[MS-MQSD]:
Message Queuing (MSMQ):
Directory Service Discovery Protocol Specification

Revision Summary

Date	Revision History	Revision Class	Comments
05/11/2007	0.1		MCPP Milestone 4 Initial Availability
08/10/2007	1.0	Major	Updated and revised the technical content.
09/28/2007	1.1	Minor	Updated the technical content.
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06/04/2010	7.2	Minor	Updated the technical content.

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07/16/2010	7.2	No change	No changes to the meaning, language, or formatting of the technical content.
08/27/2010	8.0	Major	Significantly changed the technical content.
10/08/2010	9.0	Major	Significantly changed the technical content.
11/19/2010	9.0	No change	No changes to the meaning, language, or formatting of the technical content.
01/07/2011	9.0	No change	No changes to the meaning, language, or formatting of the technical content.
02/11/2011	10.0	Major	Significantly changed the technical content.

Contents

1 Introduction

This document specifies the Message Queuing (MSMQ): Directory Service Discovery Protocol (MQSD) used by **MSMQ Queue Manager** versions 1.0 and 2.0 to discover an accessible executing instance of an **MSMQ Directory Service server**.

1.1 Glossary

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

Active Directory
Augmented Backus-Naur Form (ABNF)
globally unique identifier (GUID)
little-endian
Unicode

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

connected network
ConnectedNetworkID
EnterpriseID
enterprise site
Message Queuing Information Store (MQIS)
MSMQ
MSMQ Directory Service
MSMQ Directory Service server
MSMQ queue manager
MSMQ routing server
MSMQ site
Primary Enterprise Controller (PEC)
Primary Site Controller (PSC)
queue
SiteID

The following terms are specific to this document:

Internetwork Packet Exchange (IPX): A protocol (see [IPX]) maintained by Novell NetWare that provides connectionless datagram delivery of messages. The **Internetwork Packet Exchange (IPX)** is based on Xerox Corporation's Internetwork Packet protocol, XNS.

MAY, SHOULD, MUST, SHOULD NOT, MUST NOT: These terms (in all caps) are used as specified 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.

[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-MQDMPR] Microsoft Corporation, "Message Queuing (MSMQ): Common Data Model and Processing Rules", August 2008.

[MS-MQMP] Microsoft Corporation, "Message Queuing (MSMQ): Queue Manager Client Protocol Specification", August 2007.

[MS-MQSO] Microsoft Corporation, "Message Queuing System Overview", August 2008.

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

1.2.2 Informative References

[IPX] Microsoft Corporation, "Internetwork Packet Exchange (IPX)", http://msdn.microsoft.com/en-us/library/ms817906.aspx

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

[MS-MQDSSM] Microsoft Corporation, "Message Queuing (MSMQ): Directory Service Schema Mapping", August 2008.

[MS-MQMQ] Microsoft Corporation, "Message Queuing (MSMQ): Data Structures", August 2007.

[RAS] Microsoft Corporation, "RasEnumConnections Function", http://msdn2.microsoft.com/en-us/library/aa377284(VS.85).aspx

1.3 Overview

A **queue manager** can be run in one of two roles—either running the **MSMQ Directory Service** or not running the MSMQ Directory Service. A queue manager that is not running the MSMQ Directory Service uses the Message Queuing (MSMQ): Directory Service Discovery Protocol (MQSD) to obtain a current list of network-accessible queue managers running the MSMQ Directory Service. <1>After an MSMQ Directory Service has been located, other protocols are used to obtain **MSMQ** configuration information such as **queues** and machine names containing MSMQ installations.

MQSD clients obtain a list of queue managers that provide the MSMQ Directory Service by broadcasting (via a connectionless transport) a TopologyClientRequest (section 2.2.2) packet and by receiving TopologyServerReply (section 2.2.3) packets. A TopologyClientRequest packet contains a unique identifier of the **enterprise site** of which the MQSD client is a member,<2> a unique correlation identifier for the request, and an identifier of the current **MSMQ site** (if any) of which the client is a member.<3> A TopologyServerReply packet contains the unique request correlation identifier assigned by the MQSD client and a list of known queue managers that provide the MSMQ Directory Service. In the case in which the MQSD client is already a member of the same MSMQ site as the responding MQSD server, the TopologyServerReply packet does not contain a list of queue managers that provide the MSMQ Directory Service.

1.4 Relationship to Other Protocols

The Message Queuing (MSMQ): Directory Service Discovery Protocol depends on the UDP over IP or the **IPX**<4> protocol for sending discovery requests and for receiving discovery replies.

The Message Queuing (MSMQ): Queue Manager Client Protocol, as specified in [MS-MQMP], and the Message Queuing (MSMQ): Directory Service Protocol, as specified in [MS-MQDS], make use of the information obtained by an [MS-MQSD] client request.

1.5 Prerequisites/Preconditions

MSMQ queue managers must be configured with the port number<5> that has been assigned for use by the MSMQ site for the Message Queuing (MSMQ): Directory Service Discovery Protocol.

1.6 Applicability Statement

The Message Queuing (MSMQ): Directory Service Discovery Protocol is applicable to all versions of MSMQ queue managers and is the only directory service discovery protocol used by MSMQ version 1 and MSMQ version 2 queue managers. The MSMQ: Directory Service Discovery Protocol has been deprecated for MSMQ version 3 and MSMQ version 4, but all MSMQ queue managers running the MSMQ Directory Service must respond to the protocol for support of MSMQ version 1 and MSMQ version 2 queue managers.

1.7 Versioning and Capability Negotiation

A version number is present in the TopologyPacketHeader (section 2.2.1) packet, but it is not used.

1.8 Vendor-Extensible Fields

No vendor-extensible fields are available in the Message Queuing (MSMQ): Directory Service Discovery Protocol.

1.9 Standards Assignments

No standards assignments have been made for the Message Queuing (MSMQ): Directory Service Discovery Protocol and its data structures. Port number 1801 for UDP and TCP has been registered with the Internet Assigned Numbers Authority (IANA) by Microsoft Corporation for MSMQ protocols, as specified in [IANAPORT].

2 Messages

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

Unless otherwise qualified, instances of **GUID** in sections 2 and 3 refer to [MS-DTYP] section 2.3.2.

2.1 Transport

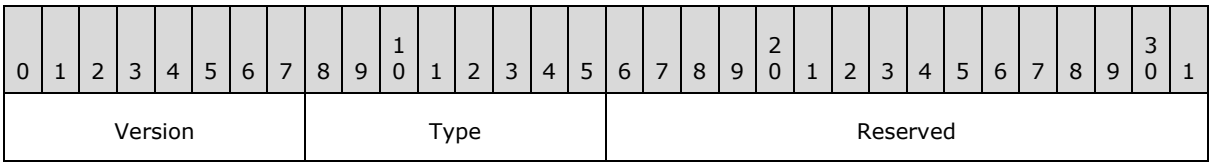
Connectionless communications MUST be used, and either UDP over IP or IPX MAY<6> be used. The UDP or SPX source port used by the client MAY<7> be any TCP or SPX port value. The protocol server MUST<8> listen for connections on TCP port 1801 or SPX port 876.

2.2 Message Syntax

Message Queuing (MSMQ): Directory Service Discovery Protocol messages are formatted as either UDP or IPX packets. This protocol references commonly used data types as defined in [MS-DTYP].

2.2.1 TopologyPacketHeader

A TopologyPacketHeader packet is sent as the first element of every TopologyClientRequest (section 2.2.2) packet and every TopologyServerReply (section 2.2.3) packet.



Version (1 byte): An 8-bit value that specifies the TopologyPacketHeader version. MQSD clients MUST set all bit positions to 0. MQSD servers MUST ignore this field.

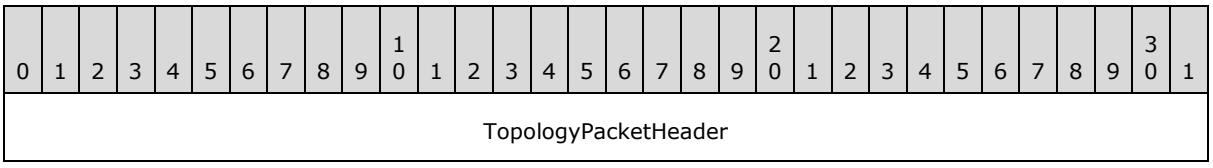
Type (1 byte): An 8-bit value that MUST specify the type of the packet that follows. The value 0x01 MUST be used to specify a TopologyClientRequest (section 2.2.2). The value 0x02 MUST be used to specify a TopologyServerReply (section 2.2.3).

Value	Meaning
0x01	Specifies a TopologyClientRequest (section 2.2.2).
0x02	Specifies a TopologyServerReply (section 2.2.3).

Reserved (2 bytes): A 16-bit value that is not used. It MUST be set to 0x0000 by MQSD clients and MUST be ignored by MQSD servers.

2.2.2 TopologyClientRequest

A TopologyClientRequest packet MUST be prefixed with a TopologyPacketHeader.



EnterpriseID
...
...
...
RequestID
...
...
...
SiteID
...
...
...
IPXNetworkCount (optional)
IPXNetworkNumberArray (variable)
...

TopologyPacketHeader (4 bytes): As specified in section 2.2.1.

EnterpriseID (16 bytes): A **GUID** that MUST contain the identifier for the **enterprise** to which the client belongs.

RequestID (16 bytes): A GUID that MUST uniquely identify a request. This value is used to correlate TopologyClientRequest packets to TopologyServerReply packets. The **CorrelationID** field of a TopologyServerReply that is generated in response to a TopologyClientRequest packet MUST contain this value.

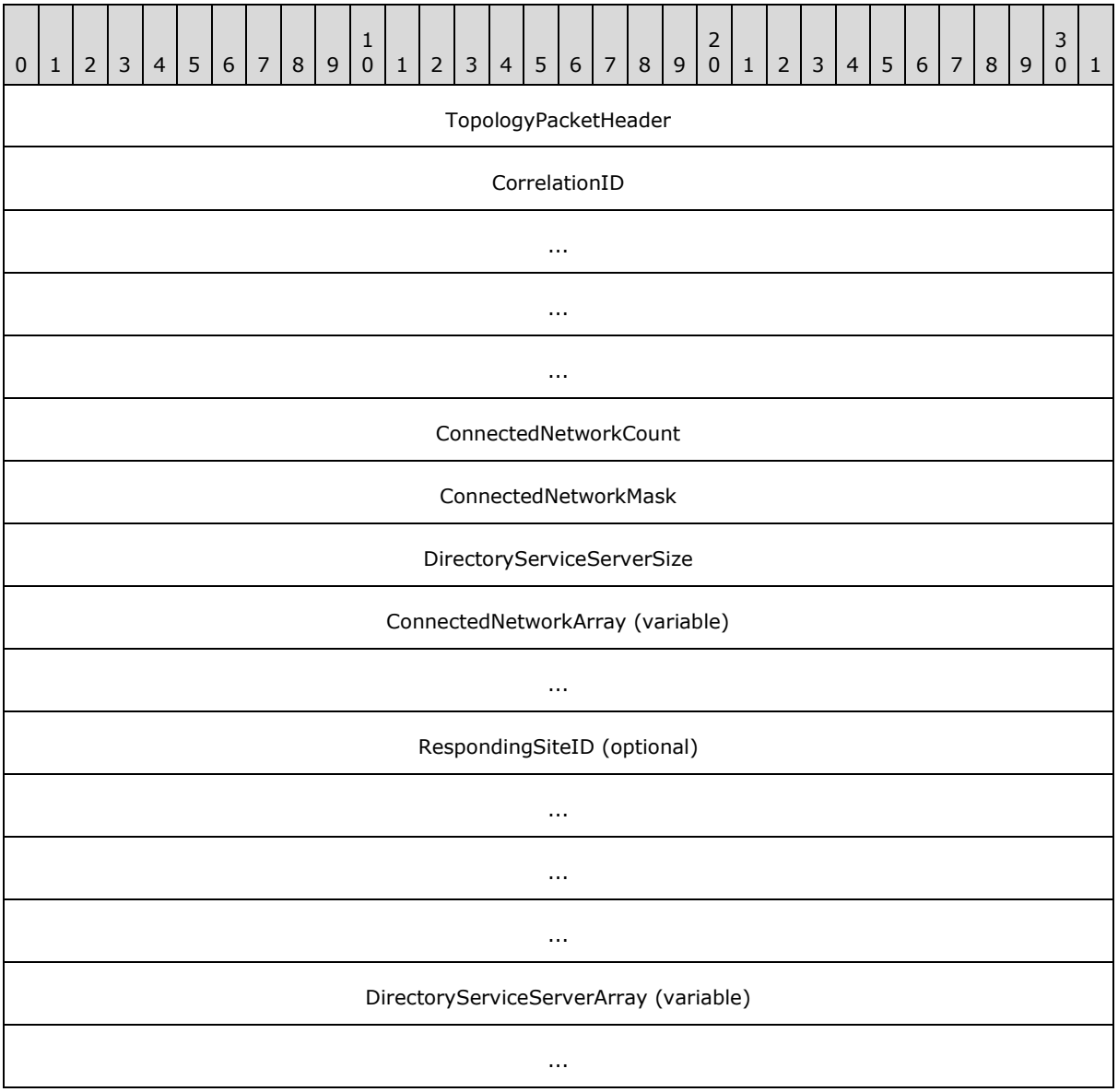
SiteID (16 bytes): A GUID that MUST contain the identifier for the MSMQ site to which the client belongs.

IPXNetworkCount (4 bytes): A 32-bit integer value in **little-endian** order. When IPX networking is being used, this value MUST specify the number of **IPXNetworkNumberArray** entries that follow. When IP networking is being used, this field MUST NOT be present. When the field is present, the value MUST be in the range 1 to 32, inclusive.

IPXNetworkNumberArray (variable): An array of 32-bit integer values in little-endian order. Each entry specifies an IPX network address.<9> When IP networking is being used, this array MUST NOT be present. When the array is present, the number of entries is specified by the **IPXNetworkCount** field.

2.2.3 TopologyServerReply

A TopologyServerReply packet MUST be prefixed with a TopologyPacketHeader.



TopologyPacketHeader (4 bytes): As specified in section 2.2.1.

CorrelationID (16 bytes): A GUID that MUST contain the value from the **RequestID** field from the TopologyClientRequest packet for which the TopologyServerReply is generated.

ConnectedNetworkCount (4 bytes): A 32-bit integer value in little-endian order. The value specifies the number of **connected network** IDs that are present in the **ConnectedNetworkArray**. The value MUST be in the range 1 to 32, inclusive.

ConnectedNetworkMask (4 bytes): This 32-bit field is treated as 32 Boolean values. This entire field MUST be set to all zeros if the networking protocol being used is IP. When the networking protocol used is IPX, the count of 1-valued bit positions MUST equal the value contained in the **ConnectedNetworkCount** field.

DirectoryServiceServerSize (4 bytes): A 32-bit integer value in little-endian order. The value of this field MUST specify the number of bytes occupied by the **DirectoryServiceServerArray**. If the **SiteID** assigned to the responding server matches the SiteID contained in the TopologyClientRequest, this value MUST be zero, and the **RespondingSiteID** and **DirectoryServiceServerArray** fields MUST NOT be present.

ConnectedNetworkArray (variable): An array of GUIDs that represents a list of directory service server **ConnectedNetworkIDs**. The number of ConnectedNetworkIDs contained in this array (and thus its size) is determined by the value contained in the **ConnectedNetworkCount** field. The entries consist of ConnectedNetworkIDs of MSMQ Directory Service servers.

RespondingSiteID (16 bytes): A GUID that identifies the MSMQ site to which the server belongs. This field MUST NOT be present if the value of the **DirectoryServiceServerSize** field is zero.

DirectoryServiceServerArray (variable): If the **DirectoryServiceServerSize** field is not zero, this field MUST contain an array of **Unicode** characters. The array MUST contain a comma (value 0x002C)–separated list of MSMQ Directory Service servers and an indication of the networking protocol or protocols used by the named MSMQ Directory Service server. The first character of each delimited entry MUST specify whether the following named MSMQ Directory Service server supports the IP networking protocol, where the character value 1 (0x0031) indicates support and the character value 0 (0x0030) indicates otherwise. The second character of each delimited entry MUST specify whether the following named MSMQ Directory Service server supports the IPX networking protocol, where the character value 1 (0x0031) indicates support and the character value 0 (0x0030) indicates otherwise. The third character of each entry is the first character of a variable-length character string containing the name of an MSMQ Directory Service server. Each entry is a machine name, and the comma (value 0x002C) or null (value 0x0000) character MUST NOT be allowed as part of the name; the end of an MSMQ Directory Service server name is delimited by a comma (value 0x002C) or a null character (value 0x0000), which is not part of the MSMQ Directory Service server name.

A **DirectoryServiceServerArray** MUST be formatted according to the following **Augmented Backus-Naur Form (ABNF)** rules.

```
DirectoryServiceServerArray = Entry 0*ContinuedEntry Endlist
Supported = %x31.00 ; A Unicode 1 indicates is supported
NotSupported = %x30.00 ; A Unicode 0 indicates not supported
IP = Supported / NotSupported ; IP networking
IPX = Supported / NotSupported ; IPX networking
R1 = %x01-2b ; Range 1
R2 = %x2c-2c ; Range 2 is x2c only
R3 = %x00-ff ; Range 3
R4 = %x01-ff ; Range 4
R5 = %x2d-ff ; Range 5
R6 = %x00-00 ; Range 6 is x00 only
```

```
X1 = R1 R3 ; Two hex digit range 1
X2 = R2 R4 ; Two hex digit range 2
X3 = R5 R3 ; Two hex digit range 3
X4 = R6 R4 ; Two hex digit range 4
NameChar = X1 / X2 / X3 / X4 ; Name character: no commas or nulls
Delim = %x2c.00 ; Use comma delimiter when more follow
EndList =  %x00.00 ; Use null for end of list
Entry = IP IPX 1*NameChar ; The layout for the final entry
ContinuedEntry = Delim Entry ; The layout for one continued entry
```

2.3 Directory Service Schema Elements

This protocol uses ADM elements specified in section 3.1.1. A subset of these elements can be published in a directory. This protocol SHOULD<10> access the directory using the algorithm specified in [MS-MQDSSM] and using LDAP [MS-ADTS]. The Directory Service schema elements for ADM elements published in the directory are defined in [MS-MQDSSM] section 2.4. <11>

3 Protocol Details

3.1 MQSD Client Details

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.

The abstract data model for this protocol comprises elements that are private to this protocol and others that are shared among multiple MSMQ protocols that are co-located at a common queue manager. The shared abstract data model is defined in [MS-MQDMPR] section 3.1.1, and the relationship between this protocol, a queue manager, and other protocols that share a common queue manager is described in [MS-MQSO].

Section 3.1.1.1 details the elements from the shared data model that are manipulated by this protocol, and section 3.1.1.2 details the data model elements that are private to this protocol.

3.1.1.1 Shared Data Elements

This protocol manipulates the following abstract data model elements from the shared abstract data model defined in [MS-MQDMPR] section 3.1.1:

- **Enterprise.Identifier**, as defined in [MS-MQDMPR] section 3.1.1.6.<12>
- **Site.Identifier**, as defined in [MS-MQDMPR] section 3.1.1.7.<13>
- **QueueManager.DirectoryServerList**, as defined in [MS-MQDMPR] section 3.1.1.1.<14>
- **QueueManager.ConnectedNetworkIdentifierList**, as defined in [MS-MQDMPR] section 3.1.1.1.

3.1.1.2 Private Data Elements

This protocol manipulates the following abstract data model (ADM) elements that are specific to this protocol:

RequestID: A GUID that uniquely identifies the current request.

LastSuccessfulNetworkAddress: The address of the network from which the client has previously received the last valid TopologyServerReply (section 2.2.3) packet.

ValidLastSuccessfulNetworkAddress: A Boolean variable indicating whether the **LastSuccessfulNetworkAddress** ADM element contains a valid network address.

LastTopologyServerReply: Holds a copy of the last **TopologyServerReply** packet received by the client.

TopologyServerReplyReceived: A Boolean variable indicating whether the client has previously received a valid **TopologyServerReply** packet on any of the networks on which previous TopologyClientRequest (section 2.2.2) packets have been sent.

NetworkAddressList: A list of addresses of networks to which the client is connected.

NumberOfNetworkAddresses: The number of network addresses listed in the **NetworkAddressList** ADM element.

CurrentNetworkIndex: An Integer variable that indicates which of the network addresses listed in the **NetworkAddressList** ADM element was used to send the last **TopologyClientRequest** packet.

3.1.2 Timers

3.1.2.1 Wait For ResponseTimer

A 15-second time-out value for receiving a response to the broadcast of the TopologyClientRequest (section 2.2.2). The timer starts when the TopologyClientRequest packet is sent on the network. If a response is not received within 15 seconds, a No Server Response (section 3.1.6.1) timer event is triggered.

3.1.3 Initialization

The protocol performs the following actions during initialization:

- The protocol MUST set **Enterprise.Identifier** to the local **EnterpriseID**.<15>
- The protocol MUST set the **ValidLastSuccessfulNetworkAddress** ADM element to FALSE.

3.1.4 Higher-Layer Triggered Events

3.1.4.1 Get Directory Server List

This event causes the Message Queuing (MSMQ): Directory Service Discovery Protocol to obtain a new list of MSMQ directory servers. The event MUST return after the protocol obtains a valid list of directory servers. If the protocol is unable to obtain a valid list of directory servers, the protocol MUST return a result that indicates a failure.<16>

When this event is triggered, the protocol executes the following steps:

- The protocol MUST add all network addresses to which the computer is connected to the **NetworkAddressList** ADM element and MUST set the **NumberOfNetworkAddresses** ADM element to the number of network addresses listed in the **NetworkAddressList** ADM element.<17>
- If the **ValidLastSuccessfulNetworkAddress** ADM element equals TRUE and none of the network addresses listed in the **NetworkAddressList** ADM element is a Remote Access Service address<18>, the protocol MUST complete the processing of this event.
- The protocol MUST create a new GUID and assign it to the **RequestID** ADM element.
- The protocol MUST set the **CurrentNetworkIndex** ADM elment to zero.
- The protocol MUST set the **TopologyServerReplyReceived** ADM element to FALSE.
- The protocol MUST initiate the sending of a TopologyClientRequest (section 2.2.2) packet, as specified in section 3.1.5.1.

3.1.5 Processing Events and Sequencing Rules

3.1.5.1 Sending a TopologyClientRequest

To send a TopologyClientRequest (section 2.2.2) packet, the protocol performs the following actions:

- The protocol MUST increment the **CurrentNetworkIndex** ADM element by 1.
- The protocol MUST set the **LastTopologyServerReply** ADM element to empty.
- The protocol MUST start the Wait For Response Timer (section 3.1.2.1) with a timeout of 15 seconds.
- The protocol MUST create a new **TopologyClientRequest** packet and set **TopologyClientRequest.EnterpriseID** to **Enterprise.Identifier**, **TopologyClientRequest.RequestID** to the **RequestID** ADM element, and **TopologyClientRequest.SiteID** to **Site.Identifier**.
- The protocol MUST broadcast the **TopologyClientRequest** packet on the network address listed in the **NetworkAddressList** ADM element at the position corresponding to the **CurrentNetworkIndex** ADM element.

3.1.5.2 Receiving a TopologyServerReply

The protocol receives a TopologyServerReply (section 2.2.3) packet as a response to the broadcast of a TopologyClientRequest (section 2.2.2) packet. If the packet is received on a network with an address other than the address specified in the **NetworkAddressList** ADM element at the position corresponding to the **CurrentNetworkIndex** ADM element, the protocol MUST discard the received packet and perform no further processing for it.

If an improperly formatted **TopologyServerReply** packet is received in response to the broadcast of the **TopologyClientRequest** packet, the protocol MUST discard the received packet and perform no further processing for it.

If **TopologyServerReply.CorrelationID** of the received **TopologyServerReply** packet does not match the **RequestID** ADM element, the protocol MUST discard the received packet and perform no further processing for it.

If the **CurrentNetworkIndex** ADM element does not equal the **NumberOfNetworkAddresses** ADM element and the **TopologyServerReply.DirectoryServiceServerSize** field equals 0x00000000, which indicates that the packet was sent by a server belonging to the local site, the protocol MUST perform the following actions:

- The protocol MUST copy the content of the received **TopologyServerReply** packet to the **LastTopologyServerReply** ADM element.
- The protocol MUST set the **TopologyServerReplyReceived** ADM element to TRUE.
- The protocol MUST set the **LastSuccessfulNetworkAddress** ADM element to the address of the network via which the **TopologyServerReply** packet was received and MUST set the **ValidLastSuccessfulNetworkAddress** ADM element to TRUE.
- The protocol MUST stop the Wait For Response Timer (section 3.1.2.1).
- The protocol MUST send a new **TopologyClientRequest** packet, as specified in section 3.1.5.1.

- The protocol MUST stop performing any further processing for the received **TopologyServerReply** packet.

If the **CurrentNetworkIndex** ADM element does not equal the **NumberOfNetworkAddresses** ADM element, the **LastTopologyServerReply** ADM element is not empty, and the **TopologyServerReply.DirectoryServiceServerSize** field does not equal 0x00000000, which indicates that the packet was sent by a server that does not belong to the local site, the protocol MUST send a new **TopologyClientRequest** packet, as specified in section 3.1.5.1 and MUST perform no further processing for the received **TopologyServerReply** packet.

If the **CurrentNetworkIndex** ADM element equals the **NumberOfNetworkAddresses** ADM element and the **TopologyServerReply.DirectoryServiceServerSize** field equals 0x00000000, which indicates that the packet was sent by a server belonging to the local site, the protocol MUST perform the following actions:

- The protocol MUST stop the Wait For Response Timer (section 3.1.2.1).
- The protocol MUST set the **LastSuccessfulNetworkAddress** ADM element to the address of the network via which the **TopologyServerReply** packet was received and MUST set the **ValidLastSuccessfulNetworkAddress** ADM element to TRUE.
- If **LastTopologyServerReply.DirectoryServiceServerSize** is not zero, the protocol MUST trigger the Populate DirectoryServerList (section 3.1.7.1) event.
- The protocol MUST trigger the Populate ConnectedNetworkIdentifierList (section 3.1.7.2) event.
- The protocol MUST complete the processing of the Get Directory Server List (section 3.1.4.1) Higher-Layer Triggered Event.

If the **LastTopologyServerReply** ADM element is empty and the **TopologyServerReply.DirectoryServiceServerSize** field does not equal 0x00000000, which indicates that the packet was sent by a server that does not belong to the local site, the protocol MUST perform the following actions:

- The protocol MUST copy the content of the received **TopologyServerReply** packet to the **LastTopologyServerReply** ADM element.
- The protocol MUST set the **TopologyServerReplyReceived** ADM element to TRUE.
- The protocol MUST set the **LastSuccessfulNetworkAddress** ADM element to the address of the network via which the **TopologyServerReply** packet was received and MUST set the **ValidLastSuccessfulNetworkAddress** ADM element to TRUE.
- The protocol MUST stop and start the Wait For Response Timer (section 3.1.2.1) with a timeout of 15 seconds.
- The protocol MUST stop performing any further processing for the received **TopologyServerReply** packet.

If the **CurrentNetworkIndex** ADM element equals the **NumberOfNetworkAddresses** ADM element, the **LastTopologyServerReply** ADM element is not empty, and **TopologyServerReply.DirectoryServiceServerSize** does not equal 0, which indicates that the packet was sent by a server that does not belong to the local site, the protocol MUST perform the following actions:

- The protocol MUST stop the Wait For Response Timer (section 3.1.2.1).

- If **LastTopologyServerReply.DirectoryServiceServerSize** is not zero, the protocol MUST invoke the Populate DirectoryServerList (section 3.1.7.1) event.
- The protocol MUST trigger the Populate ConnectedNetworkIdentifierList (section 3.1.7.2) event.
- The protocol MUST set the **LastSuccessfulNetworkAddress** ADM element to the address of the network via which the **TopologyServerReply** packet was received and MUST set the **ValidLastSuccessfulNetworkAddress** ADM element to TRUE.
- The protocol MUST complete the processing of the Get Directory Server List (section 3.1.4.1) Higher-Layer Triggered Event.

3.1.6 Timer Events

3.1.6.1 No Server Response

This event is triggered by the expiration of the Wait For Response Timer (section 3.1.2.1).

If the **CurrentNetworkIndex** ADM element does not equal the **NumberOfNetworkAddresses** ADM element, the client MUST send a new TopologyClientRequest (section 2.2.2) packet.

If the **CurrentNetworkIndex** ADM element equals the **NumberOfNetworkAddresses** ADM element, the **LastTopologyServerReply** ADM element is empty, and the **TopologyServerReplyReceived** ADM element equals FALSE, the protocol MUST set the **ValidLastSuccessfulNetworkAddress** ADM element to FALSE and complete the processing of the Get Directory Server List (section 3.1.4.1) Higher-Layer Triggered event by returning a code that indicates failure.<19>

If the **CurrentNetworkIndex** ADM element equals the **NumberOfNetworkAddresses** ADM element and either the **LastTopologyServerReply** ADM element is not empty or the **TopologyServerReplyReceived** ADM element equals TRUE, the protocol MUST perform the following actions:

- If **LastTopologyServerReply.DirectoryServiceServerSize** is not zero, the protocol MUST trigger the Populate DirectoryServerList (section 3.1.7.1) event.
- The protocol MUST trigger the Populate ConnectedNetworkIdentifierList (section 3.1.7.2) event.
- The protocol MUST complete the processing of the Get Directory Server List (section 3.1.4.1) Higher-Layer Triggered Event.

3.1.7 Other Local Events

3.1.7.1 Populate DirectoryServerList

This event causes the protocol to update **LocalQueueManager.DirectoryServerList**. The protocol MUST perform the following steps:

- The protocol MUST initialize **LocalQueueManager.DirectoryServerList** as empty.
- The protocol MUST read each list item of the comma (value 0x002C) or null-value (0x0000)–separated list stored in **LastTopologyServerReply.DirectoryServiceServerArray**. For each item found, the protocol MUST remove the first two Unicode characters. The remainder of the item, which is a NetBIOS computer name, MUST be appended to the list stored in **LocalQueueManager.DirectoryServerList**.

3.1.7.2 Populate ConnectedNetworkIdentifierList

This event causes the protocol to update **LocalQueueManager.ConnectedNetworkIdentifierList**. The protocol MUST perform the following steps:

- The protocol MUST initialize **LocalQueueManager.ConnectedNetworkIdentifierList** as empty.
- The protocol MUST add all elements of the **LastTopologyServerReply.ConnectedNetworkArray** to **LocalQueueManager.ConnectedNetworkIdentifierList**.

3.2 MQSD 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.

The abstract data model for this protocol comprises elements that are private to this protocol and others that are shared among multiple MSMQ protocols that are co-located at a common queue manager. The shared abstract data model is defined in [MS-MQDMPR] section 3.1.1, and the relationship between this protocol, a queue manager, and other protocols that share a common queue manager is described in [MS-MQSO].

Section 3.2.1.1 details the elements from the shared data model that are manipulated by this protocol, and section 3.2.1.2 details the data model elements that are private to this protocol.

3.2.1.1 Shared Data Elements

This protocol manipulates the following abstract data model elements from the shared abstract data model defined in [MS-MQDMPR] section 3.1.1:

- **Enterprise.Identifier**, as defined in [MS-MQDMPR] section 3.1.1.6.
- **Site.Identifier**, as defined in [MS-MQDMPR] section 3.1.1.7.<20>
- **QueueManager.DirectoryServerList**, as defined in [MS-MQDMPR] section 3.1.1.1.<21>
- **QueueManager.ConnectedNetworkIdentifierList**, as defined in [MS-MQDMPR] section 3.1.1.1.

3.2.1.2 Private Data Elements

None.

3.2.2 Timers

There are no timers.

3.2.3 Initialization

The server starts to listen for client requests. Typically, a sockets programming select operation is used as the means for listening for the client requests.

3.2.4 Higher-Layer Triggered Events

There are no higher-layer triggered events.

3.2.5 Processing Events and Sequencing Rules

On receiving a TopologyClientRequest packet, the server sends a TopologyServerReply packet and then immediately returns to listening for another TopologyClientRequest packet. In the event of a network error during a send operation, the server MUST close and reopen the socket and attempt to listen for incoming packets. If the socket cannot be opened, the server thread MUST terminate.

3.2.5.1 Receiving a TopologyClientRequest

When receiving a TopologyClientRequest (section 2.2.2) packet, the protocol MUST perform the following steps:

- If the length of the data packet received is less than the length of a **TopologyClientRequest** packet, including the **IPXNetworkCount** field and at least one **IPXNetworkNumberArray** field entry, the **TopologyClientRequest** packet's **IPXNetworkCount** and **IPXNetworkNumberArray** fields are considered as not present and MUST be ignored.
- The protocol MUST create a new TopologyServerReply (section 2.2.3) packet.
- The protocol MUST set the **TopologyServerReply.CorrelationID** field to the **TopologyClientRequest.RequestID** field.
- The protocol MUST copy all elements of **LocalQueueManager.ConnectedNetworkIdentifierList** to the **TopologyServerReply.ConnectedNetworkArray** field and MUST set the **TopologyServerReply.ConnectedNetworkCount** field to the number of entries in the **TopologyServerReply.ConnectedNetworkArray** field.
- If the **TopologyClientRequest** received is an IP packet, the protocol MUST set the **TopologyServerReply.ConnectedNetworkMask** field to 0x00000000.
- If the **TopologyClientRequest** received is an IPX packet, the protocol MUST set an individual bit of the **TopologyServerReply.ConnectedNetworkMask** field to 1 for every entry that is placed in the **TopologyServerReply.ConnectedNetworkArray** field. The number of bits set to 1 MUST be equal to the value of the **TopologyServerReply.ConnectedNetworkCount** field.
- If **Site.Identifier** equals the **TopologyClientRequest.SiteID** field, the protocol MUST set the **TopologyServerReply.DirectoryServiceServerSize** field to 0x00000000. The protocol MUST NOT set the **TopologyServerReply.RespondingSiteID** field or the **TopologyServerReply.DirectoryServiceServerArray** field.
- If **Site.Identifier** does not equal the **TopologyClientRequest.SiteID** field, the protocol MUST set the **TopologyServerReply.RespondingSiteID** field to **Site.Identifier**, MUST copy all entries of **LocalQueueManager.DirectoryServerList** to the **TopologyServerReply.DirectoryServiceServerArray** field and MUST set the **TopologyServerReply.DirectoryServiceServerSize** field to the number of bytes contained in the **TopologyServerReply.DirectoryServiceServerArray** field.

- The protocol MUST send the **TopologyServerReply** packet to the sender of the **TopologyClientRequest** packet.

3.2.6 Timer Events

There are no timer events.

3.2.7 Other Local Events

There are no other local events.

4 Protocol Examples

A client broadcasts a TopologyClientRequest packet and receives zero or more TopologyServerReply packets.

In a trivial example, the only response is from the current site server. In this case, the value in the **DirectoryServiceServerCount** field of the TopologyServerReply contains a zero value.

In a more typical example, there are two or more responses: one from the **Primary Site Controller (PSC)** of the site to which the client belongs and one or more responses from other PSCs.

The following sequence diagram shows a typical example.

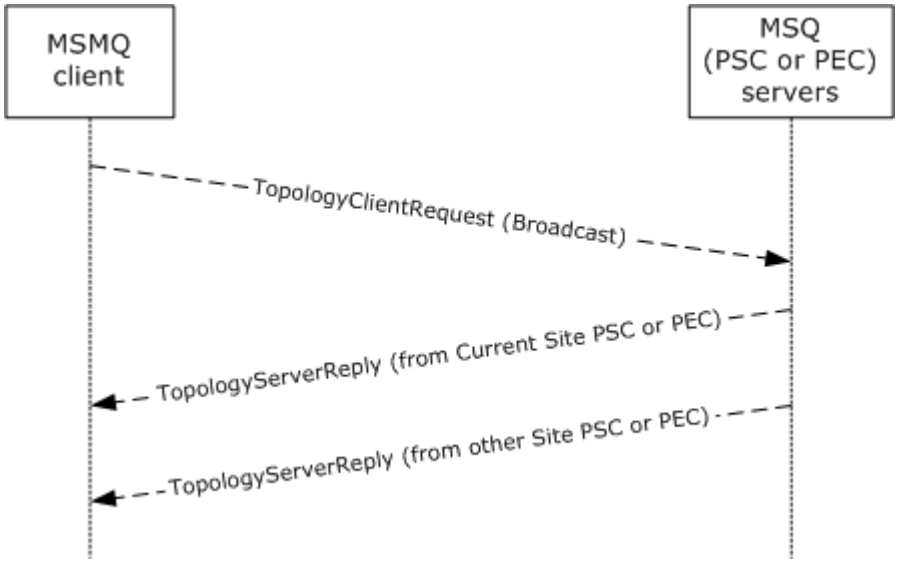


Figure 1: Typical protocol example

Examples of the content of a TopologyClientRequest and two TopologyServerReply responses sent over TCP/IP are presented as follows.

The TopologyClientRequest data packet has the following content.

```
Offset        Hexadecimal data value
in packet

00000000      00 01 00 00 61 BA EA E6 C6 D1 DB 11 BA AC 00 03
00000010      FF 4E 2D 22 03 A1 91 F2 3C E3 4F AB A9 30 BE 3A
00000020      33 E4 32 DD F6 1B C5 DC AD D4 43 45 87 39 71 56
00000030      8E 8F 91 28
```

The first TopologyServerReply data packet is from the local site server and does not contain a list of MSMQ Directory Service servers. The packet has the following content.

```
Offset        Hexadecimal data value
```

```
in packet

00000000      00 02 00 00 03 A1 91 F2 3C E3 4F AB A9 30 BE 3A
00000010      33 E4 32 DD 01 00 00 00 00 00 00 00 00 00 00 00
00000020      62 BA EA E6 C6 D1 DB 11 BA AC 00 03 FF 4E 2D 22
```

The second TopologyServerReply data packet is from a site server of which the client is not a member and thus contains a list of MSMQ Directory Service servers; this packet is ignored because the requestor has received a reply from a server in the site of which the requestor is a member. The packet has the following content.

```
Offset        Hexadecimal data value
in packet

00000000      00 02 00 00 03 A1 91 F2 3C E3 4F AB A9 30 BE 3A
00000010      33 E4 32 DD 01 00 00 00 00 00 00 00 12 00 00 00
00000020      62 BA EA E6 C6 D1 DB 11 BA AC 00 03 FF 4E 2D 22
00000030      60 BA EA E6 C6 D1 DB 11 BA AC 00 03 FF 4E 2D 22
00000040      31 00 30 00 6E 00 74 00 34 00 70 00 65 00 63 00
00000050      00 00
```

5 Security

5.1 Security Considerations for Implementers

The Message Queuing (MSMQ): Directory Service Discovery Protocol has no explicit security facilities. External security, such as IPsec, can be used to encrypt the packets as they flow in an IP network.

5.2 Index of Security Parameters

None.

6 Appendix A: Product Behavior

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

- Microsoft Windows NT® operating system
- Microsoft Windows® 2000 operating system
- Microsoft Windows® 2000 Server operating system
- Windows Server® 2003 operating system
- Windows Server® 2008 operating system

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

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

<1> Section 1.3: Only Windows NT, Windows 2000, Windows XP, Windows Server 2003, Windows Vista, and Windows Server 2008 support Directory Service Discovery Protocol. Windows 7 and Windows Server 2008 R2 do not support this protocol.

<2> Section 1.3: For a nonclustered MSMQ installation, the enterprise site identifier for an MSMQ site is a GUID obtained by reading the registry with the value name HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\MSMQ\Parameters\MachineCache\EnterpriseId.

For a clustered MSMQ installation, the enterprise site identifier for an MSMQ site is a GUID obtained by reading the registry with the value name HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\MSMQ\ClusteredQMs\servicename\Parameters\MachineCache\EnterpriseId, where servicename is replaced by the Windows service names of the installed MSMQ clusters.

<3> Section 1.3: For a nonclustered MSMQ installation, the MSMQ site identifier for an MSMQ site is a GUID obtained by reading the registry with the value name HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\MSMQ\Parameters\MachineCache\SiteId.

For a clustered MSMQ installation, the MSMQ site identifier for an MSMQ site is a GUID obtained by reading the registry with the value name HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\MSMQ\ClusteredQMs\servicename\Parameters\MachineCache\SiteId, where servicename is replaced by the Windows service names of the installed MSMQ clusters.

<4> Section 1.4: IPX is not supported on MSMQ version 3 or 4 servers.

<5> Section 1.5: On Windows machines, the value for the directory service discovery port number is read from the Windows registry. If the MQSD client or MQSD server is unable to read the value from the registry, the default values 1801 and 876 are used for IP and IPX, respectively.

For a nonclustered MSMQ installation, the IP port number is acquired by reading the registry with the value name HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\MSMQ\Parameters\MsmqIpPort.

For a clustered MSMQ installation, the IP port number is acquired by reading the registry with the value name HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\MSMQ\ClusteredQMs\servicename\Parameters\MsmqIpPort, where servicename is replaced by the Windows service names of the installed MSMQ clusters.

For a nonclustered MSMQ installation, the IPX port number is acquired by reading the registry with the value name HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\MSMQ\Parameters\MsmqIpxPort.

For a clustered MSMQ installation, the IPX port number is acquired by reading the registry with the value name HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\MSMQ\ClusteredQMs\servicename\Parameters\MsmqIpxPort, where servicename is replaced by the Windows service names of the installed MSMQ clusters.

<6> Section 2.1: IPX is not supported on MSMQ version 3 or 4 servers.

<7> Section 2.1: The Windows implementation utilizes the Windows Sockets API for TCP or SPX connections. The Windows Sockets API is responsible for operations such as selection of the source port used by an initiator and listening/accepting connections by the acceptor.

<8> Section 2.1: The Windows implementation utilizes the Windows Sockets API for TCP or SPX connections. The Windows Sockets API is responsible for operations such as selection of the source port used by an initiator and listening/accepting connections by the acceptor.

<9> Section 2.2.2: This list is generated for IPX by calling the sockets function getsockopt with parameters as follows:

```
CALL getsockopt with socket_descriptor, NSPROTO_IPX, IPX_ADDRESS, &addressAdapter, &cbOpt
```

The IPX adapter list is in the buffer denoted by the addressAdapter pointer.

<10> Section 2.3: For Windows NT and Windows 2000, this protocol uses the Message Queuing (MSMQ): Directory Service Protocol [MS-MQDS].

<11> Section 2.3: For the Message Queuing (MSMQ): Directory Service Protocol [MS-MQDS], the Directory Service schema elements are described in [MS-MQDS] sections 2.2.10 and 3.1.4.21.1 through 3.1.4.21.4.

<12> Section 3.1.1.1: On Windows clients, the values for SiteID and EnterpriseID are read from the Windows registry.

<13> Section 3.1.1.1: On Windows clients, the values for SiteID and EnterpriseID are read from the Windows registry.

<14> Section 3.1.1.1: Windows [MS-MQSD] clients receive this information as a **DirectoryServiceServerArray** (see section 2.2.3), and process the **DirectoryServiceServerArray** as indicated in 3.1.5. The information is used as the **DirectoryServerList** by the Message Queuing (MSMQ): Queue Manager Client Protocol, as specified in [MS-MQMP].

<15> Section 3.1.3: On Windows clients, the values for SiteID and EnterpriseID are read from the Windows registry.

<16> Section 3.1.4.1: Windows clients write a message to the event log, noting the failure of the client to initialize.

<17> Section 3.1.4.1: The Windows implementation utilizes the Windows Sockets function **gethostbyname** to obtain the IP and IPX addresses of a computer.

<18> Section 3.1.4.1: To determine whether an IPAddress is a RAS address, use the RASAPI32.dll function **RasEnumConnections** (see [RAS]).

<19> Section 3.1.6.1: Windows clients write a message to the event log, noting the failure of the client to initialize.

<20> Section 3.2.1.1: In MSMQ version 1, the value for **Site.Identifier** is read from the Windows registry; for MSMQ version 2, the value for SiteID is read from the **Message Queuing Information Store (MQIS)** database.

<21> Section 3.2.1.1: The list of server names is stored in the Directory Service. Windows NT employs the Message Queuing Information Store (MQIS) database, which runs on top of SQL Server as the Directory Service. In Windows 2000, Windows XP, Windows Server 2003, Windows Vista, Windows Server 2008, Windows 7, and Windows Server 2008 R2, the MSMQ Directory Service is exposed by **Active Directory**.

7 Change Tracking

This section identifies changes that were made to the [MS-MQSD] protocol document between the January 2011 and February 2011 releases. Changes are classified as New, Major, Minor, Editorial, or No change.

The revision class **New** means that a new document is being released.

The revision class **Major** means that the technical content in the document was significantly revised. Major changes affect protocol interoperability or implementation. Examples of major changes are:

- A document revision that incorporates changes to interoperability requirements or functionality.
- An extensive rewrite, addition, or deletion of major portions of content.
- The removal of a document from the documentation set.
- Changes made for template compliance.

The revision class **Minor** means that the meaning of the technical content was clarified. Minor changes do not affect protocol interoperability or implementation. Examples of minor changes are updates to clarify ambiguity at the sentence, paragraph, or table level.

The revision class **Editorial** means that the language and formatting in the technical content was changed. Editorial changes apply to grammatical, formatting, and style issues.

The revision class **No change** means that no new technical or language changes were introduced. The technical content of the document is identical to the last released version, but minor editorial and formatting changes, as well as updates to the header and footer information, and to the revision summary, may have been made.

Major and minor changes can be described further using the following change types:

- New content added.
- Content updated.
- Content removed.
- New product behavior note added.
- Product behavior note updated.
- Product behavior note removed.
- New protocol syntax added.
- Protocol syntax updated.
- Protocol syntax removed.
- New content added due to protocol revision.
- Content updated due to protocol revision.
- Content removed due to protocol revision.
- New protocol syntax added due to protocol revision.

- Protocol syntax updated due to protocol revision.
- Protocol syntax removed due to protocol revision.
- New content added for template compliance.
- Content updated for template compliance.
- Content removed for template compliance.
- Obsolete document removed.

Editorial changes are always classified with the change type **Editorially updated.**

Some important terms used in the change type descriptions are defined as follows:

- **Protocol syntax** refers to data elements (such as packets, structures, enumerations, and methods) as well as interfaces.
- **Protocol revision** refers to changes made to a protocol that affect the bits that are sent over the wire.

The changes made to this document are listed in the following table. For more information, please contact protocol@microsoft.com.

Section	Tracking number (if applicable) and description	Major change (Y or N)	Change type
2.2.3 TopologyServerReply	60843 Provided the hex value for the comma.	Y	Content updated.
3.1.7.1 Populate DirectoryServerList	60843 Provided the hex value for the comma.	Y	Content updated.

8 Index

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