MEF Standard

MEF 111

MEF Services Model:

Information Model for Layer 1 Connectivity Service

December 2020

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1 List of Contributing Members

The following members of the MEF participated in the development of this document and have requested to be included in this list.

- *CenturyLink*
- *Cisco*
- *NEC/Netcracker*
- *Tata Communications*
- *Nokia*

2 Abstract

The MEF Services Model (MSM) is an information and data model representation of multiple object model efforts for the following services: Carrier Ethernet, IP, Layer 1 and SD-WAN. The object definitions, object attributes and relationships specified in the MSM are based on MEF standards that define the given services. This document defines UML classes, data types and enumerations for representing Layer 1 Services, as defined in MEF 63[5] for Subscriber Layer 1 Service and MEF 64[6] for Operator Layer 1 Service, as part of MSM.

This document normatively includes the content of the following Papyrus[9] UML files as if they were contained within this document (pull request #168**,** GitHub Repository[7]):

- L1_CS.di
- L1_CS.notation
- L1_CS.uml

3 Terminology and Abbreviations

This section defines the terms used in this document. In many cases, the normative definitions to terms are found in other documents. In these cases, the third column is used to provide the reference that is controlling, in other MEF or external documents.

Term	Definition	Reference
AT	Available Time	MEF 63[5]
Available Time	The one second intervals when the service is considered available for use by the L1 Subscriber.	MEF 63[5]
Coding Function	Functionality which encodes bits for transmission and the corresponding decode upon reception.	MEF 63[5]
EB	Errored Block.	MEF 63[5]
EI	External Interface.	MEF 64[6]
Errored Block	A block of bits which has a detectable error. In this specification, the Layer 1 Characteristic Information corresponds to a block.	MEF 63[5]
Errored Second	A one-second interval with at least one errored Layer 1 Characteristic Information.	MEF 63[5]
ES	Errored Second.	MEF 63[5]
External Interface	Either an L1 UNI or an L1 ENNI.	MEF 64[6]
GCC(0,1,2)	General Communication Channel (level 0,1,2).	ITU-T G.709 [3]
HO	Higher Order.	MEF 64[6]
HO OPU*k*/ODU*k*	An OPU*k*/ODU*k* which transports multiple LO OPU*k*/ODU*k*.	MEF 64[6]
L1 ENNI	Layer 1 External Network Network Interface.	MEF 64[6]
L1 Operator	An organization with administrative control over a network and which provides services to an L1 Super Operator or to an L1 Service Provider.	MEF 64[6]
L1 Service	A connectivity service which delivers Layer 1 Characteristic Information that is specified using Service Attributes as defined in a MEF Specification.	MEF 63[5]
L1 Service Provider	An organization that provides Subscriber Layer 1 Services.	MEF 63[5]
L1 Subscriber	The end-user of a Subscriber Layer 1 Service.	MEF 63[5]
L1 Super Operator	An Operator that uses other Operators to provide connectivity to one of the Operator Layer 1 Virtual Connection End Points of its Operator Layer 1 Virtual Connection.	MEF 64[6]
L1 UNI	Layer 1 User Network Interface.	MEF 63[5]

L1 Virtual Connection	An association of two Layer 1 Virtual Connection End Points that limits the transport of Layer 1 Characteristic Information between those Layer 1 Virtual Connection End Points.	MEF 63[5]
L1CI	Layer 1 Characteristic Information.	MEF 63[5]
Layer 1 Characteristic Information	A block of consecutive bits which can be monitored by an error detection code.	MEF 63[5]
Layer 1 External Network Network Interface	The demarcation point marking the boundary of responsibility between two L1 Operators whose networks are operated as separate administrative domains.	MEF 64[6]
Layer 1 User Network Interface	The demarcation point between the responsibility of the L1 Service Provider and the responsibility of the L1 Subscriber.	MEF 63[5]
LO	Lower Order.	MEF 64[6]
LO OPU*k*/ODU*k*	An OPU*k*/ODU*k* which transports a single client protocol.	MEF 64[6]
Maintenance Interval Time	A period of time agreed to by the L1 Subscriber and L1 Service Provider during which the Subscriber L1VC may not perform well or at all.	MEF 63[5]
MIT	Maintenance Interval Time.	MEF 63[5]
ODU	Optical Data Unit.	MEF 64[6]
ODU L1CI	Optical Data Unit Layer 1 Characteristic Information.	MEF 64[6]
ODU*k*	Optical Data Unit-*k*.	ITU-T G.709 [3]
ODU*k* Path	Optical Data Unit-*k* Path.	ITU-T G.709 [3]
OH	Overhead.	ITU-T G.709 [3]
Operator	Used within this Standard for brevity when referring to an L1 Operator.	MEF 64[6]
Operator Access L1VC	Operator Access Layer 1 Virtual Connection.	MEF 64[6]
Operator Access Layer 1 Service	An Operator Layer 1 Service between an L1 UNI and an L1 ENNI.	MEF 64[6]
Operator Access Layer 1 Virtual Connection	An Operator Layer 1 Virtual Connection with one Operator Layer 1 Virtual Connection End Point at an L1 UNI and the other Operator Layer 1 Virtual Connection End Point at an L1 ENNI.	MEF 64[6]
Operator L1VC	Operator Layer 1 Virtual Connection.	MEF 64[6]
Operator L1VC End Point	Operator Layer 1 Virtual Connection End Point.	MEF 64[6]

Operator Layer 1 Service	A connectivity service provided by an Operator to an L1 Super Operator or to a Service Provider that delivers Layer 1 Characteristic Information between two External Interfaces where at least one External Interface is an L1 ENNI, specified using the Service Attributes in this Standard.	MEF 64[6]
Operator Layer 1 Virtual Connection	An association of two Operator Layer 1 Virtual Connection End Points that limits the transport of Layer 1 Characteristic Information between those Operator Layer 1 Virtual Connection End Points where at least one of the Operator Layer 1 Virtual Connection End Points is at an L1 ENNI.	MEF 64[6]
Operator Layer 1 Virtual Connection End Point	Represents the logical attachment of an Operator Layer 1 Virtual Connection to a given External Interface.	MEF 64[6]
Operator Network	A network used by the Operator to provide services to one or more Service Providers or other Operators.	MEF 64[6]
Operator Transit L1VC	Operator Transit Layer 1 Virtual Connection.	MEF 64[6]
Operator Transit Layer 1 Service	An Operator Layer 1 Service between an L1 ENNI and another L1 ENNI.	MEF 64[6]
Operator Transit Layer 1 Virtual Connection	An Operator Layer 1 Virtual Connection with one Operator Layer 1 Virtual Connection End Point at an L1 ENNI and the other Operator Layer 1 Virtual Connection End Point at another L1 ENNI.	MEF 64[6]
Operator UNI Service Attribute	Operator UNI Service Attribute values are agreed to by the Service Provider/Super Operator and the Operator.	MEF 64[6]
Optical Data Unit Layer 1 Characteristic Information	An ODU*k* frame of a BIP-8 encoded protocol.	MEF 64[6]
Optical Interface Function	Functionality which converts encoded electrical bits into an optical signal(s) and the corresponding conversion into electrical format upon reception.	MEF 63[5]
OPU	Optical Payload Unit.	ITU-T G.709 [3]
OPU*k*	Optical Payload Unit-*k*.	ITU-T G.709 [3]
OTL	Optical Transport Lane.	ITU-T G.709 [3]
OTL*k.n*	A group of n Optical Transport Lanes that carries one OTU*k*.	ITU-T G.709 [3]
OTN	Optical Transport Network.	MEF 63[5]
OTS*i*	Optical Tributary Signal.	ITU-T G.709 [3]
OTSiG	Optical Tributary Signal Group.	ITU-T G.709 [3]
OTU	Optical Transport Unit.	ITU-T G.709 [3]
OTU*k*	Optical Transport Unit-*k*.	ITU-T G.709 [3]

Path Overhead	The APS, GCC, TTI overhead fields of an ODU*k*.	MEF 64[6]
PCS	Physical Coding Sublayer.	IEEE Std 802.3[1]
Performance Metric	A quantitative characterization of Layer 1 Characteristic Information delivery quality experienced by the L1 Subscriber.	MEF 63[5]
SDH	Synchronous Digital Hierarchy.	ITU-T G.707[2]51
Service Attribute	Specific information that is agreed between the provider and the user of the service, as described in a MEF specification, that describes some aspect of the service behavior.	MEF 63[5]
Service Level Specification	The technical details of the service level, including performance objectives, agreed between the provider and the user of the service.	MEF 63[5]
Service Provider	Used within this document for brevity when referring to a L1 Service Provider.	MEF 63[5]
Service Provider Network	An interconnected network used by the Service Provider to provide services to one or more Subscribers.	MEF 63[5]
SES	Severely Errored Seconds.	MEF 63[5]
Severely Errored Second	A one second interval which contains ≥ 15% errored Layer 1 Characteristic Information or a one-second defect interval.	MEF 63[5]
SHO	Super Higher Order.	MEF 64[6]
SHO OPU*k*/ODU*k*	An OPU*k*/ODU*k* which transports multiple HO OPU*k*/ODU*k*.	MEF 64[6]
SLS	Service Level Specification.	MEF 63[5]
SN	Subscriber Network.	MEF 63[5]
SNC/I	Subnetwork Connection with Inherent monitoring.	ITU-T G.709[3]
SONET	Synchronous Optical Network.	Telcordia GR-253-CORE[10]
SP/SO	Service Provider/Super Operator.	MEF 64[6]
Subscriber	Used within this document for brevity when referring to a L1 Subscriber.	MEF 63[5]
Subscriber L1VC	Subscriber Layer 1 Virtual Connection.	MEF 63[5]
Subscriber L1VC EP	Subscriber Layer 1 Virtual Connection End Point	MEF 63[5]
Subscriber Layer 1 Service	A connectivity service which delivers Layer 1 Characteristic Information between two L1 UNIs, specified using the Service Attributes described in this document.	MEF 63[5]
Subscriber Layer 1 Virtual Connection	An association of two Subscriber Layer 1 Virtual Connection End Points that limits the transport of Layer 1 Characteristic Information between those Subscriber Layer 1 Virtual Connection End Points.	MEF 63[5]

Subscriber Layer 1 Virtual Connection End Point	Represents the logical attachment of a Subscriber Layer 1 Virtual Connection to a L1 UNI.	MEF 63[5]
Subscriber Network	An interconnected network belonging to a given Subscriber, which is connected to the Service Provider at one or more UNIs.	MEF 63[5]
TS	Tributary Slot.	ITU-T G.709 [3]
TTI	Trail Trace Identifier.	ITU-T G.709 [3]
UAT	Unavailable Time.	MEF 63[5]
Unavailable Second	A second during Unavailable Time.	MEF 63[5]
Unavailable Time	The one second intervals when the service is considered not available for use by the L1 Subscriber.	MEF 63[5]
UNI	Used within this document for brevity when referring to a Layer 1 User Network Interface.	MEF 63[5]
UAS	Unavailable Second.	MEF 63[5]

Table 1 - Terminology and Abbreviations

4 Introduction

The MEF Services Model (MSM) Layer 1 Connectivity Service is a service model intended to support management of Layer 1 Services. The model is based on MEF 63[5] for Subscriber Layer 1 Service and MEF 64 for Operator Layer 1 Service. The MSM includes common classes and type definitions from MEF-Common and MEF-Types models that can be used by other MEF models. Figure 1 illustrates the model relationships.

The MSM is intended to be used at multiple LSO interface reference points for multiple API development efforts. Relevant interface reference points include: Sonata, Cantata, Allegro, Interlude and Legato. Each of these interfaces can use the common objects, attributes and relationships defined in the MSM.

The MSM can be used with TM Forum APIs where the JSON payload is derived from the MSM, by YANG-based APIs (via NETCONF or RESTCONF) where the YANG model is derived from the MSM or by OpenAPI based APIs where the OpenAPI specification is derived from the MSM.

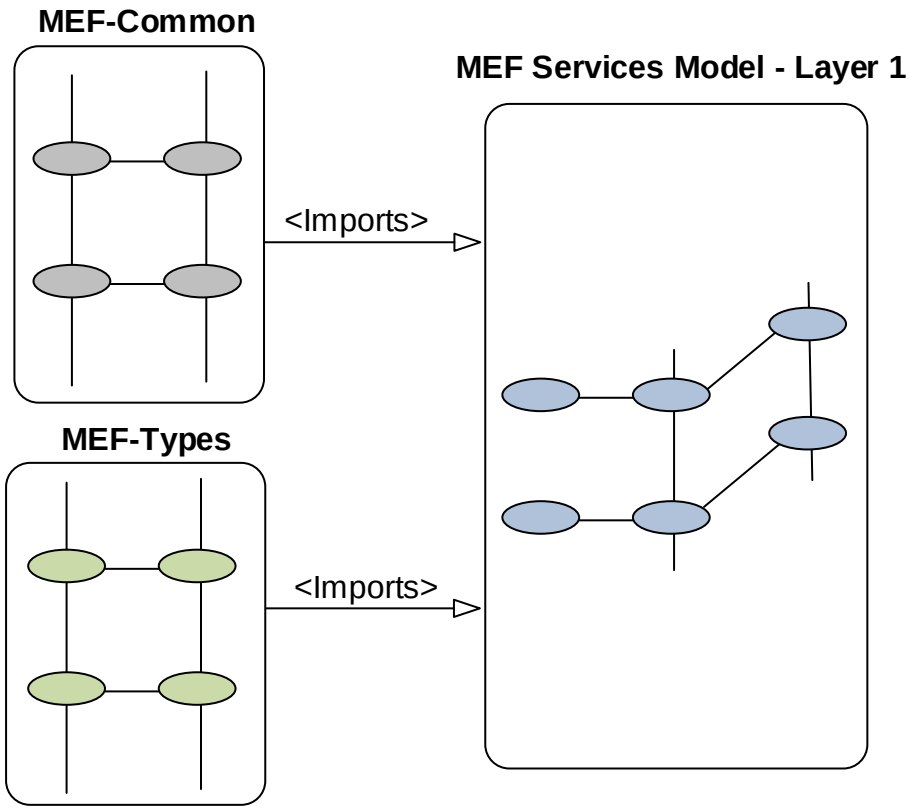

Figure 1 – MEF Services Model–Layer 1 and other model associations

5 Service Information Model Overview

The service information model consists of a set of object classes, data types, enumerations their attributes and the relationships among them. The object classes defined in this document are modeled based on the services defined in the service related MEF standards, for supporting Subscriber Layer 1 Service and Operator Layer 1 Service. In the following, Figure 2 and Figure 3 illustrate the overviews of object classes, data types, enumerations and their relationships for Subscriber Layer 1 Service and Operator Layer 1 Service respectively. To simplify the overview, some of the minor supporting classes, data type and enumerations are not shown in the figures.

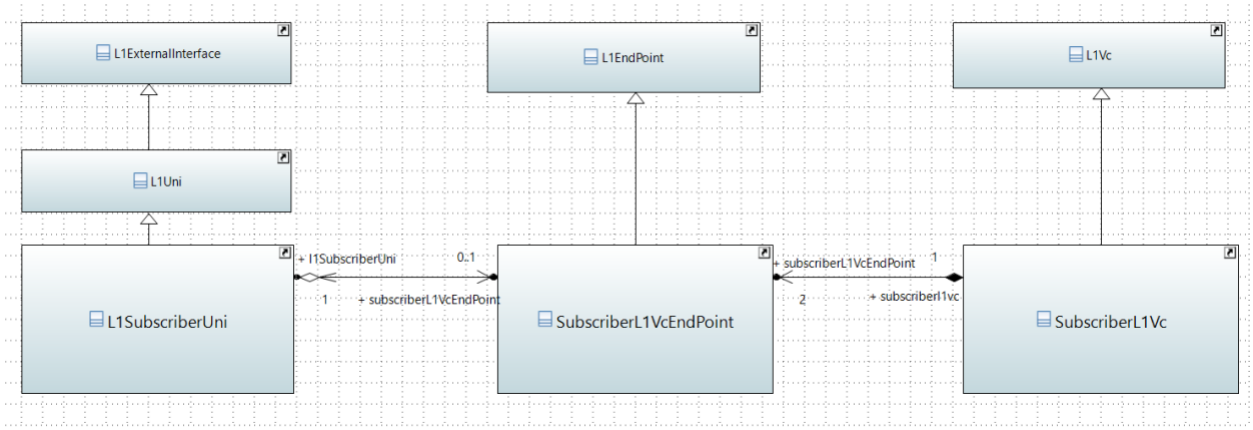

Figure 2 – Subscriber Layer 1 Service Overview

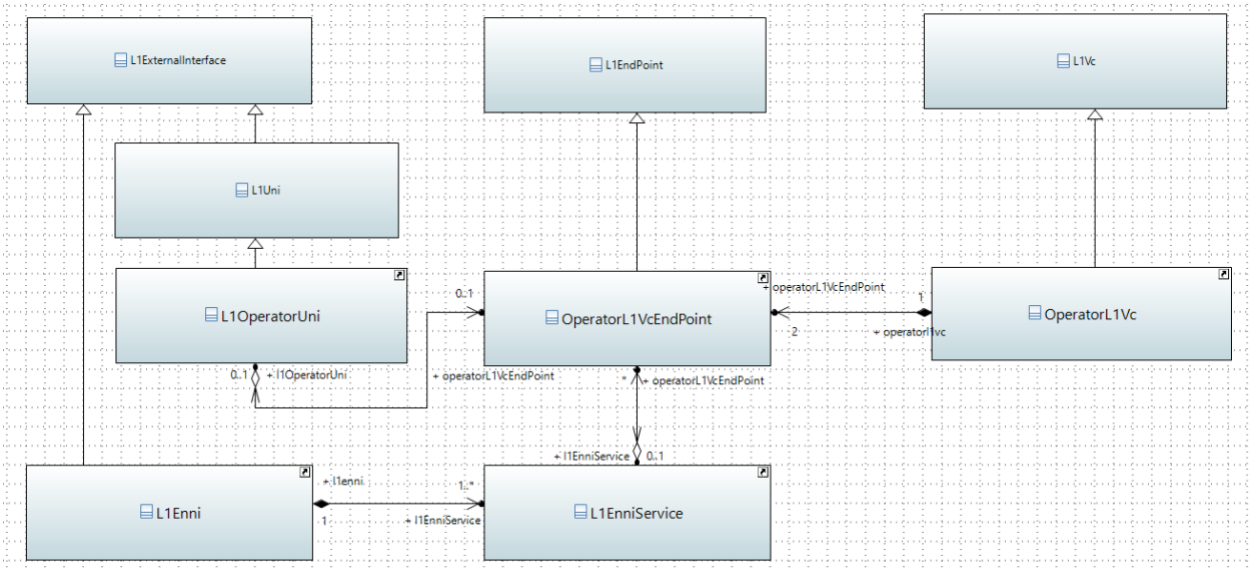

Figure 3 – Operator Layer 1 Service Overview

6 MEF-Types

This section details the data types imported from MEF-Types that are used by the Layer 1 Service models.

6.1 AdminState

Data type enumeration for Administrative states. Values are LOCKED and UNLOCKED.

6.2 OperationalState

Data type enumeration for Operational states. Values are DISABLED and ENABLED.

6.3 Identifier45

Data type attribute unique by network administrative domain, containing no more than 45 characters and non-null RFC Display String but not contain the characters 0x00 through 0x1F.

6.4 Integer

Integer is a primitive type representing integer values.

6.5 PositiveInteger

An integer greater than 0.

6.6 NaturalNumber

This is a whole, non-negative number.

6.7 TimeAndDate

This data type is for Time and Date in UTC. The datatype specifies year, month, day, hour, minute and second to represent the time and date.

Attribute Name	Type	Mult.	Description
year	PositiveInteger	1	A positive Integer value represents the year
month	PositiveInteger	1	A positive Integer value represents the month.
day	PositiveInteger	1	A positive Integer value represents the day.
hour	NaturalNumber	1	A natural number value represents the hour.
minute	NaturalNumber	1	A natural number value represents the minute.
second	NaturalNumber	1	A natural number value represents the second

Table 2 – Time and Date Data Type Attributes

6.8 TimeInterval

Time interval T for PM. E.g., 1 month, 20 days, 2 weeks, etc. The datatype specifies a time period and unit.

Attribute Name	Type	Mult.	Description
number	PositiveInteger	1	Values represents a time unit. Reference section
unit	TimeIntervalUnit	1	A positive Integer value represents the time interval.

Table 3 – Time IntervalT Data Type Definition

6.9 TimeIntervalUnit

Time interval unit, e.g., month, day, week, hour, etc..
Contains Enumeration Literals:

- YEAR
- MONTH
- WEEK
- DAY
- HOUR
- MINUTE
- SECOND

7 Layer 1 Service Superclasses

This section defines the set of superclasses that are used by the L1 Service information models. The superclass objects are L1ExternalInterface, L1EndPoint, L1Vc, L1Uni. These are superclass for L1SubscriberUni, L1Enni, SubscriberL1VcEndPoint and SubscriberL1Vc. The superclasses and the relationship with L1 service classes are shown in Figure 4.

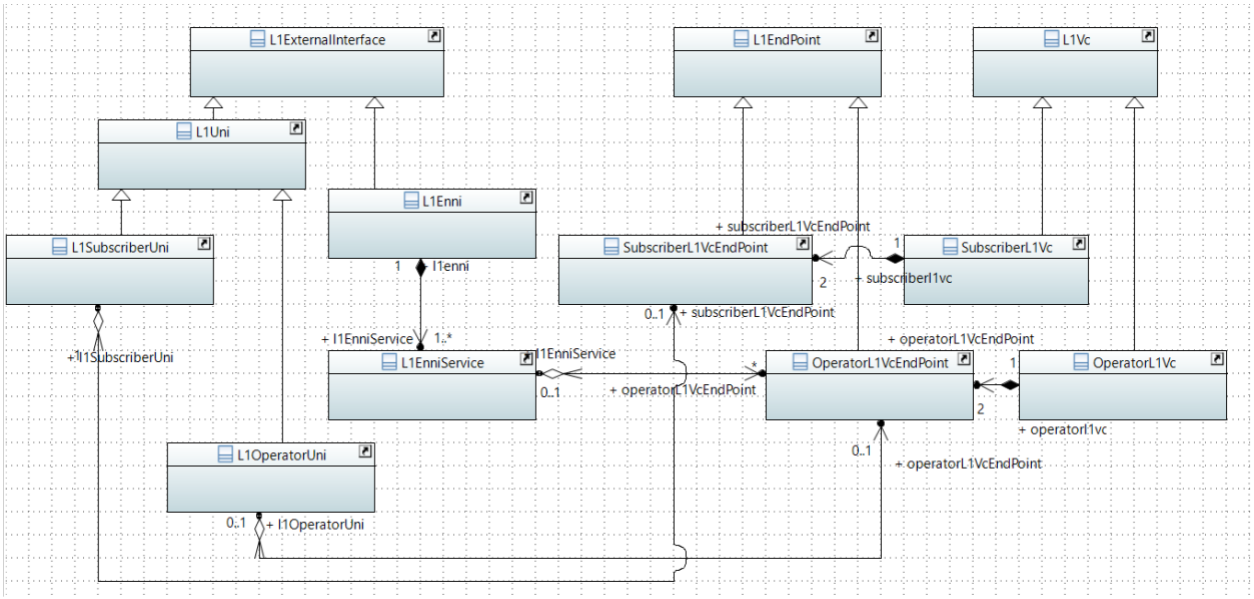

Figure 4 – Subscriber and Operator L1 Service super classes

7.1 L1ExternalInterface

The L1ExternalInterface represents the physical interface used for L1 services. This is an abstract class and the superclass. It contains the common attributes of three classes: L1SubscriberUni, L1OperatorUni and L1Enni defined in MEF 63[5] and MEF 64[6].

Attribute Name	Type	Mult.	Description
administrativeState	AdminState	1	This attribute denotes the administrative state of L1ExternalInterface. The values supported are LOCKED and UNLOCKED. When set to UNLOCK, the L1ExternalInterface is enabled and ready to forward traffic. When set to LOCKED, the L1ExternalInterface is disabled and will block (i.e., not forward) traffic.
operationalState	OperationalState	1	This attribute denotes the operational state of the L1ExternalInterface, as working ENABLED or not working DISABLED.

Table 4 – L1ExternalInterface Attributes

7.2 L1Uni

The L1Uni represents the physical interface used for L1 services with common attributes. This is an abstract class and the supper class. It contains the common attributes of L1SubscriberUni and L1OperatorUni not included in L1ExternalInterface superclass as defined in MEF 63[5] and MEF 64[6].

Attribute Name	Type	Mult.	Description
physicalLayer	L1UniPhysicalLayer	1	The Physical Layer Service Attribute specifies the Client Protocol, the Coding Function and the optical interface Function. Reference MEF 63 Section 8.1.2 Physical Layer Service Attribute and MEF 64 Section 8.3.2 Operator UNI Physical Layer Service Attribute.

Table 5 – L1Uni Attributes

7.3 L1EndPoint

The L1EndPoint represents the Subscriber L1 End Point or the Operator L1 End Point. This is an abstract class and the superclass of SubscriberL1EndPoint and OperatorL1EndPoint. It contains the common attributes of SubscriberL1EndPoint and OperatorL1EndPoint defined in MEF 63[5] and MEF 64[6].

Attribute Name	Type	Mult.	Description
administrativeState	AdminState	1	This attribute denotes the administrative state of L1EndPoint. The values supported are LOCKED and UNLOCKED. When set to UNLOCK, the L1EndPoint is enabled and ready to forward traffic. When set to LOCKED, the L1EndPoint is disabled and will block (i.e., not forward) traffic.
operationalState	OperationalState	1	This attribute denotes the operational state of the L1EndPoint, as working ENABLED or not working DISABLED.

Table 6 – L1EndPoint Attributes

7.4 L1Vc

The L1Vc represents the SubscriberL1Vc or Operator L1Vc. This is an abstract class and the superclass of SubscriberL1Vc and OperatorL1Vc. It contains the common attributes of SubscriberL1Vc and OperatorL1Vc classes defined in MEF 63[5] and MEF 64[6].

Attribute Name	Type	Mult.	Description
administrativeState	AdminState	1	This attribute denotes the administrative state of L1Vc. The values supported are LOCKED and UNLOCKED. When set to UNLOCK, the L1Vc is enabled and ready to forward traffic. When set

			to LOCKED, the L1Vc is disabled and will block (i.e., not forward) traffic.
operationalState	OperationalState	1	This attribute denotes the operational state of the L1Vc, as working ENABLED or not working DISABLED.
l1ServiceLevelSpecification	L1ServiceLevelSpecification	0..1	The Subscriber L1VC Service Level Specification (SLS) Service Attribute is the technical specification of aspects of the service performance agreed to by the Service Provider and Subscriber. Reference MEF 63 Section 8.2.3 and MEF 64 Section 8.4.3 Operator L1VC Service Level Specification Service Attribute.

Table 7 – L1Vc Attributes

8 Subscriber Layer 1 Service Model

The following section provides the details of Subscriber Layer 1 Service model with objects, attributes and relationships. The Subscriber L1 Service classes are composed of L1SubscriberUni, SubscriberL1VcEndPoint and SubscriberL1Vc.

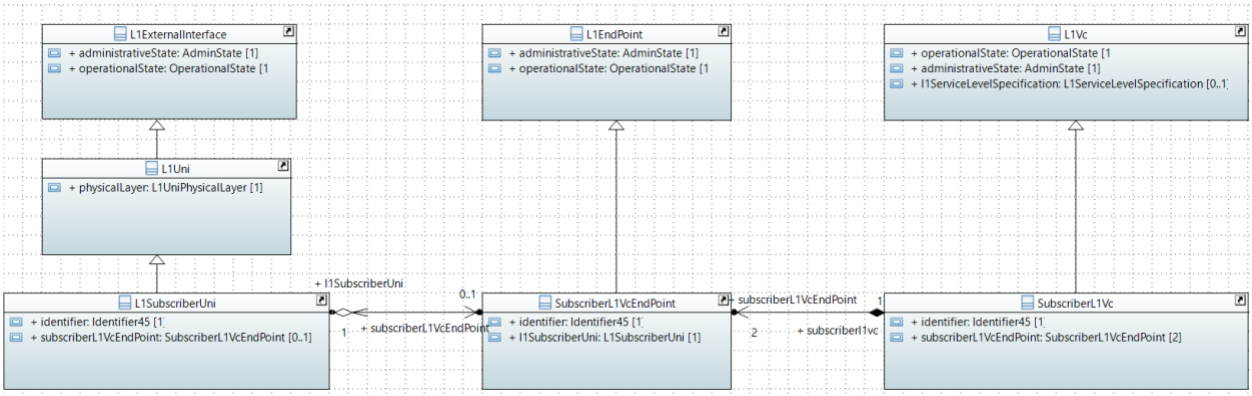

Figure 5 – Subscriber Layer 1 Service Model

8.1 L1SubscriberUni

The UNI is the physical demarcation point between the responsibility of the L1 Service Provider and the responsibility of the L1 Subscriber. Reference MEF 63[5] Section 8.

Attribute Name	Type	Mult.	Description
identifier	Identifier45	1	The value of the UNI ID Service Attribute is a string that is used to allow Subscriber and Service Provider to uniquely identify the UNI. Reference MEF 63 Section 8.1.1 UNI ID Service Attribute.
subscriberL1VcEndPoint	SubscriberL1VcEndPoint	0..1	L1SubscriberUni association to SubscriberL1VcEndPoint.

Table 8 – L1SubscriberUni Attributes

8.2 SubscriberL1VcEndPoint

A Subscriber L1VC End Point is a logical entity at a given UNI that is associated with L1CI passing over that UNI. Reference MEF 63[5] Section 8.3.

Attribute Name	Type	Mult.	Description
identifier	Identifier45	1	The value of the Subscriber L1VC End Point identifier Service Attribute is a string that is used to allow the Subscriber and Service Provider to uniquely identify the Subscriber L1VC End Point. Reference MEF 63 Section 8.3.1.
l1SubscriberUni	L1SubscriberUni	1	SubscriberL1VcEndPoint association to L1SubscriberUNI.

Table 9 – L1SubscriberL1VcEndPoint Attributes

8.3 SubscriberL1Vc

A subscriber L1VC represents the logical attachment of a Subscriber L1VC to two SubscriberL1VCEndPoint. Reference MEF 63[5] Section 8.2.

Attribute Name	Type	Mult.	Description
identifier	Identifier45	1	The value of the Subscriber L1VC ID service attribute is a string that is used to identify the Subscriber L1VC within the service provider network. Reference MEF 63 Section 8.2.1.
subscriberL1VcEndPoint	SubscriberL1VcEndPoint	2	SubscriberL1VC association to SubscriberL1VcEndPoint.

Table 10 – SubscriberL1Vc Attributes

9 Operator Layer 1 Service Model

The following section provides the details of Operator Layer 1 Service model with objects, attributes and relationships. The Operator L1 Service classes are composed of L1Enni, L1EnniService, OperatorL1VcEndPoint, L1OperatorUni and OperatorL1Vc.

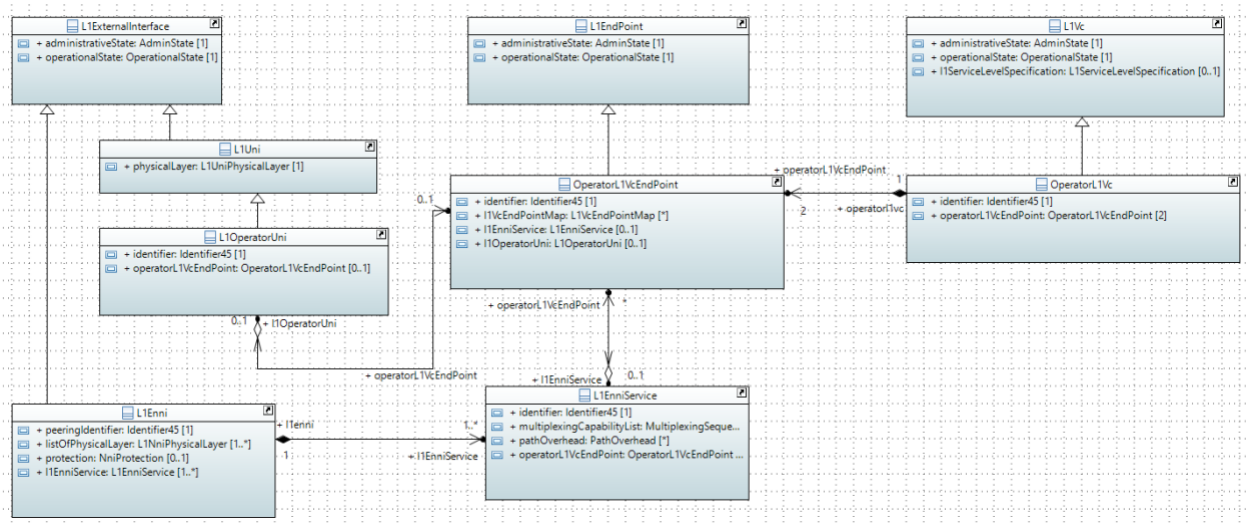

Figure 6 – Operator Layer 1 Service Model

9.1 L1 OperatorUni

The L1 Operator UNI Service Attribute values are agreed to by the SP/SO and the Operator.

Attribute Name	Type	Mult.	Description
identifier	Identifier45	1	An identifier for the UNI intended for SP/SO and Operator to uniquely identify the UNI. Reference MEF 64 Section 8.3.1 Operator UNI Identifier Service Attribute.
operatorL1VcEndPoint	OperatorL1VcEndPoint	0..1	Attribute pointing Operator L1VC End Point.

Table 11 – L1OperatorUni Attributes

9.2 OperatorL1VcEndPoint

An Operator L1VC End Point represents the logical attachment of an Operator L1VC to an EI. Reference MEF 64[6] Section 8.5 Operator L1VC End Point Service Attributes.

Attribute Name	Type	Mult.	Description
identifier	Identifier45	1	An identifier for the Operator L1VC End Point is a string that is used to allow the SP/SO and operator to uniquely identify the Operator L1VC End Point. Reference MEF 64 Section 8.5.1 Operator L1VC End Point Identifier Service Attribute.
l1VcEndPointMap	L1VcEndPointMap	0..*	The L1VC End Point Map specifies which bits that cross the ENNI are mapped to and from the Operator L1VC End Point and Tributary Slot rate. The L1VC End Point Map is empty when the Operator L1VC End Point is associated with UNI. Reference MEF 64 Section 8.5.4 Operator L1VC End Point Map Service Attribute.
l1EnniService	L1EnniService	0..1	Attribute pointing L1EnniService.

l1OperatorUni	L1OperatorUni	0..1	Attribute pointing L1 Operator UNI.

Table 12 – OperatorL1VcEndPoint Attributes

9.3 OperatorL1Vc

An Operator L1VC is an association of two Operator L1VC End Points. Reference MEF 64[6] Section 8.4 Operator L1VC Service Attributes.

Attribute Name	Type	Mult.	Description
identifier	Identifier45	1	An identifier for the Operator L1VC is a string that is used to allow the SP/SO and operator to uniquely identify an Operator L1VC. Reference MEF 64 Section 8.4.1 Operator L1VC Identifier Service Attribute.
operatorL1VcEndPoint	OperatorL1VcEndPoint	2	Attribute pointing Operator L1VC End Point class.

Table 13 – OperatorL1Vc Attributes

9.4 L1Enni

The L1 ENNI class controls Operator Network behaviors that enable Operator Networks to be interconnected and exchanged OTU*k* frames. The interconnection is achieved by the Operators agreeing on the value for each ENNI attributes. Reference MEF 64[6] Section 8.1 ENNI Common Attributes.

Attribute Name	Type	Mult.	Description
peeringIdentifier	Identifier45	1	The ENNI Peering Identifier value is a string used to allow the Operators at ENNI to uniquely identify the ENNI. Reference MEF 64 Section 8.1.1 ENNI Peering Identifier Common Attribute.
listOfPhysicalLayer	L1NniPhysicalLayer	1..*	The list of coding function and wavelength structure supporting the ENNI. Reference MEF 64 Section 8.1.2 ENNI List of Physical Layers Common Attribute.
protection	Protection	0..1	The protection protocol deployed at ENNI for the ODU container exchanged by the Operator. Reference MEF 64 Section 8.1.3 ENNI Protection Common Attribute.
l1EnniService	L1EnniService	1..*	Attribute pointing to L1ENNIService.

Table 14 – L1Enni Attributes

9.5 L1EnniService

For each instance of an ENNI, there are multiple sets of ENNI Service Attributes. The value for each ENNI Service Attribute in a set for an Operator network is specific to the SP/SO that is using the ENNI. Reference MEF 64[6] Section 8.2 ENNI Service Attributes.

Attribute Name	Type	Mult.	Description
identifier	Identifier45	1	The Operator ENNI Identifier Service Attribute value is a string

			used to allow the SP/SO and Operator to uniquely identify the ENNI. Reference MEF 64 Section 8.2.1 Operator ENNI Identifier Service Attribute.
multiplexingCapabilityList	MultiplexingSequences	0..*	The multiplexing capability list indicates the list of operator's ability to multiplex a given LO ODUj into HO ODUk (single-stage), or multiplex a given LO ODUi into a HO ODUj and into a SHO ODUk (two-stage), or more multiplexing stages. Reference MEF 64 Section 8.2.2 Operator Multiplexing Capability List Service Attribute.
pathOverhead	PathOverhead	0..*	The path overhead represents the overhead values corresponding to each of the SHO/HO/LO ODU paths carried across an ENNI which is terminated in an Operator's network. Reference MEF 64 Section 8.2.3 Operator Path Overhead Service Attribute.
operatorL1VcEndPoint	OperatorL1VcEndPoint	0..*	Attribute pointing to Operator L1VC End Point.

Table 15 – L1EnniService Attributes

10 L1 Service Data Type Definitions

The following section details the associated set of data types that are used by the Layer 1 Service models.

10.1 L1UniPhysicalLayer

The L1UniPhysical Layer Service Attribute specifies the Client Protocol, the l1UniCoding Function and the l1UniOptical Interface Function. Reference MEF 63[5] Section 8.1.2 Physical Layer Service Attribute.

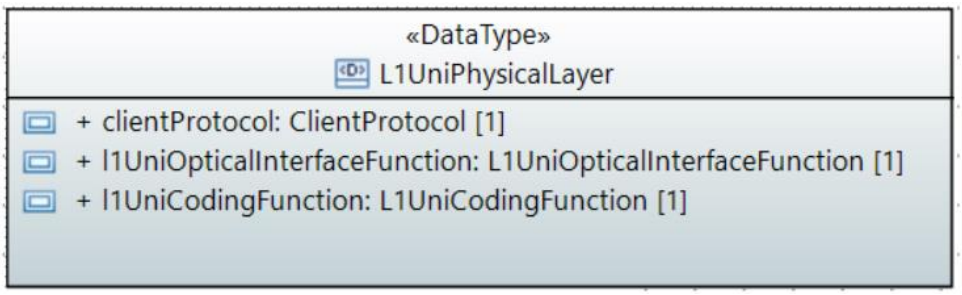

Figure 7 – L1 Physical Layer Types

Attribute Name	Type	Mult.	Description
clientProtocol	ClientProtocol	1	The Client Protocol must be one of the following values: Ethernet, Fiber Channel, SDH or SONET. Reference MEF 63 Section 8.1.2.
l1UniOpticalInterfaceFunction	L1UniOpticalInterfaceFunction	1	Optical Interface Function value. Reference MEF 63 Section 8.1.2.
l1UniCodingFunction	L1UniCodingFunction	1	The coding function value. Reference MEF 63 Section 8.1.2.

Table 16 – L1 Physical Layer Data Type Attributes

10.2 L1NniPhysicalLayer

The L1 NNI Physical Layer Service Attribute is a list of 2-tuples of the L1 NNI Coding Function and L1 NNI Optical Interface Function. Reference MEF 64[6] Section 8.1.2 ENNI List of Physical Layers Common Attribute.

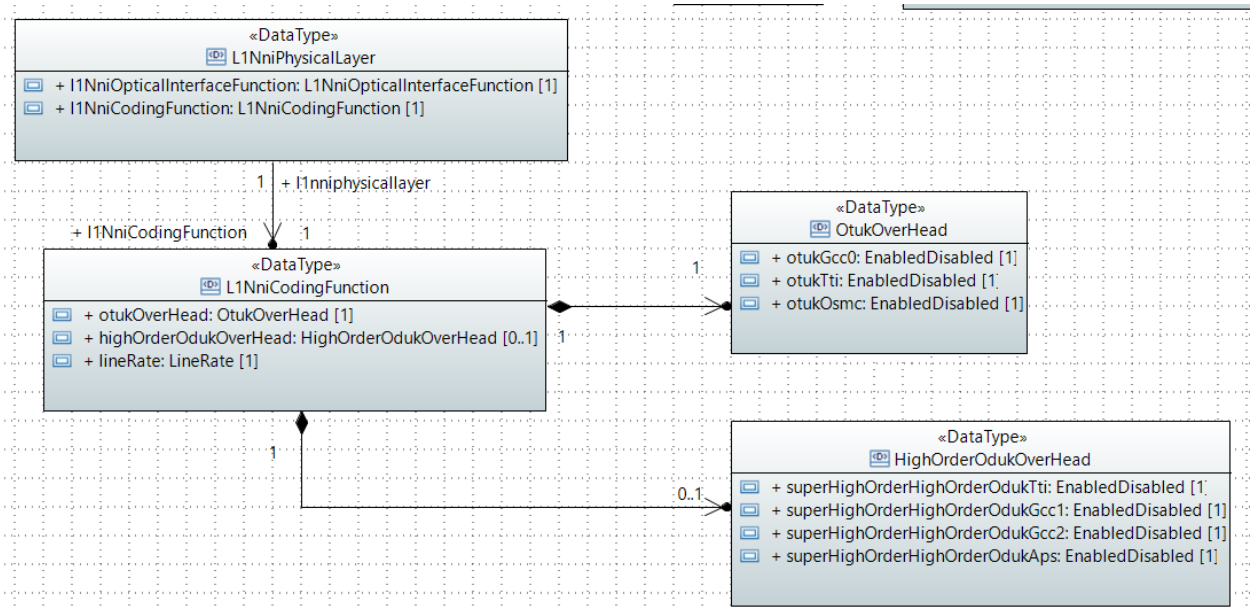

Figure 8 – L1 ENNI Physical Layer Types

Attribute Name	Type	Mult.	Description
l1NniOpticalInterfaceFunction	L1NniOpticalInterfaceFunction	1	Pointer to NNI Optical Interface Function.
l1NniCodingFunction	L1NniCodingFunction	1	Pointer to NNI Coding Function.

Table 17 – L1 ENNI Physical Layer Data Type Attributes

10.2.1 L1NniCodingFunction

L1 NNI Coding function is a 3-tuple of the <k, OTU*k* OH, HO ODU*k* OH>. k is an index representing the physical layer line rate. OTU*k* OH is a list of overhead values corresponding to the terminated OTU*k*. HO ODU*k* OH is either None or List where the value represents the overhead values corresponding to the terminated HO ODU*k*.

Attribute Name	Type	Mult.	Description
otukOverHead	OtukOverHead	1..*	A list of overhead values corresponding to the terminated OTU*k*.
highOrderOduk	HighOrderOdukOverHead	0..*	The overhead values corresponding to the terminated HO ODU*k* (or SHO ODU*k*), where each entry in the list has the value Disabled or Enabled.
lineRate	LineRate	1	LineRate representing the OTL*k*.4/OTU*k* physical layer line rate.

Table 18 – L1 ENNI Coding Function Data Type Attributes

10.2.2 OTU*k* Overhead

OTU*k* Overhead must be a list of three pairs {field,values} with each field and corresponding values in Table 19 – OTUk Overhead Data Type Attributes.

Attribute Name	Type	Mult.	Description
otukTti	EnabledDisabled	1	OTU*k* Trail Trace Identifier.
otukGcc0	EnabledDisabled	1	OTU*k* General Communications Channel.
otukOsmc	EnabledDisabled	1	OTU*k* OTN Synchronization Messaging Channel.

Table 19 – OTUk Overhead Data Type Attributes

10.2.3 HighOrderODU*k*Overhead

The value of HO ODU*k* OH is either None or List of overhead values corresponding to the terminated HO ODU*k*, where each entry in the list has the value Disabled or Enabled.

Attribute Name	Type	Mult.	Description
superHighOrderHighOrderOdukTti	EnabledDisabled	1	Super High Order/High Order ODU*k* Trail Trace Identifier.
superHighOrderHighOrderOdukGcc1	EnabledDisabled	1	Super High Order/High Order ODU*k* General Communications Channel 1.
superHighOrderHighOrderOdukGcc2	EnabledDisabled	1	Super High Order/High Order ODU*k* General Communications Channel 2.
superHighOrderHighOrderOdukAps	EnabledDisabled	1	Super High Order/High Order ODU*k* Automatic Protection Switching.

Table 20 – High Order ODU*k* Overhead Data Type Attributes

10.3 PathOverhead

An ODU path is the connectivity between the locations where the path overhead is terminated. Either None or List. When the value of the Operator Path Overhead Service Attribute is List, the entries are the overhead values corresponding to each of the SHO/HO/LO ODU paths carried across an ENNI which is terminated in an Operator's network. Reference MEF 64[6] Section 8.2.3 Operator Path Overhead Service Attribute.

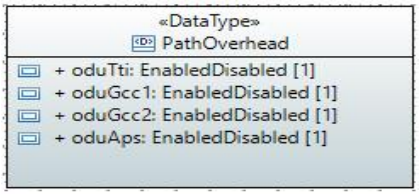

Figure 9 – Path Overhead Types

Attribute Name	Type	Mult.	Description
oduTti	EnabledDisabled	1	Overhead value, corresponding to each of the SHO/HO/LO ODU paths carried across an ENNI, ODU TTI is enabled or disabled.
oduGcc1	EnabledDisabled	1	Overhead value, corresponding to each of the SHO/HO/LO ODU paths carried across an ENNI, ODU GCC1 is enabled or disabled.
oduGcc2	EnabledDisabled	1	Overhead value, corresponding to each of the SHO/HO/LO ODU paths carried

			across an ENNI, ODU GCC2 is enabled or disabled.
oduAps	EnabledDisabled	1	Overhead value, corresponding to each of the SHO/HO/LO ODU paths carried across an ENNI, ODU APS is enabled or disabled.

Table 21 – Path Overhead Data Type Attributes

10.4 L1VcEndPointMap

Either Not Applicable or non-empty list of tuples of attributes in Table 22. Reference MEF 64[6] Section 8.5.4 Operator L1VC End Point Map Service Attribute.

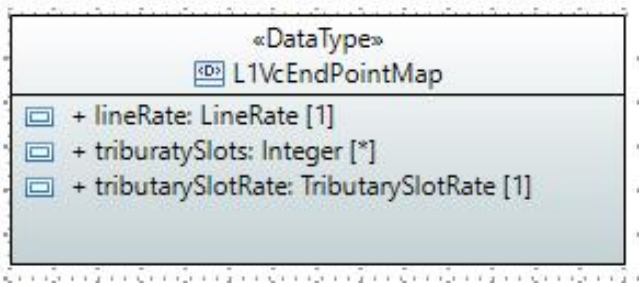

Figure 10 – L1VC End Point Map Types

Attribute Name	Type	Mult.	Description
lineRate	LineRate	1	Line Rate representing element in the set {1,2,..,k} and k is specified in the value of ENNI List of Physical Layer Common Attribute for the ENNI Identified by the value of Operator L1VC End Point External Interface Identifier Service Attribute.
tributarySlotRate	TributarySlotRate	1	Tributary Slot Rate indicates the normal Tributary Slot rate.
triburatySlots	Integer	0..*	Tributary Slot is list of integers that represents Tributary Slots occupied in a HO ODUi.

Table 22 – L1VC End Point Map Data Type Attributes

10.5 L1ServiceLevelSpecification

The Subscriber L1VC Service Level Specification (SLS) Service Attribute is the technical specification of aspects of the service performance agreed to by the Service Provider and the Subscriber. For any given SLS, a given Performance Metric may or may not be specified.

The value of the Subscriber L1VC SLS Service Attribute is either None or a 3-tuple of the form (t-s, T, PM) where:

1) t-s is a time that represents the date and time for the start of the SLS.

2) T is a duration that is used in conjunction with t-s to specify a contiguous sequence of time intervals for determining when performance objectives are met. The units for T are not constrained.

For example, a calendar month is an allowable value. Since the duration of a month varies it could be specified as, e.g. from midnight on the 10th of one month up to but not including midnight on the 10th of the following month.

3) PM is a list where each element in the list consists of a Performance Metric Name, a list of parameter values specific to the definition of the Performance Metric, and Performance Metric Objective.

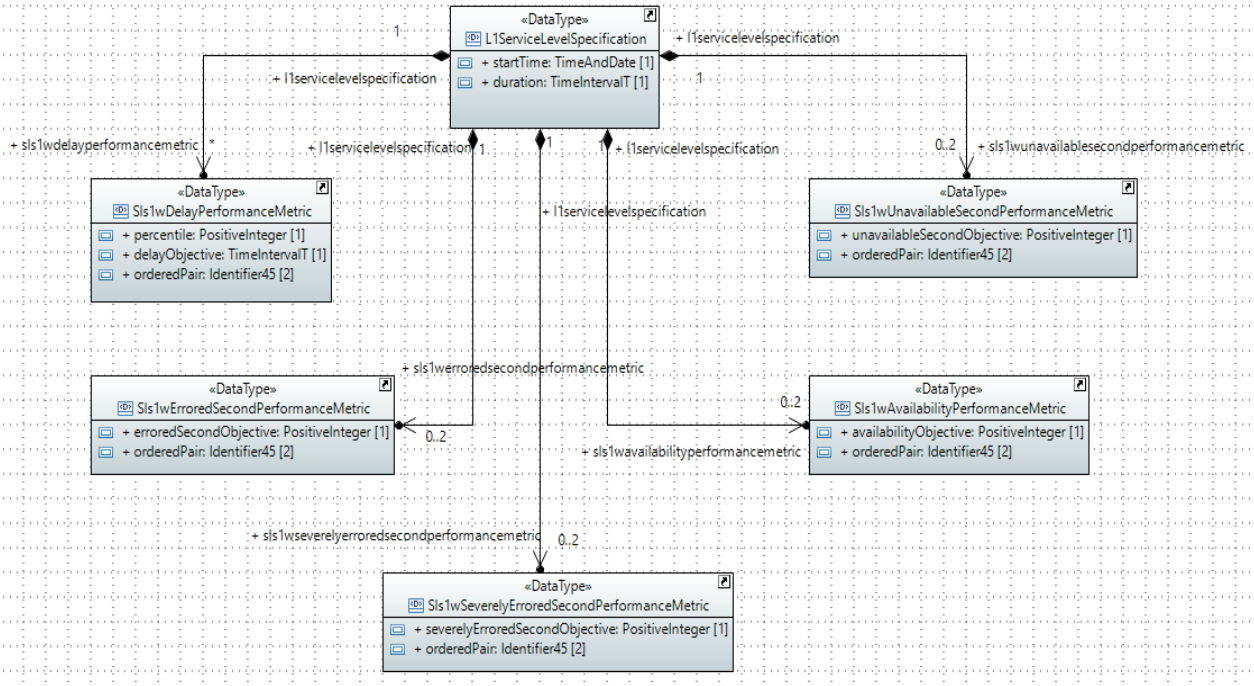

Figure 11 – L1 Service Level Specification Types

Attribute Name	Type	Mult.	Description
startTime	TimeAndDate	1	StartTime is a time that represents the date and time for the start of the SLS. MEF 63: [R22] t-start MUST be specified to the nearest second. MEF 64: [R30] t-start MUST be specified to the nearest second.
duration	TimeIntervalT	1	Duration is a duration that is used in conjunction with ts to specify a contiguous sequence of time intervals for determining when performance objectives are met. The units for T are not constrained. For example, a calendar month is an allowable value. Since the duration of a month varies it could be specified as, e.g. from midnight on the 10th of one month up to but not including midnight on the 10th of the following month. MEF 63: [R23] T MUST contain an integer number of seconds. MEF 64: [R31] T MUST contain an integer number of seconds.

sls1wAvailabilityPerformanceMetric	Sls1wAvailabilityPerformanceMEtric	0..*	One way availability performance metric.
sls1wDelayPerformanceMetric	Sls1wDelayPerformanceMetric	0..2	One way delay performance metric.
sls1wErroredSecondPerformanceMetric	Sls1wErroredSecondPerformanceMetric	0..2	One way errored second performance metric.
sls1wSeverelyErroredSecondPerformanceMetric	Sls1wSeverelyErroredSecondPerformanceMetric	0..2	One way severely errored second performance metric.
sls1wUnavailableSecondPerformanceMetric	Sls1wUnavailableSecondPerformanceMetric	0..2	One way unavailable second performance metric.

Table 23 – SLS Service Level Specification Data Type Attributes

10.5.1 Sls1WDelayPerformanceMetric

MEF 63[5]:The One-way Delay for the L1CI that ingresses at UNI 1 and that egresses at UNI 2 is defined as the time elapsed from the reception of the first bit of the ingress L1CI at UNI 1 until the reception of that first bit of the corresponding L1CI egressing at UNI 2. [R27] The SLS MUST define the One-way Delay Performance Metric Objective as met during Available Time (AT) over T-l for a PM entry if and only if measured delay D <= delayObjective.
MEF 64[6]: The One-way Delay for the L1CI that ingresses at External Interface 1 and that egresses at External Interface 2 is defined as the time elapsed from the reception of the first bit of the ingress L1CI at External Interface 1 until the reception of that first bit of the corresponding L1CI egressing at External Interface 2. [R33] The SLS MUST define the One-way Delay Performance Metric Objective as met during Available Time over T-l for a PM entry if and only if measured delay D <= delayObjective.

Attribute Name	Type	Mult.	Description
percentile	PositiveInteger	1	MEF 63 & MEF 64: the Pd-percentile allows the One-way Delay Performance Metric Objective to be met although different delays may occur following a protection switch. To place an upper bound on any longer delays a second One-way Delay Performance Metric Objective for a higher Pd_percentile value (e.g., 100th) may be specified.
delayObjective	Time	1	MEF 63 & MEF 64: The value of the One-way Delay Performance Metric, time units>0
orderedPairSrc	L1EndPoint	1	MEF 63: Ordered pair of Subscriber L1VC EPs. MEF 64: Ordered pair of Operator L1VC EPs.
orderedPairDst	L1EndPoint	1	MEF 63: Ordered pair of Subscriber L1VC EPs. MEF 64: Ordered pair of Operator L1VC EPs.

Table 24 – SLS One-Way Delay Performance Metrics Data Type Attributes

10.5.2 Sls1wErroredSecondPerformanceMetric

An errored second (ES) is defined as one second sigma-k in Available Time with at least one errored block (EB) and is not a SES. An EB is defined as a block in which one or more bits are in error. In this specification the L1CI corresponds to a block.

MEF 63[5] & MEF 64[6]: The SLS MUST define the One-way Errored Second Performance Metric Objective as met during Available Time over T-l for a PM entry if and only if measured Errored Second PM <= erroredSecondObjective.

Attribute Name	Type	Mult.	Description
erroredSecondObjective	PositiveInteger	1	MEF 63 & MEF 64: The value of the One-way Errored Second Performance Metric, integer >=0
orderedPairSrc	L1EndPoint	1	MEF 63: Ordered pair of Subscriber L1VC EPs. MEF 64: Ordered pair of Operator L1VC EPs.
orderedPairDst	L1EndPoint	1	MEF 63: Ordered pair of Subscriber L1VC EPs. MEF 64: Ordered pair of Operator L1VC EPs.

Table 25 – SLS One-Way Errored Second Performance Metric Data Type Attributes

10.5.3 Sls1wSeverelyErroredSecondPerformanceMetric

A Severely Errored Second (SES) is defined as: - One second sigma-k which contains >= 15% errored L1CI, or - One second sigma-k which contains a defect (e.g., loss of signal), where a defect on ingress to (client protocol specific), or within the Service Provider's network (transport technology specific) may result in the insertion of a replacement signal (transport technology specific). Note that if a replacement signal is not inserted, a defect (such as a loss of signal) may propagate to the egress UNI. Note that a SES is not counted as a ES.
MEF 63[5] & MEF 64[6]: The SLS MUST define the One-way Severely Errored Second Performance Metric Objective as met during Available Time over T-l for a PM entry if and only if measured Severely Errored Second PM <= severelyErroredSecondObjective.

Attribute Name	Type	Mult.	Description
severelyErroredSecondObjective	PositiveInteger	1	MEF 63 & MEF 64: The value of the One-way Severely Errored Second Performance Metric, integer >=0
orderedPairSrc	L1EndPoint	1	MEF 63: Ordered pair of Subscriber L1VC EPs. MEF 64: Ordered pair of Operator L1VC EPs.
orderedPairDst	L1EndPoint	1	MEF 63: Ordered pair of Subscriber L1VC EPs. MEF 64: Ordered pair of Operator L1VC EPs.

Table 26 – SLS One-Way Severely Errored Seconds Performance Metric Data Type Attributes

10.5.4 Sls1wAvailabilityPerformanceMetric

Availability is defined as the percentage of Available Time over a given interval T-l which does not include Maintenance Interval Time (MIT).
MEF 63[5] & MEF 64[6]: The SLS MUST define the One-way Availability Performance Metric Objective as met over T-l for a PM entry if and only if measured Availability PM >= availabilityObjective.

Attribute Name	Type	Mult.	Description

availabilityObjective	PositiveInteger	1	MEF 63 & MEF 64: The value of the One-way Availability Performance Metric, percentage > 0
orderedPairSrc	L1EndPoint	1	MEF 63: Ordered pair of Subscriber L1VC EPs. MEF 64: Ordered pair of Operator L1VC EPs.
orderedPairDst	L1EndPoint	1	MEF 63: Ordered pair of Subscriber L1VC EPs. MEF 64: Ordered pair of Operator L1VC EPs.

Table 27 – SLS One-Way Availability Performance Metric Data Type Attributes

10.5.5 Sls1wUnavailableSecondPerformanceMetric

An Unavailable Second (UAS) is defined as a second during Unavailable Time (UAT).
MEF 63[5] & MEF64[6]: The SLS MUST define the One-way Unavailable Second Performance Metric Objective as met over T-l for a PM entry if and only if measured Unavailable Seconds PM <= unavailableSecondObjective.

Attribute Name	Type	Mult.	Description
unavailableSecondObjective	PositiveInteger	1	MEF 63 & MEF 64: The value of the One-way Unavailable Second Performance Metric, integer >=0
orderedPairSrc	L1EndPoint	1	MEF 63: Ordered pair of Subscriber L1VC EPs. MEF 64: Ordered pair of Operator L1VC EPs.
orderedPairDst	L1EndPoint	1	MEF 63: Ordered pair of Subscriber L1VC EPs. MEF 64: Ordered pair of Operator L1VC EPs.

Table 28 – SLS One-Way Unavailable Second Performance Metric Data Type Attributes

10.6 Time

A data type used to represent time in various units.

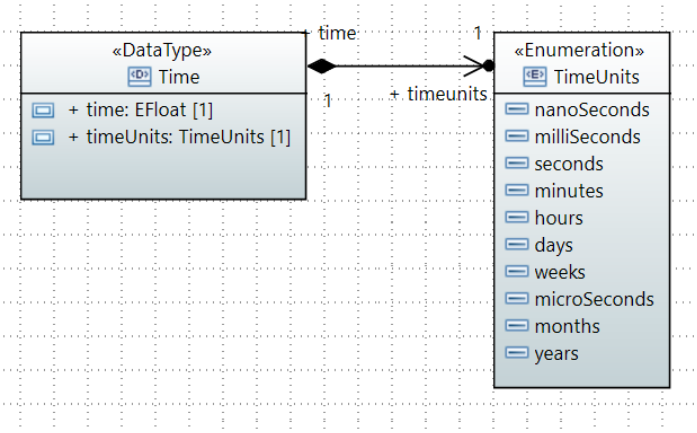

Figure 12 – Time Data Type

Attribute Name	Type	Mult.	Description
time	EFloat	1	Time as a float value.

Attribute Name	Type	Mult.	Description
timeUnits	TimeUnits	1	Time units as a set of enumerations.

Table 29 – Time Data Type Attributes

11 L1 Service Enumerations Definitions

The following section details the set of Enumerations used in support of the MSM Layer 1 Service models.

11.1 ClientProtocol

Enumeration representing Client Protocol of L1 Physical Layer.

Contains Enumeration Literals:

- ETHERNET:
  - Representing Ethernet is used as client protocol for UNI.
- FIBERCHANNEL:
  - Representing Fiber Channel is used as client protocol for UNI.
- SDH:
  - Representing Synchronous Digital Hierarchy (SDH) is used as client protocol for UNI.
- SONET:
  - Representing Synchronous Optical Networking (SONET) is used as client protocol for UNI.

11.2 EnabledDisabled

Enumeration used to indicate state as ENABLED OR DISABLED.

Contains Enumeration Literals:

- ENABLED:
  - Enumeration representing an ENABLED state.
- DISABLED:
  - Enumeration representing a DISABLED state.

11.3 L1VcEndPointExternalInterfaceType

Enumeration used to indicate if the L1VC End Point is either UNI or ENNI.
Contains Enumeration Literals:

- UNI:
  - Enumeration representing a UNI.
- ENNI:
  - Enumeration representing an ENNI.

11.4 NniProtection

Enumeration representing the protection protocol deployed at ENNI for the ODU container exchanged by the Operator. The enumeration value is either None or One of the rows as specified in G.873.1 Section 8.5, Table 8-1.

Contains Enumeration Literals:

- 1_PLUS_1_UNIDIR_SNC_I:
  - The 1st row of the G.873.1 Section 8.5, Table 8-1.
- 1_PLUS_1_BIDIR_SNC_I:
  - The 2nd row of the G.873.1 Section 8.5, Table 8-1.
- 1_TO_N_BIDIR_SNC_I:
  - The 3rd row of the G.873.1 Section 8.5, Table 8-1.
- 1_PLUS_1_UNIDIR_SNC_NE:
  - The 4th row of the G.873.1 Section 8.5, Table 8-1.
- 1_PLUS_1_BIDIR_SNC_NE:
  - The 5th row of the G.873.1 Section 8.5, Table 8-1.
- 1_PLUS_1_UNIDIR_SNC_NS:
  - The 6th row of the G.873.1 Section 8.5, Table 8-1.
- 1_PLUS_1_BIDIR_SNC_NS:
  - The 7th row of the G.873.1 Section 8.5, Table 8-1.
- 1_PLUS_1_UNIDIR_SNC_S:
  - The 8th row of the G.873.1 Section 8.5, Table 8-1.
- 1_PLUS_1_BIDIR_SNC_S:
  - The 9th row of the G.873.1 Section 8.5, Table 8-1.
- 1_TO_N_BIDIR_SNC_S:
  - The 10th row of the G.873.1 Section 8.5, Table 8-1.
- 1_PLUS_1_UNIDIR_CL-SNCG_1:
  - The 11th row of the G.873.1 Section 8.5, Table 8-1.
- 1_PLUS_1_BIDIR_CL-SNCG_1:
  - The 12th row of the G.873.1 Section 8.5, Table 8-1.
- 1_TO_1_BIDIR_CL-SNCG_1:
  - The 13th row of the G.873.1 Section 8.5, Table 8-1.

11.5 TributarySlotRate

Enumeration representing Tributary Slot rate in Gb/s.

Contains Enumeration Literals:

- 1.25:
  - 1.25 Gb/s.
- 2.5:
  - 2.5 Gb/s.

11.6 LineRate

Enumeration representing physical line rate.

Contains Enumeration Literals:

- OTU1:
  - Enumeration representing when k=1.
- OTU2:
  - Enumeration representing when k=2.
- OTU2E:
  - Enumeration representing when k=2e.
- OTU3:
  - Enumeration representing when k=3.
- OTU4:
  - Enumeration representing when k=4.

11.7 L1UniCodingFunction

MEF 63 Coding Function <c>, functionality which encodes bits for transmission and the corresponding decode upon reception.

Contains Enumeration Literals:

- 1000BASE-X:
  - IEEE Std 802.3: PCS clause 36 coding function
- 10GBASE-W:
  - IEEE Std 802.3: PCS clause 49 and WIS clause 50 coding function (WAN PHY)
- 10GBASE-R:
  - IEEE Std 802.3: PCS clause 49 coding function (LAN PHY)
- 40GBASE-R:
  - IEEE Std 802.3: PCS clause 82 coding function
- 100GBASE-R:
  - IEEE Std 802.3: PCS clause 82 coding function
- FC-100:
  - ANSI INCITS 424-2007[R2012], February 2007: FC-FS-2 clause 5 FC-1 8B/10B coding function (1.0625 Gb/s)
- FC-200:
  - ANSI INCITS 424-2007[R2012], February 2007: FC-FS-2 clause 5 FC-1 8B/10B coding function (2.125 Gb/s)
- FC-400:
  - ANSI INCITS 424-2007[R2012], February 2007: FC-FS-2 clause 5 FC-1 8B/10B coding function (4.250 Gb/s)
- FC-800:
  - ANSI INCITS 424-2007[R2012], February 2007: FC-FS-2 clause 5 FC-1 8B/10B coding function (8.500 Gb/s)
- FC-1200:
  - MEF 63: ANSI INCITS 364-2003, November 2003: FC-10GFC clause 13 FC-1 coding function (10.51875 Gb/s)
- FC-1600:
  - ANSI INCITS 470-2011, December 2011: FC-FS-3 clause 5 FC-1 64B/66B coding function (14.025 Gb/s)

- FC-3200:
  - ANSI INCITS 488-2016, December 2016: FC-FS-4 clause 5 FC-1 64B/66B coding function plus 256B/257B transcoding and FEC encoding (28.05 Gb/s)
- STM-1:
  - ITU-T G.707/Y.1322 January 2007: framer, N=1
- STM-4:
  - ITU-T G.707/Y.1322 January 2007: framer, N=4
- STM-16:
  - ITU-T G.707/Y.1322 January 2007: framer, N=16
- STM-64:
  - ITU-T G.707/Y.1322 January 2007: framer, N=64
- STM-256:
  - ITU-T G.707/Y.1322 January 2007: framer, N=256
- OC-3:
  - Telcordia GR-253-CORE Issue 5, October 2009: framer, N=3
- OC-12:
  - Telcordia GR-253-CORE Issue 5, October 2009: framer, N=12
- OC-48:
  - Telcordia GR-253-CORE Issue 5, October 2009: framer, N=48
- OC-192:
  - Telcordia GR-253-CORE Issue 5, October 2009: framer, N=192
- OC-768:
  - Telcordia GR-253-CORE Issue 5, October 2009: framer, N=768

11.8 MultiplexingSequences

The value of the Operator Multiplexing Capability List Service Attribute indicates the Operator's ability to multiplex a given LO ODU*j* into a HO ODU*k* (single-stage), or multiplex a given LO ODU*i* into a HO ODU*j* and into a SHO ODU*k* (two-stage), or more multiplexing stages. Enumeration represents the possible multiplexing sequences for a given LO ODU into a HO ODU using a nomenclature similar to OIF ENNI [8]. Each enumeration value in the subsection represents the possible multiplexing sequences depending on the selection of lineRate in Section 10.2.1.

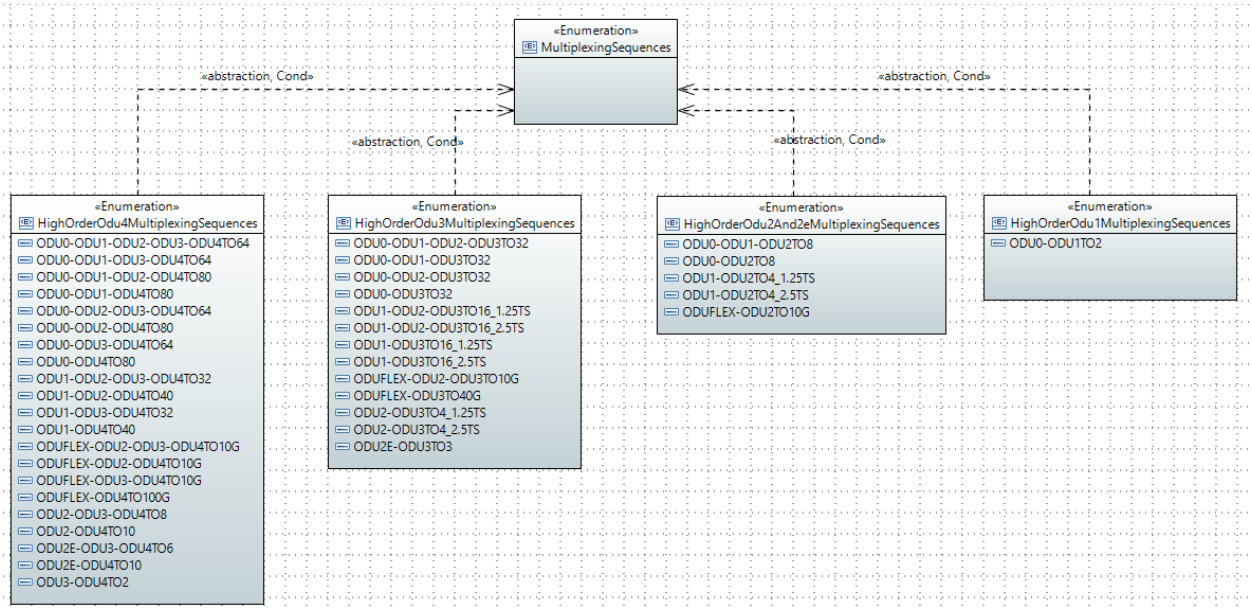

Figure 13 – Multiplexing Sequences Enumerations

11.8.1 HighOrderODU4MultiplexingSequences

Enumeration representing the available multiplexing sequences when Line Rate equals OTU4.

Contains Enumeration Literals:

- ODU0-ODU1-ODU2-ODU3-ODU4TO64:
  - Up to 64 LO ODU0 can be multiplexed in that sequence of HO ODU4.
- ODU0-ODU1-ODU3-ODU4TO64:
  - Up to 64 LO ODU0 can be multiplexed in that sequence of HO ODU4.
- ODU0-ODU1-ODU2-ODU4TO80:
  - Up to 80 LO ODU0 can be multiplexed in that sequence of HO ODU4.
- ODU0-ODU1-ODU4TO80:
  - Up to 80 LO ODU0 can be multiplexed in that sequence of HO ODU4.
- ODU0-ODU2-ODU3-ODU4TO64:
  - Up to 64 LO ODU0 can be multiplexed in that sequence of HO ODU4.
- ODU0-ODU2-ODU4TO80:
  - Up to 80 LO ODU0 can be multiplexed in that sequence of HO ODU4.
- ODU0-ODU3-ODU4TO64:
  - Up to 64 LO ODU0 can be multiplexed in that sequence of HO ODU4.
- ODU0-ODU4TO80:
  - Up to 80 LO ODU0 can be multiplexed in that sequence of HO ODU4.
- ODU1-ODU2-ODU3-ODU4TO32:
  - Up to 32 LO ODU1 can be multiplexed in that sequence of HO ODU4.
- ODU1-ODU2-ODU4TO40:
  - Up to 40 LO ODU1 can be multiplexed in that sequence of HO ODU4.
- ODU1-ODU3-ODU4TO32:
  - Up to 32 LO ODU1 can be multiplexed in that sequence of HO ODU4.

- ODU1-ODU4TO40:
  - Up to 40 LO ODU1 can be multiplexed in that sequence of HO ODU4.
- ODUFLEX-ODU2-ODU3-ODU4TO10G:
  - LO ODUflex up to 10Gb/s can be multiplexed in this sequence.
- ODUFLEX-ODU2-ODU4TO10G:
  - LO ODUflex up to 10Gb/s can be multiplexed in this sequence.
- ODUFLEX-ODU3-ODU4TO40G:
  - LO ODUflex up to 40Gb/s can be multiplexed in this sequence.
- ODUFLEX-ODU4TO100G:
  - LO ODUflex up to 100Gb/s can be multiplexed in this sequence.
- ODU2-ODU3-ODU4TO8:
  - Up to 8 LO ODU2 can be multiplexed in that sequence of HO ODU4.
- ODU2-ODU4TO10:
  - Up to 10 LO ODU2 can be multiplexed in that sequence of HO ODU4.
- ODU2E-ODU3-ODU4TO6:
  - Up to 6 LO ODU2E can be multiplexed in that sequence of HO ODU4.
- ODU2E-ODU4TO10:
  - Up to 10 LO ODU2E can be multiplexed in that sequence of HO ODU4.
- ODU3-ODU4TO2:
  - Up to 2 LO ODU3 can be multiplexed in that sequence of HO ODU4.

11.8.2 HighOrderODU3MultiplexingSequences

Enumeration representing the available multiplexing sequences when Line Rate equals OTU3.

Contains Enumeration Literals:

- ODU0-ODU1-ODU2-ODU3TO32:
  - Up to 32 LO ODU0 can be multiplexed in that sequence of HO ODU3.
- ODU0-ODU1-ODU3TO32:
  - Up to 32 LO ODU0 can be multiplexed in that sequence of HO ODU3.
- ODU0-ODU2-ODU3TO32:
  - Up to 32 LO ODU0 can be multiplexed in that sequence of HO ODU3.
- ODU0-ODU3TO32:
  - Up to 32 LO ODU0 can be multiplexed in that sequence of HO ODU3.
- ODU1-ODU2-ODU3TO16_1.25TS:
  - Up to 16 LO ODU1 can be multiplexed in that sequence of HO ODU3 supports 1.25 Gb/s Tributary Slot.
- ODU1-ODU2-ODU3TO16_2.5TS:
  - Up to 16 LO ODU1 can be multiplexed in that sequence of HO ODU3 supports 2.5 Gb/s Tributary Slot.
- ODU1-ODU3TO16_1.25TS:
  - Up to 16 LO ODU1 can be multiplexed in that sequence of HO ODU3 supports 1.25 Gb/s Tributary Slot.
- ODU1-ODU3TO16_2.5TS:
  - Up to 16 LO ODU1 can be multiplexed in that sequence of HO ODU3 supports 2.5 Gb/s Tributary Slot.

- ODUFLEX-ODU2-ODU3TO10G:
  - LO ODUflex up to 10Gb/s can be multiplexed in this sequence.
- ODUFLEX-ODU3TO40G:
  - LO ODUflex up to 40Gb/s can be multiplexed in this sequence.
- ODU2-ODU3TO4_1.25TS:
  - Up to 4 LO ODU2 can be multiplexed in that sequence of HO ODU3 supports 1.25 Gb/s Tributary Slot.
- ODU2-ODU3TO4_2.5TS:
  - Up to 4 LO ODU2 can be multiplexed in that sequence of HO ODU3 supports 2.5 Gb/s Tributary Slot.
- ODU2E-ODU3TO3:
  - Up to 3 LO ODU2E can be multiplexed in that sequence of HO ODU3.

11.8.3 HighOrderODU2And2EMultiplexingSequences

Enumeration representing the available multiplexing sequences when Line Rate equals OTU2 or OTU2E.

Contains Enumeration Literals:

- ODU0-ODU1-ODU2TO8:
  - Up to 8 LO ODU0 can be multiplexed in that sequence of HO ODU2.
- ODU0-ODU2TO8:
  - Up to 8 LO ODU0 can be multiplexed in that sequence of HO ODU2.
- ODU1-ODU2TO4_1.25TS:
  - Up to 4 LO ODU1 can be multiplexed in that sequence of HO ODU2 supports 1.25 Gb/s Tributary Slot.
- ODU1-ODU2TO4_2.5TS:
  - Up to 4 LO ODU1 can be multiplexed in that sequence of HO ODU2 supports 2.5 Gb/s Tributary Slot.
- ODUFLEX-ODU2TO10G:
  - LO ODUflex up to 10Gb/s can be multiplexed in this sequence.

11.8.4 HighOrderODU1MultiplexingSequences

Enumeration representing the available multiplexing sequences when Line Rate equals OTU1.
Contains Enumeration Literals:

- ODU0-ODU1TO2:
  - Up to 2 LO ODU0 can be multiplexed in that sequence of HO ODU1.

11.9 L1UniOpticalInterfaceFunction

MEF 63[5] Optical Interface Function <o>, functionality which converts encoded electrical bits into an optical signal(s) and the corresponding conversion into electrical format upon reception.

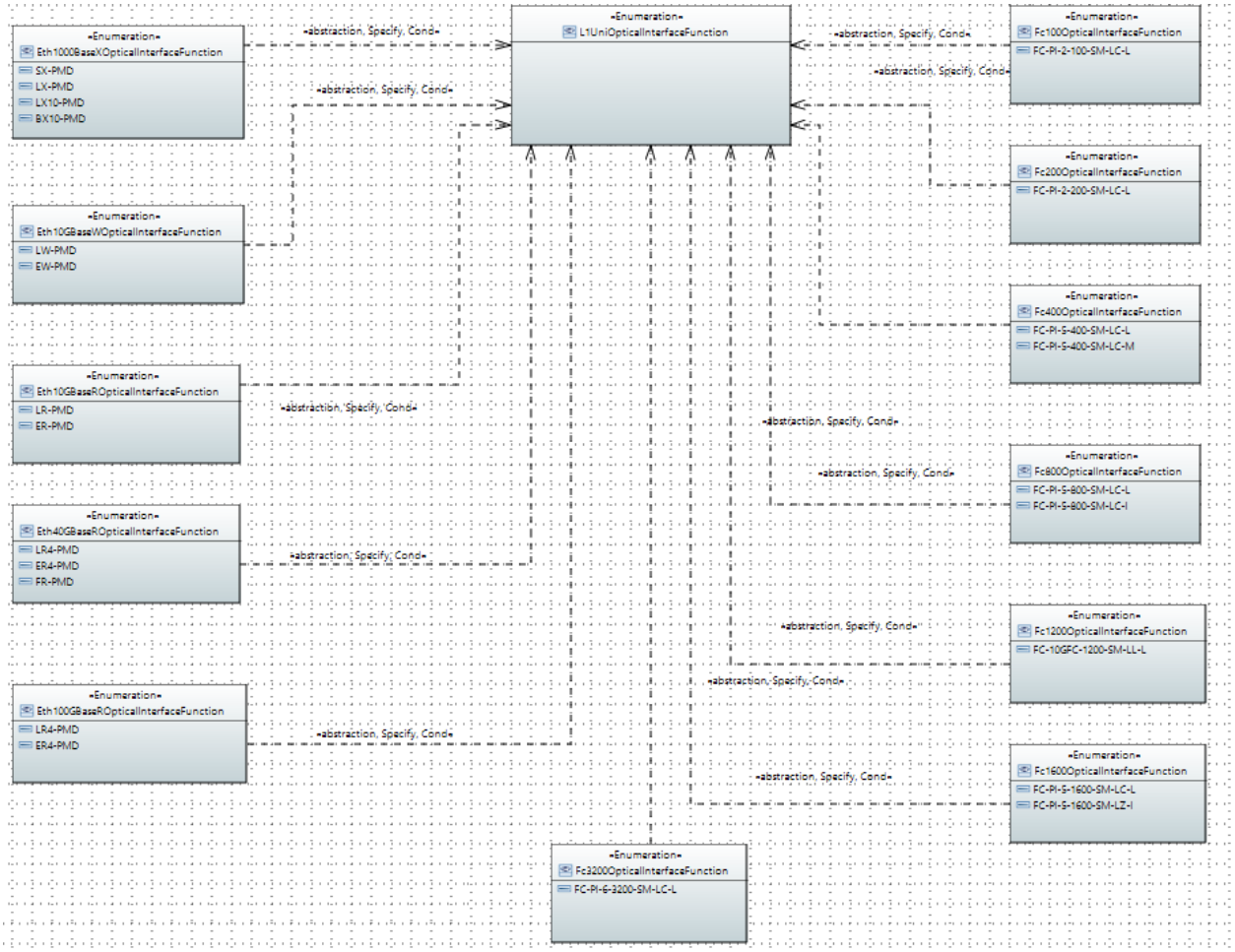

Figure 14 – L1 Uni Optical Interface Function Enumerations of Ethernet and Fiber Channel

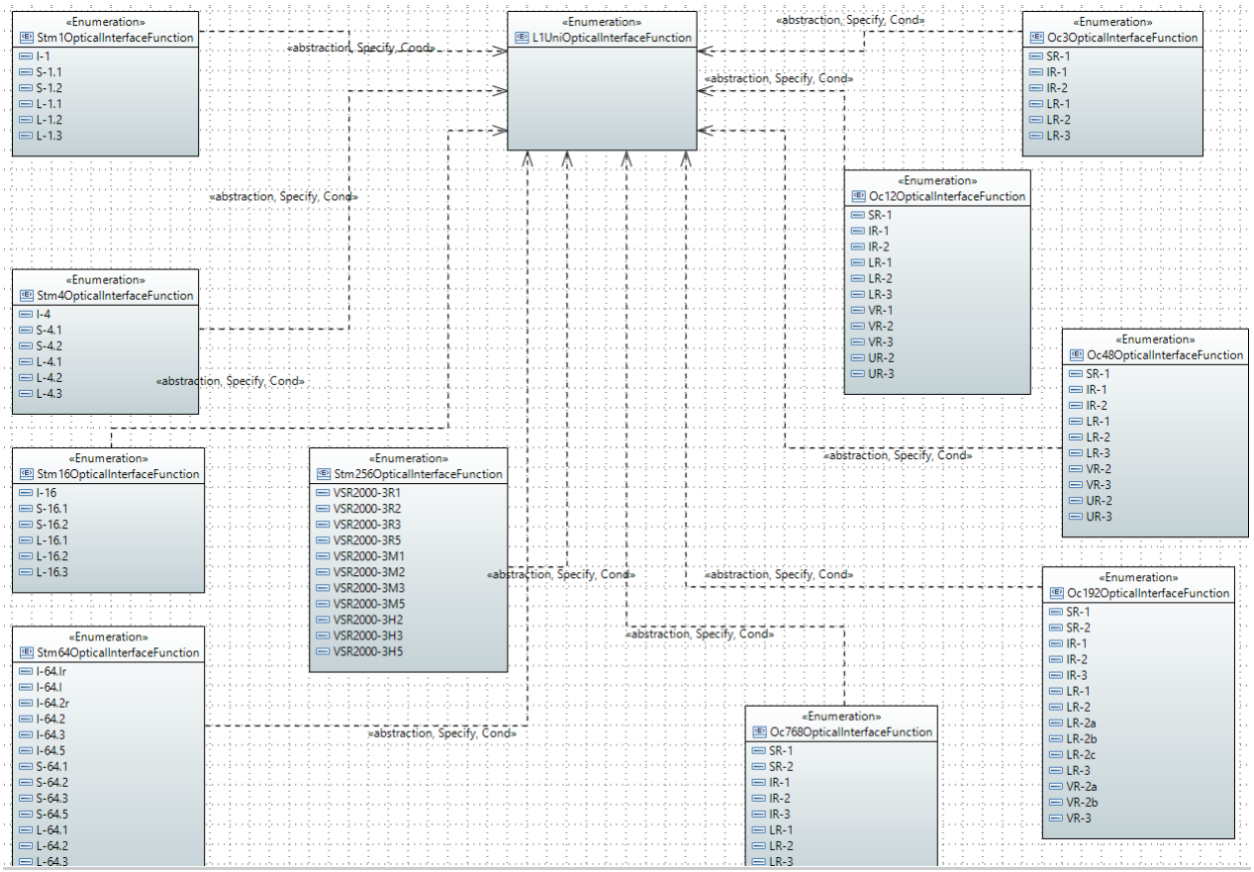

Figure 15 – L1 Uni Optical Interface Function Enumerations of SDH and SONET

11.9.1 Eth1000BaseXOpticalInterfaceFunction

MEF 63[5]: IEEE Std 802.3[1], 1000BASE-X PCS clause 36 coding function
Contains Enumeration Literals:

- SX-PMD:
  - IEEE Std 802.3: clause 38
- LX-PMD:
  - IEEE Std 802.3: clause 38
- LX10-PMD:
  - IEEE Std 802.3: clause 59
- BX10-PMD:
  - IEEE Std 802.3: clause 59

11.9.2 Eth10GBaseROpticalInterfaceFunction

MEF 63[5]: IEEE Std 802.3[1], 10GBASE-R (LAN PHY) PCS clause 49 coding function

Contains Enumeration Literals:

- LR-PMD:
  - IEEE Std 802.3: clause 52
- ER-PMD:
  - IEEE Std 802.3: clause 52

11.9.3 Eth10GBaseWOpticalInterfaceFunction

MEF 63[5]: IEEE Std 802.3[1], 10GBASE-W (WAN PHY) PCS clause 49 and WIS clause 50 coding function

Contains Enumeration Literals:

- LW-PMD:
  - IEEE Std 802.3: clause 52
- EW-PMD:
  - IEEE Std 802.3: clause 52

11.9.4 Eth40GBaseROpticalInterfaceFunction

MEF 63[5]: IEEE Std 802.3[1], 40GBASE-R PCS clause 82 coding function

Contains Enumeration Literals:

- LR4-PMD:
  - IEEE Std 802.3: clause 87
- ER4-PMD:
  - IEEE Std 802.3: clause 87
- FR-PMD:
  - IEEE Std 802.3: clause 89

11.9.5 Eth100GBaseROpticalInterfaceFunction

MEF 63[5]: IEEE Std 802.3[1], 100GBASE-R PCS clause 82 coding function

Contains Enumeration Literals:

- LR4-PMD:
  - IEEE Std 802.3: clause 88
- ER4-PMD:
  - IEEE Std 802.3: clause 88

11.9.6 Fc100OpticalInterfaceFunction

MEF 63[5]: ANSI INCITS 424-2007[R2012], February 2007: FC-100 FC-FS-2 clause 5 FC-1 8B/10B coding function (1.0625 Gb/s)

Contains Enumeration Literals:

- FC-PI-2-100-SM-LC-L:
  - MEF 63: ANSI INCITS 404-2006, August 2006: FC-PI-2 clause 6.3 FC-0 100-SM-LC-L

11.9.7 Fc200OpticalInterfaceFunction

MEF 63[5]: ANSI INCITS 424-2007[R2012], February 2007: FC-200 FC-FS-2 clause 5 FC-1 8B/10B coding function (2.125 Gb/s)
Contains Enumeration Literals:

- FC-PI-2-200-SM-LC-L:
  - MEF 63: ANSI INCITS 404-2006, August 2006: FC-PI-2 clause 6.3 FC-0 200-SM-LC-L

11.9.8 Fc400OpticalInterfaceFunction

MEF 63[5]: ANSI INCITS 424-2007[R2012], February 2007: FC-400 FC-FS-2 clause 5 FC-1 8B/10B coding function (4.250 Gb/s)

Contains Enumeration Literals:

- FC-PI-5-400-SM-LC-L:
  - MEF 63: ANSI INCITS 479-2011, November 2011: FC-PI-5 clause 6.3 FC-0: 400-SM-LC-L
- FC-PI-5-400-SM-LC-M:
  - MEF 63: ANSI INCITS 479-2011, November 2011: FC-PI-5 clause 6.3 FC-0: 400-SM-LC-M

11.9.9 Fc800OpticalInterfaceFunction

MEF 63[5]: ANSI INCITS 424-2007[R2012], February 2007: FC-800 FC-FS-2 clause 5 FC-1 8B/10B coding function (8.500 Gb/s)

Contains Enumeration Literals:

- FC-PI-5-800-SM-LC-L:
  - MEF 63: ANSI INCITS 479-2011, November 2011: FC-PI-5 clause 6.3 FC-0: 800-SM-LC-L
- FC-PI-5-800-SM-LC-I:
  - MEF 63: ANSI INCITS 479-2011, November 2011: FC-PI-5 clause 6.3 FC-0: 800-SM-LC-I

11.9.10 Fc1200OpticalInterfaceFunction

MEF 63[5]: ANSI INCITS 364-2003, November 2003: FC-1200 (10.51875 Gb/s) FC-10GFC clause 13 FC-1 coding function (10.51875 Gb/s)

Contains Enumeration Literals:

- FC-10GFC-1200-SM-LL-L:
  - MEF 63: ANSI INCITS 364-2003, November 2003: FC-10GFC clause 6.4 FC-0: 1200-SM-LL-L

11.9.11 Fc1600OpticalInterfaceFunction

MEF 63[5]: ANSI INCITS 470-2011, December 2011: FC-FS-3 clause 5 FC-1 64B/66B coding function (14.025 Gb/s)

Contains Enumeration Literals:

- FC-PI-5-1600-SM-LC-L:
  - MEF 63: ANSI INCITS 479-2011, November 2011: FC-PI-5 clause 6.3 FC-0: 1600-SM-LC-L
- FC-PI-5-1600-SM-LZ-I:
  - MEF 63: ANSI INCITS 479-2011, November 2011: FC-PI-5 clause 6.3 FC-0: 1600-SM-LZ-I

11.9.12 Fc3200OpticalInterfaceFunction

MEF 63[5]: ANSI INCITS 488-2016, December 2016: FC-FS-4 clause 5 FC-1 64B/66B coding function plus 256B/257B transcoding and FEC encoding (28.05 Gb/s)

Contains Enumeration Literals:

- FC-PI-6-3200-SM-LC-L:
  - MEF 63: ANSI INCITS 512-2015, January 2015: FC-PI-6 clause 5.3 FC-0: 3200-SM-LC-L

11.9.13 Stm1OpticalInterfaceFunction

ITU-T G.707/Y.1322, January 2007: framer, N=1

Contains Enumeration Literals:

- I-1:
  - ITU-T G.957, March 2006: I-1
- S-1.1:
  - ITU-T G.957, March 2006: S-1.1
- S-1.2:
  - ITU-T G.957, March 2006: S-1.2
- L-1.1:
  - ITU-T G.957, March 2006: L-1.1
- L-1.2:
  - ITU-T G.957, March 2006: L-1.2
- L-1.3:
  - ITU-T G.957, March 2006: L-1.3

11.9.14 Stm4OpticalInterfaceFunction

ITU-T G.707/Y.1322, January 2007: framer, N=4

Contains Enumeration Literals:

- I-4:
  - ITU-T G.957, March 2006: I-4
- S-4.1:
  - ITU-T G.957, March 2006: S-4.1
- S-4.2:
  - ITU-T G.957, March 2006: S-4.2
- L-4.1:
  - ITU-T G.957, March 2006: L-4.1
- L-4.2:
  - ITU-T G.957, March 2006: L-4.2
- L-4.3:
  - ITU-T G.957, March 2006: L-4.3

11.9.15 Stm16OpticalInterfaceFunction

ITU-T G.707/Y.1322, January 2007: framer, N=16

Contains Enumeration Literals:

- I-16:
  - ITU-T G.957, March 2006: I-16
- S-16.1:
  - ITU-T G.957, March 2006: S-16.1
- S-16.2:
  - ITU-T G.957, March 2006: S-16.2
- L-16.1:
  - ITU-T G.957, March 2006: L-16.1
- L-16.2:
  - ITU-T G.957, March 2006: L-16.2
- L-16.3:
  - ITU-T G.957, March 2006: L-16.3

11.9.16 Stm64OpticalInterfaceFunction

ITU-T G.707/Y.1322, January 2007: framer, N=64

Contains Enumeration Literals:

- I-64.lr:
  - ITU-T G.957, March 2006: I-64.lr
- I-64.l:
  - ITU-T G.957, March 2006: I-64.l
- I-64.2r:
  - ITU-T G.957, March 2006: I-64.2r
- I-64.2:
  - ITU-T G.957, March 2006: I-64.2
- I-64.3:
  - ITU-T G.957, March 2006: I-64.3
- I-64.5:
  - ITU-T G.957, March 2006: I-64.5
- S-64.1:
  - ITU-T G.957, March 2006: S-64.1
- S-64.2:
  - ITU-T G.957, March 2006: S-64.2
- S-64.3:
  - ITU-T G.957, March 2006: S-64.3
- S-64.5:
  - ITU-T G.957, March 2006: S-64.5
- L-64.1:
  - ITU-T G.957, March 2006: L-64.1
- L-64.2:
  - ITU-T G.957, March 2006: L-64.2
- L-64.3:
  - ITU-T G.957, March 2006: L-64.3

11.9.17 Stm256OpticalInterfaceFunction

ITU-T G.707/Y.1322, January 2007: framer, N=256

Contains Enumeration Literals:

- VSR2000-3R1:
  - ITU-T G.693, November 2009: VSR2000-3R1
- VSR2000-3R2:
  - ITU-T G.693, November 2009: VSR2000-3R2
- VSR2000-3R3:
  - ITU-T G.693, November 2009: VSR2000-3R3
- VSR2000-3R5:
  - ITU-T G.693, November 2009: VSR2000-3R5
- VSR2000-3M1:
  - ITU-T G.693, November 2009: VSR2000-3M1
- VSR2000-3M2:
  - ITU-T G.693, November 2009: VSR2000-3M2
- VSR2000-3M3:
  - ITU-T G.693, November 2009: VSR2000-3M3
- VSR2000-3M5:
  - ITU-T G.693, November 2009: VSR2000-3M5
- VSR2000-3H2:
  - ITU-T G.693, November 2009: VSR2000-3H2
- VSR2000-3H3:
  - ITU-T G.693, November 2009: VSR2000-3H3
- VSR2000-3H5:
  - ITU-T G.693, November 2009: VSR2000-3H5

11.9.18 Oc3OpticalInterfaceFunction

Telcordia GR-253-CORE Issue 5, October 2009: framer, N=3

Contains Enumeration Literals:

- SR-1:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: SR-1
- IR-1:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: IR-1
- IR-2:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: IR-2
- LR-1:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: LR-1
- LR-2:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: LR-2
- LR-3:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: LR-3

11.9.19 Oc12OpticalInterfaceFunction

Telcordia GR-253-CORE Issue 5, October 2009: framer, N=12

Contains Enumeration Literals:

- SR-1:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: SR-1
- IR-1:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: IR-1
- IR-2:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: IR-2
- LR-1:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: LR-1
- LR-2:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: LR-2
- LR-3:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: LR-3
- VR-1:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: VR-1
- VR-2:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: VR-2
- VR-3:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: VR-3
- UR-2:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: UR-2
- UR-3:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: UR-3

11.9.20 Oc48OpticalInterfaceFunction

Telcordia GR-253-CORE Issue 5, October 2009: framer, N=48

Contains Enumeration Literals:

- SR-1:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: SR-1
- IR-1:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: IR-1
- IR-2:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: IR-2
- LR-1:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: LR-1
- LR-2:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: LR-2
- LR-3:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: LR-3
- VR-2:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: VR-2

- VR-3:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: VR-3
- UR-2:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: UR-2
- UR-3:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: UR-3

11.9.21 Oc192OpticalInterfaceFunction

Telcordia GR-253-CORE Issue 5, October 2009: framer, N=192

Contains Enumeration Literals:

- SR-1:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: SR-1
- SR-2:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: SR-2
- IR-1:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: IR-1
- IR-2:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: IR-2
- IR-3:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: IR-3
- LR-1:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: LR-1
- LR-2:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: LR-2
- LR-2a:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: LR-2a
- LR-2b:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: LR-2b
- LR-2c:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: LR-2c
- LR-3:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: LR-3
- VR-2a:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: VR-2a
- VR-2b:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: VR-2b
- VR-3:
  - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: VR-3

11.9.22 Oc768OpticalInterfaceFunction

Telcordia GR-253-CORE Issue 5, October 2009: framer, N=768

Contains Enumeration Literals:

- SR-1:

    - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: SR-1
- SR-2:
    - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: SR-2
- IR-1:
    - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: IR-1
- IR-2:
    - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: IR-2
- IR-3:
    - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: IR-3
- LR-1:
    - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: LR-1
- LR-2:
    - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: LR-2
- LR-3:
    - Telcordia GR-253-CORE, Issue 5, October 2009, clause 4.1: LR-3

11.10 L1NniOpticalInterfaceFunction

The values of L1 NNI Optical Interface Function are grouped into Classes defined in G.959.1[4]. Within a class there are several possible values for the L1 NNI Optical Interface Function.

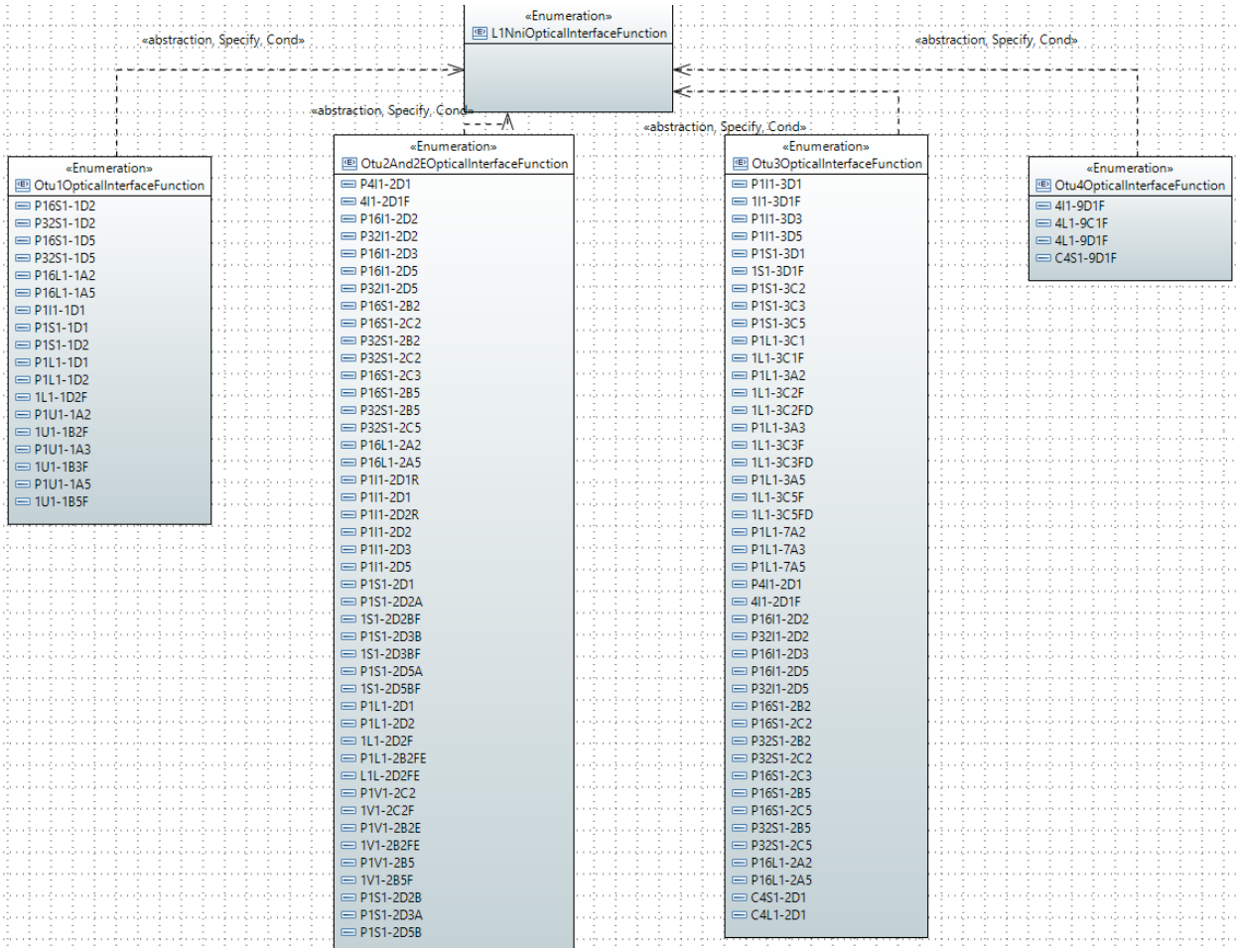

Figure 16 – L1 NNI Optical Interface Function Enumerations

11.10.1 Otu1OpticalInterfaceFunction

Enumeration values for l1NniOpticalInterfaceFunction when Line Rate attribute equals to OTU1.

Contains Enumeration Literals:

- P16S1-1D2:
  - G.959.1 July 2018: Optical tributary signal class NRZ 2.5G, ITU-T G.652 type Fiber, P16S1-1D2
- P32S1-1D2:
  - G.959.1 July 2018: Optical tributary signal class NRZ 2.5G, ITU-T G.652 type Fiber, P32S1-1D2
- P16S1-1D5:
  - G.959.1 July 2018: Optical tributary signal class NRZ 2.5G, ITU-T G.655 type Fiber, P16S1-1D5
- P32S1-1D5:
  - G.959.1 July 2018: Optical tributary signal class NRZ 2.5G, ITU-T G.655 type Fiber, P32S1-1D5

- P16L1-1A2:
  - G.959.1 July 2018: Optical tributary signal class NRZ 2.5G, ITU-T G.652 type Fiber, P16L1-1A2
- P16L1-1A5:
  - G.959.1 July 2018: Optical tributary signal class NRZ 2.5G, ITU-T G.652 type Fiber, P16L1-1A5
- P1I1-1D1:
  - G.959.1 July 2018: Optical tributary signal class NRZ 2.5G, ITU-T G.652 type Fiber, P1I1-1D1
- P1S1-1D1:
  - G.959.1 July 2018: Optical tributary signal class NRZ 2.5G, ITU-T G.652 type Fiber, P1S1-1D1
- P1S1-1D2:
  - G.959.1 July 2018: Optical tributary signal class NRZ 2.5G, ITU-T G.652 type Fiber, P1S1-1D2
- P1L1-1D1:
  - G.959.1 July 2018: Optical tributary signal class NRZ 2.5G, ITU-T G.652 type Fiber, P1L1-1D1
- P1L1-1D2:
  - G.959.1 July 2018: Optical tributary signal class NRZ 2.5G, ITU-T G.652 type Fiber, P1L1-1D2
- 1L1-1D2F:
  - G.959.1 July 2018: Optical tributary signal class NRZ 2.5G, ITU-T G.652 type Fiber, 1L1-1D2F
- P1U1-1A2:
  - G.959.1 July 2018: Optical tributary signal class NRZ 2.5G, ITU-T G.652 type Fiber, P1U1-1A2
- 1U1-1B2F:
  - G.959.1 July 2018: Optical tributary signal class NRZ 2.5G, ITU-T G.652 type Fiber, 1U1-1B2F
- P1U1-1A3:
  - G.959.1 July 2018: Optical tributary signal class NRZ 2.5G, ITU-T G.653 type Fiber, P1U1-1A3
- 1U1-1B3F:
  - G.959.1 July 2018: Optical tributary signal class NRZ 2.5G, ITU-T G.653 type Fiber, 1U1-1B3F
- P1U1-1A5:
  - G.959.1 July 2018: Optical tributary signal class NRZ 2.5G, ITU-T G.655 type Fiber, P1U1-1A5
- 1U1-1B5F:
  - G.959.1 July 2018: Optical tributary signal class NRZ 2.5G, ITU-T G.655 type Fiber, 1U1-1B5F

11.10.2 Otu2And2EOpticalInterfaceFunction

Enumeration values for l1NniOpticalInterfaceFunction when Line Rate attribute equals to OTU2 or OTU2E.

Contains Enumeration Literals:

- P4I1-2D1:
  - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, P4I1-2D1
- 4I1-2D1F:
  - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, 4I1-2D1F
- P16I1-2D2:
  - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, P16I1-2D2
- P32I1-2D2:
  - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, P32I1-2D2
- P16I1-2D3:
  - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.653 type Fiber, P16I1-2D3
- P16I1-2D5:
  - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.655 type Fiber, P16I1-2D5
- P32I1-2D5:
  - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.655 type Fiber, P32I1-2D5
- P16S1-2B2:
  - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, P16S1-2B2
- P16S1-2C2:
  - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, P16S1-2C2
- P32S1-2B2:
  - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, P32S1-2B2
- P32S1-2C2:
  - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, P32S1-2C2
- P16S1-2C3:
  - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.653 type Fiber, P16S1-2C3
- P16S1-2B5:
  - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.655 type Fiber, P16S1-2B5
- P16S1-2C5:

    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.655 type Fiber, P16S1-2C5
- P32S1-2B5:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.655 type Fiber, P32S1-2B5
- P32S1-2C5:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.655 type Fiber, P32S1-2C5
- P16L1-2A2:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, P16L1-2A2
- P16L1-2A5:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.655 type Fiber, P16L1-2A5
- P1I1-2D1R:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, P1I1-2D1R
- P1I1-2D1:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, P1I1-2D1
- P1I1-2D2R:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, P1I1-2D2R
- P1I1-2D2:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, P1I1-2D2
- P1I1-2D3:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.653 type Fiber, P1I1-2D3
- P1I1-2D5:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.655 type Fiber, P1I1-2D5
- P1S1-2D1:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, P1S1-2D1
- P1S1-2D2A:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, P1S1-2D2A
- P1S1-2D2B:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, P1S1-2D2B
- 1S1-2D2BF:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, 1S1-2D2BF
- P1S1-2D3A:

    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.653 type Fiber, P1S1-2D3A
- P1S1-2D3B:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.653 type Fiber, P1S1-2D3B
- 1S1-2D3BF:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.653 type Fiber, 1S1-2D3BF
- P1S1-2D5A
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.655 type Fiber, P1S1-2D5A
- P1S1-2D5B:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.655 type Fiber, P1S1-2D5B
- 1S1-2D5BF:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.655 type Fiber, 1S1-2D5BF
- P1L1-2D1:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, P1L1-2D1
- P1L1-2D2:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, P1L1-2D2
- 1L1-2D2F:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, 1L1-2D2F
- P1L1-2B2FE:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, P1L1-2B2FE
- L1L-2D2FE:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, 1L1-2D2FE
- P1V1-2C2:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, P1V1-2C2
- 1V1-2C2F:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, 1V1-2C2F
- P1V1-2B2E:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, P1V1-2B2E
- 1V1-2B2FE:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, 1V1-2B2FE
- P1V1-2B5:

    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.655 type Fiber, P1V1-2B5
- 1V1-2B5F:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.655 type Fiber, 1V1-2B5F

11.10.3 Otu3OpticalInterfaceFunction

Enumeration values for l1NniOpticalInterfaceFunction when Line Rate attribute equals to OTU3.

Contains Enumeration Literals:

- P1I1-3D1:
    - G.959.1 July 2018: Optical tributary signal class NRZ 40G, ITU-T G.652 type Fiber, P1I1-3D1
- 1I1-3D1F:
    - G.959.1 July 2018: Optical tributary signal class NRZ 40G, ITU-T G.652 type Fiber, 1I1-3D1F
- P1I1-3D3:
    - G.959.1 July 2018: Optical tributary signal class NRZ 40G, ITU-T G.653 type Fiber, P1I1-3D3
- P1I1-3D5:
    - G.959.1 July 2018: Optical tributary signal class NRZ 40G, ITU-T G.655 type Fiber, P1I1-3D5
- P1S1-3D1:
    - G.959.1 July 2018: Optical tributary signal class NRZ 40G, ITU-T G.652 type Fiber, P1S1-3D1
- 1S1-3D1F:
    - G.959.1 July 2018: Optical tributary signal class NRZ 40G, ITU-T G.652 type Fiber, 1S1-3D1F
- P1S1-3C2:
    - G.959.1 July 2018: Optical tributary signal class NRZ 40G, ITU-T G.652 type Fiber, P1S1-3C2
- P1S1-3C3:
    - G.959.1 July 2018: Optical tributary signal class NRZ 40G, ITU-T G.653 type Fiber, P1S1-3C3
- P1S1-3C5:
    - G.959.1 July 2018: Optical tributary signal class NRZ 40G, ITU-T G.655 type Fiber, P1S1-3C5
- P1L1-3C1:
    - G.959.1 July 2018: Optical tributary signal class NRZ 40G, ITU-T G.652 type Fiber, P1L1-3C1
- 1L1-3C1F:
    - G.959.1 July 2018: Optical tributary signal class NRZ 40G, ITU-T G.652 type Fiber, 1L1-3C1F
- P1L1-3A2:

    - G.959.1 July 2018: Optical tributary signal class NRZ 40G, ITU-T G.652 type Fiber, P1L1-3A2
- 1L1-3C2F:
    - G.959.1 July 2018: Optical tributary signal class NRZ 40G, ITU-T G.652 type Fiber, 1L1-3C2F
- 1L1-3C2FD:
    - G.959.1 July 2018: Optical tributary signal class NRZ 40G, ITU-T G.652 type Fiber, 1L1-3C2FD
- P1L1-3A3:
    - G.959.1 July 2018: Optical tributary signal class NRZ 40G, ITU-T G.652 type Fiber, P1L1-3A3
- 1L1-3C3F:
    - G.959.1 July 2018: Optical tributary signal class NRZ 40G, ITU-T G.652 type Fiber, 1L1-3C3F
- 1L1-3C3FD:
    - G.959.1 July 2018: Optical tributary signal class NRZ 40G, ITU-T G.653 type Fiber, 1L1-3C3FD
- P1L1-3A5:
    - G.959.1 July 2018: Optical tributary signal class NRZ 40G, ITU-T G.655 type Fiber, P1L1-3A5
- 1L1-3C5F:
    - G.959.1 July 2018: Optical tributary signal class NRZ 40G, ITU-T G.655 type Fiber, 1L1-3C5F
- 1L1-3C5FD:
    - G.959.1 July 2018: Optical tributary signal class NRZ 40G, ITU-T G.655 type Fiber, 1L1-3C5FD
- P1L1-7A2:
    - G.959.1 July 2018: Optical tributary signal class NRZ 40G, ITU-T G.652 type Fiber, P1L1-7A2
- P1L1-7A3:
    - G.959.1 July 2018: Optical tributary signal class NRZ 40G, ITU-T G.653 type Fiber, P1L1-7A3
- P1L1-7A5:
    - G.959.1 July 2018: Optical tributary signal class NRZ 40G, ITU-T G.655 type Fiber, P1L1-7A5
- P4I1-2D1:
    - G.959.1 July 2018: Optical tributary signal class NRZ 40G, ITU-T G.652 type Fiber, P4I1-2D1
- 4I1-2D1F:
    - G.959.1 July 2018: Optical tributary signal class NRZ 40G, ITU-T G.652 type Fiber, 4I1-2D1F
- P16I1-2D2:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, P16I1-2D2
- P32I1-2D2:

    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, P32I1-2D2
- P16I1-2D3:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.653 type Fiber, P16I1-2D3
- P16I1-2D5:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.655 type Fiber, P16I1-2D5
- P32I1-2D5:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.655 type Fiber, P32I1-2D5
- P16S1-2B2:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, P16I1-2B2
- P16S1-2C2:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, P16S1-2C2
- P32S1-2B2:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, P32S1-2B2
- P32S1-2C2:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, P32S1-2C2
- P16S1-2C3:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.653 type Fiber, P16S1-2C3
- P16S1-2B5:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.655 type Fiber, P16S1-2B5
- P16S1-2C5:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.655 type Fiber, P16S1-2C5
- P32S1-2B5:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.655 type Fiber, P32S1-2B5
- P32S1-2C5:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.655 type Fiber, P32S1-2C5
- P16L1-2A2:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, P16L1-2A2
- P16L1-2A5:
    - G.959.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.655 type Fiber, P16L1-2A5
- C4S1-2D1:

    - G.695.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, C4S1-2D1
- C4L1-2D1:
    - G.695.1 July 2018: Optical tributary signal class NRZ 10G, ITU-T G.652 type Fiber, C4S1-2D1

11.10.4 Otu4OpticalInterfaceFunction

Enumeration values for l1NniOpticalInterfaceFunction when Line Rate attribute equals to OTU4.

Contains Enumeration Literals:

- 4I1-9D1F:
    - G.959.1 July 2018: Optical tributary signal class NRZ 25G, ITU-T G.652 type Fiber, 4I1-9D1F
- 4L1-9C1F:
    - G.959.1 July 2018: Optical tributary signal class NRZ 25G, ITU-T G.652 type Fiber, 4L1-9C1F
- 4L1-9D1F:
    - G.959.1 July 2018: Optical tributary signal class NRZ 25G, ITU-T G.652 type Fiber, 4L1-9D1F
- C4S1-9D1F:
    - G.695.1 July 2018: Optical tributary signal class NRZ 25G, ITU-T G.652 type Fiber, C4S1-9D1F

12 References

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[2] ITU-T Recommendation G.707/Y.1322, Network node interface for the synchronous digital hierarchy (SDH), January 2007.

[3] ITU-T Recommendation G.709/Y.1331, Interfaces for the optical transport network, Amendment 3, March 2019.

[4] ITU-T Recommendation G.959.1, Optical transport network physical layer interfaces, July 2018.

[5] MEF 63 *Subscriber Layer 1 Service Attributes*, August 2018.

[6] MEF 64 *Operator Layer 1 Service Attributes*, February 2020.

[7] MEF GitHub repository: https://github.com/MEF-GIT/Services-Common-Model.

[8] OIF Implementation Agreement OIF-ENNI-OTNv3-AM-01.0, *OTNv3 Amendment to OIF UNI 2.0 and ENNI 2.0/2.1 Common Part*, May 19, 2014.

[9] Papyrus UML Tool – Version 2018-09(4.9.0). Copyright © CEA LIST and others 2017.

[10] Telcordia GR-253-CORE, Synchronous Optical Network Transport Systems: Common Generic Criteria, Issue 5, October 2009.

