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.

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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 dot1agCfmMepEntry (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 dot1agCfmMepDbTable, and rows are automatically added or deleted from this table based upon row creation and destruction of the dot1agCfmMepDbTable.

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:

- dot1agCfmMdIndex
- dot1agCfmMaIndex
From the [LLDP-MIB], the following objects are imported:

- LldpChassisId
- LldpChassisIdSubtype
- 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
dot1agCfmMdIndex,
dot1agCfmMaIndex,
dot1agCfmMepIdentifier,
dot1agCfmMepEntry,
dot1agCfmMepDbEntry,
Dot1agCfmIngressActionFieldValue,
Dot1agCfmEgressActionFieldValue,
Dot1agCfmRemoteMepState
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

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFM</td>
<td>Connectivity Fault Management</td>
</tr>
<tr>
<td>IEEE</td>
<td>Institute of Electrical and Electronics Engineers</td>
</tr>
<tr>
<td>IETF</td>
<td>Internet Engineering Task Force</td>
</tr>
<tr>
<td>ITU-T</td>
<td>International Telecommunication Union - Telecommunication Standardization Bureau</td>
</tr>
<tr>
<td>FCOI</td>
<td>The Final, Cross-Connect Error, Out-of-band, and In-band flags from the TRILL OAM Application Identifier TLV.</td>
</tr>
<tr>
<td>LBM</td>
<td>Loopback Message</td>
</tr>
<tr>
<td>MA</td>
<td>Maintenance Association (equivalent to a MEG)</td>
</tr>
<tr>
<td>MAC</td>
<td>Media Access Control</td>
</tr>
<tr>
<td>MD</td>
<td>Maintenance Domain (equivalent to an OAM Domain in Metro Ethernet Forum (MEF) 17)</td>
</tr>
<tr>
<td>MEG</td>
<td>Maintenance Entity Group (equivalent to a MA)</td>
</tr>
<tr>
<td>MEG Level</td>
<td>Maintenance Entity Group Level (equivalent to MD Level)</td>
</tr>
<tr>
<td>MEP</td>
<td>Maintenance Association End Point</td>
</tr>
<tr>
<td>MIB</td>
<td>Management Information Base</td>
</tr>
<tr>
<td>MIP</td>
<td>Maintenance Domain Intermediate Point</td>
</tr>
<tr>
<td>MTVM</td>
<td>Multi-destination Tree Verification Message</td>
</tr>
<tr>
<td>MTVR</td>
<td>Multi-destination Tree Verification Reply</td>
</tr>
<tr>
<td>OAM</td>
<td>Operations, Administration, and Maintenance</td>
</tr>
<tr>
<td>PTM</td>
<td>Path Trace Message</td>
</tr>
<tr>
<td>PTR</td>
<td>Path Trace Reply</td>
</tr>
<tr>
<td>RFC</td>
<td>Request for Comments</td>
</tr>
<tr>
<td>SNMP</td>
<td>Simple Network Management Protocol</td>
</tr>
<tr>
<td>TLV</td>
<td>Type-Length-Value, a method of encoding Objects</td>
</tr>
<tr>
<td>TRILL</td>
<td>Transparent Interconnection of Lots of Links</td>
</tr>
<tr>
<td>VLAN</td>
<td>Virtual LAN&quot;</td>
</tr>
</tbody>
</table>

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,
  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,
  trillOamMepTxMtvmHC            Unsigned32,
  trillOamMepTxMtvmReplyModeOob  TruthValue,
  trillOamMepTransmitMtvmReplyIp OCTET STRING,
  trillOamMepTxMtvmFlowEntropy   OCTET STRING,
  trillOamMepTxMtvmStatus        TruthValue,
  trillOamMepTxMtvmResultOK      TruthValue,
  trillOamMepTxMtvmMessages      Integer32,
  trillOamMepTxMtvmSeqNumber     Unsigned32,
  trillOamMepTxMtvmScopeList     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"
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 19 }

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 20 }

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 }
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 29 }

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 30 }

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 31 }

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           {
    dot1agCfmMdIndex,
    dot1agCfmMaIndex,
    dot1agCfmMepIdentifier,
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 {
    dot1agCfmMdIndex,
    dot1agCfmMaIndex,
    dot1agCfmMepIdentifier,
    trillOamMepPtrTransactionId
}
::= { trillOamPtrTable 1 }

TrillOamPtrEntry ::= SEQUENCE {
    trillOamMepPtrTransactionId           Unsigned32,
    trillOamMepPtrHC                      Unsigned32,
    trillOamMepPtrFlag                    Unsigned32,
    trillOamMepPtrErrorCode               Unsigned32,
    trillOamMepPtrTerminalMep             TruthValue,
    trillOamMepPtrLastEgressId            Unsigned32,
    trillOamMepPtrIngress       Dot1agCfmIngressActionFieldValue,
    trillOamMepPtrIngressMac              MacAddress,
    trillOamMepPtrIngressPortIdSubtype    LldpPortIdSubtype,
    trillOamMepPtrIngressPortId           LldpPortId,
    trillOamMepPtrEgress        Dot1agCfmEgressActionFieldValue,
    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"
trillOamPtrIngress OBJECT-TYPE
  SYNTAX Dot1agCfmIngressActionFieldValue
  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 6 }

trillOamPtrIngressMac 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 7 }

trillOamPtrIngressPortIdSubtype 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 trillOamPtrIngressPortIdSubtype object."
  REFERENCE  "RFC 7455, Section 8.4.1"
::= { trillOamPtrEntry 8 }

trillOamPtrIngressPortId 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 trillOamPtrIngressPortId object."
  REFERENCE  "RFC 7455, Section 8.4.1"
::= { trillOamPtrEntry 9 }

trillOamPtrEgress OBJECT-TYPE
  SYNTAX Dot1agCfmEgressActionFieldValue
  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 }

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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
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.

```
::= { trillOamMep 4 }
```

```
trillOamMtvrEntry OBJECT-TYPE
SYNTAX TrillOamMtvrEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "The conceptual row of trillOamMtvrTable."
INDEX {
    dot1agCfmMdIndex,
    dot1agCfmMaIndex,
    dot1agCfmMepIdentifier,
    trillOamMepPtrTransactionId,
    trillOamMepMtvrReceiveOrder
}
 ::= { trillOamMtvrTable 1 }
```

```
TrillOamMtvrEntry ::= SEQUENCE {
    trillOamMepMtvrTransactionId           Unsigned32,
    trillOamMepMtvrReceiveOrder            Unsigned32,
    trillOamMepMtvrFlag                    Unsigned32,
    trillOamMepMtvrErrorCode               Unsigned32,
    trillOamMepMtvrLastEgressId            Unsigned32,
    trillOamMepMtvrIngress    Dot1agCfmIngressActionFieldValue,
    trillOamMepMtvrIngressMac              MacAddress,
    trillOamMepMtvrIngressPortIdSubtype    LldpPortIdSubtype,
    trillOamMepMtvrIngressPortId           LldpPortId,
    trillOamMepMtvrEgress     Dot1agCfmEgressActionFieldValue,
    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 MTVR Upstream NBridge Nickname TLV of the MTVR. The Last Egress Identifier identifies the Upstream Nickname."
REFERENCE "RFC 7455, Section 8.4.1"
::= { trillOamMtvrEntry 5 }

trillOamMepMtvrIngress OBJECT-TYPE
SYNTAX DotlagCfmIngressActionFieldValue
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The value returned in the Ingress Action field of the MTVR. The value ingNoTlv(0) indicates that no Reply Ingress TLV was returned in the MTVM."
REFERENCE "RFC 7455, Section 11.2.3"
::= { trillOamMtvrEntry 6 }

trillOamMepMtvrIngressMac 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"
::= { trillOamMtvrEntry 7 }

trillOamMepMtvrIngressPortIdSubtype 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 trillOamMepMtvrIngressPortIdSubtype object."
REFERENCE "RFC 7455, Section 8.4.1"
::= { trillOamMtvrEntry 8 }

trillOamMepMtvrIngressPortId 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 trillOamMepMtvrIngressPortId object."
REFERENCE "RFC 7455, Section 8.4.1"
::= { trillOamMtvrEntry 9 }
trillOamMepMtvrEgress OBJECT-TYPE  
SYNTAX Dot1agCfmEgressActionFieldValue  
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
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 14 }

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 15 }

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 16 }

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,  
    trillOamMepDbFlowFailed0kTime     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          Dot1agCfmRemoteMepState
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..65535)
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 the specific flow for the MEP"
REFERENCE       "RFC 7455"
::= { trillOamNotifications 1 }

Kumar, et al. Standards Track [Page 36]
-- 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,
         trillOamMepNextMtvmTId,
         trillOamMepPtrIn,
         trillOamMepPtrInOutofOrder,
         trillOamMepPtrOut,
         trillOamMepMtvrIn,
         trillOamMepMtvrInOutofOrder,
         trillOamMepMtvrOut,
         trillOamMepTxLbmDestRName,
         trillOamMepTxLbmHC,
         trillOamMepTxLbmReplyModeOob,
         trillOamMepTransmitLbmReplyIp,
         trillOamMepTxLbmFlowEntropy,
         trillOamMepTxPtmDestRName,
         trillOamMepTxPtmHC,
         trillOamMepTxPtmReplyModeOob,
         trillOamMepTransmitPtmReplyIp,
         trillOamMepTxPtmFlowEntropy,
         trillOamMepTxPtmStatus,
         trillOamMepTxPtmResultOK,
         trillOamMepTxPtmMessages,
         trillOamMepTxPtmSeqNumber,
         trillOamMepTxMtvmTree,
         trillOamMepTxMtvmHC,
         trillOamMepTxMtvmReplyModeOob,
         trillOamMepTransmitMtvmReplyIp,
         trillOamMepTxMtvmFlowEntropy,
         trillOamMepTxMtvmStatus,
         trillOamMepTxMtvmResultOK,
         trillOamMepTxMtvmMessages,
         trillOamMepTxMtvmSeqNumber,
      }
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 }
trillOamMtpvTableGroup OBJECT-GROUP
   OBJECTS
      {
         trillOamMtpvFlag,
         trillOamMtpvErrorCode,
         trillOamMtpvLastEgressId,
         trillOamMtpvIngress,
         trillOamMtpvIngressMac,
         trillOamMtpvIngressPortIdSubtype,
         trillOamMtpvIngressPortId,
         trillOamMtpvIngressEgress,
         trillOamMtpvIngressEgressMac,
         trillOamMtpvIngressEgressPortIdSubtype,
         trillOamMtpvEgressPortId,
         trillOamMtpvEgressChassisIdSubtype,
         trillOamMtpvEgressChassisId,
         trillOamMtpvEgressOrganizationSpecificTlv,
         trillOamMtpvEgressNextHopNicknames,
         trillOamMtpvEgressReceiverAvailability,
         trillOamMtpvEgressReceiverCount
      }
   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 }
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 }

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  trillOamMep TxPtmResultOK
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:

- 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.

- 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.

- trillOamMepTxPtmMessages allows the generation of PTMs and can be used to generate lots of CPU-driven traffic.

- 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.

- 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.

- 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.
- trillOamMepLbmReplyModeOob is used to indicate whether the reply is in or out of band. This object’s vulnerability is covered as part of trillOamMepTransmitLbmReplyIp.

- trillOamMepLbmFlowEntropy 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 systems, they will be dropped in forwarding.

- trillOamMepLbmDestRName 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.

- trillOamMepLbmHC 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.

- trillOamMepLbmReplyModeOob is used to indicate whether the reply is in or out of band. This object’s vulnerability is covered as part of trillOamMepTransmitLbmReplyIp.

- trillOamMepLbmFlowEntropy 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.

- trillOamMepLbmDestRName 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.

- trillOamMepLbmStatus is required for normal PTM operation.

- trillOamMepLbmResultOK is required for normal PTM operation.

- trillOamMepLbmSeqNumber is required for normal PTM operation.

- trillOamMepLbmMessages is required for normal PTM operation.

- trillOamMepLbmMtvmTree is required for normal MTVM operation.

- trillOamMepLbmMtvmHC 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.

- trillOamMepLbmMtvmReplyModeOob is used to indicate whether the reply is in or out of band. This object’s vulnerability is covered as part of trillOamMepTransmitMtmReplyIp
- `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.

- `trillOamMepTxMtvmStatus` is required for normal MTVM operation.

- `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:

<table>
<thead>
<tr>
<th>Descriptor</th>
<th>OBJECT IDENTIFIER value</th>
</tr>
</thead>
<tbody>
<tr>
<td>trillOamMIB</td>
<td>{ mib-2 238 }</td>
</tr>
</tbody>
</table>

10. References

10.1. Normative References


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10.2. Informative References


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.

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