MPLS Networks: Design and Routing Functions

Course Description

This course provides an understanding of how MPLS works its advantages and limitations and how it can be deployed to provide effective services over a 21st Century converged network. It will provide a detailed understanding for implementers, designers, managers and infrastructure engineers that need to plan, implement and use the new generation of networks and services.

The next generation of telecommunications networks will deliver broadband data and multimedia services to users. The Ethernet interface is becoming the interface of preference for user computers, IP Phones, Digital IP Television and network servers within the network itself. The network infrastructure will deliver these high performance IP services over Switched infrastructures deployed using Multi-Protocol Label Switching (MPLS) running over carrier grade optical Ethernet..

MPLS is a radically new approach to delivering IP services and must be built on an IP routed infrastructure. However by deploying switching hardware it becomes possible to deliver quality of service by bypassing queues in routing functions and switching essentially in OSI layer 2. Once constructed, MPLS networks can be used to deliver emulation services. These provide customers with more traditional circuits provisioned over interfaces such as E1, Frame Relay and STM1 which in reality are delivered as emulated services over MPLS running over Gigabit Ethernet infrastructures.

This course will provide technical and engineering staff a working introduction to how MPLS can be used to deploy services in Next Generation Networks.

Students Will Learn

- **Describe The Basic Function Of MPLS**
- **Appreciate Different Options Available For Label Distribution**
- **Select The Appropriate Options And Mechanisms For Label Distribution**
- **Compare The Efficiency Of Routed And MPLS Switched Options For Qos Networks**
- **Build Infrastructures Using MPLS Over Different Physical Infrastructures**
- **Provide Reliability By Deploying The Re-Routing Options In The Event Of Failures**
- **Deliver High Bandwidth MPLS Services For OSPF And BGP4 Routed Networks**
- **Engineer Traffic On MPLS Services**
- **Provide Emulated Services Over MPLS Infrastructures**
- **And More...**

Target Audience

An Overview for Engineering and Design Professionals

Course Outline

Module I: Evolution of Multi-Service Telecommunications Networks

Business environment for 21st Century Networks

Projecting the near future demands for services

Delivering Multimedia Services for Voice, Video and Television

Identifying the Quality of Service (QoS) needs

Analysing the problems with traditional IP routed Services

Technology Trends

Module II: MPLS Basics

What exactly is MPLS?

Identifying the characteristics of simple Plain Vanilla MPLS Services

Label Switched Routers

Ingress and Egress Label Edge Routers

Forward Equivalent Classes

Label Switched Paths

Selecting the Label headers appropriate to the technology

Distributing Labels with Label Distribution Protocol (LDP)

MPLS Labels: encapsulation, assignment, distribution

Upstream and downstream LSR

VPN L3, VRF, Route Target and Route Distinguishers

Comparing traffic patterns in routed and MPLS switched networks

Module III: Stacking Labels for Service Discrimination

Multi-Service Provisioning

Mechanisms used in networks and their problems

Deploying Label Stacking for identification of Services

Tunnelling VPN services

Delivering Transit Networks Services

Module IV: Gigabit Ethernet for Carrier Service

Evolution of Ethernet

Standardization: IEEE, ITU, Metro-Ethernet Forum

802.3 standard for Gigabit Carrier services

Ethernet in the First Mile

802.1 Baggy pants Model

Rapid Spanning tree

Delivering High Bandwidth and reliability with Aggregation

GARP

Multicasting over Ethernet

GMRP

Carrier Ethernet Design Options: Q in Q, MAC in MAC, Provider Backbone Bridging

GVRP

Module V: Pseudo Wire Services

Carrier Circuit Services

Edge to Edge Circuits

Pseudo-Wire Standardization

Requirements for PWE3 Pseudo-Wire Edge to Edge: RFC 3916

PWE3 Architecture RFC 3985

Edge-to-Edge Emulation of TDM RFC 4197

Edge-to-Edge Emulation Control Word over MPLS RFC 4385

IANA Allocations RFC 4446

Pseudowire Setup and Maintenance of LDP RFC 4447

Structure Agnostic TDM over Packet RFC 4553

PWE3 Fragmentation and Reassembly RFC 4623

Encapsulation Methods for :

Ethernet Over MPLS RFC 4448

Frame Relay RFC RFC 4619

PPP/HDLC RFC 4618

PWE3 Management MIBs

Module VI: Quality of Service Options in MPLS Networks

Introduction to Quality of Service: What is Quality and What is Service?

Defining the objectives of QoS

QoS Options and Metrics

Selecting Between Multiple QoS Paths

Deploying QoS using Class of Service and Experimental bits

Explicitly Routed LSP

RSVP for QoS

Constraint Based Label Switched Paths

Module VII: Deploying QoS and Differentiated Services

Delivering QoS using Differentiated Services Code Points within IP

Forwarding Models for Diff-Serv Label Switched Routers

Tunnelling model

Pipe Model

Uniform Model

Preconfigured Explicit Label Switched Paths

RSVP Extensions for Diff-Serv support

Intserv Service types

Module VIII: Delivering Reliability

Fault Tolerance objectives for MPLS

Establishing a Fault Tolerant Session with LDP

Recovering Failed LDP Sessions

Check-pointing and graceful termination

Fast rerouting Alternatives

Security Considerations

Implementation Issues

Module IX: Delivering Quality In Practice

Conditions affecting QoS in Practice

Sporadicity

Queue Management Issues

Input and Output queues

Flow Based Queues

Class based Queues

Weighted Fair Queuing

Random Early Determination

Module X: Virtual Private Services

Virtual private LAN Service (VPLS) RFC 4665 and 4664

VPLS using LDP RFC 4762

Ethernet Line Service

Ethernet LAN Service

Advantages and Disadvantages with MPLS L3 VRF

Multicasting over MPLS

Module XI: MPLS Design and Migration

Sizing for Service Level Agreements

VPN design and topologies

Migrating to an MPLS network

Ethernet design criteria for carrier services

Designing a Carrier MPLS Network

Provisioning a Customer Service

Key MPLS service design Considerations

Module XII: Generalization of MPLS for Carrier Deployment (GMPLS)

GMPLS Structure

GMPLS Building Blocks

GMPLS Mechanisms

Link Management Protocol

Traffic Engineering

Primary and Secondary LSP

Fault Tolerance for LDP RFC 3479

Dynamic Optical Networks

High Reliability using Optical Restoration

Review and Evaluation

Delivery Method

Instructor-Led with numerous case studies and exercises.

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

3 Days