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A YANG Data Model for SNMP Configuration

Abstract

This document defines a collection of YANG definitions for configuring SNMP engines.

Status of This Memo

This is an Internet Standards Track document.

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1. Introduction

This document defines a YANG [RFC6020] data model for the configuration of SNMP engines. The configuration model is consistent with the MIB modules defined in [RFC3411], [RFC3412], [RFC3413], [RFC3414], [RFC3415], [RFC3417], [RFC3418], [RFC3419], [RFC3584], [RFC3826], [RFC5591], [RFC5592], and [RFC6353] but takes advantage of YANG's ability to define hierarchical configuration data models.

The configuration data model in particular has been designed for SNMP deployments where SNMP runs in read-only mode and the Network Configuration Protocol (NETCONF) is used to configure the SNMP agent. Nevertheless, the data model allows implementations that support write access both via SNMP and NETCONF in order to interwork with SNMP management applications manipulating SNMP agent configuration using SNMP. Further details can be found in Section 3.

The YANG data model focuses on configuration. Operational state objects are not explicitly modeled. The operational state of an SNMP agent can be accessed either directly via SNMP or, alternatively, via NETCONF using the read-only translation of the relevant SNMP MIB modules into YANG modules [RFC6643].

This document also defines a YANG data model for mapping an X.509 certificate to a name.

The keywords "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].

2. Data Model

In order to preserve the modularity of SNMP, the YANG configuration data model is organized in a set of YANG submodules, all sharing the same module namespace. This allows adding configuration support for additional SNMP features while keeping the number of namespaces that have to be dealt with down to a minimum.

2.1. Tree Diagrams

A simplified graphical representation of the data model is used in this document. The meaning of the symbols in these diagrams is as follows:

- o Brackets "[" and "]" enclose list keys.
- o Abbreviations before data node names: "rw" means configuration (read-write), and "ro" means state data (read-only).
- o Symbols after data node names: "?" means an optional node, "!" means a presence container, and "*" denotes a list and leaf-list.
- o Parentheses enclose choice and case nodes, and case nodes are also marked with a colon (":").
- o Ellipsis ("...") stands for contents of subtrees that are not shown.

2.2. General Considerations

Most YANG nodes are mapped 1-1 to the corresponding MIB object. The "reference" statement is used to indicate which corresponding MIB object the YANG node is mapped to. When there is not a simple 1-1 mapping, the "description" statement explains the mapping.

The persistency models in SNMP and NETCONF are quite different. In NETCONF, the persistency is defined by the datastore, whereas in SNMP, it is defined either explicitly in the data model or on a row-by-row basis using the Textual Convention "StorageType". Thus, in the YANG model defined here, the "StorageType" columns are not present. For implementation guidelines, see Section 3.

In SNMP, row creation and deletion are controlled using the Textual Convention "RowStatus". In NETCONF, creation and deletion are handled by the protocol, not in the data model. Thus, in the YANG model defined here, the "RowStatus" columns are not present.

2.3. Common Definitions

The submodule "ietf-snmp-common" defines a set of common typedefs and the top-level container "snmp". All configuration parameters defined in the other submodules are organized under this top-level container.

2.4. Engine Configuration

The submodule "ietf-snmp-engine", which defines configuration parameters that are specific to SNMP engines, has the following structure:

```

+--rw snmp
  +--rw engine
    +--rw enabled?                boolean
    +--rw listen* [name]
      +--rw name                  snmp:identifier
      +--rw (transport)
        +--:(udp)
          +--rw udp
            +--rw ip              inet:ip-address
            +--rw port?           inet:port-number
        +--rw version
          +--rw v1?               empty
          +--rw v2c?              empty
          +--rw v3?               empty
      +--rw engine-id?           snmp:engine-id
      +--rw enable-authen-traps? boolean

```

The leaf `"/snmp/engine/enabled"` can be used to enable/disable an SNMP engine.

The list `"/snmp/engine/listen"` provides configuration of the transport endpoints the engine is listening to. In this submodule, SNMP over UDP is defined. The Secure Shell (SSH) Protocol, Transport Layer Security (TLS), and Datagram Transport Layer Security (DTLS) are also supported, defined in "ietf-snmp-ssh" (Section 2.13) and "ietf-snmp-tls" (Section 2.12), respectively. The "transport" choice is expected to be augmented for other transports.

The `"/snmp/engine/version"` container can be used to enable/disable the different message processing models [RFC3411].

2.5. Target Configuration

The submodule "ietf-snmp-target", which defines configuration parameters that correspond to the objects in SNMP-TARGET-MIB, has the following structure:

```

+--rw snmp
  +--rw target* [name]
    +--rw name          snmp:identifier
    +--rw (transport)
      +--:(udp)
        +--rw udp
          +--rw ip          inet:ip-address
          +--rw port?       inet:port-number
          +--rw prefix-length? uint8
        +--rw tag*        snmp:identifier
        +--rw timeout?    uint32
        +--rw retries?    uint8
      +--rw target-params snmp:identifier
  +--rw target-params* [name]
    +--rw name          snmp:identifier
    +--rw (params)?

```

An entry in the list "/snmp/target" corresponds to an "snmpTargetAddrEntry".

The "snmpTargetAddrTDomain" and "snmpTargetAddrTAddress" objects are mapped to transport-specific YANG nodes. Each transport is configured as a separate case in the "transport" choice. In this submodule, SNMP over UDP is defined. TLS and DTLS are also supported, defined in "ietf-snmp-tls" (Section 2.12). The "transport" choice is expected to be augmented for other transports.

An entry in the list "/snmp/target-params" corresponds to an "snmpTargetParamsEntry". This list contains a choice "params", which is augmented by submodules specific to the security model, currently, "ietf-snmp-community" (Section 2.8), "ietf-snmp-usm" (Section 2.10), and "ietf-snmp-tls" (Section 2.12).

2.6. Notification Configuration

The submodule "ietf-snmp-notification", which defines configuration parameters that correspond to the objects in SNMP-NOTIFICATION-MIB, has the following structure:

```

+--rw snmp
  +--rw notify* [name]
    |   +--rw name      snmp:identifier
    |   +--rw tag       snmp:identifier
    |   +--rw type?     enumeration
  +--rw notify-filter-profile* [name]
    +--rw name          snmp:identifier
    +--rw include*      snmp:wildcard-object-identifier
    +--rw exclude*      snmp:wildcard-object-identifier

```

This submodule also augments the "target-params" list defined in the "ietf-snmp-target" submodule (Section 2.5) with one leaf:

```

+--rw snmp
  +--rw target-params* [name]
    ...
    +--rw notify-filter-profile?  leafref

```

An entry in the list "/snmp/notify" corresponds to an "snmpNotifyEntry".

An entry in the list "/snmp/notify-filter-profile" corresponds to an "snmpNotifyFilterProfileEntry". In the MIB, there is a sparse relationship between "snmpTargetParamsTable" and "snmpNotifyFilterProfileTable". In the YANG model, this sparse relationship is represented with a leafref leaf "notify-filter-profile" in the "/snmp/target-params" list, which refers to an entry in the "/snmp/notify-filter-profile" list.

The "snmpNotifyFilterTable" is represented as a list "filter" within the "/snmp/notify-filter-profile" list.

This submodule defines the feature "notification-filter". A server implements this feature if it supports SNMP notification filtering [RFC3413].

2.7. Proxy Configuration

The submodule "ietf-snmp-proxy", which defines configuration parameters that correspond to the objects in SNMP-PROXY-MIB, has the following structure:

```

+--rw snmp
  +--rw proxy* [name]
    +--rw name                snmp:identifier
    +--rw type                enumeration
    +--rw context-engine-id   snmp:engine-id
    +--rw context-name?      snmp:context-name
    +--rw target-params-in?   snmp:identifier
    +--rw single-target-out?  snmp:identifier
    +--rw multiple-target-out? snmp:identifier

```

An entry in the list "/snmp/proxy" corresponds to an "snmpProxyEntry".

This submodule defines the feature "proxy". A server implements this feature if it can act as an SNMP proxy [RFC3413].

2.8. Community Configuration

The submodule "ietf-snmp-community", which defines configuration parameters that correspond to the objects in SNMP-COMMUNITY-MIB, has the following structure:

```

+--rw snmp
  +--rw community* [index]
    +--rw index                snmp:identifier
    +--rw (name)?
      | +--:(text-name)
      | | +--rw text-name?      string
      | +--:(binary-name)
      | | +--rw binary-name?    binary
    +--rw security-name        snmp:security-name
    +--rw engine-id?           snmp:engine-id
    +--rw context?             snmp:context-name
    +--rw target-tag?          snmp:identifier

```

This submodule also augments the "/snmp/target-params/params" choice with nodes for the Community-based Security Model used by SNMPv1 and SNMPv2c:


```

+--rw snmp
  +--rw target-params* [name]
    |   ...
    |   +--rw (params)?
    |   |   +--:(v1)
    |   |   |   +--rw v1
    |   |   |   |   +--rw security-name      snmp:security-name
    |   |   +--:(v2c)
    |   |   |   +--rw v2c
    |   |   |   |   +--rw security-name      snmp:security-name
    |   +--rw target* [name]
    +--rw mms?          union

```

An entry in the list `"/snmp/community"` corresponds to an `"snmpCommunityEntry"`.

When a case `"v1"` or `"v2c"` is chosen, it implies an `snmpTargetParamsMPPModel` 0 (SNMPv1) or 1 (SNMPv2), and an `snmpTargetParamsSecurityModel` 1 (SNMPv1) or 2 (SNMPv2), respectively. Both cases imply an `snmpTargetParamsSecurityLevel` of `noAuthNoPriv`.

2.9. View-Based Access Control Model Configuration

The submodule `"ietf-snmp-vacm"`, which defines configuration parameters that correspond to the objects in `SNMP-VIEW-BASED-ACM-MIB`, has the following structure:

```

+--rw snmp
  +--rw vacm
    +--rw group* [name]
      |   +--rw name          group-name
      |   +--rw member* [security-name]
      |   |   +--rw security-name      snmp:security-name
      |   |   +--rw security-model*    snmp:security-model
      |   +--rw access* [context security-model security-level]
      |   |   +--rw context          snmp:context-name
      |   |   +--rw context-match?   enumeration
      |   |   +--rw security-model    snmp:security-model-or-any
      |   |   +--rw security-level    snmp:security-level
      |   |   +--rw read-view?        view-name
      |   |   +--rw write-view?       view-name
      |   |   +--rw notify-view?      view-name
      +--rw view* [name]
        |   +--rw name          view-name
        |   +--rw include*      snmp:wildcard-object-identifier
        |   +--rw exclude*      snmp:wildcard-object-identifier

```

The "vacmSecurityToGroupTable" and "vacmAccessTable" are mapped to a structure of nested lists in the YANG model. Groups are defined in the list "/snmp/vacm/group", and for each group, there is a sublist "member" that maps to "vacmSecurityToGroupTable" and a sublist "access" that maps to "vacmAccessTable".

MIB views are defined in the list "/snmp/vacm/view", and for each MIB view, there is a leaf-list of included subtree families and a leaf-list of excluded subtree families. This is more compact and thus a more readable representation of the "vacmViewTreeFamilyTable".

2.10. User-Based Security Model Configuration

The submodule "ietf-snmp-usm", which defines configuration parameters that correspond to the objects in SNMP-USER-BASED-SM-MIB, has the following structure:

```

+--rw snmp
  +--rw usm
    +--rw local
      |   +--rw user* [name]
      |       +-- {common user params}
    +--rw remote* [engine-id]
      +--rw engine-id      snmp:engine-id
      +--rw user* [name]
          +-- {common user params}

```

The "{common user params}" are:

```

+--rw name      snmp:identifier
+--rw auth!
  |   +--rw (protocol)
  |       +--:(md5)
  |           |   +--rw md5
  |           |       +-- rw key      yang:hex-string
  |       +--:(sha)
  |           |   +--rw sha
  |           |       +-- rw key      yang:hex-string
+--rw priv!
  |   +--rw (protocol)
  |       +--:(des)
  |           |   +--rw des
  |           |       +-- rw key      yang:hex-string
  |       +--:(aes)
  |           |   +--rw aes
  |           |       +-- rw key      yang:hex-string

```

This submodule also augments the `"/snmp/target-params/params"` choice with nodes for the SNMP User-based Security Model.

```

+--rw snmp
  +--rw target-params* [name]
    ...
    +--rw (params)?
      +--:(usm)
        +--rw usm
          +--rw user-name          snmp:security-name
          +--rw security-level     security-level

```

In the MIB, there is a single table with local and remote users, indexed by the engine ID and user name. In the YANG model, there is one list of local users and a nested list of remote users.

In the MIB, there are several objects related to changing the authentication and privacy keys. These objects are not present in the YANG model. However, the localized key can be changed. This implies that if the engine ID is changed, all users keys need to be changed as well.

2.11. Transport Security Model Configuration

The submodule `"ietf-snmp-tsm"`, which defines configuration parameters that correspond to the objects in SNMP-TSM-MIB, has the following structure:

```

+--rw snmp
  +--rw tsm
    +--rw use-prefix?    boolean

```

This submodule also augments the `"/snmp/target-params/params"` choice with nodes for the SNMP Transport Security Model.

```

+--rw snmp
  +--rw target-params* [name]
    ...
    +--rw (params)?
      +--:(tsm)
        +--rw tsm
          +--rw security-name      snmp:security-name
          +--rw security-level     security-level

```

This submodule defines the feature `"tsm"`. A server implements this feature if it supports the Transport Security Model (TSM) [RFC5591].

2.12. Transport Layer Security Transport Model Configuration

The submodule "ietf-snmp-tls", which defines configuration parameters that correspond to the objects in SNMP-TLS-TM-MIB, has the following structure:

```

+--rw snmp
  ...
  +--rw target* [name]
    ...
    +--rw (transport)
      ...
      +--:(tls)
        +--rw tls
          +-- {common (d)tls transport params}
      +--:(dtls)
        +--rw dtls
          +-- {common (d)tls transport params}
  +--rw tlstm
    +--rw cert-to-name* [id]
      +--rw id                uint32
      +--rw fingerprint       x509c2n:tls-fingerprint
      +--rw map-type           identityref
      +--rw name               string

```

The "{common (d)tls transport params}" are:

```

+--rw ip?                inet:host
+--rw port?              inet:port-number
+--rw client-fingerprint? x509c2n:tls-fingerprint
+--rw server-fingerprint? x509c2n:tls-fingerprint
+--rw server-identity?    snmp:admin-string

```

This submodule also augments the `"/snmp/engine/listen/transport"` choice with objects for the D(TLS) transport endpoints:

```

+--rw snmp
  +--rw engine
    ...
    +--rw listen* [name]
      ...
      +--rw (transport)
        ...
        +--:(tls)
          +--rw tls
            +--rw ip          inet:ip-address
            +--rw port?       inet:port-number
        +--:(dtls)
          +--rw dtls
            +--rw ip          inet:ip-address
            +--rw port?       inet:port-number

```

This submodule defines the feature `"tlstm"`. A server implements this feature if it supports the Transport Layer Security (TLS) Transport Model (TLSTM) [RFC6353].

2.13. Secure Shell Transport Model Configuration

The submodule `"ietf-snmp-ssh"`, which defines configuration parameters that correspond to the objects in SNMP-SSH-TM-MIB, has the following structure:

```

+--rw snmp
  ...
  +--rw target* [name]
    ...
    +--rw (transport)
      ...
      +--:(ssh)
        +--rw ssh
          +--rw ip          inet:host
          +--rw port?       inet:port-number
          +--rw username?   string

```

It also augments the `"/snmp/engine/listen/transport"` choice with objects for the SSH transport endpoints:

```

+--rw snmp
  +--rw engine
    ...
    +--rw listen* [name]
      ...
      +--rw (transport)
        ...
        +--:(ssh)
          +--rw ssh
            +--rw ip          inet:host
            +--rw port?       inet:port-number
            +--rw username?   string
```

This submodule defines the feature `"sshtm"`. A server implements this feature if it supports the Secure Shell Transport Model (SSTM) [RFC5592].

3. Implementation Guidelines

This section describes some challenges for implementations that support both the YANG models defined in this document and either read-write or read-only SNMP access to the same data, using the standard MIB modules.

As described in Section 2.2, the persistency models in NETCONF and SNMP are quite different. This poses a challenge for an implementation to support both NETCONF and SNMP access to the same data, in particular if the data is writable over both protocols. Specifically, the configuration data may exist in some combination of the three NETCONF configuration datastores, and this data must be mapped to rows in the SNMP tables, in some SNMP contexts, with proper values for the `StorageType` columns.

This problem is not new; it has been handled in many implementations that support configuration of the SNMP engine over a command line interface (CLI), which normally have a persistency model similar to NETCONF.

Since there is not one solution that works for all cases, this document does not provide a recommended solution. Instead, some of the challenges involved are described below.

3.1. Supporting read-only SNMP Access

If a device implements only `:writable-running`, it is trivial to map the contents of "running" to data in the SNMP tables, where all instances of the `StorageType` columns have the value "nonVolatile".

If a device implements `:candidate` but not `:startup`, the implementation may choose to not expose the contents of the "candidate" datastore over SNMP and map the contents of "running" as described above. As an option, the contents of "candidate" might be accessible in a separate SNMP context.

If a device implements `:startup`, the handling of `StorageType` becomes more difficult. Since the contents of "running" and "startup" might differ, data in "running" cannot automatically be mapped to instances with `StorageType` "nonVolatile". If a particular entry exists in "running" but not in "startup", its `StorageType` should be "volatile". If a particular entry exists in "startup" but not "running", it should not be mapped to an SNMP instance, at least not in the default SNMP context.

3.2. Supporting read-write SNMP Access

If the implementation supports read-write access to data over SNMP, and specifically creation of table rows, special attention has to be given to the handling of the `RowStatus` and `StorageType` columns. The problem is to determine which table rows to store in the configuration datastores and which configuration datastore is appropriate for each row.

The SNMP tables contain a mix of configured data and operational state, and only rows with an "active" `RowStatus` column should be stored in a configuration datastore.

If a device implements only `:writable-running`, "active" rows with a "nonVolatile" `StorageType` column can be stored in "running". Rows with a "volatile" `StorageType` column are operational state.

If a device implements `:candidate` but not `:writable-running`, all configuration changes typically go through the "candidate", even if they are done over SNMP. An implementation might have to perform some automatic commit of the "candidate" when data is written over SNMP, since there is no explicit "commit" operation in SNMP.

If a device implements `:startup`, "nonVolatile" rows cannot just be written to "running"; they must also be copied into "startup". "volatile" rows may be treated as operational state and not copied to any datastore, or they may be copied into "running".

Cooperating SNMP management applications may use spin lock objects (snmpTargetSpinLock [RFC3413], usmUserSpinLock [RFC3414], vacmViewSpinLock [RFC3415]) to coordinate concurrent write requests. Implementations supporting modifications of MIB objects protected by a spin lock via NETCONF should ensure that the spin lock objects are properly incremented whenever objects are changed via NETCONF. This allows cooperating SNMP management applications to discover that concurrent modifications are taking place.

4. Definitions

4.1. Module 'ietf-x509-cert-to-name'

This YANG module imports typedefs from [RFC6991].

<CODE BEGINS> file "ietf-x509-cert-to-name.yang"

```
module ietf-x509-cert-to-name {  
  
    namespace "urn:ietf:params:xml:ns:yang:ietf-x509-cert-to-name";  
    prefix x509c2n;  
  
    import ietf-yang-types {  
        prefix yang;  
    }  
  
    organization  
        "IETF NETMOD (NETCONF Data Modeling Language) Working Group";  
  
    contact  
        "WG Web:    <http://tools.ietf.org/wg/netmod/>  
        WG List:    <mailto:netmod@ietf.org>  
  
        WG Chair: Thomas Nadeau  
                  <mailto:tnadeau@lucidvision.com>  
  
        WG Chair: Juergen Schoenwaelder  
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        Editor:    Martin Bjorklund  
                  <mailto:mbj@tail-f.com>  
  
        Editor:    Juergen Schoenwaelder  
                  <mailto:j.schoenwaelder@jacobs-university.de>";  
  
    description  
        "This module contains a collection of YANG definitions for  
        extracting a name from an X.509 certificate."
```


The algorithm used to extract a name from an X.509 certificate was first defined in RFC 6353.

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This version of this YANG module is part of RFC 7407; see the RFC itself for full legal notices.";

reference

"RFC 6353: Transport Layer Security (TLS) Transport Model for the Simple Network Management Protocol (SNMP)";

revision 2014-12-10 {

description

"Initial revision.";

reference

"RFC 7407: A YANG Data Model for SNMP Configuration";

}

typedef tls-fingerprint {

type yang:hex-string {

pattern '([0-9a-fA-F]){2}(:([0-9a-fA-F]){2}){0,254}';

}

description

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

A tls-fingerprint value is composed of a 1-octet hashing algorithm identifier followed by the fingerprint value. The first octet value identifying the hashing algorithm is taken from the IANA 'TLS HashAlgorithm Registry' (RFC 5246). The remaining octets are filled using the results of the hashing algorithm.";

reference

"RFC 6353: Transport Layer Security (TLS) Transport Model for the Simple Network Management Protocol (SNMP).
SNMP-TLS-TM-MIB.SnmpTLSPFingerprint";

}

```
/* Identities */

identity cert-to-name {
  description
    "Base identity for algorithms to derive a name from a
    certificate.";
}

identity specified {
  base cert-to-name;
  description
    "Directly specifies the name to be used for the certificate.
    The value of the leaf 'name' in the cert-to-name list is
    used.";
  reference
    "RFC 6353: Transport Layer Security (TLS) Transport Model
    for the Simple Network Management Protocol (SNMP).
    SNMP-TLS-TM-MIB.snmpTlstmCertSpecified";
}

identity san-rfc822-name {
  base cert-to-name;
  description
    "Maps a subjectAltName's rfc822Name to a name. The local part
    of the rfc822Name is passed unaltered, but the host-part of
    the name must be passed in lowercase. For example, the
    rfc822Name field FooBar@Example.COM is mapped to name
    FooBar@example.com.";
  reference
    "RFC 6353: Transport Layer Security (TLS) Transport Model
    for the Simple Network Management Protocol (SNMP).
    SNMP-TLS-TM-MIB.snmpTlstmCertSANRFC822Name";
}

identity san-dns-name {
  base cert-to-name;
  description
    "Maps a subjectAltName's dNSName to a name 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 name values.";
  reference
    "RFC 6353: Transport Layer Security (TLS) Transport Model
    for the Simple Network Management Protocol (SNMP).
    SNMP-TLS-TM-MIB.snmpTlstmCertSANDNSName";
}
```

```

identity san-ip-address {
  base cert-to-name;
  description
    "Maps a subjectAltName's ipAddress to a name 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 name values.";
  reference
    "RFC 6353: Transport Layer Security (TLS) Transport Model
    for the Simple Network Management Protocol (SNMP).
    SNMP-TLS-TM-MIB.snmpTlstmCertSANIpAddress";
}

```

```

identity san-any {
  base cert-to-name;
  description
    "Maps any of the following fields using the corresponding
    mapping algorithms:

```

Type	Algorithm
rfc822Name	san-rfc822-name
dNSName	san-dns-name
iPAddress	san-ip-address

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

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

```

reference
  "RFC 6353: Transport Layer Security (TLS) Transport Model
  for the Simple Network Management Protocol (SNMP).
  SNMP-TLS-TM-MIB.snmpTlstmCertSANAny";

```

```
}  
  
identity common-name {  
    base cert-to-name;  
    description  
        "Maps a certificate's CommonName to a name 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 name  
        values.";  
    reference  
        "RFC 6353: Transport Layer Security (TLS) Transport Model  
        for the Simple Network Management Protocol (SNMP).  
        SNMP-TLS-TM-MIB.snmpTlstmCertCommonName";  
}  
  
/*  
 * Groupings  
 */  
  
grouping cert-to-name {  
    description  
        "Defines nodes for mapping certificates to names. Modules  
        that use this grouping should describe how the resulting  
        name is used.";  
  
    list cert-to-name {  
        key id;  
        description  
            "This list defines how certificates are mapped to names.  
            The name is derived by considering each cert-to-name  
            list entry in order. The cert-to-name entry's fingerprint  
            determines whether the list entry is a match:  
  
            1) If the cert-to-name list entry's fingerprint value  
            matches that of the presented certificate, then consider  
            the list entry a successful match.  
  
            2) If the cert-to-name list entry's fingerprint value  
            matches that of a locally held copy of a trusted CA  
            certificate, and that CA certificate was part of the CA  
            certificate chain to the presented certificate, then  
            consider the list entry a successful match.  
  
            Once a matching cert-to-name list entry has been found, the  
            map-type is used to determine how the name associated with  
            the certificate should be determined. See the map-type
```

leaf's description for details on determining the name value. If it is impossible to determine a name from the cert-to-name list entry's data combined with the data presented in the certificate, then additional cert-to-name list entries MUST be searched to look for another potential match.

Security administrators are encouraged to make use of certificates with subjectAltName fields that can be mapped to names so that a single root CA certificate can allow all child certificates' subjectAltName fields to map directly to a name via a 1:1 transformation.";

reference

"RFC 6353: Transport Layer Security (TLS) Transport Model for the Simple Network Management Protocol (SNMP).
SNMP-TLS-TM-MIB.snmpTlstmCertToTSNEntry";

leaf id {

type uint32;

description

"The id specifies the order in which the entries in the cert-to-name list are searched. Entries with lower numbers are searched first.";

reference

"RFC 6353: Transport Layer Security (TLS) Transport Model for the Simple Network Management Protocol (SNMP).
SNMP-TLS-TM-MIB.snmpTlstmCertToTSNID";

}

leaf fingerprint {

type x509c2n:tls-fingerprint;

mandatory true;

description

"Specifies a value with which the fingerprint of the full certificate presented by the peer is compared. If the fingerprint of the full certificate presented by the peer does not match the fingerprint configured, then the entry is skipped, and the search for a match continues.";

reference

"RFC 6353: Transport Layer Security (TLS) Transport Model for the Simple Network Management Protocol (SNMP).
SNMP-TLS-TM-MIB.snmpTlstmCertToTSNFingerprint";

}

leaf map-type {

type identityref {

base cert-to-name;

```

    }
    mandatory true;
    description
      "Specifies the algorithm used to map the certificate
       presented by the peer to a name.

       Mappings that need additional configuration objects should
       use the 'when' statement to make them conditional based on
       the map-type.";
    reference
      "RFC 6353: Transport Layer Security (TLS) Transport Model
       for the Simple Network Management Protocol
       (SNMP).
       SNMP-TLS-TM-MIB.snmpTlstmCertToTSNMapType";
  }

  leaf name {
    when "../map-type = 'x509c2n:specified'";
    type string;
    mandatory true;
    description
      "Directly specifies the NETCONF username when the
       map-type is 'specified'.";
    reference
      "RFC 6353: Transport Layer Security (TLS) Transport Model
       for the Simple Network Management Protocol
       (SNMP).
       SNMP-TLS-TM-MIB.snmpTlstmCertToTSNData";
  }
}
}
}
}
}

```

<CODE ENDS>

4.2. Module 'ietf-snmp'

<CODE BEGINS> file "ietf-snmp.yang"

```

module ietf-snmp {

  namespace "urn:ietf:params:xml:ns:yang:ietf-snmp";
  prefix snmp;

  include ietf-snmp-common {
    revision-date 2014-12-10;
  }
  include ietf-snmp-engine {

```

```
    revision-date 2014-12-10;
  }
  include ietf-snmp-target {
    revision-date 2014-12-10;
  }
  include ietf-snmp-notification {
    revision-date 2014-12-10;
  }
  include ietf-snmp-proxy {
    revision-date 2014-12-10;
  }
  include ietf-snmp-community {
    revision-date 2014-12-10;
  }
  include ietf-snmp-usm {
    revision-date 2014-12-10;
  }
  include ietf-snmp-tsm {
    revision-date 2014-12-10;
  }
  include ietf-snmp-vacm {
    revision-date 2014-12-10;
  }
  include ietf-snmp-tls {
    revision-date 2014-12-10;
  }
  include ietf-snmp-ssh {
    revision-date 2014-12-10;
  }
}
```

organization

"IETF NETMOD (NETCONF Data Modeling Language) Working Group";

contact

"WG Web: <<http://tools.ietf.org/wg/netmod/>>
WG List: <<mailto:netmod@ietf.org>>

WG Chair: Thomas Nadeau
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Editor: Martin Bjorklund
<<mailto:mbj@tail-f.com>>

Editor: Juergen Schoenwaelder
<<mailto:j.schoenwaelder@jacobs-university.de>>";

description

"This module contains a collection of YANG definitions for configuring SNMP engines.

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This version of this YANG module is part of RFC 7407; see the RFC itself for full legal notices.";

```
revision 2014-12-10 {  
  description  
    "Initial revision.";  
  reference  
    "RFC 7407: A YANG Data Model for SNMP Configuration";  
}
```

```
}
```

<CODE ENDS>

4.3. Submodule 'ietf-snmp-common'

<CODE BEGINS> file "ietf-snmp-common.yang"

```
submodule ietf-snmp-common {  
  
  belongs-to ietf-snmp {  
    prefix snmp;  
  }  
  
  import ietf-yang-types {  
    prefix yang;  
  }  
  
  organization  
    "IETF NETMOD (NETCONF Data Modeling Language) Working Group";  
  
  contact  
    "WG Web:  <http://tools.ietf.org/wg/netmod/>  
    WG List:  <mailto:netmod@ietf.org>
```


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<mailto:tnadeau@lucidvision.com>

WG Chair: Juergen Schoenwaelder
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Editor: Martin Bjorklund
<mailto:mbj@tail-f.com>

Editor: Juergen Schoenwaelder
<mailto:j.schoenwaelder@jacobs-university.de>;

description

"This submodule contains a collection of common YANG definitions for configuring SNMP engines.

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```
revision 2014-12-10 {  
  description  
    "Initial revision.";  
  reference  
    "RFC 7407: A YANG Data Model for SNMP Configuration";  
}
```

/* Collection of SNMP-specific data types */

```
typedef admin-string {  
  type string {  
    length "0..255";  
  }  
  description  
    "Represents SnmpAdminString as defined in RFC 3411.  
  
    Note that the size of an SnmpAdminString is measured in  
    octets, not characters.";
```

```
reference
  "RFC 3411: An Architecture for Describing Simple Network
  Management Protocol (SNMP) Management Frameworks.
  SNMP-FRAMEWORK-MIB.SnmpAdminString";
}

typedef identifier {
  type admin-string {
    length "1..32";
  }
  description
    "Identifiers are used to name items in the SNMP configuration
    datastore.";
}

typedef context-name {
  type admin-string {
    length "0..32";
  }
  description
    "The context type represents an SNMP context name.";
  reference
    "RFC 3411: An Architecture for Describing Simple Network
    Management Protocol (SNMP) Management Frameworks";
}

typedef security-name {
  type admin-string {
    length "1..32";
  }
  description
    "The security-name type represents an SNMP security name.";
  reference
    "RFC 3411: An Architecture for Describing Simple Network
    Management Protocol (SNMP) Management Frameworks";
}

typedef security-model {
  type union {
    type enumeration {
      enum v1 { value 1; }
      enum v2c { value 2; }
      enum usm { value 3; }
      enum tsm { value 4; }
    }
    type int32 {
      range "1..2147483647";
    }
  }
}
```

```
    }
    reference
      "RFC 3411: An Architecture for Describing Simple Network
        Management Protocol (SNMP) Management Frameworks";
  }

  typedef security-model-or-any {
    type union {
      type enumeration {
        enum any { value 0; }
      }
      type security-model;
    }
    reference
      "RFC 3411: An Architecture for Describing Simple Network
        Management Protocol (SNMP) Management Frameworks";
  }

  typedef security-level {
    type enumeration {
      enum no-auth-no-priv { value 1; }
      enum auth-no-priv    { value 2; }
      enum auth-priv       { value 3; }
    }
    reference
      "RFC 3411: An Architecture for Describing Simple Network
        Management Protocol (SNMP) Management Frameworks";
  }

  typedef engine-id {
    type yang:hex-string {
      pattern '([0-9a-fA-F]){2}(:([0-9a-fA-F]){2}){4,31}';
    }
    description
      "The engine ID specified as a list of colon-specified
        hexadecimal octets, e.g., '80:00:02:b8:04:61:62:63'.";
    reference
      "RFC 3411: An Architecture for Describing Simple Network
        Management Protocol (SNMP) Management Frameworks";
  }

  typedef wildcard-object-identifier {
    type string;
    description
      "The wildcard-object-identifier type represents an SNMP object
        identifier where subidentifiers can be given either as a label,
        in numeric form, or a wildcard, represented by an asterisk
        ('*').";
  }
```

```
}  
typedef tag-value {  
  type string {  
    length "0..255";  
  }  
  description  
    "Represents SnmpTagValue as defined in RFC 3413.  
  
    Note that the size of an SnmpTagValue is measured in  
    octets, not characters.";  
  reference  
    "RFC 3413: Simple Network Management Protocol (SNMP)  
    Applications.  
    SNMP-TARGET-MIB.SnmpTagValue";  
}  
  
container snmp {  
  description  
    "Top-level container for SNMP-related configuration and  
    status objects.";  
}  
}  
  
<CODE ENDS>
```

4.4. Submodule 'ietf-snmp-engine'

```
<CODE BEGINS> file "ietf-snmp-engine.yang"  
  
submodule ietf-snmp-engine {  
  
  belongs-to ietf-snmp {  
    prefix snmp;  
  }  
  
  import ietf-inet-types {  
    prefix inet;  
  }  
  
  include ietf-snmp-common;  
  
  organization  
    "IETF NETMOD (NETCONF Data Modeling Language) Working Group";  
  
  contact  
    "WG Web:  <http://tools.ietf.org/wg/netmod/>
```

WG List: <mailto:netmod@ietf.org>

WG Chair: Thomas Nadeau
<mailto:tnadeau@lucidvision.com>

WG Chair: Juergen Schoenwaelder
<mailto:j.schoenwaelder@jacobs-university.de>

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Editor: Juergen Schoenwaelder
<mailto:j.schoenwaelder@jacobs-university.de>;

description

"This submodule contains a collection of YANG definitions for configuring SNMP engines.

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```
revision 2014-12-10 {  
  description  
    "Initial revision."  
  reference  
    "RFC 7407: A YANG Data Model for SNMP Configuration";  
}
```

```
augment /snmp:snmp {  
  container engine {  
    description  
      "Configuration of the SNMP engine."  
  
    leaf enabled {  
      type boolean;  
      default "false";  
      description
```

```

    "Enables the SNMP engine.";
}

list listen {
  key "name";
  description
    "Configuration of the transport endpoints on which the
    engine listens.";

  leaf name {
    type snmp:identifier;
    description
      "An arbitrary name for the list entry.";
  }

  choice transport {
    mandatory true;
    description
      "The transport-protocol-specific parameters for this
      endpoint. Submodules providing configuration for
      additional transports are expected to augment this
      choice.";
    case udp {
      container udp {
        leaf ip {
          type inet:ip-address;
          mandatory true;
          description
            "The IPv4 or IPv6 address on which the engine
            listens.";
        }
        leaf port {
          type inet:port-number;
          description
            "The UDP port on which the engine listens.

            If the port is not configured, an engine that
            acts as a Command Responder uses port 161, and
            an engine that acts as a Notification Receiver
            uses port 162.";
        }
      }
    }
  }
}

```

```
container version {
  description
    "SNMP version used by the engine.";
  leaf v1 {
    type empty;
  }
  leaf v2c {
    type empty;
  }
  leaf v3 {
    type empty;
  }
}

leaf engine-id {
  type snmp:engine-id;
  description
    "The local SNMP engine's administratively assigned unique
    identifier.

    If this leaf is not set, the device automatically
    calculates an engine ID, as described in RFC 3411. A
    server MAY initialize this leaf with the automatically
    created value.";
  reference
    "RFC 3411: An Architecture for Describing Simple Network
    Management Protocol (SNMP) Management
    Frameworks.
    SNMP-FRAMEWORK-MIB.snmpEngineID";
}

leaf enable-authen-traps {
  type boolean;
  description
    "Indicates whether the SNMP entity is permitted to
    generate authenticationFailure traps.";
  reference
    "RFC 3418: Management Information Base (MIB) for the
    Simple Network Management Protocol (SNMP)
    SNMPv2-MIB.snmpEnableAuthenTraps";
}
}
}
}
}
<CODE ENDS>
```

4.5. Submodule 'ietf-snmp-target'

```
<CODE BEGINS> file "ietf-snmp-target.yang"

submodule ietf-snmp-target {

  belongs-to ietf-snmp {
    prefix snmp;
  }

  import ietf-inet-types {
    prefix inet;
  }

  include ietf-snmp-common;

  organization
    "IETF NETMOD (NETCONF Data Modeling Language) Working Group";

  contact
    "WG Web:    <http://tools.ietf.org/wg/netmod/>
    WG List:    <mailto:netmod@ietf.org>

    WG Chair: Thomas Nadeau
               <mailto:tnadeau@lucidvision.com>

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    Editor:    Martin Bjorklund
               <mailto:mbj@tail-f.com>

    Editor:    Juergen Schoenwaelder
               <mailto:j.schoenwaelder@jacobs-university.de>";

  description
    "This submodule contains a collection of YANG definitions
    for configuring SNMP targets.

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```


This version of this YANG module is part of RFC 7407; see the RFC itself for full legal notices.";

reference

"RFC 3413: Simple Network Management Protocol (SNMP) Applications";

revision 2014-12-10 {

description

"Initial revision.";

reference

"RFC 7407: A YANG Data Model for SNMP Configuration";

}

augment /snmp:snmp {

list target {

key name;

description

"List of targets.";

reference

"RFC 3413: Simple Network Management Protocol (SNMP) Applications.
SNMP-TARGET-MIB.snmpTargetAddrTable";

leaf name {

type snmp:identifier;

description

"Identifies the target.";

reference

"RFC 3413: Simple Network Management Protocol (SNMP) Applications.
SNMP-TARGET-MIB.snmpTargetAddrName";

}

choice transport {

mandatory true;

description

"Transport address of the target.

The snmpTargetAddrTDomain and snmpTargetAddrTAddress objects are mapped to transport-specific YANG nodes. Each transport is configured as a separate case in this choice. Submodules providing configuration for additional transports are expected to augment this choice.";

```

reference
  "RFC 3413: Simple Network Management Protocol (SNMP)
  Applications.
  SNMP-TARGET-MIB.snmpTargetAddrTDomain
  SNMP-TARGET-MIB.snmpTargetAddrTAddress";
case udp {
  reference
    "RFC 3417: Transport Mappings for the Simple Network
    Management Protocol (SNMP).
    SNMPv2-TM.snmpUDPDomain
    RFC 3419: Textual Conventions for Transport Addresses.
    TRANSPORT-ADDRESS-MIB.transportDomainUdpIpv4
    TRANSPORT-ADDRESS-MIB.transportDomainUdpIpv4z
    TRANSPORT-ADDRESS-MIB.transportDomainUdpIpv6
    TRANSPORT-ADDRESS-MIB.transportDomainUdpIpv6z";
  container udp {
    leaf ip {
      type inet:ip-address;
      mandatory true;
      reference
        "RFC 3413: Simple Network Management Protocol (SNMP).
        SNMP-TARGET-MIB.snmpTargetAddrTAddress";
    }
    leaf port {
      type inet:port-number;
      default 162;
      description
        "UDP port number.";
      reference
        "RFC 3413: Simple Network Management Protocol (SNMP).
        SNMP-TARGET-MIB.snmpTargetAddrTAddress";
    }
    leaf prefix-length {
      type uint8;
      description
        "The value of this leaf must match the value of
        ../snmp:ip. If ../snmp:ip contains an IPv4 address,
        this leaf must be less than or equal to 32. If it
        contains an IPv6 address, it must be less than or
        equal to 128.

        Note that the prefix-length is currently only used
        by the Community-based Security Model to filter
        incoming messages. Furthermore, the prefix-length
        filtering does not cover all possible filters
        supported by the corresponding MIB object.";
    }
  }
}

```

```

        reference
            "RFC 3584: Coexistence between Version 1, Version 2,
            and Version 3 of the Internet-standard
            Network Management Framework.
            SNMP-COMMUNITY-MIB.snmpTargetAddrTMask";
    }
}
}
}
leaf-list tag {
    type snmp:tag-value;
    description
        "List of tag values used to select target addresses.";
    reference
        "RFC 3413: Simple Network Management Protocol (SNMP).
        Applications.
        SNMP-TARGET-MIB.snmpTargetAddrTagList";
}
leaf timeout {
    type uint32;
    units "0.01 seconds";
    default 1500;
    description
        "Needed only if this target can receive
        InformRequest-PDUs.";
    reference
        "RFC 3413: Simple Network Management Protocol (SNMP).
        Applications.
        SNMP-TARGET-MIB.snmpTargetAddrTimeout";
}
leaf retries {
    type uint8;
    default 3;
    description
        "Needed only if this target can receive
        InformRequest-PDUs.";
    reference
        "RFC 3413: Simple Network Management Protocol (SNMP).
        Applications.
        SNMP-TARGET-MIB.snmpTargetAddrRetryCount";
}
leaf target-params {
    type snmp:identifier;
    mandatory true;
    reference
        "RFC 3413: Simple Network Management Protocol (SNMP).
        Applications.
        SNMP-TARGET-MIB.snmpTargetAddrParams";
}

```

```
    }  
  }  
  list target-params {  
    key name;  
    description  
      "List of target parameters.";  
    reference  
      "RFC 3413: Simple Network Management Protocol (SNMP).  
      Applications.  
      SNMP-TARGET-MIB.snmpTargetParamsTable";  
  
    leaf name {  
      type snmp:identifier;  
    }  
    choice params {  
      description  
        "This choice is augmented with case nodes containing  
        configuration parameters specific to the security model.";  
    }  
  }  
}
```

<CODE ENDS>

4.6. Submodule 'ietf-snmp-notification'

<CODE BEGINS> file "ietf-snmp-notification.yang"

```
submodule ietf-snmp-notification {  
  belongs-to ietf-snmp {  
    prefix snmp;  
  }  
  
  include ietf-snmp-common;  
  include ietf-snmp-target;  
  
  organization  
    "IETF NETMOD (NETCONF Data Modeling Language) Working Group";  
  
  contact  
    "WG Web:  <http://tools.ietf.org/wg/netmod/>  
    WG List:  <mailto:netmod@ietf.org>  
  
    WG Chair: Thomas Nadeau  
              <mailto:tnadeau@lucidvision.com>
```

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Editor: Martin Bjorklund
<mailto:mbj@tail-f.com>

Editor: Juergen Schoenwaelder
<mailto:j.schoenwaelder@jacobs-university.de>;

description

"This submodule contains a collection of YANG definitions for configuring SNMP notifications.

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This version of this YANG module is part of RFC 7407; see the RFC itself for full legal notices.";

reference

"RFC 3413: Simple Network Management Protocol (SNMP) Applications";

revision 2014-12-10 {

description

"Initial revision.";

reference

"RFC 7407: A YANG Data Model for SNMP Configuration";

}

feature notification-filter {

description

"A server implements this feature if it supports SNMP notification filtering.";

reference

"RFC 3413: Simple Network Management Protocol (SNMP) Applications";

}

augment /snmp:snmp {

```
list notify {
  key name;
  description
    "Targets that will receive notifications.

    Entries in this list are mapped 1-1 to entries in
    snmpNotifyTable, except that if an entry in snmpNotifyTable
    has an snmpNotifyTag for which no snmpTargetAddrEntry
    exists, then the snmpNotifyTable entry is not mapped to an
    entry in this list.";
  reference
    "RFC 3413: Simple Network Management Protocol (SNMP).
    Applications.
    SNMP-NOTIFICATION-MIB.snmpNotifyTable";

  leaf name {
    type snmp:identifier;
    description
      "An arbitrary name for the list entry.";
    reference
      "RFC 3413: Simple Network Management Protocol (SNMP).
      Applications.
      SNMP-NOTIFICATION-MIB.snmpNotifyName";
  }
  leaf tag {
    type snmp:tag-value;
    mandatory true;
    description
      "Target tag, selects a set of notification targets.

      Implementations MAY restrict the values of this leaf
      to be one of the available values of /snmp/target/tag in
      a valid configuration.";
    reference
      "RFC 3413: Simple Network Management Protocol (SNMP).
      Applications.
      SNMP-NOTIFICATION-MIB.snmpNotifyTag";
  }
  leaf type {
    type enumeration {
      enum trap { value 1; }
      enum inform { value 2; }
    }
    default trap;
    description
      "Defines the notification type to be generated.";
```

```
        reference
          "RFC 3413: Simple Network Management Protocol (SNMP).
           Applications.
           SNMP-NOTIFICATION-MIB.snmpNotifyType";
      }
    }
  list notify-filter-profile {
    if-feature snmp:notification-filter;
    key name;

    description
      "Notification filter profiles.

      The leaf /snmp/target/notify-filter-profile is used
      to associate a filter profile with a target.

      If an entry in this list is referred to by one or more
      /snmp/target/notify-filter-profile items, each such
      notify-filter-profile is represented by one
      snmpNotifyFilterProfileEntry.

      If an entry in this list is not referred to by any
      /snmp/target/notify-filter-profile, the entry is not mapped
      to snmpNotifyFilterProfileTable.";

    reference
      "RFC 3413: Simple Network Management Protocol (SNMP).
       Applications.
       SNMP-NOTIFICATION-MIB.snmpNotifyFilterProfileTable
       SNMP-NOTIFICATION-MIB.snmpNotifyFilterTable";

    leaf name {
      type snmp:identifier;
      description
        "Name of the filter profile.";
      reference
        "RFC 3413: Simple Network Management Protocol (SNMP).
         Applications.
         SNMP-NOTIFICATION-MIB.snmpNotifyFilterProfileName";
    }

    leaf-list include {
      type snmp:wildcard-object-identifier;
      description
        "A family of subtrees included in this filter.";
```

```
        reference
          "RFC 3413: Simple Network Management Protocol (SNMP).
           Applications.
           SNMP-NOTIFICATION-MIB.snmpNotifyFilterSubtree
           SNMP-NOTIFICATION-MIB.snmpNotifyFilterMask
           SNMP-NOTIFICATION-MIB.snmpNotifyFilterType";
      }

      leaf-list exclude {
        type snmp:wildcard-object-identifier;
        description
          "A family of subtrees excluded from this filter.";
        reference
          "RFC 3413: Simple Network Management Protocol (SNMP).
           Applications.
           SNMP-NOTIFICATION-MIB.snmpNotifyFilterSubtree
           SNMP-NOTIFICATION-MIB.snmpNotifyFilterMask
           SNMP-NOTIFICATION-MIB.snmpNotifyFilterType";
      }
    }
  }

  augment /snmp:snmp/snmp:target-params {
    reference
      "RFC 3413: Simple Network Management Protocol (SNMP).
       Applications.
       SNMP-NOTIFICATION-MIB.snmpNotifyFilterProfileTable";
    leaf notify-filter-profile {
      if-feature snmp:notification-filter;
      type leafref {
        path "/snmp/notify-filter-profile/name";
      }
      description
        "This leafref leaf is used to represent the sparse
         relationship between the /snmp/target-params list and the
         /snmp/notify-filter-profile list.";
      reference
        "RFC 3413: Simple Network Management Protocol (SNMP).
         Applications.
         SNMP-NOTIFICATION-MIB.snmpNotifyFilterProfileName";
    }
  }
}

<CODE ENDS>
```


4.7. Submodule 'ietf-snmp-proxy'

```
<CODE BEGINS> file "ietf-snmp-proxy.yang"

submodule ietf-snmp-proxy {

  belongs-to ietf-snmp {
    prefix snmp;
  }

  include ietf-snmp-common;
  include ietf-snmp-target;

  organization
    "IETF NETMOD (NETCONF Data Modeling Language) Working Group";

  contact
    "WG Web:    <http://tools.ietf.org/wg/netmod/>
    WG List:    <mailto:netmod@ietf.org>

    WG Chair: Thomas Nadeau
               <mailto:tnadeau@lucidvision.com>

    WG Chair: Juergen Schoenwaelder
               <mailto:j.schoenwaelder@jacobs-university.de>

    Editor:    Martin Bjorklund
               <mailto:mbj@tail-f.com>

    Editor:    Juergen Schoenwaelder
               <mailto:j.schoenwaelder@jacobs-university.de>";

  description
    "This submodule contains a collection of YANG definitions
    for configuring SNMP proxies.

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    Relating to IETF Documents
    (http://trustee.ietf.org/license-info).

    This version of this YANG module is part of RFC 7407; see
    the RFC itself for full legal notices.";
```

```
reference
  "RFC 3413: Simple Network Management Protocol (SNMP)
  Applications";

revision 2014-12-10 {
  description
    "Initial revision.";
  reference
    "RFC 7407: A YANG Data Model for SNMP Configuration";
}

feature proxy {
  description
    "A server implements this feature if it can act as an
    SNMP proxy.";
  reference
    "RFC 3413: Simple Network Management Protocol (SNMP)
    Applications";
}

augment /snmp:snmp {
  if-feature snmp:proxy;

  list proxy {
    key name;

    description
      "List of proxy parameters.";
    reference
      "RFC 3413: Simple Network Management Protocol (SNMP).
      Applications.
      SNMP-PROXY-MIB.snmpProxyTable";

    leaf name {
      type snmp:identifier;
      description
        "Identifies the proxy parameter entry.";
      reference
        "RFC 3413: Simple Network Management Protocol (SNMP).
        Applications.
        SNMP-PROXY-MIB.snmpProxyName";
    }
    leaf type {
      type enumeration {
        enum read { value 1; }
        enum write { value 2; }
        enum trap { value 3; }
        enum inform { value 4; }
      }
    }
  }
}
```

```
}
mandatory true;
reference
  "RFC 3413: Simple Network Management Protocol (SNMP).
  Applications.
  SNMP-PROXY-MIB.snmpProxyType";
}
leaf context-engine-id {
  type snmp:engine-id;
  mandatory true;
  reference
    "RFC 3413: Simple Network Management Protocol (SNMP).
    Applications.
    SNMP-PROXY-MIB.snmpProxyContextEngineID";
}
leaf context-name {
  type snmp:context-name;
  reference
    "RFC 3413: Simple Network Management Protocol (SNMP).
    Applications.
    SNMP-PROXY-MIB.snmpProxyContextName";
}
leaf target-params-in {
  type snmp:identifier;
  description
    "The name of a target parameters list entry.

    Implementations MAY restrict the values of this
    leaf to be one of the available values of
    /snmp/target-params/name in a valid configuration.";
  reference
    "RFC 3413: Simple Network Management Protocol (SNMP).
    Applications.
    SNMP-PROXY-MIB.snmpProxyTargetParamsIn";
}
leaf single-target-out {
  when "../type = 'read' or ../type = 'write'";
  type snmp:identifier;
  description
    "Implementations MAY restrict the values of this leaf
    to be one of the available values of /snmp/target/name in
    a valid configuration.";
  reference
    "RFC 3413: Simple Network Management Protocol (SNMP).
    Applications.
    SNMP-PROXY-MIB.snmpProxySingleTargetOut";
}
```

```
leaf multiple-target-out {
  when "../type = 'trap' or ../type = 'inform'";
  type snmp:tag-value;
  description
    "Implementations MAY restrict the values of this leaf
     to be one of the available values of /snmp/target/tag in
     a valid configuration.";
  reference
    "RFC 3413: Simple Network Management Protocol (SNMP).
     Applications.
     SNMP-PROXY-MIB.snmpProxyMultipleTargetOut";
}
}
}
}
<CODE ENDS>
```

4.8. Submodule 'ietf-snmp-community'

```
<CODE BEGINS> file "ietf-snmp-community.yang"

submodule ietf-snmp-community {

  belongs-to ietf-snmp {
    prefix snmp;
  }

  import ietf-netconf-acm {
    prefix nacm;
  }

  include ietf-snmp-common;
  include ietf-snmp-target;
  include ietf-snmp-proxy;

  organization
    "IETF NETMOD (NETCONF Data Modeling Language) Working Group";

  contact
    "WG Web:    <http://tools.ietf.org/wg/netmod/>
     WG List:   <mailto:netmod@ietf.org>

     WG Chair:  Thomas Nadeau
                <mailto:tnadeau@lucidvision.com>

     WG Chair:  Juergen Schoenwaelder
                <mailto:j.schoenwaelder@jacobs-university.de>
```

Editor: Martin Bjorklund
<mailto:mbj@tail-f.com>

Editor: Juergen Schoenwaelder
<mailto:j.schoenwaelder@jacobs-university.de>;

description

"This submodule contains a collection of YANG definitions for configuring community-based SNMP.

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This version of this YANG module is part of RFC 7407; see the RFC itself for full legal notices.";

reference

"RFC 3584: Coexistence between Version 1, Version 2, and Version 3 of the Internet-standard Network Management Framework";

revision 2014-12-10 {

description

"Initial revision.";

reference

"RFC 7407: A YANG Data Model for SNMP Configuration";

}

augment /snmp:snmp {

list community {
key index;

description

"List of communities.";

reference

"RFC 3584: Coexistence between Version 1, Version 2, and Version 3 of the Internet-standard Network Management Framework.
SNMP-COMMUNITY-MIB.snmpCommunityTable";

```
leaf index {
  type snmp:identifier;
  description
    "Index into the community list.";
  reference
    "RFC 3584: Coexistence between Version 1, Version 2,
    and Version 3 of the Internet-standard
    Network Management Framework.
    SNMP-COMMUNITY-MIB.snmpCommunityIndex";
}
choice name {
  nacm:default-deny-all;
  description
    "The community name, specified as either a string or
    a binary value. The binary name is used when the
    community name contains characters that are not legal
    in a string.

    If not set, the value of 'security-name' is operationally
    used as the snmpCommunityName.";
  reference
    "RFC 3584: Coexistence between Version 1, Version 2,
    and Version 3 of the Internet-standard
    Network Management Framework.
    SNMP-COMMUNITY-MIB.snmpCommunityName";
  leaf text-name {
    type string;
    description
      "A community name that can be represented as a
      YANG string.";
  }
  leaf binary-name {
    type binary;
    description
      "A community name represented as a binary value.";
  }
}
leaf security-name {
  type snmp:security-name;
  mandatory true;
  nacm:default-deny-all;
  description
    "The snmpCommunitySecurityName of this entry.";
  reference
    "RFC 3584: Coexistence between Version 1, Version 2,
    and Version 3 of the Internet-standard
    Network Management Framework.
    SNMP-COMMUNITY-MIB.snmpCommunitySecurityName";
```

```
}
leaf engine-id {
  if-feature snmp:proxy;
  type snmp:engine-id;
  description
    "If not set, the value of the local SNMP engine is
    operationally used by the device.";
  reference
    "RFC 3584: Coexistence between Version 1, Version 2,
    and Version 3 of the Internet-standard
    Network Management Framework.
    SNMP-COMMUNITY-MIB.snmpCommunityContextEngineID";
}
leaf context {
  type snmp:context-name;
  default "";
  description
    "The context in which management information is accessed
    when using the community string specified by this entry.";
  reference
    "RFC 3584: Coexistence between Version 1, Version 2,
    and Version 3 of the Internet-standard
    Network Management Framework.
    SNMP-COMMUNITY-MIB.snmpCommunityContextName";
}
leaf target-tag {
  type snmp:tag-value;
  description
    "Used to limit access for this community to the specified
    targets.

    Implementations MAY restrict the values of this leaf
    to be one of the available values of /snmp/target/tag in
    a valid configuration.";
  reference
    "RFC 3584: Coexistence between Version 1, Version 2,
    and Version 3 of the Internet-standard
    Network Management Framework.
    SNMP-COMMUNITY-MIB.snmpCommunityTransportTag";
}
}
}

grouping v1-target-params {
  container v1 {
    description
      "SNMPv1 parameters type.
      Represents snmpTargetParamsMPModel '0',
```

```
        snmpTargetParamsSecurityModel '1', and
        snmpTargetParamsSecurityLevel 'noAuthNoPriv'.
    leaf security-name {
        type snmp:security-name;
        mandatory true;
        description
            "Implementations MAY restrict the values of this leaf
             to be one of the available values of
             /snmp/community/security-name in a valid configuration.";
        reference
            "RFC 3413: Simple Network Management Protocol (SNMP).
             Applications.
             SNMP-TARGET-MIB.snmpTargetParamsSecurityName";
    }
}

grouping v2c-target-params {
    container v2c {
        description
            "SNMPv2 community parameters type.
             Represents snmpTargetParamsMPPModel '1',
             snmpTargetParamsSecurityModel '2', and
             snmpTargetParamsSecurityLevel 'noAuthNoPriv'.";
        leaf security-name {
            type snmp:security-name;
            mandatory true;
            description
                "Implementations MAY restrict the values of this leaf
                 to be one of the available values of
                 /snmp/community/security-name in a valid configuration.";
            reference
                "RFC 3413: Simple Network Management Protocol (SNMP).
                 Applications.
                 SNMP-TARGET-MIB.snmpTargetParamsSecurityName";
        }
    }
}

augment /snmp:snmp/snmp:target-params/snmp:params {
    case v1 {
        uses v1-target-params;
    }
    case v2c {
        uses v2c-target-params;
    }
}
```



```
augment /snmp:snmp/snmp:target {
  when "snmp:v1 or snmp:v2c";
  leaf mms {
    type union {
      type enumeration {
        enum "unknown" { value 0; }
      }
      type int32 {
        range "484..max";
      }
    }
    default "484";
    description
      "The maximum message size.";
    reference
      "RFC 3584: Coexistence between Version 1, Version 2,
       and Version 3 of the Internet-standard
       Network Management Framework.
       SNMP-COMMUNITY-MIB.snmpTargetAddrMMS";
  }
}
```

```
}
```

<CODE ENDS>

4.9. Submodule 'ietf-snmp-vacm'

<CODE BEGINS> file "ietf-snmp-vacm.yang"

```
submodule ietf-snmp-vacm {
  belongs-to ietf-snmp {
    prefix snmp;
  }

  include ietf-snmp-common;

  organization
    "IETF NETMOD (NETCONF Data Modeling Language) Working Group";

  contact
    "WG Web:  <http://tools.ietf.org/wg/netmod/>
     WG List: <mailto:netmod@ietf.org>

     WG Chair: Thomas Nadeau
               <mailto:tnadeau@lucidvision.com>
```

WG Chair: Juergen Schoenwaelder
<mailto:j.schoenwaelder@jacobs-university.de>

Editor: Martin Bjorklund
<mailto:mbj@tail-f.com>

Editor: Juergen Schoenwaelder
<mailto:j.schoenwaelder@jacobs-university.de>;

description

"This submodule contains a collection of YANG definitions for configuring the View-based Access Control Model (VACM) of SNMP.

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This version of this YANG module is part of RFC 7407; see the RFC itself for full legal notices.";

reference

"RFC 3415: View-based Access Control Model (VACM) for the Simple Network Management Protocol (SNMP)";

revision 2014-12-10 {

description

"Initial revision.";

reference

"RFC 7407: A YANG Data Model for SNMP Configuration";

}

typedef view-name {

type snmp:identifier;

description

"The view-name type represents an SNMP VACM view name.";

}

typedef group-name {

type snmp:identifier;

description

"The group-name type represents an SNMP VACM group name.";

```
}  
augment /snmp:snmp {  
  container vacm {  
    description  
      "Configuration of the View-based Access Control Model.";   
  
    list group {  
      key name;  
      description  
        "VACM groups.  
  
        This data model has a different structure than the MIB.  
        Groups are explicitly defined in this list, and group  
        members are defined in the 'member' list (mapped to  
        vacmSecurityToGroupTable), and access for the group is  
        defined in the 'access' list (mapped to  
        vacmAccessTable).";  
      reference  
        "RFC 3415: View-based Access Control Model (VACM) for the  
        Simple Network Management Protocol (SNMP).  
        SNMP-VIEW-BASED-ACM-MIB.vacmSecurityToGroupTable  
        SNMP-VIEW-BASED-ACM-MIB.vacmAccessTable";  
  
      leaf name {  
        type group-name;  
        description  
          "The name of this VACM group.";   
        reference  
          "RFC 3415: View-based Access Control Model (VACM) for the  
          Simple Network Management Protocol (SNMP).  
          SNMP-VIEW-BASED-ACM-MIB.vacmGroupName";  
      }  
  
      list member {  
        key "security-name";  
        description  
          "A member of this VACM group.  
  
          A specific combination of security-name and  
          security-model MUST NOT be present in more than  
          one group.";   
        reference  
          "RFC 3415: View-based Access Control Model (VACM) for the  
          Simple Network Management Protocol (SNMP).  
          SNMP-VIEW-BASED-ACM-MIB.vacmSecurityToGroupTable";  
      }  
    }  
  }  
}
```

```
leaf security-name {
  type snmp:security-name;
  description
    "The securityName of a group member.";
  reference
    "RFC 3415: View-based Access Control Model (VACM) for
     the Simple Network Management Protocol (SNMP).
     SNMP-VIEW-BASED-ACM-MIB.vacmSecurityName";
}

leaf-list security-model {
  type snmp:security-model;
  min-elements 1;
  description
    "The security models under which this security-name
     is a member of this group.";
  reference
    "RFC 3415: View-based Access Control Model (VACM) for
     the Simple Network Management Protocol (SNMP).
     SNMP-VIEW-BASED-ACM-MIB.vacmSecurityModel";
}

list access {
  key "context security-model security-level";
  description
    "Definition of access right for groups.";
  reference
    "RFC 3415: View-based Access Control Model (VACM) for
     the Simple Network Management Protocol (SNMP).
     SNMP-VIEW-BASED-ACM-MIB.vacmAccessTable";

  leaf context {
    type snmp:context-name;
    description
      "The context (prefix) under which the access rights
       apply.";
    reference
      "RFC 3415: View-based Access Control Model (VACM) for
       the Simple Network Management Protocol (SNMP).
       SNMP-VIEW-BASED-ACM-MIB.vacmAccessContextPrefix";
  }

  leaf context-match {
    type enumeration {
      enum exact { value 1; }
      enum prefix { value 2; }
    }
  }
}
```

```
    default exact;
    reference
      "RFC 3415: View-based Access Control Model (VACM) for
       the Simple Network Management Protocol (SNMP).
       SNMP-VIEW-BASED-ACM-MIB.vacmAccessContextMatch";
  }

  leaf security-model {
    type snmp:security-model-or-any;
    description
      "The security model under which the access rights
       apply.";
    reference
      "RFC 3415: View-based Access Control Model (VACM) for
       the Simple Network Management Protocol (SNMP).
       SNMP-VIEW-BASED-ACM-MIB.vacmAccessSecurityModel";
  }

  leaf security-level {
    type snmp:security-level;
    description
      "The minimum security level under which the access
       rights apply.";
    reference
      "RFC 3415: View-based Access Control Model (VACM) for
       the Simple Network Management Protocol (SNMP).
       SNMP-VIEW-BASED-ACM-MIB.vacmAccessSecurityLevel";
  }

  leaf read-view {
    type view-name;
    description
      "The name of the MIB view of the SNMP context
       authorizing read access. If this leaf does not
       exist in a configuration, it maps to a zero-length
       vacmAccessReadViewName.

       Implementations MAY restrict the values of this
       leaf to be one of the available values of
       /snmp/vacm/view/name in a valid configuration.";
    reference
      "RFC 3415: View-based Access Control Model (VACM) for
       the Simple Network Management Protocol (SNMP).
       SNMP-VIEW-BASED-ACM-MIB.vacmAccessReadViewName";
  }

  leaf write-view {
    type view-name;
```

```
description
  "The name of the MIB view of the SNMP context
  authorizing write access. If this leaf does not
  exist in a configuration, it maps to a zero-length
  vacmAccessWriteViewName.

  Implementations MAY restrict the values of this
  leaf to be one of the available values of
  /snmp/vacm/view/name in a valid configuration.";
reference
  "RFC 3415: View-based Access Control Model (VACM) for
  the Simple Network Management Protocol (SNMP).
  SNMP-VIEW-BASED-ACM-MIB.vacmAccessWriteViewName";
}

leaf notify-view {
  type view-name;
  description
    "The name of the MIB view of the SNMP context
    authorizing notify access. If this leaf does not
    exist in a configuration, it maps to a zero-length
    vacmAccessNotifyViewName.

    Implementations MAY restrict the values of this
    leaf to be one of the available values of
    /snmp/vacm/view/name in a valid configuration.";
  reference
    "RFC 3415: View-based Access Control Model (VACM) for
    the Simple Network Management Protocol (SNMP).
    SNMP-VIEW-BASED-ACM-MIB.vacmAccessNotifyViewName";
}
}

list view {
  key name;
  description
    "Definition of MIB views.";
  reference
    "RFC 3415: View-based Access Control Model (VACM) for
    the Simple Network Management Protocol (SNMP).
    SNMP-VIEW-BASED-ACM-MIB.vacmViewTreeFamilyTable";

  leaf name {
    type view-name;
    description
      "The name of this VACM MIB view.";
```



```
import ietf-yang-types {
  prefix yang;
}
import ietf-netconf-acm {
  prefix nacm;
}

include ietf-snmp-common;
include ietf-snmp-target;
include ietf-snmp-proxy;

organization
  "IETF NETMOD (NETCONF Data Modeling Language) Working Group";

contact
  "WG Web:    <http://tools.ietf.org/wg/netmod/>
   WG List:   <mailto:netmod@ietf.org>

   WG Chair:  Thomas Nadeau
               <mailto:tnadeau@lucidvision.com>

   WG Chair:  Juergen Schoenwaelder
               <mailto:j.schoenwaelder@jacobs-university.de>

   Editor:    Martin Bjorklund
               <mailto:mbj@tail-f.com>

   Editor:    Juergen Schoenwaelder
               <mailto:j.schoenwaelder@jacobs-university.de>";

description
  "This submodule contains a collection of YANG definitions for
   configuring the User-based Security Model (USM) of SNMP.

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   authors of the code. All rights reserved.

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   Relating to IETF Documents
   (http://trustee.ietf.org/license-info).

   This version of this YANG module is part of RFC 7407; see
   the RFC itself for full legal notices.";
```



```
reference
  "RFC 3414: User-based Security Model (USM) for version 3 of the
  Simple Network Management Protocol (SNMPv3)";

revision 2014-12-10 {
  description
    "Initial revision.";
  reference
    "RFC 7407: A YANG Data Model for SNMP Configuration";
}

grouping key {
  leaf key {
    type yang:hex-string;
    mandatory true;
    nacm:default-deny-all;
    description
      "Localized key specified as a list of colon-specified
      hexadecimal octets.";
  }
}

grouping user-list {
  list user {
    key "name";

    reference
      "RFC 3414: User-based Security Model (USM) for version 3
      of the Simple Network Management Protocol (SNMPv3).
      SNMP-USER-BASED-SM-MIB.usmUserTable";

    leaf name {
      type snmp:identifier;
      reference
        "RFC 3414: User-based Security Model (USM) for version 3
        of the Simple Network Management Protocol (SNMPv3).
        SNMP-USER-BASED-SM-MIB.usmUserName";
    }
  }
  container auth {
    presence "enables authentication";
    description
      "Enables authentication of the user.";
    choice protocol {
      mandatory true;
      reference
        "RFC 3414: User-based Security Model (USM) for version 3
        of the Simple Network Management Protocol (SNMPv3).
        SNMP-USER-BASED-SM-MIB.usmUserAuthProtocol";
    }
  }
}
```

```
    container md5 {
      uses key;
      reference
        "RFC 3414: User-based Security Model (USM) for
         version 3 of the Simple Network Management Protocol
         (SNMPv3).
         SNMP-USER-BASED-SM-MIB.usmHMACMD5AuthProtocol";
    }
    container sha {
      uses key;
      reference
        "RFC 3414: User-based Security Model (USM) for
         version 3 of the Simple Network Management Protocol
         (SNMPv3).
         SNMP-USER-BASED-SM-MIB.usmHMACSHAAuthProtocol";
    }
  }
}
container priv {
  must "../auth" {
    error-message
      "when privacy (confidentiality) is used, "
      + "authentication must also be used";
  }
  presence "enables encryption";
  description
    "Enables encryption of SNMP messages.";
}
choice protocol {
  mandatory true;
  reference
    "RFC 3414: User-based Security Model (USM) for version 3
     of the Simple Network Management Protocol (SNMPv3).
     SNMP-USER-BASED-SM-MIB.usmUserPrivProtocol";
  container des {
    uses key;
    reference
      "RFC 3414: User-based Security Model (USM) for
       version 3 of the Simple Network Management Protocol
       (SNMPv3).
       SNMP-USER-BASED-SM-MIB.usmDESPrivProtocol";
  }
  container aes {
    uses key;
  }
}
```

```

        reference
        "RFC 3826: The Advanced Encryption Standard (AES)
        Cipher Algorithm in the SNMP User-based Security
        Model.
        SNMP-USM-AES-MIB.usmAesCfb128Protocol";
    }
}
}

augment /snmp:snmp {
    container usm {
        description
        "Configuration of the User-based Security Model.";
        container local {
            uses user-list;
        }

        list remote {
            key "engine-id";

            leaf engine-id {
                type snmp:engine-id;
                reference
                "RFC 3414: User-based Security Model (USM) for version 3
                of the Simple Network Management Protocol (SNMPv3).
                SNMP-USER-BASED-SM-MIB.usmUserEngineID";
            }

            uses user-list;
        }
    }
}

grouping usm-target-params {
    container usm {
        description
        "User-based SNMPv3 parameters type.

        Represents snmpTargetParamsMPModel '3' and
        snmpTargetParamsSecurityModel '3'.";
        leaf user-name {
            type snmp:security-name;
            mandatory true;
        }
    }
}

```

```
        reference
          "RFC 3413: Simple Network Management Protocol (SNMP).
           Applications.
           SNMP-TARGET-MIB.snmpTargetParamsSecurityName";
      }
    leaf security-level {
      type snmp:security-level;
      mandatory true;
      reference
        "RFC 3413: Simple Network Management Protocol (SNMP).
         Applications.
         SNMP-TARGET-MIB.snmpTargetParamsSecurityLevel";
    }
  }
}

augment /snmp:snmp/snmp:target-params/snmp:params {
  case usm {
    uses usm-target-params;
  }
}
```

<CODE ENDS>

4.11. Submodule 'ietf-snmp-tsm'

<CODE BEGINS> file "ietf-snmp-tsm.yang"

```
submodule ietf-snmp-tsm {

  belongs-to ietf-snmp {
    prefix snmp;
  }

  include ietf-snmp-common;
  include ietf-snmp-target;
  include ietf-snmp-proxy;

  organization
    "IETF NETMOD (NETCONF Data Modeling Language) Working Group";

  contact
    "WG Web:  <http://tools.ietf.org/wg/netmod/>
     WG List:  <mailto:netmod@ietf.org>
```

WG Chair: Thomas Nadeau

<mailto:tnadeau@lucidvision.com>

WG Chair: Juergen Schoenwaelder

<mailto:j.schoenwaelder@jacobs-university.de>

Editor: Martin Bjorklund

<mailto:mbj@tail-f.com>

Editor: Juergen Schoenwaelder

<mailto:j.schoenwaelder@jacobs-university.de>;

description

"This submodule contains a collection of YANG definitions for configuring the Transport Security Model (TSM) of SNMP.

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This version of this YANG module is part of RFC 7407; see the RFC itself for full legal notices.";

reference

"RFC 5591: Transport Security Model for the Simple Network Management Protocol (SNMP)";

revision 2014-12-10 {

description

"Initial revision.";

reference

"RFC 7407: A YANG Data Model for SNMP Configuration";

}

feature tsm {

description

"A server implements this feature if it supports the Transport Security Model for SNMP.";

reference

"RFC 5591: Transport Security Model for the Simple Network Management Protocol (SNMP)";

}

```
augment /snmp:snmp {
  if-feature tsm;
  container tsm {
    description
      "Configuration of the Transport Security Model.";

    leaf use-prefix {
      type boolean;
      default false;
      reference
        "RFC 5591: Transport Security Model for the Simple
        Network Management Protocol (SNMP).
        SNMP-TSM-MIB.snmpTsmConfigurationUsePrefix";
    }
  }
}

grouping tsm-target-params {
  container tsm {
    description
      "Transport-based security SNMPv3 parameters type.

      Represents snmpTargetParamsMPModel '3' and
      snmpTargetParamsSecurityModel '4'.";
    leaf security-name {
      type snmp:security-name;
      mandatory true;
      reference
        "RFC 3413: Simple Network Management Protocol (SNMP).
        Applications.
        SNMP-TARGET-MIB.snmpTargetParamsSecurityName";
    }
    leaf security-level {
      type snmp:security-level;
      mandatory true;
      reference
        "RFC 3413: Simple Network Management Protocol (SNMP).
        Applications.
        SNMP-TARGET-MIB.snmpTargetParamsSecurityLevel";
    }
  }
}

augment /snmp:snmp/snmp:target-params/snmp:params {
  if-feature tsm;
  case tsm {
    uses tsm-target-params;
  }
}
```

```
}  
}
```

<CODE ENDS>

4.12. Submodule 'ietf-snmp-tls'

<CODE BEGINS> file "ietf-snmp-tls.yang"

```
submodule ietf-snmp-tls {  
    belongs-to ietf-snmp {  
        prefix snmp;  
    }  
  
    import ietf-inet-types {  
        prefix inet;  
    }  
    import ietf-x509-cert-to-name {  
        prefix x509c2n;  
    }  
  
    include ietf-snmp-common;  
    include ietf-snmp-engine;  
    include ietf-snmp-target;  
  
    organization  
        "IETF NETMOD (NETCONF Data Modeling Language) Working Group";  
  
    contact  
        "WG Web:    <http://tools.ietf.org/wg/netmod/>  
         WG List:   <mailto:netmod@ietf.org>  
  
         WG Chair:  Thomas Nadeau  
                   <mailto:tnadeau@lucidvision.com>  
  
         WG Chair:  Juergen Schoenwaelder  
                   <mailto:j.schoenwaelder@jacobs-university.de>  
  
         Editor:    Martin Bjorklund  
                   <mailto:mbj@tail-f.com>  
  
         Editor:    Juergen Schoenwaelder  
                   <mailto:j.schoenwaelder@jacobs-university.de>";
```

description

"This submodule contains a collection of YANG definitions for configuring the Transport Layer Security Transport Model (TLSTM) of SNMP.

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This version of this YANG module is part of RFC 7407; see the RFC itself for full legal notices.";

reference

"RFC 6353: Transport Layer Security (TLS) Transport Model for the Simple Network Management Protocol (SNMP)";

revision 2014-12-10 {**description**

"Initial revision.";

reference

"RFC 7407: A YANG Data Model for SNMP Configuration";

}**feature tlstm {****description**

"A server implements this feature if it supports the Transport Layer Security Transport Model for SNMP.";

reference

"RFC 6353: Transport Layer Security (TLS) Transport Model for the Simple Network Management Protocol (SNMP)";

}**augment /snmp:snmp/snmp:engine/snmp:listen/snmp:transport {**

if-feature tlstm;

case tls {**container** tls {**description**

"A list of IPv4 and IPv6 addresses and ports to which the engine listens for SNMP messages over TLS.";


```
    leaf ip {
      type inet:ip-address;
      mandatory true;
      description
        "The IPv4 or IPv6 address on which the engine listens
        for SNMP messages over TLS.";
    }
    leaf port {
      type inet:port-number;
      description
        "The TCP port on which the engine listens for SNMP
        messages over TLS.

        If the port is not configured, an engine that
        acts as a Command Responder uses port 10161, and
        an engine that acts as a Notification Receiver
        uses port 10162.";
    }
  }
}
case dtls {
  container dtls {
    description
      "A list of IPv4 and IPv6 addresses and ports to which the
      engine listens for SNMP messages over DTLS.";

    leaf ip {
      type inet:ip-address;
      mandatory true;
      description
        "The IPv4 or IPv6 address on which the engine listens
        for SNMP messages over DTLS.";
    }
    leaf port {
      type inet:port-number;
      description
        "The UDP port on which the engine listens for SNMP
        messages over DTLS.

        If the port is not configured, an engine that
        acts as a Command Responder uses port 10161, and
        an engine that acts as a Notification Receiver
        uses port 10162.";
    }
  }
}
}
```

```
augment /snmp:snmp {
  if-feature tlstm;
  container tlstm {
    uses x509c2n:cert-to-name {
      description
        "Defines how certificates are mapped to names. The
        resulting name is used as a security name.";
      refine cert-to-name/map-type {
        description
          "Mappings that use the snmpTlstmCertToTSNData column
          need to augment the cert-to-name list with
          additional configuration objects corresponding
          to the snmpTlstmCertToTSNData value. Such objects
          should use the 'when' statement to make them
          conditional based on the map-type.";
      }
    }
  }
}

grouping tls-transport {
  leaf ip {
    type inet:host;
    mandatory true;
    reference
      "RFC 3413: Simple Network Management Protocol (SNMP).
      Applications.
      SNMP-TARGET-MIB.snmpTargetAddrTAddress
      RFC 6353: Transport Layer Security (TLS) Transport Model
      for the Simple Network Management Protocol (SNMP).
      SNMP-TLS-TM-MIB.SnmpTLSAddress";
  }
  leaf port {
    type inet:port-number;
    default 10161;
    reference
      "RFC 3413: Simple Network Management Protocol (SNMP).
      Applications.
      SNMP-TARGET-MIB.snmpTargetAddrTAddress
      RFC 6353: Transport Layer Security (TLS) Transport Model
      for the Simple Network Management Protocol (SNMP).
      SNMP-TLS-TM-MIB.SnmpTLSAddress";
  }
  leaf client-fingerprint {
    type x509c2n:tls-fingerprint;
    reference
      "RFC 6353: Transport Layer Security (TLS) Transport Model
      for the Simple Network Management Protocol (SNMP).";
  }
}
```

```
        SNMP-TLS-TM-MIB.snmpTlstmParamsClientFingerprint";
    }
    leaf server-fingerprint {
        type x509c2n:tls-fingerprint;
        reference
            "RFC 6353: Transport Layer Security (TLS) Transport Model
             for the Simple Network Management Protocol (SNMP).
             SNMP-TLS-TM-MIB.snmpTlstmAddrServerFingerprint";
    }
    leaf server-identity {
        type snmp:admin-string;
        reference
            "RFC 6353: Transport Layer Security (TLS) Transport Model
             for the Simple Network Management Protocol (SNMP).
             SNMP-TLS-TM-MIB.snmpTlstmAddrServerIdentity";
    }
}

augment /snmp:snmp/snmp:target/snmp:transport {
    if-feature tlstm;
    case tls {
        reference
            "RFC 6353: Transport Layer Security (TLS) Transport Model
             for the Simple Network Management Protocol (SNMP).
             SNMP-TLS-TM-MIB.snmpTLSTCPDomain";
        container tls {
            uses tls-transport;
        }
    }
}

augment /snmp:snmp/snmp:target/snmp:transport {
    if-feature tlstm;
    case dtls {
        reference
            "RFC 6353: Transport Layer Security (TLS) Transport Model
             for the Simple Network Management Protocol (SNMP).
             SNMP-TLS-TM-MIB.snmpDTLSUDPDDomain";
        container dtls {
            uses tls-transport;
        }
    }
}
}

<CODE ENDS>
```

4.13. Submodule 'ietf-snmp-ssh'

<CODE BEGINS> file "ietf-snmp-ssh.yang"

```
submodule ietf-snmp-ssh {  
    belongs-to ietf-snmp {  
        prefix snmp;  
    }  
  
    import ietf-inet-types {  
        prefix inet;  
    }  
  
    include ietf-snmp-common;  
    include ietf-snmp-engine;  
    include ietf-snmp-target;  
  
    organization  
        "IETF NETMOD (NETCONF Data Modeling Language) Working Group";  
  
    contact  
        "WG Web:    <http://tools.ietf.org/wg/netmod/>  
         WG List:   <mailto:netmod@ietf.org>  
  
         WG Chair:  Thomas Nadeau  
                   <mailto:tnadeau@lucidvision.com>  
  
         WG Chair:  Juergen Schoenwaelder  
                   <mailto:j.schoenwaelder@jacobs-university.de>  
  
         Editor:    Martin Bjorklund  
                   <mailto:mbj@tail-f.com>  
  
         Editor:    Juergen Schoenwaelder  
                   <mailto:j.schoenwaelder@jacobs-university.de>";  
  
    description  
        "This submodule contains a collection of YANG definitions for  
        configuring the Secure Shell Transport Model (SSHTM)  
        of SNMP."
```

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reference

"RFC 5592: Secure Shell Transport Model for the Simple Network Management Protocol (SNMP)";

revision 2014-12-10 {

description

"Initial revision.";

reference

"RFC 7407: A YANG Data Model for SNMP Configuration";

}

feature sshtm {

description

"A server implements this feature if it supports the Secure Shell Transport Model for SNMP.";

reference

"RFC 5592: Secure Shell Transport Model for the Simple Network Management Protocol (SNMP)";

}

augment /snmp:snmp/snmp:engine/snmp:listen/snmp:transport {

if-feature sshtm;

case ssh {

container ssh {

description

"The IPv4 or IPv6 address and port to which the engine listens for SNMP messages over SSH.";

leaf ip {

type inet:ip-address;

mandatory true;

description

"The IPv4 or IPv6 address on which the engine listens for SNMP messages over SSH.";

}

leaf port {

type inet:port-number;

description

"The TCP port on which the engine listens for SNMP messages over SSH."

If the port is not configured, an engine that acts as a Command Responder uses port 5161, and an engine that acts as a Notification Receiver uses port 5162.";

```
    }
  }
}
```

```
augment /snmp:snmp/snmp:target/snmp:transport {
  if-feature sshtm;
  case ssh {
    reference
      "RFC 5592: Secure Shell Transport Model for the
       Simple Network Management Protocol (SNMP).
       SNMP-SSH-TM-MIB.snmpSSHDomain";
    container ssh {
      leaf ip {
        type inet:host;
        mandatory true;
        reference
          "RFC 3413: Simple Network Management Protocol (SNMP).
           Applications.
           SNMP-TARGET-MIB.snmpTargetAddrTAddress
           RFC 5592: Secure Shell Transport Model for the
           Simple Network Management Protocol (SNMP).
           SNMP-SSH-TM-MIB.SnmpSSHAddress";
      }
      leaf port {
        type inet:port-number;
        default 5161;
        reference
          "RFC 3413: Simple Network Management Protocol (SNMP).
           Applications.
           SNMP-TARGET-MIB.snmpTargetAddrTAddress
           RFC 5592: Secure Shell Transport Model for the
           Simple Network Management Protocol (SNMP).
           SNMP-SSH-TM-MIB.SnmpSSHAddress";
      }
      leaf username {
        type string;
        reference
          "RFC 3413: Simple Network Management Protocol (SNMP).
           Applications.
           SNMP-TARGET-MIB.snmpTargetAddrTAddress
           RFC 5592: Secure Shell Transport Model for the
           Simple Network Management Protocol (SNMP).
           SNMP-SSH-TM-MIB.SnmpSSHAddress";
      }
    }
  }
}
```

```

    }
  }
}

```

<CODE ENDS>

5. IANA Considerations

This document registers two URIs in the "IETF XML Registry" [RFC3688]. Following the format in RFC 3688, the following registrations have been made.

URI: urn:ietf:params:xml:ns:yang:ietf-snmp
 Registrant Contact: The NETMOD WG of the IETF.
 XML: N/A, the requested URI is an XML namespace.

URI: urn:ietf:params:xml:ns:yang:ietf-x509-cert-to-name
 Registrant Contact: The NETMOD WG of the IETF.
 XML: N/A, the requested URI is an XML namespace.

This document registers the following YANG modules in the "YANG Module Names" registry [RFC6020].

name: ietf-snmp
 namespace: urn:ietf:params:xml:ns:yang:ietf-snmp
 prefix: snmp
 reference: RFC 7407

name: ietf-x509-cert-to-name
 namespace: urn:ietf:params:xml:ns:yang:ietf-x509-cert-to-name
 prefix: x509c2n
 reference: RFC 7407

The document registers the following YANG submodules in the "YANG Module Names" registry [RFC6020].

name: ietf-snmp-common
 parent: ietf-snmp
 reference: RFC 7407

name: ietf-snmp-engine
 parent: ietf-snmp
 reference: RFC 7407

name:	ietf-snmp-community
parent:	ietf-snmp
reference:	RFC 7407
name:	ietf-snmp-notification
parent:	ietf-snmp
reference:	RFC 7407
name:	ietf-snmp-target
parent:	ietf-snmp
reference:	RFC 7407
name:	ietf-snmp-vacm
parent:	ietf-snmp
reference:	RFC 7407
name:	ietf-snmp-usm
parent:	ietf-snmp
reference:	RFC 7407
name:	ietf-snmp-tsm
parent:	ietf-snmp
reference:	RFC 7407
name:	ietf-snmp-tls
parent:	ietf-snmp
reference:	RFC 7407
name:	ietf-snmp-ssh
parent:	ietf-snmp
reference:	RFC 7407

6. Security Considerations

The YANG module and submodules defined in this memo are designed to be accessed via the NETCONF protocol [RFC6241]. The lowest NETCONF layer is the secure transport layer and the mandatory to implement secure transport is SSH [RFC6242]. The NETCONF access control model [RFC6536] provides the means to restrict access for particular NETCONF users to a pre-configured subset of all available NETCONF protocol operations and content.

There are a number of data nodes defined in the YANG module and submodules which are writable/creatable/deletable (i.e., config true, which is the default). These data nodes may be considered sensitive or vulnerable in some network environments. Write operations (e.g.,

edit-config) to these data nodes without proper protection can have a negative effect on network operations. These are the subtrees and data nodes and their sensitivity/vulnerability:

- o The `"/snmp/engine"` subtree contains the configuration of general parameters of an SNMP engine such as the endpoints to listen on, the transports and SNMP versions enabled, or the engine's identity. Write access to this subtree should only be granted to entities configuring general SNMP engine parameters.
- o The `"/snmp/target"` subtree contains the configuration of SNMP targets and, in particular, which transports to use and their security parameters. Write access to this subtree should only be granted to the security administrator and entities configuring SNMP notification forwarding behavior.
- o The `"/snmp/notify"` and `"/snmp/notify-filter-profile"` subtrees contain the configuration for the SNMP notification forwarding and filtering mechanism. Write access to these subtrees should only be granted to entities configuring SNMP notification forwarding behavior.
- o The `"/snmp/proxy"` subtree contains the configuration for SNMP proxies. Write access to this subtree should only be granted to entities configuring SNMP proxies.
- o The `"/snmp/community"` subtree contains the configuration of the Community-based Security Model. Write access to this subtree should only be granted to the security administrator.
- o The `"/snmp/usm"` subtree contains the configuration of the User-based Security Model. Write access to this subtree should only be granted to the security administrator.
- o The `"/snmp/tsm"` subtree contains the configuration of the Transport Layer Security (TLS) Transport Model for SNMP. Write access to this subtree should only be granted to the security administrator.
- o The `"/snmp/tlstm"` subtree contains the configuration of the SNMP transport over (D)TLS and, in particular, the configuration of how certificates are mapped to SNMP security names. Write access to this subtree should only be granted to the security administrator.
- o The `"/snmp/vacm"` subtree contains the configuration of the View-based Access Control Model used by SNMP to authorize access to management information via SNMP. Write access to this subtree should only be granted to the security administrator.

Some of the readable data nodes in the YANG module and submodules may be considered sensitive or vulnerable in some network environments. It is thus important to control read access (e.g., via get, get-config, or notification) to these data nodes. These are the subtrees and data nodes and their sensitivity/vulnerability:

- o The `"/snmp/engine"` subtree exposes general information about an SNMP engine such as which version(s) of SNMP are enabled or which transports are enabled.
- o The `"/snmp/target"` subtree exposes information about which transports are used to reach certain SNMP targets and which transport-specific parameters are used.
- o The `"/snmp/notify"` and `"/snmp/notify-filter-profile"` subtrees expose information about how notifications are filtered and forwarded to notification targets.
- o The `"/snmp/proxy"` subtree exposes information about proxy relationships.
- o The `"/snmp/community"`, `"/snmp/usm"`, `"/snmp/tsm"`, `"/snmp/tlstm"`, and `"/snmp/vacm"` subtrees are specifically sensitive since they expose information about the authentication and authorization policy used by an SNMP engine.

Changes to the SNMP access control rules should be done in an atomic way (through a single edit-config or a single commit), or care must be taken that they are done in a sequence that does not temporarily open access to resources. Implementations supporting SNMP write access must ensure that any SNMP access control rule changes over NETCONF are also atomic to the SNMP instrumentation. In particular, changes involving an internal delete/create cycle (e.g., to move a user to a different group) must be done with sufficient protections such that even a power fail immediately after the delete does not leave the administrator locked out.

Security administrators need to ensure that NETCONF access control rules and SNMP access control rules implement a consistent security policy. Specifically, the SNMP access control rules should prevent accidental leakage of sensitive security parameters such as community strings. See the Security Considerations section of [RFC3584] for further details.

7. References

7.1. Normative References

- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997, <<http://www.rfc-editor.org/info/rfc2119>>.
- [RFC6020] Bjorklund, M., "YANG - A Data Modeling Language for the Network Configuration Protocol (NETCONF)", RFC 6020, October 2010, <<http://www.rfc-editor.org/info/rfc6020>>.
- [RFC6241] Enns, R., Bjorklund, M., Schoenwaelder, J., and A. Bierman, "Network Configuration Protocol (NETCONF)", RFC 6241, June 2011, <<http://www.rfc-editor.org/info/rfc6241>>.
- [RFC6242] Wasserman, M., "Using the NETCONF Protocol over Secure Shell (SSH)", RFC 6242, June 2011, <<http://www.rfc-editor.org/info/rfc6242>>.
- [RFC6536] Bierman, A. and M. Bjorklund, "Network Configuration Protocol (NETCONF) Access Control Model", RFC 6536, March 2012, <<http://www.rfc-editor.org/info/rfc6536>>.
- [RFC6991] Schoenwaelder, J., "Common YANG Data Types", RFC 6991, July 2013, <<http://www.rfc-editor.org/info/rfc6991>>.

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Appendix A. Example Configurations

A.1. Engine Configuration Example

Below is an XML instance document showing a configuration of an SNMP engine listening on UDP port 161 on IPv4 and IPv6 endpoints and accepting SNMPv2c and SNMPv3 messages.

```
<snmp xmlns="urn:ietf:params:xml:ns:yang:ietf-snmp">
  <engine>
    <enabled>true</enabled>
    <listen>
      <name>all-ipv4-udp</name>
      <udp>
        <ip>0.0.0.0</ip>
        <port>161</port>
      </udp>
    </listen>
    <listen>
      <name>all-ipv6-udp</name>
      <udp>
        <ip>:::</ip>
        <port>161</port>
      </udp>
    </listen>
    <version>
      <v2c/>
      <v3/>
    </version>
    <engine-id>80:00:02:b8:04:61:62:63</engine-id>
  </engine>
</snmp>
```

A.2. Community Configuration Example

Below is an XML instance document showing a configuration that maps the community name "public" to the security-name "community-public" on the local engine with the default context name. The target tag "community-public-access" filters the access to this community name.

```
<snmp xmlns="urn:ietf:params:xml:ns:yang:ietf-snmp">
  <community>
    <index>1</index>
    <text-name>public</text-name>
    <security-name>community-public</security-name>
    <target-tag>community-public-access</target-tag>
  </community>
  <target>
```

```

    <name>management-station</name>
    <udp>
      <ip>2001:db8::abcd</ip>
      <port>161</port>
    </udp>
    <tag>blue</tag>
    <tag>community-public-access</tag>
    <target-params>v2c-public</target-params>
  </target>
  <target-params>
    <name>v2c-public</name>
    <v2c>
      <security-name>community-public</security-name>
    </v2c>
  </target-params>
</snmp>

```

A.3. User-Based Security Model Configuration Example

Below is an XML instance document showing the configuration of a local user "joey" who has no authentication or privacy keys. For the remote SNMP engine identified by the snmpEngineID '800002b804616263'H, two users are configured. The user "matt" has a localized SHA authentication key, and the user "russ" has a localized SHA authentication key and an AES encryption key.

```

<snmp xmlns="urn:ietf:params:xml:ns:yang:ietf-snmp">
  <usm>
    <local>
      <user>
        <name>joey</name>
      </user>
    </local>
    <remote>
      <engine-id>00:00:00:00:00:00:00:00:00:00:00:02</engine-id>
      <user>
        <name>matt</name>
        <auth>
          <sha>
            <!--
              The 'key' value is split into two lines to conform to
              the RFC formatting rules.
            -->
            <key>66:95:fe:bc:92:88:e3:62:82:23:
              5f:c7:15:1f:12:84:97:b3:8f:3f</key>
          </sha>
        </auth>
      </user>
    </remote>
  </usm>
</snmp>

```

```
<user>
  <name>russ</name>
  <auth>
    <sha>
      <!--
        The 'key' value is split into two lines to conform to
        the RFC formatting rules.
      -->
      <key>66:95:fe:bc:92:88:e3:62:82:23:
        5f:c7:15:1f:12:84:97:b3:8f:3f</key>
    </sha>
  </auth>
  <priv>
    <aes>
      <!--
        The 'key' value is split into two lines to conform to
        the RFC formatting rules.
      -->
      <key>66:95:fe:bc:92:88:e3:62:82:23:
        5f:c7:15:1f:12:84</key>
    </aes>
  </priv>
</user>
</remote>
</usm>
<target>
  <name>bluebox</name>
  <udp>
    <ip>2001:db8::abcd</ip>
    <port>161</port>
  </udp>
  <tag>blue</tag>
  <target-params>matt-auth</target-params>
</target>
<target-params>
  <name>matt-auth</name>
  <usm>
    <user-name>matt</user-name>
    <security-level>auth-no-priv</security-level>
  </usm>
</target-params>
</snmp>
```


A.4. Target and Notification Configuration Example

Below is an XML instance document showing the configuration of a notification generator application (see Appendix A of [RFC3413]). Note that the USM-specific objects are defined in the "ietf-snmp-usm" submodule.

```
<snmp xmlns="urn:ietf:params:xml:ns:yang:ietf-snmp">
  <target>
    <name>addr1</name>
    <udp>
      <ip>192.0.2.3</ip>
      <port>162</port>
    </udp>
    <tag>group1</tag>
    <target-params>joe-auth</target-params>
  </target>
  <target>
    <name>addr2</name>
    <udp>
      <ip>192.0.2.6</ip>
      <port>162</port>
    </udp>
    <tag>group1</tag>
    <target-params>joe-auth</target-params>
  </target>
  <target>
    <name>addr3</name>
    <udp>
      <ip>192.0.2.9</ip>
      <port>162</port>
    </udp>
    <tag>group2</tag>
    <target-params>bob-priv</target-params>
  </target>
  <target-params>
    <name>joe-auth</name>
    <usm>
      <user-name>joe</user-name>
      <security-level>auth-no-priv</security-level>
    </usm>
  </target-params>
  <target-params>
    <name>bob-priv</name>
    <usm>
      <user-name>bob</user-name>
      <security-level>auth-priv</security-level>
    </usm>
  </target-params>
</snmp>
```

```

</target-params>
<notify>
  <name>group1</name>
  <tag>group1</tag>
  <type>trap</type>
</notify>
<notify>
  <name>group2</name>
  <tag>group2</tag>
  <type>trap</type>
</notify>
</snmp>

```

A.5. Proxy Configuration Example

Below is an XML instance document showing the configuration of a proxy forwarder application. It proxies SNMPv2c messages from command generators to a file server running an SNMPv1 agent that recognizes two community strings, "private" and "public", with different associated read views. The file server is represented as two "target" instances, one for each community string.

If the proxy receives an SNMPv2c message with the community string "public" from a device in the "Office Network" or "Home Office Network", it gets tagged as "trusted", and the proxy uses the "private" community string when sending the message to the file server. Other SNMPv2c messages with the community string "public" get tagged as "non-trusted", and the proxy uses the "public" community string for these messages. There is also a special "backdoor" community string that can be used from any location to get "trusted" access.

The "Office Network" and "Home Office Network" are represented as two "target" instances. These "target" instances have target-params "none", which refers to a non-existing target-params entry.

```

<snmp xmlns="urn:ietf:params:xml:ns:yang:ietf-snmp">
  <target>
    <name>File Server (private)</name>
    <udp>
      <ip>192.0.2.1</ip>
    </udp>
    <target-params>v1-private</target-params>
  </target>
  <target>
    <name>File Server (public)</name>
    <udp>
      <ip>192.0.2.1</ip>
    </udp>
  </target>
</snmp>

```

```
</udp>
<target-params>v1-public</target-params>
</target>
<target>
  <name>Office Network</name>
  <udp>
    <ip>192.0.2.0</ip>
    <prefix-length>24</prefix-length>
  </udp>
  <tag>office</tag>
  <target-params>none</target-params>
</target>
<target>
  <name>Home Office Network</name>
  <udp>
    <ip>203.0.113.0</ip>
    <prefix-length>24</prefix-length>
  </udp>
  <tag>home-office</tag>
  <target-params>none</target-params>
</target>
<target-params>
  <name>v1-private</name>
  <v1>
    <security-name>private</security-name>
  </v1>
</target-params>
<target-params>
  <name>v1-public</name>
  <v1>
    <security-name>public</security-name>
  </v1>
</target-params>
<target-params>
  <name>v2c-public</name>
  <v2c>
    <security-name>public</security-name>
  </v2c>
</target-params>
<!--
  Communities c1, c2, c3, and c4 are used for incoming messages
  that should be forwarded.

  Communities c3 and c5 are used for outgoing messages to the
  file server.
-->
<community>
```

```
<index>c1</index>
<security-name>public</security-name>
<engine-id>80:00:61:81:c8</engine-id>
<context>trusted</context>
<target-tag>office</target-tag>
</community>
<community>
  <index>c2</index>
  <security-name>public</security-name>
  <engine-id>80:00:61:81:c8</engine-id>
  <context>trusted</context>
  <target-tag>home-office</target-tag>
</community>
<community>
  <index>c3</index>
  <security-name>public</security-name>
  <engine-id>80:00:61:81:c8</engine-id>
  <context>not-trusted</context>
</community>
<community>
  <index>c4</index>
  <text-name>backdoor</text-name>
  <security-name>public</security-name>
  <engine-id>80:00:61:81:c8</engine-id>
  <context>trusted</context>
</community>
<community>
  <index>c5</index>
  <security-name>private</security-name>
  <engine-id>80:00:61:81:c8</engine-id>
  <context>trusted</context>
</community>

<proxy>
  <name>p1</name>
  <type>read</type>
  <context-engine-id>80:00:61:81:c8</context-engine-id>
  <context-name>trusted</context-name>
  <target-params-in>v2c-public</target-params-in>
  <single-target-out>File Server (private)</single-target-out>
</proxy>
<proxy>
  <name>p2</name>
  <type>read</type>
  <context-engine-id>80:00:61:81:c8</context-engine-id>
  <context-name>not-trusted</context-name>
  <target-params-in>v2c-public</target-params-in>
  <single-target-out>File Server (public)</single-target-out>
```

```
</proxy>
</snmp>
```

If an SNMPv2c Get request with community string "public" is received from an IP address tagged as "office" or "home-office", or if the request is received from anywhere else with community string "backdoor", the implied context is "trusted" so proxy entry "p1" matches. The request is forwarded to the file server as SNMPv1 with community "private" using community table entry "c5" for outbound params lookup.

If an SNMPv2c Get request with community string "public" is received from any other IP address, the implied context is "not-trusted" so proxy entry "p2" matches, and the request is forwarded to the file server as SNMPv1 with community "public".

A.6. View-Based Access Control Model Configuration Example

Below is an XML instance document showing the minimum-secure VACM configuration (see Appendix A of [RFC3415]).

```
<snmp xmlns="urn:ietf:params:xml:ns:yang:ietf-snmp">
  <vacm>
    <group>
      <name>initial</name>
      <member>
        <security-name>initial</security-name>
        <security-model>usm</security-model>
      </member>
      <access>
        <context></context>
        <security-model>usm</security-model>
        <security-level>no-auth-no-priv</security-level>
        <read-view>restricted</read-view>
        <notify-view>restricted</notify-view>
      </access>
      <access>
        <context></context>
        <security-model>usm</security-model>
        <security-level>auth-no-priv</security-level>
        <read-view>internet</read-view>
        <write-view>internet</write-view>
        <notify-view>internet</notify-view>
      </access>
    </group>
    <view>
      <name>initial</name>
      <include>1.3.6.1</include>
```

```
</view>
<view>
  <name>restricted</name>
  <include>1.3.6.1</include>
</view>
</vacm>
</snmp>
```

The following XML instance document shows the semi-secure VACM configuration (only the view configuration is different).

```
<snmp xmlns="urn:ietf:params:xml:ns:yang:ietf-snmp">
  <vacm>
    <group>
      <name>initial</name>
      <member>
        <security-name>initial</security-name>
        <security-model>usm</security-model>
      </member>
      <access>
        <context></context>
        <security-model>usm</security-model>
        <security-level>no-auth-no-priv</security-level>
        <read-view>restricted</read-view>
        <notify-view>restricted</notify-view>
      </access>
      <access>
        <context></context>
        <security-model>usm</security-model>
        <security-level>auth-no-priv</security-level>
        <read-view>internet</read-view>
        <write-view>internet</write-view>
        <notify-view>internet</notify-view>
      </access>
    </group>
    <view>
      <name>initial</name>
      <include>1.3.6.1</include>
    </view>
    <view>
      <name>restricted</name>
      <include>1.3.6.1.2.1.1</include>
      <include>1.3.6.1.2.1.11</include>
      <include>1.3.6.1.6.3.10.2.1</include>
      <include>1.3.6.1.6.3.11.2.1</include>
      <include>1.3.6.1.6.3.15.1.1</include>
    </view>
  </vacm>
```

</snmp>

A.7. Transport Layer Security Transport Model Configuration Example

Below is an XML instance document showing the configuration of the mapping of certificate to security name (see Appendices A.2 and A.3 of [RFC6353]).

```
<snmp xmlns="urn:ietf:params:xml:ns:yang:ietf-snmp"
      xmlns:x509c2n=
        "urn:ietf:params:xml:ns:yang:ietf-x509-cert-to-name">
  <tlstm>
    <cert-to-name>
      <id>1</id>
      <fingerprint>11:0A:05:11:00</fingerprint>
      <map-type>x509c2n:san-any</map-type>
    </cert-to-name>
    <cert-to-name>
      <id>2</id>
      <fingerprint>11:0A:05:11:00</fingerprint>
      <map-type>x509c2n:specified</map-type>
      <name>
        Joe Cool
      </name>
    </cert-to-name>
  </tlstm>
</snmp>
```

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