MEF White Paper

Orchestrated MEF 3.0 Optical Transport Services

March 2020

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1 Abstract

MEF is the first industry body to publish standards for Optical Transport services and their orchestration. MEF 63 (Subscriber Layer 1 Service Attributes) defines Subscriber (UNI-to-UNI) Layer 1 Services while MEF 64 (Operator Layer 1 Service Attributes and Services) defines Operator (UNI-to-ENNI and ENNI-to-ENNI) Layer 1 Services. These standards, together with MEF 72 (Network Resource Model – Subscriber Layer 1) and other MEF standards provide a standardized approach to delivering fully orchestrated multi-operator MEF 3.0 services comprising the most advanced high-performance Optical Transport services available in the market today.

This paper provides an overview of these standards, the most prominent use cases of Optical Transport services, and an introduction to the use of MEF LSO (Lifecycle Service Orchestration) APIs to orchestrate these services.

2 Introduction

High bandwidth, high performance point-to-point connectivity services are becoming increasingly important to Service Providers in order to meet the demands of large enterprises for applications such as data center interconnect. The MEF has addressed this need by being the only industry organization to define standardized Layer 1 connectivity services (interchangeably referred to in this document as 'Optical Transport services'). Additionally, MEF has expanded the Lifecycle Service Orchestration (LSO) framework with support for automated Layer 1 Service ordering and configuration, enabling Service Providers to leverage the faster time-to-revenue and lower operating costs of MEF 3.0.

The standard MEF 63 (Subscriber Layer 1 Service Attributes) defines the Subscriber Layer 1 (L1) service attributes supporting Ethernet and Fibre Channel client protocols used in LAN and SAN extension for data center interconnect, as well as SONET and SDH client protocols for legacy WAN services.

The standard MEF 64 (Operator Layer 1 Service Attributes and Services) defines Operator L1 Services between a UNI and OTN ENNI (access) and between OTN ENNIs (transit). This provides the basis for streamlining the interconnection of multi-domain L1 Services.

2.1 Motivations

The motivation for defining Layer 1 Services in MEF are similar to those for the MEF definition work for Carrier Ethernet and IP services.

Although service offerings at Layer 1 are widely available today, Service Providers vary in their use of terminology to describe them (e.g., "Wavelength Services" or "Optical Wavelength Services") and they lack standardized service attribute definitions. Therefore, from a Subscriber perspective, having a standard L1 Service definition allows a far more effective comparison of offerings and their attributes from different Service Providers, such as the performance metrics for

delay and availability. Also, it provides the Subscriber with a means to clearly communicate their service requirements to a Service Provider.

Similarly, due to the pre-MEF 64 lack of standard Layer 1 Service definitions at an ENNI, the interconnection of Layer 1 Services between Operators is typically done today with adhoc agreements which are slow to establish between the two parties, difficult to manage and impede the automation of end-to-end service delivery. With the publication of MEF 64, Service Providers and Operators therefore benefit from standardized Layer 1 Service definitions for ENNI interconnection.

From an Operator perspective, the definition of an L1 ENNI enables simplified and faster interconnect between Operators providing the supporting services for the end-to-end Service Provider. An L1 ENNI can aggregate multiple Operator Access Services (UNI-to-ENNI) into a single Operator Transit Service (ENNI-to-ENNI), thereby providing a single service to manage with potentially global reach.

The primary motivation for this MEF definitions work is to define an L1 Service that can be orchestrated in accordance with MEF LSO standards. This will enable Service Providers to improve service delivery times and benefit from the lower operating costs of MEF-defined services.

Subscriber MEF 3.0 Optical Transport Services have a total of only seven attributes, thereby simplifying compliance testing between partnering Service Providers or in a certification context.

2.2 Relevant Standards

Table 1 shows the current MEF standards relevant for Service Providers offering Optical Transport services.

Reference	Description
MEF 63	Subscriber Layer 1 Service Attributes
MEF 64	Operator Layer 1 Service Attributes and Services
MEF 72	Network Resource Model - Subscriber Layer 1

Table 1 – Reference to Relevant Standards

It should be noted that MEF has also aligned its work with that of Open Network Foundation (ONF) that has developed a generic Transport API (T-API) with the latest release being T-API 2.2.0 made available in July 2019. MEF has used T-API 2.2.0 as the basis of its LSO Presto Network Resource Provisioning (NRP) API which is suitable for orchestrating MEF 63 and MEF 64-compliant Optical Transport services.

3 Business Drivers and Market Opportunities

Interestingly, despite the widespread use of optical transport networks as evidenced by extensive analyst coverage of optical transport vendors, there is very limited corresponding analyst coverage of Optical Transport services per se. This may in part be due to the lack of relevant standardized terminology in the industry and a lack of Service Provider emphasis of their L1 connectivity service offerings.

One example of coverage of this market is a study published in April 2019 by MarketsandMarkets Analysis which indicates continued growth in Service Provider revenues for Optical Transport Services, referred to as "Optical Wavelength Services (OWS)" in the study.

Figure 1 – Optical Transport Services Revenue Forecast

The same study provides a regional split of service revenues over the forecast period.

It is the hope of the authors that this White Paper will trigger renewed awareness of the importance of orchestrated and standardized Optical Transport services within the telecommunications industry as well as the analyst community.

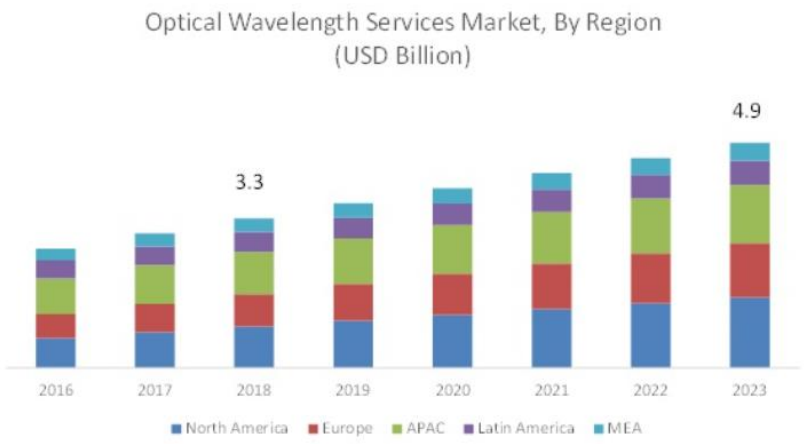

Figure 2 – Optical Transport Services Revenue Forecast by Region

4 Optical Transport Services Overview

In this section, an overview is provided of the contents of the newly published MEF standards defining Optical Transport services – MEF 63 and MEF 64.

4.1 MEF 63 Subscriber Optical Transport Services

Typically, the MEF standardization process for a service begins with the definition of the service attributes which are used to establish an agreement between the Subscriber and the Service Provider. Based on those service attributes, specific service types can then be defined.

MEF 63 defines the service attributes for Subscriber L1 Services and inherently also defines the Subscriber L1 Services as there are no options for the service attributes. Subscriber MEF 3.0 Optical Transport Services are defined in MEF 63 as point-to-point, bi-directional, full port rate (wire speed) connections with a single service instance per UNI and no service multiplexing.

These services always have the same client protocol (e.g., Ethernet, Fiber Channel, SONET, SDH) at both UNIs.

MEF Specification
MEF 63

Subscriber Layer 1 Service Attributes
Technical Specification

August 2018

Figure 3 – MEF 63 Reference

In addition, the physical ports at both UNIs have the same rate and coding function (e.g., 1000BASE-X (8B/10B), FC-1600 (64B/66B), SONET/SDH (section frame)). An encoded data block is the entity carried by the L1 Virtual Connection (L1VC) between the UNIs. The physical port at each UNI may have a different reach optical interface function (e.g., short reach, intermediate reach, long reach, etc.) as required by the deployment.

4.2 MEF 64 Operator Optical Transport Services

Similarly, MEF 64 defines the service attributes for Operator L1 Services and defines the service types between a UNI and ENNI, called Access, and between a pair of ENNIs, called Transit. These are the L1 equivalents of the Carrier Ethernet OVC-based services defined in MEF 51.1 and 26.2.

MEF Standard
MEF 64

Operator Layer 1 Service Attributes and Services

February 2020

Figure 4 – MEF 64 Reference

MEF 64 defines that Operator L1 Services interconnect at an ENNI provided by OTN (Optical Transport Network) ports at standard rates of 2.5G, 10G, 40G and 100G. Access L1VCs (L1 Virtual Connections) from multiple UNIs can be aggregated to a single OTUk port at an ENNI. Similarly, Transit L1VCs from multiple ENNIs can be aggregated to a single OTUk port at another ENNI.

A given ENNI may support Operator L1VCs for different Service Providers, called a Shared ENNI.

5 Key Optical Transport Service Features

Optical Transport Services are most compelling for use cases requiring high rates (e.g., 10Gb/s - 100Gb/s) and high performance, such as the lowest possible latency, zero loss and virtually zero delay variation.

Compared with packet-based services there is no manipulation of the Subscriber traffic, such as header fields, providing inherent transparency and security.

Furthermore, an entire wavelength can be assigned to a Subscriber, providing physical separation from other traffic.

6 Use Cases

6.1 Enterprise Outsourcing L1 Service-on-Demand to Service Provider

In this use case, an enterprise (in this example, a bank) connects multiple sites using a multi-point LAN or VPN to a headquarters.

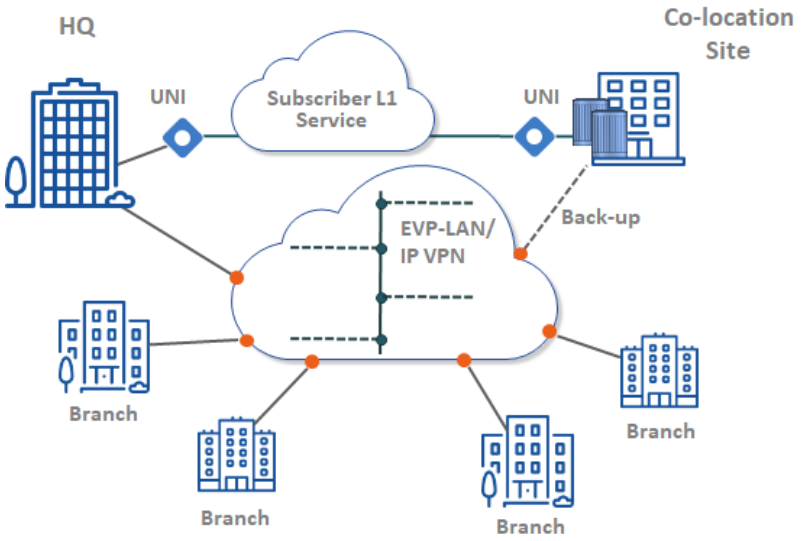

Figure 5 – Multi-Site Network Example

In order to maintain Business Continuity (zero recovery time) or for the purposes of Disaster Recovery, the bank decides to establish back-up computing and storage capability at a co-location (colo) site, where it can:

- Lease space and power from the Carrier Neutral Provider (CNP) and deploy its own equipment, or
- Lease computing and storage from an IT provider with a presence in the colo, or
- In the case of a Communications Service Provider (CSP), lease private Cloud services.

The bank leases a Subscriber L1 Service from a CSP for the headquarters-to-colo connectivity appropriate for the outsourcing scenario, such as:

- An Ethernet L1 Service for LAN extension, and/or
- A Fibre Channel L1 Service for SAN extension.

Typically, the LAN or VPN is extended via an Internet connection to the colo so the branch sites can access the backup computing and storage when the headquarters is no longer accessible.

The bank can also arrange with the CSP for additional, scheduled bandwidth between its headquarters and the colo to accommodate periodic or impromptu demand for higher capacity - for example, to perform a full back-up every night for an hour or for a couple of days every three months during end-of-quarter financials. The additional bandwidth would be provided by another Subscriber L1 Service, requested by the bank from its Service Provider using an API at the LSO Cantata reference point and scheduled by the bank using an API at the LSO Allegro reference point.

6.2 Web-scale Cloud Provider Data Center Interconnect

Often a web-scale Cloud provider (e.g., AWS or MS Azure) does not have private network connectivity between its data centers or would prefer a managed Optical Transport Service. In such cases, the Cloud provider leases a high-speed Subscriber L1 Service from a CSP to provide the connectivity, for example using 100GigE client interfaces.

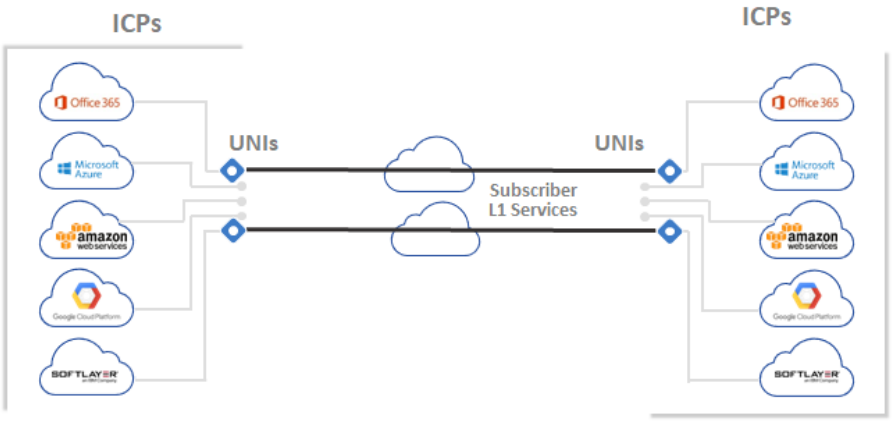

Figure 6 – Data Center Interconnect Example

7 Optical Transport Services Orchestration

With the service attributes and services defined, the next step is to enable orchestration of the Optical Transport Services at the LSO reference points (see MEF 55). This requires enhancements of the MEF information models and MEF data models for the network resources and the corresponding services. Based on these OTS-capable MEF models, standardized APIs can be generated which support the Optical Transport Service types.

The figure below illustrates the general flow of the LSO API development process for a new service type.

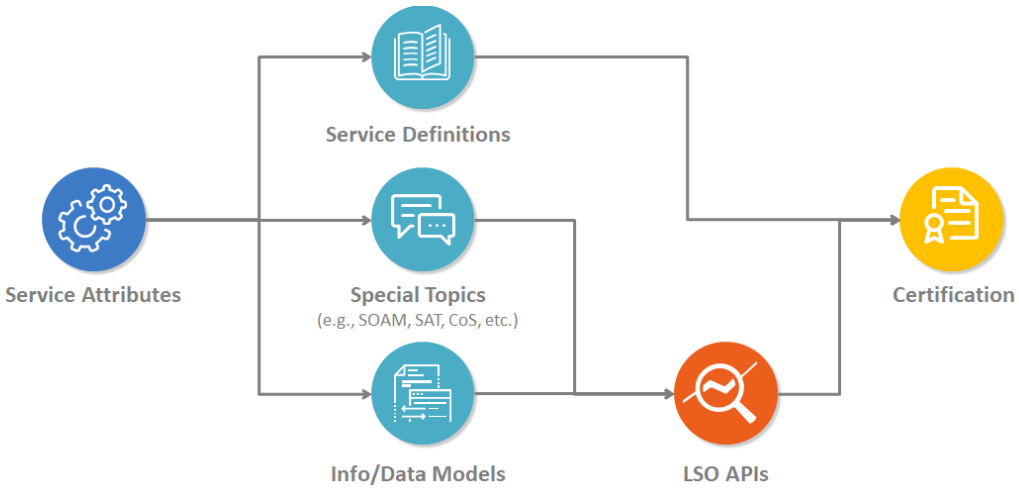

Figure 7 – MEF LSO API Development Process

The figure below provides a more detailed illustration of the specific MEF documents involved in the development of LSO support for L1 Services (MEF 63 and MEF 64).

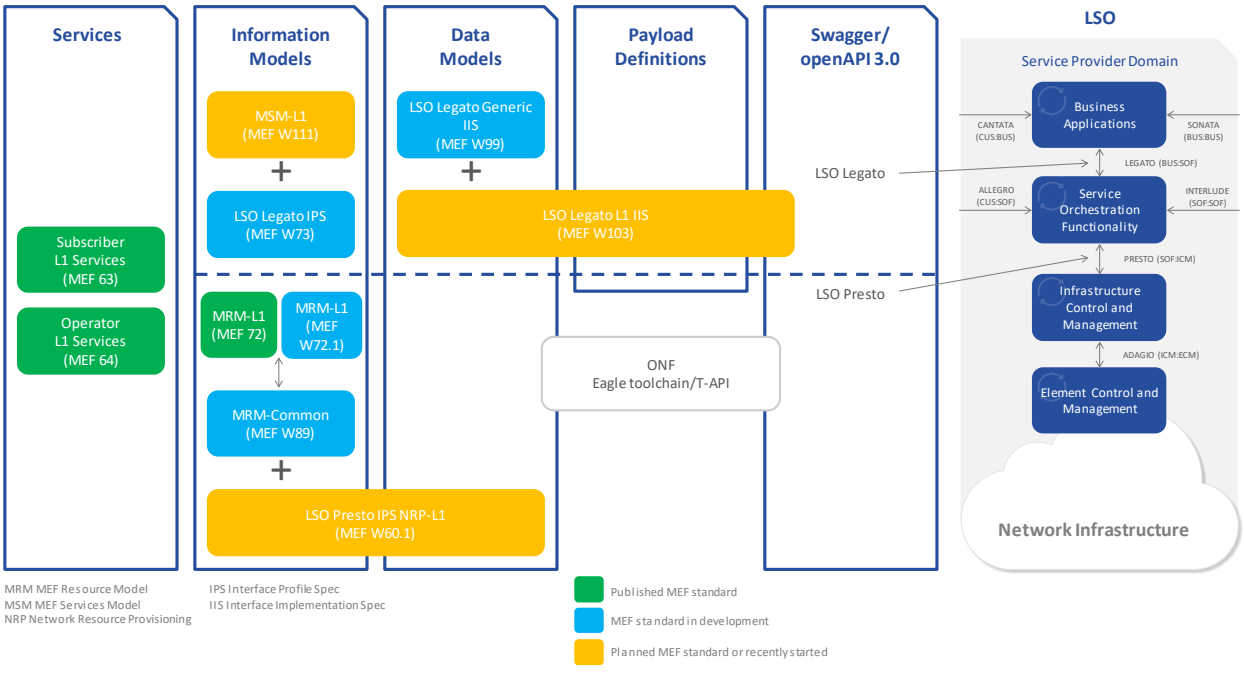

Figure 8 – LSO-Related Specifications for MEF 63 and MEF 64

8 Summary

Using MEF 63 and MEF 64, Service Providers have a valuable baseline to enhance current products or introduce new Optical Transport service products into the market for some of the most important use cases in the industry with the increasing dependence on cloud-based applications and services.

In the longer term, MEF's LSO orchestration framework enables Service Providers to integrate their MEF 3.0 Optical Transport Underlay Connectivity Services into a federation of service providers supporting multi-operator on-demand connectivity services, SD-WAN services and 5G use cases.

This White Paper also provides a basis for analysts to define and track the emerging Optical Transport Services market.

9 About MEF

An industry association of 200+ member companies, MEF has introduced the MEF 3.0 transformational global services framework for defining, delivering, and certifying assured services orchestrated across a global ecosystem of automated networks. MEF 3.0 services are designed to provide an on-demand, cloud-centric experience with user- and application-directed control over network resources and service capabilities. MEF 3.0 services are delivered over automated, virtualized, and interconnected networks powered by LSO, SDN, and NFV. MEF produces service specifications, LSO frameworks, open LSO APIs, software-driven reference implementations, and certification programs. MEF 3.0 work will enable automated delivery of standardized Carrier Ethernet, Optical Transport, IP, SD-WAN, Security-as-a-Service, and other Layer 4-7 services across multiple provider networks. For more information, visit https://www.mef.net and follow us on LinkedIn and Twitter @MEF_Forum.

10 References

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

[2] MEF 64, *Operator Layer 1 Service Attributes and Services*, February 2020

[3] MEF 72, *Network Resource Model – Subscriber Layer 1*, May 2019

[4] ONF T-API 2.2.0, Transport API, July 2019

11 Acknowledgements

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