        Definition of Managed Objects for the Mobile Ad Hoc Network (MANET)
                Simplified Multicast Framework Relay Set Process

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 module also reports state
   information, performance information, 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 module also
   reports state information, performance information, 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", "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 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) that 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
that 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 module 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 1 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 acquired 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   |
   |               |     neighbor      |             |
   |_____|      info         |_____|
             \                                /
   neighbor\  \                              / forwarding
     info*   \  \         _____     /   status
              \  \       |             |   /
               `-->      | Forwarding  | <--'
                         | Process     |
   ------------------>   |             | ------------------>
   incoming packet,      |_____|    forwarded packets
   interface id*, and
   previous hop*
```
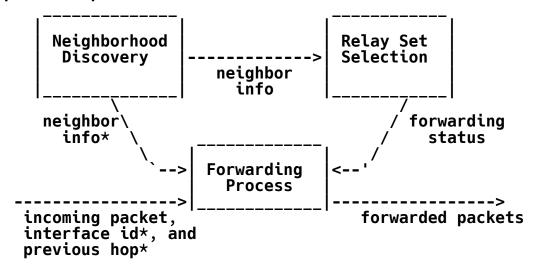
Figure 1: SMF Router Architecture

The asterisks (*) mark the primitives and relationships needed by
relay set algorithms requiring previous-hop packet-forwarding
knowledge.

4.2. Terms

   The following definitions apply throughout this document:

   Configuration Objects: switches, tables, and objects that are
      initialized to default settings or set through the management
      interfaces such as defined by this MIB module.

   Tunable Configuration Objects: objects whose values affect timing or
      attempt bounds on the SMF Relay Set (RS) process.

   State Objects: automatically generated values that define the
      current operating state of the SMF RS process in the router.

   Performance Objects: automatically generated values that 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 process.

   o smfMIBObjects - defines the objects forming the basis for the SMF-
      MIB module. 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 process and the resulting multicast performance.

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

      * Performance Group - Contains objects that help to characterize
         the performance of the SMF process, typically counters for
         statistical computations.

   o smfMIBConformance - defines two, i.e., minimal and full,
      conformance implementations for the SMF-MIB module.

5.1. Textual Conventions

The Textual Conventions defined within the SMF-MIB module:

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

The Textual Conventions defined for the SMF-MIB module and maintained
by IANA are:

o The IANAsmfOpModeIdTC represents an index that identifies a
   specific SMF operational mode. This Textual Convention is
   maintained by IANA in the IANA-SMF-MIB.

o The IANAsmfRssaIdTC represents an index that identifies, through
   reference, a specific RSSA available for operation on the device.
   This Textual Convention is maintained by IANA also in the IANA-
   SMF-MIB.

5.2. The Capabilities Group

The SMF device supports a set of capabilities. The list of
capabilities that the device can advertise is as follows:

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 a separate MIB module.

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 are:

o Operational Mode - determines from where topology information is
   derived, e.g., 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 (I-DPD or H-DPD, respectively).

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

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

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

o SMF Address Forwarding Table - a table identifying configured
   multicast addresses to be forwarded by the SMF process.

5.4. The State Group

The State sub-tree reports current state information, for example,

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

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

5.5. The Performance Group

The Performance sub-tree primarily reports counters that relate to
SMF RSSA performance. The SMF performance counters consist 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 module and their intended purpose and
utility.

5.7. Tables and Indexing

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

   o configuration and operation of packet forwarding on the local
      router,

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

   o configuration and operation of various RSSAs for packet
      forwarding.

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

   o smfCapabilitiesIndex - the index identifying the combination of
      SMF mode and SMF RSSA available on this device.

   o smfCfgAddrForwardingIndex - the index to configured multicast
      address lists that are forwarded by the SMF process.

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

   o smfStateNeighborIpAddrType, smfStateNeighborIpAddr, and
      smfStateNeighborPrefixLen - the interface index set of specific
      one-hop neighbor nodes to this local router.

   These tables and their associated indexing are defined in the SMF-MIB
   module:

   o smfCapabilitiesTable - identifies the resident set of (SMF
      Operational Modes, SMF RSSA algorithms) available on this router.
      This table has 'INDEX { smfCapabilitiesIndex }'.

   o smfCfgAddrForwardingTable - contains information on multicast
      addresses that are to be forwarded by the SMF process on this
      device. This table has 'INDEX { smfCfgAddrForwardingIndex }'.

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

   o smfStateNeighborTable - describes the current neighbor nodes,
      their addresses and the SMF RSSA and the interface on which they
      can be reached. This table has 'INDEX {
      smfStateNeighborIpAddrType, smfStateNeighborIpAddr,
      smfStateNeighborPrefixLen }'.

   o smfPerfIpv4InterfacePerfTable - contains the IPv4-related SMF
      statistics per each SMF interface on this device. This table has
      'INDEX { smfCfgIfIndex }'.

   o smfPerfIpv6InterfacePerfTable - contains the IPv6-related SMF
      statistics per each SMF interface on this device. This table has
      'INDEX { smfCfgIfIndex }'.

6. Relationship to Other MIB Modules

6.1. Relationship to the SNMPv2-MIB

   The 'system' group in the SNMPv2-MIB module [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
   module does not duplicate those objects.

6.2. Relationship to the IP-MIB

   It is an expectation that SMF devices will implement the standard IP-
   MIB module [RFC4293]. Exactly how to integrate SMF packet handling
   and management into the standard IP-MIB module management are part of
   the experiment.

   The SMF-MIB module counters within the smfPerformanceGroup count
   packets handled by the system and interface local SMF process (as
   discussed above). Not all IP (unicast and multicast) packets on a
   device interface are handled by the SMF process. So the counters are
   tracking different packet streams in the IP-MIB and SMF-MIB modules.

6.3. Relationship to the IPMCAST-MIB

   The smfCfgAddrForwardingTable is essentially a filter table (if
   populated) that identifies addresses/packets to be forwarded via the
   local SMF flooding process. The IP Multicast MIB module in RFC 5132
   [RFC5132] manages objects related to standard IP multicast, which
   could be running in parallel to SMF on the device.

   RFC 5132 manages traditional IP-based multicast (based upon multicast
   routing mechanisms). The SMF-MIB module provides management for a
   MANET subnet-based flooding mechanism which, may be used for

   multicast transport (through SMF broadcast) depending upon the MANET
   dynamics and other factors regarding the MANET subnet. Further, they
   may coexist in certain MANET deployments using the
   smfCfgAddrForwardingTable to hand certain IP multicast addresses to
   the SMF process and other IP multicast packets to be forwarded by
   other multicast mechanisms that are IP route based. SMF and the
   associated SMF-MIB module are experimental and these are some of the
   experiments to be had with SMF and the SMF-MIB module.

6.4. MIB Modules Required for IMPORTS

   The objects imported for use in the SMF-MIB module are as follows.
   The MODULE-IDENTITY, OBJECT-TYPE, NOTIFICATION-TYPE, Counter32,
   Integer32, TimeTicks and experimental macros are imported from RFC
   2578 [RFC2578]. The TEXTUAL-CONVENTION, RowStatus, and TruthValue
   macros are imported from RFC 2579 [RFC2579]. The MODULE-COMPLIANCE,
   OBJECT-GROUP, and NOTIFICATION-GROUP macros are imported from RFC
   2580 [RFC2580]. The InterfaceIndexOrZero and ifName textual
   conventions are 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].

6.5. Relationship to Future RSSA-MIB Modules

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

7. SMF-MIB Definitions

   SMF-MIB DEFINITIONS ::= BEGIN

   IMPORTS

      MODULE-IDENTITY, OBJECT-TYPE, NOTIFICATION-TYPE,
      Counter32, Integer32, TimeTicks, experimental
         FROM SNMPv2-SMI   -- RFC 2578

      TEXTUAL-CONVENTION, RowStatus, TruthValue
         FROM SNMPv2-TC   -- RFC 2579

```
      MODULE-COMPLIANCE, OBJECT-GROUP,
      NOTIFICATION-GROUP
         FROM SNMPv2-CONF                              -- RFC 2580

      InterfaceIndexOrZero, ifName
         FROM IF-MIB                                   -- RFC 2863

      SnmpAdminString
         FROM SNMP-FRAMEWORK-MIB                       -- RFC 3411

      InetAddress, InetAddressType,
      InetAddressPrefixLength
         FROM INET-ADDRESS-MIB                         -- RFC 4001

      IANAsmfOpModeIdTC,
      IANAsmfRssaIdTC
            FROM IANA-SMF-MIB
      ;

   smfMIB MODULE-IDENTITY
      LAST-UPDATED "201410100000Z"  -- October 10, 2014
      ORGANIZATION "IETF MANET Working Group"
      CONTACT-INFO
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```

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

           Macker, J., Ed., Simplified Multicast Forwarding, RFC 6621,
           May 2012.

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           set forth in Section 4.c of the IETF Trust's Legal Provisions
           Relating to IETF Documents
           (http://trustee.ietf.org/license-info)."

        -- Revision History
        REVISION      "201410100000Z"   -- October 10, 2014
        DESCRIPTION
          "The first version of this MIB module,
           published as RFC 7367.
          "
        ::= { experimental 126 }

  --
  -- TEXTUAL CONVENTIONs
  --

  SmfStatus ::= TEXTUAL-CONVENTION
      STATUS        current
      DESCRIPTION
        "An indication of the operability of an SMF
         function or feature.  For example, the status
         of an interface: 'enabled' indicates that
         this interface is performing SMF functions
         and 'disabled' indicates that it is not.
         Similarly, for the status of the device:
         'enabled' indicates that the device has
         enabled the SMF functions on the device and
         'disabled' means that the device and all interfaces
         have disabled all SMF functions."
      SYNTAX  INTEGER {
                     enabled (1),
                     disabled (2)
             }
  --
  -- 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 Capabilities Table
   --

   smfCapabilitiesTable OBJECT-TYPE
       SYNTAX       SEQUENCE OF SmfCapabilitiesEntry
       MAX-ACCESS   not-accessible
       STATUS       current
       DESCRIPTION
           "The smfCapabilitiesTable identifies the
            resident set of SMF Operational Modes and
            RSSA combinations that can run on this
            forwarder."
       REFERENCE
          "See Section 7.2 'Reduced Relay Set Forwarding',
           Section 8.1.1 'SMF Message TLV Type', and
           the Appendices A, B, and C in
           RFC 6621 - 'Simplified Multicast Forwarding',
           Macker, J., May 2012."
       ::= { smfCapabilitiesGroup 1 }

   smfCapabilitiesEntry OBJECT-TYPE
       SYNTAX       SmfCapabilitiesEntry
       MAX-ACCESS   not-accessible
       STATUS       current
```

```
        DESCRIPTION
            "Information about a particular operational
             mode and RSSA combination.
             "
        INDEX   { smfCapabilitiesIndex }
        ::= { smfCapabilitiesTable 1 }

    SmfCapabilitiesEntry ::= SEQUENCE {
        smfCapabilitiesIndex                Integer32,
        smfCapabilitiesOpModeID             IANAsmfOpModeIdTC,
        smfCapabilitiesRssaID               IANAsmfRssaIdTC
    }

    smfCapabilitiesIndex      OBJECT-TYPE
        SYNTAX        Integer32 (1..2147483647)
        MAX-ACCESS  not-accessible
        STATUS        current
        DESCRIPTION
            "The index for this entry; a unique value,
             greater than zero, for each combination of
             a particular operational mode and RSSA
             available on this device.
             It is recommended that values are assigned
             contiguously starting from 1.

             Rows in this table are automatically
             populated by the entity's management system
             on initialization.

             By default, the agent should support at least the
             Classical Flooding 'cF' algorithm.  All compliant
             SMF forwarders must support Classical Flooding.
             Hence, the first entry in this table MUST exist
             and MUST be defined as:

                 smfCapabilitiesIndex i '1'
                 smfCapabilitiesOpModeID i 'cfOnly(1)'
                 smfCapabilitiesRssaID i 'cF(1)'

             The value for each combination MUST remain
             constant at least from one re-initialization
             of the entity's management system to the
             next re-initialization."
        ::= { smfCapabilitiesEntry 1 }

    smfCapabilitiesOpModeID     OBJECT-TYPE
        SYNTAX        IANAsmfOpModeIdTC
        MAX-ACCESS  read-only
```

```
          STATUS        current
          DESCRIPTION
              "This object identifies
               the particular operational mode for this device."
          ::= { smfCapabilitiesEntry 2 }

      smfCapabilitiesRssaID      OBJECT-TYPE
          SYNTAX        IANAsmfRssaIdTC
          MAX-ACCESS    read-only
          STATUS        current
          DESCRIPTION
              "This object identifies
               the particular RSSA algorithm in this MIB
               module.  Example RSSAs are found in the
               appendix of RFC 6621."
          REFERENCE
              "For example, see Section 8.1.1 'SMF Message TLV Type',
               and the Appendices A, B, and C in
               RFC 6621 - 'Simplified Multicast Forwarding',
               Macker, J., May 2012."
          ::= { smfCapabilitiesEntry 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 }

      smfCfgAdminStatus  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)' means that the SMF process
               is configured off.

               Prior to SMF functions being performed over
               specific interfaces, this object must first
               be 'enabled'.  If this object is 'disabled',
               then no SMF functions are being performed on
```

```
               the device and all smfCfgIfAdminStatus objects
               MUST also be set to 'disabled'.  When this
               object is changed from 'enabled' to 'disabled'
               by the manager, then all smfCfgIfAdminStatus
               objects MUST also be automatically set to
               'disabled' by the agent.

               The default value for this object SHOULD be
               'enabled'.

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

       smfCfgSmfSysUpTime OBJECT-TYPE
          SYNTAX   TimeTicks
          MAX-ACCESS   read-only
          STATUS   current
          DESCRIPTION
               "The time (in hundredths of a second) since the
               system SMF process was last re-initialized.
               The SMF process is re-initialized when the
               value of the 'smfCfgAdminStatus' object
               transitions to 'enabled' from either a prior
               value of 'disabled' or upon initialization
               of this device."
       ::= { smfConfigurationGroup 2 }

       smfCfgRouterIDAddrType  OBJECT-TYPE
          SYNTAX       InetAddressType { ipv4(1), ipv6(2) }
          MAX-ACCESS   read-write
          STATUS       current
          DESCRIPTION
               "The address type of the address used for
               the SMF ID of this router as specified
               in the 'smfCfgRouterID' next.

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

               This object is persistent and, when written,
               the entity SHOULD save the change to
               non-volatile storage."
          DEFVAL { ipv4 }
       ::= { smfConfigurationGroup 3 }
```

```
smfCfgRouterID  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 'smfCfgRouterID'.

       The smfCfgRouterID 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.  An smfCfgRouterID 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
      "For example, see

       Appendix A.1 'E-CDS Relay Set Selection Overview'

       and

       Appendix C.1 'MPR-CDS Relay Set Selection
       Overview' in

       RFC 6621 - 'Simplified Multicast Forwarding',
       Macker, J., Ed., May 2012."
 ::= { smfConfigurationGroup 4 }

smfCfgOperationalMode  OBJECT-TYPE
   SYNTAX       Integer32 (1..2147483647)
   MAX-ACCESS   read-write
   STATUS       current
   DESCRIPTION
      "The SMF RSS node operational mode and
       RSSA combination active on this
       local forwarder.  This object is defined
       to be equal to the smfCapabilitiesIndex,
```

              which identifies the specific active
              operational mode and RSSA.

              The default value for this object is
              '1', which corresponds to:

                 smfCapabilitiesOpModeID i 'cfOnly(1)'
                 smfCapabilitiesRssaID i 'cF(1)'

              This object is persistent and, when written,
              the entity SHOULD save the change to
              non-volatile storage."
       REFERENCE
              "See Section 7.2 'Reduced Relay Set Forwarding',
               and the Appendices A, B, and C in
               RFC 6621 - 'Simplified Multicast Forwarding',
               Macker, J., Ed., May 2012."
       DEFVAL { 1 }
    ::= { smfConfigurationGroup 5 }

    smfCfgRssaMember 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(2)' forces the selected
           RSSA to 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
      "See Section 7 'Relay Set Selection' in
      RFC 6621 - 'Simplified Multicast Forwarding',
      Macker, J., Ed., May 2012."
   DEFVAL { potential }
 ::= { smfConfigurationGroup 6 }

 smfCfgIpv4Dpd  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
      router's 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
      "See Section 6.2 'IPv4 Duplicate Packet
      Detection' in
      RFC 6621 - 'Simplified Multicast Forwarding',
      Macker, J., Ed., May 2012."
   DEFVAL { hashBased }
 ::= { smfConfigurationGroup 7 }

 smfCfgIpv6Dpd  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
          'smfCfgIpv4Dpd'.

          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
         "See Section 6.1 'IPv6 Duplicate Packet
          Detection' in
          RFC 6621 - 'Simplified Multicast Forwarding',
          Macker, J., Ed., May 2012."
      DEFVAL { hashBased }
   ::= { smfConfigurationGroup 8 }

   smfCfgMaxPktLifetime  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
         "See Section 6 'SMF Duplicate Packet
          Detection' in
          RFC 6621 - 'Simplified Multicast Forwarding',
          Macker, J., Ed., May 2012."
      DEFVAL { 60 }
   ::= { smfConfigurationGroup 9 }

   smfCfgDpdEntryMaxLifetime  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
          MaxLifetime 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
         "See Section 6 'SMF Duplicate Packet
          Detection' in
          RFC 6621 - 'Simplified Multicast Forwarding',
          Macker, J., Ed., May 2012."
      DEFVAL { 600 }
   ::= { smfConfigurationGroup 10 }

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

   smfCfgNhdpRssaMesgTLVIncluded  OBJECT-TYPE
      SYNTAX      TruthValue
      MAX-ACCESS  read-write
      STATUS      current
      DESCRIPTION
         "Indicates whether or not the associated NHDP
          messages include the RSSA Message TLV.  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
         "See Section 8.1.1 'SMF Message TLV Type' in
          RFC 6621 - 'Simplified Multicast Forwarding',
```

```
            Macker, J., Ed., May 2012."
         DEFVAL { true }
      ::= { smfConfigurationGroup 11 }

      smfCfgNhdpRssaAddrBlockTLVIncluded  OBJECT-TYPE
         SYNTAX       TruthValue
         MAX-ACCESS  read-write
         STATUS       current
         DESCRIPTION
            "Indicates whether or not the associated NHDP
            messages include the RSSA Address Block TLV.
            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 smfCfgNhdpRssaAddrBlockTLVIncluded is optional
            in all cases as it depends on the existence of
            an address block that 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
            "See Section 8.1.2 'SMF Address Block TLV
            Type' in
            RFC 6621 - 'Simplified Multicast Forwarding',
            Macker, J., Ed., May 2012."
         DEFVAL { true }
      ::= { smfConfigurationGroup 12 }

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

      smfCfgAddrForwardingTable  OBJECT-TYPE
         SYNTAX       SEQUENCE OF SmfCfgAddrForwardingEntry
         MAX-ACCESS not-accessible
         STATUS       current
         DESCRIPTION
            "The smfCfgAddrForwardingTable is essentially a filter
            table (if populated) that identifies addresses/packets
            to be forwarded via the local SMF flooding process.
            The IP Multicast MIB module in RFC 5132 manages objects
            related to standard IP multicast, which could be running
            in parallel to SMF on the device.
```

RFC 5132 manages traditional IP-based multicast (based
upon multicast routing mechanisms). The SMF-MIB module
provides management for a MANET subnet-based flooding
mechanism that may be used for multicast transport
(through SMF broadcast) depending upon the MANET dynamics
and other factors regarding the MANET subnet. Further,
they may coexist in certain MANET deployments
using the smfCfgAddrForwardingTable to hand certain IP
multicast addresses to the SMF process and other IP
multicast packets to be forwarded by other
multicast mechanisms that are IP route based. SMF and
the associated SMF-MIB module are experimental and these
are some of the experiments to be had with SMF and
the SMF-MIB module.

This is the (conceptual) table containing information on
multicast addresses that are to be forwarded by the SMF
process. This table represents an IP filters table for
forwarding (or not) packets based upon their IP
multicast address.

The SMF process can be configured to forward only those
multicast addresses found within the
smfCfgAddrForwardingTable. As such, addresses that are
to be forwarded by the SMF process MUST be found within
the address ranges configured within this table, unless
this table is empty.

Each row is associated with a range of multicast
addresses, and ranges for different rows must be disjoint.
Different rows MAY share a common
smfCfgAddrForwardingGroupName to administratively
associate different rows.

The objects in this table are persistent and, when written,
the entity SHOULD save the change to non-volatile storage."
    REFERENCE
        "See Section 9.1 'Forwarded Multicast Groups' in
        RFC 6621 - 'Simplified Multicast Forwarding',
        Macker, J., Ed., May 2012."
  ::= { smfConfigurationGroup 13 }

  smfCfgAddrForwardingEntry OBJECT-TYPE
      SYNTAX   SmfCfgAddrForwardingEntry
      MAX-ACCESS not-accessible
      STATUS   current
      DESCRIPTION
          "An entry (conceptual row) containing the information on a

```
          particular multicast scope."
      INDEX { smfCfgAddrForwardingIndex }
      ::= { smfCfgAddrForwardingTable 1 }

   SmfCfgAddrForwardingEntry ::= SEQUENCE {
      smfCfgAddrForwardingIndex           Integer32,
      smfCfgAddrForwardingGroupName       SnmpAdminString,
      smfCfgAddrForwardingAddrType        InetAddressType,
      smfCfgAddrForwardingAddress         InetAddress,
      smfCfgAddrForwardingAddrPrefixLength
                                          InetAddressPrefixLength,
      smfCfgAddrForwardingStatus          RowStatus
   }

   smfCfgAddrForwardingIndex     OBJECT-TYPE
      SYNTAX      Integer32 (1..2147483647)
      MAX-ACCESS  not-accessible
      STATUS      current
      DESCRIPTION
         "This object identifies a unique entry
          for a forwarding group.  The index for
          this entry is a unique value,
          greater than zero, for each row.
          It is recommended that values are assigned
          contiguously starting from 1.

          The value for each row index MUST remain
          constant from one re-initialization
          of the entity's management system to the
          next re-initialization."
      ::= { smfCfgAddrForwardingEntry 1 }

   smfCfgAddrForwardingGroupName  OBJECT-TYPE
      SYNTAX      SnmpAdminString
      MAX-ACCESS  read-create
      STATUS      current
      DESCRIPTION
         "This object identifies a group name for a set of
          row entries in order to administratively associate
          a set of address ranges.

          If there is no group name or this object is
          otherwise not applicable, then this object contains
          a zero-length string.

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

```
    ::= { smfCfgAddrForwardingEntry 2 }

    smfCfgAddrForwardingAddrType OBJECT-TYPE
        SYNTAX       InetAddressType { ipv4(1), ipv6(2) }
        MAX-ACCESS read-create
        STATUS       current
        DESCRIPTION
            "The type of the addresses in the multicast
             forwarding ranges identified by this table.

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

             This object is persistent and, when written,
             the entity SHOULD save the change to
             non-volatile storage."
    ::= { smfCfgAddrForwardingEntry 3 }

    smfCfgAddrForwardingAddress OBJECT-TYPE
        SYNTAX       InetAddress (SIZE(4|16))
        MAX-ACCESS read-create
        STATUS       current
        DESCRIPTION
            "The multicast group address that, when
             combined with smfCfgAddrForwardingAddrPrefixLength,
             gives the group prefix for this forwarding range.
             The InetAddressType is given by
             smfCfgAddrForwardingAddrType.

             This address object is only significant up to
             smfCfgAddrForwardingAddrPrefixLength bits.  The
             remaining address bits are set to zero.  This is
             especially important for this index field.
             Any non-zero bits would signify an entirely
             different entry.

             Legal values correspond to the subset of address
             families for which multicast address allocation
             is supported.

             This object is persistent and, when written,
             the entity SHOULD save the change to
             non-volatile storage."
    ::= { smfCfgAddrForwardingEntry 4 }

    smfCfgAddrForwardingAddrPrefixLength OBJECT-TYPE
        SYNTAX       InetAddressPrefixLength
        MAX-ACCESS read-create
```

```
           STATUS      current
           DESCRIPTION
              "The length in bits of the mask that, when
               combined with smfCfgAddrForwardingAddress,
               gives the group prefix for this forwarding
               range.

               This object is persistent and, when written,
               the entity SHOULD save the change to
               non-volatile storage."
      ::= { smfCfgAddrForwardingEntry 5 }

      smfCfgAddrForwardingStatus 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."
      ::= { smfCfgAddrForwardingEntry 6 }

      --
      -- SMF Interfaces Configuration Table
      --

      smfCfgInterfaceTable  OBJECT-TYPE
           SYNTAX       SEQUENCE OF SmfCfgInterfaceEntry
           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 module (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 automatically supports and runs SMF as part
               of the device's initialization process.

               The manager creates a row in this table by setting
               the 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.

                    As the smfCfgInterfaceTable sparsely augments the
                    IfTable. Hence,

                        + an entry cannot exist in smfCfgInterfaceTable
                          without a corresponding entry in the ifTable.

                        + if an entry in the ifTable is removed, the
                          corresponding entry (if it exists) in the
                          smfCfgInterfaceTable MUST be removed.

                        + the smfCfgIfStatus can have a value of
                          'enabled' or 'disabled' independent of the
                          current value of the ifAdminStatus of the
                          corresponding entry in the ifTable.

                    The values of the objects smfCfgAdminStatus and
                    smfCfgIfAdminStatus reflect the up-down status of
                    the SMF process running on the device and on the
                    specific interfaces, respectively. Hence,

                        + the value of the smfCfgAdminStatus can be
                          'enabled' or 'disabled' reflecting the current
                          running status of the SMF process on the device.

                        + the value of the smfCfgIfAdminStatus can be
                          'enabled' or 'disabled' if the value of the
                          smfCfgAdminStatus is set to 'enabled'.

                        + if the value of the smfCfgAdminStatus is
                          'disabled', then the corresponding
                          smfCfgIfAdminStatus objects MUST be set
                          to 'disabled' in the smfCfgInterfaceTable.

                        + once the value of the smfCfgAdminStatus changes
                          from 'disabled' to 'enabled', it is up to the
                          management system to make the corresponding
                          changes to the smfCfgIfAdminStatus values
                          back to 'enabled'.
                    "
                REFERENCE
                    "RFC 2863 - 'The Interfaces Group MIB', McCloghrie,
                    K., and F. Kastenholtz, June 2000."
            ::= { smfConfigurationGroup 14 }

```
   smfCfgInterfaceEntry OBJECT-TYPE
      SYNTAX       SmfCfgInterfaceEntry
      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 smfCfgIfRowStatus
          object."
      INDEX { smfCfgIfIndex }
   ::= { smfCfgInterfaceTable 1 }

   SmfCfgInterfaceEntry ::=
      SEQUENCE {
          smfCfgIfIndex        InterfaceIndexOrZero,
          smfCfgIfAdminStatus  SmfStatus,
          smfCfgIfSmfUpTime    TimeTicks,
          smfCfgIfRowStatus    RowStatus
          }

   smfCfgIfIndex  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.
          If the manager attempts to create a row
          for which the ifIndex does not exist on the
          local device, then the agent SHOULD issue
          a return value of 'inconsistentValue' and
          the operation SHOULD fail."
      REFERENCE
         "RFC 2863 - 'The Interfaces Group MIB', McCloghrie,
          K., and F. Kastenholtz, June 2000."
      ::= { smfCfgInterfaceEntry 1 }

   smfCfgIfAdminStatus 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
              currently external to the SMF forwarding process.

              When the value of the smfCfgAdminStatus is
              'disabled', then the corresponding smfCfgIfAdminStatus
              objects MUST be set to 'disabled' in the
              smfCfgInterfaceTable.

              If this object is not equal to 'enabled', all associated
              entries in the 'smfPerfIpv4InterfacePerfTable' and the
              'smfPerfIpv6InterfacePerfTable' MUST be deleted.

          The default value for this object is 'enabled(1)'.

              This object SHOULD be persistent and when
              written the device SHOULD save the change to
              non-volatile storage."
          DEFVAL { enabled }
          ::= { smfCfgInterfaceEntry 2 }

      smfCfgIfSmfUpTime OBJECT-TYPE
          SYNTAX   TimeTicks
          MAX-ACCESS   read-only
          STATUS   current
          DESCRIPTION
              "The time (in hundredths of a second) since
              this interface SMF process was last
              re-initialized. The interface SMF process is
              re-initialized when the value of the
              'smfCfgIfAdminStatus' object transitions to 'enabled'
              from either a prior value of 'disabled' or upon
              initialization of this interface or this device."
          ::= { smfCfgInterfaceEntry 3 }

      smfCfgIfRowStatus OBJECT-TYPE
          SYNTAX   RowStatus
          MAX-ACCESS   read-create
          STATUS   current
          DESCRIPTION
              "This object permits management of this 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' 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 these objects in order
              for the row to transit to the 'active' state; the default
              value for these objects is used. For objects that do not
              have DEFVAL clauses, the network manager MUST
              specify the value of these objects prior to this row
              transitioning to the 'active' state.

              When this object transitions to 'active', 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 smfCfgIfRowStatus of 'active'
              is changed, then the updated value MUST be reflected in SMF
              and this new object value MUST be written to non-volatile
              storage."
         ::= { smfCfgInterfaceEntry 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 }

      smfStateNodeRsStatusIncluded 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
            "See Section 7 'Relay Set Selection' in
             RFC 6621 - 'Simplified Multicast Forwarding',
             Macker, J., Ed., May 2012."
      ::= { smfStateGroup 1 }

      smfStateDpdMemoryOverflow OBJECT-TYPE
         SYNTAX   Counter32
         UNITS   "DPD Records"
         MAX-ACCESS   read-only

```
        STATUS        current
        DESCRIPTION
           "The number of DPD records that had to be flushed to
            prevent memory overruns for caching of these records.
            The number of records to be flushed upon a buffer
            overflow is an implementation specific decision.

            There is the potential for a counter discontinuity
            in this object if the system SMF process has been
            disabled and later enabled.  In order to check for
            the occurrence of such a discontinuity when monitoring
            this counter object, it is recommended that the
            smfCfgSmfSysUpTime object also be monitored."
        REFERENCE
           "See Section 6 'SMF Duplicate Packet
            Detection' in
            RFC 6621 - 'Simplified Multicast Forwarding',
            Macker, J., Ed., May 2012."
    ::= { smfStateGroup 2 }


    --
    -- SMF Neighbor Table
    --

    smfStateNeighborTable  OBJECT-TYPE
        SYNTAX        SEQUENCE OF SmfStateNeighborEntry
        MAX-ACCESS    not-accessible
        STATUS        current
        DESCRIPTION
           "The SMF StateNeighborTable describes the
            current one-hop neighbor nodes, their address
            and SMF RSSA, and the interface on which
            they can be reached."
        REFERENCE
           "See Section 8 'SMF Neighborhood Discovery' and
            Section 8.1. 'SMF Relay Algorithm TLV
            Types' in
            RFC 6621 - 'Simplified Multicast Forwarding',
            Macker, J., Ed., May 2012."
    ::= { smfStateGroup 3 }

    smfStateNeighborEntry  OBJECT-TYPE
        SYNTAX        SmfStateNeighborEntry
        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 { smfStateNeighborIpAddrType,
                 smfStateNeighborIpAddr,
                 smfStateNeighborPrefixLen }
      ::= { smfStateNeighborTable 1 }

      SmfStateNeighborEntry ::=
         SEQUENCE {
            smfStateNeighborIpAddrType        InetAddressType,
            smfStateNeighborIpAddr            InetAddress,
            smfStateNeighborPrefixLen         InetAddressPrefixLength,
            smfStateNeighborRSSA              IANAsmfRssaIdTC,
            smfStateNeighborNextHopInterface  InterfaceIndexOrZero
            }

      smfStateNeighborIpAddrType  OBJECT-TYPE
         SYNTAX      InetAddressType { ipv4(1), ipv6(2) }
         MAX-ACCESS  not-accessible
         STATUS      current
         DESCRIPTION
            "The one-hop neighbor IP address type.

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

      smfStateNeighborIpAddr  OBJECT-TYPE
         SYNTAX      InetAddress (SIZE(4|16))
         MAX-ACCESS  not-accessible
         STATUS      current
         DESCRIPTION
            "The one-hop neighbor Inet IPv4 or IPv6
            address.

            Only IPv4 and IPv6 addresses
            are supported."
      ::= { smfStateNeighborEntry 2 }

      smfStateNeighborPrefixLen  OBJECT-TYPE
         SYNTAX      InetAddressPrefixLength
         UNITS       "bits"
         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."
      ::= { smfStateNeighborEntry 3 }

      smfStateNeighborRSSA  OBJECT-TYPE
         SYNTAX          IANAsmfRssaIdTC
         MAX-ACCESS   read-only
         STATUS          current
         DESCRIPTION
            "The current RSSA running on the neighbor."
      ::= { smfStateNeighborEntry 4 }

      smfStateNeighborNextHopInterface OBJECT-TYPE
         SYNTAX          InterfaceIndexOrZero
         MAX-ACCESS   read-only
         STATUS          current
         DESCRIPTION
            "The interface ifIndex over which the
             neighbor is reachable in one-hop."
      ::= { smfStateNeighborEntry 6 }


      --
      -- SMF Performance Group
      --
      --      Contains objects that 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.
      --
      --      It is an expectation that SMF devices will
      --      implement the standard IP-MIB module in RFC 4293.
      --      Exactly how to integrate SMF packet handling and
      --      management into the standard IP-MIB module management
      --      is part of the experiment.
      --
      --      The SMF-MIB module counters within the
      --      smfPerformanceGroup count packets handled by the
      --      system and interface local SMF process (as discussed
      --      above).  Not all IP (unicast and multicast) packets
      --      on a device interface are handled by the SMF process.
      --      So the counters are tracking different packet streams
      --      in the IP-MIB and SMF-MIB modules.
      --

      smfPerformanceGroup  OBJECT IDENTIFIER ::= { smfMIBObjects 4 }

      smfPerfGobalGroup  OBJECT IDENTIFIER ::= { smfPerformanceGroup 1 }

      --
```

```
-- IPv4 packet counters
--

smfPerfIpv4MultiPktsRecvTotal  OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "Packets"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "A counter of the total number of
         multicast IPv4 packets received by the
         device and delivered to the SMF process.

         There is the potential for a counter discontinuity
         in this object if the system SMF process has been
         disabled and later enabled.  In order to check for
         the occurrence of such a discontinuity when monitoring
         this counter object, it is recommended that the
         smfCfgSmfSysUpTime object also be monitored."
    ::= { smfPerfGobalGroup 1 }

smfPerfIpv4MultiPktsForwardedTotal  OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "Packets"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "A counter of the total number of
         multicast IPv4 packets forwarded by the
         device.

         There is the potential for a counter discontinuity
         in this object if the system SMF process has been
         disabled and later enabled.  In order to check for
         the occurrence of such a discontinuity when monitoring
         this counter object, it is recommended that the
         smfCfgSmfSysUpTime object also be monitored."
    ::= { smfPerfGobalGroup 2 }

smfPerfIpv4DuplMultiPktsDetectedTotal  OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "Packets"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "A counter of the total number of duplicate
         multicast IPv4 packets detected by the
         device.
```

          There is the potential for a counter discontinuity
          in this object if the system SMF process has been
          disabled and later enabled. In order to check for
          the occurrence of such a discontinuity when monitoring
          this counter object, it is recommended that the
          smfCfgSmfSysUpTime object also be monitored."
     REFERENCE
        "See Section 6.2 'IPv4 Duplicate Packet
        Detection' in
        RFC 6621 - 'Simplified Multicast Forwarding',
        Macker, J., Ed., May 2012."
  ::= { smfPerfGobalGroup 3 }

  smfPerfIpv4DroppedMultiPktsTTLExceededTotal OBJECT-TYPE
     SYNTAX   Counter32
     UNITS   "Packets"
     MAX-ACCESS   read-only
     STATUS   current
     DESCRIPTION
        "A counter of the total number of dropped
        multicast IPv4 packets by the
        device due to Time to Live (TTL) exceeded.

        There is the potential for a counter discontinuity
        in this object if the system SMF process has been
        disabled and later enabled. In order to check for
        the occurrence of such a discontinuity when monitoring
        this counter object, it is recommended that the
        smfCfgSmfSysUpTime object also be monitored."
     REFERENCE
        "See Section 5 'SMF Packet Processing and
        Forwarding' in
        RFC 6621 - 'Simplified Multicast Forwarding',
        Macker, J., Ed., May 2012."
  ::= { smfPerfGobalGroup 4 }

  smfPerfIpv4TTLLargerThanPreviousTotal OBJECT-TYPE
     SYNTAX   Counter32
     UNITS   "Packets"
     MAX-ACCESS   read-only
     STATUS   current
     DESCRIPTION
        "A counter of the total number of IPv4 packets
        received that have a TTL larger than that
        of a previously received identical packet.

        There is the potential for a counter discontinuity
        in this object if the system SMF process has been

```
              disabled and later enabled.  In order to check for
              the occurrence of such a discontinuity when monitoring
              this counter object, it is recommended that the
              smfCfgSmfSysUpTime object also be monitored."
        REFERENCE
           "See Section 5 'SMF Packet Processing and
           Forwarding' in
           RFC 6621 - 'Simplified Multicast Forwarding',
           Macker, J., Ed., May 2012."
     ::= { smfPerfGobalGroup 5 }

     --
     -- IPv6 packet counters
     --

     smfPerfIpv6MultiPktsRecvTotal  OBJECT-TYPE
        SYNTAX        Counter32
        UNITS         "Packets"
        MAX-ACCESS  read-only
        STATUS        current
        DESCRIPTION
           "A counter of the total number of
            multicast IPv6 packets received by the
            device and delivered to the SMF process.

            There is the potential for a counter discontinuity
            in this object if the system SMF process has been
            disabled and later enabled.  In order to check for
            the occurrence of such a discontinuity when monitoring
            this counter object, it is recommended that the
            smfCfgSmfSysUpTime object also be monitored."
     ::= { smfPerfGobalGroup 6 }

     smfPerfIpv6MultiPktsForwardedTotal  OBJECT-TYPE
        SYNTAX        Counter32
        UNITS         "Packets"
        MAX-ACCESS  read-only
        STATUS        current
        DESCRIPTION
           "A counter of the total number of
            multicast IPv6 packets forwarded by the
            device.

            There is the potential for a counter discontinuity
            in this object if the system SMF process has been
            disabled and later enabled.  In order to check for
            the occurrence of such a discontinuity when monitoring
            this counter object, it is recommended that the
```

```
               smfCfgSmfSysUpTime object also be monitored."
         ::= { smfPerfGobalGroup 7 }

         smfPerfIpv6DuplMultiPktsDetectedTotal  OBJECT-TYPE
            SYNTAX       Counter32
            UNITS        "Packets"
            MAX-ACCESS   read-only
            STATUS       current
            DESCRIPTION
               "A counter of the total number of duplicate
               multicast IPv6 packets detected by the
               device.

               There is the potential for a counter discontinuity
               in this object if the system SMF process has been
               disabled and later enabled.  In order to check for
               the occurrence of such a discontinuity when monitoring
               this counter object, it is recommended that the
               smfCfgSmfSysUpTime object also be monitored."
            REFERENCE
               "See Section 6.1 'IPv6 Duplicate Packet
               Detection' in
               RFC 6621 - 'Simplified Multicast Forwarding',
               Macker, J., Ed., May 2012."
         ::= { smfPerfGobalGroup 8 }

         smfPerfIpv6DroppedMultiPktsTTLExceededTotal  OBJECT-TYPE
            SYNTAX       Counter32
            UNITS        "Packets"
            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.

               There is the potential for a counter discontinuity
               in this object if the system SMF process has been
               disabled and later enabled.  In order to check for
               the occurrence of such a discontinuity when monitoring
               this counter object, it is recommended that the
               smfCfgSmfSysUpTime object also be monitored."
            REFERENCE
               "See Section 5 'SMF Packet Processing and
               Forwarding' in
               RFC 6621 - 'Simplified Multicast Forwarding',
               Macker, J., Ed., May 2012."
         ::= { smfPerfGobalGroup 9 }
```

```
   smfPerfIpv6TTLLargerThanPreviousTotal  OBJECT-TYPE
      SYNTAX       Counter32
      UNITS        "Packets"
      MAX-ACCESS   read-only
      STATUS       current
      DESCRIPTION
         "A counter of the total number of IPv6 packets
          received that have a TTL larger than that
          of a previously received identical packet.

          There is the potential for a counter discontinuity
          in this object if the system SMF process has been
          disabled and later enabled.  In order to check for
          the occurrence of such a discontinuity when monitoring
          this counter object, it is recommended that the
          smfCfgSmfSysUpTime object also be monitored."
      REFERENCE
         "See Section 5 'SMF Packet Processing and
          Forwarding' in
          RFC 6621 - 'Simplified Multicast Forwarding',
          Macker, J., Ed., May 2012."
   ::= { smfPerfGobalGroup 10 }

   smfPerfIpv6HAVAssistsReqdTotal  OBJECT-TYPE
      SYNTAX       Counter32
      UNITS        "Packets"
      MAX-ACCESS   read-only
      STATUS       current
      DESCRIPTION
         "A counter of the total number of IPv6 packets
          received that required the Hash Assist Value (HAV)
          for DPD.

          There is the potential for a counter discontinuity
          in this object if the system SMF process has been
          disabled and later enabled.  In order to check for
          the occurrence of such a discontinuity when monitoring
          this counter object, it is recommended that the
          smfCfgSmfSysUpTime object also be monitored."
      REFERENCE
         "See Section 6.1.1 'IPv6 SMF_DPD Option Header' in
          RFC 6621 - 'Simplified Multicast Forwarding',
          Macker, J., Ed., May 2012."
   ::= { smfPerfGobalGroup 11 }

   smfPerfIpv6DpdHeaderInsertionsTotal  OBJECT-TYPE
      SYNTAX       Counter32
      UNITS        "Packets"
```

```
     MAX-ACCESS   read-only
     STATUS       current
     DESCRIPTION
        "A counter of the total number of IPv6 packets
         received that the device inserted the
         DPD header option.

         There is the potential for a counter discontinuity
         in this object if the system SMF process has been
         disabled and later enabled.  In order to check for
         the occurrence of such a discontinuity when monitoring
         this counter object, it is recommended that the
         smfCfgSmfSysUpTime object also be monitored."
     REFERENCE
        "See Section 6.1.2 'IPv6 Identification-Based
         DPD' in
         RFC 6621 - 'Simplified Multicast Forwarding',
         Macker, J., Ed., May 2012."
  ::= { smfPerfGobalGroup 12 }


  --
  -- Per SMF Interface Performance Table
  --

  smfPerfInterfaceGroup OBJECT IDENTIFIER ::= { smfPerformanceGroup 2 }

  smfPerfIpv4InterfacePerfTable OBJECT-TYPE
     SYNTAX       SEQUENCE OF SmfPerfIpv4InterfacePerfEntry
     MAX-ACCESS   not-accessible
     STATUS       current
     DESCRIPTION
        "The SMF Interface Performance Table
         describes the SMF counters per
         interface."
  ::= { smfPerfInterfaceGroup 1 }

  smfPerfIpv4InterfacePerfEntry OBJECT-TYPE
     SYNTAX       SmfPerfIpv4InterfacePerfEntry
     MAX-ACCESS   not-accessible
     STATUS       current
     DESCRIPTION
        "The SMF Interface Performance entry
         describes the statistics for a particular
         node interface."
     INDEX { smfCfgIfIndex }
  ::= { smfPerfIpv4InterfacePerfTable 1 }

  SmfPerfIpv4InterfacePerfEntry ::=
```

```
       SEQUENCE {
           smfPerfIpv4MultiPktsRecvPerIf                Counter32,
           smfPerfIpv4MultiPktsForwardedPerIf           Counter32,
           smfPerfIpv4DuplMultiPktsDetectedPerIf        Counter32,
           smfPerfIpv4DroppedMultiPktsTTLExceededPerIf  Counter32,
           smfPerfIpv4TTLLargerThanPreviousPerIf        Counter32
           }

   smfPerfIpv4MultiPktsRecvPerIf  OBJECT-TYPE
       SYNTAX      Counter32
       UNITS       "Packets"
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
           "A counter of the number of multicast IP
            packets received by the SMF process on
            this device on this interface.

            There is the potential for a counter discontinuity
            in this object if the system SMF process has been
            disabled and later enabled on this interface.
            In order to check for the occurrence of such a
            discontinuity when monitoring this counter object,
            it is recommended that the smfCfgIfSmfUpTime
            object also be monitored."
   ::= { smfPerfIpv4InterfacePerfEntry 1 }

   smfPerfIpv4MultiPktsForwardedPerIf  OBJECT-TYPE
       SYNTAX      Counter32
       UNITS       "Packets"
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
           "A counter of the number of
            multicast IP packets forwarded by the
            SMF process on this device
            on this interface.

            There is the potential for a counter discontinuity
            in this object if the system SMF process has been
            disabled and later enabled on this interface.
            In order to check for the occurrence of such a
            discontinuity when monitoring this counter object,
            it is recommended that the smfCfgIfSmfUpTime
            object also be monitored."
   ::= { smfPerfIpv4InterfacePerfEntry 2 }

   smfPerfIpv4DuplMultiPktsDetectedPerIf  OBJECT-TYPE
```

```
        SYNTAX       Counter32
        UNITS        "Packets"
        MAX-ACCESS   read-only
        STATUS       current
        DESCRIPTION
           "A counter of the number of duplicate
            multicast IP packets detected by the
            SMF process on this device
            on this interface.

            There is the potential for a counter discontinuity
            in this object if the system SMF process has been
            disabled and later enabled on this interface.
            In order to check for the occurrence of such a
            discontinuity when monitoring this counter object,
            it is recommended that the smfCfgIfSmfUpTime
            object also be monitored."
     ::= { smfPerfIpv4InterfacePerfEntry 3 }

     smfPerfIpv4DroppedMultiPktsTTLExceededPerIf  OBJECT-TYPE
        SYNTAX       Counter32
        UNITS        "Packets"
        MAX-ACCESS   read-only
        STATUS       current
        DESCRIPTION
           "A counter of the total number of dropped
            multicast IPv4 packets by the SMF process
            on this device on this interface
            due to TTL exceeded.

            There is the potential for a counter discontinuity
            in this object if the system SMF process has been
            disabled and later enabled on this interface.
            In order to check for the occurrence of such a
            discontinuity when monitoring this counter object,
            it is recommended that the smfCfgIfSmfUpTime
            object also be monitored."
     ::= { smfPerfIpv4InterfacePerfEntry 4 }

     smfPerfIpv4TTLLargerThanPreviousPerIf  OBJECT-TYPE
        SYNTAX       Counter32
        UNITS        "Packets"
        MAX-ACCESS   read-only
        STATUS       current
        DESCRIPTION
           "A counter of the total number of IPv4 packets
            received by the SMF process on this device
            on this interface that have a TTL larger than
```

          that of a previously received identical packet.

          There is the potential for a counter discontinuity
          in this object if the system SMF process has been
          disabled and later enabled on this interface.
          In order to check for the occurrence of such a
          discontinuity when monitoring this counter object,
          it is recommended that the smfCfgIfSmfUpTime
          object also be monitored."
   ::= { smfPerfIpv4InterfacePerfEntry 5 }

   smfPerfIpv6InterfacePerfTable OBJECT-TYPE
      SYNTAX   SEQUENCE OF SmfPerfIpv6InterfacePerfEntry
      MAX-ACCESS   not-accessible
      STATUS   current
      DESCRIPTION
         "The SMF Interface Performance Table
          describes the SMF counters per
          interface."
   ::= { smfPerfInterfaceGroup 2 }

   smfPerfIpv6InterfacePerfEntry OBJECT-TYPE
      SYNTAX   SmfPerfIpv6InterfacePerfEntry
      MAX-ACCESS   not-accessible
      STATUS   current
      DESCRIPTION
         "The SMF Interface Performance entry
          describes the counters for a particular
          node interface."
      INDEX { smfCfgIfIndex }
   ::= { smfPerfIpv6InterfacePerfTable 1 }

   SmfPerfIpv6InterfacePerfEntry ::=
      SEQUENCE {
         smfPerfIpv6MultiPktsRecvPerIf   Counter32,
         smfPerfIpv6MultiPktsForwardedPerIf   Counter32,
         smfPerfIpv6DuplMultiPktsDetectedPerIf   Counter32,
         smfPerfIpv6DroppedMultiPktsTTLExceededPerIf Counter32,
         smfPerfIpv6TTLLargerThanPreviousPerIf   Counter32,
         smfPerfIpv6HAVAssistsReqdPerIf   Counter32,
         smfPerfIpv6DpdHeaderInsertionsPerIf   Counter32
         }

   smfPerfIpv6MultiPktsRecvPerIf OBJECT-TYPE
      SYNTAX   Counter32
      UNITS   "Packets"
      MAX-ACCESS   read-only
      STATUS   current

```
      DESCRIPTION
         "A counter of the number of
          multicast IP packets received by the
          SMF process on this device
          on this interface.

          There is the potential for a counter discontinuity
          in this object if the system SMF process has been
          disabled and later enabled on this interface.
          In order to check for the occurrence of such a
          discontinuity when monitoring this counter object,
          it is recommended that the smfCfgIfSmfUpTime
          object also be monitored."
   ::= { smfPerfIpv6InterfacePerfEntry 1 }

   smfPerfIpv6MultiPktsForwardedPerIf  OBJECT-TYPE
      SYNTAX       Counter32
      UNITS        "Packets"
      MAX-ACCESS   read-only
      STATUS       current
      DESCRIPTION
         "A counter of the number of
          multicast IP packets forwarded by the
          SMF process on this device
          on this interface.

          There is the potential for a counter discontinuity
          in this object if the system SMF process has been
          disabled and later enabled on this interface.
          In order to check for the occurrence of such a
          discontinuity when monitoring this counter object,
          it is recommended that the smfCfgIfSmfUpTime
          object also be monitored."
   ::= { smfPerfIpv6InterfacePerfEntry 2 }

   smfPerfIpv6DuplMultiPktsDetectedPerIf  OBJECT-TYPE
      SYNTAX       Counter32
      UNITS        "Packets"
      MAX-ACCESS   read-only
      STATUS       current
      DESCRIPTION
         "A counter of the number of duplicate
          multicast IP packets detected by the
          SMF process on this device
          on this interface.

          There is the potential for a counter discontinuity
          in this object if the system SMF process has been
```

```
             disabled and later enabled on this interface.
             In order to check for the occurrence of such a
             discontinuity when monitoring this counter object,
             it is recommended that the smfCfgIfSmfUpTime
             object also be monitored."
        ::= { smfPerfIpv6InterfacePerfEntry 3 }

    smfPerfIpv6DroppedMultiPktsTTLExceededPerIf  OBJECT-TYPE
        SYNTAX        Counter32
        UNITS         "Packets"
        MAX-ACCESS    read-only
        STATUS        current
        DESCRIPTION
            "A counter of the number of dropped
             multicast IP packets by the
             SMF process on this device
             on this interface due to TTL
             exceeded.

             There is the potential for a counter discontinuity
             in this object if the system SMF process has been
             disabled and later enabled on this interface.
             In order to check for the occurrence of such a
             discontinuity when monitoring this counter object,
             it is recommended that the smfCfgIfSmfUpTime
             object also be monitored."
        ::= { smfPerfIpv6InterfacePerfEntry 4 }

    smfPerfIpv6TTLLargerThanPreviousPerIf  OBJECT-TYPE
        SYNTAX        Counter32
        UNITS         "Packets"
        MAX-ACCESS    read-only
        STATUS        current
        DESCRIPTION
            "A counter of the total number of IPv6 packets
             received that have a TTL larger than that
             of a previously received identical packet
             by the SMF process on this device on this
             interface.

             There is the potential for a counter discontinuity
             in this object if the system SMF process has been
             disabled and later enabled on this interface.
             In order to check for the occurrence of such a
             discontinuity when monitoring this counter object,
             it is recommended that the smfCfgIfSmfUpTime
             object also be monitored."
        ::= { smfPerfIpv6InterfacePerfEntry 5 }
```

```
   smfPerfIpv6HAVAssistsReqdPerIf  OBJECT-TYPE
      SYNTAX        Counter32
      UNITS         "Packets"
      MAX-ACCESS    read-only
      STATUS        current
      DESCRIPTION
         "A counter of the total number of IPv6 packets
          received by the SMF process on this device
          on this interface that required the
          HAV assist for DPD.

          There is the potential for a counter discontinuity
          in this object if the system SMF process has been
          disabled and later enabled on this interface.
          In order to check for the occurrence of such a
          discontinuity when monitoring this counter object,
          it is recommended that the smfCfgIfSmfUpTime
          object also be monitored."
   ::= { smfPerfIpv6InterfacePerfEntry 6 }

   smfPerfIpv6DpdHeaderInsertionsPerIf  OBJECT-TYPE
      SYNTAX        Counter32
      UNITS         "Packets"
      MAX-ACCESS    read-only
      STATUS        current
      DESCRIPTION
         "A counter of the total number of IPv6 packets
          received by the SMF process on this device
          on this interface that the device inserted the
          DPD header option.

          There is the potential for a counter discontinuity
          in this object if the system SMF process has been
          disabled and later enabled on this interface.
          In order to check for the occurrence of such a
          discontinuity when monitoring this counter object,
          it is recommended that the smfCfgIfSmfUpTime
          object also be monitored."
   ::= { smfPerfIpv6InterfacePerfEntry 7 }

   --
   -- Notifications
   --

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

   -- smfMIBNotifObjects
```

```
   smfNotifAdminStatusChange NOTIFICATION-TYPE
        OBJECTS { smfCfgRouterIDAddrType, -- The originator of
                                          --   the notification.
                  smfCfgRouterID,         -- The originator of
                                          --   the notification.
                  smfCfgAdminStatus       -- The new status of the
                                          --   SMF process.
                }
        STATUS        current
        DESCRIPTION
          "smfCfgAdminStatusChange is a notification sent when
           the 'smfCfgAdminStatus' object changes."
        ::= { smfMIBNotifObjects 1 }

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

   smfNotifIfAdminStatusChange NOTIFICATION-TYPE
        OBJECTS { smfCfgRouterIDAddrType, -- The originator of
                                          --   the notification.
                  smfCfgRouterID,         -- The originator of
                                          --   the notification.
                  ifName,                 -- The interface whose
                                          --   status has changed.
                  smfCfgIfAdminStatus     -- The new status of the
                                          --   SMF interface.
                }
        STATUS        current
        DESCRIPTION
          "smfCfgIfAdminStatusChange is a notification sent when
           the 'smfCfgIfAdminStatus' object changes."
        ::= { smfMIBNotifObjects 3 }

  smfNotifDpdMemoryOverflowEvent NOTIFICATION-TYPE
        OBJECTS { smfCfgRouterIDAddrType,    -- The originator of
```

```
                                     --    the notification.
                    smfCfgRouterID,         -- The originator of
                                     --    the notification.
                    smfStateDpdMemoryOverflow -- The counter of
                                     --    the overflows.
            }
       STATUS         current
       DESCRIPTION
          "smfNotifDpdMemoryOverflowEvents is sent when the
           number of memory overflow events exceeds
           the 'smfNotifDpdMemoryOverflowThreshold' within the
           previous number of seconds defined by the
           'smfNotifDpdMemoryOverflowWindow'."
       ::= { smfMIBNotifObjects 4 }

   -- smfMIBNotifControl
   smfNotifDpdMemoryOverflowThreshold OBJECT-TYPE
       SYNTAX        Integer32 (0..255)
       UNITS         "Events"
       MAX-ACCESS   read-write
       STATUS         current
       DESCRIPTION
          "A threshold value for the
           'smfNotifDpdmemoryOverflowEvents' object.
           If the number of occurrences exceeds
           this threshold within the previous
           number of seconds
           'smfNotifDpdMemoryOverflowWindow',
           then the 'smfNotifDpdMemoryOverflowEvent'
           notification is sent.

           The default value for this object is
           '1'."
       DEFVAL { 1 }
        ::= { smfMIBNotifControl 1 }

   smfNotifDpdMemoryOverflowWindow OBJECT-TYPE
       SYNTAX         TimeTicks
       MAX-ACCESS   read-write
       STATUS         current
       DESCRIPTION
          "A time window value for the
           'smfNotifDpdmemoryOverflowEvents' object.
           If the number of occurrences exceeds
           the 'smfNotifDpdMemoryOverflowThreshold'
           within the previous number of seconds
           'smfNotifDpdMemoryOverflowWindow',
           then the 'smfNotifDpdMemoryOverflowEvent'
```

```
             notification is sent.

             The default value for this object is
             '1'."
          DEFVAL { 1 }
           ::= { smfMIBNotifControl 2 }

   --
   -- 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 {
             smfCapabilitiesOpModeID,
             smfCapabilitiesRssaID
      }
```

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

   smfConfigObjectsGroup OBJECT-GROUP
      OBJECTS {
              smfCfgAdminStatus,
              smfCfgSmfSysUpTime,
              smfCfgRouterIDAddrType,
              smfCfgRouterID,
              smfCfgOperationalMode,
              smfCfgRssaMember,
              smfCfgIpv4Dpd,
              smfCfgIpv6Dpd,
              smfCfgMaxPktLifetime,
              smfCfgDpdEntryMaxLifetime,
              smfCfgNhdpRssaMesgTLVIncluded,
              smfCfgNhdpRssaAddrBlockTLVIncluded,

              smfCfgAddrForwardingGroupName,
              smfCfgAddrForwardingAddrType,
              smfCfgAddrForwardingAddress,
              smfCfgAddrForwardingAddrPrefixLength,
              smfCfgAddrForwardingStatus,

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

   smfStateObjectsGroup  OBJECT-GROUP
      OBJECTS {
              smfStateNodeRsStatusIncluded,
              smfStateDpdMemoryOverflow,

              smfStateNeighborRSSA,
              smfStateNeighborNextHopInterface
         }
      STATUS  current
      DESCRIPTION
         "Set of SMF state objects implemented
```

```
            in this module."
   ::= { smfMIBGroups 3 }

   smfPerfObjectsGroup  OBJECT-GROUP
       OBJECTS {
               smfPerfIpv4MultiPktsRecvTotal,
               smfPerfIpv4MultiPktsForwardedTotal,
               smfPerfIpv4DuplMultiPktsDetectedTotal,
               smfPerfIpv4DroppedMultiPktsTTLExceededTotal,
               smfPerfIpv4TTLLargerThanPreviousTotal,

               smfPerfIpv6MultiPktsRecvTotal,
               smfPerfIpv6MultiPktsForwardedTotal,
               smfPerfIpv6DuplMultiPktsDetectedTotal,
               smfPerfIpv6DroppedMultiPktsTTLExceededTotal,
               smfPerfIpv6TTLLargerThanPreviousTotal,
               smfPerfIpv6HAVAssistsReqdTotal,
               smfPerfIpv6DpdHeaderInsertionsTotal,

               smfPerfIpv4MultiPktsRecvPerIf,
               smfPerfIpv4MultiPktsForwardedPerIf,
               smfPerfIpv4DuplMultiPktsDetectedPerIf,
               smfPerfIpv4DroppedMultiPktsTTLExceededPerIf,
               smfPerfIpv4TTLLargerThanPreviousPerIf,
               smfPerfIpv6MultiPktsRecvPerIf,
               smfPerfIpv6MultiPktsForwardedPerIf,
               smfPerfIpv6DuplMultiPktsDetectedPerIf,
               smfPerfIpv6DroppedMultiPktsTTLExceededPerIf,
               smfPerfIpv6TTLLargerThanPreviousPerIf,
               smfPerfIpv6HAVAssistsReqdPerIf,
               smfPerfIpv6DpdHeaderInsertionsPerIf
       }
       STATUS  current
       DESCRIPTION
          "Set of SMF performance objects implemented
           in this module by total and per interface."
   ::= { smfMIBGroups 4 }

   smfNotifObjectsGroup  OBJECT-GROUP
       OBJECTS {
               smfNotifDpdMemoryOverflowThreshold,
               smfNotifDpdMemoryOverflowWindow
       }
       STATUS   current
       DESCRIPTION
          "Set of SMF notification control
           objects implemented in this module."
   ::= { smfMIBGroups 5 }
```

```
smfNotificationsGroup  NOTIFICATION-GROUP
   NOTIFICATIONS {
           smfNotifAdminStatusChange,
           smfNotifConfiguredOpModeChange,
           smfNotifIfAdminStatusChange,
           smfNotifDpdMemoryOverflowEvent
   }
   STATUS   current
   DESCRIPTION
      "Set of SMF notifications implemented
       in this module."
::= { smfMIBGroups 6 }


   END
```

8. IANA-SMF-MIB Definitions

This section contains the IANA-SMF-MIB module. This MIB module
defines two Textual Conventions for which IANA SHOULD maintain and
keep synchronized with the registry identified below within the
IANAsmfOpModeIdTC and the IANAsmfRssaIdTC TEXTUAL-CONVENTIONs.

The IANAsmfOpModeIdTC defines an index that identifies through
reference to a specific SMF operations mode. The index is an integer
valued named-number enumeration consisting of an integer and label.
IANA is to create and maintain this Textual Convention. Future
assignments are made to anyone on a first come, first served basis.
There is no substantive review of the request, other than to ensure
that it is well-formed and does not duplicate an existing assignment.
However, requests must include a minimal amount of clerical
information, such as a point of contact (including an email address)
and a brief description of the method being identified as a new SMF
operations mode.

The IANAsmfRssaIdTC defines an index that identifies through
reference to a specific Reduced Set Selection Algorithm (RSSA). The
index is an integer valued named-number enumeration consisting of an
integer and label. IANA is to create and maintain this Textual
Convention.

Future assignments to the IANAsmfRssaIdTC for the index range 5-127
require an RFC publication (either as an IETF submission or as an
Independent submission [RFC5742]). The category of RFC MUST be
Standards Track. The specific RSSAs MUST be documented in sufficient
detail so that interoperability between independent implementations
is possible.

Future assignments to the IANAsmfRssaIdTC for the index range 128-239
are private or local use only, with the type and purpose defined by
the local site. No attempt is made to prevent multiple sites from
using the same value in different (and incompatible) ways. There is
no need for IANA to review such assignments (since IANA will not
record these), and assignments are not generally useful for broad
interoperability. It is the responsibility of the sites making use
of the Private Use range to ensure that no conflicts occur (within
the intended scope of use).

Future assignments to the IANAsmfRssaIdTC for the index range 240-255
are to facilitate experimentation. These require an RFC publication
(either as an IETF submission or as an Independent submission
[RFC5742]). The category of RFC MUST be Experimental. The RSSA
algorithms MUST be documented in sufficient detail so that
interoperability between independent implementations is possible.

This MIB module references [RFC3626], [RFC5614], [RFC6621], and
[RFC7181].

IANA-SMF-MIB DEFINITIONS ::= BEGIN

IMPORTS
    MODULE-IDENTITY, mib-2
            FROM SNMPv2-SMI   -- RFC 2578
    TEXTUAL-CONVENTION
            FROM SNMPv2-TC;   -- RFC 2579

ianaSmfMIB MODULE-IDENTITY
    LAST-UPDATED "201410100000Z" -- October 10, 2014
    ORGANIZATION "IANA"
    CONTACT-INFO "Internet Assigned Numbers Authority

                  Postal: ICANN
                          12025 Waterfront Drive, Suite 300
                          Los Angeles, CA 90094-2536
                          United States

                  Tel: +1 310 301 5800
                  EMail: iana@iana.org"
    DESCRIPTION "This MIB module defines the
                  IANAsmfOpModeIdTC and IANAsmfRssaIdTC
                  Textual Conventions, and thus the
                  enumerated values of the
                  smfCapabilitiesOpModeID and
                  smfCapabilitiesRssaID objects defined
                  in the SMF-MIB."
    REVISION   "201410100000Z" -- October 10, 2014

         DESCRIPTION
            "Initial version of this MIB as published in RFC 7367.

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             authors of the code. All rights reserved.

             Redistribution and use in source and binary forms, with or
             without modification, is permitted pursuant to, and subject
             to the license terms contained in, the Simplified BSD License
             set forth in Section 4.c of the IETF Trust's Legal Provisions
             Relating to IETF Documents
             (http://trustee.ietf.org/license-info).
             "
         ::= { mib-2 225 }

   IANAsmfOpModeIdTC ::= 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 currently
             identified:
               Independent operation 'independent(1)' -
                   SMF performs its own relay
                   set selection using information from an associated
                   MANET NHDP process.

               CDS-aware unicast routing operation 'routing(2)'-
                   a coexistent unicast routing
                   protocol provides dynamic relay
                   set state based upon its own control plane
                   Connected Dominating Set (CDS) or neighborhood
                   discovery information.

               Cross-layer operation 'crossLayer(3)' -
                   SMF operates using neighborhood
                   status and triggers from a
                   cross-layer information base for dynamic relay
                   set selection and maintenance.

             IANA MUST update this Textual Convention accordingly.

             The definition of this Textual Convention with the
             addition of newly assigned values is updated
             periodically by the IANA, in the
             IANA-maintained registries. (The
             latest arrangements can be obtained by contacting the
             IANA.)

```
         Requests for new values SHOULD be made to IANA via
         email (iana@iana.org)."
      REFERENCE
         "See Section 7.2 'Reduced Relay Set Forwarding',
         and the Appendices A, B, and C in
         RFC 6621 - 'Simplified Multicast Forwarding',
         Macker, J., Ed., May 2012."
      SYNTAX   INTEGER {
                     independent (1),
                     routing (2),
                     crossLayer (3)
                     -- future (4-255)
      }

   IANAsmfRssaIdTC ::= TEXTUAL-CONVENTION
      STATUS        current
      DESCRIPTION
         "An index that identifies through reference to specific
         RSSAs.  Several are currently defined
         in the Appendices A, B, and C of RFC 6621.

         Examples of RSSAs already identified within
         this Textual Convention (TC) are:

            Classical Flooding (cF(1)) - is the standard
               flooding algorithm where each node in the next
               retransmits the information on each of its interfaces.

            Source-Based Multipoint Relay (sMPR(2)) -
               this algorithm is used by Optimized Link State Routing
               (OLSR) and OLSR version 2 (OLSRv2) protocols for the
               relay of link state updates and other control
               information (RFC 3626, RFC 7181).  Since each router
               picks its neighboring relays independently, sMPR
               forwarders depend upon previous hop information
               (e.g., source Media Access Control (MAC) address) to
               operate correctly.

            Essential Connected Dominating Set (eCDS(3)) -
               defined in RFC 5614, this algorithm forms a single
               CDS mesh for the SMF operating region.  Its
               packet-forwarding rules are not dependent upon
               previous hop knowledge in contrast to sMPR.

            Multipoint Relay Connected Dominating Set (mprCDS(4)) -
               This algorithm is an extension to the basic sMPR
               election algorithm that results in a shared
               (non-source-specific) SMF CDS.  Thus, its forwarding
```

rules are not dependent upon previous hop information,
similar to eCDS.

IANA MUST update this Textual Convention accordingly.

The definition of this Textual Convention with the
addition of newly assigned values is updated
periodically by the IANA, in the
IANA-maintained registries. (The
latest arrangements can be obtained by contacting the
IANA.)

Requests for new values SHOULD be made to IANA via
email (iana@iana.org)."
REFERENCE
    "For example, see:

    Section 8.1.1. 'SMF Message TLV Type' and the Appendices
    A, B, and C in
    RFC 6621 - 'Simplified Multicast Forwarding',
    Macker, J., Ed., May 2012.

    RFC 3626 - Clausen, T., Ed., and P. Jacquet, Ed., 'Optimized
    Link State Routing Protocol (OLSR)', October 2003.

    RFC 5614 - Ogier, R. and P. Spagnolo, 'Mobile Ad Hoc
    Network (MANET) Extension of OSPF Using Connected
    Dominating Set (CDS) Flooding', August 2009.

    RFC 7181 - Clausen, T., Dearlove, C., Jacquet, P., and
    U. Herberg, 'The Optimized Link State Routing Protocol
    Version 2', April 2014."
SYNTAX   INTEGER {
                  cF(1),
                  sMPR(2),
                  eCDS(3),
                  mprCDS(4)
                  -- future(5-127)
                  -- noStdAction(128-239)
                  -- experimental(240-255)
              }

   END

9. 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 'smfCfgAdminStatus' - 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 'smfCfgRouterIDAddrType' and 'smfCfgRouterID' - 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 smfCfgRouterID is a logical identification that MUST be configured as unique across interoperating 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 smfCfgRouterID MUST be unique within the scope of the operating MANET network regardless of the method used for selecting it. If these objects are misconfigured or configured inconsistently across the MANET, then the ability of various RSSAs, e.g., eCDS, may be compromised. This would potentially result in some routers within the MANET not receiving multicast packets destine to them. Hence, intentionally misconfiguring these objects could pose a form of Denial-of-Service (DoS) attack against the MANET.

o 'smfCfgOpMode' - this writable configuration object defines the operational mode of the SMF process. The operational mode defines how the SMF process receives its data to form its local estimate of the CDS. It is recommended that the value for this object be set consistently across the MANET to ensure proper operation of the multicast packet forwarding. If the value for this object is set inconsistently across the MANET, the result may be that multicast packet delivery will be compromised within the MANET. Hence, intentionally misconfiguring this object could pose a form DoS attack against the MANET.

o 'smfCfgRssa' - this writable configuration object sets the
   specific RSSA for the SMF process. If this object is set
   inconsistently across the MANET domain, multicast delivery of data
   will likely fail. Hence, intentionally misconfiguring this object
   could pose a form DoS attack against the MANET.

o 'smfCfgRssaMember' - 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 connected device
   could lead to frequent island formation. Setting this object to
   'always(2)' could support data ex-filtration from the MANET
   domain.

o 'smfCfgIpv4Dpd' - this writable configuration object sets the
   duplicate packet detection method, i.e., H-DPD or I-DPD, for
   forwarding of IPv4 multicast packets. Forwarders may operate with
   mixed H-DPD and I-DPD modes as long as they consistently perform
   the appropriate DPD routines outlined in [RFC6621]. However, it
   is RECOMMENDED that a deployment be configured with a common mode
   for operational consistency.

o 'smfCfgIpv6Dpd' - this writable configuration object sets the
   duplicate packet detection method for the forwarding of IPv6
   multicast packets. Since IPv6 SMF does specify an option header,
   the interoperability constraints are not as loose as in the IPv4
   version, and forwarders SHOULD NOT operate with mixed H-DPD and
   I-DPD modes. Hence, the value for this object SHOULD be
   consistently set within the forwarders comprising the MANET, else
   inconsistent forwarding may result unnecessary multicast packet
   dropping.

o 'smfCfgMaxPktLifetime' - 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. This could serve as a form of DoS
   attack if this object value is set too small.

o 'smfCfgDpdEntryMaxLifetime' - 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 MaxLifetime being exceeded, the local SMF devices
   should purge the oldest records first. If this object value is
   set too small, then the effectiveness of the SMF DPD algorithms
   may become greatly diminished causing a higher than necessary
   packet load on the MANET.

o 'smfCfgNhdpRssaMesgTLVIncluded' - this writable configuration
   object indicates whether or not the associated NHDP messages
   include the RSSA Message TLV. It is highly RECOMMENDED that this
   object be set to 'true(1)' when the SMF operation mode is set to
   independent as this information will inform the local forwarder of
   the RSSA implemented in neighboring forwarders and is used to
   ensure consistent forwarding across the MANET. While it is
   possible that SMF neighbors MAY be configured differently with
   respect to the RSSA and still operate cooperatively, but these
   cases will vary dependent upon the algorithm types designated and
   this situation SHOULD be avoided.

o 'smfCfgNhdpRssaAddrBlockTLVIncluded' - this writable configuration
   object indicates whether or not the associated NHDP messages
   include the RSSA Address Block TLV. The
   smfNhdpRssaAddrBlockTLVIncluded is optional in all cases as it
   depends on the existence of an address block that may not be
   present. If this SMF device is configured with NHDP, then this
   object should be set to 'true(1)' as this TLV enables CDS relay
   algorithm operation and configuration to be shared among 2-hop
   neighborhoods. Some relay algorithms require 2-hop neighbor
   configuration in order to correctly select relay sets.

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

o 'smfCfgInterfaceTable' - 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
   properly 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
   whether or not this SMF node is part of the CDS. Being part of
   the CDS makes this node a distinguished device. It could be
   exploited for data ex-filtration, or DoS attacks.

o   'smfStateNeighborTable' - 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 module 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 poses 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 SHOULD provide the security features described by the
SNMPv3 framework (see [RFC3410]), and implementations claiming
compliance to the SNMPv3 standard MUST include 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.

10. Applicability Statement

This document describes objects for configuring parameters of the
Simplified Multicast Forwarding [RFC6621] process on a Mobile Ad Hoc
Network (MANET) router. This MIB module, denoted SMF-MIB, also
reports state and performance information and notifications. This
section 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 is out of scope for this
document.

SMF is designed to allow MANET 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 is

estimated using the Relay Set Selection Algorithms (RSSAs) discussed within this document. In the following, three scenarios are listed where this MIB module is useful:

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 Operations 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. The set of interesting
   configuration objects for the SMF process are listed within this
   MIB module.

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 that 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.

Here we provide an example of the simplest of configurations to establish an operational multicast forwarding capability in a MANET. This discussion only identifies the configuration necessary through the SMF-MIB module and assumes that other configuration has occurred. Assume that the MANET is to support only IPv4 addressing and that the MANET nodes are to be configured in the context of the Parking Lot Initialization case above. Then, the SMF-MIB module defines ten configuration OIDs and two configuration tables, i.e., the smfCfgAddrForwardingTable and the smfCfgInterfaceTable. Of the ten OIDs defined, all but one, i.e., the smfCfgRouterID, have DEFVAL clauses that allow for a functional configuration of the SMF process within the MANET. The smfCfgRouterIDType defaults to 'ipv4' so the smfCfgRouterID can be set as, e.g., (assuming the use of the Net-SNMP toolkit),:

snmpset [options] <smfCfgRouterID_OID>.0 a 192.0.2.100

If the smfCfgAddrForwardingTable is left empty, then the SMF local
forwarder will forward all multicast addresses. So this table does
not require configuration if you want to have the MANET forward all
multicast addresses.

All that remains is to configure at least one row in the
smfCfgInterfaceTable. Assume that the node has a wireless interface
with an <ifName>='wlan0' and an <ifIndex>='1'. All of the objects in
the rows of the smfCfgInterfaceTable have a DEFVAL clause; hence,
only the RowStatus object needs to be set. So the SMF process will
be activated on the 'wlan0' interface by the following network
manager snmpset command:

snmpset [options] <smfCfgIfRowStatus>.1 i active(1)

At this point, the configured forwarder will begin a Classical
Flooding algorithm to forward all multicast addresses IPv4 packets it
receives.

To provide a more efficient multicast forwarding within the MANET,
the network manager could walk the smfCapabilitiesTable to identify
other SMF Operational Modes, for example:

snmpwalk [options] <smfCapabilitiesTable>

SMF-MIB::smfCapabilitiesIndex.1 = INTEGER: 1

SMF-MIB::smfCapabilitiesIndex.2 = INTEGER: 2

SMF-MIB::smfCapabilitiesOpModeID.1 = INTEGER: cfOnly(1)

SMF-MIB::smfCapabilitiesOpModeiD.2 = INTEGER: independent(2)

SMF-MIB::smfCapabilitiesRssaID.1 = INTEGER: cF(1)

SMF-MIB::smfCapabilitiesRssaID.2 = INTEGER: eCDS(3)

In this example, the forwarding device also supports the Essential
Connected Dominating Set (eCDS) RSSA with the forwarder in the
'independent(2)' operational mode. If the network manager were to
then issue an snmpset, for example:

snmpset [options] <smfCfgOperationalMode>.0 i 2

then the local forwarder would switch its forwarding behavior from
Classical Flooding to the more efficient eCDS flooding.

11. IANA Considerations

This document defines two MIB modules:

1. SMF-MIB is defined in Section 7 and is an experimental MIB module.

2. IANA-SMF-MIB is defined in Section 8 and is an IANA MIB module that IANA maintains.

Thus, IANA has completed three actions:

IANA has allocated an OBJECT IDENTIFIER value and recorded it in the SMI Numbers registry in the subregistry called "SMI Experimental Codes" under the experimental branch (1.3.6.1.3).

Decimal	Name	Description	Reference
126	smfMib	SMF-MIB	[RFC7367]

IANA has allocated an OBJECT IDENTIFIER value and recorded it in the SMI Numbers registry in the subregistry called "SMI Network Management MGMT Codes Internet-standard MIB" under the mib-2 branch (1.3.6.1.2.1).

Decimal	Name	Description	Reference
225	ianaSmfMIB	IANA-SMF-MIB	[RFC7367]

IANA maintains a MIB module called ianaSmfMIB and has populated it with the initial MIB module defined in Section 8 of this document by creating a new entry in the registry "IANA Maintained MIBs" called "IANA-SMF-MIB".

12. References

12.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997, <http://www.rfc-editor.org/info/rfc2119>.

[RFC2578] McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Structure of Management Information Version 2 (SMIv2)", STD 58, RFC 2578, April 1999, <http://www.rfc-editor.org/info/rfc2578>.

   [RFC2579] McCloghrie, K., Ed., Perkins, D., Ed., and J.
              Schoenwaelder, Ed., "Textual Conventions for SMIv2", STD
              58, RFC 2579, April 1999,
              <http://www.rfc-editor.org/info/rfc2579>.

   [RFC2580] McCloghrie, K., Perkins, D., and J. Schoenwaelder,
              "Conformance Statements for SMIv2", STD 58, RFC 2580,
              April 1999, <http://www.rfc-editor.org/info/rfc2580>.

   [RFC2863] McCloghrie, K. and F. Kastenholz, "The Interfaces Group
              MIB", RFC 2863, June 2000,
              <http://www.rfc-editor.org/info/rfc2863>.

   [RFC3410] Case, J., Mundy, R., Partain, D., and B. Stewart,
              "Introduction and Applicability Statements for Internet-
              Standard Management Framework", RFC 3410, December 2002,
              <http://www.rfc-editor.org/info/rfc3410>.

   [RFC3411] Harrington, D., Presuhn, R., and B. Wijnen, "An
              Architecture for Describing Simple Network Management
              Protocol (SNMP) Management Frameworks", STD 62, RFC 3411,
              December 2002, <http://www.rfc-editor.org/info/rfc3411>.

   [RFC3414] Blumenthal, U. and B. Wijnen, "User-based Security Model
              (USM) for version 3 of the Simple Network Management
              Protocol (SNMPv3)", STD 62, RFC 3414, December 2002,
              <http://www.rfc-editor.org/info/rfc3414>.

   [RFC3418] Presuhn, R., "Management Information Base (MIB) for the
              Simple Network Management Protocol (SNMP)", STD 62, RFC
              3418, December 2002,
              <http://www.rfc-editor.org/info/rfc3418>.

   [RFC3626] Clausen, T. and P. Jacquet, "Optimized Link State Routing
              Protocol (OLSR)", RFC 3626, October 2003,
              <http://www.rfc-editor.org/info/rfc3626>.

   [RFC3826] Blumenthal, U., Maino, F., and K. McCloghrie, "The
              Advanced Encryption Standard (AES) Cipher Algorithm in the
              SNMP User-based Security Model", RFC 3826, June 2004,
              <http://www.rfc-editor.org/info/rfc3826>.

   [RFC4001] Daniele, M., Haberman, B., Routhier, S., and J.
              Schoenwaelder, "Textual Conventions for Internet Network
              Addresses", RFC 4001, February 2005,
              <http://www.rfc-editor.org/info/rfc4001>.

   [RFC5591] Harrington, D. and W. Hardaker, "Transport Security Model
              for the Simple Network Management Protocol (SNMP)", STD
              78, RFC 5591, June 2009,
              <http://www.rfc-editor.org/info/rfc5591>.

   [RFC5592] Harrington, D., Salowey, J., and W. Hardaker, "Secure
              Shell Transport Model for the Simple Network Management
              Protocol (SNMP)", RFC 5592, June 2009,
              <http://www.rfc-editor.org/info/rfc5592>.

   [RFC5614] Ogier, R. and P. Spagnolo, "Mobile Ad Hoc Network (MANET)
              Extension of OSPF Using Connected Dominating Set (CDS)
              Flooding", RFC 5614, August 2009,
              <http://www.rfc-editor.org/info/rfc5614>.

   [RFC5742] Alvestrand, H. and R. Housley, "IESG Procedures for
              Handling of Independent and IRTF Stream Submissions", BCP
              92, RFC 5742, December 2009,
              <http://www.rfc-editor.org/info/rfc5742>.

   [RFC6353] Hardaker, W., "Transport Layer Security (TLS) Transport
              Model for the Simple Network Management Protocol (SNMP)",
              STD 78, RFC 6353, July 2011,
              <http://www.rfc-editor.org/info/rfc6353>.

   [RFC6621] Macker, J., "Simplified Multicast Forwarding", RFC 6621,
              May 2012, <http://www.rfc-editor.org/info/rfc6621>.

   [RFC7181] Clausen, T., Dearlove, C., Jacquet, P., and U. Herberg,
              "The Optimized Link State Routing Protocol Version 2", RFC
              7181, April 2014,
              <http://www.rfc-editor.org/info/rfc7181>.

12.2. Informative References

   [RFC4293] Routhier, S., "Management Information Base for the
              Internet Protocol (IP)", RFC 4293, April 2006,
              <http://www.rfc-editor.org/info/rfc4293>.

   [RFC5132] McWalter, D., Thaler, D., and A. Kessler, "IP Multicast
              MIB", RFC 5132, December 2007,
              <http://www.rfc-editor.org/info/rfc5132>.

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Contributors

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