Orchestrated MEF 3.0 Optical Transport Services

White Paper

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March 2020

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Orchestrated MEF 3.0 Optical Transport Services White Paper

- Explores a standardized approach to delivering fully orchestrated multi-operator MEF 3.0 services.

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Motivation for MEF 3.0 Optical Transport Services

Standard set of L1 service definitions* (similar to L2 CE and emerging L3 IP)

- Provides subscribers with consistent offerings for comparison (e.g., performance)

Standard definition of a L1 ENNI and associated Operator services

- Enables simplified, faster interconnect between Operators for Service Providers

Certification of another set of Service Provider offerings

- Marketing benefit to advertise services as MEF compliant

Will allow Service Providers to leverage LSO service management benefits for L1 services

- Improved service delivery times through automated service ordering and configuration processes
- Faster time-to-revenue and lower OPEX

*Often referred to as Wavelength Services commercially

MEF 63 – Subscriber Layer 1 Service (UNI-UNI)

- **Point-to-point, bi-directional, full port rate (wire speed) connectivity with a single service instance per UNI**
  - No service multiplexing
- **The same client protocol at both UNIs**
  - Ethernet, Fibre Channel, SONET, SDH
- **Physical ports at both UNIs have same rate and coding function, such as**
  - 1000BASE-X (8B/10B), FC-1600 (64B/66B), SONET/SDH (section frame)
  - An encoded data block is the entity (L1 Characteristic Information) transported by the L1 Virtual Connection (L1VC)
- **Physical port at each UNI may have a different optical interface function**
  - Short reach, intermediate reach, long reach, etc

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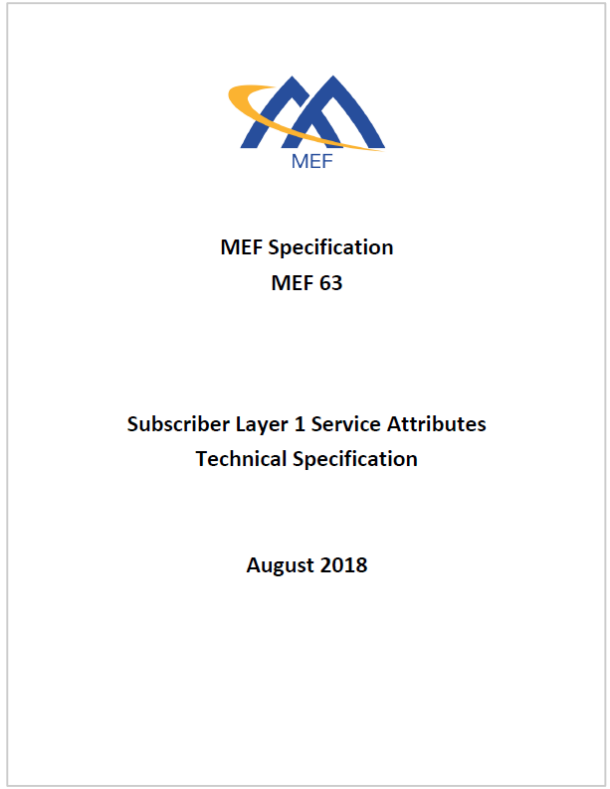
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MEF Specification
MEF 63

Subscriber Layer 1 Service Attributes
Technical Specification

August 2018

MEF 63 – Subscriber Layer 1 Service Attributes

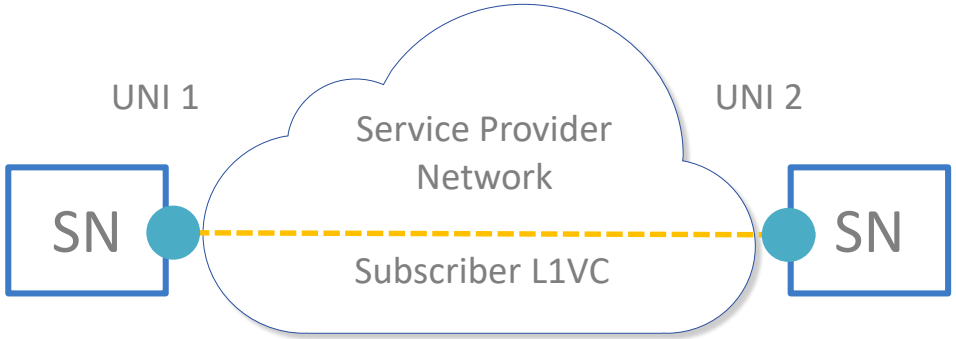
- **UNI Service Attributes (2)**
  - UNI ID, **Physical Layer**
- **Subscriber L1VC Service Attributes (3)**
  - Subscriber L1VC ID, Subscriber L1VC End Point List, **Subscriber L1VC Service Level Specification**
  - The Service Level Specification (SLS) includes five Performance Metrics
    - One-way Delay, Errored Second (ES), Severely Errored Second (SES), Unavailable Second (UAS), Availability
- **Subscriber L1VC End Point Service Attributes (2)**
  - Subscriber L1VC End Point ID, Subscriber L1VC End Point UNI
- **With only 7 attributes, certification testing for both services and equipment should be faster and less expensive than for CE**

L1VC Layer 1 Virtual Connection

Subscriber Layer 1 Service Instance

Subscriber L1VC End Point

SA Service Attribute
SN Subscriber Network



UNI$_1$ SAs

UNI$_1$ ID

Physical Layer$_1$: *(p, c, o)*
- Client protocol
- Coding function
- Optical Interface function

UNI$_2$ SAs

UNI$_2$ ID

Physical Layer$_2$: *(p, c, o)*
- Client protocol = UNI$_1$ *(p)*
- Coding function = UNI$_1$ *(c)*
- Optical Interface may differ

Subscriber L1VC SAs

Subscriber L1VC ID

Subscriber L1VC End Point List

Subscriber L1VC SLS: *(t_s, T, PM)*
Metrics: Delay, ES, SES, UAS, Availability

Subscriber L1VC End Point$_1$ SAs

L1VC End Point ID$_1$

L1VC End Point UNI$_1$

Subscriber L1VC End Point$_2$ SAs

L1VC End Point ID$_2$

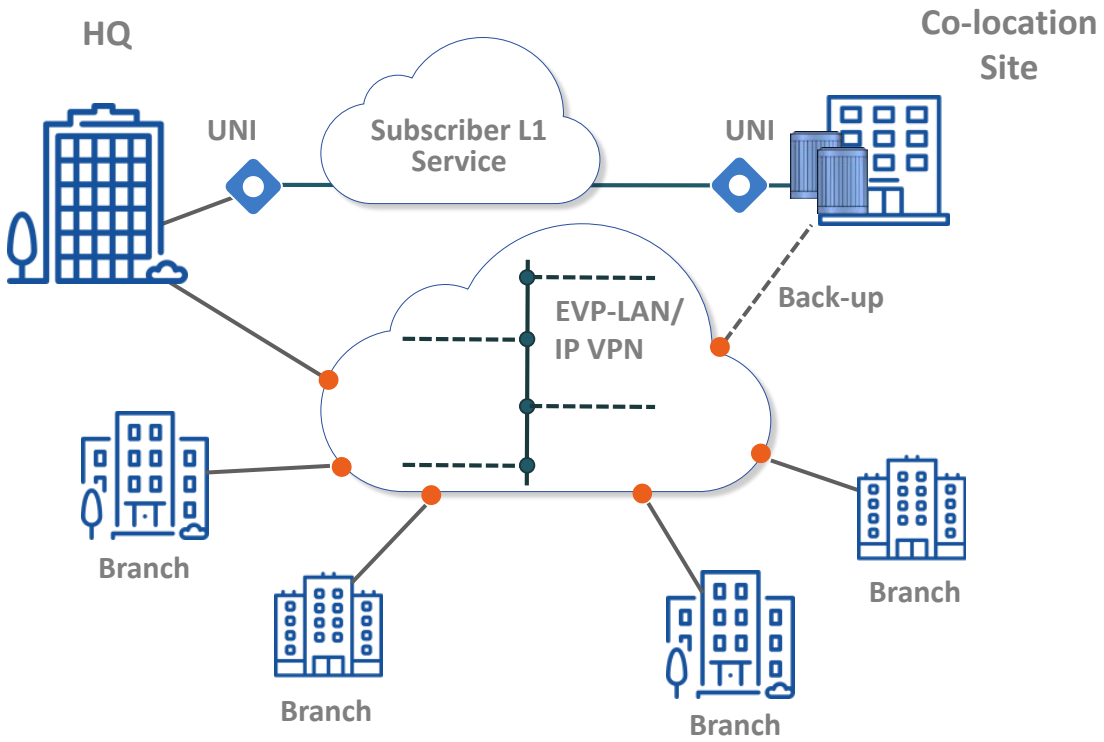
L1VC End Point UNI$_2$

Subscriber Layer 1 Service Use Cases

- **When the highest rates (10G-100G) and highest performance are required**
  - Lowest latency, negligible variation, zero loss
- **Data centre interconnect use cases**
  1) Enterprise to a co-location site (outsourcing)
  2) Co-location site to a web-scale Cloud Provider (Hybrid Cloud)

Enterprise Outsourcing to Co-location Use Case

Enterprise Leases Subscriber Layer 1 Service from CSP (HQ to Colo)



CNP Carrier Neutral Provider
CSP Communications Service Provider

BC Business Continuity
DR Disaster Recovery

Enterprise outsources to co-location site for BC/DR or Cloud services where it can

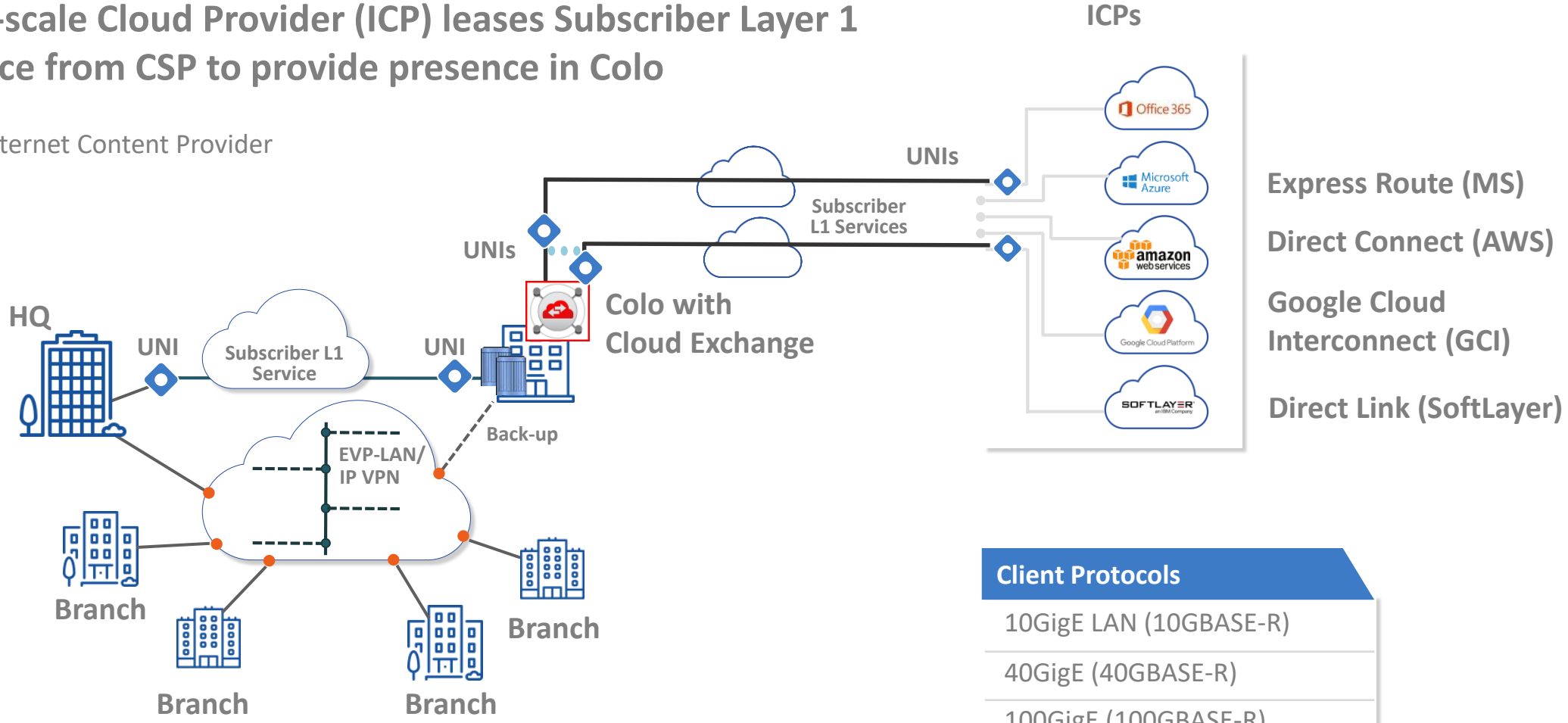
- Use its own equipment and lease space, power, remote hands, or
- Lease computing/storage from an IT provider (CNP case), or the CSP for IaaS, PaaS, SaaS

Client Protocols	
FC-1200 (10GFC)	SAN Extension
FC-1600	SAN Extension
FC-3200	SAN Extension
10GigE LAN (10GBASE-R)	LAN Extension
40GigE (40GBASE-R)	LAN Extension
100GigE (100GBASE-R)	LAN Extension

Enterprise Hybrid Cloud Use Case

Web-scale Cloud Provider (ICP) leases Subscriber Layer 1 Service from CSP to provide presence in Colo

ICP Internet Content Provider



Client Protocols
10GigE LAN (10GBASE-R)
40GigE (40GBASE-R)
100GigE (100GBASE-R)

MEF 64 – Operator Layer 1 Services (UNI-ENNI, ENNI-ENNI)

- **Same client protocols at the UNI as for Subscriber Layer 1 Service (by definition)**
  - Ethernet, Fibre Channel, SONET, SDH
- **The client protocol at the ENNI is OTN and the physical port is an OTUk (k=1, 2, 2e, 3, 4)**
  - ENNI interface rates of 2.5G, 10G, 40G, 100G
- **Access L1 Virtual Connections from multiple UNIs may be aggregated to a single OTUk port at the ENNI**
- **Transit L1 Virtual Connections from multiple ENNIs may be aggregated to a single OTUk port at another ENNI**
- **An ENNI may support multiple Service Provider L1 Virtual Connections (Shared ENNI)**

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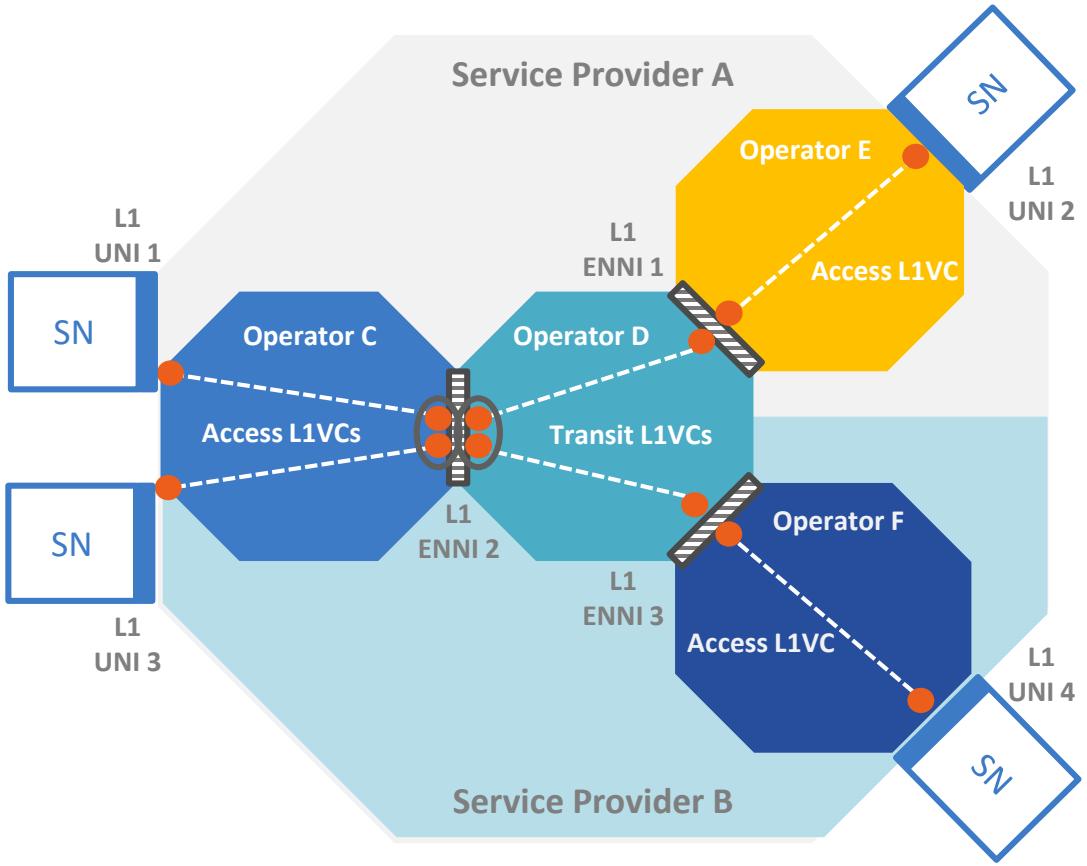
MEF

MEF Standard
MEF 64

Operator Layer 1 Service Attributes and Services

February 2020

Operator Access & Transit Aggregation, Shared ENNI



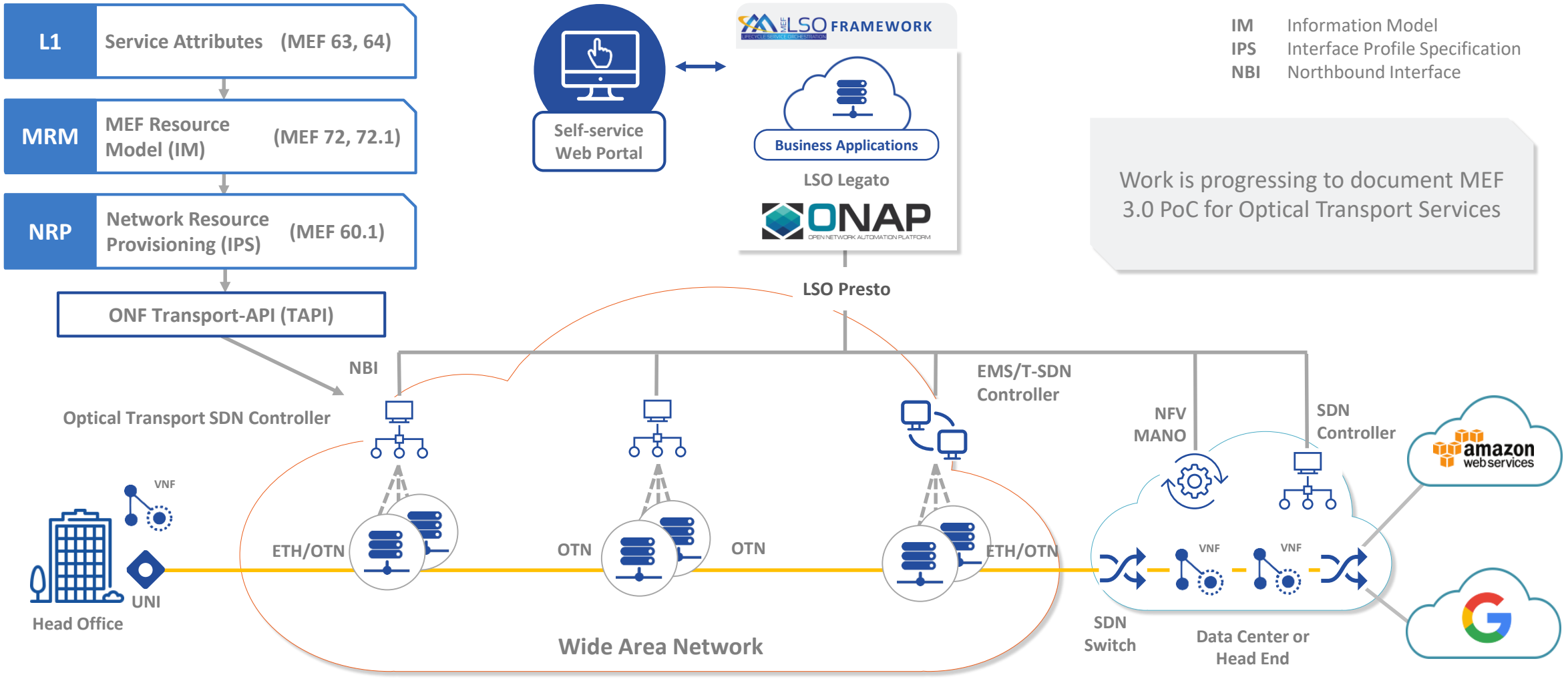
Operator L1VC End Point

Multiplexed L1VC End Points

- Operator C multiplexes Access L1VCs of two Service Providers to shared ENNI 2
- Operator D demultiplexes the ENNI 2 Transit L1VCs to their respective ENNIs 1 and 3
- Service Provider A is responsible for the e2e Subscriber L1 Service between UNIs 1 and 2
- Service Provider B is responsible for the e2e Subscriber L1 Service between UNIs 3 and 4

Operator L1VC Service Attributes
Operator L1VC ID
Operator L1VC End Point List
Operator L1VC SLS: *(ts, T, PM)* *Metrics: Delay, ES, SES, UAS, Availability*

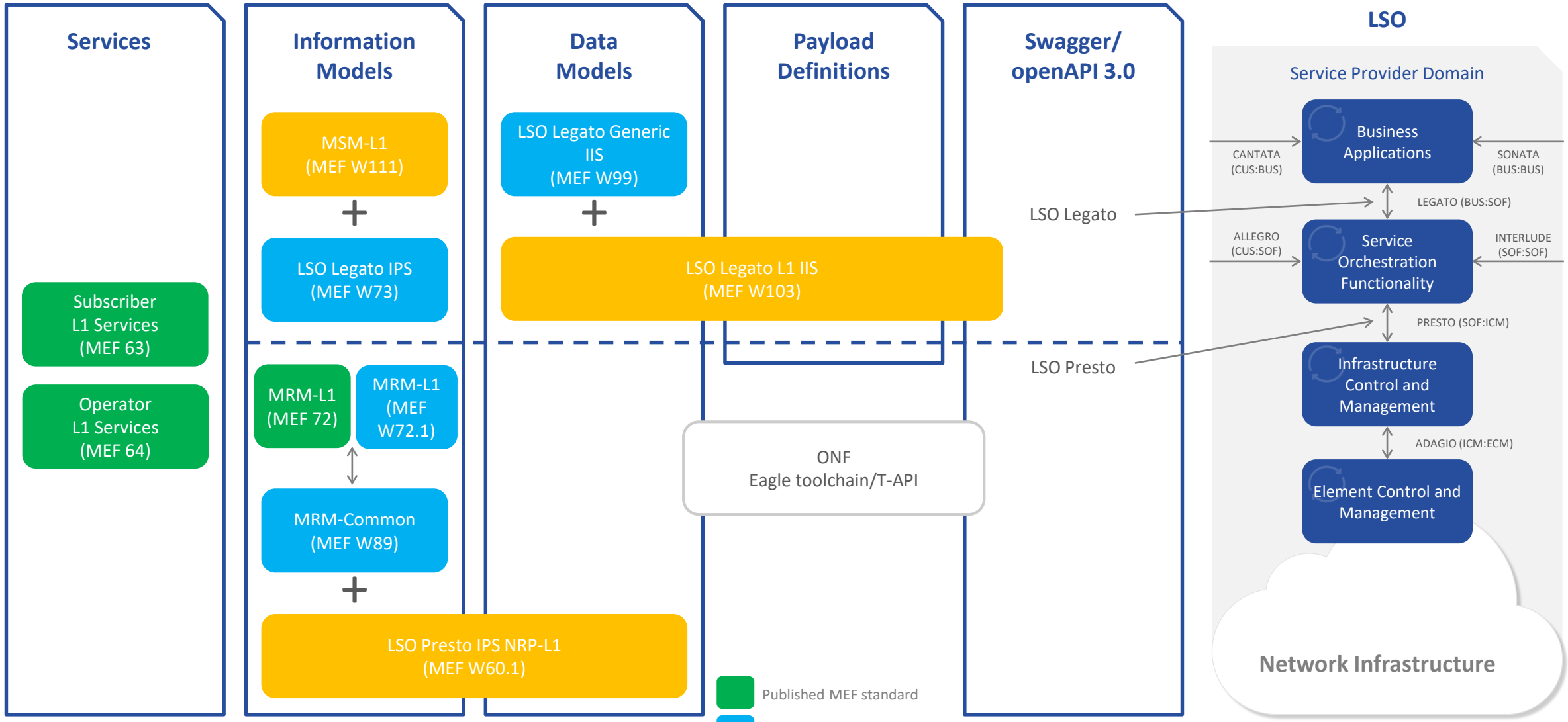
Presto Resource Orchestration for Optical Transport Services



IM Information Model
IPS Interface Profile Specification
NBI Northbound Interface

Work is progressing to document MEF 3.0 PoC for Optical Transport Services

LSO-Related Standards and Projects for MEF 63 and MEF 64



MRM MEF Resource Model
MSM MEF Services Model
NRP Network Resource Provisioning

IPS Interface Profile Spec
IIS Interface Implementation Spec

Future Work

- **Service OAM for Subscriber and Operator Layer 1 Services**
  - Equivalents of MEF 30 (Fault Management) and MEF 35 (Performance Monitoring)
- **Service Activation Testing for Layer 1 Services**
  - Equivalent of MEF 48
- **Amendment to Subscriber Layer 1 Service Attributes**
  - Add latest IEEE 802.3 Ethernet and INCITS T11 Fibre Channel interfaces
- **Amendment to Operator Layer 1 Service Attributes**
  - Add support for ‘Beyond 100G’ OTN ENNI and FlexO interfaces
- **LSO Committee, enhance Network Resource Provisioning IPS for Layer 1 (Presto)**
  - NRP Classes, data types, service operations (W60.1)
- **LSO Committee, add support for Subscriber and Operator L1 Services (Legato)**
  - MEF Service Model for L1 (W111) and LSO Legato L1 IIS (W103)
  - APIs for L1 Service Catalog, Ordering, Inventory, Topology, Notification