00000010		
ATTR_ARCHIVE 0x00000020	No	File has not been archived since it was last modified.
ATTR_NORMAL 0x00000080	No	File has no other attributes set. This value is valid only when used alone.
ATTR_TEMPORARY 0x00000100	No	File is temporary.
ATTR_SPARSE 0x00000200	Yes	File is a sparse file.
ATTR_REPARSE_POINT 0x00000400	Yes	File or directory has an associated <b>reparse point</b> .
ATTR_COMPRESSED 0x00000800	No	File is compressed on the disk. This does not affect how it is transferred over the network.
ATTR_OFFLINE 0x00001000	Yes	File data is not available. The attribute indicates that the file has been moved to offline storage.
ATTR_NOT_CONTENT_INDEXED 0x00002000	Yes	File or directory SHOULD NOT be indexed by a content indexing service.
ATTR_ENCRYPTED 0x00004000	Yes	File or directory is encrypted. For a file, this means that all data in the file is encrypted. For a directory, this means that encryption is the default for newly created files and subdirectories.
Reserved 0xFFFF8048	N/A	SHOULD be set to zero when sending and MUST be ignored upon receipt of the message.

### 2.2.1.2.2 File System Attribute Extensions

The list of file system attributes, as specified in [\[MS-CIFS\]](#) section 2.2.8.2.6, has been extended. For completeness, the following table lists all of the available attribute flags and their symbolic constants. Unless otherwise noted, any combination of the following bits is valid. Any bit that is not listed in this section is considered reserved; the sender SHOULD set it to zero, and the receiver MUST ignore it. For more information, see [\[MS-FSCC\]](#) section 2.5.1.

Name & bitmask	Extension	Meaning
FILE_CASE_SENSITIVE_SEARCH 0x00000001	No	File system supports case-sensitive file names.
FILE_CASE_PRESERVED_NAMES 0x00000002	No	File system preserves the case of file names when it stores the name on disk.
FILE_UNICODE_ON_DISK 0x00000004	No	File system supports <b>Unicode</b> in file names.

Name & bitmask	Extension	Meaning
FILE_PERSISTENT_ACLS 0x00000008	No	File system preserves and enforces access control lists.
FILE_FILE_COMPRESSION 0x00000010	No	File system supports file-based compression. This flag is incompatible with FILE_VOLUME_IS_COMPRESSED. This flag does not affect how data is transferred over the network.
FILE_VOLUME_QUOTAS 0x00000020	Yes	File system supports per-user quotas.
FILE_SUPPORTS_SPARSE_FILES 0x00000040	Yes	File system supports sparse files.
FILE_SUPPORTS_REPARSE_POINTS 0x00000080	Yes	File system supports reparse points.
FILE_SUPPORTS_REMOTE_STORAGE 0x00000100	Yes	File system supports remote storage.
FILE_VOLUME_IS_COMPRESSED 0x00008000	No	Volume is a compressed volume. This flag is incompatible with FILE_FILE_COMPRESSION. This does not affect how data is transferred over the network.
FILE_SUPPORTS_OBJECT_IDS 0x00010000	Yes	File system supports object identifiers.
FILE_SUPPORTS_ENCRYPTION 0x00020000	Yes	File system supports encryption.
FILE_NAMED_STREAMS 0x00040000	Yes	File system supports multiple named data <b>streams</b> for a file.
FILE_READ_ONLY_VOLUME 0x00080000	Yes<7>	Specified volume is read-only.
FILE_SEQUENTIAL_WRITE_ONCE 0x00100000	Yes<8>	Specified volume can be written to one time only. The write MUST be performed in sequential order.
FILE_SUPPORTS_TRANSACTIONS 0x00200000	Yes<9>	File system supports transaction processing.
FILE_SUPPORTS_HARD_LINKS 0x00400000	Yes<10>	File system supports direct links to other devices and partitions.
FILE_SUPPORTS_EXTENDED_ATTRIBUTES 0x00800000	Yes<11>	File system supports extended attributes (EAs).
FILE_SUPPORTS_OPEN_BY_FILE_ID 0x01000000	Yes<12>	File system supports open by <b>FileID</b> .

Name & bitmask	Extension	Meaning
FILE_SUPPORTS_USN_JOURNAL 0x02000000	Yes<13>	File system supports update sequence number (USN) journals.
Reserved 0xFE007E00	N/A	These bits fields SHOULD be set to zero when sending and MUST be ignored when the message is received.

### 2.2.1.3 Unique Identifiers

The SMB Version 1.0 Protocol makes use of the following data types from [\[MS-DTYP\]](#):

- [GUID](#) as specified in section [2.3.4.2](#)

The list of unique identifiers, specified in [\[MS-CIFS\]](#) section 2.2.1.6, has been extended to include the following new unique identifiers:

- 64-bit file identifier (FileId)
- Volume GUID (VolumeGUID)
- **Copychunk Resume Key**

#### 2.2.1.3.1 FileId Generation

64-bit file identifiers (FileIds) are generated on SMB servers. The generation of FileIds MUST satisfy the following constraints:

- The FileId MUST be a 64-bit opaque value.
- The FileId MUST be unique for a file on a given object store. <14>
- The FileId for a file MUST persist for the lifetime of a file on a given object store. A FileId MUST NOT be changed when a file is renamed. When the file is deleted, the FileId MAY be reused.
- All possible values for FileId are valid.

#### 2.2.1.3.2 VolumeGUID Generation

VolumeGUIDs (Volume Globally Unique Identifiers, or **volume identifiers**, see also [\[MS-DTYP\]](#) section 2.3.4) are generated on SMB servers. The generation of VolumeGUIDs MUST satisfy the following constraints:

- The VolumeGUID MUST be a 128-bit opaque value.
- The VolumeGUID MUST be unique for a logical file system volume on a given server.
- The VolumeGUID for the volume can change while the system is running. The VolumeGUID can change when the system is restarted.
- All possible values for the VolumeGUID are valid.

### 2.2.1.3.3 Copychunk Resume Key Generation

Copychunk Resume Keys are generated on SMB servers. The generation of Copychunk Resume Keys MUST satisfy the following constraints:

- The Copychunk Resume Key MUST be a 24-byte opaque value generated by an SMB server in response to a request by the client (an SMB\_COM\_NT\_TRANSACTION request with an NT\_TRANSACT\_IOCTL subcommand for the FSCTL\_SRV\_REQUEST\_RESUME\_KEY). For more information, see section [2.2.7.2](#).
- The Copychunk Resume Key MUST be unique on the SMB server for a given open file on a server.
- The Copychunk Resume Key MUST remain valid for the lifetime of the open file on the server.
- All possible values for the Copychunk Resume Key are valid.

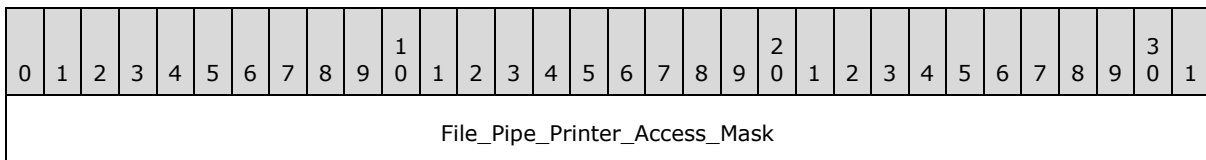
COPYCHUNK\_RESUME\_KEY (see sections [2.2.7.2.1](#) and [2.2.7.2.2.2](#)) represents an opaque data type that contains the server-returned Copychunk Resume Key.

### 2.2.1.4 Access Masks

The SMB protocol introduces the use of Access Mask structures, which are based on the ACCESS\_MASK data type specified in [\[MS-DTYP\]](#) section 2.4.3. SMB defines two types of access masks for two basic groups: either for a file, pipe, or printer (specified in section [2.2.1.4.1](#)) or for a directory (specified in section [2.2.1.4.2](#)). Each access mask MUST be a combination of zero or more of the bit positions.

#### 2.2.1.4.1 File\_Pipe\_Printer\_Access\_Mask

The following SMB Access Mask structure is defined for use on a file, named pipe, or printer.



**File\_Pipe\_Printer\_Access\_Mask (4 bytes):** For a file, named pipe, or printer, the value MUST be constructed using the following values. For a printer, the value MUST have at least one of the following: FILE\_WRITE\_DATA, FILE\_APPEND\_DATA, or GENERIC\_WRITE.

Value	Meaning
FILE_READ_DATA 0x00000001	This value indicates the right to read data from the file or named pipe.
FILE_WRITE_DATA 0x00000002	This value indicates the right to write data into the file, named pipe, or printer beyond the end of the file.
FILE_APPEND_DATA 0x00000004	This value indicates the right to append data into the file, named pipe, or printer.
FILE_READ_EA 0x00000008	This value indicates the right to read the extended attributes of the file or named pipe.
FILE_WRITE_EA	This value indicates the right to write or change the extended



Value	Meaning
0x00000010	attributes to the file or named pipe.
FILE_EXECUTE 0x00000020	This value indicates the right to execute the file.
FILE_READ_ATTRIBUTES 0x00000080	This value indicates the right to read the attributes of the file.
FILE_WRITE_ATTRIBUTES 0x00000100	This value indicates the right to change the attributes of the file.
DELETE 0x00010000	This value indicates the right to delete the file.
READ_CONTROL 0x00020000	This value indicates the right to read the security descriptor for the file or named pipe.
WRITE_DAC 0x00040000	This value indicates the right to change the <b>discretionary access control list (DACL)</b> in the <b>security descriptor</b> for the file or named pipe. For the DACL data structure, see ACL in <a href="#">[MS-DTYP]</a> section 2.4.5.
WRITE_OWNER 0x00080000	This value indicates the right to change the owner in the security descriptor for the file or named pipe.
SYNCHRONIZE 0x00100000	This flag SHOULD NOT be used by the client and MUST be ignored by the server unless on a named pipe as discussed in section <a href="#">3.2.4.3.1</a> and section <a href="#">3.3.5.5</a> .
ACCESS_SYSTEM_SECURITY 0x01000000	This value indicates the right to read or change the <b>system access control list (SACL)</b> in the security descriptor for the file or named pipe. For the SACL data structure, see ACL in <a href="#">[MS-DTYP]</a> section 2.4.5.
MAXIMUM_ALLOWED 0x02000000	This value indicates that the client is requesting an <b>open</b> to the file with the highest level of access the client has on this file. If no access is granted for the client on this file, the server MUST fail the open with STATUS_ACCESS_DENIED.
GENERIC_ALL 0x10000000	This value indicates a request for all the access flags that are previously listed, except MAXIMUM_ALLOWED and ACCESS_SYSTEM_SECURITY.
GENERIC_EXECUTE 0x20000000	This value indicates a request for the following combination of access flags listed above: FILE_READ_ATTRIBUTES, FILE_EXECUTE, SYNCHRONIZE, and READ_CONTROL.
GENERIC_WRITE 0x40000000	This value indicates a request for the following combination of access flags listed above: FILE_WRITE_DATA, FILE_APPEND_DATA, FILE_WRITE_ATTRIBUTES, FILE_WRITE_EA, SYNCHRONIZE, and READ_CONTROL.
GENERIC_READ 0x80000000	This value indicates a request for the following combination of access flags listed above: FILE_READ_DATA, FILE_READ_ATTRIBUTES, FILE_READ_EA, SYNCHRONIZE, and READ_CONTROL.

## 2.2.1.4.2 Directory\_Access\_Mask

The following SMB Access Mask is defined for use on a directory.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Directory_Access_Mask																															

**Directory\_Access\_Mask (4 bytes):** For a directory, the value MUST be constructed using the following values:

Value	Meaning
FILE_LIST_DIRECTORY 0x00000001	This value indicates the right to enumerate the contents of the directory.
FILE_ADD_FILE 0x00000002	This value indicates the right to create a file under the directory.
FILE_ADD_SUBDIRECTORY 0x00000004	This value indicates the right to add a sub-directory under the directory.
FILE_READ_EA 0x00000008	This value indicates the right to read the extended attributes of the directory.
FILE_WRITE_EA 0x00000010	This value indicates the right to write or change the extended attributes of the directory.
FILE_TRAVERSE 0x00000020	This value indicates the right to traverse this directory if the underlying object store enforces traversal checking.
FILE_DELETE_CHILD 0x00000040	This value indicates the right to delete the files and directories within this directory.
FILE_READ_ATTRIBUTES 0x00000080	This value indicates the right to read the attributes of the directory.
FILE_WRITE_ATTRIBUTES 0x00000100	This value indicates the right to change the attributes of the directory.
DELETE 0x00010000	This value indicates the right to delete the directory.
READ_CONTROL 0x00020000	This value indicates the right to read the security descriptor for the directory.
WRITE_DAC 0x00040000	This value indicates the right to change the DACL in the security descriptor for the directory. For the DACL data structure, see ACL in <a href="#">[MS-DTYP]</a> section 2.4.5.
WRITE_OWNER 0x00080000	This value indicates the right to change the owner in the security descriptor for the directory.
SYNCHRONIZE 0x00100000	This flag MUST be ignored by both clients and servers.

Value	Meaning
ACCESS_SYSTEM_SECURITY 0x01000000	This value indicates the right to read or change the SACL in the security descriptor for the directory. For the SACL data structure, see ACL in <a href="#">[MS-DTYP]</a> section 2.4.5.
MAXIMUM_ALLOWED 0x02000000	This value indicates that the client is requesting an open to the directory with the highest level of access that the client has on this directory. If no access is granted for the client on this directory, then the server MUST fail the open with STATUS_ACCESS_DENIED.
GENERIC_ALL 0x10000000	This value indicates a request for all of the access flags that are listed above, except MAXIMUM_ALLOWED and ACCESS_SYSTEM_SECURITY.
GENERIC_EXECUTE 0x20000000	This value indicates a request for the following access flags listed above: FILE_READ_ATTRIBUTES, FILE_TRAVERSE, SYNCHRONIZE, and READ_CONTROL.
GENERIC_WRITE 0x40000000	This value indicates a request for the following access flags listed above: FILE_ADD_FILE, FILE_ADD_SUBDIRECTORY, FILE_WRITE_ATTRIBUTES, FILE_WRITE_EA, SYNCHRONIZE, and READ_CONTROL.
GENERIC_READ 0x80000000	This value indicates a request for the following access flags listed above: FILE_LIST_DIRECTORY, FILE_READ_ATTRIBUTES, FILE_READ_EA, SYNCHRONIZE, and READ_CONTROL.

## 2.2.2 Defined Constant Extensions

### 2.2.2.1 SMB\_COM Command Codes

No new SMB\_COM command codes are introduced other than those specified in [\[MS-CIFS\]](#) section 2.2.2.1. [<15>](#)

### 2.2.2.2 Transaction Subcommand Codes

In addition to the transaction subcommand codes specified in [\[MS-CIFS\]](#) section 2.2.2.2, the following modifications and extensions apply. In the following tables, the Description column is also used to specify changes in a particular subcommand's current usage status.

#### Transaction Codes used with SMB\_COM\_TRANSACTION

Constant/value	Description
TRANS_RAW_READ_NMPIPE 0x0011	This command code has changed from <b>deprecated</b> to <b>obsolescent</b> .
TRANS_CALL_NMPIPE 0x0054	This command code has changed from current to obsolescent.

#### Transaction Codes used with SMB\_COM\_TRANSACTION2

Constant/value	Description
TRANS2_SET_FS_INFORMATION 0x0004	Set information on a file system on the server. This command code has changed from reserved but not implemented to current.

### Transaction Codes used with SMB\_COM\_NT\_TRANSACT

Constant/value	Description
NT_TRANSACT_QUERY_QUOTA 0x0007	Query a server for a user's disk quota information. This command code is new to these extensions.
NT_TRANSACT_SET_QUOTA 0x0008	Set a user's disk quota information on a server. This command code is new to these extensions.
NT_TRANSACT_CREATE2 0x0009	This command code is new to these extensions. The client requests and processes the NT_TRANSACT_CREATE2 command the same way it would for an NT_TRANSACT_CREATE command, as specified in <a href="#">[MS-CIFS]</a> section 3.2.5.40.1. The server also processes and responds the same way it would for an NT_TRANSACT_CREATE command, as specified in <a href="#">[MS-CIFS]</a> section 3.3.5.59.1. <a href="#">&lt;16&gt;</a>

### 2.2.2.3 Information Level Codes

The following new Information Level codes are specified in addition to those defined in [\[MS-CIFS\]](#) section 2.2.2.3.

#### 2.2.2.3.1 FIND Information Level Codes

The following new Information Level codes are specified in addition to those specified in [\[MS-CIFS\]](#) section 2.2.2.3.1. [<17>](#)

Name	Code	Meaning	Dialect
SMB_FIND_FILE_ID_FULL_DIRECTORY_INFO	0x0105	Returns the SMB_FIND_FULL_DIRECTORY_INFO data with a FileId.	NT LANMAN
SMB_FIND_FILE_ID_BOTH_DIRECTORY_INFO	0x0106	Returns the SMB_FIND_FILE_ID_BOTH_DIRECTORY_INFO data with a FileId.	NT LANMAN

#### 2.2.2.3.2 QUERY\_FS Information Level Codes

No new SMB-specific Information Level codes are specified for these extensions.

#### 2.2.2.3.3 QUERY Information Level Codes

No new SMB-specific Information Level codes are specified for these extensions.

#### 2.2.2.3.4 SET Information Level Codes

No new SMB-specific Information Level codes are specified for these extensions.

### 2.2.2.3.5 Pass-through Information Level Codes

This document provides an extension of a new Information Level code value range called **pass-through Information Levels**, which can be used to set or query information on the server. These Information Levels allow SMB clients to directly query Information Levels native to the underlying object store. <18>

Servers indicate support for these new pass-through Information Levels by setting the new CAP\_INFOLEVEL\_PASSTHRU capability flag in an SMB\_COM\_NEGOTIATE server response (section 2.2.4.5.2).

To access these new Information Levels, a client adds the constant SMB\_INFO\_PASSTHROUGH (0x03e8) to the desired native information class level value. This value is then sent in the **InformationLevel** field of the particular SMB\_COM\_TRANSACTION2 subcommand being used to access the Information Levels.

### 2.2.2.3.6 Other Information Level Codes

In addition, SMB\_COM\_TRANSACTION2 Information Levels in the range 0x200 to 0x3E0 (inclusive) are reserved for third-party extensions, as described in section 1.8. <19>

### 2.2.2.4 SMB Error Classes and Codes

The following is a list of 32-bit status codes that are required to implement these extensions, their associated values, and a description of what they represent. <20>

NT status value	Description
0x00000000 STATUS_SUCCESS	The client request is successful.
0x00010002 STATUS_INVALID_SMB	An invalid SMB client request is received by the server.
0x00050002 STATUS_SMB_BAD_TID	The client request received by the server contains an invalid TID value.
0x00160002 STATUS_SMB_BAD_COMMAND	The client request received by the server contains an unknown SMB command code.
0x005B0002 STATUS_SMB_BAD_UID	The client request to the server contains an invalid UID value.
0x00FB0002 STATUS_SMB_USE_STANDARD	The client request received by the server is for a non-standard SMB operation (for example, an SMB_COM_READ_MPX request on a non-disk share ). The client SHOULD send another request with a different SMB command to perform this operation.
0x80000005 STATUS_BUFFER_OVERFLOW	The data was too large to fit into the specified buffer.
0x80000006 STATUS_NO_MORE_FILES	No more files were found that match the file specification.
0x8000002D STATUS_STOPPED_ON_SYMLINK	The create operation stopped after reaching a symbolic link.

<b>NT status value</b>	<b>Description</b>
0xC0000002 STATUS_NOT_IMPLEMENTED	The requested operation is not implemented.
0xC000000D STATUS_INVALID_PARAMETER	The parameter specified in the request is not valid.
0xC000000E STATUS_NO_SUCH_DEVICE	A device that does not exist was specified.
0xC0000010 STATUS_INVALID_DEVICE_REQUEST	The specified request is not a valid operation for the target device.
0xC0000016 STATUS_MORE_PROCESSING_REQUIRED	If extended security has been negotiated, then this error code can be returned in the SMB_COM_SESSION_SETUP_ANDX response from the server to indicate that additional authentication information is to be exchanged. See section <a href="#">2.2.4.6</a> for details.
0xC0000022 STATUS_ACCESS_DENIED	The client did not have the required permission needed for the operation.
0xC0000023 STATUS_BUFFER_TOO_SMALL	The buffer is too small to contain the entry. No information has been written to the buffer.
0xC0000034 STATUS_OBJECT_NAME_NOT_FOUND	The object name is not found.
0xC0000035 STATUS_OBJECT_NAME_COLLISION	The object name already exists.
0xC000003A STATUS_OBJECT_PATH_NOT_FOUND	The path to the directory specified was not found. This error is also returned on a create request if the operation requires the creation of more than one new directory level for the path specified.
0xC00000A5 STATUS_BAD_IMPERSONATION_LEVEL	A specified impersonation level is invalid. This error is also used to indicate that a required impersonation level was not provided.
0xC00000B5 STATUS_IO_TIMEOUT	The specified I/O operation was not completed before the time-out period expired.
0xC00000BA STATUS_FILE_IS_A_DIRECTORY	The file that was specified as a target is a directory and the caller specified that it could be anything but a directory.
0xC00000BB STATUS_NOT_SUPPORTED	The client request is not supported.
0xC00000C9 STATUS_NETWORK_NAME_DELETED	The network name specified by the client has been deleted on the server. This error is returned if the client specifies an incorrect TID or the share on the server represented by the TID was deleted.
0xC0000203 STATUS_USER_SESSION_DELETED	The user session specified by the client has been deleted on the server. This error is returned by the server if the client sends an incorrect UID.

NT status value	Description
0xC000035C STATUS_NETWORK_SESSION_EXPIRED	The client's session has expired; therefore, the client MUST re-authenticate to continue accessing remote resources.
0xC000205A STATUS_SMB_TOO_MANY_UIDS	The client has requested too many UID values from the server or the client already has an <b>SMB session</b> setup with this UID value.

### 2.2.2.5 Session Key Protection Hash

The SSKeyHash is a well-known constant array.

```

BYTE SSKeyHash[256] = {
0x53, 0x65, 0x63, 0x75, 0x72, 0x69, 0x74, 0x79,
0x20, 0x53, 0x69, 0x67, 0x6e, 0x61, 0x74, 0x75,
0x72, 0x65, 0x20, 0x4b, 0x65, 0x79, 0x20, 0x55,
0x70, 0x67, 0x72, 0x61, 0x64, 0x65, 0x79, 0x07,
0x6e, 0x28, 0x2e, 0x69, 0x88, 0x10, 0xb3, 0xdb,
0x01, 0x55, 0x72, 0xfb, 0x74, 0x14, 0xfb, 0xc4,
0xc5, 0xaf, 0x3b, 0x41, 0x65, 0x32, 0x17, 0xba,
0xa3, 0x29, 0x08, 0xc1, 0xde, 0x16, 0x61, 0x7e,
0x66, 0x98, 0xa4, 0x0b, 0xfe, 0x06, 0x83, 0x53,
0x4d, 0x05, 0xdf, 0x6d, 0xa7, 0x51, 0x10, 0x73,
0xc5, 0x50, 0xdc, 0x5e, 0xf8, 0x21, 0x46, 0xaa,
0x96, 0x14, 0x33, 0xd7, 0x52, 0xeb, 0xaf, 0x1f,
0xbf, 0x36, 0x6c, 0xfc, 0xb7, 0x1d, 0x21, 0x19,
0x81, 0xd0, 0x6b, 0xfa, 0x77, 0xad, 0xbe, 0x18,
0x78, 0xcf, 0x10, 0xbd, 0xd8, 0x78, 0xf7, 0xd3,
0xc6, 0xdf, 0x43, 0x32, 0x19, 0xd3, 0x9b, 0xa8,
0x4d, 0x9e, 0xaa, 0x41, 0xaf, 0xcb, 0xc6, 0xb9,
0x34, 0xe7, 0x48, 0x25, 0xd4, 0x88, 0xc4, 0x51,
0x60, 0x38, 0xd9, 0x62, 0xe8, 0x8d, 0x5b, 0x83,
0x92, 0x7f, 0xb5, 0x0e, 0x1c, 0x2d, 0x06, 0x91,
0xc3, 0x75, 0xb3, 0xcc, 0xf8, 0xf7, 0x92, 0x91,
0x0b, 0x3d, 0xa1, 0x10, 0x5b, 0xd5, 0x0f, 0xa8,
0x3f, 0x5d, 0x13, 0x83, 0x0a, 0x6b, 0x72, 0x93,
0x14, 0x59, 0xd5, 0xab, 0xde, 0x26, 0x15, 0x6d,
0x60, 0x67, 0x71, 0x06, 0x6e, 0x3d, 0x0d, 0xa7,
0xcb, 0x70, 0xe9, 0x08, 0x5c, 0x99, 0xfa, 0x0a,
0x5f, 0x3d, 0x44, 0xa3, 0x8b, 0xc0, 0x8d, 0xda,
0xe2, 0x68, 0xd0, 0x0d, 0xcd, 0x7f, 0x3d, 0xf8,
0x73, 0x7e, 0x35, 0x7f, 0x07, 0x02, 0x0a, 0xb5,
0xe9, 0xb7, 0x87, 0xfb, 0xa1, 0xbf, 0xcb, 0x32,
0x31, 0x66, 0x09, 0x48, 0x88, 0xcc, 0x18, 0xa3,
0xb2, 0x1f, 0x1f, 0x1b, 0x90, 0x4e, 0xd7, 0xe1
};

```

## 2.2.3 SMB Message Structure Extensions

### 2.2.3.1 SMB Header Extensions

All client requests MUST begin with a fixed-size SMB header, as specified in [\[MS-CIFS\]](#) section 2.2.3.1. All server responses, with the exception of the SMB\_COM\_READ\_RAW response message, as specified in [\[MS-CIFS\]](#) section 2.2.4.22.2, MUST begin with the same fixed-size SMB header.

```

SMB_Header
{
    UCHAR Protocol[4];
    UCHAR Command;
    SMB_ERROR Status;
    UCHAR Flags;
    USHORT Flags2;
    USHORT PIDHigh;
    UCHAR SecurityFeatures[8];
    USHORT Reserved;
    USHORT TID;
    USHORT PIDLow;
    USHORT UID;
    USHORT MID;
}

```

The following SMB header fields contain extensions:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Protocol																															
Command																Status															
...																Flags								Flags2							
PIDHigh																SecurityFeatures															
...																															
...																Reserved															
TID																PIDLow															
UID																MID															

**Flags2 (2 bytes):** The **Flags2** field contains individual bit flags that, depending on the negotiated SMB dialect, indicate various client and server capabilities. This field is defined as specified in [\[MS-CIFS\]](#) section 2.2.3.1. There are several new Flags2 values in the SMB header that are not in [\[MS-CIFS\]](#), but are part of these extensions. Unused bit fields SHOULD be set to zero by the sender when sending an SMB message and SHOULD [<21>](#) be ignored when received by the receiver. This field is constructed using the values listed in section [2.2.3.1](#) of [\[MS-CIFS\]](#), as well as the following additional values:

Name & bitmask	Meaning
SMB_FLAGS2_COMPRESSED 0x0008	If set by the client, the client is requesting compressed data for an SMB_COM_READ_ANDX request. If cleared by the server, the server is



Name & bitmask	Meaning
	notifying the client that the data was written uncompressed. This bit field SHOULD only be set to one when NT LAN Manager or later is negotiated for the SMB dialect.
SMB_FLAGS2_SMB_SECURITY_SIGNATURE_REQUIRED 0x0010	This flag SHOULD <22> be set by the client on the first <a href="#">SMB_COM_SESSION_SETUP_ANDX request (section 2.2.4.6.1)</a> sent to a server that supports extended security if the client requires all further communication with this server to be signed. If the server does not support signing, it MUST disconnect the client by closing the underlying transport connection. Clients and servers MUST ignore this value for other requests and responses. If the client receives a non-signed response from the server, it MUST disconnect the underlying transport connection. This bit field SHOULD only be set to one when NT LAN Manager or later is negotiated for the SMB dialect, the client supports extended security, and the client is configured to require security signatures.
SMB_FLAGS2_IS_LONG_NAME 0x0040	If set, the path contained in the message contains long names; otherwise, the paths are restricted to <b>8.3 names</b> . This bit field SHOULD only be set to one when NT LAN Manager or later is negotiated for the SMB dialect. If client sets this bit in the request, the server SHOULD <23> also set this bit in the response.
SMB_FLAGS2_REPARSE_PATH 0x0400	If set, the path in the request MUST contain an @GMT token (that is, a Previous Version token), as specified in section <a href="#">2.2.1.1.1</a> .
SMB_FLAGS2_EXTENDED_SECURITY 0x0800	Indicates that the client or server supports SPNEGO authentication, as specified in section <a href="#">3.2.5.2</a> for client behavior and section <a href="#">3.3.5.2</a> for server behavior. This bit field SHOULD be set to one only when NT LAN Manager or later is negotiated for the SMB dialect and the client or server supports extended security.

**PIDHigh (2 bytes):** This field MUST give the 2 high bytes of the **process identifier (PID)** if the *Client.Supports32BitPIDs*, as specified in section [3.2.1.1](#), is TRUE. Otherwise, it MUST be set to zero.

## 2.2.4 SMB Command Extensions

### 2.2.4.1 SMB\_COM\_OPEN\_ANDX (0x2D)

#### 2.2.4.1.1 Client Request Extensions

An SMB\_COM\_OPEN\_ANDX request is sent by a client to open a file or named pipe on a server. The new flag value in the **Flags** field of the SMB\_COM\_OPEN\_ANDX request, SMB\_OPEN\_EXTENDED\_RESPONSE, is used to trigger new behavior that is specified in this document. All other fields are as specified in [\[MS-CIFS\]](#) section 2.2.4.41.1.

This command has been deprecated. Client implementations SHOULD use SMB\_COM\_NT\_CREATE\_ANDX.

```
SMB_Parameters
{
  UCHAR WordCount;
  Words
  {
    UCHAR          AndXCommand;
    UCHAR          AndXReserved;
    USHORT         AndXOffset;
    USHORT         Flags;
    USHORT         AccessMode;
    SMB_FILE_ATTRIBUTES SearchAttrs;
    SMB_FILE_ATTRIBUTES FileAttrs;
    UTIME          CreationTime;
    USHORT         OpenMode;
    ULONG          AllocationSize;
    ULONG          Timeout;
    USHORT         Reserved[2];
  }
}
SMB_Data
{
  USHORT ByteCount;
  Bytes
  {
    SMB_STRING FileName;
  }
}
```

#### SMB\_Parameters

Words (34 bytes):

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31		
AndXCommand										AndXReserved						AndXOffset																	
Flags															AccessMode																		

SearchAttrs	FileAttrs
CreationTime	
OpenMode	AllocationSize
...	Timeout
...	Reserved
...	

**Flags (2 bytes):** A 16-bit field of bit flags. For completeness, all flags are listed in the following table. Bit values listed as reserved SHOULD be set to zero by the client and MUST be ignored by the server.

Name & bitmask	Meaning
SMB_OPEN_QUERY_INFORMATION 0x0001	If set, the client is requesting additional info in the response. The server MUST set <b>FileDataSize</b> , <b>FileAttrs</b> , <b>AccessRights</b> , <b>ResourceType</b> , and <b>NMPipeStatus</b> in the response. If not set, the server MUST set these fields to zero.
SMB_OPEN_OPLOCK 0x0002	If set, the client is requesting an <b>oplock</b> .
SMB_OPEN_OPBATCH 0x0004	If set, the client is requesting a batch oplock.
SMB_OPEN_EXTENDED_RESPONSE 0x0010	If set, the client is requesting the extended format of the response, as described later in this section.
Reserved 0xFFE8	Reserved; SHOULD be set to zero by the client, and MUST be ignored by the server.

### 2.2.4.1.2 Server Response Extensions

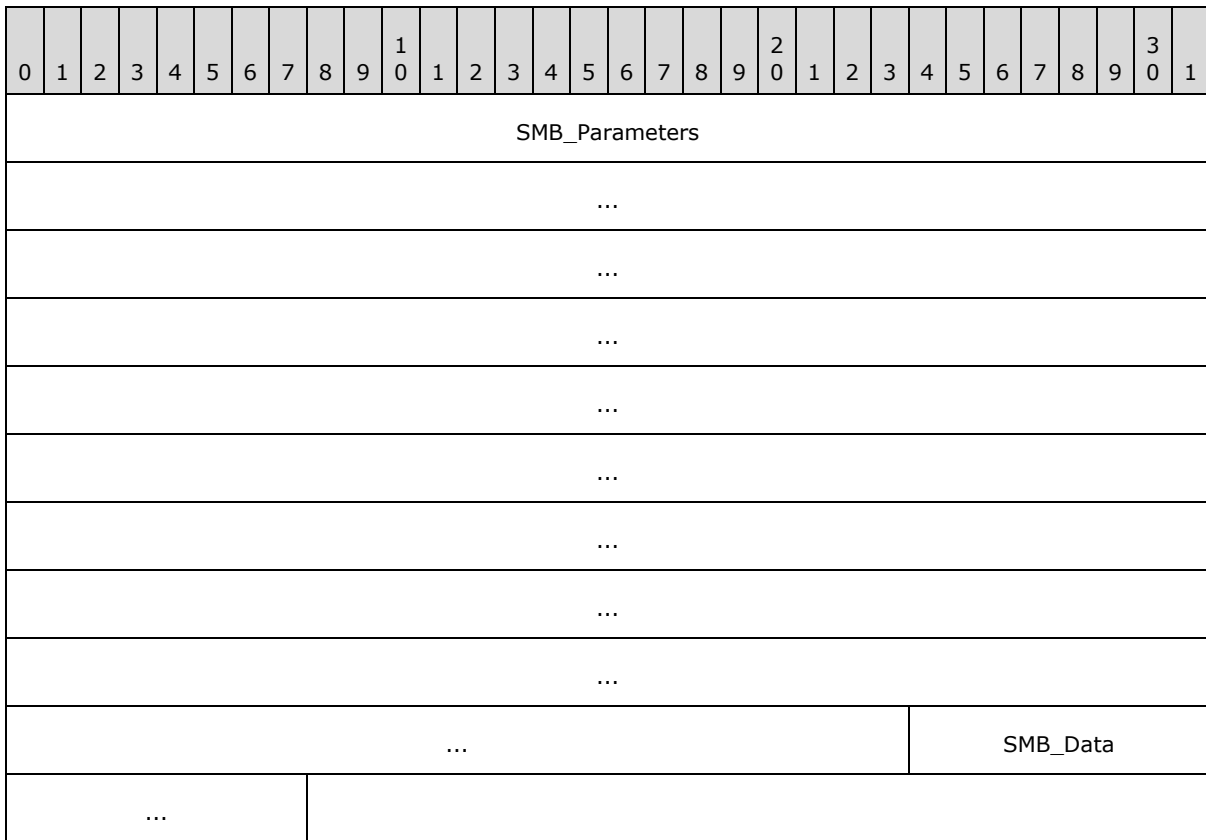
If the client requested extended information by setting SMB\_OPEN\_EXTENDED\_RESPONSE, then a successful response takes the following format. Aside from **WordCount**, **ResourceType**, **ServerFID**, **Reserved**, **MaximalAccessRights**, and **GuestMaximalAccessRights** fields, all other fields are as specified in [\[MS-CIFS\]](#) section 2.2.4.41.2.

```
SMB_Parameters
{
  UCHAR WordCount;
  Words
  {
    UCHAR          AndXCommand;
    UCHAR          AndXReserved;
    USHORT         AndXOffset;
    USHORT         FID;
    SMB_FILE_ATTRIBUTES FileAttrs;
    UTIME          LastWriteTime;
  }
}
```

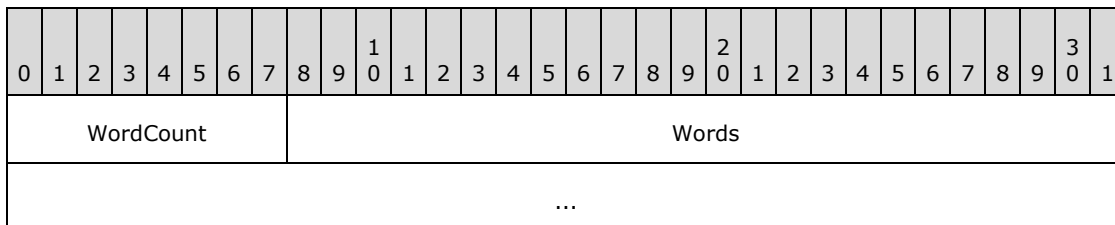
```

    ULONG           FileDataSize;
    USHORT          AccessRights;
    USHORT          ResourceType;
    USHORT          NMPipeStatus;
    USHORT          OpenResults;
    ULONG           ServerFID;
    USHORT          Reserved;
    ACCESS_MASK     MaximalAccessRights;
    ACCESS_MASK     GuestMaximalAccessRights;
}
}
SMB_Data
{
    USHORT ByteCount;
}

```



**SMB\_Parameters (39 bytes):**



...
...
...
...
...
...
...
...
...
...
...

**WordCount (1 byte):** The value of this field MUST be 0x13.

**Words (38 bytes):**

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31						
AndXCommand										AndXReserved										AndXOffset																	
FID																FileAttrs																					
LastWriteTime																																					
FileDataSize																																					
AccessRights																ResourceType																					
NMPipeStatus																OpenResults																					
ServerFID																																					
Reserved																MaximalAccessRights																					
...																GuestMaximalAccessRights																					
...																																					

**ResourceType (2 bytes):** The file type. This field MUST be interpreted as follows:

Name & value	Meaning
FileTypeDisk 0x0000	File or Directory
FileTypeByteModePipe 0x0001	<b>Byte mode</b> named pipe
FileTypeMessageModePipe 0x0002	<b>Message mode</b> named pipe
FileTypePrinter 0x0003	Printer Device
FileTypeUnknown 0xFFFF	Unknown file type

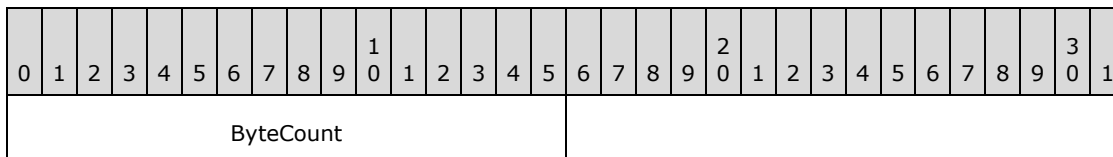
**ServerFID (4 bytes):** Reserved but not implemented. Intended as a 32-bit server file identifier that uniquely identifies the file on the server. This field **MUST** be set to zero by the server and ignored by the client.

**Reserved (2 bytes):** An unused value that **SHOULD** be set to zero when sending this message. The client **MUST** ignore this field when receiving this message.

**MaximalAccessRights (4 bytes):** The maximum access rights that this user has on this object. This field **MUST** be encoded in an ACCESS\_MASK format, as specified in section [2.2.1.4](#).

**GuestMaximalAccessRights (4 bytes):** The maximum access rights that the **guest account** has on this file. This field **MUST** be encoded in an ACCESS\_MASK format, as specified in section [2.2.1.4](#). Support and exact specifications of the notion of a guest account is implementation specific. Implementations that do not support the notion of a guest account **MUST** set this field to zero. [<24>](#)

**SMB\_Data (2 bytes):**



**ByteCount (2 bytes):** The value of this field **SHOULD** [<25>](#) be set to zero. The server **MUST NOT** send any data in this message.

## 2.2.4.2 SMB\_COM\_READ\_ANDX (0x2E)

### 2.2.4.2.1 Client Request Extensions

An SMB\_COM\_READ\_ANDX request is sent by a client to read from a file or named pipe on a server. These extensions overload the **Timeout** field with the new **Timeout\_or\_MaxCountHigh** field, which allows the use of read lengths above 0xFFFF when CAP\_LARGE\_READX has been negotiated. All other fields are defined as specified in [\[MS-CIFS\]](#) section 2.2.4.42.1.

```
SMB_Parameters
{
    UCHAR WordCount;
    Words
```

```

{
  UCHAR  AndXCommand;
  UCHAR  AndXReserved;
  USHORT AndXOffset;
  USHORT FID;
  ULONG  Offset;
  USHORT MaxCountOfBytesToReturn;
  USHORT MinCountOfBytesToReturn;
  ULONG  Timeout_or_MaxCountHigh;
  USHORT Remaining;
  ULONG  OffsetHigh (optional);
}
}
SMB_Data
{
  USHORT ByteCount;
}

```

## SMB\_Parameters

### Words (24 bytes):

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
AndXCommand										AndXReserved						AndXOffset															
FID															Offset																
...															MaxCountOfBytesToReturn																
MinCountOfBytesToReturn															Timeout_or_MaxCountHigh																
...															Remaining																
OffsetHigh (optional)																															

**Timeout\_or\_MaxCountHigh (4 bytes):** This field is extended to be treated as a union of a 32-bit **Timeout** field and a 16-bit **MaxCountHigh** field. When reading from a regular file, the field MUST be interpreted as **MaxCountHigh** and the two unused bytes MUST be zero. When reading from a name pipe or I/O device, the field MUST be interpreted as **Timeout**.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Timeout																															

**Timeout (4 bytes):** The client can set the **Timeout** field to a requested time-out value in milliseconds. The client SHOULD [≤26>](#) set this field to any integer value. The values 0, 0xFFFFFFFF, and 0xFFFFFFFFE have special meaning, as specified in [\[MS-CIFS\]](#) section 3.3.5.36.

0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
MaxCountHigh																Reserved															

**MaxCountHigh (2 bytes):** This field is a 16-bit integer. If the read being requested is larger than 0xFFFF bytes in size, then the client MUST use the **MaxCountHigh** field to hold the two most significant bytes of the requested size, which allows for 32-bit read lengths to be requested when combined with **MaxCountOfBytesToReturn**. If the read is not larger than 0xFFFF bytes, then the client MUST set the **MaxCountHigh** to zero. <27>

**Reserved (2 bytes):** Unlike most other reserved fields, this field can sometimes take specific values. The **Reserved** field SHOULD be set to zero by the client if **MaxCountHigh** is zero, and SHOULD be set to 0xFFFF by the client if **MaxCountHigh** is 0xFFFF. For all other values, this field SHOULD be set to zero by the client. For all values, this field MUST be ignored by the server.

#### 2.2.4.2.2 Server Response Extensions

A successful response takes the following format. Aside from the first two bytes of the **SMB\_Parameters.Words.Reserved2[]** field being extended for use as the new **DataLengthHigh** field, all other fields are defined as specified in [MS-CIFS] section 2.2.4.42.2.

```
SMB_Parameters
{
  UCHAR WordCount;
  Words
  {
    UCHAR AndXCommand;
    UCHAR AndXReserved;
    USHORT AndXOffset;
    USHORT Available;
    USHORT DataCompactionMode;
    USHORT Reserved1;
    USHORT DataLength;
    USHORT DataOffset;
    USHORT DataLengthHigh;
    USHORT Reserved2[4];
  }
}
SMB_Data
{
  USHORT ByteCount;
  Bytes
  {
    UCHAR Pad[] (optional);
    UCHAR Data[variable];
  }
}
```

#### SMB\_Parameters

Words (24 bytes):



0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
AndXCommand										AndXReserved										AndXOffset											
Available															DataCompactionMode																
Reserved1															DataLength																
DataOffset															DataLengthHigh																
Reserved2																															
...																															

**DataLengthHigh (2 bytes):** If the data read is greater than or equal to 0x00010000 bytes (64KB) in length, then the server MUST set the two least-significant bytes of the length in the **DataLength** field of the response and the two most-significant bytes of the length in the **DataLengthHigh** field. Otherwise, this field MUST be set to zero.

**Reserved2 (8 bytes):** This field MUST be set to zero by the server and MUST be ignored by the client.

### 2.2.4.3 SMB\_COM\_WRITE\_ANDX (0x2F)

#### 2.2.4.3.1 Client Request Extensions

An SMB\_COM\_WRITE\_ANDX request is sent by a client to write data to a file or named pipe on a server. These extensions allocate the **SMB\_Parameters.Words.Reserved** field for use as the **DataLengthHigh** field. This field is used when the CAP\_LARGE\_WRITEX capability has been negotiated to allow for file writes larger than 0xFFFF bytes in length. All other fields are defined as specified in [\[MS-CIFS\]](#) section 2.2.4.43.1.

```
SMB_Parameters
{
    UCHAR WordCount;
    Words
    {
        UCHAR AndXCommand;
        UCHAR AndXReserved;
        USHORT AndXOffset;
        USHORT FID;
        ULONG Offset;
        ULONG Timeout;
        USHORT WriteMode;
        USHORT Remaining;
        USHORT DataLengthHigh;
        USHORT DataLength;
        USHORT DataOffset;
        ULONG OffsetHigh (optional);
    }
}
SMB_Data
```

```

{
USHORT ByteCount;
Bytes
{
  UCHAR Pad;
  UCHAR Data[variable];
}
}

```

## SMB\_Parameters

### Words (variable):

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
AndXCommand										AndXReserved										AndXOffset											
FID																Offset															
...																Timeout															
...																WriteMode															
Remaining																DataLengthHigh															
DataLength																DataOffset															
OffsetHigh (optional)																															

**DataLengthHigh (2 bytes):** This field contains the two most significant bytes of the length of the data to write to the file. If the number of bytes to be written is greater than or equal to 0x00010000( 64 kilobytes), then the client MUST set the two least significant bytes of the length in the **DataLength** field of the request and the two most significant bytes of the length in the **DataLengthHigh** field.

### 2.2.4.3.2 Server Response Extensions

A successful response takes the following format. These extensions allocate the first two bytes of the **SMB\_Parameters.Words.Reserved** field for use as the **CountHigh** field. This field is used when the CAP\_LARGE\_WRITEX capability has been negotiated to allow for file writes larger than 0xFFFF bytes in length. All other fields are defined as specified in [\[MS-CIFS\]](#) section 2.2.4.43.2.

```

SMB_Parameters
{
  UCHAR WordCount;
  Words
  {
    UCHAR AndXCommand;
    UCHAR AndXReserved;
    USHORT AndXOffset;
    USHORT Count;
  }
}

```

```

    USHORT Available;
    USHORT CountHigh;
    USHORT Reserved;
}
}
SMB_Data
{
    USHORT ByteCount;
}

```

## SMB\_Parameters

### Words (12 bytes):

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
AndXCommand										AndXReserved										AndXOffset											
Count																Available															
CountHigh																Reserved															

**CountHigh (2 bytes):** This field contains the two most significant bytes of the count of bytes written. If the number of bytes written is greater than or equal to 0x00010000 ( 64 kilobytes), then the server MUST set the two least significant bytes of the length in the **Count** field of the request and the two most significant bytes of the length in the **CountHigh** field.

**Reserved (2 bytes):** This field is reserved. Servers MUST set this field to zero and clients MUST ignore this field upon receipt.

### 2.2.4.4 SMB\_COM\_TRANSACTION2 (0x32) Extensions

The SMB\_COM\_TRANSACTION2 request is sent by a client to execute a specific operation of various types on the server. These operations include file enumeration, query and set file attribute operations, and DFS referral retrieval. The general format of the SMB\_COM\_TRANSACTION2 command requests and responses is given in [MS-CIFS] sections [2.2.4.46](#) and [2.2.4.47](#). Execution of SMB\_COM\_TRANSACTION2 is defined as specified in [MS-CIFS] sections [3.2.4.1.5](#), [3.2.5.1.4](#), and [3.3.5.2.5](#).

Valid SMB\_COM\_TRANSACTION2 subcommand codes, also known as "Trans2 subcommands", are specified in section [2.2.2.2](#). The format and syntax of these subcommands are specified in section [2.2.6](#) and in [MS-CIFS] section 2.2.6.

### 2.2.4.5 SMB\_COM\_NEGOTIATE (0x72)

#### 2.2.4.5.1 Client Request Extensions

All fields are defined as specified in [MS-CIFS] section 2.2.4.52.1. In order to support the extension in this document, the client MUST include the NT LAN Manager dialect (identified by the "NT LM 0.12" dialect string) in the **SMB\_Data.Bytes.Dialects[]** array of the request.

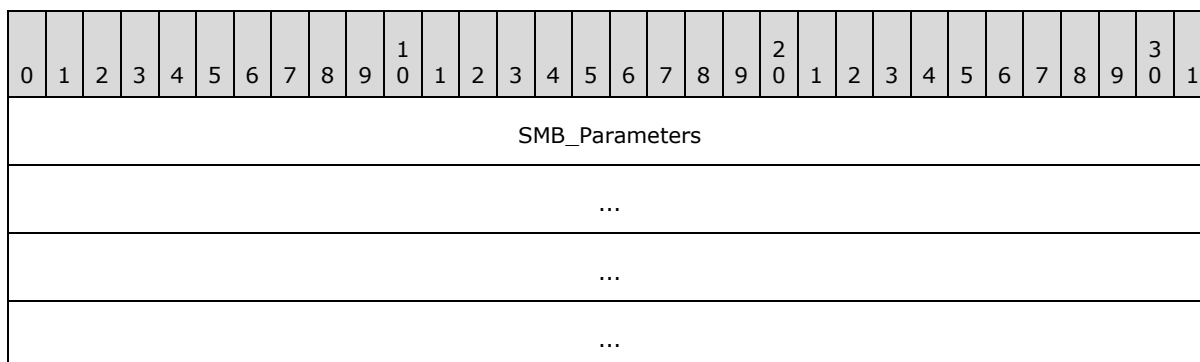
When set, the **SMB\_Header.Flags2** `SMB_FLAGS2_EXTENDED_SECURITY` flag indicates support for specification [\[RFC2743\]](#) and GSS authentication (see section [3.1.5.1](#)), and indicates to the server that it should send an Extended Security response (see section [2.2.4.5.2](#)).

## 2.2.4.5.2 Server Response Extensions

### 2.2.4.5.2.1 Extended Security Response

If the selected dialect is NT LAN Manager and the client has indicated extended security is being used, a successful response MUST take the following form. Aside from the additional notes to the **SMB\_Parameters.Words.MaxBufferSize** and **SMB\_Parameters.Words.ChallengeLength** fields, the new **SMB\_Parameters.Words.Capabilities** bits, and the **SMB\_Data.Bytes.ServerGuid** and **SMB\_Data.Bytes.SecurityBlob** fields, all other fields are defined as specified in [\[MS-CIFS\]](#) section 2.2.4.52.2.

```
SMB_Parameters
{
  UCHAR  WordCount;
  Words
  {
    USHORT  DialectIndex;
    UCHAR   SecurityMode;
    USHORT  MaxMpxCount;
    USHORT  MaxNumberVcs;
    ULONG   MaxBufferSize;
    ULONG   MaxRawSize;
    ULONG   SessionKey;
    ULONG   Capabilities;
    FILETIME SystemTime;
    SHORT   ServerTimeZone;
    UCHAR   ChallengeLength;
  }
}
SMB_Data
{
  USHORT ByteCount;
  Bytes
  {
    GUID ServerGUID;
    UCHAR SecurityBlob[];
  }
}
```





...	SessionKey
...	Capabilities
...	SystemTime
...	
...	ServerTimeZone
...	ChallengeLength

**MaxBufferSize (4 bytes):** Maximum size, in bytes, of the server buffer for receiving SMB messages. This value accounts for the size of the largest SMB message that the client can send to the server, measured from the start of the SMB header to the end of the packet. This value does not account for any underlying transport-layer packet headers, and thus does not account for the size of the complete network packet. <28>

The only cases in which this maximum buffer size MUST be exceeded are:

- When the SMB\_COM\_WRITE\_ANDX command is used and the client and server both support the CAP\_LARGE\_WRITEX capability (see the **Capabilities** field for more information).
- When the SMB\_COM\_WRITE\_RAW command is used and both the client and server support the CAP\_RAW\_MODE capability.

**Capabilities (4 bytes):** A 32-bit field providing a set of server capability indicators. This bit field is used to indicate to the client which features are supported by the server. Any value not listed in the following table is unused. The server MUST set the unused bits to zero. The client MUST ignore these bits.

These extensions provide the following new capability bits:

- CAP\_COMPRESSED\_DATA
- CAP\_DYNAMIC\_REAUTH
- CAP\_EXTENDED\_SECURITY
- CAP\_INFOLEVEL\_PASSTHRU
- CAP\_LARGE\_WRITEX
- CAP\_LWIO
- CAP\_UNIX

The rest of the values in the capabilities table are included for completeness.

Name and bitmask	Meaning
CAP_RAW_MODE 0x00000001	The server supports SMB_COM_READ_RAW and SMB_COM_WRITE_RAW requests. <29> Raw mode is

Name and bitmask	Meaning
	not supported over connectionless transports.
CAP_MPX_MODE 0x00000002	The server supports SMB_COM_READ_MPX and SMB_COM_WRITE_MPX requests.<30> MPX mode is supported only over connectionless transports.
CAP_UNICODE 0x00000004	The server supports UTF-16LE <b>Unicode strings</b> .
CAP_LARGE_FILES 0x00000008	The server supports large files with 64-bit offsets.
CAP_NT_SMBS 0x00000010	The server supports SMB commands particular to the NT LAN Manager dialect.
CAP_RPC_REMOTE_APIS 0x00000020	The server supports the use of remote procedure call [MS-RPCE] for remote API calls. Similar functionality would otherwise require use of the legacy Remote Administration Protocol, as specified in [MS-RAP].
CAP_STATUS32 0x00000040	The server is capable of responding with 32-bit status codes in the <b>Status</b> field of the SMB header (for more information, see [MS-CIFS] 2.2.3.1). CAP_STATUS32 can also be referred to as CAP_NT_STATUS.
CAP_LEVEL_II_OPLOCKS 0x00000080	The server supports level II opportunistic locks (oplocks).
CAP_LOCK_AND_READ 0x00000100	The server supports the SMB_COM_LOCK_AND_READ command requests.
CAP_NT_FIND 0x00000200	The server supports the TRANS2_FIND_FIRST2, TRANS2_FIND_NEXT2, and FIND_CLOSE2 command requests. This bit SHOULD<31> be set if CAP_NT_SMBS is set.
CAP_DFS 0x00001000	The server is aware of the DFS Referral Protocol, as specified in [MS-DFSC], and can respond to DFS referral requests. For more information, see [MS-CIFS] sections 2.2.6.16.1 and 2.2.6.16.2.
CAP_INFOLEVEL_PASSTHRU 0x00002000	The server supports pass-through Information Levels, as specified in section 2.2.2.3. This allows the client to pass Information Level structures in QUERY and SET operations.<32>
CAP_LARGE_READX 0x00004000	The server supports large read operations. This capability affects the maximum size, in bytes, of the server buffer for sending an SMB_COM_READ_ANDX response to the client. When this capability is set by the server (and set by the client in the SMB_COM_SESSION_SETUP_ANDX request), then the maximum server buffer size for sending data can exceed the <b>MaxBufferSize</b> field. Therefore, the server can send a single SMB_COM_READ_ANDX response to the client up to an implementation-specific default size.<33>

Name and bitmask	Meaning
	When signing is active on a connection, then clients MUST limit read lengths to the <b>MaxBufferSize</b> value negotiated by the server irrespective of the value of the CAP_LARGE_READX flag.
CAP_LARGE_WRITEX 0x00008000	The server supports large write operations. This capability affects the maximum size, in bytes, of the server buffer for receiving an SMB_COM_WRITE_ANDX client request. When this capability is set by the server (and set by the client in the SMB_COM_SESSION_SETUP_ANDX request), then the maximum server buffer size of bytes it writes can exceed the <b>MaxBufferSize</b> field. Therefore, a client can send a single SMB_COM_WRITE_ANDX request up to this size. <34>  When signing is active on a connection, then clients MUST limit write lengths to the <b>MaxBufferSize</b> value negotiated by the server, irrespective of the value of the CAP_LARGE_WRITEX flag.
CAP_LWIO 0x00010000	The server supports new light-weight I/O control ( <b>IOCTL</b> ) and file system control (FSCTL) operations. These operations are accessed using the NT_TRANSACT_IOCTL subcommand (section 2.2.7.2). <35>
CAP_UNIX 0x00800000	The server supports UNIX extensions. <36> For more information, see [SNIA].
CAP_COMPRESSED_DATA 0x02000000	Reserved but not implemented. <37> The server supports compressed SMB packets.
CAP_DYNAMIC_REAUTH 0x20000000	The server supports re-authentication. <38>
CAP_PERSISTENT_HANDLES 0x40000000	Reserved but not implemented. <39> The server supports persistent handles.
CAP_EXTENDED_SECURITY 0x80000000	The server supports extended security for authentication, as specified in section 3.2.4.2.4. This bit is used in conjunction with the SMB_FLAGS2_EXTENDED_SECURITY <b>SMB_Header.Flags2</b> flag, as specified in section 2.2.3.1.

**ChallengeLength (1 byte):** When the CAP\_EXTENDED\_SECURITY bit is set, the server MUST set this value to zero and clients MUST ignore this value.

**SMB\_Data (variable):**

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
ByteCount																Bytes (variable)															



...

**ByteCount (2 bytes):** The number of bytes in the **SMB\_Data.Bytes** array, which follows. This field MUST be greater than or equal to 0x0010.

**Bytes (variable):**

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
ServerGUID																															
...																															
...																															
...																															
SecurityBlob (variable)																															
...																															

**ServerGUID (16 bytes):** This field MUST be a GUID generated by the server to uniquely identify this server. This field SHOULD NOT be used by a client as a secure method of identifying a server because it can be forged. A client SHOULD use this information to detect whether connections to different textual names resolve to the same target server when direct TCP is used. This knowledge can then be used to set the **SMB\_Parameters.Words.VcNumber** field in the SMB\_COM\_SESSION\_SETUP\_ANDX request (see [\[MS-CIFS\]](#) section 2.2.4.53.1). [<40>](#)

**SecurityBlob (variable):** A security binary large object (BLOB) that SHOULD contain an authentication token as produced by the GSS protocol (as specified in section [3.2.4.2.4](#) and [\[RFC2743\]](#)).

### 2.2.4.5.2.2 Non-Extended Security Response

If extended security is not being used and the NT LAN Manager dialect has been selected, then a successful response MUST take the following form. Aside from the new **SMB\_Parameters.Words.Capabilities** bits, the additional notes to the **SMB\_Parameters.Words.MaxBufferSize** field, and the **SMB\_Data.Bytes.ServerName** field, all other fields are defined as specified in [\[MS-CIFS\]](#) section 2.2.4.52.2. The **SMB\_Parameters.Words.ChallengeLength** field and the entire **SMB\_Data** block are included from [\[MS-CIFS\]](#) to highlight the differences between the Extended and Non-Extended Security responses.

In order to determine whether the **SMB\_Data.Bytes.ServerName** field is present, the client MUST check the **SMB\_Data.ByteCount** field to determine whether additional data is present beyond the NULL terminator of the **SMB\_Data.Bytes.DomainName** string.

```
SMB_Parameters
{
    UCHAR    WordCount;
```





value does not account for any underlying transport-layer packet headers and thus does not account for the size of the complete network packet. <41>

The only exceptions in which this maximum buffer size can be exceeded are:

- When the SMB\_COM\_WRITE\_ANDX command is used and both the client and server support the CAP\_LARGE\_WRITEX capability (see the **Capabilities** field for more information).
- When the SMB\_COM\_READ\_ANDX command is used and both the client and server support the CAP\_LARGE\_READX capability (see the Capabilities field for more information).
- When the SMB\_COM\_WRITE\_RAW command is used and both the client and server support the CAP\_RAW\_MODE capability.

**Capabilities (4 bytes):** A 32-bit field providing a set of server capability indicators. This bit field is used to indicate to the client which features are supported by the server. Any value not listed in the following table is unused. The server MUST set the unused bits to zero in a response and the client MUST ignore these bits.

There are several new capability bits:

- CAP\_COMPRESSED\_DATA
- CAP\_DYNAMIC\_REAUTH
- CAP\_EXTENDED\_SECURITY
- CAP\_INFOLEVEL\_PASSTHRU
- CAP\_LARGE\_WRITEX
- CAP\_LWIO
- CAP\_UNIX

Any value not listed in the following table SHOULD be unused. A server SHOULD set the unused bits to zero in a response and a client MUST ignore these bits. The table of server capabilities is provided in the previous section.

**ChallengeLength (1 byte):** The value of this field MUST be 0x08 and is the length of the random challenge used in challenge/response authentication. This field is often referred to as EncryptionKeyLength.

**SMB\_Data (variable):**

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
ByteCount																Bytes (variable)															
...																															

**ByteCount (2 bytes):** This field MUST be greater than or equal to 0x0003.

## Bytes (variable):

0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1		
Challenge (variable)																																	
...																																	
DomainName (variable)																																	
...																																	
ServerName (variable)																																	
...																																	

**Challenge (variable):** An array of unsigned bytes that MUST be the length of the number of bytes specified in the **ChallengeLength** field and MUST represent the server challenge. This array MUST NOT be NULL-terminated. [<42>](#)

**DomainName (variable):** The name of the **domain** or workgroup to which the server belongs.

**ServerName (variable):** A variable-length, NULL-terminated Unicode string that contains the name of the Server.

## 2.2.4.6 SMB\_COM\_SESSION\_SETUP\_ANDX (0x73)

### 2.2.4.6.1 Client Request Extensions

An SMB\_COM\_SESSION\_SETUP\_ANDX request MUST be sent by a client to begin user authentication on an SMB connection and establish an SMB session.

When extended security is being used (see section [3.2.4.2.4](#)), the request MUST take the following form. Aside from the **SecurityBlobLength** field, the additional capabilities used in the **Capabilities** field, and the **ByteCount** and **SecurityBlob** fields, all other fields are as specified in [\[MS-CIFS\]](#) section 2.2.4.53.1.

```
SMB_Parameters
{
    UCHAR    WordCount;
    Words
    {
        UCHAR    AndXCommand;
        UCHAR    AndXReserved;
        USHORT   AndXOffset;
        USHORT   MaxBufferSize;
        USHORT   MaxMpxCount;
        USHORT   VcNumber;
        ULONG    SessionKey;
        USHORT   SecurityBlobLength;
        ULONG    Reserved;
        ULONG    Capabilities;
    }
}
```

```

    }
}
SMB_Data
{
    USHORT ByteCount;
    Bytes
    {
        UCHAR      SecurityBlob[SecurityBlobLength];
        SMB_STRING NativeOS[];
        SMB_STRING NativeLanMan[];
    }
}

```

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
SMB_Parameters																															
...																															
...																															
...																															
...																															
...																															
...																SMB_Data (variable)															
...																															

**SMB\_Parameters (25 bytes):**

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
WordCount										Words																					
...																															
...																															
...																															
...																															
...																															

...

**WordCount (1 byte):** The value of this field MUST be 0x0C.

**Words (24 bytes):**

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
AndXCommand								AndXReserved								AndXOffset															
MaxBufferSize																MaxMpxCount															
VcNumber																SessionKey															
...																SecurityBlobLength															
Reserved																															
Capabilities																															

**SecurityBlobLength (2 bytes):** This value MUST specify the length in bytes of the variable-length **SecurityBlob** field that is contained within the request.

**Capabilities (4 bytes):** A set of client capabilities. This field has the same structure as the **SMB\_Parameters.Capabilities** field of the SMB\_COM\_NEGOTIATE Server Response specified in section [2.2.4.5.2.<43>](#)

**SMB\_Data (variable):**

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
ByteCount																Bytes (variable)															
...																															

**ByteCount (2 bytes):** If SMB\_FLAGS2\_UNICODE is set in the **SMB\_Header.Flags2** field, then this field MUST be greater than or equal to 0x0004. If SMB\_FLAGS2\_UNICODE is not set, then this field MUST be greater than or equal to 0x0002.

**Bytes (variable):**

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
SecurityBlob (variable)																															
...																															

NativeOS (variable)
...
NativeLanMan (variable)
...

**SecurityBlob (variable):** This field MUST be the authentication token sent to the server, as specified in section [3.2.4.2.4](#) and in [\[RFC2743\]](#).

**NativeOS (variable):** A string that represents the native operating system of the SMB client. If SMB\_FLAGS2\_UNICODE is set in the **Flags2** field of the SMB header of the request, then the name string MUST be a NULL-terminated array of 16-bit Unicode characters. Otherwise, the name string MUST be a NULL-terminated array of **OEM characters**. If the name string consists of Unicode characters, then this field MUST be aligned to start on a 2-byte boundary from the start of the SMB header. [<44>](#)

**NativeLanMan (variable):** A string that represents the native LAN manager type of the client. If SMB\_FLAGS2\_UNICODE is set in the **Flags2** field of the SMB header of the request, then the name string MUST be a NULL-terminated array of 16-bit Unicode characters. Otherwise, the name string MUST be a NULL-terminated array of OEM characters. If the name string consists of Unicode characters, then this field MUST be aligned to start on a 2-byte boundary from the start of the SMB header. [<45>](#)

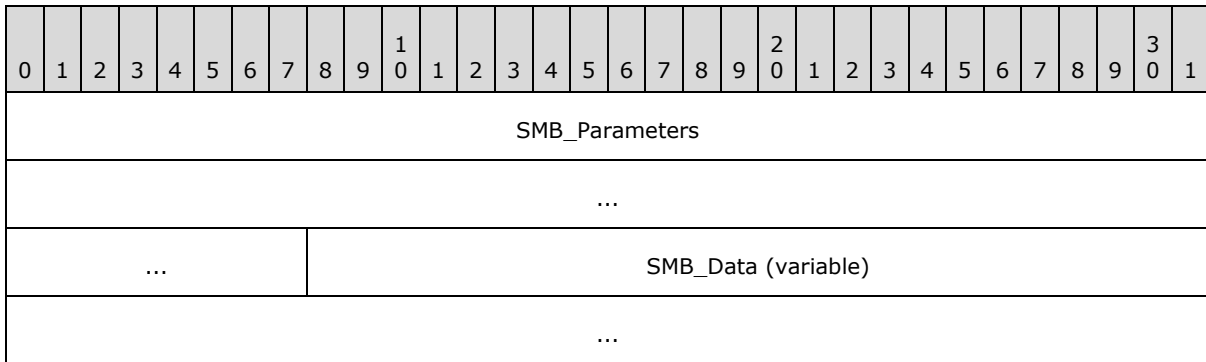
### 2.2.4.6.2 Server Response Extensions

When extended security is being used (see section [3.2.4.2.4](#)), a successful response MUST take the following form. Aside from the SecurityBlobLength field, the additional capabilities used in the Capabilities field, the ByteCount and SecurityBlob fields, and the omission of the PrimaryDomain field, all of the other fields are as specified in [\[MS-CIFS\]](#) section 2.2.4.53.2.

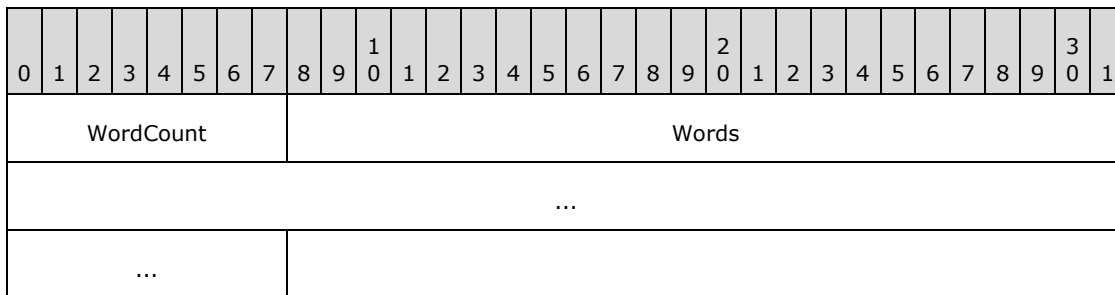
```
SMB_Parameters
{
  UCHAR  WordCount;
  Words
  {
    UCHAR  AndXCommand;
    UCHAR  AndXReserved;
    USHORT AndXOffset;
    USHORT Action;
    USHORT SecurityBlobLength;
  }
}
SMB_Data
{
  USHORT ByteCount;
  Bytes
  {
    UCHAR      SecurityBlob[SecurityBlobLength];
    SMB_STRING NativeOS[];
    SMB_STRING NativeLanMan[];
  }
}
```



}

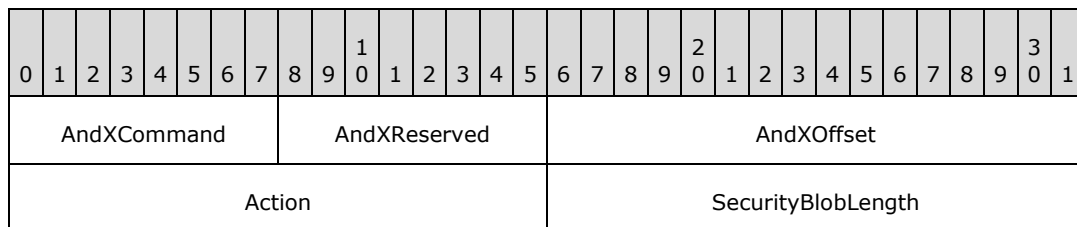


**SMB\_Parameters (9 bytes):**



**WordCount (1 byte):** The value of this field MUST be 0x04.

**Words (8 bytes):**



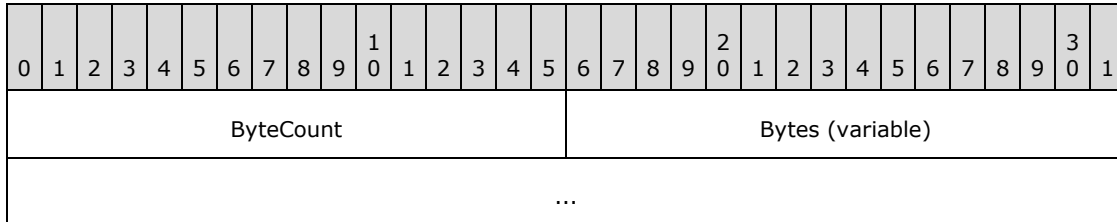
**Action (2 bytes):** A 16-bit field. The two lowest-order bits have been defined.

Name and bitmask	Meaning
SMB_SETUP_GUEST 0x0001	If clear (0), then the user successfully authenticated and is logged in. If set (1), then authentication failed but the server has granted guest access; the user is logged in as a Guest.
SMB_SETUP_USE_LANMAN_KEY 0x0002	This bit is not used with extended security and MUST be clear.

The server's response does not specify whether the access granted is of type Anonymous. However, the security system can provide that information once authorization completes.

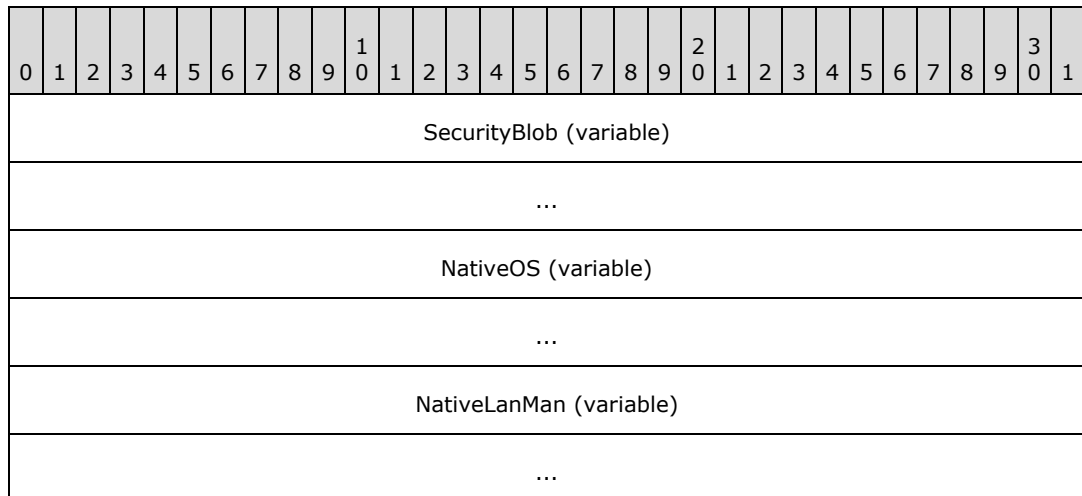
**SecurityBlobLength (2 bytes):** This value MUST specify the length, in bytes, of the variable-length **SecurityBlob** that is contained within the response.

**SMB\_Data (variable):**



**ByteCount (2 bytes):** If SMB\_FLAGS2\_UNICODE is set in the **SMB\_Header.Flags2** field, then this field MUST be greater than or equal to 0x0006. If SMB\_FLAGS2\_UNICODE is not set, then this field MUST be greater than or equal to 0x0003.

**Bytes (variable):**



**SecurityBlob (variable):** This value MUST contain the authentication token being returned to the client, as specified in section [3.3.5.3](#) and [\[RFC2743\]](#).

**NativeOS (variable):** A string that represents the native operating system of the server. If SMB\_FLAGS2\_UNICODE is set in the **Flags2** field of the SMB header of the response, then the string MUST be a NULL-terminated array of 16-bit Unicode characters. Otherwise, the string MUST be a NULL-terminated array of OEM characters. If the name string consists of Unicode characters, then this field MUST be aligned to start on a 2-byte boundary from the start of the SMB header. [<46>](#)

**NativeLanMan (variable):** A string that represents the native LAN Manager type of the server. If SMB\_FLAGS2\_UNICODE is set in the **Flags2** field of the SMB header of the response, then the string MUST be a NULL-terminated array of 16-bit Unicode characters. Otherwise, the string MUST be a NULL-terminated array of OEM characters. If the name string consists of Unicode characters, then this field MUST be aligned to start on a 2-byte boundary from the start of the SMB header. [<47>](#)

## 2.2.4.7 SMB\_COM\_TREE\_CONNECT\_ANDX (0x75)

### 2.2.4.7.1 Client Request Extensions

An SMB\_COM\_TREE\_CONNECT\_ANDX request MUST be sent by a client to establish a **tree connect** to a share. These extensions define new flags (TREE\_CONNECT\_ANDX\_EXTENDED\_SIGNATURES and TREE\_CONNECT\_ANDX\_EXTENDED\_RESPONSE) in the **SMB\_Parameters.Words.Flags** field that are used to trigger the new behavior defined in this specification. The full field description from [\[MS-CIFS\]](#) is included for completeness. All other fields are as specified in [\[MS-CIFS\]](#) section 2.2.4.55.1.

```
SMB_Parameters
{
  UCHAR  WordCount;
  Words
  {
    UCHAR  AndXCommand;
    UCHAR  AndXReserved;
    USHORT AndXOffset;
    USHORT Flags;
    USHORT PasswordLength;
  }
}
SMB_Data
{
  USHORT ByteCount;
  Bytes
  {
    UCHAR  Password[PasswordLength];
    UCHAR  Pad[];
    SMB_STRING Path;
    OEM_STRING Service;
  }
}
```

#### SMB\_Parameters

Words (8 bytes):

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
AndXCommand										AndXReserved						AndXOffset															
Flags																PasswordLength															

**Flags (2 bytes):** A set of options that modify the SMB\_COM\_TREE\_CONNECT\_ANDX request. The entire flag set is given here with its symbolic constants. Any combination of the following flags is valid. Any values not given as follows are considered reserved.

Name & bitmask	Meaning
TREE_CONNECT_ANDX_DISCONNECT_TID 0x0001	If set and <b>SMB_Header.TID</b> is valid, the tree connect specified by the TID in the SMB

Name & bitmask	Meaning
	header of the request SHOULD be disconnected when the server sends the response. If this tree disconnect fails, then the error SHOULD be ignored. If set and TID is invalid, the server MUST ignore this bit.
TREE_CONNECT_ANDX_EXTENDED_SIGNATURES 0x0004	If set, then the client is requesting signing key protection, as specified in sections <a href="#">3.2.4.2.5</a> and <a href="#">3.2.5.4</a> .
TREE_CONNECT_ANDX_EXTENDED_RESPONSE 0x0008	If set, then the client is requesting extended information in the SMB_COM_TREE_CONNECT_ANDX response.

### 2.2.4.7.2 Server Response Extensions

When a server returns extended information, the response takes the following format. Aside from the **WordCount**, **MaximalShareAccessRights**, and **GuestMaximalShareAccessRights** fields, and the new **OptionalSupport** flags, all other fields are defined as specified in [\[MS-CIFS\]](#) section 2.2.4.55.2.

```

SMB_Parameters
{
  UCHAR  WordCount;
  Words
  {
    UCHAR      AndXCommand;
    UCHAR      AndXReserved;
    USHORT     AndXOffset;
    USHORT     OptionalSupport;
    ACCESS_MASK MaximalShareAccessRights;
    ACCESS_MASK GuestMaximalShareAccessRights;
  }
}

SMB_Data
{
  USHORT ByteCount;
  Bytes
  {
    OEM_STRING Service;
    UCHAR      Pad[];
    SMB_STRING NativeFileSystem;
  }
}

```

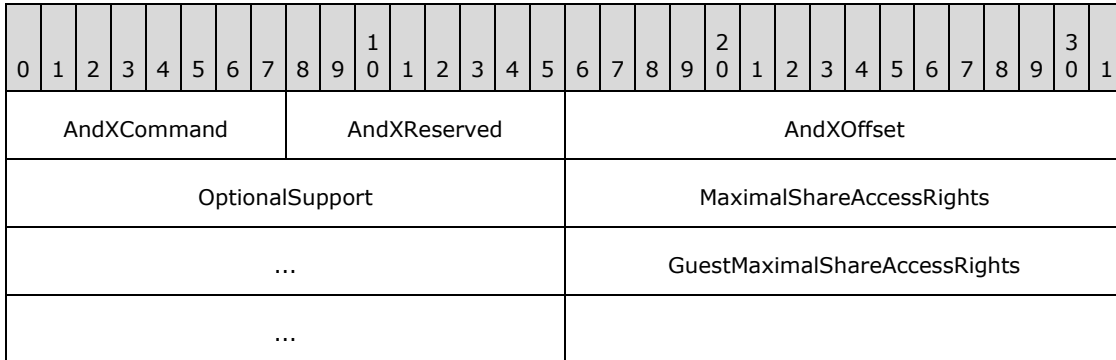
#### SMB\_Parameters

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
WordCount										Words																					



**WordCount (1 byte):** The value of this field MUST be 0x07.

**Words (14 bytes):**



**OptionalSupport (2 bytes):** The following **OptionalSupport** bit fields are new extensions: SMB\_CSC\_MASK, SMB\_UNIQUE\_FILE\_NAME, and SMB\_EXTENDED\_SIGNATURES. Values from [MS-CIFS] are included for completeness. The values of SMB\_CSC\_MASK each have their own name and are included for reference purposes only. Any combination of the following flags MUST be supported. All undefined values are considered reserved. The server SHOULD set them to zero and the client MUST ignore them.

Name & bitmask	Value	Meaning
SMB_SUPPORT_SEARCH_BITS 0x0001	0	If set, then the server supports the use of SMB_FILE_ATTRIBUTES Search Attributes in client directory search requests, as specified in [MS-CIFS].
	1	
SMB_SHARE_IS_IN_DFS 0x0002	0	If set, this share is managed by Distributed File System (DFS), as specified in <a href="#">[MS-DFSC]</a> .
	1	
SMB_CSC_MASK 0x000C	0	SMB_CSC_CACHE_MANUAL_REINT Clients are allowed to cache files that the user requests for offline use, but there is no automatic file-by-file reintegration.
	1	SMB_CSC_CACHE_AUTO_REINT Clients are allowed to automatically cache the files that a user or application modifies for offline use. Automatic file-by-file reintegration MUST be permitted.
	2	SMB_CSC_CACHE_VDO Clients are allowed to automatically cache the files that a user or

Name & bitmask	Value	Meaning
		application modifies for offline use. Clients are permitted to work from their local cache even while online.
	3	SMB_CSC_NO_CACHING No offline caching is allowed for this share.
SMB_UNIQUE_FILE_NAME 0x0010	0	If set, then the server is using long file names only and does not support short file names. If set, then the server allows the client to assume that there is no name aliasing for this share (in other words, a single file cannot have two different names). If set, then the server permits the client to cache directory enumerations and file metadata based on the pathname.  The client MAY <a href="#">&lt;48&gt;</a> choose to satisfy file attribute queries from its cache and thus could present a slightly stale view of files on the share. The client MUST NOT cache remote file system information for more than 60 seconds.
	1	
SMB_EXTENDED_SIGNATURES 0x0020	0	If set, then the server is using signing key protection (see section <a href="#">3.3.5.4</a> ), as requested by the client.
	1	

**MaximalShareAccessRights (4 bytes):** This field MUST specify the maximum rights that the user has to this share based on the security enforced by the share. This field MUST be encoded in an ACCESS\_MASK format, as specified in section [2.2.1.4](#).

**GuestMaximalShareAccessRights (4 bytes):** This field MUST specify the maximum rights that the guest account has on this share based on the security enforced by the share. Note that the notion of a guest account is implementation specific. [<49>](#)

Implementations that do not support the notion of a guest account MUST set this field to zero, which implies no access. This field MUST be encoded in an ACCESS\_MASK format, as specified in section [2.2.1.4](#).

## 2.2.4.8 SMB\_COM\_NT\_TRANSACT (0xA0) Extensions

The SMB\_COM\_NT\_TRANSACT request is sent by a client to specify operations on the server. The operations include file open, file create, device I/O control, notify directory change, and set and query security descriptors. The general format of the SMB\_COM\_NT\_TRANSACT command requests and responses is given in [\[MS-CIFS\]](#) sections [2.2.4.62](#) and [2.2.4.63](#). Execution of SMB\_COM\_NT\_TRANSACT is as specified in [\[MS-CIFS\]](#) sections [3.2.4.1.5](#), [3.2.5.1.4](#), and [3.3.5.2.5](#).

Valid SMB\_COM\_NT\_TRANSACT subcommand codes, also known as "NT Trans subcommand" codes, are specified in section [2.2.2.2](#). The format and syntax of these subcommands are specified in section [2.2.7](#) and in [\[MS-CIFS\]](#) section 2.2.7.

## 2.2.4.9 SMB\_COM\_NT\_CREATE\_ANDX (0xA2)

### 2.2.4.9.1 Client Request Extensions

An SMB\_COM\_NT\_CREATE\_ANDX request is sent by a client to open a file or device on the server. This extension adds the following:

- An additional flag bit is added to the **Flags** field of the SMB\_COM\_NT\_CREATE\_ANDX request. The additional flag, NT\_CREATE\_REQUEST\_EXTENDED\_RESPONSE, is used to request an extended response from the server.
- An additional parameter value is added to the **ImpersonationLevel** field. SECURITY\_DELEGATION is added to allow the server to call other servers while impersonating the original client.

All other fields are as specified in [\[MS-CIFS\]](#) section 2.2.4.64.1.<50>

```

SMB_Parameters
{
  UCHAR WordCount;
  Words
  {
    UCHAR      AndXCommand;
    UCHAR      AndXReserved;
    USHORT     AndXOffset;
    UCHAR      Reserved;
    USHORT     NameLength;
    ULONG      Flags;
    ULONG      RootDirectoryFID;
    ULONG      DesiredAccess;
    LARGE_INTEGER AllocationSize;
    SMB_EXT_FILE_ATTR  ExtFileAttributes;
    ULONG      ShareAccess;
    ULONG      CreateDisposition;
    ULONG      CreateOptions;
    ULONG      ImpersonationLevel;
    UCHAR      SecurityFlags;
  }
}
SMB_Data
{
  USHORT ByteCount;
  Bytes
  {
    SMB_STRING FileName;
  }
}

```

### SMB\_Parameters

Words (48 bytes):

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
AndXCommand										AndXReserved						AndXOffset															
Reserved										NameLength												Flags									
...																								RootDirectoryFID							

...	DesiredAccess
...	AllocationSize
...	
...	ExtFileAttributes
...	ShareAccess
...	CreateDisposition
...	CreateOptions
...	ImpersonationLevel
...	SecurityFlags

**Flags (4 bytes):** A set of flags that modify the client request, as defined in the table below. NT\_CREATE\_REQUEST\_EXTENDED\_RESPONSE is new to MS-SMB. All other flags are included in the table for completeness. Unused bits SHOULD be set to zero by the client when sending a request and MUST be ignored when received by the server.

Name & bitmask	Meaning
NT_CREATE_REQUEST_OPLOCK 0x00000002	If set, then the client is requesting an oplock.
NT_CREATE_REQUEST_OPBATCH 0x00000004	If set, then the client is requesting a batch oplock.
NT_CREATE_OPEN_TARGET_DIR 0x00000008	If set, then the client indicates that the parent directory of the target is to be opened.
NT_CREATE_REQUEST_EXTENDED_RESPONSE 0x00000010	If set, then the client is requesting extended information in the response.

**ImpersonationLevel (4 bytes):** This field specifies the impersonation level requested by the application that is issuing the create request, and MUST contain one of the following values. The server MUST validate this field, but otherwise ignore it.

Impersonation is described in [\[MS-WPO\]](#) section 9.7; for more information about impersonation, see [\[MSDN-IMPERS\]](#).

Value	Meaning
SECURITY_ANONYMOUS 0x00000000	The application-requested impersonation level is Anonymous.
SECURITY_IDENTIFICATION 0x00000001	The application-requested impersonation level is Identification.



Value	Meaning
SECURITY_IMPERSONATION 0x00000002	The application-requested impersonation level is Impersonation.
SECURITY_DELEGATION 0x00000003	The application-requested impersonation level is Delegation.

### 2.2.4.9.2 Server Response Extensions

A successful response takes the following format. If the server receives more than one SMB\_COM\_NT\_CREATE\_ANDX request from a client before it sends back any response, then the server can respond to these requests in any order.

When a client requests extended information, then the response takes the form described below. Aside from the **WordCount**, **ResourceType**, **NMPipeStatus\_or\_FileStatusFlags**, **FileId**, **VolumeGUID**, **FileId**, **MaximalAccessRights**, and **GuestMaximalAccessRights** fields, all other fields are as specified in [\[MS-CIFS\]](#) section 2.2.4.64.2.

```
SMB_Parameters
{
    UCHAR WordCount;
    Words
    {
        UCHAR          AndXCommand;
        UCHAR          AndXReserved;
        USHORT         AndXOffset;
        UCHAR          OplockLevel;
        USHORT         FID;
        ULONG          CreateDisposition;
        FILETIME       CreateTime;
        FILETIME       LastAccessTime;
        FILETIME       LastWriteTime;
        FILETIME       LastChangeTime;
        SMB_EXT_FILE_ATTR  ExtFileAttributes;
        LARGE_INTEGER  AllocationSize;
        LARGE_INTEGER  EndOfFile;
        USHORT         ResourceType;
        USHORT         NMPipeStatus_or_FileStatusFlags;
        UCHAR          Directory;
        GUID           VolumeGUID;
        ULONGLONG      FileId;
        ACCESS_MASK    MaximalAccessRights;
        ACCESS_MASK    GuestMaximalAccessRights;
    }
}
SMB_Data
{
    USHORT ByteCount;
}
```

#### SMB\_Parameters:

**WordCount (1 bytes):** This field SHOULD [<51>](#) be 0x2A.

0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
AndXCommand										AndXReserved										AndXOffset											
OplockLevel										FID										CreateDisposition											
...																				CreateTime											
...																															
...																				LastAccessTime											
...																															
...																				LastWriteTime											
...																															
...																				LastChangeTime											
...																															
...																				ExtFileAttributes											
...																				AllocationSize											
...																															
...																				EndOfFile											
...																															
...																				ResourceType											
...										NMPipeStatus_or_FileStatusFlags										Directory											
...										VolumeGUID																					
...																															
...																															
...																															
...										FileId																					

...
MaximalAccessRights
GuestMaximalAccessRights

**ResourceType (2 bytes):** The file type. This field MUST be interpreted as follows:

Name & value	Meaning
FileTypeDisk 0x0000	File or Directory
FileTypeByteModePipe 0x0001	Byte mode named pipe
FileTypeMessageModePipe 0x0002	Message mode named pipe
FileTypePrinter 0x0003	Printer Device

**NMPipeStatus\_or\_FileStatusFlags (2 bytes):** A union between the **NMPipeStatus** field and the new **FileStatusFlags** field. If the **ResourceType** field is a named pipe (**FileTypeByteModePipe** or **FileTypeMessageModePipe**), then this field MUST be the **NMPipeStatus** field:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
NMPipeStatus																FileStatusFlags															

**NMPipeStatus (2 bytes):** A 16-bit field that shows the status of the opened named pipe. This field is formatted as an SMB\_NMPIPE\_STATUS ([\[MS-CIFS\]](#) section 2.2.1.3).

If the **ResourceType** field is FileTypeDisk, then this field MUST be the **FileStatusFlags** field:

**FileStatusFlags (2 bytes):** A 16-bit field that shows extra information about the opened file or directory. Any combination of the following flags is valid. Unused bit fields SHOULD be set to zero by the server and MUST be ignored by the client.

Name & bitmask	Meaning
NO_EAS 0x0001	The file or directory has no extended attributes.
NO_SUBSTREAMS 0x0002	The file or directory has no data streams other than the main data stream.
NO_REPARSETAG 0x0004	The file or directory is not a reparse point.

For all other values of **ResourceType**, this field SHOULD be set to zero by the server when sending a response and MUST be ignored when received by the client.

**VolumeGUID (16 bytes):** This field MUST be a GUID value that uniquely identifies the volume on which the file resides. This field MUST be zero if the underlying file system does not support volume GUIDs. <52>

**FileId (8 bytes):** This field MUST be a 64-bit opaque value that uniquely identifies this file on a volume. This field MUST be set to zero if the underlying file system does not support unique FileId numbers on a volume. If the underlying file system does support unique FileId numbers, then this value SHOULD <53> be set to the unique FileId for this file.

**MaximalAccessRights (4 bytes):** The maximum access rights that the user opening the file has been granted for this file open. This field MUST be encoded in an ACCESS\_MASK format, as specified in section 2.2.1.4.

**GuestMaximalAccessRights (4 bytes):** The maximum access rights that the guest account has when opening this file. This field MUST be encoded in an ACCESS\_MASK format, as specified in section 2.2.1.4. Note that the notion of a guest account is implementation-specific <54>. Implementations that do not support the notion of a guest account MUST set this field to zero.

#### **SMB\_Data:**

**ByteCount (2 bytes):** This field SHOULD <55> be zero.

### **2.2.4.10 SMB\_COM\_SEARCH (0x81) Extensions**

The SMB\_COM\_SEARCH request is sent by a client to search a directory for files or other objects on the server that have names matching a given wildcard template. The general format of the SMB\_COM\_SEARCH command requests and responses are given in [MS-CIFS] section 2.2.4.58.

## **2.2.5 Transaction Subcommand Extensions**

### **2.2.5.1 TRANS\_RAW\_READ\_NMPIPE (0x0011)**

The TRANS\_RAW\_READ\_NMPIPE subcommand allows for a **raw read** of data from a named pipe. This method of reading data from a named pipe ignores message boundaries even if the pipe was set up as a message mode pipe.

The status of this subcommand is **obsolescent**. <56> Aside from its new status as obsolescent, this subcommand is exactly as described in [MS-CIFS] section 2.2.5.2.

### **2.2.5.2 TRANS\_CALL\_NMPIPE (0x0054)**

The TRANS\_CALL\_NMPIPE subcommand allows a client to connect to a named pipe, write to the named pipe, read from the named pipe, and close the named pipe in a single command.

The status of this subcommand is obsolescent. <57> Aside from its new status as obsolescent, this subcommand is exactly as described in [MS-CIFS] section 2.2.5.11.

## 2.2.6 Transaction 2 Subcommand Extensions

### 2.2.6.1 TRANS2\_FIND\_FIRST2 (0x0001)

#### 2.2.6.1.1 Client Request Extensions

A TRANS2\_FIND\_FIRST2 subcommand of [SMB\\_COM\\_TRANSACTION2](#) is sent by the client to retrieve an enumeration of files, as specified in [\[MS-CIFS\]](#) section 2.2.6.2.1.

The list of valid Information Level values has been extended, as specified in section [2.2.2.3.1](#), to include SMB\_FIND\_FILE\_ID\_FULL\_DIRECTORY\_INFO and SMB\_FIND\_FILE\_ID\_BOTH\_DIRECTORY\_INFO. Extensions are also presented to the SMB\_FIND\_FILE\_BOTH\_DIRECTORY\_INFO Information Level, as specified in section [2.2.8.1.1](#). This Information Level now provides support for accessing enumerations of available previous version timestamps of files or directories.

Aside from the Information Level extensions and the **FileName** field, all of the other fields are as specified in [\[MS-CIFS\]](#) [2.2.6.2.1](#).

#### Trans2\_Parameters

**FileName (variable)**: This field is extended to support use of the @GMT token wildcard (section [2.2.1.1.1](#)). [<58>](#) If this character sequence contains the @GMT-\* wildcard,

**Trans2\_Data.InformationLevel** SHOULD be set to SMB\_FIND\_FILE\_BOTH\_DIRECTORY\_INFO. [<59>](#)

#### Trans2\_Data

**InformationLevel (2 bytes)**: This field contains an Information Level code, which determines the information contained in the response. The list of valid Information Level codes is specified in section [2.2.2.3.1](#). A client that has not negotiated long names support MUST request only SMB\_INFO\_STANDARD. If a client that has not negotiated long names support requests an **InformationLevel** other than SMB\_INFO\_STANDARD, then the server MUST return a status of STATUS\_INVALID\_PARAMETER (ERRDOS/ERRinvalidparam).

#### 2.2.6.1.2 Server Response Extensions

A server MUST send a TRANS2\_FIND\_FIRST2 response in reply to a client TRANS2\_FIND\_FIRST2 subcommand request when the request is successful, as specified in [\[MS-CIFS\]](#) section 2.2.6.2.2.

This subcommand also supports two new Information Levels, as well as extensions to the SMB\_FIND\_FILE\_BOTH\_DIRECTORY\_INFO Information Level, as defined in section [2.2.2.3.1](#). The format of the file information returned for these two Information Levels (and the format of information for a TRANS2\_FIND\_FIRST2 response for the special FileName pattern @GMT token) is listed in section [2.2.8.1](#). If a client does not support long names (that is, SMB\_FLAGS2\_KNOWS\_LONG\_NAMES is not set in the **Flags2** field of the SMB Header), then any TRANS2\_FIND\_FIRST2 request with an Information Level other than SMB\_INFO\_STANDARD, or any TRANS2\_FIND\_NEXT2 request with an Information Level other than SMB\_INFO\_STANDARD or SMB\_FIND\_FILE\_ID\_BOTH\_DIRECTORY\_INFO, MUST be failed with STATUS\_INVALID\_PARAMETER.

## 2.2.6.2 TRANS2\_FIND\_NEXT2 (0x0002)

### 2.2.6.2.1 Client Request Extensions

The TRANS2\_FIND\_NEXT2 subcommand of the [SMB\\_COM\\_TRANSACTION2](#) request is sent by a client to continue a file enumeration, as specified in [\[MS-CIFS\]](#) section 2.2.6.3.1. The request format is identical to the request format that is specified in [\[MS-CIFS\]](#) section 2.2.6.3.1, except that two new Information Levels have been added and one has been extended. See section [2.2.6.1.1](#) for details.

### 2.2.6.2.2 Server Response Extensions

The server MUST send a TRANS2\_FIND\_NEXT2 response in reply to a client [TRANS2\\_FIND\\_NEXT2](#) subcommand request when the request is successful. The format of this packet is identical to what is specified in [\[MS-CIFS\]](#) section 2.2.6.3.2, except that two new Information Levels have been added and one has been extended. See section [2.2.6.1.2](#) for details.

## 2.2.6.3 TRANS2\_QUERY\_FS\_INFORMATION (0x0003)

This subcommand supports new pass-through Information Level capabilities, as specified in section [2.2.2.3.5](#).

### 2.2.6.3.1 Client Request Extensions

A TRANS2\_QUERY\_FS\_INFORMATION subcommand of the [SMB\\_COM\\_TRANSACTION2](#) is sent by the client to request attribute information about the file system, as specified in [\[MS-CIFS\]](#) section 2.2.6.4.1.

### 2.2.6.3.2 Server Response Extensions

A server MUST send a TRANS2\_QUERY\_FS\_INFORMATION response in reply to an SMB\_COM\_TRANSACTION2 client request with a [TRANS2\\_QUERY\\_FS\\_INFORMATION](#) subcommand when the request is successful, as specified in [\[MS-CIFS\]](#) section 2.2.6.4.2.

## 2.2.6.4 TRANS2\_SET\_FS\_INFORMATION (0x0004)

The TRANS2\_SET\_FS\_INFORMATION subcommand of the SMB\_COM\_TRANSACTION2 command (section [2.2.4.4](#)) is sent by the client to set file system attribute information on the server. This subcommand was introduced in the LAN Manager 2.0 dialect. [<60>](#)

The TRANS2\_SET\_FS\_INFORMATION request and response formats are special cases of SMB\_COM\_TRANSACTION2 command. Only the TRANS2\_SET\_FS\_INFORMATION specifics are described here.

### 2.2.6.4.1 Client Request

#### SMB\_Parameters:

**WordCount (1 byte):** This field MUST be 0x0F.

**Words (30 bytes):**

**TotalParameterCount (2 bytes):** This field MUST be 0x0004.

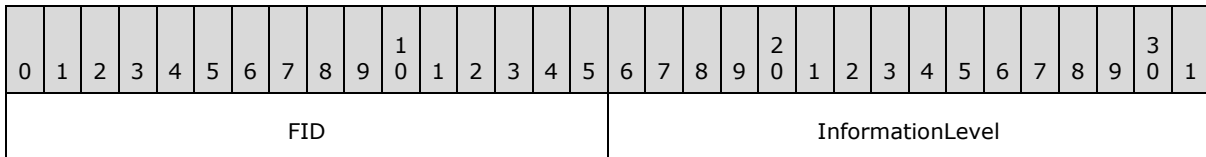
**TotalDataCount (2 bytes):** This field MUST be greater than or equal to 0x0000.

**SetupCount (1 byte):** This field MUST be 0x01.

**Setup (2 bytes):** This field MUST be TRANS2\_SET\_FS\_INFORMATION (0x0004).

### Trans2\_Parameters

```
Trans2_Parameters
{
    USHORT FID;
    USHORT InformationLevel;
}
```



**FID (2 bytes):** A valid Fid that represents the open file on the server that is to have its file attributes changed.

**InformationLevel (2 bytes):** The Information Level of the request. This field MUST be a pass-through Information Level, as described in section [2.2.2.3.5](#).

### Trans2\_Data

The Trans2\_Data block carries the structure of the Information Level specified by the request's **Trans2\_Parameters.InformationLevel** field. Because this subcommand only accepts pass-through Information Levels, the structure of this section is implementation specific.

#### 2.2.6.4.2 Server Response

A server MUST send a TRANS2\_SET\_FS\_INFORMATION response in reply to a client TRANS2\_SET\_FS\_INFORMATION subcommand request when the request is successful. The server MUST set an error code in the **Status** field of the SMB header of the response to indicate whether the request was successful or failed. The server MUST respond with STATUS\_NOT\_SUPPORTED if the information level of the request is not a pass-through information level.

### Trans2\_Parameters

No Trans2\_Parameters are sent by this message.

### Trans2\_Data

No Trans2\_Data is sent by this message.

### Error Codes

SMB error class	SMB error code	NT status code	POSIX equivalent	Description
ERRDOS (0x01)	ERRnoaccess(0x0005)	STATUS_ACCESS_DENIED(0xC0000022)	EPERM	Access denied.
	ERRbadfid(0x0)	STATUS_INVALID_HANDLE(0xC0000008)	ENOENT	The Fid supplied is

SMB error class	SMB error code	NT status code	POSIX equivalent	Description
	006)		NT	invalid.
	ERRnomem(0x0008)	STATUS_INSUFF_SERVER_RESOURCES(0xC000205)	ENOMEM	The server is out of resources.
	ERRrunsup(0x0032)	STATUS_NOT_SUPPORTED(0xC00000BB)		The supplied Information Level, as indicated by the Trans2_Parameters.InformationLevel value, is not a valid pass-through Information Level.
	ERRinvalidparam(0x0057)	STATUS_INVALID_PARAMETER(0xC000000D)		The supplied pass-through Information Level values in the Trans2_Data block contain at least one invalid parameter. OR Server does not support pass-through Information Levels.
ERRSRV (0x02)	ERRerror(0x0001)	STATUS_INVALID_SMB(0x00010002)		Invalid SMB. Not enough parameter bytes were sent.
	ERRinvtid(0x0005)	STATUS_INVALID_HANDLE(0xC0000008)STATUS_SMB_BAD_TID(0x00050002)		The TID is no longer valid.
	ERRbaduid(0x005B)	STATUS_INVALID_HANDLE(0xC0000008)STATUS_SMB_BAD_UID(0x005B0002)		The UID supplied is not known to the session.
ERRHRD (0x03)	ERRnowrite(0x0013)	STATUS_MEDIA_WRITE_PROTECTED(0xC00000A2)		The Fid supplied is on write-protected media.
	ERRdata(0x0017)	STATUS_DATA_ERROR(0xC000003E)	EIO	Disk I/O error.

### 2.2.6.5 TRANS2\_QUERY\_PATH\_INFORMATION (0x0005)

This subcommand supports new pass-through Information Level capabilities, as specified in section [2.2.2.3.5](#).



### 2.2.6.5.1 Client Request Extensions

A TRANS2\_QUERY\_PATH\_INFORMATION subcommand of SMB\_COM\_TRANSACTION2 is sent by the client to request attribute information for a file or directory by specifying the path, as specified in [\[MS-CIFS\]](#), section [2.2.6.6.1](#).

### 2.2.6.5.2 Server Response Extensions

A server MUST send a TRANS2\_QUERY\_PATH\_INFORMATION response in reply to an SMB\_COM\_TRANSACTION2 client request with a TRANS2\_QUERY\_PATH\_INFORMATION subcommand when the request is successful, as specified in [\[MS-CIFS\]](#) section 2.2.6.6.2.

## 2.2.6.6 TRANS2\_SET\_PATH\_INFORMATION (0x0006)

This subcommand supports new pass-through Information Level capabilities, as specified in section [2.2.2.3.5](#).

### 2.2.6.6.1 Client Request Extensions

A TRANS2\_SET\_PATH\_INFORMATION subcommand of SMB\_COM\_TRANSACTION2 is sent by the client to request a change of attribute information for a file or directory by path, as specified in [\[MS-CIFS\]](#) section 2.2.6.7.1.

### 2.2.6.6.2 Server Response Extensions

A server MUST send a TRANS2\_SET\_PATH\_INFORMATION response in reply to an [SMB\\_COM\\_TRANSACTION2 \(section 2.2.4.4\)](#) client request with a TRANS2\_SET\_PATH\_INFORMATION subcommand when the request is successful, as specified in [\[MS-CIFS\]](#) section 2.2.6.7.2.

## 2.2.6.7 TRANS2\_QUERY\_FILE\_INFORMATION (0x0007)

This subcommand supports new pass-through Information Level capabilities, as specified in section [2.2.2.3.5](#).

### 2.2.6.7.1 Client Request Extensions

A TRANS2\_QUERY\_FILE\_INFORMATION subcommand of [SMB\\_COM\\_TRANSACTION2](#) is sent by a client to request attribute information for a file or directory that has been opened, as specified in [\[MS-CIFS\]](#) section 2.2.6.8.1.

### 2.2.6.7.2 Server Response Extensions

A server MUST send a TRANS2\_QUERY\_PATH\_INFORMATION response in reply to an SMB\_COM\_TRANSACTION2 client request with a TRANS2\_QUERY\_PATH\_INFORMATION subcommand when the request is successful. The Trans2\_Data block of the transaction response contains the information requested by the Information Level in the request, as specified in [\[MS-CIFS\]](#) section 2.2.6.8.2.

## 2.2.6.8 TRANS2\_SET\_FILE\_INFORMATION (0x0008)

This subcommand supports new pass-through Information Level capabilities, as specified in section [2.2.2.3.5](#).

### 2.2.6.8.1 Client Request Extensions

A TRANS2\_SET\_FILE\_INFORMATION subcommand of [SMB\\_COM\\_TRANSACTION2](#) is sent by the client to request a change of attribute information for a file or directory that has been opened, as specified in [\[MS-CIFS\]](#) section 2.2.6.9.1.

### 2.2.6.8.2 Server Response Extensions

A server MUST send a TRANS2\_SET\_FILE\_INFORMATION response in reply to an SMB\_COM\_TRANSACTION2 client request with a TRANS2\_SET\_FILE\_INFORMATION subcommand when the request is successful, as specified in [\[MS-CIFS\]](#) section 2.2.6.9.2.

## 2.2.7 NT Transact Subcommand Extensions

### 2.2.7.1 NT\_TRANSACT\_CREATE (0x0001) Extensions

#### 2.2.7.1.1 Client Request Extensions

An [SMB\\_COM\\_NT\\_TRANSACT \(section 2.2.4.8\)](#) command with an NT\_TRANSACT\_CREATE subcommand is sent by a client to open a file or device on the server. The NT\_TRANSACT\_CREATE subcommand is specified in [\[MS-CIFS\]](#) section 2.2.7.1. This extension adds the following:

- An additional flag bit is added to the **Flags** field. The additional flag, NT\_CREATE\_REQUEST\_EXTENDED\_RESPONSE, is used to request an extended response from the server.
- An additional parameter value, SECURITY\_DELEGATION, is added to the **ImpersonationLevel** field.

All other fields are as specified in [\[MS-CIFS\]](#) section 2.2.7.1.

```
NT_Trans_Parameters
{
    ULONG          Flags;
    ULONG          RootDirectoryFID;
    ULONG          DesiredAccess;
    LARGE_INTEGER  AllocationSize;
    SMB_EXT_FILE_ATTR ExtFileAttributes;
    ULONG          ShareAccess;
    ULONG          CreateDisposition;
    ULONG          CreateOptions;
    ULONG          SecurityDescriptorLength;
    ULONG          EALength;
    ULONG          NameLength;
    ULONG          ImpersonationLevel;
    UCHAR          SecurityFlags;
    UCHAR          Name[NameLength];
}
NT_Trans_Data
{
    SECURITY_DESCRIPTOR SecurityDescriptor;
    FILE_FULL_EA_INFORMATION ExtendedAttributes[];
}
```

#### NT\_Trans\_Parameters (variable):

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Flags																															
RootDirectoryFID																															
DesiredAccess																															
AllocationSize (variable)																															
...																															
ExtFileAttributes																															
ShareAccess																															
CreateDisposition																															
CreateOptions																															
SecurityDescriptorLength																															
EALength																															
NameLength																															
ImpersonationLevel																															
SecurityFlags																Name (variable)															
...																															

**Flags (4 bytes):** A 32-bit field containing a set of flags that modify the client request. Unused bits SHOULD be set to 0 by the client when sending a message and MUST be ignored when received by the server.

Name & bitmask	Meaning
NT_CREATE_REQUEST_OPLOCK 0x00000002	Level I (exclusive) OpLock requested.
NT_CREATE_REQUEST_OPBATCH 0x00000004	Batch OpLock requested.
NT_CREATE_OPEN_TARGET_DIR 0x00000008	Parent directory of the target is to be opened.
NT_CREATE_REQUEST_EXTENDED_RESPONSE	Extended information is requested in the

Name & bitmask	Meaning
0x00000010	response.

**ImpersonationLevel (4 bytes):** This field specifies the impersonation level requested by the application that is issuing the create request, and MUST contain one of the following values. The server MUST validate this field but otherwise ignore it.

Impersonation is described in [\[MS-WPO\]](#) section 9.7; for more information about impersonation, see [\[MSDN-IMPERS\]](#).

Value	Meaning
SECURITY_ANONYMOUS 0x00000000	The application-requested impersonation level is Anonymous.
SECURITY_IDENTIFICATION 0x00000001	The application-requested impersonation level is Identification.
SECURITY_IMPERSONATION 0x00000002	The application-requested impersonation level is Impersonation.
SECURITY_DELEGATION 0x00000003	The application-requested impersonation level is Delegation.

### 2.2.7.1.2 Server Response Extensions

When a client requests extended information by setting `NT_CREATE_REQUEST_EXTENDED_RESPONSE`, a successful response takes the following format.

Aside from **ResponseType**, **NMPipeStatus\_or\_FileStatusFlags**, **VolumeGUID**, **FileId**, **MaximalAccessRights**, and **GuestMaximalAccessRights** fields, all other fields are as specified in [\[MS-CIFS\]](#) section 2.2.7.1.2.

```

NT_Trans_Parameters
{
    UCHAR          OpLockLevel;
    UCHAR          ResponseType;
    USHORT         FID;
    ULONG          CreateAction;
    ULONG          EAErrorOffset;
    FILETIME       CreationTime;
    FILETIME       LastAccessTime;
    FILETIME       LastWriteTime;
    FILETIME       LastChangeTime;
    SMB_EXT_FILE_ATTR ExtFileAttributes;
    LARGE_INTEGER AllocationSize;
    LARGE_INTEGER EndOfFile;
    USHORT         ResourceType;
    SMB_NMPIPE_STATUS NMPipeStatus_or_FileStatusFlags;
    UCHAR          Directory;
    GUID           VolumeGUID;
    ULONGLONG      FileId;
    ACCESS_MASK    MaximalAccessRights;
    ACCESS_MASK    GuestMaximalAccessRights;
}

```

}

**NT\_Trans\_Parameters (69 bytes):**

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31							
OpLockLevel										ResponseType										FID																		
CreateAction																																						
EAErrorOffset																																						
CreationTime (variable)																																						
...																																						
LastAccessTime (variable)																																						
...																																						
LastWriteTime (variable)																																						
...																																						
LastChangeTime (variable)																																						
...																																						
ExtFileAttributes																																						
AllocationSize (variable)																																						
...																																						
EndOfFile (variable)																																						
...																																						
ResourceType																NMPipeStatus_or_FileStatusFlags																						
Directory										VolumeGUID																												
...																																						
...																																						

...	
...	FileId
...	
...	MaximalAccessRight
...	GuestMaximalAccessRights
...	

**ResponseType (1 byte):** The response type received. This field MUST be set to any one of the following values, based on the response type.

Name & bitmask	Meaning
NON_EXTENDED_RESPONSE 0x00	Response received is not an extended response.
EXTENDED_RESPONSE 0x01	Response received is an extended response.

**NMPipeStatus\_or\_FileStatusFlags (2 bytes):** A union between the **NMPipeStatus** field and the new **FileStatusFlags** field. If the **ResourceType** field is a named pipe (**FileTypeByteModePipe** or **FileTypeMessageModePipe**), then this field MUST be the **NMPipeStatus** field:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
NMPipeStatus																FileStatusFlags															

**NMPipeStatus (2 bytes):** A 16-bit field that shows the status of the opened named pipe. This field is formatted as an SMB\_NMPIPE\_STATUS ([\[MS-CIFS\]](#) section 2.2.1.3).

If the **ResourceType** field is FileTypeDisk, then this field MUST be the **FileStatusFlags** field.

**FileStatusFlags (2 bytes):** A 16-bit field that shows extra information about the opened file or directory. Any combination of the following flags is valid. Unused bit fields SHOULD be set to zero by the server and MUST be ignored by the client.

Name & bitmask	Meaning
NO_EAS 0x0001	The file or directory has no extended attributes.
NO_SUBSTREAMS 0x0002	The file or directory has no data streams other than the main data stream.

Name & bitmask	Meaning
NO_REPARSETAG 0x0004	The file or directory is not a reparse point.

For all other values of **ResourceType**, this field SHOULD be set to zero by the server when sending a response and MUST be ignored when received by the client.

**VolumeGUID (16 bytes):** This field MUST be a GUID value that uniquely identifies the volume on which the file resides. This field MUST be zero if the underlying file system does not support volume GUIDs. [<61>](#)

**FileId (8 bytes):** This field MUST be a 64-bit opaque value that uniquely identifies this file on a volume. This field MUST be set to zero if the underlying file system does not support unique **FileId** numbers on a volume. If the underlying file system does support unique **FileId** numbers, then this value SHOULD [<62>](#) be set to the unique **FileId** for this file.

**MaximalAccessRight (4 bytes):** The maximum access rights that the user opening the file has been granted for this file open. This field MUST be encoded in an ACCESS\_MASK format, as specified in section [2.2.1.4](#).

**GuestMaximalAccessRights (4 bytes):** The maximum access rights that the guest account has when opening this file. This field MUST be encoded in an ACCESS\_MASK format, as specified in section [2.2.1.4](#). Note that the notion of a guest account is implementation-specific [<63>](#). Implementations that do not support the notion of a guest account MUST set this field to zero.

## 2.2.7.2 NT\_TRANSACT\_IOCTL (0x0002)

An SMB\_COM\_NT\_TRANSACT (section [2.2.4.8](#)) command with an NT\_TRANSACT\_IOCTL subcommand is sent by a client to pass an IOCTL or file system control (FSCTL) command to a server. The NT\_TRANSACT\_IOCTL subcommand is specified in [\[MS-CIFS\]](#) section 2.2.7.2.

### 2.2.7.2.1 Client Request Extensions

The NT\_TRANSACT\_IOCTL request is a special case of the SMB\_COM\_NT\_TRANSACT command request. Only the NT\_TRANSACT\_IOCTL specifics are described here.

The FSCTL operations listed in the table below are new to these extensions and only those are specific to the SMB protocol. [<64>](#) Other FSCTL and IOCTL control codes are not defined in this specification and are specific to the underlying object store of the server. [<65>](#) If an application requests an undefined FSCTL or IOCTL operation, then the client SHOULD still pass the request through to the server.

Name	Value	Description
FSCTL_SRV_ENUMERATE_SNAPSHOTS	0x00144064	Enumerate previous versions of a file.
FSCTL_SRV_REQUEST_RESUME_KEY	0x00140078	Retrieve an opaque file reference for server-side data movement. <a href="#">&lt;66&gt;</a>
FSCTL_SRV_COPYCHUNK	0x001440F2	Perform server-side data movement. <a href="#">&lt;67&gt;</a>

FSCTL\_SRV\_ENUMERATE\_SNAPSHOTS Request

This FSCTL is used to enumerate available previous version timestamps (snapshots) of a file or directory.

The FSCTL\_SRV\_ENUMERATE\_SNAPSHOTS request format is a special case of the NT\_TRANSACT\_IOCTL subcommand. Only the FSCTL\_SRV\_ENUMERATE\_SNAPSHOTS request specifics are described here.

### SMB\_Parameters

**WordCount (1 byte):** The value of this field MUST be 0x17.

**Words (46 bytes):** As specified in [\[MS-CIFS\]](#) section 2.2.4.62.1 and with the following exceptions:

**MaxDataCount (4 bytes):** This field MUST be greater than or equal to 0x000C.

**SetupCount (1 byte):** The number of setup words that are included in the transaction request. The value MUST be set to 0x04.

**Setup (8 bytes):** As specified in [\[MS-CIFS\]](#) section 2.2.7.2.1 and with the following exceptions:

**FunctionCode (4 bytes):** This field MUST be set to 0x00144064.

**FID (2 bytes):** This field MUST contain a valid Fid representing a valid Open on a file. This is the file for which snapshots are being requested.

**IsFsctl (1 byte):** MUST be TRUE (any non-zero value).

**IsFlags (1 byte):** MUST be zero (0x00).

### NT\_Trans\_Parameters

No NT Trans parameters are sent in this request.

### NT\_Trans\_Data

No NT Trans data is sent in this request.

FSCTL\_SRV\_REQUEST\_RESUME\_KEY Request

This FSCTL is used to retrieve an opaque file reference for server-side data movement operations, as specified in section [3.2.4.11.2](#).

The FSCTL\_SRV\_REQUEST\_RESUME\_KEY request format is a special case of the NT\_TRANSACT\_IOCTL subcommand. Only the FSCTL\_SRV\_REQUEST\_RESUME\_KEY request specifics are described here.

### SMB\_Parameters

**WordCount (1 byte):** The value of this field MUST be 0x17.

**Words (46 bytes):**

**MaxDataCount (4 bytes):** This field MUST be greater than or equal to 0x001D.

**Setup (8 bytes):**

**FunctionCode (4 bytes):** This field MUST be 0x00140078.



**FID (2 bytes):** This field MUST contain a valid Fid that represents a valid Open on a file. This file is the source file for a server-side data copy operation.

**IsFsctl (1 byte):** MUST be TRUE (any non-zero value).

**IsFlags (1 byte):** MUST be zero (0x00).

### NT\_Trans\_Parameters

No NT Trans parameters are sent in this request.

### NT\_Trans\_Data

No NT Trans data is sent in this request.

FSCTL\_SRV\_COPYCHUNK Request

This FSCTL is used for server-side data movement, as specified in section [3.2.4.11.2](#).

The FSCTL\_SRV\_COPYCHUNK request format is a special case of NT\_TRANSACT\_IOCTL subcommand. Only the FSCTL\_SRV\_COPYCHUNK request specifics are described here.

### SMB\_Parameters

**WordCount (1 byte):** The value of this field MUST be 0x17.

#### Words (46 bytes):

**TotalDataCount (4 bytes):** This field MUST be greater than or equal to 0x0034.

**MaxDataCount (4 bytes):** This field MUST be greater than or equal to 0x001D.

#### Setup (8 bytes):

**FunctionCode (4 bytes):** This field MUST be 0x00144078.

**FID (2 bytes):** This field MUST contain a valid Fid that represents a valid Open on a file. This file is the destination file for a server-side data copy operation.

**IsFsctl (1 byte):** This field MUST be TRUE (any non-zero value).

**IsFlags (1 byte):** The value of this field MUST be zero (0x00).

### NT\_Trans\_Parameters

No NT Trans parameters are sent in this request.

### NT\_Trans\_Data

```
NT_Trans_Data
{
    COPYCHUNK_RESUME_KEY CopychunkResumeKey;
    ULONG                ChunkCount;
    ULONG                Reserved;
    SRV_COPYCHUNK        CopychunkList[ChunkCount];
}
```

0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
CpochunkResumeKey																															
...																															
...																															
...																															
...																															
...																															
...																															
ChunkCount																															
Reserved																															
CpochunkList (variable)																															
...																															

**CpochunkResumeKey (24 bytes):** An opaque 24-byte server cpochunk resume key for a source file in a server-side file copy operation. This field value is received from a previous FSCTL\_SRV\_REQUEST\_RESUME\_KEY server response.

**ChunkCount (4 bytes):** The number of entries, or "cpochunks", in the **CopyChunkList**. This field also represents the number of server-side data movement operations being requested. This field MUST NOT be zero.

**Reserved (4 bytes):** A reserved field. This field SHOULD be set to zero when sending the request. This field MUST be ignored by the server when the message is received.

**CpochunkList (variable):** A concatenated list of cpochunks. Each entry is formatted as a SRV\_COPYCHUNK structure.

### 2.2.7.2.1.1 SRV\_COPYCHUNK

```

SRV_COPYCHUNK
{
    LARGE_INTEGER SourceOffset;
    LARGE_INTEGER DestinationOffset;
    ULONG         CopyLength;
    ULONG         Reserved;
}

```

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
SourceOffset																															
...																															
DestinationOffset																															
...																															
CopyLength																															
Reserved																															

**SourceOffset (8 bytes):** The offset, in bytes, into the source file from which data is being copied.

**DestinationOffset (8 bytes):** The offset, in bytes, into the destination file to which data is being copied.

**CopyLength (4 bytes):** The number of bytes to copy from the source file to the destination file.

**Reserved (4 bytes):** This field SHOULD [<68>](#) be set to zero by the client and MUST be ignored upon receipt by the server.

### 2.2.7.2.2 Server Response Extensions

An [SMB\\_COM\\_NT\\_TRANSACT \(section 2.2.4.8\)](#) response for an NT\_TRANSACT\_IOCTL ([\[MS-CIFS\]](#) section 2.2.7.2) subcommand MUST be sent by a server in reply to a successful NT\_TRANSACT\_IOCTL request.

The NT\_TRANSACT\_IOCTL response is a special case of the SMB\_COM\_NT\_TRANSACT command response. Only the NT\_TRANSACT\_IOCTL specifics are described here.

#### 2.2.7.2.2.1 FSCTL\_SRV\_ENUMERATE\_SNAPSHOTS Response

The FSCTL\_SRV\_ENUMERATE\_SNAPSHOTS response format is a special case of the NT\_TRANSACT\_IOCTL subcommand. Only the FSCTL\_SRV\_ENUMERATE\_SNAPSHOTS response specifics are described here.

##### SMB\_Parameters

**WordCount (1 byte):** This field MUST be set to 0x16.

**SetupCount (1 byte):** The number of setup words that are included in the transaction response. The value MUST be set to 0x04.

**Setup (8 bytes):** This field contains the following:

**Function(2 bytes):** The transaction subcommand code, which is used to identify the operation performed by the server. The value MUST be set to 0x0002.

**FunctionCode (4 bytes):** This field MUST be set to 0x00144064.

**FID (2 bytes):** This field MUST contain a File ID representing the open of a file for which snapshots are requested.

### NT\_Trans\_Parameters

No NT Trans parameters are sent in this response.

### NT\_Trans\_Data

```
NT_Trans_Data
{
    ULONG NumberOfSnapShots;
    ULONG NumberOfSnapShotsReturned;
    ULONG SnapShotArraySize;
    WCHAR SnapShotMultiSZ[];
}
```

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
NumberOfSnapShots																															
NumberOfSnapShotsReturned																															
SnapShotArraySize																															
SnapShotMultiSZ (variable)																															
...																															

**NumberOfSnapShots (4 bytes):** The number of snapshots that the underlying object store contains of this file.

**NumberOfSnapShotsReturned (4 bytes):** This value MUST be the number of snapshots that are returned in this response. If this value is less than **NumberOfSnapshots**, then there are more snapshots than were able to fit in this response.

**SnapShotArraySize (4 bytes):** The length, in bytes, of the **SnapShotMultiSZ** field.

**SnapShotMultiSZ (variable):** A concatenated list of available snapshots. Each snapshot MUST be encoded as a NULL-terminated sequence of 16-bit Unicode characters, and MUST take on the following form: @GMT-YYYY.MM.DD-HH.MM.SS. The concatenated list MUST be terminated by one additional 16-bit Unicode NULL character. If the response contains no snapshots, then the server MUST set this field to two 16-bit Unicode NULL characters.

### 2.2.7.2.2.2 FSCTL\_SRV\_REQUEST\_RESUME\_KEY Response

The FSCTL\_SRV\_REQUEST\_RESUME\_KEY response format is a special case of the NT\_TRANSACT\_IOCTL subcommand. Only the FSCTL\_SRV\_REQUEST\_RESUME\_KEY response specifics are described here.

Although this FSCTL includes support for returning extended context information for a copychunk resume key, this feature is considered reserved but not implemented and is not used in this response.

### NT\_Trans\_Parameters

No NT Trans parameters are sent in this response.

### NT\_Trans\_Data

```

NT_Trans_Data
{
    COPYCHUNK_RESUME_KEY CopychunkResumeKey;
    ULONG                 ContextLength;
    UCHAR                 Context[ContextLength] (optional);
}

```

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
CopychunkResumeKey																															
...																															
...																															
...																															
...																															
...																															
ContextLength																															
Context (variable)																															
...																															

**CopychunkResumeKey (24 bytes):** A 24-byte copychunk resume key generated by the server that can be subsequently used by the client to uniquely identify the open source file in a FSCTL\_SRV\_COPYCHUNK request. The client MUST NOT attach any interpretation to this key and MUST treat it as an opaque value. For more information, see section [3.3.5.11.1](#).

**ContextLength (4 bytes):** The length, in bytes, of the **Context** field. Since this feature is not used, this field SHOULD be set to zero by the server and MUST be ignored by the client.

**Context (variable):** The copychunk resume key's extended context information. Since this feature is not used, this field SHOULD [<69>](#) be zero bytes in length. The client MUST ignore it on receipt.

### 2.2.7.2.2.3 FSCTL\_SRV\_COPYCHUNK Response

The FSCTL\_SRV\_COPYCHUNK response format is a special case of NT\_TRANSACT\_IOCTL subcommand. Only the FSCTL\_SRV\_COPYCHUNK response specifics are described here.

#### NT\_Trans\_Parameters

No NT Trans parameters are sent in this response.

#### NT\_Trans\_Data

```
NT_Trans_Data
{
    ULONG ChunksWritten;
    ULONG ChunkBytesWritten;
    ULONG TotalBytesWritten;
}
```

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
ChunksWritten																															
ChunkBytesWritten																															
TotalBytesWritten																															

**ChunksWritten (4 bytes):** This field MUST represent the number of copychunk operations successfully processed by the server.

**ChunkBytesWritten (4 bytes):** This field is unused. This field MUST be set to zero by the server and MUST be ignored by the client.

**TotalBytesWritten (4 bytes):** This field MUST represent the total number of bytes written to the destination file across all copychunk operations.

### 2.2.7.3 NT\_TRANSACT\_SET\_SECURITY\_DESC (0x0003) Extensions

An SMB\_COM\_NT\_TRANSACT command (section [2.2.4.8](#)) with an NT\_TRANSACT\_SET\_SECURITY\_DESC allows a client to set the security descriptors for a file or device on the server. The NT\_TRANSACT\_SET\_SECURITY\_DESC subcommand is specified in [\[MS-CIFS\]](#) section 2.2.7.3. This extension adds an additional parameter value to the **SecurityInformation** field. The LABEL\_SECURITY\_INFORMATION constant is added to allow the server to set the integrity label in the security descriptor of the file or named pipe.

**SecurityInformation (4 bytes):** A ULONG. Fields of the security descriptor to be set. These values can be logically OR-ed together to set several descriptors in one request. The server MUST set only the descriptors requested by **SecurityInformation**.

Name and bitmask	Meaning
OWNER_SECURITY_INFORMATION 0x00000001	Owner of the object or resource.

Name and bitmask	Meaning
GROUP_SECURITY_INFORMATION 0x00000002	Group associated with the object or resource.
DACL_SECURITY_INFORMATION 0x00000004	DACL associated with the object or resource.
SACL_SECURITY_INFORMATION 0x00000008	SACL associated with the object or resource.
LABEL_SECURITY_INFORMATION 0x00000010	Integrity label in the security descriptor of the file or named pipe.

#### 2.2.7.4 NT\_TRANSACT\_QUERY\_SECURITY\_DESC (0x0006) Extensions

An SMB\_COM\_NT\_TRANSACT command (section [2.2.4.8](#)) with an NT\_TRANSACT\_QUERY\_SECURITY\_DESC allows a client to retrieve the security descriptors for a file or device on the server. The NT\_TRANSACT\_QUERY\_SECURITY\_DESC subcommand is specified in [\[MS-CIFS\]](#) section 2.2.7.6. This extension adds an additional parameter value to the **SecurityInfoFields** field. The LABEL\_SECURITY\_INFORMATION constant is added to allow the server to query the integrity label from the security descriptor of the file or named pipe.

**SecurityInfoFields (4 bytes):** A ULONG. This field represents the requested fields of the security descriptor to be retrieved. These values can be logically OR-ed together to request several descriptors in one request. The descriptor response format contains storage for all of the descriptors. The client MUST ignore the values returned for descriptors corresponding to bits that were not included in this field as part of the request.

Name and bitmask	Meaning
OWNER_SECURITY_INFORMATION 0x00000001	Owner of the object or resource.
GROUP_SECURITY_INFORMATION 0x00000002	Group associated with the object or resource.
DACL_SECURITY_INFORMATION 0x00000004	DACL associated with the object or resource.
SACL_SECURITY_INFORMATION 0x00000008	SACL associated with the object or resource.
LABEL_SECURITY_INFORMATION 0x00000010	Integrity label in the security descriptor of the file or named pipe.

#### 2.2.7.5 NT\_TRANSACT\_QUERY\_QUOTA (0x0007)

An [SMB\\_COM\\_NT\\_TRANSACT](#) (section [2.2.4.8](#)) command with an NT\_TRANSACT\_QUERY\_QUOTA subcommand code is used by a client to query quota information for a user or multiple users. This subcommand is new to these extensions.

### 2.2.7.5.1 Client Request

The NT\_TRANSACT\_QUERY\_QUOTA request is a special case of the SMB\_COM\_NT\_TRANSACT command request. Only the NT\_TRANSACT\_QUERY\_QUOTA specifics are described here.

At least one of **NT\_Trans\_Parameters.SidListLength** or **NT\_Trans\_Parameters.StartSidLength** MUST be zero. If both are zero, then the quota information for all **SIDs**, as specified in [\[MS-DTYP\]](#) section 2.4.2, on the underlying object store of a share MUST be enumerated by the server.

#### SMB\_Parameters

**WordCount (1 byte):** The value of this field MUST be 0x13.

**Words (38 bytes):** As specified in [\[MS-CIFS\]](#) section 2.2.4.62.1 and with the following exceptions:

**SetupCount (1 bytes):** This field MUST be 0x00.

#### NT\_Trans\_Parameters:

```

NT_Trans_Parameters
{
    USHORT    FID;
    BOOLEAN   ReturnSingleEntry;
    BOOLEAN   RestartScan;
    ULONG     SidListLength;
    ULONG     StartSidLength;
    ULONG     StartSidOffset;
}

```

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31						
FID											ReturnSingleEntry							RestartScan																			
SidListLength																																					
StartSidLength																																					
StartSidOffset																																					

**FID (2 bytes):** An Fid to a file or directory. The quota information of the object store underlying the file or directory MUST be queried.

**ReturnSingleEntry (1 byte):** If TRUE (any non-zero value), then this field indicates that the server behavior is to be restricted to only return a single SID's quota information instead of filling the entire buffer.

**RestartScan (1 byte):** If TRUE (any non-zero value), then this field indicates that the scan of quota information is to be restarted.

**SidListLength (4 bytes):** If non-zero, then this field indicates that the client is requesting quota information of a particular set of SIDs and MUST represent the length of the **NT\_Trans\_Data.SidList** field.

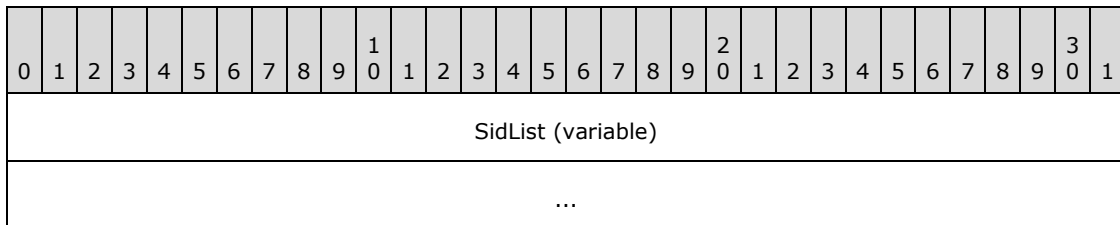


**StartSidLength (4 bytes):** If non-zero, then this field indicates that the **SidList** field contains a start SID (that is, a single SID entry indicating to the server where to start user quota information enumeration) and MUST represent the length, in bytes, of that **SidList** entry.

**StartSidOffset (4 bytes):** If **StartSidLength** is non-zero, then this field MUST represent the offset from the start of the NT\_Trans\_Data to the specific **SidList** entry at which to begin user quota information enumeration. Otherwise, this field SHOULD be set to zero and MUST be ignored by the server.

#### NT\_Trans\_Data:

```
NT_Trans_Data
{
    FILE_GET_QUOTA_INFORMATION SidList[] (optional);
}
```

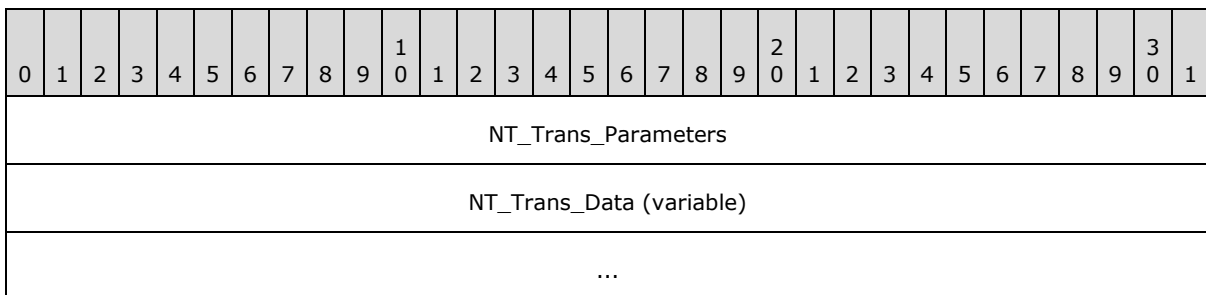


**SidList (variable):** A list of one or more SIDs that are formatted as a FILE\_GET\_QUOTA\_INFORMATION structure, as specified in [\[MS-FSCC\]](#) section 2.4.33.1. If **SidListLength** is non-zero, then this field MUST contain a list of one or more SIDs for which quota information is being requested. If **StartSidLength** is non-zero, then this field MUST contain a start SID. If both **SidListLength** and **StartSidLength** are zero, then this field MUST NOT be included in the request.

#### 2.2.7.5.2 Server Response

An [SMB\\_COM\\_NT\\_TRANSACT \(section 2.2.4.8\)](#) response for an NT\_TRANSACT\_QUERY\_QUOTA subcommand MUST be sent by a server in reply to a client [NT\\_TRANSACT\\_QUERY\\_QUOTA](#) subcommand request when the request is successful.

The NT\_TRANSACT\_QUERY\_QUOTA response is a special case of the SMB\_COM\_NT\_TRANSACT command response. Only the NT\_TRANSACT\_QUERY\_QUOTA specifics are described here.



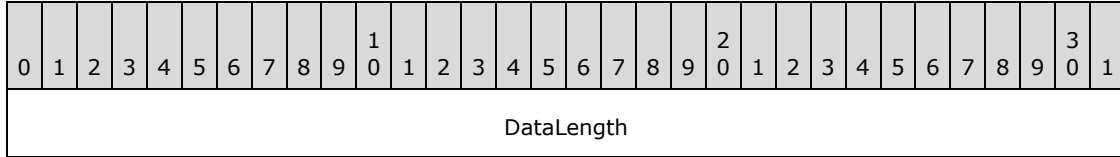
#### NT\_Trans\_Parameters (4 bytes):

```
NT_Trans_Parameters
```

```

{
  ULONG DataLength;
}

```



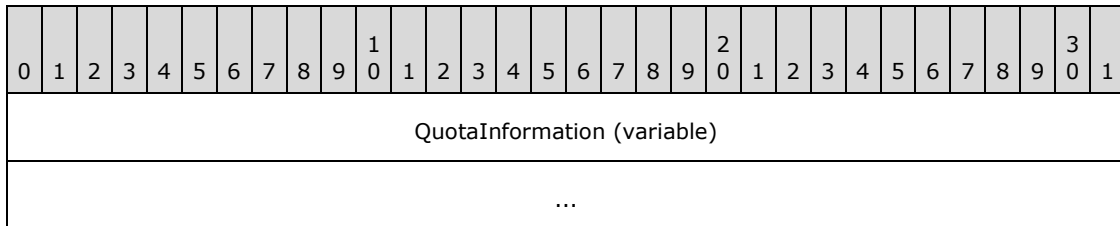
**DataLength (4 bytes):** The length, in bytes, of the returned user quota information. This field **MUST** be equal to the **SMB\_Parameters.Words.TotalDataCount** field.

**NT\_Trans\_Data (variable):**

```

NT_Trans_Data
{
  FILE_QUOTA_INFORMATION QuotaInformation[] (variable);
}

```



**QuotaInformation (variable):** A concatenated list of FILE\_QUOTA\_INFORMATION structures, as specified in [\[MS-FSCC\]](#) section 2.4.33.

Error Codes

SMB error class	SMB error code	NT status code	POSIX equivalent	Description
ERRDOS(0x01)	ERRbadfunc(0x0001)	STATUS_INVALID_DEVICE_REQUEST(0xC0000008)		Quotas are not enabled on the volume.
ERRDOS(0x01)	ERRbadfid(0x0006)	STATUS_INVALID_HANDLE(0xC0000008)	EBADF	The Fid is invalid.
ERRDOS(0x01)	ERRnoaccess(0x0005)	STATUS_ACCESS_DENIED(0xC0000022)	EPERM	Access denied.
ERRDOS(0x01)	ERRinvalidparam(0x0057)	STATUS_INVALID_PARAMETER(0xC000000D)		A parameter is invalid.
ERRDOS(0x01)	ERRinvalidsid(0x0539)	STATUS_INVALID_SID(0xC0000078)		The <b>StartSid</b> parameter did not contain a valid SID.
ERRSRV(0x01)	ERRerror(0x0001)	STATUS_INVALID_SMB(0x00010002)		Invalid

SMB error class	SMB error code	NT status code	POSIX equivalent	Description
02)				SMB. Byte count and sizes are inconsistent.
ERRSRV(0x02)	ERRinvtid(0x0005)	STATUS_BAD_TID(0x00050002)		The TID is no longer valid.
ERRSRV(0x02)	ERRnomem(0x0008)	STATUS_INSUFF_SERVER_RESOURCES(0xC0000205)	ENOMEM	The server is out of resources.
ERRSRV(0x02)	ERRbaduid(0x005B)	STATUS_BAD_UID(0x005B0002)		The UID supplied is not known to the session.
ERRSRV(0x02)		STATUS_QUOTA_LIST_INCONSISTENT(0xC0000266)		The <b>SidList</b> parameter did not contain a valid, properly formed list.
ERRSRV(0x02)	ERRmoredata(0x00EA)	STATUS_BUFFER_OVERFLOW(0x80000005)		The number of bytes of changed data exceeded the MaxParameter Count field in the client request.
ERRHRD(0x03)	ERRdata(0x0017)	STATUS_DATA_ERROR(0xC000003E)	EIO	Disk I/O error.
ERRHRD(0x03)	ERRnowrite(0x0013)	STATUS_MEDIA_WRITE_PROTECTED(0xC00000A2)	EROFS	Attempt to modify a read-only file system.

### 2.2.7.6 NT\_TRANSACT\_SET\_QUOTA (0x0008)

An [SMB\\_COM\\_NT\\_TRANSACT \(section 2.2.4.8\)](#) request with an NT\_TRANSACT\_SET\_QUOTA subcommand code is sent by a client to set user quota information on the underlying object store of a server. This subcommand is new to these extensions.

#### 2.2.7.6.1 Client Request

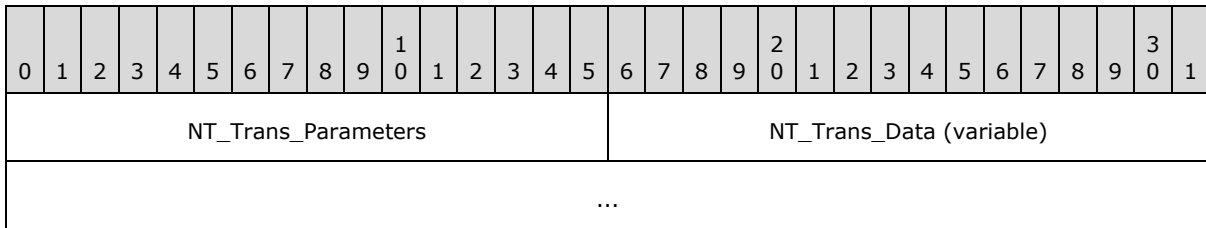
The NT\_TRANSACT\_SET\_QUOTA request is a special case of the SMB\_COM\_NT\_TRANSACT command request. Only the NT\_TRANSACT\_SET\_QUOTA specifics are described here.

##### SMB\_Parameters:

**WordCount (1 byte):** The value of this field MUST be 0x13.

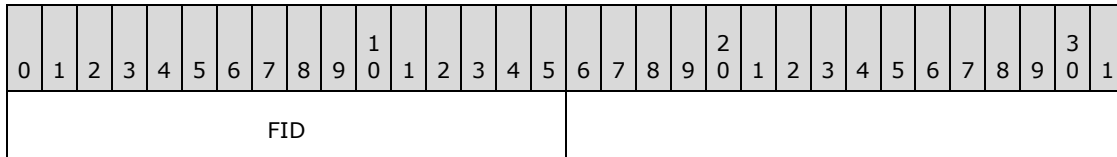
**Words (38 bytes):** As specified in [\[MS-CIFS\]](#) section 2.2.4.62.1 and with the following exceptions:

**SetupCount (1 bytes):** This field MUST be 0x00.



**NT\_Trans\_Parameters (2 bytes):**

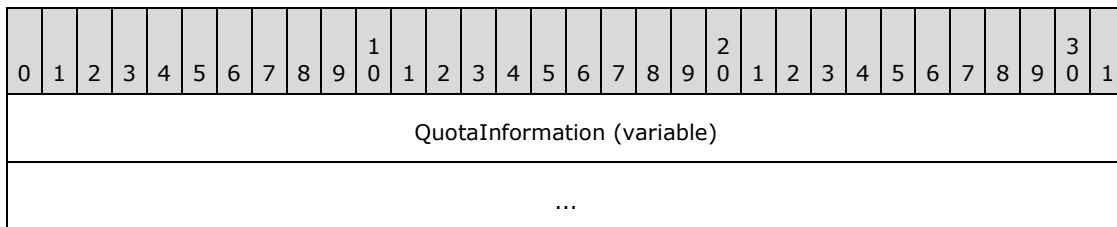
```
NT_Trans_Parameters
{
    USHORT FID;
}
```



**FID (2 bytes):** An Fid to a file or directory. The quota information of the object store underlying the file or directory MUST be modified.

**NT\_Trans\_Data (variable):**

```
NT_Trans_Data
{
    FILE_QUOTA_INFORMATION QuotaInformation[] (variable);
}
```



**QuotaInformation (variable):** A concatenated list of FILE\_QUOTA\_INFORMATION structures, as specified in [\[MS-FSCC\]](#) section 2.4.33.

**2.2.7.6.2 Server Response**

An [SMB\\_COM\\_NT\\_TRANSACT \(section 2.2.4.8\)](#) response for the NT\_TRANSACT\_SET\_QUOTA subcommand MUST be sent by a server in reply to a client NT\_TRANSACT\_SET\_QUOTA request when the request is successful.

The NT\_TRANSACT\_SET\_QUOTA response is a special case of the SMB\_COM\_NT\_TRANSACT command response. Only the NT\_TRANSACT\_SET\_QUOTA specifics are described here.

### NT\_Trans\_Parameters

No NT Trans parameters are returned in this response.

### NT\_Trans\_Data

No NT Trans data is returned in this response.

### Error Codes

SMB error class	SMB error code	NT status code	POSIX equivalent	Description
ERRDOS(0x01)	ERRbadfunc(0x0001)	STATUS_INVALID_DEVICE_REQUEST(0xC0000008)		Quotas are not enabled on the volume.
ERRDOS(0x01)	ERRbadfid(0x0006)	STATUS_INVALID_HANDLE(0xC0000008)	EBADF	The Fid is invalid.
ERRDOS(0x01)	ERRnoaccess(0x0005)	STATUS_ACCESS_DENIED(0xC0000022)	EPERM	Access denied.
ERRDOS(0x01)	ERRinvalidparam(0x0057)	STATUS_INVALID_PARAMETER(0xC000000D)		A parameter is invalid.
ERRSRV(0x02)	ERRerror(0x0001)	STATUS_INVALID_SMB(0x00010002)		Invalid SMB. Byte count and sizes are inconsistent.
ERRSRV(0x02)	ERRinvtid(0x0005)	STATUS_BAD_TID(0x00050002)		The TID is no longer valid.
ERRSRV(0x02)	ERRnomem(0x0008)	STATUS_INSUFF_SERVER_RESOURCES(0xC0000205)	ENOMEM	The server is out of resources.
ERRSRV(0x02)	ERRbaduid(0x005B)	STATUS_BAD_UID(0x005B0002)		The UID supplied is not known to the session.
ERRSRV(0x02)		STATUS_QUOTA_LIST_INCONSISTENT(0xC0000266)		The <i>Sid</i> parameter in FILE_QUOTA_INFORMATION did not contain a valid <a href="#">SID</a> .
ERRHRD(0x03)	ERRdata(0x0017)	STATUS_DATA_ERROR(0xC000003E)	EIO	Disk I/O error.
ERRHRD(0x03)	ERRnowrite(0x0013)	STATUS_MEDIA_WRITE_PROTECTED(0xC00000A2)	EROFS	Attempt to modify a read-only file system.

## 2.2.8 Information Levels

In addition to the specification in [\[MS-CIFS\]](#) section 2.2.8, the client MUST map the application provided FSCC information levels to SMB information levels as specified below.

FIND Information Levels

FSCC Level	SMB Level
FileIdFullDirectoryInformation	SMB_FIND_FILE_ID_FULL_DIRECTORY_INFO
FileIdBothDirectoryInformation	SMB_FIND_FILE_ID_BOTH_DIRECTORY_INFO

### 2.2.8.1 FIND Information Level Extensions

#### 2.2.8.1.1 SMB\_FIND\_FILE\_BOTH\_DIRECTORY\_INFO Extensions

If the query being executed is a request for the enumeration of available previous versions (section [2.2.1.1.1](#)), then the returned structure is identical to the structure that is specified in [\[MS-CIFS\]](#) section 2.2.8.1.7. However, the fields have a slightly different definition.

```
SMB_FIND_FILE_BOTH_DIRECTORY_INFO[SearchCount]
{
    ULONG          NextEntryOffset;
    ULONG          FileIndex;
    FILETIME       CreationTime;
    FILETIME       LastAccessTime;
    FILETIME       LastWriteTime;
    FILETIME       LastChangeTime;
    LARGE_INTEGER  EndOfFile;
    LARGE_INTEGER  AllocationSize;
    SMB_EXT_FILE_ATTR  ExtFileAttributes;
    ULONG          FileNameLength;
    ULONG          EaSize;
    UCHAR          ShortNameLength;
    UCHAR          Reserved;
    WCHAR          ShortName[12];
    SMB_STRING     FileName;
}
```

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
NextEntryOffset																															
FileIndex																															
CreationTime																															
...																															
LastAccessTime																															

...		
LastWriteTime		
...		
LastChangeTime		
...		
EndOfFile		
...		
AllocationSize		
...		
ExtFileAttributes		
FileNameLength		
EaSize		
ShortNameLength	Reserved	ShortName
...		
...		
...		
...		
...		
...		FileName (variable)
...		

**FileIndex (4 bytes):** This field SHOULD [<70>](#) be set to zero when sent in a response and SHOULD be ignored when received by the client.

**CreationTime (8 bytes):** A FILETIME time stamp of when the previous version represented by the @GMT token was created. The FILETIME format is defined in [\[MS-DTYP\]](#), section [2.3.3](#).

**LastAccessTime (8 bytes):** A FILETIME time stamp of when the previous version represented by the @GMT token was last accessed.

**LastWriteTime (8 bytes):** A FILETIME time stamp of when the previous version represented by the @GMT token last had data written to it.

**LastChangeTime (8 bytes):** A FILETIME time stamp of when the previous version represented by the @GMT token was last changed.

**EndOfFile (8 bytes):** This field MUST be set to zero when sending a response and MUST be ignored when the client receives this message.

**AllocationSize (8 bytes):** This field MUST be set to zero when sending a response and MUST be ignored when the client receives this message.

**ExtFileAttributes (4 bytes):** Extended attributes for this file that MUST be marked as a DIRECTORY.

**FileNameLength (4 bytes):** Length, in bytes, of the **FileName** field.

**EaSize (4 bytes):** This field MUST be set to zero when sending a response and MUST be ignored when the client receives this message.

**Reserved (1 byte):** An 8-bit unsigned integer used to maintain byte alignment. This field MUST be 0x00.

**ShortName (24 bytes):** The 8.3 name for the file formatted as @GMT~XXX where XXX is an array index value in decimal of an array of snapshots returned, starting at an array index value of zero. The **ShortName** field MUST be formatted as an array of 16-bit Unicode characters and MUST NOT be NULL terminated.

**FileName (variable):** An @GMT token that represents an available previous version for the file or directory.

### 2.2.8.1.2 SMB\_FIND\_FILE\_ID\_FULL\_DIRECTORY\_INFO

The fields and encoding of the TRANS2\_FIND\_FIRST2 SMB\_FIND\_FILE\_ID\_FULL\_DIRECTORY\_INFO Information Level response message are identical to the fields and encoding of the TRANS2\_FIND\_FIRST2 SMB\_FIND\_FILE\_FULL\_DIRECTORY\_INFO Information Level response, as specified in [\[MS-CIFS\]](#) section 2.2.6.2.2, with the addition of the **FileId** field described in the list that follows the table in this section. [<71>](#)

```
SMB_FIND_FILE_ID_FULL_DIRECTORY_INFO[SearchCount]
{
    ULONG           NextEntryOffset;
    ULONG           FileIndex;
    FILETIME        CreationTime;
    FILETIME        LastAccessTime;
    FILETIME        LastWriteTime;
    FILETIME        LastAttrChangeTime;
    LARGE_INTEGER   EndOfFile;
    LARGE_INTEGER   AllocationSize;
    SMB_EXT_FILE_ATTR ExtFileAttributes;
    ULONG           FileNameLength;
    ULONG           EaSize;
    ULONG           Reserved;
    LARGE_INTEGER   FileID;
}
```



```
SMB_STRING FileName;
}
```

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
NextEntryOffset																															
FileIndex																															
CreationTime																															
...																															
LastAccessTime																															
...																															
LastWriteTime																															
...																															
LastAttrChangeTime																															
...																															
EndOfFile																															
...																															
AllocationSize																															
...																															
ExtFileAttributes																															
FileNameLength																															
EaSize																															
Reserved																															
FileId																															
...																															

FileName (variable)
...

**FileIndex (4 bytes):** This field SHOULD [<72>](#) be set to zero when sent in a response and SHOULD be ignored when received by the client.

**EndOfFile (8 bytes):** This **LARGE\_INTEGER** field MUST be set to zero when sending a response and MUST be ignored when the client receives this message.

**AllocationSize (8 bytes):** This **LARGE\_INTEGER** field MUST be set to zero when sending a response and MUST be ignored when the client receives this message.

**ExtFileAttributes (4 bytes):** Extended attributes for this file that MUST be marked as a DIRECTORY.

**FileNameLength (4 bytes):** The length, in bytes, of the **FileName** field.

**EaSize (4 bytes):** This field SHOULD [<73>](#) be set to zero when sending a response and MUST be ignored when the client receives this message.

**Reserved (4 bytes):** This field SHOULD be set to 0x00000000 in the server response. The client MUST ignore this field.

**FileId (8 bytes):** A **LARGE\_INTEGER** that serves as an internal file system identifier. This number MUST be unique for each file on a given volume. If a remote file system does not support unique FileId values, then the **FileId** field MUST be set to zero.

**FileName (variable):** This field contains the name of the file.

### 2.2.8.1.3 SMB\_FIND\_FILE\_ID\_BOTH\_DIRECTORY\_INFO

The fields and encoding of the TRANS2\_FIND\_FIRST2 SMB\_FIND\_FILE\_ID\_BOTH\_DIRECTORY\_INFO Information Level response message are identical to the fields and encoding of SMB\_FIND\_FILE\_BOTH\_DIRECTORY\_INFO Information Level, as specified in [\[MS-CIFS\]](#), section [2.2.6.2.2](#), with the addition of the **Reserved2** and **FileId** fields described in the list that follows the table. [<74>](#)

```
SMB_FIND_FILE_ID_BOTH_DIRECTORY_INFO[SearchCount]
{
    ULONG           NextEntryOffset;
    ULONG           FileIndex;
    FILETIME       CreationTime;
    FILETIME       LastAccessTime;
    FILETIME       LastWriteTime;
    FILETIME       LastChangeTime;
    LARGE_INTEGER  EndOfFile;
    LARGE_INTEGER  AllocationSize;
    SMB_EXT_FILE_ATTR  ExtFileAttributes;
    ULONG           FileNameLength;
    ULONG           EaSize;
    UCHAR          ShortNameLength;
    UCHAR          Reserved;
    WCHAR          ShortName[12];
    USHORT         Reserved2;
    LARGE_INTEGER  FileID;
}
```

```
SMB_STRING FileName;
}
```

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
NextEntryOffset																															
FileIndex																															
CreationTime																															
...																															
LastAccessTime																															
...																															
LastWriteTime																															
...																															
LastChangeTime																															
...																															
EndOfFile																															
...																															
AllocationSize																															
...																															
ExtFileAttributes																															
FileNameLength																															
EaSize																															
ShortNameLength										Reserved										ShortName											
...																															
...																															



#### **2.2.8.4 SET Information level Extensions**

No new SMB-specific Information Levels are specified for these extensions.

## 3 Protocol Details

An SMB implementation MUST implement CIFS, as specified by section 3 of the [\[MS-CIFS\]](#) specification.

### 3.1 Common Details

#### 3.1.1 Abstract Data Model

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

The following elements extend the global abstract data model that is specified in [\[MS-CIFS\]](#) section 3.1.1.

##### 3.1.1.1 Global

There are no global parameters defined as common to both client and server.

##### 3.1.2 Timers

There are no timers common to both client and server.

##### 3.1.3 Initialization

No new common variables are defined in this document.

##### 3.1.4 Higher-Layer Triggered Events

###### 3.1.4.1 Sending Any Message

Processing of any message is handled as specified in [\[MS-CIFS\]](#) section 3.1.4.1 with the following additions: The MD5 algorithm, as specified in [\[RFC1321\]](#), MUST be used to generate a hash of the SMB message (from the start of the SMB\_Header), which is defined as follows.

```
IF ( Connection.SigningChallengeResponse != NULL ) THEN
    CALL MD5Init( md5context )
    CALL MD5Update( md5context, Connection.SigningSessionKey )
    CALL MD5Update( md5context,
                    Connection.SigningChallengeResponse )
    CALL MD5Update( md5context, SMB message )
    CALL MD5Final( digest, md5context )
ELSE
    CALL MD5Init( md5context )
    CALL MD5Update( md5context, Connection.SigningSessionKey )
    CALL MD5Update( md5context, SMB message )
    CALL MD5Final( digest, md5context )
END IF
SET the signature TO the first 8 bytes of the digest
```

The resulting 8-byte signature MUST be copied into the **SecuritySignature** field of the SMB header, after which the message can be transmitted.

### 3.1.5 Message Processing Events and Sequencing Rules

#### 3.1.5.1 Receiving Any Message

Processing of any message is handled as specified in [\[MS-CIFS\]](#) section 3.1.5.1 with the following additions:

The MD5 algorithm, as specified in [\[RFC1321\]](#), MUST be used to generate a hash of the SMB message (from the start of the SMB header), and SHOULD be used as follows.

```
IF ( Connection.SigningChallengeResponse != NULL ) THEN
  CALL MD5Init( md5context )
  CALL MD5Update( md5context, Connection.SigningSessionKey )
  CALL MD5Update( md5context,
    Connection.SigningChallengeResponse )
  CALL MD5Update( md5context, SMB message )
  CALL MD5Final( digest, md5context )
ELSE
  CALL MD5Init( md5context )
  CALL MD5Update( md5context, Connection.SigningSessionKey )
  CALL MD5Update( md5context, SMB message )
  CALL MD5Final( digest, md5context )
END IF
SET the signature TO the first 8 bytes of the digest
```

The resulting 8-byte signature is compared with the original value of the **SMB\_Header.SecuritySignature** field. If the signature received with the message does not match the signature that is calculated, then the message MUST be discarded and no further processing on it is done. The receiver MAY also terminate the connection by disconnecting the underlying transport connection and cleaning up any state associated with the connection.

#### 3.1.6 Timer Events

There are no timers common to both client and server.

#### 3.1.7 Other Local Events

There are no local events common to both client and server.

### 3.2 Client Details

#### 3.2.1 Abstract Data Model

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

The following elements extend the client abstract data model specified in [\[MS-CIFS\]](#) section 3.2.1.

### 3.2.1.1 Global

**Client.MessageSigningPolicy:** A state that determines whether or not this node signs messages. This parameter has four possible values:

- *Required* -- Message signing is required. Any connection to a server that does not use signing MUST be disconnected.
- *Enabled* -- Message signing is enabled. If the other node enables or requires signing, signing MUST be used.
- *Declined* -- Message signing is disabled unless the other party requires it. If the other party requires message signing, it MUST be used. Otherwise, message signing MUST NOT be used.
- *Disabled* -- Message signing is disabled. Message signing MUST NOT be used. The *Disabled* state is obsolete and SHOULD NOT [<77>](#) be used.

**Client.SupportsExtendedSecurity:** A flag that indicates whether the client supports Generic Security Services (GSS), as specified in [\[RFC2743\]](#), for selecting the authentication protocol.

**Client.Supports32BitPIDs:** A flag that indicates whether the client supports 32-bit process IDs.

### 3.2.1.2 Per SMB Connection

**Client.Connection.GSSNegotiateToken:** A byte array that contains the token received during an extended security negotiation and that is remembered for authentication.

**Client.Connection.ServerGUID:** A GUID generated by the server to uniquely identify this server.

### 3.2.1.3 Per SMB Session

**Client.Session.AuthenticationState:** A session can be in one of three states:

- *InProgress* -- A session setup (an extended SMB\_COM\_SESSION\_SETUP\_ANDX exchange as described in section [3.2.4.2.4.1](#)) is in progress for this session.
- *Valid* -- A session setup exchange has successfully completed; the session is valid and a UID for the session has been assigned by the server.
- *Expired* -- The Kerberos ticket for this session has expired and the session needs to be re-established.

**Client.Session.SessionKeyState:** The session key state. This can be either Unavailable or Available.

**Client.Session.UserCredentials:** An opaque implementation-specific entity that identifies the credentials that were used to authenticate to the server.

### 3.2.1.4 Per Tree Connect

**Client.TreeConnect.GuestMaximalShareAccessRights:** The **GuestMaximalShareAccessRights** value as returned in the [SMB\\_COM\\_TREE\\_CONNECT\\_ANDX server response \(section 2.2.4.7.2\)](#).

**Client.TreeConnect.MaximalShareAccessRights:** The **MaximalShareAccessRights** value as returned in the SMB\_COM\_TREE\_CONNECT\_ANDX server response (section 2.2.4.7.2).



### 3.2.1.5 Per Unique Open

None.

### 3.2.2 Timers

There are no new client timers other than those specified in [\[MS-CIFS\]](#) section 3.2.2.

### 3.2.3 Initialization

Initialization of the following additional parameters is required beyond that specified in [\[MS-CIFS\]](#) section 3.2.3.

The following values MUST be initialized at system startup:

- **Client.MessageSigningPolicy** and **Client.SupportsExtendedSecurity** MUST be set based on system policy. [<78>](#) The value of this is not constrained by the values of any other policies.
- **Client.Supports32BitPIDs** MUST be set to TRUE if the client supports 32-bit process IDs. [<79>](#)

When an SMB connection is established, the following values MUST be initialized:

- **Client.Connection.GSSNegotiateToken** is set to an empty array.
- **Client.Connection.ServerGUID** is set to the GUID of the server.

When an SMB session is established on an SMB connection, the following value MUST be initialized:

- **Client.Session.AuthenticationState** MUST be set to *InProgress*.
- **Client.Session.SessionKeyState** MUST be set to *Unavailable*.
- **Client.Session.UserCredentials** MUST be empty.
- **Client.Session.TimeoutValue** (see [\[MS-CIFS\]](#) (section 3.2.1.1)) SHOULD be set to 60 seconds.

All other values are initialized as specified in [\[MS-CIFS\]](#) section 3.2.3.

### 3.2.4 Higher-Layer Triggered Events

#### 3.2.4.1 Sending Any Message

The following global details are presented to a client that sends any message in addition to what is specified in [\[MS-CIFS\]](#) section 3.2.4.1.

##### 3.2.4.1.1 Scanning a Path for a Previous Version Token

The application requests a previous version of a file by placing a time indicator in the path as a directory element, as specified in section [2.2.1.1.1](#). For any path-based operation (for example, SMB\_COM\_NT\_CREATE\_ANDX) the client SHOULD scan the file path being provided by the application for a formatted @GMT token.

If a previous version token is present in the pathname as a directory element or a final target, the client SHOULD [<80>](#) set the SMB\_FLAGS2\_REPARSE\_PATH flag in the SMB header of the request.

### 3.2.4.2 Application Requests Connecting to a Share

Processing of this event is handled as specified in [\[MS-CIFS\]](#) section 3.2.4.2.

#### 3.2.4.2.1 Connection Establishment

Processing of this event is handled as specified in [\[MS-CIFS\]](#) section 3.2.4.2.1.

#### 3.2.4.2.2 Dialect Negotiation

Processing of this event is handled as specified in [\[MS-CIFS\]](#) section 3.2.4.2.2.

#### 3.2.4.2.3 Capabilities Negotiation

Processing of this event is handled as specified in [\[MS-CIFS\]](#) section 3.2.4.2.3, with the addition that the new capabilities flags (specified in section [2.2.4.5.2](#)) are also to be considered in the list of possible capabilities.

#### 3.2.4.2.4 User Authentication

Processing of this event is handled as specified in [\[MS-CIFS\]](#) section 3.2.4.2.4, with the following additions:

If **Client.Connection.ShareLevelAccessControl** is FALSE:

For each existing **Connection** to the server in **Client.ConnectionTable[ServerName]**, the client MUST search the **Client.Connection.SessionTable** for a Session that corresponds to the user that establishes the connection to the share. The client MUST search for a valid Session by either a **security context** or a **UID** representing the user.

- If a **Connection** with an existing Session for this user is found, then the client MUST reuse the Session and continue processing.
- If none of the existing **Connections** to the server has a valid Session for this user, the client SHOULD [<81>](#) reuse one of the existing **Connections** identified or established in section [3.2.4.2.1](#). The client MUST establish a new Session for the user. The user's credentials, typically a username or principal and an associated password or password hash, MUST be stored in **Client.Session.UserCredentials**.

Signing

The client-global **Client.MessageSigningPolicy** MUST be compared against the selected **Client.Connection.ServerSigningState**, as per the following table. If the result is *Blocked*, the underlying transport connection SHOULD be closed. [<82>](#)

Client signing state	Server signing state			
	Disabled	Declined	Enabled	Required
Disabled	Message Unsigned	Message Unsigned	Message Unsigned	Blocked
Declined	Message Unsigned	Message Unsigned	Message Unsigned	Message Signed
Enabled	Message Unsigned	Message Unsigned	Message Signed	Message Signed

Client signing state	Server signing state			
Required	Blocked	Message Signed	Message Signed	Message Signed

If the client's **Client.MessageSigningPolicy** is "Required", the client MUST set the SMB\_FLAGS2\_SMB\_SECURITY\_SIGNATURE\_REQUIRED bit in the **Flags2** field of the [SMB\\_COM\\_SESSION\\_SETUP\\_ANDX request](#) SMB header to indicate that the client refuses to connect if signing is not used.

Extended Security

If **Client.Connection.ServerCapabilities** has the CAP\_EXTENDED\_SECURITY flag set (which indicates that the server supports extended security), then the client MUST construct an SMB\_COM\_SESSION\_SETUP\_ANDX request, as specified in section [2.2.4.6.1](#).

The client MUST do one of the following:

- Pass the **Client.Connection.GSSNegotiateToken** (if valid) to the configured GSS authentication mechanism to obtain a GSS output token for the authentication protocol exchange. [<83>](#)
- Choose to ignore the **Client.Connection.GSSNegotiateToken** received from the server, and give an empty input token to the configured GSS authentication protocol to obtain a GSS output token for the authentication protocol exchange.

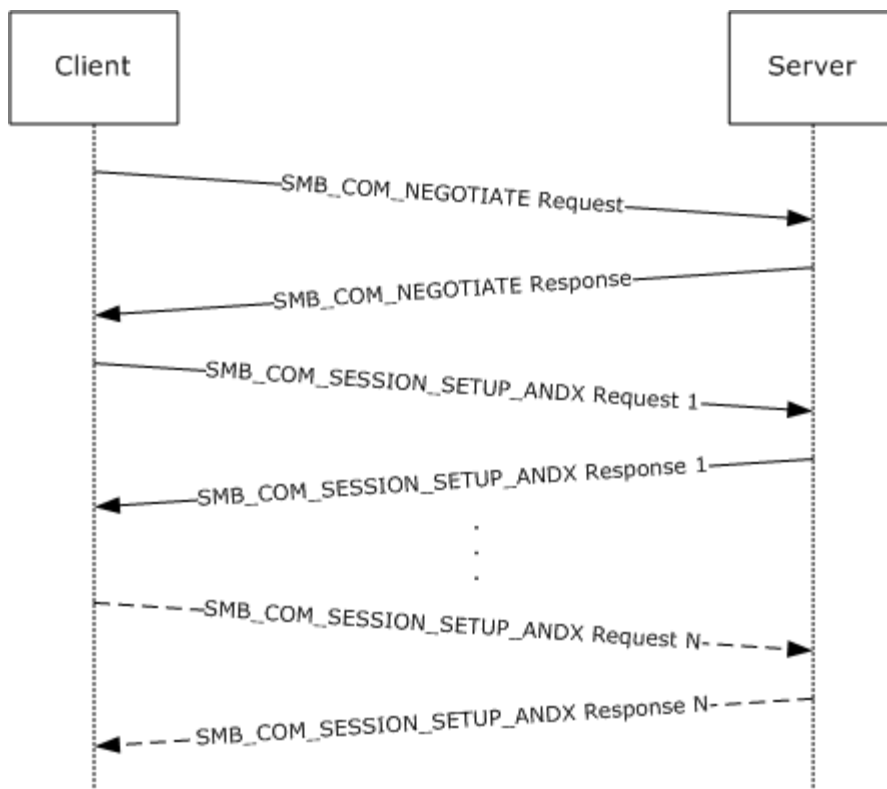
In either case, the client MUST initiate the GSS authentication protocol via the GSS\_Init\_sec\_context() interface, as specified in [\[RFC2743\]](#), passing in the input **Client.Connection.GSSNegotiateToken** as previously described, along with the credentials from **Client.Session.UserCredentials**. The client MUST set the MutualAuth and Delegate options which are specified in [\[MS-KILE\]](#) section 3.2.1. [<84>](#)

The client MUST then create an SMB\_COM\_SESSION\_SETUP\_ANDX request (section 2.2.4.6.1) message. The client MUST set CAP\_EXTENDED\_SECURITY in the **Capabilities** field, SMB\_FLAGS2\_EXTENDED\_SECURITY in the **SMB\_Header.Flags2** field, the **SMB\_Data.Bytes.SecurityBlob** field to the GSS output token generated by the GSS\_Init\_sec\_context() interface, and the **SMB\_Parameters.Words.SecurityBlobLength** to the length of the GSS output token.

### 3.2.4.2.4.1 Sequence Diagram

For the user to be successfully authenticated and to establish a session, the client MUST follow a security negotiation scheme that can involve one or more roundtrips of SMB\_COM\_SESSION\_SETUP\_ANDX request and response. In each roundtrip, the server and client exchange security tokens. The exchange of security tokens MUST continue until either the client or the server determines that authentication has failed or both sides decide that authentication is complete. If authentication fails, then the client drops the connection and indicates the error (see the following diagram for details). If authentication succeeds, then the application protocol can be assured of the identity of the participants as far as the supporting authentication protocol can accomplish.

In the sequence diagram that follows, requests with straight line arrows stand for the requests that the client MUST send. Requests with dotted line arrows stand for the requests the client may send. The server MUST respond to each client request that it receives.



**Figure 2: User authentication and session establishment sequence**

The diagram illustrates the sequence of events during the protocol negotiation and session establishment process. After the initial SMB\_COM\_NEGOTIATE command exchange has been completed, the SMB\_COM\_NEGOTIATE exchange MUST NOT be repeated over the same SMB connection; otherwise, the server disconnects the client by closing the underlying transport connection. The parameters returned in the SMB\_COM\_NEGOTIATE response MUST be used when creating new sessions over the same connection.

### Session Setup Roundtrip

The SMB\_COM\_NEGOTIATE Server response is processed as described in [\[MS-CIFS\]](#) section 3.2.5.2. The protocol extensions in this document apply only to the NT LM 0.12 dialect of SMB. For further information on SMB dialects, see [\[MS-CIFS\]](#) section 1.7.

If the NT LM 0.12 dialect is successfully negotiated, then the SMB client examines the Capabilities field in the SMB\_COM\_NEGOTIATE server response (section [2.2.4.5.2](#)). If the CAP\_EXTENDED\_SECURITY bit is clear (0x00000000), then the SMB server does not support extended security. In order for authentication to proceed, the SMB client MUST build a non-extended SMB\_COM\_SESSION\_SETUP\_ANDX request, and MUST set the **WordCount** field to 0x0d. Authentication then proceeds as described in [\[MS-CIFS\]](#) section 3.2.4.2.4.

If the CAP\_EXTENDED\_SECURITY bit is set (0x80000000), then the SMB server does support extended security. The SMB client MUST build an SMB\_COM\_SESSION\_SETUP\_ANDX request in the extended form, as specified in section [2.2.4.6.1](#). The request is sent to the SMB server, and the server builds an extended SMB\_COM\_SESSION\_SETUP\_ANDX server response (section [2.2.4.6.2](#)). The security BLOB in the session setup response is built as specified in [\[RFC2743\]](#).

Upon receiving the extended SMB\_COM\_SESSION\_SETUP\_ANDX server response (section 2.2.4.6.2), the SMB client invokes the local security package to determine whether the session setup request SHOULD be completed, aborted, or continued. A completed session indicates that the server has enough information to establish the session. An aborted session indicates that the server cannot proceed with the session setup because of an error in the information presented by the client, or otherwise. If the session setup has to be continued, the security package on the client and/or server requires an additional roundtrip before the session setup can be established. This is especially true of new security packages that support mutual authentication between the client and server.

In the case of extended security, the SMB protocol does not make the distinction between NTLM and Kerberos; therefore, the sequence defined previously in this section is the same in both cases. If authentication succeeds after a single roundtrip, then only one session setup exchange is required. Otherwise, additional roundtrips will be required.

Each additional roundtrip MUST consist of one SMB\_COM\_SESSION\_SETUP\_ANDX client request and one SMB\_COM\_SESSION\_SETUP\_ANDX server response. In the sequence diagram, this is represented in the horizontal dotted line that symbolizes additional roundtrips until the final roundtrip, which is represented as SMB\_COM\_SESSION\_SETUP\_ANDX Client Request N and SMB\_COM\_SESSION\_SETUP\_ANDX Server Response N, where N is a number larger than 1.

All additional SMB session setup roundtrips follow the same sequence details as Session Setup Roundtrip, as described earlier in this topic. <85>

### 3.2.4.2.5 Connecting to the Share (Tree Connect)

Processing of this event is handled as specified in [\[MS-CIFS\]](#) section 3.2.4.2.5, with the following additions:

If a tree connect is already established to the target share in **Client.Connection.TreeConnectTable**, then it SHOULD be reused. If not, then the client creates an SMB\_COM\_TREE\_CONNECT\_ANDX request, as specified in section [2.2.4.7.1](#), to connect to the target share.

#### Session Key Protection

The client SHOULD <86> request **Client.Session.SessionKey** protection by setting the TREE\_CONNECT\_ANDX\_EXTENDED\_SIGNATURES flag in the **Flags** field of the SMB\_COM\_TREE\_CONNECT\_ANDX request to TRUE.

#### Extended Information Response

The client MUST request extended information in the response by setting the TREE\_CONNECT\_ANDX\_EXTENDED\_RESPONSE flag in the **Flags** field of the SMB\_COM\_TREE\_CONNECT\_ANDX request to TRUE, as defined in section [2.2.4.3.2](#).

The client sends this message to the server.

### 3.2.4.3 Application Requests Opening a File

The processing of this event is handled as specified in [\[MS-CIFS\]](#) sections [3.2.4.5](#) and [3.2.4.6](#), with the following additions:

The application can request that additional information be returned for the Open, in particular maximal access information. The client can issue either an SMB\_COM\_NT\_CREATE\_ANDX request or

an SMB\_COM\_OPEN\_ANDX request to make use of these extensions, as specified in section [3.2.4.3.1.<87>](#)

### 3.2.4.3.1 SMB\_COM\_NT\_CREATE\_ANDX Request

To access these extensions, the application can also provide:

- **RequestExtendedResponse:** A BOOLEAN. If TRUE, then it indicates that the application is requesting a server to send an extended response.

If the application is requesting an extended server response, then the client MUST set the NT\_CREATE\_REQUEST\_EXTENDED\_RESPONSE flag in the **SMB\_Parameters.Flags** field of the request.

For a named pipe request, the client MUST set the SYNCHRONIZE bit in the **DesiredAccess** field if the FILE\_SYNCHRONOUS\_IO\_ALERT or FILE\_SYNCHRONOUS\_IO\_NONALERT bit is set in the **CreateOptions** field.

### 3.2.4.3.2 SMB\_COM\_OPEN\_ANDX Request (deprecated)

To access these extensions, the application can also provide:

- **RequestExtendedResponse:** A BOOLEAN. If TRUE, then it indicates that the application is requesting a server to send an extended response.

If the application is requesting an extended server response, then the client SHOULD [<88>](#) set the SMB\_OPEN\_EXTENDED\_RESPONSE flag in the **SMB\_Parameters.Flags** field of the request.

### 3.2.4.4 Application Requests Reading from a File, Named Pipe, or Device

Processing of this event is handled as specified in [\[MS-CIFS\]](#) section 3.2.4.14, with the following additions:

The SMB\_COM\_READ\_ANDX command request has been extended as specified below.

#### Timeout\_or\_MaxCountHigh

The **Timeout** field specified in [\[MS-CIFS\]](#) section 2.2.4.42.1 has been extended to be the **Timeout\_or\_MaxCountHigh** field. This field is treated as a union of a 32-bit **Timeout** field and a 16-bit unsigned integer named **MaxCountHigh**, as specified in section [2.2.4.2.1](#).

- For pipe reads, the client MUST use **Timeout\_or\_MaxCountHigh** as the **Timeout** field. The client MUST set the **Timeout** field either to a time-out value in milliseconds, or to 0xFFFFFFFF. [<89>](#) The latter value indicates to the server that the operation MUST NOT time out.
- For file reads, the client MUST use this as the **MaxCountHigh** field. If the count of bytes to read is larger than 0xFFFF bytes in length, then the client MUST use the **MaxCountHigh** field to hold the two most significant bytes of the count, thus allowing for a 32-bit read count when combined with **MaxCountOfBytesToReturn** field. If the read count is not larger than 0xFFFF, then the client MUST set **MaxCountHigh** to zero.

#### 3.2.4.4.1 Large Read Support

If the CAP\_LARGE\_READX bit is set in **Client.Connection.ServerCapabilities**, then the client is allowed to issue a read of a size larger than **Client.Connection.MaxBufferSize** using an

SMB\_COM\_READ\_ANDX request. Otherwise, the client MUST split the read into multiple requests in order to retrieve the entire amount of data. <90>

- If a large read is being issued and the object being read is not a file, then the count of bytes to read MUST be placed into the **MaxCountOfBytesToReturn** field. This field is a 16-bit unsigned integer; therefore, the maximum count of bytes that can be read is 0xFFFF bytes (64K - 1 byte).
- If a large read is being issued and the object being read is a file, then the two least significant bytes of the count of bytes to read MUST be placed into the **MaxCountOfBytesToReturn** field and the two most significant bytes of the count MUST be placed into the **MaxCountHigh** field.

### 3.2.4.5 Application Requests Writing to a File, Named Pipe, or Device

Processing of this event is handled as specified in [\[MS-CIFS\]](#) section 3.2.4.15 with the following additions:

The SMB\_COM\_WRITE\_ANDX command request has been extended as specified in section [2.2.4.3.1](#).

#### Large Write Support

If the CAP\_LARGE\_WRITEX bit is set in **Client.Connection.ServerCapabilities**, then the client is allowed to issue a write of a size larger than **Client.Connection.MaxBufferSize** using an SMB\_COM\_WRITE\_ANDX request. Otherwise, it MUST split the write into multiple requests to write the entire amount of data.

If the CAP\_LARGE\_WRITEX bit is set in **Client.Connection.ServerCapabilities**, and the client is issuing a write of a size larger than **Client.Connection.MaxBufferSize**, the client MUST ensure that the total length of the SMB packet does not exceed the maximum packet length allowed by the underlying transport, as specified in section [2.1](#).

If the count of bytes to be written is greater than or equal to 0x00010000 (64K), then the client MUST set the two least significant bytes of the count in the **DataLength** field of the request and the two most significant bytes of the count in the **DataLengthHigh** field.

### 3.2.4.6 Application Requests a Directory Enumeration

Processing of this event is handled as specified in [\[MS-CIFS\]](#) section 3.2.4.27, with the following additions:

The TRANS2\_FIND\_FIRST2 subcommand request has been extended as specified below.

#### New Information Levels

To request the new Information Levels specified in section [2.2.6.1.1](#), the client MUST set the **InformationLevel** field of the TRANS2\_FIND\_FIRST2 request to the corresponding Information Level.

#### Enumerating Previous Versions

An application is allowed to request an enumeration of available previous versions of a file or directory using a TRANS2\_FIND\_FIRST2 request (see section [2.2.1.1.1](#)). To do this, the request MUST have the @GMT token wildcard, @GMT-\*, as part of the search pattern in the **FileName** field and it MUST use the SMB\_FIND\_FILE\_BOTH\_DIRECTORY\_INFO Information Level. This extension is not available for Information Levels other than SMB\_FIND\_FILE\_BOTH\_DIRECTORY\_INFO. The client MAY <91> fail such requests or simply send the requests to the server. Because it is a path-based operation, this request follows the same previous version token parsing rules as specified in section [3.2.4.1.1](#).

The message is sent to the server.

### 3.2.4.7 Application Requests Querying File Attributes

Processing of this event is handled as specified in [\[MS-CIFS\]](#) section 3.2.4.12, with the following additions:

#### Pass-through Information Levels

The extension adds support for pass-through Information Levels, as defined in section [2.2.2.3.5](#). If the CAP\_INFOLEVEL\_PASSTHRU bit in **Client.Connection.ServerCapabilities** is set, the client MUST increment the Information Level value by SMB\_INFO\_PASSTHROUGH (0x03e8) and place the resulting value in the **InformationLevel** field of a TRANS2\_QUERY\_FILE\_INFORMATION or TRANS2\_QUERY\_PATH\_INFORMATION request.

#### File Streams

A client can send a TRANS2\_QUERY\_FILE\_INFORMATION subcommand of the [SMB\\_COM\\_TRANSACTION2 request](#) to the server with the **InformationLevel** field set to SMB\_QUERY\_FILE\_STREAM\_INFO (see [\[MS-CIFS\]](#) section 2.2.6.8). If the FID field in the client request is on an SMB share that does not support streams, then the server MUST fail the request with STATUS\_INVALID\_PARAMETER.

A client can send a TRANS2\_QUERY\_PATH\_INFORMATION subcommand of the SMB\_COM\_TRANSACTION2 request to the server with the **InformationLevel** field set to SMB\_QUERY\_FILE\_STREAM\_INFO (see [\[MS-CIFS\]](#) section 2.2.6.6.2). If the **FileName** field in the client request is on an SMB share that does not support streams, then the server MUST fail the request with STATUS\_INVALID\_PARAMETER.

#### Previous Version Tokens

Because the TRANS2\_QUERY\_PATH\_INFORMATION subcommand request is a path-based operation, the path SHOULD be scanned for previous version tokens by the client, as specified in section [3.2.4.1.1](#).

### 3.2.4.8 Application Requests Setting File Attributes

Processing of this event is handled as specified in [\[MS-CIFS\]](#) section 3.2.4.13, with the following additions:

#### Pass-Through Information Levels

The extension adds support for pass-through **Information Levels**, as defined in section [2.2.2.3.5](#). If the CAP\_INFOLEVEL\_PASSTHRU bit in **Client.Connection.ServerCapabilities** is set the client MUST increment the level value by SMB\_INFO\_PASSTHROUGH (0x03e8) and place the resulting value in the **InformationLevel** field of a TRANS2\_SET\_FILE\_INFORMATION or TRANS2\_SET\_PATH\_INFORMATION request. The serialized native structure is placed in the Trans2\_Data block of the request and the **SMB\_Parameters.TotalDataCount** is set to the length of this buffer.

#### Previous Version Tokens

Because the TRANS2\_SET\_PATH\_INFORMATION subcommand request is a path-based operation, the path SHOULD be scanned for previous version tokens by the client, as specified in section [3.2.4.1.1](#).



### 3.2.4.9 Application Requests Querying File System Attributes

The processing of this event is handled as specified in [\[MS-CIFS\]](#) section 2.2.2.3.5, with the following additions:

Support of pass-through Information Levels for the querying file system attributes through the use of the TRANS2\_QUERY\_FS\_INFORMATION subcommand is defined in section [2.2.2.3.5](#). If the CAP\_INFOLEVEL\_PASSTHRU bit in **Client.Connection.ServerCapabilities** is set, the client MUST increment the Information Level value by SMB\_INFO\_PASSTHROUGH (0x03e8) and place the resulting value in the **InformationLevel** field of a TRANS2\_QUERY\_FS\_INFORMATION request.

### 3.2.4.10 Application Requests Setting File System Attributes

The application MUST provide the following:

- An **Open** that identifies a file on the file system that will have its attributes set.
- The Information Level that defines the format of the data to set. Valid Information Levels are specified in [\[MS-FSCC\]](#) section 2.5.
- A buffer that contains the attribute data to be set on the server. The buffer is formatted as specified in the subsection of [\[MS-FSCC\]](#) section 2.5 that corresponds to the Information Level supplied by application.

This operation supports the use of pass-through Information Levels only. If the CAP\_INFOLEVEL\_PASSTHRU flag in **Client.Connection.ServerCapabilities** is not set, then the client MUST fail the request and return the error code STATUS\_NOT\_SUPPORTED to the calling application.

The client MUST construct a TRANS2\_SET\_FS\_INFORMATION subcommand request, as specified in section [2.2.6.4.1](#).

The client MUST use **Open.TreeConnect** and **Open.Session** to send the request to the server. The request MUST be sent to the server, as specified in section [3.2.4.1](#).

### 3.2.4.11 Application Requests Sending an I/O Control to a File or Device

Processing of this event is handled as specified in [\[MS-CIFS\]](#) section 3.2.4.22, with the following additions:

A list of **FSCTLs** is specified in [\[MS-FSCC\]](#) section 2.3. Three I/O control codes specific to the extension are described in the following subsections.

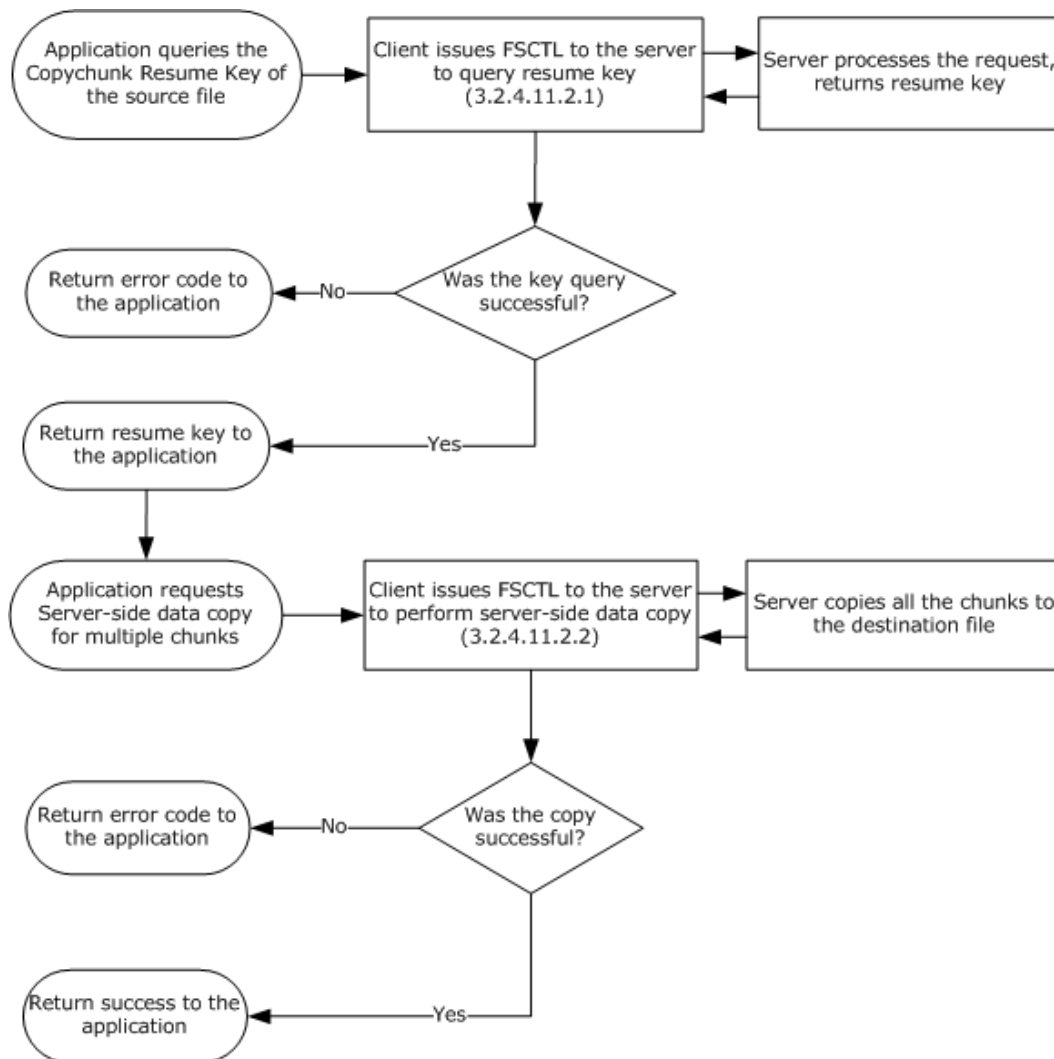
#### 3.2.4.11.1 Application Requests Enumerating Available Previous Versions

An application can request that a client retrieve an enumeration of available previous version time stamps for a share by issuing the FSCTL\_SRV\_ENUMERATE\_SNAPSHOTS control code, as specified in section [2.2.7.2.1.<92>](#) The request is sent to the server.

#### 3.2.4.11.2 Performing a Server-Side Data Copy

An outline of the steps taken for a server-side data copy follows. The application first requests the FSCTL\_SRV\_REQUEST\_RESUME\_KEY operation and the client issues the request to the server as specified in section [3.2.4.11.2.1](#). The client then returns the Copychunk Resume Key received from the server to the application. The application then requests the FSCTL\_SRV\_COPYCHUNK operation

and the client issues the request to the server as specified in section [3.2.4.11.2.2](#). The client then returns the status received from the server to the application.



**Figure 3: Server-side data copy of an entire file**

### 3.2.4.11.2.1 Application queries the Copychunk Resume Key of the Source File

The application provides a handle to the **Open** representing the source file.

To request a Copychunk Resume Key for an open file, the client constructs an NT\_TRANSACT\_IOCTL FSCTL\_SRV\_REQUEST\_RESUME\_KEY request, as specified in section [2.2.7.2.1](#). The Fid of the source file (**Open.FID**) is placed in the **FID** field of the client request along with the FSCTL\_SRV\_REQUEST\_RESUME\_KEY function code. No **NT\_Trans\_Data** block is required. The request is sent to the server and the server's response is processed as specified in section [3.2.5.9.1.1](#).

### 3.2.4.11.2.2 Application requests a Server-side Data Copy

The application provides:

- A handle to the **Open** representing the destination file.
- Copychunk Resume Key of the source file.
- List of source and destination offsets and the lengths of data blocks to copy from the source file.

To request a server-side copy of a data range, the client constructs an NT\_TRANSACT\_IOCTL FSCTL\_SRV\_COPYCHUNK request, as specified in section [2.2.7.2.1](#). The Fid of the destination file (**Open.FID**) is placed in the **FID** field of the request along with the FSCTL\_SRV\_COPYCHUNK function code.

The NT\_Trans\_Data buffer of the request is constructed as follows:

- **CopychunkResumeKey** is set to the application-provided resume key.
- **CopyChunkList** is set to a list of SRV\_COPYCHUNK structures (section [2.2.7.2.1.1](#)), where each structure is filled with the application-supplied source and destination offsets and the length of each data block.
- **ChunkCount** is set to the total number of the data blocks supplied by the application.

The request is sent to the server and the server's response is processed as specified in section [3.2.5.9.1.2](#).

### 3.2.4.12 Application Requests Querying of DFS Referral

Processing of this event is handled as specified in [\[MS-CIFS\]](#) section 3.2.4.44. [<93>](#)

### 3.2.4.13 Application Requests Querying User Quota Information

The application MUST provide:

- A valid **Open** to a file or directory on a share. The quota information on the object store that underlies the file or directory is the quota information to be queried.
- A buffer to receive the quota information and the maximum number of bytes to receive.
- **RestartScan**: A **BOOLEAN** that indicates whether or not a scan on the volume is to be restarted.
- **ReturnSingleEntry**: A **BOOLEAN**. If TRUE, then the server MUST return a single user quota information entry.
- A security identifier (SID) list, a start SID, or no SID. If the application provides both an SID list and a start SID, then the client MUST fail the request with STATUS\_INVALID\_PARAMETER.

The client MUST construct an NT\_TRANSACT\_QUERY\_QUOTA subcommand request, as specified in section [2.2.7.5.1](#), with the following additional requirements:

- **NT\_Trans\_Parameters.FID** MUST be set to the Fid of the application-supplied Open.
- **NT\_Trans\_Parameters.ReturnSingleEntry** MUST be set to the value of the application-supplied **ReturnSingleEntry** BOOLEAN.

- **NT\_Trans\_Parameters.RestartScan** MUST be set to the value of the application-supplied RestartScan BOOLEAN.
- The **NT\_Trans\_Data.SidList** field is set to either the application-supplied SID list or start **SID**. If neither were supplied, then this field is not included.
- The NT\_Trans\_Parameters fields of **SidListLength**, **StartSidLength**, and **StartSidOffset** MUST be set according to the following rules:
  - If the application provides a SID list (a list of SIDs that represents users whose quota information is to be queried), then the client MUST set the **SidList** field of the request to this list and set **SidListLength** to the length of the list. In this case, **StartSidLength** and **StartSidOffset** MUST be zero.
  - If the application provides a start SID (a single SID that indicates to the server where to start user quota information enumeration), then the client MUST set **StartSidLength** to the length of the SID and **StartSidOffset** to the offset in bytes of the **NT\_Trans\_Data.SidList** field relative to the start of the SMB header. In this case, **SidListLength** MUST be zero.
  - If the application does not provide a SID list or a start SID, then **StartSidLength**, **StartSidOffset**, and **SidListLength** MUST be zero. If the application provides both a SID list and a start SID, then the client MUST fail the request and return the error code STATUS\_INVALID\_PARAMETER to the calling application.

The request is sent to the server.

#### 3.2.4.14 Application Requests Setting User Quota Information

The application MUST provide:

- A valid Open to a file or directory on a share. The quota information of the object store that underlies the file or directory is the quota information to be modified.
- A list of the security identifiers (SIDs, representing users) and their associated quota information to be set.

The client MUST construct an NT\_TRANSACT\_SET\_QUOTA subcommand request, as specified in section [2.2.7.6.1](#), with the following additional parameters:

- **NT\_Trans\_Parameters.FID** MUST be set to the Fid of the application-supplied Open.
- The application-supplied list of SIDs and associated user quota information MUST be set as the contents of the NT\_Trans\_Data block, as specified in section [2.2.7.6.1](#).

The client sends the request to the server.

#### 3.2.4.15 Application Requests the Session Key for a Connection

An application provides one of the following:

- An **Open** to a file or pipe.
- OR
- An SMB session that identifies an authenticated connection to the server.

If an Open was supplied by the caller, then **Client.Open.Session** MUST be used.

If a **Session** is found, but **Client.Session.AuthenticationState** is not *Valid*, then an implementation-specific error MUST be returned to the caller that indicates that the session key is not available.

If a session is found and **Client.Session.AuthenticationState** is *Valid*, but **Client.Session.SessionKeyState** is *Unavailable*, then the request MUST be failed with `STATUS_ACCESS_DENIED`.

If a session is found, **Client.Session.AuthenticationState** is *Valid*, and **Client.Session.SessionKeyState** is *Available*, then the 16-byte **Client.Session.SessionKey** MUST be returned to the calling application.

## 3.2.5 Message Processing Events and Sequencing Rules

### 3.2.5.1 Receiving Any Message

In addition to the global processing rules for a client that receives any message, as specified in [\[MS-CIFS\]](#) section 3.2.5.1, the following processing rules apply to the extensions presented in this document.

#### Signing

If a message is received and `Client.Connection.IsSigningActive` is `TRUE` for the connection, the client uses **Client.Connection.ClientResponseSequenceNumber[PID,MID]** as the sequence number in signature verification, as specified in section [3.1.5.1](#). If signature verification fails, then the message MUST be discarded and not processed. The client SHOULD disconnect the underlying connection and tear down all states associated with this connection. If the message is an oplock break, the signature is never verified, as specified in [\[MS-CIFS\]](#) section 3.2.5.42.

#### Session Expiration and Re-authentication

If the request passed a valid authenticated session identifier in the **SMB\_Header.UID** field and the status code in the SMB header of the response is `STATUS_NETWORK_SESSION_EXPIRED`, then the client MUST look up the **Client.Connection.SessionTable [UID]**, set **Client.Session.AuthenticationState** to `Expired`, and attempt to re-authenticate this session. Re-authentication follows the steps as specified in section [3.2.4.2.4](#), except that the UID sent in the SMB header of the `SMB_COM_SESSION_SETUP_ANDX` request MUST be set to the UID that represents the expired Session. Also, as described in section [3.2.5.3](#), the existing `Client.Session.SessionKey` MUST NOT be modified during re-authentication after a session expiry.

If the authentication fails, then the resulting error code MUST be returned for whichever operation failed with `STATUS_NETWORK_SESSION_EXPIRED` and the session associated with this UID is removed from the **Client.Connection.SessionTable**. If authentication succeeds, then the client MUST set **Client.Session.AuthenticationState** to `Valid` and retry the operation that failed with `STATUS_NETWORK_SESSION_EXPIRED`.

### 3.2.5.2 Receiving an SMB\_COM\_NEGOTIATE Response

Processing of an [SMB\\_COM\\_NEGOTIATE response](#) is handled as specified in [\[MS-CIFS\]](#) section 3.2.5.2 with the following additions:

Storing extended security token and ServerGUID

If the capabilities returned in the `SMB_COM_NEGOTIATE` response include `CAP_EXTENDED_SECURITY`, then the response MUST take the form defined in section [2.2.4.5.2](#), and the client MUST set the **Client.Connection.GSSNegotiateToken** to the value returned in the

**SecurityBlob** field in the SMB\_COM\_NEGOTIATE server response.<94> If **SecurityBlobLength** is 0, then client-initiated authentication, with an authentication protocol of the client's choice, will be used instead of server-initiated SPNEGO authentication as described in [MS-AUTHSOD] section 2.1.2.2. The client MUST also set the **Client.Connection.ServerGUID** to the value returned in the **ServerGUID** field in the SMB\_COM\_NEGOTIATE server response.<95>

### 3.2.5.3 Receiving an SMB\_COM\_SESSION\_SETUP\_ANDX Response

The processing of an [SMB\\_COM\\_SESSION\\_SETUP\\_ANDX response](#) is handled as specified in [MS-CIFS] section 3.2.5.3 with the following additions:

#### Extended Security Authentication

If **Client.Connection.ServerCapabilities** has the CAP\_EXTENDED\_SECURITY bit set, then the client MUST reject any SMB\_COM\_SESSION\_SETUP\_ANDX responses that do not take the form specified in section 2.2.4.6.2. If the **Status** field of the SMB header is not STATUS\_SUCCESS and is not STATUS\_MORE\_PROCESSING\_REQUIRED, then the authentication has failed and the error code MUST be propagated back to the application that initiated the connection attempt. Otherwise, if there is no entry in **Client.Connection.SessionTable** for the UID in the response, then one MUST be created with the following additional requirements:

- **Client.Session.SessionUID** MUST be set to the UID in the response.
- **Client.Session.AuthenticationState** MUST be set to InProgress.
- **Client.Session.UserCredentials** MUST be set to the authentication credentials of the user that initiated the authentication attempt.
- **Client.Session.SessionKey** MUST be set to zero.
- **Client.Session.SessionKeyState** MUST be set to Unavailable.

The client MUST then process the GSS token (the **SecurityBlob** field of the response with its length given in the **SecurityBlobLength** field).<96> The client MUST use the configured GSS authentication protocol to obtain the next GSS token for the authentication exchange. Based on the status code received in the response and the result from the GSS authentication protocol, one of the following actions MUST be taken:

- If the GSS authentication protocol indicates an error, then the error MUST be returned to the calling application that initiated the connection.
- If the **Status** field of the response contains STATUS\_SUCCESS and the GSS authentication protocol does not indicate an error, then authentication is complete. The **Client.Session.AuthenticationState** MUST be set to Valid and the **Client.Session.SessionKey** MUST be set using the value queried from the GSS protocol. For information about how this is calculated for Kerberos authentication via Generic Security Service Application Programming Interface (GSS-API), see [MS-KILE]. The client MUST set **Client.Session.SessionKeyState** to Available.
- If the **Status** field of the response contains STATUS\_MORE\_PROCESSING\_REQUIRED and the GSS authentication protocol did not indicate an error, then the client MUST create an [SMB\\_COM\\_SESSION\\_SETUP\\_ANDX request \(section 2.2.4.6.1\)](#) with the following parameters:
  - The client MUST set CAP\_EXTENDED\_SECURITY in the **Capabilities** field and set SMB\_FLAGS2\_EXTENDED\_SECURITY in the SMB header **Flags2** field.

- The **SecurityBlob** and **SecurityBlobLength** fields MUST be set to the output token and its length returned by the GSS protocol.
- The **SMB\_Header.UID** field MUST be set to the value of the **SMB\_Header.UID** field received in the SMB\_COM\_SESSION\_SETUP\_ANDX response.
- This message MUST be sent to the server, and further processing listed in the remainder of this section is not necessary.

### NTLM Authentication

If the CAP\_EXTENDED\_SECURITY bit in **Client.Connection.ServerCapabilities** is not set, then the client processes the response. [<97>](#) If the **Status** field of the response does not contain STATUS\_SUCCESS, then the client MUST propagate the error to the application that initiated the authentication. The connection MUST remain open for the client to attempt another authentication.

If the **Status** field of the response contains STATUS\_SUCCESS, then authentication was successful. The client associates the returned **SMB\_Header.UID** of the response with this user for further requests, as specified in [MS-CIFS]. The **Client.Session.AuthenticationState** MUST be set to Valid. If the **Client.Session.SessionKey** is zero, then the client MUST query the authentication package for the 16-byte session key, as specified in [\[MS-NLMP\]](#), and set **Client.Session.SessionKey** to the returned value. If **Client.Session.SessionKey** is non-zero, then the client MUST NOT overwrite the existing session key. The client MUST set **Client.Session.SessionKeyState** to Available.

### Activating Signing

If authentication has completed successfully, **Client.Connection.IsSigningActive** is FALSE, and the targeted behavior for this connection is signed according to the description in section [3.2.4.2.3](#), then the client MUST determine whether signing is required to be activated.

To determine whether signing is required to be active, the user security context that completed authentication is verified. If the user that authenticated is a guest or is anonymous, then signing MUST NOT be activated. Guest authentication is indicated by bit zero in the **Action** field of the SMB\_COM\_SESSION\_SETUP\_ANDX response being set. Anonymous authentication is indicated by the fact that no credentials are provided.

If neither of these conditions are true, then the client MUST activate signing as follows:

- If CAP\_EXTENDED\_SECURITY is set in **Client.Connection.ServerCapabilities**, the client MUST use GSS-API to query the session key used in this authentication and store the ExportedSessionKey returned by GSS-API into **Client.Connection.SigningSessionKey**. The client MUST set **Client.Connection.SigningChallengeResponse** to NULL.
- If CAP\_EXTENDED\_SECURITY is not set in **Client.Connection.ServerCapabilities**, the client MUST use NTLM to query the session key used in this authentication.
  - For NTLMv1 – the client MUST store SessionBaseKey, returned by the **NTOWFv1** function defined in [\[MS-NLMP\]](#) section 3.3.1, into **Client.Connection.SigningSessionKey**.
  - For NTLMv2 – the client MUST store SessionBaseKey, returned by the **NTOWFv2** function defined in [\[MS-NLMP\]](#) section 3.3.2, into **Client.Connection.SigningSessionKey**.

The client MUST set **Client.Connection.SigningChallengeResponse** to the challenge response that is sent in the SMB\_COM\_SESSION\_SETUP\_ANDX response.

Once these steps are completed, the client MUST verify the signature of this response. The client follows the steps specified in section [3.1.5.1](#), by passing in a sequence number of one because this is the first signed packet.

### 3.2.5.4 Receiving an SMB\_COM\_TREE\_CONNECT\_ANDX Response

The processing of an [SMB\\_COM\\_TREE\\_CONNECT\\_ANDX Response](#) is handled as specified in [\[MS-CIFS\]](#) section 3.2.5.4 with the following additions:

#### Requesting Extended Information

The client MUST determine whether or not the server returned an extended response, as specified in section [2.2.4.7](#). The client does this by determining whether or not the **WordCount** is equal to 0x07. If it is, then the client MUST make the new extended information available to the calling application by using the **SMB\_Header.TID** value to set

**Client.Connection.TreeConnectTable[TID].MaximalShareAccessRights** and **Client.Connection.TreeConnectTable[TID].GuestMaximalShareAccessRights** to the values that are in the response fields of **SMB\_Parameters.Words.MaximalShareAccessRights** and **SMB\_Parameters.Words.GuestMaximalShareAccessRights**, respectively.

#### Session Key Protection

If the response status is STATUS\_SUCCESS and the SMB\_EXTENDED\_SIGNATURE bit is set in the **OptionalSupport** field of the SMB\_COM\_TREE\_CONNECT\_ANDX response, then the client MUST hash the session key of the calling user. This protects the key that is used for signing by making it unavailable to the calling applications.

The one-way hash MUST be performed on **Client.Session.SessionKey** that uses the HMAC-MD5 algorithm, as specified in [\[RFC2104\]](#). The steps are as follows:

1. Take the 16-byte user session key from **Client.Session.SessionKey**.
  - If this is an LM authentication where the session key is only 8 bytes, then zero extend it to 16 bytes.
  - If the session key is more than 16 bytes, then use only the first 16 bytes.
2. Calculate the one-way hash as follows:

```
CALL hmac_md5( SSKeyHash, 256, session key, session key length, digest )
SET user session key = digest
```

The resulting 16-byte digest is treated as the user's new session key and is returned to the caller who requests it. SSKeyHash is the well-known constant array that is described in section [2.2.2.5](#).

After the session key has been hashed, the client MUST place the hash into **Client.Session.SessionKey** and set **Client.Session.SessionKeyState** to Available, which allows applications to query the session key.

If the TREE\_CONNECT\_ANDX\_EXTENDED\_SIGNATURE bit is not set, then the **Client.Session.SessionKey** is not changed and **Client.Session.SessionKeyState** MUST be set to Available.



### 3.2.5.5 Receiving an SMB\_COM\_NT\_CREATE\_ANDX Response

The processing of an SMB\_COM\_NT\_CREATE\_ANDX response is handled as specified in [\[MS-CIFS\]](#) section 3.2.5.36 with the following additions:

The client MUST determine whether the server returned an extended response, as specified in section [2.2.4.9.2](#). It does this by checking for a proper **WordCount** value. If **WordCount** is not equal to 0x2A, then the client MUST process the response as specified in [\[MS-CIFS\]](#) section 3.2.5.36. Otherwise, the extended information that is specified in section [2.2.4.9.2](#) MUST also be propagated back to the calling application.

### 3.2.5.6 Receiving an SMB\_COM\_OPEN\_ANDX Response

The processing of an SMB\_COM\_OPEN\_ANDX response is handled as specified in [\[MS-CIFS\]](#) section 3.2.5.25 with the following additions:

The client MUST determine whether or not the server returned an extended response, as specified in section [2.2.4.1.2](#). It does this by checking whether or not the **WordCount** is equal to 0x13. If the response is not an extended response, then the client MUST process the response as specified in [\[MS-CIFS\]](#) section [3.2.5.25](#). If the response is an extended response, then the new information specified in section [2.2.4.1.2](#) MUST be propagated back to the calling application.

### 3.2.5.7 Receiving an SMB\_COM\_READ\_ANDX Response

The processing of an SMB\_COM\_READ\_ANDX response is handled as specified in [\[MS-CIFS\]](#) section 3.2.5.26 with the following additions:

The first two bytes of the **SMB\_Parameters.Words.Reserved2[]** field, specified in [\[MS-CIFS\]](#) section 2.2.4.42.2, are interpreted as the 16-bit **DataLengthHigh** field (specified in section [2.2.4.2.2](#)). The remaining 8 bytes of **Reserved2[]** remain unused and MUST be ignored by the client. The **DataLengthHigh** field MUST contain the two most-significant bytes of a 32-bit length count of bytes read from the server.

### 3.2.5.8 Receiving an SMB\_COM\_WRITE\_ANDX Response

The processing of an SMB\_COM\_WRITE\_ANDX response is handled as specified in [\[MS-CIFS\]](#) section 3.2.5.27 with the following additions:

The 16-bit **SMB\_Parameters.Words.Reserved** field, specified in [\[MS-CIFS\]](#) section 2.2.4.43.2, is now interpreted as a 16-bit **CountHigh** field followed by an 8-bit **Reserved** field. The **CountHigh** field MUST contain the two most-significant bytes of a 32-bit count of bytes written by the server.

### 3.2.5.9 Receiving any SMB\_COM\_NT\_TRANSACT Response

The processing of any SMB\_COM\_NT\_TRANSACT response is handled as specified in [\[MS-CIFS\]](#) section 3.2.5.40.

#### 3.2.5.9.1 Receiving an NT\_TRANSACT\_IOCTL Response

The processing of an NT\_TRANSACT\_IOCTL response is handled as specified in [\[MS-CIFS\]](#) section 3.2.5.40.2 with the following additions.

#### **3.2.5.9.1.1 Receiving an FSCTL\_SRV\_REQUEST\_RESUME\_KEY Function Code**

If the response indicates that an error occurred, then the client MUST propagate the error to the application that initiated the call.

If the response indicates that the operation is successful, then the client MUST return the copychunk resume key that is received in the Data block of the response to the application that initiated the call.

#### **3.2.5.9.1.2 Receiving an FSCTL\_SRV\_COPYCHUNK Function Code**

The success or failure code MUST be returned to the calling application. The FSCTL\_SRV\_COPYCHUNK response (section [2.2.7.2.2](#)) MUST also be returned to the calling application in both success and failure situations.

#### **3.2.5.9.2 Receiving an NT\_TRANSACT\_QUERY\_QUOTA Response**

If the response indicates an error occurred, then the client MUST propagate the error to the application that initiated the call.

If the response indicates the operation is successful, then the client MUST return the information received in the Data block of the response to the application that initiated the call.

#### **3.2.5.9.3 Receiving an NT\_TRANSACT\_SET\_QUOTA Response**

The client MUST propagate the success or failure code in the response to the application that initiated the call.

#### **3.2.5.10 Receiving an SMB\_COM\_SEARCH Response**

The processing of an SMB\_COM\_SEARCH response is handled as specified in [\[MS-CIFS\]](#) section 3.2.5.33.

#### **3.2.5.11 Receiving any SMB\_COM\_TRANSACTION2 subcommand Response**

Aside from the following subcommand responses, all other SMB\_COM\_TRANSACTION2 subcommand responses are handled as specified in [\[MS-CIFS\]](#) section [3.2.5.39](#).

##### **3.2.5.11.1 Receiving any TRANS2\_SET\_FS\_INFORMATION Response**

The client MUST propagate the success or failure code in the response to the application that initiated the call.

### **3.2.6 Timer Events**

There are no new client timers other than those specified in [\[MS-CIFS\]](#) section 3.2.6.

### **3.2.7 Other Local Events**

There are no new client local events other than those specified in [\[MS-CIFS\]](#) section 3.2.7.

## 3.3 Server Details

### 3.3.1 Abstract Data Model

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

The following elements extend the client abstract data model specified in [\[MS-CIFS\]](#) section 3.3.1.

#### 3.3.1.1 Global

**ServerStatistics:** Server statistical information. This contains all the members of the **STAT\_SERVER\_0** structure, as specified in [\[MS-SRVS\]](#) section 2.2.4.39.

**Server.MessageSigningPolicy:** This ADM element is extended from the specification in [\[MS-CIFS\]](#) section 3.3.1.1 to include a new possible value:

- Declined -- Message signing is disabled unless the other party requires it. If the other party requires message signing, then it MUST be used. Otherwise, message signing MUST NOT be used.

**Server.SupportsExtendedSecurity:** A flag that indicates whether or not this node supports Generic Security Services (GSS), as specified in [\[RFC2743\]](#), for selecting the authentication protocol.

**Server.IsDfsCapable:** A Boolean that, if set, indicates that the server supports the Distributed File System.

**Server.MaxCopyChunks:** The maximum number of chunks the server will accept in a server-side data copy operation.

**Server.MaxCopyChunkSize:** The maximum number of bytes the server will accept in a single chunk for a server-side data copy operation.

**Server.MaxTotalCopyChunkSize:** The maximum total number of bytes the server will accept for a server-side data copy operation.

**Server.CopyChunkTimeOut:** The amount of time for which the server restricts the processing of a single server-side data copy operation.

#### 3.3.1.2 Per Share

**Server.Share.ShareFlags** is a **DWORD** bitmask value that MUST contain zero or more of the values, as specified in [\[MS-SRVS\]](#) section 2.2.2.5.

**Server.Share.IsDfs:** A Boolean that, if set, indicates that this share is configured for DFS. For more information, see [\[MSDFS\]](#).

#### 3.3.1.3 Per SMB Connection

**Server.Connection.GSSNegotiateToken:** A byte array that contains the token received during an extended security negotiation and that is remembered for authentication.

### 3.3.1.4 Per Pending SMB Command

There is no new state introduced per pending SMB command.

### 3.3.1.5 Per SMB Session

**Server.Session.AuthenticationState:** A session can be in one of four states:

- **InProgress:** A session setup (an extended SMB\_COM\_SESSION\_SETUP\_ANDX exchange, as described in section [3.2.4.2.4.1](#)) is in progress for this session for the first time.
- **Valid:** The session is valid and a session key and UID are available for this session.
- **Expired:** The Kerberos ticket for this session has expired and the session needs to be re-established.
- **ReauthInProgress:** A session setup (an extended SMB\_COM\_SESSION\_SETUP\_ANDX exchange, as described in section [3.2.4.2.4.1](#)) is in progress for re-authentication of an expired or valid session.

**Server.Session.SessionKeyState:** The session key state. This can be either Unavailable or Available.

**Server.Session.AuthenticationExpirationTime:** A value that specifies the time at which the session will be expired.

### 3.3.1.6 Per Tree Connect

There is no new state introduced per tree connect.

### 3.3.1.7 Per Unique Open

**Server.Open.GrantedAccess:** The access level granted on this Open.

## 3.3.2 Timers

### 3.3.2.1 Authentication Expiration Timer

The Authentication Expiration Timer, a re-authentication timer, is used to mark an authentication as expired when its authentication-specific expiration time is reached. This timer controls the periodic scheduling of searching for sessions that have passed their Authentication expiration time. The server SHOULD [<98>](#) schedule this timer such that sessions are expired in a timely manner.

## 3.3.3 Initialization

The Authentication Expiration Timer, as specified in section [3.3.2.1](#), MUST be started at system startup. The following values MUST be initialized at system startup:

- **Server.MessageSigningPolicy** and **Server.SupportsExtendedSecurity** MUST be set based on system policy. [<99>](#) The value of this is not constrained by the values of any other policies.
- **Server.MaxCopyChunks** MUST be set to an implementation-specific [<100>](#) default value.
- **Server.MaxCopyChunkSize** MUST be set to an implementation-specific [<101>](#) default value.

- **Server.MaxTotalCopyChunkSize** MUST be set to an implementation-specific<102> default value.
- **Server.CopyChunkTimeOut** MUST be set to an implementation-specific<103> default value.

When an SMB connection is established, the following values MUST be initialized.

- **Server.Connection.GSSNegotiateToken** MUST be empty.

When an SMB session is established on an SMB connection, the following value MUST be initialized:

- **Server.Session.AuthenticationState** MUST be set to InProgress.
- **Server.Session.SessionKeyState** MUST be set to Unavailable.
- **Server.IsDFSCapable** MUST be set to FALSE.
- **Server.Share.IsDfs** MUST be set to FALSE.

All other values are initialized as specified in [\[MS-CIFS\]](#) section 3.3.3.

### 3.3.4 Higher-Layer Triggered Events

#### 3.3.4.1 Sending Any Message

This interface is used internally by the server to send a message to the client. It is not exposed to external callers.

No new global details are presented to a server that sends any message beyond what is specified in [\[MS-CIFS\]](#) section 3.3.4.1.

##### 3.3.4.1.1 Sending Any Error Response Message

In response to an error in the processing of any SMB request, the server SHOULD<104> follow the format as specified in [\[MS-CIFS\]](#) section 3.3.4.1.2.

##### 3.3.4.2 Server Application Queries a User Session Key

The application MUST provide:

- The security context of the user whose session is being sought.
- Either a valid ClientName or a valid **Open**.

The server MUST locate an SMB connection that uses either the application-supplied **ServerName** to look in the **Server.ConnectionTable[ClientName]** or the application-supplied **Open.Connection**. If a valid **Connection** is found, then the server MUST scan for an SMB session in the **Server.Connection.SessionTable** that matches the security context of the user. If no entry is found, then the application request MUST be failed with STATUS\_INVALID\_PARAMETER. If a Session is found but **Server.Session.SessionKeyState** is Unavailable, the request MUST be failed with STATUS\_ACCESS\_DENIED and **ServerStatistics.sts0\_permerrors** MUST be increased by 1. If **Server.Session.SessionKeyState** is Available, then the 16-byte **Server.Session.SessionKey** MUST be returned to the calling application.

### 3.3.4.3 DFS Server Notifies SMB Server That DFS Is Active

In response to this event, the SMB server MUST set the global state variable **Server.IsDfsCapable** to TRUE. If the DFS server is running on this computer, it MUST notify the SMB server that the DFS capability is available via this event.

### 3.3.4.4 DFS Server Notifies SMB Server That a Share Is a DFS Share

In response to this event, the SMB server MUST set the **Server.Share.IsDfs** to TRUE. When a DFS server running on this computer claims a share as a DFS share, it MUST notify the SMB server via this event.

### 3.3.4.5 DFS Server Notifies SMB Server That a Share Is Not a DFS Share

In response to this event, the SMB server MUST clear the **Server.Share.IsDfs** attribute of the share specified in section [3.3.1.2](#).

### 3.3.4.6 Server Application Updates a Share

The calling application MUST provide a share in the **SHARE\_INFO\_503\_I** and **SHARE\_INFO\_1005** structures as input parameters to update an existing share. The server MUST look up the share in **Server.ShareTable** through the tuple <sh1503\_servername, sh1503\_netname>. If the matching share is found, the server MUST update the share as specified in [\[MS-CIFS\]](#) section [3.3.4.10](#) with the following values set; otherwise, the server MUST return an implementation-dependent error.

- **Share.FileSecurity** MUST be set to sh1503\_security\_descriptor.
- **Share.ShareFlags** MUST be set to sh1005\_flags.

### 3.3.4.7 Server Application Requests Querying a Share

The calling application MUST provide the tuple <ServerName, ShareName> of the share that is being queried. The server MUST look up the share in the **Server.ShareTable**. If the matching share is found, the server MUST return a share in the **SHARE\_INFO\_503\_I** and **SHARE\_INFO\_1005** structures to the caller as specified in [\[MS-CIFS\]](#) section [3.3.4.12](#) with the following values set; otherwise, the server MUST return an implementation-dependent error.

Output Parameters	MS-SMB Share Properties
SHARE_INFO_503_I.sh1503_security_descriptor	<b>Server.Share.FileSecurity</b>
SHARE_INFO_1005.sh1005_flags	<b>Server.Share.ShareFlags</b>

## 3.3.5 Message Processing Events and Sequencing Rules

### 3.3.5.1 Receiving Any Message

The following global details are presented to a server that receives any message in addition to what is specified in [\[MS-CIFS\]](#) section [3.3.5.2](#).

#### Signing

If a message is received and **Server.Connection.IsSigningActive** is TRUE the server uses **Server.Connection.ServerNextReceiveSequenceNumber** and the signature MUST be verified, as specified in section [3.1.5.1](#).

The server MUST insert the sequence number for the response to this request into the **Server.Connection.ServerSendSequenceNumber** table with the **PID** and **MID** that identifies the request/response pair. (**PID** and **MID** are specified in [\[MS-CIFS\]](#) section 2.2.1.6.)

If the signature on the received packet is incorrect, then the server MUST return STATUS\_ACCESS\_DENIED (ERRDOS/ERRnoaccess) and **ServerStatistics.sts0\_permerrors** MUST be increased by 1. If the signature on the current message is correct, then the server MUST take the following steps.

```
IF request command EQUALS SMB_COM_NT_CANCEL THEN
    INCREMENT ServerNextReceiveSequenceNumber
ELSE IF request has no response THEN
    INCREMENT ServerNextReceiveSequenceNumber BY 2
ELSE
    SET ServerSendSequenceNumber[PID,MID] TO
        ServerNextReceiveSequenceNumber + 1
    INCREMENT ServerNextReceiveSequenceNumber BY 2
END IF
```

### Session Validation and Re-authentication

If the **SMB\_Header.UID** of the request is zero, then the server does not need to check for the expiry because a session is not being used for this request.

If the **SMB\_Header.UID** of the request is not zero, then the server MUST check the state of the session.

- If **Connection.SessionTable[UID].AuthenticationState** is equal to Expired or ReauthInProgress, and the received message is an SMB\_COM\_SESSION\_SETUP\_ANDX request (indicating a session renewal), the behavior is as specified in section [3.3.5.3](#). For details on how the client handles a session expiration, see section [3.2.5.1](#).
- If **Connection.SessionTable[UID].AuthenticationState** is equal to Expired or ReauthInProgress, and the received message is one of the following requests, the server MUST continue processing the request.
  - SMB\_COM\_CLOSE
  - SMB\_COM\_LOGOFF\_ANDX
  - SMB\_COM\_FLUSH
  - SMB\_COM\_LOCKING\_ANDX
  - SMB\_COM\_TREE\_DISCONNECT

If the received message is not one of the preceding requests, the server SHOULD [<105>](#) fail all operations with STATUS\_NETWORK\_SESSION\_EXPIRED until the session renewal is successful.

- If **Server.Connection.SessionTable** is not empty, **Server.Connection.SessionTable[UID].AuthenticationState** is InProgress, and the received message is not an SMB\_COM\_SESSION\_SETUP\_ANDX request, then the server SHOULD [<106>](#) fail all operations with STATUS\_INVALID\_HANDLE and MUST increase **ServerStatistics.sts0\_permerrors** by 1.
- If **Server.Connection.SessionTable** is not empty, **SMB\_Header.UID** is not found in **Server.Connection.SessionTable**, and the received message is not an

SMB\_COM\_SESSION\_SETUP\_ANDX request, then the server MUST fail all operations with STATUS\_SMB\_BAD\_UID and MUST increase **ServerStatistics.sts0\_permerrors** by 1.

- If **Server.Connection.SessionTable** is empty, then the server SHOULD [<107>](#) disconnect the connection.
- If **Server.Connection.SessionTable[UID].AuthenticationState** is InProgress and the received message is an SMB\_COM\_SESSION\_SETUP\_ANDX request, the behavior is as specified in section [3.3.5.3](#).
- If **Server.Connection.SessionTable[UID].AuthenticationState** is Valid, then the server MUST allow all operations.

### 3.3.5.1.1 Scanning a Path for a Previous Version Token

If a request is a path-based operation (for example, SMB\_COM\_NT\_CREATE\_ANDX) and has SMB\_FLAGS2\_REPARSE\_PATH set in the **Flag2** field of the SMB header, then the server MUST perform a parse of the path by checking for previous version tokens (section [2.2.1.1.1](#)). If the flag is not set, then the server MAY [<108>](#) parse the path anyway.

If a previous version token is found in the pathname, but the file or directory does not exist for the given snapshot, then the server MUST fail the operation with STATUS\_OBJECT\_NAME\_NOT\_FOUND. If the file or directory does exist, then processing continues as normal, except that the execution is against the previous version selected.

If no previous version token is found in the pathname, the server MUST process the path-based operation normally.

### 3.3.5.1.2 Granting Oplocks

The server SHOULD grant oplocks according to the process specified in [\[MS-CIFS\]](#) section 3.3.5.2.7, with the following additions:

- If **Server.Share.ShareFlags** contains the SHI1005\_FLAGS\_FORCE\_LEVELII\_OPLOCK bit as defined in [\[MS-SRVS\]](#) section 2.2.4.29, and the request is for NT\_CREATE\_REQUEST\_OPLOCK or NT\_CREATE\_REQUEST\_OPBATCH oplock, the server SHOULD [<109>](#) downgrade the request and grant a level II oplock.

### 3.3.5.2 Receiving an SMB\_COM\_NEGOTIATE Request

The processing of an [SMB\\_COM\\_NEGOTIATE request](#) is handled as specified in [\[MS-CIFS\]](#) section 3.3.5.42, with the following additions:

#### New Capabilities

The new capabilities flags specified in section [2.2.4.5.1](#) MUST also be considered when setting the **SMB\_Parameters.Words.Capabilities** field of the response based on the **Server.Capabilities** attribute.

#### Generating Extended Security Token

If the client indicated support for extended security by setting SMB\_FLAGS2\_EXTENDED\_SECURITY in the Flags2 field of the SMB header of the SMB\_COM\_NEGOTIATE request, then the server SHOULD set CAP\_EXTENDED\_SECURITY in the SMB\_COM\_NEGOTIATE response if it supports extended security. The response MUST take the form specified in section [2.2.4.5.2](#).



The server SHOULD set the **SecurityBlob** of the SMB\_COM\_NEGOTIATE response to the first GSS token (or fragment thereof) produced by the GSS authentication protocol it is configured to use (GSS tokens are as specified in [\[RFC2743\]](#)). Otherwise, it leaves it empty. This token is also stored in **Server.Connection.GSSNegotiateToken**.

The server MUST initialize its GSS mechanism with the Integrity, Confidentiality, and Delegate options and use the Server-Initiated variation, as specified in [\[RFC4178\]](#). The SMB\_COM\_NEGOTIATE response packet is sent to the client. [<110>](#)

### 3.3.5.3 Receiving an SMB\_COM\_SESSION\_SETUP\_ANDX Request

The processing of an [SMB\\_COM\\_SESSION\\_SETUP\\_ANDX request](#) is handled as specified in [\[MS-CIFS\]](#) section 3.3.5.43 with the following additions: [<111>](#)

#### Storing Client Capabilities

If **Server.Connection.ClientCapabilities** is equal to zero, then the server MUST set **Server.Connection.ClientCapabilities** to the **Capabilities** field that is received in the SMB\_COM\_SESSION\_SETUP\_ANDX request. If **Server.Connection.ClientCapabilities** has already been determined and is nonzero, then the server MUST ignore the capabilities value on subsequent requests.

#### Determine Reauth or Continuation of Previous Auth

If the **SMB\_Header.UID** is not zero, the server MUST obtain the user name:

- If **Server.Connection.SessionTable[UID].UserSecurityContext** is NULL, the server MUST set it to a value representing the user that successfully authenticated this connection. The **UserSecurityContext** MUST be obtained from the GSS authentication subsystem. If it is not NULL, no changes are necessary.
- The server MUST invoke the GSS\_Inquire\_context call as specified in [\[RFC2743\]](#) section 2.2.6, passing **Server.Connection.SessionTable[UID].UserSecurityContext** as the input parameter, and obtain the user name returned in "src\_name".

If the received user name is not equal to **Server.Connection.SessionTable[UID].UserName**, the server MAY fail the session setup and tear down the underlying transport connection.

Otherwise, the server MUST look up the authentication state for this session and take the following actions based on this state.

- If **Server.Connection.SessionTable[UID].AuthenticationState** is InProgress or ReAuthInProgress, then this is a continuation of an authentication in progress. This state indicates that the authentication required multiple roundtrips, and that authentication continues.
- If **Server.Connection.SessionTable[UID].AuthenticationState** is Valid or Expired, then this is the re-authentication of a user. The server MUST set AuthenticationState to ReAuthInProgress and begin a new authentication for this session. The server MUST prevent any further operations from executing on this session until authentication is complete, and fail them with STATUS\_NETWORK\_SESSION\_EXPIRED.
- If there is no session for the provided UID, then the request MUST be failed with STATUS\_SMB\_BAD\_UID.

#### Extended Security

If CAP\_EXTENDED\_SECURITY is set in **Server.Connection.ClientCapabilities**, then the server MUST handle the authentication as defined in this section. Otherwise, it MUST continue to the following NTLM authentication section.

The server MUST extract the GSS token, which is the **SecurityBlob** contained in the request, with a length of **SecurityBlobLength**.<112> The server MUST use the configured GSS authentication protocol to obtain the next GSS output token for the authentication protocol exchange. Note that this token can be 0 bytes in length.

If the GSS mechanism indicates an error that is not STATUS\_MORE\_PROCESSING\_REQUIRED, then the server MUST fail the client request, and return only an SMB header and propagate the failure code. If a **UID** was present in this request, then its associated session MUST be removed from the **Server.Connection.SessionTable**. The authentication has failed and no further processing is done on this request. This error response is sent to the client.

If the GSS mechanism indicates success, then the server MUST create an [SMB\\_COM\\_SESSION\\_SETUP\\_ANDX response \(section 2.2.4.6.2\)](#). The **SecurityBlob** MUST be set to the output token from the GSS mechanism, and **SecurityBlobLength** is set to the length of the output token. SMB\_FLAGS2\_EXTENDED\_SECURITY is set in the **Flags2** field of the SMB header of the response. If the request did not specify a **UID** in the SMB header of the request, then a **UID** MUST be generated to represent this user's authentication and its value MUST be placed in the **UID** field of the SMB header of the response.

If the GSS mechanism indicates that the current output token is the last output token of the authentication exchange based on the return code, as specified in [\[RFC2743\]](#), the **Status** field in the SMB header of the response MUST be set to STATUS\_SUCCESS, and **Server.Connection.SessionTable[UID].AuthenticationState** MUST be set to Valid. If the client sets the CAP\_DYNAMIC\_REAUTH capability in the request or the Kerberos authentication protocol enforces session re-authentication, **Server.Session.AuthenticationExpirationTime** SHOULD<113> be set to the authentication (either NTLM or GSS processing) expiration time returned by the GSS authentication protocol, such as a Kerberos ticket time-out. If this is not the case, **Server.Session.AuthenticationExpirationTime** SHOULD be set to infinity.

Otherwise, the **Status** field in the SMB header of the response MUST be set to STATUS\_MORE\_PROCESSING\_REQUIRED, and **Server.Connection.SessionTable[UID].AuthenticationState** MUST be set to InProgress.

### Activating Signing

If **Server.Connection.IsSigningActive** is FALSE, and the response of the SMB\_COM\_SESSION\_SETUP\_ANDX operation contains STATUS\_SUCCESS, then the server MUST determine whether or not signing can be activated.

If bit zero of the **Action** field of the SMB\_COM\_SESSION\_SETUP\_ANDX response is set, then signing MUST NOT be activated. If the value of this field is one, then the user attempted to log in as a user other than Guest, but could not be authenticated for that account. Using a fallback mechanism on the server, the user is now logged in as Guest.

Otherwise, **Server.Connection.IsSigningActive** MUST be set to TRUE if any of the following conditions are satisfied:

- **Server.MessageSigningPolicy** is Required.
- The SMB\_FLAGS2\_SMB\_SECURITY\_SIGNATURE\_REQUIRED bit in the **Flags2** field of the SMB header of the request is set.

- **Server.MessageSigningPolicy** is Enabled and the SMB\_FLAGS2\_SMB\_SECURITY\_SIGNATURE bit in the **Flags2** field of the SMB header of the request is set.

The server MUST query the authentication protocol, either using NTLM or via GSS API, for the session key used in this authentication, and store it as **Server.Connection.SigningSessionKey**. If CAP\_EXTENDED\_SECURITY is set in **Server.Connection.ClientCapabilities**, then it MUST set **Server.Connection.SigningChallengeResponse** to NULL. If that capability is not set, then it MUST set **Server.Connection.SigningChallengeResponse** to the challenge response received in the SMB\_COM\_SESSION\_SETUP\_ANDX request.

Once these steps are performed, the server MUST sign the SMB\_COM\_SESSION\_SETUP\_ANDX response. The server follows the steps as specified in section 3.1.5 by passing in a sequence number of one.

### Acquire Session Key

If authentication is successful, the server MUST query the session key from the authentication package (as specified in [MS-NLMP] for implicit NTLM and in [RFC4178] for extended security). If the session key is equal to or longer than 16 bytes, only the least significant 16 bytes MUST be stored in **Server.Session.SessionKey**. Otherwise, the session key MUST be stored in **Server.Session.SessionKey** and MUST be padded with zeros up to 16 bytes. The server MUST set **Server.Session.SessionKeyState** to Unavailable.

### Authentication Expiry

If **Server.Session.AuthenticationExpirationTime** expires, the Authentication Expiration Timer marks the **Server.Connection.SessionTable[UID].AuthenticationState** as Expired when the time-out occurs, as specified in 3.3.2.1.

## 3.3.5.4 Receiving an SMB\_COM\_TREE\_CONNECT\_ANDX Request

The processing of an [SMB\\_COM\\_TREE\\_CONNECT\\_ANDX request](#) is handled as specified in [MS-CIFS] section 3.3.5.45 with the following additions: <114>

### Requesting Extended Information

If the TREE\_CONNECT\_ANDX\_EXTENDED\_RESPONSE is set in the **Flags** field of the SMB\_COM\_TREE\_CONNECT\_ANDX request, then the server MUST respond with the structure specified in section 2.2.4.7.2.

The server MUST populate the **SMB\_Parameters.Words.OptionalSupport** field of the response with a value of **Server.Share.OptionalSupport**.

The server SHOULD <115> set SMB\_UNIQUE\_FILE\_NAME bit in the **OptionalSupport** field if **Share.ShareFlags** contains the SHI1005\_FLAGS\_ALLOW\_NAMESPACE\_CACHING constant.

The server MUST calculate the maximal share access rights for the user that requests the tree connect using the following algorithm.

```

MaxRights = 0x00000000
IF Server.Share.FileSecurity == NULL
    MaxRights = 0xFFFFFFFF
ELSE
    FOR EACH AccessBit value defined in section 2.2.1.4
        Compute access for the user, using Server.Share.FileSecurity and
        Server.Session.SecurityContext, as described in [MS-DTYP] section 2.5.2.1.
        IF access was granted

```

```

        MaxRights = MaxRights | AccessBit;
    END IF
END FOR
END IF

```

The computed MaxRights ACCESS\_MASK MUST be placed in the **SMB\_Parameters.Words.MaximalShareAccessRights** of the response. If no access is granted for the client on this share, the server MUST fail the request with STATUS\_ACCESS\_DENIED and MUST increase **ServerStatistics.sts0\_permerrors** by 1.

Using the same algorithm, the **SMB\_Parameters.Words.GuestMaximalAccessRights** field of the response SHOULD <116> be set to the calculated highest access rights the guest account has on this share. Instead of using **Server.Session.SecurityContext**, the server MUST use the guest account's security context. If the system does not support the guest account, then it MUST set **GuestMaximalAccessRights** to zero.

### Session Key Protection

If the client has set the TREE\_CONNECT\_ANDX\_EXTENDED\_SIGNATURE bit in the **Flags** field of the SMB\_COM\_TREE\_CONNECT\_ANDX request, then the server MUST hash the session key of the calling user. This protects the key used for signing by making it unavailable to server-side applications.

The one-way hash MUST be performed on the user session key by using the HMAC-MD5 algorithm, as specified in [\[RFC2104\]](#). The steps are as follows:

1. Take the 16-byte user session key from **Server.Session.SessionKey**.
  - If this is an LM authentication where the session key is only 8 bytes, then zero extend it to 16 bytes.
  - If the session key is more than 16 bytes, then use only the first 16 bytes.
2. Calculate the one-way hash as follows:

```

CALL hmac_md5( SSKeyHash, 256, session key, session key length, digest )
SET user session key = digest

```

The resulting 16-byte digest is treated as the user's new session key and returned to the caller who requests it. SSKeyHash is the well-known constant array that is described in section [2.2.2.5](#).

After the session key has been hashed, the server MUST place the hash into **Server.Session.SessionKey** and set **Server.Session.SessionKeyState** to Available, which allows applications to query the session key. If the TREE\_CONNECT\_ANDX\_EXTENDED\_SIGNATURE bit is not set, then the **Server.Session.SessionKey** is not changed and **Server.Session.SessionKeyState** MUST be set to Available.

### 3.3.5.5 Receiving an SMB\_COM\_NT\_CREATE\_ANDX Request

The processing of an SMB\_COM\_NT\_CREATE\_ANDX request is handled as specified in [\[MS-CIFS\]](#) section 3.3.5.51 with the following additions:

The **ImpersonationLevel** in the request MUST have one of the values specified in section [2.2.4.9.1](#). Otherwise, the server MUST fail the request with STATUS\_BAD\_IMPERSONATION\_LEVEL.

When opening a named pipe, if the **ImpersonationLevel** level is SECURITY\_DELEGATION, the server MUST fail the request with STATUS\_BAD\_IMPERSONATION\_LEVEL.

If during the open processing the underlying object store returns STATUS\_ACCESS\_DENIED as specified in [\[MS-FSA\]](#) section 2.1.5.1, Server Requests an Open of a File, the server MUST fail the request with STATUS\_ACCESS\_DENIED and MUST increase **ServerStatistics.sts0\_permerrors** by 1.

If the underlying object store determines that encryption processing is required as specified in [\[MS-FSA\]](#) section 2.1.5.1 Server Requests an Open of a File, the object store MUST return STATUS\_CS\_ENCRYPTION\_EXISTING\_ENCRYPTED\_FILE if the encrypted file exists or STATUS\_CS\_ENCRYPTION\_NEW\_ENCRYPTED\_FILE if the file to be created will be encrypted, indicating that a UserCertificate is necessary to successfully complete the operation. In these cases, the server SHOULD attempt to obtain a user certificate by invoking the **Application Requests for a User-Certificate Binding** as specified in [\[MS-EFSR\]](#) section 3.1.4.1, passing the **Server.Session.SecurityContext** as the security context of the user. If the enrollment fails, the server MUST fail the request with the resulting error. Otherwise, the server SHOULD repeat the handling as specified in [\[MS-CIFS\]](#) section 3.3.5.51, extended [<117>](#) to additionally pass the returned certificate to the object store as the **UserCertificate** argument.

The server MUST ignore all **CreateOptions** on a named pipe except FILE\_WRITE\_THROUGH, FILE\_SYNCHRONOUS\_IO\_ALERT, and FILE\_SYNCHRONOUS\_IO\_NONALERT.

For a named pipe request, if the client sets FILE\_SYNCHRONOUS\_IO\_ALERT or FILE\_SYNCHRONOUS\_IO\_NONALERT bits in the **CreateOptions** field and does not set the SYNCHRONIZE bit in the **DesiredAccess** field, the server MUST fail the **Open** request with STATUS\_INVALID\_PARAMETER.

On a successful create or open, if the NT\_CREATE\_REQUEST\_EXTENDED\_RESPONSE flag was set in the **Flags** field of the request, the server SHOULD [<118>](#) send an extended response (section [2.2.4.9.2](#)).

If the server sends the new response, it MUST construct a response as specified in section [2.2.4.9.2](#), with the addition of the following rules:

- The server MUST query the underlying object store for file attributes and SHOULD [<119>](#) set the **FileStatusFlags** in the response, in an implementation-specific manner.
- If the underlying object store of the share in which the file is opened or created does not support streams, then the server MUST set the NO\_SUBSTREAMS bit in the **FileStatusFlags** field. [<120>](#)
- The server SHOULD [<121>](#) set the **VolumeGUID** and **FileId** fields to zero.
- The server MUST query the underlying object store for the granted access rights on the returned **Server.Open**. The server MUST use the granted access rights and SHOULD [<122>](#) set the **MaximalAccessRights** and **GuestMaximalAccessRights** fields in an implementation-specific manner. If the file has no security applied, **MaximalAccessRights** MUST be set to 0xFFFFFFFF. The server MUST use **Open.Session.UserSecurityContext** to impersonate the client.

If **Server.IsDfsCapable** is TRUE and **Server.Share.IsDfs** is True, then server MUST invoke the interface defined in [\[MS-DFSC\]](#) section 3.2.4.1 to normalize the pathname by supplying **FileName** as the input parameter. If normalization fails, the server MUST fail the create request with the error code returned by the DFS normalization routine. If the normalization procedure succeeds, returning

an altered target name, the **FileName** field MUST be set to the normalized path name, and used for further operations specified in section in [\[MS-CIFS\]](#) section 3.3.5.51.

### 3.3.5.6 Receiving an SMB\_COM\_OPEN\_ANDX Request

The processing of an SMB\_COM\_OPEN\_ANDX request is handled as specified in [\[MS-CIFS\]](#) section 3.3.5.35 with the following additions:

If during the open processing the underlying object store returns STATUS\_ACCESS\_DENIED as specified in [\[MS-FSA\]](#) section 2.1.5.1.2, Server Requests an Open of an Existing File, the server MUST fail the request with STATUS\_ACCESS\_DENIED and MUST increase **ServerStatistics.sts0\_permerrors** by 1.

If the underlying object store determines that encryption processing is required as specified in [\[MS-FSA\]](#) section 2.1.5.1.2 Open of an Existing File, the object store MUST return STATUS\_CS\_ENCRYPTION\_EXISTING\_ENCRYPTED\_FILE, indicating that a UserCertificate is necessary to successfully complete the operation. In this case, the server SHOULD attempt to obtain a user certificate by invoking the **Application Requests for a User-Certificate Binding** as specified in [\[MS-EFSR\]](#) section 3.1.4.1, passing the **Server.Session.SecurityContext** as the security context of the user. If the enrollment fails, the server MUST fail the request with the resulting error. Otherwise, the server SHOULD repeat the handling as specified in [\[MS-CIFS\]](#) section 3.3.5.35, extended [<123>](#) to additionally pass the returned certificate to the object store as the **UserCertificate** argument.

On a successful open, if the SMB\_OPEN\_EXTENDED\_RESPONSE flag was set in the **Flags** field of the request, then the server SHOULD send an extended response, as specified in section [2.2.4.1.2](#).

If the server chooses to send the new response, then it MUST construct a response as detailed in section [2.2.4.1.2](#). The server MUST query the underlying object store for the granted access rights on the returned **Server.Open**. The server MUST use the granted access rights and SHOULD [<124>](#) set the **MaximalAccessRights** and **GuestMaximalAccessRights** fields in an implementation-specific manner. If the file has no security applied, **MaximalAccessRights** MUST be set to 0xFFFFFFFF. If no access is granted for the client on this share, the server MUST fail the request with STATUS\_ACCESS\_DENIED and MUST increase **ServerStatistics.sts0\_permerrors** by 1.

### 3.3.5.7 Receiving an SMB\_COM\_READ\_ANDX Request

The processing of an SMB\_COM\_READ\_ANDX request is handled as specified in [\[MS-CIFS\]](#) section 3.3.5.36 with the following additions: [<125>](#)

If the read operation is on a named pipe, then the **Timeout\_or\_MaxCountHigh** field MUST be interpreted as the 32-bit **Timeout** field, as specified in section [2.2.4.2.1](#).

If the read operation is on a file, then the **Timeout\_or\_MaxCountHigh** field MUST be interpreted as the 16-bit **MaxCountHigh** field followed by a 16-bit **Reserved** field, as specified in section [2.2.4.2.1](#). The value in **MaxCountHigh** MUST be treated as the two most significant bytes of the count of bytes to read and is combined with the value of **MaxCountOfBytesToReturn** to create a 32-bit count of bytes to read (as specified in section [3.2.4.4](#)). If **MaxCountHigh** is set to 0xFFFF, then the value MUST be ignored, and only the length received in **MaxCountOfBytesToReturn** is used.

It is acceptable to return fewer bytes than requested by the client, with the restriction that reads from named pipes or devices MUST return at least **MinCountOfBytesToReturn** bytes. If the read operation is on a file and the count of bytes to read is greater than or equal to 0x00010000 (64K), then the server MAY [<126>](#) Return the requested number of bytes in the response, set the two least

significant bytes of the count in the **DataLength** field in the response, and the two most significant bytes of the count in the **DataLengthHigh** field (specified in section [2.2.4.2.2](#)).

### 3.3.5.8 Receiving an SMB\_COM\_WRITE\_ANDX Request

The processing of an SMB\_COM\_WRITE\_ANDX request is handled as specified in [\[MS-CIFS\]](#) section 3.3.5.37 with the following additions:

If CAP\_LARGE\_WRITEX is set in **Server.Connection.ClientCapabilities**, then it is possible that the count of bytes to be written is larger than the server's **MaxBufferSize**. The count of bytes to be written is specified in the **DataLength** and **DataLengthHigh** fields sent in the request, as specified in section [2.2.4.3.1](#). If the size of **SMB\_Data.Bytes.Data** is not equal to (**DataLength** | **DataLengthHigh** <<16), the server SHOULD [<127>](#) fail the request and return ERRSRV/ERRerror.

If the server successfully writes data to the underlying object store, then the count of bytes written MUST be set in the **Count** and **CountHigh** fields of the response, as specified in section [2.2.4.3.2](#).

### 3.3.5.9 Receiving an SMB\_COM\_SEARCH Request

The processing of an SMB\_COM\_SEARCH request is handled as specified in [\[MS-CIFS\]](#) section 3.3.5.47, with the following additions:

If the **FileName** field in the request is an empty string, the server SHOULD [<128>](#) return the root directory information in the response.

### 3.3.5.10 Receiving any SMB\_COM\_TRANSACTION2 subcommand

The processing of any SMB\_COM\_TRANSACTION2 subcommand request is handled as specified in [\[MS-CIFS\]](#) section 3.3.5.58 with the following additions:

#### 3.3.5.10.1 Receiving any Information Level

If the server receives client request with a pass-through Information Level (section [2.2.2.3.5](#)) and the server supports the CAP\_INFOLEVEL\_PASSTHRU capability in **Server.Capabilities**, then the server MUST decrement the Information Level value by SMB\_INFO\_PASSTHROUGH by treating the value as little-endian, and pass that value to the underlying object store. If the Information Level includes any request data, then the data MUST also be passed to the underlying object store. [<129>](#)

If the server does not support pass-through Information Levels, then it MUST fail this request with STATUS\_INVALID\_PARAMETER.

The returned status and response data, if any, are sent to the client in a Trans2 subcommand response message that corresponds to the same subcommand that initiated the request.

#### 3.3.5.10.2 Receiving a TRANS2\_FIND\_FIRST2 Request

##### New Information Levels

The server SHOULD allow for the new Information Levels, as specified in section [2.2.2.3.1](#). If the server does not support the new Information Levels, then it MUST fail the operation with STATUS\_NOT\_SUPPORTED. [<130>](#)

##### Enumerating Previous Versions

If a scan for previous version tokens (section [3.3.5.1.1](#)) reveals that the **FileName** of the TRANS\_FIND\_FIRST2 request contains the search pattern @GMT-\* and the requested Information

Level is SMB\_FIND\_FILE\_BOTH\_DIRECTORY\_INFO, then the server MAY [<131>](#) choose to return an enumeration of previous versions that are valid for the share. It does this by manufacturing a file entry for each previous version, as defined in section [2.2.8.1.1](#). If the server chooses not to do this, then the enumeration MUST be processed as a normal TRANS2\_FIND\_FIRST2 operation.

### **3.3.5.10.3 Receiving a TRANS2\_FIND\_NEXT2 Request**

#### **New Information Levels**

If the query is started using one of the new Information Levels, as specified in section [2.2.2.3.1](#), then the same Information Level structure MUST be used for the return of subsequent entries in the enumeration continuation.

#### **Enumerating Previous Versions**

Likewise, a query for previous version information that is started MUST be continued at the client's request with further entries generated, as defined in section [3.3.5.10.1](#).

### **3.3.5.10.4 Receiving a TRANS2\_QUERY\_FILE\_INFORMATION Request**

#### **Pass-through Information Levels**

If the client requests a pass-through Information Level, then the processing follows as specified in section [3.3.5.10.1](#).

### **3.3.5.10.5 Receiving a TRANS2\_QUERY\_PATH\_INFORMATION Request**

#### **Pass-through Information Levels**

If the client requests a pass-through Information Level, then the processing follows as specified in section [3.3.5.10.1](#).

### **3.3.5.10.6 Receiving a TRANS2\_SET\_FILE\_INFORMATION Request**

#### **Pass-through Information Levels**

If the client requests a pass-through Information Level, then the processing follows as specified in section [3.3.5.10.1.<132>](#)

### **3.3.5.10.7 Receiving a TRANS2\_SET\_PATH\_INFORMATION Request**

#### **Pass-through Information Levels**

If the client requests a pass-through Information Level, then the processing follows as specified in section [3.3.5.10.1.<133>](#)

### **3.3.5.10.8 Receiving a TRANS2\_QUERY\_FS\_INFORMATION Request**

#### **Pass-through Information Levels**

If the client requests a pass-through Information Level, then the processing follows as specified in section [3.3.5.10.1](#).



### 3.3.5.10.9 Receiving a TRANS2\_SET\_FS\_INFORMATION Request

The server MAY support setting file system information. If the server does not support setting file system information, then it MUST fail the request with STATUS\_ACCESS\_DENIED.

If the client requests a pass-through Information Level, then processing follows as specified in section [3.3.5.10.1](#).

There is no way to know if a server file system supports a given Information Level. From a protocol perspective, if a client issues a request and it fails with STATUS\_NOT\_SUPPORTED, then it MUST be inferred that the server file system does not support the request.

### 3.3.5.11 Receiving any SMB\_COM\_NT\_TRANSACT Subcommand

The processing of any SMB\_COM\_NT\_TRANSACT subcommand request is handled as specified in [\[MS-CIFS\]](#) section 3.3.5.59 with the following additions specified in section [3.3.5.11.1](#).

#### 3.3.5.11.1 Receiving an NT\_TRANSACT\_IOCTL Request

The NT\_TRANSACT\_IOCTL extensions listed in section [2.2.7.2.1](#) are not directly passed to the underlying object store. Instead, processing is as specified in the following sections.

If the IsFsctl field is set to zero, the server SHOULD [<134>](#) fail the request with STATUS\_NOT\_SUPPORTED.

When the server receives a pass-through FSCTL request, the server SHOULD [<135>](#) pass it through to the underlying object store.

When the server receives an undefined FSCTL or IOCTL operation request that does not meet the private FSCTL requirements of [\[MS-FSCC\] 2.3](#), the server MUST NOT pass the request to the underlying object store and MUST fail the request with STATUS\_NOT\_SUPPORTED.

#### 3.3.5.11.1.1 Receiving an FSCTL\_SRV\_ENUMERATE\_SNAPSHOTS Function Code

This is a request to enumerate the available previous versions for a share. The server MUST return an enumeration of available previous versions, as specified in section [2.2.7.2.2](#). The **NumberOfSnapshots** MUST contain the total number of previous versions that are available for the volume and **NumberOfSnapshotsReturned** contains the number of entries that are returned in this enumeration. If **MaxDataCount** is not large enough to hold all of the entries, then the server SHOULD return zero entries. The value returned in **SnapshotArraySize** MUST be the size required to receive all of the available previous versions. If the **MaxDataCount** of the request is smaller than the size of an FSCTL\_SRV\_ENUMERATE\_SNAPSHOTS response, then the server MUST fail the request with STATUS\_INVALID\_PARAMETER. When sending the response to the client, the server SHOULD NOT [<136>](#) include any additional data after NT\_Trans\_Data in the FSCTL\_SRV\_ENUMERATE\_SNAPSHOTS response (as specified in section [2.2.7.2.2.1](#)) and the client MUST ignore any additional data on receipt.

If the server does not support this operation, then it SHOULD fail the request with STATUS\_NOT\_SUPPORTED.

#### 3.3.5.11.1.2 Receiving an FSCTL\_SRV\_REQUEST\_RESUME\_KEY Function Code

This is a request for an opaque copychunk resume key for use in an FSCTL\_SRV\_COPYCHUNK operation. The server MUST generate a 24-byte value that is used to uniquely identify the open of the file against which this operation is executed.

If this operation is successful, then the server MUST construct an FSCTL\_SRV\_REQUEST\_RESUME\_KEY response as specified in section [2.2.7.2.2](#), with the following additional requirements:

The **CopychunkResumeKey** field MUST be the server-generated value.

If the generation of the Copychunk Resume Key fails, the server MUST fail the request with STATUS\_INVALID\_PARAMETER.

If the server does not support this operation, then it MUST fail the request with STATUS\_NOT\_SUPPORTED.

### 3.3.5.11.1.3 Receiving an FSCTL\_SRV\_COPYCHUNK Request

This is a request for a server-side data copy as specified in section [2.2.7.2.1](#). The server MUST identify the source file based on the copychunk resume key field of the FSCTL\_SRV\_COPYCHUNK request. This copychunk resume key is a value that was returned by the server from an FSCTL\_SRV\_REQUEST\_RESUME\_KEY operation. If the copychunk resume key is not valid or does not represent an open file, then the server MUST fail the operation with STATUS\_OBJECT\_NAME\_NOT\_FOUND. If the file represented by the resume key is not opened for read-data access, then the server MUST fail the operation with STATUS\_ACCESS\_DENIED. Likewise, the target file MUST be specified by the Fid in the SMB\_COM\_NT\_TRANSACTION request. If the target file is not opened for write-data access, then the server MUST fail the operation with STATUS\_ACCESS\_DENIED and **ServerStatistics.sts0\_permerrors** MUST be increased by 1.

The server MUST validate that the amount of data to be written is within the server's configured bounds. If the server determines that the total chunk count is more than **Server.MaxCopyChunks**, or the size of any chunk is more than **Server.MaxCopyChunkSize**, or the total size of all chunks exceeds **Server.MaxTotalCopyChunkSize**, the server MUST fail the request with STATUS\_INVALID\_PARAMETER and return a response as specified in section [2.2.7.2.2](#).

The server MUST iterate through the data ranges specified in the request by reading data from the source offset of the source file and writing it to the target offset of the target file. If the underlying object store returns a failure, then the server MUST stop and set the response parameters, as specified in section [2.2.7.2.2](#), to indicate how much data was successfully written, and set the **Status** field of the header with the error code received.

If the processing of FSCTL\_SRV\_COPYCHUNK operation is completed before **Server.CopyChunkTimeOut**, the server MUST return the FSCTL\_SRV\_COPYCHUNK response as specified in section [2.2.7.2.2](#) with the following values and Status field of the header set to STATUS\_SUCCESS:

- **ChunksWritten** is set to the number of copychunk operations requested by the client.
- **ChunkBytesWritten** is set to zero.
- **TotalBytesWritten** is set to the total number of bytes written to the destination file.

If the processing of FSCTL\_SRV\_COPYCHUNK operation is not completed before **Server.CopyChunkTimeOut**, the server MUST fail the call with **Status** field of the header set to STATUS\_IO\_TIMEOUT and return the FSCTL\_SRV\_COPYCHUNK response as specified in section [2.2.7.2.2.2](#) with the following values:

- **ChunksWritten** is set to the number of copychunk operations performed by the server within the time specified by **Server.CopyChunkTimeOut**.
- **ChunkBytesWritten** is set to zero.

- **TotalBytesWritten** is set to the total number of bytes written to the destination file within the time specified by **Server.CopyChunkTimeout**.

If the server does not support this operation, then it MUST fail the request with STATUS\_NOT\_SUPPORTED.

### 3.3.5.11.2 Receiving an NT\_TRANS\_QUERY\_QUOTA Request

The server MUST query the underlying object store, in an implementation-specific manner, to enumerate the quota information for the list of SIDs specified in the **SidList** field, on which the file or directory indicated by the **Server.Open** identified by the **SMB\_Parameters.Words.Setup.FID** field of the request resides. <137> If the underlying object store does not support quotas, then the server MUST return STATUS\_NOT\_SUPPORTED.

The server MUST return as much of the available quota information that is able to fit in the maximum response buffer size denoted by **MaxDataCount**. If the entire quota information cannot fit in the response buffer, then the server MUST return a status of STATUS\_BUFFER\_TOO\_SMALL. Otherwise, the server MUST return STATUS\_SUCCESS. The format of the request determines which entries need to be returned, as specified in section 2.2.7.5.1. The server MUST place the quota information in the response, as specified in section 2.2.7.5.2, and send the response back to the client.

### 3.3.5.11.3 Receiving an NT\_TRANS\_SET\_QUOTA Request

The server MUST attempt to apply the provided quota information to the underlying object store on which the file or directory indicated by the **Fid** resides, in an implementation-specific manner. <138> If the underlying object store does not support quotas, then the server MUST return STATUS\_NOT\_SUPPORTED.

The server MUST apply the quota information provided in the **NT\_Trans\_Data** block of the request (see section 2.2.7.6.1).

The resulting success or error received from the underlying object store MUST be returned in the response, as specified in section 2.2.7.6.2.

### 3.3.5.11.4 Receiving an NT\_TRANSACT\_CREATE Request

The processing of this subcommand request is handled as specified in [MS-CIFS] section 3.3.5.59.1 with the following exception.

If the **MaxParameterCount** field of the **SMB\_COM\_NT\_TRANSACT** request contains a value that is less than the size of the **NT\_TRANSACT\_CREATE** Response as specified in section 2.2.7.1.2, the server SHOULD <139> fail the request with STATUS\_INVALID\_SMB (ERRSRV/ERRerror).

## 3.3.6 Timer Events

### 3.3.6.1 Authentication Expiration Timer Event

When the Authentication Expiration Timer expires, the server MUST scan all sessions and it MUST set **Server.Connection.SessionTable[UID].AuthenticationState** to *Expired*, for which the **Server.Connection.SessionTable[UID].AuthenticationState** is valid and **Server.Session.AuthenticationExpirationTime** has passed, as specified in section 3.3.5.3.

### 3.3.7 Other Local Events

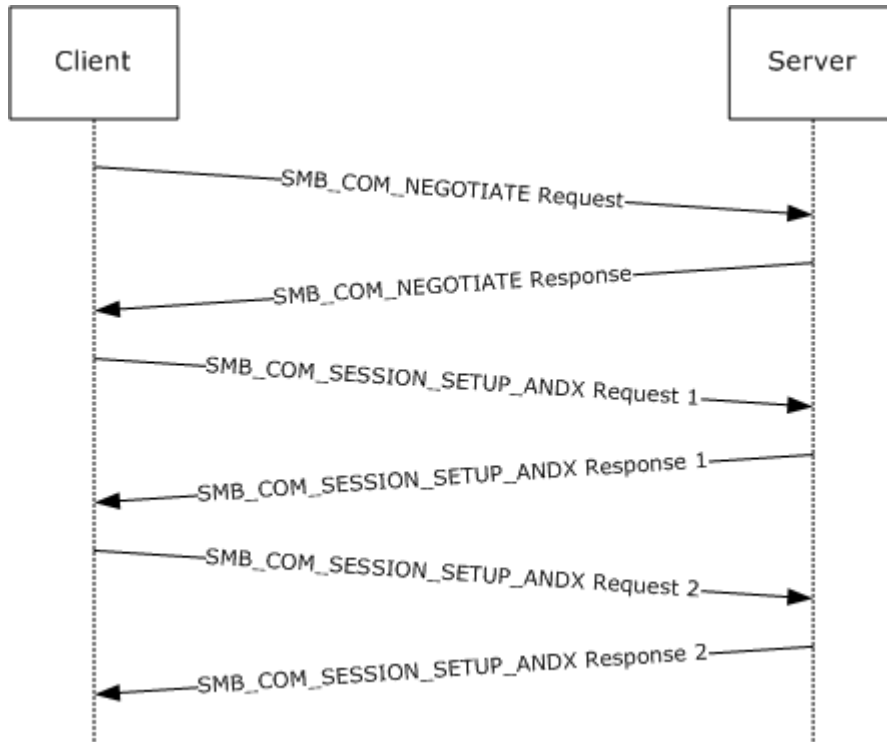
There are no new server local events other than those specified in [\[MS-CIFS\]](#) section 3.3.7.

## 4 Protocol Examples

The following sections describe common scenarios that indicate normal traffic flow on the wire in order to illustrate the extensions to **CIFS** that are specified in this document.

### 4.1 Extended Security Authentication

The following diagram depicts the protocol message sequence for a multi-phase extended security exchange and previous versions enumeration and access on the share root folder.



**Figure 4: User authentication and session establishment sequence**

Descriptions of the fields in this example are specified in [\[MS-CIFS\]](#) and section [2.2.4.1](#). Fields that are shown and highlighted in bold text are relevant to this extension. It is assumed that the client has successfully established a network connection with the server.

The client initiates the first message with an [SMB\\_COM\\_NEGOTIATE request](#), as specified in [\[MS-CIFS\]](#). The client specifies extended security negotiation in the header **Flags2** field. It also includes NT LM 0.12 in the dialect strings list. The server constructs an extended [SMB\\_COM\\_NEGOTIATE response](#) packet that is denoted by the *WordCount* field. The server returns dialect index, its capabilities, GUID value, and the initial security binary large object (BLOB) obtained, as specified in [\[RFC2743\]](#) and defined in the preceding figure.

FRAME 1. Client negotiate request

```
Client -> Server: Command = SMB_COM_NEGOTIATE
Flags2 Summary = 51207 (0xC807)
1100 1000 0000 0111
.... 1... .... = Extended security negotiation is supported
```

```
Dialect Strings
PC NETWORK PROGRAM 1.0
LANMAN1.0
Windows for Workgroups 3.1a
LM1.2X002
LANMAN2.1
NT LM 0.12
```

## FRAME 2. Server negotiate response

```
Server -> Client: Command = SMB_COM_NEGOTIATE
NT status code = 0x0, STATUS_SUCCESS
Word count = 17
Protocol Index = 5 (NT LM 0.12)
Capabilities = 2147607549 (0x8001F3FD)
1000 0000 0000 0001 1111 0011 1111 1101
.... .... = Supports Pass-Thru levels
1... .... = Supports extended security
Server GUID = 01 B3 1E 23 07 2A A4 4D A1 9F B6 69 F0 45 71 90
Security Blob in payload
```

The client uses the initial security BLOB that is returned by the server along with any user credential information in order to obtain its security BLOB, as specified in [\[RFC2743\]](#) and defined in section [3.2.4.2.4](#). The resulting security BLOB is sent to the server as part of the [SMB\\_COM\\_SESSION\\_SETUP\\_ANDX extended request](#). The client also sends its capabilities and zero **UID** to mark the start of a new session setup exchange. The server verifies that the client requests extended security by checking the **Flags2** and **Capabilities** fields in the request, accepts as input the client security BLOB, and processes it, as specified in [\[RFC2743\]](#). In this case, the security package requires more processing and returns a second security BLOB to be returned to the client. Also, the server allocates a new UID and associates it with this session setup exchange.

**Note** Extended security may require multiple request and response exchanges between client and server to complete. The **UID** is defined by the server on first response to an extended session setup and is used for the lifetime of the session.

## FRAME 3. Client request for extended session setup

```
Client -> Server: Command = SMB_COM_SESSION_SETUP_ANDX
Header: Tid = 0x0000 Mid = 0x0070 Uid = 0x0000
Flags2 Summary = 51207 (0xC807)
1100 1000 0000 0111
.... 1... = Supports extended security
Word count = 12
Capabilities = 0xA0000000
1010 0000 0000 0000 0000 0000 0000 0000
..1. .... = Supports dynamic reauth
1... .... = Requests extended security
Security Blob Length = 74 (0x4A)
Security Blob in payload
```

#### FRAME 4. Server response with session setup continuation

```
Server -> Client: Command = SMB_COM_SESSION_SETUP_ANDX
NT status code = 0xC0000016, STATUS_MORE_PROCESSING_REQUIRED
Header: Tid = 0x0000 Mid = 0x0070 Uid = 0x0802
Flags2 Summary = 51207 (0xC807)
  1100 1000 0000 0111
  .... 1... .... .... = Extended security negotiation is supported
Security Blob Length = 349 (0x15D)
      Security Blob in payload
```

The client accepts as input the server security BLOB and processes it, as specified in [RFC2743](#), and its output is returned to the server along with the UID. The server uses the **UID** value to associate this request with the pending session establishment. The server processes this request, as specified in [RFC4178](#), and receives a success result. At this point, the SMB\_SESSION\_SETUP\_ANDX exchange is complete because the status code is not equal to STATUS\_MORE\_PROCESSING\_REQUIRED. The final security BLOB is returned with the success indication.

#### FRAME 5. Client session setup request continuation

```
Client -> Server: Command = SMB_COM_SESSION_SETUP_ANDX
Header: Tid = 0x0000 Mid = 0x0080 Uid = 0x0802
Flags2 Summary = 51207 (0xC807)
  1100 1000 0000 0111
  .... 1... .... .... = Extended security negotiation is supported
Word count = 12
Security Blob Length = 226 (0xE2)
      Security Blob in payload
```

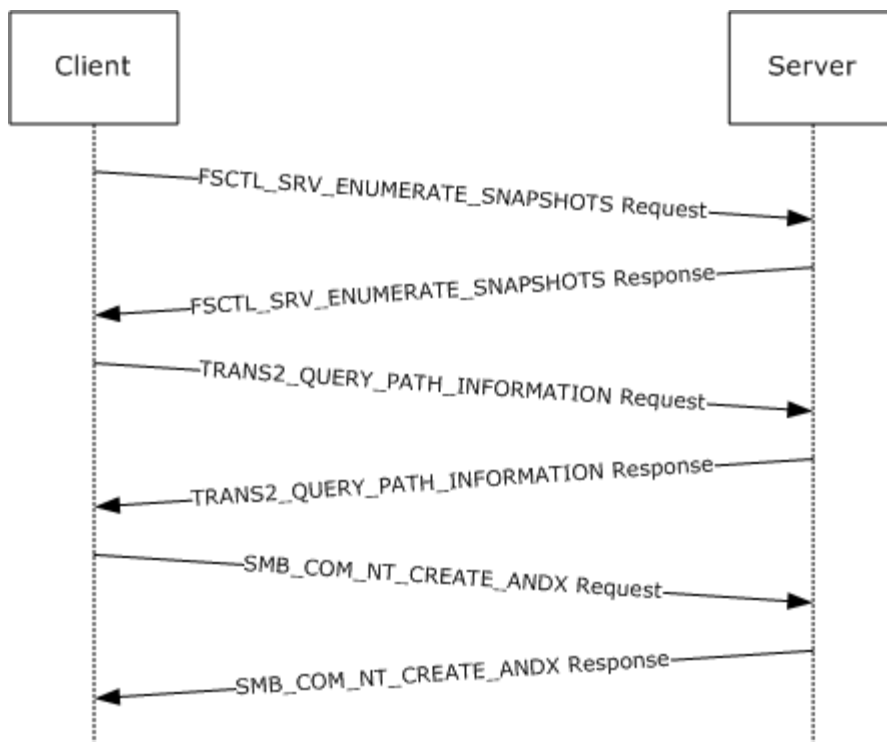
#### FRAME 6. Server response with session setup completion

```
Server -> Client: Command = SMB_COM_SESSION_SETUP_ANDX
NT status code = 0x0, STATUS_SUCCESS
Header: Tid = 0x0000 Mid = 0x0080 Uid = 0x0802
Security Blob Length = 9 (0x9)
Security Blob in payload
```

At this point, the client has been successfully authenticated.

## 4.2 Previous File Version Enumeration

The following example shows how the client accesses a previous version of the share root folder. It is assumed that the client has already authenticated, established a tree connect to the target share, and opened a handle to the root directory, as specified in [MS-CIFS](#). Thus, Frame 1 is not truly the first frame for the connection, but it is referred to as the starting point for this operation.



**Figure 5: Previous file version enumeration sequence**

The first step is to enumerate the list of available snapshots on the server by using the FSCTL\_SRV\_ENUMERATE\_SNAPSHOT command. The client requests the list of snapshots that are available on the server by using the root handle Fid. The server returns the list of snapshots in the format that is defined in the preceding figure. In this example, the server has one snapshot total for the root folder, the payload contains one snapshot string, the payload size is 0x34 bytes, and the snapshot name is @GMT-2006.04.26-04-08-27. The last 2 bytes of the payload are the snapshot strings 16-bit Unicode NULL delimiter.

**FRAME 1. Client requests FSCTL\_SRV\_ENUMERATE\_SNAPSHOTS**

```

Client -> Server: Command = SMB_COM_NT_TRANSACT
NT IOCTL Function Code 0x00144064 FSCTL_SRV_ENUMERATE_SNAPSHOTS
File ID (Fid) = 16391 (0x4007)
  
```

**FRAME 2. Server response with list of snapshots**

```

Server -> Client: Command = SMB_COM_NT_TRANSACT
NT status code = 0x0, STATUS_SUCCESS
Payload contained in Data buffer as defined in section 3.1.5.4:
00090: 01 00 00 00 01 00 00 00 34 00 00 00 40 00 .....4...@.
000A0: 47 00 4D 00 54 00 2D 00 32 00 30 00 30 00 36 00 G.M.T.-.2.0.0.6.
000B0: 2E 00 30 00 34 00 2E 00 32 00 36 00 2D 00 30 00 ..0.4...2.6.-.0.
000C0: 34 00 2E 00 30 00 38 00 2E 00 32 00 37 00 00 00 4...0.8...2.7...
000D0: 00 00
  
```



The client uses standard SMB commands to access the snapshot. The client also indicates in the header **Flags2** that the name in the request is tokenized with the previous version information. This indicates to the server that the client is accessing a previous version of the path. The server processes the request and returns the path information for the snapshot directory rather than to the current directory.

### FRAME 3. Client requests path information for snapshot 2006/04/26 04:08:27 AM

```
Client -> Server: Command = SMB_COM_TRANSACTION2
Flags2 Summary = 52231 (0xCC07)
 1100 1100 0000 0111
 .... .1.. .... .... = File name is tokenized with Previous
Version Information
Transact2 function = Query path info
File name =\@GMT-2006.04.26-04.08.27
00080:                                     5C 00 40 00
.....\.@.
00090: 47 00 4D 00 54 00 2D 00 32 00 30 00 30 00 36 00   G.M.T.-.2.0.0.6.
000A0: 2E 00 30 00 34 00 2E 00 32 00 36 00 2D 00 30 00   ..0.4...2.6.-.0.
000B0: 34 00 2E 00 30 00 38 00 2E 00 32 00 37 00 00 00   4...0.8...2.7...
```

### FRAME 4. Server response with snapshot path information

```
Server -> Client: Command = SMB_COM_TRANSACTION2
NT status code = 0x0, STATUS_SUCCESS
Data bytes = 40 (0x28)
```

### Payload contains path information for specified snapshot version

Similar to its behavior during the query path exchange, the client specifies the previous version of the root folder in an open request. The server processes the request and returns an Fid for the specified previous version of the path.

### FRAME 5. Client open request for version 2006/04/26 04:08:27 AM on "\"

```
Client -> Server: Command = SMB_COM_NT_CREATE_ANDX
Flags2 Summary = 52231 (0xCC07)
 1100 1100 0000 0111
 .... .1.. .... .... = File name is tokenized with Previous
Version Information
Create Disposition = Open: If exist, Open, else fail
File name =\@GMT-2006.04.26-04.08.27
```

### FRAME 6. Server open root folder and returns Fid

```
Server -> Client: Command = SMB_COM_NT_CREATE_ANDX
NT status code = 0x0, STATUS_SUCCESS
File ID (Fid) = 16392 (0x4008)
Create Action = File Opened
```

These similar steps can be used to open a file rather than a directory on a remote volume. In that case, the @GMT token is contained in the relative path, such as \directory\@GMT-2006.04.26-04.08.27\file.txt. This path can be used to query attributes or to open a file. The resulting Fid is used to read its contents.

Likewise, the @GMT token path in the example can be used as part of a TRANS2\_FIND\_FIRST2 and TRANS2\_FIND\_NEXT2 to enumerate the contents of the volume at the time of the snapshot.

### 4.3 Message Signing Example

The following is the sequence of events that is related to SMB message authentication. In the following scenario, as specified in [\[RFC4178\]](#), authentication is used between the client and the server. The client and server are both configured not to require SMB signing; however, both are capable of using SMB signing. This also applies to the figure in section [4.1](#); however, the parameters significant to signing a negotiation are called out.

1. The client sends an [SMB\\_COM\\_NEGOTIATE request](#) to the server.

```
Client -> Server: SMB: C negotiate, Dialect = NTLM 0.12
SMB Flags2 contains 0xC843
1... .. = Unicode Strings: Strings are Unicode
.1.. .. = Error Code Type: Error codes are NT error codes
..0. .. = Execute-Only Reads: Do not permit reads if execute-only
...0 .. = Dfs: Do not resolve pathnames with Dfs
.... 1... .. = Extended security negotiation is supported
.... .. .1.. .. = Long Names Used
.... .. .. .0.. = Security signatures are not supported
.... .. .. .1. = Extended Attributes: Extended attributes are supported
.... .. .. ...1 = Long Names Allowed
Security Signature is not set (the value is 00 00 00 00 00 00 00
00).
SECURITY_SIGNATURE: Bit2 (not set)
```

No **SecuritySignature** is generated at this stage.

2. The client receives an [SMB\\_COM\\_NEGOTIATE response](#) SMB from the server.

```
Server -> Client: SMB: R negotiate, Dialect # = 5
SMB Flags2 contains 0xC853
Binary: 00000000 00000000 11001000 01010011
          ^         ^ ^
SECURITY_SIGNATURE: Bit2: (not set)
Security Signature is not set (the value is 00 00 00 00 00 00 00 00).
```

No **SecuritySignature** is generated at this stage.

3. The client builds an [SMB\\_COM\\_SESSION\\_SETUP\\_ANDX request](#) SMB and sends it to the server.

In the SessionSetupAndX SMB, an authentication request, such as an NTLM or NTLMv2 Challenge/Response or a Kerberos ticket, is sent from the client to the server.

At this stage, the SessionKey is not yet available.

```
Client -> Server: SMB: C session setup & X
SMB Flags2 contains 0xC807
Binary: 00000000 00000000 11001000 00000111
          ^         ^         ^
```

```
SECURITY_SIGNATURE: Bit2 (set)
```

After the packet is sent by the client, the sequence number is incremented to 1, which is the expected sequence number for the response packet from the server.

4. The server processes the request and sends an [SMB\\_COM\\_SESSION\\_SETUP\\_ANDX response](#) to the client.

It is possible that multiple roundtrips of SessionSetupAndX can be required to complete a given authentication. If STATUS\_MORE\_PROCESSING\_REQUIRED is returned, then the implementer would return to the previous step and repeat. The following example demonstrates what happens when STATUS\_SUCCESS is returned. Similarly, if this authentication was for Anonymous or Guest, then signing would not be activated at this time.

```
Server -> Client: SMB: R session setup & X
SMB Flags2 contains 0xC807
Binary: 00000000 00000000 11001000 00000111
          ^         ^
```

```
SECURITY_SIGNATURE: Bit2 (set)
```

The server sets the sequence number to 1 for the response packet and generates the **SecuritySignature** as follows.

The server places the sequence number (1) in the **SecuritySignature** field of the SMB header, and an MD5 hash is performed on the SessionKey + SMB packet. This results in a 16-byte value. The first 8 bytes of the computed hash (AB 44 C4 76 45 84 1A 6A) are placed in the **SecuritySignature** field and sent to the client.

```
00000: 00 11 43 02 26 E6 00 C0 4F 60 2E 45 08 00 45 00  ..C.&f.@O'.E..E.
00010: 01 78 85 60 40 00 80 32 F6 4B AC 1B 92 B9 AC 1B  .x&'@.,2vK,9,.
00020: 92 B7 88 F2 96 BD 00 00 00 14 01 BD 05 48 8B A1  "Fr=.....=H9!
00030: 8F 6C C1 3F C0 39 50 18 FF F0 84 70 00 00 00 00  1A?@9P.pp....
00040: 01 2F FF 53 4D 42 73 00 00 00 00 98 07 C8 00 00  ./SMBs.....\H..
```

```

00050: >AB 44 C4 76 45 84 1A 6A<00 00 00 00 FF FE 00 08 +DDvE.j....~..
00060: 40 00 04 FF 00 2F 01 00 00 A2 00 04 01 A1 81 9F @.../..."...!x
00070: 30 81 9C A0 03 0A 01 00 A1 0B 06 09 2A 86 48 82 0S
.....!...* H

```

After the server sends the packet, the sequence number is incremented to 2, which is the expected sequence number for the next SMB packet from the client.

5. The client processes the response and obtains the SessionKey.

```

SMB Flags2 contains 0xC807
Binary: 00000000 00000000 11001000 00000111
                ^      ^
SECURITY_SIGNATURE: Bit2 (set)

```

The expected sequence number is 1 for the response packet from the server.

The client saves the **SecuritySignature** in the response packet. The expected sequence number (1) is placed in the **SecuritySignature** field of the SMB header, and an MD5 hash is performed on the SessionKey SMB packet. This results in a 16-byte value. The first 8 bytes of the computed hash are compared with the one sent by the server (AB 44 C4 76 45 84 1A 6A) to validate the SMB packet. For the SessionKey that is used for signing when Kerberos is used, see [\[MS-KILE\]](#) section 3.1.1.2, Cryptographic Material.

6. The client proceeds further and sends an [SMB\\_COM\\_TREE\\_CONNECT\\_ANDX request](#) SMB.

```
Client -> Server: SMB: C tree connect & X, Share
```

The client sequence number is now incremented. The new value is 2.

The sequence number (2) is placed in the **SecuritySignature** field of the SMB header, and an MD5 hash is performed on the 16-byte SessionKey + SMB packet. This results in a 16-byte value. The first 8 bytes (in this case, A5 B0 43 DC 07 51 0F 8B) are placed in the **SecuritySignature** field in the SMB header and then sent to the server.

```

00000: 00 C0 4F 60 2E 45 00 11 43 02 26 E6 08 00 45 00 .@O'.E..C.&f..E.
00010: 00 98 21 48 40 00 80 32 5B 44 AC 1B 92 B7 AC 1B .\!H@.,,2[D,.,.
00020: 92 B9 C4 70 3D 34 00 00 00 1C 05 48 01 BD C1 3F 9Dp=4.....H.=A?
00030: C0 39 8B A1 90 9F 50 18 42 EF D0 D6 00 00 00 00 @99!xP.BoPV....
00040: 00 54 FF 53 4D 42 75 00 00 00 00 18 07 C8 00 00 .TSMBu.....H..
00050: >A5 B0 43 DC 07 51 0F 8B<00 00 00 00 FF FE 00 08 %0C\.Q.9....~..
00060: 80 00 04 FF 00 54 00 0C 00 01 00 29 00 00 5C 00 ,...T.....)\.
00070: 5C 00 4D 00 4F 00 48 00 41 00 4B 00 34 00 31 00 \.M.O.H.A.K.4.1.

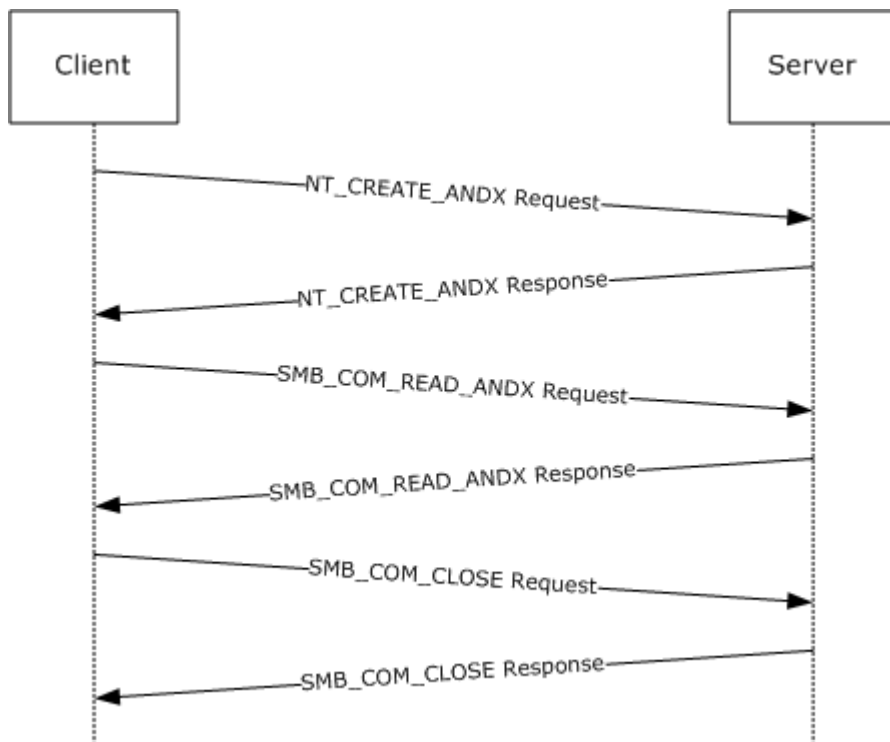
```

The sequence continues until the session is terminated.

In the case where extended security is not used, the same process is followed. However, the MD5 hash is performed on the 16-byte session key + NTLM challenge response + SMB packet with the appropriate sequence number. The NTLM challenge response is the authentication that is received in the SMB\_COM\_SESSION\_SETUP\_ANDX request in the **UnicodePassword** field if NTLM was used for authentication, or in the **OEMPassword** field if LM authentication was used.

#### 4.4 Copy File (Remote to Local)

The following example illustrates the sequence of operations during the copying of a file from a remote location to the local machine. The example assumes that the connection establishment and session management have already taken place.



**Figure 6: Copy file (remote to local) sequence**

In the preceding diagram, the first frame is to open the remote file for read access. The subsequent frames read the data from the file, and then close the file. In between the read and the close, the data is written to the local file.

#### NT\_CREATE\_ANDX

```

Client -> Server: SMB: C NT Create Andx, Dialect = NTLM 0.12
SMB: Tree ID      (Tid) = 2049 (0x801)
SMB: Process ID   (Pid) = 3592 (0xE08)
SMB: User ID      (Uid) = 2048 (0x800)
SMB: Multiplex ID (Mid) = 1712 (0x6B0)
SMB: Command = C NT create & X
      SMB: Desired Access = 0x00000089
          SMB: .....1 = Read Data Allowed
          SMB: .....0 = Write Data Denied
  
```

```

SMB: .....0.. = Append Data Denied
SMB: .....1... = Read EA Allowed
SMB: .....0.... = Write EA Denied
SMB: .....0..... = File Execute Denied
SMB: .....0..... = File Delete Denied
SMB: .....1..... = File Read Attributes Allowed
SMB: .....0..... = File Write Attributes Denied
SMB: NT File Attributes = 0x00000080
SMB: .....0 = Not Read Only
SMB: .....0. = Not Hidden
SMB: .....0.. = Not System
SMB: .....0... = Not Directory
SMB: .....0.... = Not Archive
SMB: .....0..... = Not Device
SMB: .....1..... = Normal
SMB: .....0..... = Not Temporary
SMB: .....0..... = Not Sparse File
SMB: .....0..... = Not Reparse Point
SMB: .....0..... = Not Compressed
SMB: .....0..... = Not Offline
SMB: .....0..... =
CONTENT_INDEXED
SMB: .....0..... = Not Encrypted
SMB: File Share Access = 0x00000003
SMB: .....1 = Read allowed
SMB: .....1. = Write allowed
SMB: .....0.. = Delete not
allowed
SMB: Create Disposition = Open: If exist, Open, else fail
SMB: Create Options = 68 (0x44)
SMB: .....0 = non-directory
SMB: .....0. = non-write through
SMB: .....1.. = Data must be written to the file
sequentially
SMB: .....0... = intermediate buffering allowed
SMB: .....0.... = IO alerts bits not set
SMB: .....0..... = IO non-alerts bit not set
SMB: .....1..... = Operation is on a non-directory file
SMB: .....0..... = tree connect bit not set
SMB: .....0..... = complete if oplocked bit is not set
SMB: .....0..... = no EA knowledge bit is not set
SMB: .....0..... = 8.3 filenames bit is not set
SMB: .....0..... = random access bit is not set
SMB: .....0..... = delete on close bit is not set
SMB: .....0..... = open by filename
SMB: .....0..... = open for backup bit not set
SMB: File name =\filename.txt

```

## NT\_CREATE\_ANDX Response

```

Server -> Client: SMB: C NT Create Andx, Dialect = NTLM 0.12
SMB: Tree ID (Tid) = 2049 (0x801)
SMB: Process ID (Pid) = 3592 (0xE08)
SMB: User ID (Uid) = 2048 (0x800)
SMB: Multiplex ID (Mid) = 1712 (0x6B0)
SMB: Command = R NT create & X

```

```
SMB: Oplock Level = Batch
SMB: File ID (Fid) = 16389 (0x4005)

SMB: NT File Attributes = 0x00000020
SMB: .....0 = Not Read Only
SMB: .....0 = Not Hidden
SMB: .....0.. = Not System
SMB: .....0.... = Not Directory
SMB: .....1..... = Archive
SMB: .....0..... = Not Device
SMB: .....0..... = Not Normal
SMB: .....0..... = Not Temporary
SMB: .....0..... = Not Sparse File
SMB: .....0..... = Not Reparse Point
SMB: .....0..... = Not Compressed
SMB: .....0..... = Not Offline
SMB: .....0..... = CONTENT_INDEXED
SMB: .....0..... = Not Encrypted
```

### SMB\_COM\_READ\_ANDX Request

```
Client -> Server: SMB: C Read Andx, Dialect = NTLM 0.12
SMB: Tree ID (Tid) = 2049 (0x801)
SMB: Process ID (Pid) = 65279 (0xFEFF)
SMB: User ID (Uid) = 2048 (0x800)
SMB: Multiplex ID (Mid) = 1744 (0x6D0)
SMB: Command = C read & X
SMB: File ID (Fid) = 16389 (0x4005)
SMB: Max count = 1596 (0x63C)
SMB: Min count = 1596 (0x63C)
SMB: Bytes left = 1596
```

### SMB\_COM\_READ\_ANDX Response

```
Server -> Client: SMB: R Read Andx, Dialect = NTLM 0.12
SMB: Tree ID (Tid) = 2049 (0x801)
SMB: Process ID (Pid) = 65279 (0xFEFF)
SMB: User ID (Uid) = 2048 (0x800)
SMB: Multiplex ID (Mid) = 1744 (0x6D0)
SMB: Command = C read & X
SMB: Data length = 1596 (0x63C)
SMB: Data offset = 60 (0x3C)
SMB: Byte count = 1597

Data = 00 90 27 D0 C4 6F 00 90 27 66 6D BE 08 00 45 00 .....
```

### SMB\_COM\_CLOSE Request

```
Client -> Server: SMB: C Close, Dialect = NTLM 0.12
```

```

SMB: Tree ID      (Tid) = 2049 (0x801)
SMB: Process ID   (Pid) = 65279 (0xFEFF)
SMB: User ID      (Uid) = 2048 (0x800)
SMB: Multiplex ID (Mid) = 1984 (0x7C0)
SMB: Command = C Close
SMB: File ID (Fid) = 16389 (0x4005)

```

### SMB\_COM\_CLOSE Response

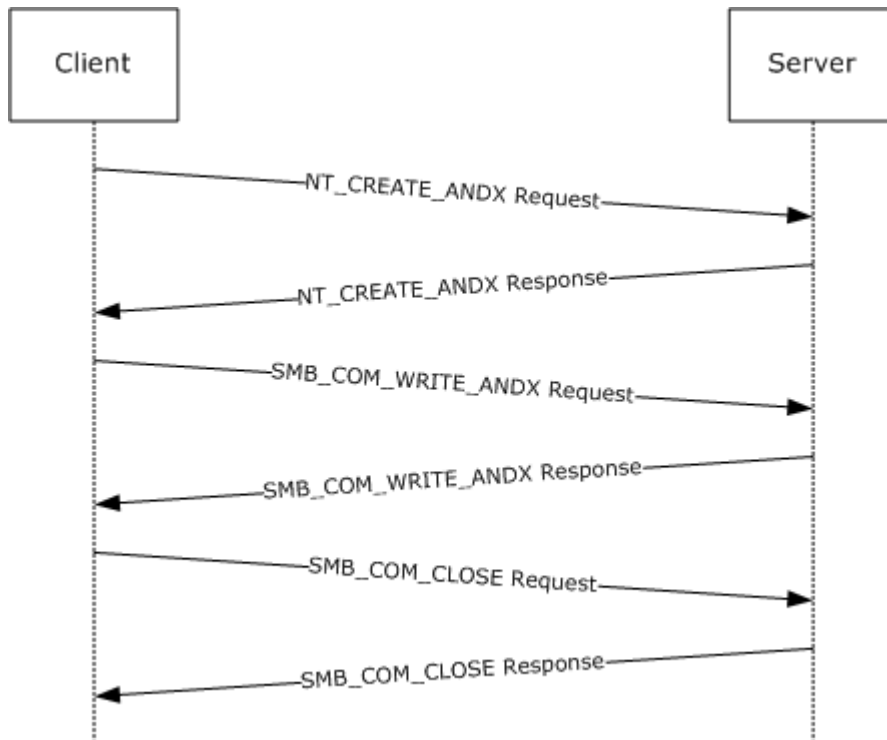
```

Server -> Client: SMB: R Close, Dialect = NTLM 0.12
SMB: Tree ID      (Tid) = 2049 (0x801)
SMB: Process ID   (Pid) = 65279 (0xFEFF)
SMB: User ID      (Uid) = 2048 (0x800)
SMB: Multiplex ID (Mid) = 1984 (0x7C0)

```

## 4.5 Copy File (Local to Remote)

The following example illustrates the sequence of operations while copying a local file to a remote share. The frames do not include the connection establishment or session management, for example.



**Figure 7: Copy file (local to remote) sequence**



In the frames in the preceding figure, the remote file is first created with the [SMB\\_COM\\_NT\\_CREATE\\_ANDX request](#). The data from the local file is then written to the remote file and, subsequently, the file is closed.

## NT\_CREATE\_ANDX

```
Client -> Server: SMB: C NT Create Andx, Dialect = NTLM 0.12
SMB: Tree ID      (Tid) = 2049 (0x801)
SMB: Process ID   (Pid) = 3592 (0xE08)
SMB: User ID      (Uid) = 2048 (0x800)
SMB: Multiplex ID (Mid) = 2288 (0x8F0)
SMB: Command = C NT create & X
SMB: Desired Access = 0x00030197
SMB: .....1 = Read Data Allowed
SMB: .....1. = Write Data Allowed
SMB: .....1.. = Append Data Allowed
SMB: .....0... = Read EA Denied
SMB: .....1.... = Write EA Allowed
SMB: .....0..... = File Execute Denied
SMB: .....0..... = File Delete Denied
SMB: .....1..... = File Read Attributes Allowed
SMB: .....1..... = File Write Attributes Allowed
SMB: NT File Attributes = 0x00000020
SMB: .....0 = Not Read Only
SMB: .....0. = Not Hidden
SMB: .....0.. = Not System
SMB: .....0... = Not Directory
SMB: .....1.... = Archive
SMB: .....0..... = Not Device
SMB: .....0..... = Not Normal
SMB: .....0..... = Not Temporary
SMB: .....0..... = Not Sparse File
SMB: .....0..... = Not Reparse Point
SMB: .....0..... = Not Compressed
SMB: .....0..... = Not Offline
SMB: .....0..... =
CONTENT_INDEXED
SMB: .....0..... = Not Encrypted
SMB: File Share Access = 0x00000000
SMB: .....0 = Read not allowed
SMB: .....0. = Write not allowed
SMB: .....0.. = Delete not allowed
SMB: Create Disposition = Overwrite_If: If exist, open
and overwrite, else create it
SMB: Create Options = 68 (0x44)
SMB: .....0 = non-directory
SMB: .....0. = non-write through
SMB: .....1.. = Data must be written to the file
sequentially
SMB: .....0... = intermediate buffering allowed
SMB: .....0... = IO alerts bits not set
SMB: .....0.... = IO non-alerts bit not set
SMB: .....1..... = Operation is on a non-directory file
SMB: .....0..... = tree connect bit not set
SMB: .....0..... = complete if oplocked bit is not set
SMB: .....0..... = no EA knowledge bit is not set
SMB: .....0..... = 8.3 filenames bit is not set
SMB: .....0..... = random access bit is not set
SMB: .....0..... = delete on close bit is not set
```

```
SMB: .....0..... = open by filename
SMB: .....0..... = open for backup bit not set
SMB: File name =\filename.txt
```

## NT\_CREATE\_ANDX Response

```
Server -> Client: SMB: R NT Create Andx, Dialect = NTLM 0.12
SMB: Tree ID      (Tid) = 2049 (0x801)
SMB: Process ID   (Pid) = 3592 (0xE08)
SMB: User ID      (Uid) = 2048 (0x800)
SMB: Multiplex ID (Mid) = 2288 (0x8F0)
SMB: Command = C NT create & X
      SMB: Oplock Level = Batch
      SMB: File ID (Fid) = 16392 (0x4008)

SMB: NT File Attributes = 0x00000020
      SMB: .....0 = Not Read Only
      SMB: .....0 = Not Hidden
      SMB: .....0.. = Not System
      SMB: .....0... = Not Directory
      SMB: .....1.... = Archive
      SMB: .....0..... = Not Device
      SMB: .....0..... = Not Normal
      SMB: .....0..... = Not Temporary
      SMB: .....0..... = Not Sparse File
      SMB: .....0..... = Not Reparse Point
      SMB: .....0..... = Not Compressed
      SMB: .....0..... = Not Offline
      SMB: .....0..... = CONTENT_INDEXED
      SMB: .....0..... = Not Encrypted
```

## SMB\_COM\_WRITE\_ANDX Request

```
Client -> Server: SMB: C Write Andx, Dialect = NTLM 0.12
      SMB: Tree ID      (Tid) = 2049 (0x801)
      SMB: Process ID   (Pid) = 65279 (0xFEFF)
      SMB: User ID      (Uid) = 2048 (0x800)
      SMB: Multiplex ID (Mid) = 2384 (0x950)
SMB: Command = C read & X
      SMB: File ID (Fid) = 16392 (0x4008)
      SMB: File offset = 0 (0x0)
      SMB: Data length = 1596 (0x63C)
Data = 00 90 27 66 6D BE 00 90 27 D0 C4 6F 08 00 45 00 ...
```

## SMB\_COM\_WRITE\_ANDX Response

```
Server -> Client: SMB: R Write Andx, Dialect = NTLM 0.12
      SMB: Tree ID      (Tid) = 2049 (0x801)
      SMB: Process ID   (Pid) = 65279 (0xFEFF)
      SMB: User ID      (Uid) = 2048 (0x800)
```

```
SMB: Multiplex ID (Mid) = 2384 (0x950)
SMB: Command = C read & X
```

### SMB\_COM\_CLOSE Request

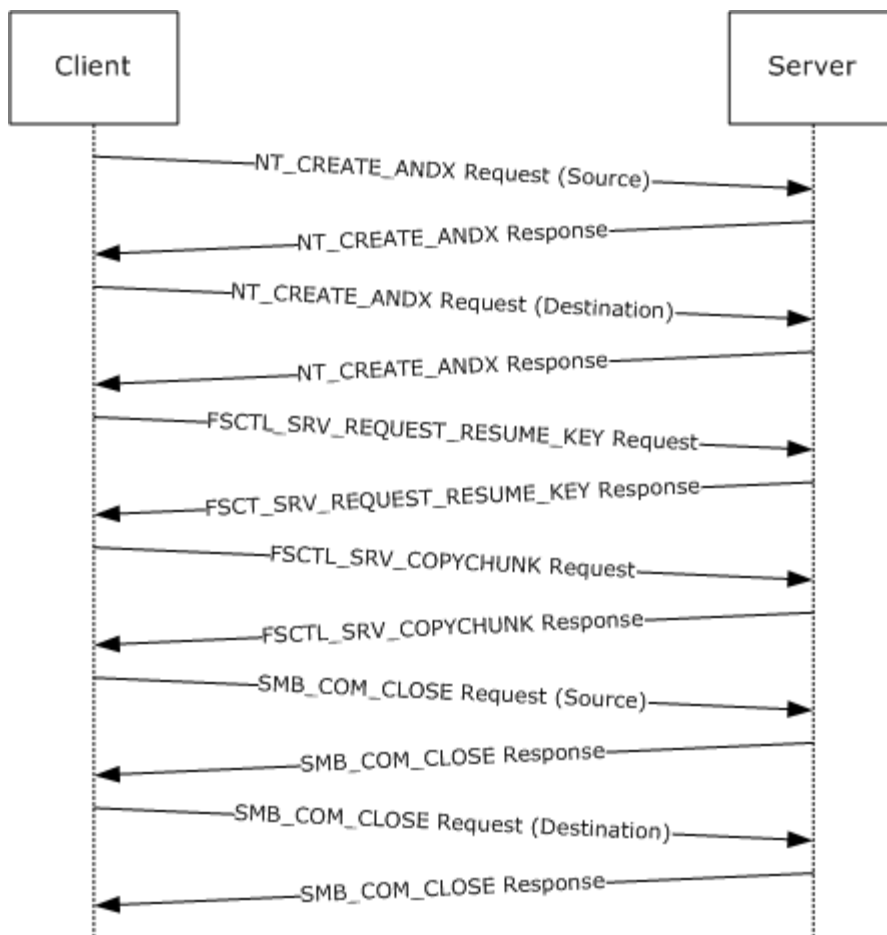
```
Client -> Server: SMB: C Close, Dialect = NTLM 0.12
SMB: Tree ID      (Tid) = 2049 (0x801)
SMB: Process ID   (Pid) = 65279 (0xFEFF)
SMB: User ID      (Uid) = 2048 (0x800)
SMB: Multiplex ID (Mid) = 2400 (0x960)
SMB: Command = C Close
SMB: File ID (Fid) = 16392 (0x4008)
```

### SMB\_COM\_CLOSE Response

```
Server -> Client: SMB: R Close, Dialect = NTLM 0.12
SMB: Tree ID      (Tid) = 2049 (0x801)
SMB: Process ID   (Pid) = 65279 (0xFEFF)
SMB: User ID      (Uid) = 2048 (0x800)
SMB: Multiplex ID (Mid) = 2400 (0x960)
```

## 4.6 FSCTL\_SRV\_COPYCHUNK

The following example refers to the sequence of operations for a file copy in which the source and the destination are on the same server. The [FSCTL\\_SRV\\_COPYCHUNK \(section 2.2.7.2\)](#) is used. The following sequence assumes that the SMB connection to the server, SMB session establishment, and other operations have been completed.



**Figure 8: Copy file (from/to same remote server) sequence**

The initial step in the preceding sequence is to open the source and the destination file using NT\_CREATE\_ANDX command. This step is followed by the FSCTL\_SRV\_REQUEST\_RESUME\_KEY request. This is sent as an NT\_TRANSACT\_IOCTL with the file ID of the source file. The server responds with the [FSCTL\\_SRV\\_REQUEST\\_RESUME\\_KEY response \(section 2.2.7.2.2.2\)](#). A 24-byte server copychunk resume key is returned.

NT\_CREATE\_ANDX Request (Source)

```
Client -> Server: SMB: C NT Create Andx, Dialect = NTLM 0.12
SMB: Tree ID      (Tid) = 2049 (0x801)
SMB: Process ID   (Pid) = 3592 (0xE08)
SMB: User ID      (Uid) = 2048 (0x800)
SMB: Multiplex ID (Mid) = 384 (0x180)
SMB: Command = C NT create & X
SMB: Desired Access = 0x00020089
SMB: .....1 = Read Data Allowed
SMB: .....0 = Write Data Denied
SMB: .....0.. = Append Data Denied
SMB: .....1... = Read EA Allowed
SMB: .....0.... = Write EA Denied
SMB: .....0..... = File Execute Denied
```

```

SMB: .....0..... = File Delete Denied
SMB: .....1..... = File Read Attributes Allowed
SMB: .....0..... = File Write Attributes Denied
SMB: NT File Attributes = 0x00000000
SMB: .....0..... = Not Read Only
SMB: .....0..... = Not Hidden
SMB: .....0..... = Not System
SMB: .....0..... = Not Directory
SMB: .....0..... = Not Archive
SMB: .....0..... = Not Device
SMB: .....0..... = Not Normal
SMB: .....0..... = Not Temporary
SMB: .....0..... = Not Sparse File
SMB: .....0..... = Not Reparse Point
SMB: .....0..... = Not Compressed
SMB: .....0..... = Not Offline
SMB: .....0..... =
CONTENT_INDEXED
SMB: .....0..... = Not Encrypted
SMB: File Share Access = 0x00000005
SMB: .....1..... = Read allowed
SMB: .....0..... = Write not allowed
SMB: .....1..... = Delete allowed
SMB: Create Disposition = Open: If exist, Open, else fail
SMB: Create Options = 2097220 (0x200044)
SMB: .....0..... = non-directory
SMB: .....0..... = non-write through
SMB: .....1..... = Data must be written to the
                        file sequentially
SMB: .....0..... = intermediate buffering allowed
SMB: .....0..... = IO alerts bits not set
SMB: .....0..... = IO non-alerts bit not set
SMB: .....1..... = Operation is on a non-directory file
SMB: .....0..... = tree connect bit not set
SMB: .....0..... = complete if oplocked bit is not set
SMB: .....0..... = no EA knowledge bit is not set
SMB: .....0..... = 8.3 filenames bit is not set
SMB: .....0..... = random access bit is not set
SMB: .....0..... = delete on close bit is not set
SMB: .....0..... = open by filename
SMB: .....0..... = open for backup bit not set
SMB: File name = sourcefile.txt

```

## NT\_CREATE\_ANDX Response

```

Server -> Client: SMB: R NT Create Andx, Dialect = NTLM 0.12
SMB: Tree ID      (Tid) = 2049 (0x801)
SMB: Process ID   (Pid) = 3592 (0xE08)
SMB: User ID      (Uid) = 2048 (0x800)
SMB: Multiplex ID (Mid) = 384 (0x180)
SMB: Command = R NT create & X
SMB: Oplock Level = II
SMB: File ID (Fid) = 16386 (0x4002)

SMB: NT File Attributes = 0x00000020
SMB: .....0..... = Not Read Only

```

```

SMB: .....0. = Not Hidden
SMB: .....0.. = Not System
SMB: .....0... = Not Directory
SMB: .....1.... = Archive
SMB: .....0..... = Not Device
SMB: .....0..... = Not Normal
SMB: .....0..... = Not Temporary
SMB: .....0..... = Not Sparse File
SMB: .....0..... = Not Reparse Point
SMB: .....0..... = Not Compressed
SMB: .....0..... = Not Offline
SMB: .....0..... =
CONTENT_INDEXED
SMB: .....0..... = Not Encrypted
SMB: File type = Disk file or directory

```

## NT\_CREATE\_ANDX Request (Destination)

```

Client -> Server: SMB: C NT Create Andx, Dialect = NTLM 0.12
SMB: Tree ID (Tid) = 2049 (0x801)
SMB: Process ID (Pid) = 3592 (0xE08)
SMB: User ID (Uid) = 2048 (0x800)
SMB: Multiplex ID (Mid) = 480 (0x1E0)
SMB: Command = C NT create & X
SMB: Desired Access = 0x00030197
SMB: .....1 = Read Data Allowed
SMB: .....1. = Write Data Allowed
SMB: .....1.. = Append Data Allowed
SMB: .....0... = Read EA Denied
SMB: .....1.... = Write EA Allowed
SMB: .....0..... = File Execute Denied
SMB: .....0..... = File Delete Denied
SMB: .....1..... = File Read Attributes Allowed
SMB: .....1..... = File Write Attributes Allowed
SMB: NT File Attributes = 0x00000020
SMB: .....0 = Not Read Only
SMB: .....0. = Not Hidden
SMB: .....0.. = Not System
SMB: .....0... = Not Directory
SMB: .....1.... = Archive
SMB: .....0..... = Not Device
SMB: .....0..... = Not Normal
SMB: .....0..... = Not Temporary
SMB: .....0..... = Not Sparse File
SMB: .....0..... = Not Reparse Point
SMB: .....0..... = Not Compressed
SMB: .....0..... = Not Offline
SMB: .....0..... = CONTENT_INDEXED
SMB: .....0..... = Not Encrypted
SMB: File Share Access = 0x00000000
SMB: .....0 = Read not allowed
SMB: .....0. = Write not allowed
SMB: .....0.. = Delete not allowed
SMB: Create Disposition = Overwrite_If: If exist, open and overwrite,
else create it
SMB: Create Options = 68 (0x44)

```

```

SMB: .....0 = non-directory
SMB: .....0 = non-write through
SMB: .....1 = Data must be written to the file
sequentially
SMB: .....0... = intermediate buffering allowed
SMB: .....0... = IO alerts bits not set
SMB: .....0... = IO non-alerts bit not set
SMB: .....1..... = Operation is on a non-directory file
SMB: .....0..... = tree connect bit not set
SMB: .....0..... = complete if oplocked bit is not set
SMB: .....0..... = no EA knowledge bit is not set
SMB: .....0..... = 8.3 filenames bit is not set
SMB: .....0..... = random access bit is not set
SMB: .....0..... = delete on close bit is not set
SMB: .....0..... = open by filename
SMB: .....0..... = open for backup bit not set
SMB: File name = destinationfile.txt

```

## NT\_CREATE\_ANDX Response

```

Server -> Client: SMB: R NT Create Andx, Dialect = NTLM 0.12
SMB: Tree ID (Tid) = 2049 (0x801)
SMB: Process ID (Pid) = 3592 (0xE08)
SMB: User ID (Uid) = 2048 (0x800)
SMB: Multiplex ID (Mid) = 480 (0x1E0)
SMB: Command = R NT create & X
SMB: Oplock Level = Batch
SMB: File ID (Fid) = 16387 (0x4003)

SMB: NT File Attributes = 0x00000020
SMB: .....0 = Not Read Only
SMB: .....0 = Not Hidden
SMB: .....0.. = Not System
SMB: .....0... = Not Directory
SMB: .....1..... = Archive
SMB: .....0..... = Not Device
SMB: .....0..... = Not Normal
SMB: .....0..... = Not Temporary
SMB: .....0..... = Not Sparse File
SMB: .....0..... = Not Reparse Point
SMB: .....0..... = Not Compressed
SMB: .....0..... = Not Offline
SMB: .....0..... = CONTENT_INDEXED
SMB: .....0..... = Not Encrypted
SMB: File type = Disk file or directory

```

## FSCTL\_SRV\_REQUEST\_RESUME\_KEY Request

```

Client -> Server: SMB: C NT Transact, Dialect = NTLM 0.12
NT IOCTL Function Code 0x00140078 FSCTL_SRV_REQUEST_RESUME_KEY
File ID (Fid) = 16386 (0x4002)

```

## FSCTL\_SRV\_REQUEST\_RESUME\_KEY Response

```
Server -> Client: SMB: R NT Transact, Dialect = NTLM 0.12
NT IOCTL Function Code 0x00140078 FSCTL_SRV_REQUEST_RESUME_KEY
File ID (Fid) = 16386 (0x4002)
Key = 2D 0B 00 00 01 00 00 00 59 84 0C 62 1B 84 C6 01 08 0E 00 00 00 00 00 00
ContextLength = 0
```

This is followed by an FSCTL\_SRV\_COPYCHUNK request. The request uses the resume key generated earlier.

## FSCTL\_SRV\_COPYCHUNK Request

```
Client -> Server: SMB: C NT Transact, Dialect = NTLM 0.12
NT IOCTL Function Code 0x001440F2 FSCTL_SRV_COPYCHUNK
File ID (Fid) = 16387 (0x4003)
Key = 2D 0B 00 00 01 00 00 00 59 84 0C 62 1B 84 C6 01 08 0E 00 00 00 00 00 00
ChunkCount = 1 (01 00 00 00)
Reserved = 0 (00 00 00 00)
```

```
List:
SourceOffset = 0 (00 00 00 00 00 00 00 00)
DestinationOffset = 0 (00 00 00 00 00 00 00 00)
Length = 1731 (3C 06 00 00)
```

## FSCTL\_SRV\_COPYCHUNK Response

```
Server -> Client: SMB: R NT Transact, Dialect = NTLM 0.12
NT IOCTL Function Code 0x001440F2 FSCTL_SRV_COPYCHUNK
File ID (Fid) = 16387 (0x4003)
ChunksWritten = 1 (01 00 00 00)
ChunkBytesWritten = 0 (00 00 00 00)
TotalBytesWritten = 1731 (3C 06 00 00)
```

The final step is to close the source and the destination file with SMB\_COM\_CLOSE commands.

## SMB\_COM\_CLOSE Request (Source)

```
Client -> Server: SMB: C Close, Dialect = NTLM 0.12
SMB: Tree ID (Tid) = 2049 (0x801)
SMB: Process ID (Pid) = 65279 (0xFEFF)
SMB: User ID (Uid) = 2048 (0x800)
SMB: Multiplex ID (Mid) = 640 (0x280)
SMB: Command = C Close
SMB: File ID (Fid) = 16386 (0x4002)
```

## SMB\_COM\_CLOSE Response

```
Server -> Client: SMB: R Close, Dialect = NTLM 0.12
```



```
SMB: Tree ID      (Tid) = 2049 (0x801)
SMB: Process ID   (Pid) = 65279 (0xFEFF)
SMB: User ID      (Uid) = 2048 (0x800)
SMB: Multiplex ID (Mid) = 640 (0x280)
```

### SMB\_COM\_CLOSE Request (Destination)

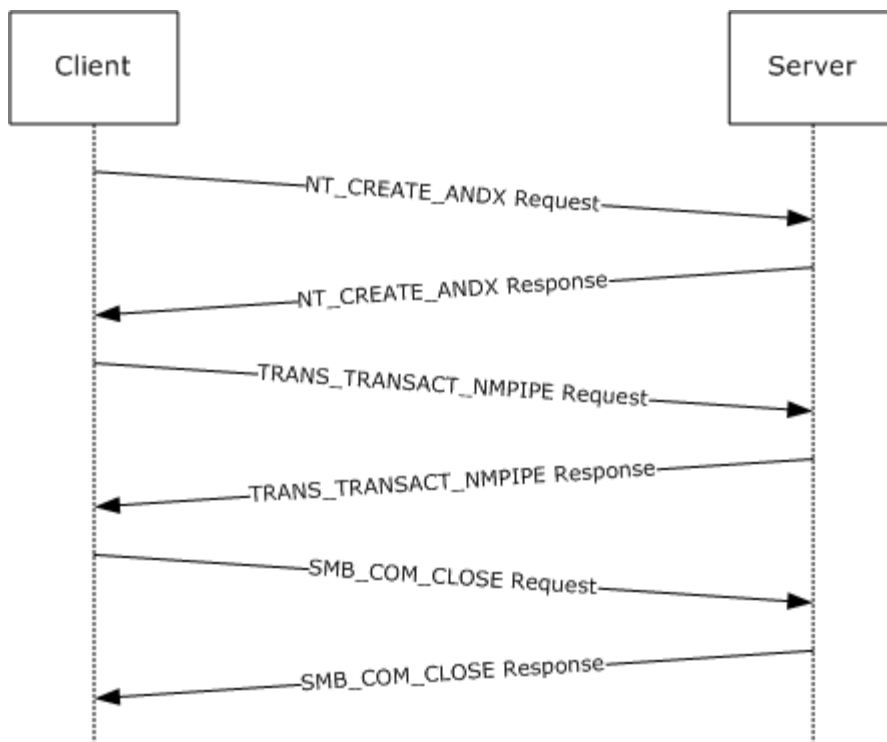
```
Client -> Server: SMB: C Close, Dialect = NTLM 0.12
SMB: Tree ID      (Tid) = 2049 (0x801)
SMB: Process ID   (Pid) = 65279 (0xFEFF)
SMB: User ID      (Uid) = 2048 (0x800)
SMB: Multiplex ID (Mid) = 656 (0x290)
SMB: Command = C Close
SMB: File ID (Fid) = 16387 (0x4003)
```

### SMB\_COM\_CLOSE Response

```
Server -> Client: SMB: R Close, Dialect = NTLM 0.12
SMB: Tree ID      (Tid) = 2049 (0x801)
SMB: Process ID   (Pid) = 65279 (0xFEFF)
SMB: User ID      (Uid) = 2048 (0x800)
SMB: Multiplex ID (Mid) = 656 (0x290)
```

## 4.7 TRANS TRANSACT NMPIPE

The following example illustrates how the TRANS\_TRANSACT\_NMPIPE is used.



**Figure 9: Named pipe request sequence**

The first frame contains the NT\_CREATE\_ANDX request to the named pipe. The TRANS\_TRANSMACT\_NMPIPE is then issued against the file ID assigned in the NT\_CREATE\_ANDX response.

#### NT\_CREATE\_ANDX

```

Client -> Server: SMB: C NT Create Andx, Dialect = NTLM 0.12
SMB: Tree ID      (Tid) = 2048 (0x800)
SMB: Process ID   (Pid) = 2292 (0x8F4)
SMB: User ID      (Uid) = 2048 (0x800)
SMB: Multiplex ID (Mid) = 4048 (0xFD0)
SMB: Command = C NT create & X
SMB: Desired Access = 0x0002019F
SMB: .....1 = Read Data Allowed
SMB: .....1 = Write Data Allowed
SMB: .....1.. = Append Data Allowed
SMB: .....1... = Read EA Allowed
SMB: .....1.... = Write EA Allowed
SMB: .....0..... = File Execute Denied
SMB: .....0..... = File Delete Denied
SMB: .....1..... = File Read Attributes Allowed
SMB: .....1..... = File Write Attributes Allowed
SMB: NT File Attributes = 0x00000000
SMB: .....0 = Not Read Only
SMB: .....0 = Not Hidden
SMB: .....0.. = Not System
SMB: .....0... = Not Directory
SMB: .....0.... = Not Archive
  
```

```

SMB: .....0..... = Not Device
SMB: .....0..... = Not Normal
SMB: .....0..... = Not Temporary
SMB: .....0..... = Not Sparse File
SMB: .....0..... = Not Reparse Point
SMB: .....0..... = Not Compressed
SMB: .....0..... = Not Offline
SMB: .....0..... =
CONTENT_INDEXED
SMB: .....0..... = Not Encrypted
SMB: File Share Access = 0x00000003
SMB: .....1..... = Read allowed
SMB: .....1..... = Write allowed
SMB: .....0.. = Delete not
allowed

SMB: Create Disposition = Open: If exist, Open, else fail
SMB: Create Options = 4194368 (0x400040)
SMB: .....0 = non-directory
SMB: .....0. = non-write through
SMB: .....0.. = non-sequential writing allowed
SMB: .....0... = intermediate buffering allowed
SMB: .....0.... = IO alerts bits not set
SMB: .....0..... = IO non-alerts bit not set
SMB: .....1..... = Operation is on a non-directory file
SMB: .....0..... = tree connect bit not set
SMB: .....0..... = complete if oplocked bit is not set
SMB: .....0..... = no EA knowledge bit is not set
SMB: .....0..... = 8.3 filenames bit is not set
SMB: .....0..... = random access bit is not set
SMB: .....0..... = delete on close bit is not set
SMB: .....0..... = open by filename
SMB: .....0..... = open for backup bit not set

SMB: File name =\srvsvc

```

## NT\_CREATE\_ANDX Response

```

Server -> Client: SMB: R NT Create Andx, Dialect = NTLM 0.12
SMB: Tree ID (Tid) = 2048 (0x800)
SMB: Process ID (Pid) = 2292 (0x8F4)
SMB: User ID (Uid) = 2048 (0x800)
SMB: Multiplex ID (Mid) = 4048 (0xFD0)
SMB: Command = R NT create & X
SMB: Oplock Level = NONE
SMB: File ID (Fid) = 16385 (0x4001)

SMB: NT File Attributes = 0x00000080
SMB: .....0 = Not Read Only
SMB: .....0. = Not Hidden
SMB: .....0.. = Not System
SMB: .....0... = Not Directory
SMB: .....0.... = Not Archive
SMB: .....0..... = Not Device
SMB: .....1..... = Normal
SMB: .....0..... = Not Temporary

```

```
SMB: .....0..... = Not Sparse File
SMB: .....0..... = Not Reparse Point
SMB: .....0..... = Not Compressed
SMB: .....0..... = Not Offline
SMB: .....0..... = CONTENT_INDEXED
SMB: .....0..... = Not Encrypted
SMB: File type = Message mode named pipe
```

## SMB\_COM\_TRANSACTION Request

```
Client -> Server: SMB: C transact TransactNmPipe, Dialect = NTLM
0.12
SMB: Tree ID      (Tid) = 2048 (0x800)
SMB: Process ID   (Pid) = 2292 (0x8F4)
SMB: User ID      (Uid) = 2048 (0x800)
SMB: Multiplex ID (Mid) = 4096 (0x1000)
SMB: Command = C transact
SMB: Data bytes = 76 (0x4C)
SMB: Data offset = 84 (0x54)
SMB: Setup words
SMB: Pipe function = Transact named pipe (TransactNmPipe)
SMB: File ID (Fid) = 16385 (0x4001)
Data = 00 90 27 66 6D BE 00 90 27 D0 C4 6F 08 00 45 00 .....
```

## SMB\_COM\_TRANSACTION Response

```
Server -> Client: SMB: R transact TransactNmPipe, Dialect = NTLM
0.12
SMB: Tree ID      (Tid) = 2048 (0x800)
SMB: Process ID   (Pid) = 2292 (0x8F4)
SMB: User ID      (Uid) = 2048 (0x800)
SMB: Multiplex ID (Mid) = 4096 (0x1000)
SMB: Command = R transact
SMB: Data bytes = 120 (0x78)
SMB: Data offset = 56 (0x38)
DATA = 00 90 27 D0 C4 6F 00 90 27 66 6D BE 08 00 45 00 ....
```

## SMB\_COM\_CLOSE Request

```
Client -> Server: SMB: C Close, Dialect = NTLM 0.12
SMB: Tree ID      (Tid) = 2048 (0x800)
SMB: Process ID   (Pid) = 65279 (0xFEFF)
SMB: User ID      (Uid) = 2048 (0x800)
SMB: Multiplex ID (Mid) = 4112 (0x1010)
SMB: Command = C Close
SMB: File ID (Fid) = 16385 (0x4001)
```

## SMB\_COM\_CLOSE Response

```
Server -> Client: SMB: R Close, Dialect = NTLM 0.12
SMB: Tree ID      (Tid) = 2048 (0x800)
SMB: Process ID   (Pid) = 65279 (0xFEFF)
SMB: User ID      (Uid) = 2048 (0x800)
SMB: Multiplex ID (Mid) = 4112 (0x1010)
```

## 5 Security

The following section specifies security considerations for implementers of the Server Message Block (SMB) Protocol.

### 5.1 Security Considerations for Implementers

The CIFS Protocol contains support for NTLM but lacks support for new authentication protocols. The extensions defined in this document offer support for increased security in remote file and printer access via SMB.

In addition to the NTLM challenge/response authentication support, as specified in [\[MS-CIFS\]](#) section 3.1.5.2, these extensions enable support for Kerberos or any other protocol that can be encapsulated inside the extensible authentication package, as specified in [\[RFC2743\]](#) and [\[RFC4178\]](#).

Extended message signing uses the HMAC\_MD5 algorithm, as specified in [\[RFC2104\]](#), to alter the user's session key.

The protocol does not sign oplock break requests from the server to the client if message signing is enabled. This can allow an attacker to affect performance but does not allow an attacker to deny access or alter data.

The algorithm used for message signing has been shown to be subject to collision attacks. See [\[MD5Collision\]](#) for more information.

The new "previous versions" feature potentially allows access to versions of a file that have been deleted or modified. This can provide access to information that was not available without these extensions. However, this access is still subject to the same access checks to which it is normally subject.

### 5.2 Index of Security Parameters

Security parameter	Section
Signing Key Protection	<a href="#">3.2.5.4</a>
Extended Security - GSS mechanism	<a href="#">3.3.5.3</a>
Extended Security - Maximal User and Guest Rights per Share	<a href="#">3.3.5.4</a>
Authentication Expiration Time	<a href="#">3.3.2.1</a>

## 6 Appendix A: Product Behavior

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

- Windows 2000 operating system
- Windows XP operating system
- Windows Server 2003 operating system
- Windows Server 2003 R2 operating system
- Windows Vista operating system
- Windows Server 2008 operating system
- Windows 7 operating system
- Windows Server 2008 R2 operating system
- Windows 8 operating system
- Windows Server 2012 operating system
- Windows 8.1 operating system
- Windows Server 2012 R2 operating system

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

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

[<1> Section 1.8:](#) UNIX extensions are not supported by Windows-based SMB clients and servers. The CAP\_UNIX capability bit and the Information Level range are reserved to allow third party implementers to collaborate on the definition of these extensions. The development of a common set of extensions has been informally supported by the Storage Networking Industry Association (SNIA). See [\[SNIA\]](#) for SNIA specification on vendor-extension fields.

[<2> Section 2.1:](#) The Direct TCP transport can be used by Windows-based SMB clients and servers.

[<3> Section 2.1:](#) Windows-based clients and servers use TCP port 445 as the destination TCP port on the SMB server, the well-known port number assigned by IANA to Microsoft-DS.

[<4> Section 2.1:](#) Windows 7 and Windows Server 2008 R2 servers without [\[MS11-048\]](#) do not disconnect the connection if the SMB message size exceeds 0x1FFFF bytes.

[<5> Section 2.2:](#) When an error occurs, Windows-based SMB servers return an Error Response message unless specifically required to return data, as specified for named pipe read operations and certain I/O control code requests and other exceptions specified in [\[MS-CIFS\]](#). Windows-based SMB

clients expect that an SMB server returns an Error Response, unless otherwise specified. Windows implementations return data along with these error codes:

- STATUS\_MORE\_PROCESSING\_REQUIRED on a session setup request
- STATUS\_BUFFER\_OVERFLOW for a read request, IOCTL request, and Query Info request
- STATUS\_INVALID\_PARAMETER or STATUS\_INVALID\_VIEW\_SIZE for CopyChunk IOCTL request return data along with the header
- STATUS\_STOPPED\_ON\_SYMLINK includes the symbolic link data
- STATUS\_BUFFER\_TOO\_SMALL returns a ULONG containing the required size

[<6> Section 2.2.1.1.1:](#) This feature is unavailable in Windows 2000 and Windows XP. When enabled on Windows Server 2003, Windows Server 2003 R2, Windows Vista, Windows Server 2008, Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1, or Windows Server 2012 R2, previous versions of files are accessible as read-only.

[<7> Section 2.2.1.2.2:](#) This value is not supported in Windows 2000.

[<8> Section 2.2.1.2.2:](#) This value is not supported in Windows 2000.

[<9> Section 2.2.1.2.2:](#) This value is not supported in Windows 2000.

[<10> Section 2.2.1.2.2:](#) This value is not supported in Windows 2000, Windows Server 2003, Windows Server 2003 R2, Windows XP, Windows Vista, or Windows Server 2008. This value is supported in Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2.

[<11> Section 2.2.1.2.2:](#) This value is not supported in Windows 2000, Windows Server 2003, Windows Server 2003 R2, Windows XP, Windows Vista, or Windows Server 2008. This value is supported in Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2.

[<12> Section 2.2.1.2.2:](#) This value is not supported in Windows 2000, Windows Server 2003, Windows Server 2003 R2, Windows XP, Windows Vista, or Windows Server 2008. This value is supported in Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2.

[<13> Section 2.2.1.2.2:](#) This value is not supported in Windows 2000, Windows Server 2003, Windows Server 2003 R2, Windows XP, Windows Vista, or Windows Server 2008. This value is supported in Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2.

[<14> Section 2.2.1.3.1:](#) Windows guarantees uniqueness of FileIds across a single volume.

[<15> Section 2.2.2.1:](#) If a client request contains an invalid command code, then Windows 2000 Server and Windows XP server fail the requests by sending an error response with an NTSTATUS code of STATUS\_SMB\_BAD\_COMMAND (ERRSRV/ERRbadcommand). Windows XP SP1, Windows Server 2003, Windows Server 2003 R2, Windows Server 2008, Windows Vista, Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2 servers do not respond to such a request, and do not process further requests on that connection.

[<16> Section 2.2.2.2:](#) Windows-based clients and servers do not support NT\_TRANSACT\_CREATE2.

[<17> Section 2.2.2.3.1:](#) The SMB\_FIND\_FILE\_ID\_FULL\_DIRECTORY\_INFO and SMB\_FIND\_FILE\_ID\_BOTH\_DIRECTORY\_INFO Information Levels are available in Windows



Server 2003, Windows Server 2003 R2, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2.

<18> [Section 2.2.2.3.5](#): Pass-through Information Levels on Windows-based servers map directly to native Windows NT Information Classes, as specified in [\[MS-FSCC\]](#) sections [2.4](#) and [2.5](#). Windows-based servers do not support setting the following NT Information Levels via the pass-through Information Level mechanism.

Information level	Error code
FileLinkInformation	STATUS_NOT_SUPPORTED
FileMoveClusterInformation	STATUS_NOT_SUPPORTED
FileTrackingInformation	STATUS_NOT_SUPPORTED
FileCompletionInformation	STATUS_NOT_SUPPORTED
FileMailslotSetInformation	STATUS_NOT_SUPPORTED

All other Information Levels are passed through to the underlying object store or file system. Refer to [\[MS-FSCC\]](#) sections [2.4](#) and [2.5](#) for a further list of Information Levels that are not supported by Windows file systems and the error codes that can be returned.

<19> [Section 2.2.2.3.6](#): These extensions, known as UNIX extensions, are not supported by Windows-based SMB clients and servers. The CAP\_UNIX capability bit and the Information Level range specified are reserved to allow third party implementers to collaborate on the definition of these extensions. The development of a common set of extensions has been informally supported by the Storage Networking Industry Association (SNIA).

<20> [Section 2.2.2.4](#): For a detailed listing of possible status codes available on Windows implementations, see [\[MS-ERREF\]](#). For a list of error codes used by the SMB Version 1.0 Protocol and CIFS Protocol, see [\[MS-CIFS\]](#) section 2.2.2.4.

<21> [Section 2.2.3.1](#): Windows-based servers set the bits in the **Flags2** field with the same value(s) that were sent by the client in the request. Windows-based clients ignore this field when they receive the response.

<22> [Section 2.2.3.1](#): Windows clients set this flag in all SMB requests if the client's configuration requires signing. This flag is not applicable to Windows 2000.

<23> [Section 2.2.3.1](#): Windows-based SMB servers always ignore the SMB\_FLAGS2\_IS\_LONG\_NAME flag.

<24> [Section 2.2.4.1.2](#): Windows-based servers support the notion of a guest account and set this field based on the defined guest account rights on the server.

<25> [Section 2.2.4.1.2](#): Windows-based SMB servers set this field to an arbitrary value that is ignored on receipt. The servers do not send any data in this message.

<26> [Section 2.2.4.2.1](#): Windows clients always set this field to 0xFFFFFFFF when reading from a Named Pipe or I/O device.

<27> [Section 2.2.4.2.1](#): Windows-based servers support MaxCountHigh, but ignore it if set to 0xFFFF.

<28> [Section 2.2.4.5.2.1](#): Windows defaults to a **MaxBufferSize** value of 16,644 bytes on server versions of Windows. Windows defaults to a **MaxBufferSize** value of 4,356 bytes on client versions of Windows.

<29> [Section 2.2.4.5.2.1](#): Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 do not support SMB\_COM\_READ\_RAW or SMB\_COM\_WRITE\_RAW and disconnect the client by closing the underlying transport connection if either command is received from the client.

<30> [Section 2.2.4.5.2.1](#): Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 do not support SMB\_COM\_READ\_MPX or SMB\_COM\_WRITE\_MPX and disconnect the client by closing the underlying transport connection if either command is received from the client.

<31> [Section 2.2.4.5.2.1](#): Windows-based clients assume that CAP\_NT\_FIND is set if CAP\_NT\_SMBS is set.

<32> [Section 2.2.4.5.2.1](#): Windows-based clients and servers take advantage of CAP\_INFOLEVEL\_PASSTHRU, when available, to prevent the need to map from native file and directory information structures to comparable SMB structures.

<33> [Section 2.2.4.5.2.1](#): With CAP\_LARGE\_READX enabled, Windows-based servers provide a statically configured maximum read length, which defaults to 64 kilobytes. Windows-based clients and servers support CAP\_LARGE\_READX, which permits file transfers larger than the negotiated MaxBufferSize.

<34> [Section 2.2.4.5.2.1](#): Windows-based clients and servers support CAP\_LARGE\_WRITEX, which permits file transfers larger than the negotiated MaxBufferSize.

<35> [Section 2.2.4.5.2.1](#): Windows Server 2003, Windows Server 2003 R2, Windows Vista, Windows Server 2008, Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1 and Windows Server 2012 R2 clients and servers support CAP\_LWIO.

<36> [Section 2.2.4.5.2.1](#): Windows-based clients and servers do not support CAP\_UNIX; therefore, this capability is never set.

<37> [Section 2.2.4.5.2.1](#): Windows-based clients and servers do not support CAP\_COMPRESSED\_DATA and this capability is never set.

<38> [Section 2.2.4.5.2.1](#): Windows servers do not set the CAP\_DYNAMIC\_REAUTH flag, even if dynamic re-authentication is supported. On Windows XP, Windows Server 2003, Windows Server 2003 R2, Windows Vista, Windows Server 2008, Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2, all clients and servers support dynamic re-authentication.

<39> [Section 2.2.4.5.2.1](#): Windows-based clients and servers do not support CAP\_PERSISTENT\_HANDLES.

<40> [Section 2.2.4.5.2.1](#): Windows-based clients use the **ServerGUID** field.

<41> [Section 2.2.4.5.2.2](#): Windows-based servers default to a **MaxBufferSize** value of 16,644 bytes. Windows-based clients default to a **MaxBufferSize** value of 4,356 bytes.

<42> [Section 2.2.4.5.2.2](#): Windows-based clients expect 8-byte cryptographic challenges. Windows-based servers provide 8-bit cryptographic challenges.

<43> [Section 2.2.4.6.1](#): Windows-based servers only check for and store a small number of client capabilities:

- CAP\_UNICODE
- CAP\_LARGE\_FILES
- CAP\_NT\_SMBS
- CAP\_NT\_FIND
- CAP\_NT\_STATUS
- CAP\_EXTENDED\_SECURITY
- CAP\_LEVEL\_II\_OPLOCKS

Windows Server 2003, Windows Server 2003 R2, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 also check for CAP\_DYNAMIC\_REAUTH.

<44> [Section 2.2.4.6.1](#): Windows-based SMB clients set this field based upon the version and service pack level of the Windows operating system. A list of possible values for this field includes the following.

Windows OS version	Native OS string
Windows 2000	Windows 5.0
Windows XP SP2	Windows 2002 Service Pack 2
Windows Server 2003 SP2	Windows Server 2003 3790 Service Pack 2

Windows Vista, Windows Server 2008, Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2 set this field to an empty string.

<45> [Section 2.2.4.6.1](#): Windows-based SMB clients set this field based upon the version of the Windows operating system. A list of possible values for this field includes the following:

Windows OS version	NativeLanMan string
Windows 2000	Windows 2000 LAN Manager
Windows XP SP2	Windows 2002 5.1
Windows Server 2003	Windows Server 2003 5.2

Windows Vista, Windows Server 2008, Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2 set this field to an empty string.

<46> [Section 2.2.4.6.2](#): Windows-based SMB servers set this field based upon the version and service pack level of the Windows operating system. The following table includes a list of possible values for this field.

Windows OS version	Native OS string
Windows 2000	Windows 5.0

Windows OS version	Native OS string
Windows XP SP2	Windows 2002 Service Pack 2
Windows Server 2003 SP2	Windows Server 2003 3790 Service Pack 2
Windows Vista Ultimate	Windows Vista Ultimate 6000
Windows Vista Home Basic	Windows Vista 6000
Windows Vista Home Premium	Windows Vista Premium 6000
Windows Server 2008 Datacenter	Windows Server Datacenter 6001 Service Pack 1
Windows 7 Enterprise	Windows 7 Enterprise 7600
Windows 7 Ultimate	Windows 7 Ultimate 7600
Windows Server 2008 R2 Enterprise	Windows Server 2008 R2 Enterprise 7600
Windows 8 Enterprise	Windows 8 Enterprise 9200
Windows 8 Pro	Windows 8 Pro 9200
Windows Server 2012 Standard	Windows Server 2012 Standard 6.2
Windows Server 2012 Datacenter	Windows Server 2012 Datacenter 6.2

<47> [Section 2.2.4.6.2](#): Windows-based SMB servers set this field based upon the version of the Windows operating system. The following table lists possible values for this field.

Windows OS version	NativeLANMan string
Windows 2000	Windows 2000 LAN Manager
Windows XP SP2	Windows 2002 5.1
Windows Server 2003	Windows Server 2003 5.2
Windows Vista Ultimate	Windows Vista Ultimate 6.0
Windows Vista Home Basic	Windows Vista 6.0
Windows Vista Home Premium	Windows Vista Premium 6.0
Windows Server 2008 Datacenter	NativeLANMAN: Windows Server 2008 Datacenter 6.0
Windows 7 Enterprise	Windows 7 Enterprise 6.1
Windows 7 Ultimate	Windows 7 Ultimate 6.1
Windows Server 2008 R2 Enterprise	Windows Server 2008 R2 Enterprise 6.1
Windows 8 Enterprise	Windows 8 Enterprise 9200
Windows 8 Pro	Windows 8 Pro 9200
Windows Server 2012 Standard	Windows Server 2012 Standard 6.2

Windows OS version	NativeLANMan string
Windows Server 2012 Datacenter	Windows Server 2012 Datacenter 6.2

<48> [Section 2.2.4.7.2](#): SMB clients on Windows XP, Windows Vista, Windows 7, Windows 8, and Windows 8.1 cache directory information if this bit is set on a share. SMB clients on all server versions of Windows do not cache directory information by default even if this bit is set on a share. Caching directory information by SMB clients on Windows Server 2003, Windows Server 2003 R2, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 can be enabled via a Windows registry setting. Windows 2000 operating system does not support directory caching.

<49> [Section 2.2.4.7.2](#): Windows-based clients and servers support the notion of a guest account and set this field to the access allowed for the guest account.

<50> [Section 2.2.4.9.1](#): Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1 and Windows Server 2012 R2 also support two new **CreateOptions** flags:

- FILE\_OPEN\_REQUIRING\_OPLOCK (0x00010000) Windows Vista, Windows Server 2008, Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2 ignore this bit if set in the request. All other Windows-based SMB servers fail requests with the FILE\_OPEN\_REQUIRING\_OPLOCK option set, and return STATUS\_INVALID\_PARAMETER in the **Status** field of the SMB header in the server response.
- FILE\_DISALLOW\_EXCLUSIVE (0x00020000) Windows Vista, Windows Server 2008, Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2 ignore this bit if it is set in the request. All other Windows-based SMB servers fail requests with this option set, and return STATUS\_INVALID\_PARAMETER in the **Status** field of the SMB header in the server response.

<51> [Section 2.2.4.9.2](#): Windows-based SMB servers send 50 (0x32) words in the extended response although they set the **WordCount** field to 0x2A.

<52> [Section 2.2.4.9.2](#): Windows 2000 Server, Windows Server 2003, Windows Server 2003 R2, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012 and Windows Server 2012 R2 set the **VolumeGUID** field to zero; otherwise, this field is uninitialized. The **VolumeGUID** field is ignored by Windows-based SMB clients.

<53> [Section 2.2.4.9.2](#): Windows 2000 Server, Windows Server 2003, Windows Server 2003 R2, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 set the **FileId** field to zero. The **FileId** field is ignored by Windows-based SMB clients.

<54> [Section 2.2.4.9.2](#): Windows-based servers and clients support the notion of a guest account.

<55> [Section 2.2.4.9.2](#): Windows Server 2003, Windows Server 2003 R2, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 set this field to zero; otherwise, this field can be sent uninitialized.

<56> [Section 2.2.5.1](#): Windows-based clients never send this request. Windows-based servers fail this request with STATUS\_INVALID\_PARAMETER.

<57> [Section 2.2.5.2](#): Windows-based clients never send this request.

<58> [Section 2.2.6.1.1](#): Windows-based clients do not issue TRANS2\_FIND\_FIRST2 requests with the special @GMT-\* pattern in the **FileName** field natively. Applications that run on Windows-based

clients, however, are allowed to explicitly include the @GMT-\* pattern in the pathname that they supply.

<59> [Section 2.2.6.1.1:](#) Windows-based clients allow the @GMT-\* wildcard to be sent using Information Levels other than SMB\_COM\_FIND\_FILE\_BOTH\_DIRECTORY\_INFO.

<60> [Section 2.2.6.4:](#) Support for this subcommand was introduced in Windows 2000.

<61> [Section 2.2.7.1.2:](#) Windows 2000 Server, Windows Server 2003, Windows Server 2003 R2, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 set the **VolumeGUID** field to zero; otherwise, this field is uninitialized. The **VolumeGUID** field is ignored by Windows-based SMB clients.

<62> [Section 2.2.7.1.2:](#) Windows 2000 Server, Windows Server 2003, Windows Server 2003 R2, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 set the **FileId** field to zero. The **FileId** field is ignored by Windows-based SMB clients.

<63> [Section 2.2.7.1.2:](#) Windows-based servers and clients support guest accounts.

<64> [Section 2.2.7.2.1:](#) Currently, only Windows Server 2003 with SP1, Windows Server 2003 R2, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 support these new FSCTLs. All other Windows-based servers fail requests that contain these FSCTL codes with STATUS\_NOT\_SUPPORTED.

<65> [Section 2.2.7.2.1:](#) A definitive list of Windows FSCTL and IOCTL control codes and their structures (if any) is specified in [\[MS-FSCC\]](#) section 2.3.

<66> [Section 2.2.7.2.1:](#) Currently, only Windows Server 2003 with SP1, Windows Server 2003 R2, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 support this FSCTL. All other Windows-based servers fail the request with STATUS\_NOT\_SUPPORTED.

<67> [Section 2.2.7.2.1:](#) Currently, only Windows Server 2003 with SP1, Windows Server 2003 R2, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 servers support this FSCTL. All other Windows-based servers fail the request with STATUS\_NOT\_SUPPORTED.

<68> [Section 2.2.7.2.1.1:](#) Windows-based clients do not initialize the **Reserved** field to zero.

<69> [Section 2.2.7.2.2.2:](#) Windows-based servers set this field to an arbitrary number of uninitialized bytes.

<70> [Section 2.2.8.1.1:](#) Windows-based SMB servers set the **FileIndex** field to a nonzero value if the underlying object store supports indicating the position of a file within the parent directory.

<71> [Section 2.2.8.1.2:](#) The SMB\_FIND\_FILE\_ID\_FULL\_DIRECTORY\_INFO Information Level was introduced in Windows Server 2003 and is not present in Windows 2000 Server and Windows XP.

<72> [Section 2.2.8.1.2:](#) Windows-based SMB servers set the **FileIndex** field to a nonzero value if the underlying object store supports indicating the position of a file within the parent directory.

<73> [Section 2.2.8.1.2:](#) Windows-based servers set this field to an arbitrary value.

<74> [Section 2.2.8.1.3:](#) The SMB\_FIND\_FILE\_ID\_BOTH\_DIRECTORY\_INFO Information Level was introduced in Windows Server 2003 and is not present in Windows 2000 Server and Windows XP.

<75> [Section 2.2.8.1.3:](#) Windows-based SMB servers set the **FileIndex** field to a nonzero value if the underlying object store supports indicating the position of a file within the parent directory.

<76> [Section 2.2.8.2.1](#): The following attribute flags are removed by the Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 SMB server before sending the attribute data block to the client:

- FILE\_SUPPORTS\_TRANSACTIONS
- FILE\_SUPPORTS\_OPEN\_BY\_FILE\_ID

<77> [Section 3.2.1.1](#): Windows 2000 Server supports the *Disabled* state.

<78> [Section 3.2.3](#): **Client.SupportsExtendedSecurity** is TRUE for Windows-based clients.

<79> [Section 3.2.3](#): Windows-based SMB clients on Windows 2000, Windows XP, and Windows Vista support 32-bit process IDs and use this field when sending the following SMB messages: SMB\_COM\_NT\_CREATE\_ANDX and SMB\_COM\_OPEN\_PRINT\_FILE. Windows-based SMB clients on Windows 2000, Windows XP, and Windows Vista also support and use this field when sending SMB\_COM\_TRANSACTION, SMB\_COM\_TRANSACTION2, and SMB\_COM\_TRANSACT messages when the server supports the CAP\_NT\_SMBS bit. The CAP\_NT\_SMBS bit is set in the Capabilities field in the SMB\_COM\_NEGOTIATE response ([\[MS-CIFS\]](#) section 2.2.4.52.2). Windows 7 and Windows 8-based SMB clients do not support 32-bit process IDs and set this field to zero when sending SMB messages. Windows-based SMB servers support 32-bit process IDs when receiving SMB messages.

<80> [Section 3.2.4.1.1](#): Windows XP, Windows Vista, Windows Server 2003, Windows Server 2003 R2, Windows Server 2008, Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2 clients scan pathnames for previous version tokens and set the SMB\_FLAGS2\_REPARSE\_PATH flag if a token is found.

<81> [Section 3.2.4.2.4](#): Windows-based SMB clients use the same connection to a server for all authentications other than terminal services. **Connections** configured for terminal services use one connection per user.

<82> [Section 3.2.4.2.4](#): In an [SMB\\_COM\\_SESSION\\_SETUP\\_ANDX request \(section 2.2.4.6.1\)](#), Windows-based SMB clients initialize the **SMB\_Header.SecurityFeatures** field to 'BSRSPYL' (0x42 0x53 0x52 0x53 0x50 0x59 0x4C). Windows-based SMB servers ignore this value.

<83> [Section 3.2.4.2.4](#): Windows-based clients implement this option.

<84> [Section 3.2.4.2.4](#):

- Windows-based clients support extended security.
- Windows systems implement the first option that is previously described.

<85> [Section 3.2.4.2.4.1](#): Windows-based SMB clients are configured by default to not send plain text passwords. Sending plain text passwords can be configured via a registry setting.

<86> [Section 3.2.4.2.5](#): Windows 2000 client does not request **Client.Session.SessionKey** protection.

<87> [Section 3.2.4.3](#): Windows -based clients issue an SMB\_COM\_NT\_CREATE\_ANDX request for the NT LM 0.12 dialect for which all of the extensions here are described.

<88> [Section 3.2.4.3.2](#): Windows-based clients do not use this flag.

<89> [Section 3.2.4.4](#): Windows-based clients set the **Timeout** field to 0xFFFFFFFF on pipe reads.

<90> [Section 3.2.4.4.1](#): Windows-based clients issue large reads if the server supports them.

<91> [Section 3.2.4.6](#): Windows-based clients send these requests to the server regardless of the Information Level provided in the request.

<92> [Section 3.2.4.11.1](#): Windows XP, Windows Vista, Windows 7, Windows 8, and Windows 8.1 clients use this FSCTL. Windows 2000-based clients can use this FSCTL if the previous versions' down-level application is installed on them.

<93> [Section 3.2.4.12](#): Windows XP SP3, Windows Server 2003 with SP1, Windows Server 2003 R2, Windows Vista, Windows Server 2008, Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2 clients support DFS.

<94> [Section 3.2.5.2](#): Windows-based SMB servers support Extended Security. They all are configured to use SPNEGO, as specified in [\[RFC4178\]](#), as their GSS authentication protocol. Windows operating systems that use extended security send a GSS token (or fragment) if their SPNEGO implementation supports it. See [\[RFC4178\]](#) for details on Windows behavior.

<95> [Section 3.2.5.2](#): When the server completes negotiation and returns the CAP\_EXTENDED\_SECURITY flag as not set, Windows-based SMB clients query the **Key Distribution Center (KDC)** to verify whether a service ticket is registered for the given **security principal name (SPN)**. If the query indicates that the SPN is registered with the KDC, then the SMB client terminates the connection and returns an implementation-specific security downgrade error to the caller.

<96> [Section 3.2.5.3](#): The Windows GSS implementation supports raw Kerberos / NTLM messages in the **SecurityBlob** as described in [\[MS-AUTHSOD\]](#) section 2.1.2.2.

<97> [Section 3.2.5.3](#): Windows Vista SP1, Windows Server 2008, Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2 servers fail a non-extended security session setup request with STATUS\_INVALID\_PARAMETER if the registry key is either missing or set to zero.

<98> [Section 3.3.2.1](#): Windows-based servers implement this timer with a default value of 300 seconds.

<99> [Section 3.3.3](#): **SupportsExtendedSecurity** is TRUE for Windows-based clients.

<100> [Section 3.3.3](#): Windows Server 2003 with SP1, Windows Server 2003 R2, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 set this value to 256.

<101> [Section 3.3.3](#): Windows Server 2003 with SP1, Windows Server 2003 R2, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 set this value to 1 megabyte.

<102> [Section 3.3.3](#): Windows Server 2003 with SP1, Windows Server 2003 R2, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 set this value to 16 megabytes.

<103> [Section 3.3.3](#): Windows Server 2003 with SP1, Windows Server 2003 R2, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 set this value to 25 seconds.

<104> [Section 3.3.4.1.1](#): Windows servers do not respond with an OS/2 error on the wire even if SMB\_FLAGS2\_NT\_STATUS is set in the client request (see [\[MS-CIFS\]](#) section 2.2.3.1). If the negotiated dialect is DOS LANMAN 2.0, DOS LANMAN 2.1, or prior to LANMAN 1.0, an ERROR\_GEN\_FAILURE error is returned. Otherwise, the following table lists the corresponding DOS error (see [\[MS-CIFS\]](#) section 2.2.2.4 SMB Error Classes and Codes) that is returned:



OS/2 Error	DOS Error
STATUS_OS2_INVALID_LEVEL	ERRunknownlevel
STATUS_OS2_EA_LIST_INCONSISTENT	ERRbadealist
STATUS_OS2_NEGATIVE_SEEK	ERRinvalidseek
STATUS_OS2_NO_MORE_SIDS	ERROR_NO_MORE_SEARCH_HANDLES
STATUS_OS2_EAS_DIDNT_FIT	ERROR_EAS_DIDNT_FIT
STATUS_OS2_EA_ACCESS_DENIED	ERROR_EA_ACCESS_DENIED
STATUS_OS2_CANCEL_VIOLATION	ERROR_CANCEL_VIOLATION
STATUS_OS2_ATOMIC_LOCKS_NOT_SUPPORTED	ERROR_ATOMIC_LOCKS_NOT_SUPPORTED
STATUS_OS2_CANNOT_COPY	ERROR_CANNOT_COPY

<105> [Section 3.3.5.1](#): Windows XP, Windows 2000, Windows Server 2003, Windows Server 2003 R2, Windows Vista, Windows Server 2008, Windows 7, and Windows Server 2008 R2 fail a TREE\_CONNECT\_ANDX request to a share that does not allow anonymous access with STATUS\_ACCESS\_DENIED. All other requests, which require an access check (such as opening a file), are failed with STATUS\_INVALID\_HANDLE.

<106> [Section 3.3.5.1](#): Windows XP, Windows 2000, Windows Server 2003, Windows Server 2003 R2, Windows Vista, Windows Server 2008, Windows 7, and Windows Server 2008 R2 will fail the request with STATUS\_ACCESS\_DENIED.

<107> [Section 3.3.5.1](#): Windows XP, Windows 2000, Windows Server 2003, Windows Server 2003 R2, Windows Vista, Windows Server 2008, Windows 7, and Windows Server 2008 R2 will fail the request with STATUS\_ACCESS\_DENIED.

<108> [Section 3.3.5.1.1](#): SMB servers on Windows Server 2003, Windows Server 2003 R2, Windows Server 2008, Windows Server 2008 R2, and Windows Server 2012 support the SMB\_FLAGS2\_REPARSE\_PATH flag and previous version access. SMB server on Windows Server 2003, Windows Server 2003 R2, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 parses paths when the flag is not set but only when configured to do so. This flag is used to expose the previous version logic to applications that run on clients whose SMB client does not understand the SMB\_FLAGS2\_REPARSE\_PATH flag and does not set it.

<109> [Section 3.3.5.1.2](#): Windows servers grant level II oplocks, even if the client does not request an oplock.

<110> [Section 3.3.5.2](#): Windows-based SMB servers support Extended Security, and are configured to use SPNEGO (as specified in [RFC4178]) as their GSS authentication protocol. Windows operating systems that use extended security send a GSS token (or fragment) if their SPNEGO implementation supports it. For details on Windows behavior, see [\[RFC4178\]](#).

<111> [Section 3.3.5.3](#): Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2 fail the [SMB\\_COM\\_SESSION\\_SETUP\\_ANDX request](#) with STATUS\_ACCESS\_DENIED if both the EncryptData and RejectUnencryptedAccess registry keys are set to nonzero values.

<112> [Section 3.3.5.3](#): The Windows GSS implementation supports raw Kerberos / NTLM messages in the **SecurityBlob** as described in [\[MS-AUTHSOD\]](#) section 2.1.2.2. If the client sends a zero length **SecurityBlob** in the request, the server-initiated SPNEGO exchange will be used.

<113> [Section 3.3.5.3](#): NTLM authentication has no expiration time, so authentications done with NTLM do not expire. For the Windows implementation of Kerberos expiration time, see [\[MS-KILE\]](#) section 3.3.1.

<114> [Section 3.3.5.4](#): Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2 fail the [SMB\\_COM\\_TREE\\_CONNECT\\_ANDX request](#) with STATUS\_ACCESS\_DENIED, if **Share.ShareFlags** contains SHI1005\_FLAGS\_ENCRYPT\_DATA and the **RejectUnencryptedAccess** registry key is set to a nonzero value.

<115> [Section 3.3.5.4](#): Windows 2000 never sets the SMB\_UNIQUE\_FILE\_NAME bit in the **OptionalSupport** field.

Windows XP sets the SMB\_UNIQUE\_FILE\_NAME bit in the **OptionalSupport** field only if short file name generation is disabled by setting the NtfsDisable8dot3NameCreation registry key to 1; see [\[MSKB-121007\]](#).

Windows Server 2003, Windows Server 2003 R2, Windows Vista, Windows Server 2008, Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2 also set the SMB\_UNIQUE\_FILE\_NAME bit in the **OptionalSupport** field if the NoAliasingOnFilesystem registry key is set to 1 (enabled).

<116> [Section 3.3.5.4](#): Windows 2000, Windows Server 2003, and Windows Server 2003 R2 set **GuestMaximalAccessRights** to access rights granted for null session. Windows Vista, Windows Server 2008, Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2 set **GuestMaximalAccessRights** to zero.

<117> [Section 3.3.5.5](#): Windows servers open or create files in the object store as described in [\[MS-FSA\]](#) section 2.1.5.1 Server Requests an Open of a File, with the following mapping of input elements:

- **RootOpen** is provided in one of two ways:
  - If the **SMB\_Parameters.Words.RootDirectoryFID** field is zero, **RootOpen** is provided by using the **SMB\_Header.TID** field to find the matching **Server.TreeConnect** in the **Server.Connection.TreeConnectTable**. The server then acquires an **Open** on the **Server.TreeConnect.Share.LocalPath**, which is passed as **RootOpen**.
  - If the **SMB\_Parameters.Words.RootDirectoryFID** field is non-zero, **RootOpen** is provided by looking up the **RootDirectoryFID** field in the **Server.Connection.FileOpenTable**.
- **PathName** is the **SMB\_Data.Bytes.FileName** field of the request.
- **SecurityContext** is found by using the **SMB\_Header.UID** field to look up the matching **Session** entry in the **Server.Connection.SessionTable**. The **Server.Session.UserSecurityContext** is passed as **SecurityContext**.
- **UserCertificate** is the certificate returned by the User-Certificate binding obtained during request processing.
- **DesiredAccess** is the **SMB\_Parameters.Words.DesiredAccess** field of the request. The FILE\_READ\_ATTRIBUTES option is added (using a bitwise OR) to the set provided by the client. If the FILE\_NO\_INTERMEDIATE\_BUFFERING flag is set, it is cleared, and FILE\_WRITE\_THROUGH is set.

- **ShareAccess** is the **SMB\_Parameters.Words.ShareAccess** field of the request.
- **CreateOptions** is the **SMB\_Parameters.Words.CreateOptions** field of the request. The **FILE\_COMPLETE\_IF\_OPLOCKED** option is added (using a bitwise OR) to the set provided by the client. If the **FILE\_NO\_INTERMEDIATE\_BUFFERING** flag is set, it is cleared, and **FILE\_WRITE\_THROUGH** is set.
- **CreateDisposition** is the **SMB\_Parameters.Words.CreateDisposition** field of the request.
- **DesiredFileAttributes** is the **SMB\_Parameters.Words.ExtFileAttributes** field of the request.
- **IsCaseSensitive** is set to **FALSE** if the **SMB\_FLAGS\_CASE\_INSENSITIVE** bit is set in the **SMB\_Header.Flags** field of the request. Otherwise, **IsCaseSensitive** is set depending upon system defaults.
- **OpLockKey** is empty.

The returned **Status** is copied into the **SMB\_Header.Status** field of the response. If the operation fails, the **Status** is returned in an Error Response, and processing is complete.

If the operation is successful, processing continues as follows:

- If either the **NT\_CREATE\_REQUEST\_OPLOCK** or the **NT\_CREATE\_REQUEST\_OPBATCH** flag is set in the **SMB\_Parameters.Words.Flags** field of the request, an OpLock is requested. Windows servers obtain OpLocks as described in [\[MS-FSA\]](#), section 3.1.5.17 Server Requests an Oplock, with the following mapping of input elements:
  - **Open** is the **Open** passed through from the preceding operation.
  - **Type** is **LEVEL\_BATCH** if the **NT\_CREATE\_REQUEST\_OPBATCH** flag is set, or **LEVEL\_ONE** if the **NT\_CREATE\_REQUEST\_OPLOCK** flag is set.

If an OpLock is granted, the **SMB\_Parameters.Words.OpLockLevel** field of the response is set.

- Windows servers obtain the extended file attribute and timestamp response information by querying file information from the **object store** as described in [\[MS-FSA\]](#), section 3.1.5.11 Server Requests a Query of File Information, with the following mapping of input elements:
  - **Open** is the **Open** passed through from the preceding operations.
  - **FileInformationClass** is **FileBasicInformation** ([\[MS-FSCC\]](#) section 2.4.7).

If the query fails, the **Status** is returned in an Error Response, and processing is complete. Otherwise:

- **SMB\_Parameters.Words.ExtFileAttributes** is set to **OutputBuffer.FileAttributes**.
- **SMB\_Parameters.Words.CreateTime** is set to **OutputBuffer.CreateTime**.
- **SMB\_Parameters.Words.LastAccessTime** is set to **OutputBuffer.LastAccessTime**.
- **SMB\_Parameters.Words.LastWriteTime** is set to **OutputBuffer.LastWriteTime**.
- **SMB\_Parameters.Words.LastChangeTime** is set to **OutputBuffer.ChangeTime**.

- Windows servers obtain the file size response field values by querying file information from the object store as described in [\[MS-FSA\]](#), section 3.1.5.11 Server Requests a Query of File Information, with the following mapping of input elements:

- **Open** is the **Open** passed through from the preceding operations.
- **FileInformationClass** is **FileStandardInformation** ([\[MS-FSCCI\]](#) section 2.4.38).

If the query fails, the **Status** is returned in an Error Response, and processing is complete. Otherwise:

- **SMB\_Parameters.Words.AllocationSize** is set to **OutputBuffer.AllocationSize**.
- **SMB\_Parameters.Words.EndOfFile** is set to **OutputBuffer.EndOfFile**.

If the query fails, the **Status** is returned in an Error Response, and processing is complete.

- **Open.File.FileType** is used to set the **SMB\_Parameters.Words.ResourceType** and **SMB\_Parameters.Words.Directory** fields of the response.
- A new **FID** is generated for the **Open** returned. All of the other results of the **Open** operation are ignored. The **FID** is copied into the **SMB\_Parameters.Words.FID** field of the response.

[<118> Section 3.3.5.5:](#) When the client sends a batched request that begins with an SMB\_COM\_NT\_CREATE\_ANDX request with the NT\_CREATE\_REQUEST\_EXTENDED\_RESPONSE bit set in the **Flags** field, Windows-based servers return the DOS error code ERRSRV/ERRerror and return an extended response only for the SMB\_COM\_NT\_CREATE\_ANDX request.

[<119> Section 3.3.5.5:](#) Windows-based servers set the **FileStatusFlags** using the following mapping of output elements specified in [\[MS-FSA\]](#) section 2.1.5.1:

- NO\_EAS is set if the returned **Open.File.ExtendedAttributesLength** is zero, otherwise it is not set.
- NO\_SUBSTREAMS is set if the returned **Open.File.StreamList** is less than or equal to one, otherwise it is not set.
- NO\_REPARSETAG is set if the returned **Open.File.ReparseTag** is empty, otherwise it is not set.

[<120> Section 3.3.5.5:](#) **NTFS** supports streams. **FAT** and FAT32 file systems do not support streams.

[<121> Section 3.3.5.5:](#) SMB servers on Windows 2000 Server, Windows Server 2003, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 return zero for the **VolumeGUID** and **FileId**. All other Windows-based servers set the **VolumeGUID** and **FileId** fields using the following mapping of output elements, specified in [\[MS-FSA\]](#) section 2.1.5.1:

- **VolumeGUID** is set to the returned **Open.File.Volume.VolumeId**.
- **FileId** is set to the returned **Open.File.FileId**.

[<122> Section 3.3.5.5:](#) Windows-based servers set the **MaximalAccessRights** and **GuestMaximalAccessRights** fields using the following mapping of output elements, specified in [\[MS-FSA\]](#) section 2.1.5.1:

- **MaximalAccessRights** is set to the returned **Open.GrantedAccess**.

- Windows 2000, Windows Server 2003, and Windows Server 2003 R2 set **GuestMaximalAccessRights** to access rights granted for null session.
- Windows Vista, Windows Server 2008, Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2 set **GuestMaximalAccessRights** to zero.

<123> [Section 3.3.5.6](#): Windows servers open existing files in the object store as described in [\[MS-FSA\]](#) section 2.1.5.1 Server Requests an Open of a File, with the following mapping of input elements:

- **RootOpen** is provided by using the **SMB\_Header.TID** to find the matching **Server.TreeConnect** in the **Server.Connection.TreeConnectTable**. The server then acquires an **Open** on **Server.TreeConnect.Share.LocalPath**, which is passed as **RootOpen**.
- **PathName** is the **SMB\_Data.Bytes.FileName** field from the request.
- **SecurityContext** is found by using the **SMB\_Header.UID** to look up the matching **Session** entry in the **Server.Connection.SessionTable**. The **Server.Session.UserSecurityContext** is passed as **SecurityContext**.
- **UserCertificate** is the certificate returned by the User-Certificate binding obtained during request processing.
- **DesiredAccess** is set as follows:
  - The **AccessMode** subfield of the **AccessMode** field in the request is used to set the value of **DesiredAccess**. The **AccessMode** subfield represents the lowest-order four bits of the **AccessMode** field (0x0007), as shown in the table in [\[MS-CIFS\]](#) section 2.2.4.3.1. The mapping of values is as follows:

AccessMode.AccessMode	DesiredAccess
0	GENERIC_READ 0x80000000
1	GENERIC_WRITE   FILE_READ_ATTRIBUTES 0x40000000   0x00000080
2	GENERIC_READ   GENERIC_WRITE 0x80000000   0x40000000
3	GENERIC_READ   GENERIC_EXECUTE 0x80000000   0x20000000

For any other value of **AccessMode.AccessMode**, this algorithm returns STATUS\_OS2\_INVALID\_ACCESS (ERRDOS/ERRbadaccess).

- **ShareAccess** is set as follows:
  - The **SharingMode** subfield of the **AccessMode** field in the request is used to set the value of **ShareAccess**. The **SharingMode** subfield is a 4-bit subfield of the **AccessMode** field (0x0070), as shown in the table in [\[MS-CIFS\]](#) section 2.2.4.3.1. The mapping of values is as follows:

AccessMode.SharingMode	ShareAccess
0	Compatibility mode (see below)
1	0x0L (don't share, exclusive use)

<b>AccessMode.SharingMode</b>	<b>ShareAccess</b>
2	FILE_SHARE_READ
3	FILE_SHARE_WRITE
4	FILE_SHARE_READ   FILE_SHARE_WRITE
0xFF	FCB mode (see below)

- For Compatibility mode, special filename suffixes (after the '.' in the filename) are mapped to **SharingMode** 4. The special filename suffix set is: "EXE", "DLL", "SYM", and "COM". All other file names are mapped to **SharingMode** 3.
- For FCB mode, if the file is already open on the server, the current sharing mode of the existing Open is preserved, and a **FID** for the file is returned. If the file is not already open on the server, the server attempts to open the file using **SharingMode** 1.
- For any other value of **AccessMode.SharingMode**, this algorithm returns STATUS\_OS2\_INVALID\_ACCESS (ERRDOS/ERRbadaccess).
- CreateOptions** bits are set as follows:

<b>CreateOptions value</b>	<b>SMB_COM_OPEN_ANDX equivalent</b>
FILE_WRITE_THROUGH	AccessMode.WritethroughMode == 1
FILE_SEQUENTIAL_ONLY	AccessMode.ReferenceLocality == 1
FILE_RANDOM_ACCESS	AccessMode.ReferenceLocality == 2 or AccessMode.ReferenceLocality == 3
FILE_NO_INTERMEDIATE_BUFFERING	AccessMode.CacheMode == 1
FILE_NON_DIRECTORY_FILE	Is set
FILE_COMPLETE_IF_OPLOCKED	Is set
FILE_NO_EA_KNOWLEDGE	SMB_Header.Flags2.SMB_FLAGS2_KNOWS_EAS == 0

- All other bits are unused.
- CreateDisposition** is set as follows:

<b>CreateDisposition value</b>	<b>SMB_Parameters.Word.OpenMode equivalent</b>
Invalid combination; return STATUS_OS2_INVALID_ACCESS (ERRDOS/ERRbadaccess)	FileExistsOpts = 0 & CreateFile = 0
FILE_CREATE	FileExistsOpts = 0 & CreateFile = 1
FILE_OPEN	FileExistsOpts = 1 & CreateFile = 0
FILE_OPEN_IF	FileExistsOpts = 1 & CreateFile = 1
FILE_OVERWRITE	FileExistsOpts = 2 & CreateFile = 0

CreateDisposition value	SMB_Parameters.Word.OpenMode equivalent
FILE_OVERWRITE_IF	FileExistsOpts = 2 & CreateFile = 1

<124> [Section 3.3.5.6](#): Windows-based servers set the **MaximalAccessRights** and **GuestMaximalAccessRights** fields using the following mapping of output elements specified in [\[MS-FSA\]](#) section 2.1.5.1:

- **MaximalAccessRights** is set to the returned **Open.GrantedAccess**.
- Windows 2000, Windows Server 2003, and Windows Server 2003 R2 set **GuestMaximalAccessRights** to access rights granted for null session.
- Windows Vista, Windows Server 2008, Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2 set **GuestMaximalAccessRights** to zero.

<125> [Section 3.3.5.7](#): Windows Vista, Windows Server 2008, Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2 SMB servers fail the SMB\_COM\_READ\_ANDX request with STATUS\_INVALID\_SMB if it is compounded with an SMB\_COM\_CLOSE request.

<126> [Section 3.3.5.7](#): If the read operation is on a file and the count of bytes to read is greater than or equal to 0x00010000 (64K), Windows SMB servers set **DataLength** and **DataLengthHigh** fields to 0 and do not return any data but return STATUS\_SUCCESS.

<127> [Section 3.3.5.8](#): Windows-based servers ignore the **ByteCount** field, and calculate the number of bytes to be written as **DataLength** | **DataLengthHigh** <<16.

<128> [Section 3.3.5.9](#): Windows 2000 Server and Windows Server 2003 return STATUS\_NO\_MORE\_FILES if the **FileName** field of the SMB\_COM\_SEARCH request is an empty string.

<129> [Section 3.3.5.10.1](#): Windows behavior for each Information Class is specified in each Information Class' corresponding subsection of either [\[MS-FSA\]](#) sections 2.1.5.11 or 2.1.5.12.

<130> [Section 3.3.5.10.2](#): Windows servers support these new Information Levels for directory queries.

<131> [Section 3.3.5.10.2](#): Windows Server 2003, Windows Server 2003 R2, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2 support previous versions but do not support this method of enumerating them, by default. This feature can be configured to be active by the administrator. The purpose is to allow an application (on a client that does not support the IOCTL command) to have a method of enumerating the previous versions.

<132> [Section 3.3.5.10.6](#): If the requested Information Class is FileRenameInformation, then the following validation is performed:

- If **RootDirectory** is not NULL, then the request must be failed with STATUS\_INVALID\_PARAMETER.
- If the file name pointed to by the *FileName* parameter of the FILE\_RENAME\_INFORMATION structure contains a separator character, then the request should be failed with STATUS\_NOT\_SUPPORTED.

If the server file system does not support this **Information Level**, then it must fail the request with STATUS\_OS2\_INVALID\_LEVEL. Otherwise, it must attempt to apply the attributes to the target file and return the success or failure code in the response.

<133> [Section 3.3.5.10.7](#): Windows 2000 Server, Windows Server 2003, Windows Server 2003 R2, and Windows Server 2008 do not break a batch oplock when processing a TRANS2\_SET\_PATH\_INFORMATION request. Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 break a batch oplock when processing the request.

<134> [Section 3.3.5.11.1](#): Windows 2000, Windows XP, Windows Server 2003, Windows Server 2003 R2, Windows Vista, Windows Server 2008, Windows 7, Windows Server 2008 R2, Windows 8.1, and Windows Server 2012 R2 SMB servers pass IOCTL requests through to the underlying object store.

<135> [Section 3.3.5.11.1](#): The server blocks certain FSCTL requests by not passing them through to the underlying file system for processing. The following FSCTLs are explicitly blocked by the server and are failed with STATUS\_NOT\_SUPPORTED.

Name	Value
FSCTL_REQUEST_OPLOCK_LEVEL_1	0x00090000
FSCTL_REQUEST_OPLOCK_LEVEL_2	0x00090004
FSCTL_REQUEST_BATCH_OPLOCK	0x00090008
FSCTL_OPLOCK_BREAK_ACKNOWLEDGE	0x0009000C
FSCTL_OPBATCH_ACK_CLOSE_PENDING	0x00090010
FSCTL_OPLOCK_BREAK_NOTIFY	0x00090014
FSCTL_MOVE_FILE	0x00090074
FSCTL_MARK_HANDLE	0x000900FC
FSCTL_QUERY_RETRIEVAL_POINTERS	0x0009003B
FSCTL_PIPE_ASSIGN_EVENT	0x00110000
FSCTL_GET_VOLUME_BITMAP	0x0009006F
FSCTL_GET_NTFS_FILE_RECORD	0x00090068
FSCTL_INVALIDATE_VOLUMES	0x00090054

Windows does not support USN journal calls because they require a volume handle. The following USN journal calls are also failed with STATUS\_NOT\_SUPPORTED.

Name	Value
FSCTL_READ_USN_JOURNAL	0x000900BB
FSCTL_CREATE_USN_JOURNAL	0x000900E7
FSCTL_QUERY_USN_JOURNAL	0x000900F4
FSCTL_DELETE_USN_JOURNAL	0x000900F8



Name	Value
FSCTL_ENUM_USN_DATA	0x000900B3

The following FSCTLs are explicitly blocked by Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 and are not passed through to the object store. They are failed with STATUS\_NOT\_SUPPORTED.

Name	Value
FSCTL_REQUEST_OPLOCK_LEVEL_1	0x00090000
FSCTL_REQUEST_OPLOCK_LEVEL_2	0x00090004
FSCTL_REQUEST_BATCH_OPLOCK	0x00090008
FSCTL_REQUEST_FILTER_OPLOCK	0x0009005C
FSCTL_OPLOCK_BREAK_ACKNOWLEDGE	0x0009000C
FSCTL_OPBATCH_ACK_CLOSE_PENDING	0x00090010
FSCTL_OPLOCK_BREAK_NOTIFY	0x00090014
FSCTL_MOVE_FILE	0x00090074
FSCTL_MARK_HANDLE	0x000900FC
FSCTL_QUERY_RETRIEVAL_POINTERS	0x0009003B
FSCTL_PIPE_ASSIGN_EVENT	0x00110000
FSCTL_GET_VOLUME_BITMAP	0x0009006F
FSCTL_GET_NTFS_FILE_RECORD	0x00090068
FSCTL_INVALIDATE_VOLUMES	0x00090054
FSCTL_READ_USN_JOURNAL	0x000900BB
FSCTL_CREATE_USN_JOURNAL	0x000900E7
FSCTL_QUERY_USN_JOURNAL	0x000900F4
FSCTL_DELETE_USN_JOURNAL	0x000900F8
FSCTL_ENUM_USN_DATA	0x000900B3
FSCTL_QUERY_DEPENDENT_VOLUME	0x000901F0
FSCTL_SD_GLOBAL_CHANGE	0x000901F4
FSCTL_GET_BOOT_AREA_INFO	0x00090230
FSCTL_GET_RETRIEVAL_POINTER_BASE	0x00090234
FSCTL_SET_PERSISTENT_VOLUME_STATE	0x00090238
FSCTL_QUERY_PERSISTENT_VOLUME_STATE	0x0009023C

Name	Value
FSCTL_REQUEST_OPLOCK	0x00090240
FSCTL_TXFS_MODIFY_RM	0x00098144
FSCTL_TXFS_QUERY_RM_INFORMATION	0x00094148
FSCTL_TXFS_ROLLFORWARD_REDO	0x00098150
FSCTL_TXFS_ROLLFORWARD_UNDO	0x00098154
FSCTL_TXFS_START_RM	0x00098158
FSCTL_TXFS_SHUTDOWN_RM	0x0009815C
FSCTL_TXFS_READ_BACKUP_INFORMATION	0x00094160
FSCTL_TXFS_WRITE_BACKUP_INFORMATION	0x00098164
FSCTL_TXFS_CREATE_SECONDARY_RM	0x00098168
FSCTL_TXFS_GET_METADATA_INFO	0x0009416C
FSCTL_TXFS_GET_TRANSACTED_VERSION	0x00094170
FSCTL_TXFS_SAVEPOINT_INFORMATION	0x00098178
FSCTL_TXFS_CREATE_MINIVERSION	0x0009817C
FSCTL_TXFS_TRANSACTION_ACTIVE	0x0009418C
FSCTL_TXFS_LIST_TRANSACTIONS	0x000941E4
FSCTL_TXFS_READ_BACKUP_INFORMATION2	0x000901F8
FSCTL_TXFS_WRITE_BACKUP_INFORMATION2	0x00090200

The following **FSCTL** is explicitly blocked by Windows 8 and Windows Server 2012 and is failed with STATUS\_NOT\_SUPPORTED.

Name	Value
FSCTL_GET_RETRIEVAL_POINTERS	0x00090073

<136> [Section 3.3.5.11.1.1](#): When the **NumberOfSnapshotsReturned** field is zero, Windows-based SMB servers incorrectly append 2 zeroed bytes after NT\_Trans\_Data in the NT\_TRANSACT\_IOCTL response buffer of the FSCTL\_SRV\_ENUMERATE\_SNAPSHOTS response.

<137> [Section 3.3.5.11.2](#): Windows-based servers request quota information from the object store, as specified in [\[MS-FSA\]](#) section 2.1.5.11.24 if **Server.Open** is a file. If **Server.Open** is on a directory, then the processing follows with the following mapping of input elements:

- **Open** is an Open of **Server.Open.TreeConnect.Share.LocalPath** for the **Server.Open** indicated by the **SMB\_Parameters.Words.FID** field of the request.
- **OutputBufferSize** is the **SMB\_Parameters.Words.MaxDataCount** field of the request.

- **ReturnSingle** is the **NT\_Trans\_Parameters.ReturnSingleEntry** field of the request.
- **RestartScan** is the **NT\_Trans\_Parameters.RestartScan** field of the request.
- **SidList** is the **NT\_Trans\_Data.SidList** field of the request.

The returned **Status** is copied into the **SMB\_Header.Status** field of the response. If the operation is successful, then the following additional mapping of output elements applies:

- **OutputBuffer** is copied into the **NT\_Trans\_Data** field of the response.
- **ByteCount** is copied into the **SMB\_Parameters.TotalDataCount** field of the response.

If quotas are disabled then the object store returns the **ChangeTime**, **QuotaUsed**, **QuotaThreshold**, and **QuotaLimit** fields set to zero in the FILE\_QUOTA\_INFORMATION.

Windows-based servers enumerate and return quota information for all SIDs on the file instead of the SIDs specified in the **SidList** field, if any of the following conditions are TRUE:

- **SidListLength** is zero.
- **StartSidOffset** is less than **SidListLength**.
- **StartSidOffset** or **SidListLength** is greater than **SMB\_Parameters.Words.DataCount**.

<138> [Section 3.3.5.11.3](#): Windows-based servers set the quota information on the object store, as specified in [\[MS-FSA\]](#) section 2.1.5.14.10, if **Server.Open** is on a file. If **Server.Open** is on a directory, then processing follows, as specified in [\[MS-FSA\]](#) section 2.1.5.21, with the following mapping of input elements:

- **Open** is an Open of **Server.Open.TreeConnect.Share.LocalPath** for the **Server.Open** indicated by the **NT\_Trans\_Parameters.FID** field of the request.
- **InputBuffer** is the **NT\_Trans\_Data.QuotaInformation** field of the request.
- **InputBuffer** is set to the size, in bytes, of the **InputBuffer** field.

<139> [Section 3.3.5.11.4](#): Windows 2000, Windows Server 2003, Windows Server 2003 R2, Windows XP, Windows Vista, and Windows Server 2008 servers fail the request but respond with arbitrary values in the NT\_TRANSACT\_CREATE Response. Windows 7, Windows Server 2008 R2, Windows 8, Windows Server 2012, Windows 8.1, and Windows Server 2012 R2 send an error response message without the parameter block or the data block.

## 7 Change Tracking

This section identifies changes that were made to the [MS-SMB] protocol document between the August 2013 and November 2013 releases. Changes are classified as New, Major, Minor, Editorial, or No change.

The revision class **New** means that a new document is being released.

The revision class **Major** means that the technical content in the document was significantly revised. Major changes affect protocol interoperability or implementation. Examples of major changes are:

- A document revision that incorporates changes to interoperability requirements or functionality.
- An extensive rewrite, addition, or deletion of major portions of content.
- The removal of a document from the documentation set.
- Changes made for template compliance.

The revision class **Minor** means that the meaning of the technical content was clarified. Minor changes do not affect protocol interoperability or implementation. Examples of minor changes are updates to clarify ambiguity at the sentence, paragraph, or table level.

The revision class **Editorial** means that the language and formatting in the technical content was changed. Editorial changes apply to grammatical, formatting, and style issues.

The revision class **No change** means that no new technical or language changes were introduced. The technical content of the document is identical to the last released version, but minor editorial and formatting changes, as well as updates to the header and footer information, and to the revision summary, may have been made.

Major and minor changes can be described further using the following change types:

- New content added.
- Content updated.
- Content removed.
- New product behavior note added.
- Product behavior note updated.
- Product behavior note removed.
- New protocol syntax added.
- Protocol syntax updated.
- Protocol syntax removed.
- New content added due to protocol revision.
- Content updated due to protocol revision.
- Content removed due to protocol revision.
- New protocol syntax added due to protocol revision.

- Protocol syntax updated due to protocol revision.
- Protocol syntax removed due to protocol revision.
- New content added for template compliance.
- Content updated for template compliance.
- Content removed for template compliance.
- Obsolete document removed.

Editorial changes are always classified with the change type **Editorially updated**.

Some important terms used in the change type descriptions are defined as follows:

- **Protocol syntax** refers to data elements (such as packets, structures, enumerations, and methods) as well as interfaces.
- **Protocol revision** refers to changes made to a protocol that affect the bits that are sent over the wire.

The changes made to this document are listed in the following table. For more information, please contact [protocol@microsoft.com](mailto:protocol@microsoft.com).

Section	Tracking number (if applicable) and description	Major change (Y or N)	Change type
<a href="#">2.2.4.2.2 Server Response Extensions</a>	69187 Changed the size of the UCHAR Data array to variable.	Y	Content updated.
<a href="#">2.2.4.3.1 Client Request Extensions</a>	69187 Changed the size of the UCHAR Data array to variable.	Y	Content updated.
<a href="#">3.3.5.8 Receiving an SMB_COM_WRITE_ANDX Request</a>	69187 Added a product behavior note on failure of the request with ERRSRV/ERRerror.	Y	New product behavior note added.

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