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Definitions of Managed Objects for the Virtual Router Redundancy Protocol

Status of this Memo

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Abstract

This specification defines an extension to the Management Information Base (MIB) for use with SNMP-based network management. In particular, it defines objects for configuring, monitoring, and controlling routers that employ the Virtual Router Redundancy Protocol (VRRP) [17].

This memo specifies a MIB module in a manner that is compliant with SMIv2 [5], and semantically identical to the SMIv1 definitions [2].

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1. The SNMP Management Framework

The SNMP Management Framework presently consists of five major components:

- An overall architecture, described in RFC 2571 [1].

- Mechanisms for describing and naming objects and events for the purpose of management. The first version of this Structure of Management Information (SMI) is called SMIv1 and described in STD 16, RFC 1155 [2], STD 16, RFC 1212 [3] and RFC 1215 [4]. The second version, called SMIv2, is described in STD 58, RFC 2578 [5], STD 58, RFC 2579 [6] and STD 58, RFC 2580 [7].

- Message protocols for transferring management information. The first version of the SNMP message protocol is called SNMPv1 and described in STD 15, RFC 1157 [8]. A second version of the SNMP message protocol, which is not an Internet standards track protocol, is called SNMPv2c and described in RFC 1901 [9] and RFC 1906 [10]. The third version of the message protocol is called SNMPv3 and described in RFC 1906 [10], RFC 2572 [11] and RFC 2574 [12].

- Protocol operations for accessing management information. The first set of protocol operations and associated PDU formats is described in STD 15, RFC 1157 [8]. A second set of protocol operations and associated PDU formats is described in RFC 1905 [13].

o A set of fundamental applications described in RFC 2573 [14] and the view-based access control mechanism described in RFC 2575 [15].

A more detailed introduction to the current SNMP Management Framework can be found in RFC 2570 [16].

Managed objects are accessed via a virtual information store, termed the Management Information Base or MIB. Objects in the MIB are defined using the mechanisms defined in the SMI.

This memo specifies a MIB module that is compliant to the SMIv2. A MIB conforming to the SMIv1 can be produced through the appropriate translations. The resulting translated MIB must be semantically equivalent, except where objects or events are omitted because no translation is possible (use of Counter64). Some machine readable information in SMIv2 will be converted into textual descriptions in SMIv1 during the translation process. However, this loss of machine readable information is not considered to change the semantics of the MIB.

2. Overview

This memo identifies the set of objects for configuring, monitoring, and controlling the Virtual Router Redundancy Protocol (VRRP), as defined in RFC 2338 [17].

VRRP specifies an election protocol that will allow one or more associated IP addresses to be assumed by another router in the event of a failure of the IP address(es) owner. Thus, IP traffic from a host using a failed router as a default gateway is transparently fowarded by the VRRP router that has assumed control. VRRP provides redundancy in routed networks without requiring configuration of dynamic routing or router discovery protocols on every end-host.

Since the VRRP protocol is intended for use with IPv4 routers only, this MIB uses the SYNTAX for IP addresses which is specific to IPv4. Thus, changes will be required for this MIB to interoperate in an IPv6 environment.

2.1. VRRP MIB Structure

The VRRP MIB contains three conformance groups:

- vrrpOperations Group: Objects related to VRRP router's configuration and control.

- vrrpStatistics Group: Objects containing information useful in monitoring the operation of VRRP routers.

- vrrpNotifications Group: Consists of objects and definitions for use in SNMP notifications sent by VRRP routers.

Tables in the MIB include the following:

(1) The vrrpOperTable, which contains objects that define the operational characteristics of a VRRP router. Rows in this table correspond to instances of virtual routers.

(2) The vrrpAssoIpAddrTable, which contains the addresses of the virtual router(s) that a given VRRP router is backing up.

(3) The vrrpRouterStatsTable which contains the operating statistics for a VRRP router.

2.2. Virtual Router Redundancy Protocol

This MIB is based on the following characteristics of VRRP as defined in the VRRP specification [17].

- A "VRRP router" is one that is configured to run the VRRP protocol in conjunction with one or more other VRRP routers attached to a LAN.

- A VRRP router can be running one or more instances of a virtual router.

- A "virtual router" is an abstraction which consists of two or more physical routers associated by a Virtual Router Identifier (VRID).

- An instance of a virtual router (on a physical VRRP router), can be uniquely identified by a combination of the 'ifIndex' [18] and "Virtual Router Identifier" (VRID).

- For each VRID there is a set of one or more "associated IP addresses" that are backed-up by the virtual router.

2.3. VRRP MIB Table Design

The tables in the VRRP MIB are structured with the assumption that a VRRP network management application would likely be designed to display information or provide configuration about a VRRP router on a "per-virtual-router basis". Thus, the tables defined in the MIB consist of conceptual rows which are grouped in a manner to present a view of individual virtual routers with a minimal number of SNMP operations.

2.3.1. Relation to Interface Group (RFC 2233) [18].

Since a router can be participating in VRRP on one or more physical interfaces, "ifIndex" is used as an index into the tables defined in the VRRP MIB.

2.4. VRRP Scenarios

The following section provides examples of how some of the objects in this MIB are instantiated for two different VRRP scenarios.

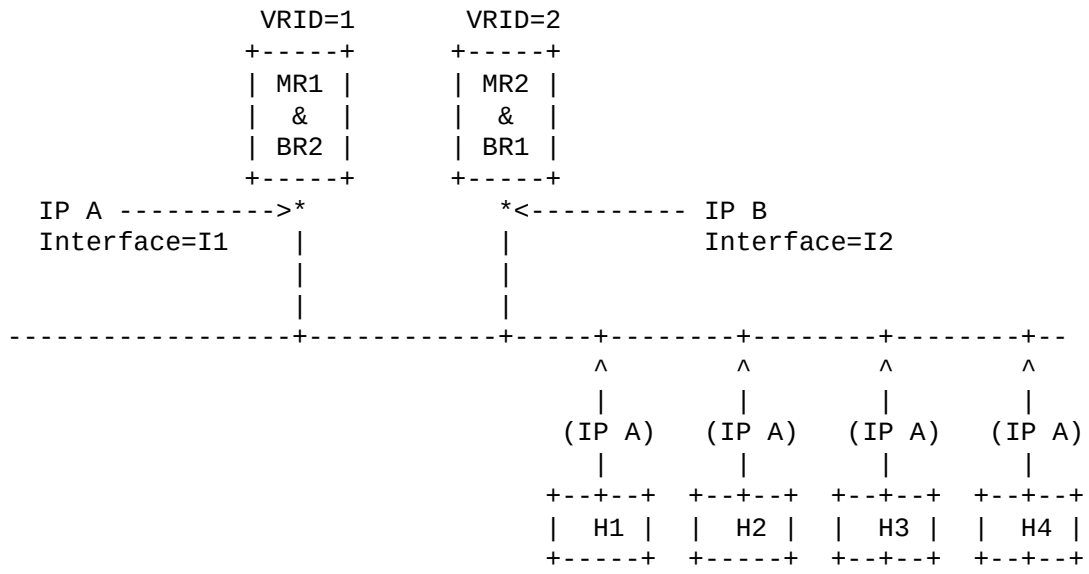
KEY:

The labels in the following tables and diagrams correspond to the actual MIB objects as follows:

```
if      = vrrpOperIfIndex
VrId    = vrrpOperVrId
State   = vrrpOperState
Prior   = vrrpOperPriority
AddrCnt = vrrpOperIpAddrCount
IpAddr  = vrrpOperMasterIpAddr
RowStat = vrrpOperRowStatus
```

2.4.1. VRRP Scenario #1

The following figure shows a simple network with two VRRP routers configured with two virtual routers. This sample topology is taken from the VRRP specification [17]. Addresses in '()' indicate the IP address of the default gateway for a given host, H1 - H4. In the diagram, "Interface" is used in the context defined in IF-MIB [18].



----- MIB Tables For VRRP Router "IP A": -----

vrrpOperTable

if	VrId	State	Prior	AddrCnt	IpAddr	...	RowStat
I1	01	M	255	1	A		active
I1	02	B	1-254	1	B		active

vrrpAssoIpAddrTable

if	VrId	IP	RowStat
I1	01	A	active
I1	02	B	active

----- MIB Tables For VRRP Router "IP B": -----

vrrpOperTable

if	VrId	State	Prior	AddrCnt	IpAddr	...	RowStat
I2	01	B	1-254	1	A		active
I2	02	M	255	1	B		active

vrrpAssoIpAddrTable

if	VrId	IP	RowStat
I2	01	A	active
I2	02	B	active

NOTES:

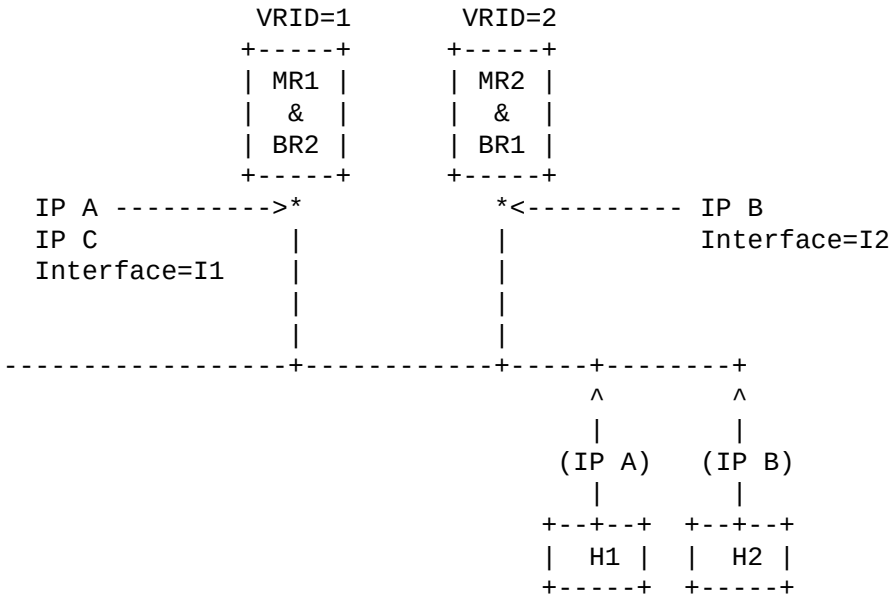
1) "I1" and "I2" are used to designate IF indices on each respective router.

2) For "State": M = Master; B = Backup.

3) In the vrrpOperTable, a "priority" of 255 indicates that the respective router owns the IP address, e.g., this IP address is native to the router (i.e., "the IP Address Owner" [17]).

2.4.2. VRRP Scenario #2

The following figure shows a simple network with two virtual routers. Here, a single interface has been configured with two IP addresses. Again, addresses in () indicate the IP address of the default gateway for a given host, H1 - H2.



----- MIB Tables For VRRP Router "IP A": -----

vrrpOperTable

if	VrId	State	Prior	AddrCnt	IpAddr	...	RowStat
I1	01	M	255	2	A		active
I1	02	B	1-254	1	B		active

vrrpAssoIpAddrTable

if	VrId	IP	RowStat
I1	01	A	active
I1	01	C	active
I1	02	B	active

----- MIB Tables For VRRP Router "IP B": -----

vrrpOperTable

if	VrId	State	Prior	AddrCnt	IpAddr	...	RowStat
I2	01	B	1-254	2	A		active
I2	02	M	255	1	B		active

vrrpAssoIpAddrTable

if	VrId	IP	RowStat
I2	01	A	active
I2	01	C	active
I2	02	B	active

3. Definitions

```
VRRP-MIB DEFINITIONS ::= BEGIN

 IMPORTS
     MODULE-IDENTITY, OBJECT-TYPE,
     NOTIFICATION-TYPE, Counter32,
     Integer32, IpAddress, mib-2         FROM SNMPv2-SMI

     TEXTUAL-CONVENTION, RowStatus,
     MacAddress, TruthValue, TimeStamp   FROM SNMPv2-TC

     MODULE-COMPLIANCE, OBJECT-GROUP,
     NOTIFICATION-GROUP                  FROM SNMPv2-CONF
     ifIndex                             FROM IF-MIB;


 vrrpMIB  MODULE-IDENTITY
     LAST-UPDATED "200003030000Z"
     ORGANIZATION "IETF VRRP Working Group"
     CONTACT-INFO
            "Brian R. Jewell
     Postal: Copper Mountain Networks, Inc.
             2470 Embarcadero Way
             Palo Alto, California 94303
     Tel:    +1 650 687 3367
     E-Mail: bjewell@coppermountain.com"

     DESCRIPTION
         "This MIB describes objects used for managing Virtual Router
          Redundancy Protocol (VRRP) routers."
     REVISION "200003030000Z"    -- 03 Mar 2000
     DESCRIPTION "Initial version as published in RFC 2787."
     ::= { mib-2 68 }

-- ****************************************************************
--  Textual Conventions
-- ****************************************************************

 VrId ::= TEXTUAL-CONVENTION
     STATUS       current
     DESCRIPTION
         "A number which, along with an interface index (ifIndex),
         serves to uniquely identify a virtual router on a given VRRP
         router. A set of one or more associated addresses is assigned
         to a VRID."
     SYNTAX      Integer32 (1..255)
```

```
-- ****************************************************************
--  VRRP MIB Groups
-- ****************************************************************

 vrrpOperations      OBJECT IDENTIFIER ::= { vrrpMIB 1 }
 vrrpStatistics      OBJECT IDENTIFIER ::= { vrrpMIB 2 }
 vrrpConformance     OBJECT IDENTIFIER ::= { vrrpMIB 3 }


-- ****************************************************************
--  Start of MIB objects
-- ****************************************************************

 vrrpNodeVersion  OBJECT-TYPE
     SYNTAX       Integer32
     MAX-ACCESS   read-only
     STATUS       current
     DESCRIPTION
        "This value identifies the particular version of the VRRP
         supported by this node."
     ::= { vrrpOperations 1 }

 vrrpNotificationCntl  OBJECT-TYPE
     SYNTAX       INTEGER {
         enabled     (1),
         disabled    (2)
     }
     MAX-ACCESS   read-write
     STATUS       current
     DESCRIPTION
        "Indicates whether the VRRP-enabled router will generate
         SNMP traps for events defined in this MIB. 'Enabled'
         results in SNMP traps; 'disabled', no traps are sent."
     DEFVAL { enabled }
     ::= { vrrpOperations 2 }

-- ****************************************************************
--  VRRP Operations Table
-- ****************************************************************

 vrrpOperTable OBJECT-TYPE
     SYNTAX       SEQUENCE OF VrrpOperEntry
     MAX-ACCESS   not-accessible
     STATUS       current
     DESCRIPTION
         "Operations table for a VRRP router which consists of a
          sequence (i.e., one or more conceptual rows) of
          'vrrpOperEntry' items."
```

```
    ::= { vrrpOperations 3 }

vrrpOperEntry OBJECT-TYPE
    SYNTAX       VrrpOperEntry
    MAX-ACCESS   not-accessible
    STATUS       current
    DESCRIPTION
        "An entry in the vrrpOperTable containing the operational
         characteristics of a virtual router. On a VRRP router,
         a given virtual router is identified by a combination
         of the IF index and VRID.

         Rows in the table cannot be modified unless the value
         of 'vrrpOperAdminState' is 'disabled' and the
         'vrrpOperState' has transitioned to 'initialize'."

    INDEX    { ifIndex, vrrpOperVrId }
    ::= { vrrpOperTable 1 }

VrrpOperEntry ::=
    SEQUENCE {
        vrrpOperVrId
            VrId,
        vrrpOperVirtualMacAddr
            MacAddress,
        vrrpOperState
            INTEGER,
        vrrpOperAdminState
            INTEGER,
        vrrpOperPriority
            Integer32,
        vrrpOperIpAddrCount
            Integer32,
        vrrpOperMasterIpAddr
            IpAddress,
        vrrpOperPrimaryIpAddr
            IpAddress,
        vrrpOperAuthType
            INTEGER,
        vrrpOperAuthKey
            OCTET STRING,
        vrrpOperAdvertisementInterval
            Integer32,
        vrrpOperPreemptMode
            TruthValue,
        vrrpOperVirtualRouterUpTime
            TimeStamp,
        vrrpOperProtocol
```

```
            INTEGER,
        vrrpOperRowStatus
            RowStatus
}

vrrpOperVrId OBJECT-TYPE
    SYNTAX       VrId
    MAX-ACCESS   not-accessible
    STATUS       current
    DESCRIPTION
        "This object contains the Virtual Router Identifier (VRID)."
    ::= { vrrpOperEntry 1 }

vrrpOperVirtualMacAddr OBJECT-TYPE
    SYNTAX       MacAddress
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
        "The virtual MAC address of the virtual router. Although this
        object can be derived from the 'vrrpOperVrId' object, it is
        defined so that it is easily obtainable by a management
        application and can be included in VRRP-related SNMP traps."
    ::= { vrrpOperEntry 2 }

vrrpOperState OBJECT-TYPE
    SYNTAX       INTEGER {
        initialize(1),
        backup(2),
        master(3)
    }
    MAX-ACCESS   read-only
    STATUS       current

    DESCRIPTION
        "The current state of the virtual router. This object has
        three defined values:

          - 'initialize', which indicates that all the
            virtual router is waiting for a startup event.

          - 'backup', which indicates the virtual router is
            monitoring the availability of the master router.

          - 'master', which indicates that the virtual router
            is forwarding packets for IP addresses that are
            associated with this router.

        Setting the 'vrrpOperAdminState' object (below) initiates
```

```
        transitions in the value of this object."
    ::= { vrrpOperEntry 3 }

vrrpOperAdminState OBJECT-TYPE
    SYNTAX      INTEGER {
        up(1),
        down(2)
    }
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This object will enable/disable the virtual router
        function. Setting the value to 'up', will transition
        the state of the virtual router from 'initialize' to 'backup'
        or 'master', depending on the value of 'vrrpOperPriority'.
        Setting the value to 'down', will transition  the
        router from 'master' or 'backup' to 'initialize'. State
        transitions may not be immediate; they sometimes depend on
        other factors, such as the interface (IF) state.

        The 'vrrpOperAdminState' object must be set to 'down' prior
        to modifying the other read-create objects in the conceptual
        row. The value of the 'vrrpOperRowStatus' object (below)
        must be 'active', signifying that the conceptual row
        is valid (i.e., the objects are correctly set),
        in order for this object to be set to 'up'."
    DEFVAL    { down }
    ::= { vrrpOperEntry 4 }

vrrpOperPriority OBJECT-TYPE
    SYNTAX      Integer32 (0..255)
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This object specifies the priority to be used for the
        virtual router master election process. Higher values imply
        higher priority.

        A priority of '0', although not settable, is sent by
        the master router to indicate that this router has ceased
        to participate in VRRP and a backup virtual router should
        transition  to become a new master.

        A priority of 255 is used for the router that owns the
        associated IP address(es)."
    DEFVAL      { 100 }
    ::= { vrrpOperEntry 5 }
```

```
 vrrpOperIpAddrCount OBJECT-TYPE
     SYNTAX       Integer32 (0..255)
     MAX-ACCESS   read-only
     STATUS       current
     DESCRIPTION
         "The number of IP addresses that are associated with this
         virtual router. This number is equal to the number of rows
         in the vrrpAssoIpAddrTable that correspond to a given IF
         index/VRID pair."
     ::= { vrrpOperEntry 6 }

 vrrpOperMasterIpAddr OBJECT-TYPE
     SYNTAX       IpAddress
     MAX-ACCESS   read-only
     STATUS       current
     DESCRIPTION
         "The master router's real (primary) IP address. This is
         the IP address listed as the source in VRRP advertisement
         last received by this virtual router."
     ::= { vrrpOperEntry 7 }

 vrrpOperPrimaryIpAddr OBJECT-TYPE
     SYNTAX       IpAddress
     MAX-ACCESS   read-create
     STATUS       current
     DESCRIPTION
         "In the case where there is more than one IP address for
         a given 'ifIndex', this object is used to specify the IP
         address that will become the 'vrrpOperMasterIpAddr', should
         the virtual router transition from backup to master. If
         this object is set to 0.0.0.0, the IP address which is
         numerically lowest will be selected."
     DEFVAL       { '00000000'H } -- 0.0.0.0
     ::= { vrrpOperEntry 8 }

 vrrpOperAuthType OBJECT-TYPE
     SYNTAX       INTEGER {
         noAuthentication(1),       -- VRRP protocol exchanges are not
                                    -- authenticated.
         simpleTextPassword(2),     -- Exchanges are authenticated by a
                                    -- clear text password.
         ipAuthenticationHeader(3)  -- Exchanges are authenticated using
                                    -- the IP authentication header.
     }
     MAX-ACCESS   read-create
     STATUS       current
     DESCRIPTION
```

```
        "Authentication type used for VRRP protocol exchanges between
        virtual routers. This value of this object is the same for a
        given ifIndex.

        New enumerations to this list can only be added via a new
        RFC on the standards track."
    DEFVAL       { noAuthentication }
    ::= { vrrpOperEntry 9 }

vrrpOperAuthKey OBJECT-TYPE
    SYNTAX       OCTET STRING (SIZE (0..16))
    MAX-ACCESS   read-create
    STATUS       current
    DESCRIPTION
        "The Authentication Key. This object is set according to
        the value of the 'vrrpOperAuthType' object
        ('simpleTextPassword' or 'ipAuthenticationHeader'). If the
        length of the value is less than 16 octets, the agent will
        left adjust and zero fill to 16 octets. The value of this
        object is the same for a given ifIndex.

        When read, vrrpOperAuthKey always returns an Octet String
        of length zero."
    ::= { vrrpOperEntry 10 }

vrrpOperAdvertisementInterval OBJECT-TYPE
    SYNTAX       Integer32 (1..255)
    UNITS        "seconds"
    MAX-ACCESS   read-create
    STATUS       current
    DESCRIPTION
        "The time interval, in seconds, between sending
        advertisement messages. Only the master router sends
        VRRP advertisements."
    DEFVAL       { 1 }
    ::= { vrrpOperEntry 11 }

vrrpOperPreemptMode OBJECT-TYPE
    SYNTAX       TruthValue
    MAX-ACCESS   read-create
    STATUS       current
    DESCRIPTION
        "Controls whether a higher priority virtual router will
        preempt a lower priority master."
    DEFVAL       { true }
    ::= { vrrpOperEntry 12 }

vrrpOperVirtualRouterUpTime OBJECT-TYPE
```

```
    SYNTAX       TimeStamp
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
        "This is the value of the 'sysUpTime' object when this
        virtual router (i.e., the 'vrrpOperState') transitioned
        out of 'initialized'."
    ::= { vrrpOperEntry 13 }

vrrpOperProtocol OBJECT-TYPE
    SYNTAX   INTEGER {
        ip (1),
        bridge (2),
        decnet (3),
        other (4)
    }
    MAX-ACCESS read-create
    STATUS     current
    DESCRIPTION
        "The particular protocol being controlled by this Virtual
        Router.

        New enumerations to this list can only be added via a new
        RFC on the standards track."
    DEFVAL { ip }
    ::= { vrrpOperEntry 14 }

vrrpOperRowStatus OBJECT-TYPE
    SYNTAX       RowStatus
    MAX-ACCESS   read-create
    STATUS       current
    DESCRIPTION
        "The row status variable, used in accordance to installation
        and removal conventions for conceptual rows. The rowstatus of
        a currently active row in the vrrpOperTable is constrained
        by the operational state of the corresponding virtual router.
        When 'vrrpOperRowStatus' is set to active(1), no other
        objects in the conceptual row, with the exception of
        'vrrpOperAdminState', can be modified. Prior to setting the
        'vrrpOperRowStatus' object from 'active' to a different value,
        the 'vrrpOperAdminState' object must be set to 'down' and the
        'vrrpOperState' object be transitioned to 'initialize'.

        To create a row in this table, a manager sets this object
        to either createAndGo(4) or createAndWait(5). Until instances
        of all corresponding columns are appropriately configured,
        the value of the corresponding instance of the 'vrrpOperRowStatus'
        column will be read as notReady(3).
```

```
        In particular, a newly created row cannot be made active(1)
        until (minimally) the corresponding instance of
        'vrrpOperVrId' has been set and there is at least one active
        row in the 'vrrpAssoIpAddrTable' defining an associated
        IP address for the virtual router."
    ::= { vrrpOperEntry 15 }


-- ****************************************************************
--  VRRP Associated IP Address Table
-- ****************************************************************

 vrrpAssoIpAddrTable OBJECT-TYPE
    SYNTAX       SEQUENCE OF VrrpAssoIpAddrEntry
    MAX-ACCESS   not-accessible
    STATUS       current
    DESCRIPTION
        "The table of addresses associated with this virtual router."
    ::= { vrrpOperations 4 }

 vrrpAssoIpAddrEntry OBJECT-TYPE
    SYNTAX       VrrpAssoIpAddrEntry
    MAX-ACCESS   not-accessible
    STATUS       current
    DESCRIPTION
        "An entry in the table contains an IP address that is
        associated with a virtual router. The number of rows for
        a given ifIndex and VrId will equal the number of IP
        addresses associated (e.g., backed up) by the virtual
        router (equivalent to 'vrrpOperIpAddrCount').

        Rows in the table cannot be modified unless the value
        of 'vrrpOperAdminState' is 'disabled' and the
        'vrrpOperState' has transitioned to 'initialize'."

    INDEX    { ifIndex, vrrpOperVrId, vrrpAssoIpAddr }
    ::= { vrrpAssoIpAddrTable 1 }

 VrrpAssoIpAddrEntry ::=
    SEQUENCE {
        vrrpAssoIpAddr
            IpAddress,
        vrrpAssoIpAddrRowStatus
            RowStatus
 }

 vrrpAssoIpAddr OBJECT-TYPE
    SYNTAX       IpAddress
```

```
    MAX-ACCESS   not-accessible
    STATUS       current
    DESCRIPTION
        "The assigned IP addresses that a virtual router is
        responsible for backing up."
    ::= { vrrpAssoIpAddrEntry 1 }

 vrrpAssoIpAddrRowStatus OBJECT-TYPE
    SYNTAX       RowStatus
    MAX-ACCESS   read-create
    STATUS       current
    DESCRIPTION
        "The row status variable, used according to installation
        and removal conventions for conceptual rows. Setting this
        object to active(1) or createAndGo(4) results in the
        addition of an associated address for a virtual router.
        Destroying the entry or setting it to notInService(2)
        removes the associated address from the virtual router.
        The use of other values is implementation-dependent."
    ::= { vrrpAssoIpAddrEntry 2 }


-- ****************************************************************
--  VRRP Router Statistics
-- ****************************************************************

 vrrpRouterChecksumErrors OBJECT-TYPE
    SYNTAX       Counter32
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
        "The total number of VRRP packets received with an invalid
        VRRP checksum value."
    ::= { vrrpStatistics 1 }

 vrrpRouterVersionErrors OBJECT-TYPE
    SYNTAX       Counter32
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
        "The total number of VRRP packets received with an unknown
        or unsupported version number."
    ::= { vrrpStatistics 2 }

 vrrpRouterVrIdErrors OBJECT-TYPE
    SYNTAX       Counter32
    MAX-ACCESS   read-only
    STATUS       current
```

```
     DESCRIPTION
         "The total number of VRRP packets received with an invalid
         VRID for this virtual router."
     ::= { vrrpStatistics 3 }

-- ****************************************************************
--  VRRP Router Statistics Table
-- ****************************************************************

 vrrpRouterStatsTable OBJECT-TYPE
     SYNTAX       SEQUENCE OF VrrpRouterStatsEntry
     MAX-ACCESS   not-accessible
     STATUS       current
     DESCRIPTION
         "Table of virtual router statistics."
     ::= { vrrpStatistics 4 }

 vrrpRouterStatsEntry OBJECT-TYPE
     SYNTAX       VrrpRouterStatsEntry
     MAX-ACCESS   not-accessible
     STATUS       current
     DESCRIPTION
         "An entry in the table, containing statistics information
         about a given virtual router."
     AUGMENTS    { vrrpOperEntry }
     ::= { vrrpRouterStatsTable 1 }

 VrrpRouterStatsEntry ::=
     SEQUENCE {
         vrrpStatsBecomeMaster
             Counter32,
         vrrpStatsAdvertiseRcvd
             Counter32,
         vrrpStatsAdvertiseIntervalErrors
             Counter32,
         vrrpStatsAuthFailures
             Counter32,
         vrrpStatsIpTtlErrors
             Counter32,
         vrrpStatsPriorityZeroPktsRcvd
             Counter32,
         vrrpStatsPriorityZeroPktsSent
             Counter32,
         vrrpStatsInvalidTypePktsRcvd
             Counter32,
         vrrpStatsAddressListErrors
             Counter32,
         vrrpStatsInvalidAuthType
```

```
            Counter32,
        vrrpStatsAuthTypeMismatch
            Counter32,
        vrrpStatsPacketLengthErrors
            Counter32
    }

 vrrpStatsBecomeMaster OBJECT-TYPE
    SYNTAX       Counter32
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
        "The total number of times that this virtual router's state
        has transitioned to MASTER."
    ::= { vrrpRouterStatsEntry 1 }

 vrrpStatsAdvertiseRcvd OBJECT-TYPE
    SYNTAX       Counter32
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
        "The total number of VRRP advertisements received by this
        virtual router."
    ::= { vrrpRouterStatsEntry 2 }

 vrrpStatsAdvertiseIntervalErrors OBJECT-TYPE
    SYNTAX       Counter32
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
        "The total number of VRRP advertisement packets received
        for which the advertisement interval is different than the
        one configured for the local virtual router."
    ::= { vrrpRouterStatsEntry 3 }

 vrrpStatsAuthFailures OBJECT-TYPE
    SYNTAX       Counter32
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
        "The total number of VRRP packets received that do not pass
        the authentication check."
    ::= { vrrpRouterStatsEntry 4 }

 vrrpStatsIpTtlErrors OBJECT-TYPE
    SYNTAX       Counter32
    MAX-ACCESS   read-only
    STATUS       current
```

```
    DESCRIPTION
        "The total number of VRRP packets received by the virtual
        router with IP TTL (Time-To-Live) not equal to 255."
    ::= { vrrpRouterStatsEntry 5 }

vrrpStatsPriorityZeroPktsRcvd OBJECT-TYPE
    SYNTAX       Counter32
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
        "The total number of VRRP packets received by the virtual
        router with a priority of '0'."
    ::= { vrrpRouterStatsEntry 6 }

vrrpStatsPriorityZeroPktsSent OBJECT-TYPE
    SYNTAX       Counter32
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
        "The total number of VRRP packets sent by the virtual router
        with a priority of '0'."
    ::= { vrrpRouterStatsEntry 7 }

vrrpStatsInvalidTypePktsRcvd OBJECT-TYPE
    SYNTAX       Counter32
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
        "The number of VRRP packets received by the virtual router
        with an invalid value in the 'type' field."
    ::= { vrrpRouterStatsEntry 8 }

vrrpStatsAddressListErrors OBJECT-TYPE
    SYNTAX       Counter32
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
        "The total number of packets received for which the address
        list does not match the locally configured list for the
        virtual router."
    ::= { vrrpRouterStatsEntry 9 }

vrrpStatsInvalidAuthType OBJECT-TYPE
    SYNTAX       Counter32
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
        "The total number of packets received with an unknown
```

```
        authentication type."
    ::= { vrrpRouterStatsEntry 10 }

 vrrpStatsAuthTypeMismatch OBJECT-TYPE
    SYNTAX       Counter32
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
        "The total number of packets received with 'Auth Type' not
        equal to the locally configured authentication method
        ('vrrpOperAuthType')."
    ::= { vrrpRouterStatsEntry 11 }

 vrrpStatsPacketLengthErrors OBJECT-TYPE
    SYNTAX       Counter32
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
        "The total number of packets received with a packet length
        less than the length of the VRRP header."
    ::= { vrrpRouterStatsEntry 12 }

-- ****************************************************************
--   Trap Definitions
-- ****************************************************************

 vrrpNotifications   OBJECT IDENTIFIER ::= { vrrpMIB 0 }

 vrrpTrapPacketSrc OBJECT-TYPE
    SYNTAX       IpAddress
    MAX-ACCESS   accessible-for-notify
    STATUS       current
    DESCRIPTION
        "The IP address of an inbound VRRP packet. Used by
         vrrpTrapAuthFailure trap."
    ::= { vrrpOperations 5 }

 vrrpTrapAuthErrorType OBJECT-TYPE
    SYNTAX        INTEGER {
        invalidAuthType (1),
        authTypeMismatch (2),
        authFailure (3)
    }
    MAX-ACCESS   accessible-for-notify
    STATUS       current
    DESCRIPTION
        "Potential types of configuration conflicts.
        Used by vrrpAuthFailure trap."
```

```
    ::= { vrrpOperations 6 }

 vrrpTrapNewMaster NOTIFICATION-TYPE
     OBJECTS      { vrrpOperMasterIpAddr
                  }
     STATUS       current
     DESCRIPTION
         "The newMaster trap indicates that the sending agent
         has transitioned to 'Master' state."
     ::= { vrrpNotifications 1 }

 vrrpTrapAuthFailure NOTIFICATION-TYPE
     OBJECTS      { vrrpTrapPacketSrc,
                    vrrpTrapAuthErrorType
                  }
     STATUS       current
     DESCRIPTION
         "A vrrpAuthFailure trap signifies that a packet has
         been received from a router whose authentication key
         or authentication type conflicts with this router's
         authentication key or authentication type. Implementation
         of this trap is optional."
     ::= { vrrpNotifications 2 }


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

 vrrpMIBCompliances  OBJECT IDENTIFIER ::= { vrrpConformance 1 }
 vrrpMIBGroups       OBJECT IDENTIFIER ::= { vrrpConformance 2 }

-- ................................................................
-- Compliance Statements
-- ................................................................

 vrrpMIBCompliance MODULE-COMPLIANCE
     STATUS current
     DESCRIPTION
        "The core compliance statement for all VRRP implementations."
     MODULE -- this module
     MANDATORY-GROUPS  {
         vrrpOperGroup,
         vrrpStatsGroup
     }
     OBJECT        vrrpOperPriority
     WRITE-SYNTAX  Integer32 (1..255)
     DESCRIPTION  "SETable values are from 1 to 255."
```

```
    ::= { vrrpMIBCompliances 1 }

-- ..............................................................
-- Conformance Groups
-- ..............................................................

 vrrpOperGroup  OBJECT-GROUP
     OBJECTS  {
         vrrpNodeVersion,
         vrrpNotificationCntl,
         vrrpOperVirtualMacAddr,
         vrrpOperState,
         vrrpOperAdminState,
         vrrpOperPriority,
         vrrpOperIpAddrCount,
         vrrpOperMasterIpAddr,
         vrrpOperPrimaryIpAddr,
         vrrpOperAuthType,
         vrrpOperAuthKey,
         vrrpOperAdvertisementInterval,
         vrrpOperPreemptMode,
         vrrpOperVirtualRouterUpTime,
         vrrpOperProtocol,
         vrrpOperRowStatus,
         vrrpAssoIpAddrRowStatus
         }
     STATUS current
     DESCRIPTION
        "Conformance group for VRRP operations."
     ::= { vrrpMIBGroups 1 }

 vrrpStatsGroup  OBJECT-GROUP
     OBJECTS  {
         vrrpRouterChecksumErrors,
         vrrpRouterVersionErrors,
         vrrpRouterVrIdErrors,
         vrrpStatsBecomeMaster,
         vrrpStatsAdvertiseRcvd,
         vrrpStatsAdvertiseIntervalErrors,
         vrrpStatsAuthFailures,
         vrrpStatsIpTtlErrors,
         vrrpStatsPriorityZeroPktsRcvd,
         vrrpStatsPriorityZeroPktsSent,
         vrrpStatsInvalidTypePktsRcvd,
         vrrpStatsAddressListErrors,
         vrrpStatsInvalidAuthType,
         vrrpStatsAuthTypeMismatch,
         vrrpStatsPacketLengthErrors
```

```
        }
    STATUS current
    DESCRIPTION
       "Conformance group for VRRP statistics."
    ::= { vrrpMIBGroups 2 }

 vrrpTrapGroup  OBJECT-GROUP
    OBJECTS  {
        vrrpTrapPacketSrc,
        vrrpTrapAuthErrorType
        }
    STATUS current
    DESCRIPTION
       "Conformance group for objects contained in VRRP notifications."
    ::= { vrrpMIBGroups 3 }

 vrrpNotificationGroup NOTIFICATION-GROUP
    NOTIFICATIONS {
        vrrpTrapNewMaster,
        vrrpTrapAuthFailure
        }
    STATUS current
    DESCRIPTION
       "The VRRP MIB Notification Group."
    ::= { vrrpMIBGroups 4 }

END
```

4. Security Considerations

There are a number of management objects defined in this MIB that have a MAX-ACCESS clause of read-write or read-create. Such objects may be considered sensitive or vulnerable to security attacks in some networking environments. The support for SET operations in a non-secure environment without proper protection can have a negative effect on VRRP router operations.

A number of objects in the vrrpOperTable possess the read-create attribute. Manipulation of these objects is capable of affecting the operation of a virtual router.

Specific examples of this include, but are not limited to:

- The vrrpOperAdminState object which could be used to disable a virtual router.

- The vrrpOperPrimaryIpAddr object which, if compromised, could allow assignment of an invalid IP address to a master router.

- o The authentication type/key related objects which could potentially render the VRRP security mechanisms ineffective.

Of additional concern is the ability to disable the transmission of traps. This would nullify the capability of a virtual router to provide notification in the event of an authentication failure.

SNMPv1 by itself is not a secure environment. 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.

It is recommended that the implementers consider the security features as provided by the SNMPv3 framework. Specifically, the use of the User-based Security Model RFC 2574 [RFC2574] and the View-based Access Control Model RFC 2575 [RFC2575] is recommended.

It is then a customer/user responsibility to ensure that the SNMP entity giving access to an instance of this MIB, 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.

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