



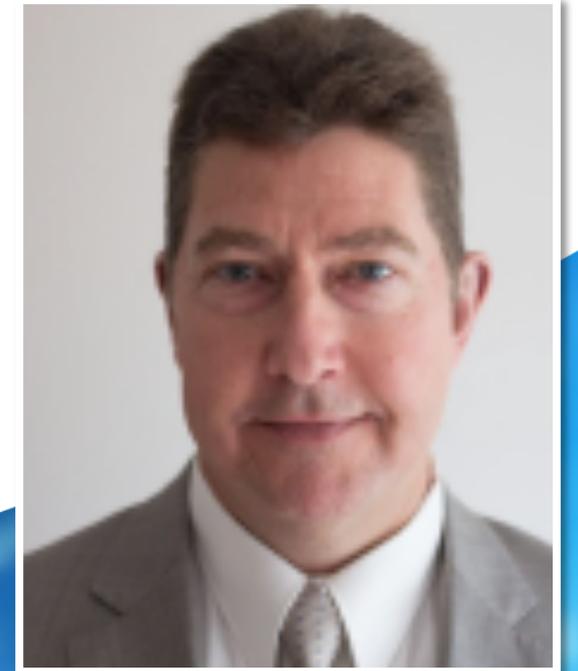
MEF19



# MEF 3.0 Optical Transport Services

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# Motivation for MEF 3.0 Optical Transport Services

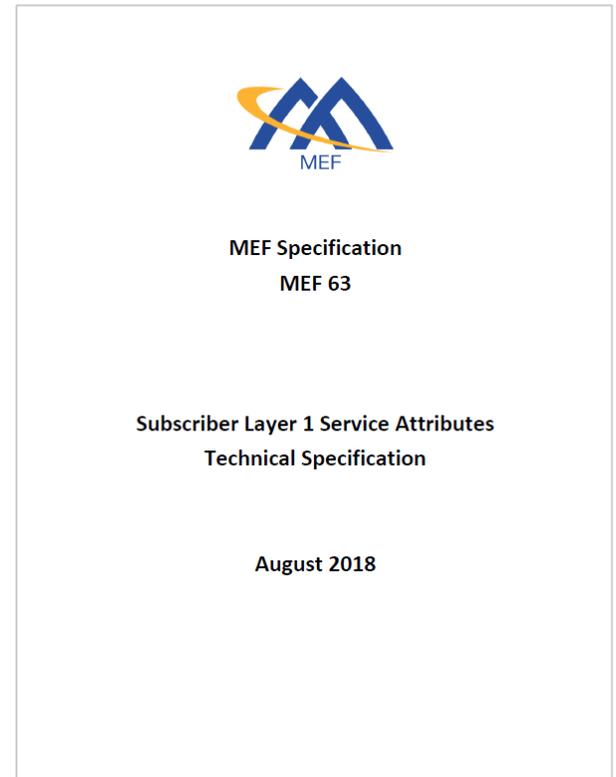
- ✓ **Standard set of L1 service definitions\*** (similar to L2 CE and emerging L3 IP)
  - Provides subscribers with consistent offerings for comparison (e.g., performance)
- ✓ **Standard definition of a L1 ENNI and associated Operator services**
  - Enables simplified, faster interconnect between Operators 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



# MEF 63 – Subscriber Layer 1 Service Attributes

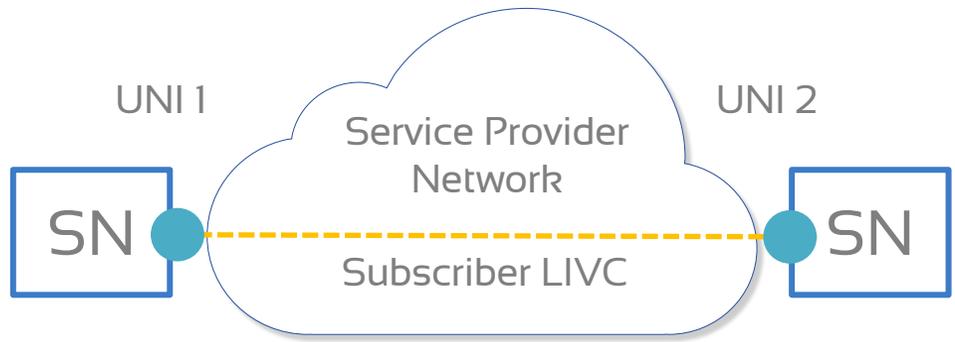
LIVC Layer 1 Virtual Connection

- **UNI Service Attributes (2)**
  - UNI ID, Physical Layer
- **Subscriber LIVC Service Attributes (3)**
  - Subscriber LIVC ID, Subscriber LIVC End Point List, **Subscriber LIVC 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 LIVC End Point Service Attributes (2)**
  - Subscriber LIVC End Point ID, Subscriber LIVC End Point UNI
- **With only 7 attributes, certification testing for both services and equipment should be faster and less expensive than for CE**



# Subscriber Layer 1 Service Instance

● Subscriber L1VC End Point    SA Service Attribute  
 SN Subscriber Network



**UNI1 SAs**

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UNI1 ID

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

**UNI2 SAs**

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UNI2 ID

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Physical Layer2:  $(p, c, o)$   
 Client protocol = UNI1  $(p)$   
 Coding function = UNI1  $(c)$   
 Optical Interface may differ

**Subscriber L1VC SAs**

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Subscriber L1VC ID

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Subscriber L1VC End Point List

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Subscriber L1VC SLS:  $(ts, T, PM)$   
 Metrics: Delay, ES, SES, UAS,  
 Availability

**Subscriber L1VC End Point1 SAs**

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L1VC End Point ID1

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L1VC End Point UNI1

**Subscriber L1VC End Point2 SAs**

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L1VC End Point ID2

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L1VC End Point UNI2

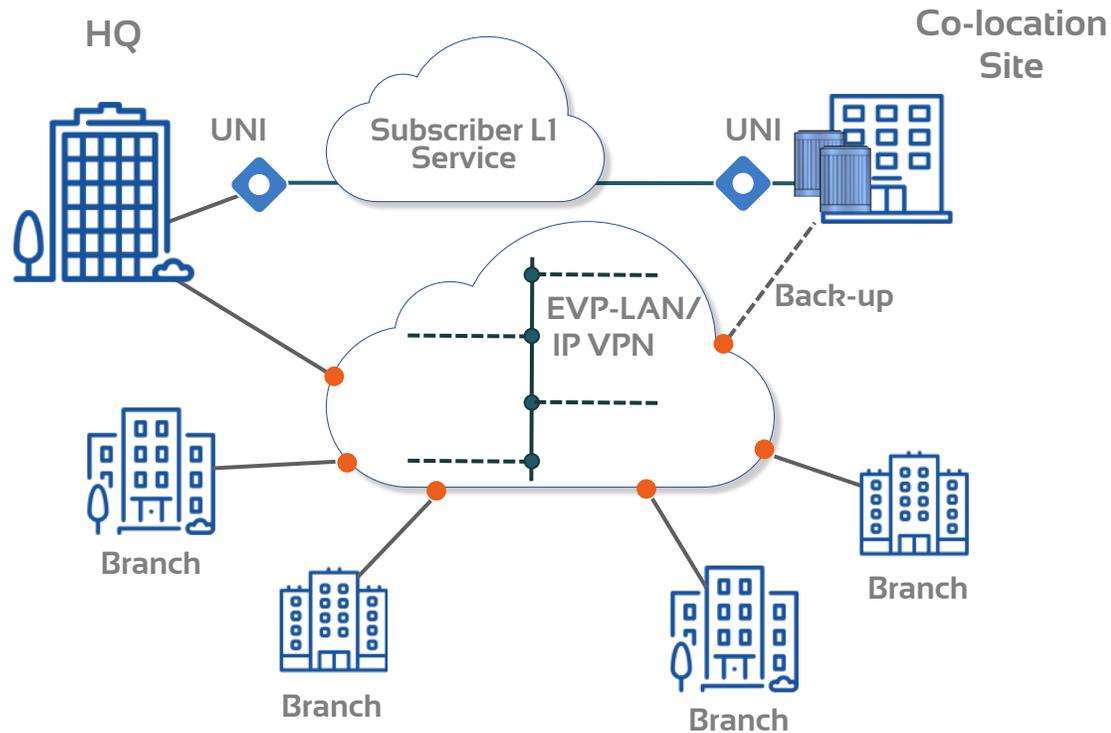
# Subscriber Layer 1 Service Use Cases

- 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

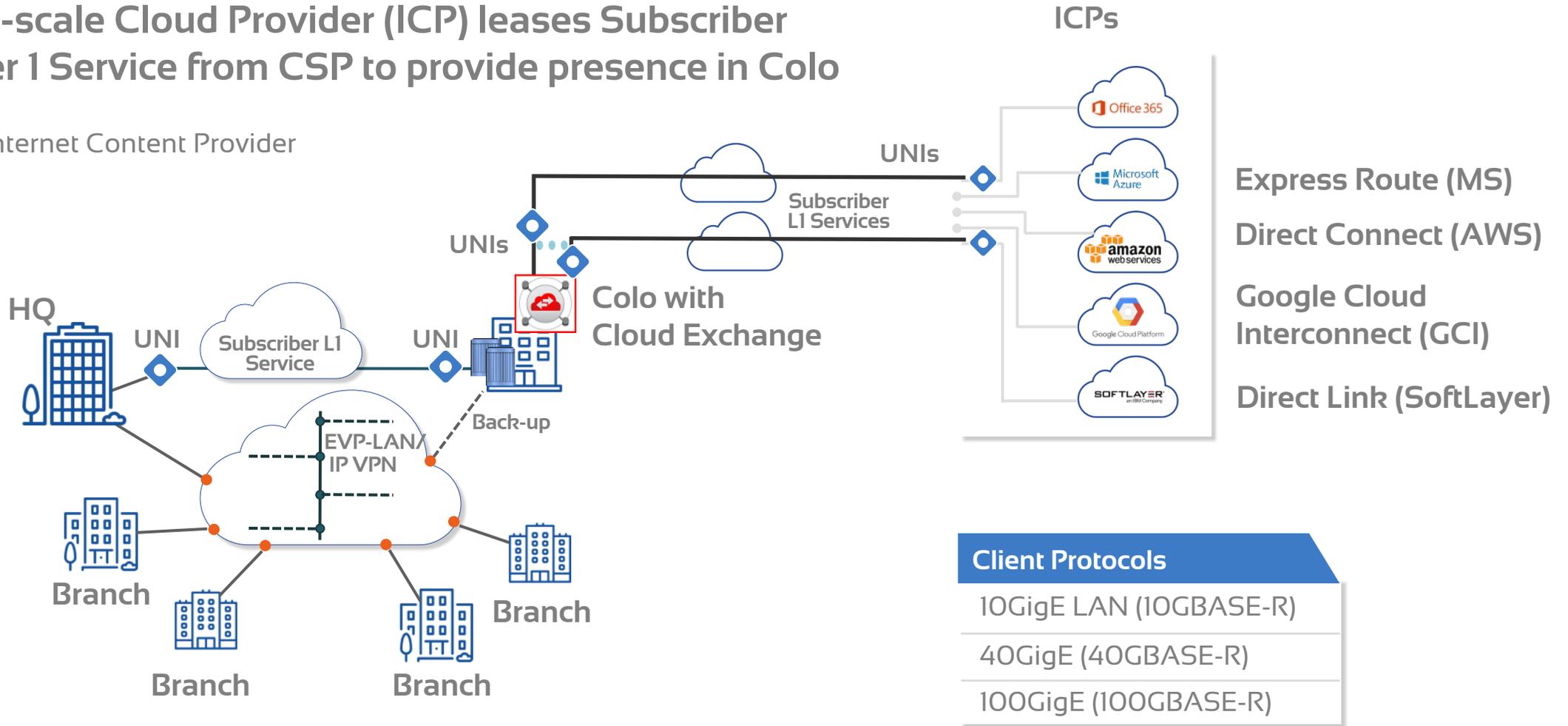
- Use its own equipment and lease space, power, remote hands, or
- Lease computing/storage from an IT provider (CNP case), or the CSP for IaaS, PaaS, SaaS

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

# 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

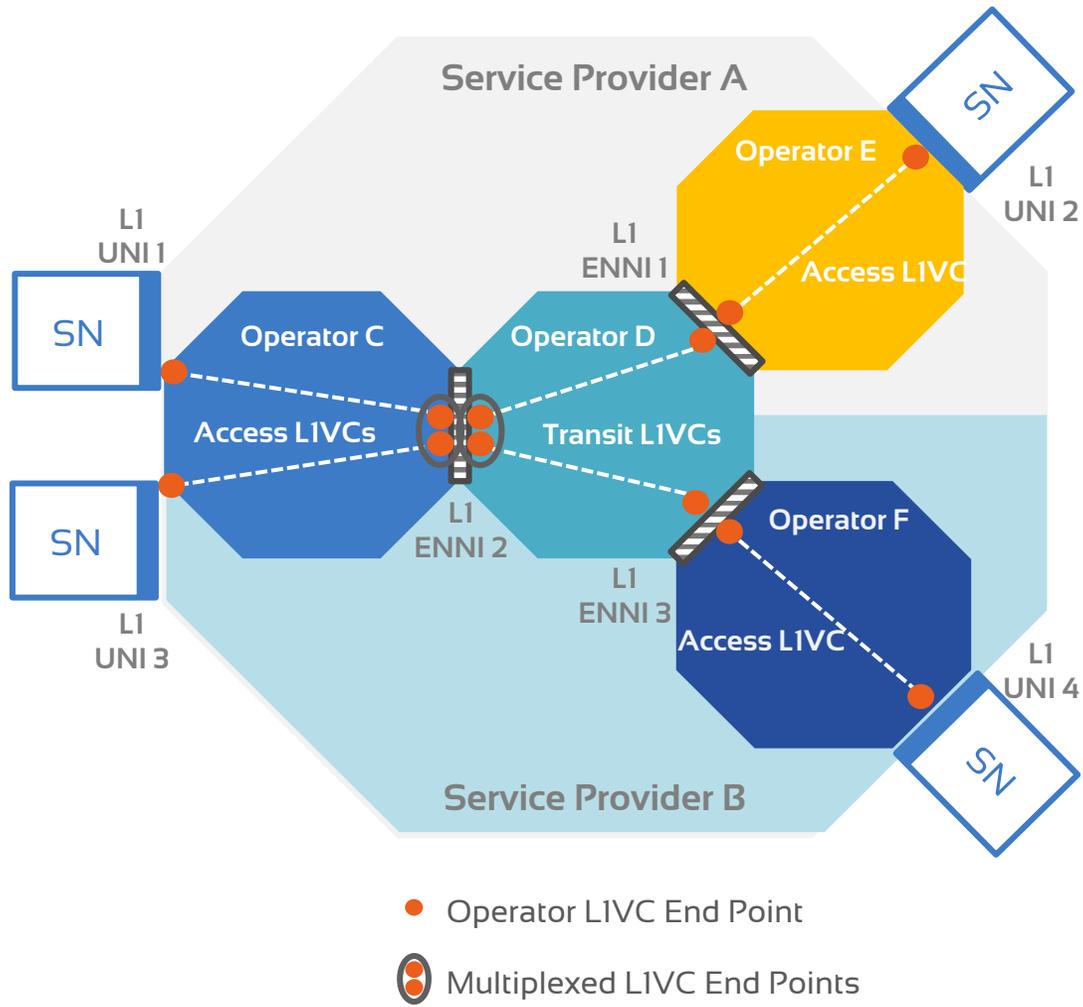


# MEF 64\* – Operator Layer 1 Services (UNI-ENNI, ENNI-ENNI)



- **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)**

# Operator Access & Transit Aggregation, Shared ENNI



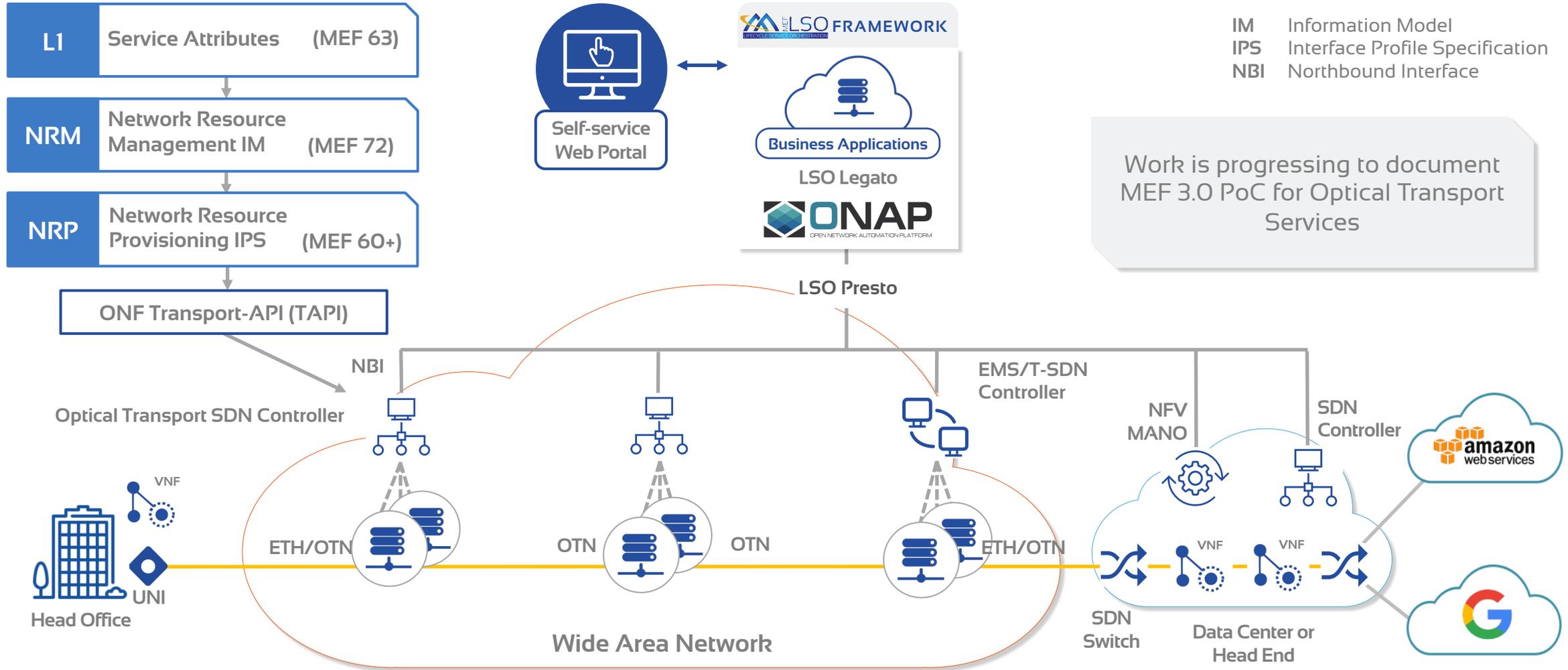
- Operator C multiplexes Access LIVCs of two Service Providers to shared ENNI 2
- Operator D demultiplexes the ENNI 2 Transit LIVCs to their respective ENNIs 1 and 3
- Service Provider A is responsible for the e2e Subscriber L1 Service between UNIs 1 and 2
- Service Provider B is responsible for the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

# Status of Layer 1 Services and Related Projects

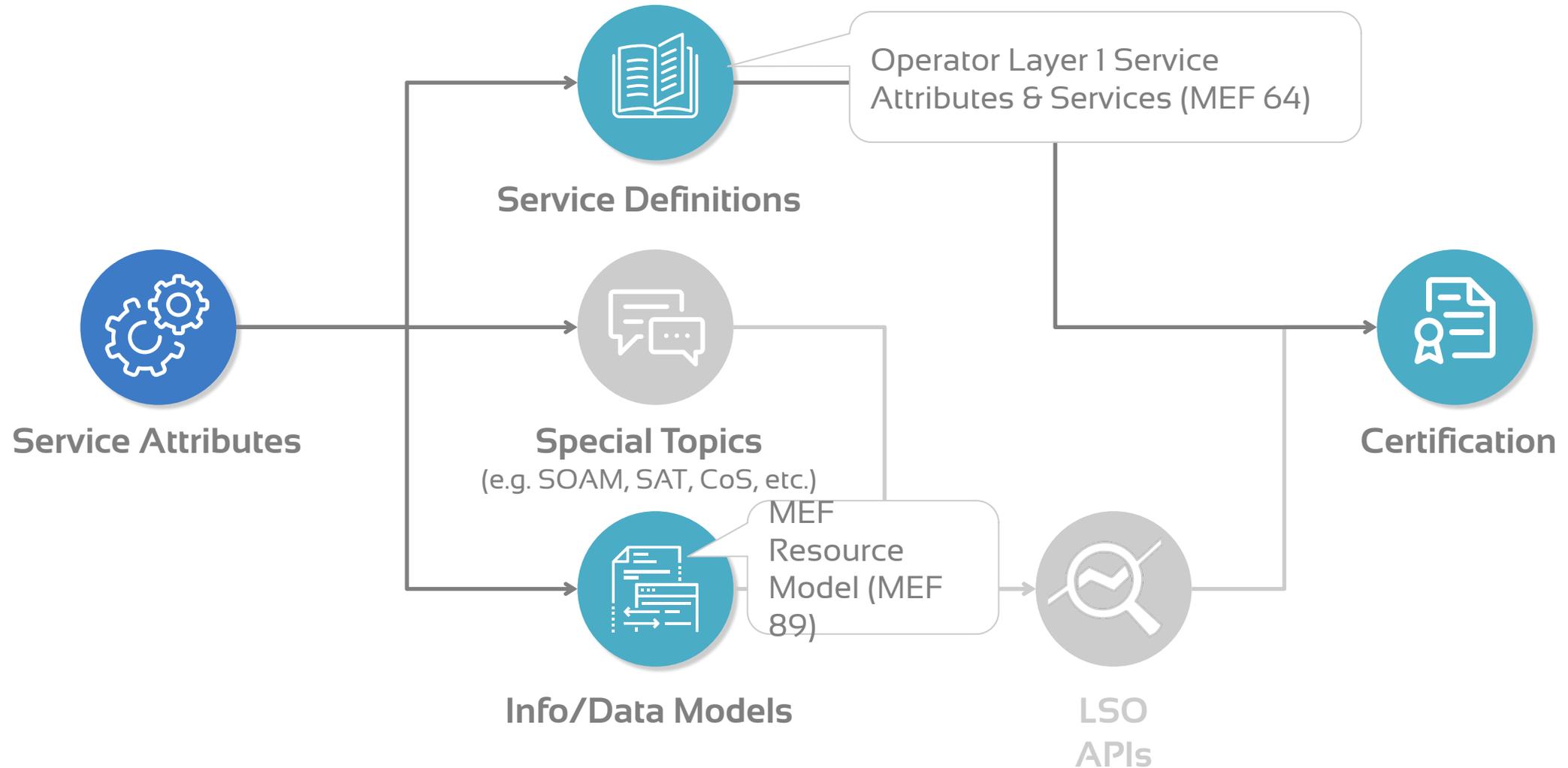


- **MEF 63 - Subscriber Layer 1 Service Attributes**
  - Published in August 2018
  - Note it also inherently defines a Subscriber L1 Service as there are no options
- **MEF 64 - Operator Layer 1 Service Attributes and Services**
  - Have resolved comments from CfC2 on draft standard
  - Targeting Letter Ballot in Q4/2019
- **In LSO Committee, the Network Resource Management Information Model for L1**
  - Added support for Subscriber L1 Service UML constructs in MEF 72
  - Work is underway to add support for Operator L1 Service constructs
- **Orchestrated MEF 3.0 Optical Transport Services work is ongoing**
  - Intent is to gain early experience and provide feedback into related projects

# Orchestrated MEF 3.0 Optical Transport Services



# Active Optical Transport Projects



# 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
- **In LSO Committee, enhance Network Resource Provisioning IPS for Layer 1 (Presto)**
  - NRP Classes, data types, service operations
- **In LSO Committee, add support for Subscriber and Operator L1 Services (Legato)**
  - APIs for Service Catalog, Ordering, Inventory, Topology, Notification

Thank You





# MEF19

