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Transparent Interconnection of Lots of Links (TRILL)
Operations, Administration, and Maintenance (OAM) MIB

Abstract

This document specifies the MIB for the OAM (Operations, Administration, and Maintenance) objects for IETF TRILL (Transparent Interconnection of Lots of Links).

Status of This Memo

This is an Internet Standards Track document.

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Table of Contents

1. Introduction	2
2. The Internet-Standard Management Framework	3
3. Conventions	3
4. Overview	4
5. Structure of the MIB Module	4
5.1. Textual Conventions	4
5.2. The TRILL OAM MIB Subtree	4
5.3.1. The Notifications Subtree	5
5.3.2. The Table Structures	5
5.3.2.1. trillOamMepTable Objects	5
5.3.2.2. trillOamMepFlowCfgTable Objects	6
5.3.2.3. trillOamPtrTable Objects	6
5.3.2.4. trillOamMtvrTable Objects	6
5.3.2.5. trillOamMepDbTable Objects	6
6. Relationship to Other MIB Modules	6
6.1. Relationship to the IEEE8021-TC-MIB	7
6.2. Relationship to the IEEE8021-CFM-MIB	7
6.3. MIB Modules Required for IMPORTS	8
7. Definitions	8
8. Security Considerations	44
9. IANA Considerations	47
10. References	47
10.1. Normative References	47
10.2. Informative References	49
Acknowledgments	50
Authors' Addresses	50

1. Introduction

Overall, TRILL OAM meets the requirements given in [RFC6905]. The general framework for TRILL OAM is specified in [RFC7174]. The details of the Fault Management (FM) solution, conforming to that framework, are presented in [RFC7455]. The solution leverages the message format defined in Ethernet Connectivity Fault Management (CFM) [802.1Q] as the basis for the TRILL OAM message channel.

This document uses the CFM MIB modules defined in [802.1Q] as the basis for TRILL OAM MIB and augments the existing tables to add new TRILL managed objects required by TRILL. This document further specifies a new table with associated managed objects for TRILL OAM-specific capabilities.

2. The Internet-Standard Management Framework

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

Managed objects are accessed via a virtual information store, termed the Management Information Base or MIB. MIB objects are generally accessed through the Simple Network Management Protocol (SNMP). Objects in the MIB are defined using the mechanisms defined in the Structure of Management Information (SMI). This memo specifies a MIB module that is compliant to the SMIV2, which is described in STD 58, RFC 2578 [RFC2578], STD 58, RFC 2579 [RFC2579] and STD 58, RFC 2580 [RFC2580].

3. Conventions

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

Abbreviations used in the document include the following:

CCM - Continuity Check Message [802.1Q]
EMS - Element Management System [Q.840.1]
MEP - Maintenance End Point [RFC7174] [802.1Q]
MIP - Maintenance Intermediate Point [RFC7174] [802.1Q]
MP - Maintenance Point [RFC7174]
MTVM - Multi-destination Tree Verification Message [RFC7455]
MTVR - Multi-destination Tree Verification Reply [RFC7455]
NMS - Network Management System [Q.840.1]
PTM - Path Trace Message [RFC7455]
PTR - Path Trace Reply [RFC7455]

4. Overview

The TRILL OAM MIB module provides an overall framework for managing TRILL OAM. It leverages the IEEE8021-CFM-MIB and IEEE8021-CFM-V2-MIB modules defined in [802.1Q], and it augments the Maintenance End Point (MEP) and MEP Db entries. It also adds a new table for messages specific to TRILL OAM.

5. Structure of the MIB Module

Objects in this MIB module are arranged into subtrees. Each subtree is organized as a set of related objects. The various subtrees are shown below, supplemented with the required elements of the IEEE8021-CFM-MIB module.

5.1. Textual Conventions

Textual conventions are defined to represent object types relevant to the TRILL OAM MIB.

5.2. The TRILL OAM MIB Subtree

The TRILL OAM MIB tree described below consists of `trilloamNotifications` (Traps) and `trilloamMibObjects`. The `trilloamNotifications` are sent to the management entity whenever a MEP loses/restores contact with its peer flow MEPs.

The TRILL OAM MIB per MEP Objects are defined in the `trilloamMepTable`. The `trilloamMepTable` augments the `dotlagCfmMepEntry` (please see Section 6.1) defined in IEEE8021-CFM-MIB. It includes objects that are locally defined for an individual MEP and its associated flow.

TRILL-OAM-MIB

```

|--trillOamNotifications          (trillOamMib 0}
  |--trillOamFaultAlarm
|--trillOamMibObjects            {trillOamMib 1}
  |--trillOamMep                 {trillOamMibObjects 1}
    |--trillOamMepTable          {trillOamMep 1} - Local TRLL config
    |--trillOamMepFlowCfgTable
    |--trillOamPtrTable
    |--trillOamMtvrTable
    |--trillOamMepDbTable

```

5.3.1. The Notifications Subtree

Notifications (fault alarms) are sent to the management entity with the OID of the MEP that has detected the fault. Notifications are generated whenever MEP loses/restores contact with its peer flow MEPs.

5.3.2. The Table Structures

The TRILL OAM MIB per MEP Objects are defined in the trillOamMepTable. The trillOamMepTable augments the dotlagCfmMepEntry (please see Section 6.1) defined in IEEE8021-CFM-MIB. It includes objects that are locally defined for an individual MEP and its associated flow.

5.3.2.1. trillOamMepTable Objects

This table is an extension of the dotlagCfmMepTable. Rows are automatically added or deleted from this table based upon row creation and destruction of the dotlagCfmMepTable.

This table represents the local MEP TRILL OAM configuration table. The primary purpose of this table is provide local parameters for the TRILL OAM function found in [RFC7455] and instantiated at a MEP.

5.3.2.2. trillOamMepFlowCfgTable Objects

Each row in this table represents a Flow Configuration Entry for the associated MEP. This table uses four indices. The first three indices are the indices of the Maintenance Domain, MANET, and MEP tables. The fourth index is the specific Flow Configuration Entry on the selected MEP. Some writable objects in this table are only applicable in certain cases (as described under each object below), and attempts to write values for them in other cases will be ignored.

5.3.2.3. trillOamPtrTable Objects

Each row in this table represents a Path Trace Reply Entry for the Defined MEP and Transaction. This table uses four indices. The first three indices identify the MEP and the fourth index specifies the Transaction Identifier. This Transaction Identifier uniquely identifies the response for a MEP, which can have multiple flows.

5.3.2.4. trillOamMtvrTable Objects

This table includes managed objects for the Multi-destination Reply. Each row in the table represents a Multi-destination Reply Entry for the defined MEP and Transaction. This table uses the following five indices: 1) Maintenance Domain, 2) MANET, 3) MEP tables, 4) Transaction Identifier of selected MEP, and 5) receive order of Multi-destination replies.

Some writable objects in this table are only applicable in certain cases (as described under each object below), and attempts to write a value for them in other cases will be ignored.

5.3.2.5. trillOamMepDbTable Objects

This table is an augmentation of the dotlagCfmMepDbTable, and rows are automatically added or deleted from this table based upon row creation and destruction of the dotlagCfmMepDbTable.

6. Relationship to Other MIB Modules

The IEEE8021-CFM-MIB [IEEE8021-CFM-MIB] and [LLDP-MIB] contain objects that are relevant to the TRILL OAM MIB. Management objects contained in these modules are not duplicated here, to reduce overlap to the extent possible. From the IEEE8021-CFM-MIB, the following objects are imported:

- o dotlagCfmMdIndex
- o dotlagCfmMaIndex

- o dotlagCfmMepIdentifier
- o dotlagCfmMepEntry
- o dotlagCfmMepDbEntry
- o DotlagCfmIngressActionFieldValue
- o DotlagCfmEgressActionFieldValue
- o DotlagCfmRemoteMepState

From the [LLDP-MIB], the following objects are imported:

- o LldpChassisId
- o LldpChassisIdSubtype
- o LldpPortId

6.1. Relationship to the IEEE8021-TC-MIB

In TRILL, traffic labeling can be done using either a 12-bit VLAN or a 24-bit Fine-Grained Label (FGL) [RFC7172].

The IEEE8021-TC-MIB definition of IEEE8021ServiceSelectorType includes the following two values:

- 1 representing a vlanId, and
- 2 representing a 24-bit isid

We have chosen to use value 2 for TRILL's FGL. As such, TRILL OAM MIB will import IEEE8021ServiceSelectorType, IEEE8021ServiceSelectorValueOrNone, and IEEE8021ServiceSelectorValue from IEEE8021-TC-MIB.

6.2. Relationship to the IEEE8021-CFM-MIB

trilloamMepTable augments dotlagCfmMepEntry. Implementation of IEEE8021-CFM-MIB is required as we are augmenting the IEEE-CFM-MIB Table. Objects/Tables that are not applicable to a TRILL implementation have to be handled by the TRILL implementation backend, and appropriate default values, as described in IEEE8021-CFM-MIB, have to be returned.

The TRILL OAM implementation doesn't support the Link Trace Message or Link Trace Reply, since, as described in RFC 7455, the Path Trace Message and Reply for unicast traffic and Multi-destination Tree verification Message and Reply for multicast traffic have been substituted for them. Statistics for these messages should default as per IEEE8021-CFM-MIB.

6.3. MIB Modules Required for IMPORTS

The following MIB module IMPORTS objects from SNMPv2-SMI [RFC2578], SNMPv2-TC [RFC2579], SNMPv2-CONF [RFC2580], IEEE-8021-CFM-MIB, and LLDP-MIB.

7. Definitions

```
TRILL-OAM-MIB DEFINITIONS ::= BEGIN
```

```
IMPORTS
```

```

MODULE-IDENTITY,
OBJECT-TYPE,
Counter32,
Unsigned32,
Integer32,
mib-2,
NOTIFICATION-TYPE
    FROM SNMPv2-SMI
RowStatus,
TruthValue,
TimeStamp,
MacAddress
    FROM SNMPv2-TC
OBJECT-GROUP,
NOTIFICATION-GROUP,
MODULE-COMPLIANCE
    FROM SNMPv2-CONF
dotlagCfmMdIndex,
dotlagCfmMaIndex,
dotlagCfmMepIdentifier,
dotlagCfmMepEntry,
dotlagCfmMepDbEntry,
DotlagCfmIngressActionFieldValue,
DotlagCfmEgressActionFieldValue,
DotlagCfmRemoteMepState
    FROM IEEE8021-CFM-MIB
LldpChassisId,
LldpChassisIdSubtype,
LldpPortId,
```


LldpPortIdSubtype
FROM LLDP-MIB;

trillOamMib MODULE-IDENTITY

LAST-UPDATED "201601141200Z"
ORGANIZATION "IETF TRILL WG"
CONTACT-INFO
"Email: trill@ietf.org"

DESCRIPTION

"This MIB module contains the management objects for the management of TRILL Services Operations, Administration and Maintenance.

Initial version. Published as RFC 7784.

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 Abbreviations Used

Term	Definition
CFM	Connectivity Fault Management
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
ITU-T	International Telecommunication Union - Telecommunication Standardization Bureau
FCOI	The Final, Cross-Connect Error, Out-of-band, and In-band flags from the TRILL OAM Application Identifier TLV.
LBM	Loopback Message
MA	Maintenance Association (equivalent to a MEG)
MAC	Media Access Control
MD	Maintenance Domain (equivalent to an OAM Domain in Metro Ethernet Forum (MEF) 17)
MEG	Maintenance Entity Group (equivalent to a MA)
MEG Level	Maintenance Entity Group Level (equivalent to MD Level)
MEP	Maintenance Association End Point
MIB	Management Information Base
MIP	Maintenance Domain Intermediate Point
MTVM	Multi-destination Tree Verification Message
MTVR	Multi-destination Tree Verification Reply
OAM	Operations, Administration, and Maintenance On-Demand OAM actions that are initiated via manual intervention for a limited time to carry out diagnostics. On-demand OAM can result in singular or periodic OAM actions during the diagnostic time interval.
PTM	Path Trace Message
PTR	Path Trace Reply
RFC	Request for Comments
SNMP	Simple Network Management Protocol
TLV	Type-Length-Value, a method of encoding Objects
TRILL	Transparent Interconnection of Lots of Links
VLAN	Virtual LAN"

REVISION "201601141200Z"

DESCRIPTION

"Initial version. Published as RFC 7784."

::= { mib-2 238 }

--

```

-- *****
-- Object Definitions in the TRILL OAM MIB Module
-- *****

trilloamNotifications OBJECT IDENTIFIER
    ::= { trilloamMib 0 }

trilloamMibObjects OBJECT IDENTIFIER
    ::= { trilloamMib 1 }

trilloamMibConformance OBJECT IDENTIFIER
    ::= { trilloamMib 2 }

-- *****
-- Groups in the TRILL OAM MIB Module
-- *****

trilloamMep OBJECT IDENTIFIER
    ::= { trilloamMibObjects 1 }

-- *****
-- TRILL OAM MEP Configuration
-- *****

trilloamMepTable OBJECT-TYPE
    SYNTAX          SEQUENCE OF TrilloamMepEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "This table is an extension of the dotlagCfmMepTable and
        rows are automatically added or deleted from this table
        based upon row creation and destruction of the
        dotlagCfmMepTable.

        This table represents the local MEP TRILL OAM
        configuration table.  The primary purpose of this table
        is provide local parameters for the TRILL OAM function
        found in RFC 7455 and instantiated at a MEP."
    REFERENCE "RFC 7455"
    ::= { trilloamMep 1 }

trilloamMepEntry OBJECT-TYPE
    SYNTAX          TrilloamMepEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "The conceptual row of trilloamMepTable."
    AUGMENTS        { dotlagCfmMepEntry }
    ::= { trilloamMepTable 1 }

```

```

TrilloamMepEntry ::= SEQUENCE {
    trilloamMepRName          Unsigned32,
    trilloamMepNextPtmTid    Counter32,
    trilloamMepNextMtvmtid   Counter32,
    trilloamMepPtrIn         Counter32,
    trilloamMepPtrInOutOfOrder Counter32,
    trilloamMepPtrOut        Counter32,
    trilloamMepMtvrIn        Counter32,
    trilloamMepMtvrInOutOfOrder Counter32,
    trilloamMepMtvrOut       Counter32,
    trilloamMepTxLbmDestRName Unsigned32,
    trilloamMepTxLbmHC       Unsigned32,
    trilloamMepTxLbmReplyModeOob TruthValue,
    trilloamMepTransmitLbmReplyIp OCTET STRING,
    trilloamMepTxLbmFlowEntropy OCTET STRING,
    trilloamMepTxPtmDestRName Unsigned32,
    trilloamMepTxPtmHC       Unsigned32,
    trilloamMepTxPtmReplyModeOob TruthValue,
    trilloamMepTransmitPtmReplyIp OCTET STRING,
    trilloamMepTxPtmFlowEntropy OCTET STRING,
    trilloamMepTxPtmStatus    TruthValue,
    trilloamMepTxPtmResultOK  TruthValue,
    trilloamMepTxPtmSeqNumber Unsigned32,
    trilloamMepTxPtmMessages  Integer32,
    trilloamMepTxMtvmtree    Unsigned32,
    trilloamMepTxMtvmtvcHC    Unsigned32,
    trilloamMepTxMtvmtvcReplyModeOob TruthValue,
    trilloamMepTransmitMtvmtvcReplyIp OCTET STRING,
    trilloamMepTxMtvmtvcFlowEntropy OCTET STRING,
    trilloamMepTxMtvmtvcStatus TruthValue,
    trilloamMepTxMtvmtvcResultOK TruthValue,
    trilloamMepTxMtvmtvcMessages Integer32,
    trilloamMepTxMtvmtvcSeqNumber Unsigned32,
    trilloamMepTxMtvmtvcScopeList OCTET STRING,
    trilloamMepDiscontinuityTime TimeStamp
}

```

```

trilloamMepRName OBJECT-TYPE
    SYNTAX      Unsigned32 (0..65471)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This object contains the RBridge Nickname field
        of the TRILL RBridge as defined in RFC 6325,
        Section 3.7."
    REFERENCE  "RFC 7455 and RFC 6325, Section 3.7"
    ::= { trilloamMepEntry 1 }

```

trillOamMepNextPtmTid OBJECT-TYPE

SYNTAX Counter32
MAX-ACCESS read-only
STATUS current

DESCRIPTION

"Next Sequence Number / Transaction Identifier to be sent in a Multi-destination message. This Sequence Number can be zero because it wraps around. Implementation of this identifier should be should provide a unique code value in order to identify the Transaction Identifier for a MEP with multiple flows."

REFERENCE "RFC 7455, Section 10.1.1"

::= { trillOamMepEntry 2 }

trillOamMepNextMtvmtid OBJECT-TYPE

SYNTAX Counter32
MAX-ACCESS read-only
STATUS current

DESCRIPTION

"Next Sequence Number / Transaction Identifier to be sent in a Multi-destination message. This Sequence Number can be zero because it wraps around. An implementation should be unique to identify Transaction Identifier for a MEP with multiple flows."

REFERENCE "RFC 7455, Section 11.2.1"

::= { trillOamMepEntry 3 }

trillOamMepPtrIn OBJECT-TYPE

SYNTAX Counter32
MAX-ACCESS read-only
STATUS current

DESCRIPTION

"Total number of valid, in-order Path Trace Replies received."

REFERENCE "RFC 7455, Section 10"

::= { trillOamMepEntry 4 }

trillOamMepPtrInOutOfOrder OBJECT-TYPE

SYNTAX Counter32
MAX-ACCESS read-only
STATUS current

DESCRIPTION

"Total number of valid, out-of-order Path Trace Replies received."

REFERENCE "RFC 7455, Section 10"

::= { trillOamMepEntry 5 }

```

trilloamMepPtrOut OBJECT-TYPE
    SYNTAX          Counter32
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "Total number of valid, Path Trace Replies
        transmitted."
    REFERENCE "RFC 7455, Section 10"
    ::= { trilloamMepEntry 6 }

trilloamMepMtvrIn OBJECT-TYPE
    SYNTAX          Counter32
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "Total number of valid, in-order Multi-destination
        Replies received."
    REFERENCE "RFC 7455, Section 11"
    ::= { trilloamMepEntry 7 }

trilloamMepMtvrInOutOfOrder OBJECT-TYPE
    SYNTAX          Counter32
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "Total number of valid, out-of-order Multi-destination
        Replies received."
    REFERENCE "RFC 7455, Section 11"
    ::= { trilloamMepEntry 8 }

trilloamMepMtvrOut OBJECT-TYPE
    SYNTAX          Counter32
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "Total number of valid, Multi-destination Replies
        transmitted."
    REFERENCE "RFC 7455, Section 11"
    ::= { trilloamMepEntry 9 }

trilloamMepTxLbmDestRName OBJECT-TYPE
    SYNTAX          Unsigned32 (0..65471)
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
        "The Target Destination RBridge Nickname field, as
        defined in RFC 6325, Section 3.7, to be transmitted."
    REFERENCE "RFC 7455 and RFC 6325, Section 3.7"

```

```
::= { trillOamMepEntry 10 }
```

```
trillOamMepTxLbmHC OBJECT-TYPE
    SYNTAX      Unsigned32(1..63)
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The Hop Count field to be transmitted."
    REFERENCE  "RFC 7455, Sections 3 and 9"
    ::= { trillOamMepEntry 11 }
```

```
trillOamMepTxLbmReplyModeOob OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "True indicates that the Reply to an LBM is out of
        band and the out-of-band IP Address TLV is to be
        transmitted. False indicates that in-band reply is
        transmitted."
    REFERENCE  "RFC 7455, Section 9.2.1"
    ::= { trillOamMepEntry 12 }
```

```
trillOamMepTransmitLbmReplyIp OBJECT-TYPE
    SYNTAX      OCTET STRING (SIZE (4..16))
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The IP address for an out-of-band IP Address TLV
        that is to be transmitted. Maximum length for IPv6
        is 16 octets and IPv4 is 4 octets."
    REFERENCE  "RFC 7455, Section 3"
    ::= { trillOamMepEntry 13 }
```

```
trillOamMepTxLbmFlowEntropy OBJECT-TYPE
    SYNTAX      OCTET STRING (SIZE (96))
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "96-byte Flow Entropy, as defined in RFC 7455, to
        be transmitted."
    REFERENCE  "RFC 7455, Section 3"
    ::= { trillOamMepEntry 14 }
```

```
trillOamMepTxPtmDestRName OBJECT-TYPE
    SYNTAX      Unsigned32 (0..65471)
    MAX-ACCESS  read-create
    STATUS      current
```

DESCRIPTION

"The Target Destination RBridge Nickname field,
as defined in RFC 6325, Section 3.7, to be transmitted."
REFERENCE "RFC 7455 and RFC 6325, Section 3.7"
::= { trilloamMepEntry 15 }

trilloamMepTxPtmHC OBJECT-TYPE

SYNTAX Unsigned32 (1..63)
MAX-ACCESS read-create
STATUS current
DESCRIPTION

"The Hop Count field to be transmitted."
REFERENCE "RFC 7455, Section 3"
::= { trilloamMepEntry 16 }

trilloamMepTxPtmReplyModeOob OBJECT-TYPE

SYNTAX TruthValue
MAX-ACCESS read-create
STATUS current
DESCRIPTION

"True indicates that a Reply to a PTM will be
out of band and the out-of-band IP Address TLV
is to be transmitted. False indicates that an
in-band reply is transmitted."
REFERENCE "RFC 7455, Section 10"
DEFVAL { false }
::= { trilloamMepEntry 17 }

trilloamMepTransmitPtmReplyIp OBJECT-TYPE

SYNTAX OCTET STRING (SIZE (4..16))
MAX-ACCESS read-create
STATUS current
DESCRIPTION

"The IP address for an out-of-band IP Address TLV
to be transmitted. The maximum length for an
IPv6 address is 16 octets. The maximum length
for an IPv4 address is 4 octets."
REFERENCE "RFC 7455, Sections 3 and 10"
::= { trilloamMepEntry 18 }

trilloamMepTxPtmFlowEntropy OBJECT-TYPE

SYNTAX OCTET STRING (SIZE (96))
MAX-ACCESS read-create
STATUS current
DESCRIPTION

"96-byte Flow Entropy, as defined in RFC 7455, to be
transmitted."
REFERENCE "RFC 7455, Section 3"


```
::= { trillOamMepEntry 19 }
```

```
trillOamMepTxPtmStatus OBJECT-TYPE
```

```
SYNTAX          TruthValue
MAX-ACCESS      read-create
STATUS          current
```

```
DESCRIPTION
```

"A Boolean flag set to TRUE by the MEP Path Trace Initiator State Machine or a MIB manager to indicate that another PTM is being transmitted. This is reset to FALSE by the MEP Initiator State Machine. The PTM managed objects in the MEP table are used in a manner similar to that described for LBM transmission in the dotlagCfmMepTable. As per RFC 7455, Section 10, operation of the Path Trace Message is identical to the Loopback message except that it is first transmitted with a TRILL Header Hop Count field value of 1 and then retransmitted with an incrementing Hop Count until a response is received from the destination RBridge, or the Hop Count reaches a configured maximum value. The trillOamMepTxPtmStatus status is reset to FALSE by the initiator when the last PTM is transmitted."

```
REFERENCE "RFC 7455, Section 10"
```

```
DEFVAL          { false }
```

```
::= { trillOamMepEntry 20 }
```

```
trillOamMepTxPtmResultOK OBJECT-TYPE
```

```
SYNTAX          TruthValue
MAX-ACCESS      read-create
STATUS          current
```

```
DESCRIPTION
```

"Indicates the following results of the operation:
- true indicates the Path Trace Message(s) will be (or has been) sent.
- false indicates the Path Trace Message(s) will not be sent."

```
REFERENCE "RFC 7455, Section 10"
```

```
DEFVAL          { true }
```

```
::= { trillOamMepEntry 21 }
```

```
trillOamMepTxPtmSeqNumber OBJECT-TYPE
```

```
SYNTAX          Unsigned32
MAX-ACCESS      read-create
STATUS          current
```

```
DESCRIPTION
```

"The Path Trace Transaction Identifier of the first PTM (to be) sent. The value returned is undefined if trillOamMepTxPtmResultOK is false."

```
REFERENCE "RFC 7455, Section 10"
```

```
::= { trillOamMepEntry 22 }
```

```
trillOamMepTxPtmMessages OBJECT-TYPE
```

```
SYNTAX Integer32 (1..1024)
```

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

```
STATUS current
```

```
DESCRIPTION
```

```
"The number of Path Trace messages to be transmitted.
```

```
As per RFC 7455, Section 10, the first Path Trace
Message is transmitted with a Hop Count of 1; an
RBridge may continue to retransmit the request at
periodic intervals with an incrementing Hop Count
until a response is received from the destination
RBridge or the Hop Count reaches a configured
maximum value. The event of the Destination
response being received or the Hop Count reaching
its maximum is treated as a single Counter
increment of this object."
```

```
REFERENCE "RFC 7455, Section 10"
```

```
::= { trillOamMepEntry 23 }
```

```
trillOamMepTxMtvMTree OBJECT-TYPE
```

```
SYNTAX Unsigned32
```

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

```
STATUS current
```

```
DESCRIPTION
```

```
"The Multi-destination Tree identifier, as
defined in RFC 6325, for an MTVM."
```

```
::= { trillOamMepEntry 24 }
```

```
trillOamMepTxMtvMHC OBJECT-TYPE
```

```
SYNTAX Unsigned32(1..63)
```

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

```
STATUS current
```

```
DESCRIPTION
```

```
"The Hop Count field to be transmitted.
"
```

```
REFERENCE "RFC 7455, Section 3, and RFC 6325, Section 3"
```

```
::= { trillOamMepEntry 25 }
```

```
trillOamMepTxMtvMReplyModeOob OBJECT-TYPE
```

```
SYNTAX TruthValue
```

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

```
STATUS current
```

```
DESCRIPTION
```

```
"True indicates that the reply to an MTVM is out of
band and this out-of-band IP Address TLV is where the
reply is to be transmitted."
```

False indicates that an in-band reply is transmitted."
 REFERENCE "RFC 7455, Section 11"
 ::= { trillOamMepEntry 26 }

trillOamMepTransmitMtvMReplyIp OBJECT-TYPE

SYNTAX OCTET STRING (SIZE (4..16))
 MAX-ACCESS read-create
 STATUS current

DESCRIPTION

"IP address for an out-of-band IP Address TLV that is to be transmitted. The maximum length for IPv6 is 16 octets and IPv4 is 4 octets."

REFERENCE "RFC 7455, Section 11"
 ::= { trillOamMepEntry 27 }

trillOamMepTxMtvMFlowEntropy OBJECT-TYPE

SYNTAX OCTET STRING (SIZE (96))
 MAX-ACCESS read-create
 STATUS current

DESCRIPTION

"96-byte Flow Entropy, as defined in RFC 7455, to be transmitted."

REFERENCE "RFC 7455, Section 3"
 ::= { trillOamMepEntry 28 }

trillOamMepTxMtvMStatus OBJECT-TYPE

SYNTAX TruthValue
 MAX-ACCESS read-create
 STATUS current

DESCRIPTION

"A Boolean flag set to TRUE by the MEP Multi-destination Initiator State Machine or a MIB manager to indicate that another MTVM is being transmitted. Reset to FALSE by the MEP Initiator State Machine. The MTVM-managed objects in the MEP table are used in a manner similar to that described for LBM transmission in the dotlagCfmMepTable. As per RFC 7455, Section 11, operation of the MTVM is identical to the Loopback message except that it is first transmitted with a TRILL Header Hop Count field value of 1 and it is retransmitted incrementing the Hop Count until a response is received from the destination RBridge or the Hop Count reaches a configured maximum value. The trillOamMepTxMtvMStatus Status is reset to FALSE by the initiator when the last MTVM is transmitted."

REFERENCE "RFC 7455, Section 11"
 DEFVAL { false }

```
::= { trillOamMepEntry 29 }
```

```
trillOamMepTxMtvMResultOK OBJECT-TYPE
```

```
SYNTAX          TruthValue
MAX-ACCESS      read-create
STATUS          current
```

```
DESCRIPTION
```

```
"Indicates the result of the operation in
the following way:
```

- true indicates the Multi-destination Message(s) will be (or has been) sent.
- false indicates the Multi-destination Message(s) will not be sent."

```
REFERENCE "RFC 7455, Section 11"
```

```
DEFVAL          { true }
```

```
::= { trillOamMepEntry 30 }
```

```
trillOamMepTxMtvMMessages OBJECT-TYPE
```

```
SYNTAX          Integer32 (1..1024)
MAX-ACCESS      read-create
STATUS          current
```

```
DESCRIPTION
```

```
"The number of Multi-destination messages to be transmitted.
The RBridge transmit the Multi-destination message
incrementing the session Identification Number at periodic
interval until this count expires."
```

```
REFERENCE "RFC 7455, Section 11"
```

```
::= { trillOamMepEntry 31 }
```

```
trillOamMepTxMtvMSeqNumber OBJECT-TYPE
```

```
SYNTAX          Unsigned32
MAX-ACCESS      read-create
STATUS          current
```

```
DESCRIPTION
```

```
"The Multi-destination Transaction Identifier of the
first MTVM (to be)
sent. The value returned is undefined if
trillOamMepTxMtvMResultOK is false."
```

```
REFERENCE "RFC 7455, Section 11"
```

```
::= { trillOamMepEntry 32 }
```

```
trillOamMepTxMtvMScopeList OBJECT-TYPE
```

```
SYNTAX          OCTET STRING
MAX-ACCESS      read-create
STATUS          current
```

```
DESCRIPTION
```

```
"The Multi-destination RBridge Scope list, which
requires 2 octets per RBridge."
```

REFERENCE "RFC 7455, Section 11"
 ::= { trillOamMepEntry 33 }

trillOamMepDiscontinuityTime OBJECT-TYPE

SYNTAX TimeStamp
 MAX-ACCESS read-only
 STATUS current

DESCRIPTION

"Snapshot of the value of the sysUpTime object at the beginning of the latest period of continuity of the statistical counters associated with this MEP."

::= { trillOamMepEntry 34 }

```
-- *****
-- TRILL OAM Tx Measurement Configuration Table
-- *****
```

trillOamMepFlowCfgTable OBJECT-TYPE

SYNTAX SEQUENCE OF TrillOamMepFlowCfgEntry
 MAX-ACCESS not-accessible
 STATUS current

DESCRIPTION

"This table includes configuration objects and operations for the TRILL OAM facilities in RFC 7455.

Each row in the table represents a Flow Configuration Entry for the defined MEP. This table uses four indices. The first three indices are the indices of the Maintenance Domain, MANET, and MEP tables. The fourth index is the specific Flow Configuration Entry on the selected MEP.

Some writable objects in this table are only applicable in certain cases (as described under each object), and attempts to write values for them in other cases will be ignored."

REFERENCE "RFC 7455"
 ::= { trillOamMep 2 }

trillOamMepFlowCfgEntry OBJECT-TYPE

SYNTAX TrillOamMepFlowCfgEntry
 MAX-ACCESS not-accessible
 STATUS current

DESCRIPTION

"The conceptual row of trillOamMepFlowCfgTable."

INDEX {
 dotlagCfmMdIndex,
 dotlagCfmMaIndex,
 dotlagCfmMepIdentifier,

```

        trillOamMepFlowCfgIndex
    }
 ::= { trillOamMepFlowCfgTable 1 }

TrillOamMepFlowCfgEntry ::= SEQUENCE {
    trillOamMepFlowCfgIndex      Unsigned32,
    trillOamMepFlowCfgFlowEntropy OCTET STRING,
    trillOamMepFlowCfgDestRName  Unsigned32,
    trillOamMepFlowCfgFlowHC     Unsigned32,
    trillOamMepFlowCfgRowStatus  RowStatus
}

trillOamMepFlowCfgIndex OBJECT-TYPE
    SYNTAX      Unsigned32 (1..65535)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "An index to the TRILL OAM MEP Flow Configuration table,
        which indicates the specific flow for the MEP.

        The index is never reused for other flow sessions on the
        same MEP while this session is active.  The index value
        keeps increasing until it wraps to 0.  This value can also be
        used in the flow-identifier TLV RFC 7455."
    REFERENCE  "RFC 7455"
 ::= { trillOamMepFlowCfgEntry 1 }

trillOamMepFlowCfgFlowEntropy OBJECT-TYPE
    SYNTAX      OCTET STRING (SIZE (96))
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This is 96 bytes of Flow Entropy as described in
        TRILL OAM, RFC 7455."
    REFERENCE  "RFC 7455, Section 3"
 ::= { trillOamMepFlowCfgEntry 2 }

trillOamMepFlowCfgDestRName OBJECT-TYPE
    SYNTAX      Unsigned32 (0..65471)
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The Target Destination RBridge Nickname field, as
        defined in RFC 6325, Section 3.7, to be transmitted."
    REFERENCE  "RFC 7455, Section 3, and RFC 6325, Section 3.7"
 ::= { trillOamMepFlowCfgEntry 3 }

```

```

trillOamMepFlowCfgFlowHC OBJECT-TYPE
    SYNTAX          Unsigned32 (1..63)
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
        "The Hop Count field to be transmitted."
    REFERENCE      "RFC 7455, Section 3, and RFC 6325, Section 3.6"
    ::= { trillOamMepFlowCfgEntry 4 }

trillOamMepFlowCfgRowStatus OBJECT-TYPE
    SYNTAX          RowStatus
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
        "The status of the row.

        The writable columns in a row cannot be changed if the row
        is active.  All columns MUST have a valid value before a row
        can be activated."
    ::= { trillOamMepFlowCfgEntry 5 }

-- *****
-- TRILL OAM Path Trace Reply Table
-- *****

trillOamPtrTable OBJECT-TYPE
    SYNTAX          SEQUENCE OF TrillOamPtrEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "This table includes Path Trace Reply objects and
        operations for the TRILL OAM facilities as described
        in RFC 7455.

        Each row in the table represents a Path Trace Reply Entry for
        the defined MEP and Transaction.  This table uses four
        indices.  The first three indices are the indices of the
        Maintenance Domain,
        MANET, and MEP tables.  The fourth index is the specific
        Transaction Identifier on the selected MEP.

        Some writable objects in this table are only applicable in
        certain cases (as described under each object),
        and attempts to
        write values for them in other cases will be ignored."
    REFERENCE      "RFC 7455"
    ::= { trillOamMep 3 }

```

```

trilloamPtrEntry OBJECT-TYPE
    SYNTAX      TrilloamPtrEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The conceptual row of trilloamPtrTable."
    INDEX       {
                dotlagCfmMdIndex,
                dotlagCfmMaIndex,
                dotlagCfmMepIdentifier,
                trilloamMepPtrTransactionId
                }
    ::= { trilloamPtrTable 1 }

TrilloamPtrEntry ::= SEQUENCE {
    trilloamMepPtrTransactionId      Unsigned32,
    trilloamMepPtrHC                 Unsigned32,
    trilloamMepPtrFlag               Unsigned32,
    trilloamMepPtrErrorCode           Unsigned32,
    trilloamMepPtrTerminalMep        TruthValue,
    trilloamMepPtrLastEgressId       Unsigned32,
    trilloamMepPtrIngress             DotlagCfmIngressActionFieldValue,
    trilloamMepPtrIngressMac          MacAddress,
    trilloamMepPtrIngressPortIdSubtype LldpPortIdSubtype,
    trilloamMepPtrIngressPortId      LldpPortId,
    trilloamMepPtrEgress             DotlagCfmEgressActionFieldValue,
    trilloamMepPtrEgressMac          MacAddress,
    trilloamMepPtrEgressPortIdSubtype LldpPortIdSubtype,
    trilloamMepPtrEgressPortId       LldpPortId,
    trilloamMepPtrChassisIdSubtype   LldpChassisIdSubtype,
    trilloamMepPtrChassisId          LldpChassisId,
    trilloamMepPtrOrganizationSpecificTlv OCTET STRING,
    trilloamMepPtrNextHopNicknames   OCTET STRING
}

trilloamMepPtrTransactionId OBJECT-TYPE
    SYNTAX      Unsigned32 (0..4294967295)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "Sequence Number / Transaction Identifier returned by a
        previous transmit path trace message command,
        indicating which PTM's response is going to be returned."
    REFERENCE   "RFC 7455, Section 10"
    ::= { trilloamPtrEntry 1 }

```



```

trillOamMepPtrHC OBJECT-TYPE
    SYNTAX      Unsigned32 (1..63)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Hop Count field value for a returned PTR."
    REFERENCE   "RFC 7455"
    ::= { trillOamPtrEntry 2 }

trillOamMepPtrFlag OBJECT-TYPE
    SYNTAX      Unsigned32 (0..15)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "FCOI (TRILL OAM Message TLV) field value for a
         returned PTR."
    REFERENCE   "RFC 7455, Section 8.4.3"
    ::= { trillOamPtrEntry 3 }

trillOamMepPtrErrorCode OBJECT-TYPE
    SYNTAX      Unsigned32 (0..65535)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Return Code and Return Sub-code value for a returned PTR."
    REFERENCE   "RFC 7455, Section 8.4.3"
    ::= { trillOamPtrEntry 4 }

trillOamMepPtrTerminalMep OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "A boolean value stating whether the forwarded PTM reached a
         MEP enclosing its MA, as returned in the Terminal MEP flag of
         the Flags field."
    REFERENCE   "RFC 7455"
    ::= { trillOamPtrEntry 5 }

trillOamMepPtrLastEgressId OBJECT-TYPE
    SYNTAX      Unsigned32 (0..65535)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "An Integer field holding the Last Egress Identifier returned
         in the PTR Upstream RBridge Nickname TLV of the PTR.
         The Last Egress Identifier identifies the Upstream Nickname."
    REFERENCE   "RFC 7455, Section 8.4.1"

```

```
::= { trillOamPtrEntry 6 }
```

```
trillOamMepPtrIngress OBJECT-TYPE
```

```
SYNTAX          DotlagCfmIngressActionFieldValue
```

```
MAX-ACCESS      read-only
```

```
STATUS          current
```

```
DESCRIPTION
```

```
"The value returned in the Ingress Action field of the PTR.
```

```
The value ingNoTlv(0) indicates that no Reply Ingress TLV was  
returned in the PTM."
```

```
REFERENCE       "RFC 7455, Section 8.4.1"
```

```
::= { trillOamPtrEntry 7 }
```

```
trillOamMepPtrIngressMac OBJECT-TYPE
```

```
SYNTAX          MacAddress
```

```
MAX-ACCESS      read-only
```

```
STATUS          current
```

```
DESCRIPTION
```

```
"MAC address returned in the ingress MAC address field."
```

```
REFERENCE       "RFC 7455, Section 8.4.1"
```

```
::= { trillOamPtrEntry 8 }
```

```
trillOamMepPtrIngressPortIdSubtype OBJECT-TYPE
```

```
SYNTAX          LldpPortIdSubtype
```

```
MAX-ACCESS      read-only
```

```
STATUS          current
```

```
DESCRIPTION
```

```
"Ingress Port ID. The format of this object is determined by  
the value of the trillOamMepPtrIngressPortIdSubtype object."
```

```
REFERENCE       "RFC 7455, Section 8.4.1"
```

```
::= { trillOamPtrEntry 9 }
```

```
trillOamMepPtrIngressPortId OBJECT-TYPE
```

```
SYNTAX          LldpPortId
```

```
MAX-ACCESS      read-only
```

```
STATUS          current
```

```
DESCRIPTION
```

```
"Ingress Port ID. The format of this object is determined by  
the value of the trillOamMepPtrIngressPortId object."
```

```
REFERENCE       "RFC 7455, Section 8.4.1"
```

```
::= { trillOamPtrEntry 10 }
```

```
trillOamMepPtrEgress OBJECT-TYPE
```

```
SYNTAX          DotlagCfmEgressActionFieldValue
```

```
MAX-ACCESS      read-only
```

```
STATUS          current
```

```
DESCRIPTION
```

```
"The value returned in the Egress Action field of the PTR."
```

The value ingNoTlv(0) indicates that no Reply Egress TLV was returned in the PTM."

REFERENCE "RFC 7455, Section 8.4.1"
 ::= { trillOamPtrEntry 11 }

trillOamMepPtrEgressMac OBJECT-TYPE

SYNTAX MacAddress
 MAX-ACCESS read-only
 STATUS current

DESCRIPTION

"MAC address returned in the egress MAC address field."

REFERENCE "RFC 7455, Section 8.4.1"
 ::= { trillOamPtrEntry 12 }

trillOamMepPtrEgressPortIdSubtype OBJECT-TYPE

SYNTAX LldpPortIdSubtype
 MAX-ACCESS read-only
 STATUS current

DESCRIPTION

"Egress Port ID. The format of this object is determined by the value of the trillOamMepPtrEgressPortIdSubtype object."

REFERENCE "RFC 7455, Section 8.4.1"
 ::= { trillOamPtrEntry 13 }

trillOamMepPtrEgressPortId OBJECT-TYPE

SYNTAX LldpPortId
 MAX-ACCESS read-only
 STATUS current

DESCRIPTION

"Egress Port ID. The format of this object is determined by the value of the trillOamMepPtrEgressPortId object."

REFERENCE "RFC 7455, Section 8.4.1"
 ::= { trillOamPtrEntry 14 }

trillOamMepPtrChassisIdSubtype OBJECT-TYPE

SYNTAX LldpChassisIdSubtype
 MAX-ACCESS read-only
 STATUS current

DESCRIPTION

"This object specifies the format of the Chassis ID returned in the Sender ID TLV of the PTR, if any. This value is meaningless if the trillOamMepPtrChassisId has a length of 0."

REFERENCE "RFC 7455, Section 8.4.1"
 ::= { trillOamPtrEntry 15 }

```

trillOamMepPtrChassisId OBJECT-TYPE
    SYNTAX          LldpChassisId
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "The Chassis ID returned in the Sender ID TLV of the PTR, if
        any. The format of this object is determined by the
        value of the trillOamMepPtrChassisIdSubtype object."
    REFERENCE       "RFC 7455, Section 8.4.1"
    ::= { trillOamPtrEntry 16 }

```

```

trillOamMepPtrOrganizationSpecificTlv OBJECT-TYPE
    SYNTAX          OCTET STRING (SIZE (0 | 4..1500))
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "All organization-specific TLVs returned in the PTR, if
        any. Includes all octets including and following the TLV
        Length field of each TLV, concatenated together."
    REFERENCE       "RFC 7455, Section 8.4.1"
    ::= { trillOamPtrEntry 17 }

```

```

trillOamMepPtrNextHopNicknames OBJECT-TYPE
    SYNTAX          OCTET STRING (SIZE (0 | 4..1500))
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "Next hop RBridge List TLV returned in the PTR, if
        any. Includes all octets including and following the TLV
        Length field of each TLV, concatenated together."
    REFERENCE       "RFC 7455, Section 8.4.1"
    ::= { trillOamPtrEntry 18 }

```

```

-- *****
-- TRILL OAM Multi-destination Reply Table
-- *****

```

```

trillOamMtvrTable OBJECT-TYPE
    SYNTAX          SEQUENCE OF TrillOamMtvrEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "This table includes Multi-destination Reply objects and
        operations for the TRILL OAM facilities described in
        RFC 7455.

        Each row in the table represents a Multi-destination Reply
        Entry for the defined MEP and Transaction. This table uses

```

five indices. The first three indices are the indices of the Maintenance Domain, MANET, and MEP tables. The fourth index is the specific Transaction Identifier on the selected MEP. The fifth index is the receive order of Multi-destination replies.

Some writable objects in this table are only applicable in certain cases (as described under each object), and attempts to write values for them in other cases will be ignored."

REFERENCE "RFC 7455"

::= { trillOamMep 4 }

```
trillOamMtvrEntry OBJECT-TYPE
    SYNTAX          TrillOamMtvrEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION     "The conceptual row of trillOamMtvrTable."
    INDEX           {
                    dotlagCfmMdIndex,
                    dotlagCfmMaIndex,
                    dotlagCfmMepIdentifier,
                    trillOamMepPtrTransactionId,
                    trillOamMepMtvrReceiveOrder
                    }
    ::= { trillOamMtvrTable 1 }
```

```
TrillOamMtvrEntry ::= SEQUENCE {
    trillOamMepMtvrTransactionId      Unsigned32,
    trillOamMepMtvrReceiveOrder       Unsigned32,
    trillOamMepMtvrFlag                Unsigned32,
    trillOamMepMtvrErrorCode           Unsigned32,
    trillOamMepMtvrLastEgressId       Unsigned32,
    trillOamMepMtvrIngress             DotlagCfmIngressActionFieldValue,
    trillOamMepMtvrIngressMac          MacAddress,
    trillOamMepMtvrIngressPortIdSubtype LldpPortIdSubtype,
    trillOamMepMtvrIngressPortId      LldpPortId,
    trillOamMepMtvrEgress             DotlagCfmEgressActionFieldValue,
    trillOamMepMtvrEgressMac           MacAddress,
    trillOamMepMtvrEgressPortIdSubtype LldpPortIdSubtype,
    trillOamMepMtvrEgressPortId       LldpPortId,
    trillOamMepMtvrChassisIdSubtype    LldpChassisIdSubtype,
    trillOamMepMtvrChassisId          LldpChassisId,
    trillOamMepMtvrOrganizationSpecificTlv OCTET STRING,
    trillOamMepMtvrNextHopNicknames   OCTET STRING,
    trillOamMepMtvrReceiverAvailability TruthValue,
    trillOamMepMtvrReceiverCount      TruthValue
}
```

```

trillOamMepMtvrTransactionId OBJECT-TYPE
    SYNTAX      Unsigned32 (0..4294967295)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "Sequence Number / Transaction Identifier returned by a
        previously transmitted Multi-destination message command
        indicating which MTVM's response is going to be returned."
    REFERENCE   "RFC 7455, Section 11"
    ::= { trillOamMtvrEntry 1 }

trillOamMepMtvrReceiveOrder OBJECT-TYPE
    SYNTAX      Unsigned32 (1..4294967295)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "An index to distinguish among multiple MTVRs with same MTVR
        Transaction Identifier field value.
        trillOamMepMtvrReceiveOrder is assigned sequentially from 1,
        in the order that the Multi-destination Tree Initiator
        received the MTVRs."
    REFERENCE   "RFC 7455, Section 11"
    ::= { trillOamMtvrEntry 2 }

trillOamMepMtvrFlag OBJECT-TYPE
    SYNTAX      Unsigned32 (0..15)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "FCOI (TRILL OAM Message TLV) field value for a
        returned MTVR."
    REFERENCE   "RFC 7455, Section 8.4.2"
    ::= { trillOamMtvrEntry 3 }

trillOamMepMtvrErrorCode OBJECT-TYPE
    SYNTAX      Unsigned32 (0..65535)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Return Code and Return Sub-code value for a returned MTVR."
    REFERENCE   "RFC 7455, Section 8.4.2"
    ::= { trillOamMtvrEntry 4 }

trillOamMepMtvrLastEgressId OBJECT-TYPE
    SYNTAX      Unsigned32 (0..65535)
    MAX-ACCESS  read-only
    STATUS      current

```

DESCRIPTION

"An Integer field holding the Last Egress Identifier returned in the MTRV Upstream RBridge Nickname TLV of the MTRV. The Last Egress Identifier identifies the Upstream Nickname."

REFERENCE "RFC 7455, Section 8.4.1"

::= { trilloamMtrvEntry 5 }

trilloamMepMtrvIngress OBJECT-TYPE

SYNTAX DotlagCfmIngressActionFieldValue

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The value returned in the Ingress Action field of the MTRV. The value ingNoTlv(0) indicates that no Reply Ingress TLV was returned in the MTRV."

REFERENCE "RFC 7455, Section 11.2.3"

::= { trilloamMtrvEntry 6 }

trilloamMepMtrvIngressMac OBJECT-TYPE

SYNTAX MacAddress

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"MAC address returned in the ingress MAC address field."

REFERENCE "RFC 7455, Section 8.4.1"

::= { trilloamMtrvEntry 7 }

trilloamMepMtrvIngressPortIdSubtype OBJECT-TYPE

SYNTAX LldpPortIdSubtype

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"Ingress Port ID. The format of this object is determined by the value of the trilloamMepMtrvIngressPortIdSubtype object."

REFERENCE "RFC 7455, Section 8.4.1"

::= { trilloamMtrvEntry 8 }

trilloamMepMtrvIngressPortId OBJECT-TYPE

SYNTAX LldpPortId

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"Ingress Port ID. The format of this object is determined by the value of the trilloamMepMtrvIngressPortId object."

REFERENCE "RFC 7455, Section 8.4.1"

::= { trilloamMtrvEntry 9 }

```

trillOamMepMtvrEgress OBJECT-TYPE
    SYNTAX          DotlagCfmEgressActionFieldValue
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "The value returned in the Egress Action field of the MTVR.
        The value ingNoTlv(0) indicates that no Reply Egress TLV was
        returned in the MTVR."
    REFERENCE      "RFC 7455, Section 8.4.1"
    ::= { trillOamMtvrEntry 10 }

trillOamMepMtvrEgressMac OBJECT-TYPE
    SYNTAX          MacAddress
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "MAC address returned in the egress MAC address field."
    REFERENCE      "RFC 7455, Section 8.4.1"
    ::= { trillOamMtvrEntry 11 }

trillOamMepMtvrEgressPortIdSubtype OBJECT-TYPE
    SYNTAX          LldpPortIdSubtype
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "Egress Port ID. The format of this object is determined by
        the value of the trillOamMepMtvrEgressPortIdSubtype object."
    REFERENCE      "RFC 7455, Section 8.4.1"
    ::= { trillOamMtvrEntry 12 }

trillOamMepMtvrEgressPortId OBJECT-TYPE
    SYNTAX          LldpPortId
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "Egress Port ID. The format of this object is determined by
        the value of the trillOamMepMtvrEgressPortId object."
    REFERENCE      "RFC 7455, Section 8.4.1"
    ::= { trillOamMtvrEntry 13 }

trillOamMepMtvrChassisIdSubtype OBJECT-TYPE
    SYNTAX          LldpChassisIdSubtype
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "This object specifies the format of the Chassis ID returned
        in the Sender ID TLV of the MTVR, if any. This value is
        meaningless if the trillOamMepMtvrChassisId has a

```


length of 0."

REFERENCE "RFC 7455, Section 8.4.1"
 ::= { trillOamMtvrEntry 14 }

trillOamMepMtvrChassisId OBJECT-TYPE

SYNTAX LldpChassisId
 MAX-ACCESS read-only
 STATUS current

DESCRIPTION

"The Chassis ID returned in the Sender ID TLV of the MTVR, if any. The format of this object is determined by the value of the trillOamMepMtvrChassisIdSubtype object."

REFERENCE "RFC 7455, Section 8.4.1"
 ::= { trillOamMtvrEntry 15 }

trillOamMepMtvrOrganizationSpecificTlv OBJECT-TYPE

SYNTAX OCTET STRING (SIZE (0 | 4..1500))
 MAX-ACCESS read-only
 STATUS current

DESCRIPTION

"All organization-specific TLVs returned in the MTVR, if any. Includes all octets including and following the TLV Length field of each TLV, concatenated together."

REFERENCE "RFC 7455, Section 8.4.1"
 ::= { trillOamMtvrEntry 16 }

trillOamMepMtvrNextHopNicknames OBJECT-TYPE

SYNTAX OCTET STRING (SIZE (0 | 4..1500))
 MAX-ACCESS read-only
 STATUS current

DESCRIPTION

"Next hop RBridge List TLV returned in the PTR, if any. Includes all octets including and following the TLV Length field of each TLV, concatenated together."

REFERENCE "RFC 7455, Section 8.4.3"
 ::= { trillOamMtvrEntry 17 }

trillOamMepMtvrReceiverAvailability OBJECT-TYPE

SYNTAX TruthValue
 MAX-ACCESS read-only
 STATUS current

DESCRIPTION

"A value of true indicates that the MTVR response contained Multicast receiver availability TLV."

REFERENCE "RFC 7455, Section 8.4.10"
 ::= { trillOamMtvrEntry 18 }

```

trillOamMepMtvrReceiverCount OBJECT-TYPE
    SYNTAX          TruthValue
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "Indicates the number of multicast receivers available on
        the responding RBridge on the VLAN specified by the
        diagnostic VLAN."
    REFERENCE       "RFC 7455, Section 8.4.10"
    ::= { trillOamMtvrEntry 19 }

-- *****
-- TRILL OAM MEP Database Table
-- *****

trillOamMepDbTable OBJECT-TYPE
    SYNTAX          SEQUENCE OF TrillOamMepDbEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "This table is an extension of the dotlagCfmMepDbTable
        and rows are automatically added to or deleted from
        this table based upon row creation and destruction of the
        dotlagCfmMepDbTable."
    REFERENCE       "RFC 7455"
    ::= { trillOamMep 5 }

trillOamMepDbEntry OBJECT-TYPE
    SYNTAX          TrillOamMepDbEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "The conceptual row of trillOamMepDbTable."
    AUGMENTS {
        dotlagCfmMepDbEntry
    }
    ::= { trillOamMepDbTable 1 }

TrillOamMepDbEntry ::= SEQUENCE {
    trillOamMepDbFlowIndex      Unsigned32,
    trillOamMepDbFlowEntropy    OCTET STRING,
    trillOamMepDbFlowState      DotlagCfmRemoteMepState,
    trillOamMepDbFlowFailedOkTime TimeStamp,
    trillOamMepDbRBridgeName    Unsigned32,
    trillOamMepDbLastGoodSeqNum Counter32
}

```

```

trilloamMepDbFlowIndex OBJECT-TYPE
    SYNTAX      Unsigned32 (1..65535)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "This object identifies the flow.  If the Flow Identifier TLV
         is received, then the index received can also be used."
    REFERENCE  "RFC 7455"
    ::= { trilloamMepDbEntry 1 }

trilloamMepDbFlowEntropy OBJECT-TYPE
    SYNTAX      OCTET STRING (SIZE (96))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "96 byte Flow Entropy."
    REFERENCE  "RFC 7455, Section 3"
    ::= { trilloamMepDbEntry 2 }

trilloamMepDbFlowState OBJECT-TYPE
    SYNTAX      DotlagCfmRemoteMepState
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The operational state of the remote MEP (flow-based)
         IFF State machines.  State Machine is running now per
         flow."
    REFERENCE  "RFC 7455"
    ::= { trilloamMepDbEntry 3 }

trilloamMepDbFlowFailedOkTime OBJECT-TYPE
    SYNTAX      TimeStamp
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The Time (sysUpTime) at which the Remote MEP flow state
         machine last entered either the RMEP_FAILED or RMEP_OK
         state."
    REFERENCE  "RFC 7455"
    ::= { trilloamMepDbEntry 4 }

trilloamMepDbRBridgeName OBJECT-TYPE
    SYNTAX      Unsigned32(0..65471)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Remote MEP RBridge Nickname."
    REFERENCE  "RFC 7455 and RFC 6325, Section 3"

```

```

 ::= { trillOamMepDbEntry 5 }

trillOamMepDbLastGoodSeqNum OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "Last Sequence Number received."
    REFERENCE   "RFC 7455, Section 13.1"
    ::= { trillOamMepDbEntry 6 }

-- *****
-- TRILL OAM MIB NOTIFICATIONS (TRAPS)
-- This notification is sent to management entity whenever a
-- MEP loses/restores
-- contact with its peer flow MEPs
-- *****
trillOamFaultAlarm NOTIFICATION-TYPE
    OBJECTS      { trillOamMepDbFlowState }
    STATUS      current
    DESCRIPTION
        "A MEP flow has a persistent defect condition.
        A notification (fault alarm) is sent to the management
        entity with the OID of the flow that has detected the fault.

        The management entity receiving the notification can identify
        the system from the network source address of the
        notification and can identify the flow reporting the defect
        by the indices in the OID of the trillOamMepFlowIndex and
        trillOamFlowDefect variable in the notification:

            dotlagCfmMdIndex - Also the index of the MEP's
                Maintenance Domain table entry
                (dotlagCfmMdTable).
            dotlagCfmMaIndex - Also an index (with the MD table index)
                of the MEP's Maintenance Association
                network table entry
                (dotlagCfmMaNetTable) and (with the MD
                table index and component ID) of the
                MEP's MA component table entry
                (dotlagCfmMaCompTable).
            dotlagCfmMepIdentifier - MEP Identifier and final index
                into the MEP table (dotlagCfmMepTable).
            trillOamMepFlowCfgIndex - Index identifies
                indicates the specific flow for
                the MEP"

    REFERENCE   "RFC 7455"
    ::= { trillOamNotifications 1 }

```

```

-- *****
-- TRILL OAM MIB Module - Conformance Information
-- *****

trilloamMibCompliances OBJECT IDENTIFIER
    ::= { trilloamMibConformance 1 }

trilloamMibGroups OBJECT IDENTIFIER
    ::= { trilloamMibConformance 2 }

-- *****
-- TRILL OAM MIB Units of Conformance
-- *****

trilloamMepMandatoryGroup OBJECT-GROUP
    OBJECTS
        {
            trilloamMepRName,
            trilloamMepNextPtmTid,
            trilloamMepNextMtmTid,
            trilloamMepPtrIn,
            trilloamMepPtrInOutOfOrder,
            trilloamMepPtrOut,
            trilloamMepMtvrIn,
            trilloamMepMtvrInOutOfOrder,
            trilloamMepMtvrOut,
            trilloamMepTxLbmDestRName,
            trilloamMepTxLbmHC,
            trilloamMepTxLbmReplyModeOob,
            trilloamMepTransmitLbmReplyIp,
            trilloamMepTxLbmFlowEntropy,
            trilloamMepTxPtmDestRName,
            trilloamMepTxPtmHC,
            trilloamMepTxPtmReplyModeOob,
            trilloamMepTransmitPtmReplyIp,
            trilloamMepTxPtmFlowEntropy,
            trilloamMepTxPtmStatus,
            trilloamMepTxPtmResultOK,
            trilloamMepTxPtmMessages,
            trilloamMepTxPtmSeqNumber,
            trilloamMepTxMtmTree,
            trilloamMepTxMtmHC,
            trilloamMepTxMtmReplyModeOob,
            trilloamMepTransmitMtmReplyIp,
            trilloamMepTxMtmFlowEntropy,
            trilloamMepTxMtmStatus,
            trilloamMepTxMtmResultOK,
            trilloamMepTxMtmMessages,
            trilloamMepTxMtmSeqNumber,
        }

```

```

        trillOamMepTxMtvMScopeList,
        trillOamMepDiscontinuityTime
    }
    STATUS          current
    DESCRIPTION
        "Mandatory objects for the TRILL OAM MEP group."
    ::= { trillOamMibGroups 1 }

trillOamMepFlowCfgTableGroup OBJECT-GROUP
    OBJECTS        {
        trillOamMepFlowCfgFlowEntropy,
        trillOamMepFlowCfgDestRName,
        trillOamMepFlowCfgFlowHC,
        trillOamMepFlowCfgRowStatus
    }
    STATUS          current
    DESCRIPTION
        "TRILL OAM MEP Flow Configuration objects group."
    ::= { trillOamMibGroups 2 }

trillOamPtrTableGroup OBJECT-GROUP
    OBJECTS        {
        trillOamMepPtrHC,
        trillOamMepPtrFlag,
        trillOamMepPtrErrorCode,
        trillOamMepPtrTerminalMep,
        trillOamMepPtrLastEgressId,
        trillOamMepPtrIngress,
        trillOamMepPtrIngressMac,
        trillOamMepPtrIngressPortIdSubtype,
        trillOamMepPtrIngressPortId,
        trillOamMepPtrEgress,
        trillOamMepPtrEgressMac,
        trillOamMepPtrEgressPortIdSubtype,
        trillOamMepPtrEgressPortId,
        trillOamMepPtrChassisIdSubtype,
        trillOamMepPtrChassisId,
        trillOamMepPtrOrganizationSpecificTlv,
        trillOamMepPtrNextHopNicknames
    }
    STATUS          current
    DESCRIPTION
        "TRILL OAM MEP PTR objects group."
    ::= { trillOamMibGroups 3 }

```

```

trilloamMtvrTableGroup OBJECT-GROUP
  OBJECTS      {
    trilloamMepMtvrFlag,
    trilloamMepMtvrErrorCode,
    trilloamMepMtvrLastEgressId,
    trilloamMepMtvrIngress,
    trilloamMepMtvrIngressMac,
    trilloamMepMtvrIngressPortIdSubtype,
    trilloamMepMtvrIngressPortId,
    trilloamMepMtvrEgress,
    trilloamMepMtvrEgressMac,
    trilloamMepMtvrEgressPortIdSubtype,
    trilloamMepMtvrEgressPortId,
    trilloamMepMtvrChassisIdSubtype,
    trilloamMepMtvrChassisId,
    trilloamMepMtvrOrganizationSpecificTlv,
    trilloamMepMtvrNextHopNicknames,
    trilloamMepMtvrReceiverAvailability,
    trilloamMepMtvrReceiverCount
  }
  STATUS      current
  DESCRIPTION
    "TRILL OAM MEP MTVR objects group."
 ::= { trilloamMibGroups 4 }

trilloamMepDbGroup OBJECT-GROUP
  OBJECTS      {
    trilloamMepDbFlowIndex,
    trilloamMepDbFlowEntropy,
    trilloamMepDbFlowState,
    trilloamMepDbFlowFailedOkTime,
    trilloamMepDbRBridgeName,
    trilloamMepDbLastGoodSeqNum
  }
  STATUS      current
  DESCRIPTION
    "TRILL OAM MEP DB objects group."
 ::= { trilloamMibGroups 5 }

trilloamNotificationGroup NOTIFICATION-GROUP
  NOTIFICATIONS { trilloamFaultAlarm }
  STATUS      current
  DESCRIPTION
    "A collection of objects describing notifications(traps)."
 ::= { trilloamMibGroups 6 }

```

```
-- *****
-- TRILL OAM MIB Module Compliance Statements
-- *****
```

```
trillOamMibCompliance MODULE-COMPLIANCE
```

```
STATUS current
```

```
DESCRIPTION
```

```
"The compliance statement for the TRILL OAM MIB."
```

```
MODULE -- this module
```

```
MANDATORY-GROUPS {
    trillOamMepMandatoryGroup,
    trillOamMepFlowCfgTableGroup,
    trillOamPtrTableGroup,
    trillOamMtvrTableGroup,
    trillOamMepDbGroup,
    trillOamNotificationGroup
}
```

```
::= { trillOamMibCompliances 1 }
```

```
-- Compliance requirement for read-only implementation.
```

```
trillOamMibReadOnlyCompliance MODULE-COMPLIANCE
```

```
STATUS current
```

```
DESCRIPTION
```

```
"Compliance requirement for implementations that only
provide read-only support for TRILL-OAM-MIB.
Such devices can be monitored but cannot be configured
using this MIB module."
```

```
MODULE -- this module
```

```
MANDATORY-GROUPS {
    trillOamMepMandatoryGroup,
    trillOamMepFlowCfgTableGroup,
    trillOamPtrTableGroup,
    trillOamMtvrTableGroup,
    trillOamMepDbGroup,
    trillOamNotificationGroup
}
```

```
-- trillOamMepTable
```

```
OBJECT trillOamMepTxLbmDestRName
```

```
MIN-ACCESS read-only
```

```
DESCRIPTION
```

```
"Write access is not required."
```

```
OBJECT trillOamMepTxLbmHC
```

```
MIN-ACCESS read-only
```

```
DESCRIPTION
```

```
"Write access is not required."
```


OBJECT trillOamMepTxLbmReplyModeOob
MIN-ACCESS read-only
DESCRIPTION
"Write access is not required."

OBJECT trillOamMepTransmitLbmReplyIp
MIN-ACCESS read-only
DESCRIPTION
"Write access is not required."

OBJECT trillOamMepTxLbmFlowEntropy
MIN-ACCESS read-only
DESCRIPTION
"Write access is not required."

OBJECT trillOamMepTxPtmDestRName
MIN-ACCESS read-only
DESCRIPTION
"Write access is not required."

OBJECT trillOamMepTxPtmHC
MIN-ACCESS read-only
DESCRIPTION
"Write access is not required."

OBJECT trillOamMepTxPtmReplyModeOob
MIN-ACCESS read-only
DESCRIPTION
"Write access is not required."

OBJECT trillOamMepTransmitPtmReplyIp
MIN-ACCESS read-only
DESCRIPTION
"Write access is not required."

OBJECT trillOamMepTxPtmFlowEntropy
MIN-ACCESS read-only
DESCRIPTION
"Write access is not required."

OBJECT trillOamMepTxPtmStatus
MIN-ACCESS read-only
DESCRIPTION
"Write access is not required."

OBJECT trillOamMepTxPtmResultOK
MIN-ACCESS read-only
DESCRIPTION
"Write access is not required."

OBJECT trillOamMepTxPtmMessages
MIN-ACCESS read-only
DESCRIPTION
"Write access is not required."

OBJECT trillOamMepTxPtmSeqNumber
MIN-ACCESS read-only
DESCRIPTION
"Write access is not required."

OBJECT trillOamMepTxMtvMTree
MIN-ACCESS read-only
DESCRIPTION
"Write access is not required."

OBJECT trillOamMepTxMtvMHC
MIN-ACCESS read-only
DESCRIPTION
"Write access is not required."

OBJECT trillOamMepTxMtvMReplyModeOob
MIN-ACCESS read-only
DESCRIPTION
"Write access is not required."

OBJECT trillOamMepTransmitMtvMReplyIp
MIN-ACCESS read-only
DESCRIPTION
"Write access is not required."

OBJECT trillOamMepTxMtvMFlowEntropy
MIN-ACCESS read-only
DESCRIPTION
"Write access is not required."

OBJECT trillOamMepTxMtvMStatus
MIN-ACCESS read-only
DESCRIPTION
"Write access is not required."

```
OBJECT trillOamMepTxMtvMResultOK
MIN-ACCESS read-only
DESCRIPTION
    "Write access is not required."
```

```
OBJECT trillOamMepTxMtvMMessages
MIN-ACCESS read-only
DESCRIPTION
    "Write access is not required."
```

```
OBJECT trillOamMepTxMtvMSeqNumber
MIN-ACCESS read-only
DESCRIPTION
    "Write access is not required."
```

```
OBJECT trillOamMepTxMtvMScopeList
MIN-ACCESS read-only
DESCRIPTION
    "Write access is not required."
```

```
-- trillOamMepFlowCfgTable
```

```
OBJECT trillOamMepFlowCfgFlowEntropy
MIN-ACCESS read-only
DESCRIPTION
    "Write access is not required."
```

```
OBJECT trillOamMepFlowCfgDestRName
MIN-ACCESS read-only
DESCRIPTION
    "Write access is not required."
```

```
OBJECT trillOamMepFlowCfgFlowHC
MIN-ACCESS read-only
DESCRIPTION
    "Write access is not required."
```

```
OBJECT trillOamMepFlowCfgRowStatus
MIN-ACCESS read-only
DESCRIPTION
    "Write access is not required."
```

```
::= { trillOamMibCompliances 2 }
```

```
END
```

8. Security Considerations

This MIB relates to a system that will provide network connectivity and packet-forwarding services. As such, improper manipulation of the objects represented by this MIB may result in denial of service to a large number of end users.

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

The following table and objects in the TRILL OAM MIB can be manipulated to interfere with the operation of RBridges by causing CPU use spikes:

- o trillOamMepTransmitLbmReplyIp allows the reply from a Loopback message to be transmitted to an IP address in the TLV, thus allowing replies to be sent to any system to cause denial of service.
- o trillOamMepTransmitPtmReplyIp allows the reply from a Path Trace message to be transmitted to an IP address in the TLV, thus allowing replies to be sent to any system to cause denial of service.
- o trillOamMepTxPtmMessages allows the generation of PTMs and can be used to generate lots of CPU-driven traffic.
- o trillOamMepTransmitMtvMReplyIp allows a from reply from an MTVM to be transmitted to an IP address in the TLV, thus allowing replies to be sent to any system to cause denial of service.
- o trillOamMepTxMtvMMessages allows the generation of MTVMs and can be used to generate lots of CPU-driven traffic.

The following objects in the TRILL OAM MIB are read-create and can be manipulated to interfere with the OAM operations of RBridges. If the number of OAM frames generated in the network is high, this can cause a CPU spike on destination RBridges if control-plane policing is not properly implemented or configured on destination RBridges.

- o trillOamMepTxLbmHC is used to set the Maximum Hop Count for the LBM. As OAM frames don't leak out of the TRILL network, it has no side effects.

- o `trillOamMepTxLbmReplyModeOob` is used to indicate whether the reply is in or out of band. This object's vulnerability is covered as part of `trillOamMepTransmitLbmReplyIp`.
- o `trillOamMepTxLbmFlowEntropy` is used to indicate the customer flow and find the exact path in the network. The creation of valid flows is its intended purpose. If invalid flows are created on vulnerable system, they will be dropped in forwarding.
- o `trillOamMepTxLbmDestRName` is read-create, but it's not vulnerable as invalid-name routes won't be present and will be rejected by the OAM application as part of normal processing.
- o `trillOamMepTxPtmHC` is used to set the Maximum Hop Count for the PTM. As OAM frames don't leak out of the TRILL network, it has no side effect.
- o `trillOamMepTxPtmReplyModeOob` is used to indicate whether the reply is in or out of band. This object's vulnerability is covered as part of `trillOamMepTransmitPtmReplyIp`.
- o `trillOamMepTxPtmFlowEntropy` is used to indicate the customer flow and find the exact path in the network. Creation of valid flows is its intended purpose. If invalid flows are created on vulnerable systems, they will be dropped in forwarding.
- o `trillOamMepTxPtmDestRName` is read-create, but it's not vulnerable as invalid-name routes won't be present and will be rejected by the OAM application as part of normal processing.
- o `trillOamMepTxPtmStatus` is required for normal PTM operation.
- o `trillOamMepTxPtmResultOK` is required for normal PTM operation.
- o `trillOamMepTxPtmSeqNumber` is required for normal PTM operation.
- o `trillOamMepTxPtmMessages` is required for normal PTM operation.
- o `trillOamMepTxMtvMTree` is required for normal MTVM operation.
- o `trillOamMepTxMtvMHC` is used to set the Maximum Hop Count for the MTVM. As OAM frames don't leak out of the TRILL network, it has no side effect
- o `trillOamMepTxMtvMReplyModeOob` is used to indicate whether the reply is in or out of band. This object's vulnerability is covered as part of `trillOamMepTransmitMtmReplyIp`

- o trillOamMepTxMtvMFlowEntropy is used to indicate the customer flow and find the exact path in the network. Creation of valid flows is its intended purpose. If invalid flows are created on vulnerable systems, they will be dropped in forwarding.
- o trillOamMepTxMtvMStatus is required for normal MTVM operation.
- o trillOamMepTxMtvMResultOK, trillOamMepTxMtvMMessages, trillOamMepTxMtvMSeqNumber, and trillOamMepTxMtvMScopeList are required for normal MTVM operation.

trillOamMepTransmitLbmReplyIp, trillOamMepTransmitPtmReplyIp, and trillOamMepTransmitMtvMReplyIp allow setting of the IP address to which reports are sent; thus, it can be used for denial of service for that IP.

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. For example, Path Trace messages expose the unicast topology of the network and Multi-destination Tree Verification Messages expose the multicast tree topology of the network. This information should not be available to all users of the network.

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.

Implementation 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 only those

principals (users) that have legitimate rights to indeed GET or SET (change/create/delete) them.

9. IANA Considerations

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

Descriptor	OBJECT IDENTIFIER	value
trillOamMIB	{ mib-2 238 }	

10. References

10.1. Normative References

- [802.1Q] IEEE, "IEEE Standard for Local and metropolitan area networks -- Media Access Control (MAC) Bridges and Virtual Bridge Local Area Networks", IEEE Std 802.1Q-2011, DOI 10.1109/IEEESTD.2011.6009146.
- [IEEE8021-CFM-MIB] IEEE, "Connectivity Fault Management module for managing IEEE 802.1ag", IEEE 802.1ag, October 2008, <<http://www.ieee802.org/1/files/public/MIBs/IEEE8021-CFM-MIB-200810150000Z.txt>>.
- [LLDP-MIB] IEEE, "Management Information Base module for LLDP configuration, statistics, local system data and remote systems data components", IEEE 802.1AB, May 2005, <<http://www.ieee802.org/1/files/public/MIBs/LLDP-MIB-200505060000Z.txt>>.
- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <<http://www.rfc-editor.org/info/rfc2119>>.
- [RFC2578] McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Structure of Management Information Version 2 (SMIV2)", STD 58, RFC 2578, DOI 10.17487/RFC2578, April 1999, <<http://www.rfc-editor.org/info/rfc2578>>.
- [RFC2579] McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Textual Conventions for SMIV2", STD 58, RFC 2579, DOI 10.17487/RFC2579, April 1999, <<http://www.rfc-editor.org/info/rfc2579>>.

- [RFC2580] McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Conformance Statements for SMIV2", STD 58, RFC 2580, DOI 10.17487/RFC2580, April 1999, <<http://www.rfc-editor.org/info/rfc2580>>.
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