The ACADEMY

DISCOVER LEARN CERTIFY

MEF-CECP
BOOT CAMP
SURVIVAL GUIDE

Welcome to Boot Camp

This survival guide will help you prepare for one of the most informative and intensive training missions that you will ever embark on. We have included some of our most effective training tools and a mission plan to help you get ready to become a MEF-CECP.

What's included:

- The link to the exam blueprint with all the topics covered on the exam to help you understand the core Carrier Ethernet concepts that you'll need to master in order to graduate Boot Camp and go on to become a Certified Professional.
- Key training tools that explain the basics of Retail and Wholesale Ethernet services, Service OAM and Activation Testing basics and MORE!
- A link to a quiz that will give you an example of what will be expected of you when you're ready to take the MEF-CECP examination.
- An acronym guide to help you learn the language of Carrier Ethernet

But if you're not quite ready to go it alone, we've included an overview of our award winning Drill Instructor-led training program that more than 5,000 fellow professionals have used to earn their certifications.

All of us at the Carrier Ethernet Academy wish you the best in your exam preparation, and if you're looking for a "boost over the wall", do not hesitate to contact us and ask for a push! We're standing by eager and ready to help you earn your stripes!
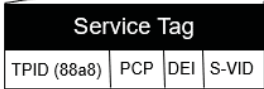
Craig Easley – Master Drill Instructor and Dean of Academic Affairs
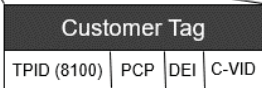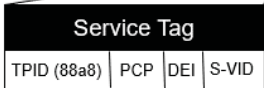
Ethernet Frame Format Options

Untagged Ethernet Frame

Destination MAC	Source MAC	Eth. type	Payload	FCS
1 ▪ ▪ ▪ 6	1 ▪ ▪ ▪ 6	1 2	1 ▪ ▪ ▪	1 2 3 4

Single Tagged Ethernet Frame (S-Tag)

Destination MAC	Source MAC	S-Tag	Eth. type	Payload	FCS
1 ▪ ▪ ▪ 6	1 ▪ ▪ ▪ 6	1 2 3 4	1 2	1 ▪ ▪ ▪	1 2 3 4

Service Tag			
TPID (88a8)	PCP	DEI	S-VID

Double Tagged Ethernet Frame (S-Tag + C-Tag)

Destination MAC	Source MAC	S-Tag	C-Tag	Eth. type	Payload	FCS
1 ▪ ▪ ▪ 6	1 ▪ ▪ ▪ 6	1 2 3 4	1 2 3 4	1 2	1 ▪ ▪ ▪	1 2 3 4

Service Tag			
TPID (88a8)	PCP	DEI	S-VID

Customer Tag			
TPID (8100)	PCP	DEI	C-VID

# Basic Ethernet Reference Concepts

- ❏ IEEE 802.3 – Std that defines Ethernet Frame format
- ❏ IEEE 802.1Q – Std that defines Ethernet VLAN Tag format
  - ❏ Provider Bridging defines the Service-tag format
- ❏ L2 Address = MAC Address
  - ❏ Unicast, multicast and broadcast
  - ❏ L2CP well known addresses
- ❏ Ethernet frame sizes
  - ❏ 1518 bytes, untagged
    1522 bytes, 1 VLAN tag
    1526 bytes, 2 VLAN tags (ENNI)
- ❏ UNI roles: Root and Leaf
- ❏ ENNI roles: Root, Leaf & Trunk
- ❏ Maximum Frame Size = MFS (aka MTU)
  - ❏ Minimum size for UNI & EVC: 1522 bytes
  - ❏ Minimum size for ENNI & OVC: 1526 bytes
- ❏ UNI MFS is always at least as large as any EVC. If the UNI and EVC have different MFS, the UNI MFS is the larger of the two
- ❏ ENNI MFS always at least as large as any OVC. If the ENNI and OVC have different MFS, the ENNI MFS is the larger of the two
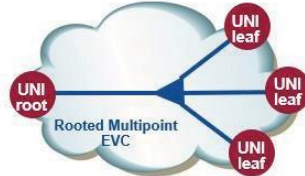
EVC And Ethernet Service Types

E-Line Services
Use point-to-point EVCs

E-LAN Services
Use multipoint-to-multipoint EVCs
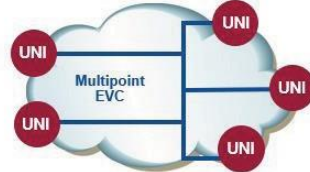
E-Tree Services
Use rooted-multipoint EVCs

Ethernet Private Services are based upon Ethernet Virtual Connections (EVCs)

Private and Virtual Private Services

❑ Each Service type supports both a Private and a Virtual Private service definition

    ❑ All to One Bundling creates Port-based or Private services

    ❑ Service Multiplexing and/or Bundling are VLAN-aware or Virtual Private services

Service Type	Port-Based (All to One Bundling)	VLAN-Based (Service Multiplexing – Bundling)
E-Line Point-to-point EVC	EPL Ethernet Private Line	EVPL Ethernet Virtual Private Line
E-LAN Multipoint-to-Multipoint EVC	EP-LAN Ethernet Private LAN	EVP-LAN Ethernet Virtual Private LAN
E-Tree Rooted-Multipoint EVC	EP-Tree Ethernet Private Tree	EVP-Tree Ethernet Virtual Private Tree

Carrier Ethernet Service Basics

- ❑ Port Based @ UNI only
- ❑ Private = EP-xxx C-Tag Blind (CTB)
    - ❑ EPL, EP-LAN, EP-Tree
- ❑ All-To-One Bundling enabled
- ❑ NO Service Multiplexing or Bundling
- ❑ Very Transparent – no filtering or tag translation
- ❑ UNI dedicated to 1 exactly EVC
- ❑ Able to Tunnel(Pass) STP/RSTP/MST
- ❑ VLAN Based @ UNI only
- ❑ Virtual Private = EVP-xxx C-Tag Aware (CTA)
    - ❑ EVPL, EVP-LAN, EVP-Tree
- ❑ Must NOT be All-To-One Bundling
- ❑ Service Multiplexing and/or Bundling can be enabled
- ❑ Bundling is multiple CE-VLAN IDs bundled to one EVC at the UNI
- ❑ CE-VLAN ID preservation is required when Bundling
- ❑ NOT as Transparent (Filters)
- ❑ UNI may be Shared (EVCs >= 1 per UNI)
- ❑ No Tunnelling/Passing any L2CP – Peer or Discard only

EVC Service Computer
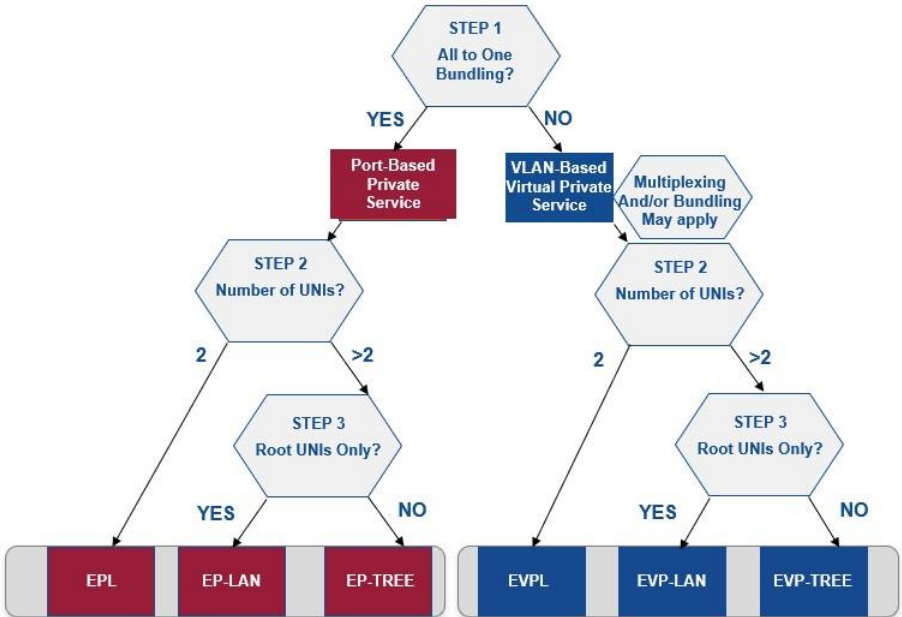
Carrier Ethernet Service Concepts

- ❑ EVC = Service
- ❑ Subscribers, Service Providers and EVCs associate UNIs only
- ❑ $2^{12} = 0\text{-}4095$
- ❑ $2^{24} = 0\text{-}16,777,216$
- ❑ In digital realm, for size and addressing, the K or M is a multiple of 1024, not 1000. Eg. 4KB = 4 x 1024 = 4096 Bytes
- ❑ Ethernet = 8 classes of services – MEF 23 defines a 3 CoS model
    - ❑ High (5), Medium (3), Low (1)
    - ❑ Discard eligibility indicator (DEI) is used to carry frame "color" (Green or Yellow)
- ❑ Qualified Service Frames = CIR compliant, Green frames only
    - ❑ Green frames have SLA guarantee
    - ❑ Yellow frames best effort no SLA
- ❑ DEI – Discard Eligible Indicator
    - ❑ DEI = 0 = Green (not eligible)
    - ❑ DEI = 1 = Yellow (discard eligible
- ❑ Performance Metrics always apply to:
    - ❑ Qualified Service Frames only
    - ❑ Measured on a specified Subset of Ordered UNI pairs
    - ❑ For a Specific Class of Service (CoS) instance
    - ❑ 1 Class of Service definition is mandatory for each EVC

External Network to Network Interface
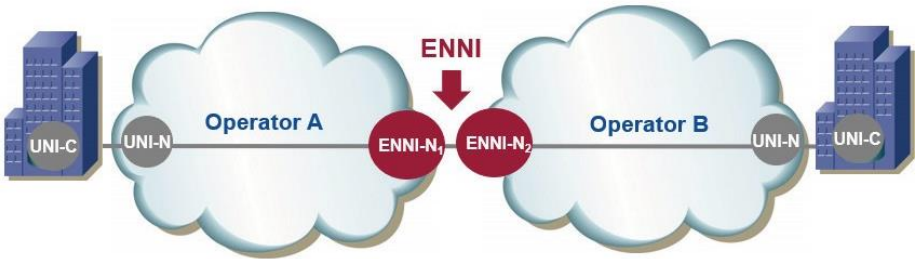
- ❑ ENNI: External Network to Network Interface
- ❑ ENNI is the demarcation point between between two network operators
- ❑ ENNI-Ns provide the functionality required to support the protocols and capabilities for the ENNI interface
- ❑ ENNI Frames are exchanged between ENNI-N_1 and ENNI-N_2

General OVC Services Definitions

❑ An Operator Virtual Connection (OVC) is the building block for constructing an EVC spanning multiple Operator MENs

❑ Several General OVC services are defined in MEF 51

O-Line Services
Point-to-point OVC

O-LAN Services
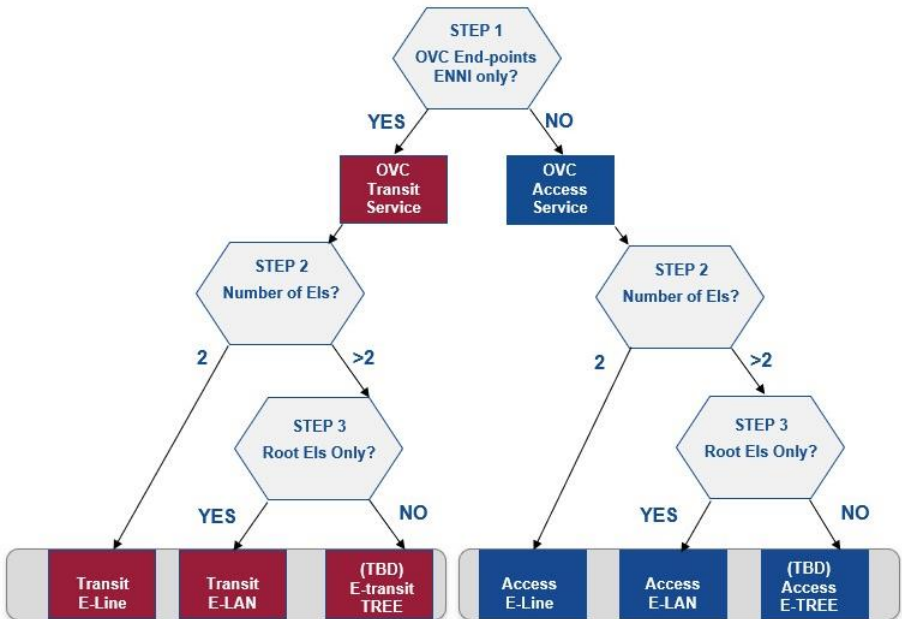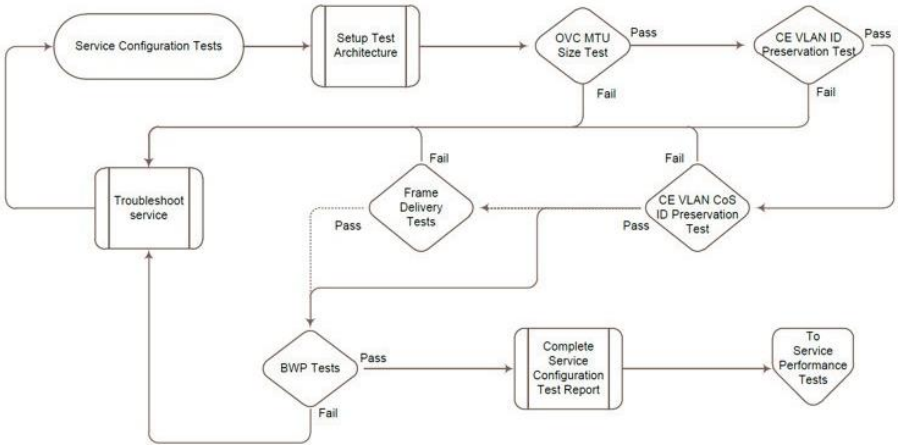Multipoint-to-multipoint OVC
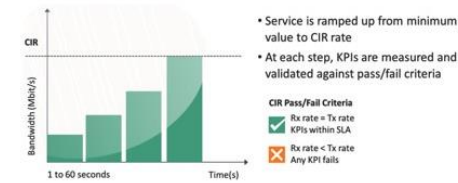
O-Tree Services
Rooted-multipoint OVC

OVC Service Computer

Service Activation Configuration Test Flow

Service Configuration Testing
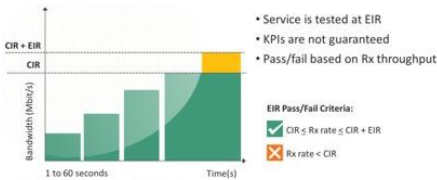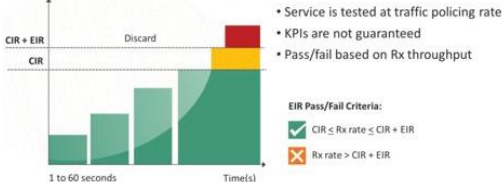
Service Activation Performance Test Flow
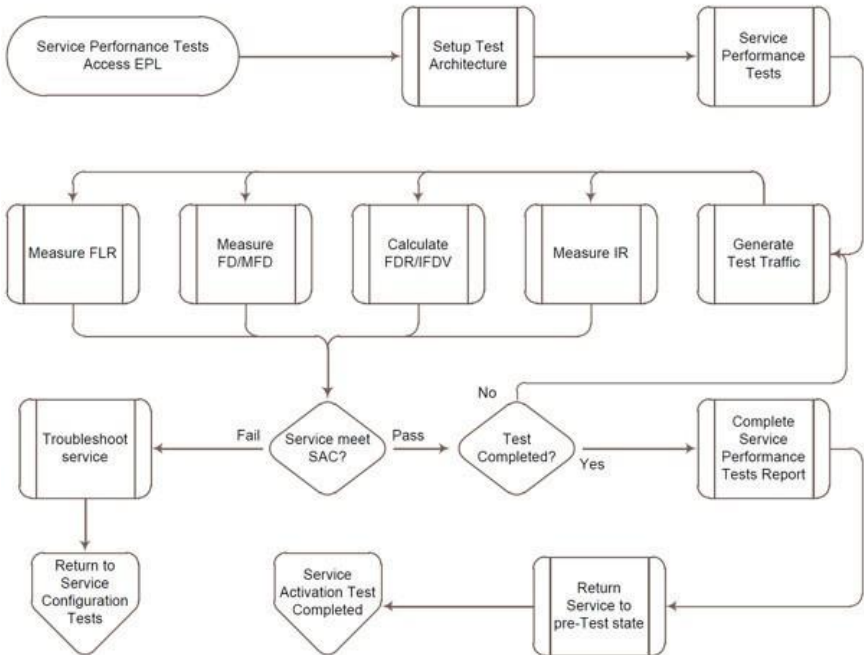
Service Performance Testing

❑ Tests are executed over a longer period: 15 min to 24 hours. The goal of that phase is to ensure that all services can be simultaneously activated and achieve Committed Information Rate while meeting all performance KPIs, thus meeting the SLS for each services.

❑ The tests are run using a single frame size, or a pattern of up to 8 frames, with varying standard sizes.

-15-
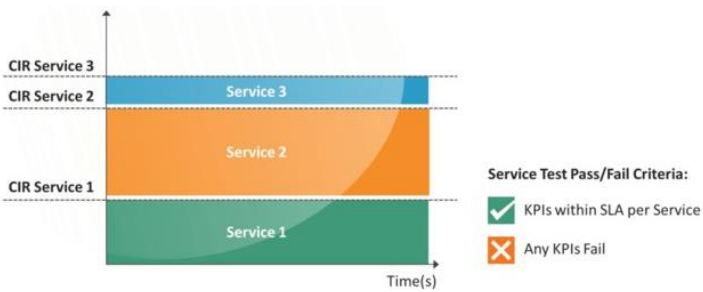
S-OAM Maintenance Entity Groups

MEG	Suggested Use	Default Level
Subscriber MEG	Subscriber monitoring of an Ethernet service	6
Test MEG	Service Provider isolation of subscriber reported problems	5
EVC MEG	Service Provider monitoring of provided service	4
Service Provider MEG	Service Provider Monitoring of Service Provider network	3
Operator MEG	Network Operator monitoring of the portion of a network	2
UNI MEG	Service Provider monitoring of a UNI	1
ENNI MEG	Network Operators' monitoring of an ENNI	1
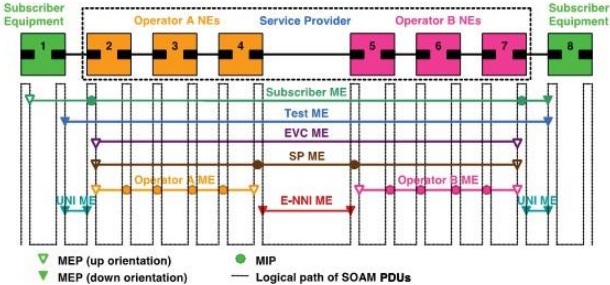
Service OAM FM Messages
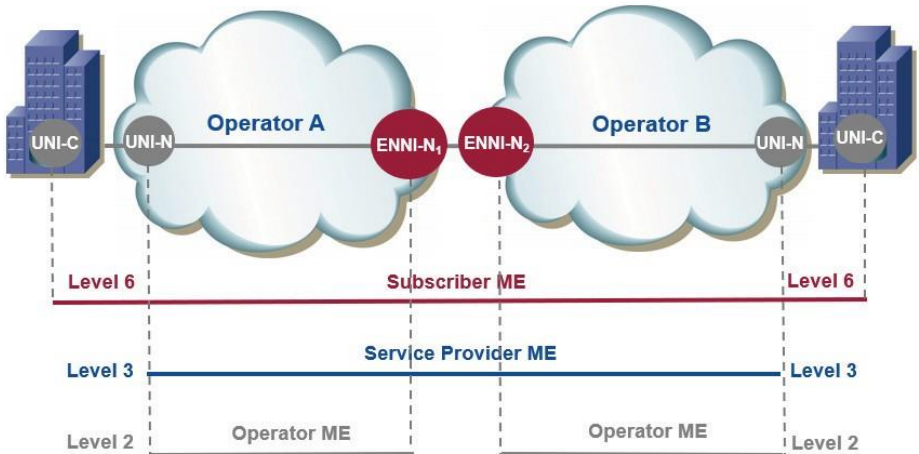
- ❏ Continuity Check Message (CCM) - Continuous service verification
- ❏ Ethernet Loopback (LBM/LBR) - Layer 2 version of IP Ping
- ❏ Ethernet Linktrace (LTM/LTR) - Layer 2 version of Traceroute

Service OAM PM Messages

PM Function	ITU-T PM Tool	ITU-T PDUs
Single-Ended Delay	ITU-T Two-way ETH-DM	DMM / DMR
Single-Ended Synthetic Loss	ITU-T Single-Ended ETH-SLM	SLM / SLR
Dual-Ended Delay	ITU-T One-way ETH-DM	1DM
Single-Ended Service Loss	ITU-T Single-Ended ETH-LM	LMM / LMR

Single-Ended Functions

Controller MEP → Responder MEP

Dual-Ended Delay Functions

Controller MEP → Sink MEP

Sink MEP ← Controller MEP

Requires time of day synchronization

Acronym Guide

Term	Abbrev.	Definition
Access Ethernet Private Line	Access EPL	Access EPL service uses a Point-to-Point OVC to associate one OVC End Point at a UNI and one OVC End Point at an ENNI. One UNI can support only a single instance of the Access EPL service.
Access Ethernet Virtual Private Line	Access EVPL	Access EVPL service uses a Point-to-Point OVC to associate one OVC End Point at a UNI and one OVC End Point at an ENNI. One UNI can support one or more Access EVPL instances.
Access Provider	AP	An Operator MEN that offers the Ethernet Access Service type.
Access Services	AS	Access Line or Access LAN Services as defined in MEF 51. An OVC that includes at least one UNI. See also O-Line and O-LAN
Bandwidth Profile	BWP	A Bandwidth Profile is a characterization of the lengths and arrival times for Service Frames at a reference point. See also IR - Information Rate
Bandwidth profile per CoS ID		A bandwidth profile applied on a per-Class of Service basis.
Bandwidth profile per OVC Endpoint		A bandwidth profile applied on a per-OVC Endpoint basis.
Bandwidth profile per UNI		A bandwidth profile applied on a per-UNI basis.
Bandwidth profile per EEC		A bandwidth profile applied on a per Egress Equivalency Class which replaces per EVC and per CoS
Bridge PDU or Spanning Tree BPDU	BPDU	This are the protocol messages exchanged by bridges that implement one of the spanning tree protocols (see STP and PDU)
Broadcast Service Frame		A Service Frame that has the broadcast destination MAC address.
Circuit Emulation Services	CES	A technique for transporting and emulating the characteristics of a TDM service such as T1/E1, T3/E3, and SONET/SDH on an asynchronous data network such as ATM, MPLS, or Ethernet.

Term	Abbrev.	Definition
Circuit Emulation Services over Ethernet	CESoETH	Performing CES over an Ethernet (or Carrier Ethernet) network.
Carrier Ethernet Network	CEN	Carrier Ethernet Network. See also MEN
CE-VLAN CoS ID		Customer Edge VLAN CoS. Also C-tag PCP.
CE-VLAN CoS ID Value Preservation (OVC)		CE-VLAN CoS ID Value Preservation describes a relationship between the format and certain field values of the frame at one External Interface and of the corresponding frame at another External Interface
CE-VLAN ID		Customer Edge VLAN ID
CE-VLAN ID Preservation (OVC)		CE-VLAN ID Preservation describes a relationship between the format and certain field values of the frame at one External Interface and of the corresponding frame at another External Interface
OVC End Point Map at the UNI		An association of CE-VLAN IDs with OVCs at a UNI.
CE-VLAN Tag		Customer Edge VLAN Tag
Class of Service Frame Set	CoS	A set of Service Frames that have a commitment from the Service Provider subject to a particular set of performance objectives.
Class of Service Identifier for Service Frames (UNI)		The mechanism and/or values of the mechanism to be used to identify the CoS Name that applies to the frame at a given UNI.
Class of Service Identifier for ENNI Frames (ENNI)		The mechanism and/or values of the parameters in the mechanism to be used to identify the CoS Name that applies to the frame at a given ENNI that maps to an OVC End Point.
Class of Service Frame Set		A set of Service or ENNI Frames that have a commitment from the Operator or Service Provider subject to a particular set of performance objectives.

Term	Abbrev.	Definition
Committed Burst Size	CBS	CBS is a Bandwidth Profile parameter. It limits the maximum number of bytes available for a burst of Frames sent at the EI speed to remain CIR-conformant. The CBS determines the amount of tokens in the committed token bucket. The minimum value is one MFS (1522 bytes at the UNI, 1526 at the ENNI)
Committed Information Rate	CIR	CIR is a Bandwidth Profile parameter. It defines the average rate in bits/s of Frames at an EI up to which the network delivers Frames, and is committed to meeting the performance objectives defined by the CoS Service Attribute.
Coupling Flag	CF	CF is a Bandwidth Profile parameter. The Coupling Flag allows the choice between two modes of operation of the rate enforcement algorithm. It takes a value of 0 or 1 only. In a Color-Aware bandwidth profile, the CF enables coupling all tokens together in order to use all tokens including green tokens to forward frames, (Green or Yellos).
Customer Edge	CE	Equipment on the Subscriber side of the UNI.
Customer Edge VLAN CoS		The Priority Code Point bits in the IEEE 802.1Q Customer VLAN Tag in a Service Frame that is either tagged or priority tagged.
Customer Edge VLAN ID		The identifier derivable from the content of a Service Frame that allows the Service Frame to be associated with an EVC at the UNI.
Discard Eligibility Indicator	DEI	A bit in the CE-VLAN and S-VLAN tags that can be used to indicate that a frame has been colored yellow by a Bandwidth Profile.
Data Over Cable Service Interface Specification	DOCSIS	An international telecommunications standard that permits the addition of high-speed data transfer to an existing cable TV (CATV) system. It is employed by many cable television operators to provide Internet access over their existing hybrid fiber-coaxial (HFC) infrastructure.
Data Terminal Equipment	DTE	In traditional data communications the data processing (computer) equipment that terminates a communication path is the DTE. Traditionally, the DTE connects to the transmission channel through a Data Communications Equipment (DCE). A modem was a DCE. With Ethernet, the DTE connects directly to the channel and therefore there is no DCE, communication is DTE to DTE.

Term	Abbrev.	Definition
Dual Ended		A procedure where frame delay or loss measurement frames are sent to the peer-MEP and returned. See also Round-trip measurement.
Ethernet Delay Measurement	ETH-DM	Ethernet Delay Measurement. This Service OAM protocol sends Delay Measurement Messages to measure the delay/latency of Ethenret frames in a Carrier Ethernet Network. ETH-DM uses DMM and DMR messages.
Ethernet Delay Measurement Message	DMM	Ethernet Delay Measurement Message. Single-Ended Delay Measurement Messages sent from the Controller Maintenance End Point (MEP) to the Responder to measure the delay/latency of Ethenret frames in a Carrier Ethernet Network
Ethernet Delay Measurement Reply	DMR	Ethernet Delay Measurement Reply. Single-Ended Delay Measurement Replies sent back from the Responder Maintenance End Point (MEP) to the Controller MEP to measure the delay/latency of Ethenret frames in a Carrier Ethernet Network
Ethernet One-Way Delay Measurement	ETH-DM	Ethernet Delay Measurement. This Service OAM protocol sends Delay Measurement Messages to measure the delay/latency of Ethenret frames in a Carrier Ethernet Network. ETH-DM uses DMM and DMR messages.
Ethernet Delay Measurement Message	1DM	Ethernet One-Way Delay Measurement Message. Dual-Ended Delay Measurement Messages sent from the Controller Maintenance End Point (MEP) to the Sink MEP to measure the delay/latency of Ethenret frames in a Carrier Ethernet Network
Ethernet Loss Measurement	ETH-LM	Ethernet Loss Measurement. This Service OAM protocol sends Loss Measurement Messages to measure the frame loss in a Carrier Ethernet Network. ETH-LMM and ETH-LMR
Ethernet Loss Measurement Message	LMM	Ethernet Loss Measurement Message. Single-Ended Loss Measurement Messages sent from the Controller Maintenance End Point (MEP) to the Responder to measure the Loss of Ethernet service frames in a Carrier Ethernet Network. LMM uses LIVE customer traffic to
Ethernet Loss Measurement Reply	LMR	Ethernet Loss Measurement Reply. Single-Ended Loss Measurement Replies sent back from the Responder Maintenance End Point (MEP) to the Controller MEP to measure the Loss of Ethenret frames in a Carrier Ethernet Network
Ethernet Synthentic Loss Measurement	ETH-SLM	Ethernet Synthetic Loss Measurement Message. Single-Ended Loss Measurement Messages sent from the Controller Maintenance End Point (MEP) to the Responder to measure the Loss of Ethernet service frames in a Carrier Ethernet Network. SLM uses synthetic frames similar to CCMs and DMMs

Term	Abbrev.	Definition
Ethernet Synthentic Loss Measurement Message	SLM	Ethernet Delay Measurement Message. Single-Ended Delay Measurement Messages sent from the Controller Maintenance End Point (MEP) to the Responder to measure the delay/latency of Ethenret frames in a Carrier Ethernet Network
Ethernet Synthentic Loss Measurement Reply	SLR	Ethernet Synthic Loss Measurement Reply. Single-Ended Loss Measurement Replies sent back from the Responder Maintenance End Point (MEP) to the Controller MEP to measure the loss of Ethenret frames in a Carrier Ethernet Network
E-Access Service Type	E-Access	Ethernet services that use an OVC with at least one UNI OVC End Point and one ENNI OVC End Point.
Egress Bandwidth Profile		A service attribute that specifies the length and arrival time characteristics of egress Frames at the egress EI.
Egress Service Frame		A Service Frame sent from within a MEN to an EI.
E-LAN Service	E-LAN	An Ethernet service type that is based on a Multipoint-to- Multipoint EVC.
E-Line Service	E-LINE	An Ethernet service type that is based on a Point-to-Point EVC.
Ethernet Private Line	EPL	Ethernet Private Line. A point to point Ethernet service designed to replace legacy T1/E1 leased line services
EMIX		Provisions for generating a statistically relevant distribution of Ethernet frame sizes during the testing of an Ethernet Service Activation Test (SAT).
ENNI		External Network-to-Network Interface - A reference point representing the boundary between two Operator MENs that are operated as separate administrative domains
ENNI Frame		The first bit of the Destination Address to the last bit of the Frame Check Sequence of the Ethernet Frame transmitted across the ENNI
ENNI MTU		MTU of an ENNI frame at the ENNI
E-Tree Service		An Ethernet service type that is based on a Rooted-Multipoint EVC.

Term	Abbrev.	Definition
Ethernet Access Provider		Operator of the MEN providing the OVC-based Ethernet service between a UNI and an ENNI.
Ethernet Virtual Connection	EVC	An association of two or more UNIs that limits the exchange of Service Frames to UNIs in the Ethernet Virtual Connection.
EVC MTU Size		The maximum sized Service Frame allowed for an EVC.
EVPL		Ethernet Virtual Private Line
Excess Burst Size	EBS	EBS is a Bandwidth Profile parameter. It limits the maximum number of bytes available for a burst of Frames sent at the EI speed to remain EIR-conformant.The CBS determines the amount of tokens in the excess token bucket. The minimum value is one MFS (1522 bytes at the UNI, 1526 at the ENNI)
Excess Information Rate	EIR	EIR is a Bandwidth Profile parameter. It defines the average rate in bits/s of Frames up to which the network may deliver Frames but without any performance objectives.
External Interface	EI	Either a UNI or an ENNI
Ethernet Test Equipment	ETE	Equipment capable of generating Ethernet test frames (Y.1731 FD or FL)
Ethernet Test Equipment Application	ETE-A	Networking equipment capable of generating Ethernet test frames as part of an integrated management function of the device.
Ethernet Test Equipment Instrument	ETE-I	Special purpose Ethernet Test Equipment that functions solely for running Ethernet service tests. See also Ethernet Equipment Test Head.
Ethernet Test Equipment Test Head	ETE-TH	Ethernet Test Equipment that can be deployed centrally to provide Ethernet test frame generation for multiple Ethernet test points.
Frame		Short for Ethernet Frame

Term	Abbrev.	Definition
Frame Delay	FD	The time elapsed from the reception of the first bit of the ingress frame at EI1 until the transmission of the last bit of the corresponding egress frame at EI2 .
Frame Delay Range	FDR	The difference between the observed percentile of delay at a target percentile and the observed minimum delay for the set of frames in interval T.
Frame Delay Performance		A measure of the delays experienced by different Service or ENNI Frames belonging to the same CoS Frame Set.
Frame Delay Range Performance		A measure of the extent of delay variability experienced by different Service or ENNI Frames belonging to the same CoS Frame Set.
Frame Loss Ratio Performance	FLR	Frame Loss Ratio is a measure of the number of lost frames between the ingress EI1 and the egress EI2 . Frame Loss Ratio is expressed as a percentage.
Ingress Bandwidth Profile		A characterization of ingress Frame arrival times and lengths at the ingress EI and a specification of disposition of each Frame based on its level of compliance with the characterization.
Ingress Service Frame		A Service Frame sent from an EI into the Service Provider network.
Inter-Frame Delay Variation	IFDV	The difference in delay of two Service or ENNI Frames belonging to the same CoS Frame Set.
Inter-Frame Delay Variation Performance		A measure of the variation in the delays experienced by different Service or ENNI Frames belonging to the same CoS Frame Set.
IR - Information Rate	IR	The amount of data forwarded across an interface (Y.1564). The maximum bandwidth configured on an interface.
Layer 2 Control Protocol Service Frame	L2CP Frame	A Service Frame that is used for Layer 2 control, e.g., Spanning Tree Protocol.
Layer 2 Control Protocol Tunneling		The process by which a Layer 2 Control Protocol Service Frame is passed through the Service Provider network without being processed and is delivered unchanged to the proper UNI(s).

Term	Abbrev.	Definition
Media Access Control	MAC	A sublayer of the Datalink Layer (layer 2 in the ISO Model). For Ethernet, the MAC layer includes the definition of the Ethernet frame structure, the format for Ethernet station address (known as MAC addresses), and the channel access protocol (CSMA/CD).
MAC Address		An Ethernet Station Address (6 Bytes)
Maintenance Entity (Group)	ME/MEG	An association of two or more S-OAM Maintenance End Points (MEPs)
Maintenance Entity Group End Point	MEP	An end point of an S-OAM Maintenance Entity Group. MEPs can intiate and respond to S-OAM commands.
Maintenance Entity Group End Point	MIP	Any Intermediate Maintenance Point configured on the same OAM level between two MEPs in a MEG
Maximum Number of OVCs per UNI		The maximum number of OVCs that may be on a UNI.
Maximum Number of CE-VLAN IDs per OVC		An integer that indicates the quantity of CE-VLANs that can be mapped to a single OVC at that UNI. A value = 1 indicates that UNI can only map single CE-VLANs to an OVC. A value > 1 indicates that up to that limit can be mapped to a single OVC.
Mean Frame Delay Performance	MFD	The arithmetic mean, or average of delays experienced by different Service or ENNI Frames belonging to the same CoS Frame Set.
MEN	MEN	Metro Ethernet Network
Metro Ethernet Network		The Service Provider's network providing Ethernet services. Synonomous with Carrier Ethernet Network (CEN)
Maximum Transmission Unit	MTU	The maximum sized Service Frame allowed for an Ethernet service.
Multicast Service Frame		A Service Frame that has a multicast destination MAC address.

Term	Abbrev.	Definition
Multipoint-to- Multipoint EVC		An EVC with two or more UNIs. A Multipoint-to-Multipoint EVC with two UNIs is different from a Point-to-Point EVC because one or more additional UNIs can be added to it.
Multi-System Operator	MSO	An operator of multiple cable or direct-broadcast satellite television systems.
Operations, Adminstrations and Maintenance	OAM	A suite of network management functions and tools for troubleshooting and measuring the service performance of Ethernet services
Service Operations, Adminstrations and Maintenance	S-OAM	A suite of network management functions and tools for troubleshooting and measuring the service performance of Ethernet services
Service Operations, Adminstrations and Maintenance Fault Management	S-OAM FM	A suite of network management functions and tools for troubleshooting Ethernet services
Service Operations, Adminstrations and Maintenance Performance Management	S-OAM PM	A suite of network management functions and tools for measuring the performance of Ethernet services
Operator Virtual Connection	OVC	Operator Virtual Connection, an association of OVC End Points
OVC End Point	OEP	An association of an OVC with a specific External Interface i.e., UNI, ENNI
OVC Identifier		string that is unique among all OVCs in the Operator MEN
N/A		Not Applicable
N/S		Not Specified
Protocol Data Unit	PDU	Information that is delivered as a unit among peer entities of a network and that may contain control information, such as address information, or user data (from Wikipedia). A PDU is the "message" that is exchanged between peer entities in a network. For example, spanning tree bridges exchange BPDUs.

Term	Abbrev.	Definition
Point-to-Point EVC		An EVC with exactly 2 UNIs.
Rooted-Multipoint EVC		A multipoint EVC in which each UNI is designated as either a Root or a Leaf. Ingress Service Frames at a Root UNI can be delivered to one or more of any of the other UNIs in the EVC. Ingress Service Frames at a Leaf UNI can only be delivered to one or more Root UNIs in the EVC.
Round-trip Measurement		A measrement procedure that sends measurement message frames to the peer-MEP which are returned. Enabling delay and loss measurements to be made without clock synchronization
Service Acceptance Crieria	SAC	A set of performance objectives that form the basis of service acceptance. They may be similar to the SLS objectives specified in the SLA, but don't have to match exactly
Service Activation Testing	SAT	A set of configuration and performance tests that are generated to verify connectivity and service performance prior to hand-off to the subscriber.
Service Frame		An Ethernet frame transmitted across the UNI toward the Service Provider or an Ethernet frame transmitted across the UNI toward the Subscriber.
Service Level Agreement	SLA	The contract between the Subscriber or Operator and Service Provider specifying the agreed to service level commitments and related business agreements.
Service Level Specification	SLS	The technical specification of the service level being offered by the Service Provider to the Subscriber or Operator. This is typically measured for each of the 8 metrics (FD, MFD, IFDV, FDR, LO, Availabilty, HLI, CHLI). The objectives for each are listed in MEF 23
Service Multiplexing		A UNI service attribute in which the UNI can be in more than one EVC instance.
Service Provider	SP	The organization providing UNI to UNI Ethernet Service(s).
Standards Developing Organization	SDO	Any organization whose primary activities are developing, coordinating, promulgating, revising, amending, reissuing, interpreting, or otherwise producing technical standards that are intended to address the needs of some relatively wide base of affected adopters. (source: Wikipedia)

Term	Abbrev.	Definition
Spanning Tree Protocol	STP	A protocol, originally specified in IEEE Std 802.1D to detect and disable loops in a bridged layer 2 (MAC-layer) network. STP also refers generically to the derivative protocols of the original Spanning Tree Protocol, RSTP, the Rapid Spanning Tree Protocol specified in the current revision of 802.1D and MSTP, the Multiple Spanning Tree Protocol, defined in IEEE Std 802.1Q.
Subscriber		The organization purchasing and/or using Ethernet Services.
S-Tag		Service VLAN Tag.
S-VLAN ID		The 12 bit VLAN ID field in the S-Tag of an ENNI Frame
Tag		An optional field in a frame header. In this document it is the 4- byte field that, when present in an Ethernet frame, appears immediately after the Source Address, or another tag in an Ethernet frame header and which consists of the 2-byte Tag Protocol Identification Field (TPID) which indicates S-Tag or C- Tag, and the 2-byte Tag Control Information field (TCI) which contains the 3-bit Priority Code Point, and the 12-bit VLAN ID field
UNI MTU Size		The maximum sized Service Frame allowed at the UNI.
Unicast Service Frame		A Service Frame that has a unicast destination MAC address.
User Network Interface	UNI	The physical demarcation point between the responsibility of the Service Provider and the responsibility of the Subscriber.
VLAN		Virtual LAN

MEF-CECP Expert Boot Camp

Course Overview

The Academy's MEF-CECP Boot Camp is a comprehensive, vendor-independent training course that covers all aspects of Carrier Ethernet and the MEF technical Ethernet services definitions. The course provides professionals in Information Communications Telecommunications (ICT) service providers or equipment vendor companies with the most advanced education available in the field of Carrier Ethernet.

The Academy's accelerated course will take you from novice to Carrier Ethernet expert in just a few fast-paced days. The course presents Carrier Ethernet from an application-oriented perspective, teaching you how to understand and apply Carrier Ethernet concepts and related technologies to:

- More effectively communicate and position your company's products and services

- Better understand your customers' specific applications and use cases

- Accurately specify solutions for the right Carrier Ethernet services to meet a variety of requirements

At the end of the course you'll have an expert level understanding of Carrier Ethernet concepts, MEF-defined services and interfaces and a solid basis for how these services are delivered using common Carrier Ethernet data networking technologies and protocols. You'll also be able to use the knowledge you gained in our Boot Camp your very first day back on the job.

Often imitated, but never duplicated, our highly successful formula has made The Academy the overwhelming choice for professionals looking to prepare for

the MEF-CECP exam. In fact, we've trained over 80% of the worldwide MEF-CECPs and our Alumni include the best and the brightest from the leading companies in the Carrier Ethernet industry.

The Academy's MEF-CECP Expert Boot Camp is available onsite, or at a publicly scheduled in-person, as well as via distance learning training sessions. We're also adding self-paced video lectures to our delivery methods.

Course Description

The Academy's MEF-CECP Expert Boot Camp course is designed for ICT professionals who work with Carrier Ethernet products and services. The course is focused on Carrier Ethernet and the technical work of MEF and is the best way to obtain expert level Carrier Ethernet knowledge and validate that expertise with the MEF-CECP certification.

Since we first began teaching the course to prepare students to pass the rigorous MEF-CECP certification, the course has evolved and been re-aligned with the on-going technical work of MEF. We've developed a formula for success that allows our faculty to cover the breadth of technical subjects on the exam concisely, so that after a few short

days of intense studying, our students are Carrier Ethernet experts and have the knowledge and confidence to pass the MEF-CECP exam the first time.
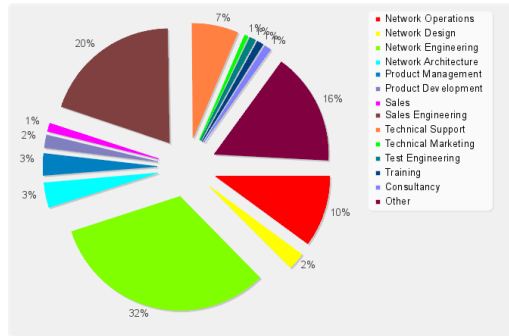
But beyond earning the certification, our graduates become Carrier Ethernet subject experts following the completion of the course and can make use of that knowledge immediately upon returning to work.

The MEF-CECP Expert Boot Camp provides comprehensive coverage on all the

subjects covered on the MEF-CECP exam including service definitions, interfaces, transport and access technologies, Service OAM, Circuit Emulation and MEF's CE certification programs—with course objectives that meet or exceed those required to pass the exam.

The accelerated course consists of instructor led lectures by highly experienced subject matter experts; interactive on-line quizzes that provide immediate feedback on students' mastery of the material; practical exercises designed to reinforce the theoretical concepts with real-world application; and a post course practice exam that provides students with a dress rehearsal for the MEF-CECP exam.
The course is taught by a faculty made exclusively of MEF veterans with years of experience working within the MEF's technical committee as well as companies actively involved in the development of Carrier Ethernet.

The MEF-CECP Expert Boot Camp course has been recently updated to cover all the MEF CE 3.0 subjects that were added to the latest MEF-CECP certification exam (detailed in Blueprint "D"). This includes coverage of the new wholesale service definitions from MEF 51, coverage of Service Activation Testing (SAT) from MEF 48 and expanded coverage of Phase 2 of the Service OAM Fault and Performance Management specifications from MEF 30 and 35.

Course Outline

Carrier Ethernet Overview

The introductory lecture gives some background on the transition to Ethernet in the Information Communications Technology (ICT) industry and explains Carrier Ethernet, following the evolution of MEF since its
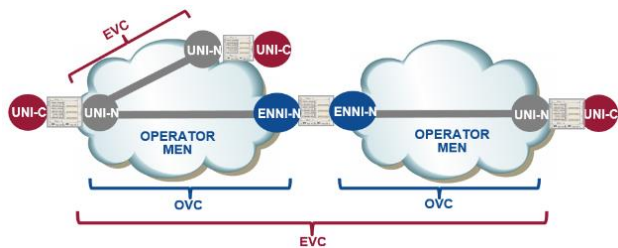
formation in 2001. It also provides a comprehensive overview of the MEF organization, technical committee processes along with a guide to the MEF's on-line and web resources. The lecture explains everything you've ever wanted to know about the MEF-CECP exam along with a strategy and timeline to successfully prepare and succeed on the exam, which is given at the end of the course.

## Module 1 - Carrier Ethernet EVC Service Definitions and the UNI Interface

This lecture begins with an introduction to networking basics and an explanation of Ethernet technical concepts, bridging and switching operations and a look at the Ethernet frame format. With an understanding of how Ethernet came to be invented, students will be able to follow Ethernet's evolution from a Local Area Networking (LAN) technology used in office and home environments to technology that powers global networks today.

It provides an in-depth analysis of the most important MEF technical specifications – including the latest versions of MEF 6 - MEF Ethernet Services Definitions standard, and MEF 10 - the Ethernet Virtual Connection (EVC) Attributes specifications. These technical specifications define the Carrier Ethernet Services types (E-Line, E-LAN and E-Tree), the attributes and parameters for each service, and form the basis for the Carrier Ethernet services being delivered around the world. Through in-depth review of these key documents, students will be able to understand and explain the characteristics and nuances of each service using precisely defined MEF terms.

Module 2 - Carrier Ethernet OVC Service Definitions and the ENNI Interface

This lecture is a detailed look at the MEF 26 - the MEF ENNI Interface, and MEF

51 - OVC-based Service Definition document. It covers both the External Network to Network Interface (ENNI) attributes
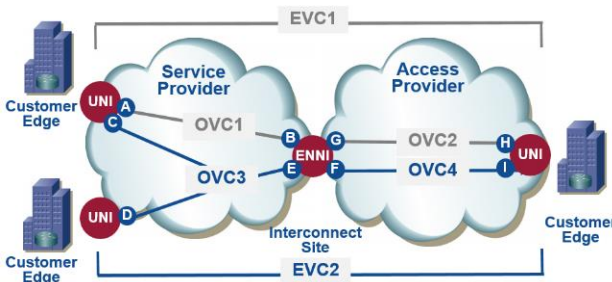
and capabilities for supporting interconnections between multi-operator networks. The module also introduces the MEF's standard Classes of Service (MEF 23) explaining the 3 class model, and demonstrates how performance tiers impact the class of service performance objectives for EVC and OVC delay and loss performance metrics.

Module 3 - Circuit Emulation, Synchronization and Mobile Backhaul

This lecture explains the interworking of Carrier Ethernet and legacy TDM services, explaining how TDM circuits can be transported over Carrier Ethernet Networks. It makes references to requirements and specifications produced by other standards organizations (notably the ITU-T, and IETF), and adapts these to address the specific requirements with respect to transport over Carrier Ethernet. This module also addresses the basics of network timing and synchronization and specific applications that require synchronization. Finally, we'll explore Carrier Ethernet for Mobile Backhaul—the most popular application for Carrier Ethernet.

Module 4 - Carrier Ethernet Service Activation Testing (SAT) and Service OAM Operations Administration and Maintenance
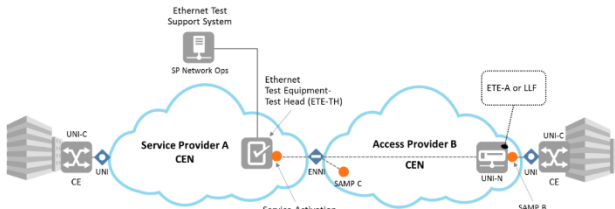

This lecture explains Service Activation Testing, and looks at the recent standards used to verify connectivity and performance across multi-operator networks. Ethernet service turn-up testing has historically lacked the consistency and diligence required to ensure the quality of the new service prior to customer hand-off. To address this, the MEF 48 SAT Implementation Agreement was developed. MEF 48 details all the mandatory and optional tests that can be performed using the ITU Y.1564 Ethernet Service Activation Measurement standard. Expertise in this recent and evolving Carrier Ethernet discipline can dramatically reduce provisioning mistakes, misunderstandings

and the frustration and customer (dis)satification that can arise from poor service turn-up and customer hand-off.

The lecture covers the management capabilities developed to troubleshoot and performance monitor Carrier Ethernet networks. Examining both Service OAM Fault Management (S-OAM FM) and Performance Management (S-OAM PM) capabilities. Looking

first at Service OAM architecture and components standardized by the IEEE 80-2.1 (CFM) connectivity fault management project and continues to explore the advanced performance monitoring recently standardized by the ITU Y.1731. Upon the completion of this lecture, students will have an expert level understanding of Ethernet Service Testing and Service OAM troubleshooting and monitoring techniques.
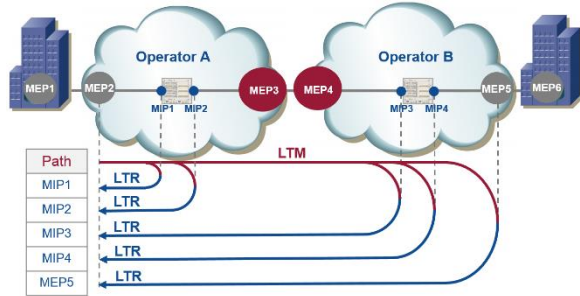
Module 5, 6 and 7 - Related Carrier Ethernet Access, Transport Technologies and MEF Certification Programs

This lecture covers the remaining material necessary to successfully master the MEF-CECP exam. As the exam has evolved over the past 10 years, these areas have gradually diminished in importance to make way for expanded coverage of things like Service Testing and OAM. So while there isn't a great emphasis on these areas, there does remain a number of questions students will need to understand in order to successful pass the MEF-CECP certification.

The lecture also goes beyond the work of MEF to survey related methods and technologies for transporting Carrier Ethernet services using modern, commonly used data networking architectures and protocols. Delivering Carrier Ethernet via networking standards defined by the IETF, IEEE and ITU-T will provide unique insight into real-world deployments of Carrier Ethernet. We'll next look at standards developed outside of MEF to deliver Carrier

Ethernet. Various methods for providing Ethernet access services over nearly any media will be surveyed and explained, highlighting their fit in specific deployment scenarios.

This final subject details the evolution from Carrier Ethernet 1.0 and certifications programs for equipment vendors and service providers to MEF 3.0. It provides information on the logistics requirements and on the different Carrier Ethernet Services available for certification in a lab environment for equipment vendors as well as in Service providers' production networks.

Module 8 - MEF-CECP Expert Boot Camp Course Review

This module combines the concepts and technologies covered in all the previous modules into a concise review of the critical components to fully prepare the students for the MEF-CECP exam. Using the MEF service definitions, Carrier Ethernet interface specifications and related technologies for Ethernet transport, and extending Ethernet into the access network, students will build a variety of Carrier Ethernet applications in an interactive capstone lab.

Take Your Career to the Next Level

The Academy's MEF-CECP Boot Camp is a comprehensive, vendor-independent training course that covers Carrier Ethernet and the MEF technical specifications. The course provides professionals Information Communications Telecommunications (ICT) providers or equipment vendor companies with the most advanced education in the field of Carrier Ethernet available anywhere! Upon completion of the MEF-CECP Boot Camp course students will be able to:

- Understand the MEF Carrier Ethernet services definitions for E-Line, E-LAN, E-Tree and E-Access Services and select a specific service to meet a given application scenario.

- Describe how Operations Administration and Maintenance (SOAM) techniques and tools for fault and performance management are used in Carrier Ethernet Networks.

- List the advantages of various Carrier Ethernet Access Technologies given a specific use case, and articulate the benefits and limitations of specific access technologies.

- Know the precise definitions and applications of UNI, EVC, ENNI and OVC in Carrier Ethernet networks and describe the relationships between the MEF defined external interfaces and connections.

- Understand UNI, ENNI, EVC and OVC service attributes and explain how they're used in combination to deliver an Ethernet service to meet a specific application requirement.

- Position MEF certification programs and be able to explain the benefits of the MEF Technology and Services certification program defined by MEF abstract test suites and by the Technical Foundation Document and Certification Blueprint for CE 2.0 and MEF 3.0.

- Demonstrate mastery of key service requirements for target Carrier Ethernet service applications (wholesale access, Ethernet access to IP, mobile backhaul, retail Ethernet services) and select specific service types and capabilities to meet the requirements of a given application scenario.

- Compare and position Carrier Ethernet services against layer 2 Frame Relay, IP/MPLS and TDM private line telecommunications services.

- Understand Circuit Emulation over Ethernet and describe the MEF recommendations for Ethernet services designed to carry legacy circuits over a Carrier Ethernet Network.

- Explain the MEF's Carrier Ethernet services and the specific documents that form the basis for the next generation of Carrier Ethernet.

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Exam Blueprint

Blueprint	Status	Start Date	End Date	Note
MEF-CECP Certification Exam Blueprint "A"	SUPERSEDED	Start of MEF-CECP	1-Dec-2013	
MEF-CECP Certification Exam Blueprint "B"	SUPERSEDED	2-Dec-2013	4-Oct-2015	
MEF-CECP Certification Exam Blueprint "C"	SUPERSEDED	5-Oct-2015	19-Mar-2018	
MEF-CECP Certification Exam Blueprint "D"	CURRENT	20-Mar-2018		

Carrier Ethernet Skills Discovery