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A YANG Data Model for L1 Connectivity Service Model (L1CSM)

Abstract

This document provides a YANG data model for Layer 1 Connectivity Service Model (L1CSM). The intent of this document is to provide a Layer 1 service model exploiting YANG data model, which can be utilized by a customer network controller to initiate a service request connectivity as well as retrieving service states toward a Layer 1 network controller communicating with its customer network controller. This YANG model is NMDA-compliant.

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1. Introduction

This document provides a YANG data model for L1VPN Connectivity Service Model (L1CSM) which can be classified as Network Service YANG module per [RFC8199]. The intent of this document is to provide a transport service model exploiting YANG data model, which can be utilized by a client network controller to initiate a service request connectivity request as well as retrieving service states toward a transport network controller communicating with the client controller via a NETCONF [RFC8341] or a RESTCONF [RFC8040] interface.

[RFC4847] provides a framework and service level requirements for Layer 1 Virtual Private Networks (L1VPNs). It classifies service models as management-based service model, signaling-based service model (Basic Mode) and signaling and routing service model (Enhanced Mode).

In the management-based service model, customer management systems and provider management systems communicate with each other. Customer management systems access provider management systems to request layer 1 connection setup/deletion between a pair of CEs. Customer management systems may obtain additional information, such as resource availability information and monitoring information,

from provider management systems. There is no control message exchange between a CE and PE.

In the signaling-based service model (Basic Model), the CE-PE interface's functional repertoire is limited to path setup signaling only. In the Signaling and routing service model (Enhanced Mode), the CE-PE interface provides the signaling capabilities as in the Basic Mode, plus permits limited exchange of information between the control planes of the provider and the customer to help such functions as discovery of customer network routing information (i.e., reachability or TE information in remote customer sites), or parameters of the part of the provider's network dedicated to the customer.

The primary focus of this document is to describe L1CS YANG model required for the instantiation of point-to-point L1VPN service. A L1VPN is a service offered by a core layer 1 network to provide layer 1 connectivity between two or more customer sites where the customer has some control over the establishment and type of the connectivity.

The data model presented in Section 3 is in consistent with [MEF63]. The data model includes configuration and state data according to the new Network Management Datastore Architecture [RFC8342].

1.1. Deployment Scenarios

Figure 1 depicts a deployment scenario of the L1VPN SDN control-based service model for an external customer instantiating L1 point-to-point connectivity to the provider.

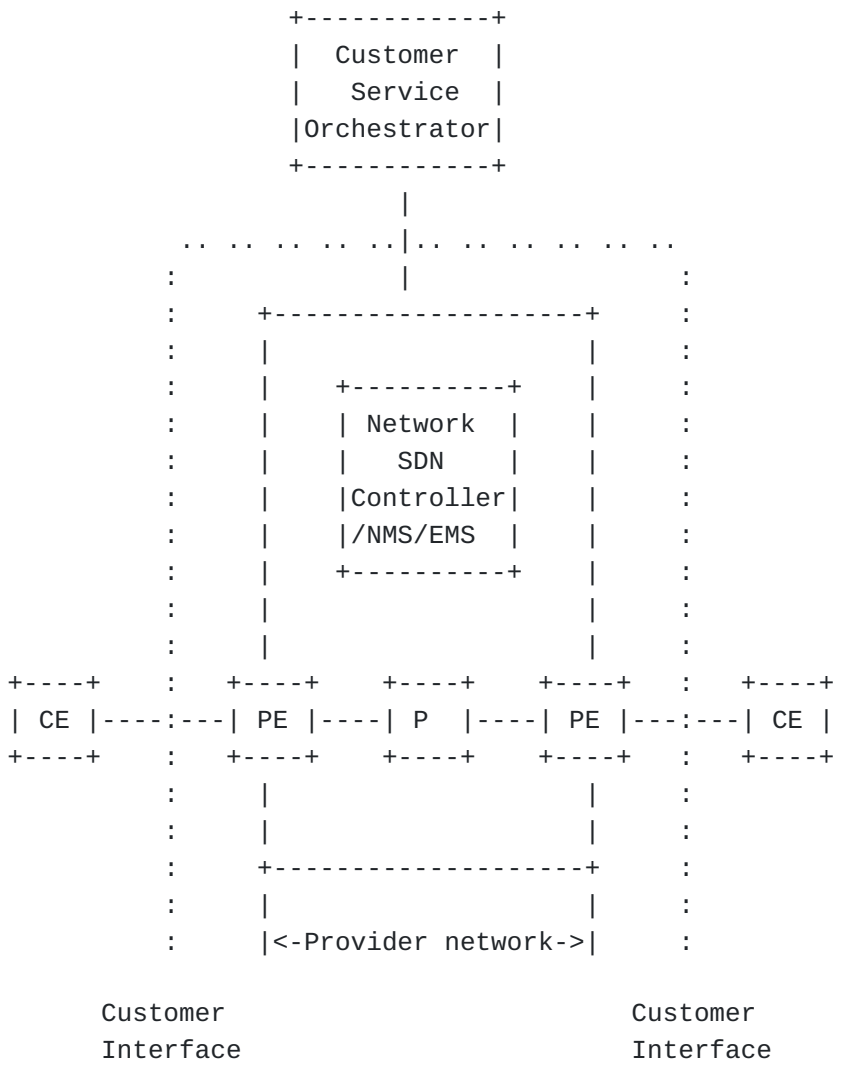

Figure 1: L1VPN SDN Controller/EMS/NMS-Based Service Model: External Customer

With this scenario, the customer service orchestrator interfaces with the network SDN controller of the provider using Customer Service Model as defined in [RFC8309].

Figure 2 depicts another deployment scenario for internal customer (e.g., higher-layer service management department(s)) interfacing the layer 1 transport network department. With this scenario, a multi-service backbone is characterized such that each service department of a provider (e.g., L2/3 services) that receives the same provider's L1VPN service provides a different kind of higher-layer service. The customer receiving the L1VPN service (i.e., each service department) can offer its own services, whose payloads can be any layer (e.g., ATM, IP, TDM). The layer 1 transport network and

each service network belong to the same organization, but may be managed separately. The Service SDN Controller is the control/ management entity owned by higher-layer service department (e.g., L2/3 VPN) whereas the Network SDN Controller is the control/ management entity responsible for Layer 1 connectivity service. The CEs in Figure 2 are L2/3 devices that interface with L1 PE devices.

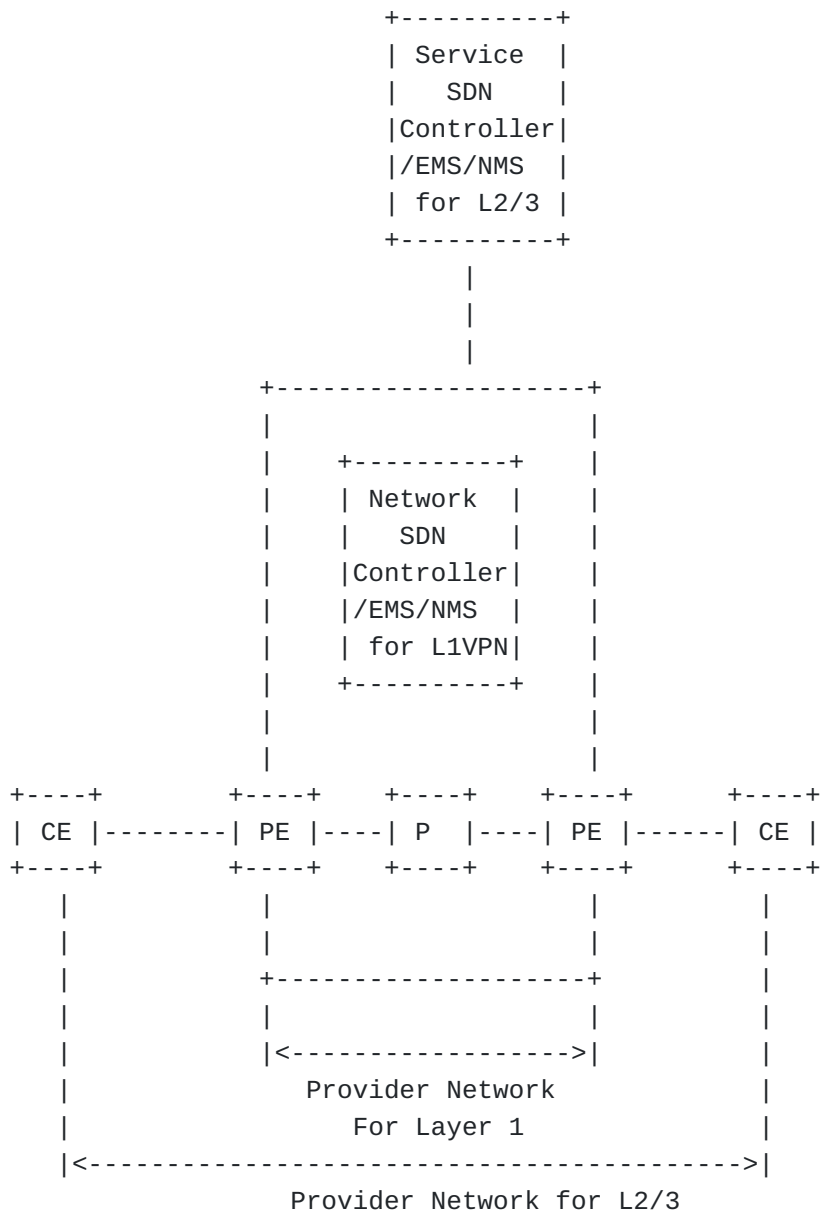

Figure 2: L1VPN SDN Controller/EMS/NMS-Based Service Model: Internal Customer

The benefit is that the same layer 1 transport network resources are shared by multiple services. A large capacity backbone network (data plane) can be built economically by having the resources shared by multiple services usually with flexibility to modify topologies, while separating the control functions for each service department. Thus, each customer can select a specific set of features that are needed to provide their own service [RFC4847].

1.2. Terminology

Refer to [RFC4847] and [RFC5253] for the key terms used in this document.

The following terms are defined in [RFC7950] and are not redefined here:

- *client
- *server
- *augment
- *data model
- *data node

The following terms are defined in [RFC6241] and are not redefined here:

- *configuration data
- *state data

The terminology for describing YANG data models is found in [RFC7950].

1.3. Tree Diagram

A simplified graphical representation of the data model is used in Section 3 of this this document. The meaning of the symbols in these diagrams is defined in [RFC8340].

1.4. Prefixes in Data Node Names

In this document, names of data nodes and other data model objects are prefixed using the standard prefix associated with the corresponding YANG imported modules. The module ietf-layer1-types specified in [I-D.ietf-ccamp-layer1-types] and ietf-yang-types specified in [RFC6991] are imported in this module.

Prefix	YANG module	Reference
l1csm	ietf-l1csm	[RFC XXXX]
l1-types	ietf-layer1-types	[I-D.ietf-ccamp-layer1-types]
yang	ietf-yang-types	[RFC6991]

Note: The RFC Editor will replace XXXX with the number assigned to the RFC once this document becomes an RFC.

2. Definitions

L1VC Layer 1 Virtual Connection

SLS Service Level Specification

UNI User Network Interface

PE Provider Edge

CE Customer Edge

EP End Point

P Protocol

C Coding

O Optical Interface

3. L1CSM YANG Model (Tree Structure)

```
module: ietf-l1csm
   +--rw l1-connectivity
      +--rw access
      |  +--rw unis
      |     +--rw uni* [id]
      |        +--rw id                    string
      |        +--rw (uni-access-type)?
      |           +--:(mef)
      |           |  +--rw protocol             identityref
      |           |  +--rw coding               identityref
      |           |  +--rw optical-interface    identityref
      |           +--:(itu)
      |              +--rw client-signal        identityref
      +--rw services
         +--rw service* [service-id]
            +--rw service-id            string
            +--rw endpoint-1
            |  +--rw id     string
            |  +--rw uni    leafref
            +--rw endpoint-2
            |  +--rw id     string
            |  +--rw uni    leafref
            +--rw start-time?           yang:date-and-time
            +--rw time-interval?        uint32
            +--rw performance-metric*   identityref
```

4. L1CSM YANG Code

```
<CODE BEGINS>file "ietf-l1csm@2021-12-13.yang"
module ietf-l1csm {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-l1csm";
  prefix "l1csm";

  import ietf-yang-types {
    prefix "yang";
    reference
      "RFC6991: Common YANG Data Types";
  }

  import ietf-layer1-types {
    prefix "l1-types";
    reference
      "RFCYYYY: A YANG Data Model for Layer 1 Types";
  }

  organization
    "Internet Engineering Task Force (IETF) CCAMP WG";

  contact
    "WG Web:  <http://tools.ietf.org/wg/ccamp/>
     WG List: <mailto:ccamp@ietf.org>

     Editor:  Young Lee
              <mailto:younglee.tx@gmail.com>

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              <mailto:zhenghaomian@huawei.com>

     Editor:  Oscar Gonzalez de Dios
              <mailto:oscar.gonzalezdedios@telefonica.com>

     Editor:  Daniele Ceccarelli
              <mailto:daniele.ceccarelli@ericsson.com>";

  description
    "This module describes L1 connectivity service based on MEF 63:
     Subscriber Layer 1 Service Attribute Technical Specification.
     Refer to MEF 63 for all terms and the original references
     used in the module.

     Copyright (c) 2021 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
   (http://trustee.ietf.org/license-info).

   This version of this YANG module is part of RFC XXXX; see
   the RFC itself for full legal notices.";

revision "2021-12-13" {
  description
    "Initial revision.";
  reference
    "RFC XXXX: A Yang Data Model for L1 Connectivity Service Model
     (L1CSM)";
// Note: The RFC Editor will replace XXXX/YYYY with the number
// assigned to the RFC once this draft becomes an RFC.
}

/*
 * Identities
 */

identity service-performance-metric {
  description
    "Base identity of service-specific performance metric";
  reference
    "MEF63: Subscriber Layer 1 Service Attributes";
}

identity one-way-delay {
  base service-performance-metric;
  description
    "The time elapsed from the reception of the first bit of the
     ingress until the reception of the first bit of the egress.";
  reference
    "MEF63: Subscriber Layer 1 Service Attributes";
}

identity one-way-errored-second {
  base service-performance-metric;
  description
    "One second in the available time with at least one errored
     block, but not a severely errored second.";
  reference
    "MEF63: Subscriber Layer 1 Service Attributes";
}

identity one-way-severely-errored-second {
  base service-performance-metric;
```

```
  description
    "One second which contains more than 15 percent errored info,
     or contains a defect (e.g., loss of signal).";
  reference
    "MEF63: Subscriber Layer 1 Service Attributes";
}

identity one-way-unavailable-second {
  base service-performance-metric;
  description
    "One second during unavailable time.";
  reference
    "MEF63: Subscriber Layer 1 Service Attributes";
}

identity one-way-availability {
  base service-performance-metric;
  description
    "The percentage of available time over a given interval.";
  reference
    "MEF63: Subscriber Layer 1 Service Attributes";
}

/*
 * Groupings
 */

grouping protocol-coding-optical-interface {
  description
    "The 3-tuple <p,c,o> where p:protocol type;
     c:coding function; o:optical interface function.

     Valid combinations are defined in Tables 4, 5, 6 and 7
     of MEF 63.";
  reference
    "MEF63: Subscriber Layer 1 Service Attributes";

  leaf protocol {
    type identityref {
      base l1-types:protocol;
    }
    mandatory true;
    description
      "The protocol being used at the UNI.";
  }
  leaf coding {
    type identityref {
      base l1-types:coding-func;
    }
```

```
    mandatory true;
    description
      "The coding function being used at the UNI.";
  }
  leaf optical-interface {
    type identityref {
      base l1-types:optical-interface-func;
    }
    mandatory true;
    description
      "The optical interface function being used at the UNI.";
  }
}

grouping subscriber-l1vc-sls-service-attributes {
  description
    "A set of service attributes on L1VC Service Level
    Specification (SLS) that are agreed between the service
    provider and the subscriber. ";
  reference
    "MEF63: Subscriber Layer 1 Service Attributes";

  leaf start-time {
    type yang:date-and-time;
    description
      "A time that represent the date and time for the start of
       the SLS";
  }
  leaf time-interval {
    type uint32;
    units seconds;
    description
      "A time interval (e.g., 2,419,200 seconds which is 28 days)
       that is used in conjunction with time-start to specify a
       contiguous sequence of time intervals T for determining
       when performance objectives are met.";
  }
  leaf-list performance-metric {
    type identityref {
      base service-performance-metric;
    }
    description
      "List of service performance metric.";
  }
}

grouping subscriber-l1vc-endpoint-attributes {
  description
    "Subscriber layer 1 connection endpoint attributes";
```

```
  reference
    "MEF63: Subscriber Layer 1 Service Attributes";

  container endpoint-1 {
    description
      "One end of UNI id's - string and id";
    leaf id {
      type string;
      mandatory true;
      description
        "Subscriber end point ID of one end";
    }
    leaf uni {
      type leafref {
        path "/l1-connectivity/access/unis/uni/id";
      }
      mandatory true;
      description
        "This is one end of subscriber L1VC end point ID value =
         UNI-1";
    }
  }
  container endpoint-2 {
    description
      "One end of UNI id's - string and id";
    leaf id {
      type string;
      must '. != ../../endpoint-1/id' {
        error-message
          "The two end points must not be equal to each other. ";
      }
      mandatory true;
      description
        "Subscriber end point ID of the other end";
    }
    leaf uni {
      type leafref {
        path "/l1-connectivity/access/unis/uni/id";
      }
      mandatory true;
      description
        "This is one other end of subscriber L1VC end point
         ID value = UNI-2";
    }
  }
}

/*
 * Data nodes
```

```
 */

container l1-connectivity {
  description
    "Serves as a top-level container for a list of layer 1
     connection services (l1cs)";

  container access {
    description
      "UNI configurations for access networks";

    container unis {
      description
        "The list of UNI's to be configured";

      list uni {
        key "id";
        description
          "UNI identifier";
        leaf id {
          type string;
          description "The UNI id of UNI Service Attributes";
        }
        choice uni-access-type {
          description
            "The UNI access type can be specified either by the
             protocol, coding function and optical interface
             function, defined in MEF, or by the client-signal,
             defined in ITU-T.";
          case mef {
            uses protocol-coding-optical-interface;
          }
          case itu {
            leaf client-signal {
              type identityref {
                base l1-types:client-signal;
              }
              mandatory true;
              description
                "The client signal being used at the UNI";
            }
          }
        }
      }
    }
  }

  container services {
    description
```

```
        "L1VC services";
      list service {
        key "service-id";
        description
          "A unique identifier of a subscriber L1VC service";

        leaf service-id {
          type string;
          description
            "A unique service identifier for subscriber L1VC.";
        }
        uses subscriber-l1vc-endpoint-attributes;
        uses subscriber-l1vc-sls-service-attributes;

      } //end of service list
    } //end of service container
  } //service top container
}
```

<CODE ENDS>

5. 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 NETCONF access control model [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.

A number of configuration data nodes defined in this document are writable/deletable (i.e., "config true") These data nodes may be considered sensitive or vulnerable in some network environments.

These are the subtrees and data nodes and their sensitivity/ vulnerability:

unis:

- id

Service:

- service-id

- endpoint-1

- endpoint-2

- start-time

- time-interval

- performance-metric

The security considerations spelled out in the YANG 1.1 specification [RFC7950] apply for this document as well.

6. IANA Considerations

It is proposed that IANA should assign new URIs from the "IETF XML Registry" [RFC3688] as follows:

```
URI: urn:ietf:params:xml:ns:yang:ietf-l1csm
Registrant Contact: The IESG
XML: N/A; the requested URI is an XML namespace.
```

This document registers following YANG modules in the YANG Module Names registry [RFC7950].

```
name:         ietf-l1csm
namespace:    urn:ietf:params:xml:ns:yang:ietf-l1csm
prefix:       l1csm
reference:    RFC XXXX
```

7. Acknowledgements

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Appendix A. JSON Example

This section provides a JSON example of the YANG module described in Section 4. This example configures one L1VC service with two UNIs that describe the UNI endpoints. The service is configured with the starting time to be 06:06:09 on 2018-09-13 for the service life time of 2419200 seconds (which is corresponds to 28 days). In addition, the service is configured to collect one performance metric, One-way-Delay.

```
{
  "l1-connectivity": {
    "access": {
      "unis": {
        "uni": [
          {
            "id": "MTL-HQ-Node3-Slot2-Port1",
            "protocol": "ETH-10GigE_LAN ",
            "coding": "ETH-10GR-PCS-49 ",
            "optical_interface": "LR-PMD-clause-52 "
          },
          {
            "id": "MTL-STL-Node5-Slot4-Port3",
            "protocol": "ETH-10GigE_LAN ",
            "coding": "ETH-10GR-PCS-49 ",
            "optical_interface": "ER-PMD-clause-52 "
          }
        ]
      },
    },
    "services": {
      "service": [
        {
          "service-id": "Sub-L1VC-1867-LT-MEGAMART",
          "endpoint-1":
            {
              "id": "MTL-HQ_1867-MEGAMART",
              "uni": "MTL-HQ-Node3-Slot2-Port1"
            },
          "endpoint-2":
            {
              "id": "MTL-STL_1867-MEGAMART",
              "uni": "MTL-STL-Node5-Slot4-Port3"
            },
          "start-time": "2018-09-13T06:06:09Z",
          "time-interval": 2419200,
          "performance-metric": "One-way-Delay "
        }
      ]
    },
}
```


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