

[MS-MMSP]: Microsoft Media Server (MMS) Protocol Specification

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1 Introduction

This specification defines a Microsoft proprietary protocol referred to as the Microsoft Media Server (MMS) Protocol. MMS **streams** multimedia from Windows Media Services to Windows Media Player or to another instance of Windows Media Services. MMS uses TCP and the User Datagram Protocol (UDP).

1.1 Glossary

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

globally unique identifier (GUID)
little-endian
Unicode

The following terms are specific to this document:

.nsc file: A Windows Media Station file that serves as an announcement of a media stream broadcast.

Advanced Systems Format (ASF): The file format used by Windows Media, as specified in [\[ASF\]](#).

content: Multimedia data. **Content** is always in **ASF** format. For example, a single **Advanced Systems Format (ASF)** music file or a single **ASF** video file.

playlist: One or more **content** items that are **streaming** sequentially.

session: The state maintained by the server when it is **streaming content** to a client. If a server-side **playlist** is used, the same **session** is used for all **content** in the **playlist**.

stream: A sequence of **Advanced Systems Format (ASF)** data packets (as specified in [\[ASF\]](#)) that can be selected individually. For example, if a movie has an English soundtrack and a Spanish soundtrack, each soundtrack may be encoded in the **ASF** file as a separate **stream**. The video data also is a separate **stream**.

streaming: The act of transferring **content** from a sender to a receiver.

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

1.2 References

1.2.1 Normative References

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

[ASF] Microsoft Corporation, "Advanced Systems Format Specification", December 2004, http://download.microsoft.com/download/7/9/0/790fecaa-f64a-4a5e-a430-0bccdab3f1b4/ASF_Specification.doc

If you have any trouble finding [ASF], please check [here](#).

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

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

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

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

[MS-NLMP] Microsoft Corporation, "[NT LAN Manager \(NTLM\) Authentication Protocol Specification](#)", June 2007.

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

[RFC2617] Franks, J., Hallam-Baker, P., Hostetler, J., Lawrence, S., Leach, P., Luotonen, A., and Stewart, L., "HTTP Authentication: Basic and Digest Access Authentication", RFC 2617, June 1999, <http://www.ietf.org/rfc/rfc2617.txt>

[RFC3986] Berners-Lee, T., Fielding, R., and Masinter, L., "Uniform Resource Identifier (URI): Generic Syntax", STD 66, RFC 3986, January 2005, <http://www.ietf.org/rfc/rfc3986.txt>

[RFC4234] Crocker, D., Ed., and Overell, P., "Augmented BNF for Syntax Specifications: ABNF", RFC 4234, October 2005, <http://www.ietf.org/rfc/rfc4234.txt>

1.2.2 Informative References

[MS-RTSP] Microsoft Corporation, "[Real-Time Streaming Protocol \(RTSP\) Windows Media Extensions](#)", July 2007.

[MS-WMSP] Microsoft Corporation, "[Windows Media HTTP Streaming Protocol Specification](#)", March 2007.

1.3 Protocol Overview (Synopsis)

The MMS Protocol is used for transferring real-time multimedia data (for example, audio and video). Because it is a **streaming** protocol, the MMS Protocol attempts to facilitate scenarios in which the multimedia data is being transferred and rendered (such as video displayed and audio played) simultaneously.

The protocol uses a TCP connection for control of the streaming media **session**.

In this specification, the entity that initiates the TCP connection is referred to as the client, and the entity that responds to the TCP connection is referred to as the server. The multimedia data flows from the server to the client.

The client can send MMS Protocol request messages to the server over the TCP connection, requesting the server to perform actions such as starting and stopping the flow of multimedia data. The multimedia data is transferred either over the same TCP connection or as a flow of UDP packets.

While the server is transmitting multimedia data to the client, the client can send MMS Protocol messages to the server, requesting that it change the stream being transmitted. For example, the client may request that the server replace the currently transmitted video stream with a lower bit-rate version of the same video stream.

If the UDP protocol is used to transmit the multimedia data to the client, the client can send an MMS Protocol message to the server requesting that it resend a UDP packet. This is useful if the client does not receive a UDP packet the server transmitted. Unlike other MMS Protocol messages sent by the client, the request to resend a UDP packet is sent using UDP.

1.4 Relationship to Other Protocols

The MMS Protocol relies on TCP for the connection that controls the streaming media session. MMS Protocol messages are sent over the TCP connection by both the client and the server. The multimedia data that is being transferred by the server is sent over either TCP or UDP.

The client also relies on UDP for sending requests that ask the server to resend lost UDP packets.

The MMS Protocol is similar in functionality to the Real-Time Streaming Protocol (RTSP) Windows Media Extensions [\[MS-RTSP\]](#). However, RTSP extensions support functionality that is not available in MMS.

1.5 Prerequisites/Preconditions

The MMS Protocol does not provide a mechanism for a client to discover the URL to the server. Therefore, it is a prerequisite that the client obtain a URL to the server before this protocol can be used.

1.6 Applicability Statement

The MMS Protocol is suitable for streaming delivery of real-time multimedia data. The term streaming means that data is transmitted at some fixed rate or at some rate related to the rate at which the data is accessed (for example, displayed) by the receiver.

It is appropriate to use this protocol when a client is streaming from a server that does not support RTSP extensions or the Windows Media HTTP Streaming Protocol, as specified in [\[MS-WMSP\]](#). Otherwise, use of the MMS Protocol is generally not appropriate.

The MMS Protocol supports seeking, but does not support seeking in a server-side **playlist**. It also does not support what is sometimes referred to as Advanced Fast Start. That functionality is available in RTSP extensions and in the Windows Media HTTP Streaming Protocol.

If MMS is used in a scenario in which the multimedia data is always transferred over TCP, it may be more appropriate to use the Windows Media HTTP Streaming Protocol instead because it does not include the UDP functionality.

1.7 Versioning and Capability Negotiation

This document covers versioning issues in the following areas:

Supported Transports: This protocol must be implemented on top of TCP. In addition, implementations that support transmitting multimedia data over UDP must support the UDP protocol. See section [2.1](#).

Protocol Versions: Clients specify the protocol version using the **subscriberName** field in the [LinkViewerToMacConnect \(section 2.2.4.17\)](#) message. Servers specify the protocol version using the **ServerVersionInfo** field in the [LinkMacToViewerReportConnectedEX \(section 2.2.4.2\)](#) message.

Security and Authentication Methods: This protocol supports Basic authentication (as specified in [\[RFC2617\]](#)) and NT LAN Manager (NTLM) authentication (as specified in [\[MS-NLMP\]](#)).

Localization: This specification does not specify any localization-dependent protocol behavior.

Capability Negotiation: This protocol performs explicit capability negotiation using the following mechanisms:

- The **playIncarnation** field in the [LinkViewerToMacFunnelInfo \(section 2.2.4.19\)](#) message.
- The **fileAttributes** field in the [LinkMacToViewerReportOpenFile \(section 2.2.4.7\)](#) message.

This protocol does not use operating system versioning because operating systems typically include multiple client implementations with different capabilities. Furthermore, the client software components are frequently updated independently of the rest of the operating system. Instead, the protocol versioning mechanism relies on the version number of the Microsoft software product that is sending the request or response.

1.8 Vendor-Extensible Fields

This protocol uses HRESULTs, as specified in [\[MS-ERREF\]](#). Vendors are free to choose their own values as long as the C bit (0x20000000) is set, indicating it is a customer code.

1.9 Standards Assignments

The following port numbers are assigned for use by MMS.

Parameter	Value	Reference
TCP port	1755	As specified in [IANAPORT] .
UDP port	1755	As specified in [IANAPORT] .

2 Messages

2.1 Transport

The MMS Protocol uses TCP for the connection that controls the streaming media session. The MMS server listens for incoming TCP connections from the client. Port 1755 has been registered with IANA for this purpose. Use of other TCP ports is permitted, but, in that case, the port must be specified on the URL.

If the server uses UDP to transmit multimedia data to the client, the client also uses UDP to send requests to resend lost UDP packets. Port 1755 has been registered with IANA as the destination UDP port for such resend requests.

2.2 Message Syntax

All 16-bit, 32-bit, and 64-bit integer fields MUST be transmitted in **little-endian** byte order.

2.2.1 Data Structures Used for Logging

Logging information sent by the client to the server is formatted as a [CLIENT_LOG \(section 2.2.1.1\)](#) data structure. The CLIENT_LOG (section 2.2.1.1) structure consists of a [CLIENT_LOG_INFO \(section 2.2.1.2\)](#) structure and other fields. This section defines these two structures.

Strings in the CLIENT_LOG (section 2.2.1.1) structure and the CLIENT_LOG_INFO (section 2.2.1.2) structure always use the ANSI code page. The character set used for the ANSI code page is U.S. ASCII for the English version of Windows®, but it can be different for versions of Windows localized into other languages.

Strings MUST always be terminated by a NULL character. If a string is empty—that is, if it consists of nothing but the NULL character—it MUST be set to a hyphen (-) followed by a terminating NULL character.

2.2.1.1 CLIENT_LOG

The CLIENT_LOG structure is used in the [LinkViewerToMacLogging \(section 2.2.4.20\)](#) message. The purpose of this structure is to provide logging information from the client when a stream stops for any reason.

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
cbSize																															
info																															
...																															
...																															

...	
...	
...	
...	
...	
(info cont'd for 277 rows)	
...	dwSourceId
...	dwIPAddress
...	szComputerDNS
...	
...	
...	
...	
...	
...	
...	
(szComputerDNS cont'd for 57 rows)	
...	szOS
...	
...	

...	
...	qwOSVersion
...	
...	szCPU
...	
...	
...	
...	szProto
...	
...	szTransport
...	
...	dwPacketsLostNet
...	dwPacketsLostContNet
...	dwResendRequests
...	dwPacketsRecoveredResent
...	dwPacketsResent
...	

cbSize (4 bytes): An unsigned 32-bit integer. Specifies the length of the CLIENT_LOG structure in bytes.

info (1142 bytes): A [CLIENT_LOG_INFO \(section 2.2.1.2\)](#) structure.

dwSourceId (4 bytes): An unsigned 32-bit integer. It MUST be the value of the **openFileId** field in the [LinkMacToViewerReportOpenFile \(section 2.2.4.7\)](#) message.

dwIPAddress (4 bytes): An unsigned 32-bit integer. It SHOULD be set to 0xFFFFFFFF but MAY be set to the client's IPv4 address if IPv4 is used.<1>

szComputerDNS (260 bytes): A string field. It SHOULD be set to a hyphen (-) but MAY be set to the client's domain name system (DNS) name.<2>

szOS (16 bytes): A string field. It SHOULD be set to the name and version of the operating system used by the client.

qwOSVersion (8 bytes): An unsigned 64-bit integer. It MUST specify the version number of the client's operating system. The version number consists of four 16-bit integer parts. The most significant 16 bits of the **qwOSVersion** field MUST be set to the most significant part of the version number—that is, what is often referred to as the major version number. The second most significant bits of the **qwOSVersion** field MUST be set to the second most significant part of the version number, often referred to as the minor version number (and so on for the other two parts of the version number).

szCPU (16 bytes): A string field. It SHOULD be set to a string that describes the brand and model number of the CPU used on the client.

szProto (8 bytes): A string field. It MUST be set to "mms".

szTransport (8 bytes): A string field. It MUST be set to the transport protocol used by the server to transmit [Data \(section 2.2.2\)](#) packets to the client. The value MUST be one of the following:

Value	Meaning
"UDP"	User Datagram Protocol.
"TCP"	Transmission Control Protocol.

dwPacketsLostNet (4 bytes): An unsigned 32-bit integer. It MUST be set to the number of Data (section 2.2.2) packets lost that are lost at the network layer.

dwPacketsLostContNet (4 bytes): An unsigned 32-bit integer. It MUST be set to the largest number of consecutive missing Data (section 2.2.2) packets.

dwResendRequests (4 bytes): An unsigned 32-bit integer. It MUST be set to the number of Data (section 2.2.2) packets that the client has asked the server to resend.

dwPacketsRecoveredResent (4 bytes): An unsigned 32-bit integer. It MUST be set to the number of Data (section 2.2.2) packets that the client recovered as the result of the server resending a Data (section 2.2.2) packet.

dwPacketsResent (4 bytes): An unsigned 32-bit integer. It MUST be set to the number of Data (section 2.2.2) packets that the client received that are resent by the server.

2.2.1.2 CLIENT_LOG_INFO

The CLIENT_LOG_INFO structure is a component of the [CLIENT_LOG \(section 2.2.1.1\)](#) structure. The purpose of this structure is to provide logging information from the client when a stream stops for any reason.

szUserAgent
...
...
...
...
...
...
...
...
(szUserAgent cont'd for 8 rows)
szHostingWebPage
...
...
...
...
...
...
...
...
(szHostingWebPage cont'd for 57 rows)
qwClientVersion
...

szLang
...
...
...
szUniquePID
...
...
...
...
...
...
...
...
(szUniquePID cont'd for 2 rows)
szHostExe
...
...
...
...
...
...
...

...
qwHostExeVer
...
msFileDuration
qwFileSize
...
dwAvgBandwidthBps
szAudioCodec
...
...
...
...
...
...
...
...
(szAudioCodec cont'd for 8 rows)
szVideoCodec
...
...
...

...	
...	
...	
...	
(szVideoCodec cont'd for 8 rows)	
msStartTime	
msPlayed	
rate	dwBufferingCount
...	msBufferingTime
...	qwBytesReceived
...	
...	dwPacketsReceived
...	dwPacketsLostClient
...	dwPacketsRecoveredECC
...	dwMinReceptionQuality
...	hr
...	

cbSize (4 bytes): An unsigned 32-bit integer. It specifies the length of the CLIENT_LOG_INFO structure, in bytes.

szURL (260 bytes): A string field. It MUST be set to the URL of the **content** that the CLIENT_LOG_INFO structure provides information on.

szChannelURL (260 bytes): A string field. If the URL in the **szURL** field is obtained from a Windows Media Station (**.nsc**) file, the **szChannelURL** field MUST be set to the URL of that .nsc file.

szUserAgent (64 bytes): A string field. It MUST be set to the HTTP User-Agent string of the embedded Web browser in the client software.

szHostingWebPage (260 bytes): A string field. If the client software is embedded in a Web page (in the form of a plug-in or ActiveX control), the **szHostingWebPage** field MUST be set to the URL of that Web page.

qwClientVersion (8 bytes): An unsigned 64-bit integer. It MUST specify the version number of the Windows Media Player software. The version number consists of four 16-bit integer parts. The most significant 16 bits of the **qwClientVersion** field MUST be set to the most significant part of the version number; that is, what is often referred to as the major version number. The second most significant bits of the **qwClientVersion** field MUST be set to the second most significant part of the version number, often referred to as the minor version number (and so on for the other two parts of the version number).

szLang (16 bytes): This is a string field. This field MUST specify the client system language; for example, en-US for a U.S. English language system.

szUniquePID (40 bytes): A string field. It MUST specify a unique player identifier that can be used to correlate multiple logging requests for the same streaming media session. It is recommended that a **globally unique identifier (GUID)** be used as the value for this field.

szHostExe (32 bytes): A string field. It MUST be set to the name of the executable file in which Windows Media Player is loaded as a plug-in.

qwHostExeVer (8 bytes): An unsigned 64-bit integer. This field MUST specify the version number of the application named in the **szHostExe** field. The version number consists of four 16-bit integer parts. The most significant 16 bits of the **qwHostExeVer** field MUST be set to the most significant part of the version number—that is, what is often referred to as the major version number. The second most significant bits of the **qwHostExeVer** field MUST be set to the second most significant part of the version number, often referred to as the minor version number (and so on for the other two parts of the version number).

msFileDuration (4 bytes): An unsigned 32-bit integer. It MUST be set to the duration, in milliseconds, of the content. When streaming live content, this field MUST be set to 0x00000000.

qwFileSize (8 bytes): An unsigned 64-bit integer. File size, in bytes, of the content. When streaming live content, this field MUST be set to 0x0000000000000000.

dwAvgBandwidthBps (4 bytes): An unsigned 32-bit integer. It MUST be set to the average bit rate, in bits per second, of the content that is received by the client (as measured by the client).

szAudioCodec (64 bytes): This is a string field. It MUST be set to the name of the codec currently in use to decompress the audio stream in the content.

szVideoCodec (64 bytes): This is a string field. It MUST be set to the name of the codec currently in use to decompress the video stream in the content.

msStartTime (4 bytes): An unsigned 32-bit integer. It MUST be set to the time (in the timeline of the content), in milliseconds, at which playback began. The timeline of the content starts at 0, so if playback started from the beginning of the content, the value of this field becomes 0x00000000. When streaming live content, this field SHOULD be set to 0x00000000.

msPlayed (4 bytes): An unsigned 32-bit integer. It MUST be set to the amount of content that has been played by the client, expressed in millisecond time units.

rate (2 bytes): A signed 16-bit integer. It MUST be set to the current playback rate in which a positive value specifies playback in the forward direction, and a negative value specifies playback in the reverse direction. The value 0x0001 MUST be specified if content has been played at the normal rate.

dwBufferingCount (4 bytes): An unsigned 32-bit integer. It MUST be set to the number of times buffering is required by the client.

msBufferingTime (4 bytes): An unsigned 32-bit integer. It MUST be set to the time spent buffering, expressed in milliseconds.

qwBytesReceived (8 bytes): An unsigned 64-bit integer. It MUST be set to the total number of data bytes the client received. This field MUST only count the bytes in the payload of the [Data \(section 2.2.2\)](#) packets.

dwPacketsReceived (4 bytes): An unsigned 32-bit integer. It MUST be set to the total number of Data (section 2.2.2) packets the client received.

dwPacketsLostClient (4 bytes): An unsigned 32-bit integer. It MUST be set to the number of Data (section 2.2.2) packets the client never received.

dwPacketsRecoveredECC (4 bytes): An unsigned 32-bit integer. It MUST be set to 0x00000000.

dwMinReceptionQuality (4 bytes): An unsigned 32-bit integer. It MUST be set to the minimum percentage of the Data (section 2.2.2) packets received or recovered in the last 30 seconds. The maximum value is 0x00000064 for all Data (section 2.2.2) packets received and 0x00000000 for no Data (section 2.2.2) packets received.

hr (4 bytes): An unsigned 32-bit integer. It MUST be set to 0x00000000.

2.2.2 Data

The Data packet is used by the server to send streaming media data to the client.

The **ASF** file header consists of the entire ASF Header Object (as specified in [\[ASF\]](#) section 3.1) plus the 50-byte fixed initial portion of the ASF Data Object (as specified in [\[ASF\]](#) section 5.1).

Data packets are sent over either UDP or TCP, depending on which transport mode the server and the client agree on.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	1	2	3	4	5	6	7	8	9	10	11
LocationId																															
playIncarnation										AFlags										PacketSize											
Payload (variable)																															
...																															

LocationId (4 bytes): A 32-bit integer field that specifies the index of the **Payload** field into the complete object being transferred. If the **Payload** field contains an ASF file header, **LocationId** MUST be 0x00000000 for the first payload, and MUST increment by 1 for each payload. If the **Payload** field contains a packet-pair packet, **LocationId** MUST be 0xF0F0F000 for the first packet-pair packet, and 0xF0F0F001 for the second packet-pair packet. If the payload contains an ASF data packet, the entire ASF file is considered the object that is being transferred. Thus, for payloads containing an ASF data packet, this field MUST be set to the payload's ASF data packet number. The first ASF data packet in an ASF file MUST have a **LocationId** of 0x00000000, the second ASF data packet in the file MUST have a **LocationId** of 0x00000001, and so on. Note that because a server may skip ASF data packets, the value of the **LocationId** field may not be sequential from one MMS Data packet to the next. If the server does not have access to the ASF file (for example, in the case of live content), the server MUST assume a virtual ASF file, incrementing **LocationId** (or decrementing it when rewinding the content) exactly as if a real ASF file existed.

playIncarnation (1 byte): An 8-bit field that is set to the least significant 8 bits of the MMS message (see section 2.2.4) that triggered the server to send this Data packet. The value 0x00 is reserved and MUST NOT be used. The value 0xFF MUST be used if the Data packet contains a packet-pair packet.

AFFlags (1 byte): An 8-bit integer field. When the **Payload** field contains an ASF data packet, the field MUST be treated as a sequence number. The initial value MUST be 0x00, and it MUST increment by 1 for each ASF data packet that is transmitted. If the most recently transmitted Data packet has an **AFFlags** field value of 0xFE, and the server receives a [LinkViewerToMacStartPlaying \(section 2.2.4.25\)](#) message or a [LinkViewerToMacStartStriding \(section 2.2.4.26\)](#) message, the first Data packet transmitted in response SHOULD have the **AFFlags** field set to 0x00. When the **Payload** field contains an ASF file header, the **AFFlags** field MUST be set to 0x04 if the ASF file header is split into multiple Data packets. **AFFlags** MUST be set to 0x0C if this is the last Data packet in the sequence. If the **Payload** field contains a packet-pair packet, **AFFlags** MUST be set to 0x10.

PacketSize (2 bytes): A 16-bit integer field. MUST be set to the total size of the Data packet in bytes.

Payload (variable): A variable size block of bytes. The content of this field is either an ASF data packet, an ASF file header, or a packet-pair packet, depending on the circumstances under which the Data packet is transmitted. If the **Payload** field contains an ASF data packet, and if the ASF packet contains a **Padding Data** field, as specified in [\[ASF\]](#) section 5.2.4, the **Padding Data** field SHOULD be removed before encapsulating the ASF data packet in the MMS Data packet, except if the client identified itself as Windows Media Services version 4.0 or 4.1 in the [LinkViewerToMacConnect \(section 2.2.4.17\)](#) message. If the **Padding Data** field is removed, the **Padding Length** field in the ASF payload parsing information (as specified in [\[ASF\]](#) section 5.2.2) MUST be updated to indicate a non-existent **Padding Data** field.

2.2.3 TcpMessageHeader

The TcpMessageHeader packet encapsulates MMS messages when they are sent over TCP. A single TcpMessageHeader packet can contain multiple MMS messages. TcpMessageHeader is not used for MMS messages that are sent over UDP.

0	1	2	3	4	5	6	7	8	9	0 ¹	1	2	3	4	5	6	7	8	9	0 ²	1	2	3	4	5	6	7	8	9	0 ³	1
rep								version								versionMinor								padding							
sessionId																															
messageLength																															
seal																															
chunkCount																															
seq																MBZ															
timeSent																															
...																															
MMS message (variable)																															
...																															

rep (1 byte): An 8-bit field. It MUST be set to 0x1.

version (1 byte): An 8-bit field. It MUST be set to 0x0.

versionMinor (1 byte): An 8-bit field. It MUST be set to 0x0.

padding (1 byte): An 8-bit field. It SHOULD be set to 0x0, and SHOULD be ignored by receivers.

sessionId (4 bytes): A 32-bit field. It MUST be set to 2953575118.

messageLength (4 bytes): An unsigned 32-bit integer that specifies the size, in bytes, of the MMS message field plus 16.

seal (4 bytes): A 32-bit field. It MUST be set to 0x20534D4D.

chunkCount (4 bytes): An unsigned 32-bit integer. It MUST be set to the total size of the TcpMessageHeader packet in multiples of 8 bytes.

seq (2 bytes): An unsigned 16-bit integer. The TcpMessageHeader packet sequence number. The value of this field MUST increment by 1 for each TcpMessageHeader packet that is sent. The first packet MUST have a seq value of 0x0000.

MBZ (2 bytes): A 16-bit field. It MUST be set to 0x0000.

timeSent (8 bytes): An unsigned 64-bit integer. The value of this field SHOULD be set to the elapsed time since the transmission of the first TcpMessageHeader packet (measured at the time the current TcpMessageHeader packet is sent), expressed in millisecond units. The value of this field MAY be chosen arbitrarily by the sender. Receivers SHOULD ignore this field. <3>

MMS message (variable): A variable-size array of bytes. The size of the field MUST be a multiple of 8 bytes. This field contains zero or more MMS messages, as specified in section 2.2.4.

2.2.4 Message Types

This section defines the MMS message types. All messages MUST be transmitted over TCP.

MMS messages adhere to a common packet structure. MMS messages always start with the **chunkLen** field that specifies the size of the MMS message in multiples of 8 bytes. If the sum of the sizes of all fields in the MMS message is not a multiple of 8 bytes, padding MUST be appended after the final field. Whether padding is required or not, the amount of padding added MUST be chosen so that the total size of the MMS message, including the padding, becomes a multiple of 8 bytes. The value of the **chunkLen** field includes the size of the padding, if any.

The **chunkLen** field is followed by a Message ID (**MID**) field that specifies the type of message contained in the packet.

2.2.4.1 LinkMacToViewerPing

The LinkMacToViewerPing message is sent by the server to verify that a particular client is still active.

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
chunkLen																															
MID																															
dwParam1																															
dwParam2																															

- chunkLen (4 bytes):** Length of the message in chunks of 8 bytes.
- MID (4 bytes):** Message ID. For this message, the value MUST be set to 0x0004001b.
- dwParam1 (4 bytes):** A 32-bit field. SHOULD be set to 0x00000000 and MUST be ignored by the receiver.
- dwParam2 (4 bytes):** A 32-bit field. SHOULD be set to 0x00000000 and MUST be ignored by the receiver. <4>

2.2.4.2 LinkMacToViewerReportConnectedEX

The `LinkMacToViewerReportConnectedEX` message is sent by the server in response to a [LinkViewerToMacConnect \(section 2.2.4.17\)](#) message from the client.

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
chunkLen																															
MID																															
hr																															
playIncarnation																															
MacToViewerProtocolRevision																															
ViewerToMacProtocolRevision																															
blockGroupPlayTime																															
...																															
blockGroupBlocks																															
nMaxOpenFiles																															
nBlockMaxBytes																															
maxBitRate																															
cbServerVersionInfo																															
cbVersionInfo																															
cbVersionUrl																															
cbAuthenPackage																															
ServerVersionInfo (variable)																															

...
VersionInfo (variable)
...
VersionUrl (variable)
...
AuthenPackage (variable)
...

chunkLen (4 bytes): Length of the message in chunks. A chunk is 8 bytes.

MID (4 bytes): Message identifier. For this message, the value MUST be 0x00040001.

hr (4 bytes): The result of processing the client LinkViewerToMacConnect (section 2.2.4.17) message. For HRESULT codes, see [\[MS-ERREF\]](#).

playIncarnation (4 bytes): A 32-bit field that specifies if the server can perform a packet-pair experiment. It MUST be set to one of the following values:

Value	Meaning
MMS_DISABLE_PACKET_PAIR 0xf0f0f0ef	The server cannot perform a packet-pair experiment.
MMS_USE_PACKET_PAIR 0xf0f0f0f0	The server can perform a packet-pair experiment.

MacToViewerProtocolRevision (4 bytes): A 32-bit field. It MUST be set to 0x0004000B.

ViewerToMacProtocolRevision (4 bytes): A 32-bit field. It MUST be set to 0x0003001C.

blockGroupPlayTime (8 bytes): A [DOUBLE](#) (floating-point) field. It MUST be set to 1.0.

blockGroupBlocks (4 bytes): A 32-bit field. It MUST be set to 0x00000001.

nMaxOpenFiles (4 bytes): A 32-bit field. It MUST be set to 0x00000001.

nBlockMaxBytes (4 bytes): A 32-bit field. It MUST be set to 0x00008000.

maxBitRate (4 bytes): A 32-bit field. It MUST be set to 0x00989680. [<5>](#)

cbServerVersionInfo (4 bytes): A 32-bit unsigned integer. This field MUST be set to the number of **Unicode** characters in the **ServerVersionInfo** field, including the terminating null character.

cbVersionInfo (4 bytes): A 32-bit unsigned integer. This field MUST be set to the number of Unicode characters in the **VersionInfo** field, including the terminating null character.

cbVersionUrl (4 bytes): A 32-bit unsigned integer. It MUST be set to the number of Unicode characters in the **VersionUrl** field, including the terminating null character.

cbAuthenPackage (4 bytes): A 32-bit unsigned integer. It MUST be set to the number of Unicode characters in the **AuthenPackage** field, including the terminating null character.

ServerVersionInfo (variable): A variable-size array of Unicode characters. It MUST be set to the major and minor version numbers of the software product (specified in section [2.2.4.17](#)) that is sending the LinkMacToViewerReportConnectedEX message and MUST adhere to the following Augmented Backus-Naur Form (ABNF) (as specified in [RFC4234](#)) syntax:

```
major = 1*2DIGIT
minor = 1*2DIGIT [ "." 1*4DIGIT "." 1*4DIGIT ]
server-version-info = major "." minor %x0000
```

VersionInfo (variable): A variable-size array of Unicode characters. If the server wants the client to upgrade to a new version, it SHOULD include a nonzero size **VersionInfo** field. When the **VersionInfo** field has a nonzero size, it MUST specify the major and minor version numbers of the client software that the client should upgrade to, and the **VersionInfo** field MUST adhere to the following ABNF syntax:

```
major = 1*2DIGIT
minor = 1*2DIGIT [ "." 1*4DIGIT "." 1*4DIGIT ]
version-info = major "." minor %x0000
```

VersionUrl (variable): A variable-size array of Unicode characters. If the **VersionInfo** field has a nonzero size, the **VersionUrl** field MUST specify the URL from which the client can download a software update of the version specified by the **VersionInfo** field. The URL MUST adhere to the URI syntax (as specified in [RFC3986](#)), it MUST be expressed using Unicode characters, and it MUST include a terminating null character.

AuthenPackage (variable): A variable-size array of Unicode characters. If the server supports authentication, and if it sends a [LinkMacToViewerSecurityChallenge \(section 2.2.4.14\)](#) message to this client, it MUST include a nonzero size **AuthenPackage** field. The **AuthenPackage** field MUST specify the authentication scheme the server uses, according to the following ABNF syntax:

```
auth-scheme= ( "BASIC" / "NTLM" ) %x0000
```

If the server does not support authentication, or if the server knows it will not send a LinkMacToViewerSecurityChallenge (section 2.2.4.14) message to this client, the **AuthenPackage** field MAY have a 0 size.

2.2.4.3 LinkMacToViewerReportConnectedFunnel

The LinkMacToViewerReportConnectedFunnel message is sent by the server in response to a [LinkViewerToMacConnectFunnel \(section 2.2.4.18\)](#) message sent by the client.

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

chunkLen (4 bytes): Length in chunks of the message. A chunk is 8 bytes.

MID (4 bytes): Message ID. For this message, the value MUST be 0x00040002.

hr (4 bytes): A 32-bit field. MUST be set to 0x00000000.

playIncarnation (4 bytes): A 32-bit field. SHOULD be set to 0x00000000. It MUST be ignored by the receiver. [<6>](#)

packetPayloadSize (4 bytes): A 32-bit field. SHOULD be set to 0x00000000. It MUST be ignored by the receiver. [<7>](#)

funnelName (variable): A variable size array of Unicode characters. MUST be set to the Unicode character string "Funnel Of The Gods". [<8>](#)

2.2.4.4 LinkMacToViewerReportDisconnectedFunnel

The LinkMacToViewerReportDisconnectedFunnel message is sent by the server in response to a [LinkViewerToMacConnectFunnel \(section 2.2.4.18\)](#) message from the client when there is an error processing the request.

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
chunkLen																															
MID																															
hr																															

playIncarnation

- chunkLen (4 bytes):** Length in chunks of the message. A chunk is 8 bytes.
- MID (4 bytes):** Message ID. For this message, the value MUST be 0x00040003.
- hr (4 bytes):** Result of processing the LinkViewerToMacConnectFunnel (section 2.2.4.18) message. For HRESULT codes, see [\[MS-ERREF\]](#).
- playIncarnation (4 bytes):** A 32-bit field. SHOULD be set to 0x00000000. It MUST be ignored by the receiver. [<9>](#)

2.2.4.5 LinkMacToViewerReportEndOfStream

The LinkMacToViewerReportEndOfStream message is sent by the server to notify the client that the end of the current playlist entry has been reached.

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
chunkLen																															
MID																															
hr																															
playIncarnation																															

- chunkLen (4 bytes):** Length in chunks of the message. A chunk is 8 bytes.
- MID (4 bytes):** Message ID. For this message, the value MUST be 0x0004001e.
- hr (4 bytes):** HRESULT. The following HRESULT codes have a special meaning (any other HRESULT code has the meaning specified in [\[MS-ERREF\]](#)):

Value	Meaning
0x00000000	The end of the current playlist entry is reached, or the server successfully processed the LinkViewerToMacStopPlaying (section 2.2.4.27) message.
0x00000001	The end of the current playlist entry is reached, and the server sends a LinkMacToViewerReportStreamChange (section 2.2.4.12) message.

- playIncarnation (4 bytes):** A 32-bit field. If this LinkMacToViewerReportEndOfStream message is sent in response to a LinkViewerToMacStopPlaying (section 2.2.4.27) message, the **playIncarnation** field MUST be set to the value of the **playIncarnation** field in the LinkViewerToMacStopPlaying (section 2.2.4.27) message. Otherwise, the **playIncarnation** field MUST be set to the value of the **playIncarnation** field in the most recently received message of the following message types: [LinkViewerToMacStartPlaying](#) and [LinkViewerToMacStartStriding](#).

2.2.4.6 LinkMacToViewerReportFunnelInfo

The LinkMacToViewerReportFunnelInfo message is sent by the server to assign a unique identifier to a client in response to a [LinkViewerToMacFunnelInfo \(section 2.2.4.19\)](#) message received from the client. This identifier is then used by the client in [RequestPacketListResend \(section 2.2.5\)](#) packets.

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
chunkLen																															
MID																															
hr																															
playIncarnation																															
transportMask																															
nBlockFragments																															
fragmentBytes																															
nCubs																															
failedCubs																															
nDisks																															
decluster																															
cubddDatagramSize																															
Packet-pair packet (variable)																															
...																															

chunkLen (4 bytes): Length of the message in chunks. A chunk is 8 bytes.

MID (4 bytes): Message ID. For this message, the value MUST be 0x00040015.

hr (4 bytes): The result of processing the client LinkViewerToMacFunnelInfo (section 2.2.4.19) request. For HRESULT codes, see [\[MS-ERREF\]](#).

playIncarnation (4 bytes): A 32-bit field. It MUST be set to one of the following values:

Value	Meaning
MMS_DISABLE_PACKET_PAIR 0xf0f0fef	The server does not send packet-pair packets.
MMS_USE_PACKET_PAIR 0xf0f0f0f0	The server sends packet-pair packets as part of the LinkMacToViewerReportFunnelInfo messages.
MMS_PACKET_PAIR_TCP_HIGH_ENTROPY 0xf0f0f0f1	The server sends packet-pair packets as part of the LinkMacToViewerReportFunnelInfo messages.
MMS_PACKET_PAIR_UDP_HIGH_ENTROPY 0xf0f0f901	The server sends packet-pair packets using Data (section 2.2.2) packets sent over UDP.

transportMask (4 bytes): A 32-bit field. It MUST be set to 0x00000008.

nBlockFragments (4 bytes): A 32-bit field. It MUST be set to 0x00000001.

fragmentBytes (4 bytes): A 32-bit field. It MUST be set to 0x00010000.

nCubs (4 bytes): A 32-bit field. This field MUST be an identifier that is chosen by the server. It is recommended that the server generate a unique identifier for each client because the client includes the identifier in any RequestPacketListResend (section 2.2.5) packets that it sends. A unique identifier can help the server associate a RequestPacketListResend (section 2.2.5) packet with a particular client.

failedCubs (4 bytes): A 32-bit field. It MUST be set to 0x00000000.

nDisks (4 bytes): A 32-bit field. It MUST be set to 0x00000001.

decluster (4 bytes): 32-bit field. It MUST be set to 0x00000000.

cubddDatagramSize (4 bytes): A 32-bit field. It MUST be set to 0x00000000.

Packet-pair packet (variable): A variable-size array of bytes. This field MUST only be present if the value of the **playIncarnation** field is 0xF0F0F0F0 or 0xF0F0F0F1. In such cases, the server sends three LinkMacToViewerReportFunnelInfo messages.

2.2.4.7 LinkMacToViewerReportOpenFile

The LinkMacToViewerReportOpenFile message is sent by the server in response to a [LinkViewerToMacOpenFile \(section 2.2.4.21\)](#) message by the client.

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

openFileId
padding
fileName
fileAttributes
fileDuration
...
fileBlocks
unused1
...
...
...
filePacketSize
filePacketCount
...
fileBitRate
fileHeaderSize
unused2
...
...
...

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

chunkLen (4 bytes): Length of the message in chunks. A chunk is 8 bytes.

MID (4 bytes): Message ID. For this message, the value MUST be 0x00040006.

hr (4 bytes): HRESULT. Result of processing the client LinkViewerToMacOpenFile (section 2.2.4.21) request. For HRESULT codes, see [\[MS-ERREF\]](#).

playIncarnation (4 bytes): A 32-bit field. It MUST be set to the value of the **playIncarnation** field in the message received from the client that triggered the transmission of this LinkMacToViewerReportOpenFile message. The message is either a LinkViewerToMacOpenFile (section 2.2.4.21) message or a [LinkViewerToMacSecurityResponse \(section 2.2.4.24\)](#) message.

openFileId (4 bytes): A 32-bit field. It SHOULD be set by the server in such a way that when the client echoes the value of this field in the [RequestPacketListResend \(section 2.2.5\)](#) packet (or in other messages that contain an **openFileId** field), the server can identify the file referred to in the message.

padding (4 bytes): A 32-bit field. It SHOULD be set to 0x00000000 and MUST be ignored by the receiver.

fileName (4 bytes): A 32-bit field. It MUST be set to 0x00000000.

fileAttributes (4 bytes): A 32-bit field. It MUST specify the attributes of the content by using a bitwise OR combination of the flags in the following table.

Value	Meaning
FILE_ATTRIBUTE_MMS_CANSTRIDE 0x00800000	Specifies that the server supports fast forward and rewinding of content.
FILE_ATTRIBUTE_MMS_CANSEEK 0x01000000	Specifies that the server supports seeking in content.
FILE_ATTRIBUTE_MMS_BROADCAST 0x02000000	Specifies that the content is a broadcast stream (the same stream may be shared by multiple clients).
FILE_ATTRIBUTE_MMS_LIVE 0x04000000	Specifies that the content is a live stream.
FILE_ATTRIBUTE_MMS_PLAYLIST 0x40000000	Specifies that the content is part of a multiple item server-side playlist.

fileDuration (8 bytes): A [DOUBLE](#) data type field. It MUST be set to the duration, in seconds, of the current playlist entry, specified as a double precision floating point number. If the duration is unknown (for example, for live content, the **fileDuration** field MUST be set to 0).

fileBlocks (4 bytes): An unsigned 32-bit integer. It MUST be set to the duration, in seconds, of the current playlist entry. If the duration is not an integer number of seconds, it MUST be rounded to the nearest higher integer value.

unused1 (16 bytes): An array of 16 bytes. Each byte in this field MUST be set to 0x00.

filePacketSize (4 bytes): An unsigned 32-bit integer. It MUST be set to the maximum size, in bytes, of the ASF data packets to be transmitted by the server for this playlist entry.

filePacketCount (8 bytes): An unsigned 64-bit integer. It MUST be set to the number of ASF data packets in the content. If this information is unavailable, the field MUST be set to 0x0000000000000000.

fileBitRate (4 bytes): An unsigned 32-bit integer. It MUST be the sum of the maximum bit rates (in bits per second) of all streams in the current playlist entry.

fileHeaderSize (4 bytes): An unsigned 32-bit integer. It MUST be set to the size, in bytes, of the ASF file header for the current playlist entry.

unused2 (36 bytes): An array of 36 bytes. Each byte in this field MUST be set to 0x00.[<10>](#)

2.2.4.8 LinkMacToViewerReportReadBlock

The LinkMacToViewerReportReadBlock message is sent by the server in response to a [LinkViewerToMacReadBlock \(section 2.2.4.23\)](#) message from the client.

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

chunkLen (4 bytes): Length of the message in chunks. A chunk is 8 bytes.

MID (4 bytes): Message ID. For this message, the value MUST be 0x00040011.

hr (4 bytes): The result of processing the client LinkViewerToMacReadBlock (section 2.2.4.23) request. For HRESULT codes, see [\[MS-ERREF\]](#).

playIncarnation (4 bytes): A 32-bit field. This field MUST be set to the value of the **playIncarnation** field in the LinkViewerToMacReadBlock (section 2.2.4.23) message that this LinkMacToViewerReportReadBlock message is a response to.

A value that specifies the type of packet-pair bandwidth estimation that should be used, if any.

playSequence (4 bytes): A 32-bit field. This field MUST be set to 0x00000000.

2.2.4.9 LinkMacToViewerReportRedirect

The LinkMacToViewerReportRedirect message is used by the server in response to a [LinkViewerToMacOpenFile \(section 2.2.4.21\)](#) message from the client. It is used to redirect the client to a new location.

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
chunkLen																															
MID																															
hr																															
RedirectType																cbLocation															
wszLocation (variable)																															
...																															

chunkLen (4 bytes): Length of the message in chunks. A chunk is 8 bytes.

MID (4 bytes): Message ID. For this message, the value MUST be 0x00040022.

hr (4 bytes): HRESULT. Result of processing the client request. For HRESULT codes, see [\[MS-ERREF\]](#).

RedirectType (2 bytes): A 16-bit field. It MUST be set to 0x0001 if the server is redirecting the client to a different URL, or set to 0x0002 if the server is requesting that the client use a different proxy server.

0x0001
0x0002

cbLocation (2 bytes): A 16-bit unsigned integer. It MUST be the size of the **wszLocation** field, in bytes, including the terminating null character.

wszLocation (variable): A variable size array of Unicode characters. MUST include a terminating null Unicode character. If the value of the **RedirectType** field is 0x0001, then **wszLocation** MUST be set to a URL. If the value of the **RedirectType** field is 0x0002, then

wszLocation MUST be set to either a URL to a proxy server or to an empty string (that is, consist of only the terminating null character). If **wszLocation** is an empty string, it means that the client is requested to stop using a proxy server and connect directly to the server that is sending the LinkMacToViewerReportRedirect message.

If **wszLocation** is set to a URL, it MUST adhere to the URI syntax specified in [\[RFC3986\]](#). Percent-encoding, as specified in [\[RFC3986\]](#), MUST NOT be used. If the URI does not contain a port component, the client MUST use TCP port 1755. The scheme component of the URI MUST be one of the values in the following table.

Value	Meaning
"mms"	MMS with Data (section 2.2.2) packets sent over UDP.
"mmsu"	MMS with Data (section 2.2.2) packets sent over UDP.
"mmst"	MMS with Data (section 2.2.2) packets sent over TCP.

2.2.4.10 LinkMacToViewerReportStartedPlaying

The LinkMacToViewerReportStartedPlaying message is sent by the server in response to a [LinkViewerToMacStartPlaying \(section 2.2.4.25\)](#) message.

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
chunkLen																															
MID																															
hr																															
playIncarnation																															
tigerFileId																															
unused1																															
unused2																															
...																															
...																															

chunkLen (4 bytes): Length of the message in chunks. A chunk is 8 bytes.

MID (4 bytes): Message ID. For this message, the value MUST be 0x00040005.

hr (4 bytes): HRESULT. The result of processing the client LinkViewerToMacStartPlaying (section 2.2.4.25) message. For HRESULT codes, see [\[MS-ERREF\]](#).

playIncarnation (4 bytes): A 32-bit field. It MUST be the value of the **playIncarnation** field in the LinkViewerToMacStartPlaying (section 2.2.4.25) message that this LinkMacToViewerReportStartedPlaying message is a response to.

tigerFileId (4 bytes): A 32-bit field. This field SHOULD [<11>](#) be set to the value of the **openFileId** field in the [LinkMacToViewerReportOpenFile \(section 2.2.4.7\)](#) message sent previously by the server. The field MUST be ignored by the receiver.

unused1 (4 bytes): A 32-bit field. It MUST be set to either 0x00000000 or 0x40000000. The field MUST be ignored by the receiver.

unused2 (12 bytes): An array of 12 bytes. Each byte in this field MUST be set to 0x00.

2.2.4.11 LinkMacToViewerReportStartStriding

The LinkMacToViewerReportStartStriding message is used by the server to respond to a [LinkViewerToMacStartStriding \(section 2.2.4.26\)](#) message from the client.

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

chunkLen (4 bytes): Length of the message in chunks. A chunk is 8 bytes.

MID (4 bytes): Message ID. For this message, the value MUST be 0x0004000a.

hr (4 bytes): HRESULT. Result of processing the client LinkViewerToMacStartStriding (section 2.2.4.26) message. For HRESULT codes, see [\[MS-ERREF\]](#).

playIncarnation (4 bytes): A 32-bit field. It MUST be the value of the **playIncarnation** field in the LinkViewerToMacStartStriding (section 2.2.4.26) message that this LinkMacToViewerReportStartStriding message is a response to.

spare (4 bytes): A 32-bit field. It MUST be set to 0x00000000.

2.2.4.12 LinkMacToViewerReportStreamChange

The LinkMacToViewerReportStreamChange message is sent by the server to notify the client that it is starting to stream the next entry in a server-side playlist.

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
chunkLen																															
MID																															
hr																															
dwTcpHdrIncarnation																															
cbPacketSize																															
cbHeaderSize																															
dwBitRate																															
dwStreamId																															

chunkLen (4 bytes): Length of the message in chunks. A chunk is 8 bytes.

MID (4 bytes): Message ID. For this message, the value MUST be 0x00040020.

hr (4 bytes): A 32-bit field. It MUST be set to 0x00000000.

dwTcpHdrIncarnation (4 bytes): A 32-bit field. It MUST be set to 0x000000FF.

cbPacketSize (4 bytes): An unsigned 32-bit integer. It MUST be set to the maximum size, in bytes, of the ASF data packets to be transmitted by the server for the new playlist entry.

cbHeaderSize (4 bytes): An unsigned 32-bit integer. It MUST be set to the size, in bytes, of the ASF file header for the new playlist entry.

dwBitRate (4 bytes): An unsigned 32-bit integer. It MUST be the sum of the maximum bit rates (in bits per second) of all streams in the new playlist entry.

dwStreamId (4 bytes): A 32-bit field. This field SHOULD be set to 0x00000000. It MUST be ignored by the receiver. [<12>](#)

2.2.4.13 LinkMacToViewerReportStreamSwitch

The LinkMacToViewerReportStreamSwitch message is used by the server to respond to a [LinkViewerToMacStreamSwitch \(section 2.2.4.28\)](#) message from the client.

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

MID
hr

chunkLen (4 bytes): Length of the message in chunks. A chunk is 8 bytes.

MID (4 bytes): Message ID. For this message, the value MUST be 0x00040021.

hr (4 bytes): HRESULT. Result of processing the client LinkViewerToMacStreamSwitch (section 2.2.4.28) message. For HRESULT codes, see [\[MS-ERREF\]](#).

2.2.4.14 LinkMacToViewerSecurityChallenge

The LinkMacToViewerSecurityChallenge message is sent by the server to request authentication from the client.

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

chunkLen (4 bytes): Length of the message in chunks. A chunk is 8 bytes.

MID (4 bytes): Message ID. For this message, the value MUST be 0x0004001A.

playIncarnation (4 bytes): A 32-bit field. It MUST be set to the value of the **playIncarnation** field in the message received from the client that triggered the transmission of this LinkMacToViewerSecurityChallenge message. The message is either a [LinkViewerToMacOpenFile \(section 2.2.4.21\)](#) message or a [LinkViewerToMacSecurityResponse \(section 2.2.4.24\)](#) message.

cookie (4 bytes): A 32-bit field. It SHOULD be set by the server in such a way that when the client echoes the value of this field in the LinkViewerToMacSecurityResponse (section 2.2.4.24) message, the server can determine what LinkMacToViewerSecurityChallenge message the LinkViewerToMacSecurityResponse (section 2.2.4.24) message is a response to.

cbToken (4 bytes): An unsigned 32-bit integer. It MUST be the size of the **pToken** field in bytes.

pToken (variable): A variable-size array of bytes. If Basic authentication (as specified in [\[RFC2617\]](#)) is used, the **pToken** field MUST consist of an array of Unicode characters, and MUST adhere to the following ABNF syntax:

```
basic-realm= "realm="
             realm-value ; as defined in [RFC2617]
ptoken-value= [ basic-realm ] %x0000
```

If the authentication realm for Basic authentication is unspecified, the basic-realm syntax element SHOULD still be included in the **pToken** field. In that case, the realm-value syntax element SHOULD be set to an empty quoted string. [<13>](#)

If NT LAN Manager (NTLM) authentication (as specified in [\[MS-NLMP\]](#)) is used, the first two bytes of the **pToken** field MUST be 0x00. The subsequent bytes of **pToken** are an [NTLM_AUTH structure \(section 2.2.4.14.1\)](#).

2.2.4.14.1 NTLM_AUTH Structure

The NTLM_AUTH structure is defined as follows:

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																															
One																															
Reserved1																															
NTLMTokenSize																															
Two																															
Reserved2																															
NTLMToken (variable)																															
...																															

Zero (4 bytes): A 32-bit field. This field MUST be set to 0x00000000.

One (4 bytes): An unsigned 32-bit integer. This field MUST be set to 0x00000001.

Reserved1 (4 bytes): A 32-bit field. This field is unused and MUST be ignored when parsing the message.

NTLMTokenSize (4 bytes): An unsigned 32-bit integer. This field specifies the size of the **NTLMToken** field, in bytes.

Two (4 bytes): An unsigned 32-bit integer. This field **MUST** be set to 0x00000002.

Reserved2 (4 bytes): A 32-bit field. This field is unused and **MUST** be ignored when parsing the message.

NTLMToken (variable): A variable size array of bytes. This field must be set to the NTLM challenge token or response token, as appropriate. These tokens are defined in [\[MS-NLMP\]](#).

2.2.4.15 LinkViewerToMacCancelReadBlock

The LinkViewerToMacCancelReadBlock message is sent by the client to request that the server cancel sending of the ASF file header that the client previously requested with a [LinkViewerToMacReadBlock \(section 2.2.4.23\)](#) message.

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
chunkLen																															
MID																															
playIncarnation																															

chunkLen (4 bytes): Length of the message in chunks. A chunk is 8 bytes.

MID (4 bytes): Message ID. For this message, the value **MUST** be 0x00030025.

playIncarnation (4 bytes): A 32-bit field. It **MUST** be the value of the **playIncarnation** field in the LinkViewerToMacReadBlock (section 2.2.4.23) message that this LinkViewerToMacCancelReadBlock message is attempting to cancel.

2.2.4.16 LinkViewerToMacCloseFile

The LinkViewerToMacCloseFile message is sent by the client to tell the server that it is finishing the streaming media session.

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
chunkLen																															
MID																															
playIncarnation																															
openFileId																															

chunkLen (4 bytes): Length of the message in chunks. A chunk is 8 bytes.

MID (4 bytes): Message ID. For this message, the value MUST be 0x0003000D.

playIncarnation (4 bytes): A 32-bit field. SHOULD be set to 0x00000000. It MUST be ignored by the receiver. <14>

openFileId (4 bytes): A 32-bit field. This MUST be the value of the **openFileId** field in the [LinkMacToViewerReportOpenFile \(section 2.2.4.7\)](#) message that the client previously received from the server.

2.2.4.17 LinkViewerToMacConnect

The LinkViewerToMacConnect message is sent by the client to request a connection to a server.

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

chunkLen (4 bytes): Length of the message in chunks. A chunk is 8 bytes.

MID (4 bytes): Message identifier. For this message, the value MUST be 0x00030001.

playIncarnation (4 bytes): A 32-bit field. The field specifies the type of packet-pair bandwidth estimation that should be used, if any. The field SHOULD be set to one of the following values: <15>

Value	Meaning
MMS_DISABLE_PACKET_PAIR 0xf0f0f0ef	Packet-pair bandwidth estimation not requested.
MMS_USE_PACKET_PAIR 0xf0f0f0f0	Requests that packet-pair bandwidth estimation be performed.

MacToViewerProtocolRevision (4 bytes): A 32-bit field. It MUST be set to 0x0004000B.

ViewerToMacProtocolRevision (4 bytes): A 32-bit field. It MUST be set to 0x0003001C.

subscriberName (variable): An array of Unicode characters that specifies the major and minor version numbers of the Microsoft software product that is sending the LinkViewerToMacConnect message.

If the LinkViewerToMacConnect message is sent through a proxy server, the **subscriberName** field MUST specify the name and port number of the server using the host-param syntax element (defined below), and SHOULD also specify the name and port number of the server using the host-string syntax element.[<16>](#16)

If a proxy server forwards a LinkViewerToMacConnect message, and the **subscriberName** field does not contain the host-string syntax element, it MUST insert that syntax element into the field. Also, each proxy server MUST add information identifying its product name and version into the via-string syntax element. If the **subscriberName** field does not contain a via-string syntax element, the proxy server MUST add it. Otherwise, the proxy server appends its information to the existing information using a comma character as the separator, as specified by the following syntax.

The ABNF (as specified in [\[RFC4234\]](#RFC4234)) syntax of the **subscriberName** field is defined as follows.

```
host-info = host ; as defined in [RFC3986]
[ ":" port ]; as defined in [RFC3986]
host-param= "; Host: " host-info
host-string= "HOST: " host-info
via-info= token [ "/" token ] *( "," [SP] token [ "/" token ] )
via-string= "VIA: " via-info
client-guid= "; { " 8HEXDIG "-" 4HEXDIG "-" 4HEXDIG "-"
              4HEXDIG "-" 12HEXDIG "}"
major = 1*2DIGIT
minor = 1*2DIGIT [ "." 1*4DIGIT "." 1*4DIGIT ]
client-token = "Spooooon!" /
( "NSPlayer" "/" major "." minor client-guid )
subscriberName= client-token [ host-param ] %x0000
[ host-string %x0000 ] [ via-string %x0000 ]
```

Clients MUST assign the values of the client-token, major, and minor ABNF syntax elements according to the table below. [<17>](#17)

Client-token	Major	Minor
Spooooon!		
Spooooon!		
NSPlayer	4	1
NSPlayer	7	0
NSPlayer	7	1
NSPlayer	8	0
NSPlayer	9	0
NSPlayer	10	0

Example:

```
NSPlayer/4.1.0.3928; {68c0a090-8797-11d2-a2b3-00a0c9b60551}
```

2.2.4.18 LinkViewerToMacConnectFunnel

The LinkViewerToMacConnectFunnel message is sent by the client to request that [Data \(section 2.2.2\)](#) packets be streamed by the server using a specific protocol and to a specific port.

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
chunkLen																															
MID																															
playIncarnation																															
maxBlockBytes																															
maxFunnelBytes																															
maxBitRate																															
funnelMode																															
funnelName (variable)																															
...																															

- chunkLen (4 bytes):** Length of the message in chunks. A chunk is 8 bytes.
- MID (4 bytes):** Message ID. For this message, the value MUST be 0x00030002.
- playIncarnation (4 bytes):** A 32-bit field. SHOULD be set to 0x00000000. It MUST be ignored by the receiver.
- maxBlockBytes (4 bytes):** A 32-bit field. SHOULD be set to 0xFFFFFFFF.
- maxFunnelBytes (4 bytes):** A 32-bit field. SHOULD be set to 0x00000000.
- maxBitRate (4 bytes):** A 32-bit field. SHOULD be set to 0x00989680.<18>
- funnelMode (4 bytes):** A 32-bit field. It MUST be set to 0x00000002.
- funnelName (variable):** An array of Unicode characters containing the description of the socket that the client uses to receive Data (section 2.2.2) packets. The syntax of the **funnelName** field MUST adhere to the following ABNF syntax.

```

ip-addr= IPv4address / IPv6address ; as defined in [RFC3986]
proto= "TCP" / "UDP"
port= 1*5DIGIT
funnelName= "\\\" ip-addr "\\\" proto "\\\" port

```

The port syntax element MUST have a value in the range 1-65535.

2.2.4.19 LinkViewerToMacFunnelInfo

The LinkViewerToMacFunnelInfo message is sent by the client to request an identifier for use in RequestPacketResend packets.

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
chunkLen																															
MID																															
playIncarnation																															

chunkLen (4 bytes): Length of the message in chunks. A chunk is 8 bytes.

MID (4 bytes): Message ID. For this message, the value MUST be 0x00030018.

playIncarnation (4 bytes): A 32-bit field. Specifies the type of packet-pair bandwidth estimation that should be used. It MUST be set to one of the values in the following table.

Value	Meaning
MMS_DISABLE_PACKET_PAIR 0xf0f0fef	Disables packet-pair.
MMS_USE_PACKET_PAIR 0xf0f0f0f0	Requests that packet-pair bandwidth estimation be performed.
MMS_PACKET_PAIR_TCP_HIGH_ENTROPY 0xf0f0f0f1	Requests that high-entropy packet-pairs be sent over TCP.
MMS_PACKET_PAIR_UDP_HIGH_ENTROPY 0xf0f0f901	Requests that high-entropy packet-pairs be sent over UDP.

2.2.4.20 LinkViewerToMacLogging

The LinkViewerToMacLogging packet is used by the client to report statistics about the current stream to the server (as specified in section [2.2.1.1](#)).

playIncarnation
spare
token
cbtoken
fileName (variable)
...
tokenData (variable)
...

chunkLen (4 bytes): Length of the message in chunks. A chunk is 8 bytes.

MID (4 bytes): Message ID. For this message, the value MUST be 0x00030005.

playIncarnation (4 bytes): A 32-bit field. It MUST be set to a value in the range 0x00000001 to 0x000000FE, inclusive.

spare (4 bytes): A 32-bit field. SHOULD be set to 0x00000000. It MUST be ignored by the receiver. [<19>](#)

token (4 bytes): A 32-bit unsigned integer. If the LinkViewerToMacOpenFile message contains a nonzero size **tokenData** field, the **token** field MUST specify the offset to the start of the **tokenData** field, counted in bytes from the start of the **fileName** field. If the size of the **tokenData** field is zero, the value of the **token** field MUST be 0x00000000.

Example: If the **fileName** field is abc.asf, and the size of the **tokenData** field is nonzero, the value of the **token** field must be 0x00000010.

cbtoken (4 bytes): A 32-bit unsigned integer. It MUST be the size, in bytes, of the **tokenData** field.

fileName (variable): A variable size array of Unicode characters specifying the path component of the URL of the content. See definition of path as specified in [\[RFC3986\]](#) section 3.3. Percent-encoding (as specified in [\[RFC3986\]](#) section 2.1) MUST NOT be used on the characters in the path. The **fileName** field SHOULD NOT include a terminating null Unicode character, unless the value of the **cbtoken** field is greater than 0, in which case the **fileName** field MUST include a terminating null Unicode character.

Example: media/mediastream.asf

tokenData (variable): A variable size array of bytes. It MUST contain authentication data of the size given by the **cbtoken** field. Thus, if the **cbtoken** field is 0x00000000, the **tokenData** field is not included in the message.

If the authentication data is for the Basic authentication scheme, as specified in [\[RFC2617\]](#), the authentication data MUST be the user name and password, according to the syntax for basic-credentials, as specified in [\[RFC2617\]](#). The basic-credentials authentication data MUST be stored in the **tokenData** field as a null-terminated ASCII string.

If the authentication data is for the NTLM authentication scheme, as specified in [\[MS-NLMP\]](#), the **tokenData** consists of an [NTLM_AUTH structure \(section 2.2.4.14.1\)](#).

2.2.4.22 LinkViewerToMacPong

The LinkViewerToMacPong message is sent by the client to inform the server that it is still active. It sends this message in response to a [LinkMacToViewerPing \(section 2.2.4.1\)](#) message from the server.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
chunkLen																															
MID																															
dwParam1																															
dwParam2																															

chunkLen (4 bytes): Length of the message in chunks. A chunk is 8 bytes.

MID (4 bytes): Message ID. For this message, the value MUST be 0x0003001b.

dwParam1 (4 bytes): A 32-bit field. It SHOULD be set to 0x00000000 and MUST be ignored by the receiver. [<20>](#)

dwParam2 (4 bytes): A 32-bit field. It SHOULD be set to 0x00000000 and MUST be ignored by the receiver. [<21>](#)

2.2.4.23 LinkViewerToMacReadBlock

The LinkViewerToMacReadBlock message is sent by the client to request the ASF file header. The ASF file header contains all of the codec initialization parameters needed by the client to decompress the multimedia data.

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
chunkLen																															

MID
openFileId
fileBlockId
offset
length
flags
padding
tEarliest
...
tDeadline
...
playIncarnation
playSequence

chunkLen (4 bytes): Length of the message in chunks. A chunk is 8 bytes.

MID (4 bytes): Message ID. For this message, the value MUST be 0x00030015.

openFileId (4 bytes): A 32-bit field. This field MUST be the value of the **openFileId** field in the [LinkMacToViewerReportOpenFile \(section 2.2.4.7\)](#) message that the client previously received from the server.

fileBlockId (4 bytes): A 32-bit field. It MUST be set to 0x00000000.

offset (4 bytes): A 32-bit field. It MUST be set to 0x00000000.

length (4 bytes): A 32-bit field. It SHOULD be set to 0x00008000. [<22>](#)

flags (4 bytes): A 32-bit field. It MUST be set to 0xFFFFFFFF.

padding (4 bytes): A 32-bit field. It SHOULD be set to 0x00000000 and MUST be ignored by the receiver. [<23>](#)

tEarliest (8 bytes): A [DOUBLE](#) data type field. This field MUST be set to the value 0 expressed as a double precision floating point number.

tDeadline (8 bytes): A **DOUBLE** data type field. It MUST be set to the value 3600 expressed as a double precision floating-point number.

playIncarnation (4 bytes): A 32-bit field. It MUST be set to a value in the range 0x00000001 to 0x000000FE, inclusive.

playSequence (4 bytes): A 32-bit field. It MUST be set to 0x00000000.

2.2.4.24 LinkViewerToMacSecurityResponse

The LinkViewerToMacSecurityResponse message is sent by the client in response to an authentication request by the server.

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
chunkLen																															
MID																															
playIncarnation																															
cookie																															
cbToken																															
pToken (variable)																															
...																															

chunkLen (4 bytes): Length of the message in chunks. A chunk is 8 bytes.

MID (4 bytes): Message ID. For this message, the value MUST be 0x0003001A.

playIncarnation (4 bytes): A 32-bit field. This field MUST be the value of the **playIncarnation** field in the [LinkMacToViewerSecurityChallenge \(section 2.2.4.14\)](#) message received from the server that triggered the transmission of this LinkViewerToMacSecurityResponse message.

cookie (4 bytes): A 32-bit field. It MUST be the value of the **cookie** field in the LinkMacToViewerSecurityChallenge (section 2.2.4.14) message received from the server that triggered the transmission of this LinkViewerToMacSecurityResponse message.

cbToken (4 bytes): An unsigned 32-bit integer. This field MUST be the size of the **pToken** field, in bytes, including the terminating byte.

oken (variable): A variable size array of bytes. If Basic authentication (as specified in [RFC2617]) is used, this field MUST be set to the user name and password, according to the syntax for basic-credentials, as specified in [RFC2617]. The basic-credentials data MUST be stored in the **pToken** field as a null-terminated ASCII string.

If NT LAN Manager (NTLM) authentication (as specified in [\[MS-NLMP\]](#)) is used, the first two bytes of the **pToken** field MUST be 0x00. The subsequent bytes of **pToken** are an [NTLM_AUTH structure \(section 2.2.4.14.1\)](#).

2.2.4.25 LinkViewerToMacStartPlaying

The `LinkViewerToMacStartPlaying` message is sent by the client to request that the server start streaming the content for playback at the normal (real-time) rate.

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
chunkLen																															
MID																															
openFileId																															
padding																															
position																															
...																															
asfOffset																															
locationId																															
frameOffset																															
playIncarnation																															
dwAccelBandwidth (optional)																															
dwAccelDuration (optional)																															
dwLinkBandwidth (optional)																															

chunkLen (4 bytes): Length of the message in chunks. A chunk is 8 bytes.

MID (4 bytes): Message ID. For this message, the value MUST be 0x00030007.

openFileId (4 bytes): A 32-bit field. This field MUST be the value of the **openFileId** field in the [LinkMacToViewerReportOpenFile \(section 2.2.4.7\)](#) message that the client previously received from the server.

padding (4 bytes): A 32-bit field. This field SHOULD be set to 0x00000000 and MUST be ignored by the receiver. <24>

position (8 bytes): A **DOUBLE** data type field. This field MUST be set to either the time offset in seconds from which the server is requested to start streaming the content, or to the maximum positive number for data type **DOUBLE** (DBL_MAX). The content is assumed to begin at time 0. For example, setting this field to 0 requests the server to stream the content from the beginning. If this field is set to the maximum positive number for data type **DOUBLE**, either the **asfOffset** field or the **locationId** field MUST be used to specify the starting point for playback.

asfOffset (4 bytes): A 32-bit unsigned integer. This field MUST be set to the offset, in bytes, counted from the beginning of the ASF file from which the server is requested to start streaming, or set to either 0xFFFFFFFF or 0x00000000. If this field is set to 0xFFFFFFFF or 0x00000000, then either the **position** or **locationId** field MUST be used to specify the starting point for playback.

locationId (4 bytes): A 32-bit unsigned integer. This field MUST be set to the ASF data packet number from which the server is requested to start streaming the content, or set to either 0xFFFFFFFF or 0x00000000. If this field is set to 0xFFFFFFFF or 0x00000000, then either the **position** field or the **asfOffset** field MUST be used to specify the starting point for playback.

frameOffset (4 bytes): A 32-bit field. If the server is requested to stream the content until its end, this field MUST be set to 0x00000000. Otherwise, the low-order 31 bits MUST be treated as an unsigned 31-bit integer. The low-order 31 bits MUST be set to the time position in the content at which the server is requested to stop streaming, in millisecond time units. The time position MUST be expressed either relative to the start of the content (time 0), in which case the most significant bit in the **frameOffset** field MUST be 0, or relative to the start position requested in this LinkViewerToMacStartPlaying message, in which case the most significant bit in the **frameOffset** field MUST be 1.

playIncarnation (4 bytes): A 32-bit field. It MUST be set to a value in the range 0x00000001 to 0x000000FE, inclusive.

dwAccelBandwidth (4 bytes): A 32-bit unsigned integer. If this field is present, the **dwAccelDuration** field MUST also be present. The **dwAccelBandwidth** field specifies a transmission rate, in bits per second, that the client is requesting the server to use when transmitting the amount of multimedia data specified by the **dwAccelDuration** field.

dwAccelDuration (4 bytes): A 32-bit unsigned integer. If this field is present, the **dwAccelBandwidth** field MUST also be present. The **dwAccelDuration** field specifies an amount of multimedia data, in millisecond units, that the client is requesting the server to transmit at the bandwidth specified by the **dwAccelBandwidth** field.

dwLinkBandwidth (4 bytes): A 32-bit unsigned integer. If this field is present, the **dwAccelBandwidth** and **dwAccelDuration** fields MUST also be present. The **dwLinkBandwidth** field specifies the client's connection bandwidth, in bits per second.

2.2.4.26 LinkViewerToMacStartStriding

The LinkViewerToMacStartStriding message is sent by the client to request that the server start streaming the content for playback at a trick-mode rate, that is, fast forward or rewind.

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
chunkLen																															
MID																															
openFileId																															
padding																															
position																															
...																															
asfOffset																															
locationId																															
frameOffset																															
playIncarnation																															
rate																															
...																															

chunkLen (4 bytes): Length of the message in chunks. A chunk is 8 bytes.

MID (4 bytes): Message ID. For this message, the value MUST be 0x00030028.

openFileId (4 bytes): A 32-bit field. This field MUST be set to the value of the **openFileId** field in the [LinkMacToViewerReportOpenFile \(section 2.2.4.7\)](#) message that the client previously received from the server.

padding (4 bytes): A 32-bit field. It SHOULD be set to 0x00000000 and MUST be ignored by the receiver.

position (8 bytes): A **DOUBLE** data type field. This field MUST be set to either the time offset in seconds from which the server is requested to start streaming the content, or to the maximum positive number for data type **DOUBLE** (DBL_MAX). The content is assumed to begin at time 0. For example, setting this field to 0 requests the server to stream the content

from the beginning. If this field is set to the maximum positive number for data type **DOUBLE**, either the **asfOffset** field or the **locationId** field MUST be used to specify the starting point for playback.

asfOffset (4 bytes): A 32-bit unsigned integer. If either the **position** field or the **locationId** field specifies the start position, the **asfOffset** field MUST be set to either 0xFFFFFFFF or 0x00000000. Otherwise, the **asfOffset** field MUST be set to the offset in bytes counted from the beginning of the ASF file from which the server is requested to start streaming.

locationId (4 bytes): A 32-bit unsigned integer. If either the **position** field or the **asfOffset** field specifies the start position, the **locationId** field MUST be set to either 0xFFFFFFFF or 0x00000000. Otherwise, the **locationId** field MUST be set to the ASF data packet number from which the server is requested to start streaming the content.

frameOffset (4 bytes): A 32-bit field. It SHOULD be set to 0x00000000 and MUST be ignored by the receiver. [<25>](#)

playIncarnation (4 bytes): A 32-bit field. This field MUST be set to a value in the range 0x00000001 to 0x000000FE, inclusive.

rate (8 bytes): A **DOUBLE** data type field. This field MUST be set to the rate at which striding is to occur, expressed as a double precision floating-point number. The valid range is from -5 to +5, inclusive. This field MUST NOT be set to 0.

2.2.4.27 LinkViewerToMacStopPlaying

The LinkViewerToMacStopPlaying message is sent by the client to request that the server stop streaming [Data \(section 2.2.2\)](#) packets.

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
chunkLen																															
MID																															
openFileId																															
playIncarnation																															

chunkLen (4 bytes): Length of the message in chunks. A chunk is 8 bytes.

MID (4 bytes): Message ID. For this message, the value MUST be 0x00030009.

openFileId (4 bytes): A 32-bit field. This field MUST be set to the value of the **openFileId** field in the [LinkMacToViewerReportOpenFile \(section 2.2.4.7\)](#) message that the client previously received from the server.

playIncarnation (4 bytes): A 32-bit field. This field MUST be set to the value of the **playIncarnation** field in the most recently sent message of the following message types: [LinkViewerToMacStartPlaying](#) and [LinkViewerToMacStartStriding](#).<26>

2.2.4.28 LinkViewerToMacStreamSwitch

The LinkViewerToMacStreamSwitch message is sent by the client to select, unselect, thin, unthin, or replace individual streams that it is currently receiving.

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
chunkLen																															
MID																															
cStreamEntries																															
aStreamEntries (variable)																															
...																															

chunkLen (4 bytes): Length of the message in chunks. A chunk is 8 bytes.

MID (4 bytes): Message ID. For this message, the value MUST be 0x00030033.

cStreamEntries (4 bytes): An unsigned 32-bit integer. It MUST be set to the number of **STREAM_SWITCH_ENTRY** elements in the aStreamEntries[] array.

aStreamEntries (variable): A variable size of array of [STREAM_SWITCH_ENTRY](#) elements.

Either stream can be set to a special value 0xFFFF to indicate that no stream is specified. If the source stream is set to 0xFFFF, the thinning level is ignored. Stream numbers are located in the ASF file header, as specified in [\[ASF\]](#), delivered by the server prior to the file stream.

2.2.4.28.1 STREAM_SWITCH_ENTRY

The **STREAM_SWITCH_ENTRY** data structure is defined as follows:

```
typedef struct {
    WORD wSrcStreamNumber;
    WORD wDstStreamNumber;
    WORD wThinningLevel;
} STREAM_SWITCH_ENTRY;
```

wSrcStreamNumber: A 16-bit unsigned integer. This field MUST be set to the ASF stream number (of the stream that the server is requested to replace with the stream specified by the **wDstStreamNumber** field) or 0xFFFF if **wDstStreamNumber** is not supposed to be replaced by any other stream.

wDstStreamNumber: A 16-bit unsigned integer. This field MUST be set to the ASF stream number (of the stream that the server is requested to replace with the stream specified by the **wSrcStreamNumber** field) or 0xFFFF if **wSrcStreamNumber** is not supposed to be replaced by any other stream.

wThinningLevel: A 16-bit unsigned integer. This field MUST be set to one of the values in the following table.

Value	Meaning
0x0000	All ASF media objects for the stream given by wDstStreamNumber are to be transmitted.
0x0001	Only ASF media objects for the stream given by wDstStreamNumber (that are marked as containing key frame data) are to be transmitted.
0x0002	No ASF media objects for the stream given by wDstStreamNumber are to be transmitted.

2.2.5 RequestPacketListResend

The RequestPacketListResend packet is sent by the client to request that a number of [Data \(section 2.2.2\)](#) packets be resent by the server. The RequestPacketListResend packet MUST be sent using UDP.

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
Signature																															
dwClientId																															
wSourceId																wNumPackets															
dwBeginPacketList (variable)																															
...																															

Signature (4 bytes): A 32-bit field. It MUST be set to 0xBEEFF00D.

dwClientId (4 bytes): A 32-bit field. It MUST be set to the value of the **nCubs** field in the [LinkMacToViewerReportFunnelInfo \(section 2.2.4.6\)](#) message that the client previously received from the server.

wSourceId (2 bytes): A 16-bit field. It MUST be set to the 16 least-significant bits of the value of the **openFileId** field in the [LinkMacToViewerReportOpenFile \(section 2.2.4.7\)](#) message that the client previously received from the server.

wNumPackets (2 bytes): A 16-bit unsigned integer. It MUST be set to the number of Data (section 2.2.2) packets that the client is requesting be resent. The value of this field MUST be in the range 1 to 32, inclusive.

dwBeginPacketList (variable): A variable-size array of 32-bit unsigned integers. The number of elements in this array MUST be equal to the value of the **wNumPackets** field. Each element MUST be set to the 32-bit sequence number of a Data (section 2.2.2) packet that is to be resent. (Data (section 2.2.2) packet sequence numbers can be obtained from the **AFFlags** field of the Data (section 2.2.2) packet. The **AFFlags** field specifies the least-significant 8 bits of the sequence number.)

3 Protocol Details

3.1 Client Details

Unless otherwise specified, the protocol reports the occurrence of an error to the higher layer, stops all timers, and stops processing further messages. Possible errors include the following:

- Failure to connect to the server.
- The connection to the server is unexpectedly closed.
- Receipt of a message in which the HRESULT field specifies an error value.

3.1.1 Abstract Data Model

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

Auth-Scheme: This variable stores the authentication scheme used by the server. Two values are BASIC, specifying Basic authentication (as specified in [\[RFC2617\]](#)), and NTLM, specifying NTLM authentication (as specified in [\[MS-NLMP\]](#)). The default value is NTLM.

Client-ID: The value of this variable is an identifier assigned by the server for the current streaming session. Since the Client-ID value is provided by the server, the initial value is undefined.

File-ID: This variable stores the value of the **openFileId** field in the [LinkMacToViewerReportOpenFile \(section 2.2.4.7\)](#) message. The initial value of this field is undefined.

HeaderIncarnation: This variable stores the next value of the **playIncarnation** field for certain MMS messages. The variable can only assume values in the range 0x00000001 to 0x00000008, inclusive. If the variable has the value 0x00000008 and is incremented, the next value becomes 0x00000001. The default value of this variable is 0x00000001.

Incarnation: This variable stores the next value of the **playIncarnation** field for certain MMS messages. The variable can only assume values in the range 0x00000001 to 0x000000FE, inclusive. If the variable has the value 0x000000FE and is incremented, the next value becomes 0x00000001. The default value of this variable is 0x00000001.

PlayIncarnation: This variable stores the next value of the **playIncarnation** field for certain MMS messages. The variable can only assume values in the range 0x00000009 to 0x000000FE, inclusive. If the variable has the value 0x000000FE and is incremented, the next value becomes 0x00000009. The default value of this variable is 0x00000009.

Server-URL: This variable stores the URL of the content that the client wants to stream from the server. The initial value of this variable is undefined.

Server-Version: This variable stores the server product name and major and minor version number that the server specified in the **ServerVersionInfo** field in the [LinkMacToViewerReportConnectedEX \(section 2.2.4.2\)](#) message.

State: This variable stores the client's state. Possible values are INIT, READY, and STREAMING.

Note The preceding conceptual data can be implemented using a variety of techniques.

3.1.2 Timers

Header: This timer is used when waiting for the ASF file header when the server transmits it using UDP. The minimum allowed value for the time-out period is 1 second and the maximum value is 30 seconds.

3.1.3 Initialization

Initialization of the protocol occurs as the result of a higher layer asking for information on multimedia content located on a server. That event is defined in section [3.1.4.1](#).

The variables defined by the abstract data model MUST initially assume their default values. Variables that do not have default defined values MUST be initialized as follows:

- The State variable MUST be set to INIT.

3.1.4 Higher-Layer Triggered Events

3.1.4.1 Request to Retrieve Content Information

This event causes the client to send a [LinkViewerToMacConnect \(section 2.2.4.17\)](#) message to the server. An application asks the client for information on multimedia content most often under the following common scenarios:

- A media player application that intends to play multimedia content that will be streamed from a server. The media player knows the URL to the content, and it might already know at what time position and at what rate it intends to play the content. However, before it can start playing the content, it needs to retrieve information on what audio and video streams are included in the content, what decoders are needed to decompress the content, and so on.
- A cache that already has a copy of the content but wants to retrieve information on the content from the server to determine if the cached copy is still fresh.
- A server or intermediate device, such as a noncaching proxy that asks for information on behalf of another client.

The higher layer MUST provide the URL that is specified in all requests that the client sends. The value of the Server-URL variable in the abstract data model MUST be set to this URL.

If this is the first request sent by the client, the client MUST perform the initialization of the protocol, as specified in section [3.1.3](#).

If an MMS proxy server is used, then the client MUST establish a TCP connection to the proxy. Otherwise, the client MUST establish a TCP connection to the server by using the IP address and port number obtained by parsing the value of the Server-URL variable. Next, the client MUST send the [LinkViewerToMacConnect \(section 2.2.4.17\)](#) message to the server, as specified in section [3.1.4.1.1](#).

3.1.4.1.1 Sending a LinkViewerToMacConnect Message

The client MUST fill in the fields of the [LinkViewerToMacConnect \(section 2.2.4.17\)](#) message.

The client-guid syntax element in the **subscriberName** field of the [LinkViewerToMacConnect \(section 2.2.4.17\)](#) message MUST be set to the same GUID value for all [LinkViewerToMacConnect](#)

(section 2.2.4.17) messages belonging to the same streaming session. The client MAY specify a different GUID in the **subscriberName** field for different streaming sessions. <27>

If the client is connected to the server through a proxy, the host-param syntax element of the **subscriberName** field MUST be set to the name and port number of the server obtained by parsing the URL stored in the Server-URL variable in the abstract data model.

If the client implementation wants to use packet-pair packets to measure the bottleneck bandwidth between the client and the server, the client MUST set the **playIncarnation** field to 0xF0F0F0F0. Otherwise, the **playIncarnation** field SHOULD be set to 0xF0F0F0EF.

The message MUST be sent by the rules specified in section 3.1.5.1.

After sending the message, the client MUST wait for the [LinkMacToViewerReportConnectedEX \(section 2.2.4.2\)](#) message to be received. How to process this message is specified in section 3.1.5.3.

3.1.4.2 Request to Start Streaming Content

This higher-layer triggered event can occur when the client is not currently streaming from the server. The event causes the client to send a [LinkViewerToMacStartPlaying \(section 2.2.4.25\)](#) message or a [LinkViewerToMacStartStriding \(section 2.2.4.26\)](#) message to the server. An application asks the client to request the server to start streaming content most often under the following common scenarios:

- A media player application that has examined the ASF file header received from the server (see section 3.1.5.12) and determined that it can decompress and play the multimedia content.
- A cache that has determined that the currently cached copy of the content, if any, is either stale or incomplete.
- A server or intermediate device, such as a noncaching proxy, that asks for content to be streamed on behalf of another client.

The State variable in the abstract data model MUST have the value READY for this higher-layer triggered event to be possible.

Since the ASF file header typically lists multiple streams, the higher layer SHOULD specify which of the streams should be streamed from the server. The list of selected streams SHOULD be sent to the server using a [LinkViewerToMacStreamSwitch \(section 2.2.4.28\)](#) message. <28>

If the client chooses to send a LinkViewerToMacStreamSwitch (section 2.2.4.28) message, it MUST fill in the fields of the message.

The **aStreamEntries** field of the LinkViewerToMacStreamSwitch (section 2.2.4.28) message MUST specify the complete selection state of all streams. That is, the **aStreamEntries** field MUST specify all available streams, and each stream MUST either be marked as on (by specifying the **wThinningLevel** field as 0x0000) or marked as off (by specifying the **wDstStreamNumber** field as 0xFFFF), depending on the selection made by the higher layer.

When sending the LinkViewerToMacStreamSwitch (section 2.2.4.28) message, it MUST be sent by the rules specified in section 3.1.5.1.

Next, the client MUST send either a LinkViewerToMacStartPlaying (section 2.2.4.25) message (as specified in section 3.1.4.2.1) to the server if it wants the content to be streamed for viewing at the normal playback rate, or a LinkViewerToMacStartStriding (section 2.2.4.26) message (as specified in

section [3.1.4.2.2](#)) if it wants the content to be streamed for viewing at a trick-mode rate (for example, fast forward or rewind).<29>

3.1.4.2.1 Sending a LinkViewerToMacStartPlaying Message

The client MUST fill in the fields of the [LinkViewerToMacStartPlaying \(section 2.2.4.25\)](#) message.

The value of the **openFileId** field in the LinkViewerToMacStartPlaying (section 2.2.4.25) message MUST be set to the value of the File-ID variable in the abstract data model.

Depending on how the higher layer has specified the position from which the server is supposed to start streaming, the client MUST assign the start position to the **position** field, the **asfOffset** field, or the **locationId** field.

If the higher layer wants only a portion of the content to be streamed, the stop position SHOULD be assigned to the **frameOffset** field.

The value of the **playIncarnation** field in the LinkViewerToMacStartPlaying (section 2.2.4.25) message MUST be set to the value of the PlayIncarnation variable in the abstract data model. The value of the PlayIncarnation variable MUST then be incremented.<30>

The higher layer SHOULD specify an amount of data that should be streamed faster than real time, and the bit rate at which the server should stream this data. The higher layer SHOULD also specify the bit rate that can be used for streaming between the server and the client. If the value of the Server-Version variable in the abstract data model is greater than or equal to 9, the client SHOULD specify this information in the **dwAccelDuration**, **dwAccelBandwidth**, and **dwLinkBandwidth** fields of the LinkViewerToMacStartPlaying (section 2.2.4.25) message.<31>

The message MUST be sent following the rules specified in section [3.1.5.1](#).

After sending the LinkViewerToMacStartPlaying (section 2.2.4.25) message, the client MUST wait to receive a [LinkMacToViewerReportStreamSwitch \(section 2.2.4.13\)](#) message if it previously sent a [LinkViewerToMacStreamSwitch \(section 2.2.4.28\)](#) message but did not yet receive the LinkMacToViewerReportStreamSwitch (section 2.2.4.13) response. How to process the LinkMacToViewerReportStreamSwitch (section 2.2.4.13) message is specified in section [3.1.5.14](#).

Otherwise, the client MUST wait for the [LinkMacToViewerReportStartedPlaying \(section 2.2.4.10\)](#) message to be received. How to process this message is specified in section [3.1.5.15](#).

3.1.4.2.2 Sending a LinkViewerToMacStartStriding Message

The client MUST fill in the fields of the [LinkViewerToMacStartStriding \(section 2.2.4.26\)](#) message.

The value of the **openFileId** field in the LinkViewerToMacStartStriding (section 2.2.4.26) message MUST be set to the value of the File-ID variable in the abstract data model.

Depending on how the higher layer has specified the position from which the server is supposed to start streaming, the client MUST assign the start position to the **position** field, the **asfOffset** field, or the **locationId** field.

If the higher layer wants only a portion of the content to be streamed, the stop position SHOULD be assigned to the **frameOffset** field.

The value of the **playIncarnation** field in the LinkViewerToMacStartStriding (section 2.2.4.26) message MUST be set to the value of the PlayIncarnation variable in the abstract data model. The value of the PlayIncarnation variable MUST then be incremented.<32>

The higher layer MUST specify at what rate the multimedia content should be played back. For example, if the higher layer wants to play the multimedia content in reverse, it MUST specify this and the rate of playback. The client MUST set the **rate** field in the LinkViewerToMacStartStriding (section 2.2.4.26) message to that rate.

The message MUST be sent following the rules specified in section [3.1.5.1](#).

After sending the LinkViewerToMacStartStriding (section 2.2.4.26) message, the client MUST wait for a [LinkMacToViewerReportStreamSwitch \(section 2.2.4.13\)](#) message to be received if it previously sent a [LinkViewerToMacStreamSwitch \(section 2.2.4.28\)](#) message but did not yet receive the LinkMacToViewerReportStreamSwitch (section 2.2.4.13) response. How to process the LinkMacToViewerReportStreamSwitch (section 2.2.4.13) message is specified in section [3.1.5.14](#).

Otherwise, the client MUST wait for the [LinkMacToViewerReportStartStriding \(section 2.2.4.11\)](#) message to be received. How to process this message is specified in section [3.1.5.16](#).

3.1.4.3 Request to Change Currently Selected Streams

This event occurs when the higher layer wants to change the streams that are currently being streamed. For example, the higher layer may decide to switch from an English-language audio stream to a Spanish-language audio stream, or it may decide to switch to a stream with higher-quality video.

The client MUST fill in the fields of the [LinkViewerToMacStreamSwitch \(section 2.2.4.28\)](#) message.

The **aStreamEntries** field of the LinkViewerToMacStreamSwitch (section 2.2.4.28) message MUST specify the streams that are affected by the change that is requested by the higher layer. Streams that are unaffected SHOULD NOT be specified in the **aStreamEntries** field.

The message MUST be sent by following the rules specified in section [3.1.5.1](#).

After sending the LinkViewerToMacStreamSwitch (section 2.2.4.28) message, the client MUST wait for the [LinkMacToViewerReportStreamSwitch \(section 2.2.4.13\)](#) message to be received. How to process this message is specified in section [3.1.5.14](#).

3.1.4.4 Selecting Streams to Play from New Playlist Entry

This event occurs after the higher layer has received the ASF file header for a new playlist entry, and the higher layer is ready to start processing the ASF data packets for the new playlist entry. This is the higher layer's opportunity to select the streams that it wants to receive from the new playlist entry. Because the bit rate needed to stream each playlist entry depends on how the content is encoded and on the streams that are selected, the higher layer may also want to specify new values for the parameters that control how much faster than real time (if at all) the content is streamed.

The State variable in the abstract data model MUST have the value STREAMING for this higher-layer triggered event to be possible.

The value of the State variable MUST be set to READY.

The higher layer SHOULD specify which of the streams should be streamed from the server. The list of selected streams SHOULD be sent to the server using a [LinkViewerToMacStreamSwitch \(section 2.2.4.28\)](#) message. <33>

If the client chooses to send a LinkViewerToMacStreamSwitch message, it MUST fill in the fields of the message as specified in section [2.2.4.28](#).

The **aStreamEntries** field of the LinkViewerToMacStreamSwitch message MUST specify the complete selection state of all streams. That is, the **aStreamEntries** field MUST specify all available streams; each stream MUST either be marked as on (by specifying the **wThinningLevel** field as 0x0000) or marked as off (by specifying the **wDstStreamNumber** field as 0xFFFF), depending on the selection made by the higher layer.

When sending the LinkViewerToMacStreamSwitch message, it MUST be sent by following the rules specified in section [3.1.5.1](#).

Next, the client MUST send either a [LinkViewerToMacStartPlaying \(section 2.2.4.25\)](#) message (as specified in section [3.1.4.2.1](#)) to the server if it wants the content to stream for viewing at the normal playback rate, or a [LinkViewerToMacStartStriding \(section 2.2.4.26\)](#) message (as specified in section [3.1.4.2.2](#)) if it wants the content to stream for viewing at a trick-mode rate (for example, fast forward or rewind).<34>

3.1.4.5 Request to Stop Streaming

This event occurs if the higher layer wants to stop streaming. The end user may have requested that streaming should stop or requested to seek to some position in the content while the client is currently streaming multimedia content from a different position.

The State variable in the abstract data model MUST have the value STREAMING for this higher-layer triggered event to be possible.

The client MUST fill in the fields of a [LinkViewerToMacStopPlaying \(section 2.2.4.27\)](#) message.

The value of the **openFileId** field in the LinkViewerToMacStopPlaying message MUST be set to the value of the File-ID variable in the abstract data model.

The value of the **playIncarnation** field in the LinkViewerToMacStopPlaying message MUST be set to the same value that the client used for the **playIncarnation** field in the most recently sent [LinkViewerToMacStartPlaying \(section 2.2.4.25\)](#) message, or to the value of the **playIncarnation** field in the most recently sent [LinkViewerToMacStartStriding \(section 2.2.4.26\)](#) message, if LinkViewerToMacStartStriding was sent more recently than LinkViewerToMacStartPlaying.

The LinkViewerToMacStopPlaying message MUST be sent by following the rules specified in section [3.1.5.1](#).

The client MUST fill in the fields of a [LinkViewerToMacLogging \(section 2.2.4.20\)](#) message.

The value of the **dwSourceId** field in the log structure of the LinkViewerToMacLogging message MUST be set to the value of the File-ID variable.

After sending the LinkViewerToMacStopPlaying message, the LinkViewerToMacLogging message MUST be sent by following the rules specified in section [3.1.5.1](#).<35>

After sending the LinkViewerToMacLogging message, the client MUST wait for the [LinkMacToViewerReportEndOfStream \(section 2.2.4.5\)](#) message to be received. How to process this message is specified in section [3.1.5.18](#).

3.1.4.6 Request to Change Playback Position

This event occurs when the higher layer wants to start streaming from some specific position in the content.

If the value of the State variable in the abstract data model is READY, this event MUST be treated the same as a request to start streaming, as specified in section [3.1.4.2](#).

If the value of the State variable is STREAMING, the client MUST first request the server to stop streaming, as specified in section [3.1.4.5](#). Once this is complete, the value of the State variable is READY, and the client MUST request to start streaming at the new playback position, as specified in section [3.1.4.2](#).

3.1.4.7 Request to Resend Lost Data Packets

This event occurs if the higher layer has detected that one or more [Data \(section 2.2.2\)](#) packets containing ASF data packets have been lost, and the higher layer wants to ask the server to resend one or more of the lost Data (section 2.2.2) packets.

For this higher-layer triggered event to be possible, the value of the State variable in the abstract data model MUST be STREAMING, the client MUST have requested that Data (section 2.2.2) packets be delivered over UDP when it sent the [LinkViewerToMacFunnelInfo \(section 2.2.4.19\)](#) message, and the client MUST also have received a [LinkMacToViewerReportFunnelInfo \(section 2.2.4.6\)](#) message from the server.

The **AFFlags** field in the Data (section 2.2.2) packets that contain ASF data packets increments sequentially; this allows the higher layer to detect if a Data (section 2.2.2) packet has been lost.

To request that the server resend one or more lost Data (section 2.2.2) packets, the client MUST fill in the fields of a [RequestPacketListResend \(section 2.2.5\)](#) packet.

The value of the **dwClientId** field in the RequestPacketListResend (section 2.2.5) packet MUST be set to the value of the Client-ID variable in the abstract data model.

Each element in the **dwBeginPacketList** field of the RequestPacketListResend (section 2.2.5) packet MUST be set to the 32-bit sequence number of a Data (section 2.2.2) packet that the clients want the server to resend. The **AFFlags** field in the Data (section 2.2.2) packets contains the least significant 8 bits of the sequence number. To correctly compute the 32-bit sequence number, the client MUST keep track of when the 8-bit **AFFlags** field wraps around.

The RequestPacketListResend (section 2.2.5) packet MUST be sent to the server using UDP to the port number obtained by parsing the URL that is stored in the Server-URL variable in the abstract data model. If the URL does not specify a port number, UDP port 1755 MUST be used.

3.1.4.8 Request to Finish Streaming Session

This event occurs if the higher layer wants to finish the streaming session. Possible causes include the end user requesting different content start streaming or attempting to exit the client software application.

The client MUST fill in the fields of a [LinkViewerToMacCloseFile \(section 2.2.4.16\)](#) message.

The value of the **openFileId** field in the LinkViewerToMacCloseFile (section 2.2.4.16) message MUST be set to the value of the File-ID variable in the abstract data model.

If the value of the State variable is STREAMING, the client MUST first request that the server stop streaming, as specified in section [3.1.4.5](#). Once this is complete, the value of the State variable is READY.

Once the value of the State variable is READY, the LinkViewerToMacCloseFile (section 2.2.4.16) message MUST be sent by following the rules specified in section [3.1.5.1.<36>](#)

The client MUST close the TCP connection to the server.

3.1.5 Message Processing Events and Sequencing Rules

3.1.5.1 Sending a Message

This section specifies common steps that **MUST** be performed whenever the client sends to the server a message of any of the types specified in section [2.2.4](#).

The message **MUST** be encapsulated in a [TcpMessageHeader \(section 2.2.3\)](#) packet. Multiple messages **MUST NOT** be combined in a single [TcpMessageHeader \(section 2.2.3\)](#) packet.

3.1.5.2 Receiving a Packet

This section specifies common steps that **MUST** be performed whenever the client receives a packet on the TCP connection.

To distinguish [TcpMessageHeader \(section 2.2.3\)](#) packets from [Data \(section 2.2.2\)](#) packets, the client **SHOULD** initially treat the packet as a [TcpMessageHeader \(section 2.2.3\)](#) packet and inspect the **sessionId** field. If the value is 2953575118, the client **MUST** treat the packet as a [TcpMessageHeader \(section 2.2.3\)](#) packet and **MUST** verify that the fields of the [TcpMessageHeader \(section 2.2.3\)](#) packet adhere to the syntax specified in section [2.2.3](#).

If the value of the **sessionId** field is not 2953575118, the client **MUST** treat the packet as a [Data \(section 2.2.2\)](#) packet and **MUST** verify that the fields of the [Data \(section 2.2.2\)](#) packet adhere to the syntax specified in section [2.2.2](#).

3.1.5.3 Receiving a LinkMacToViewerReportConnectedEX Message

The client **MUST** perform the steps in section [3.1.5.2](#). Also, the client **MUST** verify that the [LinkMacToViewerReportConnectedEX \(section 2.2.4.2\)](#) message adheres to the syntax specified in section [2.2.4.2](#).

The client **MUST** set the value of the Server-Version variable in the abstract data model to the value of the **ServerVersionInfo** field in the [LinkMacToViewerReportConnectedEX \(section 2.2.4.2\)](#) message.

The client **SHOULD** ignore the **VersionInfo** and **VersionUrl** fields in the [LinkMacToViewerReportConnectedEX \(section 2.2.4.2\)](#) message. [<37>](#) If the **AuthenPackage** field in the [LinkMacToViewerReportConnectedEX \(section 2.2.4.2\)](#) message has a nonzero size, the client **MUST** set the value of the Auth-Scheme variable in the abstract data model to the value of the **AuthenPackage** field.

The client **SHOULD** send a [LinkViewerToMacFunnelInfo \(section 2.2.4.19\)](#) message.

If the client implementation does not need to use packet-pair packets to measure the bottleneck bandwidth between the client and the server, or if the value of the **playIncarnation** field is not equal to 0xF0F0F0F0, the client **MAY** send a [LinkViewerToMacConnectFunnel \(section 2.2.4.18\)](#) message. [<38>](#)

The **funnelName** field in the [LinkViewerToMacConnectFunnel \(section 2.2.4.18\)](#) message **MUST** specify if the client expects to receive [Data \(section 2.2.2\)](#) packets using UDP or TCP. If the client expects to use UDP, the **funnelName** field **MUST** also specify the UDP port number on which the client wants to receive the [Data \(section 2.2.2\)](#) packets.

After sending the [LinkViewerToMacConnectFunnel \(section 2.2.4.18\)](#) message, the client **MUST** wait for the [LinkMacToViewerReportConnectedFunnel \(section 2.2.4.3\)](#) message to be received. How to process this message is specified in section [3.1.5.6](#).

If the client is not sending a [LinkViewerToMacConnectFunnel](#) (section 2.2.4.18) message, it MUST send a [LinkViewerToMacFunnelInfo](#) (section 2.2.4.19) message.

If the value of the **playIncarnation** field of the [LinkMacToViewerReportConnectedEX](#) (section 2.2.4.2) message is not equal to 0xF0F0F0F0 (or if the client implementation does not intend to use packet-pair packets to measure the bottleneck bandwidth between the client and the server), the value of the **playIncarnation** field in the [LinkViewerToMacFunnelInfo](#) (section 2.2.4.19) message MUST be set to 0xF0F0F0EF.

Otherwise, the value of the **playIncarnation** field in the [LinkViewerToMacFunnelInfo](#) (section 2.2.4.19) message SHOULD be set to one of the following:

- 0xF0F0F0F1 if the client intends to receive Data (section 2.2.2) packets over TCP.
- 0xF0F0F901 if the client intends to receive Data (section 2.2.2) packets over UDP.

After sending the [LinkViewerToMacFunnelInfo](#) (section 2.2.4.19) message, the client MUST wait for the [LinkMacToViewerReportFunnelInfo](#) (section 2.2.4.6) message to be received. How to process this message is specified in section 3.1.5.4.

3.1.5.4 Receiving a LinkMacToViewerReportFunnelInfo Message

The client MUST perform the steps in section 3.1.5.2. Also, the client MUST verify that the [LinkMacToViewerReportFunnelInfo](#) (section 2.2.4.6) message adheres to the syntax specified in section 2.2.4.6.

The client MUST set the value of the Client-ID variable in the abstract data model to the value of the **nCubs** field in the [LinkMacToViewerReportFunnelInfo](#) (section 2.2.4.6) message.

If the value of the **playIncarnation** field of the [LinkMacToViewerReportFunnelInfo](#) (section 2.2.4.6) message is 0xF0F0F0F1, and if this is the first [LinkMacToViewerReportFunnelInfo](#) (section 2.2.4.6) message received, the client SHOULD start measuring the time until the second [LinkMacToViewerReportFunnelInfo](#) (section 2.2.4.6) message is received. The client MUST now wait for the second [LinkMacToViewerReportFunnelInfo](#) (section 2.2.4.6) message to be received, and then process the rules (as specified in section 3.1.5.4) again.

If the value of the **playIncarnation** field of the [LinkMacToViewerReportFunnelInfo](#) (section 2.2.4.6) message is 0xF0F0F0F1, and if this is the second [LinkMacToViewerReportFunnelInfo](#) (section 2.2.4.6) message received, the client can use the time elapsed between receiving the first [LinkMacToViewerReportFunnelInfo](#) (section 2.2.4.6) message and the second [LinkMacToViewerReportFunnelInfo](#) (section 2.2.4.6) message to compute the bit rate at which the second [LinkMacToViewerReportFunnelInfo](#) (section 2.2.4.6) message is transferred. The client SHOULD make this information available to a higher layer. The client MUST now wait for the third [LinkMacToViewerReportFunnelInfo](#) (section 2.2.4.6) message to be received, and then process the rules (as specified in section 3.1.5.4) again.

If the value of the **playIncarnation** field of the [LinkMacToViewerReportFunnelInfo](#) (section 2.2.4.6) message is not equal to 0xF0F0F0F1, or if this is the third [LinkMacToViewerReportFunnelInfo](#) (section 2.2.4.6) message received, the client MUST send a [LinkViewerToMacConnectFunnel](#) (section 2.2.4.18) message.

The **funnelName** field in the [LinkViewerToMacConnectFunnel](#) (section 2.2.4.18) message MUST specify if the client expects to receive [Data](#) (section 2.2.2) packets using UDP or TCP. If the client expects to use UDP, the **funnelName** field MUST also specify the UDP port number on which the client wants to receive the Data (section 2.2.2) packets.

After sending the [LinkViewerToMacConnectFunnel \(section 2.2.4.18\)](#) message, the client MUST wait for either a [LinkMacToViewerReportDisconnectedFunnel \(section 2.2.4.4\)](#) message or a [LinkMacToViewerReportConnectedFunnel \(section 2.2.4.3\)](#) message to be received. How to process a [LinkMacToViewerReportDisconnectedFunnel \(section 2.2.4.4\)](#) message is specified in section [3.1.5.5](#); how to process a [LinkMacToViewerReportConnectedFunnel \(section 2.2.4.3\)](#) message is specified in section [3.1.5.6](#).

3.1.5.5 Receiving a LinkMacToViewerReportDisconnectedFunnel Message

The client MUST perform the steps in section [3.1.5.2](#). Also, the client MUST verify that the [LinkMacToViewerReportDisconnectedFunnel \(section 2.2.4.4\)](#) message adheres to the syntax specified in section [2.2.4.4](#).

The client SHOULD close the TCP connection to the server and report the error specified in the **hr** field of the [LinkMacToViewerReportDisconnectedFunnel \(section 2.2.4.4\)](#) message to the higher layer.

Alternatively, the client MAY send a new [LinkViewerToMacConnectFunnel \(section 2.2.4.18\)](#) message. Because the [LinkMacToViewerReportDisconnectedFunnel \(section 2.2.4.4\)](#) message indicates that the server experienced an error when processing the [LinkViewerToMacConnectFunnel \(section 2.2.4.18\)](#) message, the new [LinkViewerToMacConnectFunnel \(section 2.2.4.18\)](#) message MUST specify a different setting in the **funnelName** field. For example, if the first [LinkViewerToMacConnectFunnel \(section 2.2.4.18\)](#) message specifies the protocol as UDP, the second [LinkViewerToMacConnectFunnel \(section 2.2.4.18\)](#) message can specify the protocol as TCP.

If the client sends a new [LinkViewerToMacConnectFunnel \(section 2.2.4.18\)](#) message, it MUST wait for either a [LinkMacToViewerReportDisconnectedFunnel \(section 2.2.4.4\)](#) message or a [LinkMacToViewerReportConnectedFunnel \(section 2.2.4.3\)](#) message to be received. How to process a [LinkMacToViewerReportDisconnectedFunnel \(section 2.2.4.4\)](#) message is specified in section [3.1.5.5](#); how to process a [LinkMacToViewerReportConnectedFunnel \(section 2.2.4.3\)](#) message is specified in section [3.1.5.6](#).

3.1.5.6 Receiving a LinkMacToViewerReportConnectedFunnel Message

The client MUST perform the steps in section [3.1.5.2](#). Also, the client MUST verify that the [LinkMacToViewerReportConnectedFunnel \(section 2.2.4.3\)](#) message adheres to the syntax specified in section [2.2.4.3](#).

The client MUST send a [LinkViewerToMacOpenFile \(section 2.2.4.21\)](#) message.

The value of the **playIncarnation** field in the [LinkViewerToMacOpenFile \(section 2.2.4.21\)](#) message MUST be set to the value of the PlayIncarnation variable in the abstract data model. The value of the PlayIncarnation variable MUST then be incremented. [<39>](#)

The value of the **fileName** field in the [LinkViewerToMacOpenFile \(section 2.2.4.21\)](#) message MUST be set to the path component of the URI stored in the Server-URL variable in the abstract data model. The syntax for the path is specified in [\[RFC3986\]](#) section 3.3.

The client MAY set the value of the **tokenData** field in the [LinkViewerToMacOpenFile \(section 2.2.4.21\)](#) message to authentication data appropriate for the authentication scheme identified by the Auth-Scheme variable in the abstract data model. For example, if the value of the Auth-Scheme variable is BASIC, the client includes the user name and password in the **tokenData** field formatted according to the syntax rules for Basic authentication. [<40>](#)

After sending the [LinkViewerToMacOpenFile \(section 2.2.4.21\)](#) message, the client MUST wait for a [LinkMacToViewerReportRedirect \(section 2.2.4.9\)](#) message, a [LinkMacToViewerSecurityChallenge](#)

([section 2.2.4.14](#)) message, or a [LinkMacToViewerReportOpenFile \(section 2.2.4.7\)](#) message to be received. How to process a [LinkMacToViewerReportRedirect \(section 2.2.4.9\)](#) message is specified in [section 3.1.5.7](#); how to process a [LinkMacToViewerSecurityChallenge \(section 2.2.4.14\)](#) message is specified in [section 3.1.5.8](#); and how to process a [LinkMacToViewerReportOpenFile \(section 2.2.4.7\)](#) message is specified in [section 3.1.5.9](#).

3.1.5.7 Receiving a LinkMacToViewerReportRedirect Message

The client MUST perform the steps in [section 3.1.5.2](#). Also, the client MUST verify that the [LinkMacToViewerReportRedirect \(section 2.2.4.9\)](#) message adheres to the syntax specified in [section 2.2.4.9.<41>](#)

The client MUST close the TCP connection on which it received the [LinkMacToViewerReportRedirect \(section 2.2.4.9\)](#) message.

The client MUST perform the initialization of the protocol, as specified in [section 3.1.3](#), except that the Server-URL variable MUST NOT be initialized.

If the value of the **RedirectType** field in the [LinkMacToViewerReportRedirect \(section 2.2.4.9\)](#) message is 0x0001, the client MUST perform the following steps:

1. The value of the Server-URL variable MUST be set to the value of the **wszLocation** field of the [LinkMacToViewerReportRedirect \(section 2.2.4.9\)](#) message.
2. If an MMS proxy server is used, the client MUST establish a TCP connection to the proxy. Otherwise, the client MUST establish a TCP connection to the server by using the IP address and port number obtained by parsing the URL that is stored in the Server-URL variable.

If the value of the **RedirectType** field in the [LinkMacToViewerReportRedirect \(section 2.2.4.9\)](#) message is 0x0002, the client MUST perform the following step:

- If the value of the **wszLocation** field of the [LinkMacToViewerReportRedirect \(section 2.2.4.9\)](#) message is an empty string, the client MUST establish a TCP connection to the server by using the IP address and port number obtained by parsing the URL that is stored in the Server-URL variable. Otherwise, the client MUST establish a TCP connection to the proxy server given by the IP address and port number obtained from the **wszLocation** field of the [LinkMacToViewerReportRedirect \(section 2.2.4.9\)](#) message.

The client MUST then send a [LinkViewerToMacConnect \(section 2.2.4.17\)](#) message by following the rules specified in [section 3.1.4.1.1](#).

3.1.5.8 Receiving a LinkMacToViewerSecurityChallenge Message

The client MUST perform the steps in [section 3.1.5.2](#). Also, the client MUST verify that the [LinkMacToViewerSecurityChallenge \(section 2.2.4.14\)](#) message adheres to the syntax specified in [section 2.2.4.14](#).

If the server's major version number is greater than or equal to 9, as specified by the Server-Version variable in the abstract data model, the client SHOULD update the value of the Auth-Scheme variable as follows: If the first two bytes of the **pToken** field in the [LinkMacToViewerSecurityChallenge](#) message are both 0x00, the Auth-Scheme variable MUST be set to NTLM. Otherwise, the Auth-Scheme variable MUST be set to BASIC.

If the server's major version number is less than 9, as specified by the Server-Version variable, the client SHOULD update the value of the Auth-Scheme variable as follows: If either of the first two bytes of the **pToken** field in the [LinkMacToViewerSecurityChallenge](#) message have a value other

than 0x00, the Auth-Scheme variable MUST be set to BASIC. Otherwise, the value of the Auth-Scheme variable MUST remain unchanged. <42>

The client MUST send a [LinkViewerToMacSecurityResponse \(section 2.2.4.24\)](#) message, as specified in section 2.2.4.24.

The client MUST set the value of the **pToken** field in the LinkViewerToMacSecurityResponse message to authentication data appropriate for the authentication scheme identified by the Auth-Scheme variable in the abstract data model. For example, if the value of the Auth-Scheme variable is BASIC, the client includes the user name and password in the **pToken** field formatted according to the syntax rules for Basic authentication.

After sending the LinkViewerToMacSecurityResponse message, the client MUST wait for a [LinkMacToViewerReportRedirect \(section 2.2.4.9\)](#) message, a [LinkMacToViewerSecurityChallenge](#) message, or a [LinkMacToViewerReportOpenFile \(section 2.2.4.7\)](#) message to be received. How to process a LinkMacToViewerReportRedirect (section 2.2.4.9) message is specified in section 3.1.5.7; how to process a LinkMacToViewerSecurityChallenge message is specified in section 3.1.5.8; and how to process a LinkMacToViewerReportOpenFile (section 2.2.4.7) message is specified in section 3.1.5.9. <43>

3.1.5.9 Receiving a LinkMacToViewerReportOpenFile Message

The client MUST perform the steps in section 3.1.5.2. Also, the client MUST verify that the [LinkMacToViewerReportOpenFile \(section 2.2.4.7\)](#) message adheres to the syntax specified in section 2.2.4.7.

The client MUST set the value of the File-ID variable in the abstract data model to the value of the **openFileId** field in the LinkMacToViewerReportOpenFile (section 2.2.4.7) message.

3.1.5.9.1 Sending a LinkViewerToMacReadBlock Message

The client MUST send a [LinkViewerToMacReadBlock \(section 2.2.4.23\)](#) message.

The value of the **openFileId** field in the LinkViewerToMacReadBlock (section 2.2.4.23) message MUST be set to the value of the File-ID variable in the abstract data model.

The value of the **playIncarnation** field in the LinkViewerToMacReadBlock (section 2.2.4.23) message MUST be set to the value of the HeaderIncarnation variable in the abstract data model. The value of the HeaderIncarnation variable MUST then be incremented. <44>

If the client requested that the server use UDP in the [LinkViewerToMacConnectFunnel \(section 2.2.4.18\)](#) message, the client MUST now be prepared to receive [Data \(section 2.2.2\)](#) packets on the UDP port that it previously specified in the LinkViewerToMacConnectFunnel (section 2.2.4.18) message. Furthermore, the client SHOULD start the Header timer and set its timeout value to 1 second plus the estimated transfer time of the ASF file header. The estimated transfer time of the ASF file header SHOULD be calculated by dividing the value of the **fileHeaderSize** field in the [LinkMacToViewerReportOpenFile \(section 2.2.4.7\)](#) message with the value of the **fileBitRate** field in the LinkMacToViewerReportOpenFile (section 2.2.4.7) message. <45>

If the client requested that the server use UDP in the LinkViewerToMacConnectFunnel (section 2.2.4.18) message, the client MUST wait for either a Data (section 2.2.2) packet received over UDP or a [LinkMacToViewerReportReadBlock \(section 2.2.4.8\)](#) message received over TCP.

If the client requested that the server use TCP in the LinkViewerToMacConnectFunnel (section 2.2.4.18) message, the client MUST wait for a LinkMacToViewerReportReadBlock (section 2.2.4.8) message.

How to process a [LinkMacToViewerReportReadBlock](#) (section 2.2.4.8) message is specified in section [3.1.5.10](#). How to process a Data (section 2.2.2) packet that contains a packet-pair packet is specified in section [3.1.5.11](#); how to process a Data (section 2.2.2) packet that contains an ASF file header is specified in section [3.1.5.12](#).

3.1.5.10 Receiving a LinkMacToViewerReportReadBlock Message

The client MUST perform the steps in section [3.1.5.2](#). Also, the client MUST verify that the [LinkMacToViewerReportReadBlock](#) message adheres to the syntax specified in section [2.2.4.8](#).

If the value of the State variable in the abstract data model is READY, the client MUST wait for a [LinkMacToViewerPing](#) message. How to process a LinkMacToViewerPing message is specified in section [3.1.5.13](#).

Otherwise, if the client requested that the server use UDP in the [LinkViewerToMacConnectFunnel](#) message, the client MUST wait for a [Data](#) packet received over UDP. How to process a Data packet that contains a packet-pair is specified in section [3.1.5.11](#); how to process a Data packet that contains an ASF file header is specified in section [3.1.5.12](#).

If the client requested that the server use TCP in the LinkViewerToMacConnectFunnel message, the client MUST wait for a Data packet that contains an ASF file header. This Data packet arrives on the TCP connection. How to process the Data packet is specified in section [3.1.5.12](#).

3.1.5.11 Receiving a Data Packet Containing a Packet-Pair Packet

The client MUST verify that the [Data](#) packet contains a packet-pair packet and that it adheres to the syntax specified in section [2.2.2](#).

If this is the first Data packet received, and if the value of the **LocationId** field is 0xF0F0F000, the client SHOULD start measuring the time until the second Data packet is received.

After receiving the first Data packet, the client MUST wait for the second Data packet to be received, and then process the rules (as specified in section [3.1.5.11](#)) again.

If this is the second Data packet received, and if the value of the **LocationId** field is 0xF0F0F001, the client can use the time elapsed between receiving the first and the second Data packet to compute the bit rate at which the second Data packet was transferred. The client SHOULD make this information available to a higher layer.

After receiving the second Data packet, the client MUST wait for a Data packet that contains an ASF file header. This Data packet arrives over UDP. How to process the Data packet is specified in section [3.1.5.12](#).

3.1.5.12 Receiving a Data Packet Containing an ASF File Header

If the [Data](#) packet is received over TCP, the client MUST perform the steps in section [3.1.5.2](#). The client MUST verify that the Data packet contains an ASF file header (as specified in section [2.2.2](#)) and that it adheres to the syntax specified in section [2.2.2](#).

The client MUST accumulate the ASF file header data in the **Payload** field until it receives a Data packet in which the value **AFFlags** field is 0x08 or 0x0C.

If the client does not receive a Data packet in which the **AFFlags** field value is 0x08 or 0x0C, or if a Data packet that contains part of the ASF file header is still missing, which can be determined by inspecting the **LocationId** field of the Data packets, then the client MUST wait for another Data

packet that contains an ASF file header to be received. Then it MUST process the rules (as specified in section [3.1.5.12](#)) again.

Otherwise, the value of the State variable in the abstract data model MUST be set to READY, and if the Header timer is running, it MUST be stopped.

The ASF file header MUST be reassembled from the **Payload** field of multiple Data packets, if necessary, and SHOULD be delivered to the higher layer.

If the Data packet was received using UDP, the client MUST wait for either a [LinkMacToViewerReportReadBlock](#) message or a [LinkMacToViewerPing](#) message.

If the Data packet was received using TCP, the client MUST wait for a [LinkMacToViewerPing](#) message.

How to process a [LinkMacToViewerReportReadBlock](#) message is specified in section [3.1.5.10](#); how to process a [LinkMacToViewerPing](#) message is specified in section [3.1.5.13](#).

3.1.5.13 Receiving a LinkMacToViewerPing Message

The client MUST perform the steps in section [3.1.5.2](#). Also, the client MUST verify that the [LinkMacToViewerPing](#) message adheres to the syntax specified in section [2.2.4.1](#).

The client MUST send a [LinkViewerToMacPong \(section 2.2.4.22\)](#) message.

After sending the [LinkViewerToMacPong](#) message, the client MUST wait for a [LinkMacToViewerPing](#) message. How to process a [LinkMacToViewerPing](#) message is specified in section [3.1.5.13](#).

3.1.5.14 Receiving a LinkMacToViewerReportStreamSwitch Message

The client MUST perform the steps in section [3.1.5.2](#). Also, the client MUST verify that the [LinkMacToViewerReportStreamSwitch](#) message adheres to the syntax specified in section [2.2.4.13](#).

If the value of the State variable in the abstract data model is READY, and the client previously sent a [LinkViewerToMacStartPlaying](#) message but has not yet received the corresponding [LinkMacToViewerReportStartedPlaying](#) message, the client MUST wait for the [LinkMacToViewerReportStartedPlaying](#) to be received.

If the value of the State variable in the abstract data model is READY, and the client previously sent a [LinkViewerToMacStartStriding](#) message but has not yet received the corresponding [LinkMacToViewerReportStartStriding](#) message, the client MUST wait for the [LinkMacToViewerReportStartStriding](#) to be received.

Otherwise, if the value of the State variable in the abstract data model is READY, the client MUST wait for a [LinkMacToViewerPing](#) message.

If the value of the State variable in the abstract data model is STREAMING, the client MUST wait for either a [Data](#) packet that contains an ASF data packet or a [LinkMacToViewerReportEndOfStream](#) message.

How to process a [LinkMacToViewerReportStartedPlaying](#) message is specified in section [3.1.5.15](#).

How to process a [LinkMacToViewerReportStartStriding](#) message is specified in section [3.1.5.16](#).

How to process a [LinkMacToViewerPing](#) message is specified in section [3.1.5.13](#).

How to process a Data packet that contains an ASF data packet is specified in section [3.1.5.17](#).

How to process a [LinkMacToViewerReportEndOfStream](#) message is specified in section [3.1.5.18](#).

3.1.5.15 Receiving a LinkMacToViewerReportStartedPlaying Message

The client MUST perform the steps in section [3.1.5.2](#). Also, the client MUST verify that the [LinkMacToViewerReportStartedPlaying](#) message adheres to the syntax specified in section [2.2.4.10](#).

The value of the State variable in the abstract data model MUST be set to STREAMING.

The client MUST then wait for either a [Data](#) packet that contains an ASF data packet or a [LinkMacToViewerReportEndOfStream](#) message.

How to process a Data packet that contains an ASF data packet is specified in section [3.1.5.17](#).

How to process a [LinkMacToViewerReportEndOfStream](#) message is specified in section [3.1.5.18](#).

3.1.5.16 Receiving a LinkMacToViewerReportStartStriding Message

The client MUST perform the steps in section [3.1.5.2](#). Also, the client MUST verify that the [LinkMacToViewerReportStartStriding](#) message adheres to the syntax specified in section [2.2.4.11](#).

The value of the State variable in the abstract data model MUST be set to STREAMING.

The client MUST then wait for either a [Data](#) packet that contains an ASF data packet or a [LinkMacToViewerReportEndOfStream](#) message.

How to process a Data packet that contains an ASF data packet is specified in section [3.1.5.17](#).

How to process a [LinkMacToViewerReportEndOfStream](#) message is specified in section [3.1.5.18](#).

3.1.5.17 Receiving a Data Packet Containing an ASF Data Packet

If the [Data](#) packet is received over TCP, the client MUST perform the steps in section [3.1.5.2](#). The client MUST verify that the Data packet contains an ASF data packet and that it adheres to the syntax specified in section [2.2.2](#).

The client SHOULD make the ASF data packet and the values of the **LocationId** and **AFFlags** fields available to the higher layer. (The value of the **LocationId** field can be useful to the higher layer if it needs to specify a start position in a [LinkViewerToMacStartPlaying](#) message; see section [3.1.4.2.1](#). The value of the **AFFlags** field can help the higher layer determine if a Data packet has been lost.)

If the client sends a [LinkViewerToMacStreamSwitch](#) message but has not received the [LinkMacToViewerReportStreamSwitch](#) response, the client MUST wait for a [LinkMacToViewerReportStreamSwitch](#) message, a [LinkMacToViewerReportEndOfStream](#) message, or another Data packet that contains an ASF data packet.

Otherwise, the client MUST wait for either a Data packet that contains an ASF data packet or a [LinkMacToViewerReportEndOfStream](#) message.

How to process the [LinkMacToViewerReportStreamSwitch](#) message is specified in section [3.1.5.14](#).

How to process a Data packet that contains an ASF data packet is specified in section [3.1.5.17](#).

How to process a [LinkMacToViewerReportEndOfStream](#) message is specified in section [3.1.5.18](#).

3.1.5.18 Receiving a LinkMacToViewerReportEndOfStream Message

The client MUST perform the steps in section [3.1.5.2](#). Also, the client MUST verify that the [LinkMacToViewerReportEndOfStream](#) message adheres to the syntax specified in section [2.2.4.5](#).

If the LinkMacToViewerReportEndOfStream message is received as a result of the client sending a [LinkViewerToMacStopPlaying](#) message, the State variable in the abstract data model MUST be set to READY.

If the LinkMacToViewerReportEndOfStream message is not received as a result of the client sending a LinkViewerToMacStopPlaying message, the client MUST send a [LinkViewerToMacLogging](#) (section [2.2.4.20](#)) message. <46>

The value of the **dwSourceId** field in the log structure of the LinkViewerToMacLogging message MUST be set to the value of the File-ID variable in the abstract data model.

If the server's major version number is greater than or equal to 9, as specified by the Server-Version variable in the abstract data model, and the value of the **hr** field in the LinkMacToViewerReportEndOfStream message is not equal to 0x00000001, the State variable MUST be set to READY.

If the server's major version number is less than 9, as specified by the Server-Version variable, and the value of the **hr** field in the LinkMacToViewerReportEndOfStream message is not equal to 0x00000000, the State variable MUST be set to READY.

If the server's major version number is less than 9, as specified by the Server-Version variable, and the **fileAttributes** field in the [LinkMacToViewerReportOpenFile](#) message did not have the 0x02000000 bit set, the State variable MUST be set to READY.

If the State variable is set to READY, the client MUST report this to the higher layer.

If the value of the State variable is streaming, the client MUST wait for a [LinkMacToViewerReportStreamChange](#) message to be received. How to process this message is specified in section [3.1.5.19](#).

3.1.5.19 Receiving a LinkMacToViewerReportStreamChange Message

The client MUST perform the steps in section [3.1.5.2](#). Also, the client MUST verify that the [LinkMacToViewerReportStreamChange](#) message adheres to the syntax specified in section [2.2.4.12](#).

If the client requested that the server use TCP in the [LinkViewerToMacConnectFunnel](#) message, the client MUST now wait for a [Data](#) packet that contains an ASF file header. This Data packet arrives on the TCP connection. How to process the Data packet is specified in section [3.1.5.12](#).

If the client requested that the server use UDP in the LinkViewerToMacConnectFunnel message, the client MUST send a [LinkViewerToMacReadBlock](#) message by following the rules specified in section [3.1.5.9.1](#).

3.1.6 Timer Events

3.1.6.1 Header Timer Expires

If the value of the State variable in the abstract data model is READY, the client MUST proceed with its previous activity (for example, waiting for a message to be received) and MUST NOT follow any of the rules in this section.

The value of the retry limit SHOULD be 4.

Otherwise, if the Header timer has expired more times than what is specified by the retry limit, the TCP connection to the server MUST be closed and an error MUST be reported to the higher layer.

If the Header timer has expired fewer times than what is specified by the retry limit, the client MUST send a [LinkViewerToMacCancelReadBlock](#) message, as specified in section [2.2.4.15](#). The client MUST also follow the rules specified in section [3.1.5.9.1](#).

3.1.7 Other Local Events

None.

3.2 Server Details

3.2.1 Abstract Data Model

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

Client-ID: The value of this variable is an identifier assigned by the server for the current streaming session. The initial value is undefined.

Client-Port: The value of this variable is the UDP port number to which the client wants [Data](#) packets to be sent. The default value is 0x0000.

Client-Version: This variable stores the client product name as well as the major and minor version number that the client specified in the **subscriberName** field in the [LinkViewerToMacConnect](#) message.

File-ID: The value of this variable is an identifier assigned by the server for the current playlist. Even if the playlist consists of multiple files, the value of the **File-ID** variable is the same. The initial value of this field is undefined.

Incarnation: This variable stores a number that is used when assigning a value to the **playIncarnation** field of Data packets. The initial value of this variable is undefined.

Sequence: This variable is a 32-bit unsigned integer and stores the sequence number of the next Data packet that contains an ASF data packet that the server sends. The initial value of this variable is 0x00000000.

State: This variable stores the state of the streaming session. Possible values are INIT, READY, and STREAMING. Unless specified otherwise, the state variable for a particular message will remain in the current state.

UDP-Packet-Pair: This is a Boolean variable that is set to True if the server intends to send packet-pair packets over UDP. The default value is False.

Note The above conceptual data can be implemented using a variety of techniques.

3.2.2 Timers

KeepAlive: This timer is used for sending [LinkMacToViewerPing](#) messages. The time-out period SHOULD be 30 seconds. The minimum allowed value for the time-out period is 10 seconds.

3.2.3 Initialization

Initialization of the protocol occurs when a [LinkViewerToMacConnect](#) message is received.

The variables defined by the abstract data model MUST initially assume their default values. Variables that do not have default values defined MUST be initialized as follows:

- The value of the Client-ID token SHOULD be assigned a random number. If the server allows multiple simultaneous streaming sessions, each instance of the protocol state MUST use a different value for the Client-ID token.
- The State variable MUST be set to INIT.

3.2.4 Higher-Layer Triggered Events

3.2.4.1 Notification That the Last Data Packet Has Been Sent

This event occurs when the value of the State variable in the abstract data model is STREAMING, and the higher layer notifies the server that the last [Data](#) packet has been sent.

The server MUST fill in the fields of a [LinkMacToViewerReportEndOfStream](#) (section 2.2.4.5) message.

The higher layer MUST specify if a new ASF file header is forthcoming, so that there are additional entries in the server-side playlist, or, if this is the last entry in the playlist, so that the **hr** field in the [LinkMacToViewerReportEndOfStream](#) message can be filled in correctly. The **hr** field MUST be set to 0x00000001 if there are additional entries in the server-side playlist, and MUST be set to 0x00000000 otherwise. <47>

If the value of the **hr** field is not set to 0x00000001, the value of the State variable MUST be set to READY.

When sending the [LinkMacToViewerReportEndOfStream](#), it MUST be sent by following the rules specified in section 3.2.5.2.

If the value of the Client-Port variable is not 0x0000, the server MUST be prepared to receive [RequestPacketListResend](#) packets on the UDP port. How to process a [RequestPacketListResend](#) packet is specified in section 3.2.5.13.

The server MUST also be prepared to receive a [LinkViewerToMacLogging](#) message from the client. How to process a [LinkViewerToMacLogging](#) message is specified in section 3.2.5.15.

If the value of the **hr** field in the [LinkMacToViewerReportEndOfStream](#) message is not set to 0x00000001, the server MUST also be prepared to receive a [LinkViewerToMacStreamSwitch](#) message, a [LinkViewerToMacStartPlaying](#) message, a [LinkViewerToMacStartStriding](#) message, or a [LinkViewerToMacCloseFile](#) message from the client.

How to process a [LinkViewerToMacStreamSwitch](#) message is specified in section 3.2.5.10.

How to process a [LinkViewerToMacStartPlaying](#) message is specified in section 3.2.5.11.

How to process a [LinkViewerToMacStartStriding](#) message is specified in section 3.2.5.12.

How to process a [LinkViewerToMacCloseFile](#) message is specified in section [3.2.5.17](#).

3.2.4.2 Notification That a New ASF File Header Is Available

This event occurs when the server is ready to transmit a new entry in a server-side playlist. As a prerequisite for this event, the higher layer MUST already have notified the server that it sent the last [Data](#) packet for the previous playlist entry, as specified in section [3.2.4.1](#), and the value of the State variable MUST be STREAMING.

The server MUST fill in the fields of a [LinkMacToViewerReportStreamChange](#) (section [2.2.4.12](#)) message and then send the message by following the rules specified in section [3.2.5.2](#).

The higher layer MUST select the streams in the new playlist entry that will be streamed. This SHOULD be done by taking the value of the **dwLinkBandwidth** field of the [LinkViewerToMacStartPlaying](#) message into account, if the client previously sent a [LinkViewerToMacStartPlaying](#) message with that field. [<48>](#)

The server MUST be prepared to receive a [LinkViewerToMacLogging](#) message from the client. How to process a [LinkViewerToMacLogging](#) message is specified in section [3.2.5.15](#).

If the value of the Client-Port variable is not 0x0000, the value of the State variable MUST be set to READY, and the server MUST also be prepared to receive a [LinkViewerToMacReadBlock](#) message from the client. How to process a [LinkViewerToMacReadBlock](#) message is specified in section [3.2.5.8](#).

If the value of the Client-Port variable is 0x0000, the server MUST set the value of the Incarnation variable in the abstract data model to 0x000000FF and MUST then send the ASF file header of the new playlist entry to the client by following the rules specified in section [3.2.5.8.1](#). After that, the server MUST start transmitting the ASF data packets from the beginning of the new playlist entry by following the rules specified in section [3.2.5.11.1](#).

3.2.5 Message Processing Events and Sequencing Rules

3.2.5.1 Receiving a Packet

This section specifies common steps that MUST be performed whenever the server receives a packet.

If the packet is received on the TCP connection, the server MUST verify that the packet begins with a [TcpMessageHeader](#) (section [2.2.3](#)). Each message contained in the packet MUST be processed.

The server MUST inspect the **MID** field of the message to validate that the message is from one of the types specified in section [2.2.4](#) and process the message as specified in section [3.2.5](#).

If the packet is received over UDP, it MUST be a [RequestPacketListResend](#) (section [2.2.5](#)) packet.

If the **KeepAlive** timer (as specified in section [3.2.2](#)) is running, it MUST be stopped.

3.2.5.2 Sending a Message

This section specifies common steps that MUST be performed whenever the client sends a message to the server from any of the types specified in section [2.2.4](#).

The message MUST be encapsulated in a [TcpMessageHeader](#) packet. Multiple messages SHOULD NOT be combined in a single [TcpMessageHeader](#) packet.

The **KeepAlive** timer (as specified in section [3.2.2](#)) MUST be started.

3.2.5.3 Receiving a LinkViewerToMacConnect Message

The server MUST first follow the steps specified in section [3.2.5.1](#). Also, the server MUST verify that the [LinkViewerToMacConnect](#) message adheres to the syntax specified in section [2.2.4.17](#).

The server MUST create a new session state by performing the initialization procedure specified in section [3.2.3](#).

The server MUST set the value of the Client-Version variable in the abstract data model to the value of the **subscriberName** field in the LinkViewerToMacConnect message.

The server MUST send a [LinkMacToViewerReportConnectedEX](#) (section [2.2.4.2](#)) message.

If the value of the **playIncarnation** field of the LinkViewerToMacConnect message is 0xF0F0F0F0, and the server supports sending packet-pair packets over UDP or TCP, or both, the server SHOULD set the **playIncarnation** field in the LinkMacToViewerReportConnectedEX message to 0xF0F0F0F0. Otherwise, the **playIncarnation** field in the LinkMacToViewerReportConnectedEX message MUST be set to 0xF0F0F0EF.

If the server supports authentication, and there is a possibility that authentication will be required, the **AuthenPackage** field in the LinkMacToViewerReportConnectedEX message MUST be set to specify the name of the authentication scheme (either BASIC or NTLM).

After sending the LinkMacToViewerReportConnectedEX message, the server MUST wait for either a [LinkViewerToMacFunnelInfo](#) message or a [LinkViewerToMacConnectFunnel](#) message to be received.

How to process a LinkViewerToMacFunnelInfo message is specified in section [3.2.5.4](#); how to process a LinkViewerToMacConnectFunnel message is specified in section [3.2.5.5](#).

3.2.5.4 Receiving a LinkViewerToMacFunnelInfo Message

The server MUST first follow the steps specified in section [3.2.5.1](#). Also, the server MUST verify that the [LinkViewerToMacFunnelInfo](#) message adheres to the syntax specified in section [2.2.4.19](#).

The server MUST send a [LinkMacToViewerReportFunnelInfo](#) (section [2.2.4.6](#)) message.

The server MUST set the value of the **nCubs** field in the LinkMacToViewerReportFunnelInfo message to the value of the Client-ID variable in the abstract data model.

If the value of the **playIncarnation** field of the LinkViewerToMacFunnelInfo message is 0xF0F0F0F0 or 0xF0F0F0F1, and the server supports sending packet-pair packets over TCP, the server SHOULD set the **playIncarnation** field in the LinkMacToViewerReportFunnelInfo message to 0xF0F0F0F1.

If the value of the **playIncarnation** field of the LinkViewerToMacFunnelInfo message is 0xF0F0F901, and the server supports sending packet-pair packets over UDP, the server SHOULD set the **playIncarnation** field in the LinkMacToViewerReportFunnelInfo message to 0xF0F0F901, and the size of the **Packet-pair packet** field SHOULD be 0.

Otherwise, the **playIncarnation** field in the LinkMacToViewerReportFunnelInfo message MUST be set to 0xF0F0F0EF, and the size of the **Packet-pair packet** field SHOULD be 0.

If the value of the **playIncarnation** field in the LinkMacToViewerReportFunnelInfo message is set to 0xF0F0F901, the server MUST also set the UDP-Packet-Pair variable in the abstract data model to True.

If the value of the **playIncarnation** field in the LinkMacToViewerReportFunnelInfo message is set to 0xF0F0F0F1, the **Packet-pair packet** field MUST be set to high-entropy (random) bytes. The size of the **Packet-pair packet** field MUST be chosen so that the total size of the [TcpMessageHeader](#) packet that contains the LinkMacToViewerReportFunnelInfo message becomes 512 bytes.

After sending the LinkMacToViewerReportFunnelInfo message, if the value of the **playIncarnation** field in the LinkMacToViewerReportFunnelInfo message is set to 0xF0F0F0F1, the server MUST send a second and a third LinkMacToViewerReportFunnelInfo message. Each of these two messages MUST be identical to the first message, except that the contents of the **Packet-pair packet** field MUST be set to different random bytes. Also, the size of the **Packet-pair packet** field in the third message MUST be chosen so that the total size of the TcpMessageHeader packet that contains the third message becomes 1,056 bytes.

After sending the last LinkMacToViewerReportFunnelInfo message, the server MUST wait for a [LinkViewerToMacConnectFunnel](#) message to be received. How to process this message is specified in section [3.2.5.5](#).

3.2.5.5 Receiving a LinkViewerToMacConnectFunnel Message

The server MUST first follow the steps specified in section [3.2.5.1](#). Also, the server MUST verify that the [LinkViewerToMacConnectFunnel](#) message adheres to the syntax specified in section [2.2.4.18](#).

The server MUST parse the **funnelName** field, and if the **funnelName** field specifies that the client wants to use UDP, the server MUST save the UDP port number specified in the **funnelName** field in the Client-Port variable of the abstract data model. The IP address specified in the **funnelName** field SHOULD be ignored. Instead, [Data](#) packets SHOULD be sent to the IP address used by the client for the TCP connection to the server.

If the LinkViewerToMacConnectFunnel message is processed successfully, the server MUST send a [LinkMacToViewerReportConnectedFunnel](#) (section [2.2.4.3](#)) message. Otherwise, the server MUST send a [LinkMacToViewerReportDisconnectedFunnel](#) (section [2.2.4.4](#)) message.

If the server sent the LinkMacToViewerReportConnectedFunnel message, the server MUST wait for a [LinkViewerToMacOpenFile](#) message to be received. How to process this message is specified in section [3.2.5.6](#).

If the server sent the LinkMacToViewerReportDisconnectedFunnel message, the server MUST wait for a LinkViewerToMacConnectFunnel message to be received. How to process this message is specified in section [3.2.5.5](#).

3.2.5.6 Receiving a LinkViewerToMacOpenFile Message

The server MUST first follow the steps specified in section [3.2.5.1](#). Also, the server MUST verify that the [LinkViewerToMacOpenFile](#) message adheres to the syntax specified in section [2.2.4.21](#).

The server MUST check with the higher layer to make sure that the file path that the client specified in the **fileName** field of the LinkViewerToMacOpenFile message is valid. If the message is not valid, this is an error, and the server MUST send a [LinkMacToViewerReportOpenFile](#) message in response, and the **hr** field of the message MUST be set to indicate that an error has occurred.

If the higher layer indicates that the client is to be redirected to a different server, or to a proxy server, the server MUST send a [LinkMacToViewerReportRedirect](#) (section [2.2.4.9](#)) message. After sending a LinkMacToViewerReportRedirect message, the server MUST delete all session states and close the TCP connection.

If there is no error in processing the LinkViewerToMacOpenFile message, and the server has not sent a LinkMacToViewerReportRedirect message, the server MUST generate a numerical identifier for the resource identified by the **fileName** field and store it in the File-ID variable of the abstract data model.

If the LinkViewerToMacOpenFile message includes a nonzero size **tokenData** field, and if the server requires identification for the resource specified in the **fileName** field, the server MUST process the credentials in the **tokenData** field using the same authentication mechanism that the server previously specified in the **AuthenPackage** field of the [LinkMacToViewerReportConnectedEX](#) message. If the authentication algorithm requires that a challenge be sent (for example, because the credentials in the **tokenData** field are incorrect), the server MUST send a [LinkMacToViewerSecurityChallenge \(section 2.2.4.14\)](#) message.

If the value of the **cbtoken** field in the LinkViewerToMacOpenFile message is 0x00000000, and if the server requires identification for the resource specified in the **fileName** field, the server MUST send a LinkMacToViewerSecurityChallenge message. In this case, if the client's major version number is less than 8, as specified by the Client-Version variable, the authentication algorithm used when generating the value for the **pToken** field in the LinkMacToViewerSecurityChallenge message MUST be the same as what the server previously specified in the **AuthenPackage** field of the LinkMacToViewerReportConnectedEX message. If the client's major version number is greater than or equal to 8, the authentication algorithm used when generating the value for the **pToken** field in the LinkMacToViewerSecurityChallenge message MUST be either Basic, as specified in [\[RFC2617\]](#), or NTLM, as specified in [\[MS-NLMP\]](#).

If the server sent a LinkMacToViewerSecurityChallenge message, the server MUST wait for a [LinkViewerToMacSecurityResponse](#) message to be received. How to process this message is specified in section [3.2.5.7](#).

If the server did not send a LinkMacToViewerSecurityChallenge message, the server MUST send a LinkMacToViewerReportOpenFile (section 2.2.4.7) message.

The value of the **openFileId** field of the LinkMacToViewerReportOpenFile message MUST be set to the value of the File-ID variable in the abstract data model.

If the server sent a LinkMacToViewerReportOpenFile message, the server MUST wait for a [LinkViewerToMacReadBlock](#) message to be received. How to process this message is specified in section [3.2.5.8](#).

3.2.5.7 Receiving a LinkViewerToMacSecurityResponse Message

The server MUST first follow the steps specified in section [3.2.5.1](#). Also, the server MUST verify that the [LinkViewerToMacSecurityResponse](#) message adheres to the syntax specified in section [2.2.4.24](#).

The server MUST process the credentials in the **pToken** field of the LinkViewerToMacSecurityResponse message using the same authentication mechanism that the server previously specified in the **pToken** field of the [LinkMacToViewerSecurityChallenge](#) message. If the authentication algorithm requires that a challenge be sent (for example, because the credentials in the **pToken** field are incorrect), the server MUST send a LinkMacToViewerSecurityChallenge message.

If the server sent a LinkMacToViewerSecurityChallenge message, the server MUST wait for a LinkViewerToMacSecurityResponse message to be received. How to process this message is specified in section [3.2.5.7](#).

If the server did not send a LinkMacToViewerSecurityChallenge message, the server MUST send a [LinkMacToViewerReportOpenFile \(section 2.2.4.7\)](#) message.

The value of the **openFileId** field of the LinkMacToViewerReportOpenFile message MUST be set to the value of the File-ID variable in the abstract data model.

If the server sent a LinkMacToViewerReportOpenFile message, the server MUST wait for a [LinkViewerToMacReadBlock](#) message to be received. How to process this message is specified in section [3.2.5.8](#).

3.2.5.8 Receiving a LinkViewerToMacReadBlock Message

The server MUST first follow the steps specified in section [3.2.5.1](#). Also, the server MUST verify that the [LinkViewerToMacReadBlock](#) message adheres to the syntax specified in section [2.2.4.23](#).

The server MUST verify that the value of the **openFileId** field of the LinkViewerToMacReadBlock message is identical to the value of the File-ID variable.

The server MUST set the value of the Incarnation variable to the value of the **playIncarnation** field of the LinkViewerToMacReadBlock message.

If the value of the Client-Port variable in the abstract data model is not 0x0000, and if the value of the UDP-Packet-Pair variable is True, the server MUST send two [Data \(section 2.2.2\)](#) packets that each contain a packet-pair packet. The size of the **Payload** field of each Data packet SHOULD be 1,464 bytes, and the contents of the **Payload** field MUST consist of random data that MUST be different for each of the two Data packets.

The value of the **LocationId** field MUST be set to 0xF0F0F000 for the first Data packet and to 0xF0F0F001 for the second Data packet.

The value of the **playIncarnation** field in both Data packets MUST be set to 0xFF.

If the server is sending the two Data packets, they MUST be sent to the client using UDP to the UDP port specified by the Client-Port variable.

The server MUST then send a [LinkMacToViewerReportReadBlock \(section 2.2.4.8\)](#) message.

The server MUST send the ASF file header as one or more Data packets by following the rules specified in section [3.2.5.8.1](#).

3.2.5.8.1 Sending Data Packets Containing an ASF File Header

The server MUST encapsulate the ASF file header specified in section [2.2.2](#) in one or more Data (section 2.2.2) packets.

The value of the **playIncarnation** field in the Data packet MUST be set to the 8 least-significant bits of the value of the Incarnation variable in the abstract data model.

The size of the **Payload** field of any Data packet MUST NOT be larger than the maximum ASF data packet size. The maximum ASF data packet size is the value of the **cbPacketSize** field in the most recently sent [LinkMacToViewerReportStreamChange](#) message or, if no such message has been sent, the value of the **filePacketSize** field in the [LinkMacToViewerReportOpenFile](#) message that was sent by the server.

If the value of the Client-Port variable is not 0x0000, the server MUST then send the Data packets that contain the ASF file header to the client, using UDP, to the UDP port specified by the Client-Port variable. Otherwise, the Data packets MUST be sent to the client over the existing TCP connection.

If multiple Data packets are required to send the complete ASF file header to the client, the transmission of the Data packets MUST be paced by the server. Pacing means that the server

transmits the packets as quickly as possible, but the bit rate used when transmitting the Data packets MUST NOT exceed the average content bit rate. The average content bit rate is the value of the **dwBitRate** field in the most recently sent LinkMacToViewerReportStreamChange message or, if no such message has been sent, the value of the **fileBitRate** field in the LinkMacToViewerReportOpenFile message that was sent by the server.

While sending the Data packets, the server MUST be prepared to receive a [LinkViewerToMacCancelReadBlock](#) message from the client. How to process this message is specified in section [3.2.5.9](#).

After sending the last Data packet containing the ASF file header, if the value of the State variable is INIT, then the State variable MUST be set to READY, and the server MUST wait for a LinkViewerToMacCancelReadBlock message, a [LinkViewerToMacStreamSwitch](#) message, a [LinkViewerToMacStartPlaying](#) message, a [LinkViewerToMacStartStriding](#) message, or a [LinkViewerToMacCloseFile](#) message to be received from the client.

How to process a LinkViewerToMacCancelReadBlock message is specified in section [3.2.5.9](#).

How to process a LinkViewerToMacStreamSwitch message is specified in section [3.2.5.10](#).

How to process a LinkViewerToMacStartPlaying message is specified in section [3.2.5.11](#).

How to process a LinkViewerToMacStartStriding message is specified in section [3.2.5.12](#).

How to process a LinkViewerToMacCloseFile message is specified in section [3.2.5.17](#).

3.2.5.9 Receiving a LinkViewerToMacCancelReadBlock Message

The server MUST first follow the steps specified in section [3.2.5.1](#). Also, the server MUST verify that the [LinkViewerToMacCancelReadBlock](#) message adheres to the syntax specified in section [2.2.4.15](#).

If the server is currently sending [Data](#) packets that contain the ASF file header, it MUST discard any such Data packets that have not yet been sent.

The server MUST then wait for either a LinkViewerToMacCancelReadBlock message or a [LinkViewerToMacCloseFile](#) message to be received from the client.

How to process a LinkViewerToMacCancelReadBlock message is specified in section [3.2.5.9](#). How to process a LinkViewerToMacCloseFile message is specified in section [3.2.5.17](#).

3.2.5.10 Receiving a LinkViewerToMacStreamSwitch Message

The server MUST first follow the steps specified in section [3.2.5.1](#). Also, the server MUST verify that the [LinkViewerToMacStreamSwitch](#) message adheres to the syntax specified in section [2.2.4.28](#).

The server MUST process the stream selection information specified in the **aStreamEntries** field. Any new streams that are transmitted as a result of the **aStreamEntries** field MUST be transmitted beginning with an ASF key-frame payload. Any streams that are replaced by different streams MUST continue to be transmitted until the first ASF key-frame payload of the new stream is transmitted. For how to determine if an ASF payload contains a key-frame, see [\[ASF\]](#).

The server MUST send a [LinkMacToViewerReportStreamSwitch](#) (section [2.2.4.13](#)) message.

If the value of the State variable is STREAMING, the server MUST continue transmitting [Data](#) packets by following the rules specified in section [3.2.5.11.1](#).

If the value of the State variable is READY, the server MUST wait for a [LinkViewerToMacStartPlaying](#) message, a [LinkViewerToMacStartStriding](#) message, or a [LinkViewerToMacCloseFile](#) message to be received from the client.

How to process a LinkViewerToMacStartPlaying message is specified in section [3.2.5.11](#).

How to process a LinkViewerToMacStartStriding message is specified in section [3.2.5.12](#).

How to process a LinkViewerToMacCloseFile message is specified in section [3.2.5.17](#).

3.2.5.11 Receiving a LinkViewerToMacStartPlaying Message

The server MUST first follow the steps specified in section [3.2.5.1](#). Also, the server MUST verify that the [LinkViewerToMacStartPlaying](#) message adheres to the syntax specified in section [2.2.4.25](#).

The server MUST verify that the value of the **openFileId** field of the LinkViewerToMacStartPlaying message is identical to the value of the File-ID variable.

If the value of the State variable is READY, the server MUST seek to the position in the content specified by the **position**, **asfOffset**, and **locationId** fields, as appropriate. If the value of the State variable is STREAMING, the server MUST ignore the **position**, **asfOffset**, and **locationId** fields.

The server MUST set the value of the Incarnation variable to the value of the **playIncarnation** field of the [LinkViewerToMacReadBlock](#) message.

If the server did not previously receive a [LinkViewerToMacStreamSwitch](#) message, and the Client-Version variable indicates that the client is Windows® Media Services 4.0 or Windows Media Services 4.1 (as specified in section [2.2.4.17](#)), the server MUST assume that all streams in the content are selected.

Otherwise, if the server did not previously receive a LinkViewerToMacStreamSwitch message, the server MUST assume that none of the streams in the content are selected.

The server MUST send a [LinkMacToViewerReportStartedPlaying](#) (section [2.2.4.10](#)) message.

The value of the State variable in the abstract data model MUST be set to STREAMING.

After this, the server MUST send the ASF data packets of the current playlist entry, as specified in section [3.2.5.11.1](#).

If the LinkViewerToMacStartPlaying message includes the **dwAccelBandwidth** and **dwAccelDuration** fields, an initial amount of [Data](#) packets given by the **dwAccelDuration** field SHOULD be transmitted at the bit rate given by the **dwAccelBandwidth** field. [<49>](#)

3.2.5.11.1 Sending Data Packets Containing ASF Data Packets

When the server sends ASF data packets, each ASF data packet MUST be encapsulated in a [Data](#) (section [2.2.2](#)) packet. The ASF payloads in the ASF data packets MUST be filtered so that only ASF payloads that belong to streams that are selected by the client are included in the ASF data packets. If all payloads are filtered away from an ASF data packet, that ASF data packet MUST NOT be transmitted.

The **LocationId** field of the Data packet MUST be set to the ASF data packet's number in the ASF file. ASF data packet numbers start with 0 for the first ASF data packet. If the server does not have access to the ASF file (for example, in the case of live content), the server MUST assume a virtual

ASF file, incrementing **LocationId** (or decrementing it when rewinding the content) exactly as if a real ASF file existed.

The **AFFlags** field in the Data packet MUST be set to the least significant 8 bits of the Sequence variable in the abstract data model. After this, the value of the Sequence variable MUST be incremented.

The value of the **playIncarnation** field in the Data packet MUST be set to the 8 least-significant bits of the value of the Incarnation variable.

If the value of the Client-Port variable is not 0x0000, the Data packets MUST be sent to the client, using UDP, to the UDP port specified by the Client-Port variable. Otherwise, the Data packets MUST be sent to the client over the existing TCP connection.

While sending Data packets, the server MUST be prepared to receive a [LinkViewerToMacStreamSwitch](#) message or a [LinkViewerToMacStopPlaying](#) message from the client. How to process a LinkViewerToMacStreamSwitch message is specified in section [3.2.5.10](#). How to process a LinkViewerToMacStopPlaying message is specified in section [3.2.5.14](#).

If the value of the Client-Port variable is not 0x0000, the server MUST also be prepared to receive a [RequestPacketListResend](#) packet on the UDP port with the same number as the TCP port on which the server received the TCP connection from the client. For example, if the client connected to the server on TCP port 1755, it means that the server must be prepared to receive RequestPacketListResend packets on UDP port 1755. How to process a RequestPacketListResend packet is specified in section [3.2.5.13](#).

3.2.5.12 Receiving a LinkViewerToMacStartStriding Message

The server MUST first follow the steps specified in section [3.2.5.1](#). Also, the server MUST verify that the [LinkViewerToMacStartStriding](#) message adheres to the syntax specified in section [2.2.4.26](#).

The server MUST verify that the value of the **openFileId** field of the LinkViewerToMacStartStriding message is identical to the value of the File-ID variable.

If the value of the State variable is READY, the server MUST seek to the position in the content specified by the **position**, **asfOffset**, and **locationId** fields, as appropriate. If the value of the State variable is STREAMING, the server MUST ignore the **position**, **asfOffset**, and **locationId** fields.

The server MUST set the value of the Incarnation variable to the value of the **playIncarnation** field of the [LinkViewerToMacReadBlock](#) message.

If the server did not previously receive a [LinkViewerToMacStreamSwitch](#) message, and the Client-Version variable indicates that the client is Windows® Media Services 4.0 or Windows Media Services 4.1 (as specified in section [2.2.4.17](#)), the server MUST assume that all streams in the content are selected.

Otherwise, if the server did not previously receive a LinkViewerToMacStreamSwitch message, the server MUST assume that none of the streams in the content are selected.

The server MUST send a [LinkMacToViewerReportStartStriding](#) (section [2.2.4.11](#)) message.

The value of the State variable in the abstract data model MUST be set to STREAMING.

After this, the server MUST send the ASF data packets of the current playlist entry, at the rate specified by the **rate** field in the LinkViewerToMacStartStriding message by following the rules in section [3.2.5.11.1](#).

3.2.5.13 Receiving a RequestPacketListResend Packet

The server MUST verify that the [RequestPacketListResend](#) packet adheres to the syntax specified in section [2.2.5](#).

The server MUST verify that the value of the **dwClientId** field of the RequestPacketListResend packet is identical to the value of the Client-ID variable.

The server MUST verify that the value of the **wSourceId** field of the RequestPacketListResend packet is identical to the 16 least-significant bits of the File-ID variable.

The server SHOULD resend a copy of each [Data](#) packet that the client specified in the **dwBeginPacketList** field of the RequestPacketListResend packet. The fields in the Data packet MUST NOT be modified when the Data packet is resent.

After this, if the value of the State variable is STREAMING, the server MUST continue transmitting ASF data packets by following the rules specified in section [3.2.5.11.1](#).

3.2.5.14 Receiving a LinkViewerToMacStopPlaying Message

The server MUST first follow the steps specified in section [3.2.5.1](#). Also, the server MUST verify that the [LinkViewerToMacStopPlaying](#) message adheres to the syntax specified in section [2.2.4.27](#).

The value of the State variable MUST be set to READY.

The server MUST send a [LinkMacToViewerReportEndOfStream](#) (section [2.2.4.5](#)) message.

The value of the **hr** field in the LinkMacToViewerReportEndOfStream message MUST be set to 0x00000000.

The value of the **playIncarnation** field in the LinkMacToViewerReportEndOfStream message MUST be set to the value of the **playIncarnation** field in the LinkViewerToMacStopPlaying message.

After sending the LinkMacToViewerReportEndOfStream message, the server MUST wait for a [LinkViewerToMacLogging](#) message, a [LinkViewerToMacStreamSwitch](#) message, a [LinkViewerToMacStartPlaying](#) message, a [LinkViewerToMacStartStriding](#) message, or a [LinkViewerToMacCloseFile](#) message to be received from the client.

How to process a LinkViewerToMacLogging message is specified in section [3.2.5.15](#).

How to process a LinkViewerToMacStreamSwitch message is specified in section [3.2.5.10](#).

How to process a LinkViewerToMacStartPlaying message is specified in section [3.2.5.11](#).

How to process a LinkViewerToMacStartStriding message is specified in section [3.2.5.12](#).

How to process a LinkViewerToMacCloseFile message is specified in section [3.2.5.17](#).

3.2.5.15 Receiving a LinkViewerToMacLogging Message

The server MUST first follow the steps specified in section [3.2.5.1](#). Also, the server MUST verify that the [LinkViewerToMacLogging](#) message adheres to the syntax specified in section [2.2.4.20](#).

The server SHOULD communicate the logging information (that is, the content of the **log** field) to the higher layer.

The server MUST wait for a [LinkViewerToMacStreamSwitch](#) message, a [LinkViewerToMacStartPlaying](#) message, a [LinkViewerToMacStartStriding](#) message, or a [LinkViewerToMacCloseFile](#) message to be received from the client.

How to process a LinkViewerToMacStreamSwitch message is specified in section [3.2.5.10](#).

How to process a LinkViewerToMacStartPlaying message is specified in section [3.2.5.11](#).

How to process a LinkViewerToMacStartStriding message is specified in section [3.2.5.12](#).

How to process a LinkViewerToMacCloseFile message is specified in section [3.2.5.17](#).

3.2.5.16 Receiving a LinkViewerToMacPong Message

The server MUST first follow the steps specified in section [3.2.5.1](#). Also, the server MUST verify that the [LinkViewerToMacPong](#) message adheres to the syntax specified in section [2.2.4.22](#).

If the value of the State variable is STREAMING, the server MUST continue transmitting ASF data packets by following the rules specified in section [3.2.5.11.1](#). Otherwise, the server MUST continue waiting for the messages that it was waiting for before the **KeepAlive** timer (as specified in section [3.2.2](#)) expired.

3.2.5.17 Receiving a LinkViewerToMacCloseFile Message

The server MUST first follow the steps specified in section [3.2.5.1](#). Also, the server MUST verify that the [LinkViewerToMacCloseFile](#) message adheres to the syntax specified in section [2.2.4.16](#).

The server MUST verify that the value of the **openFileId** field of the LinkViewerToMacCloseFile message is identical to the value of the File-ID variable.

The server MUST delete all session states and close the TCP connection to the client.

3.2.6 Timer Events

3.2.6.1 KeepAlive Timer Expires

When the KeepAlive timer expires, the following actions MUST occur:

1. The server MUST send a [LinkMacToViewerPing](#) (section [2.2.4.1](#)) message. The message MUST be sent following the rules specified in section [3.2.5.2](#).
2. After sending the LinkMacToViewerPing message, the server MUST wait for the [LinkViewerToMacPong](#) message to be received. How to process this message is specified in section [3.2.5.16](#).

Note If the client is unreachable, the TCP connection eventually times out, which triggers the local event defined in section [3.2.7.1](#).

3.2.7 Other Local Events

3.2.7.1 TCP Connection Is Disconnected

If the TCP connection is disconnected, all session states SHOULD be deleted.

4 Protocol Examples

4.1 General Sequence

The following list shows the sequence of TCP packets that pass over the wire when the client attempts to stream a media file from the server using the MMS Protocol. The sequence assumes that the media stream does not require authentication and that the client does not request packet-pair bandwidth estimation.

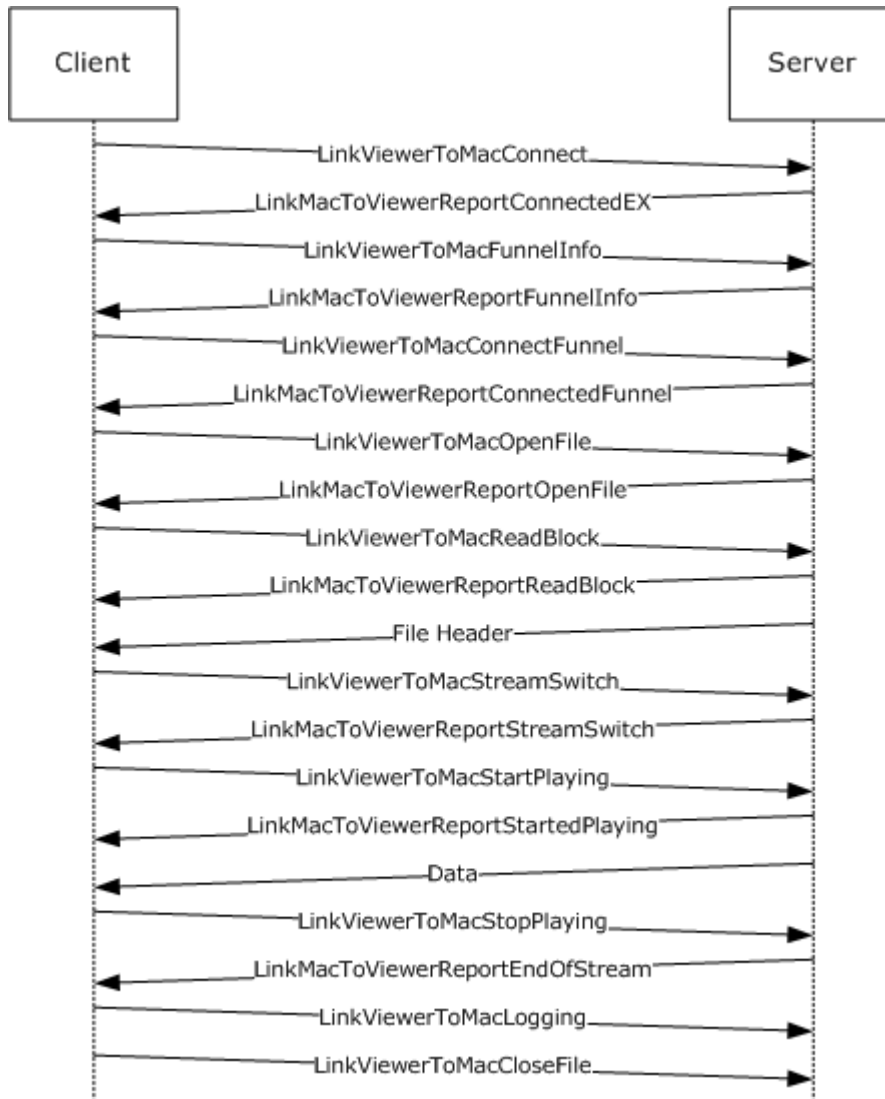


Figure 1: Sequence of TCP packets

1. The client requests a connection from the server by sending a [LinkViewerToMacConnect](#) message.
2. The server responds with a [LinkMacToViewerReportConnectedEX](#) message.

3. The client requests information from the server with a [LinkViewerToMacFunnelInfo](#) message.
4. The server responds with a [LinkMacToViewerReportFunnelInfo](#) message.
5. The client chooses a specific port and requests that the server use it to send streaming media content by sending a [LinkViewerToMacConnectFunnel](#) message.
6. The server responds by sending a [LinkMacToViewerReportConnectedFunnel](#) message to notify the client that it will use the requested port.
7. The client requests, by name, the specific media file it needs to have streamed to it from the server by sending a [LinkViewerToMacOpenFile](#) message.
8. The server responds that it was able to open the requested file with a [LinkMacToViewerReportOpenFile](#) message.
9. The client requests the file header from the server by sending a [LinkViewerToMacReadBlock](#) message.
10. The server responds with a [LinkMacToViewerReportReadBlock](#) message, also sending the file header information as a [Data](#) packet.
11. The client requests the streams it needs from the server by sending a [LinkViewerToMacStreamSwitch](#) message.
12. The server responds with a [LinkMacToViewerReportStreamSwitch](#) message.
13. The client requests that the server begin streaming the media file by sending a [LinkViewerToMacStartPlaying](#) message.
14. The server responds with a [LinkMacToViewerReportStartedPlaying](#) message and also sends a stream of Data packets.
15. During file playback, the client may send a [LinkViewerToMacStopPlaying](#) message.
16. The server sends a [LinkMacToViewerReportEndOfStream](#) message to the client either in response to the client's request or because the end of the stream has been reached.
17. The client sends a [LinkViewerToMacLogging](#) message that contains the log information.
18. The client sends a [LinkViewerToMacCloseFile](#) message. The client closes the network socket connection.

4.2 Packet-Pair Bandwidth Estimation for MMS

Packet-pair is a technique for estimating the bandwidth of a streaming media connection over the Internet.

To estimate bandwidth, the server sends two or more consecutive packets of highly entropic data, and the client estimates the bandwidth by measuring the difference between the times that it receives the packets. This method is usually reliable; however, if the client traverses a network address translation, firewall, or proxy server, the packet-pair bandwidth measurement might be inaccurate.

4.2.1 Packet-Pair Commands for UDP Connections

The sequence of commands that is required to negotiate a packet-pair depends on whether the client and server have negotiated a UDP or a TCP connection for the transmission of streaming media packets.

When UDP is used, the following sequence applies.

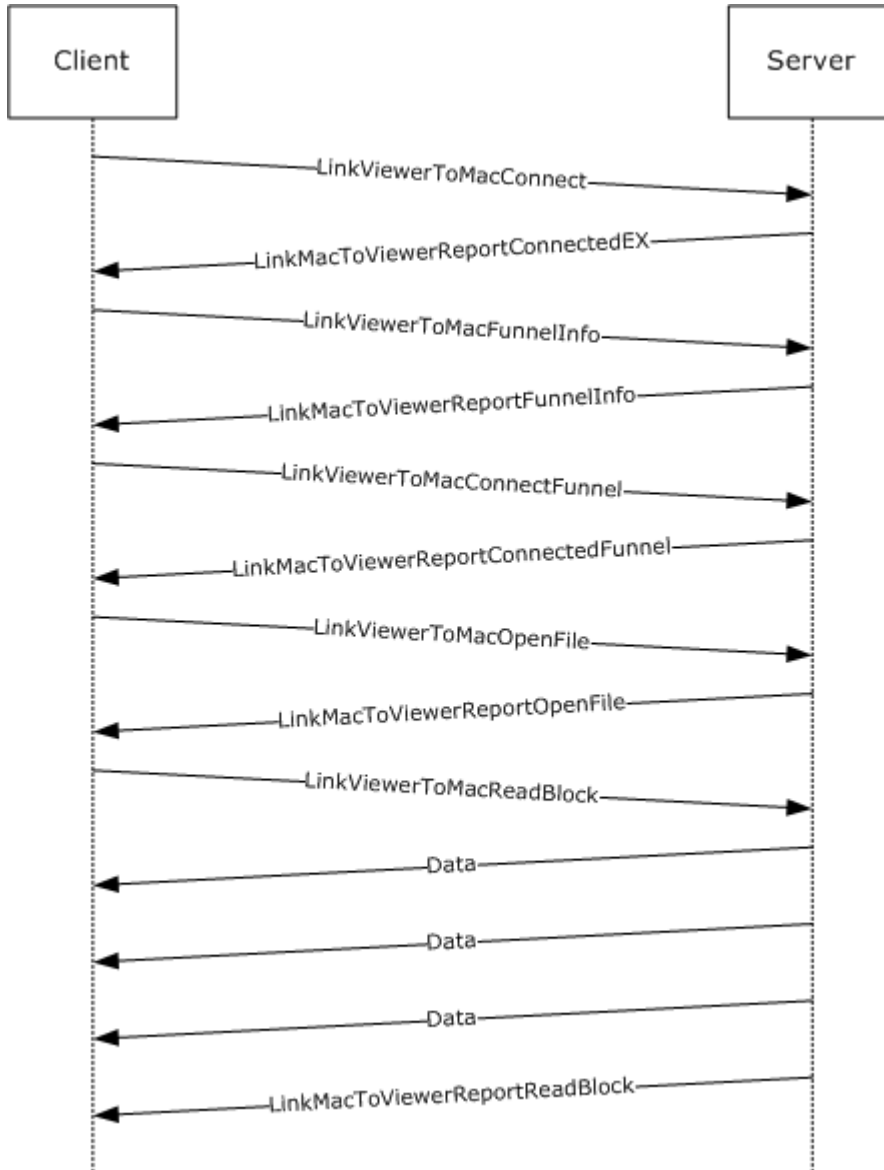


Figure 2: Sequence for UDP connections

1. The client sends a [LinkViewerToMacConnect](#) message with the **playIncarnation** field set to "0xF0F0F0F0". This value corresponds to the named value of MMS_USE_PACKET_PAIR.

2. The server sends a [LinkMacToViewerReportConnectedEX](#) message with the **playIncarnation** field set to "0xF0F0F0F0".
3. The client sends a [LinkViewerToMacFunnelInfo](#) message with the **playIncarnation** field set to "0xF0F0F901". This value corresponds to the named value of MMS_PACKET_PAIR_UDP_HIGH_ENTROPY.
4. The server sends a [LinkMacToViewerReportFunnelInfo](#) message with the **playIncarnation** field set to "0xF0F0F901".
5. The client sends a [LinkViewerToMacConnectFunnel](#) message.
6. The server sends a [LinkMacToViewerReportConnectedFunnel](#) message.
7. The client sends a [LinkViewerToMacOpenFile](#) message.
8. The server sends a [LinkMacToViewerReportOpenFile](#) message.
9. The client sends a [LinkViewerToMacReadBlock](#) message.
10. The server sends the first of three [Data](#) packets (the first two forming the packet-pair) with the fields of the first packet set as follows:
 - **LocationId** is set to "0xF0F0F000".
 - **playIncarnation** is set to "0xFF".
 - **AFFlags** is set to "0X10".
 - **payload** is 1,472 bytes of random data.
11. The server sends the second Data packet that is identical to the first except that the **LocationId** field is set to "0xF0F0F001".
12. The server sends the third Data packet, which contains an ASF file header, along with the [LinkMacToViewerReportReadBlock](#) message to complete the conversation.

4.2.2 Packet-Pair Commands for TCP Connections

When TCP is used, the following sequence applies.

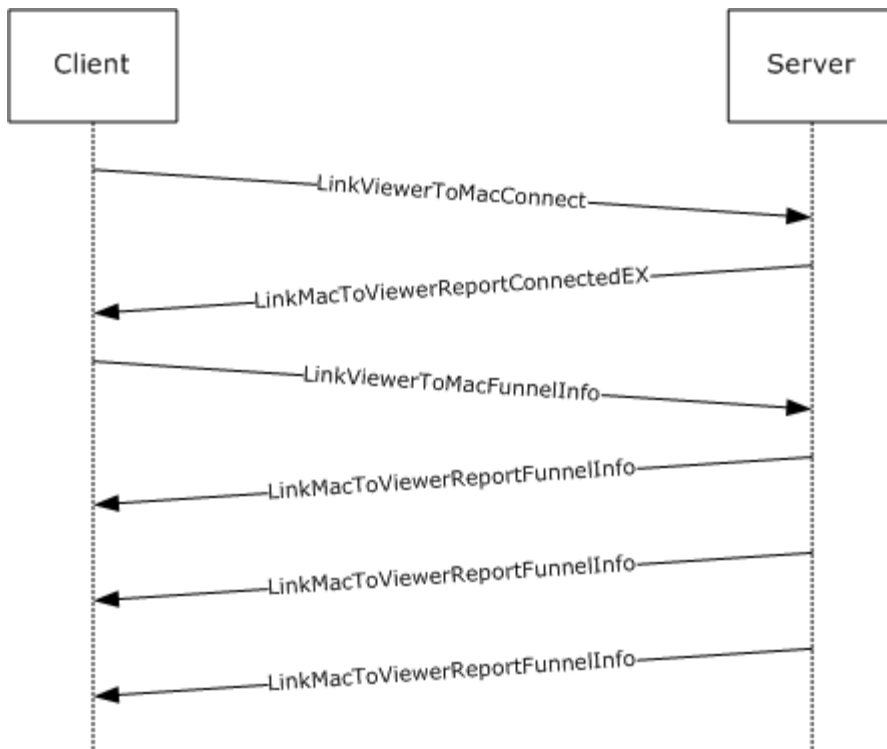


Figure 3: Packet-pair commands for TCP connections

1. The client sends a [LinkViewerToMacConnect](#) message with the **playIncarnation** field set to "0xF0F0F0F0". This value corresponds to the named value of MMS_USE_PACKET_PAIR.
2. The server sends a [LinkMacToViewerReportConnectedEX](#) message with the **playIncarnation** field set to "0xF0F0F0F0".
3. The client sends a [LinkViewerToMacFunnelInfo](#) message with the **playIncarnation** field set to "0xF0F0F0F1". This value corresponds to the named value of MMS_PACKET_PAIR_TCP_HIGH_ENTROPY.
4. The server sends the first of three [LinkMacToViewerReportFunnelInfo](#) messages (the first two form the packet-pair) with the **playIncarnation** field of the first packet set to "0xF0F0F0F1". At the end of this packet are 480 bytes of random data.
5. The server sends another `LinkMacToViewerReportFunnelInfo` message identical to the first.
6. The server sends another `LinkMacToViewerReportFunnelInfo` message similar to the first, except that it is followed by 1,016 random bytes of data rather than 480.

4.3 Playback Adjustment Sequence

The MMS Protocol is used by Windows® Media Services to stream data between the Windows Media Player and Windows Media server by means of TCP and UDP.

During the playback process, the user can drag the seek bar to a new position and fast forward and rewind the content. The following sequences are used to execute these maneuvers.

4.3.1 Sequencing During Playback

If the user drags the seek bar to a new position, the following sequence occurs.

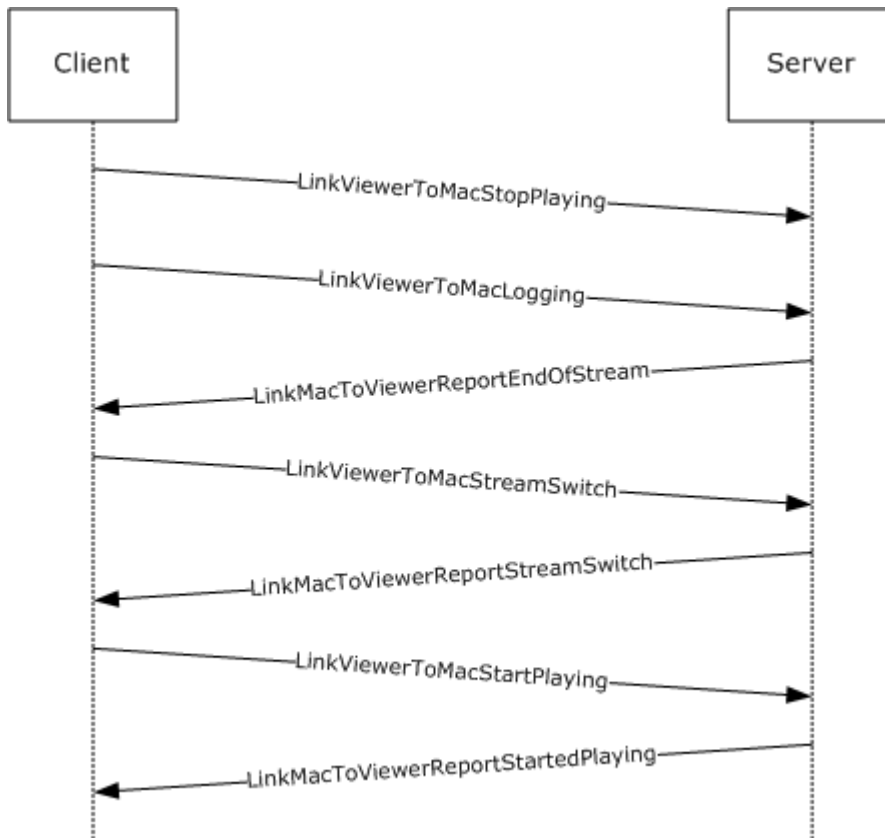


Figure 4: Sequencing during playback--new position of seek bar

1. The client sends the [LinkViewerToMacStopPlaying](#) message, followed by a [LinkViewerToMacLogging](#) message.
2. The server confirms with a [LinkMacToViewerReportEndOfStream](#) message.
3. The client sends a [LinkViewerToMacStreamSwitch](#) message.
4. The server responds with a [LinkMacToViewerReportStreamSwitch](#) message.
5. The client sends a [LinkViewerToMacStartPlaying](#) message that contains the new playback position.
6. The server responds with a [LinkMacToViewerReportStartedPlaying](#) message while also streaming data to the client.

If the user presses and holds the fast forward or rewind button, the following sequence occurs.

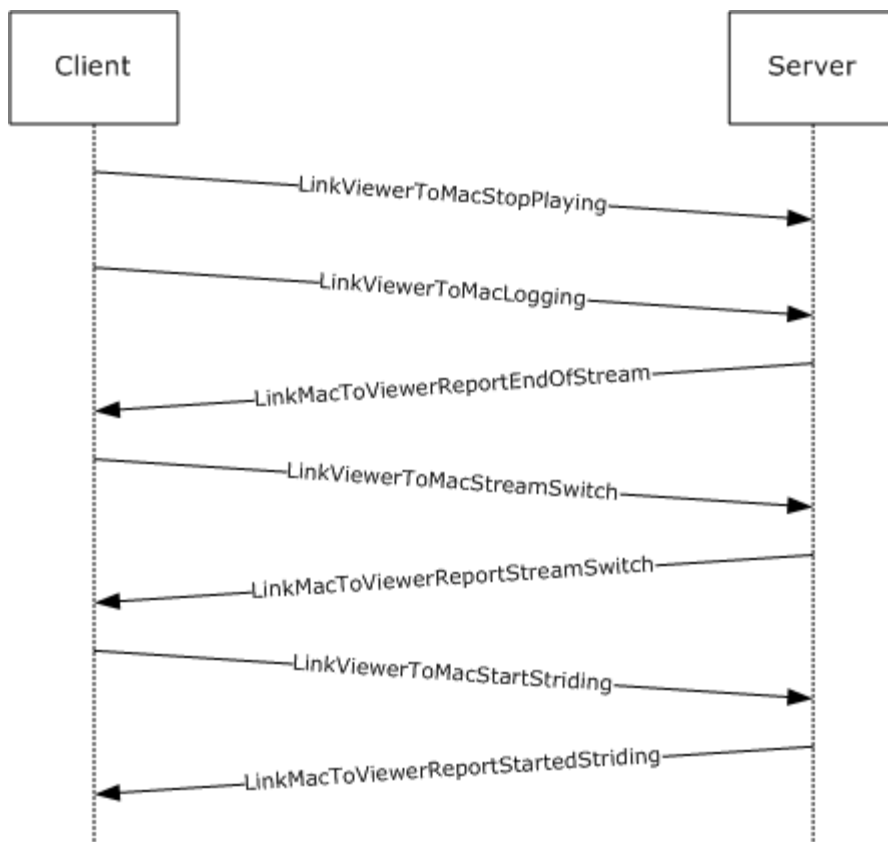


Figure 5: Sequencing during playback--fast forward and rewind buttons

1. The client sends the `LinkViewerToMacStopPlaying` message followed by a `LinkViewerToMacLogging` message.
2. The server confirms with a `LinkMacToViewerReportEndOfStream` message.
3. The client sends a `LinkViewerToMacStreamSwitch` message.
4. The server responds with a `LinkMacToViewerReportStreamSwitch` message.
5. The client sends a [LinkViewerToMacStartStriding](#) message that contains the new playback position.
6. The server responds with a [LinkMacToViewerReportStartStriding](#) message while also streaming data to the client.

When a server changes streams as part of a server-side playlist, the following sequence occurs.

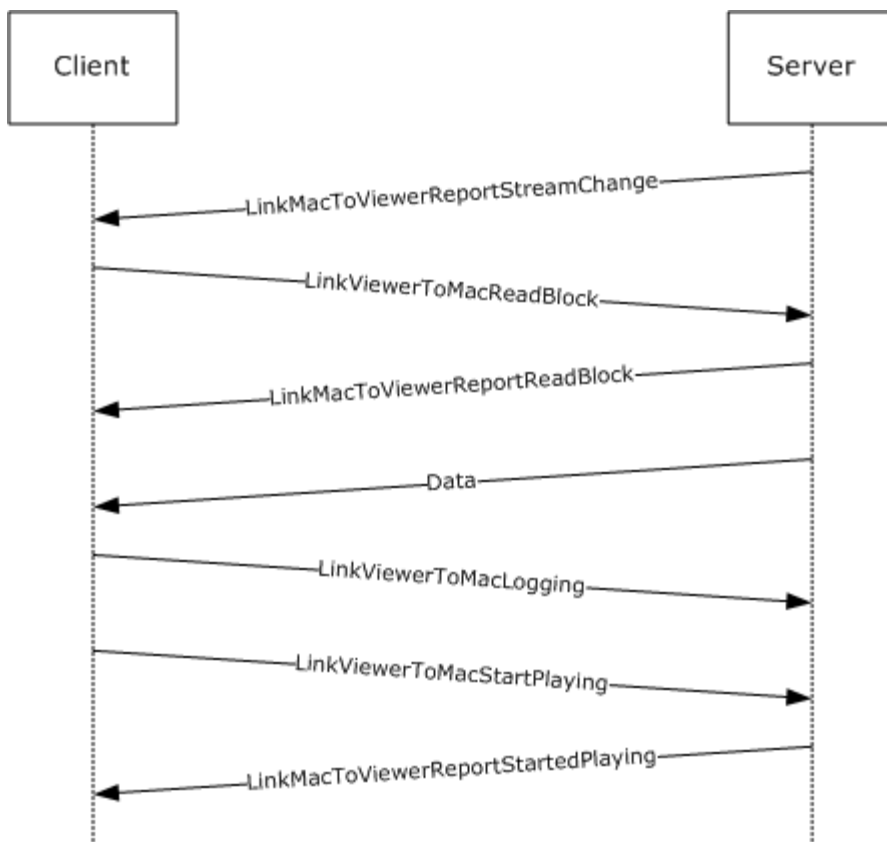


Figure 6: Sequencing during playback--server changes streams

1. The server sends a [LinkMacToViewerReportStreamChange](#) message between two consecutive items in the playlist.
2. The client sends a [LinkViewerToMacReadBlock](#) message to retrieve the ASF header for the new stream.
3. The server responds with a [LinkMacToViewerReportReadBlock](#) message and sends the ASF file header as a [Data](#) packet on the streaming channel.
4. The client sends a [LinkViewerToMacLogging](#) message, and then sends a [LinkViewerToMacStartPlaying](#) message.
5. The server responds with a [LinkMacToViewerReportStartedPlaying](#) message while also streaming data to the client.

Every time a stream stops playing, for any reason, the client sends a [LinkViewerToMacLogging](#) message.

If the control connection is lost, the client may attempt to reconnect by sending a new connection request. In response, the server re-establishes the streaming media connection with the client and seeks the playback position where the connection was interrupted.

MMS uses TCP port 1755 for command communication between the client and server. If UDP is used, the client may occasionally request that the server resend lost Data packets. These requests are sent on UDP port 1755.

When streaming ASF data packets using the MMS Protocol, for performance reasons it is recommended that ASF data packets not include padding.

4.4 Authentication Sequence

Streaming media content may be made accessible only to authorized clients. The authentication sequences supported by the MMS Protocol are based on a Basic and NTLM sequence. Both sequences are specified in the following sections.

4.4.1 Basic Authentication Sequence

For Basic authentication, the following sequence is used.

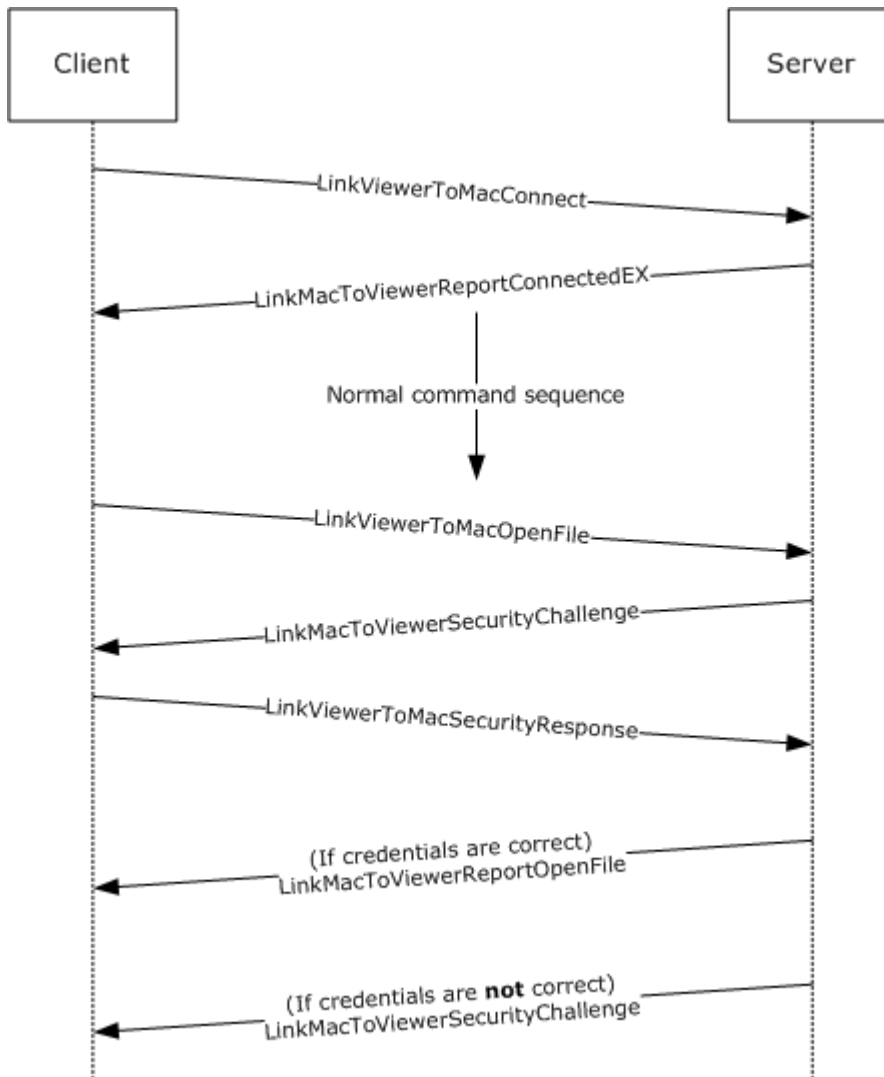


Figure 7: Basic authentication sequence

1. In response to a client [LinkViewerToMacConnect](#) message request, the server sends a [LinkMacToViewerReportConnectedEX](#) message with the following attributes:

- The **AuthenPackage** field is set to BASIC.
- The **cbAuthenPackage** field has a value of 6.

The client and server then continue their normal sequence of commands.

2. Eventually, the client sends a [LinkViewerToMacOpenFile](#) message request to which the server responds with a [LinkMacToViewerSecurityChallenge](#) message.
3. The client sends a [LinkViewerToMacSecurityResponse](#) message to the server that contains the username and password. If the credentials are correct, the server responds with a [LinkMacToViewerReportOpenFile](#) message. Otherwise, the server responds with a [LinkMacToViewerSecurityChallenge](#) message.

4.4.2 NTLM Authentication Sequence

For NTLM authentication, the following sequence is used.

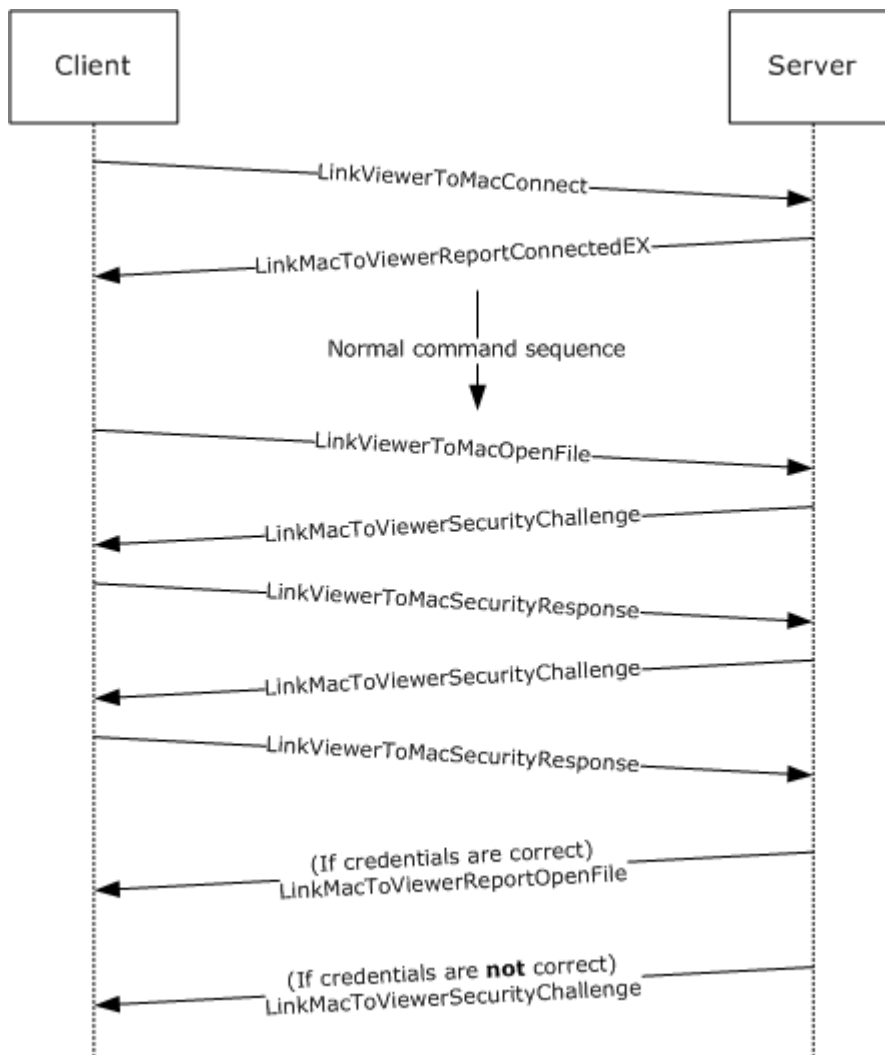


Figure 8: NTLM authentication sequence

1. In response to a client [LinkViewerToMacConnect](#) message request, the server sends a [LinkMacToViewerReportConnectedEX](#) message with the following attributes:
 - The **AuthenPackage** field is set to NTLM.
 - The **cbAuthenPackage** field has a value of 5.The client and server then continue their normal sequence of commands.
2. Eventually, the client sends a [LinkViewerToMacOpenFile](#) packet request, to which the server responds with a [LinkMacToViewerSecurityChallenge](#) message.
3. The client sends a [LinkViewerToMacSecurityResponse](#) message to the server that contains the first NTLM authentication token, and the server responds with a [LinkMacToViewerSecurityChallenge](#) message that contains the NTLM challenge token.
4. The client sends a [LinkViewerToMacSecurityResponse](#) message to the server that contains the response NTLM authentication token. If the credentials are correct, the server responds with a [LinkMacToViewerReportOpenFile](#) message. Otherwise, the server responds with a [LinkMacToViewerSecurityChallenge](#) message.

5 Security

5.1 Security Considerations for Implementers

The protocol is at risk of attack where the attacker spoofs [RequestPacketListResend](#) packets, causing the server to flood the client with unnecessarily retransmitted [Data](#) packets. To help mitigate against the attack, the server should choose the value of the **nCubs** field in the [LinkMacToViewerReportFunnelInfo](#) message in such a way that it is difficult for an attacker to predict its value. The server can also impose a limit on how many packets per second it will resend to a client.

Because MMS is a binary protocol, implementers should take care to validate that the length fields in the packet and message structures do not specify values that cause an implementation to access data out of bounds. Some message structures also have a field that specifies a byte offset, and a similar concern applies in this case. It should also be noted that strings that appear in MMS messages are sometimes not required to be null-terminated.

5.2 Index of Security Parameters

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6 Appendix A: Product Behavior

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

- Microsoft Windows® NT operating system
- Microsoft Windows® 2000 operating system
- Windows® XP operating system
- Windows Server® 2003 operating system

Exceptions, if any, are noted below. If a service pack number appears with the product version, behavior changed in that service pack. The new behavior also applies to subsequent service packs of the product unless otherwise specified.

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

[<1> Section 2.2.1.1:](#) Windows Media Services on Windows NT 4.0, Windows Media Services on Windows 2000 Server, and Windows Media Player 6 set the value of the **dwIPAddress** field to the client's IPv4 address.

[<2> Section 2.2.1.1:](#) Windows Media Services on Windows NT 4.0, Windows Media Services on Windows 2000 Server, and Windows Media Player 6 set the value of the **szComputerDNS** field to the DNS of the client machine.

[<3> Section 2.2.3:](#) Windows Media Services on Windows Server 2003 sets the value of the **timeSent** field from uninitialized memory, such that it can appear as an arbitrary value.

[<4> Section 2.2.4.1:](#) Windows Media Services on Windows NT 4.0, Windows 2000 Server, and Windows Server 2003 set the value of the **dwParam2** field from uninitialized memory so that it can appear as an arbitrary value.

[<5> Section 2.2.4.2:](#) Windows Media Services on Windows NT 4.0 and Windows 2000 Server set the value of the **maxBitRate** field from uninitialized memory, so that it appears as an arbitrary value.

[<6> Section 2.2.4.3:](#) Windows Media Services on Windows NT 4.0, Windows 2000 Server, and Windows Server 2003 set the value of the **playIncarnation** field from uninitialized memory, so that it appears as an arbitrary value.

[<7> Section 2.2.4.3:](#) Windows Media Services on Windows NT 4.0, Windows 2000 Server, and Windows Server 2003 set the value of the **packetPayloadSize** field from uninitialized memory, so that it appears as an arbitrary value.

[<8> Section 2.2.4.3:](#) Windows Media Services on Windows 2000 Server sets the **funnelName** field to be "Funnel Of The ".

[<9> Section 2.2.4.4:](#) Windows Media Services on Windows NT 4.0, Windows 2000 Server, and Windows Server 2003 set the value of the **playIncarnation** field from uninitialized memory so that it can appear as an arbitrary value.

<10> [Section 2.2.4.7](#): Windows Media Services on Windows NT 4.0, Windows 2000 Server, and Windows Server 2003 set the value of the **unused2** field from uninitialized memory so that it can appear as an arbitrary value.

<11> [Section 2.2.4.10](#): Windows sets this field to either 0x00000000 or to the value of the **openFileId** field in the [LinkMacToViewerReportOpenFile \(section 2.2.4.7\)](#) message sent previously by the server.

<12> [Section 2.2.4.12](#): Windows Media Services on Windows NT 4.0, Windows Media Services on Windows 2000 Server, Windows Media Player 6, Windows Media Format 7.0 SDK, Windows Media Format 7.1 SDK, Windows Media Player for Windows XP, Windows Media Format 9 Series SDK, and Windows Media Format 9.5 SDK set the value of the **dwStreamId** field from uninitialized memory so that it can appear as an arbitrary value.

<13> [Section 2.2.4.14](#): Windows Media Services on Windows NT 4.0 and Windows Media Services on Windows 2000 Server omit the basic-realm syntax element in the **pToken** field if a Basic authentication realm is unavailable. Windows Media Services on Windows Server 2003 does not support basic authentication.

<14> [Section 2.2.4.16](#): Windows Media Services on Windows NT 4.0, Windows Media Services on Windows 2000 Server, Windows Media Player 6, Windows Media Format 7.0 SDK, Windows Media Format 7.1 SDK, Windows Media Player for Windows XP, Windows Media Format 9 Series SDK, and Windows Media Format 9.5 SDK set the value of the **playIncarnation** field from uninitialized memory so that it can appear as an arbitrary value.

<15> [Section 2.2.4.17](#): Windows Media Services on Windows NT 4.0 and Windows Media Services on Windows 2000 Server set the value of the **playIncarnation** field from uninitialized memory so that it can appear as an arbitrary value.

<16> [Section 2.2.4.17](#): Windows Media Player 6, Windows Media Services on Windows NT 4.0, and Windows Media Services on Windows 2000 Server do not include the host-param or host-string syntax elements in the **subscriberName** field. Windows Media Format 7.0 SDK, Windows Media Format 7.1 SDK, and Windows Media Player for Windows XP include the host-param syntax element in the **subscriberName** field, but not the host-string syntax element.

<17> [Section 2.2.4.17](#): In Windows, the clients assign the values of the client-token according to the following table:

Product name	Client-token	Major	Minor
Windows Media Services 4.0	Spooooon!		
Windows Media Services 4.1	Spooooon!		
Windows Media Player 6.4	NSPlayer	4	1
Windows Media Format 7.0 SDK	NSPlayer	7	0
Windows Media Format 7.1 SDK	NSPlayer	7	1
Windows Media Player for Windows XP	NSPlayer	8	0
Windows Media Format 9 Series SDK	NSPlayer	9	0
Windows Media Format 9.5 SDK	NSPlayer	10	0

<18> [Section 2.2.4.18](#): Windows Media Services on Windows NT 4.0 and Windows Media Services on Windows 2000 Server set the values of the **playIncarnation**, **maxBlockBytes**, **maxFunnelBytes**, and **maxBitRate** fields from uninitialized memory so that they can appear as arbitrary values. Windows Media Player 6, Windows Media Format 7.0 SDK, Windows Media Format 7.1 SDK, Windows Media Player for Windows XP, Windows Media Format 9 Series SDK, and Windows Media Format 9.5 SDK set the value of the **playIncarnation** field from uninitialized memory so that it can appear as an arbitrary value.

<19> [Section 2.2.4.21](#): Windows Media Services on Windows NT 4.0, Windows Media Services on Windows 2000 Server, Windows Media Player 6, Windows Media Format 7.0 SDK, Windows Media Format 7.1 SDK, Windows Media Player for Windows XP, Windows Media Format 9 Series SDK, and Windows Media Format 9.5 SDK set the value of the **spare** field from uninitialized memory so that it can appear as an arbitrary value.

<20> [Section 2.2.4.22](#): Windows Media Services on Windows NT 4.0, Windows 2000 Server, and Windows Server 2003 set the value of the **dwParam1** field from uninitialized memory so that it can appear as an arbitrary value.

<21> [Section 2.2.4.22](#): Windows Media Services on Windows NT 4.0, Windows 2000 Server, and Windows Server 2003 set the value of the **dwParam2** field from uninitialized memory so that it can appear as an arbitrary value.

<22> [Section 2.2.4.23](#): Windows Media Services on Windows NT 4.0 and Windows Media Services on Windows 2000 Server set the value of the **length** field to 0x0000FFFF.

<23> [Section 2.2.4.23](#): Windows Media Services on Windows NT 4.0, Windows 2000 Server, and Windows Server 2003 set the value of the **padding** field from uninitialized memory so that it can appear as an arbitrary value.

<24> [Section 2.2.4.25](#): Windows Media Services on Windows NT 4.0, Windows Media Services on Windows 2000 Server, and Windows Media Player 6, Windows Media Format 7.0 SDK, Windows Media Format 7.1 SDK, Windows Media Player for Windows XP, Windows Media Format 9 Series SDK, and Windows Media Format 9.5 SDK set the value of the **padding** field from uninitialized memory so that it can appear as an arbitrary value.

<25> [Section 2.2.4.26](#): Windows Media Services on Windows NT 4.0, Windows Media Services on Windows 2000 Server, Windows Media Player 6, Windows Media Format 7.0 SDK, Windows Media Format 7.1 SDK, Windows Media Player for Windows XP, Windows Media Format 9 Series SDK, and Windows Media Format 9.5 SDK set the value of the **frameOffset** field from uninitialized memory so that it can appear as an arbitrary value.

<26> [Section 2.2.4.27](#): Windows Media Services on Windows NT 4.0, Windows Media Services on Windows 2000 Server, and Windows Media Player 6, Windows Media Format 7.0 SDK, Windows Media Format 7.1 SDK, Windows Media Player for Windows XP, Windows Media Format 9 Series SDK, and Windows Media Format 9.5 SDK set the value of the **playIncarnation** field from uninitialized memory so that it can appear as an arbitrary value.

<27> [Section 3.1.4.1.1](#): How the user configures Windows Media Player or the Windows Media Format SDK determines if the same GUID is used for all sessions or is changed between sessions.

<28> [Section 3.1.4.2](#): Windows Media Services on Windows NT 4.0 and Windows Media Services on Windows 2000 Server never send a [LinkViewerToMacStreamSwitch \(section 2.2.4.28\)](#) message.

<29> [Section 3.1.4.2](#): Windows Media Services on Windows NT 4.0 and Windows Media Services on Windows 2000 Server never send a [LinkViewerToMacStartStriding \(section 2.2.4.26\)](#) message.

<30> [Section 3.1.4.2.1](#): Windows Media Services on Windows NT 4.0, Windows Media Services on Windows 2000 Server, Windows Media Player 6, Windows Media Format 7.0 SDK, Windows Media Format 7.1 SDK, and Windows Media Player for Windows XP set the value of the **playIncarnation** field in the [LinkViewerToMacStartPlaying \(section 2.2.4.25\)](#) message to the current value of the Incarnation variable in the abstract data model; then they increment the value of the variable.

<31> [Section 3.1.4.2.1](#): Windows Media Services on Windows NT 4.0, Windows Media Services on Windows 2000 Server, and Windows Media Player 6 do not include the **dwAccelDuration**, **dwAccelBandwidth**, and **dwLinkBandwidth** fields in the [LinkViewerToMacStartPlaying \(section 2.2.4.25\)](#) message.

<32> [Section 3.1.4.2.2](#): Windows Media Services on Windows NT 4.0, Windows Media Services on Windows 2000 Server, Windows Media Player 6, Windows Media Format 7.0 SDK, Windows Media Format 7.1 SDK, and Windows Media Player for Windows XP set the value of the **playIncarnation** field in the [LinkViewerToMacStartStriding \(section 2.2.4.26\)](#) message to the current value of the Incarnation variable in the abstract data model; then they increment the value of the variable.

<33> [Section 3.1.4.4](#): Windows Media Services on Windows NT 4.0 and Windows Media Services on Windows 2000 Server never send a [LinkViewerToMacStreamSwitch \(section 2.2.4.28\)](#) message.

<34> [Section 3.1.4.4](#): Windows Media Services on Windows NT 4.0 and Windows Media Services on Windows 2000 Server never send a [LinkViewerToMacStartStriding \(section 2.2.4.26\)](#) message.

<35> [Section 3.1.4.5](#): Windows Media Services on Windows NT 4.0 and Windows Media Services on Windows 2000 Server do not send a [LinkViewerToMacLogging \(section 2.2.4.20\)](#) message.

<36> [Section 3.1.4.8](#): Windows Media Services on Windows NT 4.0 and Windows Media Services on Windows 2000 Server do not send a [LinkViewerToMacCloseFile \(section 2.2.4.16\)](#) message.

<37> [Section 3.1.5.3](#): Windows Media Player 6 uses the URL specified in the value of the **VersionUrl** field to download an update, but only if the version number specified by the **VersionInfo** field is greater than the current version number of Windows Media Player.

<38> [Section 3.1.5.3](#): Windows Media Services on Windows NT 4.0 and Windows Media Services on Windows 2000 Server always send a [LinkViewerToMacConnectFunnel \(section 2.2.4.18\)](#) message in response to the [LinkMacToViewerReportConnectedEX \(section 2.2.4.2\)](#) message.

<39> [Section 3.1.5.6](#): Windows Media Services on Windows NT 4.0, Windows Media Services on Windows 2000 Server, Windows Media Player 6, Windows Media Format 7.0 SDK, Windows Media Format 7.1 SDK, and Windows Media Player for Windows XP set the value of the **playIncarnation** field in the [LinkViewerToMacOpenFile \(section 2.2.4.21\)](#) message to the current value of the Incarnation variable in the abstract data model, and then they increment the value of the variable.

<40> [Section 3.1.5.6](#): Windows Media Services on Windows NT 4.0, Windows Media Services on Windows 2000 Server, Windows Media Player 6, Windows Media Format 7.0 SDK, Windows Media Format 7.1 SDK, and Windows Media Player for Windows XP include authentication data in the **tokenData** field if such authentication has been cached from a previous authentication attempt.

<41> [Section 3.1.5.7](#): Windows Media Services on Windows NT 4.0, Windows Media Services on Windows 2000 Server, and Windows Media Player 6 do not support the [LinkMacToViewerReportRedirect \(section 2.2.4.9\)](#) message.

<42> [Section 3.1.5.8](#): Windows Media Services on Windows NT 4.0, Windows Media Services on Windows 2000 Server, Windows Media Player 6, Windows Media Format 7.0 SDK, and Windows Media Format 7.1 SDK do not update the value of the Auth-Scheme variable when processing a [LinkMacToViewerSecurityChallenge](#) message.

<43> [Section 3.1.5.8](#): Windows Media Services on Windows NT, Windows 2000 Server, and Windows Server 2003 will only send the [LinkMacToViewerReportRedirect](#) message if instructed to do so by a plugin.

<44> [Section 3.1.5.9.1](#): Windows Media Services on Windows NT 4.0, Windows Media Services on Windows 2000 Server, Windows Media Player 6, Windows Media Format 7.0 SDK, Windows Media Format 7.1 SDK, and Windows Media Player for Windows XP set the value of the **playIncarnation** field in the [LinkViewerToMacReadBlock \(section 2.2.4.23\)](#) message to the current value of the Incarnation variable in the abstract data model; then they increment the value of the variable.

<45> [Section 3.1.5.9.1](#): Windows Media Services on Windows NT 4.0 and Windows Media Services on Windows 2000 Server never start the Header timer.

<46> [Section 3.1.5.18](#): Windows Media Services on Windows NT 4.0, Windows Media Services on Windows 2000 Server, and Windows Media Player 6 do not send a [LinkViewerToMacLogging](#) message.

<47> [Section 3.2.4.1](#): Windows Media Services on Windows NT 4.0 and Windows Media Services on Windows 2000 Server always set the value of the **hr** field to 0x00000000.

<48> [Section 3.2.4.2](#): Windows Media Services on Windows NT 4.0 and Windows Media Services on Windows 2000 Server always ignore the value of the **dwLinkBandwidth** field.

<49> [Section 3.2.5.11](#): This feature is supported only by Windows Media Services on Windows Server 2003, and the actual bit rate and duration used by the server can be smaller than what is requested by the client, depending on how the administrator has configured the server.

7 Change Tracking

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

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