MPLS
Introduction

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Abstract

Provide an overview of the business and technical requirements for Multi-protocol label switching.

Provide a brief overview of the control and data plane of MPLS and the services which may be enabled on top of MPLS.
Agenda

- Introduction
- Protocol Operation
- MPLS Applications
- Advances in MPLS
- Summary
Prior to MPLS

- ATM and FR most popular WAN technologies
- Growing interest in IP at Network Layer
- IP Inherently any-to-any, FR/ATM Circuit Based
- Many built IP overlay networks on top of ATM and Frame Relay to feed the demand for IP
- Forwarding paradigm sub-optimal
Overlay Routing Model

- Point-to-point Circuits
- No L3 awareness in Provider
- Sub-optimal Routing
- Routing as overlay
Overlay Routing Model – Mesh

- Point-to-point Circuits
- No L3 awareness in Provider
- More Optimal Routing
- \( N^2 \) Scaling Problem

100 Sites \( \rightarrow \) 4950 Circuits
Peer Routing Model

- Provider L3 Aware
- Optimal any-to-any routing
- All routes in global table
- Full routes needed in Core
Multi-Service Networks

- Pre-1997: A world of many networks
- Don’t confuse access technology with end-to-end forwarding
Introducing MPLS

- First discussed in IETF in 1997
- Main concept of forwarding Data based on labels
- Based on Cisco Proprietary Tag Switching
- Data Layer Agnostic – ATM, FR, Ethernet
Problems addressed by MPLS

- Scalability of Network Layer Routing
  Separation of Customer / Provider routing

- Greater flexibility in delivering services
  Explicit Path Definition

- Simplify integration between routing and cell switching

- Increased performance
  Label swapping vs. IP Lookups

- Separation of Data Type from Transport Protocol
MPLS Applications

- Major advantage of MPLS is Label Hierarchy
- Enables New Services without paradigm change
- L3VPN and AToM widely deployed

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MPLS Label Format

COS/EXP = Class of Service
S = Bottom of Stack
TTL = Time to Live

Payload | IP Header | MPLS Label (s) | Ethernet Header
Terminology

- Provider Routers = Core Routers
- Provider Edge Routers = Edge Routers
- Operations → Push, Pop, Swap
Protocol Operation

- **Control Plane**
  - Neighbour discovery and establishment
  - Learns labels for each FEC
  - Advertises labels to Neighbours
  - Populates the LIB
  - IGP still required to determine destination node

- **Data Plane**
  - Population of LFIB from LIB
  - Forwarding of Labelled Packets
MPLS Core Architecture Summary

1a. Routing Protocols Establish Reachability to Destination Networks

1b. LDP Establishes Label to Destination Network Mappings

2. Ingress Edge LSR Receives Packet, Performs Layer 3 Value-Added Services, and "Labels" Packets

3. LSR Switches Packets Using Label Swapping

4. Edge LSR at Egress Removes Label and Delivers Packet
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MPLS L3VPN

- Most popular MPLS Application
- Enables sharing of Core network
- Provides isolation
  - Separate Routing tables per Service
  - Overlapping addresses
- Used in 99% of Service Providers
- Increasing number of Enterprise MPLS Networks
  - Separation of Business Units
  - Separation of Internet / WAN Traffic
  - Interconnectivity of Data Centres
MPLS L3VPN

- Enables Peer Routing Model
- Enables multi-tenancy or virtualization
- Permits Routing Hierarchy
MPLS L3VPN – Shared Services

- Shared Services
- Common for Management, Value Added Services (Backup)
- Common in Banks for Payment processing / Trading Feeds
MPLS L3VPN - Protocols

- Inner Label maps Packet to Customer
- iBGP to transport Customer Routes
  - Route Distinguishers
  - Route Targets
- VRF’s defined per Service
- Ingress Interfaces mapped to VRF’s
- Customer routes imported into BGP
- RD/RT used to distribute routes to egress PE’s
- Route reflectors used for Scaling iBGP
AToM - EoMPLS

- Transit of L2 Frames over MPLS Core Network
- Ethernet most common, but also Frame Relay, PPP, HDLC
Virtual Private LAN Switching

- Enables Multi-point L2 connectivity over MPLS
- Full Mesh of Pseudowires
- Devices learn MAC addresses (from L2 Access/Core)
Hierarchical VPLS

- Simply just a hierarchy with VPLS at the Core
- Reduces number of nodes running VPLS
- Enhances scaling characteristics
MPLS Traffic Engineering

- Used predominantly for traffic steering
- Also provides fast re-route
- Ingress Node determines traffic path
MPLS-TE – Link Protection

- Pre-configured backup paths for a primary tunnel
- Can become somewhat unwieldy in a Large network
- Some auto-features can help
MPLS-TE – Node Protection

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Advances in MPLS

- Inter-Provider MPLS
- Multicast VPN (mVPN, LSM)
- IPv6 Capabilities - 6PE / 6VPE
- MPLS Transport Profile
- Seamless/Unified MPLS
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Summary

- MPLS common in Enterprise Deployments
- L3VPN’s the predominant Service
- Shared Services enables Value Added Services
- Continued Cisco Innovation in MPLS
  - Multicast VPN’s
  - Unified MPLS
  - MPLS Transport Profile
More Information

- Feel free to contact me directly if more detail is needed or you wish to discuss your scenario:
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