

Internet Engineering Task Force
Internet-Draft
Intended status: Experimental
Expires: September 22, 2013

R. Cole
US Army CERDEC
J. Macker
B. Adamson
Naval Research Laboratory
March 21, 2013

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

Abstract

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

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF). Note that other groups may also distribute working documents as Internet-Drafts. The list of current Internet-Drafts is at <http://datatracker.ietf.org/drafts/current/>.

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

This Internet-Draft will expire on September 22, 2013.

Copyright Notice

Copyright (c) 2013 IETF Trust and the persons identified as the document authors. All rights reserved.

This document is subject to BCP 78 and the IETF Trust's Legal Provisions Relating to IETF Documents (<http://trustee.ietf.org/license-info>) in effect on the date of

publication of this document. Please review these documents carefully, as they describe your rights and restrictions with respect to this document. Code Components extracted from this document must include Simplified BSD License text as described in Section 4.e of the Trust Legal Provisions and are provided without warranty as described in the Simplified BSD License.

Table of Contents

1. Introduction	3
2. The Internet-Standard Management Framework	3
3. Conventions	3
4. Overview	3
4.1. SMF Management Model	4
4.2. Terms	5
5. Structure of the MIB Module	5
5.1. Textual Conventions	6
5.2. The Capabilities Group	6
5.3. The Configuration Group	7
5.4. The State Group	7
5.5. The Performance Group	7
5.6. The Notifications Group	8
5.7. Tables and Indexing	8
6. Relationship to Other MIB Modules	9
6.1. Relationship to the SNMPv2-MIB	9
6.2. MIB modules required for IMPORTS	10
6.3. Relationship to the Future RSSA-MIBs	10
7. Definitions	10
8. Security Considerations	50
9. Applicability Statement	53
10. IANA Considerations	54
11. Contributors	54
12. Acknowledgements	54
13. References	54
13.1. Normative References	54
13.2. Informative References	55
Appendix A.	56

1. Introduction

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

2. The Internet-Standard Management Framework

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

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

3. Conventions

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

4. Overview

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

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

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

4.1. SMF Management Model

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

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

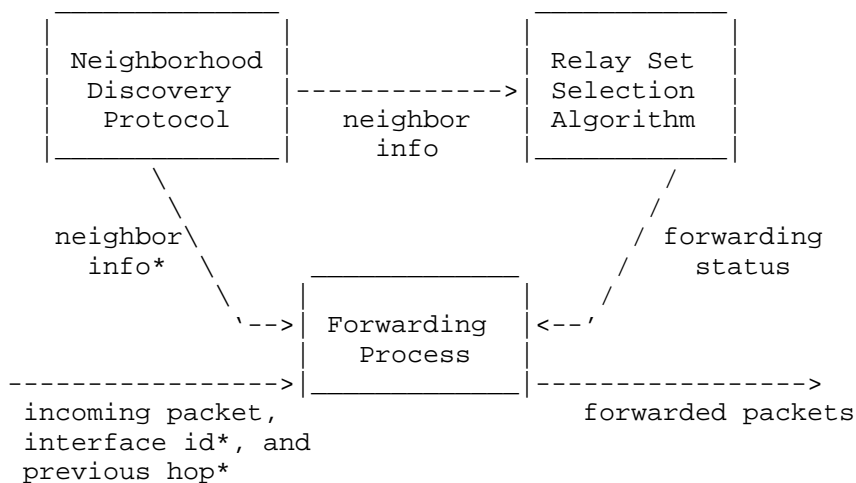


Figure 1: SMF Node Architecture

4.2. Terms

The following definitions apply throughout this document:

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

5. Structure of the MIB Module

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

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

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

5.1. Textual Conventions

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

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

5.2. The Capabilities Group

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

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

5.3. The Configuration Group

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

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

5.4. The State Group

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

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

5.5. The Performance Group

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

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

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

5.6. The Notifications Group

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

5.7. Tables and Indexing

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

- o configuration and operation of packet forwarding the local router,
- o configuration and operation of local MANET interfaces on the router, and
- o configuration and operation of various RSSA algorithms for packet forwarding.

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

- o smfOpModeCapabilitiesID - which is the index for each of the SMF modes.
- o smfRssaCapabilitiesID - which is the index for each of the RSSAs supported by this specific device.
- o smfConfiguredAddrForwardingAddrType and smfConfiguredAddrForwardingFirstAddr - indexes to multicast addresses which are forwarded by the SMF process.
- o smfIfIndex - which is the IfIndex of the local router on which SMF is configured.
- o smfDiscoveredAddrForwardingAddrType and smfDiscoveredAddrForwardingFirstAddr - indexes to discovered multicast addresses which are forwarded by the SMF process.
- o smfNeighborIpAddrType, smfNeighborIpAddr, and smfNeighborPrefixLen - which is the index set of interface specific neighbor nodes to this SMF device.

These tables and their indexing are:

- o smfOpModeCapabilitiesTable - identifies the resident set of SMF Operational Modes on this router. This table has 'INDEX { smfOpModeCapabilitiesID }'.
- o smfRssaCapabilitiesTable - contains reference to the specific set of RSSAs currently supported on this device. This table has 'INDEX { smfRssaCapabilitiesID }'.
- o smfConfiguredAddrForwardingTable - contains information on multicast addresses which are to be forwarded by the SMF process on this device. This table has 'INDEX { smfConfiguredAddrForwardingAddrType, smfConfiguredAddrForwardingFirstAddr }'.
- o smfInterfaceTable - describes the SMF interfaces on this device that are participating in the SMF packet forwarding process. This table has 'INDEX { smfIfIndex }'.
- o smfDiscoveredAddrForwardingTable - contains discovered address for SMF packet forwarding. This table has 'INDEX { smfDiscoveredAddrForwardingAddrType, smfDiscoveredAddrForwardingFirstAddr }'.
- o smfNeighborTable - describes the current neighbor nodes, their addresses and the SMF RSSA and the interface on which they can be reached. This table has 'INDEX { smfNeighborIpAddrType, smfNeighborIpAddr, smfNeighborPrefixLen }'.
- o smfIpv4InterfaceTable - contains the IPv4 related SMF statistics per each SMF interface on this device. This table has 'INDEX { smfIfIndex }'.
- o smfIpv6InterfaceTable - contains the IPv6 related SMF statistics per each SMF interface on this device. This table has 'INDEX { smfIfIndex }'.

6. Relationship to Other MIB Modules

6.1. Relationship to the SNMPv2-MIB

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

6.2. MIB modules required for IMPORTS

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

6.3. Relationship to the Future RSSA-MIBs

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

7. Definitions

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

```
IMPORTS
```

```
MODULE-IDENTITY, OBJECT-TYPE, NOTIFICATION-TYPE,  
Counter32, Integer32, TimeTicks, experimental  
    FROM SNMPv2-SMI -- [RFC2578]  
  
TEXTUAL-CONVENTION, RowStatus, TruthValue,  
DisplayString  
    FROM SNMPv2-TC -- [RFC2579]  
  
MODULE-COMPLIANCE, OBJECT-GROUP,  
NOTIFICATION-GROUP  
    FROM SNMPv2-CONF -- [RFC2580]  
  
InterfaceIndexOrZero  
    FROM IF-MIB -- [RFC2863]
```

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

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

smfMIB MODULE-IDENTITY

LAST-UPDATED "201303201300Z" -- March 20, 2013

ORGANIZATION "IETF MANET Working Group"

CONTACT-INFO

"WG E-Mail: manet@ietf.org

WG Chairs: sratliff@cisco.com
jmacker@nrl.navy.mil

Editors: Robert G. Cole
US Army CERDEC
Space and Terrestrial Communications
6010 Frankford Road
Aberdeen Proving Ground, MD 21005
USA
+1 443 395-8744
robert.g.cole@us.army.mil

Joseph Macker
Naval Research Laboratory
Washington, D.C. 20375
USA
macker@itd.nrl.navy.mil

Brian Adamson
Naval Research Laboratory
Washington, D.C. 20375
USA
adamson@itd.nrl.navy.mil"

DESCRIPTION

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

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

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

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

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

```
--
-- TEXTUAL CONVENTIONS
--
```

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

```

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

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

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

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

cross-layer information base for dynamic relay
set selection and maintenance."

REFERENCE

"Simplified Multicast Forwarding for MANET
(SMF), Macker, J., July 2012."

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

SmfRssaID ::= TEXTUAL-CONVENTION

STATUS current

DESCRIPTION

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

REFERENCE

"Simplified Multicast Forwarding for MANET
(SMF), Macker, J., July 2012."

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

--

-- Top-Level Object Identifier Assignments

--

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

--

-- smfMIBObjects Assignments:

```
-- smfCapabilitiesGroup - 1
-- smfConfigurationGroup - 2
-- smfStateGroup - 3
```

```

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

--
-- SMF Operational Mode Capabilities Table
--

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

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

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

smfOpModeCapabilitiesID      OBJECT-TYPE
    SYNTAX      SmfOpModeID

```

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

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

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

--
-- SMF RSSA Capabilities Table
--

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

```

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

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

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

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

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

```



```
 ::= { smfRssaCapabilitiesEntry 2 }

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

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

smfConfigurationGroup OBJECT IDENTIFIER ::= { smfMIBObjects 2 }

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

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

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

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

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

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

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

DEFVAL { ipv4 }

::= { smfConfigurationGroup 2 }

smfRouterID OBJECT-TYPE

SYNTAX InetAddress (SIZE(4|16))

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"The IP address used as the SMF router ID. This can be set by the management station. If not explicitly set, then the device should select a routable IP address assigned to this router for use as the 'smfRouterID'.

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

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

REFERENCE

"Simplified Multicast Forwarding for MANET (SMF), Macker, J., July 2012."

```
 ::= { smfConfigurationGroup 3 }

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

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

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

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

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

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

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

        The default value for this object is
```

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

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

REFERENCE

"Simplified Multicast Forwarding for MANET (SMF), Macker, J., July 2012."

DEFVAL { cF }

::= { smfConfigurationGroup 5 }

smfRssaMember OBJECT-TYPE

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

MAX-ACCESS read-write

STATUS current

DESCRIPTION

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

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

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

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

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

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

REFERENCE

"Simplified Multicast Forwarding for MANET (SMF), Macker, J., July 2012."

DEFVAL { potential }

::= { smfConfigurationGroup 6 }

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

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

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

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

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

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

    The default value for this object is
```

hashBased(1).

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

REFERENCE

"Simplified Multicast Forwarding for MANET (SMF), Macker, J., July 2012."

DEFVAL { hashBased }

::= { smfConfigurationGroup 8 }

smfMaxPktLifetime OBJECT-TYPE

SYNTAX Integer32 (0..65535)

UNITS "Seconds"

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"The estimate of the network packet traversal time.

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

REFERENCE

"Simplified Multicast Forwarding for MANET (SMF), Macker, J., July 2012."

DEFVAL { 60 }

::= { smfConfigurationGroup 9 }

smfDpdMaxMemorySize OBJECT-TYPE

SYNTAX Integer32 (0..65535)

UNITS "Kilo-Bytes"

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"The locally reserved memory for storage of cached DPD records for both IPv4 and IPv6 methods.

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

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

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

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

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

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

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

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

      It is RECOMMENDED that the RSSA Message TLV
```

be included in the NHDP messages.

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

REFERENCE

"Simplified Multicast Forwarding for MANET (SMF), Macker, J., July 2012."

DEFVAL { true }

::= { smfConfigurationGroup 12 }

smfNhdpRssaAddrBlockTLVIncluded OBJECT-TYPE

SYNTAX TruthValue

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"Indicates whether the associated NHDP messages include the RSSA Address Block TLV, or not.

This is an optional SMF operational setting.

The value true(1) indicates that this TLV is included; the value false(2) indicates that it is not included.

The smfNhdpRssaAddrBlockTLVIncluded is optional in all cases as it depends on the existence of an address block which may not be present.

If this SMF device is configured with NHDP, then this object should be set to 'true(1)'.

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

REFERENCE

"Simplified Multicast Forwarding for MANET (SMF), Macker, J., July 2012."

DEFVAL { true }

::= { smfConfigurationGroup 13 }

--

-- Table identifying configured multicast addresses to be forwarded.

--

smfConfiguredAddrForwardingTable OBJECT-TYPE

SYNTAX SEQUENCE OF SmfConfiguredAddrForwardingEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

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

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

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

The objects in this table are persistent and when written the entity SHOULD save the change to non-volatile storage."

REFERENCE

"Simplified Multicast Forwarding for MANET (SMF), Macker, J., July 2012."

```
::= { smfConfigurationGroup 15 }
```

```
smfConfiguredAddrForwardingEntry OBJECT-TYPE
```

```
SYNTAX      SmfConfiguredAddrForwardingEntry
```

```
MAX-ACCESS not-accessible
```

```
STATUS      current
```

DESCRIPTION

"An entry (conceptual row) containing the information on a particular multicast scope."

```
INDEX { smfConfiguredAddrForwardingAddrType,
        smfConfiguredAddrForwardingFirstAddr }
```

```
::= { smfConfiguredAddrForwardingTable 1 }
```

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

```
smfConfiguredAddrForwardingAddrType OBJECT-TYPE
```

```
SYNTAX      InetAddressType
```

```
MAX-ACCESS not-accessible
```

```
STATUS      current
```

DESCRIPTION

"The type of the addresses in the multicast forwarding range. Legal values correspond to the subset of address families for which multicast address allocation

is supported.

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

```
::= { smfConfiguredAddrForwardingEntry 1 }
```

```
smfConfiguredAddrForwardingFirstAddr OBJECT-TYPE
```

```
SYNTAX      InetAddress (SIZE(4|16))
```

```
MAX-ACCESS  not-accessible
```

```
STATUS      current
```

```
DESCRIPTION
```

```
"The first address in the multicast scope range. The type  
of this address is determined by the value of the  
smfConfiguredAddrForwardingAddrType object."
```

```
::= { smfConfiguredAddrForwardingEntry 2 }
```

```
smfConfiguredAddrForwardingLastAddr OBJECT-TYPE
```

```
SYNTAX      InetAddress (SIZE(4|16))
```

```
MAX-ACCESS  read-create
```

```
STATUS      current
```

```
DESCRIPTION
```

```
"The last address in the multicast scope range.  
The type of this address is determined by the  
value of the smfConfiguredAddrForwardingAddrType  
object."
```

```
::= { smfConfiguredAddrForwardingEntry 3 }
```

```
smfConfiguredAddrForwardingStatus OBJECT-TYPE
```

```
SYNTAX      RowStatus
```

```
MAX-ACCESS  read-create
```

```
STATUS      current
```

```
DESCRIPTION
```

```
"The status of this row, by which new entries may be  
created, or old entries deleted from this table. If write  
access is supported, the other writable objects in this  
table may be modified even while the status is 'active'."
```

```
::= { smfConfiguredAddrForwardingEntry 4 }
```

```
--
```

```
-- SMF Interfaces Configuration Table
```

```
--
```

```
smfInterfaceTable OBJECT-TYPE
```

```
SYNTAX      SEQUENCE OF SmfInterfaceEntry
```

```
MAX-ACCESS  not-accessible
```

```
STATUS      current
```

DESCRIPTION

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

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

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

If the corresponding entry with ifIndex value is deleted from the Interface Table, then the entry in this table is automatically deleted and SMF is disabled on this interface, and all configuration and state information related to this interface is to be removed from memory."

REFERENCE

"RFC 2863 - The Interfaces Group MIB, McCloghrie, K., and F. 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.

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

```

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

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

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

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

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

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

```

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

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

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

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

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

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

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

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

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

--
-- Dynamically Discovered Multicast Addr Table
--

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

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

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

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

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

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

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

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

smfDiscoveredAddrForwardingLastAddr OBJECT-TYPE
```

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

--
-- SMF Neighbor Table
--

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

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

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



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

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

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

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

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

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

smfNeighborNextHopInterface OBJECT-TYPE
    SYNTAX      InterfaceIndexOrZero
```

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

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

smfPerformanceGroup OBJECT IDENTIFIER ::= { smfMIBObjects 4 }

smfGlobalPerfGroup OBJECT IDENTIFIER ::= { smfPerformanceGroup 1 }

--
-- IPv4 packet counters
--

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

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

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

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

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

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

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

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

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

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

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

```

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

smfIpv6TTLargerThanPreviousTotal 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."
REFERENCE
    "Simplified Multicast Forwarding for MANET
      (SMF), Macker, J., July 2012."
 ::= { smfGlobalPerfGroup 10 }

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

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

--
-- Per SMF Interface Performance Table
--

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

```

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

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

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

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

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

```

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

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

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

smfIpv4TTLargerThanPreviousPerIf 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 recieved identical packet.
        "
 ::= { smfIpv4InterfacePerfEntry 5 }

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

```

 ::= { smfInterfacePerfGroup 2 }

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

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

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

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

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

```



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

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

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

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

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

```

--
-- Notifications
--

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

-- smfMIBNotifObjects

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

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

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

```

```

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

smfIfAdminStatusChange NOTIFICATION-TYPE
OBJECTS { smfRouterIDAddrType, -- The originator of
          smfRouterID,         -- the notification.
          smfIfName,          -- The originator of
          smfIfAdminStatus    -- the notification.
          }
          -- The interface whose
          -- status has changed.
          -- The new status of the
          -- SMF interface.

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

smfDpdMemoryOverflowEvent NOTIFICATION-TYPE
OBJECTS { smfRouterIDAddrType, -- The originator of
          smfRouterID,         -- the notification.
          smfDpdMemoryOverflow -- The originator of
          }
          -- the notification.
          -- 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
          smfRouterID,         -- the notification.
          smfIpv4DuplMultiPktsDetectedTotal
          }
          -- The originator of
          -- the notification.
          -- 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
          smfRouterID,         -- the notification.
          smfIpv6DuplMultiPktsDetectedTotal
          -- The originator of
          -- the notification.
          -- The counter of detected
          -- duplicates.
        }
STATUS          current
DESCRIPTION
    "smfIpv6DuplMultiPktsDetectedTotal is a
    notification sent when the number of
    IPv6 duplicate packets detected exceeds the
    'smfIpv6DuplMultiPktsDetectedTotalThreshold'
    during the previous number of seconds
    'smfIpv6DuplPktsDetectedTotalWindow'."
 ::= { smfMIBNotifObjects 7 }

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

smfDpdMemoryOverflowWindow OBJECT-TYPE
SYNTAX          TimeTicks

```

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

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

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

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

```

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

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

--
-- Compliance Statements
--

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

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

```

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

--
-- Units of Conformance
--

smfCapabObjectsGroup OBJECT-GROUP
  OBJECTS {
    smfOpModeCapabilitiesName,
    smfOpModeCapabilitiesReference,

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

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

```
        smfNhdpRssaAddrBlockTLVIncluded,

        smfConfiguredAddrForwardingLastAddr,
        smfConfiguredAddrForwardingStatus,

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

smfStateObjectsGroup OBJECT-GROUP
    OBJECTS {
        smfNodeRsStatusIncluded,
        smfDpdMemoryOverflow,

        smfDiscoveredAddrForwardingLastAddr,

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

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

        smfIpv6MultiPktsRecvTotal,
        smfIpv6MultiPktsForwardedTotal,
        smfIpv6DuplMultiPktsDetectedTotal,
        smfIpv6DroppedMultiPktsTTLExceededTotal,
        smfIpv6TTLLargerThanPreviousTotal,
        smfIpv6HAVAAssistsReqdTotal,
        smfIpv6DpdHeaderInsertionsTotal,

        smfIpv4MultiPktsRecvPerIf,
        smfIpv4MultiPktsForwardedPerIf,
```



```
    smfIpv4DuplMultiPktsDetectedPerIf,
    smfIpv4DroppedMultiPktsTTLExceededPerIf,
    smfIpv4TTLLargerThanPreviousPerIf,

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

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

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

END

8. Security Considerations

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

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

- o 'smfAdminStatus' - this writable configuration object controls the operational status of the SMF process. If this setting is configured inconsistently across the MANET multicast domain, then delivery of multicast data may be inconsistent across the domain; some nodes may not receive multicast data intended for them.
- o 'smfRouterIDAddrType' and 'smfRouterID' - these writable configuration objects define the ID of the SMF process. These objects should be configured with a routable address defined on the local SMF device. The smfRouterID is a logical identification that MUST be consistent across inter-operating SMF neighborhoods and it is RECOMMENDED to be chosen as the numerically largest address contained in a node's 'Neighbor Address List' as defined in NHDP. A smfRouterID MUST be unique within the scope of the operating MANET network regardless of the method used for selecting it.
- o 'smfConfiguredOpMode' - this writable configuration objects define the operational mode of the SMF process. The operational mode defines how the SMF process develops its local estimate of the CDS.
- o 'smfConfiguredRssa' - this writable configuration object sets the specific Reduced Set Selection Algorithm (RSSA) for the SMF process. If this object is set inconsistently across the MANET domain, multicast delivery of data will fail.
- o 'smfRssaMember' - this writable configuration object sets the 'interest' of the local SMF node in participating in the CDS. Setting this object to 'never(3)' on a highly highly connected device could lead to frequent island formation. Setting this object to 'always(2)' could support data ex-filtration from the

MANET domain.

- o 'smfIpv4Dpd' - this writable configuration object sets the duplicate packet detection method for forwarding of IPv4 multicast packets.
- o 'smfIpv6Dpd' - this writable configuration object sets the duplicate packet detection method for forwarding of IPv6 multicast packets.
- o 'smfMaxPktLifetime' - this writable configuration object sets the estimate of the network packet traversal time. If set too small, this could lead to poor multicast data delivery ratios throughout the MANET domain.
- o 'smfDpdMaxMemorySize' - this writable configuration object sets the memory storage size (in Kilo-Bytes) for the cached DPD records for the combined IPv4 and IPv6 methods. If set too small this could lead to poor performance of the duplicate packet protection algorithms and lead to inefficient resource, e.g., link, utilization within the MANET domain. The local SMF device should protect itself against memory overruns in the event that too large a setting is requested.
- o 'smfDpdEntryMaxLifetime' - this writable configuration object sets the maximum lifetime (in seconds) for the cached DPD records for the combined IPv4 and IPv6 methods. If the memory is running low prior to the MaxLifetimes being exceeded, the local SMF devices should purge the oldest records first.
- o 'smfNhdpRssaMesgTLVIncluded' - this writable configuration object indicates whether the associated NHDP messages include the the RSSA Message TLV, or not. It is highly RECOMMENDED that this object be set to 'true(1)'.
- o 'smfNhdpRssaAddrBlockTLVIncluded' - this writable configuration object indicates whether the associated NHDP messages include the the RSSA Address Block TLV, or not. The smfNhdpRssaAddrBlockTLVIncluded is optional in all cases as it depends on the existence of an address block which may not be present. If this SMF device is configured with NHDP, then this object should be set to 'true(1)'.
- o 'smfConfiguredAddrForwardingTable' - the writable configuration objects in this table indicate which multicast IP address are to be forwarded by this SMF node. Misconfiguration of rows within this table can limit the ability of this SMF device to forward multicast data.

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

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

- o 'smfNodeRsStatusIncluded' - this readable state object indicates that this SMF node is part of the CDS, or not. Being part of the CDS makes this node a distinguished device. It could be exploited for data ex-filtration, or denial of service attacks.
- o 'smfDiscoveredAddrForwardingTable' - the readable state objects in this table indicate which, dynamically discovered, multicast IP address are to be forwarded by this SMF node.
- o 'smfNeighborTable' - the readable state objects in this table indicate current neighbor nodes to this SMF node. Exposing this information to an attacker could allow the attacker easier access to the larger MANET domain.

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

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

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

Further, deployment of SNMP versions prior to SNMPv3 is NOT

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

9. Applicability Statement

This document describes objects for configuring parameters of the Simplified Multicast Forwarding [RFC6621] process on a router. This MIB module, denoted SMF-MIB, also reports state, performance information and notifications. This 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 will be provided elsewhere.

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

- o For a Parking Lot Initial Configuration Situation - it is common for the vehicles comprising the MANET being forward deployed at a remote location, e.g., the site of a natural disaster, to be off-loaded in a parking lot where an initial configuration of the networking devices is performed. The configuration is loaded into the devices from a fixed location Network Operation Center (NOC) at the parking lot and the vehicles are stationary at the parking lot while the configuration changes are made. Standards-based methods for configuration management from the co-located NOC are necessary for this deployment option.
- o For Mobile vehicles with Low Bandwidth Satellite Link to a Fixed NOC - Here the vehicles carrying the MANET routers carry multiple wireless interfaces, one of which is a relatively low-bandwidth on-the-move satellite connection which interconnects a fix NOC to the nodes of the MANET. Standards-based methods for monitoring and fault management from the fixed NOC are necessary for this deployment option.
- o For Fixed NOC and Mobile Local Manager in Larger Vehicles - for larger vehicles, a hierarchical network management arrangement is useful. Centralized network management is performed from a fixed NOC while local management is performed locally from within the vehicles. Standards-based methods for configuration, monitoring

and fault management are necessary for this deployment option.

10. IANA Considerations

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

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

11. Contributors

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

12. Acknowledgements

The authors would like to acknowledge the valuable comments from Sean Harnedy in the early phases of the development of this MIB-module. The authors would like to thank James Nguyen for his careful review and comments on this MIB-module and his work on the definitions of the follow on MIB-modules to configure specific RSSA algorithms related to SMF. Further, the authors would like to acknowledge to work of James Nguyen, Brian Little, Ryan Morgan and Justin Dean on their software development of the SMF-MIB.

13. References

13.1. 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.
- [RFC6621] Macker, J., "Simplified Multicast Forwarding", RFC 6621, May 2012.

13.2. 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.
- [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.
- [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.
- [RFC5591] Harrington, D. and W. Hardaker, "Transport Security Model for the Simple Network Management Protocol (SNMP)", RFC 5591, June 2009.
- [RFC5592] Harrington, D., Salowey, J., and W. Hardaker, "Secure Shell Transport Model for the Simple Network Management Protocol (SNMP)", RFC 5592, June 2009.
- [RFC6353] Hardaker, W., "Transport Layer Security (TLS) Transport Model for the Simple Network Management Protocol (SNMP)", RFC 6353, July 2011.

Appendix A.

```

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

```

Authors' Addresses

Robert G. Cole
 US Army CERDEC
 6010 Frankford Road
 Aberdeen Proving Ground, Maryland 21005
 USA

Phone: +1 443 395 8744
 EMail: robert.g.cole@us.army.mil

Joseph Macker
 Naval Research Laboratory
 Washington, D.C. 20375
 USA

EMail: macker@itd.nrl.navy.mil

Brian Adamson
 Naval Research Laboratory
 Washington, D.C. 20375
 USA

EMail: adamson@itd.nrl.navy.mil

