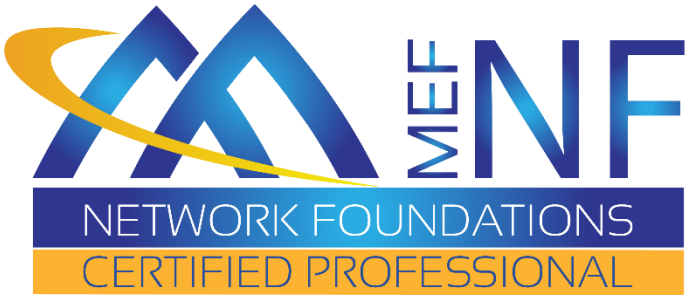

MEF Network Foundations Examination Blueprint

MEF-NF 101.1

Version Number 1.3
Date: November 1, 2017

MEF Document Name: MEF Network Foundations Examination Blueprint (MEF-NF 101.1)

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1 MEF Network Foundations Certification Exam Description

Exam Title: MEF Network Foundations (MEF-NF 101.1)

Exam Details: 60 questions in 80 minutes and a pass score of 65%. Full credit given for each correct answer, no partial credit, as all questions return a binary response (correct/incorrect).

Exam Delivery: Delivered electronically via secure login, on-site proctoring by qualified proctor or through use of remote proctor (Proctor U) with additional fee. Exam currently available in English only.

Credential Awarded: MEF Network Foundations Certified Professional (MEF-NF) upon successful completion of the exam.

Exam Purpose: This certification exam attests and formally certifies that the successful candidate has vendor-neutral conceptual knowledge of the major domains of software-driven networking. The knowledge domains include SDN, NFV, Carrier Ethernet/Connectivity Services, LSO/Orchestration, and various combinations and use cases in these practice areas, collectively called "The Software-Driven Network Vision." This certification exam presupposes foundational knowledge in computer networking practices. It is an entry-level certification examination for technical professionals asserting concept-level mastery of the 5 knowledge domains.

MEF Network Foundations is the foundation credential in a stack of professional-level certifications called the MEF Network Certification Framework. In time, a full suite of professional, practitioner-level certifications in SDN/NFV (2018), Advanced Network Security (2018), Carrier Ethernet (2013), and LSO/Automation/Orchestration (2019) will form the knowledge validation standard for advanced networking professionals.

1.1 Intended Exam Audience

Job Position	Primary Job Responsibilities
Manager/Director for a Network/IT Group	Career Development for Staff Assignment of responsibilities Articulating needs of staff to higher technical and management leadership
Network Technician (Entry Level)	Installation/Migration (entry level, with supervision) Monitoring (entry level, with supervision)
IT Analyst (Entry Level)	Recommend IT Architectures/Products/Systems Performance & Monitoring (see above in Network Technician) Business ROI Comparisons
System Administrator (Entry Level)	Manage Networks and IT Systems Operations Process Deploy Server/Network/Storage Infrastructure Hypervisors/Overlays/Virtual Switches
Consultant/Professional Services Engineer	Design/Implement Network Services ROI/CapEx/OpEx Analysis Business Proposals Recommendations for Network Architecture/Integration

Job Position	Primary Job Responsibilities
Student/Researcher	Learning more advanced networking technologies Looking for Future Job/Career Fundamental Understanding from Academic/Theory Perspective
Sales Representatives	Sell SDN/NFV/Advanced Networking Solutions or Services (assumes product knowledge about specific networking hardware/software) Price/Quote Product/Solutions Identify Opportunities and Sales Insertion Points Can carry on an intelligent and informed conversation with every individual in a sales cycle process
IT Project Manager (assumes knowledge, skills, abilities in a project management domain)	Sets/Manages schedules for IT projects Assign resources based on project estimates and deliverables Creates and updates project plans Capable of discussions with IT subject matter experts in various networking domains Communications with stakeholders
IT Program Manager (assumes knowledge, skills, abilities in a program management domain)	Manage Budget/Resources (financials) Business Case Development (technical and financial) Procurement & Contract Management & Product Certification via Testing and Interoperability via published recommendations Governance/Control/Alignment of Operations
Help Desk/NOC Engineer	First Level Triage/Network support Network outage escalations (with experience)

The major focus of this certification is the IT professional currently working in network operations (server, network, storage administrators) who is seeking greater responsibility in their current job, or seeking to validate new skills to gain a better job, are interested in modern network technologies. Additionally, the marketing, support, product management, and entry-level technical training needs of companies that make or utilize these technologies would also benefit by training and certification with this credential. In creating the MEF Network Foundations Certification Exam, MEF studied and engaged the people who are deploying and describing today's powerful, programmable, and flexible Ethernet networks (which feature programmability, orchestration, and a services menu that is easily ordered and modified). While the MEF-CECP Certification is designed for the actual practitioners and operators of these complex networks, there is a need for those who market, sell, and support these networks to be familiar at a conceptual level with the elements, functions, deployment, and management of these networks. The MEF Network Foundations validates at a concept level the key terms, processes, and elements of today's programmable Ethernet networks. By this we mean professionals who are employed in Technical Sales, Sales Engineering, Product Management, Executive Operations, Product and Services Marketing, and others whose need to communicate accurately at a conceptual level is critical to the success of their products or services.

The breadth of skills necessary to address all the facets of advanced networking is daunting and growing daily. The growing body of vendor-neutral information that an IT technical professional needs to know (networking, virtualization—in many forms, as well as SDN, NFV, orchestration, architecture, and security) is no longer found in any one domain, but must be acquired intentionally across a larger variety of previously separated disciplines. The migration from a single-role network administrator, responsible

for only one function of the network, to a multi-skilled and multivendor set of professionals managing a complex set of technologies, has already begun. For those network engineers who are practitioners with standard networking equipment and want to make the move to more software-driven topologies and technologies, this certification could validate their foundational competence in the world of advanced, virtualized networking. As there are hundreds of thousands of Cisco, Juniper, HP, and Brocade certified network engineers, the possibility that they would go through the MEF Network Foundations certification as their entrance into these new forms of networking technologies would give greater confidence of success.

1.2 Prerequisite Knowledge and Recommended Validation Certification

In order to pass the MEF Network Foundations certification exam, a foundational knowledge of computer networking is assumed, with specific familiarity with various conceptual models of networking (OSI, Internet, etc.) and technologies also required. Such knowledge is formally validated by the CompTIA Network+™ certification examination[1]. No job experience is mandated, but familiarity with all the knowledge domains of this certification is essential to succeed. Resources that would be helpful include publications on networking, as well as foundational certifications in networking from Cisco, Citrix, CompTIA, Juniper, or Microsoft, and materials freely available from MEF. Other materials and resources may be referenced on the MEF Certification landing page.

2 MEF Network Foundations Examination Blueprint & References (v1.3 November 2017)

Major Domains and Subdomains	% of Exam, # of Items	References
Pillar 1. Software Defined Networking (SDN) Concepts. Includes definitions of SDN, characteristics of SDN solutions, evolution, benefits, challenges in deployment, scenario & implementation analysis, understanding the components involved in an SDN solution. This knowledge is concept-level only.	24.53%	

[1] Students uncertain of their knowledge of these foundational networking terms and practices should consult the CompTIA Network+ certification landing page at https://certification.comptia.org/certifications/network . There they will find (upon free registration) useful resources, practice tests, and other materials that can validate this foundational level of knowledge, or resources to train and prepare to pass the CompTIA Network+ exam.

Major Domains and Subdomains	% of Exam, # of Items	References
Subdomain 1.01 Explain the different definitions of SDN today	1	Linux Foundation Website, Open Networking Website, https://www.opennetworking.org/sdn-resources/sdn-definition; https://www.opennetworking.org/sdn-resources/sdn-definition
Subdomain 1.02 Explain the key characteristics of an SDN solution	2	https://www.opennetworking.org/sdn-resources/sdn-definition; Wikipedia SDN entry; SDN architecture, ONF website; SDN architecture, ONF website
Subdomain 1.03 Compare the different characteristics of an SDN solution to those of its network predecessor	2	http://www.opennetworking.org; https://blog.ecitele.com/do-you-need-an-sdn-controller-when-you-already-have-an-nms; Wikipedia entry for SDN
Subdomain 1.04 Explain the major benefits of an SDN solution	2	https://www.opennetworking.org/sdn-resources/sdn-definition; Linux Foundation Website; RFC 6241 section 5.1; From Software Defined Networks, 2nd ed., Goranson & Black
Subdomain 1.05 Explain the major challenges presented by the move to an SDN network	2	CAPEX is capital expenditures, I.E. upfront costs. OPEX is Operating Expenditures, I.E. maintenance cost.; Wikipedia entry for SDN.
Subdomain 1.06 Given a scenario, explain how SDN would be implemented to leverage its benefits	2	SDN entry for applications under Wikipedia; SDN security framework document
Subdomain 1.06 Explain how the various SDN technologies (e.g., protocols, APIs, controllers, switches) relate to each other	2	http://searchsdn.techtarget.com/tip/REST-APIs-in-SDN-An-introduction-for-network-engineers; https://docs.microsoft.com/en-us/windows-hardware/drivers/network/network-virtualization-using-generic-routing-encapsulation--nvgre--task-offload; http://showipprotocols.blogspot.com/2014/06/northbound-southbound-and-eastwestbound.html; Open Network Foundation website; SDN book, Goranson & Black, page 43

Major Domains and Subdomains	% of Exam, # of Items	References
Pillar 2. Network Functions Virtualization (NFV) Concepts. Definitions of NFV, characteristics of NFV solutions, evolution, benefits, challenges in deployment, scenario & implementation analysis, security, understanding the components involved in an NFV solution. This knowledge is concept-level only.	25%	
Subdomain 2.01 Explain the key definitions of NFV today	1	https://transition.fcc.gov/Reports/tcom1996.pdf; https://www.sdxcentral.com/nfv/definitions/nfv-mano/; Network Function Virtualization book, Ken Gray and Thomas Nadeau, p.4
Subdomain 2.02 Explain the key characteristics of an NFV solution	2	Foundations of Modern Networking, Chapter 7, Stallings, page 177-178; Foundations of Modern Networking, Stallings, page 189
Subdomain 2.03 Compare the different characteristics of an NFV solution to those of its network predecessor	2	Network function Virtualization book, Ken Gray and Thomas Nadeau, page 22-24; Understanding OPNFV, page 17-24. Amar Kapadia & Nicholas Chase
Subdomain 2.04 Explain the major benefits of an NFV solution	2	Foundations of Modern Networking, chapter 7.4 NFV benefits, page 191; Network Functions Virtualization (NFV); Proof of Concepts; Framework, page 7; Foundations of Modern Networking, Stallings, p.199; "Integrating SDN & NFV in Future Networks", p. 169, in Virtualized Software Defined Networks and Services, Duan and Toy; NFV Security Expert Group Document, cited in Understanding OPNFV, page 25; Understanding OPNFV, page 27
Subdomain 2.05 Explain the major challenges presented by the move to an NFV solution	2	NFV White Paper 3, page 13 of 20; NFV book, Gray and Nadeau, chapter 3, page 67; Understanding OPNFV, page 27; Understanding OPNFV, page 80; 95; 107; ETSI NFV Architecture document, chapter 8

Major Domains and Subdomains	% of Exam, # of Items	References
Subdomain 2.06 Given a scenario, explain how NFV would be applied to leverage its benefits	2	Understanding OPNFV, pp 119-120; ETSI use case document http://www.etsi.org/deliver/etsi_gs/NFV/001_099/001/01.01.01_60/gs_NFV001v010101p.pdf page 10; NFV use case document (http://www.etsi.org/deliver/etsi_gs/NFV/001_099/001/01.01.01_60/gs_NFV001v010101p.pdf) page 15; ETSI use cases document (http://www.etsi.org/deliver/etsi_gs/NFV/001_099/001/01.01.01_60/gs_NFV001v010101p.pdf), page 21; ETSI use cases (http://www.etsi.org/deliver/etsi_gs/NFV/001_099/001/01.01.01_60/gs_NFV001v010101p.pdf), page 36;
Subdomain 2.07 Explain how the various NFV technologies (e.g., virtualization, tools, architecture) relate to each other	2	Foundations of Modern Networking, page 180; NFV White paper 3, page 5 of 20; NFV white paper, volume 3, page3 15 of 20; NFV White Paper, page 16 of 20; Understanding OPNFV, page 23, NFV architecture
Pillar 3. **LSO/Orchestration Concepts.** Definitions of LSO/Orchestration, Deployment aspects of orchestrated solutions, benefits and challenges in this domain. Also understand scenarios where the benefits of LSO/Orchestration can be leveraged, and familiarity with the major tool sets in this domain.	17%	
Subdomain 3.01 Explain the key definitions of LSO/orchestration today	1	MEF 55, on MEF Wiki; Mehmet & Toy, page 186
Subdomain 3.02 Explain the key characteristics of an orchestrated solution	1	MEF LSO document ("LSO Service and Orchestration"), cited in Virtualized Software Defined Networks and services, Duan & Toy, page 289; MEF Third Network LSO document, page 7 of 18; Third Network LSO document, Feb 2015, page 7 of 18; Third Network LSO vision, February 2015, page 8 or 18.
Subdomain 3.03 Explain the major benefits of an orchestrated solution	1	Third Network LSO document, Feb 2015, page 7 of 18; Third Network LSO vision, February 2015, page 8 of 18

Major Domains and Subdomains	% of Exam, # of Items	References
Subdomain 3.04 Explain the major challenges presented by the move to an orchestrated solution	1	https://blog.gruntwork.io/why-we-use-terraform-and-not-chef-puppet-ansible-saltstack-or-cloudformation-7989dad2865c; https://puppet.com; LSO Third Network 2015, page 14-15.
Subdomain 3.05 Given a scenario, explain how LSO/orchestration would be implemented to leverage its benefits	2	https://www.mef.net/Assets/Technical_Specifications/PDF/MEF_55.pdf; https://www.mef.net/Assets/Technical_Specifications/PDF/MEF_55.pdf; MEF Third Network Vision document, page 12, 2014; Third Network LSO diagram and document, 2015, page 6
Subdomain 3.06 Explain how the various LSO/orchestration technologies (e.g., Tosca, YANG, PNDA, information models, tools) relate to each other	2	Wikipedia; https://www.oasis-open.org/committees/tc_home.php?wg_abbrev=tosca#announcements;
Pillar 4. Carrier Ethernet Concepts. Understand the major building blocks of connectivity services, the evolution in the services from L2 to L1-L3, benefits and challenges in deployment, and how a scenario can leverage carrier-based connectivity services.	18%	
Subdomain 4.01 Explain the major building blocks of carrier-based connectivity services	1	MEF 10.3 Section 7; MEF 26.2; MEF 10.3
Subdomain 4.02 Explain the roles of the organizations/actors involved in buying and selling carrier-based connectivity services	1	MEF 26.2
Subdomain 4.03 Compare the different characteristics of a carrier-based connectivity solution to those of its predecessor	2	MEF 6.2; MEF 51
Subdomain 4.04 Explain the major benefits of a carrier-based connectivity services solution	2	What is Carrier Ethernet? Introduction to carrier Ethernet (Keiffer), page 10

Major Domains and Subdomains	% of Exam, # of Items	References
Subdomain 4.05 Explain the major challenges presented in deploying a carrier-based connectivity solution	2	Introduction to Carrier Ethernet, Keiffer, page 75
Subdomain 4.06 Given a scenario, explain how a carrier-based connectivity solution would be implemented to leverage its benefits	2	MEF 6.2; https://www.mef.net/Assets/White_Papers/CE_2_0-Service_Life_Cycle_White_Paper.pdf;
Pillar 5. The Software-Driven Network Vision. Understand the key components and characteristics of modern network technologies. What are the benefits, and what are the challenges in deploying software-enabled systems? How can SDN, NFV, Carrier Ethernet, and LSO/Orchestration be leveraged to	15%	
Subdomain 5.01 Explain the key characteristics (i.e., agile, assured, and orchestrated) of MEF's Third Network	1	MEF 55; https://wiki.mef.net/display/CESG/Third+Network+Service; MEF 53; MEF Document An Industry Initiative for Third Generation Network and Services November 2016; An Industry Initiative for Third Generation Network and Services November 2016 page 9; MEF 55, page 1;
Subdomain 5.02 Explain the predecessors to MEF's Third Network (i.e., the Internet, Carrier Ethernet 2.0)	1	An Industry Initiative for Third Generation Network and Services November 2016, page 3; John Wiley SD-WAN book, page 15
Subdomain 5.03 Explain the major benefits promised by a software-driven connectivity/functional service	2	An Industry Initiative for Third Generation Network and Services November 2016, page 3. An Industry Initiative for Third Generation Network and Services November 2016, page 11; An Industry Initiative for Third Generation Network and Services November 2016, page 20; John Wiley SD-WAN book, page 24
Subdomain 5.04 Explain the major challenges in deploying a software-driven connectivity/functional service	2	John Wiley book, SD-WAN's, page 11, security perimeters; http://www.telecomramblings.com/2014/09/third-network/blog arguing for Third Network

Major Domains and Subdomains	% of Exam, # of Items	References
Subdomain 5.05 Given a scenario, explain how combinations of SDN, NFV, and LSO/orchestration are leveraged to form a Software-Driven connectivity/functional solutions	2	MEF SD-WAN Managed Service paper, version 1, page of 9; MEF SD-WAN managed service paper DRAFT 1, page 5 of 9; Foundations of Modern Networking, William Stallings, page 70

3 List of Abbreviations, Acronyms, and Defined Terms

Please *note: terms and basic definitions are referenced to Wikipedia and TechTerms.com, reference texts, as well as other non-proprietary sources, including MEF[2] and other SDO publications as referenced in Section 4: References. All terms reproduced by permission of their respective copyright owners, unmodified.*

Term, Abbreviation, or Acronym	Full Text Name/Definition
3GPP	Third generation partnership project
Abstraction	A representation of an entity in terms of selected characteristics, while hiding or summarizing characteristics irrelevant to the selection criteria.
Access Provider	A wide area network service provider that delivers connectivity between an ENNI and one of more UNIs
ACL	Access Control List
A-CPI	Application-controller plane interface
AES	Advanced Encryption Standard
Agile	Relating to a Service Provider's ability to rapidly introduce new, on demand services using new technologies without disrupting their top-to-bottom operational environment. Agility can be achieved via proper product / service / resource abstractions using APIs and orchestration.
API	Application Program Interface. In the context of LSO, API describes one of the Management Interface Reference Points based on the requirements specified in an Interface Profile, along with a data model, the protocol that defines operations on the data and the encoding format used to encode data according to the data model.
ARP	Address Resolution Protocol
ASIC	Application-Specific Integrated Circuit
Assured	Relating to the Customer's expectations that a network Connectivity Service will provide consistent performance and security assurances to meet the needs of their applications.

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Term, Abbreviation, or Acronym	Full Text Name/Definition
BGP	Border Gateway Protocol
Broadcast	Broadcast or flooding is a simple routing algorithm in which every incoming packet is sent through every outgoing link except the one it arrived on.
BSS	Business Support System
Business Process Flow	Graphically represents the behavior of Process Elements in an “end-to-end” or “through” Process view across the business (i.e., Enterprise).
CAPEX	CAPital Expenditure. Money spent by a business or organization on acquiring or maintaining fixed assets, such as land, buildings, and equipment.
CE 2.0	Carrier Ethernet 2.0 generation
CHAP	Challenge Handshake Redundancy Protocol
CLI	Command Line Interface
CO	Central Office. A CO contains at least one Class-5 telephone switch, which is a telephone switch or telephone exchange in the public switched telephone network located at the local telephone company's central office, directly serving subscribers. Class-5 switch services include basic dial-tone, calling features, and additional digital and data services to subscribers connected to a local loop.
Controller	see *SDN Controller*
Connectivity Service	A service delivering network connectivity (i.e. traffic) among service access points described by a set of both static and/or dynamic service attributes.
CPU	Central Processing Unit
Customer	A Customer is the organization purchasing, managing, and/or using Connectivity Services from a Service Provider. This may be an end user business organization, mobile operator, or a partner network operator.
DC	Data Center
Data link layer	The second lowest layer of the seven-layer Open Systems Interconnection (OSI) model of computer networking.
Data Model	Models managed objects based on an Information Model at a more detailed level using a specific data modeling language. Data modeling languages include XSD, IDL, and YANG.
DDoS	Distributed Denial of Service. In computing, a denial-of-service attack (DDoS attack) is a cyber-attack where the perpetrator seeks to make a machine or network resource unavailable to its intended users by temporarily or indefinitely disrupting services of a host connected to the Internet. Denial of service is typically accomplished by flooding the targeted machine or resource with superfluous requests in an attempt to overload systems and prevent some or all legitimate requests from being fulfilled.
DHCP	Dynamic Host Configuration Protocol
DPI	Deep Packet Inspection

Term, Abbreviation, or Acronym	Full Text Name/Definition
DNS	Domain Name System
EMS	Element Management System. A management system used to manage the individual network elements as well as the networks that connect them. One or more EMSs may be deployed within a Service Provider management domain depending on the different supplier products and geographic distribution of the network elements in the network.
ENNI	External Network-to-Network Interface. A reference point representing the boundary between two Operator networks that are operated as separate administrative domains.
EPL	Ethernet Private Line
EVC	Ethernet Virtual Connection. An association of two or more Ethernet UNIs.
East-West SDN Architecture	How entities within the same plane of the SDN architectures interrelate
FEC	Forward Error Correction
Flood	Flooding is a simple routing algorithm in which every incoming packet is sent through every outgoing link except the one it arrived on.
Frame	A unit of data transferred over a L2 network
FTP	File Transfer Protocol
FOSS	Free and Open Source Software
Forwarding Construct (FC)	Enabled forwarding between two or more LTPs which supports any transport protocol including all circuit and packet forms.
Forwarding Domain (FD)	The topological component which represents the opportunity to enable forwarding between points represented by LTPs.
Functional Management Entity	A set of specific management layer functionality within the LSO Reference Architecture.
HTTP	Hypertext Transfer Protocol. A stateless application-level protocol for distributed, collaborative, hypertext information systems.
HTTPS	Hypertext Transfer Protocol Secure
IaaS	Infrastructure as a Service. (IaaS) refers to online services that provide high-level APIs used to de-reference various low-level details of underlying network infrastructure like physical computing resources, location, data partitioning, scaling, security, backup etc. A hypervisor runs the virtual machines as guests. Pools of hypervisors within the cloud operational system can support large numbers of virtual machines and the ability to scale services up and down according to customers' varying requirements. IaaS clouds often offer additional resources such as a virtual-machine disk-image library, raw block storage, file or object storage, firewalls, load balancers, IP addresses, virtual local area networks (VLANs), and software bundles
iBGP	Interior Border Gateway Protocol

Term, Abbreviation, or Acronym	Full Text Name/Definition
ICMP	Internet Control Message Protocol
IDS	Intrusion Detection System
Information model	A set of entities, together with their attributes and the operations that can be performed on the entities. An instance of an information model is visible at an interface. Models managed objects at a conceptual level, independent of any specific implementations or protocols used to transport the data. Information models may be described using UML class diagrams.
INNI	Internal Network-to-Network Interface. A reference point representing the boundary between two networks or network elements that are operated within the same administrative domain.
Interface Profile	Defines the structure, behavior, and semantics supporting a specific Management Interface Reference Point identified in the LSO Reference Architecture. The Interface Profile specification contains all the necessary information to implement the related API, including objects, attributes, operations, notifications, and parameters.
iSCSI	Internet Small Computer Systems Interface
IPS	Intrusion Prevention System
IP	Internet Protocol
IP address	The unique value assigned to each host on a computer network that is employing the Internet Protocol for addressing
IPsec	Internet Protocol Security
IPv4	Internet Protocol Version 4, using a 32-bit integer value for host addressing
IPv6	Internet Protocol Version 6, using a 128-bit integer value for host addressing
IS-IS	Intermediate System to Intermediate System protocol
JavaScript Object Notation (JSON)	A text format that facilitates structured data interchange between all programming languages.
Layer	A stratum in a framework that is used to describe recursion within the data plane. Adjacent layers have a client-server relationship.
Layer 1 or Layer One or L1	See Physical layer in the OSI model
Layer 2 or Layer Two or L2	See data link layer in the OSI model
Layer 3 or Layer Three or L3	See the network layer in the OSI model
Layer 4 or Layer Four or L4	See the transport layer in the OSI model
Layer 5 or Layer Five or L5	See the session layer in the OSI model

Term, Abbreviation, or Acronym	Full Text Name/Definition
Layer 6 or Layer Six or L6	See the presentation layer in the OSI model
Layer 7 or Layer Seven or L7	See the application layer in the OSI model
Level	A stratum of hierarchical SDN or networking abstraction.
LAN	Local Area Network
LIFO	Last In/First Out
LLDP	Link Layer Discovery Protocol
Lifecycle Service Orchestration (LSO)	Open and interoperable automation of management operations over the entire lifecycle of Layer 2 and Layer 3 Connectivity Services. This includes fulfillment, control, performance, assurance, usage, security, analytics and policy capabilities, over all the network domains that require coordinated management and control in order to deliver the service. LSO is an agile approach to streamlining and automating the service lifecycle in a sustainable fashion for coordinated management and control across all network domains responsible for delivering an end-to-end Connectivity Service (e.g., Carrier Ethernet, IP VPN, MPLS, etc.).
LSO Reference Architecture	A layered abstraction architecture that characterizes the management and control domains and entities, and the interfaces among them, to enable cooperative orchestration of Connectivity Services.
Logical Termination Point (LTP)	Termination point that encapsulates the termination, adaptation and OAM functions of one or more transport layers.
MAC	Media Access Control
MAN	Metropolitan Area Network
MANO	Management and Orchestration (see also NFV MANO)
Management Abstraction	A management view of information categories and high-level information classes that hides the details of the underlying complexity. LSO identifies Management Abstractions for the Product, Service, and Resource views.
Management Interface Reference Point	The logical point of interaction between specific management entities
MPLS	Multiprotocol Label Switching Protocol
NaaS	Network-as-a-Service
NAT	Network Address Translation
Network Control Domain	Manages the subnetwork boundary edge to subnetwork boundary edge aspects of the network connectivity along with the resources and infrastructure under its control within a specific subnetwork domain.
Network layer	Provides the functions and processes that allow data to be transmitted from sender to receiver across multiple intermedia networks.

Term, Abbreviation, or Acronym	Full Text Name/Definition
NFV	Network Functions Virtualization. The principle of separating network functions from the hardware they run on by using virtual hardware abstraction. Network functions virtualization (NFV) is an initiative to virtualize the network services that are now being carried out by proprietary, dedicated hardware. If successful, NFV will decrease the amount of proprietary hardware that's needed to launch and operate network services.
NFV Orchestrator (NFVO)	The functionality that coordinates the management of the connectivity lifecycle, Virtualized Network Functions (VNF) lifecycle, and Network Functions Virtualization Infrastructure (NFVI) resources to ensure an optimized allocation of the necessary supporting resources and connectivity.
NOC	Network Operations Center
NBI	North Bound Interface (see SDN Architecture). In a software-defined network (SDN) architecture, the northbound application program interfaces (APIs) are used to communicate between the SDN Controller and the services and applications running over the network. The northbound APIs can be used to facilitate innovation and enable efficient orchestration and automation of the network to align with the needs of different applications via SDN network programmability.
NFaaS	Network Functions-as-a-Service
NOS	Network Operating System
NV-GRE	Network Virtualization Using Generic Routing Encapsulation
OAM	Operations, Administration, and Maintenance
Object Class	Used to convey the representation of an entity, including behavior, properties, and attributes. An instance of an Object Class may be referred to as an Object.
OC	Optical Carrier
OFA	OpenFlow agent
OFC	OpenFlow controller
OPEX	OPerational EXpense. An operating expense, operating expenditure, operational expense, operational expenditure or OPEX is an ongoing cost for running a product, business, or system. Its counterpart, a capital expenditure (CAPEX), is the cost of developing or providing non-consumable parts for the product or system. For example, the purchase of a photocopier involves CAPEX, and the annual paper, toner, power and maintenance costs represents OPEX. For larger systems like businesses, OPEX may also include the cost of workers and facility expenses such as rent and utilities.
Operator Service Endpoint	The demarcation points between network operators
OSS	Operational Support System
Operator Virtual Connection (OVC)	An association of “external interfaces” within the same Operator network.

Term, Abbreviation, or Acronym	Full Text Name/Definition
Orchestrated	Relating to automated service management across potentially multiple operator networks which includes fulfillment, control, performance, assurance, usage, security, analytics, and policy capabilities, which are achieved programmatically through APIs that provide abstraction from the particular network technology used to deliver the service.
OS	Operating System
OSPF	Open Shortest Path First
OTN	Optical Transport Network
OTT	Over the Top
OTU	Optical Channel Transport Unit
Overlay Architecture	An overlay network is a computer network that is built on top of another network
OVSDB	Open vSwitch database management protocol
Packet	a unit of data transferred over an L3 network.
Packet Switch	A packet switch is a node in a network, which uses the packet switching paradigm for data communication. Packet switches can operate at a number of different levels in a protocol suite; although the exact technical details differ, fundamentally they all perform the same function: they store and forward packets.
Partner	An organization providing Products and Services to the Service Provider in order to allow the Service Provider to instantiate and manage Service Components external to the Service Provider domain.
Physical layer	lowest layer of the seven-layer Open Systems Interconnection (OSI) model of computer networking
Pipeline Processing	A chain of data-processing processes or other software entities
PaaS	Platform-as-a-Service
PNF	Physical Network Function
Public Key Infrastructure (PKI)	A public key infrastructure (PKI) is a set of roles, policies, and procedures needed to create, manage, distribute, use, store, and revoke digital certificates and manage public-key encryption. The purpose of a PKI is to facilitate the secure electronic transfer of information for a range of network activities such as e-commerce, internet banking and confidential email. It is required for activities where simple passwords are an inadequate authentication method and more rigorous proof is required to confirm the identity of the parties involved in the communication and to validate the information being transferred. In cryptography, a PKI is an arrangement that binds public keys with respective identities of entities (like people and organizations). The binding is established through a process of registration and issuance of certificates at and by a certificate authority (CA). Depending on the assurance level of the binding, this

Term, Abbreviation, or Acronym	Full Text Name/Definition
	may be carried out by an automated process or under human supervision.
Port	A virtual data connection between computer programs connected through a computer network
Process	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.
Product Lifecycle	The sequence of phases in the life of a Product Offering, including definition, planning, design and implementation of new Product Offerings, changes for existing Product Offerings, and the withdrawal and retirement of Product Offerings.
P-SDN	Packet-Software Defined Networking
PSTN	Public Switched Telephone Network
QOS	Quality of Service
RDP	Remote Desktop Protocol
Resource	A physical or non-physical component (or some combination of these) within a Service Provider's infrastructure or inventory.
Return on Investment (ROI)	Return on Investment (ROI) is the benefit to an investor resulting from an investment of some resource. A high ROI means the investment's gains compare favorably to its cost. As a performance measure, ROI is used to evaluate the efficiency of an investment or to compare the efficiencies of several different investments. In purely economic terms, it is one way of relating profits to capital invested.
Router	A router is a networking device that forwards data packets between computer networks. A router is connected to two or more data lines from different networks (as opposed to a network switch, which connects data lines from one single network). When a data packet comes in on one of the lines, the router reads the address information in the packet to determine its ultimate destination. Then, using information in its routing table or routing policy, it directs the packet to the next network on its journey.
RSVP	Resource Reservation Protocol
SaaS	Software-as-a-Service
SDN	Software Defined Networking. (SDN) technology is an approach to computer networking that allows network administrators to programmatically initialize, control, change, and manage network behavior dynamically via open interfaces and provide abstraction of lower-level functionality. SDN is meant to address the fact that the static architecture of traditional networks doesn't support the dynamic, scalable computing and storage needs of more modern computing environments such as data centers. This is done by decoupling or disassociating the system that makes decisions about where traffic is sent (the SDN controller, or control plane) from the underlying systems that forward traffic to the selected destination (the data plane). SDN was commonly associated with the OpenFlow

Term, Abbreviation, or Acronym	Full Text Name/Definition
	protocol (for remote communication with network plane elements for the purpose of determining the path of network packets across network switches) since the latter's emergence in 2011. Since 2012, however, many companies have moved away from OpenFlow, and have embraced different techniques. These include Cisco Systems' Open Network Environment and Nicira's network virtualization platform.
SDN Architecture	The SDN architecture is: • Directly programmable: Network control is directly programmable because it is decoupled from forwarding functions. • Agile: Abstracting control from forwarding lets administrators dynamically adjust network-wide traffic flow to meet changing needs. • Centrally managed: Network intelligence is (logically) centralized in software-based SDN controllers that maintain a global view of the network, which appears to applications and policy engines as a single, logical switch. • Programmatically configured: SDN lets network managers configure, manage, secure, and optimize network resources very quickly via dynamic, automated SDN programs, which they can write themselves because the programs do not depend on proprietary software. • Open standards-based and vendor-neutral: When implemented through open standards, SDN simplifies network design and operation because instructions are provided by SDN controllers instead of multiple, vendor-specific devices and protocols.
SDN Controller	A software entity that has exclusive control over an abstract set of data plane resources. An SDN controller may also offer an abstracted information model instance to at least one client. An SDN Controller Translates SDN applications' requirements and exerts more granular control over network elements, while providing relevant information up to SDN applications.
SDO	Standards Development Organization
SD-WAN	An SD-WAN is a Wide Area Network (WAN) managed using the principles of software-defined networking. The main driver of SD-WAN is to lower WAN costs using more affordable and commercially available leased lines, as an alternative or partial replacement of more expensive MPLS lines. Control and management is administered separately from the hardware with central controllers allowing for easier configuration and administration.
Service	Represents the Customer experience of a Product Instance that has been realized within the Service Provider's and / or Partners' infrastructure. (TMF GB922)
Service Component	A segment or element of a Service that is managed independently by the Service Provider.
Service Access Point	The endpoint of a specific Connectivity Service at an Service Interface (e.g., UNI, ENNI).
Service Level Agreement (SLA)	The contract between the Customer and Service Provider or Operator specifying the agreed to service level commitments and related business agreements.

Term, Abbreviation, or Acronym	Full Text Name/Definition
Service Level Specification (SLS)	The technical specification of the service level being offered by the Service Provider to the Customer.
Service Operations, Administration, and Maintenance (SOAM)	Mechanisms for monitoring connectivity and performance for entities (links, services, etc.) within the Carrier Ethernet Network.
SLA	A service-level agreement is an agreement between two or more parties, where one is the customer and the others are service providers. This can be a legally binding formal or an informal "contract" (for example, internal department relationships). The agreement may involve separate organizations, or different teams within one organization. Contracts between the service provider and other third parties are often (incorrectly) called SLAs – because the level of service has been set by the (principal) customer, there can be no "agreement" between third parties; these agreements are simply "contracts." Operational-level agreements or OLAs, however, may be used by internal groups to support SLAs. If some aspect of a service has not been agreed with the customer, it is not an "SLA"
Service Provider	The seller of network services.
Service Specification	The detailed description of the characteristics and behavior of a Service.
SNMP	Simple Network Management Protocol
Synchronous Optical Networking (SONET)	Synchronous optical networking (SONET) and synchronous digital hierarchy (SDH) are standardized protocols that transfer multiple digital bit streams synchronously over optical fiber using lasers or highly coherent light from light-emitting diodes (LEDs). At low transmission rates data can also be transferred via an electrical interface. The method was developed to replace the plesiochronous digital hierarchy (PDH) system for transporting large amounts of telephone calls and data traffic over the same fiber without synchronization problems.
Stateless v. Stateful packet flow classification	A stateless protocol is a communications protocol in which no information is retained by either sender or receiver. The sender transmits a packet to the receiver and does not expect an acknowledgment of receipt. A UDP connection-oriented session is a stateless connection because the system doesn't maintain information about the session during its life. A stateless protocol does not require the server to retain session information or status about each communications partner for the duration of multiple requests. In contrast, a protocol that requires keeping of the internal state on the server is known as a stateful protocol. A TCP connection-oriented session is a 'stateful' connection because both systems maintain information about the session itself during its life. Examples of stateless protocols include the Internet Protocol (IP), which is the foundation for the Internet, and the Hypertext Transfer Protocol (HTTP), which is the foundation of data communication for the World Wide Web.
STM	Synchronous Optical Networking
Subscriber	The buyer of network services
Subscriber Service	The demarcation points for the beginning or end of a NaaS

Term, Abbreviation, or Acronym	Full Text Name/Definition
Endpoint	
Switch	A network switch (also called switching hub, bridging hub, officially MAC bridge) is a computer networking device that connects devices together on a computer network, by using packet switching to receive, process and forward data to the destination device. A network switch forwards data only to one or multiple devices that need to receive it, rather than broadcasting the same data out of each of its ports.
TCP	Transmission Control Protocol
TDM	Time Division Multiplexing
Transaction Language 1 (TL1)	Transaction Language 1 (TL1) is a widely used management protocol in telecommunications. It is a cross-vendor, cross-technology man-machine language, and is widely used to manage optical (SONET) and broadband access infrastructure in North America. TL1 is used in the input and output messages that pass between Operations Support Systems (OSSs) and Network Elements (NEs). Operations domains such as surveillance, memory administration, and access and testing define and use TL1 messages to accomplish specific functions between the OS and the NE. TL1 is defined in Telcordia Technologies (formerly Bellcore) Generic Requirements document GR-831-CORE.
TLS	Transport-Layer Security
UDP	User Datagram Protocol
Unified Markup Language (UML)	A general-purpose, developmental, modeling language in the field of software engineering that is intended to provide a standard way to visualize the design of a system. (OMG UML)
Use Case	In UML, a Use Case represents one particular type of a system's behavior based on stimuli from an external source (i.e., an actor). A system may have several Use Cases that define all its behavior. (OMG UML)
User Network Interface (UNI)	The physical demarcation point between the responsibility of the Service Provider and the responsibility of the Customer.
Virtualization	An abstraction whose selection criterion is dedication of resources to a particular client or application. When the context is general, for example when speaking of virtual network elements (VNEs), the term virtual may be used even when abstract might suffice. Virtual is also sometimes used colloquially to mean non-physical.
VM	Virtual Machine
Virtual Network Element (VNE)	An abstraction representing a set of network functions providing network element capabilities implemented in a virtualized environment.
VoIP	Voice over IP
Virtual Private LAN Service (VPLS)	Virtual Private LAN Service (VPLS) is a way to provide Ethernet-based multipoint to multipoint communication over IP or MPLS networks. It allows geographically dispersed sites to share an Ethernet broadcast domain by connecting sites

Term, Abbreviation, or Acronym	Full Text Name/Definition
	through pseudowires. The term 'sites' includes multiplicities of both servers and clients. The technologies that can be used as pseudo-wire can be Ethernet over MPLS, L2TPv3 or even GRE. There are two IETF standards track RFCs (RFC 4761 and RFC 4762) describing VPLS establishment.
VXLAN	Virtual Extensible LAN
WAN	Wide Area Network
WLAN	Wireless Local Area Network
XML	Extensible Markup Language. A markup language that defines a set of rules for encoding documents in a format which is both human-readable and machine-readable.

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