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

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Abstract

This document presents YANG Data model for TRILL OAM. It extends the Generic YANG model for OAM defined in with TRILL technology specifics. Table of Contents.

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[1.](#) Introduction

Fault Management for TRILL is defined in [TRILLOAMFM]. 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 [TRILLOAMFM]. In this document, we extend the YANG model defined in [GENYANGOAM] with TRILL OAM specifics.

[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](#)]. In this document, these words will appear with that interpretation only when in ALL CAPS. Lower case uses of these words are not to be interpreted as carrying [RFC-2119](#) significance.

2.1. Terminology

CCM - Continuity Check Message [[8021Q](#)]
 ECMP - Equal Cost Multipath
 LBM - Loopback Message [[8021Q](#)]
 MP - Maintenance Point [[8021Q](#)]

MEP - Maintenance End Point [[RFC7174](#)] [[8021Q](#)] [[RFC6371](#)]
 MIP - Maintenance Intermediate Point [[RFC7174](#)] [[8021Q](#)] [[RFC6371](#)]
 MA - Maintenance Association [[8021Q](#)] [[RFC7174](#)]
 MD - Maintenance Domain [[8021Q](#)]
 MTV - Multi-destination Tree Verification Message
 OAM - Operations, Administration, and Maintenance [[RFC6291](#)]
 TRILL - Transparent Interconnection of Lots of Links [[RFC6325](#)]

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

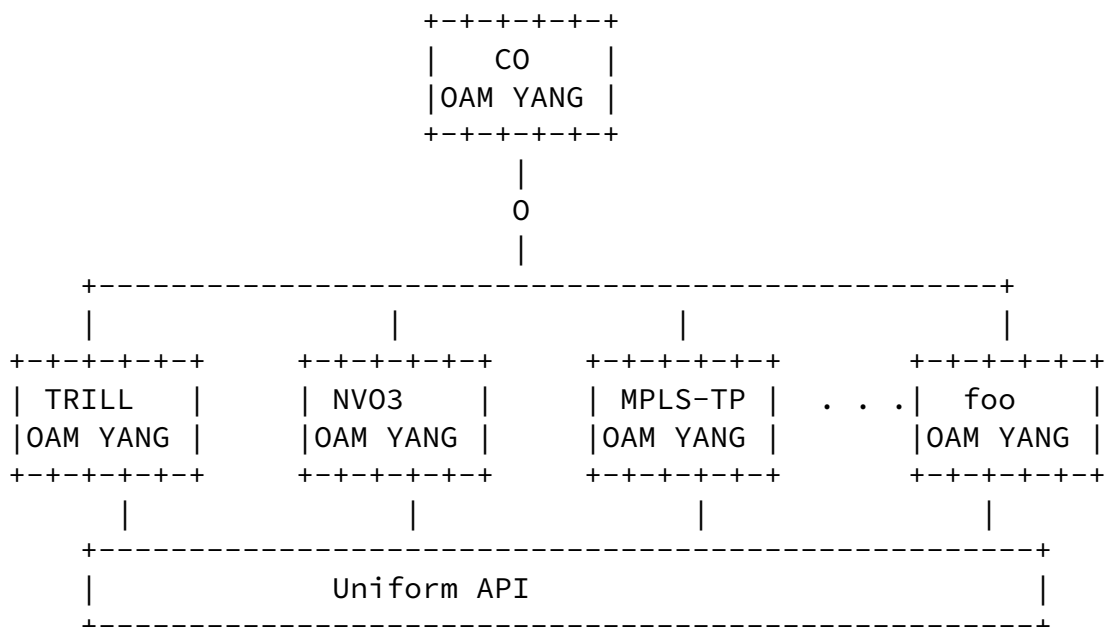


Figure 1 Relationship of TRILL OAM YANG model to
Generic Connection Oriented OAM YANG model

4. TRILL extensions to Generic YANG Model

The Technology parameter is defined in the [GENYANGOAM] as an identity. This allows easy extension of the YANG model by other technologies. Technology-specific extensions are applied only when the Technology parameter is set to the specific type. "trill" is defined as an identity that augments the base "technology-types".

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

Figure 2 Trill identity type.

4.1 MEP Address

In TRILL, the MEP address is the 2 octet RBridge Nickname. In [GENYANGOAM] MEP address is defined as a combination choice and case statement. We augment this to include TRILL RBridge nickname. augment
"/goam:domains/goam:domain/goam:MAS/goam:MA/goam:MEP/goam:mep-address" {
 case mep-address-trill {
 leaf mep-address-trill {
 when "/goam:domains/goam:domain/goam:technology='trill'";
 type tril-rb-nickname; } } } }

Figure 3 Augment MEP address

4.2 Flow Entropy

In TRILL, flow-entropy is defined as a 96 octet field. [GENYANGOAM] defines a placeholder for flow-entropy. This allows other technologies to easily augment that to include technology-specific augmentations. Below figure depicts an example of augmenting flow-entropy to include TRILL flow-entropy. augment
"/goam:domains/goam:domain/goam:MAS/goam:MA/goam:flow-entropy" {
 case flow-entropy-trill {
 leaf flow-entropy-trill {
 type

```
flow-entropy-trill;    }    }    }
```

Figure 4 TRILL flow-entropy

[4.3](#) Context-id

In TRILL, context-id is either 12 bit VLAN identifier or 24 bit fine-grained label. [GENYANGOAM] defines a placeholder for context-id. This allows other technologies to easily augment that to include technology specific extensions. The snippet below depicts an example of augmenting context-id to include the TRILL context-id.

```
augment
"/goam:domains/goam:domain/goam:MA/goam:MA/goam:MEP/goam:context-id"
{
  case context-id-vlan {
    leaf context-id-vlan {
      type
vlan;    }    }
  case context-id-fgl {
    leaf context-id-fgl {
      type fgl;    }    }
}
```

Figure 5 TRILL context-id

[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 statement command-ext-trill defines the input extensions for TRILL.

Continuity-check (CCM) [RFC7455], continuity-verification (LBM/LBR) [RFC7455], and traceroute (PTM/PTR) [RFC7455] are defined in Generic Lime Model [GENYANGOAM].

Multicast Tree Verification (MTV) [RFC7455] rpc command, defined in TRILL YANG model, is TRILL specific and allows to verify connectivity as well as data-plane and control-plane integrity of TRILL multicast forwarding.

[5.](#) OAM data hierarchy

The complete data hierarchy related to the OAM YANG model is presented below. The following notations are used within the data 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: ietf-trill-oam
augment /goam:domains/goam:domain/goam:MAS/goam:MA/goam:MEP/goam:mep-address
  +--:(mep-address-trill)
    +--rw mep-address-trill?   trill-rb-nickname
augment /goam:domains/goam:domain/goam:MAS/goam:MA/goam:connectivity-context
  +--:(connectivity-context-vlan)
    | +--rw connectivity-context-vlan?   vlan
  +--:(connectivity-context-fgl)
    +--rw connectivity-context-fgl?     fgl
augment /goam:domains/goam:domain/goam:MAS/goam:MA:
  +--rw flow-entropy-trill?   flow-entropy-trill
augment /goam:domains/goam:domain/goam:MAS/goam:MA/goam:MEP:
  +--rw flow-entropy-trill?   flow-entropy-trill
augment /goam:domains/goam:domain/goam:MAS/goam:MA/goam:MEP/goam:session:
```

```
  +--rw flow-entropy-trill?   flow-entropy-trill
augment /goam:continuity-check/goam:input:
  +---- (out-of-band)?
    | +--:(ipv4-address)
    | | +---- ipv4-address?     inet:ipv4-address
    | +--:(ipv6-address)
    | | +---- ipv6-address?     inet:ipv6-address
    | +--:(trill-nickname)
```

```

    | +---- trill-nickname?    tril-rb-nickname
+---- diagnostic-vlan?    boolean
augment /goam:continuity-check/goam:input:
+---- flow-entropy-trill?  flow-entropy-trill
augment /goam:continuity-check/goam:output:
+---- upstream-rbridge?    tril-rb-nickname
+---- next-hop-rbridge*    tril-rb-nickname
augment /goam:continuity-verification/goam:input:
+---- (out-of-band)?
| +--:(ipv4-address)
| | +---- ipv4-address?      inet:ipv4-address
| +--:(ipv6-address)
| | +---- ipv6-address?      inet:ipv6-address
| +--:(trill-nickname)
|   +---- trill-nickname?    tril-rb-nickname
+---- diagnostic-vlan?    boolean
augment /goam:continuity-verification/goam:input:
+---- flow-entropy-trill?  flow-entropy-trill
augment /goam:continuity-verification/goam:output:
+--:(monitor-stats-resp)
| +---- tx-packet-count?     oam-counter32
| +---- rx-packet-count?     oam-counter32
| +---- min-delay?           oam-counter32
| +---- average-delay?       oam-counter32
| +---- max-delay?           oam-counter32
+---- upstream-rbridge?     tril-rb-nickname
+---- next-hop-rbridge*     tril-rb-nickname
augment /goam:traceroute/goam:input:
+---- (out-of-band)?
| +--:(ipv4-address)
| | +---- ipv4-address?      inet:ipv4-address
| +--:(ipv6-address)
| | +---- ipv6-address?      inet:ipv6-address
| +--:(trill-nickname)
|   +---- trill-nickname?    tril-rb-nickname
+---- diagnostic-vlan?    boolean
augment /goam:traceroute/goam:input:
+---- flow-entropy-trill?  flow-entropy-trill
augment /goam:traceroute/goam:output/goam:response:
+--:(monitor-stats-ext)

```

```

| +---- tx-packet-count?     oam-counter32

```



```

| +---- rx-packet-count?    oam-counter32
| +---- min-delay?         oam-counter32
| +---- average-delay?     oam-counter32
| +---- max-delay?         oam-counter32
+---- upstream-rbridge?    tril-rb-nickname
+---- next-hop-rbridge*    tril-rb-nickname
rpcs:
+---x mtv
+---w input
| +---w technology          identityref
| +---w MD-name-string     MD-name-string
| +---w MA-name-string?    MA-name-string
| +---w (out-of-band)?
| | +---:(ipv4-address)
| | | +---w ipv4-address?   inet:ipv4-address
| | +---:(ipv6-address)
| | | +---w ipv6-address?   inet:ipv6-address
| | +---:(trill-nickname)
| | | +---w trill-nickname?  tril-rb-nickname
+---w diagnostic-vlan?     boolean
+---w (flow-entropy)?
| +---:(flow-entropy-null)
| | +---w flow-entropy-null?  empty
| +---:(flow-entropy-trill)
| | +---w flow-entropy-trill?  flow-entropy-trill
+---w max-hop-count?      uint8
+---w type?              identityref
+---w scope*             tril-rb-nickname
+---w ecmp-choice?       enumeration
+---w outgoing-interfaces* [interface]
| +---w interface         if:interface-ref
+---w source-mep
| +---w (mep-address)?
| | +---:(mac-address)
| | | +---w mac-address?     yang:mac-address
| | +---:(ipv4-address)
| | | +---w ipv4-address?    inet:ipv4-address
| | +---:(ipv6-address)
| | | +---w ipv6-address?    inet:ipv6-address
| | +---w mep-id?          tril-rb-nickname
+---w destination-mep
+---w (mep-address)?
| +---:(mac-address)
| | +---w mac-address?     yang:mac-address
| +---:(ipv4-address)
| | +---w ipv4-address?    inet:ipv4-address
| +---:(ipv6-address)

```

```
|      |      +---w ipv6-address?  inet:ipv6-address
|      +---w mep-id?              tril-rb-nickname
+--ro output
  +--ro response* [mep-address mep-id]
    +--ro hop-count?              uint8
    +--ro mep-id                  tril-rb-nickname
    +--ro mep-address             tril-rb-nickname
    +--ro next-hop-rbridge*       tril-rb-nickname
    +--ro upstream-rbridge?       tril-rb-nickname
    +--ro multicast-receiver-count? uint32
    +--ro tx-packet-count?        oam-counter32
    +--ro rx-packet-count?        oam-counter32
    +--ro min-delay?              oam-counter32
    +--ro average-delay?          oam-counter32
    +--ro max-delay?              oam-counter32
```

6. OAM YANG module

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

  import ietf-conn-oam {
    prefix goam;
  }
  import ietf-inet-types {
    prefix inet;
  }
  import ietf-interfaces {
    prefix if;
  }
  import ietf-yang-types {
    prefix yang;
  }
  organization "IETF TRILL Working Group";
  contact
    "
      WG List: mailto:trill@ietf.org
      Editor: Deepak Kumar dekkumar@cisco.com";
  description
    "This YANG module defines the configuration for TRILL,
    OAM Fault Management statistics and rpc";
```

revision 2016-07-17 {

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```
    description
      "Initial revision.";
    reference "draft-ietf-trill-yang-oam";
  }

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

typedef oam-counter32 {
  type yang:zero-based-counter32;
  description
    "defines 32 bit counter for OAM";
}

typedef trill-rb-nickname {
  type uint16;
  description
    "Trill Rbridge Nickname";
}

typedef flow-entropy-trill {
  type binary {
    length "1..96";
  }
  description
    "Flow entropy as defined in RFC7455";
}

typedef vlan {
  type uint16 {
    range "0..4095";
  }
  description
    "Vlan Identifier.";
}
```

```
typedef fgl {
    type uint32;
    description
        "Fine Grain Label";
}

identity trill-mtv {
    base goam:command-sub-type;
    description
```

```
    "identfies this command as multicast tree verification comand";
}

identity trill-ping {
    base goam:command-sub-type;
    description
        "identifies the command as TRILL Loopback Request";
}

identity trill-trace-route {
    base goam:command-sub-type;
    description
        "identifies the command as TRILL Pathtrace Request.";
}

grouping command-ext-trill {
    description
        "group the rpc command extensions for trill";
    choice out-of-band {
        case ipv4-address {
            leaf ipv4-address {
                type inet:ipv4-address;
                description
                    "ip version 4 address of the device where out of
                    band reply should be sent.";
            }
        }
        case ipv6-address {
            leaf ipv6-address {
                type inet:ipv6-address;
                description
                    "ip version 6 address of the device where out of
```

```

        band reply should be sent.";
    }
}
case trill-nickname {
    leaf trill-nickname {
        type tril-rb-nickname;
        description
            "TRILL Rbridge Nickname of the device where out of
            band reply should be sent.";
    }
}
description
    "presence of this node indicate out of band request needed";
}
leaf diagnostic-vlan {
    type boolean;
}

```

```

        description
            "indicates whether to include diagnostic VLAN/fgl TLV or not
            in the request. actual value is the VLAN/FGL specified
            in the command";
    }
}
grouping monitor-stats-trill {
    leaf tx-packet-count {
        type oam-counter32;
        description
            "Transmitted Packet count";
    }
    leaf rx-packet-count {
        type oam-counter32;
        description
            "Received packet count, zero for one way message (CCM).";
    }
    leaf min-delay {
        type oam-counter32;
        units milliseconds;
        description
            "Delay is specified in milliseconds, zero for one
            way message (CCM).";
    }
    leaf average-delay {

```

```

    type oam-counter32;
    units millisecond;
    description
        "average delay in milliseconds, zero for one way
        message (CCM).";
}

leaf max-delay {
    type oam-counter32;
    units millisecond;
    description
        "Maximum delay in milliseconds, zero for one way
        message (CCM).";
}
description
    "Monitor Statistics";
}

augment "/goam:domains/goam:domain/goam:MA/goam:MA/goam:MEP/goam:mep-add
case mep-address-trill {
    leaf mep-address-trill {
        when "/goam:domains/goam:domain/goam:technology='trill'" {
            description

```

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```

        "Technology TRILL";
    }
    type tril-rb-nickname;
    description
        "MEP Address TRILL Rbridge Nickname.";
    }
}
description
    "Extend Generic OAM Maintenance Point Address.";
}

augment "/goam:domains/goam:domain/goam:MA/goam:MA/goam:connectivity-c
case connectivity-context-vlan {
    leaf connectivity-context-vlan {
        type vlan;
        description
            "Connectivity context Vlan Identifier.";
    }
}

```

```

    }
    case connectivity-context-fgl {
      leaf connectivity-context-fgl {
        type fgl;
        description
          "connectivity context Fine Grain Label.";
      }
    }
  }
  description
    "Extends connectivity context.";
}

augment "/goam:domains/goam:domain/goam:MA/goam:MA" {
  leaf flow-entropy-trill {
    type flow-entropy-trill;
    description
      "connectivity context flow entropy.";
  }
  description
    "Extends Flow Entropy.";
}

augment
"/goam:domains/goam:domain/goam:MA/goam:MA/goam:MEP" {
  leaf flow-entropy-trill {
    type flow-entropy-trill;
    description
      "Flow Entropy TRILL";
  }
  description

```

```

    "Extends Flow Entropy defined under Generic OAM MEP.";
  }

  augment
"/goam:domains/goam:domain/goam:MA/goam:MA/goam:MEP/goam:session" {
  leaf flow-entropy-trill {
    type flow-entropy-trill;
    description
      "Flow Entropy TRILL";
  }
  description

```

```

    "Extends Flow Entropy defined under Generic OAM Session.";
}
augment "/goam:continuity-check/goam:input" {
    uses command-ext-trill;
    description
        "Extends continuity check input.";
}
augment "/goam:continuity-check/goam:input" {
    leaf flow-entropy-trill {
        type flow-entropy-trill;
        description
            "Flow Entropy TRILL";
    }
    description
        "Extends continuity check input Flow entropy.";
}
augment "/goam:continuity-check/goam:output" {
    description
        "adds trill specific items on the response";
    leaf upstream-rbridge {
        type trill-rb-nickname;
        description
            "Trill Rbridge nickname.";
    }
    leaf-list next-hop-rbridge {
        type trill-rb-nickname;
        description
            "nickname of the next hop RBRdige";
    }
}
augment "/goam:continuity-verification/goam:input" {
    uses command-ext-trill;
    description
        "Extends continuity check input.";
}

augment "/goam:continuity-verification/goam:input" {

```

```

leaf flow-entropy-trill {
    type flow-entropy-trill;
    description
        "Flow Entropy TRILL";
}

```



```

    }
    description
      "Extends continuity check input Flow entropy.";
  }

augment "/goam:continuity-verification/goam:output" {
  description
    "adds trill specific items on the response";
  case monitor-stats-resp {
    uses monitor-stats-trill;
  }
  leaf upstream-rbridge {
    type trill-rb-nickname;
    description
      "Trill Rbridge nickname.";
  }
  leaf-list next-hop-rbridge {
    type trill-rb-nickname;
    description
      "nickname of the next hop RBRdige";
  }
}

augment "/goam:traceroute/goam:input" {
  uses command-ext-trill;
  description
    "Extends path discovery Input.";
}

augment "/goam:traceroute/goam:input" {
  leaf flow-entropy-trill {
    type flow-entropy-trill;
    description
      "Flow entropy TRILL.";
  }
  description
    "Extends path discovery input flow entropy.";
}

augment "/goam:traceroute/goam:output/goam:response" {
  description
    "adds trill specific items on the response";
  case monitor-stats-ext {
    uses monitor-stats-trill;
  }
}

```

```
leaf upstream-rbridge {
  type trill-rb-nickname;
  description
    "Upstream Rbridge nickname.";
}
leaf-list next-hop-rbridge {
  type trill-rb-nickname;
  description
    "nickname of the next hop RBRdige";
}
}

rpc mtv {
  description
    "Generates Trace-route and return response. Starts with TTL
    of one and increment by one at each hop. Untill destination
    reached or TTL reach max valune";
  input {
    uses goam:maintenance-domain-id {
      description
        "Specifies the MA-domain";
    }
    uses goam:ma-identifier {
      description
        "identfies the Maintenance association";
    }
    uses command-ext-trill {
      description
        "defines extensions needed for trill.
        We are using this structure so mtv command is in line
        with ping and trace-route";
    }
  }

  choice flow-entropy {
    case flow-entropy-null {
      leaf flow-entropy-null {
        type empty;
        description
          "Empty flow entropy";
      }
    }
    case flow-entropy-trill {
      leaf flow-entropy-trill {
        type flow-entropy-trill;
        description
          "Flow Entroy TRILL";
      }
    }
  }
}
```

```
}
```

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```
    description
      "Flow Entropy choices.";
  }

  leaf max-hop-count {
    type uint8;
    default "255";
    description
      "Defines maximum value of hop count";
  }

  leaf type {
    type identityref {
      base goam:command-sub-type;
    }
    description
      "defines different command types";
  }

  leaf-list scope {
    type trill-rb-nickname;
    description
      "This list contain rbridges that needed to respond
      Empty list indicate all Rbridges needed to respond";
    reference "RFC7455";
  }

  leaf ecmp-choice {
    type enumeration {
      enum "ecmp-use-platform-hash" {
        value 0;
        description
          "Use Platform hashing to send packet on
          specified interface.";
      }
      enum "ecmp-use-round-robin" {
        value 1;
        description
          "Use round robin hashing.";
      }
    }
  }
}
```

```
    }
    description
      "Ecmp Choice enumeration.";
  }
```

```
list outgoing-interfaces {
  key "interface";
  leaf interface {
```

```
    type if:interface-ref;
    description
      "Interface";
  }
  description
    "List of Outgoing Interface.";
}
container source-mep {
  uses goam:mep-address;
  description
    "Source MEP Container.";
  leaf mep-id {
    type trill-rb-nickname;
    description
      "Trill Rbridge Nickname";
  }
}
container destination-mep {
  uses goam:mep-address;
  leaf mep-id {
    type trill-rb-nickname;
    description
      "MEP Identifier.";
  }
  description
    "Destination MEP Identifier.";
}
}
output {
  list response {
    key "mep-address mep-id";
    leaf hop-count {
      type uint8;
    }
  }
}
```


that MUST be present in the devices that comply with this document. Base Mode allows users to have a zero-touch experience. Details of TRILL Base Mode for OAM are defined in [RFC7455 Appendix B](#).

8. Security Considerations

There are no security considerations relevant to this document.

9. IANA Considerations

This document registers the following namespace URI in the IETF XML registry. URI:urn:ietf:params:xml:ns:yang:ietf-trill-oam

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