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

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Abstract

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

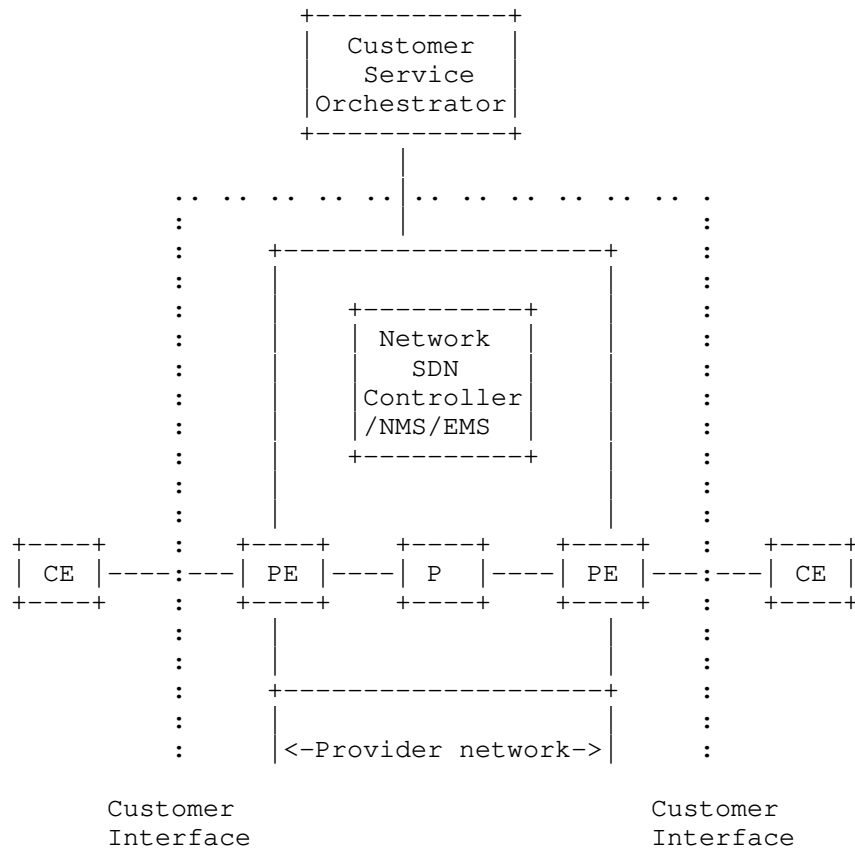


Figure 1: L1VPN SDN Controller/EMS/NMS-Based Service Model:
External Customer

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 CE's in Figure 2 are L2/3 devices that interface with L1 PE devices.

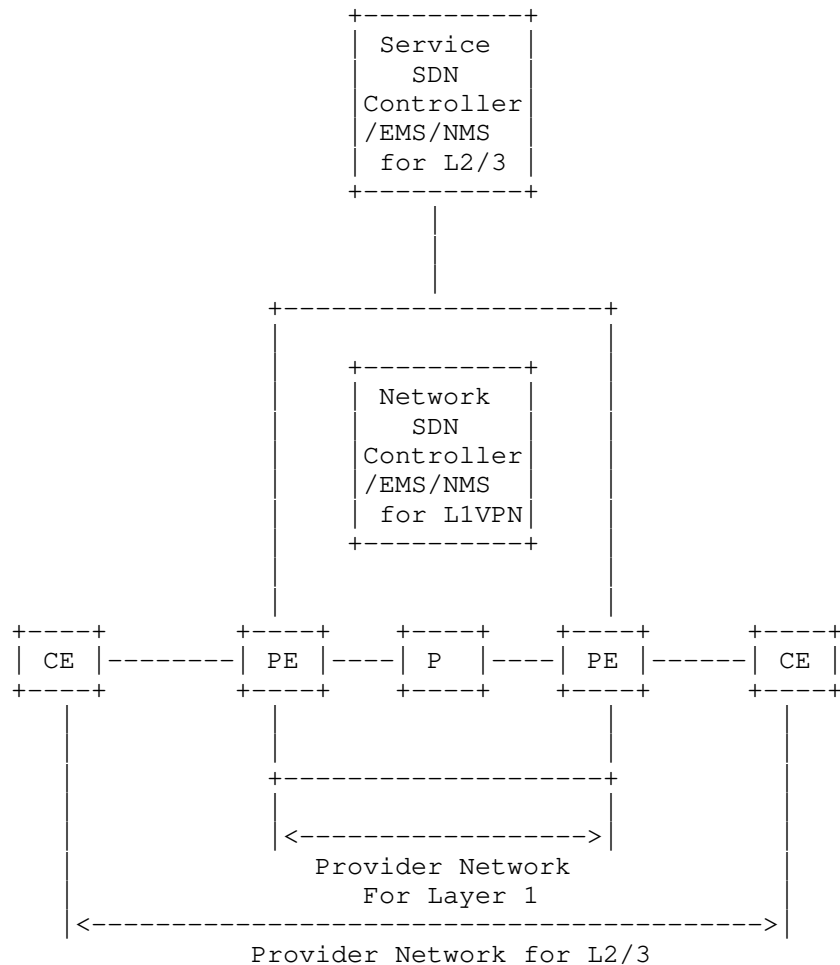


Figure 2: L1VPN SDN Controller/EMS/NMS-Based Service Model:
Internal Customer

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:

- o client
- o server
- o augment
- o data model
- o data node

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

- o configuration data
- o 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 chapter 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, as shown in Table 1.

Prefix	YANG module	Reference
l1csm	ietf-l1csm	[RFC XXXX]
l1-st	ietf-l1-service-types	[RFC XXXX]
yang	ietf-yang-types	[RFC6991]

Table 1: Prefixes and corresponding YANG modules

Note: The RFC Editor will replace XXXX with the number assigned to the RFC once this draft 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. L1SM YANG Model (Tree Structure)

```

module: ietf-l1csm
  +--rw ll-connectivity
    +--rw access
      +--rw unis
        +--rw uni* [id]
          +--rw id string
          +--rw protocol? identityref
          +--rw coding? identityref

```

```

|         +--rw optical-interface?  identityref
+--rw services
  +--rw service* [service-id]
    +--rw service-id                string
    +--rw endpoint-1
      |   +--rw id                  string
      |   +--rw uni                  -> /l1-connectivity/access/unis/uni/id
    +--rw endpoint-2
      |   +--rw id                  string
      |   +--rw uni                  -> /l1-connectivity/access/unis/uni/id
    +--rw start-time?               yang:date-and-time
    +--rw time-interval?            int32
    +--rw performance-metric*      identityref

```

4. L1SM YANG Code

The YANG code is as follows:

```

<CODE BEGINS> file "ietf-l1csm@2018-09-12.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 "RFC 6991 - Common YANG Data Types";
  }

  import ietf-l1-service-types {
    prefix "l1-st";
    reference "RFC XXXX - A YANG Data Model for L1 Connectivity
              Service Model (L1CSM)";
  }

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

  contact

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    Editor: K. Lee (kwangkoog.lee@kt.com)
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    Editor: O. G. de-Dios (oscar.gonzalezdedios@telefonica.com)
    Editor: D. Ceccarelli (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.

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

```
revision "2018-09-12" {  
    description "Initial revision.";   
    reference "RFC XXXX: A YANG Data Model for L1 Connectivity  
        Service Model (L1CSM)";  
    // Note: The RFC Editor will replace XXXX with the number  
    // assigned to the RFC once this draft becomes an RFC.  
}
```

```
grouping protocol-coding-optical-interface {  
    description  
        "describes <p,c,o> where p:protocol type; c:coding  
        function; o:optical interface function";  
    reference "MEF 63";  
    leaf protocol {  
        type identityref {  
            base "l1-st:protocol-type";  
        }  
        description  
            "List of physical layer L1VC clientprotocol";  
    }  
    leaf coding {  
        type identityref {  
            base "l1-st:coding-func";  
        }  
        description "coding function";  
    }  
  
    leaf optical-interface {
```

```
        type identityref {
          base "l1-st:optical-interface-func";
        }
        description "optical-interface-function";
      }
    }

    grouping subscriber-l1vc-sls-service-attribute {
      description
        "The value of the Subscriber L1VC SLS (Service Level
        Specification) Service Attribute";
      reference "MEF 63";

      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 int32;
        units seconds;
        description "a time interval (e.g., 2,419,200 seconds
          which is 28 days) that is used in
          conjunction wuth 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 "l1-st:performance-metric";
        }
        description "list of performance metric";
      }
    }

    grouping subscriber-l1vc-endpoint-attributes {
      description
        "subscriber layer 1 connection endpoint attributes";
      reference "MEF 63";

      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;
        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";
    }
}

}

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";
                }
            }
        }
    }
}
```

```
        }
        uses protocol-coding-optical-interface;
    }
}

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

        leaf service-id {
            type string;
            mandatory true;
            description "a unique service identifier for
                subscriber L1VC.";
        }

        uses subscriber-llvc-endpoint-attributes;
        uses subscriber-llvc-sls-service-attribute;

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

<CODE ENDS>

<CODE BEGINS> file "ietf-ll-service-types@2018-09-12.yang"

```
module ietf-ll-service-types {
    namespace "urn:ietf:params:xml:ns:yang:ietf-ll-service-types";
    prefix "ll-st";

    organization
        "IETF CCAMP Working Group";
    contact
        "WG Web: <http://tools.ietf.org/wg/ccamp/>
        WG List: <mailto:ccamp@ietf.org>

        Editor: G. Fioccola (giuseppe.fioccola@telecomitalia.it)
        Editor: K. Lee (kwangkoog.lee@kt.com)
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        Editor: O. G. de-Dios (oscar.gonzalezdedios@telefonica.com)
```

Editor: D. Ceccarelli(daniele.ceccarelli@ericsson.com)";

description

"This module defines L1 service types 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. As for the protocol-type, refer also to the client-type in G.709.

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

```
revision "2018-09-12" {  
  description "Initial revision.";  
  reference "RFC XXXX: A Yang Data Model for L1 Connectivity  
            Service Model (L1CSM)";  
  // Note: The RFC Editor will replace XXXX with the number  
  // assigned to the RFC once this draft becomes an RFC.  
}
```

```
identity protocol-type {  
  description  
  "base identity from which client protocol type is derived.";  
}
```

```
identity ETH-1GbE {  
  base "protocol-type";  
  description  
    "Gigabit Ethernet protocol type";  
  reference "MEF63 & G.709";  
}
```

```
identity ETH-10GbE-WAN {  
  base "protocol-type";  
  description  
    "10 Gigabit Ethernet-WAN protocol type";  
  reference "MEF63 & G.709";  
}
```

```
}

identity ETH-10GbE-LAN {
    base "protocol-type";
    description
        "10 Gigabit Ethernet-LAN protocol type";
    reference "MEF63 & G.709";
}

identity ETH-40GbE {
    base "protocol-type";
    description
        "40 Gigabit Ethernet protocol type";
    reference "MEF63 & G.709";
}

identity ETH-100GbE {
    base "protocol-type";
    description
        "100 Gigabit Ethernet protocol type";
    reference "MEF63 & G.709";
}

identity FC-100 {
    base "protocol-type";
    description
        "Fiber Channel - 100 protocol type";
    reference "MEF63 & G.709";
}

identity FC-200 {
    base "protocol-type";
    description
        "Fiber Channel - 200 protocol type";
    reference "MEF63 & G.709";
}

identity FC-400 {
    base "protocol-type";
    description
        "Fiber Channel - 400 protocol type";
    reference "MEF63 & G.709";
}

identity FC-800 {
    base "protocol-type";
    description
```

```
        "Fiber Channel - 800 protocol type";
        reference "MEF63 & G.709";
    }

    identity FC-1200 {
        base "protocol-type";
        description
            "Fiber Channel - 1200 protocol type";
        reference "MEF63 & G.709";
    }

    identity FC-1600 {
        base "protocol-type";
        description
            "Fiber Channel - 1600 protocol type";
        reference "MEF63 & G.709";
    }

    identity FC-3200 {
        base "protocol-type";
        description
            "Fiber Channel - 3200 protocol type";
        reference "MEF63 & G.709";
    }

    identity STM-1 {
        base "protocol-type";
        description
            "SDH STM-1 protocol type";
        reference "MEF63 & G.709";
    }

    identity STM-4 {
        base "protocol-type";
        description
            "SDH STM-4 protocol type";
        reference "MEF63 & G.709";
    }

    identity STM-16 {
        base "protocol-type";
        description
            "SDH STM-16 protocol type";
        reference "MEF63 & G.709";
    }

    identity STM-64 {
```

```
    base "protocol-type";
    description
        "SDH STM-64 protocol type";
    reference "MEF63 & G.709";
}

identity STM-256 {
    base "protocol-type";
    description
        "SDH STM-256 protocol type";
    reference "MEF63 & G.709";
}

identity OC-3 {
    base "protocol-type";
    description
        "SONET OC-3 protocol type";
    reference "MEF63 & G.709";
}

identity OC-12 {
    base "protocol-type";
    description
        "SONET OC-12 protocol type";
    reference "MEF63 & G.709";
}

identity OC-48 {
    base "protocol-type";
    description
        "SONET OC-48 protocol type";
    reference "MEF63 & G.709";
}

identity OC-192 {
    base "protocol-type";
    description
        "SONET OC-192 protocol type";
    reference "MEF63 & G.709";
}

identity OC-768 {
    base "protocol-type";
    description
        "SONET OC-768 protocol type";
    reference "MEF63 & G.709";
}
```



```
identity coding-func {
  description
    "base identity from which coding func is derived.";
}

identity ETH-1000X-PCS-36 {
  base "coding-func";
  description
    "PCS clause 36 coding function that corresponds to
    1000BASE-X";
  reference "MEF63 & IEEE802.3";
}

identity ETH-10GW-PCS-49-WIS-50 {
  base "coding-func";
  description
    "PCS clause 49 and WIS clause 50 coding func that
    corresponds to 10GBASE-W (WAN PHY)";
  reference "MEF63 & IEEE802.3";
}

identity ETH-10GR-PCS-49 {
  base "coding-func";
  description
    "PCS clause 49 coding function that corresponds to
    10GBASE-R (LAN PHY)";
  reference "MEF63 & IEEE802.3";
}

identity ETH-40GR-PCS-82 {
  base "coding-func";
  description
    "PCS clause 82 coding function that corresponds to
    40GBASE-R";
  reference "MEF63 & IEEE802.3";
}

identity ETH-100GR-PCS-82 {
  base "coding-func";
  description
    "PCS clause 82 coding function that corresponds to
    100GBASE-R";
  reference "MEF63 & IEEE802.3";
}

/* coding func needs to expand for Fiber Channel, SONET, SDH */

identity optical-interface-func {
```

```
description
  "base identity from which optical-interface-function is
  derived.";
}

identity SX-PMD-clause-38 {
  base "optical-interface-func";
  description
    "SX-PMD-clause-38 Optical Interface function for
    1000BASE-X PCS-36";
  reference "MEF63 & IEEE802.3";
}

identity LX-PMD-clause-38 {
  base "optical-interface-func";
  description
    "LX-PMD-clause-38 Optical Interface function for
    1000BASE-X PCS-36";
  reference "MEF63 & IEEE802.3";
}

identity LX10-PMD-clause-59 {
  base "optical-interface-func";
  description
    "LX10-PMD-clause-59 Optical Interface function for
    1000BASE-X PCS-36";
  reference "MEF63 & IEEE802.3";
}

identity BX10-PMD-clause-59 {
  base "optical-interface-func";
  description
    "BX10-PMD-clause-59 Optical Interface function for
    1000BASE-X PCS-36";
  reference "MEF63 & IEEE802.3";
}

identity LW-PMD-clause-52 {
  base "optical-interface-func";
  description
    "LW-PMD-clause-52 Optical Interface function for
    10GBASE-W PCS-49-WIS-50";
  reference "MEF63 & IEEE802.3";
}

identity EW-PMD-clause-52 {
  base "optical-interface-func";
  description
```

```
        "EW-PMD-clause-52 Optical Interface function for
        10GBASE-W PCS-49-WIS-50";
        reference "MEF63 & IEEE802.3";
    }

    identity LR-PMD-clause-52 {
        base "optical-interface-func";
        description
            "LR-PMD-clause-52 Optical Interface function for
            10GBASE-R PCS-49";
        reference "MEF63 & IEEE802.3";
    }

    identity ER-PMD-clause-52 {
        base "optical-interface-func";
        description
            "ER-PMD-clause-52 Optical Interface function for
            10GBASE-R PCS-49";
        reference "MEF63 & IEEE802.3";
    }

    identity LR4-PMD-clause-87 {
        base "optical-interface-func";
        description
            "LR4-PMD-clause-87 Optical Interface function for
            40GBASE-R PCS-82";
        reference "MEF63 & IEEE802.3";
    }

    identity ER4-PMD-clause-87 {
        base "optical-interface-func";
        description
            "ER4-PMD-clause-87 Optical Interface function for
            40GBASE-R PCS-82";
        reference "MEF63 & IEEE802.3";
    }

    identity FR-PMD-clause-89 {
        base "optical-interface-func";
        description
            "FR-PMD-clause-89 Optical Interface function for
            40GBASE-R PCS-82";
        reference "MEF63 & IEEE802.3";
    }

    identity LR4-PMD-clause-88 {
        base "optical-interface-func";
```

```
        description
            "LR4-PMD-clause-88 Optical Interface function for
            100GBASE-R PCS-82";
        reference "MEF63 & IEEE802.3";
    }

    identity ER4-PMD-clause-88 {
        base "optical-interface-func";
        description
            "ER4-PMD-clause-88 Optical Interface function for
            100GBASE-R PCS-82";
        reference "MEF63 & IEEE802.3";
    }

    /* optical interface func needs to expand for Fiber Channel,
       SONET and SDH */

    identity performance-metric {
        description "list of performance metric";
    }

    identity One-way-Delay {
        base "performance-metric";
        description "one-way-delay";
    }

    identity One-way-Errored-Second {
        base "performance-metric";
        description "one-way-errored-second";
    }

    identity One-way-Severely-Errored-Second {
        base "performance-metric";
        description "one-way-severely-errored-second";
    }

    identity One-way-Unavailable-Second {
        base "performance-metric";
        description "one-way-unavailable-second";
    }

    identity One-way-Availability {
        base "performance-metric";
        description "one-way-availability";
    }
}
```

```
}  
  
<CODE ENDS>
```

5. 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 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 "
      }
    ]
  },
}
```

6. Security Considerations

The configuration, state, and action data defined in this document are designed to be accessed via a management protocol with a secure transport layer, 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 users to a preconfigured subset of all available NETCONF 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

7. IANA Considerations

This document registers the following namespace URIs in the IETF XML registry [RFC3688]:

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

```
-----  
URI: urn:ietf:params:xml:ns:yang:ietf-l1-service-types  
Registrant Contact: The IESG.  
XML: N/A, the requested URI is an XML namespace.  
-----
```

This document registers the following YANG modules in the YANG Module

Names registry [RFC6020]:

```
-----  
name:          ietf-l1csm  
namespace:     urn:ietf:params:xml:ns:yang:ietf-l1csm  
reference:     RFC XXXX (TDB)  
-----
```

```
-----  
name:          ietf-l1-service-types  
namespace:     urn:ietf:params:xml:ns:yang:ietf-l1-service-types  
reference:     RFC XXXX (TDB)  
-----
```

8. Acknowledgments

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