

TRILL
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YANG Data Model for TRILL Operations, Administration, and
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Abstract

This document presents YANG Data model for TRILL OAM. It extends the Generic YANG model for OAM defined in [[GENYANGOAM](#)] with TRILL technology specifics.

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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 [[80210](#)]

ECMP - Equal Cost Multipath

LBM - Loopback Message [[80210](#)]

MP - Maintenance Point [[80210](#)]

MEP - Maintenance End Point [[TRLOAMFRM](#)] [[80210](#)] [[RFC6371](#)]

MIP - Maintenance Intermediate Point [[TRLOAMFRM](#)] [[80210](#)] [[RFC6371](#)]

MA - Maintenance Association [[80210](#)] [[TRLOAMFRM](#)]

MD - Maintenance Domain [[80210](#)]

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

The Generic OAM YANG model acts as the basis for other OAM YANG models. This allows users to traverse between OAM tools of different

technologies at ease through a uniform API set. This is also referred as the nested OAM workflow. The following Figure depicts the relationship of TRILL OAM YANG model to Generic YANG Model.

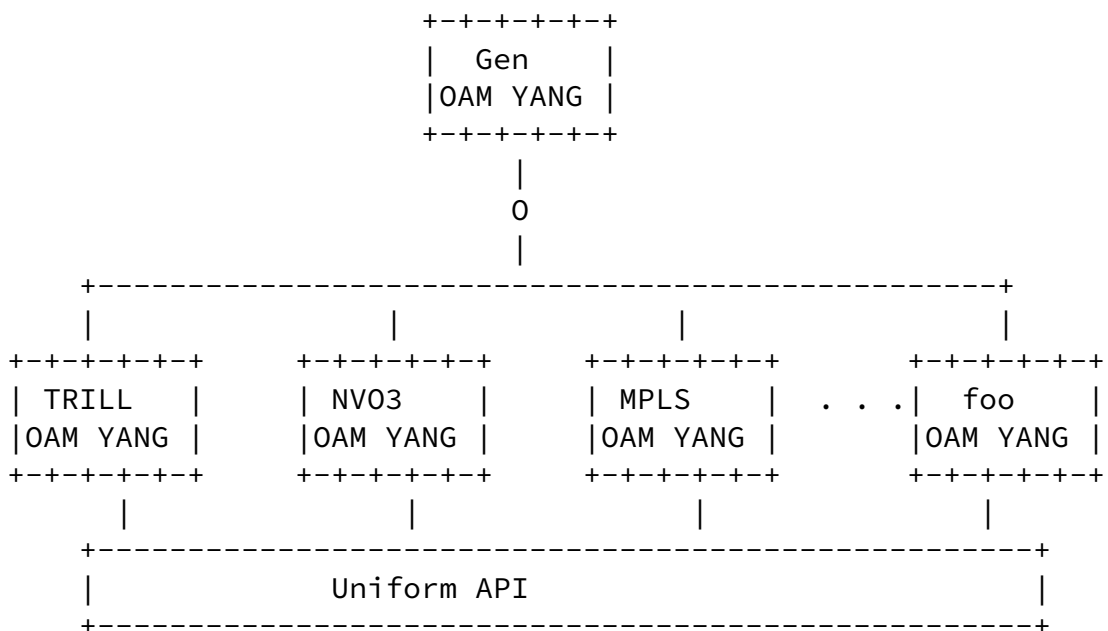


Figure 1 Relationship of TRILL OAM YANG model to Generic OAM YANG model

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 trill-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

[4.4.](#) rpc definitions

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.

Multicast Tree Verification (MTV) [TRILLOAMFM] 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: trill-oam
augment /goam:domains/goam:domain/goam:MAS/goam:MA/goam:MEP/goam:mep-
address:
  +--:(mep-address-trill)
    +--rw mep-address-trill?   tril-rb-nickname
augment /goam:domains/goam:domain/goam:MAS/goam:MA/goam:context-id:
  +--:(context-id-vlan)
  | +--rw context-id-vlan?   vlan
  +--:(context-id-fgl)
    +--rw context-id-fgl?   fgl
augment /goam:domains/goam:domain/goam:MAS/goam:MA/goam:flow-entropy:
  +--:(flow-entropy-trill)
    +--rw flow-entropy-trill?   flow-entropy-trill
augment
/goam:domains/goam:domain/goam:MAS/goam:MA/goam:MEP/goam:context-id:
```



```

    +--:(context-id-vlan)
      | +--rw context-id-vlan?   vlan
    +--:(context-id-fgl)
      +--rw context-id-fgl?     fgl
augment
/goam:domains/goam:domain/goam:MAAs/goam:MA/goam:MEP/goam:flow-
entropy:
  +--:(flow-entropy-trill)
    +--rw flow-entropy-trill?   flow-entropy-trill
augment
/goam:domains/goam:domain/goam:MAAs/goam:MA/goam:MEP/goam:session/goam
:context-id:
  +--:(context-id-vlan)
    | +--rw context-id-vlan?   vlan
  +--:(context-id-fgl)
    +--rw context-id-fgl?     fgl
augment
/goam:domains/goam:domain/goam:MAAs/goam:MA/goam:MEP/goam:session/goam
:flow-entropy:
  +--:(flow-entropy-trill)
    +--rw flow-entropy-trill?   flow-entropy-trill
augment /goam:ping/goam:input:
  +--ro (out-of-band)?
  | +--:(ipv4-address)
  | | +--ro ipv4-address?      inet:ipv4-address
  | +--:(ipv6-address)
  | | +--ro ipv6-address?      inet:ipv6-address
  | +--:(trill-nickname)
  |   +--ro trill-nickname?     trill-nickname
  +--ro diagnostic-vlan?   boolean
augment /goam:ping/goam:input/goam:context-id:

```

```

    +--:(context-id-vlan)
      | +--ro context-id-vlan?   vlan
    +--:(context-id-fgl)
      +--ro context-id-fgl?     fgl
augment /goam:ping/goam:input/goam:flow-entropy:
  +--:(flow-entropy-trill)
    +--ro flow-entropy-trill?   flow-entropy-trill
augment /goam:ping/goam:input/goam:source-mep/goam:mep-address:
  +--:(trill-nickname)
    +--ro trill-nickname?     trill-nickname
augment /goam:ping/goam:input/goam:destination-mep/goam:mep-address:

```

```

    +---:(trill-nickname)
      +--ro trill-nickname?   tril-rb-nickname
augment /goam:ping/goam:output:
  +--ro upstream-rbridge?   tril-rb-nickname
  +--ro next-hop-rbridge*   tril-rb-nickname
augment /goam:trace-route/goam:input:
  +--ro (out-of-band)?
  | +---:(ipv4-address)
  | | +--ro ipv4-address?   inet:ipv4-address
  | +---:(ipv6-address)
  | | +--ro ipv6-address?   inet:ipv6-address
  | +---:(trill-nickname)
  |   +--ro trill-nickname?   tril-rb-nickname
  +--ro diagnostic-vlan?   boolean
augment /goam:trace-route/goam:input/goam:context-id:
  +---:(context-id-vlan)
  | +--ro context-id-vlan?   vlan
  +---:(context-id-fgl)
  | +--ro context-id-fgl?   fgl
augment /goam:trace-route/goam:input/goam:flow-entropy:
  +---:(flow-entropy-trill)
  | +--ro flow-entropy-trill?   flow-entropy-trill
augment /goam:trace-route/goam:input/goam:source-mep/goam:mep-
address:
  +---:(trill-nickname)
  | +--ro trill-nickname?   tril-rb-nickname
augment /goam:trace-route/goam:input/goam:destination-mep/goam:mep-
address:
  +---:(trill-nickname)
  | +--ro trill-nickname?   tril-rb-nickname
augment /goam:trace-route/goam:output/goam:response/goam:destination-
mep/goam:mep-address:
  +---:(trill-nickname)
  | +--ro trill-nickname?   tril-rb-nickname
augment /goam:trace-route/goam:output/goam:response:
  +--ro upstream-rbridge?   tril-rb-nickname

```

```

  +--ro next-hop-rbridge*   tril-rb-nickname
rpcs:
  +---x mtv
    +--ro input
      | +--ro technology           identityref
      | +--ro md-name-format       MD-name-format

```

```

| +---ro md-name?                binary
| +---ro md-level                int32
| +---ro ma-name-format          MA-name-format
| +---ro ma-name                 binary
| +---ro (out-of-band)?
| | +---:(ipv4-address)
| | | +---ro ipv4-address?      inet:ipv4-address
| | +---:(ipv6-address)
| | | +---ro ipv6-address?      inet:ipv6-address
| | +---:(trill-nickname)
| | | +---ro trill-nickname?    trill-rb-nickname
| +---ro diagnostic-vlan?        boolean
| +---ro (context-id)?
| | +---:(context-id-vlan)
| | | +---ro context-id-vlan?   vlan
| | +---:(context-id-fgl)
| | | +---ro context-id-fgl?    fgl
| +---ro (flow-entropy)?
| | +---:(flow-entropy-null)
| | | +---ro flow-entropy-null? empty
| | +---:(flow-entropy-trill)
| | | +---ro flow-entropy-trill? flow-entropy-trill
| +---ro max-hop-count?          uint8
| +---ro type?                   identityref
| +---ro scope*                  trill-rb-nickname
| +---ro ecmp-choice?            goam:ecmp-choices
| +---ro outgoing-interfaces* [interface]
| | +---ro interface            if:interface-ref
| +---ro source-mep
| | +---ro (mep-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?              goam:MEP-id
| +---ro destination-mep
| | +---ro (mep-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?             goam:MEP-id
+--ro output
  +--ro response* [mep-address mep-id]
    +--ro hop-count?             uint8
    +--ro mep-id                 goam:MEP-id
    +--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

```

Figure 1 Data hierarchy of TRILL OAM

6. OAM YANG module

```
<CODE BEGINS> file "xxx.yang"

module trill-oam {
  namespace "urn:cisco:params:xml:ns:yang:tril-oam";
  prefix trilloam;

  import gen-oam {
    prefix goam;
  }
  import ietf-inet-types {
    prefix inet;
  }
  import ietf-interfaces {
    prefix if;
  }

  revision 2014-04-16 {
    description
      "Initial revision.";
  }

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

  typedef tril-rb-nickname {
    type uint16;
  }

  typedef flow-entropy-trill {
    type binary {
      length "1..96";
    }
  }

  typedef vlan {
    type uint16 {
      range "0..4095";
    }
  }

  typedef fgl {
    type uint32;
```

```
}

identity trill-mtv {
  base goam:command-sub-type;
  description
    "identifies this command as multicast tree verification comand";
}

identity trill-ping {
  base goam:command-sub-type;
}

identity trill-trace-route {
  base goam:command-sub-type;
}

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;
      }
    }
    case ipv6-address {
      leaf ipv6-address {
        type inet:ipv6-address;
      }
    }
    case trill-nickname {
      leaf trill-nickname {
        type trill-rb-nickname;
      }
    }
  }
  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";
    }
}
```

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

```
  augment
"/goam:domains/goam:domain/goam:MAAs/goam:MA/goam:MEP/goam:flow-
entropy" {
  case flow-entropy-trill {
    leaf flow-entropy-trill {
      type flow-entropy-trill;
    }
  }
}
  augment
"/goam:domains/goam:domain/goam:MAAs/goam:MA/goam:MEP/goam:session/goa
m:context-id" {
  case context-id-vlan {
    leaf context-id-vlan {
      type vlan;
    }
  }
  case context-id-fgl {
    leaf context-id-fgl {
      type fgl;
    }
  }
}
  augment
"/goam:domains/goam:domain/goam:MAAs/goam:MA/goam:MEP/goam:session/goa
m:flow-entropy" {
  case flow-entropy-trill {
    leaf flow-entropy-trill {
      type flow-entropy-trill;
    }
  }
}
```



```

augment "/goam:ping/goam:input" {
  uses command-ext-trill;
}
augment "/goam:ping/goam:input/goam:context-id" {
  case context-id-vlan {
    leaf context-id-vlan {
      type vlan;
    }
  }
  case context-id-fgl {
    leaf context-id-fgl {
      type fgl;
    }
  }
}
}

```

```

augment "/goam:ping/goam:input/goam:flow-entropy" {
  case flow-entropy-trill {
    leaf flow-entropy-trill {
      type flow-entropy-trill;
    }
  }
}
augment "/goam:ping/goam:input/goam:source-mep/goam:mep-address" {
  case trill-nickname {
    leaf trill-nickname {
      type tril-rb-nickname;
    }
  }
}
augment "/goam:ping/goam:input/goam:destination-mep/goam:mep-
address" {
  case trill-nickname {
    leaf trill-nickname {
      type tril-rb-nickname;
    }
  }
}
augment "/goam:ping/goam:output" {
  description
    "adds trill specific items on the response";
  leaf upstream-rbridge {
    type tril-rb-nickname;
  }
}

```

```

    }
    leaf-list next-hop-rbridge {
      type tril-rb-nickname;
      description
        "nickname of the next hop RBRdige";
    }
  }
  augment "/goam:trace-route/goam:input" {
    uses command-ext-trill;
  }
  augment "/goam:trace-route/goam:input/goam:context-id" {
    case context-id-vlan {
      leaf context-id-vlan {
        type vlan;
      }
    }
    case context-id-fgl {
      leaf context-id-fgl {
        type fgl;
      }
    }
  }

```

```

    }
  }
  augment "/goam:trace-route/goam:input/goam:flow-entropy" {
    case flow-entropy-trill {
      leaf flow-entropy-trill {
        type flow-entropy-trill;
      }
    }
  }
  augment "/goam:trace-route/goam:input/goam:source-mep/goam:mep-
address" {
    case trill-nickname {
      leaf trill-nickname {
        type tril-rb-nickname;
      }
    }
  }
  augment "/goam:trace-route/goam:input/goam:destination-
mep/goam:mep-address" {
    case trill-nickname {
      leaf trill-nickname {
        type tril-rb-nickname;
      }
    }
  }

```

```

    }
  }
}
augment "/goam:trace-
route/goam:output/goam:response/goam:destination-mep/goam:mep-
address" {
  case trill-nickname {
    leaf trill-nickname {
      type tril-rb-nickname;
    }
  }
}
augment "/goam:trace-route/goam:output/goam:response" {
  description
    "adds trill specific items on the response";
  leaf upstream-rbridge {
    type tril-rb-nickname;
  }
  leaf-list next-hop-rbridge {
    type tril-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 {
    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 context-id {
        case context-id-vlan {
            leaf context-id-vlan {
                type vlan;
            }
        }
        case context-id-fgl {
            leaf context-id-fgl {
                type fgl;
            }
        }
    }
    choice flow-entropy {
        case flow-entropy-null {
            leaf flow-entropy-null {
                type empty;
            }
        }
        case flow-entropy-trill {
            leaf flow-entropy-trill {
                type flow-entropy-trill;
            }
        }
    }
    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 tril-rb-nickname;
        reference "draft-ietf-trill-oam-fm";
    }

```

```

    description
      "This list contain rbridges that needed to respond
      Empty list indicate all Rbridges needed to respond";
  }
  leaf ecmp-choice {
    type goam:ecmp-choices;
    description
      "0 means use the specified interface
      1 means use round robin";
  }
  list outgoing-interfaces {
    key "interface";
    leaf interface {
      type if:interface-ref;
    }
  }
  container source-mep {
    uses goam:mep-address;
    leaf mep-id {
      type goam:MEP-id;
    }
  }
  container destination-mep {
    uses goam:mep-address;
    leaf mep-id {
      type goam:MEP-id;
    }
  }
}
output {
  list response {
    key "mep-address mep-id";
    leaf hop-count {
      type uint8;
    }
  }
}

```

```

  leaf mep-id {
    type goam:MEP-id;
  }
  leaf mep-address {
    type tril-rb-nickname;
  }
  leaf-list next-hop-rbridge {

```


10. References

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