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RFC 8689
SMTP Require TLS Option

Abstract

The SMTP STARTTLS option, used in negotiating transport-level encryption of SMTP connections, is not as useful from a security standpoint as it might be because of its opportunistic nature; message delivery is, by default, prioritized over security. This document describes an SMTP service extension, REQUIRETLS, and a message header field, TLS-Required. If the REQUIRETLS option or TLS-Required message header field is used when sending a message, it asserts a request on the part of the message sender to override the default negotiation of TLS, either by requiring that TLS be negotiated when the message is relayed or by requesting that recipient-side policy mechanisms such as MTA-STS and DNS-Based Authentication of Named Entities (DANE) be ignored when relaying a message for which security is unimportant.

Status of This Memo

This is an Internet Standards Track document.

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Further information on Internet Standards is available in Section 2 of RFC 7841.

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Author's Address

1. Introduction

The SMTP [RFC5321] STARTTLS service extension [RFC3207] provides a means by which an SMTP server and client can establish a Transport Layer Security (TLS) protected session for the transmission of email messages. By default, TLS is used only upon mutual agreement (successful negotiation) of STARTTLS between the client and server; if this is not possible, the message is sent without transport encryption. Furthermore, it is common practice for the client to negotiate TLS even if the SMTP server's certificate is invalid.

Policy mechanisms such as DANE [RFC7672] and MTA-STS [RFC8461] may impose requirements for the use of TLS for email destined for some domains. However, such policies do not allow the sender to specify which messages are more sensitive and require transport-level encryption and which ones are less sensitive and ought to be relayed even if TLS cannot be negotiated successfully.

The default opportunistic nature of SMTP TLS enables several on-the-wire attacks on SMTP security between MTAs. These include passive eavesdropping on connections for which TLS is not used, interference in the SMTP protocol to prevent TLS from being negotiated (presumably accompanied by eavesdropping), and insertion of a man-in-the-middle attacker exploiting the lack of server authentication by the client. Attacks are described in more detail in the Security Considerations section of this document.

REQUIRETLS consists of two mechanisms: an SMTP service extension and a message header field. The service extension is used to specify that a given message sent during a particular session **MUST** be sent over a TLS-protected session with specified security characteristics. It also requires that the SMTP server advertise that it supports REQUIRETLS, in effect promising that it will honor the requirement to enforce TLS transmission and REQUIRETLS support for onward transmission of those messages.

The TLS-Required message header field is used to convey a request to ignore recipient-side policy mechanisms such as MTA-STS and DANE, thereby prioritizing delivery over ability to negotiate TLS. Unlike the service extension, the TLS-Required header field allows the message to transit through one or more MTAs that do not support REQUIRETLS.

1.1. Requirements Language

The key words "**MUST**", "**MUST NOT**", "**REQUIRED**", "**SHALL**", "**SHALL NOT**", "**SHOULD**", "**SHOULD NOT**", "**RECOMMENDED**", "**NOT RECOMMENDED**", "**MAY**", and "**OPTIONAL**" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

The formal syntax uses the Augmented Backus-Naur Form (ABNF) [RFC5234], including the core rules defined in Appendix B of that document.

2. The REQUIRETLS Service Extension

The REQUIRETLS SMTP service extension has the following characteristics:

1. The textual name of the extension is "Require TLS".
2. The EHLO keyword value associated with this extension is "REQUIRETLS".
3. No additional SMTP verbs are defined by this extension.
4. One optional parameter ("REQUIRETLS") is added to the MAIL FROM command by this extension. No value is associated with this parameter.
5. The maximum length of a MAIL FROM command line is increased by 11 octets by the possible addition of a space and the REQUIRETLS keyword.
6. One new SMTP status code is defined by this extension to convey an error condition resulting from failure of the client to send data to a server that does not also support the REQUIRETLS extension.
7. The REQUIRETLS extension is valid for message relay [RFC5321], submission [RFC6409], and the Local Mail Transfer Protocol (LMTP) [RFC2033].
8. The ABNF syntax for the MAIL FROM parameter is as follows:

```
requiretls-param  = "REQUIRETLS"
                  ; where requiretls-param is an instance of an
                  ; esmtp-param used in Mail-parameters in
                  ; RFC 5321, Section 4.1.2. There is no esmtp-value
                  ; associated with requiretls-param.
```

In order to specify REQUIRETLS treatment for a given message, the REQUIRETLS option is specified in the MAIL FROM command when that message is transmitted. This option **MUST** only be specified in the context of an SMTP session meeting the security requirements of REQUIRETLS:

- The session itself **MUST** employ TLS transmission.
- If the SMTP server to which the message is being transmitted is identified through an MX record lookup, its name **MUST** be validated via a DNSSEC signature on the recipient domain's MX record, or the MX hostname **MUST** be validated by an MTA-STS policy as described in Section 4.1 of [RFC8461]. DNSSEC is defined in [RFC4033], [RFC4034], and [RFC4035].
- The certificate presented by the SMTP server either **MUST** be verified successfully by a trust chain leading to a certificate trusted by the SMTP client, or it **MUST** be verified successfully using DANE, as specified in [RFC7672]. For trust chains, the choice of trusted (root) certificates is at the discretion of the SMTP client.
- Following the negotiation of STARTTLS, the SMTP server **MUST** advertise in the subsequent EHLO response that it supports REQUIRETLS.

3. The TLS-Required Header Field

One new message header field [RFC5322], TLS-Required, is defined by this specification. It is used for messages for which the originator requests that the recipient TLS policy (including MTA-STS [RFC8461] and DANE [RFC7672]) be ignored. This might be done, for example, to report a misconfigured mail server, such as an expired TLS certificate.

The TLS-Required header field has a single **REQUIRED** parameter:

- No - The SMTP client **SHOULD** attempt to send the message regardless of its ability to negotiate STARTTLS with the SMTP server, ignoring policy-based mechanisms (including MTA-STS and DANE), if any, asserted by the recipient domain. Nevertheless, the client **SHOULD** negotiate STARTTLS with the server if available.

More than one instance of the TLS-Required header field **MUST NOT** appear in a given message.

The ABNF syntax for the TLS-Required header field is as follows:

```
requiretls-field = "TLS-Required:" [FWS] "No" CRLF
        ; where requiretls-field in an instance of an
        ; optional-field defined in RFC 5322, Section 3.6.8.
FWS = <as defined in RFC 5322>
CRLF = <as defined in RFC 5322>
```

4. REQUIRETLS Semantics

4.1. REQUIRETLS Receipt Requirements

Upon receipt of the REQUIRETLS option on a MAIL FROM command during the receipt of a message, an SMTP server **MUST** tag that message as needing REQUIRETLS handling.

Upon receipt of a message not specifying the REQUIRETLS option on its MAIL FROM command but containing the TLS-Required header field in its message header, an SMTP server implementing this specification **MUST** tag that message with the option specified in the TLS-Required header field. If the REQUIRETLS MAIL FROM parameter is specified, the TLS-Required header field **MUST** be ignored but **MAY** be included in the onward relay of the message.

The manner in which the above tagging takes place is implementation dependent. If the message is being locally aliased and redistributed to multiple addresses, all instances of the message **MUST** be tagged in the same manner.

4.2. REQUIRETLS Sender Requirements

4.2.1. Sending with TLS Required

When sending a message tagged as requiring TLS for which the MAIL FROM return-path is not empty (an empty MAIL FROM return-path indicating a bounce message), the sending (client) MTA **MUST**:

1. Look up the SMTP server to which the message is to be sent, as described in [RFC5321], Section 5.1.
2. If the server lookup is accomplished via the recipient domain's MX record (the usual case) and is not accompanied by a valid DNSSEC signature, the client **MUST** also validate the SMTP server name using MTA-STS, as described in [RFC8461], Section 4.1.
3. Open an SMTP session with the peer SMTP server using the EHLO verb.
4. Establish a TLS-protected SMTP session with its peer SMTP server and authenticate the server's certificate as specified in [RFC6125] or [RFC7672], as applicable. The hostname from the MX record lookup (or the domain name in the absence of an MX record where an A record is used directly) **MUST** match the DNS-ID or CN-ID of the certificate presented by the server.
5. Ensure that the response to the subsequent EHLO following establishment of the TLS protection advertises the REQUIRETLS capability.

The SMTP client **SHOULD** follow the recommendations in [RFC7525] or its successor with respect to negotiation of the TLS session.

If any of the above steps fail, the client **MUST** issue a QUIT to the server and repeat steps 2-5 with each host on the recipient domain's list of MX hosts in an attempt to find a mail path that meets the sender's requirements. The client **MAY** send other, unprotected messages to that server if it has any such messages prior to issuing the QUIT. If there are no more MX hosts, the client **MUST NOT** transmit the message to the domain.

Following such a failure, the SMTP client **MUST** send a non-delivery notification to the reverse-path of the failed message, as described in Section 3.6 of [RFC5321]. The following status codes [RFC5248] **SHOULD** be used:

- REQUIRETLS not supported by server: 5.7.30 REQUIRETLS support required
- Unable to establish TLS-protected SMTP session: 5.7.10 Encryption needed

Refer to Section 5 for further requirements regarding non-delivery messages.

If all REQUIRETLS requirements have been met, transmit the message, issuing the REQUIRETLS option on the MAIL FROM command with the required option(s), if any.

4.2.2. Sending with TLS Optional

Messages tagged "TLS-Required: No" are handled as follows. When sending such a message, the sending (client) MTA **MUST**:

- Look up the SMTP server to which the message is to be sent, as described in [RFC5321], Section 5.1.
- Open an SMTP session with the peer SMTP server using the EHLO verb. Attempt to negotiate STARTTLS if possible, and follow any policy published by the recipient domain, but do not fail if this is unsuccessful.

Some SMTP servers may be configured to require STARTTLS connections as a matter of policy and not accept messages in the absence of STARTTLS. A non-delivery notification **MUST** be returned to the sender if message relay fails due to an inability to negotiate STARTTLS when required by the server.

Since messages tagged with "TLS-Required: No" will sometimes be sent to SMTP servers not supporting REQUIRETLS, that option will not be uniformly observed by all SMTP relay hops.

4.3. REQUIRETLS Submission

A Mail User Agent (MUA) or other agent making the initial introduction of a message has the option to decide whether to require TLS. If TLS is to be required, it **MUST** do so by negotiating STARTTLS and REQUIRETLS and including the REQUIRETLS option on the MAIL FROM command, as is done for message relay.

When TLS is not to be required, the sender **MUST** include the TLS-Required header field in the message. SMTP servers implementing this specification **MUST** interpret this header field as described in Section 4.1.

In either case, the decision whether to specify REQUIRETLS **MAY** be done based on a user interface selection or based on a ruleset or other policy. The manner in which the decision to require TLS is made is implementation dependent and is beyond the scope of this specification.

4.4. Delivery of REQUIRETLS messages

Messages are usually retrieved by end users using protocols other than SMTP such as IMAP [RFC3501], POP [RFC1939], or Web mail systems. Mail delivery agents supporting the REQUIRETLS SMTP option **SHOULD** observe the guidelines in [RFC8314].

5. Non-delivery Message Handling

Non-delivery ("bounce") messages usually contain important metadata about the message to which they refer, including the original message header. They therefore **MUST** be protected in the same manner as the original message. All non-delivery messages resulting from messages with the REQUIRETLS SMTP option, whether resulting from a REQUIRETLS error or some other issue, **MUST** also specify the REQUIRETLS SMTP option unless redacted as described below.

The path from the origination of an error bounce message back to the MAIL FROM address may not share the same REQUIRETLS support as the forward path. Therefore, users requiring TLS are advised to make sure that they are capable of receiving mail using REQUIRETLS as well. Otherwise, such non-delivery messages will be lost.

If a REQUIRETLS message is bounced, the server **MUST** behave as if RET=HDRS was present, as described in [RFC3461]. If both RET=FULL and REQUIRETLS are present, the RET=FULL **MUST** be disregarded. The SMTP client for a REQUIRETLS bounce message uses an empty MAIL FROM return-path, as required by [RFC5321]. When the MAIL FROM return-path is empty, the REQUIRETLS parameter **SHOULD NOT** cause a bounce message to be discarded even if the next-hop relay does not advertise REQUIRETLS.

Senders of messages requiring TLS are advised to consider the possibility that bounce messages will be lost as a result of REQUIRETLS return path failure and that some information could be leaked if a bounce message is not able to be transmitted with REQUIRETLS.

6. Reorigination Considerations

In a number of situations, a mediator [RFC5598] originates a new message as a result of an incoming message. These situations include but are not limited to mailing lists (including administrative traffic such as message approval requests), Sieve [RFC5228], "vacation" responders, and other filters to which incoming messages may be piped. These newly originated messages may essentially be copies of the incoming message, such as with a forwarding service or a mailing list expander. In other cases, such as with a vacation message or a delivery notification, they will be different but might contain parts of the original message or other information for which the original message sender wants to influence the requirement to use TLS transmission.

Mediators that reoriginate messages should apply REQUIRETLS requirements in incoming messages (both requiring TLS transmission and requesting that TLS not be required) to the reoriginated messages to the extent feasible. A limitation to this might be that for a message requiring TLS, redistribution to multiple addresses while retaining the TLS requirement could result in the message not being delivered to some of the intended recipients.

User-side mediators (such as use of Sieve rules on a user agent) typically do not have access to the SMTP details and therefore may not be aware of the REQUIRETLS requirement on a delivered message. Recipients that expect sensitive traffic should avoid the use of user-side mediators. Alternatively, if operationally feasible (such as when forwarding to a specific, known address), they should apply REQUIRETLS to all reoriginated messages that do not contain the "TLS-Required: No" header field.

7. IANA Considerations

Per this document, IANA has added the following keyword to the "SMTP Service Extensions" subregistry of the "Mail Parameters" registry [MailParams]:

EHLO Keyword:	REQUIRETLS
Description:	Require TLS
Syntax and parameters:	(no parameters)
Additional SMTP verbs:	none
MAIL and RCPT parameters:	REQUIRETLS parameter on MAIL
Behavior:	Use of the REQUIRETLS parameter on the MAIL verb causes that message to require the use of TLS and tagging with REQUIRETLS for all onward relay.
Command length increment:	11 characters

Per this document, IANA has added an entry to the "Enumerated Status Codes" subregistry of the "Simple Mail Transfer Protocol (SMTP) Enhanced Status Codes Registry" [SMTPStatusCodes]:

Code:	X.7.30
Sample Text:	REQUIRETLS support required
Associated basic status code:	550
Description:	This indicates that the message was not able to be forwarded because it was received with a REQUIRETLS requirement and none of the SMTP servers to which the message should be forwarded provide this support.
Reference:	RFC 8689
Submitter:	J. Fenton
Change Controller:	IESG

Per this document, IANA has added an entry to the "Permanent Message Header Field Names" subregistry of the "Message Headers" registry [MessageHeaders] as follows:

Header field name:	TLS-Required
Applicable protocol:	mail
Status:	standard
Author/change controller:	IETF
Specification document:	RFC 8689

8. Security Considerations

The purpose of REQUIRETLS is to give the originator of a message control over the security of email they send, either by conveying an expectation that it will be transmitted in an encrypted form over the wire or explicitly indicating that transport encryption is not required if it cannot be successfully negotiated.

The following considerations apply to the REQUIRETLS service extension but not the TLS-Required header field, since messages specifying the header field are less concerned with transport security.

8.1. Passive Attacks

REQUIRETLS is generally effective against passive attackers who are merely trying to eavesdrop on an SMTP exchange between an SMTP client and server. This assumes, of course, the cryptographic integrity of the TLS connection being used.

8.2. Active Attacks

Active attacks against TLS-encrypted SMTP connections can take many forms. One such attack is to interfere in the negotiation by changing the STARTTLS command to something illegal such as XXXXXXXX. This causes TLS negotiation to fail and messages to be sent in the clear, where they can be intercepted. REQUIRETLS detects the failure of STARTTLS and declines to send the message rather than send it insecurely.

A second form of attack is a man-in-the-middle attack where the attacker terminates the TLS connection rather than the intended SMTP server. This is possible when, as is commonly the case, the SMTP client either does not verify the server's certificate or establishes the connection even when the verification fails. REQUIRETLS requires successful certificate validation before sending the message.

Another active attack involves the spoofing of DNS MX records of the recipient domain. An attacker with this capability could potentially cause the message to be redirected to a mail server under the attacker's own control, which would presumably have a valid certificate. REQUIRETLS requires that the recipient domain's MX record lookup be validated either using DNSSEC or via a published MTA-STS policy that specifies the acceptable SMTP server hostname(s) for the recipient domain.

8.3. Bad-Actor MTAs

A bad-actor MTA along the message transmission path could misrepresent its support of REQUIRETLS and/or actively strip REQUIRETLS tags from messages it handles. However, since intermediate MTAs are already trusted with the cleartext of messages they handle, and are not part of the threat model for transport-layer security, they are also not part of the threat model for REQUIRETLS.

It should be reemphasized that since SMTP TLS is a transport-layer security protocol, messages sent using REQUIRETLS are not encrypted end-to-end and are visible to MTAs that are part of the message delivery path. Messages containing sensitive information that MTAs should not have access to **MUST** be sent using end-to-end content encryption such as OpenPGP [RFC4880] or S/MIME [RFC8551].

8.4. Policy Conflicts

In some cases, the use of the TLS-Required header field may conflict with a recipient domain policy expressed through the DANE [RFC7672] or MTA-STS [RFC8461] protocols. Although these protocols encourage the use of TLS transport by advertising the availability of TLS, the use of the "TLS-Required: No" header field represents an explicit decision on the part of the sender not to

require the use of TLS, such as to overcome a configuration error. The recipient domain has the ultimate ability to require TLS by not accepting messages when STARTTLS has not been negotiated; otherwise, "TLS-Required: No" is effectively directing the client MTA to behave as if it does not support DANE or MTA-STS.

9. References

9.1. Normative References

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Appendix A. Examples

This section is informative.

A.1. REQUIRETLS SMTP Option

The TLS-Required SMTP option is used to express the intention of the sender to have the associated message relayed using TLS. In the following example, lines beginning with "C:" are transmitted from the SMTP client to the server, and lines beginning with "S:" are transmitted in the opposite direction.

```
S: 220 mail.example.net ESMTP
C: EHLO mail.example.org
S: 250-mail.example.net Hello example.org [192.0.2.1]
S: 250-SIZE 52428800
S: 250-8BITMIME
S: 250-PIPELINING
S: 250-STARTTLS
S: 250 HELP
C: STARTTLS
S: TLS go ahead
```

(at this point TLS negotiation takes place. The remainder of this session occurs within TLS.)

```
S: 220 mail.example.net ESMTP
C: EHLO mail.example.org
S: 250-mail.example.net Hello example.org [192.0.2.1]
S: 250-SIZE 52428800
S: 250-8BITMIME
S: 250-PIPELINING
S: 250-REQUIRETLS
S: 250 HELP
C: MAIL FROM:<roger@example.org> REQUIRETLS
S: 250 OK
C: RCPT TO:<editor@example.net>
S: 250 Accepted
C: DATA
S: 354 Enter message, ending with "." on a line by itself
```

(message follows)

```
C: .
S: 250 OK
C: QUIT
```

A.2. TLS-Required Header Field

The TLS-Required header field is used when the sender requests that the mail system not heed a default policy of the recipient domain requiring TLS. It might be used, for example, to allow problems with the recipient domain's TLS certificate to be reported:

```
From: Roger Reporter <roger@example.org>
To: Andy Admin <admin@example.com>
Subject: Certificate problem?
TLS-Required: No
Date: Fri, 18 Jan 2019 10:26:55 -0800
Message-ID: <5c421a6f79c0e_d153ff8286d45c468473@mail.example.org>

Andy, there seems to be a problem with the TLS certificate
on your mail server. Are you aware of this?

Roger
```

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