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June ~~21,~~ **22,** 2020

A YANG Data Model for ~~Layer-2~~ **Layer 2** Network Topologies
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Abstract

This document defines a YANG data model for Layer 2 network topologies.

Editorial Note (To be removed by RFC Editor)

Please update these statements within the document with the RFC number to be assigned to this document:

- "This version of this YANG module is part of RFC XXXX;"
- "RFC XXXX: A YANG Data Model for Layer-2 Network Topologies";
- reference: RFC XXXX

Please update the "revision" date of the YANG module.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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This Internet-Draft will expire on December ~~23,~~ **24,** 2020.

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1. Introduction

[RFC8345] defines the YANG [RFC6020] [RFC7950] data models of the abstract (generic) network and network topology. Such models can be augmented with technology-specific details to build more specific topology models.

This document defines the YANG data model for Layer 2 (L2) network topologies by augmenting the generic network (Section 6.1 of [RFC8345]) and network topology (Section 6.2 of [RFC8345]) data models with L2-specific topology attributes. A sample example is provided in Appendix B.

This document uses the common YANG types defined in [RFC6991] and adopts the Network Management Datastore Architecture (NMDA [RFC8342]).

The terminology for describing YANG modules is defined in [RFC7950]. The meanings of the symbols used in the tree diagram are defined in [RFC8340].

2. Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

3. Layer 2 Topology Model

The Layer 2 **(L2)** network topology YANG module is designed to be generic and applicable to Layer 2 networks built with different L2 technologies. It can be used to describe both the physical and the logical (virtual) L2 network topologies.

The relationship between the Layer 2 topology module and the generic network and network topology module is shown in Figure 1. In order to represent a Layer 2 network topology, the generic network and topology models are augmented with ~~Layer-2~~ **Layer 2** specific information, such as the identifiers, identities (e.g., Provider Backbone ~~Bridging[IEEE802.1ah]~~ **Bridging [IEEE802.1ah], QinQ[IEEE802.1ad]**, or ~~QinQ[IEEE802.1ad]),~~ **VXLAN [RFC7348])**, attributes, and states of the ~~Layer-2~~ **Layer 2** networks, nodes, links, and termination points. Some of the information may be collected via Link Layer Discovery Protocol (LLDP) [IEEE802.1AB] or other ~~Layer-2~~ **Layer 2** protocols, and some of them may be locally configured.

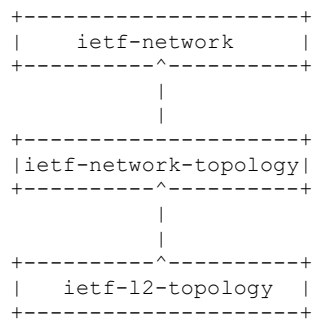

Figure 1: ~~Layer-2~~ **Layer 2** Topology YANG Module Structure

The structure of **the** "ietf-l2-topology" YANG module is depicted in the following tree diagram:

```
module: ietf-l2-topology
  augment /nw:networks/nw:network/nw:network-types:
    +--rw l2-network!
  augment /nw:networks/nw:network:
    +--rw l2-network-attributes
       +--rw name?   string
```

```
     +--rw flag*   l2-flag-type
augment /nw:networks/nw:network/nw:node:
  +--rw l2-node-attributes
     +--rw name?                 string
     +--rw description?          string
     +--rw management-address*   inet:ip-address
     +--rw sys-mac-address?      yang:mac-address
     +--rw management-vid?       dot1q-types:vlanid {VLAN}?
     +--rw flag*                 node-flag-type
augment /nw:networks/nw:network/nt:link:
  +--rw l2-link-attributes
     +--rw name?    string
     +--rw flag*    link-flag-type
     +--rw rate?    decimal64
     +--rw delay?   uint32
     +--rw srlg*    uint32
augment /nw:networks/nw:network/nw:node/nt:termination-point:
  +--rw l2-termination-point-attributes
     +--rw description?          string
     +--rw maximum-frame-size?   uint32
     +--rw (l2-termination-point-type)?
     |  +--:(ethernet)
     |  |  +--rw mac-address?          yang:mac-address
     |  |  +--rw eth-encapsulation?    identityref
     |  |  +--rw lag?                  boolean
     |  |  +--rw member-link-tp*       leafref
     |  |  +--rw mode?                 neg-mode
     |  |  +--rw port-vlan-id?         dot1q-types:vlanid {VLAN}?
     |  |  +--rw vlan-id-name* [vlan-id] {VLAN}?
     |  |  |  +--rw vlan-id      dot1q-types:vlanid
     |  |  |  +--rw vlan-name?   string
     |  |  +--rw qinq* [svlan-id cvlan-id] {QinQ}?
     |  |  |  +--rw svlan-id    dot1q-types:vlanid
     |  |  |  +--rw cvlan-id    dot1q-types:vlanid
     |  |  +--rw vxlan {VXLAN}?
     |  |     +--rw vni-id?   vni
     |  +--:(legacy)
     |     +--rw layer-2-address?      yang:phys-address
     |     +--rw encapsulation?        identityref
     +--ro tp-state?             enumeration

notifications:

  +---n l2-node-event
  |  +--ro event-type?           l2-network-event-type
  |  +--ro node-ref?             leafref
  |  +--ro network-ref?          -> /nw:networks/network/network-id
  |  +--ro l2-network!
  |  +--ro l2-node-attributes
  |     +--ro name?                 string
  |     +--ro description?          string
  |     +--ro management-address*   inet:ip-address
  |     +--ro sys-mac-address?      yang:mac-address
  |     +--ro management-vid?       dot1q-types:vlanid {VLAN}?
  |     +--ro flag*                 node-flag-type
  +---n l2-link-event
  |  +--ro event-type?           l2-network-event-type
  |  +--ro link-ref?             leafref
  |  +--ro network-ref?          -> /nw:networks/network/network-id
  |  +--ro l2-network!
  |  +--ro l2-link-attributes
  |     +--ro name?    string
  |     +--ro flag*    link-flag-type
  |     +--ro rate?    decimal64
  |     +--ro delay?   uint32
  |     +--ro srlg*    uint32
  +---n l2-termination-point-event
     +--ro event-type?                        l2-network-event-type
     +--ro tp-ref?                            leafref
     +--ro node-ref?                          leafref
     +--ro network-ref?
     |       -> /nw:networks/network/network-id
     +--ro l2-network!
     +--ro l2-termination-point-attributes
        +--ro description?          string
        +--ro maximum-frame-size?   uint32
        +--ro (l2-termination-point-type)?
```

```
|  +--:(ethernet)
|  |  +--ro mac-address?          yang:mac-address
|  |  +--ro eth-encapsulation?    identityref
|  |  +--ro lag?                  boolean
|  |  +--ro member-link-tp*       leafref
|  |  +--ro mode?                 neg-mode
|  |  +--ro port-vlan-id?         dot1q-types:vlanid
|  |  |       {VLAN}?
|  |  +--ro vlan-id-name* [vlan-id] {VLAN}?
|  |  |  +--ro vlan-id      dot1q-types:vlanid
|  |  |  +--ro vlan-name?   string
|  |  +--ro qinq* [svlan-id cvlan-id] {QinQ}?
|  |  |  +--ro svlan-id    dot1q-types:vlanid
|  |  |  +--ro cvlan-id    dot1q-types:vlanid
|  |  +--ro vxlan {VXLAN}?
|  |     +--ro vni-id?   vni
|  +--:(legacy)
|     +--ro layer-2-address?      yang:phys-address
|     +--ro encapsulation?        identityref
+--ro tp-state?             enumeration
```

The ~~Layer-2~~ **Layer 2** topology YANG module augments the 'ietf-network' and 'ietf-network-topology' YANG modules as follows:

- A new network type "l2-network-type" is introduced. This is represented by a container object, and is inserted under the "network-types" container of the generic 'ietf-network' module defined in **Section 6.1 of** [RFC8345].

- Additional network attributes are introduced in a grouping "l2-network-attributes", which augments the "network" list of the 'ietf-network' module. The attributes include ~~Layer-2~~ **Layer 2** network name and a set of flags. Each type of flag is represented by a separate identity.

- Additional data objects for ~~Layer-2~~ **Layer 2** nodes are introduced by augmenting the "node" list of the generic 'ietf-network' module. New objects include ~~Layer-2~~ **Layer 2** node identifier, description, management address, and a set of flags.

- Additional data objects for ~~Layer-2~~ **Layer 2** termination points are introduced by augmenting the "termination-point" list of the 'ietf-network-topology' module defined in **Section 6.2 of** [RFC8345]. New objects include ~~Layer-2~~ **Layer 2** termination point descriptions, ~~Layer-2~~ **Layer 2** termination point type specific attributes and ~~Layer-2~~ **Layer 2** termination point states.

- Links in the 'ietf-network-topology' module are augmented as well with a set of ~~Layer-2~~ **Layer 2** parameters, allowing to associate a link with a name, a set of ~~Layer-2~~ **Layer 2** link ~~attributes~~ **attributes,** and flags.

- Some optional L2 technology specific attributes are introduced in this module as ~~Layer-2~~ **Layer 2** features because these attributes may be useful to expose to above services/applications. Note that learning or configuring advanced L2 technology-specific attributes is not within the scope of the ~~Layer-2~~ **Layer 2** Topology YANG module; dedicated YANG modules should be used instead (e.g., [I-D.ietf-trill-yang]).

4. Layer 2 Topology YANG Module

This module uses types defined in [RFC6991], [RFC7224], [IEEE802.1Qcp], and [RFC8345]. It also references [RFC4761], [RFC4762], and [RFC4202].

<CODE BEGINS> file ~~"ietf-l2-topology@2019-10-15.yang"~~ **"ietf-l2-topology@2020-06-22.yang"**

```
module ietf-l2-topology {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-l2-topology";
  prefix l2t;

  import ietf-network {
    prefix nw;
    reference
      "RFC 8345: A YANG Data Model for Network Topologies";
  }
  import ietf-network-topology {
```

```
  prefix nt;
  reference
    "RFC 8345: A YANG Data Model for Network Topologies";
}
import ietf-inet-types {
  prefix inet;
  reference
    "Section 4 of RFC 6991";
}
import ietf-yang-types {
  prefix yang;
  reference
    "Section 3 of RFC 6991";
}
import iana-if-type {
  prefix ift;
  reference
    "RFC 7224: IANA Interface Type YANG Module";
}
import ieee802-dot1q-types {
  prefix dot1q-types;
  reference
    "IEEE Std 802.1Qcp-2018: Bridges and Bridged
     Networks - Amendment: YANG Data Model.";  Model";
}

organization
  "IETF I2RS (Interface to the Routing System) Working Group";
contact
  "WG Web:   <http://tools.ietf.org/wg/i2rs/>
   WG List:  <mailto:i2rs@ietf.org>
   Editor:    Jie Dong
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   Editor:    Mohamed Boucadair
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   Editor:   Anders Liu
              <andersliu@tencent.com>";
description
  "This module defines a basic model for the layer-2 Layer 2 topology
   of a network.

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   authors of the code.  All rights reserved.

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   This version of this YANG module is part of
   RFC XXXX: A YANG Data Model for Layer-2 Layer 2 Network Topologies
   see the RFC itself for full legal notices.";

revision 2019-10-15 2020-06-22 {
  description
    "Initial revision";
  reference
    "RFC XXXX: A YANG Data Model for Layer-2 Layer 2 Network
               Topologies";
}

/*
 * Typedefs
 */

typedef vni {
  type uint32 {
```

```
    range "0..16777215";

  }
  description
    "VXLAN Network Identifier or VXLAN Segment ID.
     It allows up to 16 M VXLAN segments to coexist
     within the same administrative ~~domain.";~~ domain.

     The use of value '0' is implementation-specific.";
  reference
    "RFC 7348: Virtual eXtensible Local Area  Network (VXLAN):
               A Framework for Overlaying Virtualized Layer 2
               Networks over Layer 3
     ~~Networks.";~~ Networks";
}

typedef l2-flag-type {
  type identityref {
    base flag-identity;
  }
  description
    "Base type for L2 flags. One example of L2 flag
     type is trill which represents trill topology
     type.";
}

typedef node-flag-type {
  type identityref {
    base flag-identity;
  }
  description
    "Node flag ~~attributes.The~~ attributes. The physical node can be
     one example of node flag attribute.";
}

typedef link-flag-type {
  type identityref {
    base flag-identity;
  }
  description
    "Link flag attributes. One example of link flag
     attribute is the pseudowire.";
}

typedef l2-network-event-type {
  type enumeration {
    enum add {
      value 0;
      description
        "A ~~Layer-2~~ Layer 2 node or link or termination-point
         has been added.";

    }
    enum remove {
      value 1;
      description
        "A ~~Layer-2~~ Layer 2 node or link or termination-point
         has been removed.";
    }
    enum update {
      value 2;
      description
        "A ~~Layer-2~~ Layer 2 node or link or termination-point
         has been updated.";
    }
  }
  description
    ~~"Layer-2~~
    "Layer 2 network event type for notifications.";
}

// l2-topology-event-type

typedef neg-mode {
  type enumeration {
    enum full-duplex {
      description
```

```
        "Indicates full-duplex mode.";
    }
    enum auto-neg {
      description
        "Indicates auto-negotiation mode.";
    }
    enum half-duplex {
      description
        "Indicates half-duplex mode.";
    }
  }
  description
    "Indicates the type of the negotiation mode.";
}

// negotiation mode
/*

 * Features
 */

feature VLAN {
  description
    "Indicates that the system supports the
     vlan functions (also known as an IEEE 802.1Q tag).";
}

feature QinQ {
  description
    "Indicates that the system supports the
     qinq functions (also known as IEEE 802.1ad double ~~tag)";~~ tag).";
}

feature VXLAN {
  description
    "Indicates that the device supports VXLAN functions.";
  reference
    "RFC 7348: Virtual eXtensible Local Area  Network (VXLAN):
               A Framework for Overlaying Virtualized Layer 2
               Networks over Layer 3 Networks";
}

/*
 * Identities
 */

identity flag-identity {
  description
    "Base type for flags.";
}

identity eth-encapsulation-type {
  base ift:iana-interface-type;
  description
    "Base identity from which specific Ethernet
     encapsulation types are derived.";
  reference
    "RFC 7224: IANA Interface Type YANG Module";
}

identity ethernet {
  base eth-encapsulation-type;
  description
    "Native Ethernet encapsulation.";
}

identity vlan {
  base eth-encapsulation-type;
  description
    "VLAN encapsulation.";
}
identity qinq {
  base eth-encapsulation-type;
  description
    "QinQ encapsulation.";
}
```

```
identity pbb {
  base eth-encapsulation-type;
  description
    "Provider-backbone-bridging (PBB) encapsulation.
     The PBB functions are developed in IEEE 802.1ah.";
}

identity trill {
  base eth-encapsulation-type;
  description
    "TRILL encapsulation.";
}

identity vpls {
  base eth-encapsulation-type;
  description
    "Ethernet VPLS interface encapsulation.";
}

identity vxlan {
  base eth-encapsulation-type;
  description
    "VXLAN MAC in UDP encapsulation.";
}

/*
 * Groupings
 */

grouping l2-network-type {
  description
    "Indicates the topology type to be L2.";
  container l2-network {
    presence "indicates L2 Network";
    description
      "The presence of the container node indicates
       L2 Topology.";
  }
}

grouping l2-network-attributes {
  description
    "L2 Topology scope attributes.";
  container l2-network-attributes {
    description
      "Contains L2 network attributes.";
    leaf name {
      type string;
      description
        "Name of the L2 network.";
    }
    leaf-list flag {
      type l2-flag-type;
      description
        "L2 network flags.";
    }
  }
}

grouping l2-node-attributes {
  description
    "L2 node attributes";
  container l2-node-attributes {
    description
      "Contains L2 node attributes.";
    leaf name {
      type string;
      description
        "Node name.";
    }
    leaf description {
      type string;
      description
        "Node description.";
    }
    leaf-list management-address {
      type inet:ip-address;
```

```
      description
        "System management address.";
    }
    leaf sys-mac-address {
      type yang:mac-address;
      description
        "System MAC-address.";  MAC address.";
    }
    leaf management-vid {
      if-feature "VLAN";
      type dot1q-types:vlanid;
      description
        "System management VID.";

    }
    leaf-list flag {
      type node-flag-type;
      description
        "Node operational flags.";
    }
  }
}

// grouping l2-node-attributes

grouping l2-link-attributes {
  description
    "L2 link attributes";
  container l2-link-attributes {
    description
      "Contains L2 link attributes.";
    leaf name {
      type string;
      description
        "Link name.";
    }
    leaf-list flag {
      type link-flag-type;
      description
        "Link flags.";
    }
    leaf rate {
      type decimal64 {
        fraction-digits 2;
      }
      units "Mbps";
      description
        "Link rate.";
    }
    leaf delay {
      type uint32;
      units "microseconds";
      description
        "Link delay in microseconds.";
    }
    leaf-list srlg {
      type uint32;
      description
        "List of Shared Risk Link Groups
         this link belongs to.";
      reference
        "RFC 4202: Routing Extensions in Support of
                   Generalized Multi-Protocol Label Switching
                   (GMPLS)";
    }
  }
}

// grouping l2-link-attributes

grouping l2-termination-point-attributes {
  description
    "L2 termination point attributes";
  container l2-termination-point-attributes {
    description
      "Containing L2 termination point attributes.";
    leaf description {
```

```
      type string;
      description
        "Port description.";
    }
    leaf maximum-frame-size {
      type uint32;
      description
        "Maximum L2 frame size. If L2 frame is an Ethernet
         frame, the Ethernet header should be included;
         if L2 frame is other type ~~(e.g.,PPP),~~ (e.g., PPP), the L2
         header should be included.";
    }
    choice l2-termination-point-type {
      description
        "Indicates termination-point type
         specific attributes.";
      case ethernet {
        leaf mac-address {
          type yang:mac-address;
          description
            "Interface MAC address.";
        }
        leaf eth-encapsulation {
          type identityref {
            base eth-encapsulation-type;
          }
          description
            "Encapsulation type of this
             termination point.";
        }
        leaf lag {
          type boolean;
          default "false";
          description
            "Defines whether lag is support or not.";
        }
        leaf-list member-link-tp {
          when "../lag = 'true'" {
            description
              "Relevant only when the lag interface is supported.";
          }
          type leafref {
            path "~~/nw:networks/nw:network/nw:node/"~~+ "/nw:networks/nw:network/nw:node/"
               + "nt:termination-point/nt:tp-id";
          }
          description
            "Member link termination points.";
        }
        leaf mode {
          type neg-mode;
          default "auto-neg";
          description
            "Exposes the negotiation mode.";
        }
        leaf port-vlan-id {
          when "~~derived-from-or-self(../eth-encapsulation"~~+ "derived-from-or-self(../eth-encapsulation"
             + ", 'l2t:vlan')" {
            description
              "Only applies when the type of the Ethernet
               encapsulation is 'vlan'.";
          }
          if-feature "VLAN";
          type dot1q-types:vlanid;
          description
            "Port VLAN ID is the VLAN ~~id~~ identifier that
             will be assigned to any untagged frames entering
             the switch on the specific port.";
        }
        list vlan-id-name {
          when "~~derived-from-or-self(../eth-encapsulation"~~+ "derived-from-or-self(../eth-encapsulation"
             + ", 'l2t:vlan')" {
            description
              "Only applies when the type of the Ethernet
               encapsulation is 'vlan'.";
          }
          if-feature "VLAN";
          key "vlan-id";
```

```
        description
          "Interface configured VLANs.";
        leaf vlan-id {
          type dot1q-types:vlanid;
          description
            "VLAN ID.";
        }
        leaf vlan-name {
          type string {
            length "1..31";
          }
          description
            "VLAN name.";
        }
      }
      list qinq {
        when "derived-from-or-self(../eth-encapsulation"+ "derived-from-or-self(../eth-encapsulation"
           + ", 'l2t:qinq')" {
          description
            "Only applies when the type of the Ethernet
             encapsulation is 'qinq'.";
        }
        if-feature "QinQ";
        key "svlan-id cvlan-id";
        description
          "Interface configured SVLANs and CVLANs.";
        leaf svlan-id {
          type dot1q-types:vlanid;
          description
            "SVLAN ID.";
        }
        leaf cvlan-id {
          type dot1q-types:vlanid;
          description
            "CVLAN ID.";
        }
      }
      container vxlan {
        when "derived-from-or-self(../eth-encapsulation"+ "derived-from-or-self(../eth-encapsulation"
           + ", 'l2t:vxlan')" {
          description
            "Only applies when the type of the Ethernet
             encapsulation is 'vxlan'.";
        }
        if-feature "VXLAN";
        leaf vni-id {
          type vni;
          description
            "VXLAN Network Identifier (VNI).";
        }
        description
          "Vxlan encapsulation type.";

      }
    }
    //case ethernet
    case legacy {
      leaf layer-2-address {
        type yang:phys-address;
        description
          "Interface Layer 2 address.";
      }
      leaf encapsulation {
        type identityref {
          base ift:iana-interface-type;
        }
        description
          "Other legacy encapsulation type of this
           termination point.";
      }
    }
    //case legacy such as atm, ppp, hdlc, etc.
  }
  //choice termination-point-type
  leaf tp-state {
    type enumeration {
      enum in-use {
```

```
          value 1;
          description
            "The termination point is in forwarding state.";
        }
        enum blocking {
          value 2;
          description
            "The termination point is in blocking state.";
        }
        enum down {
          value 3;
          description
            "The termination point is in down state.";
        }
        enum others {
          value 4;
          description
            "The termination point is in other state.";
        }
      }
      config false;
      description
        "State of the termination point.";
    }

  }
}

// grouping l2-termination-point-attributes
/*
 * Data nodes
 */

augment "/nw:networks/nw:network/nw:network-types" {
  description
    "Introduces new network type for L2 topology.";
  uses l2-network-type;
}

augment "/nw:networks/nw:network" {
  when '/nw:networks/nw:network/nw:network-types/l2t:l2-network' {
    description
      "Augmentation parameters apply only for networks
       with L2 topology.";
  }
  description
    "Configuration parameters for the L2 network
     as a whole.";
  uses l2-network-attributes;
}

augment "/nw:networks/nw:network/nw:node" {
  when '/nw:networks/nw:network/nw:network-types/l2t:l2-network' {
    description
      "Augmentation parameters apply only for networks
       with L2 topology.";
  }
  description
    "Configuration parameters for L2 at the node
     level.";
  uses l2-node-attributes;
}

augment "/nw:networks/nw:network/nt:link" {
  when '/nw:networks/nw:network/nw:network-types/l2t:l2-network' {
    description
      "Augmentation parameters apply only for networks
       with L2 topology.";
  }
  description
    "Augments L2 topology link information.";
  uses l2-link-attributes;
}
augment "/nw:networks/nw:network/nw:node/nt:termination-point" {
  when '/nw:networks/nw:network/nw:network-types/l2t:l2-network' {
    description
      "Augmentation parameters apply only for networks
```

```
        with L2 topology.";
    }
    description
      "Augments L2 topology termination point information.";
    uses l2-termination-point-attributes;
  }

  /*
   * Notifications
   */

  notification l2-node-event {
    description
      "Notification event for L2 node.";
    leaf event-type {
      type l2-network-event-type;
      description
        "Event type.";
    }
    uses nw:node-ref;
    uses l2-network-type;
    uses l2-node-attributes;
  }

  notification l2-link-event {
    description
      "Notification event for L2 link.";
    leaf event-type {
      type l2-network-event-type;
      description
        "Event type.";
    }
    uses nt:link-ref;
    uses l2-network-type;
    uses l2-link-attributes;
  }

  notification l2-termination-point-event {
    description
      "Notification event for L2 termination point.";
    leaf event-type {
      type l2-network-event-type;
      description
        "Event type.";

    }
    uses nt:tp-ref;
    uses l2-network-type;
    uses l2-termination-point-attributes;
  }
}
<CODE ENDS>
```

5. IANA Considerations

This document requests IANA to register the following URIs in the "ns" subregistry within the "IETF XML Registry" [RFC3688]:

```
 URI: urn:ietf:params:xml:ns:yang:ietf-l2-topology
 Registrant Contact: The IESG.
 XML: N/A; the requested URI is an XML namespace.

 URI: urn:ietf:params:xml:ns:yang:ietf-l2-topology-state
 Registrant Contact: The IESG.
 XML: N/A; the requested URI is an XML namespace.
```

This document requests IANA to register the following YANG modules in the "YANG Module Names" subregistry [RFC6020] within the "YANG Parameters" registry.

```
  name: ietf-l2-topology
  namespace: urn:ietf:params:xml:ns:yang:ietf-l2-topology
  prefix: l2t
  reference: RFC XXXX

  name: ietf-l2-topology-state
  namespace: urn:ietf:params:xml:ns:yang:ietf-l2-topology-state
```

```
      prefix: l2t-s
      reference: RFC XXXX
```

These modules are not maintained by IANA.

6. Security Considerations

The YANG module specified in this document defines a schema for data that is designed to be accessed via network management protocols such as NETCONF [RFC6241] or RESTCONF [RFC8040]. The lowest NETCONF layer is the secure transport layer, and the mandatory-to-implement secure transport is Secure Shell (SSH) [RFC6242]. The lowest RESTCONF layer is HTTPS, and the mandatory-to-implement secure transport is TLS [RFC8446].

The Network Configuration Access Control Model (NACM) [RFC8341] provides the means to restrict access for particular NETCONF or RESTCONF users to a preconfigured subset of all available NETCONF or RESTCONF protocol operations and content.

In general, Layer 2 network topologies are system-controlled and provide ephemeral topology information. In an NMDA-complient server, they are only part of <operational> which provides read-only access to clients, they are less vulnerable. That said, the YANG module does in principle allow information to be configurable.

The Layer 2 topology module define information that can be configurable in certain instances, for example in the case of virtual topologies that can be created by client applications. In such cases, a malicious client could introduce topologies that are undesired. Specifically, a malicious client could attempt to remove or add a node, a link, a termination point, by creating or deleting corresponding elements in the node, link, and termination point lists, respectively. In the case of a topology that is learned, the server will automatically prohibit such misconfiguration attempts. In the case of a topology that is configured, i.e. whose origin is "intended", the undesired configuration could become effective and be reflected in the operational state datastore, leading to disruption of services provided via this topology might be disrupted. For those reasons, it is important that the NETCONF access control model is vigorously applied to prevent topology misconfiguration by unauthorized clients.

There are a number of data nodes defined in this YANG module that 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. These are the subtrees and data nodes and their sensitivity/vulnerability in the ~~ietf-network~~ **'ietf-network'** module:

- l2-network-attributes: A malicious client could attempt to sabotage the configuration of any of the contained attributes, such as the name or the flag data nodes.

- l2-node-attributes: A malicious client could attempt to sabotage the configuration of important node attributes, such as the name or the management-address.

- l2-link-attributes: A malicious client could attempt to sabotage the configuration of important link attributes, such as the rate or the delay data nodes.

- l2-termination-point-attributes: A malicious client could attempt to sabotage the configuration of important termination point ~~attributes, such as the maximum-frame-size.~~ **attributes (e.g., 'maximum-frame-size').**

7. Acknowledgements

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Appendix A. Companion YANG Module for Non-NMDA Compliant Implementations

The YANG module ietf-l2-topology defined in this document augments two modules, 'ietf-network' and 'ietf-network-topology', that are designed to be used in conjunction with implementations that support the Network Management Datastore Architecture (NMDA) defined in [RFC8342]. In order to allow implementations to use the model even in cases when NMDA is not supported, a set of companion modules have been defined that represent a state model of networks and network topologies, 'ietf-network-state' and 'ietf-network-topology-state', respectively.

In order to be able to use the model for layer 2 topologies defined in this document in conjunction with non-NMDA compliant implementations, a corresponding companion module is defined that represent the operational state of layer 2 network topologies. The module 'ietf-l2-topology-state' mirrors the module 'ietf-l2-topology' defined earlier in this document. However, it augments 'ietf-network-state' and 'ietf-network-topology-state' (instead of 'ietf-network' and 'ietf-network-topology') and all its data nodes are non-configurable.

The companion module 'ietf-l2-topology' SHOULD NOT be supported by implementations that support NMDA. It is for this reason that this module is defined in the informative Appendix.

As the structure of this modules mirrors that of its underlying modules, the YANG tree is not depicted separately.

<CODE BEGINS> file ~~"ietf-l2-topology-state@2019-06-04.yang"~~ **"ietf-l2-topology-state@2020-06-22.yang"**

```
module ietf-l2-topology-state {
  yang-version 1.1;
```

```
namespace "urn:ietf:params:xml:ns:yang:ietf-l2-topology-state";
prefix "l2t-s"; l2t-s;

import ietf-network-state {
  prefix "nw-s"; nw-s;
  reference
    "RFC 8345: A YANG Data Model for Network Topologies";
}
import ietf-network-topology-state {
  prefix "nt-s"; nt-s;
  reference
    "RFC 8345: A YANG Data Model for Network Topologies";
}
import ietf-l2-topology {
  prefix "l2t"; l2t;
  reference
    "RFC XXXX: A YANG Data Model for Layer-2 Layer 2 Network
               Topologies";
}

organization
  "IETF I2RS (Interface to the Routing System) Working Group";
contact
  "WG Web:   <http://tools.ietf.org/wg/i2rs/>
   WG List:  <mailto:i2rs@ietf.org>
   Editor:    Jie Dong
              <mailto:jie.dong@huawei.com>
   Editor:    Xiugang Wei
              <mailto:weixiugang@huawei.com>
   Editor:    Qin Wu
              <mailto:bill.wu@huawei.com>
   Editor:    Mohamed Boucadair
              <mailto:mohamed.boucadair@orange.com>
   Editor:   Anders Liu
              <andersliu@tencent.com>";
description
  " This module defines a model for Layer 2 Network Topology
    state, representing topology that either is learned or
    results from applying topology that has been configured per
    the 'ietf-l2-topology' model, mirroring the
    corresponding data nodes in this model.

    This model mirrors 'ietf-l2-topology' but contains only
    read-only state data.  The model is not needed when the
    underlying implementation infrastructure supports the
    Network Management Datastore Architecture (NMDA).

    Copyright (c) 2020 IETF Trust and the persons identified as
    authors of the code.  All rights reserved.

    Redistribution and use in source and binary forms, with or
    without modification, is permitted pursuant to, and subject
    to the license terms contained in, the Simplified BSD License
    set forth in Section 4.c of the IETF Trust's Legal Provisions
    Relating to IETF Documents
    (https://trustee.ietf.org/license-info).

   This version of this YANG module is part of
   RFC XXXX: A YANG Data Model for Layer-2 Layer 2 Network Topologies
   see the RFC itself for full legal notices.";

revision "2019-06-04" 2020-06-22 {
  description
    "Initial revision";
  reference
    "RFC XXXX: A YANG Data Model for Layer-2 Layer 2 Network
               Topologies";
}

/*
 * Data nodes
 */

augment "/nw-s:networks/nw-s:network/nw-s:network-types" {
  description
      "Introduce
    "Introduces a new network type for L2 topology"; topology.";
```

```
      uses l2t:l2-network-type;
    }
    augment "/nw-s:networks/nw-s:network" {
      when "/nw-s:networks/nw-s:network/nw-s:network-types/"+
           "l2t-s:l2-network" '/nw-s:networks/nw-s:network/nw-s:network-types/'
         + 'l2t-s:l2-network' {
        description
          "Augmentation parameters apply only for networks
           with L2 topology.";
      }
      description
        "Configuration parameters for the L2 network
         as a whole.";
      uses l2t:l2-network-attributes;
    }

    augment "/nw-s:networks/nw-s:network/nw-s:node" {
      when "../nw-s:network-types/l2t-s:l2-network" '../nw-s:network-types/l2t-s:l2-network' {
        description
          "Augmentation parameters apply only for networks
           with L2 topology.";
      }
      description
        "Configuration parameters for L2 at the node
         level.";
      uses l2t:l2-node-attributes;
    }

    augment "/nw-s:networks/nw-s:network/nt-s:link" {
      when "../nw-s:network-types/l2t-s:l2-network" '../nw-s:network-types/l2t-s:l2-network' {
        description
          "Augmentation parameters apply only for networks
           with L2 topology.";
      }
      description
        "Augments L2 topology link information.";
      uses l2t:l2-link-attributes;
    }

    augment "/nw-s:networks/nw-s:network/nw-s:node/"+ "/nw-s:networks/nw-s:network/nw-s:node/"
          + "nt-s:termination-point" {
      when "../../nw-s:network-types/l2t-s:l2-network" '../../nw-s:network-types/l2t-s:l2-network' {
        description
          "Augmentation parameters apply only for networks
           with L2 topology.";
      }
      description
        "Augments L2 topology termination point information.";
      uses l2t:l2-termination-point-attributes;
    }
    /*
     * Notifications
     */

    notification l2-node-event {
      description
        "Notification event for L2 node.";
      leaf event-type {
        type l2t:l2-network-event-type;
        description
          "Event type.";
      }
      uses nw-s:node-ref;
      uses l2t:l2-network-type;
      uses l2t:l2-node-attributes;
    }

    notification l2-link-event {
      description
        "Notification event for a L2 link.";
      leaf event-type {
        type l2t:l2-network-event-type;
        description
          "Event type.";
      }
      uses nt-s:link-ref;
      uses l2t:l2-network-type;
```

```
        uses l2t:l2-link-attributes;
      }

      notification l2-termination-point-event {
        description
          "Notification event for L2 termination point.";
        leaf event-type {
          type l2t:l2-network-event-type;
          description
            "Event type.";
        }
        uses nt-s:tp-ref;
        uses l2t:l2-network-type;
        uses l2t:l2-termination-point-attributes;
      }
    }
    <CODE ENDS>
```

Appendix B. An Example

This section contains an example of an instance data tree in JSON encoding [RFC7951]. The example instantiates "ietf-l2- topology" for the topology that is depicted in the following diagram. There are three nodes: D1, D2, and D3. D1 has three termination points: 1-0-1, 1-2-1, and 1-3-1. D2 has three termination points as well: 2-1-1, 2-0-1, and 2-3-1. D3 has two termination points: 3-1-1 and 3-2-1. In addition, there are six links, two between each pair of nodes, with one going in each direction.

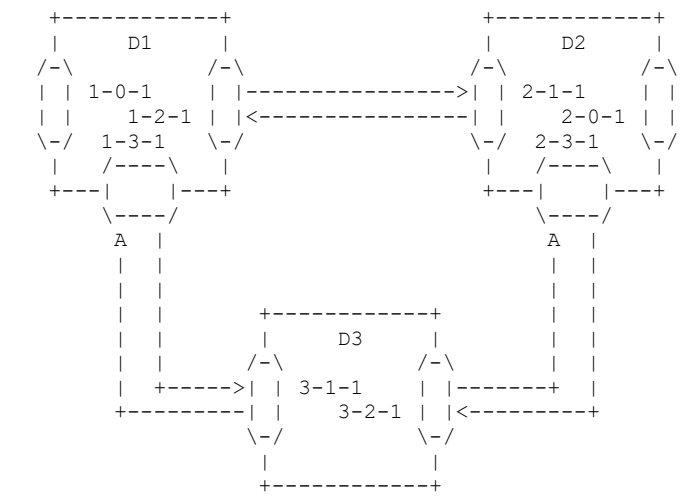

Figure 2. A Network Topology Example

The corresponding instance data tree is depicted ~~as below. Note that some lines have been wrapped to adhere to the 72-character line limitation of RFCs.~~ **below:**

```
 {
  "ietf-network:networks": {
    "network": [
      {
        "network-types": {
          "ietf-l2-topology:l2-network": {}
        },
        "network-id": "l2-topo-example",
        "node": [
          {
            "node-id": "D1",
            "termination-point": [
              {
                "tp-id": "1-0-1",
                   ~~"ietf-l2-topology:~~
~~                     l2-termination-point-attributes":~~
                "ietf-l2-topology:l2-termination-point-attributes": {
                  "mac-address": "00-00-5E-00-53-D0"
                }
              },
              {
```

```
                    "tp-id": "1-2-1",
                      "ietf-l2-topology:
                        l2-termination-point-attributes":
                    "ietf-l2-topology:l2-termination-point-attributes": {
                      "mac-address": "00-00-5E-00-53-D1"
                    }
                  },
                  {
                    "tp-id": "1-3-1",
                      "ietf-l2-topology:
                        l2-termination-point-attributes":
                    "ietf-l2-topology:l2-termination-point-attributes": {
                      "mac-address": "00-00-5E-00-53-D2"
                    }
                  }
                ],
                "ietf-l2-topology:l2-node-attributes": {
                  "management-address": ["192.0.2.1"] [
                    "192.0.2.1"
                  ]
                }
              },
              {
                "node-id": "D2",
                "termination-point": [
                  {
                    "tp-id": "2-0-1",
                      "ietf-l2-topology:
                        l2-termination-point-attributes":
                    "ietf-l2-topology:l2-termination-point-attributes": {
                      "mac-address": "00-00-5E-00-53-E0"
                    }
                  },
                  {
                    "tp-id": "2-1-1",
                      "ietf-l2-topology:
                        l2-termination-point-attributes":
                    "ietf-l2-topology:l2-termination-point-attributes": {
                      "mac-address": "00-00-5E-00-53-E1"
                    }
                  },
                  {
                    "tp-id": "2-3-1",
                      "ietf-l2-topology:

                        l2-termination-point-attributes":
                    "ietf-l2-topology:l2-termination-point-attributes": {
                      "mac-address": "00-00-5E-00-53-E2"
                    }
                  }
                ],
                "ietf-l2-topology:l2-node-attributes": {
                  "management-address": ["192.0.2.2"] [
                    "192.0.2.2"
                  ]
                }
              },
              {
                "node-id": "D3",
                "termination-point": [
                  {
                    "tp-id": "3-1-1",
                      "ietf-l2-topology:
                        l2-termination-point-attributes":
                    "ietf-l2-topology:l2-termination-point-attributes": {
                      "mac-address": "00-00-5E-00-53-F0"
                    }
                  },
                  {
                    "tp-id": "3-2-1",
                      "ietf-l2-topology:
                        l2-termination-point-attributes":
                    "ietf-l2-topology:l2-termination-point-attributes": {
                      "mac-address": "00-00-5E-00-53-F1"
                    }
                  }
                ],
```

```
      "ietf-l2-topology:l2-node-attributes": {
        "management-address": ~~["192.0.2.3"]~~ [
          "192.0.2.3"
        ]
      }
    }
  ],
  "ietf-network-topology:link": [
    {
      "link-id": "D1,1-2-1,D2,2-1-1",
      "source": {
        "source-node": "D1",
        "source-tp": "1-2-1"
        +
      },
      "destination": {
        "dest-node": "D2",
        "dest-tp": "2-1-1"
      },
      "ietf-l2-topology:l2-link-attributes": {
        "rate": "1000"
      }
    },
    {
      "link-id": "D2,2-1-1,D1,1-2-1",
      "source": {
        "source-node": "D2",
        "source-tp": "2-1-1"
        +

      },
      "destination": {
        "dest-node": "D1",
        "dest-tp": "1-2-1"
      },
      "ietf-l2-topology:l2-link-attributes": {
        "rate": "1000"
      }
    },
    {
      "link-id": "D1,1-3-1,D3,3-1-1",
      "source": {
        "source-node": "D1",
        "source-tp": "1-3-1"
        +
      },
      "destination": {
        "dest-node": "D3",
        "dest-tp": "3-1-1"
      },
      "ietf-l2-topology:l2-link-attributes": {
        "rate": "1000"
      }
    },
    {
      "link-id": "D3,3-1-1,D1,1-3-1",
      "source": {
        "source-node": "D3",
        "source-tp": "3-1-1"
        +
      },
      "destination": {
        "dest-node": "D1",
        "dest-tp": "1-3-1"
      },
      "ietf-l2-topology:l2-link-attributes": {
        "rate": "1000"
      }
    },
    {
      "link-id": "D2,2-3-1,D3,3-2-1",
      "source": {
        "source-node": "D2",
        "source-tp": "2-3-1"
        +
      },
      "destination": {
```

```
                  "dest-node": "D3",
                  "dest-tp": "3-2-1"
                },
                "ietf-l2-topology:l2-link-attributes": {
                  "rate": "1000"
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                "link-id": "D3,3-2-1,D2,2-3-1",
                "source": {
                  "source-node": "D3",
                  "source-tp": "3-2-1"
                },
                "destination": {
                  "dest-node": "D2",
                  "dest-tp": "2-3-1"
                },
                "ietf-l2-topology:l2-link-attributes": {
                  "rate": "1000"
                }
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            ]
          }
        ]
      }
    }
```

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