The Definitions of Managed Objects for IP Mobility Support using SMIPv2

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.

Abstract

This memo defines the Management Information Base (MIB) for use with network management protocols in TCP/IP-based internets. In particular, it describes managed objects used for managing the Mobile Node, Foreign Agent and Home Agent of the Mobile IP Protocol.

Table of Contents

1. The Network Management Framework ...................... 2
2. Objects ............................................... 2
2.1 Object Definitions .................................. 2
3. Overview ............................................ 2
3.1 Object Selection Criteria ............................ 2
3.2 Structure of the Mobile IP ......................... 3
3.3 MIB Groups ....................................... 4
4. Definitions .......................................... 5
5. Acknowledgements ..................................... 49
6. Security Considerations ............................... 49
7. References .......................................... 50
8. Chair’s Address ..................................... 51
9. Editors’ Addresses ................................... 52
1. The SNMP Network Management Framework

The Internet-standard Network Management Framework presently consists of three major components. They are:

- The SMI, described in RFC 1902 [1] - the mechanisms used for describing and naming objects for the purpose of management.


- The protocol, RFC 1157 [3] and/or RFC 1905 [4], - the protocol for accessing managed objects.

The Framework permits new objects to be defined for the purpose of experimentation and evaluation.

2. Objects

2.1. Object Definitions

Managed objects are accessed via a virtual information store, termed the Management Information Base or MIB. Objects in the MIB are defined using the subset of Abstract Syntax Notation One (ASN.1) defined in the SMI. In particular, each object type is named by an OBJECT IDENTIFIER, an administratively assigned name. The object type together with an object instance serves to uniquely identify a specific instantiation of the object. For human convenience, we often use a textual string, termed the descriptor, to refer to the object type.

3. Overview

3.1. Object Selection Criteria

To be consistent with IAB directives and good engineering practice, the authors have applied some criteria to select managed objects for the Mobile IP Protocol.

(1) Partition management functionality among the Mobile Node, Home Agent, and Foreign Agent according to the partitioning seen in the Mobile IP Protocol.

(2) Require that objects be essential for either fault or configuration management.

(3) Limit the total number of objects.
(4) Exclude objects which are simply derivable from others in this or other MIBs.

3.2. Structure of the Mobile IP

This section describes the basic model of Mobile IP used in developing the Mobile IP MIB. This information should be useful to the implementor in understanding some of the basic design decisions of the MIB.

The Mobile IP Protocol introduces these new functional entities:

Mobile Node

A host or router that changes its point of attachment from one network or subnetwork to another. A mobile node may change its location without losing connectivity and without changing its IP address; it may continue to communicate with other Internet nodes at any location using its (constant) IP address, assuming link-layer connectivity to a point of attachment is available.

Home Agent

A router on a mobile node’s home network which tunnels packets for delivery to the mobile node when it is away from home, and maintains current location information for the mobile node.

Foreign Agent

A router on a mobile node’s visited network which provides routing services to the mobile node while registered. The foreign agent detunnels and delivers packets to the mobile node that were tunneled by the mobile node’s home agent. For datagrams sent by a mobile node, the foreign agent may serve as a default router for registered mobile nodes.

This document specifies the objects used in managing these entities; namely, the Mobile Node, the Home Agent, and the Foreign Agent.
3.3. MIB Groups

Objects in this MIB are arranged into groups. Each group is organized as a set of related objects. The overall structure and the relationship between groups and the Mobile IP entities are shown below:

<table>
<thead>
<tr>
<th>Groups</th>
<th>Mobile Node</th>
<th>Foreign Agent</th>
<th>Home Agent</th>
</tr>
</thead>
<tbody>
<tr>
<td>mipSystemGroup</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>mipSecAssociationGroup</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>mipSecViolationGroup</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>mnSystemGroup</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mnDiscoveryGroup</td>
<td>X</td>
<td></td>
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<tr>
<td>mnRegistrationGroup</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>maAdvertisementGroup</td>
<td>X</td>
<td>X</td>
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<tr>
<td>faSystemGroup</td>
<td>X</td>
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<tr>
<td>faAdvertisementGroup</td>
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<tr>
<td>faRegistrationGroup</td>
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<td></td>
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<tr>
<td>haRegistrationGroup</td>
<td>X</td>
<td></td>
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</tr>
<tr>
<td>haRegNodeCountersGroup</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4. Definitions

MIP-MIB DEFINITIONS ::= BEGIN

IMPORTS
Counter32, Gauge32, Integer32, IpAddress, experimental,
MODULE-IDENTITY, OBJECT-TYPE, NOTIFICATION-TYPE
FROM SNMPv2-SMI

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

MODULE-COMPLIANCE, OBJECT-GROUP
FROM SNMPv2-CONF;

mipMIB    MODULE-IDENTITY
    LAST-UPDATED    "9606040000Z"
    ORGANIZATION    "IETF Mobile IP Working Group"
    CONTACT-INFO
    "       David Cong
Postal: Motorola
1301 E. Algonquin Rd.
Schaumburg, IL 60196
Phone: +1-847-576-1357
Email:  cong@comm.mot.com"

DESCRIPTION
"The MIB Module for the Mobile IP."
 ::= { mib-2 44 }

mipMIBObjects    OBJECT IDENTIFIER ::= { mipMIB 1 }

-- Groups under mipMIBObjects

mipSystem    OBJECT IDENTIFIER ::= { mipMIBObjects 1 }

mipSecurity    OBJECT IDENTIFIER ::= { mipMIBObjects 2 }

mipMN    OBJECT IDENTIFIER ::= { mipMIBObjects 3 }

mipMA    OBJECT IDENTIFIER ::= { mipMIBObjects 4 }

mipFA    OBJECT IDENTIFIER ::= { mipMIBObjects 5 }

mipHA    OBJECT IDENTIFIER ::= { mipMIBObjects 6 }

mnSystem    OBJECT IDENTIFIER ::= { mipMN 1 }

mnDiscovery    OBJECT IDENTIFIER ::= { mipMN 2 }

mnRegistration    OBJECT IDENTIFIER ::= { mipMN 3 }

maAdvertisement    OBJECT IDENTIFIER ::= { mipMA 2 }

faSystem    OBJECT IDENTIFIER ::= { mipFA 1 }

faAdvertisement    OBJECT IDENTIFIER ::= { mipFA 2 }

faRegistration    OBJECT IDENTIFIER ::= { mipFA 3 }
haRegistration OBJECT IDENTIFIER ::= { mipHA 3 }

-- Textual convention

RegistrationFlags ::= TEXTUAL-CONVENTION
STATUS current
DESCRIPTION "This data type is used to define the registration
flags for Mobile IP registration extension:
  vjCompression
  -- Request to use VJ compression
  gre
  -- Request to use GRE
  minEnc
  -- Request to use minimal encapsulation
decapsulationByMN
  -- Decapsulation by mobile node
broadcastDatagram
  -- Request to receive broadcasts
simultaneousBindings
  -- Request to retain prior binding(s)."
SYNTAX BITS {
  vjCompression(0),
gre(1),
minEnc(2),
decapsulationByMN(3),
broadcastDatagram(4),
simultaneousBindings(5)
}

-- mipSystem Group

mipEntities OBJECT-TYPE
SYNTAX BITS {
  mobileNode(0),
foreignAgent(1),
homeAgent(2)
}
MAX-ACCESS read-only
STATUS current
DESCRIPTION "This object describes which Mobile IP entities are
supported by this managed entity. The entity may
support more than one Mobile IP entities. For example,
the entity supports both Foreign Agent (FA) and Home
Agent (HA). Therefore, bit 1 and bit 2 are set to 1
for this object."
 ::= { mipSystem 1 }
mipEnable OBJECT-TYPE
SYNTAX      INTEGER { enabled(1), disabled(2) }
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
"Indicates whether the Mobile IP protocol should be
enabled for the managed entity. If it is disabled, the
entity should disable both agent discovery and
registration functions."
 ::= { mipSystem 2 }

mipEncapsulationSupported   OBJECT-TYPE
SYNTAX      BITS {
    ipInIp(0),
    gre(1),
    minEnc(2),
    other(3)
}
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
"Encapsulation methods supported by the Mobile IP
entity. The entity may support multiple encapsulation
methods or none of them:
    ipInIp(0), -- IP Encapsulation within IP
    gre(1),    -- Generic Routing Encapsulation,
                -- refers to RFC1701
    minEnc(2), -- Minimal Encapsulation within IP."
 ::= { mipSystem 3 }

-- mipSecurity Group

mipSecAssocTable OBJECT-TYPE
SYNTAX      SEQUENCE OF MipSecAssocEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
"A table containing Mobility Security Associations."
 ::= { mipSecurity 1 }

mipSecAssocEntry OBJECT-TYPE
SYNTAX      MipSecAssocEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
"One particular Mobility Security Association."
INDEX   { mipSecPeerAddress, mipSecSPI }
 ::= { mipSecAssocTable 1 }
MipSecAssocEntry ::= SEQUENCE {
    mipSecPeerAddress IpAddress,
    mipSecSPI Unsigned32,
    mipSecAlgorithmType INTEGER,
    mipSecAlgorithmMode INTEGER,
    mipSecKey OCTET STRING,
    mipSecReplayMethod INTEGER
}

mipSecPeerAddress OBJECT-TYPE
SYNTAX IpAddress
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "The IP address of the peer entity with which this
node shares the mobility security association."
::= { mipSecAssocEntry 1 }

mipSecSPI OBJECT-TYPE
SYNTAX Unsigned32 (0..4294967295)
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "The SPI is the 4-byte opaque index within the
Mobility Security Association which selects the
specific security parameters to be used to
authenticate the peer, i.e. the rest of the variables
in this MipSecAssocEntry."
::= { mipSecAssocEntry 2 }

mipSecAlgorithmType OBJECT-TYPE
SYNTAX INTEGER {
    other(1),
    md5(2)
}
MAX-ACCESS read-create
STATUS current
DESCRIPTION "Type of security algorithm."
::= { mipSecAssocEntry 3 }

mipSecAlgorithmMode OBJECT-TYPE
SYNTAX INTEGER {
    other(1),
    prefixSuffix(2)
}
MAX-ACCESS read-create
mipSecKey OBJECT-TYPE
SYNTAX OCTET STRING (SIZE(16))
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"The shared secret key for the security associations. Reading this object will always return zero length value."
::= { mipSecAssocEntry 5 }

mipSecReplayMethod OBJECT-TYPE
SYNTAX INTEGER {
    other(1),
    timestamps(2),
    nonces(3)
}
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"The replay-protection method supported for this SPI within this Mobility Security Association."
::= { mipSecAssocEntry 6 }

-- Mobile IP security violation total counter
mipSecTotalViolations OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"Total number of security violations in the entity"
::= { mipSecurity 2 }

-- Mobile IP security violation table
mipSecViolationTable OBJECT-TYPE
SYNTAX SEQUENCE OF MipSecViolationEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"A table containing information about security violations."
::= { mipSecurity 3 }
mipSecViolationEntry OBJECT-TYPE
SYNTAX    MipSecViolationEntry
MAX-ACCESS not-accessible
STATUS    current
DESCRIPTION
   "Information about one particular security violation."
INDEX    { mipSecViolatorAddress }
::= { mipSecViolationTable 1 }

MipSecViolationEntry ::= SEQUENCE {
    mipSecViolatorAddress  IpAddress,
    mipSecViolationCounter  Counter32,
    mipSecRecentViolationSPI  Integer32,
    mipSecRecentViolationTime  TimeStamp,
    mipSecRecentViolationIDLow  Integer32,
    mipSecRecentViolationIDHigh  Integer32,
    mipSecRecentViolationReason  INTEGER
}

mipSecViolatorAddress  OBJECT-TYPE
SYNTAX    IpAddress
MAX-ACCESS accessible-for-notify
STATUS    current
DESCRIPTION
   "Violator’s IP address. The violator is not necessary
    in the mipSecAssocTable."
::= { mipSecViolationEntry 1 }

mipSecViolationCounter  OBJECT-TYPE
SYNTAX    Counter32
MAX-ACCESS read-only
STATUS    current
DESCRIPTION
   "Total number of security violations for this peer."
::= { mipSecViolationEntry 2 }

mipSecRecentViolationSPI  OBJECT-TYPE
SYNTAX    Integer32
MAX-ACCESS read-only
STATUS    current
DESCRIPTION
   "SPI of the most recent security violation for this
    peer. If the security violation is due to an
    identification mismatch, then this is the SPI from the
    Mobile-Home Authentication Extension. If the security
    violation is due to an invalid authenticator, then
    this is the SPI from the offending authentication
extension. In all other cases, it should be set to zero.
 ::= { mipSecViolationEntry 3 }

mipSecRecentViolationTime OBJECT-TYPE
SYNTAX     TimeStamp
MAX-ACCESS read-only
STATUS     current
DESCRIPTION "Time of the most recent security violation for this
 peer."
 ::= { mipSecViolationEntry 4 }

mipSecRecentViolationIDLow  OBJECT-TYPE
SYNTAX     Integer32
MAX-ACCESS read-only
STATUS     current
DESCRIPTION "Low-order 32 bits of identification used in request or
 reply of the most recent security violation for this
 peer."
 ::= { mipSecViolationEntry 5 }

mipSecRecentViolationIDHigh  OBJECT-TYPE
SYNTAX     Integer32
MAX-ACCESS read-only
STATUS     current
DESCRIPTION "High-order 32 bits of identification used in request
 or reply of the most recent security violation for
 this peer."
 ::= { mipSecViolationEntry 6 }

mipSecRecentViolationReason   OBJECT-TYPE
SYNTAX     INTEGER { noMobilitySecurityAssociation(1),
 badAuthenticator(2),
 badIdentifier(3),
 badSPI(4),
 missingSecurityExtension(5),
 other(6)
 }
MAX-ACCESS read-only
STATUS     current
DESCRIPTION "Reason for the most recent security violation for
 this peer."
 ::= { mipSecViolationEntry 7 }

mnState OBJECT-TYPE
   SYNTAX       INTEGER {
                   home(1),
                   registered(2),
                   pending(3),
                   isolated(4),
                   unknown(5)
               }  
   MAX-ACCESS  read-only
   STATUS      current
   DESCRIPTION
      "Indicates mobile node's state of Mobile IP: 
       home,
       -- MN is connected to home network.
       registered,
       -- MN has registered on foreign network
       pending,
       -- MN has sent registration request and is 
          waiting for the reply
       isolated,
       -- MN is isolated from network
       unknown
       -- MN can not determine its state."
   ::= { mnSystem 1 }

mnHomeAddress OBJECT-TYPE
   SYNTAX       IpAddress
   MAX-ACCESS  read-only
   STATUS      current
   DESCRIPTION
      "An IP address that is assigned for an extended period 
       of time to the mobile node. It remains unchanged 
       regardless of the mobile node's current point of 
       attachment."
   ::= { mnSystem 2 }

-- Mobile node's home agent list

mnHATable OBJECT-TYPE
   SYNTAX       SEQUENCE OF MnHAEntry
   MAX-ACCESS  not-accessible
   STATUS      current
   DESCRIPTION
"A table containing all of the mobile node’s potential home agents."

::= { mnSystem 3 }

mnHAEntry OBJECT-TYPE
SYNTAX MnHAEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "Information for a particular Home Agent."
INDEX { mnHAAddress }
::= { mnHATable 1 }

MnHAEntry ::= SEQUENCE {
  mnHAAddress IpAddress,
  mnCurrentHA TruthValue,
  mnHAStatus RowStatus
}

mnHAAddress OBJECT-TYPE
SYNTAX IpAddress
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "IP address of mobile node’s Home Agent."
::= { mnHAEntry 1 }

mnCurrentHA OBJECT-TYPE
SYNTAX TruthValue
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Whether this home agent is the current home agent for the mobile node. If it is true, the mobile node is registered with that home agent."
::= { mnHAEntry 2 }

mnHAStatus OBJECT-TYPE
SYNTAX RowStatus
MAX-ACCESS read-create
STATUS current
DESCRIPTION "The row status for this home agent entry. If the status is set to ‘createAndGo’ or ‘active’, then the mobile node can use mnHAAddress as a valid candidate for a home agent. If the status is set to ‘destroy’, then the mobile node should delete this row, and deregister from that home agent."
::= { mnHAEntry 3 }

mnFATable OBJECT-TYPE
SYNTAX      SEQUENCE OF MnFAEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
        "A table containing all foreign agents that the mobile
node knows about and their corresponding COA (care-of
address). This COA is an address of a foreign agent
with which the mobile node is registered. The table is
updated when advertisements are received by the mobile
node. If an advertisement expires, its entry(s) should
be deleted from the table. One foreign agent can
provide more than one COA in its advertisements."
::= { mnDiscovery 1 }

MnFAEntry OBJECT-TYPE
SYNTAX      MnFAEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
        "One pair of foreign agent IP address and COA for that
foreign agent."
INDEX { mnFAAddress, mnCOA }
 ::= { mnFATable 1 }

MnFAEntry ::= SEQUENCE {
    mnFAAddress IpAddress,
    mnCOA   IpAddress
}

mnFAAddress OBJECT-TYPE
SYNTAX      IpAddress
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
        "Foreign agent’s IP address."
 ::= { mnFAEntry 1 }

mnCOA   OBJECT-TYPE
SYNTAX      IpAddress
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
        "A care-of address being offered by this foreign agent
or a co-located care-of address which the mobile node
has associated with one of its own network
interfaces."
 ::= { mnFAEntry 2 }

-- Mobile node could store multiple agent advertisements, however,
-- only the most recently received agent advertisement information
-- is required to be made available to the manager station.

mnRecentAdvReceived OBJECT IDENTIFIER ::= { mnDiscovery 2 }

mnAdvSourceAddress OBJECT-TYPE
 SYNTAX      IpAddress
 MAX-ACCESS  read-only
 STATUS      current
 DESCRIPTION
 "The source IP address of the most recently received
 Agent Advertisement. This address could be the address
 of a home agent or a foreign agent."
 ::= { mnRecentAdvReceived 1 }

mnAdvSequence OBJECT-TYPE
 SYNTAX      INTEGER (0..65535)
 MAX-ACCESS read-only
 STATUS      current
 DESCRIPTION
 "The sequence number of the most recently received
 advertisement. The sequence number ranges from 0 to
 0xffff. After the sequence number attains the value
 0xffff, it will roll over to 256."
 ::= { mnRecentAdvReceived 2 }

mnAdvFlags OBJECT-TYPE
 SYNTAX      BITS {
       vjCompression(0),
       gre(1),
       minEnc(2),
       foreignAgent(3),
       homeAgent(4),
       busy(5),
       regRequired(6)
    }
 MAX-ACCESS read-only
 STATUS      current
 DESCRIPTION
 "The flags are contained in the 7th byte in the
 extension of the most recently received mobility agent
 advertisement:
 vjCompression
  -- Agent supports Van Jacobson compression
gre
  -- Agent offers Generice Routing Encapsulation
minEnc,
  -- Agent offers Minimal Encapsulation
foreignAgent,
  -- Agent is a Foreign Agent
homeAgent,
  -- Agent is a Home Agent
busy,
  -- Foreign Agent is busy
regRequired,
  -- FA registration is required"
::= { mnRecentAdvReceived 3 }

mnAdvMaxRegLifetime OBJECT-TYPE
SYNTAX INTEGER (0..65535)
UNITS "seconds"
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The longest lifetime in seconds that the agent is
  willing to accept in any registration request."
::= { mnRecentAdvReceived 4 }

mnAdvMaxAdvLifetime OBJECT-TYPE
SYNTAX INTEGER (0..65535)
UNITS "seconds"
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The maximum length of time that the Advertisement is
  considered valid in the absence of further
  Advertisements."
REFERENCE "AdvertisementLifeTime in RFC1256."
::= { mnRecentAdvReceived 5 }

mnAdvTimeReceived OBJECT-TYPE
SYNTAX TimeStamp
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The time at which the most recently received
  advertisement was received."
::= { mnRecentAdvReceived 6 }

-- Mobile Node Discovery Group Counter
mnSolicitationsSent OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Total number of Solicitation sent by the mobile node."
::= { mnDiscovery 3 }

mnAdvertisementsReceived OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Total number of advertisements received by the mobile node."
::= { mnDiscovery 4 }

mnAdvsDroppedInvalidExtension OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Total number of advertisements dropped by the mobile node due to both poorly formed extensions and unrecognized extensions with extension number in the range 0-127."
::= { mnDiscovery 5 }

mnAdvsIgnoredUnknownExtension OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Total number of unrecognized extensions in the range 128-255 that were ignored by the mobile node."
::= { mnDiscovery 6 }

mnMoveFromHAToFA OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Number of times that the mobile node has decided to move from its home network to a foreign network."
::= { mnDiscovery 7 }

mnMoveFromFAToFA OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Number of times that the mobile node has decided to move from one foreign network to another foreign network."
::= { mnDiscovery 8 }

mnMoveFromFAToHA OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Number of times that the mobile node has decided to move from a foreign network to its home network."
::= { mnDiscovery 9 }

mnGratuitousARPsSend OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Total number of Gratuitous ARPs sent by mobile node in order to clear out any stale ARP entries in the ARP caches of nodes on the home network."
::= { mnDiscovery 10 }

mnAgentRebootsDectected OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Total number of agent reboots detected by the mobile node through sequence number of the advertisement."
::= { mnDiscovery 11 }

-- Mobile Node Registration Group

-- Registration table of mobile node

mnRegistrationTable OBJECT-TYPE
SYNTAX SEQUENCE OF MnRegistrationEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "A table containing information about the mobile node’s attempted registration(s). The mobile node
updates this table based upon Registration Requests sent and Registration Replies received in response to these requests. Certain variables within this table are also updated if when Registration Requests are retransmitted."

 ::= { mnRegistration 1 }

mnRegistrationEntry OBJECT-TYPE
SYNTAX       MnRegistrationEntry
MAX-ACCESS   not-accessible
STATUS       current
DESCRIPTION   "Information about one registration attempt."
INDEX { mnRegAgentAddress, mnRegCOA }
 ::= { mnRegistrationTable 1 }

MnRegistrationEntry ::= SEQUENCE {
  mnRegAgentAddress IpAddress,
  mnRegCOA IpAddress,
  mnRegFlags RegistrationFlags,
  mnRegIDLow Integer32,
  mnRegIDHigh Integer32,
  mnRegTimeRequested Integer32,
  mnRegTimeRemaining Gauge32,
  mnRegTimeSent  TimeStamp,
  mnRegIsAccepted  TruthValue,
  mnCOAIsLocal TruthValue
}

mnRegAgentAddress OBJECT-TYPE
SYNTAX       IpAddress
MAX-ACCESS   read-only
STATUS       current
DESCRIPTION   "IP address of the agent as used in the destination IP address of the Registration Request. The agent may be a home agent or a foreign agent."
 ::= { mnRegistrationEntry 1 }

mnRegCOA OBJECT-TYPE
SYNTAX       IpAddress
MAX-ACCESS   read-only
STATUS       current
DESCRIPTION   "Care-of address for the registration."
 ::= { mnRegistrationEntry 2 }

mnRegFlags OBJECT-TYPE
RegistrationFlags

MAX-ACCESS  read-only
STATUS      current
DESCRIPTION  "Registration flags sent by the mobile node. It is the
              second byte in the Mobile IP Registratation Request
              message."
::= { mnRegistrationEntry 3 }

mnRegIDLow OBJECT-TYPE
SYNTAX      Integer32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION  "Low-order 32 bits of the Identification used in that
              registration by the mobile node."
::= { mnRegistrationEntry 4 }

mnRegIDHigh OBJECT-TYPE
SYNTAX      Integer32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION  "High-order 32 bits of the Identification used in that
              registration by the mobile node."
::= { mnRegistrationEntry 5 }

mnRegTimeRequested OBJECT-TYPE
SYNTAX      Integer32
UNITS       "seconds"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION  "If the registration is pending, then this is the
              lifetime requested by the mobile node (in seconds).
              If the registration has been accepted, then this is
              the lifetime actually granted by the home agent in the
              reply."
::= { mnRegistrationEntry 6 }

mnRegTimeRemaining OBJECT-TYPE
SYNTAX      Gauge32
UNITS       "seconds"
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION  "The number of seconds remaining until this
              registration expires. It has the same initial value
as mnRegTimeRequested and is only valid if
  mnRegIsAccepted is TRUE.
::= { mnRegistrationEntry 7 }

mnRegTimeSent OBJECT-TYPE
SYNTAX     TimeStamp
MAX-ACCESS read-only
STATUS     current
DESCRIPTION
  "The time when the last (re-)transmission occurred."
::= { mnRegistrationEntry 8 }

mnRegIsAccepted OBJECT-TYPE
SYNTAX     TruthValue
MAX-ACCESS read-only
STATUS     current
DESCRIPTION
  "true(1) if the mobile node has received a
  Registration Reply indicating that service has been
  accepted; false(2) otherwise. false(2) implies that
  the registration is still pending."
::= { mnRegistrationEntry 9 }

mnCOAIsLocal OBJECT-TYPE
SYNTAX     TruthValue
MAX-ACCESS read-only
STATUS     current
DESCRIPTION
  "Whether the COA is local to (dynamically acquired by)
  the mobile node or not. If it is false(2), the COA is
  an address of the foreign agent."
::= { mnRegistrationEntry 10 }

-- Mobile Node Registration Group Counters

mnRegRequestsSent OBJECT-TYPE
SYNTAX     Counter32
MAX-ACCESS read-only
STATUS     current
DESCRIPTION
  "Total number of registration requests sent by the
  mobile node. This does not include deregistrations
  (those with Lifetime equal to zero)."
::= { mnRegistration 2 }

mnDeRegRequestsSent OBJECT-TYPE
SYNTAX     Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Total number of deregistration requests sent by the mobile node (those with Lifetime equal to zero)."
::= { mnRegistration 3 }

mnRegRepliesRecieved OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Total number of registration replies received by the mobile node in which the Lifetime is greater than zero."
::= { mnRegistration 4 }

mnDeRegRepliesRecieved OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Total number of (de)registration replies received by the mobile node in which the Lifetime is equal to zero."
::= { mnRegistration 5 }

mnRepliesInvalidHomeAddress OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Total number of replies with invalid home address for the mobile node."
::= { mnRegistration 6 }

mnRepliesUnknownHA OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Total number of replies with unknown home agents (not in home agent table)."
::= { mnRegistration 7 }

mnRepliesUnknownFA OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
   "Total number of replies with unknown foreign agents if replies relayed through foreign agent."
 ::= { mnRegistration 8 }

mnRepliesInvalidID OBJECT-TYPE
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
   "Total number of replies with invalid Identification fields."
 ::= { mnRegistration 9 }

mnRepliesDroppedInvalidExtension OBJECT-TYPE
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
   "Total number of Registration Replies dropped by the mobile node due to both poorly formed extensions and unrecognized extensions with extension number in the range 0-127."
 ::= { mnRegistration 10 }

mnRepliesIgnoredUnknownExtension OBJECT-TYPE
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
   "Total number of Registration Replies that contained one or more unrecognized extensions in the range 128-255 that were ignored by the mobile node."
 ::= { mnRegistration 11 }

mnRepliesHAAuthenticationFailure OBJECT-TYPE
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
   "Total number of replies without a valid Home Agent to Mobile Node authenticator."
 ::= { mnRegistration 12 }

mnRepliesFAAuthenticationFailure OBJECT-TYPE
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
"Total number of replies without a valid Foreign Agent
to Mobile Node authenticator."
::= { mnRegistration 13 }

*mnRegRequestsAccepted* OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"Total number of registration requests accepted by the
mobile node’s home agent (Code 0 and Code 1)."
::= { mnRegistration 14 }

*mnRegRequestsDeniedByHA* OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"Total number of registration requests denied by the
mobile node’s home agent (Sum of Code 128 through
Code 191)."
::= { mnRegistration 15 }

*mnRegRequestsDeniedByFA* OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"Total number of registration requests denied by the
foreign agent (Sum of Codes 64 through Code 127)."
::= { mnRegistration 16 }

*mnRegRequestsDeniedByHADueToID* OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"Total number of Registration Request denied by home
agent due to identification mismatch."
::= { mnRegistration 17 }

*mnRegRequestsWithDirectedBroadcast* OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"Total number of Registration Requests sent by mobile
..."
node with a directed broadcast address in the home
agent field."
 ::= { mnRegistration 18 }

-- MA Advertisement Group

-- Mobility agent advertisement configuration table

maAdvConfigTable OBJECT-TYPE
SYNTAX      SEQUENCE OF MaAdvConfigEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
 "A table containing configurable advertisement
parameters for all advertisement interfaces in
the mobility agent."
 ::= { maAdvertisement 1 }

maAdvConfigEntry OBJECT-TYPE
SYNTAX      MaAdvConfigEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
 "Advertisement parameters for one advertisement
interface."
INDEX   { maInterfaceAddress }
 ::= { maAdvConfigTable 1 }

MaAdvConfigEntry ::= SEQUENCE {
   maInterfaceAddress IpAddress,
   maAdvMaxRegLifetime Integer32,
   maAdvPrefixLengthInclusion TruthValue,
   maAdvAddress IpAddress,
   maAdvMaxInterval Integer32,
   maAdvMinInterval Integer32,
   maAdvMaxAdvLifetime Integer32,
   maAdvResponseSolicitationOnly TruthValue,
   maAdvStatus RowStatus
 }

maInterfaceAddress OBJECT-TYPE
SYNTAX      IpAddress
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
 "IP address for advertisement interface."
 ::= { maAdvConfigEntry 1 }
maAdvMaxRegLifetime OBJECT-TYPE
SYNTAX      Integer32 (0..65535)
UNITS       "seconds"
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION  "The longest lifetime in seconds that mobility agent
is willing to accept in any Registration Request."
 ::= { maAdvConfigEntry 2 }

maAdvPrefixLengthInclusion OBJECT-TYPE
SYNTAX      TruthValue
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION  "Whether the advertisement should include the Prefix-
Lengths Extension. If it is true, all advertisements
sent over this interface should include the
Prefix-Lengths Extension."
 ::= { maAdvConfigEntry 3 }

maAdvAddress OBJECT-TYPE
SYNTAX      IpAddress
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION  "The IP destination address to be used for
advertisements sent from the interface. The only
permissible values are the all-systems multicast
address (224.0.0.1) or the limited-broadcast address
(255.255.255.255)."
REFERENCE    "AdvertisementAddress in RFC1256."
 ::= { maAdvConfigEntry 4 }

maAdvMaxInterval OBJECT-TYPE
SYNTAX      Integer32 (4..1800)
UNITS       "seconds"
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION  "The maximum time in seconds between successive
transmissions of Agent Advertisements from this
interface."
REFERENCE    "MaxAdvertisementInterval in RFC1256."
 ::= { maAdvConfigEntry 5 }
maAdvMinInterval OBJECT-TYPE
SYNTAX      Integer32 (3..1800)
UNITS       "seconds"
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION  "The minimum time in seconds between successive
               transmissions of Agent Advertisements from this
               interface."
REFERENCE    "MinAdvertisementInterval in RFC1256."
 ::= { maAdvConfigEntry 6 }

maAdvMaxAdvLifetime OBJECT-TYPE
SYNTAX      Integer32 (4..9000)
UNITS       "seconds"
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION  "The time (in seconds) to be placed in the Lifetime
               field of the RFC 1256-portion of the Agent
               Advertisements sent over this interface."
REFERENCE    "AdvertisementLifetime in RFC1256."
 ::= { maAdvConfigEntry 7 }

maAdvResponseSolicitationOnly OBJECT-TYPE
SYNTAX      TruthValue
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION  "The flag indicates whether the advertisement from
               that interface should be sent only in response to an
               Agent Solicitation message."
DEFVAL      { false }
 ::= { maAdvConfigEntry 8 }

maAdvStatus OBJECT-TYPE
SYNTAX      RowStatus
MAX-ACCESS  read-create
STATUS      current
DESCRIPTION  "The row status for the agent advertisement table. If
               this column status is 'active', the manager should not
               change any column in the row."
 ::= { maAdvConfigEntry 9 }

-- MA Advertisement Group Counters
maAdvertisementsSent OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"Total number of advertisements sent by the mobility agent."
::= { maAdvertisement 2 }

maAdvsSentForSolicitation OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"Total number of advertisements sent by mobility agent in response to mobile node solicitations."
::= { maAdvertisement 3 }

maSolicitationsReceived OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"Total number of solicitations received by the mobility agent."
::= { maAdvertisement 4 }

-- Foreign Agent Group

-- Foreign Agent System Group

faCOATable OBJECT-TYPE
SYNTAX SEQUENCE OF FaCOAEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"A table containing all of the care-of addresses (COAs) supported by the foreign agent. New entries can be added to the table. The order of entries in the faCOATable is also the order in which the COAs are listed in the Agent Advertisement."
::= { faSystem 1 }

faCOAEntry OBJECT-TYPE
SYNTAX FaCOAEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"Entry of COA"
INDEX { faSupportedCOA }
::= { faCOATable 1 }

FaCOAEntry ::= SEQUENCE {
    faSupportedCOA IpAddress,
    faCOAStatus RowStatus
}

faSupportedCOA OBJECT-TYPE
SYNTAX    IpAddress
MAX-ACCESS not-accessible
STATUS    current
DESCRIPTION "Care-of-address supported by this foreign agent."
::= { faCOAEntry 1 }

faCOAStatus OBJECT-TYPE
SYNTAX    RowStatus
MAX-ACCESS read-create
STATUS    current
DESCRIPTION "The row status for COA entry."
::= { faCOAEntry 2 }

-- Foreign Agent Advertisement Group
-- FA needs to implement MA Advertisement Group plus that group

faIsBusy OBJECT-TYPE
SYNTAX    TruthValue
MAX-ACCESS read-only
STATUS    current
DESCRIPTION "Whether or not the foreign agent is too busy to accept additional registrations. If true(1), the agent is busy and any Agent advertisements sent from this agent should have the 'B' bit set to 1."
::= { faAdvertisement 1 }

faRegistrationRequired OBJECT-TYPE
SYNTAX    TruthValue
MAX-ACCESS read-write
STATUS    current
DESCRIPTION "Whether or not this foreign agent requires registration even from those mobile nodes that have acquired their own, colocated care-of address. If
true(1), registration is required and any Agent
Advertisements sent from this agent should have the
'R' bit set to 1.

::= { faAdvertisement 2 }

-- Foreign Agent Registration Group

-- Foreign Agent Visitors List

faVisitorTable OBJECT-TYPE
SYNTAX      SEQUENCE OF FaVisitorEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
"A table containing the foreign agent’s visitor list.
The foreign agent updates this table in response to
registration events from mobile nodes."
::= { faRegistration 1 }

faVisitorEntry OBJECT-TYPE
SYNTAX      FaVisitorEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
"Information for one visitor."
INDEX   { faVisitorIPAddress }
::= { faVisitorTable 1 }

FaVisitorEntry ::= SEQUENCE {
  faVisitorIPAddress IpAddress,
  faVisitorHomeAddress IpAddress,
  faVisitorHomeAgentAddress IpAddress,
  faVisitorTimeGranted Integer32,
  faVisitorTimeRemaining Gauge32,
  faVisitorRegFlags RegistrationFlags,
  faVisitorRegIDLow Integer32,
  faVisitorRegIDHigh Integer32,
  faVisitorRegIsAccepted TruthValue
}

faVisitorIPAddress OBJECT-TYPE
SYNTAX      IpAddress
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
"Source IP address of visitor’s Registration Request."
::= { faVisitorEntry 1 }

Cong, Hamlen & Perkins Standards Track [Page 30]
faVisitorHomeAddress OBJECT-TYPE
SYNTAX IpAddress
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"Home (IP) address of visiting mobile node."
::= { faVisitorEntry 2 }

faVisitorHomeAgentAddress OBJECT-TYPE
SYNTAX IpAddress
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"Home agent IP address for that visiting mobile node."
::= { faVisitorEntry 3 }

faVisitorTimeGranted OBJECT-TYPE
SYNTAX Integer32
UNITS "seconds"
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The lifetime in seconds granted to the mobile node
for this registration. Only valid if
faVisitorRegIsAccepted is true(1)."
::= { faVisitorEntry 4 }

faVisitorTimeRemaining OBJECT-TYPE
SYNTAX Gauge32
UNITS "seconds"
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of seconds remaining until the
registration is expired. It has the same initial value
as faVisitorTimeGranted, and is counted down by the
foreign agent."
::= { faVisitorEntry 5 }

faVisitorRegFlags OBJECT-TYPE
SYNTAX RegistrationFlags
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"Registration flags sent by mobile node."
::= { faVisitorEntry 6 }

faVisitorRegIDLow OBJECT-TYPE
SYNTAX       Integer32
MAX-ACCESS   read-only
STATUS       current
DESCRIPTION  "Low 32 bits of Identification used in that
registration by the mobile node."
 ::= { faVisitorEntry 7 }

faVisitorRegIDHigh OBJECT-TYPE
SYNTAX       Integer32
MAX-ACCESS   read-only
STATUS       current
DESCRIPTION  "High 32 bits of Identification used in that
registration by the mobile node."
 ::= { faVisitorEntry 8 }

faVisitorRegIsAccepted OBJECT-TYPE
SYNTAX       TruthValue
MAX-ACCESS   read-only
STATUS       current
DESCRIPTION  "Whether the registration has been accepted or not. If
it is false(2), this registration is still pending for
reply."
 ::= { faVisitorEntry 9 }

-- Foreign Agent Registration Group Counters

faRegRequestsReceived OBJECT-TYPE
SYNTAX       Counter32
MAX-ACCESS   read-only
STATUS       current
DESCRIPTION  "Total number of valid Registration Requests
received."
 ::= { faRegistration 2 }

faRegRequestsRelayed OBJECT-TYPE
SYNTAX       Counter32
MAX-ACCESS   read-only
STATUS       current
DESCRIPTION  "Total number of Registration Requests relayed to home
agent by foreign agent."
 ::= { faRegistration 3 }

faReasonUnspecified OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"Total number of Registration Requests denied by
foreign agent -- reason unspecified (Code 64)."
::= { faRegistration 4 }

faAdmProhibited OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"Total number of Registration Requests denied by
foreign agent -- administratively prohibited (Code
65)."
::= { faRegistration 5 }

faInsufficientResource OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"Total number of Registration Requests denied by
foreign agent -- insufficient resources (Code
66)."
::= { faRegistration 6 }

faMNAuthenticationFailure OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"Total number of Registration Requests denied by
foreign agent -- mobile node failed authentication
(Code 67)."
::= { faRegistration 7 }

faRegLifetimeTooLong OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"Total number of Registration Requests denied by
foreign agent -- requested lifetime too long (Code
69)."
::= { faRegistration 8 }

faPoorlyFormedRequests OBJECT-TYPE
SYNTAX   Counter32
MAX-ACCESS read-only
STATUS    current
DESCRIPTION
"Total number of Registration Requests denied by
foreign agent -- poorly formed request (Code 70)."
::= { faRegistration 9 }

faEncapsulationUnavailable OBJECT-TYPE
SYNTAX   Counter32
MAX-ACCESS read-only
STATUS    current
DESCRIPTION
"Total number of Registration Requests denied by
foreign agent -- requested encapsulation unavailable
(Code 72)."
::= { faRegistration 10 }

faVJCompressionUnavailable OBJECT-TYPE
SYNTAX   Counter32
MAX-ACCESS read-only
STATUS    current
DESCRIPTION
"Total number of Registration Requests denied by
foreign agent -- requested Van Jacobson header
compression unavailable (Code 73)."
::= { faRegistration 11 }

faHAUnreachable OBJECT-TYPE
SYNTAX   Counter32
MAX-ACCESS read-only
STATUS    current
DESCRIPTION
"Total number of Registration Requests denied by
foreign agent -- home agent unreachable (Codes
80-95)."
::= { faRegistration 12 }

faRegRepliesRecieved OBJECT-TYPE
SYNTAX   Counter32
MAX-ACCESS read-only
STATUS    current
DESCRIPTION
"Total number of well-formed Registration Replies
received by foreign agent."
::= { faRegistration 13 }

faRegRepliesRelayed OBJECT-TYPE
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
"Total number of valid Registration Replies relayed to
the mobile node by foreign agent."
::= { faRegistration 14 }

faHAAuthenticationFailure OBJECT-TYPE
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
"Total number of Registration Replies denied by
foreign agent -- home agent failed authentication
(Code 68)."
::= { faRegistration 15 }

faPoorlyFormedReplies OBJECT-TYPE
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
"Total number of Registration Replies denied by
foreign agent -- poorly formed reply (Code 71)."
::= { faRegistration 16 }

-- Home Agent Group

-- Home Agent Registration Group

-- Home agent mobility binding list

haMobilityBindingTable  OBJECT-TYPE
SYNTAX      SEQUENCE OF HaMobilityBindingEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
"A table containing the home agent’s mobility binding
list. The home agent updates this table in response
to registration events from mobile nodes."
::= { haRegistration 1 }

haMobilityBindingEntry OBJECT-TYPE
SYNTAX      HaMobilityBindingEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
"An entry on the mobility binding list."

INDEX { haMobilityBindingMN, haMobilityBindingCOA }
::= { haMobilityBindingTable 1 }

HaMobilityBindingEntry ::= SEQUENCE {
  haMobilityBindingMN    IpAddress,
  haMobilityBindingCOA   IpAddress,
  haMobilityBindingSourceAddress    IpAddress,
  haMobilityBindingRegFlags    RegistrationFlags,
  haMobilityBindingRegIDLow Integer32,
  haMobilityBindingRegIDHigh Integer32,
  haMobilityBindingTimeGranted Integer32,
  haMobilityBindingTimeRemaining Gauge32
}

haMobilityBindingMN    OBJECT-TYPE
SYNTAX      IpAddress
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
  "Mobile node’s home (IP) address."
::= { haMobilityBindingEntry 1 }

haMobilityBindingCOA    OBJECT-TYPE
SYNTAX      IpAddress
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
  "Mobile node’s care-of-address. One mobile node can have multiple bindings with different care-of-addresses."
::= { haMobilityBindingEntry 2 }

haMobilityBindingSourceAddress    OBJECT-TYPE
SYNTAX      IpAddress
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
  "IP source address of the Registration Request as received by the home agent. Will be either a mobile node’s co-located care-of address or an address of the foreign agent."
::= { haMobilityBindingEntry 3 }

haMobilityBindingRegFlags OBJECT-TYPE
SYNTAX      RegistrationFlags
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
"Registration flags sent by mobile node."
::= { haMobilityBindingEntry 4 }

haMobilityBindingRegIDLow OBJECT-TYPE
SYNTAX Integer32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"Low 32 bits of Identification used in that binding by
the mobile node."
::= { haMobilityBindingEntry 5 }

haMobilityBindingRegIDHigh OBJECT-TYPE
SYNTAX Integer32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"High 32 bits of Identification used in that binding by
the mobile node."
::= { haMobilityBindingEntry 6 }

haMobilityBindingTimeGranted OBJECT-TYPE
SYNTAX Integer32
UNITS "seconds"
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The lifetime in seconds granted to the mobile node
for this registration."
::= { haMobilityBindingEntry 7 }

haMobilityBindingTimeRemaining OBJECT-TYPE
SYNTAX Gauge32
UNITS "seconds"
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of seconds remaining until the
registration is expired. It has the same initial value
as haMobilityBindingTimeGranted, and is counted down
by the home agent."
::= { haMobilityBindingEntry 8 }

-- Home Agent Registration Group Counters

-- Home agent registration Counters per node
haCounterTable OBJECT-TYPE
SYNTAX      SEQUENCE OF HaCounterEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION  "A table containing registration statistics for all mobile nodes authorized to use this home agent."
::= { haRegistration 2 }

haCounterEntry OBJECT-TYPE
SYNTAX      HaCounterEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION  "Registration statistics for one mobile node."
INDEX   { haMobilityBindingMN }
 ::= { haCounterTable 1 }

HaCounterEntry ::= SEQUENCE {
  haServiceRequestsAccepted Counter32,
  haServiceRequestsDenied Counter32,
  haOverallServiceTime Gauge32,
  haRecentServiceAcceptedTime TimeStamp,
  haRecentServiceDeniedTime TimeStamp,
  haRecentServiceDeniedCode INTEGER
}

haServiceRequestsAccepted OBJECT-TYPE
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION  "Total number of service requests for the mobile node accepted by the home agent (Code 0 + Code 1)."
 ::= { haCounterEntry 2 }

haServiceRequestsDenied OBJECT-TYPE
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION  "Total number of service requests for the mobile node denied by the home agent (sum of all registrations denied with Code 128 through Code 159)."
 ::= { haCounterEntry 3 }

haOverallServiceTime OBJECT-TYPE
SYNTAX      Gauge32
UNITS "seconds"
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Overall service time (in seconds) that has
accumulated for the mobile node since the home agent
last rebooted."
 ::= { haCounterEntry 4 }

haRecentServiceAcceptedTime OBJECT-TYPE
SYNTAX TimeStamp
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The time at which the most recent Registration
Request was accepted by the home agent for this mobile
node."
 ::= { haCounterEntry 5 }

haRecentServiceDeniedTime OBJECT-TYPE
SYNTAX TimeStamp
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The time at which the most recent Registration
Request was denied by the home agent for this mobile
node."
 ::= { haCounterEntry 6 }

haRecentServiceDeniedCode OBJECT-TYPE
SYNTAX INTEGER {
  reasonUnspecified(128),
  admProhibited(129),
  insufficientResource(130),
  mnAuthenticationFailure(131),
  faAuthenticationFailure(132),
  idMismatch(133),
  poorlyFormedRequest(134),
  tooManyBindings(135),
  unknownHA(136)
}
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The Code indicating the reason why the most recent
Registration Request for this mobile node was rejected
by the home agent."
 ::= { haCounterEntry 7 }
-- Home agent registration Counters for all mobile nodes.

haRegistrationAccepted OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Total number of Registration Requests accepted by home agent (Code 0)."
 ::= { haRegistration 3 }

haMultiBindingUnsupported OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Total number of Registration Requests accepted by home agent -- simultaneous mobility bindings unsupported (Code 1)."
 ::= { haRegistration 4 }

haReasonUnspecified OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Total number of Registration Requests denied by home agent -- reason unspecified (Code 128)."
 ::= { haRegistration 5 }

haAdmProhibited OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Total number of Registration Requests denied by home agent -- administratively prohibited (Code 129)."
 ::= { haRegistration 6 }

haInsufficientResource OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Total number of Registration Requests denied by home agent -- insufficient resources (Code 130)."
 ::= { haRegistration 7 }
haMNAuthenticationFailure OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"Total number of Registration Requests denied by home agent -- mobile node failed authentication (Code 131)."
 ::= { haRegistration 8 }

haFAAuthenticationFailure OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"Total number of Registration Requests denied by home agent -- foreign agent failed authentication (Code 132)."
 ::= { haRegistration 9 }

haIDMismatch OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"Total number of Registration Requests denied by home agent -- Identification mismatch (Code 133)."
 ::= { haRegistration 10 }

haPoorlyFormedRequest OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"Total number of Registration Requests denied by home agent -- poorly formed request (Code 134)."
 ::= { haRegistration 11 }

haTooManyBindings OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"Total number of Registration Requests denied by home agent -- too many simultaneous mobility bindings (Code 135)."
 ::= { haRegistration 12 }
haUnknownHA OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"Total number of Registration Requests denied by home
agent -- unknown home agent address (Code 136)."
 ::= { haRegistration 13 }

haGratuitiousARPsSent OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"Total number of gratuition ARPs sent by the home
agent on behalf of mobile nodes."
 ::= { haRegistration 14 }

haProxyARPsSent OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"Total number of proxy ARPs sent by the home agent on
behalf of mobile nodes."
 ::= { haRegistration 15 }

haRegRequestsReceived OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"Total number of Registration Requests received by the
home agent."
 ::= { haRegistration 16 }

haDeRegRequestsReceived OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"Total number of Registration Requests received by the
home agent with a Lifetime of zero (requests to
deregister)."
 ::= { haRegistration 17 }

haRegRepliesSent OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION  
"Total number of Registration Replies sent by the home agent."
::= { haRegistration 18 }

haDeRegRepliesSent OBJECT-TYPE
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION  
"Total number of Registration Replies sent by the home agent in response to requests to deregister."  
::= { haRegistration 19 }

mipMIBNotifcationPrefix OBJECT IDENTIFIER ::= { mipMIB 2 }

mipMIBNotifications OBJECT IDENTIFIER ::= 
{ mipMIBNotifcationPrefix 0 }
mipAuthFailure NOTIFICATION-TYPE
OBJECTS   { mipSecViolatorAddress, 
mipSecRecentViolationSPI, 
mipSecRecentViolationIDLow, 
mipSecRecentViolationIDHigh, 
mipSecRecentViolationReason 
}
STATUS      current
DESCRIPTION  
"The mipAuthFailure indicates that the Mobile IP entity has an authentication failure when it validates the mobile Registration Request or Reply. Implementation of this trap is optional."  
::= { mipMIBNotifications 1 }

mipMIBConformance OBJECT IDENTIFIER ::= { mipMIB 3 }
mipGroups OBJECT IDENTIFIER ::= { mipMIBConformance 1 }
mipCompliances OBJECT IDENTIFIER ::= { mipMIBConformance 2 }

-- compliance statements

mipCompliance MODULE-COMPLIANCE
STATUS      current
DESCRIPTION  

"The compliance statement for SNMPv2 entities which implement the Mobile IP MIB."

MODULE
MANDATORY-GROUPS { mipSystemGroup }

GROUP    mipSecAssociationGroup
DESCRIPTION
"This group is mandatory for Mobile IP entities (MN, FA, and HA) which support security associations. Mobile Nodes and Home Agents must implement this group. Foreign Agents must implement this group if they maintain any security associations."

GROUP    mipSecViolationGroup
DESCRIPTION
"This group is mandatory for Mobile IP entities (MN, FA, and HA) that can log security violations."

GROUP    mnSystemGroup
DESCRIPTION
"This group is mandatory for mobile node."

GROUP    mnDiscoveryGroup
DESCRIPTION
"This group is mandatory for mobile nodes which implement the Agent Discovery function."

GROUP    mnRegistrationGroup
DESCRIPTION
"This group is mandatory for mobile nodes."

GROUP    maAdvertisementGroup
DESCRIPTION
"This group is mandatory for the mobility agents (HA and FA) since they must implement Agent Advertisement."

GROUP    faSystemGroup
DESCRIPTION
"This group is mandatory for foreign agents."

GROUP    faAdvertisementGroup
DESCRIPTION
"This group is mandatory for foreign agents."

GROUP    faRegistrationGroup
DESCRIPTION
"This group is mandatory for foreign agents."
GROUP   haRegistrationGroup
DESCRIPTION
   "This group is mandatory for home agents."

GROUP   haRegNodeCountersGroup
DESCRIPTION
   "This group is mandatory for home agents which log
   registration counters for each individual mobile
   node."

GROUP   mipSecNotificationsGroup
DESCRIPTION
   "This group is mandatory for Mobile IP entities (MN,
   FA, and HA) that can report the security violations."

::= { mipCompliances 1 }

-- Units of conformance

mipSystemGroup OBJECT-GROUP
OBJECTS    { mipEntities, mipEnable, mipEncapsulationSupported }
STATUS     current
DESCRIPTION
   "A collection of objects providing the basic Mobile IP
   entity's management information."
::= { mipGroups 1 }

mipSecAssociationGroup OBJECT-GROUP
OBJECTS    { mipSecAlgorithmType, mipSecAlgorithmMode,
                mipSecKey, mipSecReplayMethod }
STATUS     current
DESCRIPTION
   "A collection of objects providing the management
   information for security associations of Mobile IP
   entities."
::= { mipGroups 2 }

mipSecViolationGroup OBJECT-GROUP
OBJECTS    { mipSecTotalViolations,
                mipSecViolationCounter, mipSecRecentViolationSPI,
                mipSecRecentViolationTime,
                mipSecRecentViolationIDLow,
                mipSecRecentViolationIDHigh,
                mipSecRecentViolationReason }
STATUS     current
DESCRIPTION
   "A collection of objects providing the management
information for security violation logging of Mobile
IP entities."
 ::= { mipGroups 3 }

mnSystemGroup OBJECT-GROUP
OBJECTS { mnState, mnCurrentHA, mnHomeAddress,
mnHAStatus } STATUS current
DESCRIPTION "A collection of objects providing the basic
management information for mobile nodes."
 ::= { mipGroups 4 }

mnDiscoveryGroup OBJECT-GROUP
OBJECTS { mnFAAddress, mnCOA, mnAdvSourceAddress,
mnAdvSequence, mnAdvFlags, mnAdvMaxRegLifetime,
mnAdvMaxAdvLifetime, mnAdvTimeReceived, 
mnSolicitationsSent, mnAdvertisementsReceived,
mnAdvsDroppedInvalidExtension,
mnAdvIsIgnoredUnknownExtension, mnMoveFromHAtoFA,
mnMoveFromFAToFA, mnMoveFromFAToHA,
mnGratuitousARPsWithSent, mnAgentRebootsDetected }
STATUS current
DESCRIPTION "A collection of objects providing management
information for the Agent Discovery function within a
mobile node."
 ::= { mipGroups 5 }

mnRegistrationGroup OBJECT-GROUP
OBJECTS { mnRegAgentAddress, mnRegCOA, mnRegFlags, mnRegIDLow,
mnRegIDHigh, mnRegTimeRequested, mnRegTimeRemaining,
mnRegTimeSent, mnRegIsAccepted, mnCOAIsLocal,
mnRegRequestsSent, mnRegRepliesReceived,
mnDeRegRequestsSent, mnDeRegRepliesReceived,
mnRepliesInvalidHomeAddress, mnRepliesUnknownHA,
mnRepliesUnknownFA, mnRepliesInvalidID,
mnRepliesDroppedInvalidExtension,
mnRepliesIgnoredUnknownExtension,
mnRepliesHAAuthenticationFailure,
mnRepliesFAAuthenticationFailure,
mnRegRequestsAccepted, mnRegRequestsDeniedByHA,
mnRegRequestsDeniedByFA,
mnRegRequestsDeniedByHADueToID,
mnRegRequestsWithDirectedBroadcast }
STATUS current
DESCRIPTION "A collection of objects providing management
information for the registration function within a mobile node.

::= { mipGroups 6 }

maAdvertisementGroup OBJECT-GROUP
OBJECTS { maAdvMaxRegLifetime, maAdvPrefixLengthInclusion, maAdvAddress, maAdvMaxInterval, maAdvMinInterval, maAdvMaxAdvLifetime, maAdvResponseSolicitationOnly, maAdvStatus, maAdvertisementsSent, maAdvsSentForSolicitation, maSolicitationsReceived }

STATUS current

DESCRIPTION
"A collection of objects providing management information for the Agent Advertisement function within mobility agents."

::= { mipGroups 7 }

faSystemGroup OBJECT-GROUP
OBJECTS { faCOAStatus}

STATUS current

DESCRIPTION
"A collection of objects providing the basic management information for foreign agents."

::= { mipGroups 8 }

faAdvertisementGroup OBJECT-GROUP
OBJECTS { faIsBusy, faRegistrationRequired }

STATUS current

DESCRIPTION
"A collection of objects providing supplemental management information for the Agent Advertisement function within a foreign agent."

::= { mipGroups 9 }

faRegistrationGroup OBJECT-GROUP
OBJECTS { faVisitorIPAddress, faVisitorHomeAddress, faVisitorHomeAgentAddress, faVisitorTimeGranted, faVisitorTimeRemaining, faVisitorRegFlags, faVisitorRegIDLow, faVisitorRegIDHigh, faVisitorRegIsAccepted, faRegRequestsReceived, faRegRequestsRelayed, faReasonUnspecified, faAdmProhibited, faInsufficientResource, faMNAuthenticationFailure, faRegLifetimeTooLong, faPoorlyFormedRequests, faEncapsulationUnavailable, faVJCompressionUnavailable, faHAUnreachable,

Cong, Hamlen & Perkins Standards Track [Page 47]
faRegRepliesRecieved, faRegRepliesRelayed,
faHAAuthenticationFailure, faPoorlyFormedReplies }

STATUS current
DESCRIPTION
"A collection of objects providing management
information for the registration function within a
foreign agent."
::= { mipGroups 10 }

haRegistrationGroup OBJECT-GROUP
OBJECTS { haMobilityBindingMN, haMobilityBindingCOA,
haMobilityBindingSourceAddress,
haMobilityBindingRegFlags,
haMobilityBindingRegIDLow, 
haMobilityBindingRegIDHigh, 
haMobilityBindingTimeGranted, 
haMobilityBindingTimeRemaining, 
haRegistrationAccepted, haMultiBindingUnsupported, 
haReasonUnspecified, haAdmProhibited, 
haInsufficientResource, haMNAAuthenticationFailure, 
haFAAuthenticationFailure, haIMismatch, 
haPoorlyFormedRequest, haTooManyBindings, 
haUnknownHA, haGratuitiousARPsSent, 
haProxyARPsSent, haRegRequestsReceived, 
haDeRegRequestsReceived, haRegRepliesSent, 
haDeRegRepliesSent }

STATUS current
DESCRIPTION
"A collection of objects providing management
information for the registration function within a
home agent."
::= { mipGroups 11 }

haRegNodeCountersGroup OBJECT-GROUP
OBJECTS { haServiceRequestsAccepted, 
haServiceRequestsDenied, haOverallServiceTime, 
haRecentServiceAcceptedTime, 
haRecentServiceDeniedTime, 
haRecentServiceDeniedCode }
STATUS current
DESCRIPTION
"A collection of objects providing management
information for counters related to the registration
function within a home agent."
::= { mipGroups 12 }

mipSecNotifcationsGroup NOTIFICATION-GROUP
NOTIFICATIONS { mipAuthFailure }

Cong, Hamlen & Perkins Standards Track [Page 48]
STATUS current
DESCRIPTION
"The notification related to security violations."
 ::= { mipGroups 13 }

END

5. Acknowledgments

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6. Security Considerations

The Mobile IP MIB affords the network operator the ability to configure and control the Mobile IP links of a particular system, including the Mobile IP authentication protocols, and shared secret key. This represents a security risk.

These risks are addressed in the following manners:

1. All variables which represent a significant security risk are placed in separate MIB Groups. By providing Agent Capability Statements, the implementor of the MIB may elect not to implement these groups.

2. The MIB allows the manager station to create the security association for Mobile IP entities. However, the agent should always return 0 length octet string when the manager station retrieves the shared security key in the mipSecAssocTable. In this way, the Mobile IP entities can prevent the key leaking from SNMP GET, GET-NEXT, or GET-BULK requests.

3. The MIB defines a trap for Mobile IP entities to send a notification to the manager station if there is a security violation. In this way, the operator can notice the source of an intruder.

4. The MIB also defines a table to log the security violations in the Mobile IP entities. The manager station can retrieve this log to analyze the security violation instances in the
Thus, in order to preserve the integrity, security and privacy of the Mobile IP security features, an implementation SHOULD allow access to this MIB only via SNMPv2 and with other security enhancement such as SNMPv2Sec. The other way to access this information is in concert with the IP security protocols (IP Authentication Header and IP Encapsulating Security Payload).

7.0 References


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