A YANG Data Model for Layer 1 Network Topology
draft-zhang-ccamp-l1-topo-yang-01.txt

Abstract

This draft describes a YANG data model to manipulate the topologies of a layer 1 Optical Transport Network (OTN). It is independent of control plane protocols and captures topology related information pertaining to OTN and also enables manipulation of an OTN network via the I2RS interface.

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Table of Contents
1. Introduction ................................................ 2
2. Conventions used in this document ......................... 3
3. Terminology and Notations .................................. 3
4. YANG Data Model for Layer 1 Topology ..................... 3
   4.1. YANG Tree ......................................... 4
      4.1.1. Augmentation ................................... 5
      4.1.2. The node and link list .......................... 5
      4.1.3. Notification ..................................... 6
   4.2. YANG Code ........................................... 6
5. Security Considerations ..................................... 17
6. Manageability Considerations ............................... 17
7. IANA Considerations ....................................... 17
8. Acknowledgements .......................................... 17
9. References ................................................ 18
   9.1. Normative References ................................. 18
   9.2. Informative References ............................... 18
10. Contributors’ Address ...................................... 18
    Authors’ Addresses ...................................... 19

1. Introduction

This document defines a data model of a layer one network topology, using YANG [RFC6020]. The model can be used by an application exposing to a management system. Moreover, it can also be used by an application via the I2RS interface [draft-ietf-i2rs-architecture], in the following ways (but not limited to):

   o to obtain a whole view of the network topology information of its interest e.g., via a network element or maybe a Path Computation Element (PCE) or a network management system within the network;
to receive notifications with regard to the information of the change of the network topology of its interest;

- to enforce the establishment/update of a network topology with the characteristic specified in the data model, e.g., by a network controller or a client controller to manipulate the network provided by the provider for flexible control and management;

The YANG model defined in this draft is independent of control plane protocols and captures topology related information pertaining to an Optical Transport Networks (OTN) and also enables manipulation of an OTN network via the I2RS interface. Other network layers, such as fixed Dense Wavelength Switched Optical Network (WSON) and flexible optical networks (a.k.a., flexi-grid networks) are covered in [WSON-YANG] and [Flexi-YANG], respectively.

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].

3. Terminology and Notations

A simplified graphical representation of the data model is used in this document. The meaning of the symbols in the YANG data tree presented later in this draft is defined in [ietf-netmod-rfc6087bis]. They are provided below for reference.

- Brackets "[" and "]" enclose list keys.

- Abbreviations before data node names: "rw" means configuration (read-write) and "ro" state data (read-only).

- Symbols after data node names: "?" means an optional node, "!" means a presence container, and "*" denotes a list and leaf-list.

- Parentheses enclose choice and case nodes, and case nodes are also marked with a colon (":").

- Ellipsis ("...") stands for contents of subtrees that are not shown.

4. YANG Data Model for Layer 1 Topology

[Editor’s note: It was agreed that the model presented in this draft will be augmenting from TE topology YANG, which is not available...
during the time of writing due to its revision to augment from the
generic topology YANG produced in I2RS WG. So, this issue will be
addressed in the further versions of this draft.)

4.1. YANG Tree

module: ietf-layer1topology
augment /nt:network/nt:network-types:
  +--rw l1-network!
augment /nt:network:
  +--rw l1-network-attributes
      +--rw name? string
augment /nt:network/nt:node:
  +--rw l1-node-attributes
      +--rw name? string
      +--rw connectivity-matrix* [id]
          |  +--rw id uint32
          |  +--rw type? enumeration
          |  +--rw in-typ* [tp-ref]
          |      |  +--rw tp-ref leafref
          |  +--rw out-typ* [tp-ref]
          |      |  +--rw tp-ref leafref
          |  +--rw dir enumeration
      +--ro oper-status? enumeration
augment /nt:network/nt:node/nttopo:termination-point:
  +--rw physical-info
      +--rw shelf-id? uint32
      +--rw board-id? uint32
      +--rw subcard-id? uint32
      +--rw port-id? uint32
augment /nt:network/nttopo:link:
  +--rw l1-link-attributes!
      +--rw source-tp-type enumeration
      +--rw admin-status? enumeration
      +--rw link-protection-type? enumeration
      +--rw switching-capability? identityref
      +--rw encoding? identityref
      +--rw srlg
          |  +--rw srlg-values* uint32
      +--rw (link-attributes)?
          |  +--:(ODU)
          |      |  +--rw ODU-type? uint32
          |      |  +--rw available-resources
          |      |      |  +--rw granularity enumeration
          |      |      |  +--rw num? uint32
          |      |  +--rw availability-bitmap* boolean
          |  +--rw mapping-info
4.1.1. Augmentation

As can be seen in the YANG module presented augments from a more
generic network topology model, i.e., the ietf-network-topology YANG
module as specified in [draft-ietf-i2rs-yang-network-topo]. This is
to follow the network model structure suggested in [draft-ietf-i2rs-
yang-network-topo] figure 1.

[Editor’s note: how TE topo YANG fits in this figure has been
discussed and yet to be updated in that draft.]

4.1.2. The node and link list

The module presented in this draft contains all the nodes and links
information pertaining to a layer one network. As specified in the
ietf-network YANG module, a node is identified by the node-id, which
is unique within the network. Within the nodes, all the interfaces
pertaining to this node and their potential capabilities/constraints
SHOULD be present. Besides this, the constraints associated with a
node as a whole SHOULD also be present, such as the connectivity
constraints introduced due to abstraction or due to the hardware
limitations.

Similarly, a link is identified by the link-id, which is unique
within a node. It includes the association with nodes as well as
interfaces. Moreover, it includes information that is of interest to
the management and I2RS client, for purposes, such as path
computation, monitoring etc. For termination points, physical
information is provided as an optional feature and it provides
additional information to allow management/I2RS client to be better informed of this attribute and can help visualize and simply the operation of termination points selection.

[editor’s note]: for next update: any specific information related to an OTN interface has to be described in the context of technologic specific extension of OTN-TDM ISCD”.

Since for an optical transport network, its client interface attributes may be different with that of the links within the network. For full control purpose, this attributes and information are also captured and listed in this YANG module.

4.1.3. Notification

Two types of notifications are introduced: node failure and link failure.

4.2. YANG Code

<CODE BEGINS> file "ietf-layer1topology@2015-10-19.yang"

module ietf-layer1topology {
  yang-version 1;

  namespace "urn:ietf:params:xml:ns:yang:ietf-layer1topology";
  prefix "l1topo";

  import ietf-inet-types {
    prefix "inet";
  }
  import ietf-network {
    prefix "nt";
  }

  import ietf-network-topology {
    prefix "nttopo";
  }

  import ietf-te-types {
    prefix "ietf-te-types";
  }

  organization
    "Internet Engineering Task Force (IETF) CCAMP WG";
  contact
    "ID-draft editor: zhang.xian@huawei.com";

  ...
This module defines a protocol independent Layer One/OTN topology data model.

Initial version.

"RFC 4203: OSPF Extensions in Support of Generalized Multi-Protocol Label Switching (GMPLS)"

SRLG value list;

"l1 network type"

"l1-network-type"

"l1 network type"

"l1-network-type"

"the network name"

"name attribute for l1 network"
grouping l1-node-attributes {
    description "l1-node-attributes";
    container l1-node-attributes {
        description "l1-node-attributes";
        leaf name {
            type string;
            description "a name for this node.";
        }
    }
    list connectivity-matrix {
        key "id";
        description "This describes the connectivity constraints within a node in the network. It can be one matrix or a set of matrixes. Further details, read the reference provided below."
        leaf id {
            type uint32;
            description "matrix id";
        }
        leaf type {
            type enumeration {
                enum fixed {
                    value 0;
                    description "Fixed";
                }
                enum dynamic {
                    value 1;
                    description "Dynamic/changeable";
                }
            }
            description "This field describes the attribute of a connectivity matrix, i.e., whether it is fixed or switched.";
        }
        list in-tp {
            key "tp-ref";
            description "This list describes a (sub)-set of ingoing
interfaces within a node that may have connectivity constraints.
Note: directionality may not be relevant and it is decided by the dir parameter."

leaf tp-ref {
  type leafref {
    path "../../../../nttopo:termination-point/+
    "nttopo:tp-id";
  }
  description "reference to an incoming interface,
  must be within the same node";
}

list out-tp {
  key "tp-ref";

description
  "This list describes a (sub)-set of outgoing interfaces within a node that may have
  connectivity constraints. Note: directionality may not be relevant and it is decided by the dir parameter.";

leaf tp-ref {
  type leafref {
    path "../../../../nttopo:termination-point/+
    "nttopo:tp-id";
  }
  description "reference to an outgoing interface,
  must be within the same node";
}

leaf dir{
  type enumeration{
    enum "uni-dir"{
      description
        "the matrix is unidirectional.";
    }
    enum "bi-dir"{
      description
        "this matrix is bidirectional.";
    }
  }
  mandatory true;

description
  "the directionality attribute of a conn. matrix.";
leaf oper-status {
  type enumeration {
    enum "unknown" {
      description "unknown - lost connect with control plane.";
    }
    enum "up" {
      description "normal";
    }
    enum "down" {
      description "not available";
    }
  }
  config false;
  description "operational status of a node";
}
}

grouping l1-link-attributes {
  description "l1-link-attributes";
  container l1-link-attributes {
    presence "L1 link attributes";
    description "l1 link attributes";
    leaf source-tp-type {
      type enumeration {
        enum "client-side" {
          description "client side";
        }
        enum "line-side" {
          description "line side";
        }
      }
      mandatory true;
      description "the type of a port:0-client side; 1 - line side";
    }
    leaf admin-status {
      type enumeration {
        enum "up" {
          description "up";
        }
      }
    }
  }
}
enum "down" {
    description "normal";
}

description "administrative status of a link";

leaf link-protection-type {
    type enumeration {
        enum "extra-traffic" {
            description "Extra traffic";
        }
        enum "unprotected" {
            description "unprotected";
        }
        enum "shared" {
            description "Shared";
        }
        enum "1-for-1" {
            description "Dedicated one for one protection";
        }
        enum "1-plus-1" {
            description "Dedicated one plus one protection";
        }
        enum "enhanced" {
            description "a protection type that is more reliable
            than Dedicated 1+1, e.g., 4 fiber BLSR/MS-SPRING.";
        }
    }
    description "Link Protection Type configured for this link";
    reference "RFC3471: Generalized Multi-Protocol Label Switching (GMPLS) Signaling Functional Description.";
}

leaf switching-capability {
    type identityref{
        base ietf-te-types:switching-capabilities;
    }
    description "the switching capability supported by the link";
}

leaf encoding {
    type identityref{
        base ietf-te-types:lsp-encoding-types;
description "the encoding type supported by this link."

container srlg {
    uses srlg-attributes;
    description "the SRLG values of a link"
}

choice link-attributes {
    case ODU {
        leaf ODU-type {
            type uint32;
            description "link capacity, subject to change to the type of enumeration"
        }
    }

    container available-resources {
        leaf granularity {
            type enumeration {
            enum "1.25G" {
                description "1.25G"
            }
            enum "2.5G" {
                description "2.5G"
            }
        }
        mandatory true;
        description "the base unit for unreserved-bandwidth description"
    }

    leaf num {
        type uint32;
        description "number * granularity = max-bandwidth"
    }

    leaf-list availability-bitmap {
        type boolean;
        description "0-available, 1- unavailable"
    }

    description "describe what is available in the unit of granularity"
}

container mapping-info {
    leaf-list mapping-list {
        type string;
    }
}
description "it can be one or multiple mapping
route";
}
description "mapping supported by this link; subject
to further change";
}
}
case client {
leaf max-bandwidth {
    type uint32;
    description "max bandwidth supported by this client
facing link";
}
leaf unreserved-bandwidth {
    type uint32;
    description "available bandwidth on this link";
}
leaf local-ip {
    type inet:ip-address;
    description "the local-end ip address of a link";
}
leaf remote-ip {
    type inet:ip-address;
    description "the remote-end ip address of a link";
}
}
description "attributes for a client interface";
}
leaf oper-status {
    type enumeration {
        enum "unknown" {
            description "unknown-lost connection with control
plane";
        }
        enum "normal" {
            description "normal";
        }
        enum "down" {
            description "down";
        }
        enum "degraded" {
            description "degraded, temporarily unusable";
        }
    }
    config false;
description "status of a link";
}
}

grouping l1-tp-attributes {

description "l1-tp-attributes";

container physical-info {

description "physical info of an termination point/port";

leaf shelf-id {

type uint32;

description "shelf-id of which this tp belongs to";
}

leaf board-id {

type uint32;

description "board-id of which this tp belongs to";
}

leaf subcard-id {

type uint32;

description "subcard id information, if no such info," +
"fill in 0xff.";
}

leaf port-id {

type uint32;

description "port-id of which this tp belongs to";
}
}
}

/*
 * Data nodes
 */

augment "/nt:network/nt:network-types" {

uses l1-network-type;

description "augment network types to include L1 network";
}

augment "/nt:network" {

when "nt:network-types/l1-network" {

description "Augment only for L1 network";
}

uses l1-network-attributes;

description "Augment network configuration";
}

augment "/nt:network/nt:node" {


when "nt:network-types/l1-network" {
    description "Augment only for L1 network";
}
description "Augment node configuration";

uses l1-node-attributes;
}

augment "/nt:network/nt:node/nttopo:termination-point" {
    when "nt:network-types/l1-network" {
        description "Augment only for L1 network";
    }
    description "Augment tp configuration";

    uses l1-tp-attributes;
}

augment "/nt:network/nttopo:link" {
    when "nt:network-types/l1-network" {
        description "Augment only for L1 network.";
    }
    description "Augment link configuration";

    uses l1-link-attributes;
}

notification link-failure {
    leaf topology-ref {
        type leafref {
            path "/nt:network/nt:network-id";
        }
        mandatory true;
        description "the topology reference of which"
        +"this link belongs to";
    }
    leaf link-ref {
        type leafref {
            path "/nt:network[nt:network-id= current ()]"+ 
                "../..topology-ref]/nttopo:link/nttopo:link-id";
        }
        mandatory true;
        description "";
    }
    leaf admin_status {
        type leafref {
            path 
                "/nt:network/nttopo:link[nttopo:link-id ="+

leaf oper-status {
  type leafref {
    path
      "/nt:network/nttopo:link[nttopo:link-id = current()]
          +"/../link-ref]/l1-link-attributes/admin-status";
    description "admin status of the reported link";
  }
  description "link failure information";
} //notification-link failure

notification node-failure {
  leaf topology-ref {
    type leafref {
      path "/nt:network/nt:network-id";
    } mandatory true;
    description "";
  }
  leaf node-ref {
    type leafref {
      path "/nt:network[nt:network-id= current ()]" + 
          "+"/../topology-ref]/nt:node/nt:node-id";
    } mandatory true;
    description "";
  }
  leaf oper-status {
    type leafref {
      path
        "/nt:network/nt:node[nt:node-id = current()]" + 
        "+"/../node-ref]/l1-node-attributes/oper-status";
    } description "";
  }
  description "node failure information";
}
5. Security Considerations

Since the data model defined in this draft is manipulated via the I2RS interface. The security concerns mentioned in [draft-ietf-i2rs-architecture] also applies to this draft.

The YANG module defined in this memo is designed to be accessed via the NETCONF protocol [RFC6241]. The lowest NETCONF layer is the secure transport layer and the mandatory-to-implement secure transport is SSH [RFC6242]. The NETCONF access control model [RFC6536] provides the means to restrict access for particular NETCONF users to a pre-configured subset of all available NETCONF protocol operations and content.

There are a number of data nodes defined in the YANG module which are writable/creatable/deletable (i.e., config true, which is the default). These data nodes may be considered sensitive or vulnerable in some network environments. Write operations (e.g., <edit-config>) to these data nodes without proper protection can have a negative effect on network operations.

[Editor’s note: to List specific subtrees and data nodes and their sensitivity/vulnerability.]

6. Manageability Considerations

TBD.

7. IANA Considerations

TBD.

8. Acknowledgements

The initial YANG model specified in this draft is based on draft-clemm-i2rs-yang-network-topo but it is modified according to the features of the layer one networks.

We would like to thank the authors of the above mentioned draft for their helpful discussion during the creation of this draft.
9. References

9.1. Normative References


9.2. Informative References


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