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K. Tiruveedhula, Ed.
Juniper Networks
U. Joorde
Deutsche Telekom
A. Venkateswaran
Cisco Systems

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**Definitions of Managed Objects for the LDP Point-to-Multipoint and
Multipoint-to-Multipoint Label Switched Paths
draft-ietf-mpls-mldp-mib-02**

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 extension of 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 focusses on the management of following multicast LDP (mLDP) features, which were defined after unicast LDP [[RFC5036](#)].

[RFC6388](#): Label Distribution Protocol Extensions for Point-to-Multipoint and Multipoint-to-Multipoint Label Switched Paths.

[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

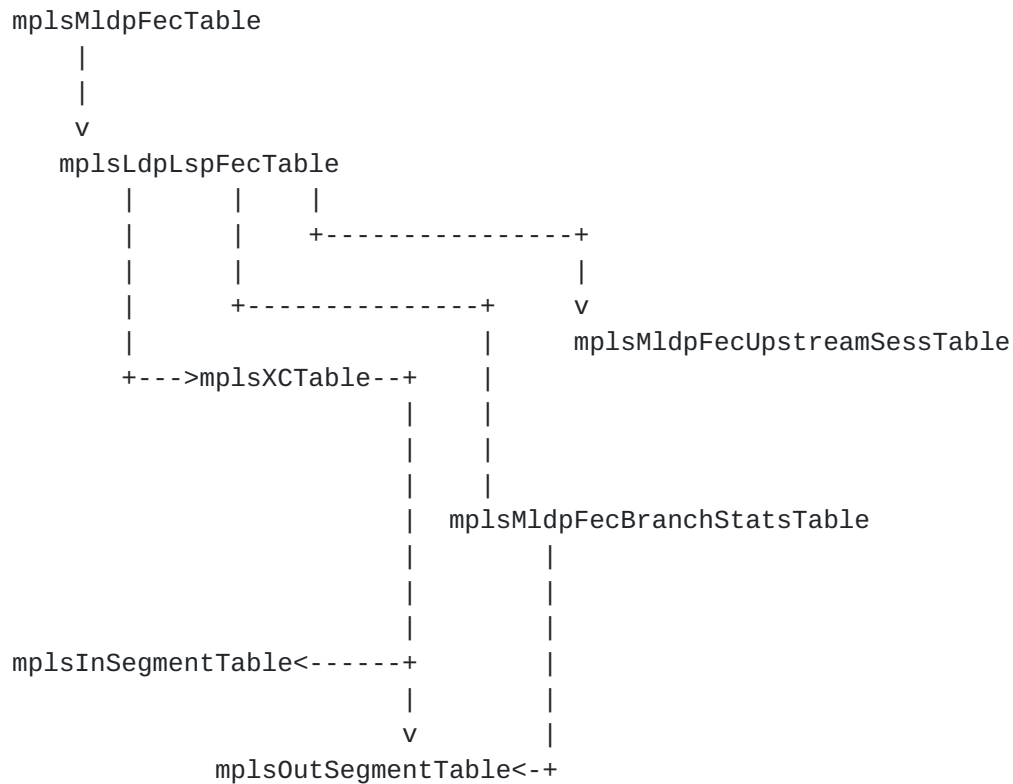


Figure 1 : Dependencies Between MIB Tables

Figure 1

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, TimeTicks

FROM SNMPv2-SMI -- [RFC 2578](#)

MODULE-COMPLIANCE, OBJECT-GROUP, NOTIFICATION-GROUP

FROM SNMPv2-CONF -- [RFC 2580](#)

TruthValue, RowStatus, StorageType, 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, IndexIntegerNextFree

FROM DIFFSERV-MIB -- [RFC 3289](#)

InetAddress, InetAddressType

FROM INET-ADDRESS-MIB -- [RFC 4001](#)

mplsLdpStdMIB, mplsLdpEntityLdpId, mplsLdpEntityIndex,
mplsLdpPeerLdpId, mplsLdpSessionStatsEntry

FROM MPLS-LDP-STD-MIB -- [RFC 3815](#)

;

mplsMldpStdMIB MODULE-IDENTITY

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ORGANIZATION "Multiprotocol Label Switching (mpls)
Working Group"

CONTACT-INFO

" Kishore Tiruveedhula
Juniper Networks

Email: kishoret@juniper.net

Uwe Joorde
Deutsche Telekom
Email: Uwe.Joorde@telekom.de

Arvind Venkateswaran
Cisco Systems
Email: arvvenka@cisco.com

Comments about this document should be emailed
directly to the MPLS working group mailing list at
mpls@lists.ietf.org"

DESCRIPTION

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restrictions with respect to this document.

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 "201703280000Z" -- March 28, 2017

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.


```
-- notifications

mplsMldpNotifications OBJECT IDENTIFIER ::= { mplsMldpStdMIB 0 }
-- tables, scalars
mplsMldpScalars          OBJECT IDENTIFIER ::= { mplsMldpStdMIB 1 }
mplsMldpObjects          OBJECT IDENTIFIER ::= { mplsMldpStdMIB 2 }

-- MPLS mLDP LSP scalars.

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 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

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"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

SYNTAX INTEGER {
 enable(1),
 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."

::= { 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 is augmented by
the mplsLdpSessionTable."

INDEX { mplsLdpEntityLdpId,
mplsLdpEntityIndex,
mplsLdpPeerLdpId
}

::= { mplsLdpPeerCapabilityTable 1 }

MplsLdpPeerCapabilityEntry ::= SEQUENCE {

mplsLdpPeerLdpId MplsLdpIdentifier,

mplsLdpPeerCapability BITS

}

mplsLdpPeerLdpId OBJECT-TYPE

SYNTAX MplsLdpIdentifier

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The LDP identifier of this LDP Peer."

::= { mplsLdpPeerCapabilityEntry 1 }

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 2 }

```

```

--

```

```

-- The MPLS mLDP Session Statistics Table

```

```

--

```

mplsMldpSessionStatsTable OBJECT-TYPE

```

SYNTAX      SEQUENCE OF MplsMldpSessionStatsEntry

```

MAX-ACCESS not-accessible

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STATUS current

DESCRIPTION

"A table of statistics related to mLDP on Sessions.

This table AUGMENTS the mplsLdpSessionStatsTable."

::= { 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."

INDEX { mplsLdpEntityLdpId,
mplsLdpEntityIndex,
mplsLdpPeerLdpId
}

::= { 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 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 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 decremented when the MBB Ack received."

::= { mplsMldpSessionStatsEntry 2 }

mplsMldpSessionStatsNumFecRcvd 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

STATUS current

DESCRIPTION

"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 an 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 values 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."

::= { mplsMldpObjects 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
            }
```

```
::= { mplsMldpFecBranchStatsTable 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 wating
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
        mplsMldpFecUpstreamSessDiscontinuityTime."
```

```
::= { mplsMldpFecUpstreamSessEntry 5 }
```

```
mplsMldpFecUpstreamSessBytes        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 mLDP LSP from this upstream
        session. This object should be read in conjunction with
        mplsMldpFecUpstreamSessDiscontinuityTime."
```

```
::= { mplsMldpFecUpstreamSessEntry 6 }
```

```
mplsMldpFecUpstreamSessDiscontinuityTime 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."
```

```
::= { mplsMldpFecUpstreamSessEntry 7 }
```

```
-- End of mplsMldpFecBranchStatsTable
```

```
-- MPLS mLDP Interface Traffic Stats Table.
```

```
mplsMldpInterfaceStatsTable OBJECT-TYPE
```

```
    SYNTAX          SEQUENCE OF MplsMldpInterfaceStatsEntry
```

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

```
    STATUS          current
```


DESCRIPTION

"This table provides mLDP Traffic Stats on specified interface."

::= { mplsMldpObjects 6 }

mplsMldpInterfaceStatsEntry OBJECT-TYPE

SYNTAX MplsMldpInterfaceStatsEntry

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 { mplsMldpInterfaceIndex
}

::= { mplsMldpInterfaceStatsTable 1 }

MplsMldpInterfaceStatsEntry ::= SEQUENCE {

mplsMldpInterfaceIndex	InterfaceIndex,
mplsMldpInterfaceStatsSentPackets	Counter64,
mplsMldpInterfaceStatsSentBytes	Counter64,
mplsMldpInterfaceStatsRecvPackets	Counter64,
mplsMldpInterfaceStatsRecvBytes	Counter64

}

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.
```

```
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:

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

The authors wish to thank Santosh Esale, Alia Atlas and Martin Ehlers for doing the detailed review. Thanks to Adrian Farrel and Raveendra Torvi for their input to this work and for many helpful suggestions.

15. References

15.1. Normative References

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Authors' Addresses

Kishore Tiruveedhula (editor)
Juniper Networks
10 Technology Park Drive
Westford MA 01886
USA

Phone: +1 9785898861
EMail: kishoret@juniper.net

Uwe Joorde
Deutsche Telekom
Dahlweg 100
Munster 48153
Germany

E-Mail: Uwe.Joorde@telekom.de

Arvind Venkateswaran
Cisco Systems
510 McCarthy Blvd
Milpitas CA 95035
USA

E-Mail: arvvenka@cisco.com

