   **Definition of Managed Objects for the Manet Simplified Multicast
                    Framework Relay Set Process
                    draft-ietf-manet-smf-mib-07**

Abstract

   This memo defines a portion of the Management Information Base (MIB)
   for use with network management protocols in the Internet community.
   In particular, it describes objects for configuring aspects of the
   Simplified Multicast Forwarding (SMF) process for Mobile Ad-Hoc
   Networks (MANETs). The SMF-MIB also reports state information,
   performance metrics, and notifications. In addition to
   configuration, the additional state and performance information is
   useful to operators troubleshooting multicast forwarding problems.

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1. Introduction

   This memo defines a portion of the Management Information Base (MIB)
   for use with network management protocols in the Internet community.
   In particular, it describes objects for configuring aspects of a
   process implementing Simplified Multicast Forwarding (SMF) [RFC6621]
   for Mobile Ad-Hoc Networks (MANETs). SMF provides multicast
   Duplicate Packet Detection (DPD) and supports algorithms for
   constructing an estimate of a MANET Minimum Connected Dominating Set
   (MCDS) for efficient multicast forwarding. The SMF-MIB also reports
   state information, performance metrics, and notifications. In
   addition to configuration, this additional state and performance
   information is useful to operators troubleshooting multicast
   forwarding problems.

2. The Internet-Standard Management Framework

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

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

3. Conventions

   The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT",
   "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this
   document are to be interpreted as described in RFC 2119 [RFC2119].

4. Overview

   SMF provides methods for implementing DPD-based multicast forwarding
   with the optional use of Connected Dominating Set (CDS)-based relay
   sets. The CDS provides a complete connected coverage of the nodes
   comprising the MANET. The MCDS is the smallest set of MANET nodes
   (comprising a connected cluster) which cover all the nodes in the
   cluster with their transmissions. As the density of the MANET nodes
   increase, the fraction of nodes required in an MCDS decreases. Using
   the MCDS as a multicast forwarding set then becomes an efficient
   multicast mechanism for MANETs.

Various algorithms for the construction of estimates of the MCDS
exist. The Simplified Multicast Framework [RFC6621] describes some
of these. It further defines various operational modes for a node
which is participating in the collective creation of the MCDS
estimates. These modes depend upon the set of related MANET routing
and discovery protocols and mechanisms in operation in the specific
MANET node.

A SMF router's MIB contains SMF process configuration parameters
(e.g. specific CDS algorithm), state information (e.g., current
membership in the CDS), performance counters (e.g., packet counters),
and notifications.

4.1. SMF Management Model

This section describes the management model for the SMF node process.

Figure 1 (reproduced from Figure 4 of [RFC6621]) shows the
relationship between the SMF Relay Set selection algorithm and the
related algorithms, processes and protocols running in the MANET
nodes. The Relay Set Selection Algorithm (RSSA) can rely upon
topology information gotten from the MANET Neighborhood Discovery
Protocol (NHDP), from the specific MANET routing protocol running on
the node, or from Layer 2 information passed up to the higher layer
protocol processes.

```
         _____                  _____
        |              |                |            |
        | Neighborhood |                | Relay Set  |
        |  Discovery   |-------------->| Selection  |
        |   Protocol   |   neighbor     | Algorithm  |
        |_____|     info       |_____|
              \                              /
               \                            /
          neighbor\                        / forwarding
            info*   \     _____    /     status
                 \    |            |   /
                  `-->| Forwarding |<--'
                      |  Process   |
    ---------------->|_____|---------------->
     incoming packet,                 forwarded packets
     interface id*, and
     previous hop*
```
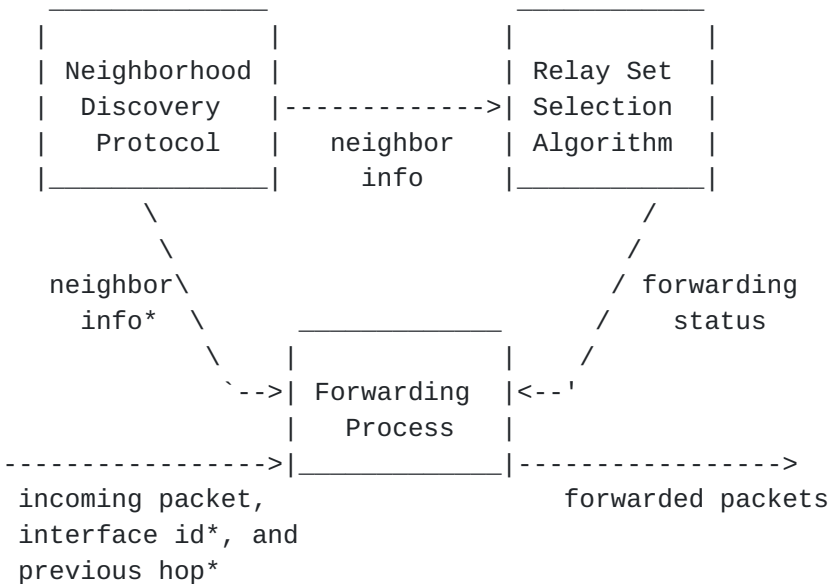
                Figure 1: SMF Node Architecture

4.2. Terms

   The following definitions apply throughout this document:

   o Configuration Objects - switches, tables, objects which are
      initialized to default settings or set through the management
      interface defined by this MIB.

   o Tunable Configuration Objects - objects whose values affect timing
      or attempt bounds on the SMF RS process.

   o State Objects - automatically generated values which define the
      current operating state of the SMF RS process in the router.

   o Performance Objects - automatically generated values which help an
      administrator or automated tool to assess the performance of the
      CDS multicast process on the router and the overall multicast
      performance within the MANET routing domain.

5. Structure of the MIB Module

   This section presents the structure of the SMF-MIB module. The
   objects are arranged into the following groups:

   o smfMIBNotifications - defines the notifications associated with
      the SMF-MIB.

o smfMIBObjects - defines the objects forming the basis for the SMF-
   MIB. These objects are divided up by function into the following
   groups:

   * Capabilities Group - This group contains the SMF objects that
      the device uses to advertise its local capabilities with
      respect to, e.g., the supported RSSAs.

   * Configuration Group - This group contains the SMF objects that
      configure specific options that determine the overall operation
      of the SMF RSSA and the resulting multicast performance.

   * State Group - Contains information describing the current state
      of the SMF RSSA process such as the Neighbor Table.

   * Performance Group - Contains objects which help to characterize
      the performance of the SMF RSSA process, typically statistics
      counters.

o smfMIBConformance - defines minimal and full conformance of
   implementations to this SMF-MIB.

5.1. Textual Conventions

The textual conventions defined within the SMF-MIB are as follows:

o The SmfStatus is defined within the SMF-MIB. This contains the
   current operational status of the SMF process on an interface.

o The SmfOpModeID represents an index that identifies a specific SMF
   operational mode.

o The SmfRssaID represents an index that identifies, through
   reference, a specific RSSA available for operation on the device.

5.2. The Capabilities Group

The SMF device supports a set of capabilities. The list of
capabilities which the device can advertise are:

o Operational Mode - topology information from NHDP, CDS-aware
   unicast routing or Cross-layer from Layer 2.

o SMF RSSA - the specific RSSA operational on the device. Note that
   configuration, state and performance objects related to a specific
   RSSA must be defined within another separate MIB.

5.3. The Configuration Group

   The SMF device is configured with a set of controls. Some of the
   prominent configuration controls for the SMF device follow:

   o Operational Mode - topology information from NHDP, CDS-aware
      unicast routing or Cross-layer from Layer 2.

   o SMF RSSA - the specific RSSA operational on the device.

   o Duplicate Packet detection for IPv4 - Identification-based or
      Hash-based DPD.

   o Duplicate Packet detection for IPv6 - Identification-based or
      Hash-based DPD.

   o SMF Type Message TLV - if NHDP mode is selected, then is the SMF
      Type Message TLV may be included in the NHDP exchanges.

   o SMF Address Block TLV - if NHDP mode is selected, then is the SMF
      Address Block TLV should be included in the NHDP exchanges.

5.4. The State Group

   The State sub-tree reports current state information, e.g.,

   o Node RSSA State - is the node currently in or out of the Relay
      Set.

   o Neighbors Table - a table containing current neighbors and their
      operational RSSA.

5.5. The Performance Group

   The Performance sub-tree reports primarily counters that relate to
   SMF RSSA performance. The SMF performance counters consists of per
   node and per interface objects:

   o Total multicast packets received.

   o Total multicast packets forwarded.

   o Total duplicate multicast packets detected.

   o Per interface statistics table with the following entries:

      * Multicast packets received.

      * Multicast packets forwarded.

      * Duplicate multicast packets detected.

5.6. The Notifications Group

   The Notifications Sub-tree contains the list of notifications
   supported within the SMF-MIB and their intended purpose or utility.

5.7. Tables and Indexing

   The SMF-MIB module contains a number of tables which record data
   related to:

   o configuration and operation of packet forwarding the local router,

   o configuration and operation of local MANET interfaces on the
      router, and

   o configuration and operation of various RSSA algorithms for packet
      forwarding.

   The SMF-MIB module's tables are indexed via the following constructs:

   o smfOpModeCapabilitiesID - which is the index for each of the SMF
      modes.

   o smfRssaCapabilitiesID - which is the index for each of the RSSAs
      supported by this specific device.

   o smfConfiguredAddrForwardingAddrType and
      smfConfiguredAddrForwardingFirstAddr - indexes to multicast
      addresses which are forwarded by the SMF process.

   o smfIfIndex - which is the IfIndex of the local router on which SMF
      is configured.

   o smfDiscoveredAddrForwardingAddrType and
      smfDiscoveredAddrForwardingFirstAddr - indexes to discovered
      multicast addresses which are forwarded by the SMF process.

   o smfNeighborIpAddrType, smfNeighborIpAddr, and smfNeighborPrefixLen
      - which is the index set of interface specific neighbor nodes to
      this SMF device.

   These tables and their indexing are:

o smfOpModeCapabilitiesTable - identifies the resident set of SMF
   Operational Modes on this router. This table has 'INDEX {
   smfOpModeCapabilitiesID }.

o smfRssaCapabilitiesTable - contains reference to the specific set
   of RSSAs currently supported on this device. This table has
   'INDEX { smfRssaCapabilitiesID }'.

o smfConfiguredAddrForwardingTable - contains information on
   multicast addresses which are to be forwarded by the SMF process
   on this device. This table has 'INDEX {
   smfConfiguredAddrForwardingAddrType,
   smfConfiguredAddrForwardingFirstAddr }'.

o smfInterfaceTable - describes the SMF interfaces on this device
   that are participating in the SMF packet forwarding process. This
   table has 'INDEX { smfIfIndex }'.

o smfDiscoveredAddrForwardingTable - contains discovered address for
   SMF packet forwarding. This table has 'INDEX {
   smfDiscoveredAddrForwardingAddrType,
   smfDiscoveredAddrForwardingFirstAddr }'.

o smfNeighborTable - describes the current neighbor nodes, their
   addresses and the SMF RSSA and the interface on which they can be
   reached. This table has 'INDEX { smfNeighborIpAddrType,
   smfNeighborIpAddr, smfNeighborPrefixLen }'.

o smfIpv4InterfaceTable - contains the IPv4 related SMF statistics
   per each SMF interface on this device. This table has 'INDEX {
   smfIfIndex }'.

o smfIpv6InterfaceTable - contains the IPv6 related SMF statistics
   per each SMF interface on this device. This table has 'INDEX {
   smfIfIndex }'.

6. Relationship to Other MIB Modules

6.1. Relationship to the SNMPv2-MIB

The 'system' group in the SNMPv2-MIB [RFC3418] is defined as being
mandatory for all systems, and the objects apply to the entity as a
whole. The 'system' group provides identification of the management
entity and certain other system-wide data. The SMF-MIB does not
duplicate those objects.

6.2. **MIB modules required for IMPORTS**

   The textual conventions imported for use in the SMF-MIB are as
   follows. The MODULE-IDENTITY, OBJECT-TYPE, NOTIFICATION-TYPE,
   Counter32, Unsigned32, Integer32 and mib-2 textual conventions are
   imported from RFC 2578 [RFC2578]. The TEXTUAL-CONVENTION, RowStatus
   and TruthValue textual conventions are imported from RFC 2579
   [RFC2579]. The MODULE-COMPLIANCE, OBJECT-GROUP and NOTIFICATION-
   GROUP textual conventions are imported from RFC 2580 [RFC2580]. The
   InterfaceIndexOrZero textual convention is imported from RFC 2863
   [RFC2863]. The SnmpAdminString textual convention is imported from
   RFC 3411 [RFC3411]. The InetAddress, InetAddressType and
   InetAddressPrefixLength textual conventions are imported from RFC
   4001 [RFC4001].

6.3. **Relationship to the Future RSSA-MIBs**

   In a sense, the SMF-MIB is a general front-end to a set of, yet to be
   developed, RSSA-specific MIBs. These RSSA-specific MIBs will define
   the objects for the configuration, state, performance and
   notification objects required for the operation of these specific
   RSSAs. The SMF-MIB Capabilities Group allows the remote management
   station the ability to query the router to discover the set of
   supported RSSAs.

7. **Definitions**

   SMF-MIB DEFINITIONS ::= BEGIN

   IMPORTS

      MODULE-IDENTITY, OBJECT-TYPE, NOTIFICATION-TYPE,
      Counter32, Integer32, TimeTicks, experimental
         FROM SNMPv2-SMI   -- [RFC2578]

      TEXTUAL-CONVENTION, RowStatus, TruthValue,
      DisplayString
         FROM SNMPv2-TC   -- [RFC2579]

      MODULE-COMPLIANCE, OBJECT-GROUP,
      NOTIFICATION-GROUP
         FROM SNMPv2-CONF   -- [RFC2580]

      InterfaceIndexOrZero
         FROM IF-MIB   -- [RFC2863]

```
     SnmpAdminString
        FROM SNMP-FRAMEWORK-MIB                    -- [RFC3411]

     InetAddress, InetAddressType,
     InetAddressPrefixLength
        FROM INET-ADDRESS-MIB                      -- [RFC4001]
     ;

   smfMIB MODULE-IDENTITY
     LAST-UPDATED "201303201300Z"  -- March 20, 2013
     ORGANIZATION "IETF MANET Working Group"
     CONTACT-INFO
        "WG E-Mail: manet@ietf.org

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     DESCRIPTION
        "This MIB module contains managed object definitions for
         the Manet SMF RSSA process defined in:

         [SMF] Macker, J.(ed.),
         Simplified Multicast Forwarding, RFC XXXX,
         July 2012.

         Copyright (C) The IETF Trust (2012). This version
```

```
          of this MIB module is part of RFC xxxx; see the RFC
          itself for full legal notices."

       -- Revision History
       REVISION    "201303201300Z"   -- March 20, 2013
       DESCRIPTION
         "The first version of this MIB module,
          published as RFC xxxx.
          "
       -- RFC-Editor assigns xxxx
       ::= { experimental xxxx }   -- to be assigned by IANA


  --
  -- TEXTUAL CONVENTIONs
  --

  SmfStatus ::= TEXTUAL-CONVENTION
      STATUS       current
      DESCRIPTION
         "An indication of the operability of a SMF
         function or feature.  For example, the status
         of an interface: 'enabled' indicates that
         it is performing SMF functions,
         and 'disabled' indicates that it is not."
      SYNTAX   INTEGER {
                    enabled (1),
                    disabled (2)
              }

  SmfOpModeID ::= TEXTUAL-CONVENTION
      STATUS       current
      DESCRIPTION
          "An index that identifies through reference to a specific
           SMF operations mode.  There are basically three styles
           of SMF operation with reduced relay sets:

              Independent operation - SMF performs its own relay
                  set selection using information from an associated
                  MANET NHDP process.

              CDS-aware unicast routing operation - a coexistent
                  unicast routing protocol provides dynamic relay
                  set state based upon its own control plane
                  CDS or neighborhood discovery information.

              Cross-layer operation -  SMF operates using
                  neighborhood status and triggers from a
```

```
                    cross-layer information base for dynamic relay
                    set selection and maintenance."
          REFERENCE
             "Simplified Multicast Forwarding for MANET
              (SMF), Macker, J., July 2012."
          SYNTAX   INTEGER {
                           independent (1),
                           routing (2),
                           crossLayer (3)
                           -- future (4-255)
                 }


      SmfRssaID ::= TEXTUAL-CONVENTION
          STATUS       current
          DESCRIPTION
              "An index that identifies through reference to a specific
               RSSA algorithms.  Several are currently defined
               in the appendix of SMF (RFC XXXX)."
          REFERENCE
             "Simplified Multicast Forwarding for MANET
              (SMF), Macker, J., July 2012."
          SYNTAX       INTEGER {
                               cF(1),
                               sMPR(2),
                               eCDS(3),
                               mprCDS(4)
                               -- future(5-127)
                               -- noStdAction(128-239)
                               -- experimental(240-255)
                     }



      --
      -- Top-Level Object Identifier Assignments
      --

      smfMIBNotifications OBJECT IDENTIFIER ::= { smfMIB 0 }
      smfMIBObjects       OBJECT IDENTIFIER ::= { smfMIB 1 }
      smfMIBConformance   OBJECT IDENTIFIER ::= { smfMIB 2 }



      --
      -- smfMIBObjects Assignments:
      --      smfCapabilitiesGroup  - 1
      --      smfConfigurationGroup - 2
      --      smfStateGroup         - 3
```

```
     --       smfPerformanceGroup   - 4
     --


     --
     -- smfCapabilitiesGroup
     --
     --    This group contains the SMF objects that identify specific
     --    capabilities within this device related to SMF functions.
     --

     smfCapabilitiesGroup  OBJECT IDENTIFIER ::= { smfMIBObjects 1 }

   --
     -- SMF Operational Mode Capabilities Table
     --

     smfOpModeCapabilitiesTable OBJECT-TYPE
         SYNTAX      SEQUENCE OF SmfOpModeCapabilitiesEntry
         MAX-ACCESS  not-accessible
         STATUS      current
         DESCRIPTION
            "The smfOpModeCapabilitiesTable identifies the
             resident set of SMF Operational Modes on this
             router."
         REFERENCE
           "Simplified Multicast Forwarding for MANET
            (SMF), Macker, J., July 2012."
         ::= { smfCapabilitiesGroup 1 }

     smfOpModeCapabilitiesEntry OBJECT-TYPE
         SYNTAX      SmfOpModeCapabilitiesEntry
         MAX-ACCESS  not-accessible
         STATUS      current
         DESCRIPTION
            "Information about a particular operational
             mode.
            "
         INDEX   { smfOpModeCapabilitiesID }
         ::= { smfOpModeCapabilitiesTable 1 }

     SmfOpModeCapabilitiesEntry ::= SEQUENCE {
           smfOpModeCapabilitiesID              SmfOpModeID,
           smfOpModeCapabilitiesName            SnmpAdminString,
           smfOpModeCapabilitiesReference       SnmpAdminString
     }

     smfOpModeCapabilitiesID     OBJECT-TYPE
         SYNTAX      SmfOpModeID
```

```
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
            "The index for this entry.  This object identifies
             the particular operational mode for this device."
        ::= { smfOpModeCapabilitiesEntry 1 }

    smfOpModeCapabilitiesName OBJECT-TYPE
        SYNTAX      SnmpAdminString
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The textual name of this operational
             mode.  Current operational modes include:
                 Independent Mode,
                 CDS-aware Routing Mode, and
                 Cross-layer Mode.
             Others may be defined
             in future revisions of [SMF]."
        ::= { smfOpModeCapabilitiesEntry 2 }

    smfOpModeCapabilitiesReference OBJECT-TYPE
        SYNTAX      SnmpAdminString
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "This object contains a reference to the document
             that defines this operational mode."
        ::= { smfOpModeCapabilitiesEntry 3 }


    --
    -- SMF RSSA Capabilities Table
    --

    smfRssaCapabilitiesTable OBJECT-TYPE
        SYNTAX      SEQUENCE OF SmfRssaCapabilitiesEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
            "The smfRssaCapabilitiesTable contains
             reference to the specific set of RSSAs
             currently supported on this device.
            "
        REFERENCE
           "Simplified Multicast Forwarding for MANET
            (SMF), Macker, J., July 2012."
        ::= { smfCapabilitiesGroup 2 }
```

```
    smfRssaCapabilitiesEntry OBJECT-TYPE
        SYNTAX       SmfRssaCapabilitiesEntry
        MAX-ACCESS   not-accessible
        STATUS       current
        DESCRIPTION
            "Information about a particular RSSA
             algorithm."
        INDEX   { smfRssaCapabilitiesID }
        ::= { smfRssaCapabilitiesTable 1 }

    SmfRssaCapabilitiesEntry ::= SEQUENCE {
        smfRssaCapabilitiesID            SmfRssaID,
        smfRssaCapabilitiesName          SnmpAdminString,
        smfRssaCapabilitiesReference     SnmpAdminString
    }

    smfRssaCapabilitiesID    OBJECT-TYPE
        SYNTAX       SmfRssaID
        MAX-ACCESS   not-accessible
        STATUS       current
        DESCRIPTION
            "The index for this entry.  This object identifies
             the particular RSSA algorithm in this MIB
             module.  Example RSSAs are found in the
             appendix of [SMF].

             By default, the agent should support at least the
             Classical Flooding algorithm.  All compliant
             SMF forwarders must support Classical Flooding.
             Hence, at least one entry in this table must
             exist."
        ::= { smfRssaCapabilitiesEntry 1 }

    smfRssaCapabilitiesName OBJECT-TYPE
        SYNTAX       SnmpAdminString
        MAX-ACCESS   read-only
        STATUS       current
        DESCRIPTION
            "The textual name of this RSSA algorithm.
             Currently defined names are:
                 Classical Flooding - cF,
                 Source-based MultiPoint
                     Relay - sMPR,
                 Essential Connecting Dominating
                     Set - eCDS,
                 MultiPoint Relay Connected
                     Dominating Set - mprCDS.
             "
```

```
          ::= { smfRssaCapabilitiesEntry 2 }


   smfRssaCapabilitiesReference OBJECT-TYPE
       SYNTAX      SnmpAdminString
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
           "This object contains a published reference
            to the document that defines this algorithm.
           "
       ::= { smfRssaCapabilitiesEntry 3 }




   --
   -- smfConfigurationGroup
   --
   --    This group contains the SMF objects that configure specific
   --    options that determine the overall performance and operation
   --    of the multicast forwarding process for the router device
   --    and its interfaces.
   --

   smfConfigurationGroup  OBJECT IDENTIFIER ::= { smfMIBObjects 2 }

   smfAdminStatus  OBJECT-TYPE
      SYNTAX      SmfStatus
      MAX-ACCESS  read-write
      STATUS      current
      DESCRIPTION
         "The configured status of the SMF process
          on this device.  Enabled(1) means that
          SMF is configured to run on this device.
          Disabled(2) mean that the SMF process
          is configured off.

          This object is persistent and when written
          the entity SHOULD save the change to
          non-volatile storage.
         "
   ::= { smfConfigurationGroup 1 }

   smfRouterIDAddrType  OBJECT-TYPE
      SYNTAX      InetAddressType
      MAX-ACCESS  read-write
      STATUS      current
      DESCRIPTION
```

         "The address type of the address used for
          SMF ID of this router as specified
          in the 'smfRouterID' next.

          Only the values ipv4(1) and ipv6(2)
          are supported.

          This can be set by the management station,
          the smfRouterID must be a routable address
          assigned to this router. If the management
          station does not assign this value, then the
          router should choose the highest routable
          IP address assigned to this router.

          This object is persistent and when written
          the entity SHOULD save the change to
          non-volatile storage."
      DEFVAL { ipv4 }
    ::= { smfConfigurationGroup 2 }

    smfRouterID OBJECT-TYPE
       SYNTAX   InetAddress (SIZE(4|16))
       MAX-ACCESS read-write
       STATUS   current
       DESCRIPTION
          "The IP address used as the SMF router ID.
           This can be set by the management station.
           If not explicitly set, then the device
           should select a routable IP address
           assigned to this router for use as
           the 'smfRouterID'.

           The smfRouterID is a logical identification
           that MUST be consistent across interoperable
           SMF neighborhoods and it is RECOMMENDED to be
           chosen as the numerically largest address
           contained in a node's 'Neighbor Address List'
           as defined in NHDP. A smfRouterID MUST be
           unique within the scope of the operating
           MANET network regardless of the method used
           for selecting it.

           This object is persistent and when written
           the entity SHOULD save the change to
           non-volatile storage."
       REFERENCE
          "Simplified Multicast Forwarding for MANET
           (SMF), Macker, J., July 2012."

```
     ::= { smfConfigurationGroup 3 }

   smfConfiguredOpMode  OBJECT-TYPE
      SYNTAX        INTEGER {
                         withNHDP(1),
                         cdsAwareRouting(2),
                         crossLayer(3),
                         other(4)
                         }
      MAX-ACCESS  read-write
      STATUS      current
      DESCRIPTION
         "The SMF RSS node operational mode as defined
          in the TEXTUAL CONVENTION for `SmfOpModeID'
          and in [SMF]..

          The value withNHDP(1) indicates Independent
          Mode of operation.

          The value cdsAwareRouting(2) indicates
          CDS-aware Routing Mode of operation.

          The value crossLayer(3) indicates
          Cross-layer Mode of operation.

          The default value for this object is
          withNHDP(1).

          This object is persistent and when written
          the entity SHOULD save the change to
          non-volatile storage."
      REFERENCE
         "Simplified Multicast Forwarding for MANET
          (SMF), Macker, J., July 2012."
      DEFVAL { withNHDP }
   ::= { smfConfigurationGroup 4 }


   smfConfiguredRssa  OBJECT-TYPE
      SYNTAX        SmfRssaID
      MAX-ACCESS  read-write
      STATUS      current
      DESCRIPTION
         "The SMF RSS currently operational algorithm
          as defined in the TEXTUAL CONVENTION for
          `SmfRssaID' and in [SMF].

           The deflaut value for this object is
```

        cF(1), i.e., Classical Flooding.

        This object is persistent and when written
        the entity SHOULD save the change to
        non-volatile storage."
    REFERENCE
       "Simplified Multicast Forwarding for MANET
        (SMF), Macker, J., July 2012."
    DEFVAL { cF }
 ::= { smfConfigurationGroup 5 }

 smfRssaMember OBJECT-TYPE
    SYNTAX   INTEGER {
                    potential(1),
                    always(2),
                    never(3)
                    }
    MAX-ACCESS read-write
    STATUS   current
    DESCRIPTION
       "The RSSA downselects a set of forwarders for
        multicast forwarding. Sometimes it is useful
        to force an agent to be included or excluded
        from the resulting RSS. This object is a
        switch to allow for this behavior.

        The value potential(1) allows the selected
        RSSA to determine if this agent is included
        or excluded from the RSS.

        The value always(1) forces the selected
        RSSA include this agent in the RSS.

        The value never(3) forces the selected
        RSSA to exclude this agent from the RSS.

        The default setting for this object is
        'potential(1)'. Other settings could pose
        operational risks under certain conditions.

        This object is persistent and when written
        the entity SHOULD save the change to
        non-volatile storage."
    REFERENCE
       "Simplified Multicast Forwarding for MANET
        (SMF), Macker, J., July 2012."
    DEFVAL { potential }
 ::= { smfConfigurationGroup 6 }

```
smfIpv4Dpd  OBJECT-TYPE
   SYNTAX      INTEGER {
                      hashBased(1),
                      identificationBased(2)
                      }
   MAX-ACCESS  read-write
   STATUS      current
   DESCRIPTION
      "The current method for IPv4 duplicate packet
       detection.

       The value hashBased(1) indicates that the
       routers duplicate packet detection is based
       upon comparing a hash over the packet fields.
       This is the default setting for this object.

       The value identificationBased(2)
       indicates that the duplicate packet
       detection relies upon header information
       in the multicast packets to identify
       previously received packets.

       This object is persistent and when written
       the entity SHOULD save the change to
       non-volatile storage."
   REFERENCE
      "Simplified Multicast Forwarding for MANET
       (SMF), Macker, J., July 2012."
   DEFVAL { hashBased }
 ::= { smfConfigurationGroup 7 }

smfIpv6Dpd  OBJECT-TYPE
   SYNTAX      INTEGER {
                      hashBased(1),
                      identificationBased(2)
                      }
   MAX-ACCESS  read-write
   STATUS      current
   DESCRIPTION
      "The current method for IPv6 duplicate packet
       detection.

       The values indicate the type of method used
       for duplicate packet detection as described
       the previous description for the object
       `smfIpv4Dpd'.

       The default value for this object is
```

          hashBased(1).

          This object is persistent and when written
          the entity SHOULD save the change to
          non-volatile storage."
       REFERENCE
          "Simplified Multicast Forwarding for MANET
          (SMF), Macker, J., July 2012."
       DEFVAL { hashBased }
    ::= { smfConfigurationGroup 8 }

    smfMaxPktLifetime OBJECT-TYPE
       SYNTAX   Integer32 (0..65535)
       UNITS   "Seconds"
       MAX-ACCESS read-write
       STATUS   current
       DESCRIPTION
          "The estimate of the network packet
           traversal time.

           This object is persistent and when written
           the entity SHOULD save the change to
           non-volatile storage."
       REFERENCE
          "Simplified Multicast Forwarding for MANET
           (SMF), Macker, J., July 2012."
       DEFVAL { 60 }
    ::= { smfConfigurationGroup 9 }

    smfDpdMaxMemorySize OBJECT-TYPE
       SYNTAX   Integer32 (0..65535)
       UNITS   "Kilo-Bytes"
       MAX-ACCESS read-write
       STATUS   current
       DESCRIPTION
          "The locally reserved memory for storage
           of cached DPD records for both IPv4 and
           IPv6 methods.

           The local SMF device should protect itself
           against the SNMP manager from requesting
           too large a memory value. If this is the case,
           an error indication should be returned in response
           to the SNMP SET request.

           This object is persistent and when written
           the entity SHOULD save the change to
           non-volatile storage."

```
      REFERENCE
         "Simplified Multicast Forwarding for MANET
          (SMF), Macker, J., July 2012."
      DEFVAL { 1024 }
   ::= { smfConfigurationGroup 10 }

   smfDpdEntryMaxLifetime  OBJECT-TYPE
      SYNTAX       Integer32 (0..65525)
      UNITS        "Seconds"
      MAX-ACCESS   read-write
      STATUS       current
      DESCRIPTION
         "The maximum lifetime of a cached DPD
          record in the local device storage.

          If the memory is running low prior to the
          MaxLifetimes being exceeded, the local SMF
          devices should purge the oldest records first.

          This object is persistent and when written
          the entity SHOULD save the change to
          non-volatile storage."
      REFERENCE
         "Simplified Multicast Forwarding for MANET
          (SMF), Macker, J., July 2012."
      DEFVAL { 600 }
   ::= { smfConfigurationGroup 11 }


   --
   -- Configuration of messages to be included in
   -- NHDP message exchanges in support of SMF
   -- operations.
   --

   smfNhdpRssaMesgTLVIncluded  OBJECT-TYPE
      SYNTAX       TruthValue
      MAX-ACCESS   read-write
      STATUS       current
      DESCRIPTION
         "Indicates whether the associated NHDP messages
          include the RSSA Message TLV, or not.  This
          is an optional SMF operational setting.
          The value true(1) indicates that this TLV is
          included; the value false(2) indicates that it
          is not included.

          It is RECOMMENDED that the RSSA Message TLV
```

          be included in the NHDP messages.

          This object is persistent and when written
          the entity SHOULD save the change to
          non-volatile storage."
      REFERENCE
         "Simplified Multicast Forwarding for MANET
          (SMF), Macker, J., July 2012."
      DEFVAL { true }
   ::= { smfConfigurationGroup 12 }

   smfNhdpRssaAddrBlockTLVIncluded OBJECT-TYPE
      SYNTAX   TruthValue
      MAX-ACCESS   read-write
      STATUS   current
      DESCRIPTION
         "Indicates whether the associated NHDP messages
          include the RSSA Address Block TLV, or not.
          This is an optional SMF operational setting.
          The value true(1) indicates that this TLV is
          included; the value false(2) indicates that it
          is not included.

          The smfNhdpRssaAddrBlockTLVIncluded is optional
          in all cases as it depends on the existence of
          an address block which may not be present.
          If this SMF device is configured with NHDP,
          then this object should be set to 'true(1)'.

          This object is persistent and when written
          the entity SHOULD save the change to
          non-volatile storage."
      REFERENCE
         "Simplified Multicast Forwarding for MANET
          (SMF), Macker, J., July 2012."
      DEFVAL { true }
   ::= { smfConfigurationGroup 13 }

   --
   -- Table identifying configured multicast addresses to be forwarded.
   --

   smfConfiguredAddrForwardingTable OBJECT-TYPE
      SYNTAX   SEQUENCE OF SmfConfiguredAddrForwardingEntry
      MAX-ACCESS not-accessible
      STATUS   current

         DESCRIPTION
            "The (conceptual) table containing information on multicast
             addresses which are to be forwarded by the SMF process.

             Entries in this table are configured. As well, addresses
             to be forwarded by the SMF device can be dynamically
             discovered by other means. The corresponding state
             table, smfDiscoveredAddrForwardingTable, contains
             these additional, dynamically discovered address for
             forwarding.

             Each row is associated with a range of multicast
             addresses, and ranges for different rows must be disjoint.

             The objects in this table are persistent and when written
             the entity SHOULD save the change to
             non-volatile storage."
         REFERENCE
            "Simplified Multicast Forwarding for MANET
             (SMF), Macker, J., July 2012."
      ::= { smfConfigurationGroup 15 }

      smfConfiguredAddrForwardingEntry OBJECT-TYPE
         SYNTAX   SmfConfiguredAddrForwardingEntry
         MAX-ACCESS not-accessible
         STATUS   current
         DESCRIPTION
            "An entry (conceptual row) containing the information on a
             particular multicast scope."
         INDEX { smfConfiguredAddrForwardingAddrType,
                 smfConfiguredAddrForwardingFirstAddr }
         ::= { smfConfiguredAddrForwardingTable 1 }

      SmfConfiguredAddrForwardingEntry ::= SEQUENCE {
         smfConfiguredAddrForwardingAddrType   InetAddressType,
         smfConfiguredAddrForwardingFirstAddr   InetAddress,
         smfConfiguredAddrForwardingLastAddr   InetAddress,
         smfConfiguredAddrForwardingStatus   RowStatus
      }

      smfConfiguredAddrForwardingAddrType OBJECT-TYPE
         SYNTAX   InetAddressType
         MAX-ACCESS not-accessible
         STATUS   current
         DESCRIPTION
            "The type of the addresses in the multicast forwarding
             range. Legal values correspond to the subset of
             address families for which multicast address allocation

          is supported.

          Only the values ipv4(1) and
          ipv6(2) are supported."
    ::= { smfConfiguredAddrForwardingEntry 1 }

    smfConfiguredAddrForwardingFirstAddr OBJECT-TYPE
       SYNTAX   InetAddress (SIZE(4|16))
       MAX-ACCESS not-accessible
       STATUS   current
       DESCRIPTION
          "The first address in the multicast scope range. The type
           of this address is determined by the value of the
           smfConfiguredAddrForwardingAddrType object."
    ::= { smfConfiguredAddrForwardingEntry 2 }

    smfConfiguredAddrForwardingLastAddr OBJECT-TYPE
       SYNTAX   InetAddress (SIZE(4|16))
       MAX-ACCESS read-create
       STATUS   current
       DESCRIPTION
          "The last address in the multicast scope range.
           The type of this address is determined by the
           value of the smfConfiguredAddrForwardingAddrType
           object."
    ::= { smfConfiguredAddrForwardingEntry 3 }

    smfConfiguredAddrForwardingStatus OBJECT-TYPE
       SYNTAX   RowStatus
       MAX-ACCESS read-create
       STATUS   current
       DESCRIPTION
          "The status of this row, by which new entries may be
           created, or old entries deleted from this table. If write
           access is supported, the other writable objects in this
           table may be modified even while the status is `active'."
    ::= { smfConfiguredAddrForwardingEntry 4 }

    --
    -- SMF Interfaces Configuration Table
    --

    smfInterfaceTable OBJECT-TYPE
       SYNTAX   SEQUENCE OF SmfInterfaceEntry
       MAX-ACCESS not-accessible
       STATUS   current

          DESCRIPTION
              "The SMF Interface Table describes the SMF
               interfaces that are participating in the
               SMF packet forwarding process. The ifIndex is
               from the interfaces group defined in the
               Interfaces Group MIB (RFC 2863). As such,
               this table 'sparse augments' the ifTable
               specifically when SMF is to be configured to
               operate over this interface.

               A conceptual row in this table exists if and only
               if either a manager has explicitly created the row
               or there is an interface on the managed device
               that supports and runs SMF.

               The manager can create a row by setting
               rowStatus to 'createAndGo' or 'createAndWait'.
               Row objects having associated DEFVAL clauses are
               automatically defined by the agent with these
               values during row creation, unless the manager
               explicitly defines these object values during the
               row creation.

               If the corresponding entry with ifIndex value
               is deleted from the Interface Table, then the entry
               in this table is automatically deleted and
               SMF is disabled on this interface,
               and all configuration and state information
               related to this interface is to be removed
               from memory."
          REFERENCE
              "RFC 2863 - The Interfaces Group MIB, McCloghrie,
               K., and F. Kastenholtz, June 2000."
          ::= { smfConfigurationGroup 16 }

      smfInterfaceEntry OBJECT-TYPE
          SYNTAX   SmfInterfaceEntry
          MAX-ACCESS   not-accessible
          STATUS   current
          DESCRIPTION
              "The SMF interface entry describes one SMF
               interface as indexed by its ifIndex.

               The objects in this table are persistent and when
               written the device SHOULD save the change to
               non-volatile storage. For further information
               on the storage behavior for these objects, refer
               to the description for the smfIfRowStatus

```
         object."
      INDEX { smfIfIndex }
   ::= { smfInterfaceTable 1 }

   SmfInterfaceEntry ::=
      SEQUENCE {
         smfIfIndex        InterfaceIndexOrZero,
         smfIfName         DisplayString,
         smfIfAdminStatus  SmfStatus,
         smfIfRowStatus    RowStatus
         }

   smfIfIndex  OBJECT-TYPE
      SYNTAX      InterfaceIndexOrZero
      MAX-ACCESS  not-accessible
      STATUS      current
      DESCRIPTION
         "The ifIndex for this SMF interface. This value
          MUST correspond to an ifIndex referring
          to a valid entry in The Interfaces Table."
      REFERENCE
         "RFC 2863 - The Interfaces Group MIB, McCloghrie,
          K., and F. Kastenholtz, June 2000."
      ::= { smfInterfaceEntry 1 }

   smfIfName  OBJECT-TYPE
      SYNTAX      DisplayString
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "The textual name of the interface.  The value of this
         object should be the name of the interface as assigned by
         the local device and should be suitable for use in commands
         entered at the device's `console'.  This might be a text
         name, such as `le0' or a simple port number, such as `1',
         depending on the interface naming syntax of the device.

         If there is no local name, or this object is otherwise not
         applicable, then this object contains a zero-length string."
   ::= { smfInterfaceEntry 2 }

   smfIfAdminStatus OBJECT-TYPE
      SYNTAX      SmfStatus
      MAX-ACCESS  read-create
      STATUS      current
      DESCRIPTION
          "The SMF interface's administrative status.
           The value 'enabled' denotes that the interface
```

            is running the SMF forwarding process.
            The value 'disabled' denotes that the interface is
            external to the SMF forwarding process.
            "
       ::= { smfInterfaceEntry 3 }

    smfIfRowStatus OBJECT-TYPE
       SYNTAX   RowStatus
       MAX-ACCESS   read-create
       STATUS   current
       DESCRIPTION
          "This object permits management of the table
           by facilitating actions such as row creation,
           construction, and destruction. The value of
           this object has no effect on whether other
           objects in this conceptual row can be
           modified.

           An entry may not exist in the active(1) state unless all
           objects in the entry have a defined appropriate value. For
           objects with DEFVAL clauses, the management station
           does not need to specify the value of this object in order
           for the row to transit to the active(1) state; the default
           value for this object is used. For objects that do not
           have DEFVAL clauses, then the network manager MUST
           specify the value of this object prior to this row
           transitioning to the active(1) state.

           When this object transitions to active(1), all objects
           in this row SHOULD be written to non-volatile (stable)
           storage. Read-create objects in this row MAY be modified.
           When an object in a row with smfIfRowStatus of active(1)
           is changed, then the updated value MUST be reflected in SMF
           and this new object value MUST be written to non-volatile
           storage.

           If this object is not equal to active(1), all associated
           entries in the smfIpv4InterfaceperfTable and the
           smfIpv6InterfacePerfTable MUST be deleted."
       ::= { smfInterfaceEntry 4 }

       --
       -- smfStateGroup
       --
       --   Contains information describing the current state of the SMF
       --   process such as the current inclusion in the RS or not.
       --

```
    smfStateGroup  OBJECT IDENTIFIER ::= { smfMIBObjects 3 }

    smfNodeRsStatusIncluded  OBJECT-TYPE
       SYNTAX       TruthValue
       MAX-ACCESS   read-only
       STATUS       current
       DESCRIPTION
          "The current status of the SMF node in the context of
           the MANETs relay set. A value of true(1) indicates
           that the node is currently part of the MANET Relay
           Set. A value of false(2) indicates that the node
           is currently not part of the MANET Relay Set."
       REFERENCE
          "Simplified Multicast Forwarding for MANET
           (SMF), Macker, J., July 2012."
    ::= { smfStateGroup 1 }

    smfDpdMemoryOverflow  OBJECT-TYPE
       SYNTAX       Counter32
       MAX-ACCESS   read-only
       STATUS       current
       DESCRIPTION
          "The number of times that the memory for caching
           records for DPD overran and records had to be flushed.
           The number of records to be flushed upon a buffer
           overflow is an implementation specific decision."
       REFERENCE
          "Simplified Multicast Forwarding for MANET
           (SMF), Macker, J., July 2012."
    ::= { smfStateGroup 2 }



    --
    -- Dynamically Discovered Multicast Addr Table
    --

    smfDiscoveredAddrForwardingTable  OBJECT-TYPE
       SYNTAX       SEQUENCE OF SmfDiscoveredAddrForwardingEntry
       MAX-ACCESS not-accessible
       STATUS       current
       DESCRIPTION
          "This state  table, smfDiscoveredAddrForwardingTable
           contains additional, dynamically discovered address
           for forwarding.

           Each row is associated with a range of
           multicast addresses, and ranges for different rows
```

```
         must be disjoint."
      REFERENCE
         "Simplified Multicast Forwarding for MANET
          (SMF), Macker, J., July 2012."
   ::= { smfStateGroup 3 }

   smfDiscoveredAddrForwardingEntry OBJECT-TYPE
      SYNTAX      SmfDiscoveredAddrForwardingEntry
      MAX-ACCESS not-accessible
      STATUS      current
      DESCRIPTION
         "An entry (conceptual row) containing the information on a
          particular multicast scope."
      INDEX { smfDiscoveredAddrForwardingAddrType,
             smfDiscoveredAddrForwardingFirstAddr }
      ::= { smfDiscoveredAddrForwardingTable 1 }

   SmfDiscoveredAddrForwardingEntry ::= SEQUENCE {
      smfDiscoveredAddrForwardingAddrType   InetAddressType,
      smfDiscoveredAddrForwardingFirstAddr  InetAddress,
      smfDiscoveredAddrForwardingLastAddr    InetAddress
   }

   smfDiscoveredAddrForwardingAddrType OBJECT-TYPE
      SYNTAX      InetAddressType
      MAX-ACCESS not-accessible
      STATUS      current
      DESCRIPTION
         "The type of the addresses in the multicast forwarding
          range.  Legal values correspond to the subset of
          address families for which multicast address allocation
          is supported.

          Only the values ipv4(1) and
          ipv6(2) are supported."
   ::= { smfDiscoveredAddrForwardingEntry 1 }

   smfDiscoveredAddrForwardingFirstAddr OBJECT-TYPE
      SYNTAX      InetAddress (SIZE(4|16))
      MAX-ACCESS not-accessible
      STATUS      current
      DESCRIPTION
         "The first address in the multicast scope range.  The type
          of this address is determined by the value of the
          smfConfiguredAddrForwardingAddrType object."
   ::= { smfDiscoveredAddrForwardingEntry 2 }

   smfDiscoveredAddrForwardingLastAddr OBJECT-TYPE
```

```
      SYNTAX      InetAddress (SIZE(4|16))
      MAX-ACCESS read-create
      STATUS      current
      DESCRIPTION
         "The last address in the multicast scope range.
          The type of this address is determined by the
          value of the smfConfiguredAddrForwardingAddrType
          object."
   ::= { smfDiscoveredAddrForwardingEntry 3 }


   --
   -- SMF Neighbor Table
   --

   smfNeighborTable  OBJECT-TYPE
      SYNTAX       SEQUENCE OF SmfNeighborEntry
      MAX-ACCESS   not-accessible
      STATUS       current
      DESCRIPTION
         "The SMF NeighborTable describes the
          current neighbor nodes, their address
          and SMF RSSA and the interface on which
          they can be reached."
      REFERENCE
         "Simplified Multicast Forwarding for MANET
          (SMF), Macker, J., July 2012.
          Section 7: SMF Neighborhood Discovery
          Requirements."
   ::= { smfStateGroup 4 }

   smfNeighborEntry  OBJECT-TYPE
      SYNTAX       SmfNeighborEntry
      MAX-ACCESS   not-accessible
      STATUS       current
      DESCRIPTION
         "The SMF Neighbor Table contains the
          set of one-hop neighbors, the interface
          they are reachable on and the SMF RSSA
          they are currently running."
      INDEX { smfNeighborIpAddrType,
              smfNeighborIpAddr,
              smfNeighborPrefixLen }
   ::= { smfNeighborTable 1 }

   SmfNeighborEntry ::=
      SEQUENCE {
         smfNeighborIpAddrType       InetAddressType,
```

```
        smfNeighborIpAddr              InetAddress,
        smfNeighborPrefixLen           InetAddressPrefixLength,
        smfNeighborRSSA                SmfRssaID,
        smfNeighborNextHopInterface    InterfaceIndexOrZero
        }

smfNeighborIpAddrType  OBJECT-TYPE
   SYNTAX      InetAddressType
   MAX-ACCESS  not-accessible
   STATUS      current
   DESCRIPTION
      "The neighbor IP address type.

       Only the values ipv4(1) and
       ipv6(2) are supported."
::= { smfNeighborEntry 1 }

smfNeighborIpAddr  OBJECT-TYPE
   SYNTAX      InetAddress (SIZE(4|16))
   MAX-ACCESS  not-accessible
   STATUS      current
   DESCRIPTION
      "The neighbor Inet IPv4 or IPv6 address."
::= { smfNeighborEntry 2 }

smfNeighborPrefixLen  OBJECT-TYPE
   SYNTAX      InetAddressPrefixLength
   MAX-ACCESS  not-accessible
   STATUS      current
   DESCRIPTION
      "The prefix length. This is a decimal value that
       indicates the number of contiguous, higher-order
       bits of the address that make up the network
       portion of the address."
::= { smfNeighborEntry 3 }

smfNeighborRSSA  OBJECT-TYPE
   SYNTAX      SmfRssaID
   MAX-ACCESS  read-only
   STATUS      current
   DESCRIPTION
      "The current RSSA running on the neighbor.
       The list is identical to that described
       above for the smfRssa object."
::= { smfNeighborEntry 4 }

smfNeighborNextHopInterface OBJECT-TYPE
   SYNTAX      InterfaceIndexOrZero
```

```
      MAX-ACCESS    read-only
      STATUS        current
      DESCRIPTION
         "The interface ifIndex over which the
          neighbor is reachable in one-hop."
   ::= { smfNeighborEntry 5 }




   --
   -- SMF Performance Group
   --
   --    Contains objects which help to characterize the
   --    performance of the SMF RSSA process, such as statistics
   --    counters. There are two types of SMF RSSA statistics:
   --    global counters and per interface counters.
   --

   smfPerformanceGroup  OBJECT IDENTIFIER ::= { smfMIBObjects 4 }

   smfGlobalPerfGroup  OBJECT IDENTIFIER ::= { smfPerformanceGroup 1 }

   --
   -- IPv4 packet counters
   --

   smfIpv4MultiPktsRecvTotal  OBJECT-TYPE
      SYNTAX        Counter32
      MAX-ACCESS  read-only
      STATUS        current
      DESCRIPTION
         "A counter of the total number of
          multicast IPv4 packets received by the
          device."
      REFERENCE
         "Simplified Multicast Forwarding for MANET
          (SMF), Macker, J., July 2012."
   ::= { smfGlobalPerfGroup 1 }

   smfIpv4MultiPktsForwardedTotal  OBJECT-TYPE
      SYNTAX        Counter32
      MAX-ACCESS  read-only
      STATUS        current
      DESCRIPTION
         "A counter of the total number of
          multicast IPv4 packets forwarded by the
          device."
```

```
      REFERENCE
         "Simplified Multicast Forwarding for MANET
          (SMF), Macker, J., July 2012."
   ::= { smfGlobalPerfGroup 2 }

   smfIpv4DuplMultiPktsDetectedTotal  OBJECT-TYPE
      SYNTAX       Counter32
      MAX-ACCESS   read-only
      STATUS       current
      DESCRIPTION
         "A counter of the total number of duplicate
          multicast IPv4 packets detected by the
          device."
      REFERENCE
         "Simplified Multicast Forwarding for MANET
          (SMF), Macker, J., July 2012."
   ::= { smfGlobalPerfGroup 3 }

   smfIpv4DroppedMultiPktsTTLExceededTotal  OBJECT-TYPE
      SYNTAX       Counter32
      MAX-ACCESS   read-only
      STATUS       current
      DESCRIPTION
         "A counter of the total number of dropped
          multicast IPv4 packets by the
          device due to TTL exceeded."
      REFERENCE
         "Simplified Multicast Forwarding for MANET
          (SMF), Macker, J., July 2012."
   ::= { smfGlobalPerfGroup 4 }

   smfIpv4TTLLargerThanPreviousTotal  OBJECT-TYPE
      SYNTAX       Counter32
      MAX-ACCESS   read-only
      STATUS       current
      DESCRIPTION
         "A counter of the total number of IPv4 packets
          recieved which have a TTL larger than that
          of a previously received identical packet."
      REFERENCE
         "Simplified Multicast Forwarding for MANET
          (SMF), Macker, J., July 2012."
   ::= { smfGlobalPerfGroup 5 }

   --
   -- IPv6 packet counters
   --
```

```
   smfIpv6MultiPktsRecvTotal  OBJECT-TYPE
      SYNTAX       Counter32
      MAX-ACCESS   read-only
      STATUS       current
      DESCRIPTION
         "A counter of the total number of
          multicast IPv6 packets received by the
          device."
      REFERENCE
         "Simplified Multicast Forwarding for MANET
          (SMF), Macker, J., July 2012."
   ::= { smfGlobalPerfGroup 6 }

   smfIpv6MultiPktsForwardedTotal  OBJECT-TYPE
      SYNTAX       Counter32
      MAX-ACCESS   read-only
      STATUS       current
      DESCRIPTION
         "A counter of the total number of
          multicast IPv6 packets forwarded by the
          device."
      REFERENCE
         "Simplified Multicast Forwarding for MANET
          (SMF), Macker, J., July 2012."
   ::= { smfGlobalPerfGroup 7 }

   smfIpv6DuplMultiPktsDetectedTotal  OBJECT-TYPE
      SYNTAX       Counter32
      MAX-ACCESS   read-only
      STATUS       current
      DESCRIPTION
         "A counter of the total number of duplicate
          multicast IPv6 packets detected by the
          device."
      REFERENCE
         "Simplified Multicast Forwarding for MANET
          (SMF), Macker, J., July 2012."
   ::= { smfGlobalPerfGroup 8 }

   smfIpv6DroppedMultiPktsTTLExceededTotal  OBJECT-TYPE
      SYNTAX       Counter32
      MAX-ACCESS   read-only
      STATUS       current
      DESCRIPTION
         "A counter of the total number of dropped
          multicast IPv6 packets by the
          device due to TTL exceeded."
      REFERENCE
```

```
         "Simplified Multicast Forwarding for MANET
          (SMF), Macker, J., July 2012."
   ::= { smfGlobalPerfGroup 9 }

   smfIpv6TTLLargerThanPreviousTotal  OBJECT-TYPE
      SYNTAX      Counter32
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "A counter of the total number of IPv6 packets
          recieved which have a TTL larger than that
          of a previously recived identical packet."
      REFERENCE
         "Simplified Multicast Forwarding for MANET
          (SMF), Macker, J., July 2012."
   ::= { smfGlobalPerfGroup 10 }

   smfIpv6HAVAssistsReqdTotal  OBJECT-TYPE
      SYNTAX      Counter32
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "A counter of the total number of IPv6 packets
          recieved which required the HAV assist for DPD."
      REFERENCE
         "Simplified Multicast Forwarding for MANET
          (SMF), Macker, J., July 2012."
   ::= { smfGlobalPerfGroup 11 }

   smfIpv6DpdHeaderInsertionsTotal  OBJECT-TYPE
      SYNTAX      Counter32
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "A counter of the total number of IPv6 packets
          recieved which the device inserted the
          DPD header option."
      REFERENCE
         "Simplified Multicast Forwarding for MANET
          (SMF), Macker, J., July 2012."
   ::= { smfGlobalPerfGroup 12 }


   --
   -- Per SMF Interface Performance Table
   --

   smfInterfacePerfGroup OBJECT IDENTIFIER ::= { smfPerformanceGroup 2 }
```

    smfIpv4InterfacePerfTable OBJECT-TYPE
       SYNTAX   SEQUENCE OF SmfIpv4InterfacePerfEntry
       MAX-ACCESS   not-accessible
       STATUS   current
       DESCRIPTION
          "The SMF Interface Performance Table
           describes the SMF statistics per
           interface."
       REFERENCE
          "Simplified Multicast Forwarding for MANET
           (SMF), Macker, J., July 2012."
    ::= { smfInterfacePerfGroup 1 }

    smfIpv4InterfacePerfEntry OBJECT-TYPE
       SYNTAX   SmfIpv4InterfacePerfEntry
       MAX-ACCESS   not-accessible
       STATUS   current
       DESCRIPTION
          "The SMF Interface Performance entry
           describes the statistics for a particular
           node interface."
       INDEX { smfIfIndex }
    ::= { smfIpv4InterfacePerfTable 1 }

    SmfIpv4InterfacePerfEntry ::=
       SEQUENCE {
          smfIpv4MultiPktsRecvPerIf   Counter32,
          smfIpv4MultiPktsForwardedPerIf   Counter32,
          smfIpv4DuplMultiPktsDetectedPerIf   Counter32,
          smfIpv4DroppedMultiPktsTTLExceededPerIf Counter32,
          smfIpv4TTLLargerThanPreviousPerIf   Counter32
          }

    smfIpv4MultiPktsRecvPerIf OBJECT-TYPE
       SYNTAX   Counter32
       MAX-ACCESS read-only
       STATUS   current
       DESCRIPTION
          "A counter of the number of
           multicast IP packets received by the
           device on this interface."
    ::= { smfIpv4InterfacePerfEntry 1 }

    smfIpv4MultiPktsForwardedPerIf OBJECT-TYPE
       SYNTAX   Counter32
       MAX-ACCESS read-only
       STATUS   current
       DESCRIPTION

```
          "A counter of the number of
           multicast IP packets forwarded by the
           device on this interface."
   ::= { smfIpv4InterfacePerfEntry 2 }


   smfIpv4DuplMultiPktsDetectedPerIf  OBJECT-TYPE
      SYNTAX       Counter32
      MAX-ACCESS   read-only
      STATUS       current
      DESCRIPTION
          "A counter of the number of duplicate
           multicast IP packets detected by the
           device on this interface."
   ::= { smfIpv4InterfacePerfEntry 3 }


   smfIpv4DroppedMultiPktsTTLExceededPerIf  OBJECT-TYPE
      SYNTAX       Counter32
      MAX-ACCESS   read-only
      STATUS       current
      DESCRIPTION
          "A counter of the total number of dropped
           multicast IPv4 packets by the
           device due to TTL exceeded."
   ::= { smfIpv4InterfacePerfEntry 4 }


   smfIpv4TTLLargerThanPreviousPerIf  OBJECT-TYPE
      SYNTAX       Counter32
      MAX-ACCESS   read-only
      STATUS       current
      DESCRIPTION
          "A counter of the total number of IPv4 packets
           recieved which have a TTL larger than that
           of a previously recived identical packet.
          "
   ::= { smfIpv4InterfacePerfEntry 5 }



   smfIpv6InterfacePerfTable OBJECT-TYPE
      SYNTAX        SEQUENCE OF SmfIpv6InterfacePerfEntry
      MAX-ACCESS    not-accessible
      STATUS        current
      DESCRIPTION
          "The SMF Interface Performance Table
           describes the SMF statistics per
           interface."
      REFERENCE
          "Simplified Multicast Forwarding for MANET
           (SMF), Macker, J., July 2012."
```

```
   ::= { smfInterfacePerfGroup 2 }

   smfIpv6InterfacePerfEntry OBJECT-TYPE
      SYNTAX        SmfIpv6InterfacePerfEntry
      MAX-ACCESS    not-accessible
      STATUS        current
      DESCRIPTION
         "The SMF Interface Performance entry
          describes the statistics for a particular
          node interface."
      INDEX { smfIfIndex }
   ::= { smfIpv6InterfacePerfTable 1 }

   SmfIpv6InterfacePerfEntry ::=
      SEQUENCE {
         smfIpv6MultiPktsRecvPerIf              Counter32,
         smfIpv6MultiPktsForwardedPerIf         Counter32,
         smfIpv6DuplMultiPktsDetectedPerIf      Counter32,
         smfIpv6DroppedMultiPktsTTLExceededPerIf Counter32,
         smfIpv6TTLLargerThanPreviousPerIf      Counter32,
         smfIpv6HAVAssistsReqdPerIf             Counter32,
         smfIpv6DpdHeaderInsertionsPerIf        Counter32
         }

   smfIpv6MultiPktsRecvPerIf  OBJECT-TYPE
      SYNTAX        Counter32
      MAX-ACCESS    read-only
      STATUS        current
      DESCRIPTION
         "A counter of the number of
          multicast IP packets received by the
          device on this interface."
   ::= { smfIpv6InterfacePerfEntry 1 }

   smfIpv6MultiPktsForwardedPerIf  OBJECT-TYPE
      SYNTAX        Counter32
      MAX-ACCESS    read-only
      STATUS        current
      DESCRIPTION
         "A counter of the number of
          multicast IP packets forwarded by the
          device on this interface."
   ::= { smfIpv6InterfacePerfEntry 2 }

   smfIpv6DuplMultiPktsDetectedPerIf  OBJECT-TYPE
      SYNTAX        Counter32
      MAX-ACCESS    read-only
      STATUS        current
```

```
      DESCRIPTION
         "A counter of the number of duplicate
          multicast IP packets detected by the
          device on this interface."
   ::= { smfIpv6InterfacePerfEntry 3 }

   smfIpv6DroppedMultiPktsTTLExceededPerIf  OBJECT-TYPE
      SYNTAX      Counter32
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "A counter of the number of dropped
          multicast IP packets by the
          device on this interface due to TTL
          exceeded."
   ::= { smfIpv6InterfacePerfEntry 4 }

   smfIpv6TTLLargerThanPreviousPerIf  OBJECT-TYPE
      SYNTAX      Counter32
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "A counter of the total number of IPv6 packets
          recieved which have a TTL larger than that
          of a previously recieved identical packet."
   ::= { smfIpv6InterfacePerfEntry 5 }

   smfIpv6HAVAssistsReqdPerIf  OBJECT-TYPE
      SYNTAX      Counter32
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "A counter of the total number of IPv6 packets
          recieved which required the HAV assist for DPD."
   ::= { smfIpv6InterfacePerfEntry 6 }

   smfIpv6DpdHeaderInsertionsPerIf  OBJECT-TYPE
      SYNTAX      Counter32
      MAX-ACCESS  read-only
      STATUS      current
      DESCRIPTION
         "A counter of the total number of IPv6 packets
          recieved which the device inserted the
          DPD header option."
   ::= { smfIpv6InterfacePerfEntry 7 }
```

```
   --
   -- Notifications
   --

smfMIBNotifObjects OBJECT IDENTIFIER ::= { smfMIBNotifications 0 }
smfMIBNotifControl OBJECT IDENTIFIER ::= { smfMIBNotifications 1 }


   -- smfMIBNotifObjects

   smfAdminStatusChange NOTIFICATION-TYPE
         OBJECTS { smfRouterIDAddrType, -- The originator of
                                        --   the notification.
                   smfRouterID,         -- The originator of
                                        --   the notification.
                   smfAdminStatus       -- The new status of the
                                        --   SMF process.
                 }
         STATUS      current
         DESCRIPTION
            "smfAdminStatusChange is a notification sent when a
             the 'smfAdminStatus' object changes."
         ::= { smfMIBNotifObjects 1 }

   smfConfiguredOpModeChange NOTIFICATION-TYPE
         OBJECTS { smfRouterIDAddrType, -- The originator of
                                        --   the notification.
                   smfRouterID,         -- The originator of
                                        --   the notification.
                   smfConfiguredOpMode  -- The new Operations
                                        --   Mode of the SMF
                                        --   process.
                 }
         STATUS      current
         DESCRIPTION
            "smfConfiguredOpModeChange is a notification
             sent when a the 'smfConfiguredOpMode' object
             changes."
         ::= { smfMIBNotifObjects 2 }

   smfConfiguredRssaChange NOTIFICATION-TYPE
         OBJECTS { smfRouterIDAddrType, -- The originator of
                                        --   the notification.
                   smfRouterID,         -- The originator of
                                        --   the notification.
                   smfConfiguredRssa    -- The new RSSA for
                                        --   the SMF process.
                 }
```

```
          STATUS       current
          DESCRIPTION
             "smfAdminStatusChange is a notification sent when a
              the 'smfConfiguredRssa' object changes."
          ::= { smfMIBNotifObjects 3 }

   smfIfAdminStatusChange NOTIFICATION-TYPE
          OBJECTS { smfRouterIDAddrType, -- The originator of
                                         --   the notification.
                    smfRouterID,         -- The originator of
                                         --   the notification.
                    smfIfName,           -- The interface whose
                                         --   status has changed.
                    smfIfAdminStatus     -- The new status of the
                                         --   SMF interface.
                  }
          STATUS       current
          DESCRIPTION
             "smfIfAdminStatusChange is a notification sent when a
              the 'smfIfAdminStatus' object changes."
          ::= { smfMIBNotifObjects 4 }

    smfDpdMemoryOverflowEvent NOTIFICATION-TYPE
          OBJECTS { smfRouterIDAddrType, -- The originator of
                                         --   the notification.
                    smfRouterID,         -- The originator of
                                         --   the notification.
                    smfDpdMemoryOverflow -- The counter of
                                         --   the overflows.
              }
          STATUS       current
          DESCRIPTION
             "smfDpdMemoryOverflowEvents is sent when the
              number of memory overflow events exceeds the
              the 'smfDpdMemoryOverflowThreshold' within the
              previous number of seconds defined by the
              'smfDpdMemoryOverflowWindow'."
          ::= { smfMIBNotifObjects 5 }

   smfIpv4DuplMultiPktsDetectedTotalEvents NOTIFICATION-TYPE
          OBJECTS { smfRouterIDAddrType, -- The originator of
                                         --   the notification.
                    smfRouterID,         -- The originator of
                                         --   the notification.
                    smfIpv4DuplMultiPktsDetectedTotal
                                         -- The counter of detected
                                         --   duplicates.
              }
```

```
          STATUS       current
          DESCRIPTION
            "smfIpv4DuplMultiPktsDetectedTotal is a
             notification sent when the number of
             IPv4 duplicate packets detected exceeds the
             'smfIpv4DuplMultiPktsDetectedTotalThreshold'
             during the previous number of seconds
             'smfIpv4DuplPktsDetectedTotalWindow'."
          ::= { smfMIBNotifObjects 6 }

   smfIpv6DuplMultiPktsDetectedTotalEvents NOTIFICATION-TYPE
          OBJECTS { smfRouterIDAddrType, -- The originator of
                                         --   the notification.
                   smfRouterID,          -- The originator of
                                         --   the notification.
                   smfIpv6DuplMultiPktsDetectedTotal
                                         -- The counter of detected
                                         --   duplicates.
              }
          STATUS       current
          DESCRIPTION
            "smfIpv6DuplMultiPktsDetectedTotal is a
             notification sent when the number of
             IPv6 duplicate packets detected exceeds the
             'smfIpv6DuplMultiPktsDetectedTotalThreshold'
             during the previous number of seconds
             'smfIpv6DuplPktsDetectedTotalWindow'."
          ::= { smfMIBNotifObjects 7 }


   -- smfMIBNotifControl
   smfDpdMemoryOverflowThreshold OBJECT-TYPE
          SYNTAX       Integer32 (0..255)
          MAX-ACCESS   read-write
          STATUS       current
          DESCRIPTION
            "A threshold value for the
             `smfDpdmemoryOverflowEvents' object.
             If the number of occurences exceeds
             this threshold within the previous
             number of seconds
             'smfDpdMemoryOverflowWindow',
             then the `smfDpdMemoryOverflowEvent'
             notification is sent."
           ::= { smfMIBNotifControl 1 }

   smfDpdMemoryOverflowWindow OBJECT-TYPE
          SYNTAX       TimeTicks
```

```
          MAX-ACCESS    read-write
          STATUS        current
          DESCRIPTION
             "A time window value for the
              `smfDpdmemoryOverflowEvents' object.
              If the number of occurences exceeds
              the `smfDpdMemoryOverflowThreshold'
              within the previous number of seconds
              'smfDpdMemoryOverflowWindow',
              then the `smfDpdMemoryOverflowEvent'
              notification is sent."
           ::= { smfMIBNotifControl 2 }

   smfIpv4DuplMultiPktsDetectedTotalThreshold OBJECT-TYPE
          SYNTAX        Integer32 (0..255)
          MAX-ACCESS    read-write
          STATUS        current
          DESCRIPTION
             "A threshold value for the
              `smfIpv4DuplMultiPktsDetectedTotal'
              object.  If the number of occurences
              exceeds this threshold within the
              previous number of seconds
              `smfIpv4DuplMultiPktsDetectedTotalWindow',
              then the
              `smfIpv4DuplMultiPktsDetectedTotalEvent'
              notification is sent."
           ::= { smfMIBNotifControl 3 }

   smfIpv4DuplMultiPktsDetectedTotalWindow OBJECT-TYPE
          SYNTAX        TimeTicks
          MAX-ACCESS    read-write
          STATUS        current
          DESCRIPTION
             "A time window value for the
              `smfIpv4DuplMultiPktsDetectedTotalEvents'
              object.  If the number of occurences
              exceeds the
              `smfIpv4DuplMultiPktsDetectedTotalThreshold'
              within the previous number of seconds
              'smfIpv4DuplMultiPktsDetectedTotalWindow',
              then the
              `smfIpv4DuplMultiPktsDetectedTotalEvent'
              notification is sent."
           ::= { smfMIBNotifControl 4 }

   smfIpv6DuplMultiPktsDetectedTotalThreshold OBJECT-TYPE
          SYNTAX        Integer32 (0..255)
```

```
          MAX-ACCESS   read-write
          STATUS       current
          DESCRIPTION
             "A threshold value for the
              `smfIpv6DuplMultiPktsDetectedTotal'
              object.  If the number of occurences
              exceeds this threshold within the
              previous number of seconds
              `smfIpv6DuplMultiPktsDetectedTotalWindow',
              then the
              `smfIpv6DuplMultiPktsDetectedTotalEvent'
              notification is sent."
           ::= { smfMIBNotifControl 5 }

   smfIpv6DuplMultiPktsDetectedTotalWindow OBJECT-TYPE
          SYNTAX       TimeTicks
          MAX-ACCESS   read-write
          STATUS       current
          DESCRIPTION
             "A time window value for the
              `smfIpv6DuplMultiPktsDetectedTotalEvents'
              object.  If the number of occurences
              exceeds the
              `smfIpv6DuplMultiPktsDetectedTotalThreshold'
              within the previous number of seconds
              'smfIpv6DuplMultiPktsDetectedTotalWindow',
              then the
              `smfIpv6DuplMultiPktsDetectedTotalEvent'
              notification is sent."
           ::= { smfMIBNotifControl 6 }


   --
   -- Compliance Statements
   --

   smfCompliances  OBJECT IDENTIFIER ::= { smfMIBConformance 1 }
   smfMIBGroups    OBJECT IDENTIFIER ::= { smfMIBConformance 2 }

   smfBasicCompliance  MODULE-COMPLIANCE
      STATUS current
      DESCRIPTION "The basic implementation requirements for
                   managed network entities that implement
                   the SMF RSSA process."
      MODULE  -- this module
      MANDATORY-GROUPS { smfCapabObjectsGroup,
                         smfConfigObjectsGroup }
   ::= { smfCompliances 1 }
```

    smfFullCompliance MODULE-COMPLIANCE
        STATUS current
        DESCRIPTION "The full implementation requirements for
                     managed network entities that implement
                     the SMF RSSA process."
        MODULE -- this module
        MANDATORY-GROUPS { smfCapabObjectsGroup,
                           smfConfigObjectsGroup,
                           smfStateObjectsGroup,
                           smfPerfObjectsGroup,
                           smfNotifObjectsGroup,
                           smfNotificationsGroup
                         }
    ::= { smfCompliances 2 }

    --
    -- Units of Conformance
    --

    smfCapabObjectsGroup OBJECT-GROUP
       OBJECTS {
               smfOpModeCapabilitiesName,
               smfOpModeCapabilitiesReference,

               smfRssaCapabilitiesName,
               smfRssaCapabilitiesReference
       }
       STATUS current
       DESCRIPTION
          "Set of SMF configuration objects implemented
           in this module."
    ::= { smfMIBGroups 1 }

    smfConfigObjectsGroup OBJECT-GROUP
       OBJECTS {
               smfAdminStatus,
               smfRouterIDAddrType,
               smfRouterID,
               smfIfName,
               smfConfiguredOpMode,
               smfConfiguredRssa,
               smfRssaMember,
               smfIpv4Dpd,
               smfIpv6Dpd,
               smfMaxPktLifetime,
               smfDpdMaxMemorySize,
               smfDpdEntryMaxLifetime,
               smfNhdpRssaMesgTLVIncluded,

```
            smfNhdpRssaAddrBlockTLVIncluded,

            smfConfiguredAddrForwardingLastAddr,
            smfConfiguredAddrForwardingStatus,

            smfIfAdminStatus,
            smfIfRowStatus
    }
    STATUS  current
    DESCRIPTION
       "Set of SMF configuration objects implemented
        in this module."
 ::= { smfMIBGroups 2 }

 smfStateObjectsGroup  OBJECT-GROUP
    OBJECTS {
            smfNodeRsStatusIncluded,
            smfDpdMemoryOverflow,

            smfDiscoveredAddrForwardingLastAddr,

            smfNeighborRSSA,
            smfNeighborNextHopInterface
    }
    STATUS  current
    DESCRIPTION
       "Set of SMF state objects implemented
        in this module."
 ::= { smfMIBGroups 3 }

 smfPerfObjectsGroup  OBJECT-GROUP
    OBJECTS {
            smfIpv4MultiPktsRecvTotal,
            smfIpv4MultiPktsForwardedTotal,
            smfIpv4DuplMultiPktsDetectedTotal,
            smfIpv4DroppedMultiPktsTTLExceededTotal,
            smfIpv4TTLLargerThanPreviousTotal,

            smfIpv6MultiPktsRecvTotal,
            smfIpv6MultiPktsForwardedTotal,
            smfIpv6DuplMultiPktsDetectedTotal,
            smfIpv6DroppedMultiPktsTTLExceededTotal,
            smfIpv6TTLLargerThanPreviousTotal,
            smfIpv6HAVAssistsReqdTotal,
            smfIpv6DpdHeaderInsertionsTotal,

            smfIpv4MultiPktsRecvPerIf,
            smfIpv4MultiPktsForwardedPerIf,
```

```
            smfIpv4DuplMultiPktsDetectedPerIf,
            smfIpv4DroppedMultiPktsTTLExceededPerIf,
            smfIpv4TTLLargerThanPreviousPerIf,

            smfIpv6MultiPktsRecvPerIf,
            smfIpv6MultiPktsForwardedPerIf,
            smfIpv6DuplMultiPktsDetectedPerIf,
            smfIpv6DroppedMultiPktsTTLExceededPerIf,
            smfIpv6TTLLargerThanPreviousPerIf,
            smfIpv6HAVAssistsReqdPerIf,
            smfIpv6DpdHeaderInsertionsPerIf
    }
    STATUS  current
    DESCRIPTION
        "Set of SMF performance objects implemented
         in this module by total and per interface."
 ::= { smfMIBGroups 4 }

 smfNotifObjectsGroup  OBJECT-GROUP
    OBJECTS {
            smfDpdMemoryOverflowThreshold,
            smfDpdMemoryOverflowWindow,
            smfIpv4DuplMultiPktsDetectedTotalThreshold,
            smfIpv4DuplMultiPktsDetectedTotalWindow,
            smfIpv6DuplMultiPktsDetectedTotalThreshold,
            smfIpv6DuplMultiPktsDetectedTotalWindow
    }
    STATUS  current
    DESCRIPTION
        "Set of SMF notification control
         objects implemented in this module."
 ::= { smfMIBGroups 5 }

 smfNotificationsGroup  NOTIFICATION-GROUP
    NOTIFICATIONS {
            smfAdminStatusChange,
            smfConfiguredOpModeChange,
            smfConfiguredRssaChange,
            smfIfAdminStatusChange,
            smfDpdMemoryOverflowEvent,
            smfIpv4DuplMultiPktsDetectedTotalEvents,
            smfIpv6DuplMultiPktsDetectedTotalEvents
    }
    STATUS  current
    DESCRIPTION
        "Set of SMF notifications implemented
         in this module."
 ::= { smfMIBGroups 6 }
```

       END

8. Security Considerations

    This section discusses security implications of the choices made in
    this SMF-MIB module.

    There are a number of management objects defined in this MIB module
    with a MAX-ACCESS clause of read-write and/or read-create. Such
    objects may be considered sensitive or vulnerable in some network
    environments. The support for SET operations in a non-secure
    environment without proper protection can have a negative effect on
    network operations. These are the tables and objects and their
    sensitivity/vulnerability:

    o 'smfAdminStatus' - this writable configuration object controls the
       operational status of the SMF process. If this setting is
       configured inconsistently across the MANET multicast domain, then
       delivery of multicast data may be inconsistent across the domain;
       some nodes may not receive multicast data intended for them.

    o 'smfRouterIDAddrType' and 'smfRouterID' - these writable
       configuration objects define the ID of the SMF process. These
       objects should be configured with a routable address defined on
       the local SMF device. The smfRouterID is a logical identification
       that MUST be consistent across inter-operating SMF neighborhoods
       and it is RECOMMENDED to be chosen as the numerically largest
       address contained in a node's 'Neighbor Address List' as defined
       in NHDP. A smfRouterID MUST be unique within the scope of the
       operating MANET network regardless of the method used for
       selecting it.

    o 'smfConfiguredOpMode' - this writable configuration objects define
       the operational mode of the SMF process. The operational mode
       defines how the SMF process develops its local estimate of the
       CDS.

    o 'smfConfiguredRssa' - this writable configuration object sets the
       specific Reduced Set Selection Algorithm (RSSA) for the SMF
       process. If this object is set inconsistently across the MANET
       domain, multicast delivery of data will fail.

    o 'smfRssaMember' - this writable configuration object sets the
       'interest' of the local SMF node in participating in the CDS.
       Setting this object to 'never(3)' on a highly highly connected
       device could lead to frequent island formation. Setting this
       object to 'always(2)' could support data ex-filtration from the

MANET domain.

o 'smfIpv4Dpd' - this writable configuration object sets the
   duplicate packet detection method for forwarding of IPv4 multicast
   packets.

o 'smfIpv6Dpd' - this writable configuration object sets the
   duplicate packet detection method for forwarding of IPv6 multicast
   packets.

o 'smfMaxPktLifetime' - this writable configuration object sets the
   estimate of the network packet traversal time. If set too small,
   this could lead to poor multicast data delivery ratios throughout
   the MANET domain.

o 'smfDpdMaxMemorySize' - this writable configuration object sets
   the memory storage size (in Kilo-Bytes) for the cached DPD records
   for the combined IPv4 and IPv6 methods. If set too small this
   could lead to poor performance of the duplicate packet protection
   algorithms and lead to inefficient resource, e.g., link,
   utilization within the MANET domain. The local SMF device should
   protect itself against memory overruns in the event that too large
   a setting is requested.

o 'smfDpdEntryMaxLifetime' - this writable configuration object sets
   the maximum lifetime (in seconds) for the cached DPD records for
   the combined IPv4 and IPv6 methods. If the memory is running low
   prior to the MaxLifetimes being exceeded, the local SMF devices
   should purge the oldest records first.

o 'smfNhdpRssaMesgTLVIncluded' - this writable configuration object
   indicates whether the associated NHDP messages include the the
   RSSA Message TLV, or not. It is highly RECOMMENDED that this
   object be set to 'true(1)'.

o 'smfNhdpRssaAddrBlockTLVIncluded' - this writable configuration
   object indicates whether the associated NHDP messages include the
   the RSSA Address Block TLV, or not. The
   smfNhdpRssaAddrBlockTLVIncluded is optional in all cases as it
   depends on the existence of an address block which may not be
   present. If this SMF device is configured with NHDP, then this
   object should be set to 'true(1)'.

o 'smfConfiguredAddrForwardingTable' - the writable configuration
   objects in this table indicate which multicast IP address are to
   be forwarded by this SMF node. Misconfiguration of rows within
   this table can limit the ability of this SMF device to forward
   multicast data.

o 'smfInterfaceTable' - the writable configuration objects in this
   table indicate which SMF node interfaces are participating in the
   SMF packet forwarding process. Misconfiguration of rows within
   this table can limit the ability of this SMF device to forward
   multicast data.

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

o 'smfNodeRsStatusIncluded' - this readable state object indicates
   that this SMF node is part of the CDS, or not. Being part of the
   CDS makes this node a distinguished device. It could be exploited
   for data ex-filtration, or denial of service attacks.

o 'smfDiscoveredAddrForwardingTable' - the readable state objects in
   this table indicate which, dynamically discovered, multicast IP
   address are to be forwarded by this SMF node.

o 'smfNeighborTable' - the readable state objects in this table
   indicate current neighbor nodes to this SMF node. Exposing this
   information to an attacker could allow the attacker easier access
   to the larger MANET domain.

The remainder of the objects in the SMF-MIB are performance counter
objects. While these give an indication of the activity of the SMF
process on this node, it is not expected that exposing these values
pose a security risk to the MANET network.

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

Implementations MUST provide the security features described by the
SNMPv3 framework (see [RFC3410]), including full support for
authentication and privacy via the User-based Security Model (USM)
[RFC3414] with the AES cipher algorithm [RFC3826]. Implementations
MAY also provide support for the Transport Security Model (TSM)
[RFC5591] in combination with a secure transport such as SSH
[RFC5592] or TLS/DTLS [RFC6353].

Further, deployment of SNMP versions prior to SNMPv3 is NOT

RECOMMENDED. Instead, it is RECOMMENDED to deploy SNMPv3 and to
enable cryptographic security. It is then a customer/operator
responsibility to ensure that the SNMP entity giving access to an
instance of this MIB module is properly configured to give access to
the objects only to those principals (users) that have legitimate
rights to indeed GET or SET (change/create/delete) them.

9. Applicability Statement

This document describes objects for configuring parameters of the
Simplified Multicast Forwarding [RFC6621] process on a router. This
MIB module, denoted SMF-MIB, also reports state, performance
information and notifications. This sections provides some examples
of how this MIB module can be used in MANET network deployments. A
fuller discussion of MANET network management use cases and
challenges will be provided elsewhere.

SMF is designed to allow routers to forward IPv4 and IPv6 packets
over the MANET and cover the MANET nodes through the automatic
discovery of efficient estimates of the Minimum Connected Dominating
Set (MCDS) of nodes within the MANET. The MCDS are estimated using
the RSSAs discussed within this document. In the following, three
scenarios are listed where this MIB module is useful, i.e.,

o For a Parking Lot Initial Configuration Situation - it is common
   for the vehicles comprising the MANET being forward deployed at a
   remote location, e.g., the site of a natural disaster, to be off-
   loaded in a parking lot where an initial configuration of the
   networking devices is performed. The configuration is loaded into
   the devices from a fixed location Network Operation Center (NOC)
   at the parking lot and the vehicles are stationary at the parking
   lot while the configuration changes are made. Standards-based
   methods for configuration management from the co-located NOC are
   necessary for this deployment option.

o For Mobile vehicles with Low Bandwidth Satellite Link to a Fixed
   NOC - Here the vehicles carrying the MANET routers carry multiple
   wireless interfaces, one of which is a relatively low-bandwidth
   on-the-move satellite connection which interconnects a fix NOC to
   the nodes of the MANET. Standards-based methods for monitoring
   and fault management from the fixed NOC are necessary for this
   deployment option.

o For Fixed NOC and Mobile Local Manager in Larger Vehicles - for
   larger vehicles, a hierarchical network management arrangement is
   useful. Centralized network management is performed from a fixed
   NOC while local management is performed locally from within the
   vehicles. Standards-based methods for configuration, monitoring

and fault management are necessary for this deployment option.

10. IANA Considerations

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

```
Descriptor          OBJECT IDENTIFIER value
----------          -----------------------
SMF-MIB             { experimental XXXX }
IANA EDITOR NOTE: please assign XXXX, and remove this note.
```

11. Contributors

This MIB document uses the template authored by D. Harrington which
is based on contributions from the MIB Doctors, especially Juergen
Schoenwaelder, Dave Perkins, C.M.Heard and Randy Presuhn.

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the follow on MIB-modules to configure specific RSSA algorithms
related to SMF. Further, the authors would like to acknowledge to
work of James Nguyen, Brian Little, Ryan Morgan and Justin Dean on
their software development of the SMF-MIB.

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Appendix A.

```
****************************************************************
* Note to the RFC Editor (to be removed prior to publication) *
*                                                             *
* The reference to RFC xxxx within the DESCRIPTION clauses    *
* of the MIB module point to this draft and are to be         *
* assigned by the RFC Editor.                                 *
*                                                             *
****************************************************************
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