Abstract

This memo defines a portion of the Management Information Base (MIB) for use with network management protocols. In particular, it describes a backward-compatible extension to the View-based Access Control Model (VACM) for SNMPv3 for use with RADIUS and other AAA services to provide authorization of MIB database access, and defines objects for managing this extension. This extension is intended to be used in conjunction with secure SNMP Transport Models that facilitate RADIUS authentication, such as the Secure Shell Transport Model.

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1. Introduction

1.1. General


It is possible to authenticate SNMPv3 messages via a RADIUS when those messages are sent over the SSH transport. As originally envisioned, VACM authorizes a given SNMP transaction using on-device, pre-existing authorization configuration. In order to leverage a centralized RADIUS service to its full extent, the access control decision in the Access Control Subsystem needs to be able to make use of authorization information received from RADIUS as well. This document defines an extension to the View-based Access Control Model to obtain authorization information for an authenticated principal, from RADIUS.

Additional introductory material on the RADIUS operational model and RADIUS usage with SNMP may be found in Sections 1.3 and 1.5 of [RFC5608].

It is important to understand the SNMP architecture and the terminology of the architecture to understand where the Extended View-based Access Control Model described in this memo fits into the architecture and interacts with other subsystems and models within the architecture. It is expected that reader will have also read and understood RFC3411 [RFC3411], RFC3412 [RFC3412], RFC3413 [RFC3413], RFC3415 [RFC3415] and RFC3418 [RFC3418]. As this document describes an extension to VACM, a thorough understanding of RFC3415 [RFC3415] is assumed.

2. The Internet-Standard Management Framework

For a detailed overview of the documents that describe the current Internet-Standard Management Framework, please refer to section 7 of RFC 3410 [RFC3410].

Managed objects are accessed via a virtual information store, termed
the Management Information Base or MIB. MIB objects are generally accessed through the Simple Network Management Protocol (SNMP). Objects in the MIB are defined using the mechanisms defined in the Structure of Management Information (SMI). This memo specifies a MIB module that is compliant to the SMIv2, which is described in STD 58, RFC 2578 [RFC2578], STD 58, RFC 2579 [RFC2579] and STD 58, RFC 2580 [RFC2580].

3. Conventions

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 RFC 2119 [RFC2119].

4. Overview

4.1. System Block Diagram

A block diagram of the major system components referenced in this document may be useful to understanding the text that follows.

```
Block Diagram

+--------+  +-----------------+
| Network|    | RADIUS Client /|
| Manag  |    | SNMP Engine /  |
| Applic |    | Network Device |
+--------+    +-----------------+

This diagram illustrates that a network management application communicates with a network device, the managed entity, using SNMP over SSH. The network devices uses RADIUS to communicate with a RADIUS Server to authenticate the network management application (or the user whose credentials that application provides) and to obtain
authorization information related to access via SNMP for purpose of device management. Other secure transport protocols might be used instead of SSH.

4.2. Using RADIUS with SNMP

There are two use cases for RADIUS support of management access via SNMP. These are (a) service authorization and (b) access control authorization. RADIUS almost always involves user authentication as prerequisite to authorization, and there is a user authentication phase for each of these two use cases. The first use case is discussed in detail in \[RFC5608\]. The second use case is the subject of this document. This document describes how RADIUS attributes and messages are applied to the specific application area of SNMP Access Control Models, and VACM in particular.

This document assumes that Extended VACM will be used in conjunction with an SNMP secure Transport Model and the SNMP Transport Security Model. The rationale for this assumption is as follows. The RFC 3411 SNMP architecture maintains strong modularity and separation of concerns, extending to separating user identity (authentication) from user database access rights (authorization). The former is the business of the Security Subsystem and the latter is the business of the Access Control Subsystem. RADIUS, on the other hand, allows for no such separation of authorization from authentication. In order to use RADIUS with SNMP, binding of user authentication to user authorization must be achieved, without violating the modularity of the RFC 3411 SNMP architecture.

RADIUS does support a limited form of Authorize-Only operations. The RADIUS "Authorize Only" Service-Type Attribute can be specified in an Access-Request message, but only when accompanied by a RADIUS State Attribute, which contains an implementation specific "cookie" representing the successful outcome of a previous authentication transaction. For that reason, it is not possible to completely separate the use of RADIUS by the Access Control Subsystem from the use of RADIUS by other subsystems. This suggests that the most straightforward approach is to leverage the existing RADIUS usage, as documented in \[RFC5608\], and the tmStateReference cache, as documented in Section 5.2 of \[RFC5590\].

This document also assumes that the detailed access control rules are pre-configured in the NAS. Dynamic user authorization for MIB database access control, as defined herein, is limited to mapping the authenticated user to a pre-existing group, which in turn is mapped to the pre-existing rules. The operative use case assumption is that roles within an organization (i.e. groups and rules) change infrequently while the users assigned to those roles change much more
frequently. It is the user to role mapping that is outsourced to the RADIUS server.

5. Structure of the MIB Module

5.1. Textual Conventions

This MIB module makes use of the RowStatus, StorageType, SnmpAdminString, and SnmpSecurityModel textual conventions.

5.2. The extVacmCounters Subtree

The extVacmCounters subtree contains all of this module’s counters.

5.3. The Notifications Subtree

No notifications are defined in this MIB module

5.4. The Table Structures

6. Relationship to Other MIB Modules

6.1. Relationship to the VACM MIB

6.1.1. Extended VACM for RADIUS Authorization

This document will rely on implementation specific integration of the RADIUS client for user authentication and authorization. Further, it will rely on implementation specific caching of MIB database access policy information, in the form of the RADIUS Management-Policy-Id Attribute, such that it will be available to Extended VACM.

A NAS that is compliant to this specification, MUST treat any RADIUS Access-Accept message that provisions a specific policy for MIB database access control that cannot be provided as if an Access-Reject message had been received instead.

The RADIUS Management-Policy-Id Attribute MUST be used in an Access-Accept message to provision a user-specific access control policy for use in conjunction with Extended VACM. The syntax and semantics of the Management-Policy-Id attribute are described in Section 6.3 of [RFC5607].

The intended use of the content of the Management-Policy-Id attribute is to provision a mapping between the authenticated user, associated with the secure transport session, and an access control group pre-
provisioned in the VACM MIB module. Details of this mapping are described in following sections.

6.1.2. VACM Extension for RAIDUS Authorization

The extension to VACM [RFC3415] described in this document is a method for one or more of its MIB module objects to be dynamically provisioned based on information received from RADIUS, or some similar AAA service. This extension requires no changes to the Abstract Service Interface (ASI) for the Access Control Subsystem, nor any changes in the Elements of Procedure (EOP) for VACM. A new MIB module that augments the vacmSecurityToGroupTable is defined in this document, as well as supplemental EOP for Extended VACM to follow. It does require that a module of code somewhere in the NAS be able to write to the VACM MIB module and Extended VACM MIB Module, and that it reliably and consistently do so in immediate response to access control policy information received from RADIUS.

6.1.2.1. Dynamic Update of VACM and Extended VACM MIB Module Objects

The implementation dependent interface between the RADIUS Client function in the NAS and the SNMP Engine in the NAS is responsible for updating the vacmSecurityToGroupTable table within the VACM MIB Module [RFC3415] and the corresponding rows of the extendedVacmSecurityToGroupTable. These row objects are dynamically updated from RADIUS authorization data. Specifically, the RADIUS User-Name Attribute is used as the vacmSecurityName and the RADIUS Management-Policy-Id Attribute is used as the vacmGroupName. The vacmSecurityModel is the encoding for the Transport Security Model. The vacmSecurityToGroupStorageType should be (2) volatile.

In creating a row entry in the vacmSecurityToGroupTable, there are three cases to consider:

- No existing row has a matching vacmSecurityName.
- An existing row has a matching vacmSecurityName.
- No additional rows can be created, e.g. because of resource constraints, etc.

The second and third cases require special consideration. The second case may represent a conflict between dynamic access control authorization from RADIUS and local access control configuration by a security administrator, e.g. via remote or local SNMP MIB module updates. If one assumes that the security administrator
intentionally configured a table entry for the "conflicting" vacmSecurityName, with full knowledge that it might over-ride dynamic authorization information from RADIUS, the right thing to do would be nothing. That is to say, do not update the table based on RADIUS authorization information. On the other hand, it is possible that the "name collision" is the result of a mistake, or the result of stale configuration information.

The behavior specified for Extended VACM is to make not update to the vacmSecurityToGroupTable, and to increment the extVacmSecurityNameConflict counter.

The third case is likely to be rare, and SHOULD result in a notification of some sort being logged for action by the system administrator.

It is expected that the value of the RADIUS Management-Policy-Id Attribute match an existing vacmGroupName that can be successfully used as an index to the vacmAccessTable. If no matching vacmGroupName exists, then the access control defaults to this will result in the default access rights of "no access", which is the desired result. The NAS should increment the extVacmMissingGroupName counter, for troubleshooting purposes, as this most likely indicates an administrative misconfiguration.

In addition to creating a new row in the vacmSecurityToGroupTable, the NAS creates a corresponding new row in the extVacmSecurityToGroupTable, using the same values for index as were used to create the row in the vacmSecurityToGroupTable. The value of the rowCreatedBy object is set to RADIUS (1), and the value of rowLifetime is set to the value of the RADIUS Session-Timeout Attribute, if one was received by the RADIUS Client for this session, or to zero (0) otherwise.

6.1.2.2. Purging Volatile Entries in the Extended VACM MIB Module

When the secure transport session is torn down, disconnected or times out, any volatile table rows created in the vacmSecurityToGroup table by the Extended VACM function MUST be removed. The mechanism to accomplish this task is implementation specific.

6.1.3. Elements of Procedure for Extended VACM

This section describes the Elements of Procedure for Extended VACM. The function of the VACM extension is to manage the creation and deletion of rows in the vacmSecurityToGroupTable, based on the outcome of RADIUS authorization. All access control decision functions are taken by VACM, as defined in [RFC3415]. The EOP for VACM remains as
listed in Section 3 of that document.

When a RADIUS (or other AAA service) authorizes SNMP data access control for a user-authenticated secure transport session, the NAS causes the RADIUS provisioning information to be made available to the Extended VACM facility, which populates the vacmSecurityToGroupTable, as follows:

1. If the the RADIUS Management-Policy-Id Attribute is not available, increment the extVacmNoPolicy counter. Do not create a table row.

2. If the the RADIUS Management-Policy-Id Attribute is available, and if no existing row has a vacmSecurityName matching the RADIUS User-Name Attribute, create a new row with the columns populated as follows:
   A. vacmSecurityModel = (x) secureTransportSecurityModel
   B. vacmSecurityName = RADIUS User-Name Attribute
   C. vacmGroupName = RADIUS Management-Policy-Id Attribute
   D. vacmSecurityToGroupStorageType = (2)
   E. volatilevacmSecurityToGroupStatus = createAndGo ???
   F. extVacmRowCreatedBy = (1)
   G. radiusextVacmRowLifetime = RADIUS Session-Timeout Attribute | zero (0)
   H. extVacmTransportSessionID = ID provided by the Secure Transport Model

3. If an existing table row has a matching vacmSecurityName, increment the extVacmSecurityNameConflict counter. Do not create a table row. If no additional table rows can be created, e.g. because of resource constraints, increment the extVacmResourceError counter.

When a RADIUS-authenticated secure transport session is disconnected by the remote peer, the NAS causes the Extended VACM to remove the corresponding table row from the vacmSecurityToGroupTable. The NAS provides an implementation dependent identifier of the session in question to Extended VACM.
1. Search for a row with a matching extVacmTransportSessionID.

2. If found, check to see that the extVacmRowCreateby value is (1) radius. If not, ignore the request.

3. If a table row exists with a matching value of extVACMTransportSessionID, that row is deleted.

6.2. MIB modules required for IMPORTS

The MIB module defined employs textual conventions from [RFC2579] and [RFC3411].

7. Definitions

SNMP-EXT-VACM-MIB DEFINITIONS ::= BEGIN

IMPORTS
    MODULE-COMPLIANCE, OBJECT-GROUP FROM SNMPv2-CONF
    MODULE-IDENTITY, OBJECT-TYPE,
        mib-2,
        Unsigned32,
        Counter32 FROM SNMPv2-SMI
    RowStatus, StorageType FROM SNMPv2-TC
    SnmpAdminString, SnmpSecurityModel FROM SNMP-FRAMEWORK-MIB;

snmpExtVacmMIB MODULE-IDENTITY
    LAST-UPDATED "200912020000Z" -- 1 Dec. 2009, midnight
    ORGANIZATION "ISMS Working Group"
    CONTACT-INFO "WG-email: isms@ietf.org"
    DESCRIPTION "The management and local datastore information
definitions for the Extended View-based Access
Control Model for SNMP.

Copyright (C) The Internet Society (2009)."

    REVISION "200912020000Z"
    DESCRIPTION "Initial version, published as RFCZZZZ."
    ::= { mib-2 XXX }

extVacmMIBObjects OBJECT IDENTIFIER ::= { snmpExtVacmMIB 1 }

extVacmMIBConformance OBJECT IDENTIFIER ::= {snmpExtVacmMIB 2 }
extVacmCounters OBJECT IDENTIFIER ::= { extVacmMIBObjects 1 }

extVacmResourceError OBJECT-TYPE
SYNTAX Counter32
UNITS "lost rows"
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The number of VACM Security Name to Security Group table rows that could not be created by Extended VACM because of insufficient resources."
 ::= { extVacmCounters 1 }

extVacmNoPolicy OBJECT-TYPE
SYNTAX Counter32
UNITS "lost rows"
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The number of VACM Security Name to Security Group table rows that could not be created by Extended VACM because the AAA-provisioned group policy did not match an existing row in the VACM access table."
 ::= { extVacmCounters 2 }

extVacmSecurityNameConflict OBJECT-TYPE
SYNTAX Counter32
UNITS "lost rows"
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The number of VACM Security Name to Security Group table rows that could not be created by Extended VACM because the AAA-provisioned security name (user name) conflicted with an existing row in the table."
 ::= { extVacmCounters 3 }

extVacmSecurityToGroupTable OBJECT-TYPE
SYNTAX SEQUENCE OF ExtVacmSecurityToGroupEntry
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."
 ::= { extVacmMIBObjects 2 }
extVacmSecurityToGroupEntry OBJECT-TYPE
SYNTAX ExtVacmSecurityToGroupEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "An entry in this table maps the combination of a
securityModel and securityName into a groupName."
INDEX {
  extVacmSecurityModel,
  extVacmSecurityName
}
 ::= { extVacmSecurityToGroupTable 1 }

ExtVacmSecurityToGroupEntry ::= SEQUENCE
{
  extVacmSecurityModel            SnmpSecurityModel,
  extVacmSecurityName             SnmpAdminString,
  extVacmGroupName                SnmpAdminString,
  extVacmSecurityToGroupStorageType StorageType,
  extVacmSecurityToGroupStatus    RowStatus,
  extVacmRowCreatedBy             INTEGER,
  extVacmRowLifetime              Unsigned32,
  extVacmTransportSessionID       Unsigned32
}

extVacmSecurityModel 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."
 ::= { extVacmSecurityToGroupEntry 1 }

extVacmSecurityName 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."
 ::= { extVacmSecurityToGroupEntry 2 }

extVacmGroupName    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)
This groupName is used as index into the vacmAccessTable to select an access control policy. A value in this table does not imply that an instance with the value exists in table vacmAccessTable.

```
::= { extVacmSecurityToGroupEntry 3 }
```

```
extVacmSecurityToGroupStorageType 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 }
::= { extVacmSecurityToGroupEntry 4 }
```

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

   Until instances of all corresponding columns are appropriately configured, the value of the corresponding instance of the vacmSecurityToGroupStatus column is 'notReady'.

   In particular, a newly created row cannot be made active until a value has been set for vacmGroupName.

   The RowStatus TC [RFC2579] 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."
::= { extVacmSecurityToGroupEntry 5 }
```

```
extVacmRowCreatedBy OBJECT-TYPE
SYNTAX      INTEGER
   { radius (1), -- Row created by Extended VACM other (2) -- ???

   MAX-ACCESS read-create
   STATUS       current
   DESCRIPTION "The source of the information in this row
is indicated by the value of this object.
In the case of VACM this column probably won’t exist."
::= { extVacmSecurityToGroupEntry 6 }

extVacmRowLifetime OBJECT-TYPE
  SYNTAX Unsigned32
  MAX-ACCESS read-create
  STATUS current
  DESCRIPTION "The number of seconds for which this row
  is valid. Extended VACM SHOULD delete the
  row after this lifetime expires."
::= { extVacmSecurityToGroupEntry 7 }

extVacmTransportSessionID OBJECT-TYPE
  SYNTAX Unsigned32
  MAX-ACCESS read-create
  STATUS current
  DESCRIPTION "An identifier of the secure transport
  model’s session associated with this
  authenticated user. The identifier
  MUST be unique within the scope of the NAS.
  It’s content is implementation dependant
  and it SHOULD be used merely as an index."
::= { extVacmSecurityToGroupEntry 8 }

-- Conformance information ******************************************

extVacmMIBCompliances
  OBJECT IDENTIFIER ::= {extVacmMIBConformance 1}
extVacmMIBGroups
  OBJECT IDENTIFIER ::= {extVacmMIBConformance 2}

-- compliance statements

extVacmMIBBasicCompliance MODULE-COMPLIANCE
  STATUS current
  DESCRIPTION "The compliance statement for SNMP engines which
  implement the Extensions to the View-based Access
  Control Model for use with RADIUS.
"
  MODULE -- this module
  MANDATORY-GROUPS { extVacmGroup }
  
::= { extVacmMIBCompliances 1 }

-- units of conformance
extVacmGroup OBJECT-GROUP
OBJECTS {
  extVacmResourceError,
  extVacmNoPolicy,
  extVacmSecurityNameConflict,
  extVacmGroupName,
  extVacmSecurityToGroupStorageType,
  extVacmSecurityToGroupStatus,
  extVacmRowCreatedBy,
  extVacmRowLifetime,
  extVacmTransportSessionID
}
STATUS       current
DESCRIPTION "A collection of objects for supporting the use of RADIUS to provide user / group mappings for VACM."
::= { extVacmMIBGroups 1 }

END

8. Security Considerations

TODO

Some of the readable objects in this MIB module (i.e., objects with a MAX-ACCESS other than not-accessible) may be considered sensitive or vulnerable in some network environments. It is thus important to control even GET and/or NOTIFY access to these objects and possibly to even encrypt the values of these objects when sending them over the network via SNMP. These are the tables and objects and their sensitivity/vulnerability:

- TBD

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

It is RECOMMENDED that implementers consider the security features as provided by the SNMPv3 framework (see [RFC3410], section 8), including full support for the SNMPv3 cryptographic mechanisms (for authentication and privacy).
Further, deployment of SNMP versions prior to SNMPv3 is NOT RECOMMENDED. Instead, it is RECOMMENDED to deploy SNMPv3 and to enable cryptographic security. It is then a customer/operator responsibility to ensure that the SNMP entity giving access to an instance of this MIB module is properly configured to give access to the objects only to those principals (users) that have legitimate rights to indeed GET or SET (change/create/delete) them.

9. IANA Considerations

The MIB module in this document uses the following IANA-assigned OBJECT IDENTIFIER values recorded in the SMI Numbers registry:

<table>
<thead>
<tr>
<th>Descriptor</th>
<th>OBJECT IDENTIFIER value</th>
</tr>
</thead>
<tbody>
<tr>
<td>snmpExtVacmMIB</td>
<td>{ mib-2 XXX }</td>
</tr>
</tbody>
</table>

Editor’s Note (to be removed prior to publication): the IANA is requested to assign a value for "XXX" under the ‘mib-2’ subtree and to record the assignment in the SMI Numbers registry. When the assignment has been made, the RFC Editor is asked to replace "XXX" (here and in the MIB module) with the assigned value and to remove this note.

10. Contributors

The following participants from the isms working group contributed to the development of this document:

- David Harrington

11. References

11.1. Normative References


11.2. Informative References


Appendix A. Open Issues

This section identifies questions and issues that have not been addressed in this version of this document. This section will probably be removed prior to publication, since there will be no questions left to address.

1. Is this document an amendment or update to RFC 3514? Or is it simply a standalone document that describes how to provision certain MIB Objects defined in RFC 3514, along with an extended set of augmenting table columns?

2. Does this document need to make any reference to the Elements of Procedure in RFC 3514, or does it simply need its own Elements of Procedure for updating the group mapping table?

3. Dave Harrington had issued a summary email after IETF75 containing apparently contradictory statements about whether the additional columns should be in the *same* table that VACM uses or in another, separate table that augments the VACM table. Basically, we need some help in actually structuring the new MIB Module.

4. The Groups and Conformance sections of the MIB Module need to be checked and kept in alignment with the definitions.

5. Make sure that the new Elements of Procedure make sense and cover all the corner cases correctly.
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