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Deepak Kumar
T. Senevirathne
CISCO
T. Singh
JUNIPER
Qin Wu
Weiguo Hao
Huawei

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YANG Data Model for TRILL Operations, Administration, and Maintenance (OAM) Performance Management
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Abstract

This document presents YANG Data model for TRILL OAM PM[TRILL-PM]. It extends the YANG model defined in [GENYANGGOAM] and [TRILLOAMYANG] for TRILL OAM Performance management technology specifics.

Table of Contents

1. Introduction 3
2. Conventions used in this document 4
2.1. Terminology 4
3. Architecture of OAM YANG Model and Relationship to TRILL OAM PM 4
4. YANG Extension 5
4.1 MEP Address 5
4.1 MEP Configuration Extension 5
4.2 Flow Entropy 6
4.3 Context-id 6
4.4 Grouping Statements 6
4.5 RPC definition 6
4.5.1 create-loss-measurement 6
4.5.2 abort-loss-measurement 6
4.5.3 create-delay-measurement 7
4.4.4 abort-delay-measurement 7
5. TRILL PM data hierarchy 7
6. TRILL PM YANG module 13
7. Security Considerations 39
8. IANA Considerations 39
9. References 40
9.1. Normative References 40
9.2. Informative References 40
Authors' Addresses 40

1. Introduction

Fault Management for TRILL is defined in [TRILL-FM]. TRILL Fault Management utilizes the [8021Q] CFM model and extends CFM with technology specific details. Those technology specific extensions are flow-entropy for multipath support, MEP addressing on TRILL identifiers, and so on. The extensions are explained in detail in [TRILL-FM].

Performance Management for TRILL is defined in [TRILL-PM]. TRILL Performance Management utilizes the [Y.1731-2013/G.8013] and extends it with Loss Measurement and Delay measurement.

Generic OAM Yang model [GENYANGGOAM] presents Generic Yang data model for all OAM technologies.

In this document we extend the YANG model defined in [GENYANGGOAM] and [TRILLOAMYANG] for TRILL OAM Performance management. Details are provided in section 4 below.

2. Conventions used in this document

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

2.1. Terminology

ECMP - Equal Cost Multipath

MP - Maintenance Point [8021.Q]

MEP - Maintenance End Point [RFC7174] [8021Q] [RFC6371]

MIP - Maintenance Intermediate Point [RFC7174] [8021.Q] [RFC6371]

MA - Maintenance Association [8021.Q] [RFC7174]

MD - Maintenance Domain [8021.Q]

OAM - Operations, Administration, and Maintenance [RFC6291]

TRILL - Transparent Interconnection of Lots of Links [RFC6325]

DMM - Delay Measurement Message

1SL - One-way Synthetic Loss Measurement message

1DM - One-way Delay Measurement message

DMR - Delay Measurement Reply

OAM - Operations, Administration, and Maintenance

PM - Performance Monitoring

SLM - Synthetic Loss Measurement Message

SLR - Synthetic Loss Measurement Reply

TLV - Type, Length, and Value

3. Architecture of OAM YANG Model and Relationship to TRILL OAM PM

+-+-+-+-+-+

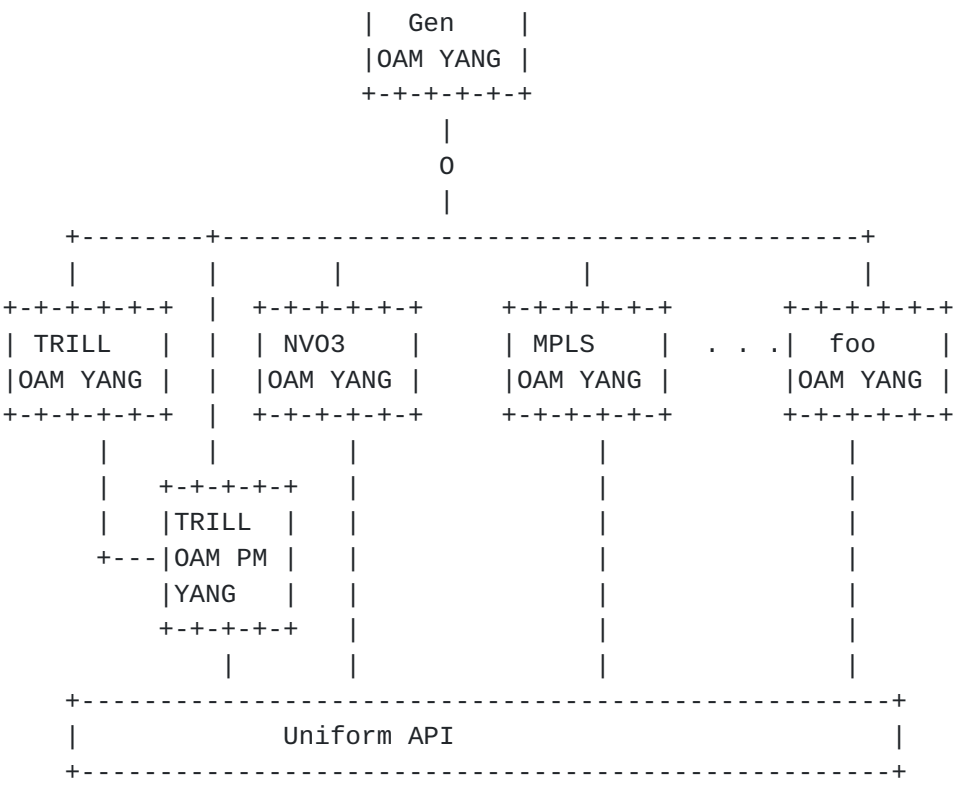

Figure 1 Relationship of TRILL OAM PM Yang model to Generic OAM YANG model

4. YANG Extension

MEP Addressing is defined in Generic OAM YANG model[GENYANGGOAM]. In this draft we augment MEP Configuration with Performance Management configuration and statistics for Delay Measurement and Performance Measurement.

For technology specific we are re-using identify defined in [TRILLOAMYANG] model.

```
identity trill {     base goam:technology-types;       description
     "trill type";   }
```

4.1 MEP Address

As defined in TRILL OAM Yang[TRILLOAMYANG] model. TRILL OAM Yang is referenced.

4.1 MEP Configuration Extension

module: trill-oam-pm

augment /goam:domains/goam:domain/goam:MAs/goam:MA/goam:MEP:

4.2 Flow Entropy

As defined in TRILL OAM Yang[TRILLOAMYANG] model.

4.3 Context-id

As defined in TRILL OAM Yang[TRILLOAMYANG] model.

4.4 Grouping Statements loss-measurement-configuration-group, groups configuration objects for Frame Loss Measurement function defined in [TRILL-PM].

loss-stats-group, groups statistics object for [TRILL-PM] Loss measurement section.

measurement-timing-group, groups object used for proactive and on-demand scheduling of PM measurement sessions.

delay-measurement-configuration-group, groups configuration objects for Delay measurement function defined in [TRILL-PM]

delay-measurement-stats-group, groups statistics objects for a TRILL Delay measurement sessions.

4.5 RPC definition

The rpc model facilitates issuing commands to a NETCONF server (in this case to the device that needs to execute the OAM command) and obtaining a response.

Grouping Statements loss-measurement-configuration-group, measurement-timing-group, and delay-measurement-configuration-group defines input extension for Delay and Loss measurement RPCs.

4.5.1 create-loss-measurement

RPC allows scheduling of one-way or two-way on-demand or proactive performance monitoring loss measurement session.

4.5.2 abort-loss-measurement

RPC allow aborting of currently running or scheduled loss measurement session.

4.5.3 create-delay-measurement

RPC allow scheduling of one-way or two-way on-demand or proactive performance monitoring delay measurement session.

4.4.4 abort-delay-measurement RPC allow aborting of currently running or scheduled delay measurement session.

5. TRILL PM data hierarchy The complete data hierarchy related to the OAM YANG is presented below. The following notations are used within the tree and carry the meaning as noted below. Each node is printed as:

```
  <status> <flags> <name> <opts> <type>

  <status> is one of:
       +  for current
       x  for deprecated
       o  for obsolete

     <flags> is one of:

       rw  for configuration data
       ro  for non-configuration data
       -x  for rpcs
       -n  for notifications


     <name> is the name of the node


      If the node is augmented into the tree from another module, its
   name is printed as <prefix>:<name>.


   <opts> is one of:

       ?  for an optional leaf or choice
       !  for a presence container
       *  for a leaf-list or list
       [<keys>] for a list's keys


   <type> is the name of the type for leafs and leaf-lists
```

```
module: trill-oam-pm
augment /goam:domains/goam:domain/goam:MAs/goam:MA/goam:MEP:
   +--rw delay-responder?   boolean
```

```
   augment /goam:domains/goam:domain/goam:MAs/goam:MA/goam:MEP:
      +--rw delay-measurements
         +--ro delay-measurements* [session-cookie]
         |  +--ro session-cookie    uint32
         |  +--ro id?               string
         |  +--ro status?           boolean
         +--rw measurement-type?                       enumeration
         +--rw measurement-enable?                     bits
         +--rw message-period?                         uint32
         +--rw frame-size?                             uint32
         +--rw data-pattern?                           enumeration
         +--rw measurement-interval?                   uint32
         +--rw number-intervals-stored?                uint32
         +--rw ifdv-selection-offset?                  uint32
         +--rw session-type?                           enumeration
         +--rw start-time
         |  +--rw (start-time)?
         |     +--:(immediate)
         |     |  +--rw immediate!
         |     +--:(absolute)
         |        +--rw absolute?    yang:date-and-time
         +--rw stop-time
         |  +--rw (stop-time)?
         |     +--:(none)
         |     |  +--rw none!
         |     +--:(absolute)
         |        +--rw absolute?   yang:date-and-time
         +--rw destination-mep
         |  +--rw (mp-address)?
         |  |  +--:(mac-address)
         |  |  |  +--rw mac-address?    yang:mac-address
         |  |  +--:(ipv4-address)
         |  |  |  +--rw ipv4-address?   inet:ipv4-address
         |  |  +--:(ipv6-address)
         |  |     +--rw ipv6-address?   inet:ipv6-address
         |  +--rw mep-id?         toam:tril-rb-nickname
         +--rw frame-delay-two-way?                    yang:gauge32
         +--rw frame-delay-forward?                    yang:gauge32
         +--rw frame-delay-backward?                   yang:gauge32
         +--rw inter-frame-delay-variation-two-way?    yang:gauge32
         +--rw inter-frame-delay-variation-forward?    yang:gauge32
         +--rw inter-frame-delay-variation-backward?   yang:gauge32
         +--rw current-stats
         |  +--rw start-time?                   yang:date-and-time
         |  +--rw elapsed-time?                              uint32
         |  +--rw suspect-status?                            boolean
         |  +--rw frame-delay-two-way-min?                   uint32
         |  +--rw frame-delay-two-way-max?                   uint32
```

```
         |  +--rw frame-delay-two-way-average?              uint32
         |  +--rw frame-delay-forward-min?                  uint32
         |  +--rw frame-delay-forward-average?              uint32
         |  +--rw frame-delay-forward-max?                  uint32
         |  +--rw frame-delay-backward-min?                 uint32
         |  +--rw frame-delay-backward-max?                 uint32
         |  +--rw frame-delay-backward-average?             uint32
         |  +--rw frame-delay-variation-backward-min?       uint32
         |  +--rw frame-delay-variation-backward-max?       uint32
         |  +--rw frame-delay-variation-backward-average?   uint32
         |  +--rw frame-delay-variation-forward-min?        uint32
         |  +--rw frame-delay-variation-forward-average?    uint32
         |  +--rw frame-delay-variation-forward-max?        uint32
         |  +--rw frame-delay-variation-two-way-min?        uint32
         |  +--rw frame-delay-variation-two-way-average?    uint32
         |  +--rw frame-delay-variation-two-way-max?        uint32
         +--rw history-stats* [id]
            +--rw id                                      uint32
            +--rw start-time?                  yang:date-and-time
            +--rw elapsed-time?                           uint32
            +--rw suspect-status?                         boolean
            +--rw frame-delay-two-way-min?                uint32
            +--rw frame-delay-two-way-max?                uint32
            +--rw frame-delay-two-way-average?            uint32
            +--rw frame-delay-forward-min?                uint32
            +--rw frame-delay-forward-average?            uint32
            +--rw frame-delay-forward-max?                uint32
            +--rw frame-delay-backward-min?               uint32
            +--rw frame-delay-backward-max?               uint32
            +--rw frame-delay-backward-average?           uint32
            +--rw frame-delay-variation-backward-min?     uint32
            +--rw frame-delay-variation-backward-max?     uint32
            +--rw frame-delay-variation-backward-average? uint32
            +--rw frame-delay-variation-forward-min?      uint32
            +--rw frame-delay-variation-forward-average?  uint32
            +--rw frame-delay-variation-forward-max?      uint32
            +--rw frame-delay-variation-two-way-min?      uint32
            +--rw frame-delay-variation-two-way-average?  uint32
            +--rw frame-delay-variation-two-way-max?      uint32
   augment /goam:domains/goam:domain/goam:MAs/goam:MA/goam:MEP:
      +--rw loss-measurements
         +--ro loss-measurements* [session-cookie]
         |  +--ro session-cookie    uint32
         |  +--ro id?               string
         |  +--ro status?           boolean
         +--rw measurement-type?           enumeration
         +--rw enabled-counters?           bits
         +--rw message-period?             uint32
```

```
         +--rw frame-size?                uint32
         +--rw data-pattern?              enumeration
         +--rw measurement-interval?      uint32
         +--rw number-intervals-stored?   uint32
         +--rw session-type?              enumeration
         +--rw start-time
         |  +--rw (start-time)?
         |     +--:(immediate)
         |     |  +--rw immediate!
         |     +--:(absolute)
         |        +--rw absolute?    yang:date-and-time
         +--rw stop-time
         |  +--rw (stop-time)?
         |     +--:(none)
         |     |  +--rw none!
         |     +--:(absolute)
         |        +--rw absolute?   yang:date-and-time
         +--rw destination-mep
         |  +--rw (mp-address)?
         |  |  +--:(mac-address)
         |  |  |  +--rw mac-address?    yang:mac-address
         |  |  +--:(ipv4-address)
         |  |  |  +--rw ipv4-address?   inet:ipv4-address
         |  |  +--:(ipv6-address)
         |  |     +--rw ipv6-address?   inet:ipv6-address
         |  +--rw mep-id?         toam:tril-rb-nickname
         +--rw measurement-forward-flr?    yang:gauge32
         +--rw measurement-backward-flr?   yang:gauge32
         +--rw current-stats
         |  +--rw start-time?               yang:date-and-time
         |  +--rw elapsed-time?                          uint32
         |  +--rw suspect-status?                        boolean
         |  +--rw backward-transmitted-frames?           yang:gauge32
         |  +--rw backward-received-frames?              yang:gauge32
         |  +--rw backward-min-frame-loss-ration?        uint32
         |  +--rw backward-max-frame-loss-ration?        uint32
         |  +--rw backward-average-frame-loss-ration?    uint32
         |  +--rw forward-transmitted-frames?            yang:gauge32
         |  +--rw forward-received-frames?               yang:gauge32
         |  +--rw forward-min-frame-loss-ration?         uint32
         |  +--rw forward-max-frame-loss-ration?         uint32
         |  +--rw forward-average-frame-loss-ration?     uint32
         +--rw history-stats* [id]
            +--rw id                                   uint32
            +--rw start-time?                yang:date-and-time
            +--rw elapsed-time?                        uint32
            +--rw suspect-status?                      boolean
            +--rw backward-transmitted-frames?         yang:gauge32
```

```
            +--rw backward-received-frames?             yang:gauge32
            +--rw backward-min-frame-loss-ration?       uint32
            +--rw backward-max-frame-loss-ration?       uint32
            +--rw backward-average-frame-loss-ration?   uint32
            +--rw forward-transmitted-frames?           yang:gauge32
            +--rw forward-received-frames?              yang:gauge32
            +--rw forward-min-frame-loss-ration?        uint32
            +--rw forward-max-frame-loss-ration?        uint32
            +--rw forward-average-frame-loss-ration?    uint32
   rpcs:
      +---x create-loss-measurement
      |  +--ro input
      |  |  +--ro measurement-type?          enumeration
      |  |  +--ro enabled-counters?          bits
      |  |  +--ro message-period?            uint32
      |  |  +--ro frame-size?                uint32
      |  |  +--ro data-pattern?              enumeration
      |  |  +--ro measurement-interval?      uint32
      |  |  +--ro number-intervals-stored?   uint32
      |  |  +--ro session-type?              enumeration
      |  |  +--ro start-time
      |  |  |  +--ro (start-time)?
      |  |  |     +--:(immediate)
      |  |  |     |  +--ro immediate!
      |  |  |     +--:(absolute)
      |  |  |        +--ro absolute?    yang:date-and-time
      |  |  +--ro stop-time
      |  |  |  +--ro (stop-time)?
      |  |  |     +--:(none)
      |  |  |     |  +--ro none!
      |  |  |     +--:(absolute)
      |  |  |        +--ro absolute?   yang:date-and-time
      |  |  +--ro destination-mep
      |  |  |  +--ro (mp-address)?
      |  |  |  |  +--:(mac-address)
      |  |  |  |  |  +--ro mac-address?    yang:mac-address
      |  |  |  |  +--:(ipv4-address)
      |  |  |  |  |  +--ro ipv4-address?   inet:ipv4-address
      |  |  |  |  +--:(ipv6-address)
      |  |  |  |     +--ro ipv6-address?   inet:ipv6-address
      |  |  |  +--ro mep-id?         toam:tril-rb-nickname
      |  |  +--ro flow-entropy?              toam:flow-entropy-trill
      |  |  +--ro context-type?              boolean
      |  |  +--ro context-id-vlan?           toam:vlan
      |  |  +--ro context-id-fgl?            toam:fgl
      |  +--ro output
      |     +--ro session-id    uint32
      +---x abort-loss-measurement
```

```
      |  +--ro input
      |     +--ro technology         identityref
      |     +--ro MD-name-string     MD-name-string
      |     +--ro MA-name-string?    MA-name-string
      |     +--ro destination-mep
      |     |  +--ro (mp-address)?
      |     |  |  +--:(mac-address)
      |     |  |  |  +--ro mac-address?    yang:mac-address
      |     |  |  +--:(ipv4-address)
      |     |  |  |  +--ro ipv4-address?   inet:ipv4-address
      |     |  |  +--:(ipv6-address)
      |     |  |     +--ro ipv6-address?   inet:ipv6-address
      |     |  +--ro mep-id?         toam:tril-rb-nickname
      |     +--ro session-id         uint32
      +---x create-delay-measurement
      |  +--ro input
      |  |  +--ro measurement-type?          enumeration
      |  |  +--ro measurement-enable?        bits
      |  |  +--ro message-period?            uint32
      |  |  +--ro frame-size?                uint32
      |  |  +--ro data-pattern?              enumeration
      |  |  +--ro measurement-interval?      uint32
      |  |  +--ro number-intervals-stored?   uint32
      |  |  +--ro ifdv-selection-offset?     uint32
      |  |  +--ro session-type?              enumeration
      |  |  +--ro start-time
      |  |  |  +--ro (start-time)?
      |  |  |     +--:(immediate)
      |  |  |     |  +--ro immediate!
      |  |  |     +--:(absolute)
      |  |  |        +--ro absolute?    yang:date-and-time
      |  |  +--ro stop-time
      |  |  |  +--ro (stop-time)?
      |  |  |     +--:(none)
      |  |  |     |  +--ro none!
      |  |  |     +--:(absolute)
      |  |  |        +--ro absolute?   yang:date-and-time
      |  |  +--ro destination-mep
      |  |  |  +--ro (mp-address)?
      |  |  |  |  +--:(mac-address)
      |  |  |  |  |  +--ro mac-address?    yang:mac-address
      |  |  |  |  +--:(ipv4-address)
      |  |  |  |  |  +--ro ipv4-address?   inet:ipv4-address
      |  |  |  |  +--:(ipv6-address)
      |  |  |  |     +--ro ipv6-address?   inet:ipv6-address
      |  |  |  +--ro mep-id?         toam:tril-rb-nickname
      |  |  +--ro flow-entropy?              toam:flow-entropy-trill
      |  |  +--ro context-type?              boolean
```

```
      |  |  +--ro context-id-vlan?          toam:vlan
      |  |  +--ro context-id-fgl?           toam:fgl
      |  +--ro output
      |     +--ro session-id    uint32
      +---x abort-delay-measurement
         +--ro input
            +--ro technology         identityref
            +--ro MD-name-string     MD-name-string
            +--ro MA-name-string?    MA-name-string
            +--ro destination-mep
            |  +--ro (mp-address)?
            |  |  +--:(mac-address)
            |  |  |  +--ro mac-address?    yang:mac-address
            |  |  +--:(ipv4-address)
            |  |  |  +--ro ipv4-address?   inet:ipv4-address
            |  |  +--:(ipv6-address)
            |  |     +--ro ipv6-address?   inet:ipv6-address
            |  +--ro mep-id?         toam:tril-rb-nickname
            +--ro context-type?      boolean
            +--ro context-id-vlan?   toam:vlan
            +--ro context-id-fgl?    toam:fgl
            +--ro session-id         uint32
```

6. TRILL PM YANG module

```
<CODE BEGINS> file "ietf-trill-oam-pm.yang"
   module ietf-trill-oam-pm {
        namespace "urn:ietf:params:xml:ns:yang:ietf-trill-oam-pm";
        prefix trilloampm;

        import ietf-gen-oam {
          prefix goam;
        }
        import ietf-trill-oam {
          prefix toam;
        }
        import ietf-yang-types {
          prefix yang;
        }
        organization "IETF TRILL Working Group";
        contact
          "Deepak Kumar dekumar@cisco.com";
        description
          "This YANG module defines the configuration for TRILL,
```

```
            OAM Performance Management statistics and rpc";

          revision 2015-01-11 {
            description
              "Initial revision.";
            reference "RFC 7456";
          }

          identity trill {
            base goam:technology-types;
            description
              "trill type";
          }

          grouping context-id-group {
             leaf context-type {
          type boolean;
             description
               "context Identifier";
          }
        description
          "If context-type is set then it's context-id-vlan, else
          it's context-id-fgl.";
             leaf context-id-vlan {
            type toam:vlan;
               description
                 "context Identifier vlan.";
          }
          leaf context-id-fgl {
             type toam:fgl;
                description
                  "context Identifier Fine Grain label.";
          }
          }

          grouping loss-measurement-configuration-group {
            description
              "This grouping includes configuration objects for Frame Loss
         Measurement function defined in TRILL-PM.";
            reference
               TRILL-PM;

          leaf measurement-type {
            type enumeration {
              enum slm {
                description
                  "TRILL PM SLM Frames generated and
                          received SLR responses
```

```
                    tracked.";
                }
                      enum 1sl {
                        description
                       "TRILL PM 1SL Frames generated.";
                        }
              }
              default slm;

              description
                "This object specifies what type of Loss Measurement will be
                 performed.";
              reference
                TRILL-PM;
            }

            leaf enabled-counters {
              type bits {
                bit forward-min-flr {
                   description
                     "Forward minimum Frame Loss Ratio.";
                   }
                bit forward-max-flr {
                   description
                     "Forward maximum Frame Loss Ratio.";
                   }
                bit forward-average-flr {
                   description
                     "Forward average Frame Loss Ratio.";
                   }
                bit backward-min-flr {
                   description
                     "Backward Minimum Frame Loss Ratio.";
                   }
                bit backward-max-flr {
                   description
                     "Backward Maximum Frame Loss Ratio.";
                   }
                bit backward-average-flr {
                   description
                      "Backward Average Frame Loss Ratio.";
                   }
                bit TRILL-PM-pdus-sent {
                   description
                      "TRILL PM Packets sent.";
                   }
                bit TRILL-PM-pdus-received {
                   description
```

```
                "TRILL PM Packets received.";
              }
          }
            default " ";

            description
              "A vector of bits that indicates the type of TRILL-PM loss
               measurement coutners found in the
               current-stats and history
               that are enabled.

               A present bit enables the specific counter. A not present
               bit disables the specific counter.

               Not all counters are supported for all
               TRILL-PM Loss Measurement types.";
        }

          leaf message-period {
          type uint32;
          default 1000;

          description
            "This objects specifies the interval between Loss
             Measurement OAM message transmission. Default value is
             1 sec.";
        }

          leaf frame-size {
          type uint32 {
            range "64 .. 9600";
          }
          default 64;
          description
            "This object specifies the Loss
                    Measurement OAM frame size.
             The adjustment of the frame size of the
                    standard frame size is
             accomplished by addition of a Data TLV
                    as mention in TRILL-PM.
             ";
        }

        leaf data-pattern {
          type enumeration {
            enum zeroes {
              description "Indicates the Data TLV contains all 0s.";
            }
```

```
            enum ones {
              description "Indicates the Data TLV contains all 1s.";
            }
          }
          default zeroes;

          description
            "This object specifies the LM data pattern included in OAM
             frame.";
        }

        leaf measurement-interval {
          type uint32;
          units minutes;
          default 15;

          description
            "This object specifies a Measurement Interval in minutes.";
        }

          leaf number-intervals-stored {
            type uint32 {
               range "2..10";
            }
            default 10;
            description
              "This object specifies the number of
               completed measurement
               intervals to store in the history statistics table.";
          }

        leaf session-type {
          type enumeration {
            enum proactive {
              description
                "The current session is 'proactive'.";
            }
            enum on-demand {
              description
                "The current session is on-demand.";
            }
          }
          description
            "This object indicates whether the current session is defined
             to be proactive or on-demand.";
        }
        }
```

```
            grouping loss-stats-group {
              description
                "This grouping includes statistics object for TRILL PM Loss
                 Measurement session.";
              leaf suspect-status {
             type boolean;
             description
               "if bit is set it means measurement
                       interval statistics is
                not valid.";
             }

              leaf backward-transmitted-frames {
                type yang:gauge32;

                description
                  "This object contains the number of
                   frames transmitted in the
                   backward direction by this session.
                   This is count of TRILL-PM SLM and 1SL frames.";
             }
              leaf backward-received-frames {
                type yang:gauge32;

                description
                  "This object contains the number of
                   frames received in the
                   backward direction by this session.
                   This is count of TRILL-PM SLM and 1SL frames.";
             }
              leaf backward-min-frame-loss-ration {
                 type uint32 {
                   range "0..100000";
                 }
                 units milli-percent;

                 description
                   "This object contains the minimum
                    one-way frame loss ratio
                    in the backward direction calculated by this
                    MEP for the session
                    in this Measurement Interval.
                    The FLR value is a ratio that
                    is expressed as a percent with a value 0
                    (ratio 0.00) through
                    100000 (ration 1.00)";
             }
              leaf backward-max-frame-loss-ration {
```

```
                type uint32 {
                  range "0..100000";
                }
                units milli-percent;

                description
                  "This object contains the maximum
                   one-way frame loss ratio
                   in the backward direction calculated by
                   this MEP for the session
                   in this Measurement Interval.
                   The FLR value is a ratio that
                   is expressed as a percent with a value 0
                   (ratio 0.00) through
                   100000 (ration 1.00)";
              }
              leaf backward-average-frame-loss-ration {
                type uint32 {
                  range "0..100000";
                }
                units milli-percent;

                description
                  "This object contains the average
                   one-way frame loss ratio
                   in the backward direction calculated
                   by this MEP for the session
                   in this Measurement Interval.
                   The FLR value is a ratio that
                   is expressed as a percent with a
                   value 0 (ratio 0.00) through
                   100000 (ration 1.00)";
              }

              leaf forward-transmitted-frames {
                type yang:gauge32;

                description
                  "This object contains the number of
                   frames transmitted in the
                   forward direction by this session.
                   This is count of TRILL-PM SLM and 1SL frames.";
              }
              leaf forward-received-frames {
                type yang:gauge32;

                description
                  "This object contains the number
```

```
                of frames received in the
                forward direction by this session.
                This is count of TRILL-PM SLM and 1SL frames.";
            }
            leaf forward-min-frame-loss-ration {
               type uint32 {
                 range "0..100000";
               }
               units milli-percent;

               description
                 "This object contains the minimum one-way
                  frame loss ratio
                  in the forward direction calculated by this MEP
                  for the session
                  in this Measurement Interval.
                  The FLR value is a ratio that
                  is expressed as a percent with a value
                  0 (ratio 0.00) through
                  100000 (ration 1.00)";
            }
            leaf forward-max-frame-loss-ration {
               type uint32 {
                 range "0..100000";
               }
               units milli-percent;

               description
                 "This object contains the maximum one-way
                  frame loss ratio
                  in the forward direction calculated by this MEP
                  for the session
                  in this Measurement Interval. The FLR value is
                  a ratio that
                  is expressed as a percent with a value
                  0 (ratio 0.00) through
                  100000 (ration 1.00)";
            }
            leaf forward-average-frame-loss-ration {
               type uint32 {
                 range "0..100000";
               }
               units milli-percent;

               description
                 "This object contains the average one-way
                  frame loss ratio
                  in the forward direction calculated by this
```

```
                MEP for the session
                in this Measurement Interval. The FLR value
                is a ratio that
                is expressed as a percent with a value
                0 (ratio 0.00) through
                100000 (ration 1.00)";
            }

          }

          grouping measurement-timing-group {
            description
              "This grouping includes objects used for
               proactive and on-demand
       scheduling of PM measurement sessions.";

      container start-time {
        description
        "This container defines the session start time.";

        choice start-time {
          description
            "Measurement sessions tart time can be immediate, relative, or
             absolute.";

          container immediate {
            presence "Start the measurement session immediately.";
               description
                 "Immediate start time.";
          }
          leaf absolute {
            type yang:date-and-time;

            description
              "This objects specifies the scheduled start time
               to perform the on-demand monitoring operations.";
          }
        }
      }

          container stop-time {
            description
              "This container defines the session stop time.";

            choice stop-time {
              description
                "Measurement session stop time can be none, or absolute.";
```

```
            container none {
              presence "Never end the measurement session.";
                 description
                   "None.";
            }

            leaf absolute {
               type yang:date-and-time;

               description
                 "This objects specifies the scheduled stop time
              to perform the on-demand monitoring operations.";
            }
          }
        }
        }

        grouping delay-measurement-configuration-group {
          description
            "This grouping includes configuration objects for Delay
       Measurement function defined in TRILL-PM.";
          reference
             "TRILL-PM.";

          leaf measurement-type {
            type enumeration {
            enum dmm {
              description
                "DMM PDU generated, DMR responses received.";
            }
            enum dm1-transmitted {
              description
                "1DM PDU generated.";
            }
            enum dm1-received {
              description
                "1DM PDU received and measurement generated.";
            }
          }
             description
               "Measurement type.";
          }

          leaf measurement-enable {
        type bits {
          bit toam-sent {
             description
               "Trill oam sent.";
```

```
            }
          bit toam-received {
            description
              "Trill oam received.";
            }
          bit frame-delay-two-way-min {
            description
              "Frame Delay Two Way Minimum.";
            }
          bit frame-delay-two-way-max {
            description
              "Frame Delay Two way Maximum.";
            }
          bit frame-delay-two-way-average {
            description
              "Frame Delay Two way Average.";
            }
          bit frame-delay-forward-min {
            description
              "Frame Delay Forward Minimum.";
            }
          bit frame-delay-forward-max {
            description
              "Frame Delay forward Maximum.";
            }
          bit frame-delay-forward-average {
            description
              "Frame Delay forward Average.";
            }
          bit frame-delay-backward-min {
            description
              "Frame Delay backward minimum.";
            }
          bit frame-delay-backward-max {
            description
              "Frame Delay backward maximum.";
            }
          bit frame-delay-backward-average {
            description
              "Frame Delay backward average.";
            }
          bit inter-frame-delay-variation-forward-min {
            description
              "Inter Frame Delay variation forward minimum.";
            }
          bit inter-frame-delay-variation-forward-max {
            description
              "Inter Frame delay variation forward maximum.";
```

```
            }
          bit inter-frame-delay-variation-forward-average {
            description
              "Inter Frame delay variation forward average.";
            }
          bit inter-frame-delay-variation-backward-min {
            description
              "Inter frame delay variation backward minimum.";
            }
          bit inter-frame-delay-variation-backward-max {
            description
              "Inter Frame Delay variation backward maximum.";
            }
          bit inter-frame-delay-variation-backward-average {
            description
              "Inter Frame delay variation backward average.";
            }
          bit inter-frame-delay-variation-two-way-min {
            description
              "Inter Frame delay variation two way minimum.";
            }
          bit inter-frame-delay-variation-two-way-max {
            description
              "Inter Frame delay variation two way maximum.";
            }
          bit inter-frame-delay-variation-two-way-average {
            description
              "Inter Frame delay variation Two way Average.";
            }
        }
        default " ";

        description
         "A vector of bits that indicates the type of DM counters
          that are enabled. A set bit enables the specific DM
          counter. A clear bit disables the specific DM counter.
          Not all DM counters are supported for all DM types.";
      }
        leaf message-period {
        type uint32;
        default 100;

        description
          "This objects specifies the interval between Delay
           Measurement OAM message transmission. Default value is
           100ms.";
      }
```

```
          leaf frame-size {
            type uint32 {
              range "64 .. 9600";
            }
            default 64;

            description
              "This object specifies the Delay Measurement OAM frame size.
               The adjustment of the frame size of the
                      standard frame size is
               accomplished by addition of a Data TLV as
                      mention in TRILL-PM.
               ";
          }

          leaf data-pattern {
            type enumeration {
              enum zeroes {
                description "Indicates the Data TLV contains all 0s.";
              }
              enum ones {
                description "Indicates the Data TLV contains all 1s.";
              }
            }
            default zeroes;

            description
              "This object specifies the DM data pattern included in OAM
               frame.";
          }

          leaf measurement-interval {
            type uint32;
            units minutes;
            default 15;

            description
              "This object specifies a Measurement Interval in minutes.";
          }

            leaf number-intervals-stored {
                type uint32 {
                   range "2..10";
                }
                default 10;
                description
                  "This object specifies the number of completed measurement
                   intervals to store in the history statistics table.";
```

```
          }

        leaf ifdv-selection-offset {
          type uint32 {
            range "1..10";
          }
          default 1;
          description
            "This object specifies the selection offset for Inter
           Frame Delay variation measurements. If this value is set
           to n, then the IFDV is calculated by taking the difference in
           frame delay between frame F and frame (F+n).";
         }

         leaf session-type {
            type enumeration {
              enum proactive {
                description
                    "The current session is 'proactive'.";
              }
              enum on-demand {
                description
                    "The current session is on-demand.";
              }
           }
           description
             "This object indicates whether the current session is defined
              to be proactive or on-demand.";
         }

         }

         grouping delay-measurement-stats-group {
           description
         "This grouping includes statistics objects for a TRILL PM
          Delay Measurement session.";

         leaf suspect-status {
           type boolean;
           description
             "if bit is set it means measurement interval statistics is
              not valid.";
         }

         leaf frame-delay-two-way-min {
           type uint32;
           units microseconds;
              description
```

```
            "Frame delay two way minimum.";
        }
        leaf frame-delay-two-way-max {
          type uint32;
          units microseconds;
             description
               "Frame delay two way maximum.";
        }

        leaf frame-delay-two-way-average {
          type uint32;
          units microseconds;
             description
               "Frame delay two way average.";
        }

        leaf frame-delay-forward-min {
          type uint32;
          units microseconds;
             description
               "Frame delay forward direction minimum.";
        }
        leaf frame-delay-forward-average {
          type uint32;
          units microseconds;
             description
               "Frame delay forward direction average.";
        }
        leaf frame-delay-forward-max {
          type uint32;
          units microseconds;
             description
               "Frame delay forward direction maximum.";
        }
        leaf frame-delay-backward-min {
          type uint32;
          units microseconds;
             description
               "Frame delay backward direction minimum.";
        }
        leaf frame-delay-backward-max {
          type uint32;
          units microseconds;
             description
               "Frame delay backward direction maximum.";
        }
        leaf frame-delay-backward-average {
          type uint32;
```

```
            units microseconds;
               description
                 "Frame delay backward direction average..";
            }
            leaf frame-delay-variation-backward-min {
              type uint32;
              units microseconds;
                 description
                   "Frame delay variation backward minimum.";
            }
            leaf frame-delay-variation-backward-max {
              type uint32;
              units microseconds;
                 description
                   "Frame delay variation backward maximum.";
            }
            leaf frame-delay-variation-backward-average {
              type uint32;
              units microseconds;
                 description
                   "Frame delay variation backward average.";
            }
            leaf frame-delay-variation-forward-min {
              type uint32;
              units microseconds;
                 description
                   "Frame delay variation forward minimum.";
            }
            leaf frame-delay-variation-forward-average {
              type uint32;
              units microseconds;
                 description
                   "Frame delay variation forward average.";
            }
            leaf frame-delay-variation-forward-max {
              type uint32;
              units microseconds;
                 description
                   "Frame delay variation forward maximum.";
            }
            leaf frame-delay-variation-two-way-min {
              type uint32;
              units microseconds;
                 description
                   "Frame delay variation two way minimum.";
            }
            leaf frame-delay-variation-two-way-average {
              type uint32;
```

```
  units microseconds;
     description
       "Frame delay variation two way average.";
}
leaf frame-delay-variation-two-way-max {
  type uint32;
  units microseconds;
     description
       "Frame delay variation two way maximum.";
}
}

augment "/goam:domains/goam:domain/goam:MAs/goam:MA/goam:MEP" {
  description
    "This set of data definitions extends the MEP as described
     in goam";

  leaf delay-responder {
     type boolean;
     default true;

     description
       "This object specifies whether Delay Measurement (DMM)
        single ended
        Responder is enabled.
        The value 'false' indicates the Delay measurement
        responder is disabled
        and received DMM will be discarded.";

   }
}
augment "/goam:domains/goam:domain/goam:MAs/goam:MA/goam:MEP" {
  description
    "This set of data definitions extends the MEP as described
     in goam, specially with regards to Delay Measurements.";

  container delay-measurements {
    description
"This container contains a collection of data definitions
 related to Delay Measurements as defined in TRILL-PM.";

 list delay-measurements {
   key "session-cookie";
   config false;
   description
     "List of Delay Measurement PM Sessions where each
      instance is uniquely identified by an session-cookie
      attribute.";
```

```
            leaf session-cookie {
                 type uint32;
                 config false;
              description
                "cookie to identify Delay Measurement session.";
            }

               leaf id {
              type string;

              description
                "This object uniquely identifies a scheduled measurement
                 time.";
            }

            leaf status {
              type boolean;
              config false;
              description
                "This object indicates DM session status, true means
                 Active, false means not-active.";
            }
          }

          uses delay-measurement-configuration-group;
                uses measurement-timing-group;
                container destination-mep {
             uses goam:mp-address;
             leaf mep-id {
               type toam:tril-rb-nickname;
                  description
                    "MEP Identifier.";
             }
                description
                  "Delay Measurement configuration group";
          }

                leaf frame-delay-two-way {
                  type yang:gauge32;
                  units microseconds;
                  description
                    "This object contains the frame delay
                     calculated by this MEP from the last
                     received TRILL-PM frame.
                     This object is undefined if
                     measurement-type is dm1.";
                }
```

```
                leaf frame-delay-forward {
                  type yang:gauge32;
                  units microseconds;
                  description
                    "This object contains the frame delay in the
                    forward direction
                     calculated by this MEP from the last received
                     TRILL-PM frame.
                     One way Delay require sufficiently precise clock
                     Synchronization.
                     This object is undefined if it's dm1-transmitted.";
                }
                leaf frame-delay-backward {
                  type yang:gauge32;
                  units microseconds;
                  description
                    "This object contains the frame delay in the
                     backward direction
                     calculated by this MEP from the last received
                     TRILL-PM frame.
                     One way Delay require sufficiently precise clock
                     Synchronization.
                     This object is undefined if it's dm1-transmitted or
                     dm1-received.";
                }
                leaf inter-frame-delay-variation-two-way {
                  type yang:gauge32;
                  units microseconds;

                  description
                    "This object contains the last two-way
                     inter-frame delay
                     interval calculated by this MEP.

                     The value of this object is undefined
                     when measurement-type
                     is dm1-transmitted or dm1-received.";
                }
                leaf inter-frame-delay-variation-forward {
                  type yang:gauge32;
                  units microseconds;

                  description
                    "This object contains the last one-way
                     inter-frame delay in
                     the forward direction calculated by this MEP.

                     The value of this object is undefined when
```

```
        measurement-type
        is dm1-transmitted.";
    }
    leaf inter-frame-delay-variation-backward {
      type yang:gauge32;
      units microseconds;

      description
        "This object contains the last one-way inter-frame
         delay in
         the backward direction calculated by this MEP.

         The value of this object is undefined when
         measurement-type
         is dm1-transmitted or dm-received.";
    }

    container current-stats {
      description
        "This container contains result of the
         current Measurement
         Interval in a TRILL-PM Delay measurement
         session gathered
         during the interval indicated by
         measurement-interval.";

      leaf start-time {
        type yang:date-and-time;

        description
          "Start time for current measurement interval.";
      }

      leaf elapsed-time {
        type uint32;

        description
          "Elapsed time for current measurement
           interval in 0.01
           seconds.";
      }
      uses delay-measurement-stats-group;
    }

    list history-stats {
      key id;

      description
```

```
                    "This list contains the result for
                     historic Measurement
                     Interval for TRILL-PM session.";

                leaf id {
                  type uint32;
                  description
                    "Identifier";
                }

                leaf start-time {
                  type yang:date-and-time;

                  description
                    "Start time for measurement interval.";
                }

                leaf elapsed-time {
                  type uint32;

                  description
                    "Elapsed time for measurement interval in 0.01
                     seconds.";
                }
                uses delay-measurement-stats-group;
              }
            }
          }

          augment "/goam:domains/goam:domain/goam:MAs/goam:MA/goam:MEP" {

            description
              "This set of data definitions extends the MEP as described
               in goam, specially with regards to Loss Measurements.";

            container loss-measurements {
              description
          "This container contains a collection of data definitions
           related to Loss Measurements as defined in TRILL-PM.";

           list loss-measurements {
             key "session-cookie";
             config false;
             description
               "List of Loss Measurement PM Sessions where each
                instance is uniquely identified by an session-cookie
                attribute.";
```

```
            leaf session-cookie {
                 type uint32;
                 config false;
              description
                "cookie to identify Loss Measurement session.";
            }

                  leaf id {
              type string;

              description
                "This object uniquely identifies a scheduled measurement
                 time.";
            }

            leaf status {
              type boolean;
              config false;
              description
                "This object indicates DM session status, true means
                 Active, false means not-active.";
            }
          }

          uses loss-measurement-configuration-group;
                uses measurement-timing-group;
                container destination-mep {
             uses goam:mp-address;
             leaf mep-id {
               type toam:tril-rb-nickname;
                  description
                    "Trill Rbridge Nickname MP address";
             }
                description
                  "Destination MEP";
             }
                leaf measurement-forward-flr {
                  type yang:gauge32 {
                    range "0..100000";
                  }
                  units milli-percent;

                  description
                    "This object contains the Frame loss Ratio in forward
                     direction.";
                }
                leaf measurement-backward-flr {
                  type yang:gauge32 {
```

```
        range "0..100000";
      }
      units milli-percent;

      description
        "This object contains the Frame loss Ratio
         in backward direction.";
    }
    container current-stats {
      description
        "This container contains result of the
         current Measurement
         Interval in a TRILL-PM Loss measurement
         session gathered
         during the interval indicated by
         measurement-interval.";

      leaf start-time {
        type yang:date-and-time;

        description
          "Start time for current measurement interval.";
      }

      leaf elapsed-time {
        type uint32;

        description
          "Elapsed time for current measurement
           interval in 0.01 seconds.";
      }
      uses loss-stats-group;
    }

    list history-stats {
      key id;

      description
         "This list contains the result for
          historic Measurement
          Interval for TRILL-PM session.";

      leaf id {
        type uint32;
        description
          "Identifier.";
      }
```

```
                leaf start-time {
                  type yang:date-and-time;

                  description
                    "Start time for measurement interval.";
                }

                leaf elapsed-time {
                  type uint32;

                  description
                    "Elapsed time for measurement interval in 0.01
                     seconds.";
                }
                uses loss-stats-group;
              }
            }
          }

          //RPCs related to TRILLOAM PM

          rpc create-loss-measurement {
            description
              "Schedule a one-way and two-way on-demand or proactive
               performance
               monitoring loss measurements on a specific MEP and Flow.

               A list entry associated with the newly created session
               will be
               created in the loss-measurements container and the assigned
               session identifier will be returned in the
               output parameter.";

            input {
              uses loss-measurement-configuration-group;
              uses measurement-timing-group;
              container destination-mep {
           uses goam:mp-address;
           leaf mep-id {
             type toam:tril-rb-nickname;
                description
                  "MEP Id.";
           }
              description
                "";
              }
        leaf flow-entropy {
                type toam:flow-entropy-trill;
```

```
            description
               "";
        }
          uses context-id-group;
        }
        output {
          leaf session-id {
            type uint32;
            mandatory true;

            description
              "The session identifier of the newly
               created loss measurement session.";
          }
        }

      } //end of rpc

      rpc abort-loss-measurement {
        description
          "Abort a currently running or scheduled
           single-ended on-demand TRILL
           PM function.";

        input {
           uses goam:maintenance-domain-id;
           uses goam:ma-identifier;
           container destination-mep {
        uses goam:mp-address;
        leaf mep-id {
          type toam:tril-rb-nickname;
             description
               "MEP Identifier.";
        }
           description
             "";
           }
           leaf session-id {
             type uint32;

             mandatory true;
             description
               "The session Id of the measurement session to
                be aborted.";
           }

        }
      } //end of RPC
```

```
            rpc create-delay-measurement {
              description
                "Schedule a one-way and two-way on-demand or proactive
                 performance
                 monitoring delay measurements on a specific MEP and Flow.

                 A list entry associated with the newly created session
                 will be created in the delay-measurements container
                 and the assigned
                 session identifier will be returned in the
                 output parameter.";

               input {
                 uses delay-measurement-configuration-group;
                 uses measurement-timing-group;
                 container destination-mep {
              uses goam:mp-address;
              leaf mep-id {
                type toam:tril-rb-nickname;
                   description
                     "MEP Identifier.";
              }
                 description
                   "Destination MEP.";
                 }
           leaf flow-entropy {
             type toam:flow-entropy-trill;
                description
                  "Flow Entropy";
           }
           uses context-id-group;
               }
               output {
                 leaf session-id {
                   type uint32;
                   mandatory true;

                   description
                     "The session identifier of the newly created
                      delay measurement session.";
                 }
               }

             } //end of rpc

             rpc abort-delay-measurement {
               description
                 "Abort a currently running or scheduled single-ended
```

```
                on-demand TRILL PM function.";

              input {
                 uses goam:maintenance-domain-id;
                 uses goam:ma-identifier;
                 container destination-mep {
              uses goam:mp-address;
              leaf mep-id {
                type toam:tril-rb-nickname;
                   description
                     "MEP Identifier.";
              }
                 description
                   "Destination MEP.";
                 }
           uses context-id-group;
                 leaf session-id {
                   type uint32;

                   mandatory true;
                   description
                     "The session Id of the measurement session to
                      be aborted.";
                 }

              }
            } //end of RP
       }
```

<CODE ENDS>

7. Security Considerations

There are no security considerations relevant to this document.

8. IANA Considerations

No actions are required from IANA as result of the publication of this document.

9. References

9.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[GENYANGGOAM] Senevirathne, T., et.al., "Generic YANG Data Model for Operations, Administration and Maintenance (OAM)", Work in Progress, October, 2014.

[TRILLOAMYANG] Senevirathne, T., et.al., "YANG Data Model for TRILL Operations, Administration, Maintenance(OAM)", Work in Progress, September, 2014.

9.2. Informative References

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Authors' Addresses

Tissa Senevirathne
CISCO Systems
375 East Tasman Drive.

San Jose, CA 95134
USA.

Phone: 408-853-2291
Email: tsenevir@gmail.com

Deepak Kumar
CISCO Systems
510 McCarthy Blvd
Milpitas, CA 95035.

Email: dekumar@cisco.com

Tapraj Singh
Juniper Networks
1194 N Mathilda Avenue
Sunnyvale, CA 94089

Email: tsingh@juniper.net

Qin Wu
Huawei
101 Software Avenue, Yuhua District
Nanjing, Jiangsu 210012

Email: bill.wu@huawei.com

Weiguo Hao
Huawei

Email: haoweiguo@huawei.com