

Course Description

Carriers have offered connectivity services based on traditional TDM, Frame Relay and ATM for many years. However customers now use Ethernet as the interface of choice for virtually all services and applications. The cost of operating separate networks to provide each service, as well as the need to sell higher bandwidth services than can be offered with traditional networks, is forcing carriers to move to newer, more cost effective technologies, namely Ethernet, Backbone Bridging, IP and MPLS.

Ethernet and IP have allowed networks to deliver high bandwidth and new services with greater flexibility, while MPLS has allowed these new services to become more "carrier-class", offering the connection-oriented behaviour, quality of service, and reliability normally associated with traditional technologies. However the signalling and routing costs of MPLS and layer 3 solutions have still been significant, which has lead to the development of other layer 2 Provider Backbone Transports (PBT) and Provider Backbone Bridging (PBB) solutions for small to medium scale carrier metro services.

The Metro Ethernet Forum has evolved a set of standard service definitions for the kinds of Ethernet services customers now require. These can deliver services between sites that look to customers like end to end Ethernet. For carriers they can emulate other traditional TDM services over the same infrastructure and deliver all services over a common unified network by adding Pseudo Wire Emulation edge to edge (PWE3).

This course provides an in-depth look at carrier Ethernet technologies, the Metro Ethernet Forum specifications for services and how these can be delivered over carrier core networks along with other services deployed over PWE3.

Students Will Learn

- **Identify How To Build Networks To Deliver Metro Ethernet Services**
- **Relate The Importance Of Metro Ethernet Switching To Service-Provider Markets**
- **Describe How Ethernet Services Can Be Delivered Over MPLS And Provider Backbone Transports**
- **Describe, Configure, And Troubleshoot Metro Ethernet Deployment Solutions**
- **Compare Operational Alternatives For Service Delivery, Metro And Core Architecture**
- **Examine Options For Delivery Of Next Generation Services Over Metro Ethernet**
- **Identify The Equipment And Solutions That Would Best Fit In Given Customer Scenarios**
- **Identify How Qos And Security Can Be Guaranteed**
- **Provision Metro Ethernet Switching Equipment With The Circuits Required To Support Various**
- **Service Models Across The Classroom**
- **Test And Troubleshoot Configurations**

Target Audience

Individuals who design Metro Ethernet Switching solutions for service providers, who implement end-to-end Metro Ethernet Switching services, who deploy networks using Metro Ethernet Switching services and anyone interested in Metro Ethernet.

Prerequisites

Attendees should have a good understanding of IP and WAN principles. They should also understand the basics of Next Generation Networks.

Course Outline

Module I: Next Generation Carrier Network Requirements

- What services carriers need from their infrastructure
- Bandwidth for services
- Customer Interfaces
- Carrier Network Interfaces
- QoS and Protection for Service Level Agreements
- Evolution mechanisms for service development
- Services to be delivered
- Migration of existing TDM using emulation
- Business Ethernet LAN services
- Customer VLAN
- VoIP, IPTV and Triple Play
- Quality and Protection Demands
- Mechanisms for protection
- Aggregation
- Ring switching
- Access and Core divisions
- Requirements for the access
- Requirements for the core
- Aggregation network
- User Network Interface (UNI)
- User interface requirements
- Private networking needs: at layer 2 and/or Layer 3
- Security and isolation
- Service models
- Management
- Mechanisms for Management
- Management protocols and services
- Automatic capability discovery

Module II: Customer Private Service Needs

- Virtual Network Services
- What are virtualised services?
- Why are they required?
- Topology needs
- Topology reliability
- Designing for Service Levels
- Point to point services using Pseudo Wires
- IETF Pseudowire Emulation Edge to Edge (PWE3)
- Key RFCs
- Metro Ethernet Forum Service Definitions
- MEF standards
- What are the MEF Standards?
- MEF 6.1
- MEF 10.1 and 10.2
- Ethernet Service Attributes
- Virtual LANs
- Emulated LAN using multipoint services
- E-Line Services for Point to Point
- E-LAN MultiPoint to MultiPoint
- Physical Interfaces
- Traffic Parameters
- Classes of Service
- Models for carrier services
- Control Plane vs Data plane
- Requirements for requested QoS and Protection

Module III: Carrier Ethernet Primer

- Ethernet Speed Evolution to 10Gbit/s and beyond
- How Ethernet Evolved
- Evolution from 10 Mbit/s LAN to Gigabit Ethernet
- Impact of Optical transmission
- Removing the distance limitations
- Ethernet switching
- Bridging functions
- Learning Bridges
- Removing Loops
- 802.1d Spanning Tree and Rapid Spanning Tree
- Ethernet Addressing
- Address characteristics
- Routability of address structures
- Problems with MAC address Tables
- How MAC addresses are used
- ARP and IP
- Limiting MAC address table sizes
- Mac-in-Mac solutions
- Multicasting
- IGMP
- Multicasting over Ethernet
- Mechanisms for signalling Ethernet characteristics

GARP and GMRP
Tag Headers
IEEE802.1Q VLANs
GVRP
Overcoming the VLAN limit
Using VLANs within customer environments
VLANs in Carrier Environments
Service Separation
Impacts on Security
What limits the number of VLANs
Scaling Services
Q-in-Q solutions
Provider Layer 2 VPN Solutions Options
Provider Backbone Bridging
IEEE 802.1ad
Delivering Provider Backbone Transport
IEEE 802.1ah

Module IV: Delivering Quality of Service in Carrier Environments QoS Motivations

Analysing What Identifies QoS
Bandwidth
Delay
Delay variation
Availability
Access to Service Features
Delivering Bandwidth and Delay
Understanding Queues
Impact of queuing on Jitter and packet loss
Traffic Shaping Mechanisms to control queues
Sizing for Service quality
QoS Signalling
Exploiting Tag Headers for QoS
Mapping QoS across the Transport network
IEEE802.1P/Q
Layer 2 vs Layer 3 QoS
Differentiated Services

Module V: Aggregation and Protection Understanding Reliability and Availability MTF and MTTR

Calculating Availability
Impact of Redundancy
Independence of Services
Mechanisms for Improving Reliability
Topology considerations
Mesh
Ring
Trees
Ethernet Rapid Packet Ring (RPR)
Ring Resilience protocol (RRP)
Comparing Layers 1, 2 and 3 protection
Physical switching

- Layer 2 switching
- Layer 3 rerouting
- Ethernet Aggregation
- 802.3ad Aggregation and Bridging
- Aggregation groups
- Aggregation for bandwidth improvement
- Protection using Aggregated Services
- Example aggregation network applications
- IPTV service protection
- Aggregation for bandwidth increase
- Ethernet Rings
- Delivering reliability for Service Level Agreements

Module VI: MPLS Primer

- Delivering High Performance Core Services
- The Key Core Objectives
- Scaling the problems of routing
- Routing vs switching in the core
- Cache Sizes
- Label switching concepts
- What is a label?
- Normal hop-by-hop routing
- Creation of Labels
- Distribution of Labels
- Function of Label switching
- Forward Equivalence Class (FEC)
- Label Edge Switches
- Label Distribution Protocol
- Explicit routed Label Switched Paths
- Constraint routed Label Switched Paths
- Traffic Engineering
- Fast Rerouting

Module VII: Metro Ethernet Service Solutions

- Service Signalling concepts
- Virtual Private Wire Services
- Requirements for Pseudo-Wire Emulation Edge-to-Edge (PWE3)
- RFC 3916
- Carrying TDM Legacy Traffic
- RFC 4197 Emulation of TDM over PWE3
- RFC 4553 Structure-Agnostic Time Division Multiplexing (TDM) over Packet (SAToP)
- MEF Service Control Word Signalling
- MAC address Learning
- Hierarchical Services
- Deployment over LDP
- Generalized Pwid FEC
- Learning Actions
- MAC address withdrawal
- Scalability
- Routing Issues for Carrier Deployment

- Control Plane and Auto Discovery
- Delivering QoS
- Ingress Bandwidth Profiling
- Egress Bandwidth Profiling
- Deploying DiffServ and CE-VLAN CoS using 802.1p
- CE-VLAN Services
- Service Attributes and Parameters
- Securing the Service
- Multicasting over VPLS
- IGMP
- IGMP snooping
- Triple-Play Solutions

Module VIII: Deploying Services in Existing Networks

- Scaling Issues
- Service Level Agreements
- MTU issues
- Operations, Administration and Management
- IEEE 802.1ag and ITU Y.1731 Management solutions
- Ethernet Service Definitions

Evaluation and Review

Delivery Method

Hands-On Instructor-Led with numerous Labs and activities.

Equipment Requirements

(This apply's to our hands-on courses only)

BTS always provides equipment to have a very successful Hands-On course. BTS also encourages all attendees to bring their own equipment to the course. This will provide attendees the opportunity to incorporate their own gear into the labs and gain valuable training using their specific equipment.

Course Length

4 Days