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SMTP Require TLS Option
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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 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 DANE be ignored when relaying a message for which security is unimportant.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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This Internet-Draft will expire on October 24, 2019.

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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

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 to a server not also supporting 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 on 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 RFC 8461 [RFC8461]. DNSSEC is defined in RFC 4033 [RFC4033], RFC 4034 [RFC4034], and RFC 4035 [RFC4035].
- The certificate presented by the SMTP server MUST either verify successfully in a trust chain leading to a certificate trusted by the SMTP client or it MUST verify successfully using DANE as specified in RFC 7672 [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 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 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 RFC 8461 [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.

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 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.YYY REQUIRETLS needed

- 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

An MUA or other agent making the initial introduction of a message has authority to decide whether to require TLS. When TLS is to be required, it MUST do so by negotiating STARTTLS and REQUIRETLS and include 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, 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

If published as an RFC, this draft requests the addition of the following keyword to the SMTP Service Extensions Registry [MailParams]:

Textual name:	Require TLS
EHLO keyword value:	REQUIRETLS
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

If published as an RFC, this draft requests the addition of an entry to the Simple Mail Transfer Protocol (SMTP) Enhanced Status Codes Registry [SMTPStatusCodes]:

Code:	5.7.YYY
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:	(this document)
Submitter:	J. Fenton
Change controller:	IESG

If published as an RFC, this draft requests the addition of an entry to the Permanent Message Header Field Names Registry [PermMessageHeaderFields]:

Header field name:	TLS-Required
Applicable protocol:	mail
Status:	standard
Author/change controller:	IETF
Specification document:	(this document)

This section is to be updated for publication by the RFC Editor.

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 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 having 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 [RFC5751].

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 availability of TLS, the use of "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 nor MTA-STS.

9. Acknowledgements

The author would like to acknowledge many helpful suggestions on the ietf-smtp and uta mailing lists, in particular those of Viktor Dukhovni, Chris Newman, Tony Finch, Jeremy Harris, Arvel Hathcock, John Klensin, Barry Leiba, John Levine, Rolf Sonneveld, and Per Thorsheim.

10. Revision History

To be removed by RFC Editor upon publication as an RFC.

10.1. Changes since -07 Draft

Changes in response to IESG review and IETF Last Call comments:

- Change associated status code for 5.7.YYY from 530 to 550.

- Correct textual name of extension in IANA Considerations for consistency with the rest of the document.
- Remove special handling of bounce messages in Section 4.1.
- Change name of header field from RequireTLS to TLS-Required and make capitalization of parameter consistent.
- Remove mention of transforming RET=FULL to RET=HDRS on relay in Section 5.
- Replace Section 6 dealing with mailing lists with a more general section on reorigination by mediators.
- Add security considerations section on policy conflicts.

10.2. Changes since -06 Draft

Various changes in response to AD review:

- Reference RFC 7525 for TLS negotiation recommendations.
- Make reference to requested 5.7.YYY error code consistent.
- Clarify applicability to LMTP and submission.
- Provide ABNF for syntax of SMTP option and header field and examples in Appendix A.
- Correct use of normative language in Section 5.
- Clarify case where REQUIRETLS option is used on bounce messages.
- Improve Security Requirements wording to be incusive of both SMTP option and header field.

10.3. Changes since -05 Draft

Corrected IANA Permanent Message Header Fields Registry request.

10.4. Changes since -04 Draft

Require validation of SMTP server hostname via DNSSEC or MTA-STS policy when TLS is required.

10.5. Changes since -03 Draft

Working Group Last Call changes, including:

- Correct reference for SMTP DANE
- Clarify that RequireTLS: NO applies to both MTA-STS and DANE policies
- Correct newly-defined status codes
- Update MTA-STS references to RFC

10.6. Changes since -02 Draft

- More complete documentation for IANA registration requests.
- Changed bounce handling to use RET parameters of [RFC3461], along with slightly more liberal transmission of bounces even if REQUIRETLS can’t be negotiated.

10.7. Changes since -01 Draft

- Converted DEEP references to RFC 8314.
- Removed REQUIRETLS options: CHAIN, DANE, and DNSSEC.
- Editorial corrections, notably making the header field name consistent (RequireTLS rather than Require-TLS).

10.8. Changes since -00 Draft

- Created new header field, Require-TLS, for use by "NO" option.
- Removed "NO" option from SMTP service extension.
- Recommend DEEP requirements for delivery of messages requiring TLS.
- Assorted copy edits

10.9. Changes since fenton-03 Draft

- Wording improvements from Rolf Sonneveld review 22 July 2017
- A few copy edits
- Conversion from individual to UTA WG draft

10.10. Changes Since -02 Draft

- Incorporation of "MAY TLS" functionality as REQUIRETLS=NO per suggestion on UTA WG mailing list.
- Additional guidance on bounce messages

10.11. Changes Since -01 Draft

- Specified retries when multiple MX hosts exist for a given domain.
- Clarified generation of non-delivery messages
- Specified requirements for application of REQUIRETLS to mail forwarders and mailing lists.
- Clarified DNSSEC requirements to include MX lookup only.
- Corrected terminology regarding message retrieval vs. delivery.
- Changed category to standards track.

10.12. Changes Since -00 Draft

- Conversion of REQUIRETLS from an SMTP verb to a MAIL FROM parameter to better associate REQUIRETLS requirements with transmission of individual messages.
- Addition of an option to require DNSSEC lookup of the remote mail server, since this affects the common name of the certificate that is presented.
- Clarified the wording to more clearly state that TLS sessions must be established and not simply that STARTTLS is negotiated.
- Introduced need for minimum encryption standards (key lengths and algorithms)
- Substantially rewritten Security Considerations section

11. References

11.1. 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 intent of the sender that the associated message be 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 of the message wants to override the default policy of the recipient domain to require 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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