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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. 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",

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 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. 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: ietf-trill-oam
augment
  /goam:domains/goam:domain/goam:MAAs/goam:MA/goam:MEP/goam:mp-address:
    +--:(mep-address-trill)
      +--rw mep-address-trill?   tril-rb-nickname
augment
  /goam:domains/goam:domain/goam:MAAs/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:MAAs/goam:MA/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: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:flow-entropy:
  +--:(flow-entropy-trill)
    +--rw flow-entropy-trill?   flow-entropy-trill
augment /goam:continuity-check/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:continuity-check/goam:input/goam:flow-entropy:
+--:(flow-entropy-trill)
  +--ro flow-entropy-trill?  flow-entropy-trill
augment /goam:continuity-check/goam:output:
+--ro upstream-rbridge?     tril-rb-nickname
+--ro next-hop-rbridge*     tril-rb-nickname
augment /goam:path-discovery/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:path-discovery/goam:input/goam:flow-entropy:
+--:(flow-entropy-trill)
  +--ro flow-entropy-trill?  flow-entropy-trill
augment /goam:path-discovery/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-string      MD-name-string
  | +--ro MA-name-string?     MA-name-string
  | +--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 (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 (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?              tril-rb-nickname
| +---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?              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-gen-oam.yang"
module ietf-trill-oam {
    namespace "urn:cisco:params:xml:ns:yang:ietf-tril-oam";
    prefix trilloam;

    import ietf-gen-oam {
        prefix goam;
    }
    import ietf-inet-types {
        prefix inet;
    }
    import ietf-interfaces {
        prefix if;
    }
    organization "IETF TRILL Working Group";
    contact
        "Deepak Kumar dekkumar@cisco.com";
    description
        "This YANG module defines the configuration for TRILL,
        OAM Fault Management statistics and rpc";

    revision 2015-11-01 {
        description
            "Initial revision.";
        reference "RFC 7455";
    }

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

    typedef tril-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 {
```

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```
    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
        "identifies 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.";
    }
}
case ipv6-address {
    leaf ipv6-address {
        type inet:ipv6-address;
        description
            "ip version 6 address.";
    }
}

```

```

    }
    case trill-nickname {
        leaf trill-nickname {
            type tril-rb-nickname;
            description
                "TRILL Rbridge 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:mp-ad
case mep-address-trill {
    leaf mep-address-trill {
        when "/goam:domains/goam:domain/goam:technology='trill'" {
            description
                "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:MAAs/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

```

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```

    "connectivity context Fine Grain Label.";
  }
}
description
  "Extends connectivity context.";
}

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

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;
      description

```

```

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

augment
"/goam:domains/goam:domain/goam:MAAs/goam:MA/goam:MEP/goam:session/goam:fl
    case flow-entropy-trill {
        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/goam:flow-entropy" {
    case flow-entropy-trill {
        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 tril-rb-nickname;
    description
        "Trill Rbridge nickname.";
}
leaf-list next-hop-rbridge {
    type tril-rb-nickname;
    description
        "nickname of the next hop RBRdige";
}
}
augment "/goam:path-discovery/goam:input" {
    uses command-ext-trill;
    description
        "Extends path discovery Input.";
}

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

augment "/goam:path-discovery/goam:output/goam:response" {
    description

```

```

    "adds trill specific items on the response";
    leaf upstream-rbridge {
        type tril-rb-nickname;
        description
            "Upstream Rbridge 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-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";
      }
    }
  }
}

```

```

}
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 tril-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 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;
    description
      "Interface";
  }
  description
    "List of Outgoing Interface.";
}

container source-mep {
  uses goam:mp-address;
  description

```

```
        "Source MEP Container.";
    leaf mep-id {
        type tril-rb-nickname;
        description
            "Trill Rbridge Nickname";
    }
}
container destination-mep {
    uses goam:mp-address;
    leaf mep-id {
        type tril-rb-nickname;
        description
            "MEP Identifier.";
    }
    description
        "Destination MEP Identifier.";
}
}
output {
    list response {
        key "mep-address mep-id";
        leaf hop-count {
            type uint8;
            description
                "unsigned integer 1-255";
        }
        leaf mep-id {
            type tril-rb-nickname;
            description
                "Maintenance Endpoint Identifier.";
        }
        leaf mep-address {
            type tril-rb-nickname;
            description
                "Maintenance Endpoint Address.";
        }
        leaf-list next-hop-rbridge {
            type tril-rb-nickname;
            description
                "list of downstream rbridges. There is no particular
order";
        }
        leaf upstream-rbridge {
            type tril-rb-nickname;
            description
                "Upstream Rbridge Nickname.";
        }
    }
}
```

```
leaf multicast-receiver-count {
```

```
        type uint32;
        description
            "number of ports that are interested in this multicast
stream";
    }
    uses goam:monitor-stats;
    description
        "Output list.";
    }
}
}
```

<CODE ENDS>

[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 [\[RFC7455\]](#).

[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:TBD

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[10.](#) References

[10.1.](#) Normative References

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Operations, Administration and Maintenance (OAM)", Work in Progress, March, 2014.

11. Acknowledgments

Giles Heron came up with the idea of developing a YANG model as a way of creating a unified OAM API set (interface), work in this document is largely an inspiration of that. Alexander Clemm provided many valuable tips, comments and remarks that helped to refine the YANG model presented in this document.

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