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Definition of Managed Objects for the Manet Simplified Multicast
Framework Relay Set Process
draft-ietf-manet-smf-mib-02

Abstract

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

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1. Introduction

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

2. The Internet-Standard Management Framework

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

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

3. Conventions

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

4. Overview

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

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

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

4.1. SMF Management Model

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

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

RGC Note: update this figure from the latest SMF draft.

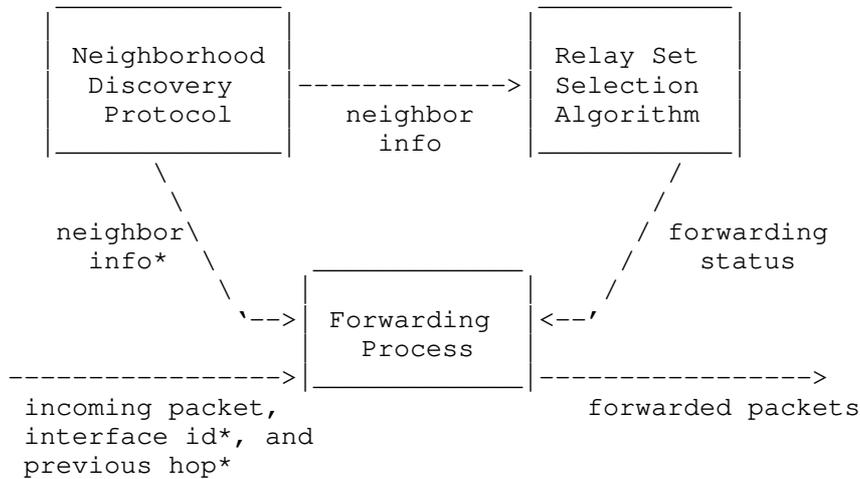


Figure 1: SMF Node Architecture

4.2. Terms

The following definitions apply throughout this document:

- o Configuration Objects - switches, tables, objects which are initialized to default settings or set through the management interface defined by this MIB.
- o Tunable Configuration Objects - objects whose values affect timing or attempt bounds on the SMF RS process.
- o State Objects - automatically generated values which define the current operating state of the SMF RS process in the router.
- o Performance Objects - automatically generated values which help an administrator or automated tool to assess the performance of the CDS multicast process on the router and the overall multicasting performance within the MANET routing domain.

5. Structure of the MIB Module

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

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

- o smfMIBObjects - defines the objects forming the basis for the SMF-MIB. These objects are divided up by function into the following groups:
 - o
 - * Capabilities Group - This group contains the SMF objects that the device uses to advertise its local capabilities with respect to, e.g., the supported RSSAs.
 - * Configuration Group - This group contains the SMF objects that configure specific options that determine the overall operation of the SMF RSSA and the resulting multicast performance.
 - * State Group - Contains information describing the current state of the SMF RSSA process such as the Neighbor Table.
 - * Performance Group - Contains objects which help to characterize the performance of the SMF RSSA process, typically statistics counters.
- o smfMIBConformance - defines minimal and full conformance of implementations to this SMF-MIB.

5.1. Textual Conventions

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

- o The SmfStatus is defined within the SMF-MIB. This contains the current operational status of the SMF process on an interface.
- o The SmfOpModeID represents an index that identifies a specific SMF operational mode.
- o The SmfRssaID represents an index that identifies, through reference, a specific RSSA available for operation on the device.

5.2. The Capabilities Group

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

- o Operational Mode - topology information from NHDP, CDS-aware unicast routing or Cross-layer from Layer 2.
- o SMF RSSA - the specific RSSA operational on the device. Note that configuration, state and performance objects related to a specific RSSA must be defined within another separate MIB.

5.3. The Configuration Group

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

- o Operational Mode - topology information from NHDP, CDS-aware unicast routing or Cross-layer from Layer 2.
- o SMF RSSA - the specific RSSA operational on the device.
- o Duplicate Packet detection for IPv4 - Identification-based or Hash-based DPD.
- o Duplicate Packet detection for IPv6 - Identification-based or Hash-based DPD.
- o SMF Type Message TLV - if NHDP mode is selected, then is the SMF Type Message TLV may be included in the NHDP exchanges.
- o SMF Address Block TLV - if NHDP mode is selected, then is the SMF Address Block TLV included in the NHDP exchanges. (Note: is this correct?)

5.4. The State Group

The State Subtree reports current state information, e.g.,

- o Node RSS State - is the node currently in or out of the Relay Set.
- o Neighbors Table - a table containing current neighbors and their operational RSSA.

5.5. The Performance Group

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

- o Total multicast packets received.
- o Total multicast packets forwarded.
- o Total duplicate multicast packets detected.
- o Per interface statistics table with the following entries:
- o

- * Multicast packets received.
- * Multicast packets forwarded.
- * Duplicate multicast packets detected.

5.6. The Notifications Group

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

6. Relationship to Other MIB Modules

[TODO]: The text of this section specifies the relationship of the MIB modules contained in this document to other standards, particularly to standards containing other MIB modules. Definitions imported from other MIB modules and other MIB modules that SHOULD be implemented in conjunction with the MIB module contained within this document are identified in this section.

6.1. Relationship to the SNMPv2-MIB

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

6.2. MIB modules required for IMPORTS

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

6.3. Relationship to the Future RSSA-MIBs

In a sense, the SMF-MIB is a general front-end to a set of, yet to be developed, RSSA-specific MIBs. These RSSA-specific MIBs will define the objects for the configuration, state, performance and

notification objects required for the operation of these specific RSSAs. The SMF-MIB Capabilities Group allows the remote management station the ability to query the router to discover the set of supported RSSAs.

7. Definitions

```
MANET-SMF-MIB DEFINITIONS ::= BEGIN
```

```
IMPORTS
```

```
    MODULE-IDENTITY, OBJECT-TYPE, NOTIFICATION-TYPE,  
    Counter32, Unsigned32, Integer32, TimeTicks, mib-2  
    FROM SNMPv2-SMI -- [RFC2578]
```

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

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

```
    InterfaceIndexOrZero  
    FROM IF-MIB -- [RFC2863]
```

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

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

```
;
```

```
manetSmfMIB MODULE-IDENTITY
```

```
    LAST-UPDATED "201101161300Z" -- January 16, 2011
```

```
    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:

[SMF] Macker, J. (ed.),
Simplified Multicast Forwarding draft-ietf-manet-smf-10,
March 06, 2010.

Copyright (C) The IETF Trust (2008). This version of this MIB module is part of RFC xxxx; see the RFC itself for full legal notices."

-- Revision History

REVISION "201101161300Z" -- January 16, 2011

DESCRIPTION

"Updated 5th revision of the draft of this MIB module published as draft-ietf-manet-smf-mib-02.txt. The changes made in this revision include:
- Added the Notification Group and cleaned

- up the Conformance section
- Completed the TEXTUAL CONVENTION for the smfOpMode.
- Completed the Description clauses of several objects within the MIB.
- Removed the routerPriority object.
- Added the definition of a smfRouterID object and associated smfRouterIDAddrType object.

"

REVISION "200910261300Z" -- October 26, 2009

DESCRIPTION

- "Updated draft of this MIB module published as draft-ietf-manet-smf-mib-01.txt. A few changes were made in the development of this draft. Specifically, the following changes were made:
- Updated the textual material, included section on IMPORTS, relationship to other MIBs, etc.

"

REVISION "200904211300Z" -- April 21, 2009

DESCRIPTION

- "Updated draft of this MIB module published as draft-ietf-manet-smf-mib-00.txt. A few changes were made in the development of this draft. Specifically, the following changes were made:
- Removed the smfGatewayFilterTable from this draft. It is a useful construct, e.g., an IPTABLES-MIB, but might best be handled as a separate MIB and worked within a security focused working group.
 - Removed the smfReportsGroup. This capability is being replaced with a new and more general method for offline reporting. This is being worked as a new MIB module referred to as the REPORT-MIB.
 - Rev'd as a new MANET WG document.

"

REVISION "200902271300Z" -- February 27, 2009

DESCRIPTION

- "Updated draft of this MIB module published as draft-cole-manet-smf-mib-02.txt. Fairly extensive revisions and additions to this MIB were made in this version. Specifically, the following changes were made in development of this version:
- added a Capabilities Group within the Objects Group to allow the device to report supported capabilities, e.g., RSSAs supported.

- added administrative status objects for device and interfaces
- added multicast address forwarding tables, both for configured (within Configuration Group) and discovered (within the State Group).
- added additional Performance counters related to DPD functions.
- Split up the performance counters into IPv4 and IPv6, for both global and per interface statistics.
- Split out the reports capability into a separate Reports Group under the Objects Group.

"

REVISION "200811031300Z" -- November 03, 2008

DESCRIPTION

"Updated draft of this MIB module published as draft-cole-manet-smf-mib-01.txt. Added gateway filter table and reports capabilities following rmon."

REVISION "200807071200Z" -- July 07, 2008

DESCRIPTION

"Initial draft of this MIB module published as draft-cole-manet-smf-mib-00.txt."

-- RFC-Editor assigns XXXX

::= { mib-2 998 } -- to be assigned by IANA

--

-- TEXTUAL CONVENTIONS

--

SmfStatus ::= TEXTUAL-CONVENTION

STATUS current

DESCRIPTION

"An indication of the operability of a SMF function or feature. For example, the status of an interface: 'enabled' indicates that it is performing SMF functions, and 'disabled' indicates that it is not."

SYNTAX INTEGER {
 enabled (1),
 disabled (2)
 }

SmfOpModeID ::= TEXTUAL-CONVENTION

STATUS current

DESCRIPTION

"An index that identifies through reference to a specific

SMF operations mode. There are basically three styles of SMF operation with reduced relay sets:

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

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

Cross-layer operation - SMF operates using neighborhood status and triggers from a cross-layer information base for dynamic relay set selection and maintenance

"

```
SYNTAX  INTEGER {
        independent (1),
        routing (2),
        crossLayer (3)
        -- future (4-255)
    }
```

SmfRssaID ::= TEXTUAL-CONVENTION

STATUS current

DESCRIPTION

"An index that identifies through reference to a specific RSSA algorithms. Several are currently defined in the appendix of

"

```
SYNTAX  INTEGER {
        cF(1),
        SMPR(2),
        eCDS(3),
        mprCDS(4)
        -- future(5-127)
        -- noStdAction(128-239)
        -- experimental(240-255)
    }
```

--

-- Top-Level Object Identifier Assignments

--

smfMIBNotifications OBJECT IDENTIFIER ::= { manetSmfMIB 0 }

```

smfMIBObjects      OBJECT IDENTIFIER ::= { manetSmfMIB 1 }
smfMIBConformance OBJECT IDENTIFIER ::= { manetSmfMIB 2 }

--
-- smfMIBObjects Assignments:
--   smfCapabilitiesGroup - 1
--   smfConfigurationGroup - 2
--   smfStateGroup - 3
--   smfPerformanceGroup - 4
--
--
-- smfCapabilitiesGroup
--
--   This group contains the SMF objects that identify specific
--   capabilities within this device related to SMF functions.
--
smfCapabilitiesGroup OBJECT IDENTIFIER ::= { smfMIBObjects 1 }

--
-- SMF Operational Mode Capabilities Table
--
smfOpModeCapabilitiesTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF SmfOpModeCapabilitiesEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The smfOpModeCapabilitiesTable identifies the
        resident set of SMF Operational Modes on this
        router."
    ::= { smfCapabilitiesGroup 1 }

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

```

```

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

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

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

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

--
-- SMF RSSA Capabilities Table
--

smfRssaCapabilitiesTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF SmfRssaCapabilitiesEntry
    MAX-ACCESS  not-accessible
    STATUS      current

```

```

DESCRIPTION
    "The smfRssaCapabilitiesTable contains
    reference to the specific set of RSSAs
    currently supported on this device.
    "
 ::= { smfCapabilitiesGroup 2 }

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

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

smfRssaCapabilitiesID      OBJECT-TYPE
    SYNTAX      SmfRssaID
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The index for this entry.  This object identifies
        the particular RSSA algorithm in this MIB
        module.  Example RSSAs are found in the
        appendix of [SMF]."
    ::= { smfRssaCapabilitiesEntry 1 }

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

```

```

    "
    ::= { smfRssaCapabilitiesEntry 2 }

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

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

smfConfigurationGroup  OBJECT IDENTIFIER ::= { smfMIBObjects 2 }

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

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

-- Note: need to better define the algorithm to
--      choose the smfRouterID.
smfRouterIDAddrType  OBJECT-TYPE
    SYNTAX      InetAddressType
```

```

MAX-ACCESS    read-write
STATUS        current
DESCRIPTION
  "The address type of the address used for
  SMF ID of this router as specified
  in the 'smfRouterID' next.

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

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

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

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

smfConfiguredOpMode OBJECT-TYPE
SYNTAX        INTEGER {
                    withNHDP(1),
                    cdsAwareRouting(2),
                    crossLayer(3),
                    other(4)
                }
MAX-ACCESS    read-write
STATUS        current
DESCRIPTION

```

"The SMF RSS node operational mode as defined in the TEXTUAL CONVENTION for `SmfOpModeID` and in [SMF]..

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

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

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

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

"

```
::= { smfConfigurationGroup 4 }
```

```
smfConfiguredRssa OBJECT-TYPE
```

```
SYNTAX      SmfRssaID
```

```
MAX-ACCESS  read-write
```

```
STATUS      current
```

```
DESCRIPTION
```

"The SMF RSS currently operational algorithm as defined in the TEXTUAL CONVENTION for `SmfRssaID` and in [SMF].

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

"

```
::= { smfConfigurationGroup 5 }
```

```
smfRssaMember OBJECT-TYPE
```

```
SYNTAX      INTEGER {
                potential(1),
                always(2),
                never(3)
            }
```

```
MAX-ACCESS  read-write
```

```
STATUS      current
```

```
DESCRIPTION
```

"The RSSA downselects a set of forwarders for multicast forwarding. Sometimes it is useful to force an agent to be included or excluded from the resulting RSS. This object is a

switch to allow for this behavior.

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

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

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

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

"

```
::= { smfConfigurationGroup 6 }
```

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

    The value identificationBased(1)
    indicates that the duplicate packet
    detection relies upon header information
    in the multicast packets to identify
    previously received packets.

    The value 'hashBased(2) indicates that the
    routers duplicate packet detection is based
    upon comparing a hash over the packet fields.

    This object is persistent and when written
    the entity SHOULD save the change to
    non-volatile storage.
    "
 ::= { smfConfigurationGroup 7 }
```

```
smfIpv6Dpd OBJECT-TYPE
  SYNTAX      INTEGER {
                identificationBased(1),
```

```

        hashBased(2)
    }
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
        "The current method for IPv6 duplicate packet
        detection.

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

        This object is persistent and when written
        the entity SHOULD save the change to
        non-volatile storage.
        "
 ::= { smfConfigurationGroup 8 }

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

        This object is persistent and when written
        the entity SHOULD save the change to
        non-volatile storage.
        "
    DEFVAL { 60 }
 ::= { smfConfigurationGroup 9 }

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

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

```

```
"
  DEFVAL { 1024 }
 ::= { smfConfigurationGroup 10 }

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

    This object is persistent and when written
    the entity SHOULD save the change to
    non-volatile storage."
"
  DEFVAL { 600 }
 ::= { smfConfigurationGroup 11 }

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

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

    This object is persistent and when written
    the entity SHOULD save the change to
    non-volatile storage."
"
 ::= { smfConfigurationGroup 12 }
```

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

         This object is persistent and when written
         the entity SHOULD save the change to
         non-volatile storage.
        "
 ::= { smfConfigurationGroup 13 }

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

smfConfiguredAddrForwardingTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF SmfConfiguredAddrForwardingEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The (conceptual) table containing information on multicast
         addresses which are to be forwarded by the SMF process.

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

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

         The objects in this table are persistent and when written
         the entity SHOULD save the change to
         non-volatile storage.
        "
 ::= { smfConfigurationGroup 15 }
```

```

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

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

smfConfiguredAddrForwardingAddrType OBJECT-TYPE
    SYNTAX      InetAddressType
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The type of the addresses in the multicast forwarding
         range.  Legal values correspond to the subset of
         address families for which multicast address allocation
         is supported."
    ::= { smfConfiguredAddrForwardingEntry 1 }

smfConfiguredAddrForwardingFirstAddr OBJECT-TYPE
    SYNTAX      InetAddress (SIZE(0..20))
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The first address in the multicast scope range.  The type
         of this address is determined by the value of the
         smfConfiguredAddrForwardingAddrType object."
    ::= { smfConfiguredAddrForwardingEntry 2 }

smfConfiguredAddrForwardingLastAddr OBJECT-TYPE
    SYNTAX      InetAddress (SIZE(0..20))
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The last address in the multicast scope range.
         The type of this address is determined by the
         value of the smfConfiguredAddrForwardingAddrType
         object."

```

```

 ::= { smfConfiguredAddrForwardingEntry 3 }

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

--
-- SMF Interfaces Configuration Table
--

smfInterfaceTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF SmfInterfaceEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The SMF Interface Table describes the SMF
        interfaces that are participating in the
        SMF packet forwarding process.  The ifIndex is
        from the interfaces group defined in the
        Interfaces Group MIB.

        The objects in this table are persistent
        and when written the entity SHOULD save
        the change to non-volatile storage.
        "
    REFERENCE
        "RFC 2863 - The Interfaces Group MIB, McCloghrie,
        K., and F. Kastenholz, June 2000."
 ::= { smfConfigurationGroup 16 }

smfInterfaceEntry OBJECT-TYPE
    SYNTAX      SmfInterfaceEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The SMF interface entry describes one SMF
        interface as indexed by its ifIndex."
    INDEX { smfIfIndex }
 ::= { smfInterfaceTable 1 }

```

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

smfIfIndex OBJECT-TYPE
    SYNTAX      InterfaceIndexOrZero
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The ifIndex for this SMF interface."
    ::= { smfInterfaceEntry 1 }

smfIfAdminStatus OBJECT-TYPE
    SYNTAX      SmfStatus
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The SMF interface's administrative status.
        The value 'enabled' denotes that the interface
        is running the SMF forwarding process.
        The value 'disabled' denotes that the interface is
        external to the SMF forwarding process.
        "
    ::= { smfInterfaceEntry 2 }

smfIfRowStatus OBJECT-TYPE
    SYNTAX      RowStatus
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This object permits management of the table
        by facilitating actions such as row creation,
        construction, and destruction. The value of
        this object has no effect on whether other
        objects in this conceptual row can be
        modified."
    ::= { smfInterfaceEntry 3 }

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

```
--  
  
smfStateGroup OBJECT IDENTIFIER ::= { smfMIBObjects 3 }  
  
smfNodeRsStatusIncluded OBJECT-TYPE  
    SYNTAX      TruthValue  
    MAX-ACCESS  read-only  
    STATUS      current  
    DESCRIPTION  
        "The current status of the SMF node in the context of  
        the MANETs relay set. A value of true(1) indicates  
        that the node is currently part of the MANET Relay  
        Set. A value of false(2) indicates that the node  
        is currently not part of the MANET Relay Set."  
    ::= { smfStateGroup 1 }  
  
smfDpdMemoryOverflow OBJECT-TYPE  
    SYNTAX      Counter32  
    MAX-ACCESS  read-only  
    STATUS      current  
    DESCRIPTION  
        "The number of times that the memory for caching  
        records for DPD overran and records had to be flushed.  
        The number of records to be flushed upon a buffer  
        overflow is an implementation specific decision."  
    ::= { smfStateGroup 2 }  
  
--  
-- Dynamically Discovered Multicast Addr Table  
--  
  
smfDiscoveredAddrForwardingTable OBJECT-TYPE  
    SYNTAX      SEQUENCE OF SmfDiscoveredAddrForwardingEntry  
    MAX-ACCESS  not-accessible  
    STATUS      current  
    DESCRIPTION  
        "The (conceptual) table containing information on multicast  
        addresses which are to be forwarded by the SMF process.  
  
        Entries in this table are configured. As well, addresses  
        to be forwarded by the SMF device can be dynamically  
        discovered by other means. The corresponding state  
        table, smfDiscoveredAddrForwardingTable contains  
        these additional, dynamically discovered address for  
        forwarding."
```

```

        Each row is associated with a range of
        multicast addresses, and ranges for different rows
        must be disjoint.
    "
 ::= { smfStateGroup 3 }

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

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

smfDiscoveredAddrForwardingAddrType OBJECT-TYPE
    SYNTAX      InetAddressType
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The type of the addresses in the multicast forwarding
        range.  Legal values correspond to the subset of
        address families for which multicast address allocation
        is supported."
    ::= { smfDiscoveredAddrForwardingEntry 1 }

smfDiscoveredAddrForwardingFirstAddr OBJECT-TYPE
    SYNTAX      InetAddress (SIZE(0..20))
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The first address in the multicast scope range.  The type
        of this address is determined by the value of the
        smfConfiguredAddrForwardingAddrType object."
    ::= { smfDiscoveredAddrForwardingEntry 2 }

smfDiscoveredAddrForwardingLastAddr OBJECT-TYPE
    SYNTAX      InetAddress (SIZE(0..20))
    MAX-ACCESS  read-create

```

```
STATUS      current
DESCRIPTION
    "The last address in the multicast scope range.
    The type of this address is determined by the
    value of the smfConfiguredAddrForwardingAddrType
    object."
 ::= { smfDiscoveredAddrForwardingEntry 3 }

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

--
-- SMF Neighbor Table
--

smfNeighborTable OBJECT-TYPE
SYNTAX      SEQUENCE OF SmfNeighborEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The SMF NeighborTable describes the
    current neighbor nodes, their address
    and SMF RSSA and the interface on which
    they can be reached."
REFERENCE
    "Simplified Multicast Forwarding for MANET
    (SMF), Macker, J., July 2009.
    Section 7: SMF Neighborhood Discovery
    Requirements."
 ::= { smfStateGroup 4 }

smfNeighborEntry OBJECT-TYPE
SYNTAX      SmfNeighborEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The SMF Neighbor Table contains the
    set of one-hop neighbors, the interface
```

```

        they are reachable on and the SMF RSSA
        they are currently running."
INDEX { smfNeighborIpAddrType,
        smfNeighborIpAddr,
        smfNeighborPrefixLen }
 ::= { smfNeighborTable 1 }

SmfNeighborEntry ::=
SEQUENCE {
    smfNeighborIpAddrType      InetAddressType,
    smfNeighborIpAddr         InetAddress,
    smfNeighborPrefixLen      InetAddressPrefixLength,
    smfNeighborRSSA           SmfRssaID,
    smfNeighborNextHopInterface InterfaceIndexOrZero
}

smfNeighborIpAddrType OBJECT-TYPE
SYNTAX      InetAddressType
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The neighbor IP address type."
 ::= { smfNeighborEntry 1 }

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

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

smfNeighborRSSA OBJECT-TYPE
SYNTAX      SmfRssaID
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION

```

```
        "The current RSSA running on the neighbor.
        The list is identical to that described
        above for the smfRssa object."
 ::= { smfNeighborEntry 4 }

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

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

smfPerformanceGroup OBJECT IDENTIFIER ::= { smfMIBObjects 4 }

smfGlobalPerfGroup OBJECT IDENTIFIER ::= { smfPerformanceGroup 1 }

--
-- IPv4 packet counters
--

smfIpv4MultiPktsRecvTotal OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "A counter of the total number of
        multicast IPv4 packets received by the
        device."
 ::= { smfGlobalPerfGroup 1 }

smfIpv4MultiPktsForwardedTotal OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
```

```
DESCRIPTION
    "A counter of the total number of
      multicast IPv4 packets forwarded by the
      device."
 ::= { smfGlobalPerfGroup 2 }

smfIpv4DuplMultiPktsDetectedTotal  OBJECT-TYPE
SYNTAX          Counter32
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
    "A counter of the total number of duplicate
      multicast IPv4 packets detected by the
      device."
 ::= { smfGlobalPerfGroup 3 }

smfIpv4DroppedMultiPktsTTLExceededTotal  OBJECT-TYPE
SYNTAX          Counter32
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
    "A counter of the total number of dropped
      multicast IPv4 packets by the
      device due to TTL exceeded."
 ::= { smfGlobalPerfGroup 4 }

smfIpv4TTLLargerThanPreviousTotal  OBJECT-TYPE
SYNTAX          Counter32
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
    "A counter of the total number of IPv4 packets
      recieved which have a TTL larger than that
      of a previously received identical packet.
      "
 ::= { smfGlobalPerfGroup 5 }

--
-- IPv6 packet counters
--

smfIpv6MultiPktsRecvTotal  OBJECT-TYPE
SYNTAX          Counter32
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
    "A counter of the total number of
      multicast IPv6 packets received by the
```

```
        device."
 ::= { smfGlobalPerfGroup 6 }

smfIpv6MultiPktsForwardedTotal OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "A counter of the total number of
        multicast IPv6 packets forwarded by the
        device."
 ::= { smfGlobalPerfGroup 7 }

smfIpv6DuplMultiPktsDetectedTotal OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "A counter of the total number of duplicate
        multicast IPv6 packets detected by the
        device."
 ::= { smfGlobalPerfGroup 8 }

smfIpv6DroppedMultiPktsTTLExceededTotal OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "A counter of the total number of dropped
        multicast IPv6 packets by the
        device due to TTL exceeded."
 ::= { smfGlobalPerfGroup 9 }

smfIpv6TTLLargerThanPreviousTotal OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "A counter of the total number of IPv6 packets
        recieved which have a TTL larger than that
        of a previously recieved identical packet.
        "
 ::= { smfGlobalPerfGroup 10 }

smfIpv6HAVAssistsReqdTotal OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
```

```

DESCRIPTION
    "A counter of the total number of IPv6 packets
      recieved which required the HAV assist for DPD.
    "
 ::= { smfGlobalPerfGroup 11 }

smfIpv6DpdHeaderInsertionsTotal OBJECT-TYPE
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "A counter of the total number of IPv6 packets
      recieved which the device inserted the
      DPD header option.
    "
 ::= { smfGlobalPerfGroup 12 }

--
-- Per SMF Interface Performance Table
--

smfInterfacePerfGroup OBJECT IDENTIFIER ::= { smfPerformanceGroup 2 }

smfIpv4InterfacePerfTable OBJECT-TYPE
SYNTAX      SEQUENCE OF SmfIpv4InterfacePerfEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The SMF Interface Performance Table
      describes the SMF statistics per
      interface."
 ::= { smfInterfacePerfGroup 1 }

smfIpv4InterfacePerfEntry OBJECT-TYPE
SYNTAX      SmfIpv4InterfacePerfEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The SMF Interface Performance entry
      describes the statistics for a particular
      node interface."
INDEX { smfIpv4IfPerfIfIndex }
 ::= { smfIpv4InterfacePerfTable 1 }

SmfIpv4InterfacePerfEntry ::=
SEQUENCE {
    smfIpv4IfPerfIfIndex          InterfaceIndexOrZero,
```

```
    smfIpv4MultiPktsRecvPerIf          Counter32,
    smfIpv4MultiPktsForwardedPerIf     Counter32,
    smfIpv4DuplMultiPktsDetectedPerIf  Counter32,
    smfIpv4DroppedMultiPktsTTLExceededPerIf Counter32,
    smfIpv4TTLargerThanPreviousPerIf   Counter32
  }

smfIpv4IfPerfIfIndex OBJECT-TYPE
    SYNTAX      InterfaceIndexOrZero
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The ifIndex for this node interface
         that is collecting this set of
         performance management statistics."
    ::= { smfIpv4InterfacePerfEntry 1 }

smfIpv4MultiPktsRecvPerIf OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "A counter of the number of
         multicast IP packets received by the
         device on this interface."
    ::= { smfIpv4InterfacePerfEntry 2 }

smfIpv4MultiPktsForwardedPerIf OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "A counter of the number of
         multicast IP packets forwarded by the
         device on this interface."
    ::= { smfIpv4InterfacePerfEntry 3 }

smfIpv4DuplMultiPktsDetectedPerIf OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "A counter of the number of duplicate
         multicast IP packets detected by the
         device on this interface."
    ::= { smfIpv4InterfacePerfEntry 4 }

smfIpv4DroppedMultiPktsTTLExceededPerIf OBJECT-TYPE
```

```

SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "A counter of the total number of dropped
    multicast IPv4 packets by the
    device due to TTL exceeded."
 ::= { smfIpv4InterfacePerfEntry 5 }

smfIpv4TTLLargerThanPreviousPerIf  OBJECT-TYPE
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "A counter of the total number of IPv4 packets
    recieved which have a TTL larger than that
    of a previously recived identical packet.
    "
 ::= { smfIpv4InterfacePerfEntry 6 }

smfIpv6InterfacePerfTable OBJECT-TYPE
SYNTAX      SEQUENCE OF SmfIpv6InterfacePerfEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The SMF Interface Performance Table
    describes the SMF statistics per
    interface."
 ::= { smfInterfacePerfGroup 2 }

smfIpv6InterfacePerfEntry OBJECT-TYPE
SYNTAX      SmfIpv6InterfacePerfEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The SMF Interface Performance entry
    describes the statistics for a particular
    node interface."
INDEX { smfIpv6IfPerfIfIndex }
 ::= { smfIpv6InterfacePerfTable 1 }

SmfIpv6InterfacePerfEntry ::=
SEQUENCE {
    smfIpv6IfPerfIfIndex          InterfaceIndexOrZero,
    smfIpv6MultiPktsRecvPerIf     Counter32,
    smfIpv6MultiPktsForwardedPerIf Counter32,
    smfIpv6DuplMultiPktsDetectedPerIf Counter32,

```

```
    smfIpv6DroppedMultiPktsTTLExceededPerIf Counter32,
    smfIpv6TTLlargerThanPreviousPerIf      Counter32,
    smfIpv6HAVAssistsReqdPerIf             Counter32,
    smfIpv6DpdHeaderInsertionsPerIf        Counter32
  }

smfIpv6IfPerfIfIndex OBJECT-TYPE
    SYNTAX      InterfaceIndexOrZero
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The ifIndex for this node interface
         that is collecting this set of
         performance management statistics.

         For packets generated locally at
         this node, performance counters
         are assigned to the loopback
         interface.
        "
 ::= { smfIpv6InterfacePerfEntry 1 }

smfIpv6MultiPktsRecvPerIf OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "A counter of the number of
         multicast IP packets received by the
         device on this interface."
 ::= { smfIpv6InterfacePerfEntry 2 }

smfIpv6MultiPktsForwardedPerIf OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "A counter of the number of
         multicast IP packets forwarded by the
         device on this interface."
 ::= { smfIpv6InterfacePerfEntry 3 }

smfIpv6DuplMultiPktsDetectedPerIf OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "A counter of the number of duplicate
```

```
        multicast IP packets detected by the
        device on this interface."
 ::= { smfIpv6InterfacePerfEntry 4 }

smfIpv6DroppedMultiPktsTTLExceededPerIf  OBJECT-TYPE
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "A counter of the number of dropped
    multicast IP packets by the
    device on this interface due to TTL
    exceeded."
 ::= { smfIpv6InterfacePerfEntry 5 }

smfIpv6TTLargerThanPreviousPerIf  OBJECT-TYPE
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "A counter of the total number of IPv6 packets
    recieved which have a TTL larger than that
    of a previously recieved identical packet.
    "
 ::= { smfIpv6InterfacePerfEntry 6 }

smfIpv6HAVAssistsReqdPerIf  OBJECT-TYPE
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "A counter of the total number of IPv6 packets
    recieved which required the HAV assist for DPD.
    "
 ::= { smfIpv6InterfacePerfEntry 7 }

smfIpv6DpdHeaderInsertionsPerIf  OBJECT-TYPE
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "A counter of the total number of IPv6 packets
    recieved which the device inserted the
    DPD header option.
    "
 ::= { smfIpv6InterfacePerfEntry 8 }
```

```
--
-- Notifications
--

smfMIBNotifControl OBJECT IDENTIFIER ::= { smfMIBNotifications 1 }
smfMIBNotifObjects OBJECT IDENTIFIER ::= { smfMIBNotifications 2 }
smfMIBNotifStates  OBJECT IDENTIFIER ::= { smfMIBNotifications 3 }

-- smfMIBNotifControl
smfSetNotification OBJECT-TYPE
    SYNTAX      OCTET STRING (SIZE(4))
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "A 4-octet string serving as a bit map for
        the notification events defined by the SMF MIB
        notifications. This object is used to enable
        and disable specific SMF MIB notifications where
        a 1 in the bit field represents enabled. The
        right-most bit (least significant) represents
        notification 0.

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

smfDpdMemoryOverflowThreshold OBJECT-TYPE
    SYNTAX      Integer32 (0..255)
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "A threshold value for the
        'smfDpdmemoryOverflowEvents' object.
        If the number of occurrences exceeds
        this threshold within the previous
        number of seconds
        'smfDpdMemoryOverflowWindow',
        then the 'smfDpdMemoryOverflowEvent'
        notification is sent.
        "
    ::= { smfMIBNotifControl 2 }

smfDpdMemoryOverflowWindow OBJECT-TYPE
    SYNTAX      TimeTicks
    MAX-ACCESS  read-write
```

```
STATUS          current
DESCRIPTION
    "A time window value for the
     '\smfDpdmemoryOverflowEvents' object.
     If the number of occurrences exceeds
     the '\smfDpdMemoryOverflowThreshold'
     within the previous number of seconds
     '\smfDpdMemoryOverflowWindow',
     then the '\smfDpdMemoryOverflowEvent'
     notification is sent.
    "
 ::= { smfMIBNotifControl 3 }

smfIpv4DuplMultiPktsDetectedTotalThreshold OBJECT-TYPE
SYNTAX          Integer32 (0..255)
MAX-ACCESS      read-write
STATUS          current
DESCRIPTION
    "A threshold value for the
     '\smfIpv4DuplMultiPktsDetectedTotal'
     object. If the number of occurrences
     exceeds this threshold within the
     previous number of seconds
     '\smfIpv4DuplMultiPktsDetectedTotalWindow',
     then the
     '\smfIpv4DuplMultiPktsDetectedTotalEvent'
     notification is sent.
    "
 ::= { smfMIBNotifControl 4 }

smfIpv4DuplMultiPktsDetectedTotalWindow OBJECT-TYPE
SYNTAX          TimeTicks
MAX-ACCESS      read-write
STATUS          current
DESCRIPTION
    "A time window value for the
     '\smfIpv4DuplMultiPktsDetectedTotalEvents'
     object. If the number of occurrences
     exceeds the
     '\smfIpv4DuplMultiPktsDetectedTotalThreshold'
     within the previous number of seconds
     '\smfIpv4DuplMultiPktsDetectedTotalWindow',
     then the
     '\smfIpv4DuplMultiPktsDetectedTotalEvent'
     notification is sent.
    "
 ::= { smfMIBNotifControl 5 }
```

```

smfIpv6DuplMultiPktsDetectedTotalThreshold OBJECT-TYPE
    SYNTAX      Integer32 (0..255)
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "A threshold value for the
        `smfIpv6DuplMultiPktsDetectedTotal'
        object.  If the number of occurrences
        exceeds this threshold within the
        previous number of seconds
        `smfIpv6DuplMultiPktsDetectedTotalWindow',
        then the
        `smfIpv6DuplMultiPktsDetectedTotalEvent'
        notification is sent.
        "
    ::= { smfMIBNotifControl 6 }

smfIpv6DuplMultiPktsDetectedTotalWindow OBJECT-TYPE
    SYNTAX      TimeTicks
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
        "A time window value for the
        `smfIpv6DuplMultiPktsDetectedTotalEvents'
        object.  If the number of occurrences
        exceeds the
        `smfIpv6DuplMultiPktsDetectedTotalThreshold'
        within the previous number of seconds
        `smfIpv6DuplMultiPktsDetectedTotalWindow',
        then the
        `smfIpv6DuplMultiPktsDetectedTotalEvent'
        notification is sent.
        "
    ::= { smfMIBNotifControl 7 }

-- smfMIBNotifObjects

smfAdminStatusChange NOTIFICATION-TYPE
    OBJECTS { smfRouterIDAddrType, -- The originator of
        -- the notification.
        smfRouterID, -- The originator of
        -- the notification.
        smfAdminStatus -- The new status of the
        -- SMF process.
    }
    STATUS      current

```



```

STATUS          current
DESCRIPTION
    "smfIfAdminStatusChange is a notification sent when a
      the 'smfIfAdminStatus' object changes.
    "
 ::= { smfMIBNotifObjects 4 }

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

smfIpv4DuplMultiPktsDetectedTotalEvents NOTIFICATION-TYPE
OBJECTS { smfRouterIDAddrType, -- The originator of
          -- the notification.
          smfRouterID,         -- The originator of
          -- the notification.
          smfIpv4DuplMultiPktsDetectedTotal -- The
          -- counter of detected
          -- duplicates.
        }
STATUS          current
DESCRIPTION
    "smfIpv4DuplMultiPktsDetectedTotal is a
      notification sent when the number of
      IPv4 duplicate packets detected exceeds the
      'smfIpv4DuplMultiPktsDetectedTotalThreshold'
      during the previous number of seconds
      'smfIpv4DuplPktsDetectedTotalWindow'.
    "
 ::= { smfMIBNotifObjects 6 }

smfIpv6DuplMultiPktsDetectedTotalEvents NOTIFICATION-TYPE
OBJECTS { smfRouterIDAddrType, -- The originator of
          -- the notification.

```

```

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

-- smfMIBNotifStates
-- is empty.

--
-- Compliance Statements
--

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

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

smfFullCompliance MODULE-COMPLIANCE
    STATUS current
    DESCRIPTION "The full implementation requirements for
    managed network entities that implement
    the SMF RSSA process."

```

```
MODULE -- this module
MANDATORY-GROUPS { smfCapabObjectsGroup,
                    smfConfigObjectsGroup,
                    smfStateObjectsGroup,
                    smfPerfObjectsGroup,
                    smfNotifObjectsGroup,
                    smfNotificationsGroup
                  }
 ::= { smfCompliances 2 }

--
-- Units of Conformance
--

smfCapabObjectsGroup OBJECT-GROUP
OBJECTS {
    smfOpModeCapabilitiesName,
    smfOpModeCapabilitiesReference,

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

smfConfigObjectsGroup OBJECT-GROUP
OBJECTS {
    smfAdminStatus,
    smfRouterIDAddrType,
    smfRouterID,
    smfIfIndex,
    smfConfiguredOpMode,
    smfConfiguredRssa,
    smfRssaMember,
    smfIpv4Dpd,
    smfIpv6Dpd,
    smfMaxPktLifetime,
    smfDpdMaxMemorySize,
    smfDpdEntryMaxLifetime,
    smfNhdprssaMesgTLVIncluded,
    smfNhdprssaAddrBlockTLVIncluded,

    smfConfiguredAddrForwardingLastAddr,
    smfConfiguredAddrForwardingStatus,
```

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

smfStateObjectsGroup OBJECT-GROUP
    OBJECTS {
        smfNodeRsStatusIncluded,
        smfDpdMemoryOverflow,

        smfDiscoveredAddrForwardingLastAddr,
        smfDiscoveredAddrForwardingStatus,

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

smfPerfObjectsGroup OBJECT-GROUP
    OBJECTS {
        smfIpv4MultiPktsRecvTotal,
        smfIpv4MultiPktsForwardedTotal,
        smfIpv4DuplMultiPktsDetectedTotal,
        smfIpv4DroppedMultiPktsTTLExceededTotal,
        smfIpv4TTLargerThanPreviousTotal,

        smfIpv6MultiPktsRecvTotal,
        smfIpv6MultiPktsForwardedTotal,
        smfIpv6DuplMultiPktsDetectedTotal,
        smfIpv6DroppedMultiPktsTTLExceededTotal,
        smfIpv6TTLargerThanPreviousTotal,
        smfIpv6HAVAssistsReqdTotal,
        smfIpv6DpdHeaderInsertionsTotal,

        smfIpv4MultiPktsRecvPerIf,
        smfIpv4MultiPktsForwardedPerIf,
        smfIpv4DuplMultiPktsDetectedPerIf,
        smfIpv4DroppedMultiPktsTTLExceededPerIf,
        smfIpv4TTLargerThanPreviousPerIf,
```

```
        smfIpv6MultiPktsRecvPerIf,
        smfIpv6MultiPktsForwardedPerIf,
        smfIpv6DuplMultiPktsDetectedPerIf,
        smfIpv6DroppedMultiPktsTTLExceededPerIf,
        smfIpv6TLLargerThanPreviousPerIf,
        smfIpv6HAVAssistsReqdPerIf,
        smfIpv6DpdHeaderInsertionsPerIf
    }
    STATUS current
    DESCRIPTION
        "Set of SMF performance objects implemented
        in this module by total and per interface."
 ::= { smfMIBGroups 4 }

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

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

END

8. Security Considerations

[TODO] Each specification that defines one or more MIB modules MUST contain a section that discusses security considerations relevant to those modules. This section MUST be patterned after the latest approved template (available at <http://www.ops.ietf.org/mib-security.html>). Remember that the objective is not to blindly copy text from the template, but rather to think and evaluate the risks/vulnerabilities and then state/document the result of this evaluation.

[TODO] if you have any read-write and/or read-create objects, please include the following boilerplate paragraph.

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 [TODO] writable MIB objects that could be especially disruptive if abused MUST be explicitly listed by name and the associated security risks MUST be spelled out; RFC 2669 has a very good example.
- o [TODO] list the writable tables and objects and state why they are sensitive.

[TODO] else if there are no read-write objects in your MIB module, use the following boilerplate paragraph.

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

[TODO] if you have any sensitive readable objects, please include the following boilerplate paragraph.

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 [TODO] you must explicitly list by name any readable objects that are sensitive or vulnerable and the associated security risks **MUST** be spelled out (for instance, if they might reveal customer information or violate personal privacy laws such as those of the European Union if exposed to unauthorized parties)
- o [TODO] list the tables and objects and state why they are sensitive.

[TODO] discuss what security the protocol used to carry the information should have. The following three boilerplate paragraphs should not be changed without very good reason. Changes will almost certainly require justification during IESG review.

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

It is RECOMMENDED that implementers consider the security features as provided by the SNMPv3 framework (see [RFC3410], section 8), including full support for the SNMPv3 cryptographic mechanisms (for authentication and privacy).

Further, deployment of SNMP versions prior to SNMPv3 is NOT RECOMMENDED. Instead, it is RECOMMENDED to deploy SNMPv3 and to enable cryptographic security. It is then a customer/operator responsibility to ensure that the SNMP entity giving access to an instance of this MIB module is properly configured to give access to the objects only to those principals (users) that have legitimate rights to indeed GET or SET (change/create/delete) them.

9. IANA Considerations

[TODO] In order to comply with IESG policy as set forth in <http://www.ietf.org/ID-Checklist.html>, every Internet-Draft that is submitted to the IESG for publication **MUST** contain an IANA Considerations section. The requirements for this section vary depending what actions are required of the IANA. see RFC4181 section 3.5 for more information on writing an IANA clause for a MIB module document.

[TODO] select an option and provide the necessary details.

Option #1:

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

Descriptor	OBJECT IDENTIFIER value
-----	-----

sampleMIB	{ mib-2 XXX }
-----------	---------------

Option #2:

Editor's Note (to be removed prior to publication): the IANA is requested to assign a value for "XXX" under the 'mib-2' subtree and to record the assignment in the SMI Numbers registry. When the assignment has been made, the RFC Editor is asked to replace "XXX" (here and in the MIB module) with the assigned value and to remove this note.

Note well: prior to official assignment by the IANA, a draft document MUST use placeholders (such as "XXX" above) rather than actual numbers. See RFC4181 Section 4.5 for an example of how this is done in a draft MIB module.

Option #3:

This memo includes no request to IANA.

10. Contributors

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

11. Acknowledgements

12. References

12.1. Normative References

- | | |
|-----------|--|
| [RFC2863] | McCloghrie, K. and F. Kastenholz, "The Interfaces Group MIB", RFC 2863, June 2000. |
| [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.
- [RFC3418] Presuhn, R., "Management Information Base (MIB) for the Simple Network Management Protocol (SNMP)", STD 62, RFC 3418, December 2002.
- [RFC4001] Daniele, M., Haberman, B., Routhier, S., and J. Schoenwaelder, "Textual Conventions for Internet Network Addresses", RFC 4001, February 2005.
- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.
- [RFC2578] McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Structure of Management Information Version 2 (SMIv2)", STD 58, RFC 2578, April 1999.
- [RFC2579] McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Textual Conventions for SMIv2", STD 58, RFC 2579, April 1999.
- [RFC2580] McCloghrie, K., Perkins, D., and J. Schoenwaelder, "Conformance Statements for SMIv2", STD 58, RFC 2580, April 1999.
- [I-D.ietf-manet-smf] Macker, J. and S. Team, "Simplified Multicast Forwarding", draft-ietf-manet-smf-10 (work in progress), March 2010.

12.2. Informative References

- [RFC3410] Case, J., Mundy, R., Partain, D., and B. Stewart, "Introduction and Applicability Statements for Internet-Standard Management Framework", RFC 3410, December 2002.

Appendix A. Change Log

This section tracks the revision history in the development of this SMF-MIB. It will be removed from the final version of this document.

These changes were made from draft-ietf-manet-smf-mib-01 to draft-ietf-manet-smf-mib-02.

1. Added the NotificationGroup to the MIB and updated the ConformanceGroup.
2. Added the definition of an smfRouterID to the MIB. This is later used in the Notifications to indicate the origin of the event to the management station.
3. Removed the Router Priority object as this was used only in the eCDS algorithm and hence should be contained within the future eCDS-MIB.
4. Cleaned up the TEXTUAL CONVENTION for the 'SmfOpMode'.
5. Filled in some of the missing text in various object descriptions.

These changes were made from draft-ietf-manet-smf-mib-00 to draft-ietf-manet-dsmf-mib-01.

1. Editorial changes to the textual material. These included the addition of the paragraphs on TEXTUAL-CONVENTIONS defined and imported into this MIB and relationships to other MIBs.
2. Identified those objects in the SMF-MIB requiring non-volatile storage.
3. Changed the name of the TEXTUAL-CONVENTION 'Status', defined within this MIB to 'SmfStatus'.

Appendix B. Open Issues

This section contains the set of open issues related to the development and design of the SMF-MIB. This section will not be present in the final version of the MIB and will be removed once all the open issues have been resolved.

1. The SMF draft states that use of the SMF Type Message TLV is optional and is used when the router runs NHDP. But the draft does not clearly state if the use of the SMF Address Block TLV is also optional.
2. Is it useful to track the effectiveness of the coverage of the current RSSA? Is it possible to track this?
3. Complete the security analysis and section.
4. Cleanup all the [TODOs] from the MIB template.

Appendix C.

```

*****
* Note to the RFC Editor (to be removed prior to publication) *
*
* 1) The reference to RFCXXXX within the DESCRIPTION clauses *
* of the MIB module point to this draft and are to be *
* assigned by the RFC Editor. *
*
* 2) The reference to RFCXXX2 throughout this document point *
* to the current draft-ietf-manet-smf-xx.txt. This *
* need to be replaced with the XXX RFC number. *
*
*****

```

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