

Internet Engineering Task Force
Internet-Draft
Intended status: Standards Track
Expires: August 18, 2014

Kishore Tiruveedhula, Ed.
Juniper Networks
Uwe Joerde
Deutsche Telekom
Arvind Venkateswaran
Cisco Systems
February 14, 2014

Definitions of Managed Objects for the LDP Point-to-Multipoint and
Multipoint-to-Multipoint Label Switched Paths
draft-tiruveedhula-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.

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 August 18, 2014.

Copyright Notice

Copyright (c) 2014 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	4
2. The Internet-Standard Management Framework	4
3. Conventions	4
4. Overview	5
5. Future Considerations	5
6. Structure of the MIB Module	5
6.1. Summary of mLDP Scalar Objects	6
6.2. Summary of mLDP Table Objects	6
7. mLDP Scalar Objects	6
7.1. mplsMldpP2mpCapable	6
7.2. mplsMldpMp2mpCapable	7
7.3. mplsMldpMbbCapable	7
7.4. mplsMldpMbbTime	7
7.5. mplsMldpNumFecs	7
7.6. mplsMldpNumFecsActive	7
7.7. mplsMldpPlrCapable	7
7.8. mplsMldpMptCapable	7
7.9. mplsMldpProtLsrCapable	7
7.10. mplsMldpNodeProtCapable	8
8. mLDP Table Objects	8
8.1. LDP Peer Capability Table mplsLdpPeerCapabilityTable	8
8.2. mLDP Session Stats Table: mplsMldpSessionStatsTable	8
8.3. mLDP Fec Table: mplsMldpFecTable	8
8.4. mLDP Fec Branch Traffic statistics Table: mplsMldpFecBranchStatsTable	8
8.5. mLDP Fec Upstream Session Table: mplsMldpFecUpstreamSessTable	8
8.6. mLDP Interface Traffic statistics Table: mplsMldpInterfaceStatsTable	8
9. The mLDP Notifications	9
10. Relationship to Other MIB Modules	9
10.1. Diagrammatic Representation	10
10.2. Relationship to the LSR MIB	10
10.3. Relationship to the LDP MIB	11
11. Multicast MPLS Label Distribution Protocol MIB Definitions	11
12. Security Considerations	32
13. IANA Considerations	34
14. Acknowledgments	34
15. References	34
15.1. Normative References	34

15.2. Informative References	35
Appendix A. Change Log	36
Appendix B. Open Issues	36

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 RFC 6826 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

[[anchor3: The title and text for this section has been copied from the official boilerplate, and should not be modified unless the official boilerplate text from the OPS Area web site has changed. See RFC4818 section 3.1 for a discussion of the boilerplate section.]]

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 BCP 14, RFC 2119 [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.

[MoFRR] Multicast only Fast Re-Route draft-ietf-rtgwg-mofrr-03 .

[MLDP_NODE_PROT] 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 per Interface: The mLDP traffic stats per Interface.
- Traps when mLDP Fec LSP up, down.

5. Future Considerations

Any new opaque TLVs added for any other mLDP fetures, 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 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

There are ten scalars, listed below are defined for 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 [MLDP_NODE_PROT]

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 [MLDP_NODE_PROT]

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 [MLDP_NODE_PROT]

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 [MLDP_NODE_PROT]

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 LDP peer. This table augments the mplsLdpPeerTable, which is defined in RFC 3815.

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 the information about 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 the information about

number of mLDP packets and number of mLDP bytes sent and received on 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.

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

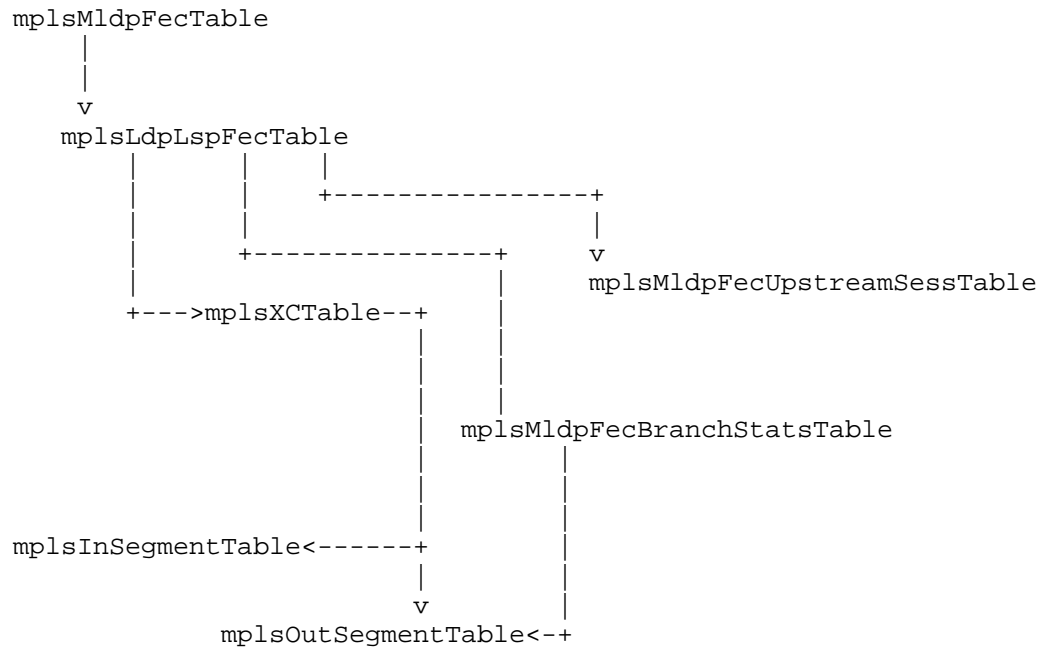


Figure 1 : Dependencies Between MIB Tables

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
        FROM MPLS-LDP-STD-MIB
        -- RFC 3815
    ;

mplsMldpStdMIB MODULE-IDENTITY
```

LAST-UPDATED "201402140000Z" -- Feb 14, 2014
ORGANIZATION "Multiprotocol Label Switching (mpls)
Working Group"

CONTACT-INFO

" Kishore Tiruveedhula
Juniper Networks
Email: kishoret@juniper.net

Uwe Joerde
Deutsche Telekom
Email: Uwe.Joerde@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

"Copyright (c) 2009 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 in effect on the
date of publication of this document
(<http://trustee.ietf.org/license-info>). Please review these
documents carefully, as they describe your rights and
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-Multipoin
t and

Multipoint-to-Multipoint Label Switched Paths, RFC 6388, November
2011."

REVISION "201402140000Z" -- Feb 14, 2014
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 99 }
-- RFC Editor. Please replace 99 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
Ack
            from upstream node."

        DEFVAL { 30 }
        ::= { mplsMldpScalars 4 }
```

mplsMldpNumFecs OBJECT-TYPE

```

        SYNTAX          Unsigned32
        MAX-ACCESS      read-only
        STATUS          current
        DESCRIPTION
            "The number of mLDp FECs setup 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 [MLDP_NODE_PROT]."
```

::= { 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 [MLDP_NODE_PROT]."
```

::= { 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 [MLDP_NODE_PROT]."
```

::= { 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 [MLDP_NODE_PROT]."
```

::= { 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     Integer32,
}
```

mplsLdpPeerCapability OBJECT-TYPE

```

    SYNTAX          BITS {
```



```

        none (0),
        p2mp (1),
        mp2mp(2),
        mbb (3),
        upstream-label-assignment (4),
        dynamic (5),
        plr (6),
        mpt (7),
        prot-lsr (8),
        node-prot (9)
    }
MAX-ACCESS read-only
STATUS current
DESCRIPTION
    " This will indicate the LDP capability information about peer.
    p2mp indicates peer supports P2MP Capability.
    mp2mp indicates peer supports MP2MP Capability.
    mbb indicates peer supports MBB Capability.
    upstream-label-assignment indicates peer supports Upstream label
    assignment Capability.
    dynamic indicates peer supports dynamic Capability.
    "

REFERENCE
    "RFC6388, Section 2.1 for P2MP Capability TLV.
    and the section 3.1 for MP2MP Capability TLV.
    The RFC6388 for MBB Capability TLV.
    RFC5561 Section 9 for Dynamic Capability Announcement TLV.
    RFC6389 Section 3 for Upstream Label Assignment Capability TLV.
    MLDP_NODE_PROT section 5 for PLR capability, MPT capability,
    The Protected LSR and The Node Protection Capability. "

 ::= { mplsLdpPeerCapability 2 }

--
-- The MPLS mLDP Session Statistics Table
--

mplsMldpSessionStatsTable OBJECT-TYPE
    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."
    ::= { 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    { mplsLdpSessionStatsEntry }
::= { 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 }

```

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

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 MplsFecEntry

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 { 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
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 mplsMldpFecOpaqueTransitSourceOrBidir
        Addr
        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 [MoFRR],
        When this is enabled, then mLDP may select two upstream sessions,
        one is priamry 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 downsteam.
        "

 ::= { 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 mplsMldpFecOperStat
us 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,
                    mplsLdpPeerLdpId,
                    mplsMldpFecBranchFecIndex,
                    mplsMldpFecBranchOutSegIndex

```

```

    }

    ::= { mplsMldpFecBranchStatsTable 1 }

mplsMldpFecBranchStatsEntry ::= SEQUENCE {
    mplsMldpFecBranchFecIndex          MplsIndexType,
    mplsMldpFecBranchOutSegIndex       MplsIndexType,
    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 }

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 3 }

```

```
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 4 }

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 5 }

-- 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 }

-- End of notifications.
```

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 mplsMldpNumFecsConfigured
- 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 under the mplsStdMIB subtree to the MPLS-MDLP-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

- [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.
- [RFC3031] Rosen, E., Viswanathan, A., and R. Callon, "Multiprotocol Label Switching Architecture", RFC 3031, January 2001.

- [RFC3811] Nadeau, T. and J. Cucchiara, "Definitions of Textual Conventions (TCs) for Multiprotocol Label Switching (MPLS) Management", RFC 3811, June 2004.
- [RFC3813] Srinivasan, C., Viswanathan, A., and T. Nadeau, "Multiprotocol Label Switching (MPLS) Label Switching Router (LSR) Management Information Base (MIB)", RFC 3813, June 2004.
- [RFC3815] Cucchiara, J., Sjostrand, H., and J. Luciani, "Definitions of Managed Objects for the Multiprotocol Label Switching (MPLS), Label Distribution Protocol (LDP)", RFC 3815, June 2004.
- [RFC5036] Andersson, L., Minei, I., and B. Thomas, "LDP Specification", RFC 5036, October 2007.
- [RFC5561] Thomas, B., Raza, K., Aggarwal, S., Aggarwal, R., and JL. Le Roux, "LDP Capabilities", RFC 5561, July 2009.
- [RFC6388] Wijnands, IJ., Minei, I., Kompella, K., and B. Thomas, "Label Distribution Protocol Extensions for Point-to-Multipoint and Multipoint-to-Multipoint Label Switched Paths", RFC 6388, November 2011.
- [RFC6826] Wijnands, IJ., Eckert, T., Leymann, N., and M. Napierala, "Multipoint LDP In-Band Signaling for Point-to-Multipoint and Multipoint-to-Multipoint Label Switched Paths", RFC 6826, January 2013.
- [RFC7060] Napierala, M., Rosen, E., and IJ. Wijnands, "Using LDP Multipoint Extensions on Targeted LDP Sessions", RFC 7060, November 2013.
- [RFC6389] Aggarwal, R. and JL. Le Roux, "MPLS Upstream Label Assignment for LDP", RFC 6389, November 2011.

15.2. Informative References

- [RFC2223] Postel, J. and J. Reynolds, "Instructions to RFC Authors", RFC 2223, October 1997.
- [RFC3410] Case, J., Mundy, R., Partain, D., and B. Stewart, "Introduction and Applicability Statements for Internet-Standard Management Framework", RFC 3410, December 2002.

- [RFC2629] Rose, M., "Writing I-Ds and RFCs using XML", RFC 2629, June 1999.
- [RFC4181] Heard, C., "Guidelines for Authors and Reviewers of MIB Documents", BCP 111, RFC 4181, September 2005.
- [RFC4001] Daniele, M., Haberman, B., Routhier, S., and J. Schoenwaelder, "Textual Conventions for Internet Network Addresses", RFC 4001, February 2005.
- [MoFRR] Karan, Filsfils, Farinacci, Leymann, Joerde, and Henderickx, "Multicast only Fast Re-Route", draft-ietf-rtgwg-mofrr-03.txt (work in progress), 2012.
- [MLDP_NODE_PROT] Wijnands, Rosen, Raza, Tantsura, Leymann, and Zhao, "mLDP Node Protection", draft-ietf-mpls-mldp-node-protection-00.txt (work in progress), 2013.

Appendix A. Change Log

Appendix B. Open Issues

Authors' Addresses

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

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

Uwe Joerde
Deutsche Telekom
Dahlweg 100
Munster 48153
Germany

EMail: Uwe.Joerde@telekom.de

Arvind Venkateswaran
Cisco Systems
510 McCarthy Blvd
Milpitas CA 95035
USA

EMail: arvvenka@cisco.com

