

TRILL
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Tissa Senevirathne
Norman Finn
Deepak Kumar
Samer Salam
Cisco

Liang Xia
Weiguo Hao
Huawei

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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 [[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 [[8021Q](#)]

ECMP - Equal Cost Multipath

LBM - Loopback Message [[8021Q](#)]

MP - Maintenance Point [[8021Q](#)]

MEP - Maintenance End Point [[TRLOAMFRM](#)] [[8021Q](#)] [[RFC6371](#)]

MIP - Maintenance Intermediate Point [[TRLOAMFRM](#)] [[8021Q](#)] [[RFC6371](#)]

MA - Maintenance Association [[8021Q](#)] [[TRLOAMFRM](#)]

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

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.


```
augment
"/goam:domains/goam:domain/goam:MA/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:MA/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: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;
    }
  }
}
```

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?   trill-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:MAS/goam:MA/goam:MEP/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: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:MAS/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-rb-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-rb-nickname
augment /goam:ping/goam:input/goam:destination-mep/goam:mep-address:
    +---:(trill-nickname)
        +-ro trill-nickname?   trill-rb-nickname
augment /goam:ping/goam:output:
    +-ro upstream-rbridge?   trill-rb-nickname
    +-ro next-hop-rbridge*   trill-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?   trill-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?   trill-rb-nickname
augment /goam:trace-route/goam:input/goam:destination-mep/goam:mep-
address:
    +---:(trill-nickname)
        +-ro trill-nickname?   trill-rb-nickname
augment /goam:trace-route/goam:output/goam:response/goam:destination-
mep/goam:mep-address:
    +---:(trill-nickname)
        +-ro trill-nickname?   trill-rb-nickname
augment /goam:trace-route/goam:output/goam:response:
    +-ro upstream-rbridge?   trill-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? tril-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*              tril-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
    "identfies 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:MA/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;
    }
  }
}
augment "/goam:domains/goam:domain/goam:MA/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:MA/goam:MA/goam:flow-
entropy" {
  case flow-entropy-trill {
    leaf flow-entropy-trill {
      type flow-entropy-trill;
    }
  }
}
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;
    }
  }
}
```



```
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 trill-rb-nickname;
    }
  }
}
augment "/goam:ping/goam:input/goam:destination-mep/goam:mep-
address" {
  case trill-nickname {
    leaf trill-nickname {
      type trill-rb-nickname;
    }
  }
}
augment "/goam:ping/goam:output" {
  description
    "adds trill specific items on the response";
  leaf upstream-rbridge {
    type trill-rb-nickname;
  }
  leaf-list next-hop-rbridge {
    type trill-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 trill-rb-nickname;
      }
    }
  }
  augment "/goam:trace-route/goam:input/goam:destination-
mep/goam:mep-address" {
    case trill-nickname {
      leaf trill-nickname {
        type trill-rb-nickname;
      }
    }
  }
  augment "/goam:trace-
route/goam:output/goam:response/goam:destination-mep/goam:mep-
address" {
    case trill-nickname {
      leaf trill-nickname {
        type trill-rb-nickname;
      }
    }
  }
  augment "/goam:trace-route/goam:output/goam:response" {
    description
      "adds trill specific items on the response";
    leaf upstream-rbridge {
      type trill-rb-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 {
    description
      "Specifies the MA-domain";
  }
  uses goam:ma-identifier {
    description
      "identifies 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 trill-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 trill-rb-nickname;
    }
    leaf-list next-hop-rbridge {
      type trill-rb-nickname;
      description
        "list of downstream rbridges. There is no particular
order";
    }
    leaf upstream-rbridge {
      type trill-rb-nickname;
    }
    leaf multicast-receiver-count {
      type uint32;
      description
        "number of ports that are interested in this multicast
stream";
    }
    uses goam:monitor-stats;
  }
}
}
```

<CODE ENDS>

Figure 2 YANG module of OAM

7. Base Mode for TRILL OAM

The Base Mode defines default configuration 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 [TRILLOAMFM].

8. Security Considerations

TBD

9. IANA Considerations

This document registers the following namespace URI in the IETF XML registry.

URI:TBD

10. References

10.1. Normative References

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10.2. Informative References

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11. Acknowledgments

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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@cisco.com

Norman Finn
CISCO Systems
510 McCarthy Blvd
Milpitas, CA 95035.

Email: nfinn@cisco.com

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

Email: dekumar@cisco.com

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

Email: ssalam@cisco.com

Liang Xia
Huawei technologies

Email: frank.xialiang@huawei.com

Weiguo Hao
Huawei Technologies
101 Software Avenue
Nanjing 210012, China

Email: haoweiguo@huawei.com