Using TLS in Applications
Internet-Draft
Intended status: Standards Track
Expires: June 7, 2018

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December 4, 2017

SMTP TLS Reporting
draft-ietf-uta-smtp-tlsrpt-12

Abstract

A number of protocols exist for establishing encrypted channels between SMTP Mail Transfer Agents, including STARTTLS, DANE TLSA, and MTA-STS. These protocols can fail due to misconfiguration or active attack, leading to undelivered messages or delivery over unencrypted or unauthenticated channels. This document describes a reporting mechanism and format by which sending systems can share statistics and specific information about potential failures with recipient domains. Recipient domains can then use this information to both detect potential attackers and diagnose unintentional misconfigurations.

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 June 7, 2018.

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1. Introduction

The STARTTLS extension to SMTP [RFC3207] allows SMTP clients and hosts to establish secure SMTP sessions over TLS. The protocol design is based on "Opportunistic Security" (OS) [RFC7435], which maintains interoperability with clients that do not support STARTTLS but means that any attacker who can delete parts of the SMTP session (such as the "250 STARTTLS" response) or redirect the entire SMTP session (perhaps by overwriting the resolved MX record of the delivery domain) can perform a downgrade or interception attack.

Because such "downgrade attacks" are not necessarily apparent to the receiving MTA, this document defines a mechanism for sending domains to report on failures at multiple stages of the MTA-to-MTA conversation.

Recipient domains may also use the mechanisms defined by MTA-STS [I-D.ietf-uta-mta-sts] or DANE [RFC6698] to publish additional encryption and authentication requirements; this document defines a mechanism for sending domains that are compatible with MTA-STS or DANE to share success and failure statistics with recipient domains.

Specifically, this document defines a reporting schema that covers failures in routing, STARTTLS negotiation, and both DANE [RFC6698] and MTA-STS [I-D.ietf-uta-mta-sts] policy validation errors, and a standard TXT record that recipient domains can use to indicate where reports in this format should be sent.

This document is intended as a companion to the specification for SMTP MTA Strict Transport Security [I-D.ietf-uta-mta-sts].

1.1. Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119].

We also define the following terms for further use in this document:

- MTA-STS Policy: A definition of the expected TLS availability, behavior, and desired actions for a given domain when a sending MTA encounters problems in negotiating a secure channel. MTA-STS is defined in [I-D.ietf-uta-mta-sts].

- DANE Policy: A mechanism by which administrators can supply a record that can be used to validate the certificate presented by an MTA. DANE is defined in [RFC6698].

- TLSRPT Policy: A policy specifying the endpoint to which sending MTAs should deliver reports.

- Policy Domain: The domain against which an MTA-STS or DANE Policy is defined.

- Sending MTA: The MTA initiating the delivery of an email message.

2. Related Technologies

- This document is intended as a companion to the specification for SMTP MTA Strict Transport Security [I-D.ietf-uta-mta-sts].

- SMTP-TLSRPT defines a mechanism for sending domains that are compatible with MTA-STS or DANE to share success and failure statistics with recipient domains. DANE is defined in [RFC6698] and MTA-STS is defined in [I-D.ietf-uta-mta-sts].

3. Reporting Policy

A domain publishes a record to its DNS indicating that it wishes to receive reports. These SMTP TLSRPT policies are distributed via DNS from the Policy Domain's zone, as TXT records (similar to DMARC policies) under the name "_smtp-tlsrpt". For example, for the Policy Domain "example.com", the recipient's TLSRPT policy can be retrieved from "_smtp-tlsrpt.example.com".

Policies consist of the following directives:

- "v": This value MUST be equal to "TLSRPTv1".

- "rua": A URI specifying the endpoint to which aggregate information about policy validation results should be sent (see Section 4, "Reporting Schema", for more information). Two URI schemes are supported: "mailto" and "https". As with DMARC [RFC7489], the policy domain can specify a comma-separated list of URIs.

- In the case of "https", reports should be submitted via POST ([RFC7231]) to the specified URI. Report submitters MAY ignore certificate validation errors when submitting reports via https.

- In the case of "mailto", reports should be submitted to the specified email address ([RFC6068]). When sending failure reports via SMTP, sending MTAs MUST deliver reports despite any TLS-related failures and SHOULD NOT include this SMTP session in the next report. This may mean that the reports are delivered in the clear. Additionally, reports sent via SMTP MUST contain a valid DKIM [RFC6376] signature by the reporting domain. Reports lacking such a signature MUST be ignored by the recipient. DKIM signatures must not use the "l=" attribute to limit the body length used in the signature.

The formal definition of the "_smtp-tlsrpt" TXT record, defined using [RFC5234] & [RFC7405], is as follows:

```
tlsrpt-record     = tlsrpt-version 1*(field-delim tlsrpt-field)
                    [field-delim]

field-delim       = *WSP ";" *WSP

tlsrpt-field      = tlsrpt-rua /        ; Note that the
                    tlsrpt-extension    ; tlsrpt-rua record is
                                        ; required.

tlsrpt-version    = %s"v=TLSRPTv1"

tlsrpt-rua        = %s"rua="
                  tlsrpt-uri *(*WSP "," *WSP tlsrpt-uri)

tlsrpt-uri        = URI
                    ; "URI" is imported from [@!RFC3986];
       ; commas (ASCII 0x2C) and exclamation
       ; points (ASCII 0x21) MUST be encoded

tlsrpt-extension  = tlsrpt-ext-name "=" tlsrpt-ext-value

tlsrpt-ext-name   = (ALPHA / DIGIT) *31(ALPHA /
                  DIGIT / "_" / "-" / ".")

tlsrpt-ext-value  = 1*(%x21-3A / %x3C / %x3E-7E)
                    ; chars excluding "=", ";", SP, and control
                    ; chars
```

If multiple TXT records for "_smtp-tlsrpt" are returned by the resolver, records which do not begin with "v=TLSRPTv1;" are

discarded. If the number of resulting records is not one, senders MUST assume the recipient domain does not implement TLSRPT. If the resulting TXT record contains multiple strings, then the record MUST be treated as if those strings are concatenated together without adding spaces.

Parsers MUST accept TXT records which are syntactically valid (i.e. valid key-value pairs separated by semi-colons) and implementing a superset of this specification, in which case unknown fields SHALL be ignored.

3.1. Example Reporting Policy

3.1.1. Report using MAILTO

```
_smtp-tlsrpt.example.com. IN TXT \
        "v=TLSRPTv1;rua=mailto:reports@example.com"
```

3.1.2. Report using HTTPS

```
_smtp-tlsrpt.example.com. IN TXT \
        "v=TLSRPTv1; \
        rua=https://reporting.example.com/v1/tlsrpt"
```

4. Reporting Schema

The report is composed as a plain text file encoded in the I-JSON format ([RFC7493]).

Aggregate reports contain the following fields:

- Report metadata:
  - The organization responsible for the report
  - Contact information for one or more responsible parties for the contents of the report
  - A unique identifier for the report
  - The reporting date range for the report
- Policy, consisting of:
  - One of the following policy types: (1) The MTA-STS policy applied (as a string) (2) The DANE TLSA record applied (as a string, with each RR entry of the RRset listed and separated by

a semicolon) (3) The literal string "no-policy-found", if neither a DANE nor MTA-STS policy could be found.

  * The domain for which the policy is applied

  * The MX host

  * An identifier for the policy (where applicable)

- Aggregate counts, comprising result type, sending MTA IP, receiving MTA hostname, session count, and an optional additional information field containing a URI for recipients to review further information on a failure type.

Note that the failure types are non-exclusive; an aggregate report may contain overlapping "counts" of failure types when a single send attempt encountered multiple errors. Reporters may report multiple applied policies (for example, an MTA-STS policy and a DANE TLSA record for the same domain and MX); even in the case where only a single policy was applied, the "policies" field of the report body MUST be an array and not a singular value.

4.1. Report Time-frame

The report SHOULD cover a full day, from 0000-2400 UTC. This should allow for easier correlation of failure events. To avoid a Denial of Service against the system processing the reports, the reports should be delivered after some delay, perhaps several hours.

4.2. Delivery Summary

4.2.1. Success Count

- "success-count": This indicates that the sending MTA was able to successfully negotiate a policy-compliant TLS connection, and serves to provide a "heartbeat" to receiving domains that reporting is functional and tabulating correctly. This field contains an aggregate count of successful connections for the reporting system.

4.2.2. Failure Count

- "failure-count": This indicates that the sending MTA was unable to successfully establish a connection with the receiving platform. Section 4.3, "Result Types", will elaborate on the failed negotiation attempts. This field contains an aggregate count of failed connections.

4.3. Result Types

The list of result types will start with the minimal set below, and is expected to grow over time based on real-world experience. The initial set is:

4.3.1. Negotiation Failures

- "starttls-not-supported": This indicates that the recipient MX did not support STARTTLS.

- "certificate-host-mismatch": This indicates that the certificate presented did not adhere to the constraints specified in the MTA-STS or DANE policy, e.g. if the MX does not match any identities listed in the Subject Alternate Name (SAN) [RFC5280].

- "certificate-expired": This indicates that the certificate has expired.

- "certificate-not-trusted": This a label that covers multiple certificate related failures that include, but not limited to errors such as untrusted/unknown CAs, certificate name constraints, certificate chain errors etc. When using this declaration, the reporting MTA SHOULD utilize the "failure-reason" to provide more information to the receiving entity.

- "validation-failure": This indicates a general failure for a reason not matching a category above. When using this declaration, the reporting MTA SHOULD utilize the "failure-reason" to provide more information to the receiving entity.

4.3.2. Policy Failures

4.3.2.1. DANE-specific Policy Failures

- "tlsa-invalid": This indicates a validation error in the TLSA record associated with a DANE policy. None of the records in the RRset were found to be valid.

- "dnssec-invalid": This would indicate that no valid records were returned from the recursive resolver. The request returned with SERVFAIL for the requested TLSA record. It should be noted that if the reporter's systems are having problems resolving destination DNS records due to DNSSEC failures, it's possible they will also be unable to resolve the TLSRPT record, therefore these types of reports may be rare.

4.3.2.2. MTA-STS-specific Policy Failures

- "sts-policy-invalid": This indicates a validation error for the overall MTA-STS policy.

- "sts-webpki-invalid": This indicates that the MTA-STS policy could not be authenticated using PKIX validation.

4.3.3. General Failures

When a negotiation failure can not be categorized into one of the "Negotiation Failures" stated above, the reporter SHOULD use the "validation-failure" category. As TLS grows and becomes more complex, new mechanisms may not be easily categorized. This allows for a generic feedback category. When this category is used, the reporter SHOULD also use the "failure-reason-code" to give some feedback to the receiving entity. This is intended to be a short text field, and the contents of the field should be an error code or error text, such as "X509_V_ERR_UNHANDLED_CRITICAL_CRL_EXTENSION".

4.3.4. Transient Failures

Transient errors due to too-busy network, TCP timeouts, etc. are not required to be reported.

4.4. JSON Report Schema

The JSON schema is derived from the HPKP JSON schema [RFC7469] (cf. Section 3)

```
{
  "organization-name": organization-name,
  "date-range": {
    "start-datetime": date-time,
    "end-datetime": date-time
  },
  "contact-info": email-address,
  "report-id": report-id,
  "policies": [{
    "policy": {
      "policy-type": policy-type,
      "policy-string": policy-string,
      "policy-domain": domain,
      "mx-host": mx-host-pattern
    },
    "summary": {
      "total-successful-session-count": total-successful-session-count,
      "total-failure-session-count": total-failure-session-count
    },
    "failure-details": [
      {
        "result-type": result-type,
        "sending-mta-ip": ip-address,
        "receiving-mx-hostname": receiving-mx-hostname,
        "receiving-mx-helo": receiving-mx-helo,
        "failed-session-count": failed-session-count,
        "additional-information": additional-info-uri,
        "failure-reason-code": failure-reason-code
        }
      ]
    }
  ]
}
```

JSON Report Format

- "organization-name": The name of the organization responsible for the report. It is provided as a string.

- "date-time": The date-time indicates the start- and end-times for the report range. It is provided as a string formatted according to Section 5.6, "Internet Date/Time Format", of [RFC3339]. The report should be for a full UTC day, 0000-2400.

- "email-address": The contact information for a responsible party of the report. It is provided as a string formatted according to Section 3.4.1, "Addr-Spec", of [RFC5321].

- "report-id": A unique identifier for the report. Report authors may use whatever scheme they prefer to generate a unique identifier. It is provided as a string.

- "policy-type": The type of policy that was applied by the sending domain. Presently, the only three valid choices are "tlsa", "sts", and the literal string "no-policy-found". It is provided as a string.

- "policy-string": A string representation of the policy, whether TLSA record ([RFC6698] section 2.3) or MTA-STS policy. Examples: TLSA: ""_25._tcp.mx.example.com. IN TLSA (3 0 1 \ 1F850A337E6DB9C609C522D136A475638CC43E1ED424F8EEC8513D7 47D1D085D)"" MTA-STS: ""version: STSv1\nmode: report\nmx: mx1.example.com\nmx: \ mx2.example.com\nmx: mx.backup-example.com\nmax_age: 12345678""

- "domain": The Policy Domain is the domain against which the MTA-STS or DANE policy is defined. In the case of Internationalized Domain Names ([RFC5891]), the domain is the Punycode-encoded A-label ([RFC3492]) and not the U-label.

- "mx-host-pattern": The pattern of MX hostnames from the applied policy. It is provided as a string, and is interpreted in the same manner as the "Checking of Wildcard Certificates" rules in Section 6.4.3 of [RFC6125]. In the case of Internationalized Domain Names ([RFC5891]), the domain is the Punycode-encoded A-label ([RFC3492]) and not the U-label.

- "result-type": A value from Section 4.3, "Result Types", above.

- "ip-address": The IP address of the sending MTA that attempted the STARTTLS connection. It is provided as a string representation of an IPv4 (see below) or IPv6 ([RFC5952]) address in dot-decimal or colon-hexadecimal notation.

- "receiving-mx-hostname": The hostname of the receiving MTA MX record with which the sending MTA attempted to negotiate a STARTTLS connection.

- "receiving-mx-helo": (optional) The HELO or EHLO string from the banner announced during the reported session.

- "total-successful-session-count": The aggregate number (integer) of successfully negotiated TLS-enabled connections to the receiving site.

- "total-failure-session-count": The aggregate number (integer) of failures to negotiate a TLS-enabled connection to the receiving site.

- "failed-session-count": The number of (attempted) sessions that match the relevant "result-type" for this section.

- "additional-info-uri": An optional URI [RFC3986] pointing to additional information around the relevant "result-type". For example, this URI might host the complete certificate chain presented during an attempted STARTTLS session.

- "failure-reason-code": A text field to include a TLS-related error code or error message.

For report purposes, an IPv4 Address is defined as: IPv4address = dec-octet "." dec-octet "." dec-octet "." dec-octet
dec-octet = DIGIT ; 0-9 / %x31-39 DIGIT ; 10-99 / "1" 2DIGIT ; 100-199 / "2" %x30-34 DIGIT ; 200-249 / "25" %x30-35 ; 250-255

5. Report Delivery

Reports can be delivered either as an email message via SMTP or via HTTP POST.

5.1. Report Filename

The filename is RECOMMENDED to be constructed using the following ABNF:

```
filename = sender "!" policy-domain "!" begin-timestamp
          "!" end-timestamp [ "!" unique-id ] "." extension

unique-id = 1*(ALPHA / DIGIT)

sender = domain        ; From the [@!RFC5321] that is used
               ; as the domain for the `contact-info`
           ; address in the report body

policy-domain   = domain

begin-timestamp = 1*DIGIT
                ; seconds since 00:00:00 UTC January 1, 1970
                ; indicating start of the time range contained
                ; in the report

end-timestamp = 1*DIGIT
                ; seconds since 00:00:00 UTC January 1, 1970
                ; indicating end of the time range contained
                ; in the report

extension = "json" / "json.gz"
```

The extension MUST be "json" for a plain JSON file, or "json.gz" for a JSON file compressed using GZIP.

"unique-id" allows an optional unique ID generated by the Sending MTA to distinguish among multiple reports generated simultaneously by different sources within the same Policy Domain. For example, this is a possible filename for the gzip file of a report to the Policy Domain "example.net" from the Sending MTA "mail.sender.example.com":

"mail.sender.example.com!example.net!1470013207!1470186007!001.json.gz"

5.2. Compression

The report SHOULD be subjected to GZIP compression for both email and HTTPS transport. Declining to apply compression can cause the report to be too large for a receiver to process (a commonly observed receiver limit is ten megabytes); compressing the file increases the chances of acceptance of the report at some compute cost.

5.3. Email Transport

The report MAY be delivered by email. To make the reports machine-parsable for the receivers, we define a top-level media type "multipart/report" with a new parameter "report-type="tlsrpt"".

Inside it, there are two parts: The first part is human readable, typically "text/plain", and the second part is machine readable with a new media type defined called "application/tlsrpt+json". If compressed, the report should use the media type "application/tlsrpt+gzip".

In addition, the following two new top level message header fields are defined:

"TLS-Report-Domain: Receiver-Domain TLS-Report-Submitter: Sender-Domain" The "TLS-Report-Submitter" value MUST match the value found in the filename and the [RFC5321] domain from the "contact-info" from the report body. These message headers MUST be included and should allow for easy searching for all reports submitted by a report domain or a particular submitter, for example in IMAP [RFC3501]:

"s SEARCH HEADER "TLS-Report-Domain" "example.com""

It is presumed that the aggregate reporting address will be equipped to process new message header fields and extract MIME parts with the prescribed media type and filename, and ignore the rest. These additional headers SHOULD be included in the DKIM [RFC6376] signature for the message.

The [RFC5322].Subject field for report submissions SHOULD conform to the following ABNF:

```
    tlsrpt-subject = %s"Report" FWS                ; "Report"
                     %s"Domain:" FWS               ; "Domain:"
              domain-name FWS                ; per RFC6376
              %s"Submitter:" FWS             ; "Submitter:"
              domain-name FWS                ; per RFC6376
              %s"Report-ID:" FWS             ; "Report-ID:
              "<" id-left "@" id-right ">" ; per RFC5322
              [CFWS]                         ; per RFC5322
                                                    ; (as with FWS)
```

The first domain-name indicates the DNS domain name about which the report was generated. The second domain-name indicates the DNS domain name representing the Sending MTA generating the report. The purpose of the Report-ID: portion of the field is to enable the Policy Domain to identify and ignore duplicate reports that might be sent by a Sending MTA.

For instance, this is a possible Subject field for a report to the Policy Domain "example.net" from the Sending MTA "mail.sender.example.com". It is line-wrapped as allowed by

```
            Subject: Report Domain: example.net
                Submitter: mail.sender.example.com
                Report-ID: <735ff.e317+bf22029@mailexample.net>
```

5.3.1. Example Report

```
    From: tlsrpt@mail.sender.example.com
        Date: Fri, May 09 2017 16:54:30 -0800
        To: mts-sts-tlsrpt@example.net
        Subject: Report Domain: example.net
            Submitter: mail.sender.example.com
            Report-ID: <735ff.e317+bf22029@example.net>
        TLS-Report-Domain: example.net
        TLS-Report-Submitter: mail.sender.example.com
        MIME-Version: 1.0
        Content-Type: multipart/report; report-type="tlsrpt";
            boundary="----=_NextPart_000_024E_01CC9B0A.AFE54C00"
        Content-Language: en-us

        This is a multipart message in MIME format.

        ------=_NextPart_000_024E_01CC9B0A.AFE54C00
        Content-Type: text/plain; charset="us-ascii"
        Content-Transfer-Encoding: 7bit

        This is an aggregate TLS report from mail.sender.example.com

        ------=_NextPart_000_024E_01CC9B0A.AFE54C00
        Content-Type: application/tlsrpt+gzip
        Content-Transfer-Encoding: base64
        Content-Disposition: attachment;
            filename="mail.sender.example!example.com!
                      1013662812!1013749130.gz"

        <gzipped content of report>

    ------=_NextPart_000_024E_01CC9B0A.AFE54C00--
    ...
```

Note that, when sending failure reports via SMTP, sending MTAs MUST NOT honor MTA-STS or DANE TLSA failures.

5.4. HTTPS Transport

The report MAY be delivered by POST to HTTPS. If compressed, the report SHOULD use the media type "application/tlsrpt+gzip", and "application/tlsrpt+json" otherwise (see section Section 6, "IANA Considerations").

A reporting entity SHOULD expect a "successful" response from the accepting HTTPS server, typically a 200 or 201 HTTP code [RFC7231]. Other codes could indicate a delivery failure, and may be retried as per local policy. The receiving system is not expected to process reports at receipt time, and MAY store them for processing at a later time.

5.5. Delivery Retry

In the event of a delivery failure, regardless of the delivery method, a sender SHOULD attempt redelivery for up to 24hrs after the initial attempt. As previously stated the reports are optional, so while it is ideal to attempt redelivery, it is not required. If multiple retries are attempted, ideally they would be on a logarithmic scale.

5.6. Metadata Variances

As stated above, there are a variable number of ways to declare information about the data therein. If it should be the case that these objects were to disagree, then the report data contained within the JSON body MUST be considered the authoritative source for those data elements.

6. IANA Considerations

The following are the IANA considerations discussed in this document.

6.1. Message headers

Below is the Internet Assigned Numbers Authority (IANA) Permanent Message Header Field registration information per [RFC3864].

Header field name:	TLS-Report-Domain
Applicable protocol:	mail
Status:	standard
Author/Change controller:	IETF
Specification document(s):	this one

Header field name:	TLS-Report-Submitter
Applicable protocol:	mail
Status:	standard
Author/Change controller:	IETF
Specification document(s):	this one

6.2. Report Type

This document registers a new parameter "report-type="tlsrpt"" under "multipart/report" top-level media type for use with [RFC6522].

The media type suitable for use as a report-type is defined in the following section.

6.3. application/tlsrpt+json Media Type

This document registers multiple media types, beginning with Table 1 below.

Type	Subtype	File extn	Specification
application	tlsrpt+json	.json	Section 5.3

Table 1: SMTP TLS Reporting Media Type

Type name: application

Subtype name: tlsrpt+json

Required parameters: n/a

Optional parameters: n/a

Encoding considerations: Encoding considerations are identical to those specified for the "application/json" media type. See [RFC7493].

Security considerations: Security considerations relating to SMTP TLS Reporting are discussed in Section 7.

Interoperability considerations: This document specifies format of conforming messages and the interpretation thereof.

Published specification: Section 5.3 of this document.

Applications that use this media type: Mail User Agents (MUA) and Mail Transfer Agents.

Additional information:

Magic number(s): n/a

File extension(s): ".json"

Macintosh file type code(s): n/a

Person & email address to contact for further information: See Authors' Addresses section.

Intended usage: COMMON

Restrictions on usage: n/a

Author: See Authors' Addresses section.

Change controller: Internet Engineering Task Force (mailto:iesg@ietf.org).

6.4. application/tlsrpt+gzip Media Type

Type	Subtype	File extn	Specification
application	tlsrpt+gzip	.gz	Section 5.3

Table 2: SMTP TLS Reporting Media Type

Type name: application

Subtype name: tlsrpt+gzip

Required parameters: n/a

Optional parameters: n/a

Encoding considerations: Binary

Security considerations: Security considerations relating to SMTP TLS Reporting are discussed in Section 7.

Interoperability considerations: This document specifies format of conforming messages and the interpretation thereof.

Published specification: Section 5.3 of this document.

Applications that use this media type: Mail User Agents (MUA) and Mail Transfer Agents.

Additional information:

Magic number(s): n/a

File extension(s): ".gz"

Macintosh file type code(s): n/a

Person & email address to contact for further information: See Authors' Addresses section.

Intended usage: COMMON

Restrictions on usage: n/a

Author: See Authors' Addresses section.

Change controller: Internet Engineering Task Force (mailto:iesg@ietf.org).

6.5. STARTTLS Validation Result Types

This document creates a new registry, "STARTTLS Validation Result Types". The initial entries in the registry are:

Result Type
"starttls-not-supported"
"certificate-host-mismatch"
"certificate-expired"
"tlsa-invalid"
"dnssec-invalid"
"sts-policy-invalid"
"sts-webpki-invalid"
"validation-failure"

The above entries are described in section Section 4.3, "Result Types." New result types can be added to this registry using "Expert Review" IANA registration policy.

7. Security Considerations

SMTP TLS Reporting provides transparency into misconfigurations or attempts to intercept or tamper with mail between hosts who support STARTTLS. There are several security risks presented by the existence of this reporting channel:

- Flooding of the Aggregate report URI (rua) endpoint: An attacker could flood the endpoint with excessive reporting traffic and prevent the receiving domain from accepting additional reports. This type of Denial-of-Service attack would limit visibility into STARTTLS failures, leaving the receiving domain blind to an ongoing attack.

- Untrusted content: An attacker could inject malicious code into the report, opening a vulnerability in the receiving domain. Implementers are advised to take precautions against evaluating the contents of the report.

- Report snooping: An attacker could create a bogus TLSRPT record to receive statistics about a domain the attacker does not own. Since an attacker able to poison DNS is already able to receive counts of SMTP connections (and, absent DANE or MTA-STS policies, actual SMTP message payloads), this does not present a significant new vulnerability.

- Reports as DDoS: TLSRPT allows specifying destinations for the reports that are outside the authority of the Policy Domain, which allows domains to delegate processing of reports to a partner organization. However, an attacker who controls the Policy Domain DNS could also use this mechanism to direct the reports to an unwitting victim, flooding that victim with excessive reports. DMARC [RFC7489] defines a solution for verifying delegation to avoid such attacks; the need for this is greater with DMARC, however, because DMARC allows an attacker to trigger reports to a target from an innocent third party by sending that third party mail (which triggers a report from the third party to the target). In the case of TLSRPT, the attacker would have to induce the third party to send the attacker mail in order to trigger reports from the third party to the victim; this reduces the risk of such an attack and the need for a verification mechanism.

Finally, because TLSRPT is intended to help administrators discover man-in-the-middle attacks against transport-layer encryption, including attacks designed to thwart negotiation of encrypted connections (by downgrading opportunistic encryption or, in the case of MTA-STS, preventing discovery of a new MTA-STS policy), we must also consider the risk that an adversary who can induce such a downgrade attack can also prevent discovery of the TLSRPT TXT record (and thus prevent discovery of the successful downgrade attack). Administrators are thus encouraged to deploy TLSRPT TXT records with a large TTL (reducing the window for successful attacks against DNS resolution of the record) or to deploy DNSSEC on the deploying zone.

8. References

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Appendix A. Example Reporting Policy

A.1. Report using MAILTO

```
_smtp-tlsrpt.mail.example.com. IN TXT \
       "v=TLSRPTv1;rua=mailto:reports@example.com"
```

A.2. Report using HTTPS

```
_smtp-tlsrpt.mail.example.com. IN TXT \
       "v=TLSRPTv1; \
       rua=https://reporting.example.com/v1/tlsrpt"
```

Appendix B. Example JSON Report

```
{
  "organization-name": "Company-X",
  "date-range": {
    "start-datetime": "2016-04-01T00:00:00Z",
    "end-datetime": "2016-04-01T23:59:59Z"
  },
  "contact-info": "sts-reporting@company-x.example",
  "report-id": "5065427c-23d3-47ca-b6e0-946ea0e8c4be",
  "policies": [{
    "policy": {
      "policy-type": "sts",
      "policy-string": "version: STSv1\r\nmode: report\r\n
                mx: .mail.company-y.example\r\nmax_age: 86400",
      "policy-domain": "company-y.example",
      "mx-host": ".mail.company-y.example"
    },
    "summary": {
      "total-successful-session-count": 5326,
      "total-failure-session-count": 303
    },
    "failure-details": [{
      "result-type": "certificate-expired",
      "sending-mta-ip": "98.136.216.25",
      "receiving-mx-hostname": "mx1.mail.company-y.example",
      "failed-session-count": 100
    }, {
      "result-type": "starttls-not-supported",
      "sending-mta-ip": "98.22.33.99",
      "receiving-mx-hostname": "mx2.mail.company-y.example",
      "failed-session-count": 200,
      "additional-information": "https://reports.company-x.example/
        report_info ? id = 5065427 c - 23 d3# StarttlsNotSupported "
    }, {
      "result-type": "validation-failure",
      "sending-mta-ip": "47.97.15.2",
      "receiving-mx-hostname": "mx-backup.mail.company-y.example",
      "failed-session-count": 3,
      "failure-error-code": "X509_V_ERR_PROXY_PATH_LENGTH_EXCEEDED"
    }]
  }]
}
```

Figure: Example JSON report for a messages from Company-X to Company-Y, where 100 sessions were attempted to Company Y servers with an expired certificate and 200 sessions were attempted to Company Y servers that did not successfully respond to the "STARTTLS" command.

Additionally 3 sessions failed due to
"X509_V_ERR_PROXY_PATH_LENGTH_EXCEEDED".

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