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A YANG Data Model for Layer-2 Network Topologies  
draft-ietf-i2rs-yang-l2-network-topology-08

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:

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

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

Status of This Memo

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Internet-Draft

Layer-2 Network Topology Data Model

July 2019

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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 network topologies by augmenting the generic network and network topology 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](#)].

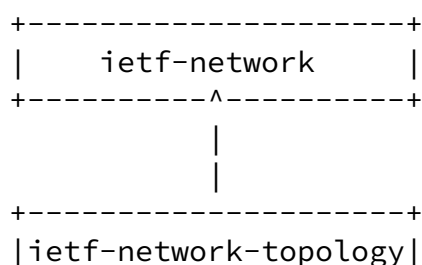
## 2. Terminology

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 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 specific information, such as the identifiers, descriptions, attributes and states of the Layer-2 networks, nodes, links and termination points. Some of the information may be collected via Link Layer Discovery Protocol (LLDP) or other Layer-2 protocols, and some of them may be locally configured.



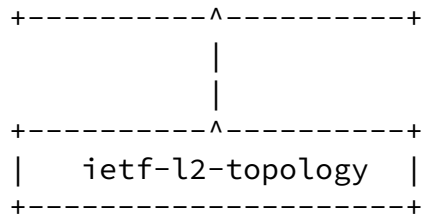


Figure 1: L2-topology YANG Module Structure

The structure of "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?     vlan {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 port-vlan-id?        vlan {VLAN}?
| | +--rw vlan-id-name* [vlan-id] {VLAN}?
| |   +--rw vlan-id          vlan
| |   +--rw vlan-name?      string
| +--:(legacy)
|   +--rw layer-2-address?    yang:phys-address
|   +--rw encapsulation?      identityref
+--ro tp-state?                enumeration
notifications:
+---n l2-node-event
| +--ro event-type?
| +--ro node-ref?
| +--ro network-ref?
| +--ro l2-network!
| +--ro l2-node-attributes
+---n l2-link-event
| +--ro event-type?
| +--ro link-ref?

```

```

| +--ro network-ref?
| +--ro l2-network!
| +--ro l2-link-attributes
+---n l2-termination-point-event
  +--ro event-type?
  +--ro tp-ref?
  +--ro node-ref?
  +--ro network-ref?
  +--ro l2-network!
  +--ro l2-termination-point-attributes

```

The L2-topology module augments the generic 'ietf-network' and 'ietf-network-topology' modules as follows:

- o 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 [[RFC8345](#)].
- o 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 network

name and a set of flags. Each type of flag is represented by a separate identity.

- o Additional data objects for Layer-2 nodes are introduced by augmenting the "node" list of the generic 'ietf-network' module. New objects include Layer-2 node identifier, description, management address, and a set of flags.
- o Additional data objects for Layer-2 termination points are introduced by augmenting the "termination-point" list of the 'ietf-network-topology' module defined in [[RFC8345](#)]. New objects include Layer-2 termination point descriptions, Layer-2 termination point type specific attributes and Layer-2 termination point states.
- o Links in the 'ietf-network-topology' module are augmented as well with a set of Layer-2 parameters, allowing to associate a link with a name, a set of Layer-2 link attributes and flags.
- o The optional L2 technology specific attributes are introduced in this module as Layer-2 features.

#### [4.](#) Layer 2 Topology YANG Module

This module uses the common YANG types defined in [[RFC6991](#)] and types defined in [[RFC8345](#)].

```
<CODE BEGINS> file "ietf-l2-topology@2019-06-21.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";
}

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 topology of a network.

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This version of this YANG module is part of [draft-ietf-i2rs-yang-l2-network-topo-07](#); see the RFC itself for full legal notices.";

```
revision "2019-06-21" {
  description "Initial revision";
  reference
    "RFC XXXX: A YANG Data Model for Layer-2 Network Topologies";
}

/*
 * Typedefs
 */

typedef vlan {
  type uint16 {
    range "1..4094";
  }
  description "VLAN ID";
  reference "IEEE 802.1Q";
}

typedef trill-nickname {
  type uint16;
  description "TRILL Nickname";
  reference "RFC 6326";
}

typedef vni {
  type uint32 {
    range "1..16777215";
  }
}
```

```
description "VxLAN Network Identifier";
```



```

    reference "RFC 7348";
}

typedef l2-flag-type {
    type identityref {
        base "flag-identity";
    }
    description "Base type for l2 flags";
}
typedef node-flag-type {
    type identityref {
        base "flag-identity";
    }
    description "Node flag attributes";
}
typedef link-flag-type {
    type identityref {
        base "flag-identity";
    }
    description "Link flag attributes";
}

typedef l2-network-event-type {
    type enumeration {
        enum "add" {
            value 0;
            description "An L2 node or link or termination-point
has been added";
        }
        enum "remove" {
            value 1;
            description "An L2 node or link or termination-point
has been removed";
        }
        enum "update" {
            value 2;
            description "An L2 node or link or termination-point
has been updated";
        }
    }
    description "l2 network event type for notifications";
} // l2-topology-event-type

/*
 * Features
 */

```

---

```
feature VLAN {
  description
    "Indicates that the system supports the
    vlan functions.";
}

feature QinQ {
  description
    "Indicates that the system supports the
    qinq functions";
  reference "IEEE 802.1ad.";
}

feature PBB {
  description
    "Indicates that the device supports the
    provider-backbone-bridging functions";
  reference "IEEE 802.1ah.";
}

feature VPLS {
  description
    "Indicates that the device supports the
    VPLS functions.";
  reference "RFC 4761, RFC 4762";
}

feature TRILL {
  description
    "Indicates that the device supports the
    TRILL functions.";
  reference "RFC 6325";
}

feature VXLAN {
  description
    "Indicates that the device supports the
    VXLAN functions.";
  reference "RFC 7348";
}

/*
 * Identities
 */

identity flag-identity {
```

```
    description "Base type for flags.";
}
```

```
identity encapsulation-type {
    description
        "Base identity from which specific encapsulation
        types are derived.";
}
```

```
identity eth-encapsulation-type {
    base encapsulation-type;
    description
        "Base identity from which specific Ethernet
        encapsulation types are derived.";
}
```

```
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
        "PBB encapsulation.";
}
```

```
identity trill {
```

```
    base eth-encapsulation-type;
    description
        "TRILL encapsulation.";
}
```

```
identity vpls {
    base eth-encapsulation-type;
    description
        "VPLS encapsulation.";
```

```
}
```

```
identity vxlan {
    base eth-encapsulation-type;
    description
        "VXLAN encapsulation.";
}
```

```
identity frame-relay {
    base encapsulation-type;
    description
        "Frame Relay encapsulation.";
}
```

```
identity ppp {
    base encapsulation-type;
    description
        "PPP encapsulation";
}
```

```
identity hdlc {
    base encapsulation-type;
    description
        "HDLC encapsulation.";
}
```

```
identity atm {
    base encapsulation-type;
    description
        "Base identity from which specific ATM
        encapsulation types are derived.";
```

```

}

identity pwe3 {
  base encapsulation-type;
  description
    "Base identity from which specific PW
    encapsulation types are derived.";
}

```

```

/*
 * Groupings
 */

```

```

grouping l2-network-type {

```

```

  description "Identify 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 "Containing 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 "Containing 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.";
    }
    leaf management-vid {
      if-feature VLAN;
      type vlan;
    }
  }
}

```

```

    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 "Containing 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;
        }
        description "Link rate.";
    }

    leaf delay {
        type uint32;
        description "Link delay in microseconds.";
    }
    leaf-list srlg {
        type uint32;
        description
            "List of Shared Risk Link Groups
            this link belongs to.";
        reference "RFC 4202";
    }
}
} // grouping l2-link-attributes

grouping l2-termination-point-attributes {
    description "L2 termination point attributes";
    container l2-termination-point-attributes {
        description "Containing L2 TP attributes";
        leaf description {
            type string;
        }
    }
}

```

```

        description "Port description.";
    }

    leaf maximum-frame-size {
        type uint32;
        description "Maximum frame size.";
    }

    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 port-vlan-id {
        if-feature VLAN;
        type vlan;
        description "Port VLAN ID is the VLAN id that
            will be assigned to any untagged frames entering
            the switch on the specific port.";
    }

    list vlan-id-name {
        if-feature VLAN;
        key "vlan-id";
        description "Interface configured VLANs.";
        leaf vlan-id {
            type vlan;
            description "VLAN ID.";
        }
        leaf vlan-name {
            type string;
            description "VLAN name.";
        }
    }
}

```

```

} //case ethernet

case legacy {
    leaf layer-2-address {

```



```

        type yang:phys-address;
        description "Interface Layer 2 address.";
    }

    leaf encapsulation {
        type identityref {
            base encapsulation-type;
        }
        description
            "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 0;
            description
                "the termination point is in forwarding state.";
        }
        enum blocking {
            value 1;
            description
                "the termination point is in blocking state.";
        }
        enum down {
            value 2;
            description
                "the termination point is in down state.";
        }
        enum others {
            value 3;
            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
    "Introduce 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 "Augment 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
        "Augment 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;
  }

} // module l2-topology
<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 [[RFC7950](#)] 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-compliant 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 module:

- o 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.
- o l2-node-attributes: A malicious client could attempt to sabotage the configuration of important node attributes, such as the name or the management-address.
- o 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.
- o l2-termination-point-attributes: A malicious client could attempt to sabotage the configuration of important termination point attributes, such as the 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 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@2019-06-21.yang"
module ietf-l2-topology-state {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-l2-topology-state";
  prefix "l2t-s";

  import ietf-network-state {
    prefix "nw-s";
  }

  import ietf-network-topology-state {
    prefix "nt-s";
  }

  import ietf-l2-topology {
    prefix "l2t";
  }

  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>";
```

```
description
```

```
"This module defines a basic model for
the layer-2 topology of a network.
```

```
Copyright (c) 2018 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
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set forth in Section 4.c of the IETF Trust's Legal Provisions
Relating to IETF Documents
(http://trustee.ietf.org/license-info).
```

```
This version of this YANG module is part of
draft-ietf-i2rs-yang-l2-network-topo-07;
see the RFC itself for full legal notices.";
```

```
revision "2019-06-21" {
  description "Initial revision";
  reference "draft-ietf-i2rs-l2-network-topology-07";
}
```

```
/*
 * Data nodes
 */
```

```
augment "/nw-s:networks/nw-s:network/nw-s:network-types" {
  description
    "Introduce new network type for L2 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" {
```

```
        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: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 L2 at the node
        level";
    uses l2t:l2-node-attributes;
}

augment "/nw-s:networks/nw-s:network/nt-s:link" {
    when "/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 "Augment L2 topology link information";
    uses l2t:l2-link-attributes;
}

augment "/nw-s:networks/nw-s:network/nw-s:node/" +
    "nt-s:termination-point" {
    when "/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
  "Augment 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 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;
}
```

```

} // module l2-topology-state
<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.

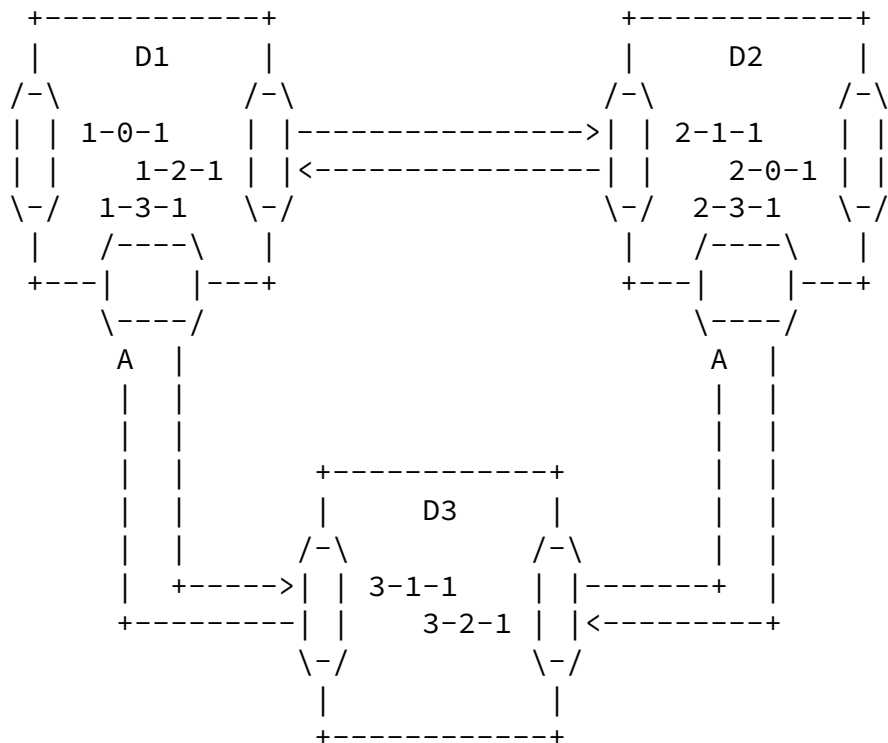


Figure 2. A Network Topology Example

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.

```
{
  "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": {
                    "mac-address": "A1:B2:C3:D4:E5:F0"
                  }
              }
            ]
          }
        ]
      }
    ]
  }
}
```

```
    },
    {
      "tp-id": "1-2-1",
      "ietf-l2-topology:
        l2-termination-point-attributes": {
          "mac-address": "A1:B2:C3:D4:E5:F1"
        }
    },
    {
      "tp-id": "1-3-1",
      "ietf-l2-topology:
        l2-termination-point-attributes": {
          "mac-address": "A1:B2:C3:D4:E5:F2"
        }
    }
  ],
  "ietf-l2-topology:l2-node-attributes": {
    "management-address": ["10.1.1.1"]
  }
},
{
```

```

"node-id": "D2",
"termination-point": [
  {
    "tp-id": "2-0-1",
    "ietf-l2-topology:
      l2-termination-point-attributes": {
        "mac-address": "A2:B2:C3:D4:E5:F0"
      }
  },
  {
    "tp-id": "2-1-1",
    "ietf-l2-topology:
      l2-termination-point-attributes": {
        "mac-address": "A2:B2:C3:D4:E5:F2"
      }
  },
  {
    "tp-id": "2-3-1",
    "ietf-l2-topology:
      l2-termination-point-attributes": {
        "mac-address": "A2:B2:C3:D4:E5:F3"
      }
  }
],
"ietf-l2-topology:l2-node-attributes": {
  "management-address": ["10.1.1.2"]
}

```

```

},
{
  "node-id": "D3",
  "termination-point": [
    {
      "tp-id": "3-1-1",
      "ietf-l2-topology:
        l2-termination-point-attributes": {
          "mac-address": "A3:B2:C3:D4:E5:F0"
        }
    },
    {
      "tp-id": "3-2-1",
      "ietf-l2-topology:

```

```

        l2-termination-point-attributes": {
          "mac-address": "A3:B2:C3:D4:E5:F1"
        }
      }
    ],
    "ietf-l2-topology:l2-node-attributes": {
      "management-address": ["10.1.1.3"]
    }
  }
],
"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"
    }
  },
  {

```

```
        "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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