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

This document provides a YANG Layer 1 Connectivity Service Model (L1CSM).

This model can be utilized by a customer network controller to initiate a connectivity service request as well as to retrieve service states for a Layer 1 network controller communicating with its customer network controller. This YANG model is in compliance of Network Management Datastore Architecture (NMDA).

Status of This Memo

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1. Introduction

This document provides a YANG Layer 1 (L1) Connectivity Service Model (L1CSM) which can be classified as Network Service YANG module per [RFC8199]. This model can be utilized by a customer network controller to initiate a connectivity service request as well as to retrieve service states for a Layer 1 network controller communicating with its customer network 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 the provision of L1VPN services into three service models (not to be confused with YANG models): the management-based service model, the signaling-based service model (Basic Mode), and the 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 the L1CSM YANG model that is used for the instantiation of point-to-point L1 connectivity services, which 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 L1CSM specified in this document is generic, and provides support for the three different service models defined in [RFC4847].

The YANG data model defined in Section 3 is consistent with the Service Attributes defined in [MEF63], with the exception of the Service Level Specification Service Attributes which are outside the scope of this document.

This YANG model is NMDA-compliant.

1.1. Deployment Scenarios

Figure 1 depicts a deployment scenario of the L1CSM SDN control-based service model for an external customer instantiating L1 point-to-point connectivity to the provider.

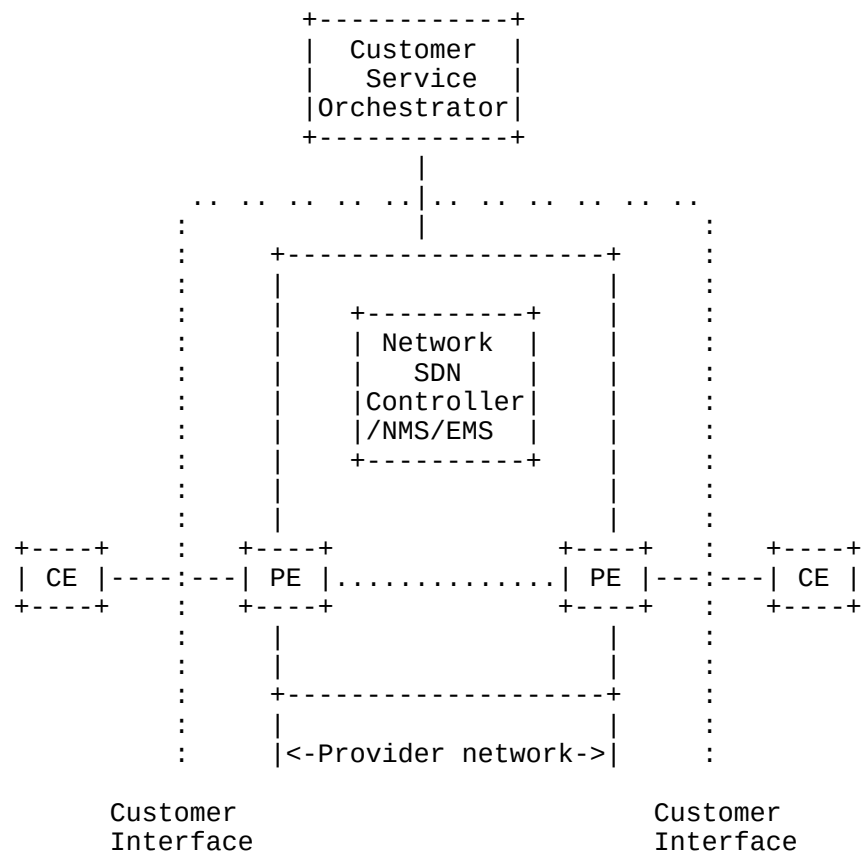

Figure 1: L1CSM SDN Controller/EMS/NMS-Based Service Model: External Customer

With this scenario, the customer service orchestrator interfaces with the network software-defined networking (SDN) controller of the provider using a Customer Service Model as defined in [RFC8309]. It is worth noting that in some scenarios, there can be a Network Management System (NMS) or Element Management System (EMS) performing the role of the SDN Controller.

Figure 2 depicts another deployment scenario for internal customer (e.g., higher-layer service management departments) 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 L1CSM service provides a different kind of higher-layer service. The customer receiving the L1CSM service (i.e., each service department) can offer its own services, whose payloads can be any layer (e.g.,

IP, OTN). 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.

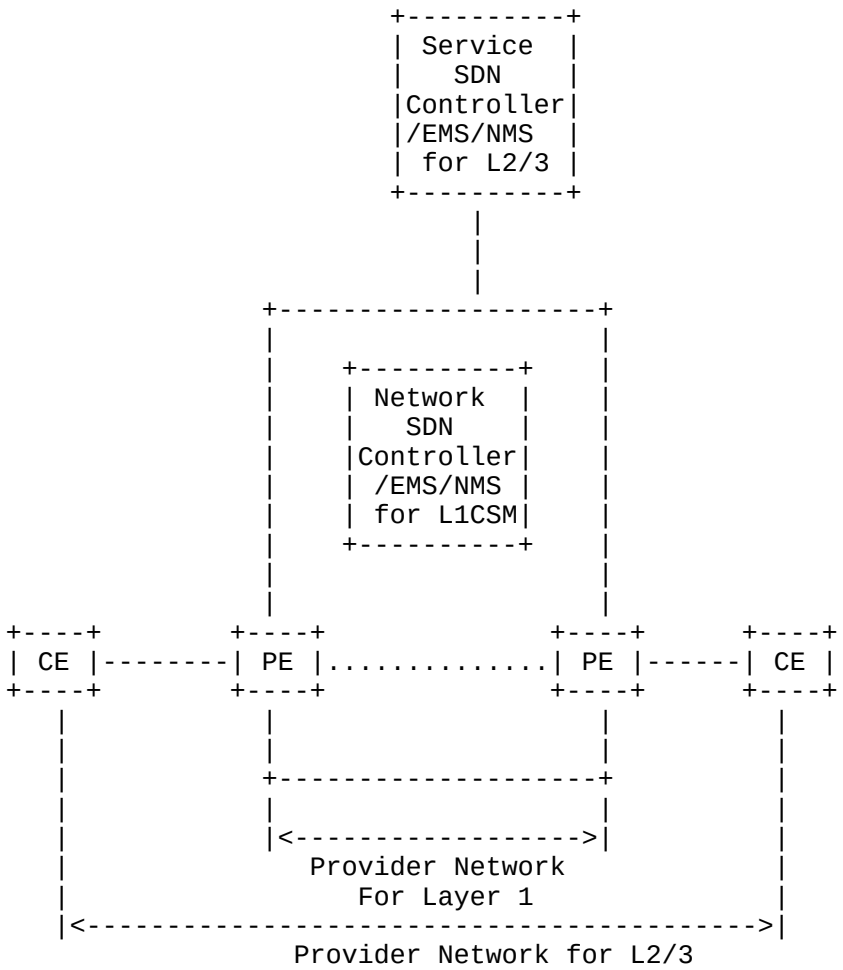

Figure 2: L1CSM SDN Controller/EMS/NMS-Based Service Model: Internal Customer

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], [RFC5253] and [MEF63]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] is imported in this module.

Prefix	YANG module	Reference
l1csm	ietf-l1csm	[RFCXXXX]
l1-types	ietf-layer1-types	[RFCYYYY]

Table 1: Prefixes and Corresponding YANG Modules

Note: The RFC Editor will replace XXXX with the number assigned to the RFC once this document becomes an RFC. The RFC Editor will replace YYYY with the number assigned to the RFC once [I-D.ietf-ccamp-layer1-types] becomes an RFC.

1.5. Abbreviations

L1VC Layer 1 Virtual Connection

UNI User Network Interface

PE Provider Edge

CE Customer Edge

2. L1CSM YANG Model Overview

The L1CSM describes the Layer 1 connectivity services following the convention defined in [MEF63] which includes the description of User Network Interface (UNI) access characteristics and L1 virtual connection (L1VC) service characteristics:

```
      +--rw l1-connectivity
        +--rw access
        |  +--rw unis
        |     +--rw uni* [uni-id]
        |        +--rw uni-id    string
        |        .....................................
        +--rw services
           +--rw service* [service-id]
              +--rw service-id    string
              .....................................
```

The UNI access characteristics can be specified using either the definitions in [MEF63], which are based on the 3-tuple protocol, coding and optical-interface, or the definitions in [I-D.ietf-ccamp-layer1-types], which are based on the client signals in [ITU-T_G.709]:

```
      +--rw (uni-access-type)?
         +--:(mef)
         |  +--rw protocol             identityref
         |  +--rw coding               identityref
         |  +--rw optical-interface    identityref
         +--:(itu)
            +--rw client-signal        identityref
```

The L1VC service characteristics are described by references to a list of L1VC end points. For point-to-point connections, only two end points are allowed.

```
      +--rw endpoint* [endpoint-id]
         +--rw endpoint-id    string
         +--rw uni -> /l1-connectivity/access/unis/uni/uni-id
```

3. L1CSM YANG Model (Tree Structure)

```
module: ietf-l1csm
  +--rw l1-connectivity
     +--rw access
     |  +--rw unis
     |     +--rw uni* [uni-id]
     |        +--rw uni-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 endpoints
              +--rw endpoint* [endpoint-id]
                 +--rw endpoint-id    string
                 +--rw uni
                         -> /l1-connectivity/access/unis/uni/uni-id
```

4. L1CSM YANG Code

```
<CODE BEGINS>
file "ietf-l1csm@2023-02-01.yang"
module ietf-l1csm {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-l1csm";
  prefix "l1csm";

  import ietf-layer1-types {
    prefix "l1-types";
    reference
      "RFCYYYY: A YANG Data Model for Layer 1 Types";
  }
  // Note: The RFC Editor will replace XXXX/YYYY with the number
  // assigned to the RFCs once this draft becomes an RFC.

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

  contact
    "WG Web: <https://datatracker.ietf.org/wg/ccamp/>
     WG List: <mailto:ccamp@ietf.org>
```

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

        Editor:  KwangKoog Lee
                 <mailto:kwangkoog.lee@kt.com>

        Editor:  Haomian Zheng
                 <mailto:zhenghaomian@huawei.com>

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

        Editor:  Daniele Ceccarelli
                 <mailto:daniele.ietf@gmail.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) 2023 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 Revised 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; see
        the RFC itself for full legal notices.";

     revision "2023-02-01" {
       description
         "Initial revision.";
       reference
         "RFC XXXX: A Yang Data Model for L1 Connectivity Service Model
          (L1CSM)";
     }

     /*
      * 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-endpoint-attributes {
        description
          "Subscriber Layer 1 connection endpoint attributes";
        reference
          "MEF63: Subscriber Layer 1 Service Attributes";

        container endpoints {
          description
            "The container for the list of the subscriber L1VC end
            points";
          list endpoint {
            key "endpoint-id";
            min-elements 2;
            max-elements 2;
```

```
          description
            "The list of the two of the subscriber L1VC end points";
          leaf endpoint-id {
            type string;
            mandatory true;
            description
              "The subscriber L1VC end point ID";
          }
          leaf uni {
            type leafref {
              path "/l1-connectivity/access/unis/uni/uni-id";
            }
            mandatory true;
            description
              "The UNI supporting the subscriber L1VC end point";
          }
        }
      }
    }

    /*
     * 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 UNIs to be configured";
          list uni {
            key "uni-id";
            description
              "UNI identifier";
            leaf uni-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";
                  reference
                    "ITU-T G.709 v6.0 (06/2020): Interfaces for the
                     Optical Transport Network (OTN)";
                }
              }
            }
          }
        }
        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;
          } //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 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.

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 negatively affect network operations and services. Nodes in this YANG module are susceptible to intentional (malicious) and unintentional (misconfiguration) configuration, adversely affecting the connection. The following data nodes and their entire subtrees are considered sensitive:

UNI:

- uni-id

Service:

- service-id

- endpoint-id

The IDs above identify a connection between the subscriber and service provider; they will be unique and may contain sensitive information such as customer information, service type, port information, and location. They must also be correctly configured to ensure the Subscriber and Service Provider connection is established. The security considerations spelled out in the YANG 1.1 specification [RFC7950] apply for this document as well.

6. IANA Considerations

This document registers the following URIs in the "ns" subregistry within 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 [RFC6020].

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

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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 connection endpoints.

```
{
  "ietf-l1csm:l1-connectivity": {
    "access": {
      "unis": {
        "uni": [
          {
            "uni-id": "MTL-HQ-Node3-Slot2-Port1",
            "protocol": "ietf-layer1-types:Ethernet",
            "coding": "ietf-layer1-types:ETH-10GR",
            "optical-interface": "ietf-layer1-types:LR-PMD-10G"
          },
          {
            "uni-id": "MTL-STL-Node5-Slot4-Port3",
            "protocol": "ietf-layer1-types:Ethernet",
            "coding": "ietf-layer1-types:ETH-10GR",
            "optical-interface": "ietf-layer1-types:ER-PMD-10G"
          }
        ]
      }
    },
    "services": {
      "service": [
        {
          "service-id": "Sub-L1VC-1867-LT-MEGAMART",
          "endpoints": {
            "endpoint": [
              {
                "endpoint-id": "MTL-HQ_1867-MEGAMART",
                "uni": "MTL-HQ-Node3-Slot2-Port1"
              },
              {
                "endpoint-id": "MTL-STL_1867-MEGAMART",
                "uni": "MTL-STL-Node5-Slot4-Port3"
              }
            ]
          }
        }
      ]
    }
  }
}
```

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