

Internet Engineering Task Force (IETF)
Request for Comments: 7784
Category: Standards Track
ISSN: 2070-1721

D. Kumar
S. Salam
Cisco
T. Senevirathne
February 2016

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.

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Further information on Internet Standards is available in Section 2 of RFC 5741.

Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at <http://www.rfc-editor.org/info/rfc7784>.

Copyright Notice

Copyright (c) 2016 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	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 TRILL 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.

Copyright (c) 2016 IETF Trust and the persons identified as authors of the code. All rights reserved.

Redistribution and use in source and binary forms, with or without modification, is permitted pursuant to, and subject to the license terms contained in, the Simplified BSD License set forth in Section 4.c of the IETF Trust's Legal Provisions Relating to IETF Documents (<http://trustee.ietf.org/license-info>).

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,
    trilloamMepNextMtmTid           Counter32,
    trilloamMepPtrIn                 Counter32,
    trilloamMepPtrInOutOfOrder      Counter32,
    trilloamMepPtrOut                Counter32,
    trilloamMepMtmrIn                Counter32,
    trilloamMepMtmrInOutOfOrder     Counter32,
    trilloamMepMtmrOut               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,
    trilloamMepTxMtmTree             Unsigned32,
    trilloamMepTxMtmHC               Unsigned32,
    trilloamMepTxMtmReplyModeOob     TruthValue,
    trilloamMepTransmitMtmReplyIp    OCTET STRING,
    trilloamMepTxMtmFlowEntropy      OCTET STRING,
    trilloamMepTxMtmStatus           TruthValue,
    trilloamMepTxMtmResultOK         TruthValue,
    trilloamMepTxMtmMessages         Integer32,
    trilloamMepTxMtmSeqNumber        Unsigned32,
    trilloamMepTxMtmScopeList        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 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 }

trillOamMepNextMtmTid 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 }
```

```
trillOamMepTxMtmTree 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 }
```

```
trillOamMepTxMtmHC 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 }
```

```
trillOamMepTxMtmReplyModeOob 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"
::= { trillOamMtvEntry 14 }

trillOamMepMtvChassisId 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 trillOamMepMtvChassisIdSubtype object."
REFERENCE "RFC 7455, Section 8.4.1"
::= { trillOamMtvEntry 15 }

trillOamMepMtvOrganizationSpecificTlv 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"
::= { trillOamMtvEntry 16 }

trillOamMepMtvNextHopNicknames 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"
::= { trillOamMtvEntry 17 }

trillOamMepMtvReceiverAvailability 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"
::= { trillOamMtvEntry 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,
            trillOamMepMtmrIn,
            trillOamMepMtmrInOutOfOrder,
            trillOamMepMtmrOut,
            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 }

trillOamMepPtrTableGroup 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 }
```

```
trillOamMepMtvrTableGroup 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 trillOamMepTxMtmvResultOK
MIN-ACCESS read-only
DESCRIPTION
    "Write access is not required."

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

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

OBJECT trillOamMepTxMtmvScopeList
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 `trillOamMepTxMtmTree` is required for normal MTVM operation.
- o `trillOamMepTxMtmHC` 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 `trillOamMepTxMtmReplyModeOob` 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 SMIPv2", STD 58, RFC 2580, DOI 10.17487/RFC2580, April 1999, <<http://www.rfc-editor.org/info/rfc2580>>.
- [RFC3414] Blumenthal, U. and B. Wijnen, "User-based Security Model (USM) for version 3 of the Simple Network Management Protocol (SNMPv3)", STD 62, RFC 3414, DOI 10.17487/RFC3414, December 2002, <<http://www.rfc-editor.org/info/rfc3414>>.
- [RFC3826] Blumenthal, U., Maino, F., and K. McCloghrie, "The Advanced Encryption Standard (AES) Cipher Algorithm in the SNMP User-based Security Model", RFC 3826, DOI 10.17487/RFC3826, June 2004, <<http://www.rfc-editor.org/info/rfc3826>>.
- [RFC5591] Harrington, D. and W. Hardaker, "Transport Security Model for the Simple Network Management Protocol (SNMP)", STD 78, RFC 5591, DOI 10.17487/RFC5591, June 2009, <<http://www.rfc-editor.org/info/rfc5591>>.
- [RFC5592] Harrington, D., Salowey, J., and W. Hardaker, "Secure Shell Transport Model for the Simple Network Management Protocol (SNMP)", RFC 5592, DOI 10.17487/RFC5592, June 2009, <<http://www.rfc-editor.org/info/rfc5592>>.
- [RFC6325] Perlman, R., Eastlake 3rd, D., Dutt, D., Gai, S., and A. Ghanwani, "Routing Bridges (RBridges): Base Protocol Specification", RFC 6325, DOI 10.17487/RFC6325, July 2011, <<http://www.rfc-editor.org/info/rfc6325>>.
- [RFC6353] Hardaker, W., "Transport Layer Security (TLS) Transport Model for the Simple Network Management Protocol (SNMP)", STD 78, RFC 6353, DOI 10.17487/RFC6353, July 2011, <<http://www.rfc-editor.org/info/rfc6353>>.
- [RFC7172] Eastlake 3rd, D., Zhang, M., Agarwal, P., Perlman, R., and D. Dutt, "Transparent Interconnection of Lots of Links (TRILL): Fine-Grained Labeling", RFC 7172, DOI 10.17487/RFC7172, May 2014, <<http://www.rfc-editor.org/info/rfc7172>>.
- [RFC7455] Senevirathne, T., Finn, N., Salam, S., Kumar, D., Eastlake 3rd, D., Aldrin, S., and Y. Li, "Transparent Interconnection of Lots of Links (TRILL): Fault Management", RFC 7455, DOI 10.17487/RFC7455, March 2015, <<http://www.rfc-editor.org/info/rfc7455>>.

10.2. Informative References

- [Q.840.1] ITU-T, "Requirements and analysis for NMS-EMS management interface of Ethernet over Transport and Metro Ethernet Network (EoT/MEN)", Recommendation Q.840.1, March 2007.
- [RFC3410] Case, J., Mundy, R., Partain, D., and B. Stewart, "Introduction and Applicability Statements for Internet-Standard Management Framework", RFC 3410, DOI 10.17487/RFC3410, December 2002, <<http://www.rfc-editor.org/info/rfc3410>>.
- [RFC6905] Senevirathne, T., Bond, D., Aldrin, S., Li, Y., and R. Watve, "Requirements for Operations, Administration, and Maintenance (OAM) in Transparent Interconnection of Lots of Links (TRILL)", RFC 6905, DOI 10.17487/RFC6905, March 2013, <<http://www.rfc-editor.org/info/rfc6905>>.
- [RFC7174] Salam, S., Senevirathne, T., Aldrin, S., and D. Eastlake 3rd, "Transparent Interconnection of Lots of Links (TRILL) Operations, Administration, and Maintenance (OAM) Framework", RFC 7174, DOI 10.17487/RFC7174, May 2014, <<http://www.rfc-editor.org/info/rfc7174>>.

Acknowledgments

We wish to thank members of the IETF TRILL WG and the MIB Doctors for their comments and suggestions. Detailed comments were provided by Sam Aldrin, Donald Eastlake, Tom Taylor, and Harrie Hazewinkel.

Authors' Addresses

Deepak Kumar
Cisco
510 McCarthy Blvd.
Milpitas, CA 95035
United States

Phone : +1 408-853-9760
Email: dekumar@cisco.com

Samer Salam
Cisco
595 Burrard St.
Suite 2123
Vancouver, BC V7X 1J1
Canada

Email: ssalam@cisco.com

Tissa Senevirathne
Consultant

Email: tsenevir@gmail.com

