

Network Working Group
Request for Comments: 2265
Category: Standards Track

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January 1998

View-based Access Control Model (VACM) for the Simple Network Management Protocol (SNMP)

Status of this Memo

This document specifies an Internet standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "Internet Official Protocol Standards" (STD 1) for the standardization state and status of this protocol. Distribution of this memo is unlimited.

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Abstract

This document describes the View-based Access Control Model for use in the SNMP architecture [RFC2261]. It defines the Elements of Procedure for controlling access to management information. This document also includes a MIB for remotely managing the configuration parameters for the View-based Access Control Model.

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1. Introduction

The Architecture for describing Internet Management Frameworks [RFC2261] describes that an SNMP engine is composed of:

- 1) a Dispatcher
- 2) a Message Processing Subsystem,
- 3) a Security Subsystem, and
- 4) an Access Control Subsystem.

Applications make use of the services of these subsystems.

It is important to understand the SNMP architecture and its terminology to understand where the View-based Access Control Model described in this document fits into the architecture and interacts with other subsystems within the architecture. The reader is expected to have read and understood the description and terminology of the SNMP architecture, as defined in [RFC2261].

The Access Control Subsystem of an SNMP engine has the responsibility for checking whether a specific type of access (read, write, notify) to a particular object (instance) is allowed.

It is the purpose of this document to define a specific model of the Access Control Subsystem, designated the View-based Access Control Model. Note that this is not necessarily the only Access Control Model.

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

1.2. Access Control

Access Control occurs (either implicitly or explicitly) in an SNMP entity when processing SNMP retrieval or modification request messages from an SNMP entity. For example a Command Responder

application applies Access Control when processing requests that it received from a Command Generator application. These requests include these types of operations: GetRequest, GetNextRequest, GetBulkRequest, and SetRequest operations.

Access Control also occurs in an SNMP entity when an SNMP notification message is generated (by a Notification Originator application). These notification messages include these types of operations: InformRequest and SNMPv2-Trap operations.

The View-based Access Control Model defines a set of services that an application (such as a Command Responder or a Notification Originator application) can use for checking access rights. It is the responsibility of the application to make the proper service calls for access checking.

1.3. Local Configuration Datastore

To implement the model described in this document, an SNMP entity needs to retain information about access rights and policies. This information is part of the SNMP engine's Local Configuration Datastore (LCD). See [RFC2261] for the definition of LCD.

In order to allow an SNMP entity's LCD to be remotely configured, portions of the LCD need to be accessible as managed objects. A MIB module, the View-based Access Control Model Configuration MIB, which defines these managed object types is included in this document.

2. Elements of the Model

This section contains definitions to realize the access control service provided by the View-based Access Control Model.

2.1. Groups

A group is a set of zero or more <securityModel, securityName> tuples on whose behalf SNMP management objects can be accessed. A group defines the access rights afforded to all securityNames which belong to that group. The combination of a securityModel and a securityName maps to at most one group. A group is identified by a groupName.

The Access Control module assumes that the securityName has already been authenticated as needed and provides no further authentication of its own.

The View-based Access Control Model uses the securityModel and the securityName as inputs to the Access Control module when called to check for access rights. It determines the groupName as a function

of securityModel and securityName.

2.2. securityLevel

Different access rights for members of a group can be defined for different levels of security, i.e., noAuthNoPriv, authNoPriv, and authPriv. The securityLevel identifies the level of security that will be assumed when checking for access rights. See the SNMP Architecture document [RFC2261] for a definition of securityLevel.

The View-based Access Control Model requires that the securityLevel is passed as input to the Access Control module when called to check for access rights.

2.3. Contexts

An SNMP context is a collection of management information accessible by an SNMP entity. An item of management information may exist in more than one context. An SNMP entity potentially has access to many contexts. Details about the naming of management information can be found in the SNMP Architecture document [RFC2261].

The View-based Access Control Model defines a vacmContextTable that lists the locally available contexts by contextName.

2.4. MIB Views and View Families

For security reasons, it is often valuable to be able to restrict the access rights of some groups to only a subset of the management information in the management domain. To provide this capability, access to a context is via a "MIB view" which details a specific set of managed object types (and optionally, the specific instances of object types) within that context. For example, for a given context, there will typically always be one MIB view which provides access to all management information in that context, and often there will be other MIB views each of which contains some subset of the information. So, the access allowed for a group can be restricted in the desired manner by specifying its rights in terms of the particular (subset) MIB view it can access within each appropriate context.

Since managed object types (and their instances) are identified via the tree-like naming structure of ISO's OBJECT IDENTIFIERS [ISO-ASN.1, RFC1902], it is convenient to define a MIB view as the combination of a set of "view subtrees", where each view subtree is a subtree within the managed object naming tree. Thus, a simple MIB view (e.g., all managed objects within the Internet Network Management Framework) can be defined as a single view subtree, while

more complicated MIB views (e.g., all information relevant to a particular network interface) can be represented by the union of multiple view subtrees.

While any set of managed objects can be described by the union of some number of view subtrees, situations can arise that would require a very large number of view subtrees. This could happen, for example, when specifying all columns in one conceptual row of a MIB table because they would appear in separate subtrees, one per column, each with a very similar format. Because the formats are similar, the required set of subtrees can easily be aggregated into one structure. This structure is named a family of view subtrees after the set of subtrees that it conceptually represents. A family of view subtrees can either be included or excluded from a MIB view.

2.4.1. View Subtree

A view subtree is the set of all MIB object instances which have a common ASN.1 OBJECT IDENTIFIER prefix to their names. A view subtree is identified by the OBJECT IDENTIFIER value which is the longest OBJECT IDENTIFIER prefix common to all (potential) MIB object instances in that subtree.

2.4.2. ViewTreeFamily

A family of view subtrees is a pairing of an OBJECT IDENTIFIER value (called the family name) together with a bit string value (called the family mask). The family mask indicates which sub-identifiers of the associated family name are significant to the family's definition.

For each possible managed object instance, that instance belongs to a particular ViewTreeFamily if both of the following conditions are true:

- the OBJECT IDENTIFIER name of the managed object instance contains at least as many sub-identifiers as does the family name, and
- each sub-identifier in the OBJECT IDENTIFIER name of the managed object instance matches the corresponding sub-identifier of the family name whenever the corresponding bit of the associated family mask is non-zero.

When the configured value of the family mask is all ones, the view subtree family is identical to the single view subtree identified by the family name.

When the configured value of the family mask is shorter than required to perform the above test, its value is implicitly extended with ones. Consequently, a view subtree family having a family mask of zero length always corresponds to a single view subtree.

2.5. Access Policy

The View-based Access Control Model determines the access rights of a group, representing zero or more securityNames which have the same access rights. For a particular context, identified by contextName, to which a group, identified by groupName, has access using a particular securityModel and securityLevel, that group's access rights are given by a read-view, a write-view and a notify-view.

The read-view represents the set of object instances authorized for the group when reading objects. Reading objects occurs when processing a retrieval (for example a GetRequest, GetNextRequest, GetBulkRequest) operation.

The write-view represents the set of object instances authorized for the group when writing objects. Writing objects occurs when processing a write (for example a Set) operation.

The notify-view represents the set of object instances authorized for the group when sending objects in a notification, such as when sending a notification (for example an Inform or SNMPv2-Trap).

3. Elements of Procedure

This section describes the procedures followed by an Access Control module that implements the View-based Access Control Model when checking access rights as requested by an application (for example a Command Responder or a Notification Originator application). The abstract service primitive is:

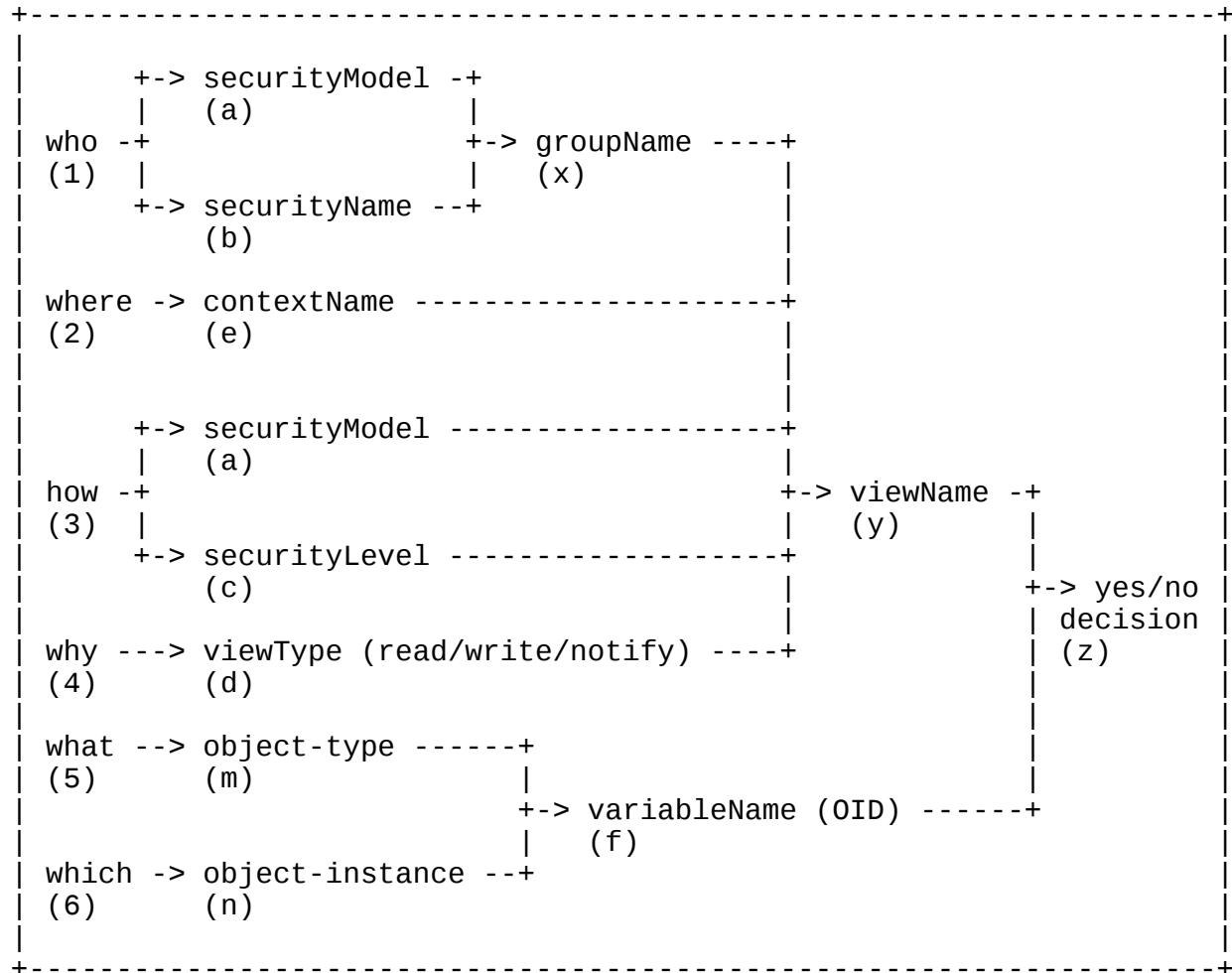
```
statusInformation =          -- success or errorIndication
  isAccessAllowed(
    securityModel             -- Security Model in use
    securityName              -- principal who wants access
    securityLevel             -- Level of Security
    viewType                  -- read, write, or notify view
    contextName               -- context containing variableName
    variableName              -- OID for the managed object
  )
```

The abstract data elements are:

- statusInformation - one of the following:
 - accessAllowed - a MIB view was found and access is granted.
 - notInView - a MIB view was found but access is denied.
The variableName is not in the configured MIB view for the specified viewType (e.g., in the relevant entry in the vacmAccessTable).
 - noSuchView - no MIB view found because no view has been configured for specified viewType (e.g., in the relevant entry in the vacmAccessTable).
 - noSuchContext - no MIB view found because of no entry in the vacmContextTable for specified contextName.
 - noGroupName - no MIB view found because no entry has been configured in the vacmSecurityToGroupTable for the specified combination of securityModel and securityName.
 - noAccessEntry - no MIB view found because no entry has been configured in the vacmAccessTable for the specified combination of contextName, groupName (from vacmSecurityToGroupTable), securityModel and securityLevel.
 - otherError - failure, an undefined error occurred.
- securityModel - Security Model under which access is requested.
- securityName - the principal on whose behalf access is requested.
- securityLevel - Level of Security under which access is requested.
- viewType - view to be checked (read, write or notify).
- contextName - context in which access is requested.
- variableName - object instance to which access is requested.

3.1. Overview of isAccessAllowed Process

The following picture shows how the decision for access control is made by the View-based Access Control Model.



How the decision for isAccessAllowed is made.

1) Inputs to the isAccessAllowed service are:

- | | | |
|-----|---------------|------------------------------------|
| (a) | securityModel | -- Security Model in use |
| (b) | securityName | -- principal who wants to access |
| (c) | securityLevel | -- Level of Security |
| (d) | viewType | -- read, write, or notify view |
| (e) | contextName | -- context containing variableName |
| (f) | variableName | -- OID for the managed object |
| | | -- this is made up of: |

- object-type (m)
 - object-instance (n)
- 2) The partial "who" (1), represented by the securityModel (a) and the securityName (b), are used as the indices (a,b) into the vacmSecurityToGroupTable to find a single entry that produces a group, represented by groupName (x).
 - 3) The "where" (2), represented by the contextName (e), the "who", represented by the groupName (x) from the previous step, and the "how" (3), represented by securityModel (a) and securityLevel (c), are used as indices (e,x,a,c) into the vacmAccessTable to find a single entry that contains three MIB views.
 - 4) The "why" (4), represented by the viewType (d), is used to select the proper MIB view, represented by a viewName (y), from the vacmAccessEntry selected in the previous step. This viewName (y) is an index into the vacmViewTreeFamilyTable and selects the set of entries that define the variableNames which are included in or excluded from the MIB view identified by the viewName (y).
 - 5) The "what" (5) type of management data and "which" (6) particular instance, represented by the variableName (f), is then checked to be in the MIB view or not, e.g., the yes/no decision (z).

3.2. Processing the isAccessAllowed Service Request

This section describes the procedure followed by an Access Control module that implements the View-based Access Control Model whenever it receives an isAccessAllowed request.

- 1) The vacmContextTable is consulted for information about the SNMP context identified by the contextName. If information about this SNMP context is absent from the table, then an errorIndication (noSuchContext) is returned to the calling module.
- 2) The vacmSecurityToGroupTable is consulted for mapping the securityModel and securityName to a groupName. If the information about this combination is absent from the table, then an errorIndication (noGroupName) is returned to the calling module.
- 3) The vacmAccessTable is consulted for information about the groupName, contextName, securityModel and securityLevel. If information about this combination is absent from the table, then an errorIndication (noAccessEntry) is returned to the calling module.

- 4) a) If the viewType is "read", then the read view is used for checking access rights.
- b) If the viewType is "write", then the write view is used for checking access rights.
- c) If the viewType is "notify", then the notify view is used for checking access rights.

If the view to be used is the empty view (zero length viewName) then an errorIndication (noSuchView) is returned to the calling module.

- 5) a) If there is no view configured for the specified viewType, then an errorIndication (noSuchView) is returned to the calling module.
- b) If the specified variableName (object instance) is not in the MIB view (see DESCRIPTION clause for vacmViewTreeFamilyTable in section 4), then an errorIndication (notInView) is returned to the calling module.

Otherwise,

- c) The specified variableName is in the MIB view.
A statusInformation of success (accessAllowed) is returned to the calling module.

4. Definitions

SNMP-VIEW-BASED-ACM-MIB DEFINITIONS ::= BEGIN

IMPORTS

```

MODULE-COMPLIANCE, OBJECT-GROUP          FROM SNMPv2-CONF
MODULE-IDENTITY, OBJECT-TYPE,
snmpModules                               FROM SNMPv2-SMI
TestAndIncr,
RowStatus, StorageType                    FROM SNMPv2-TC
SnmpAdminString,
SnmpSecurityLevel,
SnmpSecurityModel                         FROM SNMP-FRAMEWORK-MIB;
```

```

snmpVacmMIB      MODULE-IDENTITY
LAST-UPDATED "9711200000Z"      -- 20 Nov 1997, midnight
ORGANIZATION "SNMPv3 Working Group"
CONTACT-INFO "WG-email:  snmpv3@tis.com
               Subscribe:  majordomo@tis.com
               In message body:  subscribe snmpv3"
```

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DESCRIPTION "The management information definitions for the
 View-based Access Control Model for SNMP."
 "

::= { snmpModules 5 }

-- Administrative assignments *****

vacmMIBObjects OBJECT IDENTIFIER ::= { snmpVacmMIB 1 }
 vacmMIBConformance OBJECT IDENTIFIER ::= { snmpVacmMIB 2 }

-- Information about Local Contexts *****

vacmContextTable OBJECT-TYPE
 SYNTAX SEQUENCE OF VacmContextEntry
 MAX-ACCESS not-accessible
 STATUS current

DESCRIPTION "The table of locally available contexts.

This table provides information to SNMP Command Generator applications so that they can properly configure the vacmAccessTable to control access to all contexts at the SNMP entity.

This table may change dynamically if the SNMP entity allows that contexts are added/deleted dynamically (for instance when its configuration changes). Such changes would happen only if the management instrumentation at that SNMP entity recognizes more (or fewer) contexts.

The presence of entries in this table and of entries in the vacmAccessTable are independent. That is, a context identified by an entry in this table is not necessarily referenced by any entries in the vacmAccessTable; and the context(s) referenced by an entry in the vacmAccessTable does not necessarily currently exist and thus need not be identified by an entry in this table.

This table must be made accessible via the default context so that Command Responder applications have a standard way of retrieving the information.

This table is read-only. It cannot be configured via SNMP.

"

::= { vacmMIBObjects 1 }

```
vacmContextEntry OBJECT-TYPE
    SYNTAX      VacmContextEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION "Information about a particular context."
    INDEX       {
                vacmContextName
            }
    ::= { vacmContextTable 1 }
```

```
VacmContextEntry ::= SEQUENCE
{
    vacmContextName SnmpAdminString
}
```

```
vacmContextName OBJECT-TYPE
```

```

SYNTAX      SnmpAdminString (SIZE(0..32))
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION "A human readable name identifying a particular
            context at a particular SNMP entity.

            The empty contextName (zero length) represents the
            default context.
            "
 ::= { vacmContextEntry 1 }

```

-- Information about Groups *****

```

vacmSecurityToGroupTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF VacmSecurityToGroupEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION "This table maps a combination of securityModel and
                securityName into a groupName which is used to define
                an access control policy for a group of principals.
                "
    ::= { vacmMIBObjects 2 }

```

```

vacmSecurityToGroupEntry OBJECT-TYPE
    SYNTAX      VacmSecurityToGroupEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION "An entry in this table maps the combination of a
                securityModel and securityName into a groupName.
                "
    INDEX      {
                vacmSecurityModel,
                vacmSecurityName
            }
    ::= { vacmSecurityToGroupTable 1 }

```

```

VacmSecurityToGroupEntry ::= SEQUENCE
{
    vacmSecurityModel          SnmpSecurityModel,
    vacmSecurityName           SnmpAdminString,
    vacmGroupName              SnmpAdminString,
    vacmSecurityToGroupStorageType StorageType,
    vacmSecurityToGroupStatus  RowStatus
}

```

```

vacmSecurityModel OBJECT-TYPE
    SYNTAX      SnmpSecurityModel(1..2147483647)
    MAX-ACCESS  not-accessible

```

STATUS current
 DESCRIPTION "The Security Model, by which the vacmSecurityName
 referenced by this entry is provided.

Note, this object may not take the 'any' (0) value.
 "

::= { vacmSecurityToGroupEntry 1 }

vacmSecurityName OBJECT-TYPE
 SYNTAX SnmpAdminString (SIZE(1..32))
 MAX-ACCESS not-accessible
 STATUS current
 DESCRIPTION "The securityName for the principal, represented in a
 Security Model independent format, which is mapped by
 this entry to a groupName.

The securityName for a principal represented in a
 Security Model independent format.
 "

::= { vacmSecurityToGroupEntry 2 }

vacmGroupName OBJECT-TYPE
 SYNTAX SnmpAdminString (SIZE(1..32))
 MAX-ACCESS read-create
 STATUS current
 DESCRIPTION "The name of the group to which this entry (e.g., the
 combination of securityModel and securityName)
 belongs.

This groupName is used as index into the
 vacmAccessTable to select an access control policy.
 "

::= { vacmSecurityToGroupEntry 3 }

vacmSecurityToGroupStorageType OBJECT-TYPE
 SYNTAX StorageType
 MAX-ACCESS read-create
 STATUS current
 DESCRIPTION "The storage type for this conceptual row.
 Conceptual rows having the value 'permanent' need not
 allow write-access to any columnar objects in the row.
 "

DEFVAL { nonVolatile }
 ::= { vacmSecurityToGroupEntry 4 }

vacmSecurityToGroupStatus OBJECT-TYPE
 SYNTAX RowStatus
 MAX-ACCESS read-create

STATUS current
 DESCRIPTION "The status of this conceptual row.

The RowStatus TC [RFC1903] requires that this DESCRIPTION clause states under which circumstances other objects in this row can be modified:

The value of this object has no effect on whether other objects in this conceptual row can be modified.
 "

::= { vacmSecurityToGroupEntry 5 }

-- Information about Access Rights *****

vacmAccessTable OBJECT-TYPE
 SYNTAX SEQUENCE OF VacmAccessEntry
 MAX-ACCESS not-accessible
 STATUS current
 DESCRIPTION "The table of access rights for groups.

Each entry is indexed by a contextPrefix, a groupName a securityModel and a securityLevel. To determine whether access is allowed, one entry from this table needs to be selected and the proper viewName from that entry must be used for access control checking.

To select the proper entry, follow these steps:

- 1) the set of possible matches is formed by the intersection of the following sets of entries:
 the set of entries with identical vacmGroupName
 the union of these two sets:
 - the set with identical vacmAccessContextPrefix
 - the set of entries with vacmAccessContextMatch value of 'prefix' and matching vacmAccessContextPrefix
 intersected with the union of these two sets:
 - the set of entries with identical vacmSecurityModel
 - the set of entries with vacmSecurityModel value of 'any'
 intersected with the set of entries with vacmAccessSecurityLevel value less than or equal to the requested securityLevel
- 2) if this set has only one member, we're done
 otherwise, it comes down to deciding how to weight the preferences between ContextPrefixes,

SecurityModels, and SecurityLevels as follows:

- a) if the subset of entries with identical securityModels is not empty, discard the rest.
- b) if the subset of entries with identical vacmAccessContextPrefix is not empty, discard the rest
- c) discard all entries with ContextPrefixes shorter than the longest one remaining in the set
- d) select the entry with the highest securityLevel

Please note that for securityLevel noAuthNoPriv, all groups are really equivalent since the assumption that the securityName has been authenticated does not hold.

"

::= { vacmMIBObjects 4 }

```
vacmAccessEntry  OBJECT-TYPE
    SYNTAX      VacmAccessEntry
    MAX-ACCESS   not-accessible
    STATUS      current
    DESCRIPTION  "An access right configured in the Local Configuration
                  Datastore (LCD) authorizing access to an SNMP context.
                  "
    INDEX       { vacmGroupName,
                  vacmAccessContextPrefix,
                  vacmAccessSecurityModel,
                  vacmAccessSecurityLevel
                  }
    ::= { vacmAccessTable 1 }
```

```
VacmAccessEntry ::= SEQUENCE
{
    vacmAccessContextPrefix      SnmpAdminString,
    vacmAccessSecurityModel      SnmpSecurityModel,
    vacmAccessSecurityLevel      SnmpSecurityLevel,
    vacmAccessContextMatch      INTEGER,
    vacmAccessReadViewName      SnmpAdminString,
    vacmAccessWriteViewName     SnmpAdminString,
    vacmAccessNotifyViewName    SnmpAdminString,
    vacmAccessStorageType       StorageType,
    vacmAccessStatus            RowStatus
}
```

```
vacmAccessContextPrefix OBJECT-TYPE
    SYNTAX      SnmpAdminString (SIZE(0..32))
    MAX-ACCESS   not-accessible
    STATUS      current
    DESCRIPTION  "In order to gain the access rights allowed by this
```

conceptual row, a contextName must match exactly (if the value of vacmAccessContextMatch is 'exact') or partially (if the value of vacmAccessContextMatch is 'prefix') to the value of the instance of this object.

"

::= { vacmAccessEntry 1 }

vacmAccessSecurityModel OBJECT-TYPE

SYNTAX SnmpSecurityModel

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION "In order to gain the access rights allowed by this conceptual row, this securityModel must be in use.

"

::= { vacmAccessEntry 2 }

vacmAccessSecurityLevel OBJECT-TYPE

SYNTAX SnmpSecurityLevel

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION "The minimum level of security required in order to gain the access rights allowed by this conceptual row. A securityLevel of noAuthNoPriv is less than authNoPriv which in turn is less than authPriv.

If multiple entries are equally indexed except for this vacmAccessSecurityLevel index, then the entry which has the highest value for vacmAccessSecurityLevel wins.

"

::= { vacmAccessEntry 3 }

vacmAccessContextMatch OBJECT-TYPE

SYNTAX INTEGER

{ exact (1), -- exact match of prefix and contextName
prefix (2) -- Only match to the prefix
}

MAX-ACCESS read-create

STATUS current

DESCRIPTION "If the value of this object is exact(1), then all rows where the contextName exactly matches vacmAccessContextPrefix are selected.

If the value of this object is prefix(2), then all rows where the contextName whose starting octets exactly match vacmAccessContextPrefix are selected. This allows for a simple form of wildcarding.

See also the example in the DESCRIPTION clause of the vacmAccessTable above.

"

::= { vacmAccessEntry 4 }

vacmAccessReadViewName OBJECT-TYPE

SYNTAX SnmpAdminString (SIZE(0..32))

MAX-ACCESS read-create

STATUS current

DESCRIPTION "The value of an instance of this object identifies the MIB view of the SNMP context to which this conceptual row authorizes read access.

The identified MIB view is that one for which the vacmViewTreeFamilyViewName has the same value as the instance of this object; if the value is the empty string or if there is no active MIB view having this value of vacmViewTreeFamilyViewName, then no access is granted.

"

DEFVAL { ''H } -- the empty string

::= { vacmAccessEntry 5 }

vacmAccessWriteViewName OBJECT-TYPE

SYNTAX SnmpAdminString (SIZE(0..32))

MAX-ACCESS read-create

STATUS current

DESCRIPTION "The value of an instance of this object identifies the MIB view of the SNMP context to which this conceptual row authorizes write access.

The identified MIB view is that one for which the vacmViewTreeFamilyViewName has the same value as the instance of this object; if the value is the empty string or if there is no active MIB view having this value of vacmViewTreeFamilyViewName, then no access is granted.

"

DEFVAL { ''H } -- the empty string

::= { vacmAccessEntry 6 }

vacmAccessNotifyViewName OBJECT-TYPE

SYNTAX SnmpAdminString (SIZE(0..32))

MAX-ACCESS read-create

STATUS current

DESCRIPTION "The value of an instance of this object identifies the MIB view of the SNMP context to which this conceptual row authorizes access for notifications.

The identified MIB view is that one for which the vacmViewTreeFamilyViewName has the same value as the instance of this object; if the value is the empty string or if there is no active MIB view having this value of vacmViewTreeFamilyViewName, then no access is granted.

"

```
DEFVAL      { ''H }    -- the empty string
::= { vacmAccessEntry 7 }
```

vacmAccessStorageType OBJECT-TYPE

SYNTAX StorageType

MAX-ACCESS read-create

STATUS current

DESCRIPTION "The storage type for this conceptual row.

Conceptual rows having the value 'permanent' need not allow write-access to any columnar objects in the row.

"

```
DEFVAL      { nonVolatile }
::= { vacmAccessEntry 8 }
```

vacmAccessStatus OBJECT-TYPE

SYNTAX RowStatus

MAX-ACCESS read-create

STATUS current

DESCRIPTION "The status of this conceptual row.

The RowStatus TC [RFC1903] requires that this DESCRIPTION clause states under which circumstances other objects in this row can be modified:

The value of this object has no effect on whether other objects in this conceptual row can be modified.

"

```
::= { vacmAccessEntry 9 }
```

-- Information about MIB views *****

-- Support for instance-level granularity is optional.

--

-- In some implementations, instance-level access control
 -- granularity may come at a high performance cost. Managers
 -- should avoid requesting such configurations unnecessarily.

vacmMIBViews OBJECT IDENTIFIER ::= { vacmMIBObjects 5 }

vacmViewSpinLock OBJECT-TYPE

SYNTAX TestAndIncr
 MAX-ACCESS read-write
 STATUS current
 DESCRIPTION "An advisory lock used to allow cooperating SNMP
 Command Generator applications to coordinate their
 use of the Set operation in creating or modifying
 views.

When creating a new view or altering an existing view, it is important to understand the potential interactions with other uses of the view. The vacmViewSpinLock should be retrieved. The name of the view to be created should be determined to be unique by the SNMP Command Generator application by consulting the vacmViewTreeFamilyTable. Finally, the named view may be created (Set), including the advisory lock.

If another SNMP Command Generator application has altered the views in the meantime, then the spin lock's value will have changed, and so this creation will fail because it will specify the wrong value for the spin lock.

Since this is an advisory lock, the use of this lock is not enforced.

"

::= { vacmMIBViews 1 }

vacmViewTreeFamilyTable OBJECT-TYPE

SYNTAX SEQUENCE OF VacmViewTreeFamilyEntry
 MAX-ACCESS not-accessible
 STATUS current
 DESCRIPTION "Locally held information about families of subtrees
 within MIB views.

Each MIB view is defined by two sets of view subtrees:
 - the included view subtrees, and
 - the excluded view subtrees.

Every such view subtree, both the included and the excluded ones, is defined in this table.

To determine if a particular object instance is in a particular MIB view, compare the object instance's OBJECT IDENTIFIER with each of the MIB view's active entries in this table. If none match, then the object instance is not in the MIB view. If one or more match, then the object instance is included in, or excluded from, the MIB view according to the

value of vacmViewTreeFamilyType in the entry whose value of vacmViewTreeFamilySubtree has the most sub-identifiers. If multiple entries match and have the same number of sub-identifiers, then the lexicographically greatest instance of vacmViewTreeFamilyType determines the inclusion or exclusion.

An object instance's OBJECT IDENTIFIER X matches an active entry in this table when the number of sub-identifiers in X is at least as many as in the value of vacmViewTreeFamilySubtree for the entry, and each sub-identifier in the value of vacmViewTreeFamilySubtree matches its corresponding sub-identifier in X. Two sub-identifiers match either if the corresponding bit of the value of vacmViewTreeFamilyMask for the entry is zero (the 'wild card' value), or if they are equal.

A 'family' of subtrees is the set of subtrees defined by a particular combination of values of vacmViewTreeFamilySubtree and vacmViewTreeFamilyMask. In the case where no 'wild card' is defined in the vacmViewTreeFamilyMask, the family of subtrees reduces to a single subtree.

When creating or changing MIB views, an SNMP Command Generator application should utilize the vacmViewSpinLock to try to avoid collisions. See DESCRIPTION clause of vacmViewSpinLock.

When creating MIB views, it is strongly advised that first the 'excluded' vacmViewTreeFamilyEntries are created and then the 'included' entries.

When deleting MIB views, it is strongly advised that first the 'included' vacmViewTreeFamilyEntries are deleted and then the 'excluded' entries.

If a create for an entry for instance-level access control is received and the implementation does not support instance-level granularity, then an inconsistentName error must be returned.

"

::= { vacmMIBViews 2 }

vacmViewTreeFamilyEntry OBJECT-TYPE
SYNTAX VacmViewTreeFamilyEntry

MAX-ACCESS not-accessible
 STATUS current
 DESCRIPTION "Information on a particular family of view subtrees included in or excluded from a particular SNMP context's MIB view.

Implementations must not restrict the number of families of view subtrees for a given MIB view, except as dictated by resource constraints on the overall number of entries in the vacmViewTreeFamilyTable.

If no conceptual rows exist in this table for a given MIB view (viewName), that view may be thought of as consisting of the empty set of view subtrees.

"

INDEX { vacmViewTreeFamilyViewName,
 vacmViewTreeFamilySubtree
 }
 ::= { vacmViewTreeFamilyTable 1 }

VacmViewTreeFamilyEntry ::= SEQUENCE

```
{
    vacmViewTreeFamilyViewName      SnmpAdminString,
    vacmViewTreeFamilySubtree       OBJECT IDENTIFIER,
    vacmViewTreeFamilyMask          OCTET STRING,
    vacmViewTreeFamilyType          INTEGER,
    vacmViewTreeFamilyStorageType   StorageType,
    vacmViewTreeFamilyStatus        RowStatus
}
```

vacmViewTreeFamilyViewName OBJECT-TYPE

SYNTAX SnmpAdminString (SIZE(1..32))
 MAX-ACCESS not-accessible
 STATUS current
 DESCRIPTION "The human readable name for a family of view subtrees."
 ::= { vacmViewTreeFamilyEntry 1 }

vacmViewTreeFamilySubtree OBJECT-TYPE

SYNTAX OBJECT IDENTIFIER
 MAX-ACCESS not-accessible
 STATUS current
 DESCRIPTION "The MIB subtree which when combined with the corresponding instance of vacmViewTreeFamilyMask defines a family of view subtrees."
 ::= { vacmViewTreeFamilyEntry 2 }

`vacmViewTreeFamilyMask` OBJECT-TYPE`SYNTAX` OCTET STRING (SIZE (0..16))`MAX-ACCESS` read-create`STATUS` current`DESCRIPTION` "The bit mask which, in combination with the corresponding instance of `vacmViewTreeFamilySubtree`, defines a family of view subtrees.

Each bit of this bit mask corresponds to a sub-identifier of `vacmViewTreeFamilySubtree`, with the most significant bit of the *i*-th octet of this octet string value (extended if necessary, see below) corresponding to the $(8*i - 7)$ -th sub-identifier, and the least significant bit of the *i*-th octet of this octet string corresponding to the $(8*i)$ -th sub-identifier, where *i* is in the range 1 through 16.

Each bit of this bit mask specifies whether or not the corresponding sub-identifiers must match when determining if an OBJECT IDENTIFIER is in this family of view subtrees; a '1' indicates that an exact match must occur; a '0' indicates 'wild card', i.e., any sub-identifier value matches.

Thus, the OBJECT IDENTIFIER *X* of an object instance is contained in a family of view subtrees if, for each sub-identifier of the value of `vacmViewTreeFamilySubtree`, either:

the *i*-th bit of `vacmViewTreeFamilyMask` is 0, or

the *i*-th sub-identifier of *X* is equal to the *i*-th sub-identifier of the value of `vacmViewTreeFamilySubtree`.

If the value of this bit mask is *M* bits long and there are more than *M* sub-identifiers in the corresponding instance of `vacmViewTreeFamilySubtree`, then the bit mask is extended with 1's to be the required length.

Note that when the value of this object is the zero-length string, this extension rule results in a mask of all-1's being used (i.e., no 'wild card'), and the family of view subtrees is the one view subtree uniquely identified by the corresponding instance of `vacmViewTreeFamilySubtree`.

Note that masks of length greater than zero length do not need to be supported. In this case this object is made read-only.

"

```
DEFVAL      { 'H }
::= { vacmViewTreeFamilyEntry 3 }
```

vacmViewTreeFamilyType OBJECT-TYPE

```
SYNTAX      INTEGER { included(1), excluded(2) }
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION "Indicates whether the corresponding instances of
             vacmViewTreeFamilySubtree and vacmViewTreeFamilyMask
             define a family of view subtrees which is included in
             or excluded from the MIB view.
```

"

```
DEFVAL      { included }
::= { vacmViewTreeFamilyEntry 4 }
```

vacmViewTreeFamilyStorageType OBJECT-TYPE

```
SYNTAX      StorageType
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION "The storage type for this conceptual row.
```

Conceptual rows having the value 'permanent' need not allow write-access to any columnar objects in the row.

"

```
DEFVAL      { nonVolatile }
::= { vacmViewTreeFamilyEntry 5 }
```

vacmViewTreeFamilyStatus OBJECT-TYPE

```
SYNTAX      RowStatus
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION "The status of this conceptual row.
```

The RowStatus TC [RFC1903] requires that this DESCRIPTION clause states under which circumstances other objects in this row can be modified:

The value of this object has no effect on whether other objects in this conceptual row can be modified.

"

```
::= { vacmViewTreeFamilyEntry 6 }
```

-- Conformance information *****

```
vacmMIBCompliances OBJECT IDENTIFIER ::= { vacmMIBConformance 1 }
vacmMIBGroups       OBJECT IDENTIFIER ::= { vacmMIBConformance 2 }
```

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

```
vacmMIBCompliance MODULE-COMPLIANCE
```

```
    STATUS          current
```

```
    DESCRIPTION     "The compliance statement for SNMP engines which
                     implement the SNMP View-based Access Control Model
                     configuration MIB.
                     "
```

```
    MODULE -- this module
```

```
        MANDATORY-GROUPS { vacmBasicGroup }
```

```
    OBJECT          vacmAccessContextMatch
```

```
    MIN-ACCESS      read-only
```

```
    DESCRIPTION     "Write access is not required."
```

```
    OBJECT          vacmAccessReadViewName
```

```
    MIN-ACCESS      read-only
```

```
    DESCRIPTION     "Write access is not required."
```

```
    OBJECT          vacmAccessWriteViewName
```

```
    MIN-ACCESS      read-only
```

```
    DESCRIPTION     "Write access is not required."
```

```
    OBJECT          vacmAccessNotifyViewName
```

```
    MIN-ACCESS      read-only
```

```
    DESCRIPTION     "Write access is not required."
```

```
    OBJECT          vacmAccessStorageType
```

```
    MIN-ACCESS      read-only
```

```
    DESCRIPTION     "Write access is not required."
```

```
    OBJECT          vacmAccessStatus
```

```
    MIN-ACCESS      read-only
```

```
    DESCRIPTION     "Create/delete/modify access to the
                     vacmAccessTable is not required.
                     "
```

```
    OBJECT          vacmViewTreeFamilyMask
```

```
    WRITE-SYNTAX    OCTET STRING (SIZE (0))
```

```
    MIN-ACCESS      read-only
```

```
    DESCRIPTION     "Support for configuration via SNMP of subtree
                     families using wild-cards is not required.
                     "
```

```
    OBJECT          vacmViewTreeFamilyType
```

```
    MIN-ACCESS      read-only
```

DESCRIPTION "Write access is not required."

OBJECT vacmViewTreeFamilyStorageType

MIN-ACCESS read-only

DESCRIPTION "Write access is not required."

OBJECT vacmViewTreeFamilyStatus

MIN-ACCESS read-only

DESCRIPTION "Create/delete/modify access to the
vacmViewTreeFamilyTable is not required.
"

::= { vacmMIBCompliances 1 }

-- Units of conformance *****

vacmBasicGroup OBJECT-GROUP

OBJECTS {

vacmContextName,
vacmGroupName,
vacmSecurityToGroupStorageType,
vacmSecurityToGroupStatus,
vacmAccessContextMatch,
vacmAccessReadViewName,
vacmAccessWriteViewName,
vacmAccessNotifyViewName,
vacmAccessStorageType,
vacmAccessStatus,
vacmViewSpinLock,
vacmViewTreeFamilyMask,
vacmViewTreeFamilyType,
vacmViewTreeFamilyStorageType,
vacmViewTreeFamilyStatus

}

STATUS current

DESCRIPTION "A collection of objects providing for remote
configuration of an SNMP engine which implements
the SNMP View-based Access Control Model.
"

::= { vacmMIBGroups 1 }

END

5. Intellectual Property

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6. Acknowledgements

This document is the result of the efforts of the SNMPv3 Working Group. Some special thanks are in order to the following SNMPv3 WG members:

Dave Battle (SNMP Research, Inc.)
Uri Blumenthal (IBM T.J. Watson Research Center)
Jeff Case (SNMP Research, Inc.)
John Curran (BBN)
T. Max Devlin (Hi-TECH Connections)
John Flick (Hewlett Packard)
David Harrington (Cabletron Systems Inc.)
N.C. Hien (IBM T.J. Watson Research Center)
Dave Levi (SNMP Research, Inc.)
Louis A Mamakos (UUNET Technologies Inc.)
Paul Meyer (Secure Computing Corporation)
Keith McCloghrie (Cisco Systems)
Russ Mundy (Trusted Information Systems, Inc.)
Bob Natale (ACE*COMM Corporation)
Mike O'Dell (UUNET Technologies Inc.)
Dave Perkins (DeskTalk)
Peter Polkinghorne (Brunel University)
Randy Presuhn (BMC Software, Inc.)
David Reid (SNMP Research, Inc.)
Shawn Routhier (Epilogue)
Juergen Schoenwaelder (TU Braunschweig)
Bob Stewart (Cisco Systems)
Bert Wijnen (IBM T.J. Watson Research Center)

The document is based on recommendations of the IETF Security and Administrative Framework Evolution for SNMP Advisory Team. Members of that Advisory Team were:

David Harrington (Cabletron Systems Inc.)
Jeff Johnson (Cisco Systems)
David Levi (SNMP Research Inc.)
John Linn (Openvision)
Russ Mundy (Trusted Information Systems) chair
Shawn Routhier (Epilogue)
Glenn Waters (Nortel)
Bert Wijnen (IBM T. J. Watson Research Center)

As recommended by the Advisory Team and the SNMPv3 Working Group Charter, the design incorporates as much as practical from previous RFCs and drafts. As a result, special thanks are due to the authors of previous designs known as SNMPv2u and SNMPv2*:

Jeff Case (SNMP Research, Inc.)
David Harrington (Cabletron Systems Inc.)
David Levi (SNMP Research, Inc.)
Keith McCloghrie (Cisco Systems)
Brian O'Keefe (Hewlett Packard)
Marshall T. Rose (Dover Beach Consulting)
Jon Saperia (BGS Systems Inc.)
Steve Waldbusser (International Network Services)
Glenn W. Waters (Bell-Northern Research Ltd.)

7. Security Considerations

7.1. Recommended Practices

This document is meant for use in the SNMP architecture. The View-based Access Control Model described in this document checks access rights to management information based on:

- contextName, representing a set of management information at the managed system where the Access Control module is running.
- groupName, representing a set of zero or more securityNames. The combination of a securityModel and a securityName is mapped into a group in the View-based Access Control Model.
- securityModel under which access is requested.
- securityLevel under which access is requested.
- operation performed on the management information.
- MIB views for read, write or notify access.

When the User-based Access Control module is called for checking access rights, it is assumed that the calling module has ensured the authentication and privacy aspects as specified by the securityLevel that is being passed.

When creating entries in or deleting entries from the vacmViewFamilyTable it is important to do such in the sequence as recommended in the DESCRIPTION clause of the vacmViewFamilyTable definition. Otherwise unwanted access may be granted while changing the entries in the table.

7.2. Defining Groups

The groupName are used to give access to a group of zero or more securityNames. Within the View-Based Access Control Model, a groupName is considered to exist if that groupName is listed in the vacmSecurityToGroupTable.

By mapping the combination of a securityModel and securityName into a groupName, an SNMP Command Generator application can add/delete securityNames to/from a group, if proper access is allowed.

Further it is important to realize that the grouping of <securityModel, securityName> tuples in the vacmSecurityToGroupTable does not take securityLevel into account. It is therefore important that the security administrator uses the securityLevel index in the vacmAccessTable to separate noAuthNoPriv from authPriv and/or authNoPriv access.

7.3. Conformance

For an implementation of the View-based Access Control Model to be conformant, it MUST implement the SNMP-VIEW-BASED-ACM-MIB. It also SHOULD implement the initial configuration, described in appendix A.

8. References

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APPENDIX A - Installation

A.1. Installation Parameters

During installation, an authoritative SNMP engine which supports this View-based Access Control Model SHOULD be configured with several initial parameters. These include for the View-based Access Control Model:

1) A security configuration

The choice of security configuration determines if initial configuration is implemented and if so how. One of three possible choices is selected:

- initial-minimum-security-configuration
- initial-semi-security-configuration
- initial-no-access-configuration

In the case of a initial-no-access-configuration, there is no initial configuration, and so the following steps are irrelevant.

2) A default context

One entry in the vacmContextTable with a contextName of "" (the empty string), representing the default context. Note that this table gets created automatically if a default context exists.

	no privacy support	privacy support
	-----	-----
vacmContextName	""	""

3) An initial group

One entry in the vacmSecurityToGroupTable to allow access to group "initial".

	no privacy support	privacy support
	-----	-----
vacmSecurityModel	3 (USM)	3 (USM)
vacmSecurityName	"initial"	"initial"
vacmGroupName	"initial"	"initial"
vacmSecurityToGroupStorageType	anyValidStorageType	anyValidStorageType
vacmSecurityToGroupStatus	active	active

4) Initial access rights

Three entries in the vacmAccessTable as follows:

- read-notify access for securityModel USM, securityLevel "noAuthNoPriv" on behalf of securityNames that belong to the group "initial" to the <restricted> MIB view in the default context with contextName "".
- read-write-notify access for securityModel USM, securityLevel "authNoPriv" on behalf of securityNames that belong to the group "initial" to the <internet> MIB view in the default context with contextName "".
- if privacy is supported,
read-write-notify access for securityModel USM, securityLevel "authPriv" on behalf of securityNames that belong to the group "initial" to the <internet> MIB view in the default context with contextName "".

That translates into the following entries in the vacmAccessTable. Those columns marked with (index) are index-only objects and are not really present in this table.

- One entry to be used for unauthenticated access (noAuthNoPriv):

	no privacy support	privacy support
	-----	-----
vacmAccessContextPrefix	""	""
vacmGroupName (index)	"initial"	"initial"
vacmSecurityModel (index)	3 (USM)	3 (USM)
vacmAccessSecurityLevel	noAuthNoPriv	noAuthNoPriv
vacmAccessReadViewName	"restricted"	"restricted"
vacmAccessWriteViewName	""	""
vacmAccessNotifyViewName	"restricted"	"restricted"
vacmAccessStorageType	anyValidStorageType	anyValidStorageType
vacmAccessStatus	active	active

- One entry to be used for authenticated access but without privacy (authNoPriv):

	no privacy support	privacy support
	-----	-----
vacmAccessContextPrefix	""	""
vacmGroupName (index)	"initial"	"initial"
vacmSecurityModel (index)	3 (USM)	3 (USM)
vacmAccessSecurityLevel	authNoPriv	authNoPriv
vacmAccessReadViewName	"internet"	"internet"

vacmAccessWriteViewName	"internet"	"internet"
vacmAccessNotifyViewName	"internet"	"internet"
vacmAccessStorageType	anyValidStorageType	anyValidStorageType
vacmAccessStatus	active	active

- One entry to be used for authenticated access with privacy (authPriv):

	no privacy support	privacy support
	-----	-----
vacmAccessContextPrefix		""
vacmGroupName (index)		"initial"
vacmSecurityModel (index)		3 (USM)
vacmAccessSecurityLevel		authPriv
vacmAccessReadViewName		"internet"
vacmAccessWriteViewName		"internet"
vacmAccessNotifyViewName		"internet"
vacmAccessStorageType		anyValidStorageType
vacmAccessStatus		active

- 5) Two MIB views, of which the second one depends on the security configuration.

- One view, the <internet> view, for authenticated access:
 - the <internet> MIB view is the following subtree:
"internet" (subtree 1.3.6.1)
- A second view, the <restricted> view, for unauthenticated access. This view is configured according to the selected security configuration:
 - For the initial-no-access-configuration there is no default initial configuration, so no MIB views are pre-scribed.
 - For the initial-semi-secure-configuration:

the <restricted> MIB view is the union of these subtrees:

 - (a) "system" (subtree 1.3.6.1.2.1.1) [RFC1907]
 - (b) "snmp" (subtree 1.3.6.1.2.1.11) [RFC1907]
 - (c) "snmpEngine" (subtree 1.3.6.1.6.3.7.2.1) [RFC2261]
 - (d) "snmpMPDStats" (subtree 1.3.6.1.6.3.8.2.1) [RFC2262]
 - (e) "usmStats" (subtree 1.3.6.1.6.3.9.2.1) [RFC2264]
 - For the initial-minimum-secure-configuration:

the <restricted> MIB view is the following subtree.
"internet" (subtree 1.3.6.1)

This translates into the following "internet" entry in the vacmViewTreeFamilyTable:

	minimum-secure -----	semi-secure -----
vacmViewTreeFamilyViewName	"internet"	"internet"
vacmViewTreeFamilySubtree	1.3.6.1	1.3.6.1
vacmViewTreeFamilyMask	""	""
vacmViewTreeFamilyType	1 (included)	1 (included)
vacmViewTreeFamilyStorageType	anyValidStorageType	anyValidStorageType
vacmViewTreeFamilyStatus	active	active

In addition it translates into the following "restricted" entries in the vacmViewTreeFamilyTable:

	minimum-secure -----	semi-secure -----
vacmViewTreeFamilyViewName	"restricted"	"restricted"
vacmViewTreeFamilySubtree	1.3.6.1	1.3.6.1.2.1.1
vacmViewTreeFamilyMask	""	""
vacmViewTreeFamilyType	1 (included)	1 (included)
vacmViewTreeFamilyStorageType	anyValidStorageType	anyValidStorageType
vacmViewTreeFamilyStatus	active	active
vacmViewTreeFamilyViewName		"restricted"
vacmViewTreeFamilySubtree		1.3.6.1.2.1.11
vacmViewTreeFamilyMask		""
vacmViewTreeFamilyType		1 (included)
vacmViewTreeFamilyStorageType		anyValidStorageType
vacmViewTreeFamilyStatus		active
vacmViewTreeFamilyViewName		"restricted"
vacmViewTreeFamilySubtree		1.3.6.1.6.3.7.2.1
vacmViewTreeFamilyMask		""
vacmViewTreeFamilyType		1 (included)
vacmViewTreeFamilyStorageType		anyValidStorageType
vacmViewTreeFamilyStatus		active
vacmViewTreeFamilyViewName		"restricted"
vacmViewTreeFamilySubtree		1.3.6.1.6.3.8.2.1
vacmViewTreeFamilyMask		""
vacmViewTreeFamilyType		1 (included)
vacmViewTreeFamilyStorageType		anyValidStorageType
vacmViewTreeFamilyStatus		active
vacmViewTreeFamilyViewName		"restricted"
vacmViewTreeFamilySubtree		1.3.6.1.6.3.9.2.1
vacmViewTreeFamilyMask		""

vacmViewTreeFamilyType
vacmViewTreeFamilyStorageType
vacmViewTreeFamilyStatus

1 (included)
anyValidStorageType
active

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