Abstract

This memo defines a portion of the Management Information Base (MIB) for use with network management protocols. In particular it defines objects for managing multicast LDP point-to-multipoint (P2MP) and multipoint-to-multipoint (MP2MP) Label Switched Paths. The MIB module defined in this document is an extension of the LDP MIB defined in RFC3815 which supports only for LDP point-to-point LSPs.

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1. Introduction

This memo defines a portion of the Management Information Base (MIB) for use with network management protocols. In particular it defines objects for managing multicast LDP point-to-multipoint (P2MP) and multipoint-to-multipoint (MP2MP) Label Switched Paths. The MIB module defined in this document is extension of LDP MIB defined in RFC3815 which supports only for LDP point-to-point LSPs.

The RFC3815 describes only unicast Managed objects for the Label distribution protocol. The RFC6388 describes LDP protocol extensions for the point to multipoint and multipoint to multipoint LSPs. The RFC6826 describes multicast LDP inband signalling for P2MP and MP2MP LSPs.

This document defines a MIB module for managing and controlling mLDP P2MP and MP2MP LSPs. It builds on the objects and tables defined in [RFC3815] for mLDP MIB.

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 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, RFC2578 [RFC2578], STD 58, RFC2579 [RFC2579] and STD 58, RFC2580 [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 BCP 14, RFC2119 [RFC2119].
4.  Overview

This document focuses on the management of following multicast LDP (mLDP) features, which were defined after unicast LDP [RFC5036].

- **RFC6826**: Multipoint LDP In-Band Signaling for Point-to-Multipoint and Multipoint-to-Multipoint Label Switched Paths.
- **RFC7060**: Using LDP Multipoint Extensions on Targeted LDP Sessions.
- **RFC7431**: Multicast only Fast Re-Route.
- **RFC7715**: mLDP Node Protection.

For all the above features, the mLDP MIB needs to include the following information:

- Session Capability (P2MP, MP2MP) information: configured capability, negotiated capability.
- mLDP FECs: include opaque information (Generic LSP Identifier, source and group address) and MoFRR enable.
- Primary and backup upstream session when mLDP MoFRR enabled.
- Active and inactive upstream session for make before break.
- mLDP Traffic stats per mLDP Fec: The traffic stats for mLDP fec.
- mLDP Traffic stats per Interface: The mLDP traffic stats per Interface.
- Notifications when mLDP Fec LSP up, down.

5.  Future Considerations

Any new opaque TLVs added for any other mLDP features, the opaque value object in the mplsMldpFecTable need to be enhanced accordingly.

6.  Structure of the MIB Module

This section describes the structure of the mLDP MIB. In this MIB MPLS-MLDP-STD-MIB, scalar objects, table objects and notifications are defined. Following section describes in details about each object.
6.1. Summary of mLDP Scalar Objects

New scalar objects mplsMldpP2mpCapable and mplsMldpMp2mpCapable are defined to provide the mLDP capabilities of P2MP, MP2MP support.

New scalar objects mplsMldpMbbCapable and mplsMldpMbbTime are defined to provide MBB capability information.

New scalar object mplsMldpNumFecs which will give the total number of mLDP FECs setup on the LSR.

Another New scalar object mplsMldpNumFecsActive, which will give the total number of active mLDP FECs.

New scalar objects mplsMldpPlrCapable, mplsMldpMptCapable, mplsMldpProtLsrCapable and mplsMldpNodeProtCapable are defined to provide mLDP node protection capabilities.

6.2. Summary of mLDP Table Objects

mplsLdpPeerCapabilityTable to include peer capability information.

mplsMldpSessionStatsTable: This table contains the number of mLDP FECs received and advertised to a particular LDP session.

mplsMldpFecTable: This table is similar to point to point mplsLdpFecTable and will have mLDP specific Fec information.

mplsMldpFecBranchStatsTable: This table contains the traffic statistics for the given mLDP FECs on particular interface.

mplsMldpFecUpstreamSessTable: Includes the upstream session info for the particular mLDP Fec and also includes the primary or backup upstream session, that may be used for mLDP MoFRR.

mplsMldpInterfaceStatsTable: This table contains the traffic statistics for all mLDP related FECs.

7. mLDP Scalar Objects

The following scalars are defined in this MIB Module.

7.1. mplsMldpP2mpCapable

The mplsMldpP2mpCapable scalar object denotes whether the LSR is capable of supporting multicast LDP with Point-to-Multipoint capability.
7.2. mplsMldpMp2mpCapable

The mplsMldpMp2mpCapable scalar object denotes whether the LSR is capable of supporting multicast LDP with Multipoint-to-Multipoint LSPs.

7.3. mplsMldpMbbCapable

The mplsMldpMbbCapable scalar object denotes whether the LSR is capable of supporting multicast LDP with MBB (make before break) feature mentioned in the section 8 of RFC 6388.

7.4. mplsMldpMbbTime

The mplsMldpMbbTime scalar object denotes MBB time for which LSR is waiting for MBB Ack from upstream node. This timer helps LSR to prevent waiting indefinitely for the MBB Notification from upstream node.

7.5. mplsMldpNumFecs

The mplsMldpNumFecs provides a read-only counter of the number of mLDP FECs setup on this LSR.

7.6. mplsMldpNumFecsActive

The mplsMldpNumFecsActive provides a read-only counter of the number of mLDP FECs Active on this LSR.

7.7. mplsMldpPlrCapable

The mplsMldpPlrCapable scalar object denotes whether the LSR is capable of supporting PLR capability as specified in the section 5.1 of RFC7715.

7.8. mplsMldpMptCapable

The mplsMldpMptCapable scalar object denotes whether the LSR is capable of supporting MPT capability as specified in the section 5.2 of RFC7715.

7.9. mplsMldpProtLsrCapable

The mplsMldpProtLsrCapable scalar object denotes whether the LSR is capable of supporting the "Protected LSR" capability as specified in the section 5.3 of RFC7715.
7.10. mplsMldpNodeProtCapable

The mplsMldpNodeProtCapable scalar object denotes whether the LSR is capable of supporting the "Node Protection" capability as specified in the section 5.4 of RFC7715.

8. mLDP Table Objects

8.1. LDP Peer Capability Table mplsLdpPeerCapabilityTable

The new table mplsLdpPeerCapabilityTable is read-only table, which contains learned capability information from an LDP peer. This table augments the mplsLdpPeerTable, which is defined in RFC 3815. This is defined in this MIB as it is not defined in the standard LDP MIB (RFC3815).

8.2. mLDP Session Stats Table: mplsMldpSessionStatsTable

The mplsMldpSessionStatsTable is a read-only table which contains mLDP statistical information on sessions. This table augments the mplsLdpSessionStatsTable, which is defined in the RFC 3815.

8.3. mLDP Fec Table: mplsMldpFecTable

The mplsMldpFecTable is a table which contains FEC (Forwarding Equivalence Class) information relating to point to multi-point and multipoint to multipoint LDP LSP. Each entry/row represents a single FEC Element. This table is similar LDP LSP FEC Table, mplsLdpLspFecTable, which is defined in the RFC 3815, which associates FECs with the LSPs.

8.4. mLDP Fec Branch Traffic statistics Table:
     mplsMldpFecBranchStatsTable

This table mplsMldpFecBranchStatsTable gives information about the number of packets and number of bytes sent out on particular downstream session or on outgoing interface.

8.5. mLDP Fec Upstream Session Table: mplsMldpFecUpstreamSessTable

The mplsMldpFecUpstreamSessTable is a read-only table which contains mLDP upstream session information for mLDP Fec. This table is similar to mplsInSegmentLdpLspTable. This table will also have information about primary, backup upstream session, and also indicates whether the label is in MBB request or MBB Ack received state.
8.6. mLDP Interface Traffic statistics Table: mplsMldpInterfaceStatsTable

This table mplsMldpInterfaceStatsTable gives information about the number of mLDP packets and number of mLDP bytes sent and received on a particular interface for all mLDP FECs.

9. The mLDP Notifications

The RFC 3815 defined some of the notifications related to session and P2P Fec. In this MIB, the following notification added to support mLDP features.

The mplsMldpFecUp and mplsMldpFecDown notifications are generated when mLDP FEC changes the state to UP and Down.

The mplsMldpMoFrrStatusChange notification is generated when mLDP MoFRR status switches from primary to backup path and vice versa.

10. Relationship to Other MIB Modules

This section describes relationships between MIB tables defined in this document as part of MPLS-MLDP-STD-MIB, and the tables defined in MPLS-LDP-STD-MIB [RFC3815] and MPLS-LSR-STD-MIB [RFC3813].

The Figure 1 shows the diagrammatic representation of the relationship between MPLS-MLDP-STD-MIB, MPLS-LDP-STD-MIB and MPLS-LSR-STD-MIB. An arrow in the Figure shows that the MIB table pointed from contains a reference to the MIB table pointed to.

10.1. Diagrammatic Representation
10.2. Relationship to the LSR MIB

The LSR MIB [RFC3813] have below tables, which cross connects the incoming label to outgoing label. Below Tables will be used for mLDP also in the similar way as in the point to point LDP LSPs.

- mplsXCTable
- mplsInSegmentTable
- mplsOutSegmentTable

10.3. Relationship to the LDP MIB

The MIB module defined in this document is extension of MPLS-LDP-STD-MIB to support multicast LDP features.

Below optional tables in MPLS-LDP-STD-MIB, will also be used in mLDP for associating the mLDP LSPs to LSR-MIB tables.
mplsLdpLspFecTable
mplsInSegmentLdpLspTable
mplsOutSegmentLdpLspTable

11. Multicast MPLS Label Distribution Protocol MIB Definitions

MPLS-MLDP-STD-MIB DEFINITIONS ::= BEGIN
IMPORTS
    MODULE-IDENTITY, OBJECT-TYPE, NOTIFICATION-TYPE,
    Unsigned32, Counter32, Counter64
    FROM SNMPv2-SMI                                    -- RFC 2578
    MODULE-COMPLIANCE, OBJECT-GROUP, NOTIFICATION-GROUP
    FROM SNMPv2-CONF                                   -- RFC 2580
    TimeStamp
    FROM SNMPv2-TC                                     -- RFC 2579
    InterfaceIndex
    FROM IF-MIB                                        -- [RFC2020]
    mplsStdMIB, MplsLdpIdentifier
    FROM MPLS-TC-STD-MIB                               -- RFC 3811
    MplsIndexType
    FROM MPLS-LSR-STD-MIB                              -- RFC 3813
    IndexInteger
    FROM DIFFSERV-MIB                                  -- RFC 3289
    InetAddress, InetAddressType
    FROM INET-ADDRESS-MIB                              -- RFC 4001
    mplsLdpEntityLdpId, mplsLdpEntityIndex,
    mplsLdpPeerLdpId, mplsLdpPeerEntry
    FROM MPLS-LDP-STD-MIB                              -- RFC 3815
;

mplsMldpStdMIB MODULE-IDENTITY
LAST-UPDATED "201805060000Z" -- May 6, 2018 00:00:00 EST
ORGANIZATION "Multiprotocol Label Switching (mpls)
    Working Group"
CONTACT-INFO
    " Kishore Tiruveedhula
    Juniper Networks

Tiruveedhula, et al. Expires November 7, 2018
DESCRIPTION
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The initial version of this MIB module was published in RFC XXXX. For full legal notices see the RFC itself or see: http://www.ietf.org/copyrights/ianamib.html
-- RFC Editor. Please replace XXXX with the RFC number for this document and remove this note.

This MIB module contains managed object definitions for mLDP LSPS defined in Label Distribution Protocol Extensions Point-to-Multipoint and Multipoint-to-Multipoint Label Switched Paths, RFC 6388, November 2011."

REVISION "201805060000Z" -- May 6, 2018 00:00:00 EST
DESCRIPTION
"Initial version issued as part of RFC XXXX."
-- RFC Editor. Please replace XXXX with the RFC number for this document and remove this note.

 ::= { mplsStdMIB YYY }
-- RFC Editor. Please replace YYY with the codepoint issued by IANA and remove this note.

-- Top level components of this MIB module.
mplsMldpNotifications OBJECT IDENTIFIER ::= { mplsMldpStdMIB 0 }

mplsMldpScalars OBJECT IDENTIFIER ::= { mplsMldpStdMIB 1 }
mplsMldpObjects OBJECT IDENTIFIER ::= { mplsMldpStdMIB 2 }

mplsMldpP2mpCapable OBJECT-TYPE
SYNTAX      INTEGER {
            enable(1),
            disable(2)
        }
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION  "This object provides the P2MP capability of the LSR."
REFERENCE  "Section 2.1 of [RFC6388]."
::= { mplsMldpScalars 1 }

mplsMldpMp2mpCapable OBJECT-TYPE
SYNTAX      INTEGER {
            enable(1),
            disable(2)
        }
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION  "This object provides MP2MP capability of the LSR."
REFERENCE  "Section 3.1 of [RFC6388]."
::= { mplsMldpScalars 2 }

mplsMldpMbbCapable OBJECT-TYPE
SYNTAX      INTEGER {
            enable(1),
            disable(2)
        }
MAX-ACCESS  read-only
STATUS current

DESCRIPTION
"This object provides MBB (make before break) capability of the LSR."

REFERENCE
"Section 8.3 of [RFC6388]."

::= { mplsMldpScalars 3 }

mplsMldpMbbTime OBJECT-TYPE
SYNTAX Unsigned32 (1..300)
UNITS "seconds"
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The 32-bit unsigned integer value provides the time for waiting MBB Ack
from upstream node."

DEFVAL { 30 }
::= { mplsMldpScalars 4 }

mplsMldpNumFecs OBJECT-TYPE
SYNTAX Unsigned32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of active and passive mLdp Fecs on this device."

::= { mplsMldpScalars 5 }

mplsMldpNumFecsActive OBJECT-TYPE
SYNTAX Unsigned32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of mLdp FECs Active on this device. The mLDP FEC is
considered active if the mplsMldpFecOperStatus is up(1)."

::= { mplsMldpScalars 6 }

mplsMldpPlrCapable OBJECT-TYPE
SYNTAX INTEGER {
   enable(1),
   disable(2)
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION

"This object provides Point of Local Repair (PLR) capability of the LSR."

REFERENCE
"Section 5.1 of RFC7715]."

::= { mplsMldpScalars 7 }

mplsMldpMptCapable OBJECT-TYPE
SYNTAX      INTEGER {
   enable(1),
   disable(2)
}
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
"This object provides Merge Point (MPT) capability of the LSR."

REFERENCE
"Section 5.2 of RFC7715]."

::= { mplsMldpScalars 8 }

mplsMldProtLsrCapable OBJECT-TYPE
SYNTAX      INTEGER {
   enable(1),
   disable(2)
}
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
"This object provides Protected LSR capability."

REFERENCE
"Section 5.3 of RFC7715]."

::= { mplsMldpScalars 9 }

mplsMldProtNodeProtCapable OBJECT-TYPE
disable(2)
}
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
"This object provides Node Protection capability of the LSR."

REFERENCE
"Section 5.3 of RFC7715]."
::= { mplsMldpScalars 10 }

-- End of MPLS mLDP scalars.

-- MPLS mLDP tables.

-- The MPLS LDP Peer Capability Table

mplsLdpPeerCapabilityTable OBJECT-TYPE
SYNTAX      SEQUENCE OF MplsLdpPeerCapabilityEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
"This table will have learned information relating to Mldp. This table AUGMENTS the mplsLdpPeerTable."

::= { mplsMldpObjects 1 }

mplsLdpPeerCapabilityEntry OBJECT-TYPE
SYNTAX      MplsLdpPeerCapabilityEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
"Information about a single Peer which is related to a Session. This table augments the mplsLdpPeerTable."

AUGMENTS       { mplsLdpPeerEntry }
::= { mplsLdpPeerCapabilityTable 1 }

MplsLdpPeerCapabilityEntry ::= SEQUENCE {
  mplsLdpPeerCapability BITS
mplsLdpPeerCapability OBJECT-TYPE
   SYNTAX      BITS {
               none (0),
               p2mp (1),
               mp2mp(2),
               mbb  (3),
               upstreamLabelAssignment (4),
               dynamic (5),
               plr (6),
               mpt (7),
               protLsr (8),
               nodeProt (9)
   }  
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION  " This will indicate the LDP capability information about peer. 
The p2mp indicates peer supports P2MP Capability.
The mp2mp indicates peer supports MP2MP Capability.
The mbb indicates peer supports MBB Capability.
The upstream-label-assignment indicates peer supports Upstream label assignment Capability.
The dynamic indicates peer supports dynamic Capability.
The plr indicates Point of Local Repair Capability.
The mpt indicates Point of Merge Point Capability.
The prot-lsr indicates Protected LSR Capability.
The node-prot indicates Node Protection LSR Capability."
REFERENCE
"Section 2.1 of RFC6388 for P2MP Capability TLV.
and the section 3.1 of RFC6388 for MP2MP Capability TLV.
The RFC6388 for MBB Capability TLV.
Section 9 of RFC5561 for Dynamic Capability Announcement TLV.
Section 3 of RFC6389 for Upstream Label Assignment Capability TLV.
Section 5 of RFC7715 describes for Point of Local Repair (plr) capability, Merge Point (mpt) capability,
The Protected LSR (port-lsr) and Node Protection (node-prot) Capability."
 ::= { mplsLdpPeerCapabilityEntry 1 }
SYNTAX      SEQUENCE OF MplsMldpSessionStatsEntry
MAX-ACCESS  not-accessible

STATUS      current
DESCRIPTION  
"A table of statistics related to mLDP on Sessions. 
This table AUGMENTS the mplsLdpSessionStatsTable, which 
AUGMENTS the mplsLdpPeerTable."
::= { mplsMldpObjects 2 }

mplsMldpSessionStatsEntry OBJECT-TYPE
SYNTAX      MplsMldpSessionStatsEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION  
"An entry in this table represents mLDP statistical 
information on a single session between an LDP 
Entity and LDP Peer."
AUGMENTS       { mplsLdpPeerEntry }
 ::= ( mplsMldpSessionStatsTable 1 )

MplsMldpSessionStatsEntry ::= SEQUENCE {
  mplsMldpSessionStatsNumFecsSent           Counter32,
  mplsMldpSessionStatsNumMbbReqSentState    Counter32,
  mplsMldpSessionStatsNumFecsRcvd           Counter32,
  mplsMldpSessionStatsNumMbbReqRcvdState    Counter32,
  mplsMldpSessionStatsNumMbbResetAckByTimer Counter32
}

mplsMldpSessionStatsNumFecsSent OBJECT-TYPE
SYNTAX      Counter32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION  
"This object counts the number of mLDP FECs sent on this 
session. If the FEC is withdrawn, then this number is 
decmented.

Discontinuities in the value of this counter can occur 
at re-initialization of the management system, and at 
other times as indicated by the value of 
mplsLdpSessionDiscontinuityTime."
::= ( mplsMldpSessionStatsEntry 1 )
mplsMldpSessionStatsNumMbbReqSentState OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only

STATUS current
DESCRIPTION "This object counts the number of mLDP FECs sent on this
session and waiting for MBB Ack. This counter will get incremented
when MBB req sent for a label on this session and will get
decrement when the MBB Ack received."

 ::= { mplsMldpSessionStatsEntry 2 }

mplsMldpSessionStatsNumFecsRcvd OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "This object counts the number of mLDP FECs received on this
session. If the FEC is withdrawn from the downstream session,
then this is decremented.

Discontinuities in the value of this counter can occur
at re-initialization of the management system, and at
other times as indicated by the value of
mplsLdpSessionDiscontinuityTime."

 ::= { mplsMldpSessionStatsEntry 3 }

mplsMldpSessionStatsNumMbbReqRcvdState OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "This object counts the number of mLDP FECs received on this
session and waiting for sending MBB Ack. This counter will get
incremented when MBB req is received for a label on this session
and will get decremented when the MBB Ack sent."

 ::= { mplsMldpSessionStatsEntry 4 }

mplsMldpSessionStatsNumMbbResetAckByTimer OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
This object counts the number mLDP FECs for which the MBB Ack is reset by MBB timer, in which the LSR is waiting for MBB ack.

::= { mplsMldpSessionStatsEntry 5 }

-- Mpls mLDP FEC Table
--

mplsMldpFecTable OBJECT-TYPE
SYNTAX      SEQUENCE OF MplsMldpFecEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
 "This table represents the FEC (Forwarding Equivalence Class) Information associated with a mLDP LSP."

::= { mplsMldpObjects 3 }

mplsMldpFecEntry OBJECT-TYPE
SYNTAX      MplsMldpFecEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
 "Each row represents a single mLDP FEC Element."
INDEX      { mplsLdpEntityLdpId, mplsLdpEntityIndex, mplsMldpFecIndex }

::= { mplsMldpFecTable 1 }

MplsMldpFecEntry ::= SEQUENCE {
  mplsMldpFecIndex               IndexInteger,
  mplsMldpFecType                INTEGER,
  mplsMldpFecRootAddrType        InetAddressType,
  mplsMldpFecRootAddr            InetAddress,
  mplsMldpFecOpaqueType          INTEGER,
  mplsMldpFecOpaqueGenLspId      Unsigned32,
  mplsMldpFecOpaqueTransitSourceOrBidirAddrType   InetAddressType,
  mplsMldpFecOpaqueTransitSourceOrBidirAddr       InetAddress,
  mplsMldpFecOpaqueTransitGroupAddrType           InetAddressType,
}
mplsMldpFecOpaqueTransitGroupAddr InetAddress,
mplsMldpFecAdminStatus INTEGER,
mplsMldpFecOperStatus INTEGER,
mplsMldpFecMoFrr INTEGER,
mplsMldpFecLsrState INTEGER,
mplsMldpFecUpTime TimeStamp
}

mplsMldpFecIndex OBJECT-TYPE

SYNTAX IndexInteger
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "The index which uniquely identifies this entry."
::= { mplsMldpFecEntry 1 }

mplsMldpFecType OBJECT-TYPE
SYNTAX INTEGER {
    p2mp(6),
    mp2mpUpstream(7),
    mp2mpDownstream(8)
} MAX-ACCESS read-only
STATUS current
DESCRIPTION "The type of the FEC. If the value of this object is 6, then it is P2MP Fec Type, and 7, 8 are correspond to MP2MP upstream and downstream type."
REFERENCE "RFC6388, Section 2.2. The P2MP FEC Element and the section 3.3 for the MP2MP Fec elements."
::= { mplsMldpFecEntry 2 }

mplsMldpFecRootAddrType OBJECT-TYPE
SYNTAX InetAddressType
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The value of this object is the type of the Internet address. The value of this object, decides how the value of the mplsMldpFecRootAddr object..."
is interpreted."
REFERENCE
"RFC6388, Section 2.2. The P2MP FEC Element and the section 3.3 for the MP2MP Fec elements."

::= { mplsMldpFecEntry 3 }

mplsMldpFecRootAddr OBJECT-TYPE
SYNTAX InetAddress
MAX-ACCESS read-only
STATUS current
DESCRIPTION

"The value of this object is interpreted based on the value of the mplsMldpFecRootAddrType object. This is ingress node address for the mLDP LSP."
REFERENCE
"RFC6388, Section 2.2. The P2MP FEC Element and the section 3.3 for the MP2MP Fec elements."

::= { mplsMldpFecEntry 4 }

mplsMldpFecOpaqueType OBJECT-TYPE
SYNTAX INTEGER {
    genericLspId(1),
    transitIpv4Source(3),
    transitIpv6Source(4),
    transitIpv4Bidir(5),
    transitIpv6Bidir(6)
}
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"This is opaque type of the mLDP FEC. The value of this object is shown below.

1 - The Generic LSP Identifier
3 - Transit IPv4 Source TLV
4 - Transit IPv6 Source TLV
5 - Transit IPv4 Bidir TLV
6 - Transit IPv6 Bidir TLV.
"

::= { mplsMldpFecEntry 5 }
mplsMldpFecOpaqueGenLspId OBJECT-TYPE
SYNTAX         Unsigned32
MAX-ACCESS     read-only
STATUS         current
DESCRIPTION    "The 32-bit unsigned integer value which is to represent Generic LSP ID. This value is only valid if the mplsMldpFecOpaqueType is genericLspId(1), otherwise 0 must be returned."
REFERENCE      "RFC6388, Section 2.3.1."
 ::= { mplsMldpFecEntry 6 }

mplsMldpFecOpaqueTransitSourceOrBidirAddrType OBJECT-TYPE
SYNTAX         InetAddressType
MAX-ACCESS     read-only
STATUS         current
DESCRIPTION    "The value of this object is the type of the Internet address. The value of this object, decides how the value of the mplsMldpFecOpaqueTransitSourceOrBidirAddr object is interpreted."
REFERENCE      "RFC6826, Section 3.1."
 ::= { mplsMldpFecEntry 7 }

mplsMldpFecOpaqueTransitSourceOrBidirAddr OBJECT-TYPE
SYNTAX         InetAddress
MAX-ACCESS     read-only
STATUS         current
DESCRIPTION    "The value of this object is interpreted based on the value of the mplsMldpFecOpaqueTransitSourceOrBidirAddrType object. This is source node address for the mLDP inband LSP."
REFERENCE      "RFC6826, Section 3.1."
 ::= { mplsMldpFecEntry 8 }

mplsMldpFecOpaqueTransitGroupAddrType OBJECT-TYPE
SYNTAX         InetAddressType
MAX-ACCESS     read-only
STATUS    current
DESCRIPTION
"The value of this object is the type of the Internet address. The value of this object, decides how the value of the mplsMldpFecOpaqueTransitGroupAddr object is interpreted."

REFERENCE
"RFC6826, Section 3.2."

::= { mplsMldpFecEntry 9 }

mplsMldpFecOpaqueTransitGroupAddr OBJECT-TYPE
SYNTAX     InetAddress
MAX-ACCESS read-only
STATUS     current
DESCRIPTION
"The value of this object is interpreted based on the value of the mplsMldpFecOpaqueTransitGroupAddrType object. This is group node address for the mLDP inband LSP."

REFERENCE
"RFC6826, Section 3.2."

::= { mplsMldpFecEntry 10 }

mplsMldpFecAdminStatus OBJECT-TYPE
SYNTAX     INTEGER {
  up(1), -- ready to pass data
down(2)  -- out of service
}
MAX-ACCESS read-only
STATUS     current
DESCRIPTION
"Indicates the admin status of this mLDP FEC."

DEFVAL { up }

::= { mplsMldpFecEntry 11 }

mplsMldpFecOperStatus OBJECT-TYPE
SYNTAX     INTEGER {
  up(1), -- ready to pass data
down(2) -- out of service
}
max-access read-only
status current
description
"indicates the actual operational status of this mLDP Fec."
::= { mplsMldpFecEntry 12 }

mplsMldpFecMoFrr OBJECT-TYPE
syntax INTEGER {
   enable(1),
   disable(2)
}
max-access read-only
status current
description
"This object provides whether MoFRR enabled for this mLDP FEC. On this mLDP FEC. As mentioned in the section 3.2 of [ RFC7431 ], when this is enabled, then mLDP may select two upstream sessions, one is primary and other one is backup. The backup traffic is discarded when the primary upstream session is UP. When the primary upstream session goes down, the traffic from the backup upstream session will be forwarded to downstream."
::= { mplsMldpFecEntry 13 }

mplsMldpFecLsrState OBJECT-TYPE
syntax INTEGER {
   egress(1),
   bud(2),
   transit(3),
   ingress(4)
}
max-access read-only
status current
description
"Indicates the role of FEC either egress, bud, transit or ingress"
::= { mplsMldpFecEntry 14 }

mplsMldpFecUpTime OBJECT-TYPE
syntax TimeStamp
max-access read-only
status current
DESCRIPTION

"This value shows Fec UP time. This is time since mplsMldpFecOperStatus is UP."

 ::= { mplsMldpFecEntry 15 }

-- MPLS mLDP LSP Branch Traffic Stats Table.

mplsMldpFecBranchStatsTable OBJECT-TYPE
SYNTAX SEQUENCE OF MplsMldpFecBranchStatsEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION

"This table provides mLDP Fec branch MPLS Traffic Stats information."

 ::= { mplaMldpObjects 4 }

mplsMldpFecBranchStatsEntry OBJECT-TYPE
SYNTAX MplsMldpFecBranchStatsEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION

"An entry in this table is created by the LSR for each downstream branch (out-segment) from this LSR for this mLDP LSP. Each downstream session may represent a single out-segment. Each entry in the table is indexed by the four identifiers of the mLDP LSP, and the out-segment that identifies the outgoing branch."

INDEX { mplsLdpEntityLdpId,
mplsLdpEntityIndex,
mplsMldpFecBranchFecIndex,
mplsMldpFecBranchOutSegIndex }

 ::= { mplaMldpFecBranchStatsTable 1 }

MplsMldpFecBranchStatsEntry ::= SEQUENCE {
  mplsMldpFecBranchFecIndex MplsIndexType,
  mplsMldpFecBranchOutSegIndex MplsIndexType,
  mplsMldpFecBranchPeerLdpId MplsLdpIdentifier,
  mplsMldpFecBranchStatsPackets Counter64,
  mplsMldpFecBranchStatsBytes Counter64,

mplsMldpFecBranchStatsDiscontinuityTime TimeStamp

mplsMldpFecBranchFecIndex OBJECT-TYPE
SYNTAX MplsIndexType
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"This index identifies the mLDP FEC entry in the mplsMldpFecTable. This is same as mplsMldpFecIndex."
::= { mplsMldpFecBranchStatsEntry 1 }

mplsMldpFecBranchOutSegIndex OBJECT-TYPE
SYNTAX MplsIndexType
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"This object identifies an outgoing branch from this mLDP LSP. Its value is unique within the context of the mLDP LSP. This contains the same value as the mplsOutSegmentIndex in the MPLS-LSR-STD-MIBs mplsOutSegmentTable."
::= { mplsMldpFecBranchStatsEntry 2 }

mplsMldpFecBranchPeerLdpId OBJECT-TYPE
SYNTAX MplsLdpIdentifier
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"This object identifies an outgoing branch peer LDP ID for this mLDP LSP. Its value is unique within the context of the mLDP LSP. On Egress node, this value could be 0.0.0.0:00 as there will no downstream LDP session."
::= { mplsMldpFecBranchStatsEntry 3 }

mplsMldpFecBranchStatsPackets OBJECT-TYPE
SYNTAX Counter64
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"This object represent the 64-bit value, which gives the number
of packets forwarded by the mLDP LSP onto this branch. This object should be read in conjunction with mplsMldpFecBranchStatsDiscontinuityTime.

::= { mplsMldpFecBranchStatsEntry 4 }

mplsMldpFecBranchStatsBytes OBJECT-TYPE
SYNTAX Counter64
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"This object represent the 64-bit value, which gives the number of bytes forwarded by the mLDP LSP onto this branch. This object should be read in conjunction with mplsMldpFecBranchStatsDiscontinuityTime."

::= { mplsMldpFecBranchStatsEntry 5 }

mplsMldpFecBranchStatsDiscontinuityTime OBJECT-TYPE
SYNTAX TimeStamp
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The value of sysUpTime on the most recent occasion at which any one or more of this rows Counter32 or Counter64 objects experienced a discontinuity. If no such discontinuity has occurred since the last re-initialization of the local management subsystem, then this object contains a zero value."

::= { mplsMldpFecBranchStatsEntry 6 }

-- End of mplsMldpFecBranchStatsTable

-- MPLS mLDP LSP Upstream Session Table.

mplsMldpFecUpstreamSessTable OBJECT-TYPE
SYNTAX SEQUENCE OF MplsMldpFecUpstreamSessEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"This table provides mLDP Fec upstream Session information."

::= { mplsMldpObjects 5 }

mplsMldpFecUpstreamSessEntry OBJECT-TYPE
SYNTAX       MplsMldpFecUpstreamSessEntry
MAX-ACCESS   not-accessible
STATUS       current
DESCRIPTION  
"An entry in this table is created by the LSR for each upstream session (in-segment) from this LSR for this mLDP LSP. Each upstream session may represent a single in-segment. Each entry in the table is indexed by the four identifiers of the mLDP LSP, and the in-segment that identifies the incoming traffic."
INDEX
{ mplsLdpEntityLdpId,
  mplsLdpEntityIndex,
  mplsLdpPeerLdpId,
  mplsMldpFecUpstreamSessFecIndex,
  mplsMldpFecUpstreamSessInSegIndex
}
::= { mplsMldpFecUpstreamSessTable 1 }

MplsMldpFecUpstreamSessEntry ::= SEQUENCE {
  mplsMldpFecUpstreamSessFecIndex          MplsIndexType,
  mplsMldpFecUpstreamSessInSegIndex        MplsIndexType,
  mplsMldpFecUpstreamSessPrimary           INTEGER,
  mplsMldpFecUpstreamSessActive            INTEGER,
  mplsMldpFecUpstreamSessPackets           Counter64,
  mplsMldpFecUpstreamSessBytes             Counter64,
  mplsMldpFecUpstreamSessDiscontinuityTime TimeStamp
}

mplsMldpFecUpstreamSessFecIndex OBJECT-TYPE
SYNTAX       MplsIndexType
MAX-ACCESS   not-accessible

STATUS       current
DESCRIPTION  "This index identifies the mLDP FEC entry in the mplsMldpFecTable."
::= { mplsMldpFecUpstreamSessEntry 1 }

mplsMldpFecUpstreamSessInSegIndex OBJECT-TYPE
SYNTAX       MplsIndexType
MAX-ACCESS   not-accessible
STATUS       current
DESCRIPTION

"This object identifies an upstream session from this mLDP LSP. Its value is unique within the context of the mLDP LSP.

This contains the same value as the mplsInSegmentIndex in the MPLS-LSR-STD-MIBs mplsInSegmentTable."

::= { mplsMldpFecUpstreamSessEntry 2 }

mplsMldpFecUpstreamSessPrimary OBJECT-TYPE
SYNTAX INTEGER {
  primary(1),
  backup(2)
}
MAX-ACCESS read-only
STATUS current
DESCRIPTION

"This indicated wether the received traffic from upstream is primary or backup. This is valid only if the MoFRR (mplsMldpFecMoFrr) is enabled on this FEC."

::= { mplsMldpFecUpstreamSessEntry 3 }

mplsMldpFecUpstreamSessActive OBJECT-TYPE
SYNTAX INTEGER {
  active(1),
  inactive(2)
}
MAX-ACCESS read-only
STATUS current
DESCRIPTION

"This indicates whether the upstream session is active, means the LSR programmed the forwarding engine to receive the traffic from this upstream session. This will be Inactive if the LSR is waiting for MBB Ack."

::= { mplsMldpFecUpstreamSessEntry 4 }

mplsMldpFecUpstreamSessPackets OBJECT-TYPE
SYNTAX Counter64
MAX-ACCESS read-only
STATUS current
DESCRIPTION

"This object represent the 64-bit value, which gives the number of packets received by the mLDP LSP from this upstream..."
session. This object should be read in conjunction with mlsMldpFecUpstreamSessDiscontinuityTime.

::= { mlsMldpFecUpstreamSessEntry 5 }

mlsMldpFecUpstreamSessBytes OBJECT-TYPE
SYNTAX Counter64
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"This object represent the 64-bit value, which gives the number of bytes received by the mLDL LSP from this upstream session. This object should be read in conjunction with mlsMldpFecUpstreamSessDiscontinuityTime."

::= { mlsMldpFecUpstreamSessEntry 6 }

mlsMldpFecUpstreamSessDiscontinuityTime OBJECT-TYPE
SYNTAX TimeStamp
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The value of sysUpTime on the most recent occasion at which any one or more of this rows Counter32 or Counter64 objects experienced a discontinuity. If no such discontinuity has occurred since the last re-initialization of the local management subsystem, then this object contains a zero value."

::= { mlsMldpFecUpstreamSessEntry 7 }

-- End of mlsMldpFecBranchStatsTable

-- MPLS mLDP Interface Traffic Stats Table.

mlsMldpInterfaceStatsTable OBJECT-TYPE
SYNTAX SEQUENCE OF MplsMldpInterfaceStatsEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"This table provides mLDP Traffic Stats on specified interface."

::= { mlsMldpObjects 6 }

mlsMldpInterfaceStatsEntry OBJECT-TYPE
An entry in this table is created by the LSR for each downstream branch (out-segment) from this LSR for this mLDP LSP. Each downstream session may represent a single out-segment.

Each entry in the table is indexed by the four identifiers of the mLDP LSP, and the out-segment that identifies the outgoing branch.

INDEX { mplsMldpInterfaceIndex }

::= { mplsMldpInterfaceStatsTable 1 }

MplsMldpInterfaceStatsEntry ::= SEQUENCE {
  mplsMldpInterfaceIndex          OBJECT-TYPE
    SYNTAX        InterfaceIndex
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
      "This index identifies the specific interface."

    ::= { mplsMldpInterfaceStatsEntry 1 }

  mplsMldpInterfaceStatsSentPackets OBJECT-TYPE
    SYNTAX        Counter64
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
      "This is 64 bit value, which gives the number of packets forwarded by all mLDP LSPs onto this interface."

    ::= { mplsMldpInterfaceStatsEntry 2 }

  mplsMldpInterfaceStatsSentBytes OBJECT-TYPE

SYNTAX Counter64
MAX-ACCESS read-only
STATUS current
DESCRIPTION
   "This is 64 bit value, which gives the number of bytes
   forwarded by all mLDP LSPs onto this interface."
::= { mplsMldpInterfaceStatsEntry 3 }

mplsMldpInterfaceStatsRecvPackets OBJECT-TYPE
SYNTAX Counter64
MAX-ACCESS read-only
STATUS current
DESCRIPTION
   "This is 64 bit value, which gives the number of packets
   received by all mLDP LSPs from this interface."
::= { mplsMldpInterfaceStatsEntry 4 }

mplsMldpInterfaceStatsRecvBytes OBJECT-TYPE
SYNTAX Counter64
MAX-ACCESS read-only
STATUS current
DESCRIPTION
   "This is 64 bit value, which gives the number of bytes
   received by all mLDP LSPs from this interface."
::= { mplsMldpInterfaceStatsEntry 5 }

-- End of mplsMldpInterfaceStatsTable

-- Notifications.

mplsMldpFecUp NOTIFICATION-TYPE
OBJECTS { mplsMldpFecAdminStatus, mplsMldpFecOperStatus }
STATUS current
DESCRIPTION
   "This notification is generated when a mplsMldpFecOperStatus
   object changes from down to up."
::= { mplsMldpNotifications 1 }
mplsMldpFecDown NOTIFICATION-TYPE
OBJECTS {
    mplsMldpFecAdminStatus,
    mplsMldpFecOperStatus
}
STATUS current
DESCRIPTION
"This notification is generated when a mplsMldpFecOperStatus object changes from up to down."
::= { mplsMldpNotifications 2 }

mplsMldpMoFrrStatusChange NOTIFICATION-TYPE
OBJECTS {
    mplsMldpFecUpstreamSessPrimary
}
STATUS current
DESCRIPTION
"This notification is generated when a mplsMldpFecUpstreamSessPrimary object changes from primary to backup and vice versa."
::= { mplsMldpNotifications 3 }

-- End of notifications.

--****************************************************************
-- Module Conformance Statement
--****************************************************************

mplsMldpConformance OBJECT IDENTIFIER ::= { mplsMldpStdMIB 3 }
mplsMldpGroups OBJECT IDENTIFIER ::= { mplsMldpConformance 1 }
mplsMldpComplings OBJECT IDENTIFIER ::= { mplsMldpConformance 2 }

mplsMldpModuleCompliance MODULE-COMPLIANCE
STATUS current
DESCRIPTION
"The Module is implemented with support for read-only. Only monitoring is available when using this MODULE-COMPLIANCE."

MODULE -- this module
MANDATORY-GROUPS { mplsMldpScalarsGroup,
    mplsMldpObjectsGroup,
    mplsMldpNotificationsGroup
}
::= { mplsMldpCompliances 1 }

-- units of conformance

mplsMldpScalarsGroup OBJECT-GROUP
   OBJECTS {
      mplsMldpP2mpCapable,
      mplsMldpP2mpCapable,
      mplsMldpMbbCapable,
      mplsMldpMbbTime,
      mplsMldpNumFecs,
      mplsMldpNumFecsActive,
      mplsMldpP1rCapable,
      mplsMldpP2mpCapable,
      mplsMldpMptCapable,
      mplsMldpProtLsrCapable,
      mplsMldpProtLsrCapable,
      mplsMldpProtNodeProtCapable,
      mplsLdpPeerCapability
   }
   STATUS current
   DESCRIPTION
      "A collection of objects providing basic statistics and
      capability information of mLDP implementation."
::= { mplsMldpGroups 1 }

mplsMldpObjectsGroup OBJECT-GROUP
   OBJECTS {
      mplsMldpSessionStatsNumFecsSent,
      mplsMldpSessionStatsNumMbbReqSentState,
      mplsMldpSessionStatsNumFecsRcvd,
      mplsMldpSessionStatsNumFecsSent,
      mplsMldpSessionStatsNumMbbReqRcvdState,
      mplsMldpSessionStatsNumMbbResetAckByTimer,
      mplsMldpFecType,
      mplsMldpFecRootAddrType,
      mplsMldpFecRootAddr,
      mplsMldpFecOpaqueType,
      mplsMldpFecOpaqueGenLspId,
      mplsMldpFecOpaqueTransitSourceOrBidirAddrType,
      mplsMldpFecOpaqueTransitSourceOrBidirAddr,
      mplsMldpFecOpaqueTransitGroupAddrType,
      mplsMldpFecOpaqueTransitGroupAddr,
      mplsMldpFecAdminStatus,
      mplsMldpFecOperStatus,
      mplsMldpFecMoFrr,
      mplsMldpFecLsrState,
mplsMldpFecUpTime,
mplsMldpFecBranchPeerLdpId,
mplsMldpFecBranchStatsPackets,
mplsMldpFecBranchStatsBytes,
mplsMldpFecBranchStatsDiscontinuityTime,
mplsMldpFecUpstreamSessPrimary,
mplsMldpFecUpstreamSessActive,
mplsMldpFecUpstreamSessPackets,
mplsMldpFecUpstreamSessBytes,
mplsMldpFecUpstreamSessDiscontinuityTime,
mplsMldpInterfaceStatsSentPackets,
mplsMldpInterfaceStatsSentBytes,
mplsMldpInterfaceStatsRecvPackets,
mplsMldpInterfaceStatsRecvBytes
}
STATUS  current
DESCRIPTION
  "A collection of objects providing basic information
  regarding mLDP implementation."
::= { mplsMldpGroups 2 }

mplsMldpNotificationsGroup NOTIFICATION-GROUP
NOTIFICATIONS { mplsMldpFecUp,
 mplisMldpFecDown,
 mplisMldpMoFrrStatusChange
}
STATUS  current
DESCRIPTION
  "A collection of notifications for mLDP implementation."
::= { mplsMldpGroups 3 }

END

12. Security Considerations

This MIB module is useful for the configuration of certain objects
and monitoring of mLDP LSPs.

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.

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:

- mplsMldpFecTable
- mplsLdpPeerCapabilityTable
- mplsMldpSessionStatsTable
- mplsMldpFecBranchStatsTable
- mplsMldpFecUpstreamSessTable
- mplsMldpInterfaceStatsTable
- mplsMldpNumFecs
- mplsMldpNumFecsActive
- mplsMldpMbbTime

Above listed tables and objects show information about the mLDP LSPs, its route through the network, and its traffic statistics. Knowledge of this information could be used to compromise the network, or simply to breach confidentiality. If an Administrator does not want to reveal this information, these tables and objects should be considered sensitive/vulnerable.

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

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

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

13. IANA Considerations

This is new MPLS MIB module, contained in this document and IANA is requested to assign an oid (mplsStdMIB YYY) under the mplsStdMIB subtree to the MPLS-MLDP-STD-MIB module specified in this document.

14. Acknowledgments

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15. References

15.1. Normative References


15.2. Informative References


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