



The Third Network: Lifecycle Service Orchestration Vision

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Abstract

The MEF's Third Network, based on network as a service principles, combines the on-demand agility and ubiquity of the Internet with the performance and security assurances of Carrier Ethernet 2.0 (CE 2.0). The Third Network will enable services between not only physical service endpoints used today, such as Ethernet ports (UNIs), but also virtual service endpoints running on a blade server in the cloud to connect to Virtual Machines (VMs) or Virtual Network Functions (VNFs). The MEF will achieve this vision by building upon its successful CE 2.0 foundation by defining Lifecycle Service Orchestration (LSO) capabilities and supporting Application Program Interfaces (APIs). The MEF will define functional requirements and APIs for LSO that support capabilities for fulfillment, control, performance, assurance, usage, security, analytics, and policy across multi-operator networks. This approach overcomes existing complexity by defining service abstractions that hide the complexity of underlying technologies and network layers from the applications and users of the services. The purpose of this white paper is to identify the essential LSO and management capabilities necessary to achieve the key aims of the Third Network to deliver network as a service.

1. Scope

The purpose of this white paper is to identify the essential Lifecycle Service Orchestration (LSO) and management capabilities necessary to achieve the key aims of the MEF's Third Network¹. These capabilities will allow the Third Network not only to dramatically decrease the time to establish or modify the characteristics of the end-to-end service, but will also assure the overall service quality and security for these services. Differentiated service performance in the Third Network will be dynamically changeable based on the subscriber's desires. Since services may also traverse multiple operator networks, the Third Network provides orchestration for real-time management supporting global reach beyond the footprint of any single network operator. Applying network service level abstractions and virtualization within LSO allows:

- Operators to allocate common resources across many different subscribers and services.
- Subscribers to view their network services as virtual slices of the overall network.
- The service components (including virtual service components) from multiple network operators to be arranged, assembled, and orchestrated in support of end-to-end subscriber services.
- Rapid operationalization of new commercial products, technical services, and network technologies.

To support the Third Network and LSO, the MEF is extending its suite of well-defined service management and service information model specifications by defining a functional reference model describing the functional management and control infrastructure. Use cases will be applied to describe functional and informational interactions among management domains within the Third Network. The MEF will fully describe the essential LSO capabilities by defining the necessary process flows and information models supporting common service abstractions that enable the definition of open and interoperable interfaces and associated reference implementations for the management of the network and service functions (including virtualized functions) that are critical to the success of the Third Network.

2. The Third Network Overview

The Third Network, based on network as a service principles, will enable network connectivity services to be delivered among physical or virtual service endpoints using a set of dynamic service attributes that better align network connectivity services associated with the on-demand nature of cloud services. The Third Network consists of three principal characteristics: Agile, Assured and Orchestrated.

Agile refers to service providers' ability to rapidly introduce new, on-demand services leveraging new technologies without disrupting the whole top-to-bottom operational environment. Service agility is achieved via proper product / service / resource abstractions leveraging MEF-defined APIs and orchestration. Software Defined Networking (SDN) and Network Functions Virtualization (NFV) enable significant network agility but

¹ MEF Third Network Vision and Strategy based on Network as a Service Principles, November 2014, http://metroethernetforum.org/Assets/Documents/MEF_Third_Network_Vision_FINAL.pdf

require the service provider's operational environment to be more agile to achieve accelerated time-to-market for new service introduction. Service and network provisioning must move away from hard-coded paradigms to re-usable building blocks that will be more dynamic and model-driven.

Assured refers to subscribers' expectations that a network connectivity service provides consistent performance and security assurances to meet the needs of their applications. This is especially true for private or virtual private services (e.g., Ethernet Private Line (EPL) or Ethernet Virtual Private Line (EVPL) services) with Service Level Agreement (SLA) based service assurances, but it is also relevant for business Internet access services over wireless or broadband (wireline) connections. Given the dynamic, on-demand nature of connectivity services within the Third Network, the subscriber controlling the service through a customer web portal must be granted access, be authenticated, and be authorized to make the additions, changes, and deletions, and an audit trail must be generated.

Orchestrated refers to automated service management across multiple operator networks that includes fulfillment, control, performance, assurance, usage, security, analytics, and policy capabilities. Since service providers typically do not have a network footprint in all markets they serve, they must partner with access or transit providers to reach their off-net subscribers. Therefore, WAN services may be delivered via multiple network operators. Service orchestration is expected to be achieved programmatically through APIs that provide abstraction from the particular technology used to deliver the service. The APIs must work with existing networking technologies and emerging technologies, such as SDN and NFV.

LSO enables the ability to create, modify, and terminate connectivity on-demand by subscribers via customer web portals or programmatically through business applications in minutes versus weeks or months. The dynamic connectivity is established among physical or virtual service endpoints (e.g., UNIs or ENNIs) in any combination and is able to adjust service attributes, such as bandwidth and service performance, based on the changing needs of the subscriber and their application requests. LSO also includes assurance capabilities that support monitoring and troubleshooting of services.

3. Carrier Ethernet Management Overview

Carrier Ethernet management within the MEF includes a number of projects that are relevant to enabling LSO. The management work in the MEF begins with the MEF Service and Attribute definitions to create protocol-neutral information models that are then collected into interface profiles driven by use cases, which will ultimately lead to API and reference implementation development. The Carrier Ethernet management information model provides a description of the managed objects that are needed in a Carrier Ethernet provider's operations environment. The MEF also created the management foundation for SOAM Performance Monitoring and Fault Management. New initiatives are being initiated to support the identification of Interface Profiles for Element Management System (EMS) to Network Management System (NMS) and for the various use cases needed for LSO.

The MEF Technical Committee (TC) management work is tightly integrated with the use case development in the MEF Service Operations Committee (SOC). The SOC is developing a generic Service Lifecycle Process Model that may serve as the basis for Service Configuration and Activation work and the alignment that the MEF is driving with other Industry standardization groups in the areas of Carrier Ethernet Service Ordering and Product Catalog.

The MEF UNITE initiative promotes collaboration among industry stakeholders to define, deliver, and manage open connectivity services. The UNITE program maintains an assessment of the standardization efforts that are driving the definition of the Third Network. The MEF is establishing relationships with the key industry stakeholders and open source initiatives to ensure collaboration and cooperation in the development of the software-defined, virtualized, and orchestrated ecosystem. Driving an agile lifecycle that includes the best of worldwide standards groups and the fast turn-around of open source development projects provides a clear path to realizing the potential of the Third Network.

4. Vision for LSO in the Third Network

The MEF Vision of agile, assured, and orchestrated global connectivity services is executed for the entire network service lifecycle where each functional area of the lifecycle is further streamlined and automated, from product definition through service orchestration, assurance, and billing. For example, the pre-order and order

phases of the service lifecycle are focused on automating the inter-provider business interactions and interfaces for the buyer-seller process, including the product catalog, order, service location, and service qualification questionnaire. Each of these phases is based on the product offer defined by the selling carrier. Since the product offer is fully defined in the product catalog, a model-driven approach is used to execute the subsequent stages of the service lifecycle, including pre-order, order, and service orchestration. By using a model-driven approach along with abstractions representing products, services, and resources, LSO ensures an agile approach to streamlining and automating the entire service lifecycle in a sustainable fashion.

As shown in Figure 1, connectivity services in the Third Network will be orchestrated across all internal and external network domains from one or more network operators. These networks may be operated by communications service providers, data center operators, enterprises, wireless network operators, virtual network operators, or content providers. LSO encompasses all network domains that require coordinated end-to-end management and control to deliver connectivity services. Within each provider domain, the network infrastructure may be implemented with traditional WAN technologies, as well as NFV and/or SDN. LSO capabilities allow the Third Network not only to dramatically decrease the time to establish and modify the characteristics of the connectivity service, but also to assure the overall service quality and security for these services.

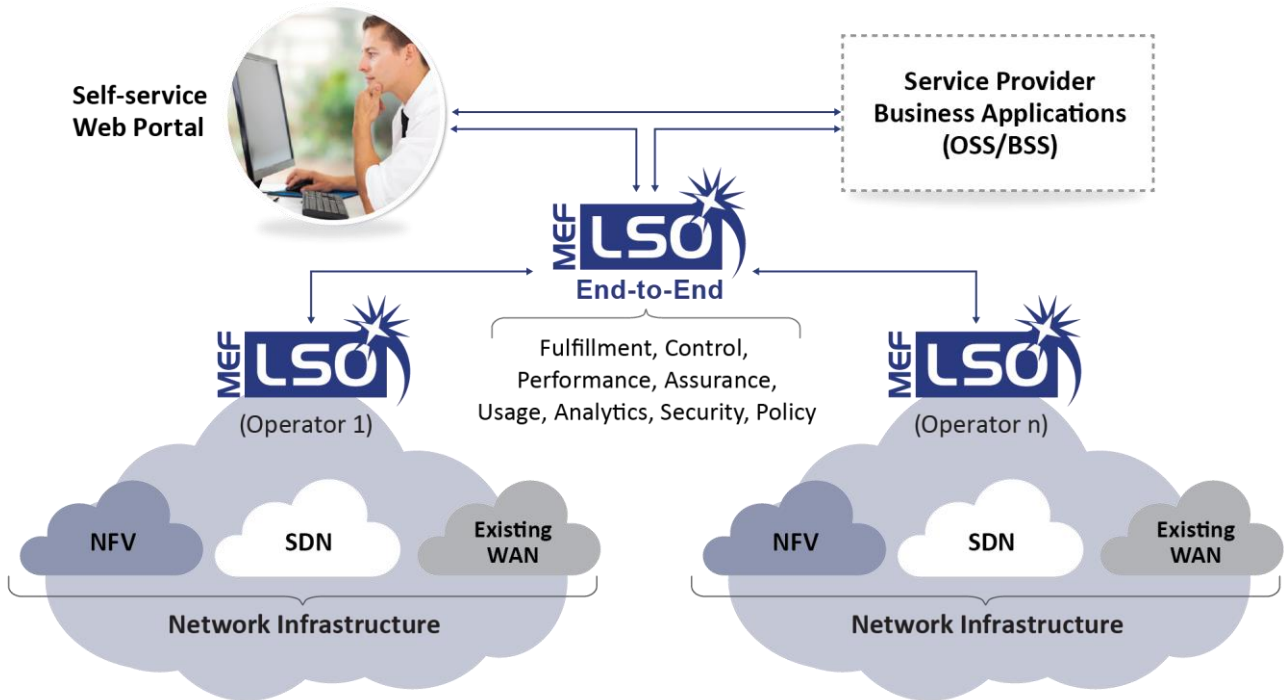


Figure 1 Conceptual LSO Model

4.1 Fulfillment Capabilities

In LSO, the product catalog lists and describes the product offerings made available to potential subscribers by the service provider. The service provider also employs the product catalog when interacting with potential subscribers and partner operators to determine service feasibility or serviceability, helping to ensure that the underlying infrastructure is both capable and available to support the desired product or service for the subscriber.

In order to rapidly satisfy service requests, the fulfillment capabilities in LSO provide service ordering orchestration, service design, service component allocation, and service configuration, while balancing the service requirements with the holistic view of the network, including performance, service constraints, and service and resource design and allocation policies.

When the subscriber (or their agent) orders a service from the service provider, the service level specification (SLS) associated with the service may define the initial service configuration, dynamic service policies, service resource pooling and sharing policies, and service performance objectives. The service provider designs the service based on these SLS constraints and implements the service within its own infrastructure, along with potentially using service components offered by partner network operators. Once the service is instantiated, the subscriber may dynamically manage their services by interacting with the service provider via control capabilities provided in LSO.

During turn-up of a new subscriber service instance, LSO provides the necessary verification and testing of the service and its components, and supports the discovery and reconciliation of the resources, topology, and connectivity associated with the service.

4.2 Control Capabilities

Control capabilities in LSO allow subscribers to actively control the elastic behavior of their service instances, including connectivity and service endpoints. These connections and service endpoints may be activated, modified, or deactivated instantaneously (e.g., on-demand) or be based on triggering events (e.g., schedule). The subscriber may also throttle up or back the bandwidth associated with specific connections or portions of a connection on a per class of service (CoS) basis. LSO control also allows the subscriber to add or remove service endpoints, move service endpoints to different locations or migrate service components to resources in accordance with the subscriber's specified dynamic service policies. In order for the subscribers to understand the controls they have available at their fingertips, LSO provides for the discovery of subscriber-specific service control capabilities.

4.3 Performance Capabilities

Performance capabilities in LSO include the collection of service performance information across all network operators who participate in delivering the service and the gathering of customer-provided feedback. Service quality is analyzed by comparing the service performance metrics with the service quality objectives described in the SLS. The results of the service quality analysis are provided to the subscriber as well as information about known events that may impact the overall service quality (e.g., maintenance events, congestion, relevant known troubles, demand peaks, etc.). LSO performance capabilities also include capacity analysis, traffic engineering, and service quality improvement. Holistic and responsive traffic engineering capabilities manage aggregate traffic flows through the network based on measured and predicted demands in order to effectively meet the demand while maintaining service quality objectives.

4.4 Assurance Capabilities

LSO assurance capabilities support alarm surveillance, including the detection of errors and faults. LSO receives trouble-related information about each service component and fuses this information to determine the overall problem status associated with the subscriber's services. Subscribers are provided with trouble-related information by LSO assurance so that they may track the service impact and status of trouble resolution. Reports related with the subscriber's services are provided to the subscriber, including: correlated alarms, performance events, trouble reports, the potential root cause of a trouble, and the identified impact on the subscriber services. The subscriber may also control the filtering of reports and notifications and may provide reports of problems and trouble-related information back to the service provider in order to aid trouble resolution. Assurance capabilities in LSO also allow the subscriber to provide feedback on the proposed resolution of a trouble. The subscriber may also request that service-related tests be performed by the service provider on their behalf.

4.5 Usage Capabilities

Usage capabilities in LSO enable operators to gather and provide usage measurements, traffic measurements, and service-related usage events (e.g., changes in service bandwidth, etc.) describing the usage of service components and associated resources. LSO usage collects and correlates such information relative to specific service instances. Exception reports may be generated to describe where service components and resources have been used beyond the usage commitments as described in the SLS.

4.6 Security Capabilities

Security in LSO provides for the safeguarding of management and control mechanisms, access to the network, and service-related traffic that flows across the network. Such security capabilities support the authentication of users and applications and provide access control to the variety of capabilities on the APIs supporting management and control based on the roles assigned to each authorized user. The security capabilities of LSO include encryption and key management to ensure that only authenticated users are allowed to successfully access the management and control entities and functions. LSO security thwarts network attacks by taking responsive steps, such as applying filtering controls on specified traffic flows, when a specific threat is identified.

4.7 Analytics Capabilities

Analytics capabilities in LSO support the fusion and analysis of information among management and control functionality across management domains in order to assemble a relevant and complete operational picture of the end-to-end services, service components, and the supporting network infrastructure – both physical and virtual. Analytics ensures that information is visible, accessible, and understandable when needed and where needed to accelerate decision-making. For example, LSO analytics may utilize service fulfillment, control, and usage information to predict and trend service growth for the network operator.

4.8 Policy Capabilities

The behavior of the Third Network may be prescribed by the set of rules under which the LSO management and control logic must operate. Service policies may be encoded in such rules in order to describe the design and dynamic behavior of the services that are implemented within the Third Network. Coordinated connectivity service relies on the orchestration of distributed capabilities across potentially many internal networks and many network operators to enable end-to-end management. LSO policy capabilities provide rules-based coordination and automation of management processes across administrative domains supporting effective configuration, assurance, and control of services and their supporting resources.

In LSO, service design policies will first enable the design and creation of end-to-end network services, and are aimed at being automated to adhere to the network as a service paradigm as described in the Third Network Vision. Furthermore, service objectives may be implemented as sets of policies with event-triggered conditions and associated actions. Such policies would adjust the behavior of services and service resources – including

bandwidth, traffic priority, and traffic admission controls – allowing connectivity services to adapt rapidly to dynamic conditions in order to satisfy critical, ever-changing needs and priorities.

5. Lifecycle Service Orchestration Use Cases

This section describes the LSO connectivity services use cases based on the MEF Vision and Strategy use case definitions. The goal is to overlay LSO views on top of the MEF Vision and Strategy use cases of dynamic connectivity among virtual or physical service end-points orchestrated over operator networks in an on-demand, automated, and assured manner. The initial set of use cases includes: MEF LSO for Wholesale Providers; MEF LSO for Enterprises; and MEF LSO for Cloud Service Delivery.

5.1 MEF LSO for Wholesale Providers

A Wholesale Access Provider sells an E-Access service to a Retail Service Provider and includes service termination at the customer edge provided by NIDs, CPE, or vCPE functionality, potentially implemented as a Virtualized Network Function (VNF) at the edge of the Wholesale Access Provider network. This eliminates the need for the Retail Service Provider to provide a physical Ethernet NID at the Access Provider UNI. The Retail Service Provider may not only use the LSO management and control infrastructure to manage service termination functions, but may also order, monitor, and configure service components from the Wholesale Service Provider in support of the end-to-end connectivity service provided to the Subscriber. An example of this use case is illustrated in Figure 2.

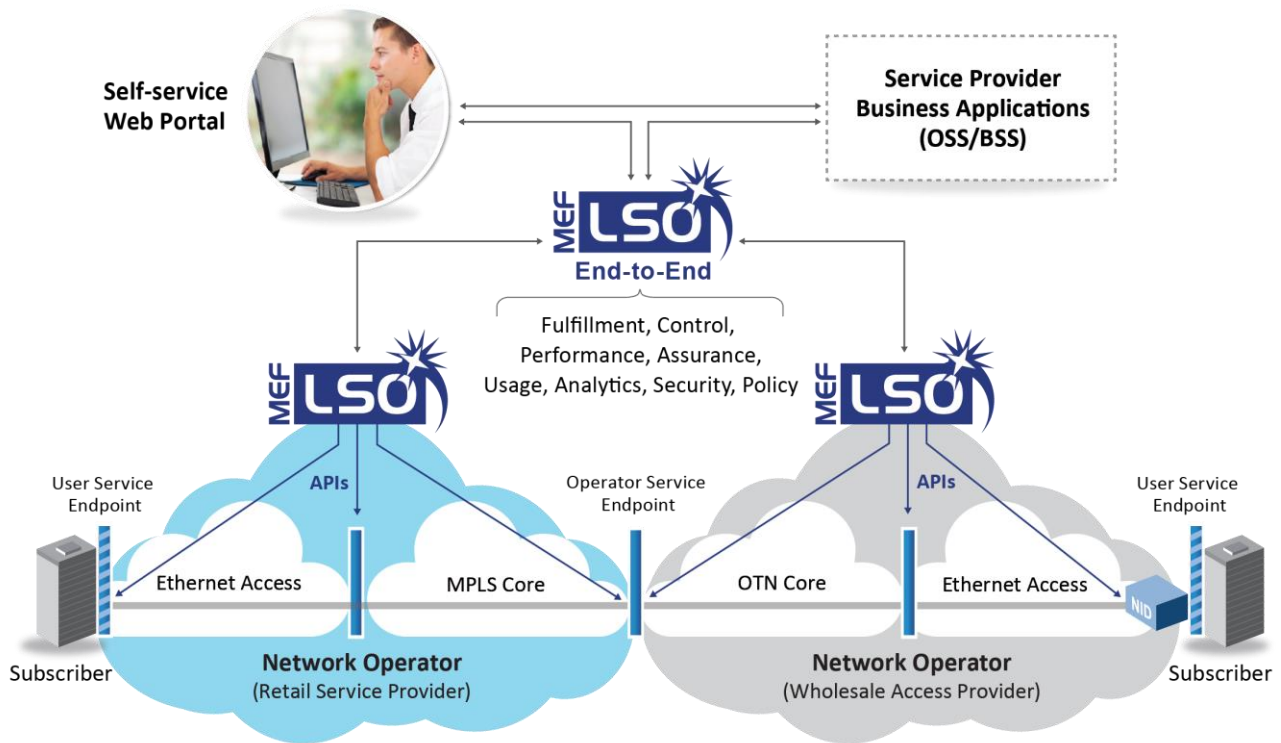


Figure 2 Example Use Case of LSO for Wholesale Providers

5.2 MEF LSO for Enterprises

This use case addresses the need for elastic bandwidth services provided by a service provider among data centers and regional offices. The service provider interconnects with an Access Provider Network Operator via Operator Service Endpoints to connect to data center sites and regional offices outside of the service provider's network footprint. The enterprise customer requires both point-to-point and multipoint network as a service among the locations. The enterprise customer, via a web portal, requests on-demand performance-assured services which are fulfilled via LSO. An example of this use case is illustrated in Figure 3.

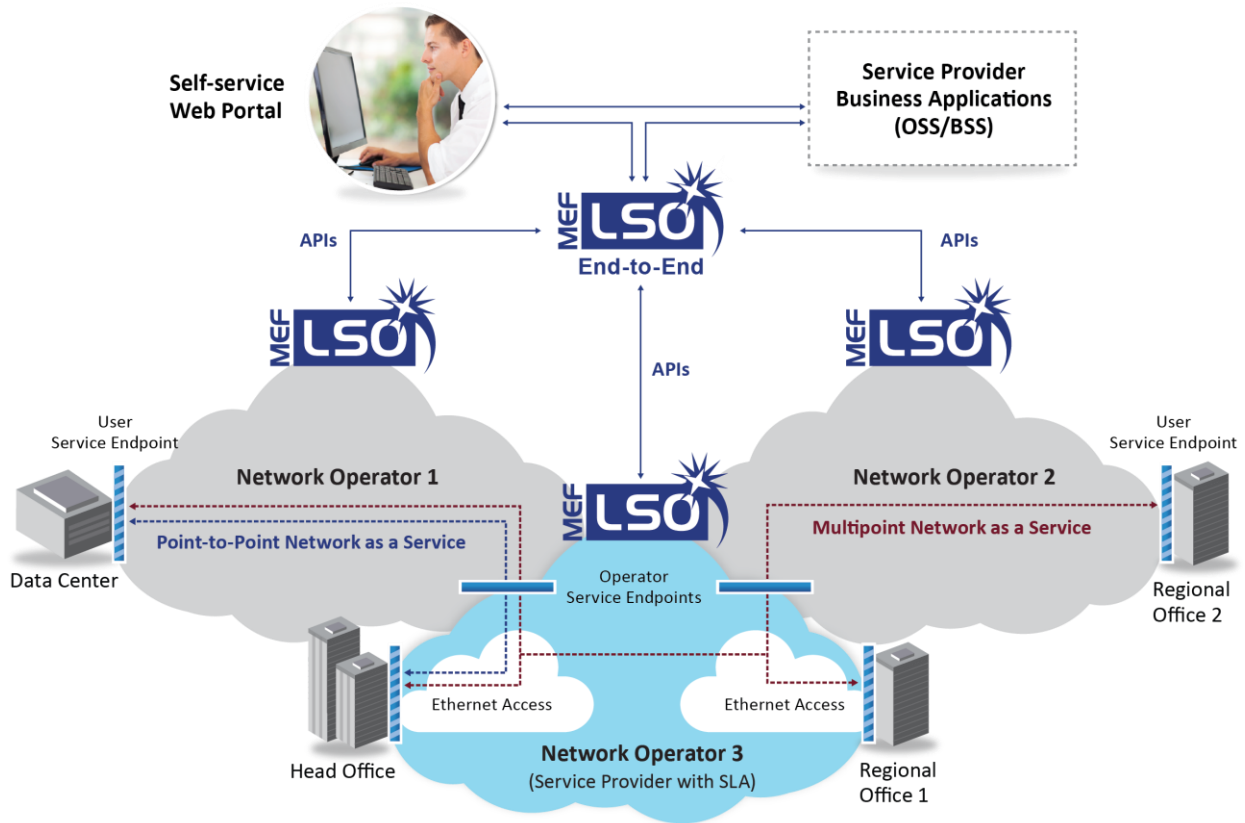


Figure 3 Example Use Case of LSO for Enterprises

5.3 MEF LSO for Cloud Service Delivery

This use case addresses the need for elastic bandwidth services provided by a WAN Service Provider in a Cloud instance involving a data center and subscriber locations. The WAN service provider interconnects with a Data Center Operator via an Operator Service Endpoint that connects the WAN network to the data center network, which in turn connects to a subscriber's virtual machine (VM) or VNF. The subscriber, via a web portal, requests bandwidth changes which are fulfilled via the LSO infrastructure. In this use case, the user service endpoint inside the data center may be provided inside a blade server by a vSwitch. This use case is illustrated in Figure 4.

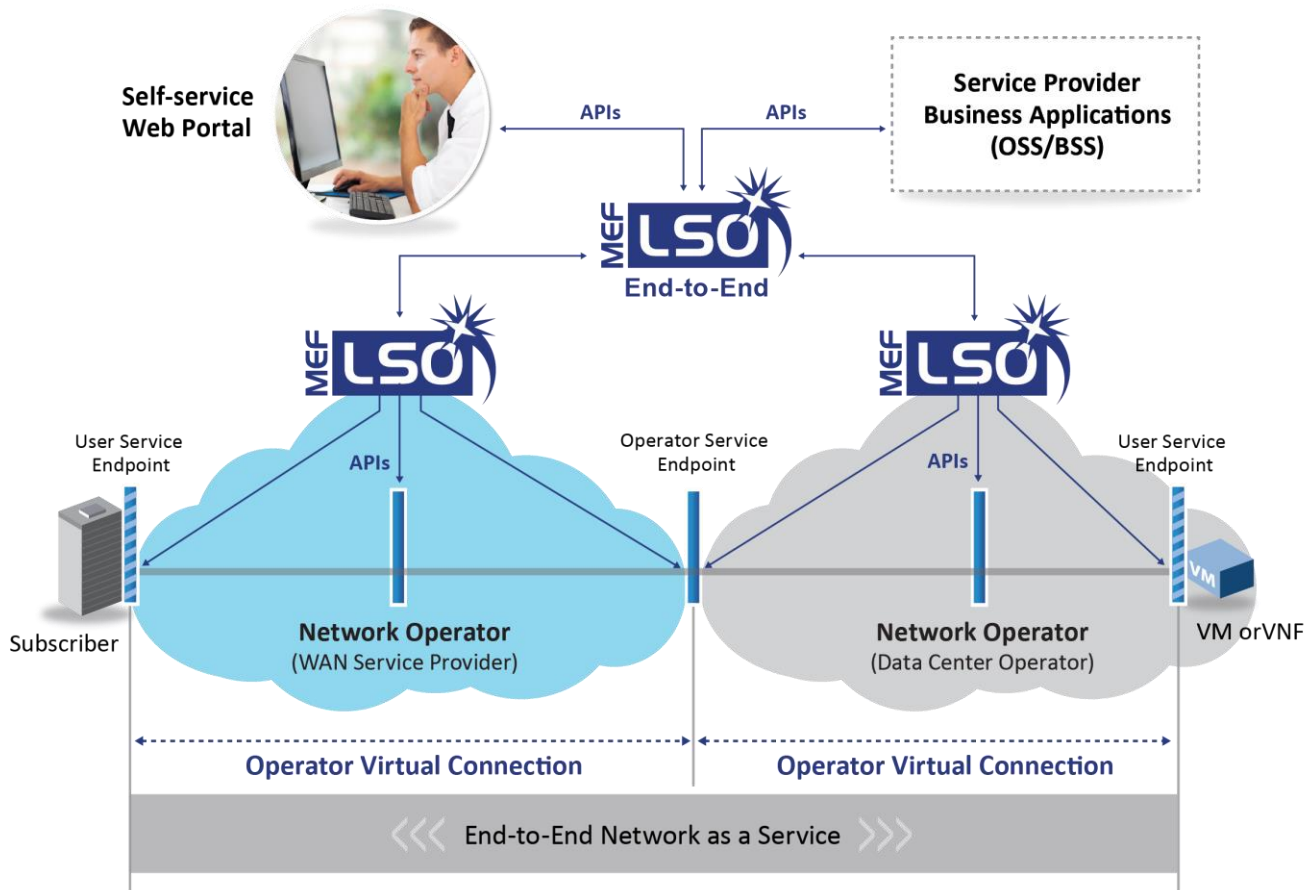


Figure 4 Example Use Case of LSO for Cloud Service Delivery

6. Engineering Methodology

The primary goal of the LSO engineering methodology being followed by the MEF is the generation of re-usable engineering specifications and artifacts capturing the Third Network LSO requirements, capabilities, functionality, behavior, processes, information, interfaces, and APIs supporting management and control of connectivity services. As the Third Network emerges, these engineering artifacts will prove to be valuable resources in enabling the transformation of LSO capabilities into interoperable, specific, consistent, and verifiable designs and implementations. Each of these items illustrated in Figure 5 will be discussed in more detail in subsequent sections.

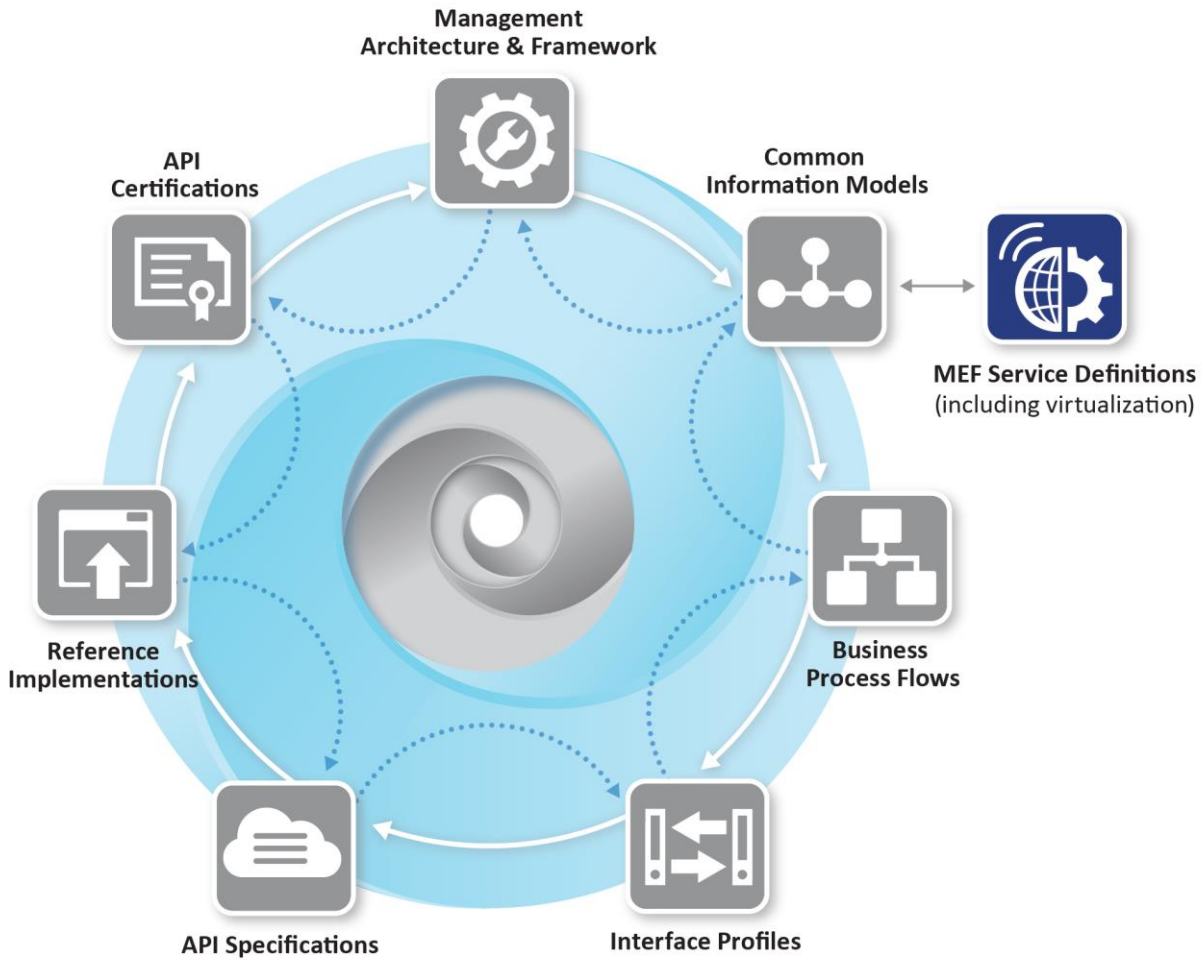


Figure 5 Engineering Methodology

6.1 Management Architecture and Framework

The LSO Management Reference Architecture and Common Framework provides a layered architecture that characterizes the management and control domains and entities that enable the cooperative LSO capabilities for connectivity services. The framework also provides high-level use cases describing orchestrated connectivity service behavior as well as interactions among management entities, expressing the vision of the MEF LSO capabilities. A reference point is the logical point of interaction between specific management entities. The management and control reference points that characterize interactions between LSO management entities are identified in the framework. These management and control reference points are further defined by interface profiles and instantiated by APIs and Reference Implementations that realize automated and orchestrated connectivity services. A simplified example of the LSO Reference Model is shown in Figure 6.

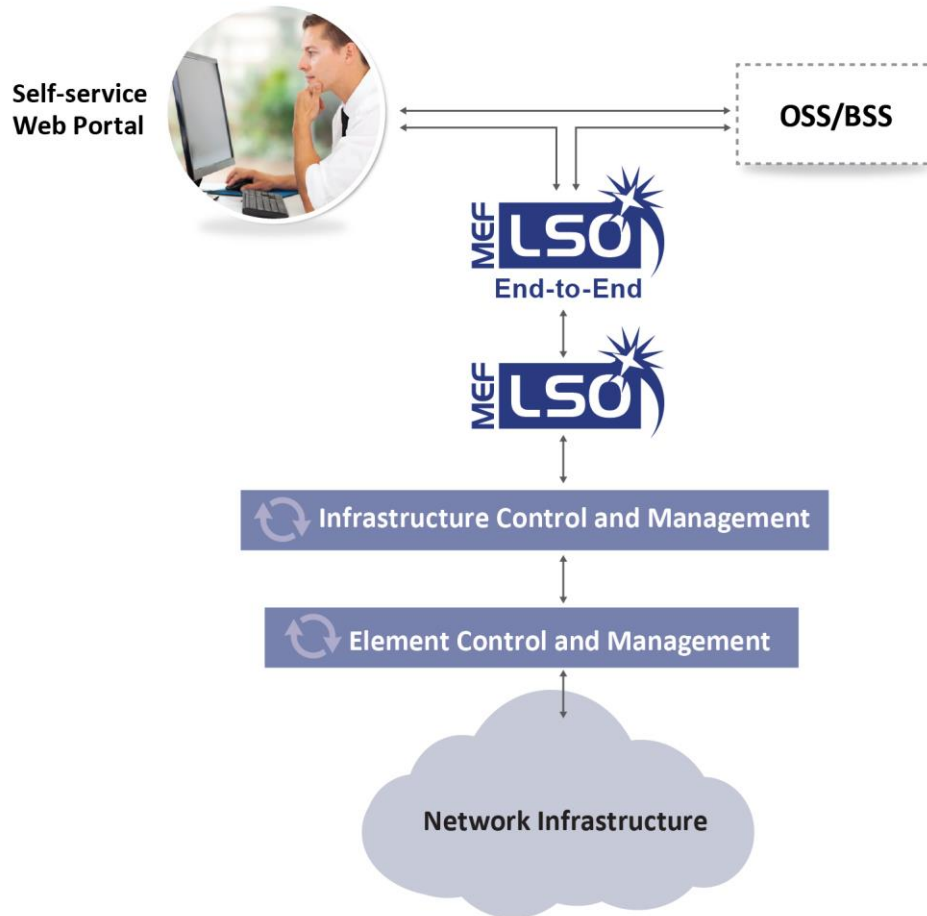


Figure 6 Simplified LSO Reference Model Example

6.2 Common Information Models

A shared Common Information Model for LSO for connectivity services – including the service attributes defined in MEF Specifications – defines a common set of consistent managed object definitions for managing the service lifecycle. This common management and control information model supports Business Management, Service Management, Network Management, and Element Management, and helps ensure that management and control functionality and information shared among Business Support Systems (BSSs), Operations Support Systems (OSSs), NMSs, Orchestrators, EMSs, Infrastructure Managers, Controllers (e.g., Network Domain Controllers, SDN Controllers, etc.), and Network Elements (NEs) are provided in a logically consistent fashion. This allows network operators to readily integrate such capabilities into their connectivity service management and control environment. Currently, MEF is extending its management information model, MEF 7.3, which describes the information associated with the generalized management interactions using protocol-neutral Unified Modeling Language (UML).

6.3 Business Process Flows

The details of the high-level use cases provided in the Management Reference Architecture and Common Framework are further expanded into more detailed Business Process Flows. Business Process Flows describes the functional activity flows among and within organizations, along with information exchanges based on the Common Information Model. A Process describes a systematic, sequenced set of functional activities that deliver a specified result. In other words, a Process is a sequence of related activities or tasks required to

deliver results or outputs. MEF LSO enables automation of the related Business Processes that operationalize connectivity services in the Third Network.

6.4 Interface Profiles

An Interface Profile is the protocol-neutral functional description that defines the structure, behavior, and semantics supporting a specific management reference point identified in the management reference architecture. An Interface Profile describes information views and interactions by identifying a subset of objects, properties, and capabilities (e.g., write, read, etc.) necessary to support each interface view relevant to a management reference point based on the Common Information Model as well as other relevant standards. The Interface Profiles provide a step in the MEF LSO Engineering Approach that will provide the logical requirements for management protocol-specific (e.g., JSON, XSD, etc.) data models and APIs.

6.5 Open Standards-Based Interfaces: API Specifications and Reference Implementations

API Reference Implementations are management protocol-specific interfaces providing the functions and information exchanges that implement reference points in the LSO reference model based on the functional requirements described in an Interface Profile. MEF API Reference Implementations may apply MEF specifications as well as specifications of partnering Standards Development Organizations (SDOs). An API specification describes how software components should interact with each other. Many times an API comes in the form of a data model library that includes specifications for routines, data structures, object classes, and variables (e.g., the Java API). In other cases, notably for Simple Object Access Protocol (SOAP) and Representational State Transfer (REST) services, an API is realized as a specification of remote calls exposed to the API consumers. To enable the exchange of information among systems that use different technologies, when an API implements a protocol it can prescribe a language-neutral message format: e.g. SOAP uses Extensible Markup Language (XML) as a general container for the messages to be exchanged. When used in the context of web development, an API is typically defined as a set of Hypertext Transfer Protocol (HTTP) request messages, along with a definition of the structure of response messages, which is usually in an XML or JavaScript Object Notation (JSON) format. The general concept of a web API has two main interpretations. It is used to refer to both a server-side API upon a web server as well as client-side API within a web browser. Common web APIs include SOAP and REST APIs.

6.6 API Certifications

The MEF has unique positioning in the industry with service-oriented certification, and will build upon this to support the Third Network LSO Vision. APIs are essential for the realization of LSO and will be incorporated in future MEF certification programs that will verify the LSO-related APIs, including API formats and behavior.

7. MEF LSO Interrelationship with SDN and NFV

The interrelationship of SDN and NFV with MEF LSO may be classified into implications on network service implementations themselves and implications on LSO management. Some of the network functions may be virtualized; therefore, MEF service types, definitions, and attributes must support a service between physical or virtual network functions, where previous physical network functions may even be distributed between physical and virtual functions in different locations. It is likely that the current MEF services are capable of supporting virtualized scenarios, but a more detailed analysis may be warranted. If the functions are simply virtualized and deployed at the same physical infrastructure, there may be no impact on the service types, definitions, and attributes, except maybe having different network APIs. There may be need to identify those network functions that may be remotely virtualized and understand if their distribution has any impact.

For the MEF LSO context, as shown in Figure 7, the SDN Controller brings an important paradigm which is about providing a “Virtual Network” API abstraction for any northbound application – agnostic to the network technology – for the network domain the SDN Controller is managing. This can be extended to classical Carrier Ethernet networks with the concept of WAN Controllers, also providing a “Virtual Network” API abstraction to northbound applications for the network domain a Controller is managing. Therefore, in the presence of SDN or

WAN controllers (or enhanced NMSs / EMSs with Virtual Network APIs), the MEF Service Orchestration layer is simplified and can design the end-to-end service down to a Virtual Network abstraction level, and finally delegate the network implementation of the technology-specific Virtual Networks to the Controllers (this is as opposed to the MEF Service Orchestration layer having to deal directly with all devices and technology-specific service implementations in the networks).

With regards to virtualized network functions, the NFV Orchestrator provides Network Function and Network Service instantiation / modification APIs which abstract the elastic data center resource management requirements (managed through VNF Managers and Virtual Infrastructure Managers) from northbound applications. The MEF LSO layer can therefore request the dynamic instantiation of a network function or network service (say, a vNID function or a vCPE network service composed of multiple functions), and not worry about any data center IT resource implications.

Altogether, NFV and SDN (and derived concepts such as WAN Controller) introduce resource abstraction, facilitating agile service operationalization as well as network agility, both of which contribute to the enablement of LSO – particularly through the advancement of open APIs between MEF LSO capabilities and the ONF SDN Controller and ETSI NFV Orchestrator functionality.

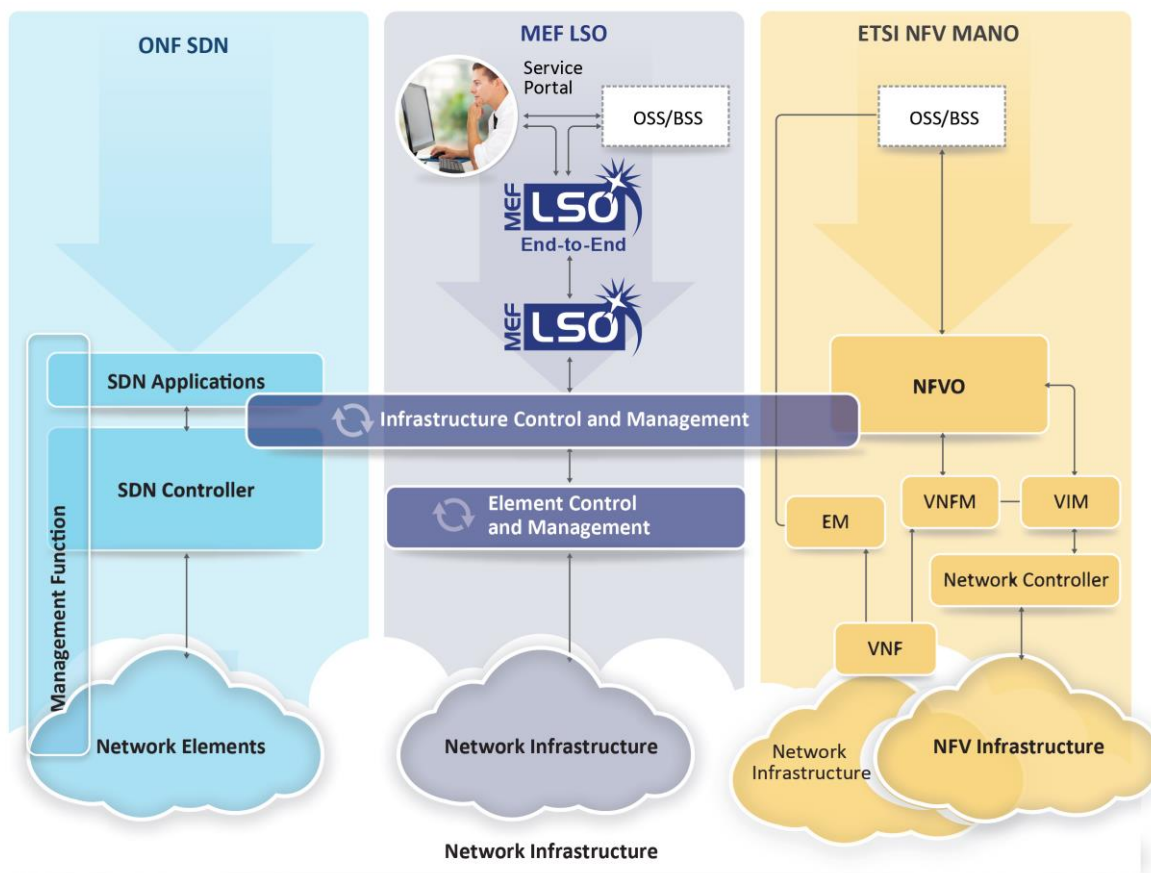


Figure 7 Interrelationship of LSO with ONF SDN and ETSI NFV MANO

8. Summary

The MEF's LSO Vision is for each function of the service lifecycle to be automated, from product definition through service orchestration, assurance and billing. This is required to achieve agile, assured, and orchestrated connectivity services delivered by the Third Network. LSO orchestrates connectivity services in the Third Network across all internal and external network domains from one or more network operators, including all communications service providers, data center operators, enterprises, wireless network operators, virtual network operators, and administrative domains supplying or consuming components of the service. LSO encompasses all network domains to provide coordinated end-to-end management and control of connectivity services.

LSO capabilities will allow the Third Network not only to dramatically decrease the time to establish and modify the characteristics of connectivity services, but will also assure the overall service quality and security guarantees for these services. The MEF is actively defining the necessary management architecture and framework for LSO, including fulfillment, control, performance, assurance, usage, security, analytics, and policy-based capabilities, along with describing the essential points for management interoperability. The engineering approach utilized by the MEF will drive to consistent reference implementations that will accelerate the deployment and realization of LSO connectivity services in the Third Network. Given the scope of the MEF's LSO Vision, the MEF will collaborate closely with industry standards development organizations and the open source community to achieve this vision as part of its UNITE program.

9. About the MEF

The MEF is the driving force behind the \$70+ billion global market for Carrier Ethernet services and technologies and the defining body for LSO standards that underpin emerging Third Network services with CE 2.0, SDN, and NFV. An industry alliance consisting of 220+ member organizations based in 43 countries, the MEF operates through a powerful collaborative framework of service providers, network solutions suppliers, and other stakeholders to achieve CE 2.0 and LSO development and globalization objectives.

MEF's flagship work is CE 2.0, including specifications, operational frameworks, and certification programs for services, equipment, and professionals. Visit www.metroethernetforum.org for more details on these programs.

Building on fourteen years of success with Carrier Ethernet, the MEF is now focused on development of LSO with APIs to enable paradigm-shifting agile, assured, and orchestrated services over more efficient, automated networks. The MEF's vision for the transformation of network connectivity services and the networks used to deliver them is referred to as the "Third Network," which combines the on-demand agility and ubiquity of the Internet with the performance and security assurances of CE 2.0. For information on the Third Network Vision, based on Network as a Service principles, [download the MEF Third Network Vision & Strategy White Paper](#).

9.1 MEF Committees



The Technical Committee focuses on four broad areas of development work: Services, Architecture, Management, Test & Measurement. Each area has teams working on specific projects to define and advance Carrier Ethernet in support of its worldwide adoption. The [Technical Specifications](#) page shows full details of all current and retired specifications.



The Marketing Committee raises awareness and educates the industry on the MEF's activities, including the work of the Technical, Certification, and Service Operations Committees. The Marketing Committee also ensures the MEF's deliverables align with current market priorities.



The Certification Committee validates how MEF’s standards are implemented on CE equipment and services being deployed. This is accomplished via the CE 2.0 Certification. The committee also validates CE 2.0 professionals via the MEF Carrier Ethernet Certified Professional 2.0 (MEF-CECP 2.0) exam with the goal to establish a baseline of qualified professionals who develop and deliver CE solutions.



The Service Operations Committee is developing specifications and implementation guidelines that allow service providers and operators to streamline and standardize processes of buying, selling, delivering, and operating MEF-defined services. The work of the Committee is divided into Partner Relationship Management (including the processes involved with negotiating and establishing an E-NNI between operators) and Service Lifecycle (including the processes involved with activation and operation of MEF-defined services over such E-NNIs).

9.2 MEF Carrier Ethernet Generations and Certifications

With the emergence of Carrier Ethernet as the dominant WAN connectivity service, the MEF recognized the need to associate the growing set of technical specifications into a format that could be easily understood by the different stakeholders: buyers, sellers, and analysts. This led to the creation of CE Generations which group MEF CE standards into a common market need based on the priorities of a particular period of time.



In 2012, the MEF branded its first generation of certification of equipment and services (previously referred to as MEF 9 and MEF 14) under the umbrella of Carrier Ethernet 1.0 (CE 1.0). CE 1.0 focused on standardization of CE services delivered over a single operator network for E-Line and E-LAN service types for business inter-site connectivity and Internet access.



In 2012, the MEF launched its second generation of standards plus equipment and services certifications called CE 2.0. CE 2.0 extended CE 1.0 to four service types; E-Line, E-LAN, and E-Tree and E-Access for off-net access services. CE 2.0 incorporates Service OAM and standardized CoS for delivery of services across multi-operator networks.



In 2012, the MEF launched its MEF Carrier Ethernet Certified Professional (MEF-CECP) certification. MEF-CECP is the industry’s first vendor-independent professional certification exam. Passing the rigorous MEF-CECP exam demonstrates key competency and skills to design, market, deploy and support Carrier Ethernet equipment, networks, and services. In December 2013, the MEF introduced the MEF-CECP 2.0 certification exam which encompasses all CE 2.0 material.

10. Acronyms

Acronyms used in this document are listed below.

Term	Description	Term	Description
API	Application Program Interface	REST	Representational State Transfer
BSS	Business Support System	SDN	Software Defined Networking
CoS	Class of Service	SDO	Standards Development Organizations

CPE	Customer Premises Equipment	SLA	Service Level Agreement
EMS	Element Management System	SLS	Service Level Specification
ENNI	External Network-Network Interface	SOAM	Service Operations, Administration, and Maintenance
EPL	Ethernet Private Line	SOAP	Simple Object Access Protocol
EVPL	Ethernet Virtual Private Line	SOC	MEF Service Operations Committee
HTTP	Hypertext Transfer Protocol	TC	MEF Technical Committee
JSON	JavaScript Object Notation	UML	Unified Modeling Language
LSO	Lifecycle Service Orchestration	UNI	User Network Interface
MANO	Management and Orchestration	vCPE	Virtual CPE
NE	Network Element	VM	Virtual Machine
NFV	Network Functions Virtualization	VNF	Virtualized Network Function
NID	Network Interface Device	vNID	Virtual NID
NMS	Network Management System	WAN	Wide Area Network
OSS	Operations Support System	XML	Extensible Markup Language
OVC	Operator Virtual Connection		

11. Acknowledgements

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