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**Using Authentication, Authorization, and Accounting services to
Dynamically Provision View-based Access Control Model User-to-Group
Mappings**

[draft-ietf-isms-radius-vacm-07.txt](#)

Abstract

This memo defines a portion of the Management Information Base (MIB) for use with network management protocols. It describes the use of information provided by Authentication, Authorization, and Accounting (AAA) services, such as the Remote Authentication Dial-In User Service (RADIUS), to dynamically update user-to-group mappings in the View-Based Access Control Model (VACM).

Comments are solicited and should be addressed to the working group's mailing list at isms@ietf.org.

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1. Introduction

This memo specifies a way to simplify the administration of the access rights granted to users of network management data. It functions to dynamically provision selected View-Based Access Control Model (VACM) [[RFC3415](#)] MIB objects, based on information received from an Authentication, Authorization, and Accounting (AAA) service, such as RADIUS [[RFC2865](#)].

This memo requires no changes to the Abstract Service Interface for the Access Control Subsystem, and requires no changes to the Elements of Procedure for VACM. It provides a MIB module that reflects the information provided by the AAA service, along with elements of procedure for maintaining that information and performing corresponding updates to VACM MIB data.

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. Using AAA services with SNMP

There are two use cases for AAA support of management access via SNMP. These are (a) service authorization and (b) access control authorization. The former is discussed in detail in [[RFC5608](#)]. The latter is the subject of this memo.

The use case assumption here is that roles within an organization, which are reflected in VACM as groups and rules, change infrequently, while the users assigned to those roles change much more frequently. This memo describes how the user-to-role (group) mapping can be delegated to the RADIUS server, avoiding the need to re-provision managed devices as users are added, deleted, or assigned new roles in an organization.

This memo assumes that the detailed access control policies are pre-configured in VACM, and does not attempt to address the question of how the policy associated with a given role is put in place.

The only additional information obtained from the AAA service is the mapping of the authenticated user's identifier to a specific role (or "group" in VACM terminology) in the access control policy. Dynamic user authorization for MIB database access control, as defined herein, is limited to mapping the authenticated user to a group, which in turn is mapped to whatever rules are already in place in VACM.

The SNMP architecture [[RFC3411](#)] maintains strong modularity and separation of concerns, separating user identity (authentication) from user database access rights (authorization). RADIUS, on the other hand, allows for no such separation of authorization from authentication. Consequently, the approach here is to leverage existing RADIUS usage for identifying a principal, documented in [[RFC5608](#)], along with the RADIUS Management-Policy-Id Attribute [[RFC5607](#)].

The tmSessionID (along with its transport model prefix) [[RFC5590](#)] is a suitable identifier for a AAA-authorized "session". This is because tmSessionID and tmSecurityName, assigned by a AAA-aware transport model, identify a specific transport session authorized to offer SNMP service, for which a principal has been AAA-authenticated. When a RADIUS-Management-Policy-ID Attribute (or equivalent) is bound to such a transport session and principal authentication, this binding provides sufficient information to compute dynamic updates to VACM. How this information is communicated within an implementation is implementation-dependent; this memo is only concerned with externally-observable behaviour.

[4.2.](#) Applicability

Though this memo was motivated to support the use of specific Transport Models, such as the Secure Shell Transport Model [[RFC5592](#)], it MAY be used with other implementation environments satisfying these requirements:

- o use an AAA service for sign-on service and data access authorization;
- o provide an indication of the start of a session for a particular authenticated principal, identified using a SecurityName, and provide the corresponding value of vacmGroupName to be used, based on information provided by the AAA service in use;
- o provide an indication of the end of the need for being able to make access decisions for a particular authenticated principal, as at the end of a session, whether due to disconnection, termination due to timeout, or any other reason.

Likewise, although this memo specifically refers to RADIUS, it MAY be used with other AAA services satisfying these requirements:

- o the service provides information semantically equivalent to the RADIUS Management-Policy-Id Attribute [[RFC5607](#)], which corresponds to a GroupName;
- o the service provides an authenticated principal identifier (e.g., the RADIUS User-Name Attribute [[RFC2865](#)]) which can be transformed to an equivalent principal identifier in the form of a SecurityName.

5. Structure of the MIB Module

5.1. Textual Conventions

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

5.2. The Table Structure

This MIB module defines a single table, the vacmAaaSecurityToGroupTable. This table is indexed by the integer assigned to each security model, the protocol-independent SecurityName corresponding to a principal, and the unique identifier of a session. This index structure was chosen to support use cases in which a given user could potentially have multiple concurrent sessions, and to support environments in which multiple security models might find concurrent usage.

6. Relationship to Other MIB Modules

This MIB module has a close operational relationship with the SNMP-VIEW-BASED-ACM-MIB (more commonly known as the "VACM MIB") from [\[RFC3415\]](#). It also relies on IMPORTS from several other modules.

6.1. Relationship to the VACM MIB

Although the MIB module defined here has a close relationship with the VACM MIB's vacmSecurityToGroupTable, it in no way changes the elements of procedure for VACM, nor does it affect any other tables defined in VACM. See the elements of procedure (below) for details of how the contents of the vacmSecurityToGroupTable are affected by this MIB module.

6.2. MIB modules required for IMPORTS

This MIB module employs definitions from [\[RFC2578\]](#), [\[RFC2579\]](#) and [\[RFC3411\]](#). The module also relies on the IANA registry defined in [\[RFC5590\]](#) for transport domain prefixes.

7. Elements of Procedure

The following elements of procedure are formulated in terms of two types of events: an indication of the establishment of a session, and an indication that one has ended. These can result in the creation of entries in the vacmAaaSecurityToGroupTable, which can in turn trigger creation, update, or deletion of entries in the vacmSecurityToGroupTable.

There are various possible implementation-specific error cases not spelled out here, such as running out of memory. By their nature, recovery in such cases will be implementation-specific. Implementors are advised to consider fail-safe strategies, e.g., prematurely terminating access in preference to erroneously perpetuating access.

7.1. Sequencing Requirements

These procedures assume that a transport model, such as [\[RFC5592\]](#), coordinates session establishment with AAA authentication and authorization. They rely critically on the receipt by the AAA client of the RADIUS Management-Policy-Id [\[RFC5607\]](#) Attribute (or its equivalent) from the RADIUS Access-Accept message (or equivalent). They also assume that the User-Name [\[RFC2865\]](#) from the RADIUS Access-Request message (or equivalent) corresponds to an SNMP Security Name [\[RFC3411\]](#).

To ensure correct processing of SNMP PDUs, the handling of the indication of the establishment of a session in accordance with the elements of procedure below MUST be completed before the `IsAccessAllowed()` abstract service interface is invoked for any SNMP PDUs from that session.

If a session termination indication occurs before all invocations of the `IsAccessAllowed()` abstract service interface have completed for all SNMP PDUs from that session, those remaining invocations MAY result in denial of access.

7.2. Actions Upon Session Establishment Indication

Four pieces of information are needed to process the session establishment indication:

- o the `SnmpSecurityModel` [[RFC3411](#)] needed as an index into the `vacmSecurityToGroupTable`;
- o the RADIUS User-Name Attribute or equivalent;
- o a session identifier, such as `tmSessionID` [[RFC5590](#)] along with the prefix for its transport domain, as a definitive identifier of the transport session that the AAA authorization is tied to;
- o the RADIUS Management-Policy-Id Attribute or equivalent

In particular, if either the User-Name or Management-Policy-Id is absent, invalid, or a zero-length string, no further processing of the session establishment indication is undertaken.

7.2.1. Creation of Entries in `vacmAaaSecurityToGroupTable`

Whenever an indication arrives that a new session has been established, determine whether a corresponding entry exists in the `vacmAaaSecurityToGroupTable`. If one does not, create a new row with the columns populated as follows:

- o `vacmAaaSecurityModel` = value of `SnmpSecurityModel` corresponding to the security model in use
- o `vacmAaaSecurityName` = RADIUS User-Name Attribute or equivalent, the `securityName` that will be used in invocations of the `isAccessAllowed()` abstract service interface;
- o `vacmAaaTransportModel` = the one- to four-character registered prefix of the transport domain [[RFC5590](#)]

- o vacmAaaTransportSessionID = unique (at least within the the scope of a transport model) session identifier
- o vacmAaaGroupName = RADIUS Management-Policy-Id Attribute or equivalent

Otherwise, if the row already exists, update the vacmAaaGroupName with the value supplied.

7.2.2. Creation of Entries in vacmSecurityToGroupTable

Whenever an entry is created in the vacmAaaSecurityToGroupTable, the vacmSecurityToGroupTable is examined to determine whether a corresponding entry exists there, using the value of vacmAaaSecurityModel for vacmSecurityModel, and the value of vacmAaaSecurityName for vacmSecurityName. If no corresponding entry exists, create one, using the vacmAaaGroupName of the newly created entry to fill in vacmGroupName, using a value of "volatile" for vacmSecurityToGroupStorageType, and a value of "active" for vacmSecurityToGroupStatus.

If a corresponding entry already exists in the vacmSecurityToGroupTable, and the row's StorageType is anything other than "volatile", or the RowStatus is anything other than "active", then a role (group) mapping for this user (principal) has already been put in place on this system, and will not be overridden.

7.2.3. Update of vacmGroupName

Whenever the value of an instance of vacmAaaGroupName is updated, if a corresponding entry exists in the vacmSecurityToGroupTable, and vacmSecurityToGroupStorageType is "volatile" and vacmSecurityToGroupStatus is "active", update the value of vacmGroupName with the value from vacmAaaGroupName.

The operational assumption here is that if the row's StorageType is "volatile", then this entry was probably dynamically created; an entry created by a security administrator would not normally be given a StorageType of "volatile". If value being provided by RADIUS (or other AAA service) is the same as what is already there, this is a no-op. If the value is different, the new information is understood as a more recent role (group) assignment for the user, which should supercede the one currently held there.

7.3. Actions Upon Session Termination Indication

Whenever a RADIUS (or other AAA) authenticated session ends for any reason, an indication is provided. This indication MUST provide

means of determining the SnmpSecurityModel, transport domain prefix, and an identifier for the transport session tied to the AAA authorization. The manner in which this occurs is implementation dependent.

7.3.1. Deletion of Entries from vacmAaaSecurityToGroupTable

Entries in the vacmAaaSecurityToGroupTable MUST NOT persist across system reboots.

When a session has been terminated, the vacmAaaSecurityToGroupTable is searched for a corresponding entry. A "matching" entry is any entry for which the SnmpSecurityModel, transport domain prefix, and session ID match the information associated with the session termination indication. Any matching entries are deleted. It is possible that no entries will match; this is not an error, and no special processing is required in this case.

7.3.2. Deletion of Entries from vacmSecurityToGroupTable

Whenever the last remaining row bearing a particular (vacmAaaSecurityModel, vacmAaaSecurityName) pair is deleted from the vacmAaaSecurityToGroupTable, the vacmSecurityToGroupTable is examined for a corresponding row. If one exists, and if its StorageType is "volatile" and its RowStatus is "active", that row MUST be deleted as well. The mechanism to accomplish this task is implementation specific.

8. Definitions

```
SNMP-VACM-AAA-MIB DEFINITIONS ::= BEGIN
```

```
IMPORTS
```

```
    MODULE-COMPLIANCE, OBJECT-GROUP          FROM SNMPv2-CONF
    MODULE-IDENTITY, OBJECT-TYPE,
    mib-2,
    Unsigned32                                FROM SNMPv2-SMI
    SnmpAdminString,
    SnmpSecurityModel                          FROM SNMP-FRAMEWORK-MIB;
```

```
snmpVacmAaaMIB      MODULE-IDENTITY
    LAST-UPDATED "201007040000Z"              -- 4 July, 2010
    ORGANIZATION "ISMS Working Group"
    CONTACT-INFO "WG-email:  isms@ietf.org"
```


DESCRIPTION "The management and local datastore information definitions for the AAA-Enabled View-based Access Control Model for SNMP.

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

REVISION "201007040000Z"

DESCRIPTION "Initial version, published as RFC XXXX."

::= { mib-2 XXX }

vacmAaaMIBObjects OBJECT IDENTIFIER ::= { snmpVacmAaaMIB 1 }

vacmAAAMIBConformance OBJECT IDENTIFIER ::= {snmpVacmAaaMIB 2 }

vacmAaaSecurityToGroupTable OBJECT-TYPE

SYNTAX SEQUENCE OF VacmAaaSecurityToGroupEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION "This table provides a listing of all currently active sessions for which a mapping of the combination of SnmpSecurityModel and SecurityName into a GroupName has been provided by an AAA service. The GroupName (in VACM) in turn identifies an access control policy to be used for the corresponding principals."

::= { vacmAaaMIBObjects 1 }

vacmAaaSecurityToGroupEntry OBJECT-TYPE

SYNTAX VacmAaaSecurityToGroupEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION "An entry in this table maps the combination of a SnmpSecurityModel and SecurityName into a GroupName for a particular session.

Each entry corresponds to a session.

Entries do not persist across reboots.

When a session is torn down, disconnected, timed out (e.g. following the RADIUS Session-Timeout Attribute), or otherwise terminated for any reason, the corresponding vacmAaaSecurityToGroupEntry is deleted."

```
INDEX      {
            vacmAaaSecurityModel,
            vacmAaaSecurityName,
            vacmAaaTransportModel,
            vacmAaaTransportSessionID
          }
 ::= { vacmAaaSecurityToGroupTable 1 }
```

```
VacmAaaSecurityToGroupEntry ::= SEQUENCE
{
    vacmAaaSecurityModel      SnmpSecurityModel,
    vacmAaaSecurityName       SnmpAdminString,
    vacmAaaTransportModel     SnmpAdminString,
    vacmAaaTransportSessionID Unsigned32,
    vacmAaaGroupName          SnmpAdminString
}
```

```
vacmAaaSecurityModel OBJECT-TYPE
    SYNTAX      SnmpSecurityModel(1..2147483647)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION "The Security Model associated with the AAA binding
                represented by this entry.
                This object cannot take the 'any' (0) value."
    ::= { vacmAaaSecurityToGroupEntry 1 }
```

```
vacmAaaSecurityName OBJECT-TYPE
    SYNTAX      SnmpAdminString (SIZE(1..32))
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION "The Security Name of the principal associated with
                the AAA binding represented by this entry.
                In RADIUS environments, this corresponds to
                the User-Name Attribute."
    ::= { vacmAaaSecurityToGroupEntry 2 }
```

```
vacmAaaTransportModel OBJECT-TYPE
    SYNTAX      SnmpAdminString (SIZE(1..4))
    MAX-ACCESS  not-accessible
```



```
STATUS      current
DESCRIPTION "The prefix of this session's transport domain."
::= { vacmAaaSecurityToGroupEntry 3 }

vacmAaaTransportSessionID OBJECT-TYPE
SYNTAX      Unsigned32
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION "A specific identifier of the session.
             This value MUST be unique among all
             currently open sessions within a transport model.
             The value has no particular significance other
             to distinguish sessions. An example of a suitable
             value would be tmSessionID."
::= { vacmAaaSecurityToGroupEntry 4 }

vacmAaaGroupName      OBJECT-TYPE
SYNTAX      SnmpAdminString (SIZE(1..32))
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION "The name of the group to which this entry
             is to belong. In RADIUS environments this
             comes from the RADIUS Management-Policy-Id
             Attribute.

             This group name is used to set the vacmGroupName
             in the corresponding vacmSecurityToGroupEntry."
::= { vacmAaaSecurityToGroupEntry 5 }

-- Conformance information *****

vacmAaaMIBCompliances
    OBJECT IDENTIFIER ::= {vacmAAAMIBConformance 1}
vacmAaaMIBGroups
    OBJECT IDENTIFIER ::= {vacmAAAMIBConformance 2}

-- compliance statements

vacmAaaMIBBasicCompliance 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 { vacmAaaGroup }

::= { vacmAaaMIBCompliances 1 }
```



```
-- units of conformance

vacmAaaGroup OBJECT-GROUP
    OBJECTS {
        vacmAaaGroupName
    }
    STATUS      current
    DESCRIPTION "A collection of objects for supporting the use
                of AAA services to provide user / group
                mappings for VACM."
    ::= { vacmAaaMIBGroups 1 }

END
```

9. Security Considerations

The algorithms in this memo make heuristic use of the `StorageType` of entries in the `vacmSecurityToGroupTable` to distinguish those provisioned by a security administrator (which would presumably not be configured as "volatile") from those dynamically generated. In making this distinction, it assumes that those entries explicitly provisioned by a security administrator and given a non-"volatile" status are not to be dynamically over-ridden. Users of this memo need to be aware of this operational assumption, which, while reasonable, is not necessarily universally valid. For example, this situation could also occur if the SNMP security administrator had mistakenly created these non-volatile entries in error.

The design of VACM ensures that if an unknown policy (group name) is used in the `vacmSecurityToGroupTable`, no access is granted. A consequence of this is that no matter what information is provided by the AAA server, no user can gain SNMP access rights not already granted to some group through the VACM configuration.

In order to ensure that the access control policy ultimately applied as a result of the mechanisms described here is indeed the intended policy for a given principal using a particular security model, care needs to be applied in the mapping of the authenticated user (principal) identity to the `securityName` used to make the access control decision. Broadly speaking, there are two approaches to ensure consistency of identity:

- o Entries for the `vacmSecurityToGroupTable` corresponding to a given security model are created only through the operation of the procedures described in this memo. A consequence of this would be that all such entries would have been created using the RADIUS

User-Name (or other AAA-authenticated identity) and RADIUS Management-Policy-Id Attribute (or equivalent).

- o Administrative policy allows a matching pre-configured entry to exist in the vacmSecurityToGroupTable, i.e., an entry with the corresponding vacmSecurityModel and with a vacmSecurityName matching the authenticated principal's RADIUS User-Name). In this case, administrative policy also needs to ensure consistency of identity between each authenticated principal's RADIUS User-Name and the administratively configured vacmSecurityName in the vacmSecurityToGroupTable row entries for that particular security model.

In the later case, inconsistent re-use of the same name for different entities or individuals (principals) can cause the incorrect access control policy to be applied for the authenticated principal, depending on whether the policy configured using SNMP, or the policy applied using the procedures of this memo, is the intended policy. This may result in greater or lesser access rights than the administrative policy intended. Inadvertent mis-identification in such cases may be undetectable by the SNMP engine or other software elements of the managed entity.

There are no management objects defined in this MIB module that have a MAX-ACCESS clause of read-write and/or read-create. So, if this MIB module is implemented correctly, then there is no risk that an intruder can alter or create any management objects of this MIB module via direct SNMP SET operations.

Some of the readable objects in this MIB module (including some objects with a MAX-ACCESS of not-accessible, whose values are exposed as a result access to indexed objects) 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:

- o vacmAaaSecurityToGroupTable - the entire table is potentially sensitive, since walking the table will reveal user names, security models in use, session identifiers, and group names.
- o vacmAaaSecurityModel - though not-accessible, this is exposed as an index of vacmAaaGroupName
- o vacmAaaSecurityName - though not-accessible, this is exposed as an index of vacmAaaGroupName

- o vacmAaaTransportSessionID - though not-accessible, this is exposed as an index of vacmAaaGroupName
- o vacmAaaGroupName - since this identifies a security policy and associates it with a particular user, this is potentially sensitive.

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.

10. IANA Considerations

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

Descriptor	OBJECT IDENTIFIER value
-----	-----
snmpVacmAaaMIB	{ mib-2 XXX }

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.

11. Contributors

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

- o Andrew Donati
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- o Jeffrey Hutzelman
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