# [MS-SRPL]:
# Directory Replication Service (DRS) Protocol Extensions for SMTP

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## Revision Summary

| Date | Revision History | Revision Class | Comments |
|---|---|---|---|
| 03/02/2007 | 1.0 | | Version 1.0 release |
| 04/03/2007 | 1.1 | | Version 1.1 release |
| 05/11/2007 | 1.2 | | Version 1.2 release |
| 06/01/2007 | 1.2.1 | Editorial | Revised and edited the technical content. |
| 07/03/2007 | 1.2.2 | Editorial | Revised and edited the technical content. |
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| 04/23/2010 | 7.0.2 | Editorial | Revised and edited the technical content. |
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| 07/16/2010 | 7.0.3 | No change | No changes to the meaning, language, or formatting of the technical content. |
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| 12/16/2011 | 7.3 | No change | No changes to the meaning, language, or formatting of the technical content. |
| 03/30/2012 | 7.4 | Minor | Clarified the meaning of the technical content. |
| 07/12/2012 | 7.4 | No change | No changes to the meaning, language, or formatting of the technical content. |
| 10/25/2012 | 7.4 | No change | No changes to the meaning, language, or formatting of the technical content. |
| 01/31/2013 | 7.4 | No change | No changes to the meaning, language, or formatting of the technical content. |
| 08/08/2013 | 8.0 | Major | Significantly changed the technical content. |

# Contents

# 1 Introduction

As specified in [MS-ADTS], **domain controllers (DCs)** use the Directory Replication Service (DRS) Remote Protocol (as specified in [MS-DRSR]) to replicate their configurations, schema, and **domain naming context (domain NC)** to other DCs. DCs are usually configured to use **Directory Replication Service (DRS)** over a **remote procedure call (RPC)** transport mechanism; however, in some environments, RPC transport is unsuitable (for example, if firewalls in the network between the DCs are configured to block the ports used by RPC).

This document defines the extensions to the DRS protocol for transport over **Simple Mail Transfer Protocol (SMTP)**. These DRS Protocol Extensions for SMTP provide an alternate transport for the DRS protocol that may allow DCs to perform **replication** in environments where the RPC transport mechanism is unsuitable. As specified in this document, the DRS Protocol Extensions for SMTP encapsulate the DRS messages into MIME attachments (as specified in [RFC2045]) that are then sent through email between DCs by using SMTP (as specified in [RFC2821]). This document does not define extensions or changes to the SMTP protocol itself.

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

## 1.1 Glossary

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

**Abstract Syntax Notation One (ASN.1)**
**Active Directory**
**base64**
**binary large object (BLOB)**
**certificate**
**certification authority (CA)**
**certificate template**
**certification**
**digital signature**
**domain controller (DC)**
**Domain Name System (DNS)**
**domain naming context (domain NC)**
**forest**
**fully qualified domain name (FQDN) (1)**
**global catalog (GC)**
**globally unique identifier (GUID)**
**GUID-based DNS name**
**hash function**
**Interface Definition Language (IDL)**
**Internet host name**
**little-endian**
**marshal**
**Microsoft Interface Definition Language (MIDL)**
**naming context (NC)**
**Network Data Representation (NDR)**
**object identifier (OID)**
**padding**

**private key**
**public key**
**remote procedure call (RPC)**
**replication**
**root CA**
**schema naming context (schema NC)**
**server object**
**Simple Mail Transfer Protocol (SMTP)**
**Unicode**

The following terms are specific to this document:

**address:** In the context of mail communication over SMTP, the address is the content of the **To** or the **From** field. The sender and receiver of a mail message are identified by their addresses, each of which consists of a **fully qualified domain name (FQDN)** portion and a user-name portion that uniquely identify the recipient within the **FQDN**. The **FQDN** portion may indicate a computer or a domain on which that user name exists.

**certificate enrollment:** See **certification**.

**delivery status notification (DSN):** A DSN is an SMTP message that describes the progress of delivery of another SMTP message. The SMTP MTA sends a DSN message to the sender when delivery is delayed or obstructed.

**Directory Replication Service (DRS):** The module of **Active Directory** that carries out replication of naming contexts between domain controllers. It uses the DRS Remote Protocol, as specified in [MS-DRSR].

**Directory System Agent (DSA):** The module of **Active Directory** that answers LDAP requests and manages the storage and replication of naming contexts that are stored on the domain controller.

**full master:** A domain controller with a readable and writable copy of the naming context for a domain.

**key length:** The number of bits in the key that is used in an encryption algorithm.

**Knowledge Consistency Checker (KCC):** The module of **Active Directory** that maintains the topology of site links between domain controllers and that computes which of the domain controllers should replicate, what transport mechanism to use, and on what schedule to replicate.

**Mail Transfer Agent (MTA):** A client or server computer that provides a mail transport service, such as SMTP.

**RC4:** A commonly used stream cipher that was invented by Ronald Rivest in 1987.

**relative distinguished name (RDN):** As specified in [X500], the portion of a distinguished name that is unique to an organization unit but might not be unique inside a domain.

**serialize:** See marshal.

**tampering:** Modification of data by anyone other than the intended recipient.

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

## 1.2 References

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

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

### 1.2.1 Normative References

We conduct frequent surveys of the normative references to assure their continued availability. If you have any issue with finding a normative reference, please contact dochelp@microsoft.com. 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.

[FIPS197] FIPS PUBS, "Advanced Encryption Standard (AES)", FIPS PUB 197, November 2001, http://csrc.nist.gov/publications/fips/fips197/fips-197.pdf

[MS-ADSC] Microsoft Corporation, "Active Directory Schema Classes".

[MS-ADTS] Microsoft Corporation, "Active Directory Technical Specification".

[MS-DRSR] Microsoft Corporation, "Directory Replication Service (DRS) Remote Protocol".

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

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

[MS-WCCE] Microsoft Corporation, "Windows Client Certificate Enrollment Protocol".

[PKCS1] RSA Laboratories, "PKCS #1: RSA Cryptography Standard", PKCS #1, Version 2.1, June 2002, http://www.rsa.com/rsalabs/node.asp?id=2125

[RC4] RSA Security, "The RC4 Encryption Algorithm", http://www.rsa.com/node.aspx?id=1204

**Note** To obtain this stream cipher that is licensed by RSA Data Security, you need to contact this company.

[RFC821] Postel, J., "Simple Mail Transfer Protocol", STD 10, RFC 821, August 1982, http://www.ietf.org/rfc/rfc0821.txt

[RFC1321] Rivest, R., "The MD5 Message-Digest Algorithm", RFC 1321, April 1992, http://www.ietf.org/rfc/rfc1321.txt

[RFC2045] Freed, N., and Borenstein, N., "Multipurpose Internet Mail Extensions (MIME) Part One: Format of Internet Message Bodies", RFC 2045, November 1996, http://ietf.org/rfc/rfc2045.txt

[RFC2046] Freed, N., and Borenstein, N., "Multipurpose Internet Mail Extensions (MIME) Part Two: Media Types", RFC 2046, November 1996, http://ietf.org/rfc/rfc2046.txt

[RFC2047] Moore, K., "MIME (Multipurpose Internet Mail Extensions) Part Three: Message Header Extensions for Non-ASCII Text", RFC 2047, November 1996, http://ietf.org/rfc/rfc2047.txt

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

[RFC2315] Kaliski, B., "PKCS #7: Cryptographic Message Syntax Version 1.5", RFC 2315, March 1998, http://www.ietf.org/rfc/rfc2315.txt

[RFC2821] Klensin, J., "Simple Mail Transfer Protocol", STD 10, RFC 2821, April 2001, http://www.ietf.org/rfc/rfc2821.txt

[RFC2822] Resnick, P., Ed., "Internet Message Format", STD 11, RFC 2822, April 2001, http://www.ietf.org/rfc/rfc2822.txt

[RFC3280] Housley, R., Polk, W., Ford, W., and Solo, D., "Internet X.509 Public Key Infrastructure Certificate and Certificate Revocation List (CRL) Profile", RFC 3280, April 2002, http://www.ietf.org/rfc/rfc3280.txt

[SCHNEIER] Schneier, B., "Applied Cryptography, Second Edition", John Wiley and Sons, 1996, ISBN: 0471117099.

If you have any trouble finding [SCHNEIER], please check here.

[SHA256] National Institute of Standards and Technology, "FIPS 180-2, Secure Hash Standard (SHS)", August 2002, http://csrc.nist.gov/publications/fips/fips180-2/fips180-2withchangenotice.pdf

[UNICODE4.0] The Unicode Consortium, "Unicode 4.0.0", http://www.unicode.org/versions/Unicode4.0.0/

[X500] ITU-T, "Information Technology - Open Systems Interconnection - The Directory: Overview of Concepts, Models and Services", Recommendation X.500, August 2005, http://www.itu.int/rec/T-REC-X.500-200508-S/en

**Note** There is a charge to download the specification.

[X509] ITU-T, "Information Technology - Open Systems Interconnection - The Directory: Public-Key and Attribute Certificate Frameworks", Recommendation X.509, August 2005, http://www.itu.int/rec/T-REC-X.509/en

**Note** There is a charge to download the specification.

### 1.2.2 Informative References

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

[MSADRTTR] Microsoft Corporation, "Active Directory Replication Topology Technical Reference", April 2005, http://technet2.microsoft.com/WindowsServer/en/Library/1f3bb1c1-ba8a-4b4e-9f23-f240566e3d661033.mspx

[MSFT-TEMPLATES] Microsoft Corporation, "Implementing and Administering Certificate Templates in Windows Server 2003", July 2004, http://technet2.microsoft.com/WindowsServer/en/library/c25f57b0-5459-4c17-bb3f-2f657bd23f781033.mspx

If you have any trouble finding [MSFT-TEMPLATES], please check here.

[MSSS] Microsoft Corporation, "Serialization Services", http://msdn.microsoft.com/en-us/library/aa378670.aspx

## 1.3 Overview

As specified in [MS-ADTS], DC (DCs) use the Directory Replication Service (DRS) Remote Protocol (as specified in [MS-DRSR]) to replicate their configurations, schema, and domain naming context (domain NC) to other DCs. DCs are usually configured to use DRS over an RPC transport mechanism; however, in some environments, RPC transport is unsuitable (for example, if firewalls in the network between the DCs are configured to block the ports used by RPC).

This document defines the extensions to the DRS Protocol for transport over the Simple Mail Transfer Protocol (SMTP). These DRS Protocol Extensions for SMTP provide an alternate transport for the DRS Protocol that may allow DCs to perform replication in environments where the RPC transport mechanism is unsuitable. As specified in this document, the DRS Protocol Extensions for SMTP encapsulate the DRS messages into MIME attachments (as specified in [RFC2045]) that are then sent in email between DCs by using SMTP (as specified in [RFC2821]).

The DRS Protocol Extensions for SMTP specified in this document are not a general transport mechanism. They can be used only for the transport of a subset of DRS messages during replication between DCs. As specified in sections 1.5 and 3.1.3, there are additional conditions that the configurations of the DCs must meet before the DRS Protocol Extensions for SMTP can be used to replicate state between the DCs.

When two DCs replicate, the DC that is initiating the replication is referred to as the client, and the other DC is referred to as the server. The basic steps of a replication are as follows:

1. The client DC sends a "get replicated change" request to the server DC.
2. The server DC accepts the "get replicated change" request from the client DC and identifies new updates for this client.
3. The server DC sends a "get replicated change" response to the client DC that is carrying those updates.
4. The client DC accepts the "get replicated change" response from the server DC and incorporates non-redundant updates from the server.

When using the DRS Protocol Extensions for SMTP, clients and servers asynchronously process batches of "get replicated change" messages. For example, a client may make multiple requests to the server before receiving a response, and a client is free to process replies at a later time than when the request was sent.

The following figure outlines the processing steps performed by the DRS Protocol Extensions for SMTP as a "get replicated change" message (either a request or a response) is prepared for transport to the other DC involved in the replication. The details of these steps are specified in section 3. When a DC receives an SMTP message, the steps are performed in the reverse order, starting with the SMTP **Mail Transfer Agent (MTA)**, and proceeding to obtaining the DRS Replication Data, which is then given to the DRS Protocol.

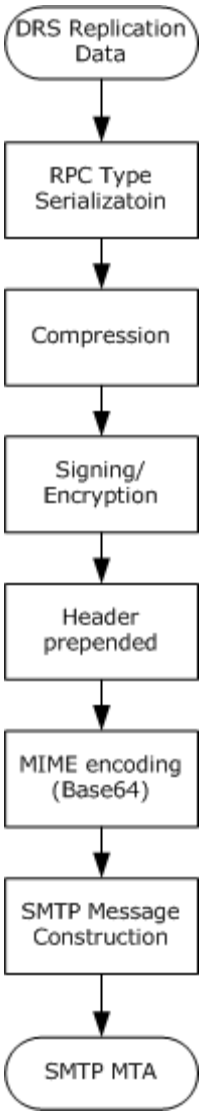



**Figure 1: Transporting a "get replicated change" message to the other DC involved in a replication**

The result is an SMTP message structured as shown in the following figure. The message is given to the SMTP MTA for delivery to the remote DC.

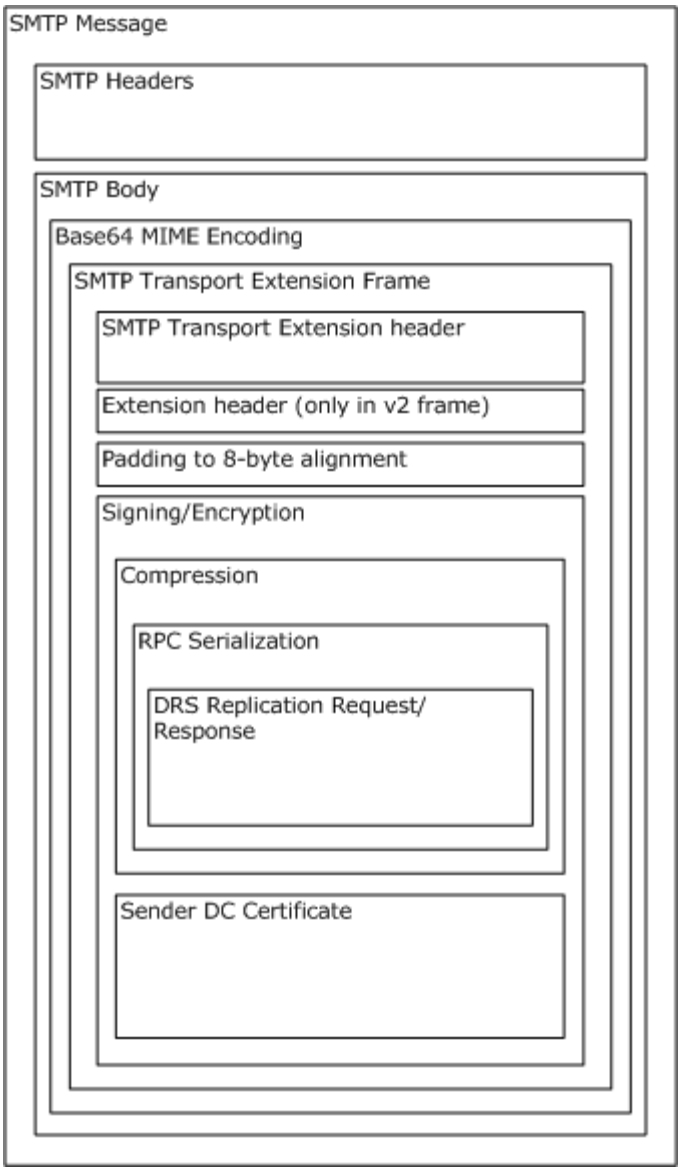



**Figure 2: SMTP message given to the SMTP MTA for delivery to the remote DC**

The specification of the DRS Protocol Extensions for SMTP depends on the terminology and concepts that are specified in [MS-ADTS] and [MS-DRSR]. For illustrative examples, see [MSADRTTR]. Summarizing information as specified in [MS-ADTS], all DCs are configured to be part of a **forest**. Each DC stores two or more **naming contexts (NCs)**, where an NC is a conceptual directory that maps names to attributes. DCs use the Directory Replication Service Protocol (as specified in [MS-DRSR]) to maintain consistency between NCs that are stored on multiple DCs.

The properties and configuration of a forest are defined by the values in a **configuration NC** and a **schema naming context (schema NC)**. Each DC maintains a copy of its forest's configuration NC and schema NC. Changes made to any copy of these NCs, at any DC, are replicated to the copies at all other DCs in the forest. DCs also store a domain NC for one or more domains. A DC may be configured to have a read/write copy of the domain NC, in which case the DC is a **full master** for

the domain, or it may have a read-only copy of the NC, in which case it is a **global catalog**. As part of the configuration NC for a forest, each DC in the forest is assigned to a **site** (conceptually, a site is a geographic region).

The following figure illustrates an example of a forest that contains two sites (Site1 and Site2). The DCs in Site2 (DC2-1 and DC2-2) are full master for the Domain2 Domain NC (D2) and global catalogs for the Domain1 Domain NC (D1). The DC DC1 in Site1 is a full master for the Domain1 NC. Each DC also has a Configuration NC (C). A scenario in which this situation might exist is the operation of a DC on a submarine that makes contact with its base only infrequently. The submarine would be configured as Site1 and the base as Site2.

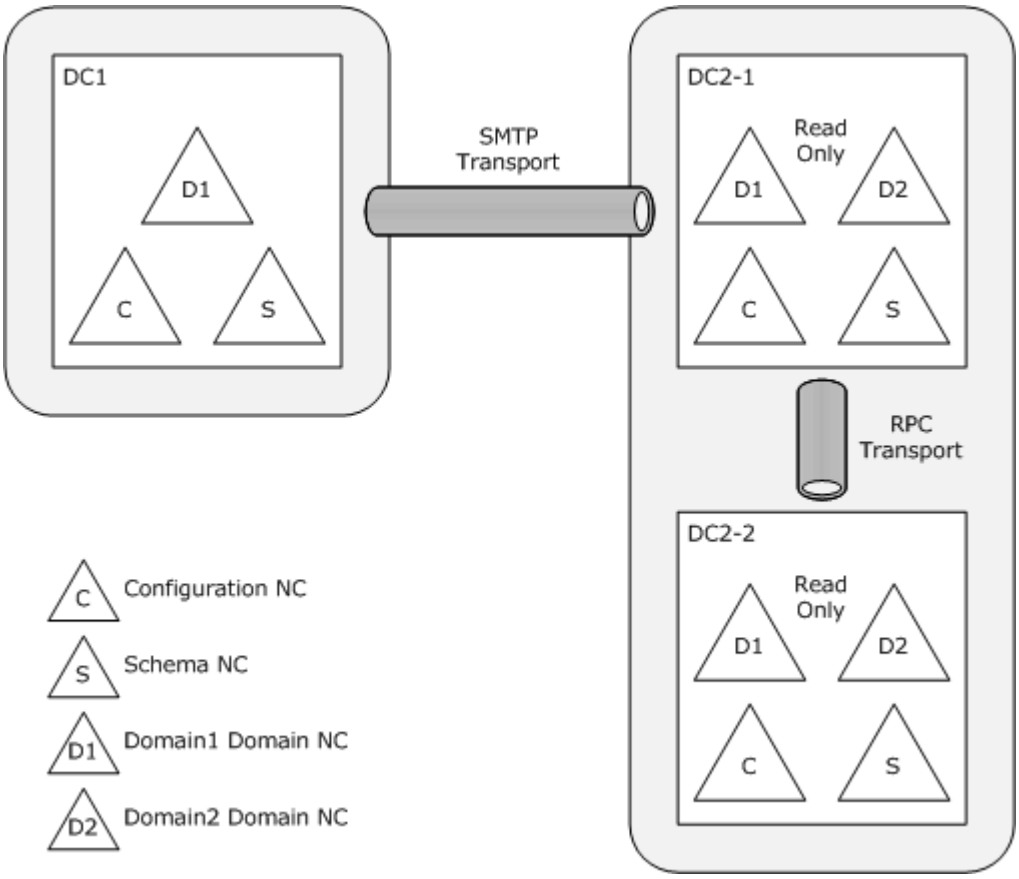



**Figure 3: Forest that contains two sites (Site1 and Site2)**

The configuration state in the forest's configuration NC dictates what transports may be used by DRS during replication. In the example in Figure 3, the two DCs in Site2 are configured to use RPC transport for their replication using DRS, as specified in [MS-DRSR], and DC1 and DC2-1 are configured to use SMTP transport for their replication using DRS, as specified in this document.

The choices regarding which DCs should replicate and on what schedule they should replicate are made by the **Knowledge Consistency Checker (KCC)**, as specified in [MS-ADTS]. For a set of informative examples of replication topology, see [MSADRTTR].

## 1.4 Relationship to Other Protocols

The DRS Protocol Extensions for SMTP are a means of encapsulating **serialized** DRS RPC messages and transporting them inside an SMTP mail message.

The following figure illustrates the relationship between the DRS Protocol Extensions for SMTP and other protocols.

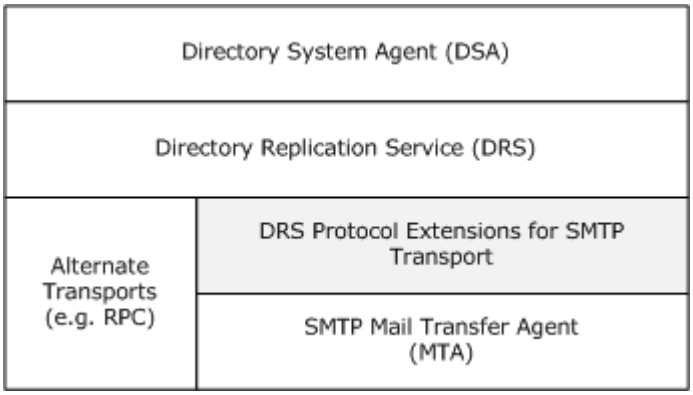



**Figure 4: Relationship between DRS Protocol Extensions for SMTP and other protocols**

The **Directory System Agent (DSA)** implements the functionality of a DC and is specified in [MS-ADTS]. The Directory Replication Service (DRS) Remote Protocol (as specified in [MS-DRSR]) controls how an NC is replicated between DCs. DRS transports its messages between DCs by using the DRS Protocol Extensions for SMTP specified in this document or by using another transport, such as RPC (as specified in [MS-RPCE]).

In carrying out the processing steps specified in section 3, the DRS Protocol Extensions for SMTP use the following additional protocols. Messages sent by DRS are serialized and deserialized by using the RPC serialization encode and decode process using type serialization, as specified [MS-RPCE] section 2.2.6. The DRS compression algorithm (as specified in [MS-DRSR] section 4.1.10.5.18) is used to compress the payload. The compressed result is optionally encrypted using **RC4** (as specified in [RC4]); it is always encapsulated in a cryptographically signed request structure, as specified in [MS-WCCE] and [PKCS1]. The hash algorithm that is used for the signature is specified in [RFC1321]. MIME encoding (as specified in [RFC2045], [RFC2046], and [RFC2047]) is used to represent binary information in a format suitable for inclusion in an SMTP message. The MIME encoded message is sent as the body of an SMTP message, as specified in [RFC2822]. An SMTP mail transfer agent (MTA) (as specified in [RFC2821]) is used to transport SMTP messages to the remote DC.

## 1.5 Prerequisites/Preconditions

The DC requires the ability to send and receive SMTP messages. Any SMTP mail transfer agent (as specified in [RFC2821]) may be used.<1>

The final choice of replication transport is made by the KCC, on a per-NC replica basis, as specified in [MS-ADTS].

## 1.6 Applicability Statement

The DRS Protocol Extensions for SMTP are used by DCs, in a forest, when they are replicating **Active Directory** contents by using the Directory Replication Service (DRS) Remote Protocol, as specified in [MS-DRSR].

The DRS Protocol Extensions for SMTP are appropriate for linking isolated, regional domains to their forest. The DRS Protocol Extensions for SMTP are appropriate for participation in global forest replicas, such as the configuration NC, schema NC, and the global catalog.

The DRS Protocol Extensions for SMTP cannot be used for replication between DCs that are part of the same site. The extensions cannot be used to replicate a domain between two DCs that are full masters of that domain. They can be used only to replicate a domain between a full master for the domain and a global catalog for that domain or between two global catalogs for that domain.

The DRS Protocol Extensions for SMTP specified in this document are not a general transport mechanism. They are defined only for transport of the IDL_DRSGetNcChanges RPC request and response messages that are part of the DRS Remote Protocol, as specified in [MS-DRSR].

## 1.7 Versioning and Capability Negotiation

This document covers versioning issues in the following areas.

- Message versions: Two message versions, MAIL_REP_MSG_V1 and MAIL_REP_MSG_V2, are used by the DRS Protocol Extensions for SMTP.
- Capability negotiation: There is no capability negotiation when the **MAIL_REP_MSG_V1** message is used. The **MAIL_REP_MSG_V2** message includes an explicit vector of capabilities. See section 2.2 for details.
- Encryption and hashing algorithms: Two encryption and hashing algorithms are allowed, but there is no negotiation in the protocol to configure which to use in sending messages or to identify which are used when receiving messages. Therefore, two machines implementing this protocol which are configured to use different encryption and/or hashing algorithms can fail decryption and verification. See section 3.3.5.3 for details.

## 1.8 Vendor-Extensible Fields

None.

## 1.9 Standards Assignments

| Parameter | Value | Reference |
|---|---|---|
| Well-known TCP/IP port for Simple Mail Transfer Service (SMTP) | 25 | [RFC821] |

# 2 Messages

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

## 2.1 Transport

The DRS Protocol Extensions for SMTP use SMTP (as specified in [RFC2821]) as a transport.

The endpoint for the DRS Protocol Extensions for SMTP is the mailbox that receives DRS SMTP messages on the target DC. This mailbox is identified by an addr-spec address (as specified in [RFC2822] section 3.4.1) that includes both a local-part and domain. Each DC publishes its preferred mailAddresses (section 2.4.2.1) in the directory. The DRS layer provides to the DRS Protocol Extensions for SMTP the mailAddresses to be used as the SMTP sender and recipient. The particular local-part and domain used in the mailAddress are implementation-specific.<2>

A DC MAY interpret SMTP **delivery status notifications (DSNs)** for error reporting purposes.<3>

## 2.2 Message Syntax

Conceptually, the message frame used by the DRS Protocol Extensions for SMTP is a backward-compatible structure that has evolved over two successive product versions. The two versions of the message structure are **MAIL_REP_MSG_V1** and **MAIL_REP_MSG_V2**.

The DRS Protocol Extensions for SMTP message frame MUST be in the form of a **MAIL_REP_MSG_V1** message or a **MAIL_REP_MSG_V2** message, as specified in the following sections.

Version Negotiation: The two message versions differ in the length of their preamble and whether a capability extension is carried. A receiver determines which version of the message was sent by examining the value of the **dwMsgVersion** field, as specified in sections 2.2.3 and 2.2.4. A sender MUST send the highest version of the message that is supported by both the sender and the intended receiver. The highest version of the message supported by a DC is determined by the DC's Functional Level. The DC's Functional Level is determined by accessing the nTDSDSA object representing the DC and reading the msDS-Behavior-Version attribute on the object, as specified in [MS-ADTS] section 6.1.4.2.

The following table describes the supported message versions and the corresponding minimum DC Functional Level required for the receiver.

| Message | Section | DC Functional Level |
|---|---|---|
| MAIL_REP_MSG_V1 support | 2.2.3 | DS_BEHAVIOR_WIN2000 |
| MAIL_REP_MSG_V2 support | 2.2.4 | DS_BEHAVIOR_WIN2003 |

Capability Negotiation: There is no capability negotiation for **MAIL_REP_MSG_V1** messages. **MAIL_REP_MSG_V2** messages carry the DRS_EXTENSIONS_INT protocol element, as described in [MS-DRSR] section 5.39. These capabilities perform identical functions as in the DSR Remote Protocol, they are not interpreted by the DRS Protocol Extensions for SMTP. In the case of the DRS Protocol Extensions for SMTP, these capabilities are present in every message, in contrast to the core DRS Remote Protocol, where they are exchanged only on the first **IDL_DRSBind** message.

### 2.2.1 DRS_MSG

The data carried by the MAIL_REP_MSG_V1 or MAIL_REP_MSG_V2 message MUST be a **Network Data Representation (NDR)**–encoded **binary large object (BLOB)** that contains one of the following DRS Remote Protocol structures, as specified in [MS-DRSR]:

- DRS_MSG_GETCHGREQ_V4
- DRS_MSG_GETCHGREQ_V7
- DRS_MSG_GETCHGREPLY_V1
- DRS_MSG_GETCHGREPLY_V6

The **dwMsgVersion** field of the MAIL_REP_MSG_V1 or MAIL_REP_MSG_V2 message identifies whether the payload is a DRS request message or a DRS response message and indicates the version of the DRS request or response.

Other DRS message structures MUST NOT be carried as payload of the DRS Protocol Extensions for SMTP.

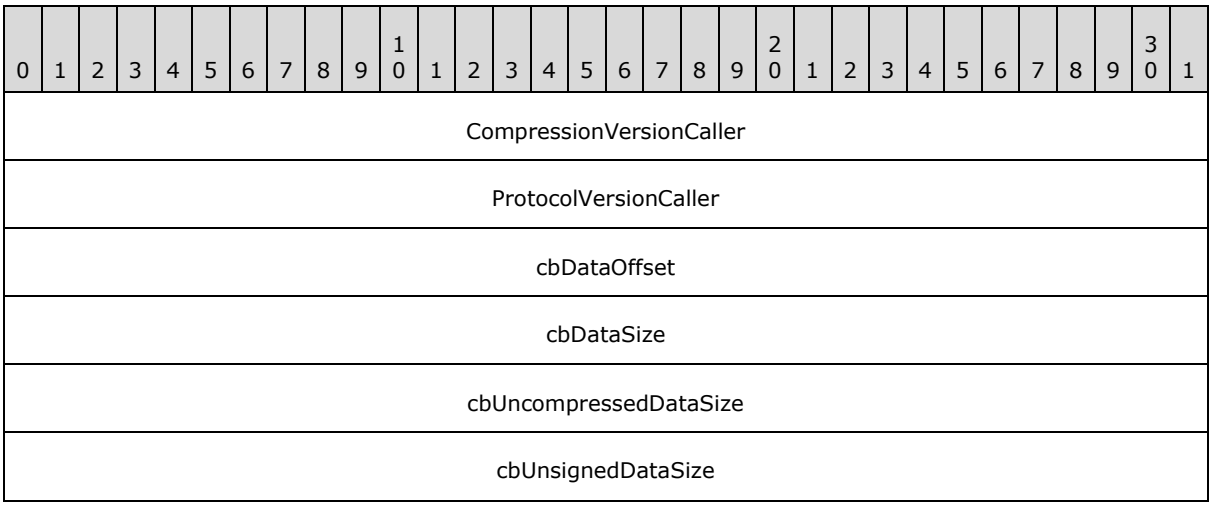
### 2.2.2 CURRENT_PROTOCOL_VERSION

The following constant is used by the DRS Protocol Extensions for SMTP.

| Constant/value | Description |
|---|---|
| CURRENT_PROTOCOL_VERSION<br>0x0000000B | This constant specifies the current version of the DRS Protocol Extensions for SMTP. |

### 2.2.3 MAIL_REP_MSG_V1

This structure defines the V1 format for a DRS Protocol Extensions for SMTP frame. This structure is not part of the RPC data stream. The RPC data stream from the higher-layer DRS protocol is encapsulated by this structure and is carried within the payload data field. This frame is "hand-**marshaled**" as specified in sections 3.2 and 3.3. It appears at the beginning of the attachment data sent using SMTP. All numeric header fields MUST be in the **little-endian** format.



| dwMsgType |
| --- |
| dwMsgVersion |
| PayloadData (variable) |
| ... |

**CompressionVersionCaller (4 bytes):** A 32-bit, unsigned integer that indicates the compression algorithm that is used for the data in this message. This field MUST be set to a valid value for the enumerated type DRS_COMP_ALG_TYPE, as specified in [MS-DRSR]. If the CP bit in the **dwMsgType** header field of a received message is 0, the value of this field MUST be ignored and the field treated as if the value was set to DRS_COMP_ALG_NONE.<4>

**ProtocolVersionCaller (4 bytes):** A 32-bit, unsigned integer that indicates the protocol version for this message. This field MUST be set to the value of the **CURRENT_PROTOCOL_VERSION**.

**cbDataOffset (4 bytes):** A 32-bit, unsigned integer that MUST be set to 0 or the size of the V1 header.<5>

**cbDataSize (4 bytes):** A 32-bit, unsigned integer that indicates the size of the payload data (not including this header), starting with the first byte of payload data, in bytes.

**cbUncompressedDataSize (4 bytes):** A 32-bit, unsigned integer that indicates the size of Send-Message-Serialized-Data byte sequence (as specified in section 3.2.1), not including this header, before compression, in bytes. If the CP bit of the dwMsgType header field is 0, this field MUST be sent as 0 and ignored on receipt.

**cbUnsignedDataSize (4 bytes):** A 32-bit, unsigned integer that indicates the size of Send-Message-Compressed-Data byte stream (as specified in section 3.2.1), not including this header, before encryption, in bytes.

**dwMsgType (4 bytes):** An unsigned 32-bit field that specifies message type options. This value is a combination of one or more of the following bit fields. Bits not specified below MUST be set to 0 by the sender, and MUST be ignored by the receiver.

| Value | Meaning |
| --- | --- |
| RQ<br>0x01000000 | If set, indicates that this is a Request Message. This field is one of 32 single-bit flags that are included in the **dwMsgType** field. |
| RP<br>0x02000000 | If set, indicates that this is a Response Message. This field is one of 32 single-bit flags that are included in the **dwMsgType** field. |
| SN<br>0x00000020 | If set, indicates that this message is signed. This field is one of 32 single-bit flags that are included in the **dwMsgType** field. |
| SL<br>0x00000040 | If set, indicates that this message is sealed. This field is one of 32 single-bit flags that are included in the **dwMsgType** field. |
| CP<br>0x00000080 | If set, indicates that this message is compressed. This field is one of 32 single-bit flags that are included in the **dwMsgType** field. |

**dwMsgVersion (4 bytes):** A 32-bit, unsigned integer that indicates whether this DRS Message is a V1 request or a V1 response. If the value of the **cbDataOffset** field is not 0, then the value of this field MUST be one of the following values.<6>

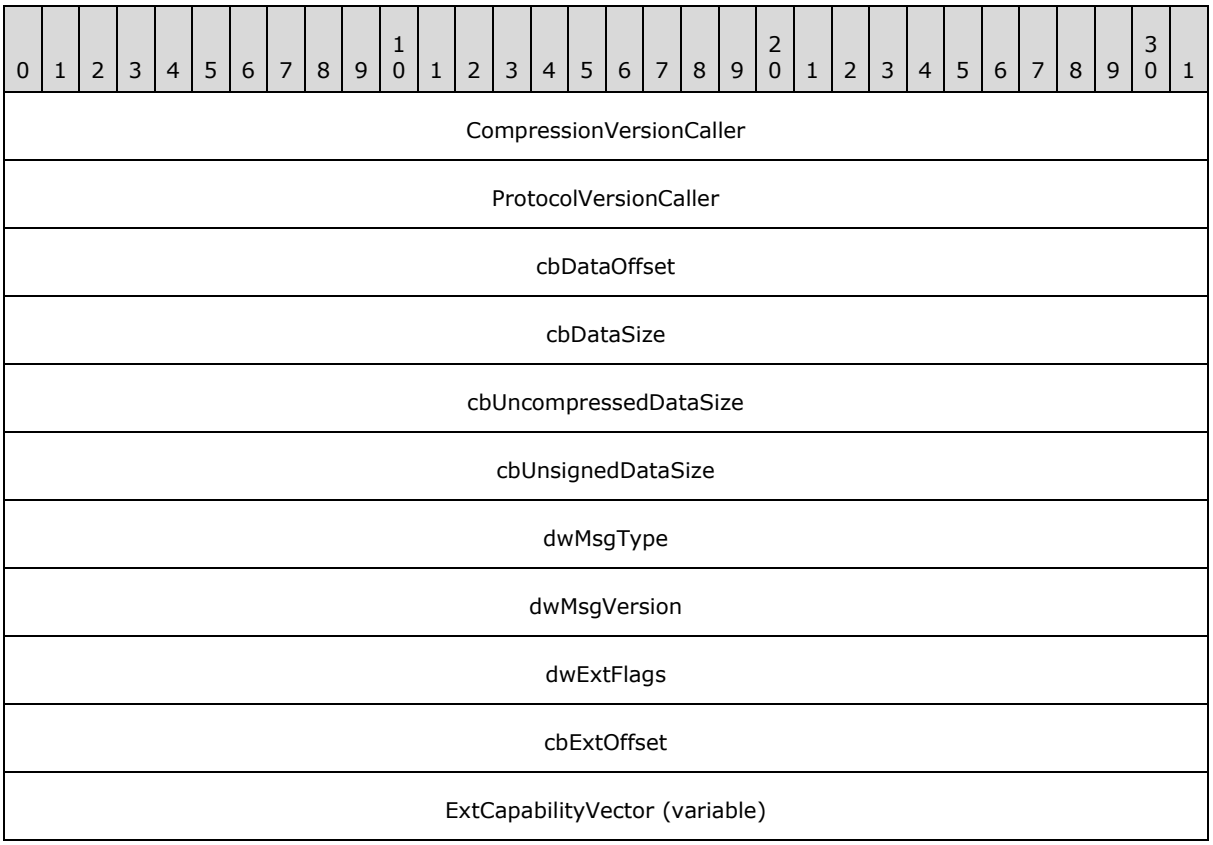
| Value | Meaning |
|---|---|
| 0x00000001 | This message contains a V1 response. **PayloadData** contains a DRS_MSG_GETCHGREPLY_V1 message. |
| 0x00000004 | This message contains a V1 request. **PayloadData** contains a DRS_MSG_GETCHGREQ_V4 message. |

If the value of the **cbDataOffset** field is 0, then the value of this field MUST be ignored on receipt. If the RP bit is set in the **dwMsgType**, then the payload is a DRS_MSG_GETCHGREPLY_V1 message; if the RQ bit is set, then the payload is a DRS_MSG_GETCHGREQ_V4 message.

**PayloadData (variable):** Variable-length region that contains the Send-Message-Payload byte stream, as specified in section 3.2.1.

### 2.2.4 MAIL_REP_MSG_V2

This structure defines the V2 format for a DRS Protocol Extensions for SMTP frame. It appears at the beginning of the attachment data sent using SMTP. All numeric header fields MUST be in the little-endian format.



| |
|---|
| ... |
| Padding (variable) |
| ... |
| PayloadData (variable) |
| ... |

**CompressionVersionCaller (4 bytes):** A 32-bit, unsigned integer that indicates the compression algorithm that is used for the data in this message. This field MUST be set to a valid value for the enumerated type DRS_COMP_ALG_TYPE, as specified in [MS-DRSR]. If the CP bit of the dwMsgType header field is 0, this field MUST be sent as 0 and ignored on receipt.

**ProtocolVersionCaller (4 bytes):** A 32-bit, unsigned integer that indicates the protocol version for this message. This field MUST be set to the value of the **CURRENT_PROTOCOL_VERSION**.

**cbDataOffset (4 bytes):** A 32-bit, unsigned integer that indicates the offset in bytes to the payload data in this message, calculated from the beginning of this frame (from the first byte of the **CompressionVersionCaller** field). This field MUST be a multiple of 8 bytes for alignment.

**cbDataSize (4 bytes):** A 32-bit, unsigned integer that indicates the size of the payload data (not including this header, starting with the first byte at **cbDataOffset**), in bytes.

**cbUncompressedDataSize (4 bytes):** A 32-bit, unsigned integer that indicates the size of Send-Message-Serialized-Data byte stream (as specified in section 3.2.1), not including this header, before compression, in bytes.

**cbUnsignedDataSize (4 bytes):** A 32-bit, unsigned integer that indicates the size of Send-Message-Compressed-Data byte stream (as specified in section 3.2.1), not including this header, before encryption, in bytes.

**dwMsgType (4 bytes):** An unsigned 32-bit field that specifies message type options. This value is a combination of one or more of the following bit fields. Bits not specified below MUST be set to zero by the sender and MUST be ignored by the receiver.

| Value | Meaning |
|---|---|
| RQ<br>0x01000000 | If set, indicates that this is a Request Message. This field is one of 32 single-bit flags that are included in the **dwMsgType** field. |
| RP<br>0x02000000 | If set, indicates that this is a Response Message. This field is one of 32 single-bit flags that are included in the **dwMsgType** field. |
| SN<br>0x00000020 | If set, indicates that this message is signed. This field is one of 32 single-bit flags that are included in the **dwMsgType** field. |
| SL<br>0x00000040 | If set, indicates that this message is sealed. This field is one of 32 single-bit flags that are included in the **dwMsgType** field. |
| CP | If set, indicates that this message is compressed. This field is one of 32 single-bit |

| Value | Meaning |
|---|---|
| 0x00000080 | flags that are included in the **dwMsgType** field. |

**dwMsgVersion (4 bytes):** A 32-bit, unsigned integer that indicates whether this DRS Message is a V2 request or a V2 response. The value of this field MUST be one of the following.

| Value | Meaning |
|---|---|
| 0x00000006 | This message contains a V2 response. **PayloadData** contains a DRS_MSG_GETCHGREPLY_V6 message. |
| 0x00000007 | This message contains a V2 request. **PayloadData** contains a DRS_MSG_GETCHGREQ_V7 message. |

**dwExtFlags (4 bytes):** A 32-bit, unsigned integer that contains the **dwFlags** field of the DRS_EXTENSIONS_INT structure, as specified in [MS-DRSR] section 5.39. The **dwFlags** field appears as bytes 5–8 of the structure, whose bytes are numbered starting from 1.

**cbExtOffset (4 bytes):** A 32-bit, unsigned integer that indicates the offset, from the start of the frame (from the first byte of the **CompressionVersionCaller** field), in bytes, to the **ExtCapabilityVector** field. This field MUST be a multiple of 8-bytes for alignment. This field MUST be 0x00000028.

**ExtCapabilityVector (variable):** The variable length region that contains the entire DRS_EXTENSIONS_INT structure, as specified in [MS-DRSR] section 5.39. The contents of bytes 5–8 of this structure also appear in **dwExtFlags**.

**Padding (variable):** Between 0 and 7 bytes, as required, to make sure that **PayloadData** begins on an 8-byte aligned boundary. If the length of this field is greater than 0 bytes, this field MUST be sent as 0 and ignored on receipt.

**PayloadData (variable):** Variable-length region that contains the Send-Message-Payload byte stream (as specified in section 3.2.1). This field MUST begin at offset **cbDataOffset**.

## 2.3 Certificate Formats

An X.509 **certificate** (as specified in [X509]) that encapsulates a **public key** for the purpose of secure communication is a prerequisite for using the DRS Protocol Extensions for SMTP. Each DC participating in directory email replication MUST have a **certificate** and **private key** that is available locally, that is unique to that computer, and that has been issued by a common **root CA**.

This **certificate** MUST be either a Domain Controller Replication **certificate** (as specified in section 2.3.1), or a Directory Email Replication **certificate**, as specified in section 2.3.2.<7>

The following **object identifiers (OIDs)** specify algorithms that are used for signing and sealing, as specified in PKCS #1 ([PKCS1]) and [SCHNEIER].

```
OID RSA MD5 (hash function) "1.2.840.113549.2.5"
OID SHA256 (hash function) "1.2.840.113549.1.1.11"
OID RSA RC4 (encryption algorithm) "1.2.840.113549.3.4"
OID AES128 (encryption algorithm) "2.16.840.1.101.3.4.1.2"
```

The algorithms corresponding to these OIDs are specified in the following documents:

- RSA MD5 in [RFC1321].
- SHA256 in [SHA256].
- RSA RC4 in [RC4].
- AES128 in [FIPS197].

Both Domain Controller Replication **certificates** and Directory Email Replication **certificates** are X.509 **certificates** that contain the following X.509v1 fields.

- Version
- Serial Number
- Signature Algorithm
- Valid From
- Valid To
- Subject (distinguished name of the DC)
- Issuer
- Public Key

### 2.3.1 Domain Controller Replication Certificate

The Domain Controller Replication **certificate** is defined as an X.509 (as specified in [X509]) certificate with specific extensions and values, as described below.

A Domain Controller Replication **certificate** contains X.509v1 fields, as specified in section 2.3.

A Domain Controller Replication **certificate** also contains the following X.509v3 extensions identified in [RFC3280] section 4.2.1.

- Authority Key Identifier
- Subject Key Identifier
- Authority Information Access
- Key Usage (**Digital Signature**, Key Encipherment [a0])
- Subject Alternative Name

  The **Certificate** Subject Alternative Name section MUST contain the **globally unique identifier (GUID)**, as defined in [MS-DTYP] section 2.3.4, of the DC object in the directory and the **Domain Name System (DNS)** name. For example:

  - Other Name: 1.3.6.1.4.1.311.25.1 (ac 4b 29 06 aa d6 5d 4f a9 9c 4c bc b0 6a 65 d9)
  - <Internet host name of the domain controller>
- CDP (CRL Distribution Point)
- Enhanced Key Usage

- Client Authentication (1.3.6.1.5.5.7.3.2)
- Server Authentication (1.3.6.1.5.5.7.3.1)

A Domain Controller Replication **certificate** also contains the following X.509v3 extensions specific to Microsoft.

- Microsoft-defined X.509v3 extension for **certificate template** name.<8>

### 2.3.2 Directory Email Replication Certificate

The Directory Email Replication **certificate** is defined as an X.509 (as specified in [X509]) certificate with specific extensions and values, as described below.

A Directory Email Replication **certificate** contains X.509v1 fields, as specified in section 2.3.

A Directory Email Replication **certificate** also contains the following X.509v3 extensions, as specified in [RFC3280] section 4.2.1.

- Authority Key Identifier
- Subject Key Identifier
- Authority Information Access
- Key Usage
  - Digital Signature, Key Encipherment = (a0)
- Subject Alternative Name

  The **Certificate** Subject Alternative Name section MUST contain the GUID of the DC object in the directory and the DNS name. For example:
  - Other Name: 1.3.6.1.4.1.311.25.1 = ac 4b 29 06 aa d6 5d 4f a9 9c 4c bc b0 6a 65 d9
  - < Internet host name of the DC>
- CDP (CRL Distribution Point)
- Enhanced Key Usage
  - Client Authentication (1.3.6.1.5.5.7.3.2)
  - Server Authentication (1.3.6.1.5.5.7.3.1)
- Extended Key Usage
  - Directory Email Replication OID = 1.3.6.1.4.1.311.21.19

A Directory Email Replication **certificate** also contains the following X.509v3 extensions specific to Microsoft.

- Microsoft-defined X.509v3 extension for Application Policies
- Microsoft-defined X.509v3 extension for **certificate** template information.<9>

## 2.4 Active Directory Objects

### 2.4.1 Computer Object

The Computer object represents a computer in the Active Directory forest, and it is found by default at the following **relative distinguished name (RDN)** within the domain NC:

"CN=computername,CN=Computers"

For this RDN, "computername" is the host part of the computer's FQDN. As specified in section 2.3, the issued **certificate** MUST contain the GUID of the Computer object of that DC to be a valid DC certificate. When DCs exchange certificates during operations (as specified in section 3), the DCs further verify that the certificate contains the GUID of a Computer object that has not been deleted.

The schema definition for the Computer object is specified in [MS-ADSC].

### 2.4.2 Server Object

This is the **Active Directory** Server object from the **Active Directory** Schema, as specified in [MS-ADTS] section 6.1.1.2.2.

The Server object represents a computer in the **Active Directory** forest that is a directory server. The Server object contains an nTDSDSA object (section 2.4.3) with configuration information for that server. The Server object is found at the following RDN within the configuration NC:

"CN=servername,CN=Servers,CN=sitename, CN=Sites"

For this RDN, "servername" is the host part of the computer's FQDN, and "sitename" is the administrator-specified name of the site to which the server belongs.

#### 2.4.2.1 mailAddress Attribute

The mailAddress attribute of the Server object (section 2.4.2) that corresponds to a DC indicates the SMTP recipient **address** used by that server for the DRS Protocol Extensions for SMTP transport.

The mailAddress is a Unicode string that MUST meet the requirements of an addr-spec, as specified in [RFC2822] section 3.4.1. This includes being in the form local-part@domain.

A directory server that is sending an update request via the DRS Protocol Extensions for SMTP determines the appropriate email To address field by querying the value of this attribute for the destination computer's Server object. The directory server sets the From address field by querying the value of this attribute for its own Server object.

### 2.4.3 nTDSDSA Object

The nTDSDSA object is the **Active Directory** Server object (section 2.4.2) from the **Active Directory** Schema, as specified in [MS-ADTS] section 6.1.1.2.2.

On a DC, the nTDSDSA object represents the replication agent, which is responsible for processing the DRS Protocol.

The nTDSDSA object has the RDN of "CN=NTDS Settings" and is a child of the Server object of the DC.

The GUID of this nTDSDSA object is invariant for the lifetime of the DC. The implementation MAY use this GUID value as an alternative identifier for the DC.<10>

#### 2.4.3.1 msDs-Behavior-Version Attribute

The nTDSDSA object (section 2.4.3) class contains the msDs-Behavior-Version attribute. This attribute specifies the DC version. The contents of this attribute are as specified in [MS-ADTS] section 6.1.4.2.

# 3 Protocol Details

The higher layer is the Directory Replication Service (DRS) Remote Protocol (as specified in [MS-DRSR]). The lower layer is the SMTP MTA delivery function.

The DRS Protocol Extensions for SMTP serializes a DRS message and encloses that message in its own message envelope, which is called the DRS Protocol Extensions for SMTP frame. The DRS Protocol Extensions for SMTP first inserts the extension frame into a MIME attachment, then inserts the MIME attachment into an SMTP message, and finally gives the SMTP message to the lower-layer SMTP MTA for delivery to the recipient.

## 3.1 Common Details

### 3.1.1 Abstract Data Model

Each DC that uses the DRS Protocol Extensions for SMTP maintains the following state.

- SMTP-ADDR-DC-CERT-MAP (address): A dictionary that maps from the SMTP mail address of a DC to the Domain Controller **certificate** of that DC. The receiving role (section 3.3) populates the dictionary over time through requests that it receives.
- Local-DC-Mail-Address: This value is the SMTP address at which the DRS Protocol Extensions for SMTP on this DC can receive SMTP messages.
- Local-DC-Certificate: This value is the DC **certificate** for the local DC.

### 3.1.2 Timers

None.

### 3.1.3 Initialization

The configurations of any two DCs are required to meet certain conditions before the DRS Protocol Extensions for SMTP can be used to replicate state between them.

Until these conditions are met all message requests received SHOULD be ignored and any message requests to send SHOULD not be generated. The conditions are as follows.

- The configuration NC on each DC MUST specify the existence of a Windows Active Directory forest, and both DCs MUST be members of this forest.
- Each DC MUST have a Domain Controller certificate, and all Domain Controller certificates MUST be signed by the same **certification authority (CA)**. Domain Controller certificates are as specified in section 2.3. **Certificate enrollment** and storage are specified in [MS-WCCE].
- The DCs MUST be configured to be in different sites.
- The configuration NC for the forest MUST specify that the DRS Protocol Extensions for SMTP can be used for replication between the DCs. The replication transport is governed by the configuration of connection, site link, and intersite transport objects, as specified in [MS-ADTS].
- One of the following statements MUST apply to the NC being replicated. The intuition behind these requirements is that replication between two full-master replicas of the same domain NC is not permitted via the DRS Protocol Extensions for SMTP to enforce an administrative best practice.

- The NC is the configuration NC.
- The NC is the schema NC.
- Both DCs hold NC replicas of the same application NC.
- Both DCs hold a partial read-only replica of the same NC (for example, both DCs are global catalogs).
- One DC holds a writable full replica of its domain NC, and the other DC holds a partial read-only copy of that domain NC (for example, the other DC is a global catalog).

- The configuration NC MUST contain a **server object** for each DC. Both server objects MUST contain a mailAddress attribute, and the mailAddress MUST be a syntactically valid SMTP recipient (as specified in [RFC2822]).

The state variable Local-DC-Mail-Address MUST be initialized with the SMTP address of the local DC, as taken from the configuration NC. The configuration NC MUST include the SMTP address of the local DC.

The state variable Local-DC-Certificate MUST be initialized with a certificate from the Public Key Infrastructure. This certificate MUST meet the criteria set forth in section 2.3.

The state variable SMTP-ADDR-DC-CERT-MAP MUST be initialized with an entry for the local DC, as follows: <Local-DC-Mail-Address, Local-DC-Certificate>.

The implementation MAY populate the map with additional entries at initialization time, although this is not required for correct operation. As an alternative, the implementation MAY populate the map with knowledge of additional partner DCs as they are discovered during operation.<11>

The SMTP MTA MUST be initialized so that it delivers messages sent with a From address of Local-DC-Mail-Address. All required initialization MUST be performed so that the local DC will be able to receive SMTP messages that are sent to Local-DC-Mail-Address. For example, the domain of Local-DC-Mail-Address may need to be registered in the DNS in a fashion that allows the local DC to receive SMTP messages that are sent to the domain.

### 3.1.4 Higher-Layer Triggered Events

None.

### 3.1.5 Message Processing Events and Sequencing Rules

None.

### 3.1.6 Timer Events

None.

### 3.1.7 Other Local Events

None.

## 3.2 Sending Role Details

This section defines the steps taken when the DRS Protocol Extensions for SMTP receive a message from the higher-layer Directory Replication Service (DRS) Remote Protocol to send to another DC.

Because this document specifies a transport protocol, the processing steps are nearly identical for a DC acting as a server and a DC acting as a client. This document describes both roles in this section with the few differences between the roles specified in the text.

### 3.2.1 Abstract Data Model

When the Directory Replication Service (DRS) Remote Protocol invokes the DRS Protocol Extensions for SMTP, it provides the transport with the following information.

- Send-Recipient-Mail-Address: An opaque Unicode string that contains the SMTP mail address of the recipient. The encoding for Unicode MIME is as specified in [RFC2047].
- Send-Message-Data: A sequence of bytes comprising a DRS Remote Protocol message, as specified in section 2.2.1. The extension does not alter or interpret the content of the message during subsequent send processing.
- Send-Message-Type: The value dictates the type of the message to send, either Request type or Response type.
- Send-Frame-Type: The value dictates the type of frame that is constructed, either **MAIL_REP_MSG_V1** type or **MAIL_REP_MSG_V2** type. The size of the **MAIL_REP_MSG_V1** and **MAIL_REP_MSG_V2** structures are defined by the following constants.
  - MINIMUM_SIZE_OF_MAIL_REP_MSG_V1: The **MAIL_REP_MSG_V1** structure is at least 32 bytes in length.
  - MINIMUM_SIZE_OF_MAIL_REP_MSG_V2: The **MAIL_REP_MSG_V2** structure is at least 40 bytes in length.
- Send-Compression-Algorithm: The value dictates the compression method that is used when compressing the message. The value is type DRS_COMP_ALG_TYPE, as specified in [MS-DRSR] section 4.1.10.2.14.
- Send-Message-Version: A 32-bit integer quantity provided by the DRS Remote Protocol layer that identifies the DRS structure version associated with Send-Message-Data. The value MUST be the structure version number specified in section 2.2.2. The extension inserts this value into the extension frame without interpretation.
- Send-Commentary: This value is a sequence of Unicode characters provided by the DRS Remote Protocol layer. This value represents a human-readable descriptive summary of the intent of the message. This particular value is implementation-specific.

This document uses the following working variables to represent intermediate representations of Send-Message-Data between processing steps.

- Send-Message-Serialized-Data
- Send-Message-Compressed-Data
- Send-Message-Data-Authenticated
- Send-Message-Payload
- Send-Message-Frame

Each variable represents a separate, contiguously allocated buffer.

### 3.2.2 Timers

None.

### 3.2.3 Initialization

None.

### 3.2.4 Higher-Layer Triggered Events

The Directory Replication Service (DRS) Remote Protocol layer invokes the DRS Protocol Extensions for SMTP after the construction of the DRS Protocol message, as follows:

- The DC, in the client role, is sending a request message. The DRS layer invokes the send processing steps at the point indicated in the text of "Client Send Behavior," as specified in [MS-DRSR] section 4.1.10.4.
- The DC, in the server role, has received a request message, completed processing of the request, and is sending a response message. The DRS Protocol layer invokes the send-processing steps at the point indicated in the text of "Server Behavior," as specified in [MS-DRSR] section 4.1.10.5.

#### 3.2.4.1 Serialization Processing

The DRS Protocol Extensions for SMTP MUST perform the following data marshaling procedure on the DRS Protocol message in the Send-Message-Data byte stream. The extension MUST encode the Send-Message-Data byte stream as an RPC IDL structured type by using the RPC Extension "Type Serialization Version 1," as specified in [MS-RPCE] section 2.2.6. (For additional examples, see [MSSS].) The result is Send-Message-Serialized-Data.

#### 3.2.4.2 Compression Processing

The DRS Protocol Extensions for SMTP SHOULD perform the following data compression procedure on the Send-Message-Serialized-Data byte stream. When compressing, the extension MUST compress the sequence of bytes comprising the Send-Message-Serialized-Data byte stream according to the DRS compression algorithm indicated by the value of the Send-Compression-Algorithm working variable. <12>

DecompressMessage (as specified in [MS-DRSR] section 4.1.10.6.18) specifies the relationship between compressed and uncompressed data for the DRS compression algorithms by detailing the processing steps for decompression. After the data is compressed, the result is the Send-Message-Compressed-Data byte stream.

#### 3.2.4.3 Cryptographic Processing

The DRS Protocol Extensions for SMTP MUST perform a certificate service (as specified in [MS-WCCE]) cryptographic operation on the Send-Message-Compressed-Data byte stream. All cryptographic operations MUST employ the **Abstract Syntax Notation One (ASN.1)** encoding, as specified in [MS-WCCE].

The certificate-based cryptographic operation consists of a conditional encryption step followed by an unconditional message-signature step. The extension MUST perform encryption on response messages and MUST NOT perform encryption on request messages.

If the value of the Send-Message-Type working variable indicates the message is of type Response, the implementation MUST encrypt the compressed data prior to signing, as follows:

- The abstract working variable Send-Recipient-Certificate MUST be set to the value of SMTP-ADDR-DC-CERT-MAP (Send-Recipient-Mail-Address). Implementations make the certificate available in the map by either populating the certificate at initialization time or populating the certificate during previous receive-processing (see section 3.3.5.3).
- The extension MUST invoke certificate-based cryptographic encryption on the Send-Message-Compressed-Data byte stream by using either the RSA RC4 encryption algorithm or the AES128 encryption algorithm and the Send-Recipient-Certificate, as specified in [SCHNEIER]. <13>
- The extension MUST use the encrypted result as the input to the subsequent signature operation.

For a Response message, the result of the encryption step defined above MUST be cryptographically signed. For Request messages, the Send-Message-Compressed-Data byte stream MUST be cryptographically signed. The result of the cryptographic signature operation MUST be in "PKCS #7 Format" as specified in [RFC2315]. The hash function used in the signature operation MUST be either RSA MD5 or SHA256. <14> The result MUST include Local-DC-Certificate in the list of associated certificates. The result of the signing operation is the Send-Message-Data-Authenticated byte stream.

#### 3.2.4.4 Frame Message Processing

The following specifies the layout of the two defined frames in sections 2.2.3 and 2.2.4.

The variable Send-Frame-Type identifies the kind of frame that is required. The frame MUST be constructed according to the rules specified for that frame using the information that is provided in the abstract interface variables. The Send-Compression-Algorithm is used as the **CompressionVersionCaller** field. The Send-Message-Data-Authenticated byte stream is used as the Send-Message-Payload. If the Send-Frame-Type indicates type **MAIL_REP_MSG_V2**, the current value of DRS_EXTENSION (as specified in [MS-DRSR]) MUST be inserted into the frame, as specified in section 2.2.4. The result is the Send-Message-Frame byte stream.

#### 3.2.4.5 Lower-Layer SMTP MTA Interaction

An SMTP message (as specified in [RFC2822]) is prepared as follows.

- The **To** field MUST be equal to the Send-Recipient-Mail-Address string variable.
- The **Subject** field MUST be computed by prepending the Unicode string "Intersite message for NTDS Replication:" to the Send-Commentary string variable. Unicode MIME support for SMTP header fields is as specified in [RFC2047].
- The following MIME options (as specified in [RFC2045]) MUST be set in the headers of the SMTP message.
  - MIME-Version: 1.0 or higher
  - Content-Transfer-Encoding: **base64**
  - Content-Type: image/gif
- The Send-Message-Frame byte stream MUST be encoded with MIME **base64**-encoding [RFC2045].
- The **base64**-encoded Send-Message-Frame byte stream MUST be used as the body of the SMTP message.

The SMTP message is given to the SMTP MTA and directs it to perform a send operation to the address specified by the Send-Recipient-Mail-Address string variable.<15>

### 3.2.5 Message Processing Events and Sequencing Rules

The lower-layer SMTP delivery agent MAY return DSNs for previously sent messages.<16>

### 3.2.6 Timer Events

None.

### 3.2.7 Other Local Events

The lower-layer SMTP MTA delivers SMTP messages on its own schedule using whatever network transport that it selects.

## 3.3 Receiving Role Details

This section specifies the behavior of the DRS Protocol Extensions for SMTP when the SMTP MTA receives an SMTP message. This section also defines the behavior for both servers and clients.

### 3.3.1 Abstract Data Model

This section defines the working variables that are used when performing in the receiving role. The following working variables are populated during frame decoding, as described in subsequent sections.

- Sender-Mail-Address: This variable holds an opaque Unicode string that contains the SMTP mail address of the sender. The extension populates this field during the steps provided in 3.3.5.1.
- Received-Message-Type: This variable indicates the type of message, which is either Request type or Response type.
- Received-Compression-Method: This variable indicates the type of compression used by the sender. The value is type **DRS_COMP_ALG_TYPE**, as specified in [MS-DRSR] section 4.1.10.2.14. The extension populates this field during the steps provided in section 3.3.5.2.
- Sender-DC-Certificate: This variable holds the **certificate** of the sending DC, as obtained during the cryptographic operation described in section 3.3.5.3.

The extension uses the following working variables to communicate intermediate data buffers between processing steps.

- Receive-Frame
- Receive-Data
- Receive-Message-Verified-Data
- Receive-Message-Deserialized-Data

Each variable represents a separate, contiguously allocated buffer. Each processing step defines the method of construction and specifies internal field alignment requirements, if any.

### 3.3.2 Timers

None.

### 3.3.3 Initialization

None.

### 3.3.4 Higher-Layer Triggered Events

There are no higher-layer triggered events for this role. The lower-layer SMTP MTA delivers messages to the DRS Protocol Extensions for SMTP, as described in the next section.

### 3.3.5 Message Processing Events and Sequencing Rules

Message processing in the DRS Protocol Extensions for SMTP begins when the SMTP MTA delivers an SMTP message to the server process for the DRS Protocol Extensions for SMTP. This operation MUST validate the frame that is received from the SMTP MTA, decode the frame into its constituent fields, and pass the resulting DRS data to the DRS Remote Protocol layer.

#### 3.3.5.1 SMTP Header Processing

The SMTP message MUST meet the following criteria. If any of the criteria are not met, the SMTP message MUST be dropped, and it MAY be logged. The SMTP header fields are specified in [RFC2822].

- The **To** field of the SMTP message MUST contain a single recipient, the Local-DC-Mail-Address.
- The SMTP message MUST contain a body section.
- The body of the message MUST use the following MIME options (as specified in [RFC2045]): Content-Transfer-Encoding = **base64**, Content-Type = image/gif.
- The **Subject** field MUST begin with the Unicode characters "Intersite message for NTDS Replication:"<17>

If all criteria are met, the contents of the SMTP message **From** field MUST be placed in the Sender-Mail-Address working variable. The body from the SMTP message MUST be extracted and the **base64**-encoding MUST be decoded. The decoded result is Receive-Frame.

#### 3.3.5.2 Frame Message Processing

The implementation MUST ensure the validity of the Receive-Frame byte stream contents prior to their use. If any of the frame validation constraints described in section 3.3.5.6 are not met, the Receive-Frame MUST be dropped.

The contents of the Receive-Frame byte stream MUST be used from the byte that begins at **cbDataOffset** for **cbDataSize** bytes as the Receive-Data payload.

The extension SHOULD set the working variable Received-Message-Type as follows.<18>

- If **dwMsgType** flag RQ is set, Received-Message-Type equals Request.
- If **dwMsgType** flag RP is set, Received-Message-Type equals Response.

The extension SHOULD set the working variable Received-Compression-Method to the value of frame field **CompressionVersionCaller**.

### 3.3.5.3 Cryptographic Processing

The extension MUST perform a certificate service [MS-WCCE] cryptographic operation on the Receive-Data. All cryptographic operations MUST employ the Abstract Syntax Notation One (ASN.1) encoding, as specified in [MS-WCCE].

The Receive-Data value MUST be a structure of type "PKCS #7 Format" as specified in [RFC2315] section 2.2.2.6.2.

The PKCS7 structure MUST contain a set of associated certificates that have been provided by the sender for the benefit of the receiver. The list of associated certificates MUST contain one Domain Controller certificate, as specified in section 2.3. This certificate is the Sender-DC-Certificate.

The validity of the Sender-DC-Certificate, MUST be verified as specified in section 3.3.5.7. If the Sender-DC-Certificate is not valid, the Receive-Frame MUST be dropped.

Certificate-based cryptographic operation consists of an unconditional signature verification step, followed by a conditional decryption step. An implementation MUST perform decryption on response type messages and MUST NOT perform decryption on request type messages.

The implementation MUST perform the signature verification operation on Receive-Data. The hash function that is used in the signature operation MUST be either RSA MD5 or SHA256, the choice of which is defined by "PKCS #7". If the verification fails, the implementation MUST discard the message. <19>

If Received-Message-Type indicates a Response, the cryptographically verified data MUST next be decrypted. The decryption algorithm MUST be either RSA RC4 or AES128, the choice of which is defined by "PKCS #7" and uses the Local-DC-Certificate. <20> The resulting plaintext is the Receive-Message-Verified-Data.

If Received-Message-Type indicates a Request, the verified data is the Receive-Message-Verified-Data.

The implementation MUST add an entry to SMTP-ADDR-DC-CERT-MAP if Received-Message-Type is Request. The entry takes the form <Sender-Mail-Address, Sender-DC-Certificate>.

If Received-Message-Type is Response, the sender's certificate MAY be included in SMTP-ADDR-DC-CERT-MAP.<21>

When the implementation updates the map, the following semantics are used: The abstract state SMTP-ADDR-DC-CERT-MAP(Sender-Mail-Address) MUST be set equal to the Sender-Certificate, and any value previously stored MUST be overwritten.

### 3.3.5.4 Decompression and Deserialization Processing

The order of operations is a decompression step, followed by a data-unmarshaling step.

The decompression method indicated by the Received-Compression-Method working variable MUST be applied. Reference "DecompressMessage," ([MS-DRSR] section 4.1.10.6.18) specifies the relationship between compressed and uncompressed data for the DRS compression algorithms by detailing the processing steps for decompression.

The expanded result MUST be deserialized as an RPC IDL structured type by using Microsoft RPC Extension "Type Serialization Version 1," as specified in [MS-RPCE] section 2.2.6. The result is the Receive-Message-Deserialized-Data byte stream.

#### 3.3.5.5 Higher-Layer DRS Protocol Interaction

The Receive-Message-Deserialized-Data byte stream is provided to the DRS Protocol layer for further interpretation.

The DRS Protocol Extensions for SMTP passes operation to the DRS Protocol layer at the following processing points.

- If the value of the Received-Message-Type working variable indicates that this is a Request, the DRS Protocol layer server-role processing MUST commence as specified in "Server Behavior," [MS-DRSR] section 4.1.10.5.
- If the value of the Received-Message-Type working variable indicates that this is a Response, DRS client-role processing MUST commence as specified in "Client Receive Behavior," [MS-DRSR] section 4.1.10.6.

#### 3.3.5.6 Extension Frame Decoding and Validation

This section defines specific frame validation constraints. The implementation MUST discard frames that are not valid.

The Receive-Frame is a **MAIL_REP_MSG_V1** type if the **cbDataOffset** field is 0, or if the **cbDataOffset** field is 32 and the **dwMsgVersion** field is either 0x00000001 or 0x00000004. To be a valid **MAIL_REP_MSG_V1**, it MUST meet the following constraints.<22>

- **ProtocolVersionCaller** is equal to **CURRENT_PROTOCOL_VERSION**.
- One and only one of the **dwMsgType** RP or RQ header flags is set.
- **CompressionVersionCaller** is a member of **DRS_COMP_ALG_TYPE**.
- **cbDataOffset** is equal to 0 or 32.
- Receive-Frame length is greater than or equal to MINIMUM_SIZE_OF_MAIL_REP_MSG_V1 + **cbDataSize**

The Receive-Frame is a **MAIL_REP_MSG_V2** type if **dwMsgVersion** is either 0x00000006 or 0x00000007. To be a valid **MAIL_REP_MSG_V2** frame, it MUST meet the following constraints.

- **ProtocolVersionCaller** is equal to **CURRENT_PROTOCOL_VERSION**.
- One and only one of the **dwMsgType** RP or RQ header flags is set.
- **CompressionVersionCaller** is a member of **DRS_COMP_ALG_TYPE**.
- **cbDataOffset** is not equal to 0.
- **cbDataOffset** is 8-byte-aligned.
- **cbExtOffset** is 8-byte-aligned.
- Receive-Frame length is equal to **cbDataOffset** + **cbDataSize**
- **cbExtOffset** is less than **cbDataOffset**.

- **cbExtOffset** is greater than or equal to MINIMUM_SIZE_OF_MAIL_REP_MSG_V2
- **cbDataOffset** - **cbExtOffset** is greater than or equal to size of DRS_EXTENSIONS_INT.

Note that MINIMUM_SIZE_OF_MAIL_REP_MSG_V1 and MINIMUM_SIZE_OF_MAIL_REP_MSG_V2 are specified in section 3.2.1.

If the Receive-Frame is neither a **MAIL_REP_MSG_V1** nor a **MAIL_REP_MSG_V2**, it MUST be considered not valid.

#### 3.3.5.7 Certificate Post-Processing

The Sender-Domain Controller-Certificate value, as a Domain Controller **Certificate** (section 2.3), MUST contain the GUID of an **Active Directory** object.

The receiving DC MUST verify the following:

- That the GUID identifies an **Active Directory** object of type Computer object (section 2.4.1). The Computer object MUST NOT be in the deleted object state.
- That the Computer object is acting in the DC state, as determined by the userAccountControl Bits, as specified in [MS-DRSR] section 5.202.
- That there is an **Active Directory** object of type Server object (section 2.4.2) associated with the Computer object. The Server object MUST NOT be in the deleted state.
- That the Server object has a child object, which is the DRS replication agent NTDSDSA object (section 2.4.3) for the DC.

When the receiving DC makes this determination, it MUST use information in its local NC replicas. The receiving DC MAY establish this correspondence and conduct a liveness check by using implementation-specific references between the Computer object in a domain NC, which might or might not be present locally as an NC replica, and the Server object in the configuration NC, which is held locally.<23>

### 3.3.6 Timer Events

None.

### 3.3.7 Other Local Events

The lower-layer SMTP MTA receives SMTP messages on its own schedule. This document does not specify the configuration or operation of the SMTP MTA.

# 4 Protocol Examples

This section illustrates the operation of the DRS Protocol Extensions for SMTP specified in this document by tracing the steps of a single DRS Remote Protocol, as specified in [MS-DRSR] exchange that is transported over the DRS Protocol Extensions for SMTP. The section describes the SMTP message that carries the DRS request and includes a decoding of the DRS Protocol Extensions for SMTP frame inside that SMTP message. Section 4.4 provides guidance about how to set up a test case in which DCs use the DRS Protocol Extensions for SMTP.

## 4.1 Data Transfer Via SMTP Replication

A single SMTP replication operation consists of four sub-operations as follows. Note that for the purposes of this section, the "client" is the DC that is requesting replicated data from a "server."

1. The client sends a request. The DRS engine hands the extension a BLOB that contains a "get changes" request. The extension performs the higher-layer triggered operation (section 3.2.4), encoding the request BLOB as a frame. The frame is then handed to the SMTP service. The frame, as an attachment to an SMTP mail message, is sent to the server.

2. The server receives the request. The SMTP service receives the mail message from the client and gives the frame to the extension. The extension performs the message processing operation (section 3.3.5), and then passes the BLOB to the DRS engine, which processes the request.

3. The server sends the response. After it processes the request, the DRS engine generates another DRS BLOB, which contains the response. The extension performs the higher-layer triggered operation and then passes the response to the SMTP service. The SMTP service sends the message to the client as an attachment to an SMTP mail message.

4. The client receives the response. The SMTP service receives the mail message from the client and gives the frame to the extension. The extension performs the message processing operation and then passes the BLOB to the DRS engine, which processes the response.

For the purpose of this example, DC1 (the "server") and DC3 (the "client") exist as described previously, configured for SMTP replication.

## 4.2 Sample SMTP Message

The following is a sample SMTP message that contains a DRS request message from DC3 to DC1. The FQDN of the machines as registered in DNS are d2975006-04cb-4f9d-b797-0c1df78f16d6._msdcs.ddsys7x28.nttest.microsoft.com and daae90dd-b957-4671-a9ae-9fc3c0f2f446._msdcs.ddsys7x28.nttest.microsoft.com, respectively.

The headers for the SMTP message are as follows.

```
From: <_IsmService@d2975006-04cb-4f9d-b797-
0c1df78f16d6._msdcs.ddsys7x28.nttest.microsoft.com>
To: <_IsmService@daae90dd-b957-4671-a9ae-9fc3c0f2f446._msdcs.ddsys7x28.nttest.microsoft.com>
Subject: Intersite message for NTDS Replication: Get changes request for NC
CN=Configuration,DC=ddsys7x28,DC=nttest,DC=microsoft,DC=com from USNs <22749/OU, 22749/PU>
with flags 0x300008d0
MIME-Version: 1.0
Content-Type: image/gif
Content-Transfer-Encoding: base64

AAAAAAsAAABIAAAAIA8AAAAAAAAgAgAAAQAAIAcAAAB/+/8fKAAAABwAAAB/+/8fFqqQfy2BLUKd
8GfV2VzRhrgCAAAAAAAAMIIPHAYJKoZIhvcNAQcCoIIPDTCCDwkCAQExDjAMBggqhkiG9w0CBQUA
```

```
MIICMwYJKoZIhvcNAQcBoIICJASCAiABEAg [rest of message elided]
```

## 4.3 DRS Protocol Extensions for SMTP Transport Frame

The following is the actual mail attachment from the sample SMTP message described in section 4.2 after **base64** decoding.

```
# offset:   value    comments

# MAIL_REP_MSG_V2 header
00000000: 0000 0000 CompressionVersionCaller (0)
00000004: 0b00 0000 ProtocolVersionCaller (11)
00000008: 4800 0000 cbDataOffset (72)
0000000c: 540d 0000 cbDataSize (3412)
00000010: 0000 0000 cbUncompressedDataSize (0)
00000014: d801 0000 cbUnsignedDataSize (472)
00000018: 0100 0020 dwMsgType (10000000000000000000000000000010) b0..31
0000001c: 0700 0000 dwMsgVersion (7)
00000020: 7ffb ff1f dwExtFlags
00000024: 2800 0000 cbExtOffset (40)

# begin DRS_EXTENSIONS extension vector
00000028: 1c00 0000
0000002c: 7ffb ff1f
00000030: e865 14d9
00000034: 5cbd 5c44
00000038: b776 dbcd
0000003c: e1db 2aec
00000040: b001 0000

# padding inserted according to section
CNDJ6nn5us4RjIIAqgBLqQsCAAAACAAAAA4AAABfAFIAZQBmADEANAAwADUANAA3ADMAMgAzAAAA
2.2.4
00000044: 0000 0000

# begin payload data
# offset:   value                                 value as ASCII char
00000048: 3082 0d50 0609 2a86                      0..P..*.
00000050: 4886 f70d 0107 02a0 820d 4130 820d 3d02  H.........A0..=.
00000060: 0101 310e 300c 0608 2a86 4886 f70d 0205  ..1.0...*.H.....
# the payload data is the SMTP-Message-Data-Authenticated
# as defined in section
CNDJ6nn5us4RjIIAqgBLqQsCAAAACAAAAA4AAABfAFIAZQBmADEANAAwADgANQA4ADEANQAxAAAA
3.2.1 above.  It is elided here.
00000d80: 1319 130e a38f be9c b97f b272 14f5 4f85  ...........r..O.
00000d90: 7a89 f8f2 b482 ac4c 4306 3dc5            z......LC.=.
# end payload data
```

## 4.4 Configuring SMTP Replication

As an aid for implementers who are attempting to set up and test the DRS Protocol Extensions for SMTP, this section provides an example of how to configure SMTP replication between two DCs. In the example, replication occurs between two DCs that are in the same forest, but in two different sites and domains. Only the configuration and schema partitions (which are common to all domains in the forest) are replicated via SMTP replication.

The relevant information with respect to the two DCs is as follows:

- DC1
  - Domain controller name: DC1
  - Domain: dc=corp,dc=contoso,dc=com
  - Site: firstsite
- DC3
  - Domain controller name: DC3
  - Domain: dc=remote,dc=corp,dc=contoso,dc=com
  - Site: remotesite

With the DCs configured as described here, create a new site link with SMTP as the transport. Place both DCs in that site link. Be sure that any other site links that also contain the two DCs have a cost greater than that of the SMTP site link.

# 5 Security

## 5.1 Security Considerations for Implementers

As specified in sections 2.2.3, 2.2.4, and 3, information such as whether the message is a request or a response and which message version is present in both the DRS Protocol Extensions for SMTP headers and inside the serialized DRS message. The fields in the DRS Protocol Extensions for SMTP headers are sent without encryption or authentication, and they are subject to potential snooping and **tampering**. The implementation must consider that all header fields are potentially not valid until verified; in particular, the values of **cbDataOffset** and **cbExtOffset** must be validated to fall within the extent of the PayloadData. The implementation must ensure that buffer under-run, buffer over-run, or integer arithmetic overflow do not occur during decoding and subsequent processing of the frame.<24>

When data is encrypted, the **key length** that is used is determined by the length of the public key in the recipient's **certificate**. The Domain Controller Replication **certificate** has a public key length of 56-bits and the Domain Controller Email **certificate** has a public key length of 128 bits.<25>

## 5.2 Index of Security Parameters

| Security parameter | Section |
|---|---|
| Encryption key length 56 Rc4AuxInfo.dwBitLen = 56 | 3.2.4.3 |
| Encryption key length 128 Rc4AuxInfo.dwBitLen = 128 | 2.3.2 and 3.2.4.3 |
| **Certificate** message signing | 3.2.4.3 |
| **Certificate** message sealing | 3.2.4.3 |
| Hash function szOID_RSA_MD5 | 3.2.4.3 |
| (PKCS_7_ASN_ENCODING \| CRYPT_ASN_ENCODING) | 3.2.4.3 |
| Encryption algorithm szOID_RSA_RC4 | 3.2.4.3 |

# 6 Appendix A: Product Behavior

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

- Windows 2000 operating system
- Windows Server 2003 operating system
- Windows Server 2008 operating system
- Windows Server 2008 R2 operating system
- Windows Server 2012 operating system
- Windows Server 2012 R2 operating system

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

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

<1> Section 1.5: The Windows implementation uses the Microsoft SMTP service (SMTPSVC) as the delivery agent. SMTPSVC is an optional component in the Windows Server package. The SMTP service is independent of Microsoft Exchange; it is a stand-alone service with functionality similar to Sendmail.

<2> Section 2.1: DCs that are running Windows automatically initialize the **mailAddress** field. DCs that are running Windows set the local-part of the mail address to the mail recipient named "_IsmService". DCs that are running Windows register a secondary domain for themselves in DNS by using the GUID of their NTDSA object (as specified in [MS-ADTS]) as the most specific label. The format of the **GUID-based DNS name** for a DC is as specified in [MS-ADTS]. DCs that are running Windows use this GUID-format DNS alias in the domain portion in their mailAddress.

<3> Section 2.1: A DC that is running Windows logs SMTP delivery status notifications (DSNs) for DRS Protocol Extensions for SMTP messages in the Windows Event Log.

<4> Section 2.2.3: As a sender, Windows 2000 can set the **CompressionVersionCaller** field to DRS_COMP_ALG_MSZIP in a V1 frame with a non-compressed payload. As a receiver, if the CP bit of the **dwMsgType** header field is 0 in a V1 frame, then Windows 2000, Windows Server 2003, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 treat the **CompressionVersionCaller** field of such frame as if it were set to DRS_COMP_ALG_NONE.

<5> Section 2.2.3: Windows 2000 systems set the **cbDataOffset** field to 0 in a V1 frame. Windows Server 2003, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 systems set the **cbDataOffset** field to 32 in a V1 frame. However, Windows Server 2003, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 systems accept V1 frames with **cbDataOffset** equal to 0, or with **cbDataOffset** equal to 32.

<6> Section 2.2.3: As a sender, Windows 2000 can set the **dwMsgVersion** field of a V1 frame to 0x00000000. Upon reception of a V1 frame with the **cbDataOffset** field set to 0, Windows 2000, Windows Server 2003, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 use the RP and RQ bits of the **dwMsgType** field to determine the message version using the following logic.

- If the RP bit in the **dwMsgType** field is 1, then the payload is a DRS_MSG_GETCHGREPLY_V1 message.
- If the RQ bit in the **dwMsgType** field is 1, then the payload is a DRS_MSG_GETCHGREQ_V4 message.

<7> Section 2.3: A DC running Windows 2000 Server can process messages sent to it that use either type of **certificate** (Domain Controller Replication or Directory Email Replication); however, it will send only requests that use a Domain Controller Replication **certificate**. A DC that is running Windows Server 2003, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, or Windows Server 2012 R2 can process messages sent to it that use either type of **certificate**. When sending requests, a DC running Windows Server 2003, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, or Windows Server 2012 R2 prefers the Directory Email Replication **certificates** over the DC Replication **certificates**, if both are available. The type of **certificate** that is used when sending a request does not depend on the operating system of the receiving DC. As specified below, the **certificate** that is used to sign the request is sent by the client as part of the request, and is used by the server to encrypt the response.

<8> Section 2.3.1: A computer running Windows Server will use Domain Controller Replication **certificates** that contain the following X.509v3 extensions specific to Windows.

- Certificate template name
- OID = 1.3.6.1.4.1.311.21.6.
- The **certificate** has the template name extension with the value "DomainController" encoded in BMPSTRING format, as specified in [MS-WCCE] and [UNICODE4.0].

For more information about certificate template names and certificate templates, see [MSFT-TEMPLATES].

<9> Section 2.3.2: A computer running Windows Server will use Directory Email Replication **certificates** that contain the following X.509v3 extensions specific to Windows.

- Application Policies (Policy Identifier = Directory Email Replication Agent)
- **Certificate** template information
- Template = Directory email Replication(1.3.6.1.4.1.311.21.8.3692315854.1256661383.1690418588.4201632533.1.29)
- Major version number
- Minor version number

<10> Section 2.4.3: The Windows implementation registers in the DNS a secondary host name for the DC that is based on the GUID of its nTDSDSA object. This alias is the GUID-based DNS name. The Windows implementation uses the GUID-based DNS name in the domain field of its mailAddress.

<11> Section 3.1.3: The Windows implementation adds dictionary entries for partner DCs dynamically during operation.

<12> Section 3.2.4.2: In the Windows implementation, if the size of the Send-Message-Serialized-Data byte stream is less than 1024 bytes, the message is not compressed.

<13> Section 3.2.4.3: For encryption, by default, Windows Server 2008 uses the AES128 encryption algorithm, but it can be configured to use the RSA RC4 encryption algorithm. The configuration mechanism is outside the scope of the protocol.

For decryption, Windows Server 2008 uses the algorithm from the messages as specified in "PKCS #7 format" [RFC2315] and is able to decrypt messages sent by Windows 2000 or Windows Server 2003. Windows 2000 and Windows Server 2003 use the RSA RC4 encryption algorithm and are only able to decrypt messages encrypted using the RSA RC4 encryption algorithm, so if the format in "PKCS #7" is set to AES128 encryption, the messages cannot be decrypted.

<14> Section 3.2.4.3: For signing, by default, Windows Server 2008 uses the SHA256 hashing algorithm, but it can be configured to use the MD5 hashing algorithm. The configuration mechanism is outside the scope of the protocol.

For signature verification, Windows Server 2008 uses the algorithm from the messages as specified in "PKCS #7 format" [RFC2315] and is able to verify the signature sent by Windows 2000 or Windows Server 2003. Windows 2000 and Windows Server 2003 use the MD5 hashing algorithm for signing and are only able to verify the signatures in messages that use the MD5 hashing algorithm for signing, so if the format in "PKCS #7" is set to SHA256, they will fail verification.

<15> Section 3.2.4.5: Domain controllers running Windows use the following strings as the format for the Send-Commentary field: The DRS layer fills the field "%ws" with the Unicode name of the NC replica, and fills the "%I64d" fields with the unsigned 64-bit quantities taken from USN_VECTOR, as specified in [MS-DRSR] 5.206.

"Get changes request for NC %ws from USNs <%I64d/OU, %I64d/PU> with flags 0x%x".

"Get changes reply for NC %ws from USNs <%I64d/OU, %I64d/PU> to USNs <%I64d/OU, %I64d/PU>".

<16> Section 3.2.5: The Windows SMTPSVC component returns DSNs. DSNs that indicate a failure are logged.

<17> Section 3.3.5.1: A DC running Windows logs SMTP DSNs for DRS Protocol Extensions for SMTP Transport messages in the Windows Event Log.

<18> Section 3.3.5.2: As a sender, Windows 2000 can set the **CompressionVersionCaller** field to DRS_COMP_ALG_MSZIP in a V1 frame with a non-compressed payload. As a receiver, if the CP bit of the **dwMsgType** header field is 0 in a V1 frame, then Windows 2000, Windows Server 2003, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 treat the **CompressionVersionCaller** field of such frame as if it were set to DRS_COMP_ALG_NONE.

<19> Section 3.3.5.3: For signing, by default, Windows Server 2008 uses the SHA256 hashing algorithm, but it can be configured to use the MD5 hashing algorithm. The configuration mechanism is outside the scope of the protocol.

For signature verification, Windows Server 2008 uses the algorithm from the messages as specified in "PKCS #7 format" [RFC2315] and is able to verify the signature sent by a Windows 2000 or Windows Server 2003. Windows 2000 and Windows Server 2003 use the MD5 hashing algorithm for

signing and are only able to verify the signatures in messages that use the MD5 hashing algorithm for signing, so if the format in "PKCS #7" is set to SHA256, they will fail verification.

<20> Section 3.3.5.3: For encryption, by default, Windows Server 2008 uses the AES128 encryption algorithm, but it can be configured to use the RSA RC4 encryption algorithm. The configuration mechanism is outside the scope of the protocol.

For decryption, Windows Server 2008 uses the algorithm from the messages as specified in "PKCS #7 format" [RFC2315] and is able to decrypt messages sent by a Windows 2000 or Windows Server 2003. Windows 2000 and Windows Server 2003 use the RSA RC4 encryption algorithm and are only able to decrypt messages encrypted using the RSA RC4 encryption algorithm, so if the format in "PKCS #7" is set to AES128 encryption, the messages cannot be decrypted.

<21> Section 3.3.5.3: In the case of a Response, the Windows implementation does not add the sender's certificate to the map.

<22> Section 3.3.5.6: As a sender, Windows 2000 can set the **dwMsgVersion** field of a V1 frame to 0x00000000. Upon reception of a V1 frame with the **cbDataOffset** field set to 0, Windows 2000, Windows Server 2003, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 use the RP and RQ bits of the **dwMsgType** field to determine the message version using the following logic:

- If the RP bit in the **dwMsgType** field is 1, then the payload is a DRS_MSG_GETCHGREPLY_V1 message.
- If the RQ bit in the **dwMsgType** field is 1, then the payload is a DRS_MSG_GETCHGREQ_V4 message.

<23> Section 3.3.5.7: The Windows implementation uses the value of the **serverReferenceBl** attribute of the Server object in the configuration NC to establish this correspondence.

<24> Section 5.1: The Microsoft implementation validates the fields in the DRS Protocol Extensions for SMTP headers, but these fields are used only until the DRS message is authenticated, decrypted, and unmarshaled. After that, the data in the headers of the DRS Protocol Extensions for SMTP is no longer needed and is ignored.

<25> Section 5.1: All request messages sent by DCs that are running Windows 2000 include a Domain Controller Replication **certificate**; therefore, the response will be encrypted with a 56-bit key. Response data to a DC that is running Windows Server 2003, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, or Windows Server 2012 R2 will be encrypted with either a 56-bit or a 128-bit key, depending on whether the DC has been configured with a Domain Controller Email **certificate** or Domain Controller Replication **certificate**.

# 7 Change Tracking

This section identifies changes that were made to the [MS-SRPL] protocol document between the January 2013 and August 2013 releases. Changes are classified as New, Major, Minor, Editorial, or No change.

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

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

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

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

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

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

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

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

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

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

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

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

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

| Section | Tracking number (if applicable) and description | Major change (Y or N) | Change type |
|---|---|---|---|
| 6 Appendix A: Product Behavior | Modified this section to include references to Windows Server 2012 R2 operating system. | Y | Content updated. |

# 8 Index

## T



## V