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Updates to the TLS Transport Model for SNMP

Abstract

This document updates the TLS Transport Model (TLSTM), as defined in RFC 6353, to reflect changes necessary to support Transport Layer Security Version 1.3 (TLS 1.3) and Datagram Transport Layer Security Version 1.3 (DTLS 1.3), which are jointly known as "(D)TLS 1.3". This document is compatible with (D)TLS 1.2 and is intended to be compatible with future versions of SNMP and (D)TLS.

This document updates the SNMP-TLS-TM-MIB as defined in RFC 6353.

Status of This Memo

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1. Introduction

This document updates and clarifies how the rules of [\[RFC6353\]](#) apply when using Transport Layer Security (TLS) or Datagram Transport Layer Security (DTLS) versions later than 1.2. This document jointly refers to these two protocols as "(D)TLS". The update also incorporates the [\[RFC8996\]](#) update, which prohibits the use of TLS versions prior to TLS 1.2. Although the text of this document specifically references SNMPv3 and (D)TLS 1.3, this document may be applicable to future versions of these protocols and is backwards compatible with (D)TLS 1.2.

1.1. Conventions

Within this document the terms "TLS", "DTLS", and "(D)TLS" apply to all versions of the indicated protocols. The term "SNMP" means "SNMPv3" unless a specific version number is indicated. Specific version numbers are used when the text needs to emphasize version numbers.

For consistency with SNMP-related specifications, this document favors terminology as defined in [\[STD62\]](#), rather than favoring terminology that is consistent with non-SNMP specifications. This is consistent with the IESG decision to not require the SNMP

terminology be modified to match the usage of other non-SNMP specifications when SNMP was advanced to a Full Standard.

"Authentication" in this document typically refers to the English meaning of "serving to prove the authenticity of" the message, not data source authentication or peer identity authentication. The terms "manager" and "agent" are not used in this document because, in the [RFC3411](#) architecture, all SNMP entities have the capability of acting as manager, agent, or both depending on the SNMP application types supported in the implementation. Where distinction is necessary, the application names of command generator, command responder, notification originator, notification receiver, and proxy forwarder are used. See ["SNMP Applications" \(RFC3411\)](#) for further information.

Throughout this document, the terms "client" and "server" are used to refer to the two ends of the TLS transport connection. The client actively opens the TLS connection, and the server passively listens for the incoming TLS connection. An SNMP entity **MAY** act as a TLS client or server or both, depending on the SNMP applications supported.

Throughout this document, the term "session" is used to refer to a secure association between two TLS Transport Models that permits the transmission of one or more SNMP messages within the lifetime of the session. The TLS protocol also has an internal notion of a session and although these two concepts of a session are related, when the term "session" is used this document is referring to the TLSTM's specific session and not directly to the TLS protocol's session.

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 [\[RFC2119\]](#).

2. Changes from RFC 6353

This document updates [\[RFC6353\]](#). The changes from [\[RFC6353\]](#) are defined in the following clauses.

2.1. TLSTM Fingerprint

[\[RFC6353\]](#) defines a fingerprint algorithm that references the one-octet TLS 1.2 hash algorithm identifier. TLS 1.3 replaced the one-octet hash algorithm identifier with a two-octet TLS 1.3 cipher suite identifier. The TLS community does not plan to ever add additional values to the TLS 1.2 hash algorithm registry because some might incorrectly infer that using a new hash algorithm with TLS 1.2 would overcome the limitations of TLS 1.2. However, there is

still a need within TLSTM to support new values as they are developed.

This document updates the definition of SnmpTLSTSFingerprint to clarify that the one-octet identifier in the fingerprint algorithm uses the IANA SNMP-TLSTM HashAlgorithm Registry; this registry is consistent with the IANA TLS HashAlgorithm Registry for its initial values but can be extended as needed to support new hashing algorithms without implying that the new values can be used by TLS version 1.2. This change allows the reuse of the existing fingerprint TEXTUAL-CONVENTION and minimizes the impact to [\[RFC6353\]](#). The initial values for the SNMP-TLSTM HashAlgorithm Registry are defined below:

Value	Description	Recommended	Reference
0	none	N	[RFC5246]
1	md5	N	[RFC5246]
2	sha1	N	[RFC5246]
3	sha224	Y	[RFC5246]
4	sha256	Y	[RFC5246]
5	sha384	Y	[RFC5246]
6	sha512	Y	[RFC5246]
7	reserved		[RFC8447]
8	intrinsic	N	[RFC8422]
9-223	reserved		[RFC8447]
224-255	private		[RFC5246]

Table 1: SNMP-TLSTM Hash Algorithms

Values zero through 2 **MUST NOT** be used by implementations of this document but are listed for historical consistency.

2.2. Security Level

The [RFC3411](#) architecture recognizes three levels of security:

- *without authentication and without privacy (noAuthNoPriv)
- *with authentication but without privacy (authNoPriv)
- *with authentication and with privacy (authPriv)

With (D)TLS 1.3, authentication and privacy are always provided. Hence, all exchanges conforming to the rules of this document will include authentication and privacy, regardless of the security level requested.

2.3. TLS Version

[[RFC6353](#)] stated that TLSTM clients and servers **MUST NOT** request, offer, or use SSL 2.0. [[RFC8996](#)] prohibits the use of (D)TLS versions prior to version 1.2. TLSTMv1.3 **MUST** only be used with (D)TLS version 1.2 and later.

3. Additional Rules for TLS 1.3

This document specifies additional rules and clarifications for the use of TLS 1.3. These rules may additionally apply to future versions of TLS.

3.1. Zero Round Trip Time Resumption (0-RTT)

TLS 1.3 implementations for SNMP **MUST NOT** enable the 0-RTT mode of session resumption (either sending or accepting) and **MUST NOT** automatically resend 0-RTT data if it is rejected by the server. The reason 0-RTT is disallowed is that there are no "safe" messages that if replayed will be guaranteed to cause no harm at a server side: all incoming notification or command responses are meant to be acted upon only once. See Security considerations section for further details.

TLS TM clients and servers **MUST NOT** request, offer or use the 0-RTT mode of TLS 1.3. [[RFC8446](#)] removed the renegotiation supported in TLS 1.2 [[RFC5246](#)]; for session resumption, it introduced a zero-RTT (0-RTT) mode, saving a round-trip at connection setup at the cost of increased risk of replay attacks (it is possible for servers to guard against this attack by keeping track of all the messages received). [[RFC8446](#)] requires a profile be written for any application that wants to use 0-RTT, specifying which messages are "safe to use" on this mode. The reason 0-RTT is disallowed here is that there are no "safe" SNMP messages that if replayed will be sure to cause no harm at a server side: all incoming notification or command responses have consequences and are to be acted upon only once.

Renegotiation of sessions is not supported as it is not supported by TLS 1.3.

3.2. TLS ciphersuites, extensions and protocol invariants

[[RFC8446](#)] section 9 requires that, in the absence of application profiles, certain cipher suites, TLS extensions, and TLS protocol invariants are mandatory to implement. This document does not specify an application profile, hence all of the compliance requirements in [[RFC8446](#)] apply.

4. MIB Module Definition

SNMP-TLS-TM-MIB DEFINITIONS ::= BEGIN

IMPORTS

```
MODULE-IDENTITY, OBJECT-TYPE,
OBJECT-IDENTITY, mib-2, snmpDomains,
Counter32, Unsigned32, Gauge32, NOTIFICATION-TYPE
    FROM SNMPv2-SMI                -- RFC 2578 or any update thereof
TEXTUAL-CONVENTION, TimeStamp, RowStatus, StorageType,
AutonomousType
    FROM SNMPv2-TC                -- RFC 2579 or any update thereof
MODULE-COMPLIANCE, OBJECT-GROUP, NOTIFICATION-GROUP
    FROM SNMPv2-CONF              -- RFC 2580 or any update thereof
SnmpAdminString
    FROM SNMP-FRAMEWORK-MIB       -- RFC 3411 or any update thereof
snmpTargetParamsName, snmpTargetAddrName
    FROM SNMP-TARGET-MIB         -- RFC 3413 or any update thereof
;
```

snmpTlstmMIB MODULE-IDENTITY

LAST-UPDATED "202203050000Z"

ORGANIZATION "OPSA Working Group"

CONTACT-INFO "WG-EMail: opsawg@ietf.org

Mailing list subscription info:

<https://www.ietf.org/mailman/listinfo/opsawg>

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DESCRIPTION "

The TLS Transport Model MIB

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(<http://trustee.ietf.org/license-info>)."

REVISION "202203050000Z"

DESCRIPTION "This version of this MIB module is part of
RFC XXXX; see the RFC itself for full legal

notices. This version:

1. Updates the definition of SnmpTLSFingerprint to clarify the registry used for the one-octet hash algorithm identifier.
2. Capitalizes key words in conformance with BCP 14
3. Replaces 'may not' with 'MUST NOT' to clarify intent in several locations."

REVISION "201107190000Z"

DESCRIPTION "This version of this MIB module is part of RFC 6353; see the RFC itself for full legal notices. The only change was to introduce new wording to reflect require changes for IDNA addresses in the SnmpTLSAddress TC."

REVISION "201005070000Z"

DESCRIPTION "This version of this MIB module is part of RFC 5953; see the RFC itself for full legal notices."

::= { mib-2 198 }

-- *****

-- subtrees of the SNMP-TLS-TM-MIB

-- *****

snmpTlstmNotifications OBJECT IDENTIFIER ::= { snmpTlstmMIB 0 }

snmpTlstmIdentities OBJECT IDENTIFIER ::= { snmpTlstmMIB 1 }

snmpTlstmObjects OBJECT IDENTIFIER ::= { snmpTlstmMIB 2 }

snmpTlstmConformance OBJECT IDENTIFIER ::= { snmpTlstmMIB 3 }

-- *****

-- snmpTlstmObjects - Objects

-- *****

snmpTLSTCPDomain OBJECT-IDENTITY

STATUS current

DESCRIPTION

"The SNMP over TLS via TCP transport domain. The corresponding transport address is of type SnmpTLSAddress.

The securityName prefix to be associated with the snmpTLSTCPDomain is 'tls'. This prefix MAY be used by security models or other components to identify which secure transport infrastructure authenticated a securityName."

REFERENCE

"RFC 2579: Textual Conventions for SMIV2"

::= { snmpDomains 8 }

snmpDTLSUDPDDomain OBJECT-IDENTITY

STATUS current

DESCRIPTION

"The SNMP over DTLS via UDP transport domain. The corresponding transport address is of type SnmpTLSAddress.

The securityName prefix to be associated with the snmpDTLSUDPDDomain is 'dtls'. This prefix MAY be used by security models or other components to identify which secure transport infrastructure authenticated a securityName."

REFERENCE

"RFC 2579: Textual Conventions for SMIV2"

::= { snmpDomains 9 }

SnmpTLSAddress ::= TEXTUAL-CONVENTION

DISPLAY-HINT "1a"

STATUS current

DESCRIPTION

"Represents an IPv4 address, an IPv6 address, or a US-ASCII-encoded hostname and port number.

An IPv4 address MUST be in dotted decimal format followed by a colon ':' (US-ASCII character 0x3A) and a decimal port number in US-ASCII.

An IPv6 address MUST be a colon-separated format (as described in RFC 5952), surrounded by square brackets ('[', US-ASCII character 0x5B, and ']', US-ASCII character 0x5D), followed by a colon ':' (US-ASCII character 0x3A) and a decimal port number in US-ASCII.

A hostname is always in US-ASCII (as per RFC 1123); internationalized hostnames are encoded as A-labels as specified in RFC 5890. The hostname is followed by a colon ':' (US-ASCII character 0x3A) and a decimal port number in US-ASCII. The name SHOULD be fully qualified whenever possible.

Values of this textual convention MUST NOT be directly usable as transport-layer addressing information, and may require run-time resolution. As such, applications that write them MUST be prepared for handling errors if such values are not supported, or cannot be resolved (if resolution occurs at the time of the management operation).

The DESCRIPTION clause of TransportAddress objects that may have SnmpTLSAddress values MUST fully describe how (and when) such names are to be resolved to IP addresses and vice versa.

This textual convention SHOULD NOT be used directly in object

definitions since it restricts addresses to a specific format. However, if it is used, it MAY be used either on its own or in conjunction with TransportAddressType or TransportDomain as a pair.

When this textual convention is used as a syntax of an index object, there may be issues with the limit of 128 sub-identifiers specified in SMIV2 (STD 58). It is RECOMMENDED that all MIB documents using this textual convention make explicit any limitations on index component lengths that management software MUST observe. This MAY be done either by

including SIZE constraints on the index components or by specifying applicable constraints in the conceptual row DESCRIPTION clause or in the surrounding documentation."

REFERENCE

"RFC 1123: Requirements for Internet Hosts - Application and Support
RFC 5890: Internationalized Domain Names for Applications (IDNA):
Definitions and Document Framework
RFC 5952: A Recommendation for IPv6 Address Text Representation
"

SYNTAX OCTET STRING (SIZE (1..255))

SnmpTLSFingerprint ::= TEXTUAL-CONVENTION

DISPLAY-HINT "1x:1x"

STATUS current

DESCRIPTION

"A fingerprint value that can be used to uniquely reference other data of potentially arbitrary length.

An SnmpTLSFingerprint value is composed of a 1-octet hashing algorithm identifier followed by the fingerprint value. The octet value encoded is based on the IANA TLS HashAlgorithm Registry (RFC 5246), However, this registry is only applicable to (D)TLS protocol versions prior to 1.3, which are now designated as obsolete and are not expected to ever support additional values. To allow the fingerprint algorithm to support additional hashing algorithms that might be used by later versions of (D)TLS, the octet value encoded is taken from IANA SNMP-TLSTM HashAlgorithm Registry, The initial values within this registry are identical to the values in the TLS HashAlgorithm registry but can be extended to support new hashing algorithms as needed.

This TEXTUAL-CONVENTION allows for a zero-length (blank) SnmpTLSFingerprint value for use in tables where the fingerprint value MAY be optional. MIB definitions or implementations MAY refuse to accept a zero-length value as

```

        appropriate."
        REFERENCE "https://www.iana.org/assignments/smi-numbers/smi-numbers.xhtml"
        SYNTAX OCTET STRING (SIZE (0..255))

-- Identities for use in the snmpTlstmCertToTSNTable

snmpTlstmCertToTSNMIdentities OBJECT IDENTIFIER
    ::= { snmpTlstmIdentities 1 }

snmpTlstmCertSpecified OBJECT-IDENTITY
    STATUS          current
    DESCRIPTION     "Directly specifies the tmSecurityName to be used for
                    this certificate. The value of the tmSecurityName
                    to use is specified in the snmpTlstmCertToTSNData
                    column. The snmpTlstmCertToTSNData column MUST
                    contain a non-zero length SnmpAdminString compliant

                    value or the mapping described in this row MUST be
                    considered a failure."
    ::= { snmpTlstmCertToTSNMIdentities 1 }

snmpTlstmCertSANRFC822Name OBJECT-IDENTITY
    STATUS          current
    DESCRIPTION     "Maps a subjectAltName's rfc822Name to a
                    tmSecurityName. The local part of the rfc822Name is
                    passed unaltered but the host-part of the name MUST
                    be passed in lowercase. This mapping results in a
                    1:1 correspondence between equivalent subjectAltName
                    rfc822Name values and tmSecurityName values except
                    that the host-part of the name MUST be passed in
                    lowercase.

                    Example rfc822Name Field:  FooBar@Example.COM
                    is mapped to tmSecurityName: FooBar@example.com."
    ::= { snmpTlstmCertToTSNMIdentities 2 }

snmpTlstmCertSANDNSName OBJECT-IDENTITY
    STATUS          current
    DESCRIPTION     "Maps a subjectAltName's dNSName to a
                    tmSecurityName after first converting it to all
                    lowercase (RFC 5280 does not specify converting to
                    lowercase so this involves an extra step). This
                    mapping results in a 1:1 correspondence between
                    subjectAltName dNSName values and the tmSecurityName
                    values."
    REFERENCE      "RFC 5280 - Internet X.509 Public Key Infrastructure
                    Certificate and Certificate Revocation
                    List (CRL) Profile."
    ::= { snmpTlstmCertToTSNMIdentities 3 }

```

snmpTlstmCertSANIpAddress OBJECT-IDENTITY

STATUS current

DESCRIPTION "Maps a subjectAltName's ipAddress to a tmSecurityName by transforming the binary encoded address as follows:

- 1) for IPv4, the value is converted into a decimal-dotted quad address (e.g., '192.0.2.1').
- 2) for IPv6 addresses, the value is converted into a 32-character all lowercase hexadecimal string without any colon separators.

This mapping results in a 1:1 correspondence between subjectAltName ipAddress values and the tmSecurityName values.

The resulting length of an encoded IPv6 address is the maximum length supported by the View-Based Access Control Model (VACM). Using both the Transport Security Model's support for transport prefixes (see the SNMP-TSM-MIB's snmpTsmConfigurationUsePrefix object for details) will result in securityName lengths that exceed what VACM can handle."

::= { snmpTlstmCertToTSNMIdentities 4 }

snmpTlstmCertSANAny OBJECT-IDENTITY

STATUS current

DESCRIPTION "Maps any of the following fields using the corresponding mapping algorithms:

-----+-----	
Type	Algorithm
-----+-----	
rfc822Name	snmpTlstmCertSANRFC822Name
dNSName	snmpTlstmCertSANDNSName
iPAddress	snmpTlstmCertSANIpAddress
-----+-----	

The first matching subjectAltName value found in the certificate of the above types MUST be used when deriving the tmSecurityName. The mapping algorithm specified in the 'Algorithm' column MUST be used to derive the tmSecurityName.

This mapping results in a 1:1 correspondence between subjectAltName values and tmSecurityName values. The three sub-mapping algorithms produced by this combined algorithm cannot produce conflicting

```

        results between themselves."
 ::= { snmpTlstmCertToTSNMIdentities 5 }

snmpTlstmCertCommonName OBJECT-IDENTITY
    STATUS          current
    DESCRIPTION     "Maps a certificate's CommonName to a tmSecurityName
                    after converting it to a UTF-8 encoding. The usage
                    of CommonNames is deprecated and users are
                    encouraged to use subjectAltName mapping methods
                    instead. This mapping results in a 1:1

                    correspondence between certificate CommonName values
                    and tmSecurityName values."
 ::= { snmpTlstmCertToTSNMIdentities 6 }

-- The snmpTlstmSession Group

snmpTlstmSession          OBJECT IDENTIFIER ::= { snmpTlstmObjects 1 }

snmpTlstmSessionOpens    OBJECT-TYPE
    SYNTAX          Counter32
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "The number of times an openSession() request has been executed
        as a (D)TLS client, regardless of whether it succeeded or
        failed."
 ::= { snmpTlstmSession 1 }

snmpTlstmSessionClientCloses OBJECT-TYPE
    SYNTAX          Counter32
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "The number of times a closeSession() request has been
        executed as a (D)TLS client, regardless of whether it
        succeeded or failed."
 ::= { snmpTlstmSession 2 }

snmpTlstmSessionOpenErrors OBJECT-TYPE
    SYNTAX          Counter32
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "The number of times an openSession() request failed to open a
        session as a (D)TLS client, for any reason."
 ::= { snmpTlstmSession 3 }

snmpTlstmSessionAccepts  OBJECT-TYPE
    SYNTAX          Counter32

```

MAX-ACCESS read-only
STATUS current
DESCRIPTION
 "The number of times a (D)TLS server has accepted a new
 connection from a client and has received at least one SNMP
 message through it."
::= { snmpTlstmSession 4 }

snmpTlstmSessionServerCloses OBJECT-TYPE

SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
 "The number of times a closeSession() request has been
 executed as a (D)TLS server, regardless of whether it
 succeeded or failed."
::= { snmpTlstmSession 5 }

snmpTlstmSessionNoSessions OBJECT-TYPE

SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
 "The number of times an outgoing message was dropped because
 the session associated with the passed tmStateReference was no
 longer (or was never) available."
::= { snmpTlstmSession 6 }

snmpTlstmSessionInvalidClientCertificates OBJECT-TYPE

SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
 "The number of times an incoming session was not established
 on a (D)TLS server because the presented client certificate
 was invalid. Reasons for invalidation include, but are not
 limited to, cryptographic validation failures or lack of a
 suitable mapping row in the snmpTlstmCertToTSNTable."
::= { snmpTlstmSession 7 }

snmpTlstmSessionUnknownServerCertificate OBJECT-TYPE

SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
 "The number of times an outgoing session was not established
 on a (D)TLS client because the server certificate presented
 by an SNMP over (D)TLS server was invalid because no
 configured fingerprint or Certification Authority (CA) was

acceptable to validate it.

This may result because there was no entry in the
snmpTlstmAddrTable or because no path could be found to a
known CA."

::= { snmpTlstmSession 8 }

snmpTlstmSessionInvalidServerCertificates OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of times an outgoing session was not established
on a (D)TLS client because the server certificate presented
by an SNMP over (D)TLS server could not be validated even if
the fingerprint or expected validation path was known. That
is, a cryptographic validation error occurred during
certificate validation processing.

Reasons for invalidation include, but are not
limited to, cryptographic validation failures."

::= { snmpTlstmSession 9 }

snmpTlstmSessionInvalidCaches OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of outgoing messages dropped because the
tmStateReference referred to an invalid cache."

::= { snmpTlstmSession 10 }

-- Configuration Objects

snmpTlstmConfig OBJECT IDENTIFIER ::= { snmpTlstmObjects 2 }

-- Certificate mapping

snmpTlstmCertificateMapping OBJECT IDENTIFIER ::= { snmpTlstmConfig 1 }

snmpTlstmCertToTSNCount OBJECT-TYPE

SYNTAX Gauge32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"A count of the number of entries in the
snmpTlstmCertToTSNTable."

::= { snmpTlstmCertificateMapping 1 }

snmpTlstmCertToTSNTableLastChanged OBJECT-TYPE

SYNTAX TimeStamp

MAX-ACCESS read-only
 STATUS current
 DESCRIPTION
 "The value of sysUpTime.0 when the snmpTlstmCertToTSNTable was last modified through any means, or 0 if it has not been modified since the command responder was started."
 ::= { snmpTlstmCertificateMapping 2 }

snmpTlstmCertToTSNTable OBJECT-TYPE

SYNTAX SEQUENCE OF SnmpTlstmCertToTSNEntry
 MAX-ACCESS not-accessible
 STATUS current
 DESCRIPTION

"This table is used by a (D)TLS server to map the (D)TLS client's presented X.509 certificate to a tmSecurityName.

On an incoming (D)TLS/SNMP connection, the client's presented certificate MUST either be validated based on an established trust anchor, or it MUST directly match a fingerprint in this table. This table does not provide any mechanisms for configuring the trust anchors; the transfer of any needed trusted certificates for path validation is expected to occur through an out-of-band transfer.

Once the certificate has been found acceptable (either by path validation or directly matching a fingerprint in this table), this table is consulted to determine the appropriate tmSecurityName to identify with the remote connection. This is done by considering each active row from this table in prioritized order according to its snmpTlstmCertToTSNID value. Each row's snmpTlstmCertToTSNFingerprint value determines whether the row is a match for the incoming connection:

- 1) If the row's snmpTlstmCertToTSNFingerprint value identifies the presented certificate, then consider the row as a successful match.
- 2) If the row's snmpTlstmCertToTSNFingerprint value identifies a locally held copy of a trusted CA certificate and that CA certificate was used to validate the path to the presented certificate, then consider the row as a successful match.

Once a matching row has been found, the snmpTlstmCertToTSNMapType value can be used to determine how the tmSecurityName to associate with the session should be determined. See the snmpTlstmCertToTSNMapType column's DESCRIPTION for details on determining the tmSecurityName value. If it is impossible to determine a tmSecurityName from

the row's data combined with the data presented in the

certificate, then additional rows MUST be searched looking for another potential match. If a resulting tmSecurityName mapped from a given row is not compatible with the needed requirements of a tmSecurityName (e.g., VACM imposes a 32-octet-maximum length and the certificate derived securityName could be longer), then it MUST be considered an invalid match and additional rows MUST be searched looking for another potential match.

If no matching and valid row can be found, the connection MUST be closed and SNMP messages MUST NOT be accepted over it.

Missing values of snmpTlstmCertToTSNID are acceptable and implementations SHOULD continue to the next highest numbered row. It is RECOMMENDED that administrators skip index values to leave room for the insertion of future rows (for example, use values of 10 and 20 when creating initial rows).

Users are encouraged to make use of certificates with subjectAltName fields that can be used as tmSecurityNames so that a single root CA certificate can allow all child certificate's subjectAltName to map directly to a tmSecurityName via a 1:1 transformation. However, this table is flexible to allow for situations where existing deployed certificate infrastructures do not provide adequate subjectAltName values for use as tmSecurityNames. Certificates MAY also be mapped to tmSecurityNames using the CommonName portion of the Subject field. However, the usage of the CommonName field is deprecated and thus this usage is NOT RECOMMENDED. Direct mapping from each individual certificate fingerprint to a tmSecurityName is also possible but requires one entry in the table per tmSecurityName and requires more management operations to completely configure a device."

```
::= { snmpTlstmCertificateMapping 3 }
```

snmpTlstmCertToTSNEntry OBJECT-TYPE

SYNTAX SnmpTlstmCertToTSNEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"A row in the snmpTlstmCertToTSNTable that specifies a mapping for an incoming (D)TLS certificate to a tmSecurityName to use for a connection."

INDEX { snmpTlstmCertToTSNID }

```
::= { snmpTlstmCertToTSNTable 1 }
```

```

SnmpTlstmCertToTSNEntry ::= SEQUENCE {
    snmpTlstmCertToTSNID          Unsigned32,
    snmpTlstmCertToTSNFingerprint SnmpTLSFingerprint,
    snmpTlstmCertToTSNMapType     AutonomousType,
    snmpTlstmCertToTSNData        OCTET STRING,
    snmpTlstmCertToTSNStorageType StorageType,
    snmpTlstmCertToTSNRowStatus   RowStatus
}

```

```

snmpTlstmCertToTSNID OBJECT-TYPE
    SYNTAX      Unsigned32 (1..4294967295)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A unique, prioritized index for the given entry.  Lower
        numbers indicate a higher priority."
    ::= { snmpTlstmCertToTSNEntry 1 }

```

```

snmpTlstmCertToTSNFingerprint OBJECT-TYPE
    SYNTAX      SnmpTLSFingerprint (SIZE(1..255))
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "A cryptographic hash of an X.509 certificate.  The results of
        a successful matching fingerprint to either the trusted CA in
        the certificate validation path or to the certificate itself
        is dictated by the snmpTlstmCertToTSNMapType column."
    ::= { snmpTlstmCertToTSNEntry 2 }

```

```

snmpTlstmCertToTSNMapType OBJECT-TYPE
    SYNTAX      AutonomousType
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "Specifies the mapping type for deriving a tmSecurityName from
        a certificate.  Details for mapping of a particular type SHALL
        be specified in the DESCRIPTION clause of the OBJECT-IDENTITY
        that describes the mapping.  If a mapping succeeds it will
        return a tmSecurityName for use by the TLSTM model and
        processing stops.

```

If the resulting mapped value is not compatible with the needed requirements of a tmSecurityName (e.g., VACM imposes a 32-octet-maximum length and the certificate derived securityName could be longer), then future rows MUST be searched for additional snmpTlstmCertToTSNFingerprint matches to look for a mapping that succeeds.

Suitable values for assigning to this object that are defined

within the SNMP-TLS-TM-MIB can be found in the
snmpTlstmCertToTSNIdentities portion of the MIB tree."
DEFVAL { snmpTlstmCertSpecified }
::= { snmpTlstmCertToTSNEntry 3 }

snmpTlstmCertToTSNData OBJECT-TYPE

SYNTAX OCTET STRING (SIZE(0..1024))
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"Auxiliary data used as optional configuration information for
a given mapping specified by the snmpTlstmCertToTSNMapType
column. Only some mapping systems will make use of this
column. The value in this column MUST be ignored for any
mapping type that does not require data present in this
column."
DEFVAL { "" }
::= { snmpTlstmCertToTSNEntry 4 }

snmpTlstmCertToTSNStorageType OBJECT-TYPE

SYNTAX StorageType
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"The storage type for this conceptual row. Conceptual rows
having the value 'permanent' need not allow write-access to
any columnar objects in the row."
DEFVAL { nonVolatile }
::= { snmpTlstmCertToTSNEntry 5 }

snmpTlstmCertToTSNRowStatus OBJECT-TYPE

SYNTAX RowStatus
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"The status of this conceptual row. This object MAY be used
to create or remove rows from this table.

To create a row in this table, an administrator MUST set this
object to either createAndGo(4) or createAndWait(5).

Until instances of all corresponding columns are appropriately
configured, the value of the corresponding instance of the
snmpTlstmParamsRowStatus column is notReady(3).

In particular, a newly created row cannot be made active until
the corresponding snmpTlstmCertToTSNFingerprint,
snmpTlstmCertToTSNMapType, and snmpTlstmCertToTSNData columns
have been set.

The following objects MUST NOT be modified while the value of this object is active(1):

- snmpTlstmCertToTSNFingerprint
- snmpTlstmCertToTSNMapType
- snmpTlstmCertToTSNData

An attempt to set these objects while the value of snmpTlstmParamsRowStatus is active(1) will result in an inconsistentValue error."

::= { snmpTlstmCertToTSNEntry 6 }

-- Maps tmSecurityNames to certificates for use by the SNMP-TARGET-MIB

snmpTlstmParamsCount OBJECT-TYPE

SYNTAX Gauge32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"A count of the number of entries in the snmpTlstmParamsTable."

::= { snmpTlstmCertificateMapping 4 }

snmpTlstmParamsTableLastChanged OBJECT-TYPE

SYNTAX TimeStamp

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The value of sysUpTime.0 when the snmpTlstmParamsTable was last modified through any means, or 0 if it has not been modified since the command responder was started."

::= { snmpTlstmCertificateMapping 5 }

snmpTlstmParamsTable OBJECT-TYPE

SYNTAX SEQUENCE OF SnmpTlstmParamsEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"This table is used by a (D)TLS client when a (D)TLS connection is being set up using an entry in the SNMP-TARGET-MIB. It extends the SNMP-TARGET-MIB's snmpTargetParamsTable with a fingerprint of a certificate to use when establishing such a (D)TLS connection."

::= { snmpTlstmCertificateMapping 6 }

snmpTlstmParamsEntry OBJECT-TYPE

SYNTAX SnmpTlstmParamsEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"A conceptual row containing a fingerprint hash of a locally

held certificate for a given snmpTargetParamsEntry. The values in this row SHOULD be ignored if the connection that needs to be established, as indicated by the SNMP-TARGET-MIB infrastructure, is not a certificate and (D)TLS based connection. The connection SHOULD NOT be established if the certificate fingerprint stored in this entry does not point to a valid locally held certificate or if it points to an unusable certificate (such as might happen when the certificate's expiration date has been reached)."

```
INDEX      { IMPLIED snmpTargetParamsName }
::= { snmpTlstmParamsTable 1 }
```

```
SnmpTlstmParamsEntry ::= SEQUENCE {
    snmpTlstmParamsClientFingerprint SnmpTLSEFingerprint,
    snmpTlstmParamsStorageType       StorageType,
    snmpTlstmParamsRowStatus         RowStatus
}
```

snmpTlstmParamsClientFingerprint OBJECT-TYPE

```
SYNTAX      SnmpTLSEFingerprint
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
```

"This object stores the hash of the public portion of a locally held X.509 certificate. The X.509 certificate, its public key, and the corresponding private key will be used when initiating a (D)TLS connection as a (D)TLS client."

```
::= { snmpTlstmParamsEntry 1 }
```

snmpTlstmParamsStorageType OBJECT-TYPE

```
SYNTAX      StorageType
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
```

"The storage type for this conceptual row. Conceptual rows having the value 'permanent' need not allow write-access to any columnar objects in the row."

```
DEFVAL      { nonVolatile }
::= { snmpTlstmParamsEntry 2 }
```

snmpTlstmParamsRowStatus OBJECT-TYPE

```
SYNTAX      RowStatus
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION
```

"The status of this conceptual row. This object MAY be used to create or remove rows from this table.

To create a row in this table, an administrator MUST set this

object to either createAndGo(4) or createAndWait(5).

Until instances of all corresponding columns are appropriately configured, the value of the corresponding instance of the snmpTlstmParamsRowStatus column is notReady(3).

In particular, a newly created row cannot be made active until the corresponding snmpTlstmParamsClientFingerprint column has been set.

The snmpTlstmParamsClientFingerprint object MUST NOT be modified while the value of this object is active(1).

An attempt to set these objects while the value of snmpTlstmParamsRowStatus is active(1) will result in an inconsistentValue error."

```
::= { snmpTlstmParamsEntry 3 }
```

snmpTlstmAddrCount OBJECT-TYPE

SYNTAX Gauge32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"A count of the number of entries in the snmpTlstmAddrTable."

```
::= { snmpTlstmCertificateMapping 7 }
```

snmpTlstmAddrTableLastChanged OBJECT-TYPE

SYNTAX TimeStamp

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The value of sysUpTime.0 when the snmpTlstmAddrTable was last modified through any means, or 0 if it has not been modified since the command responder was started."

```
::= { snmpTlstmCertificateMapping 8 }
```

snmpTlstmAddrTable OBJECT-TYPE

SYNTAX SEQUENCE OF SnmpTlstmAddrEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"This table is used by a (D)TLS client when a (D)TLS connection is being set up using an entry in the SNMP-TARGET-MIB. It extends the SNMP-TARGET-MIB's

snmpTargetAddrTable so that the client can verify that the correct server has been reached. This verification can use either a certificate fingerprint, or an identity authenticated via certification path validation.

If there is an active row in this table corresponding to the entry in the SNMP-TARGET-MIB that was used to establish the connection, and the row's snmpTlstmAddrServerFingerprint column has non-empty value, then the server's presented certificate is compared with the snmpTlstmAddrServerFingerprint value (and the snmpTlstmAddrServerIdentity column is ignored). If the fingerprint matches, the verification has succeeded. If the fingerprint does not match, then the connection MUST be closed.

If the server's presented certificate has passed certification path validation [RFC5280] to a configured trust anchor, and an active row exists with a zero-length snmpTlstmAddrServerFingerprint value, then the snmpTlstmAddrServerIdentity column contains the expected host name. This expected host name is then compared against the server's certificate as follows:

- Implementations MUST support matching the expected host name against a dNSName in the subjectAltName extension field and MAY support checking the name against the CommonName portion of the subject distinguished name.
- The '*' (ASCII 0x2a) wildcard character is allowed in the dNSName of the subjectAltName extension (and in common name, if used to store the host name), but only as the left-most (least significant) DNS label in that value. This wildcard matches any left-most DNS label in the server name. That is, the subject *.example.com matches the server names a.example.com and b.example.com, but does not match example.com or a.b.example.com. Implementations MUST support wildcards in certificates as specified above, but MAY provide a configuration option to disable them.
- If the locally configured name is an internationalized domain name, conforming implementations MUST convert it to the ASCII Compatible Encoding (ACE) format for performing comparisons, as specified in Section 7 of [RFC5280].

If the expected host name fails these conditions then the connection MUST be closed.

If there is no row in this table corresponding to the entry in the SNMP-TARGET-MIB and the server can be authorized by another, implementation-dependent means, then the connection MAY still proceed."

::= { snmpTlstmCertificateMapping 9 }

snmpTlstmAddrEntry OBJECT-TYPE

SYNTAX SnmpTlstmAddrEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"A conceptual row containing a copy of a certificate's fingerprint for a given snmpTargetAddrEntry. The values in this row SHOULD be ignored if the connection that needs to be established, as indicated by the SNMP-TARGET-MIB infrastructure, is not a (D)TLS based connection. If an snmpTlstmAddrEntry exists for a given snmpTargetAddrEntry, then the presented server certificate MUST match or the connection MUST NOT be established. If a row in this table does not exist to match an snmpTargetAddrEntry row, then the connection SHOULD still proceed if some other certificate validation path algorithm (e.g., RFC 5280) can be used."

INDEX { IMPLIED snmpTargetAddrName }

::= { snmpTlstmAddrTable 1 }

SnmpTlstmAddrEntry ::= SEQUENCE {

snmpTlstmAddrServerFingerprint SnmpTLSFingerprint,

snmpTlstmAddrServerIdentity SnmpAdminString,

snmpTlstmAddrStorageType StorageType,

snmpTlstmAddrRowStatus RowStatus

}

snmpTlstmAddrServerFingerprint OBJECT-TYPE

SYNTAX SnmpTLSFingerprint

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"A cryptographic hash of a public X.509 certificate. This object should store the hash of the public X.509 certificate that the remote server should present during the (D)TLS connection setup. The fingerprint of the presented certificate and this hash value MUST match exactly or the connection MUST NOT be established."

DEFVAL { "" }

::= { snmpTlstmAddrEntry 1 }

snmpTlstmAddrServerIdentity OBJECT-TYPE

SYNTAX SnmpAdminString

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"The reference identity to check against the identity presented by the remote system."

DEFVAL { "" }

::= { snmpTlstmAddrEntry 2 }

snmpTlstmAddrStorageType OBJECT-TYPE

SYNTAX StorageType
MAX-ACCESS read-create
STATUS current

DESCRIPTION

"The storage type for this conceptual row. Conceptual rows having the value 'permanent' need not allow write-access to any columnar objects in the row."

DEFVAL { nonVolatile }
::= { snmpTlstmAddrEntry 3 }

snmpTlstmAddrRowStatus OBJECT-TYPE

SYNTAX RowStatus
MAX-ACCESS read-create
STATUS current

DESCRIPTION

"The status of this conceptual row. This object may be used to create or remove rows from this table.

To create a row in this table, an administrator MUST set this object to either createAndGo(4) or createAndWait(5).

Until instances of all corresponding columns are appropriately configured, the value of the corresponding instance of the snmpTlstmAddrRowStatus column is notReady(3).

In particular, a newly created row cannot be made active until the corresponding snmpTlstmAddrServerFingerprint column has been set.

Rows MUST NOT be active if the snmpTlstmAddrServerFingerprint column is blank and the snmpTlstmAddrServerIdentity is set to '*' since this would insecurely accept any presented certificate.

The snmpTlstmAddrServerFingerprint object MUST NOT be modified while the value of this object is active(1).

An attempt to set these objects while the value of snmpTlstmAddrRowStatus is active(1) will result in an inconsistentValue error."

::= { snmpTlstmAddrEntry 4 }

```
-- *****  
-- snmpTlstmNotifications - Notifications Information  
-- *****
```

snmpTlstmServerCertificateUnknown NOTIFICATION-TYPE

```

OBJECTS { snmpTlstmSessionUnknownServerCertificate }
STATUS current
DESCRIPTION
    "Notification that the server certificate presented by an SNMP
    over (D)TLS server was invalid because no configured
    fingerprint or CA was acceptable to validate it. This may be
    because there was no entry in the snmpTlstmAddrTable or
    because no path could be found to known Certification
    Authority.

    To avoid notification loops, this notification MUST NOT be
    sent to servers that themselves have triggered the
    notification."
    ::= { snmpTlstmNotifications 1 }

snmpTlstmServerInvalidCertificate NOTIFICATION-TYPE
    OBJECTS { snmpTlstmAddrServerFingerprint,
              snmpTlstmSessionInvalidServerCertificates}
    STATUS current
    DESCRIPTION
        "Notification that the server certificate presented by an SNMP
        over (D)TLS server could not be validated even if the
        fingerprint or expected validation path was known. That is, a
        cryptographic validation error occurred during certificate
        validation processing.

        To avoid notification loops, this notification MUST NOT be
        sent to servers that themselves have triggered the
        notification."
        ::= { snmpTlstmNotifications 2 }

-- *****
-- snmpTlstmCompliances - Conformance Information
-- *****

snmpTlstmCompliances OBJECT IDENTIFIER ::= { snmpTlstmConformance 1 }

snmpTlstmGroups OBJECT IDENTIFIER ::= { snmpTlstmConformance 2 }

-- *****
-- Compliance statements
-- *****

snmpTlstmCompliance MODULE-COMPLIANCE
    STATUS current
    DESCRIPTION
        "The compliance statement for SNMP engines that support the
        SNMP-TLS-TM-MIB"
    MODULE
        MANDATORY-GROUPS { snmpTlstmStatsGroup,

```

```

        snmpTlstmIncomingGroup,
        snmpTlstmOutgoingGroup,
        snmpTlstmNotificationGroup }
    ::= { snmpTlstmCompliances 1 }

-- *****
-- Units of conformance
-- *****

snmpTlstmStatsGroup OBJECT-GROUP
    OBJECTS {
        snmpTlstmSessionOpens,
        snmpTlstmSessionClientCloses,
        snmpTlstmSessionOpenErrors,
        snmpTlstmSessionAccepts,
        snmpTlstmSessionServerCloses,
        snmpTlstmSessionNoSessions,
        snmpTlstmSessionInvalidClientCertificates,
        snmpTlstmSessionUnknownServerCertificate,
        snmpTlstmSessionInvalidServerCertificates,
        snmpTlstmSessionInvalidCaches
    }
    STATUS      current
    DESCRIPTION
        "A collection of objects for maintaining
        statistical information of an SNMP engine that
        implements the SNMP TLS Transport Model."
    ::= { snmpTlstmGroups 1 }

snmpTlstmIncomingGroup OBJECT-GROUP
    OBJECTS {
        snmpTlstmCertToTSNCount,
        snmpTlstmCertToTSNTableLastChanged,
        snmpTlstmCertToTSNFingerprint,
        snmpTlstmCertToTSNMapType,
        snmpTlstmCertToTSNData,
        snmpTlstmCertToTSNStorageType,
        snmpTlstmCertToTSNRowStatus
    }
    STATUS      current
    DESCRIPTION
        "A collection of objects for maintaining
        incoming connection certificate mappings to
        tmSecurityNames of an SNMP engine that implements the
        SNMP TLS Transport Model."
    ::= { snmpTlstmGroups 2 }

snmpTlstmOutgoingGroup OBJECT-GROUP
    OBJECTS {
        snmpTlstmParamsCount,

```

```

        snmpTlstmParamsTableLastChanged,
        snmpTlstmParamsClientFingerprint,
        snmpTlstmParamsStorageType,
        snmpTlstmParamsRowStatus,
        snmpTlstmAddrCount,
        snmpTlstmAddrTableLastChanged,
        snmpTlstmAddrServerFingerprint,
        snmpTlstmAddrServerIdentity,
        snmpTlstmAddrStorageType,
        snmpTlstmAddrRowStatus
    }
    STATUS      current
    DESCRIPTION
        "A collection of objects for maintaining
        outgoing connection certificates to use when opening
        connections as a result of SNMP-TARGET-MIB settings."
    ::= { snmpTlstmGroups 3 }

snmpTlstmNotificationGroup NOTIFICATION-GROUP
    NOTIFICATIONS {
        snmpTlstmServerCertificateUnknown,
        snmpTlstmServerInvalidCertificate
    }
    STATUS current
    DESCRIPTION
        "Notifications"
    ::= { snmpTlstmGroups 4 }

END

```

5. Security Considerations

This document updates a transport model that permits SNMP to utilize (D)TLS security services. The security threats and how the TLS transport model mitigates these threats are covered throughout this document and in [\[RFC6353\]](#). Security considerations for TLS are described in Section 10 and Appendix E of TLS 1.3 [\[RFC8446\]](#).

SNMP versions prior to SNMPv3 did not include adequate security. Even if the network itself is secure (for example, by using IPsec), even then, there is no control as to who on the secure network is allowed to access and GET/SET (read/change/create/delete) the objects in this MIB module.

It is **RECOMMENDED** that only SNMPv3 messages using the Transport Security Model (TSM) or another secure-transport aware security model be sent over the TLSTM transport.

6. IANA Considerations

IANA is asked to create a new registry called the SNMP-TLSTM HashAlgorithm Registry in the Structure of Management Information (SMI) Numbers (MIB Module Registrations) Group and to update the proposed URL reference in the above MIB (listed as "https://www.iana.org/assignments/smi-numbers/smi-numbers.xhtml" under SnmpTLSTMFingerprint), if needed, to accurately reflect its location.

The registry should have the following fields: value, description, recommended, and reference. The range of values is zero to 255, with initial assignments shown in Section 2.1. The "recommended" column indicates "Y" for hashing algorithms that are deemed to be acceptable for current use and "N" for hashing algorithms that reflect historical meanings that are not recommended (e.g., because they do not provide sufficient security for modern systems). A blank field indicates that no recommendation is made (e.g., because the value is reserved or left for private use).

The policy for updates is Expert Review. The expert should consult the Security Area, e.g. via the mailing list of the TLS WG (the initial values of this registry are taken from an existing TLS Registry so the TLS WG would seem the best fit for this).

While future additions to the IANA TLS HashAlgorithm Registry are not expected, any future addition to the IANA TLS HashAlgorithm Registry **MUST** be consistent with the values assigned in the IANA SNMP-TLSTM HashAlgorithm Registry.

7. Acknowledgements

This document is based on [RFC6353]. This document was reviewed by the following people who helped provide useful comments: Michaela Vanderveen, Joe Clarke, Jurgen Schonwalder, and Tom Petch

8. References

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