

Power your team with a customized class taught by a world class instructor!

Learn from our 25+ years' technology experience and knowledge of industry best practices.

"Talk to us, an onsite class may be more affordable than you realize."

## Why Eogogics?

- **Unmatched Expertise:** Industry-leading 500-course curriculum based on first-hand technology experience. We have been engaged in ground-breaking projects worldwide for 25+ years.
- **High Client Satisfaction:** All of our classes rate good-to-excellent, high client retention, bulk of our business is from loyal clients or their referrals. See our website for enthusiastic testimonials.
- **World-class Instructors:** Advanced degrees, 15-30 years in the real world, publications, patents, awards, honors. They mix teaching with R&D and consulting to keep their tech edge razor sharp. They are as dynamic and entertaining as they are knowledgeable.
- **Customized, Practical Courses** that focus on your technical needs. Take a class onsite or, in some cases, on the Web. Flexible schedules.
- **Buy Coach, Travel First Class:** Using technology to lower our operating expense, we offer best-in-class instructors and tailored courses for 10-15% below market.

**Power Your Organization with an Eogogics Workshop!** Avoid the cost and delay of trial-and-error. Benefit from our 25+ year knowledge of industry best practices and unbiased advice.

## Join a Distinguished Clientele of Fortune 100/500 Companies

Lockheed Martin, UBS, Boeing, Disney, Raytheon, Dell, AT&T, ABC News, Verizon, Sprint, Comcast, LightSquared, TruePosition, DIRECTV, L-3, ITT, SAIC, URS. Shaw, NII, Intelsat, Crown Castle, Harris, Booz Allen Hamilton, Spectra Energy, Xerox, Cooper, Bain & Co., DoD, DHS, DoE, DoC, DoJ, GSA, NASA.

*So minimize the time and money lost to the learning curve, synch up with the industry best practices, receive a second opinion on your technology strategy, and arrive at your technology destination happier, more successful.  
Call or email us today!*

Contact us today for free consultation with a subject matter expert!

# MPLS Comprehensive: Technology, Engineering, Applications, QoS

COURSE ID MPLS10 | Duration 2-4 days | Private Class taught onsite

## Course Overview

### Course in a Nutshell



In this course, you will study all of the key issues related to the design and implementation of MPLS in IP networks. We will begin with a quick review of IP routing and the OSI stack. We will then study the basics of MPLS label switching and continue with applications including VPNs, Quality of Service (QoS), and Traffic Engineering. Advanced and emerging applications of MPLS are next including multicast, circuit emulation, and hierarchical LSPs. We will finish up with discussion of MPLS marketing opportunities and real-world network designs. Examples and short exercises are interspersed throughout the course.

### Customize It!

Let us know your motivation for studying MPLS so we can customize the course to your specific needs. If you are not already familiar with IP or other telecom basics, the course can be expanded to four days to cover these topics.

### Learn How To

- Identify the problems with conventional IP networks and how to correct them with MPLS
- Understand and implement MPLS labels and paths
- Analyze and implement Quality of Service (QoS) in IP networks using MPLS
- Analyze and implement VPNs using MPLS
- Implement new, advanced functions with MPLS that add value to your network offerings

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## Audience / Prerequisites

### Aimed At

IT or telecom professionals, network designers, sales engineers, proposal writers, and others whose job requires a good understanding of MPLS.

### Prerequisites

Basic knowledge of TCP/IP and telecommunications networks.

## Related Courses

- MPLS Applications ([MPLSEA](#), 2-4 days)
- MPLS ([MPLS](#), 2-3 days)
- MPLS Short Course ([MPLS1D](#), 1 day)
- TCP/IP Networks Overview ([TCPIP3](#), 3 days)
- TCP/IP Networks: Advanced Topics ([TCPIP2](#), 2 days)

## Course Outline

- Review of OSI Protocol Stack and Packet Switching
  - Packet vs. circuit switching
  - Connection-oriented and connectionless network architectures
  - Reason for layered telecom architectures
  - OSI stack
  - Function of each layer
  - Layer 2 switching
  - Ethernet and OSI
  - Packet construction and addressing
- Overview of Routing and MPLS
  - Layer 3 routing

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- Native Hop-by-Hop Network Layer (Layer 3) routing
- Next Hop Selection Functions
- Advantages of Layer 3 switching
- Label Switching as way to speed packets through network
- MPLS implementation of label switching
- MPLS forwarding paradigm
- Integration of IP and MPLS
- Advantages of MPLS forwarding over conventional network layer forwarding
  
- MPLS Labels
  - MPLS labels basics
  - Label encapsulation
  - Label assignment and distribution
  - Label switched routers and routing (LSR)
  - Label distribution: Purpose
  - Label distribution: Protocols (LDP)
  - Label distribution: Methods
  - Label retention modes
  - Label Switched Paths (LSP)
  - LSP setup control
  
- Route Selection
  - Basics
  - Standard IP and MPLS
  - IP forwarding
  - MPLS label distribution
  - Label switched paths

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- Explicitly routed LSP (ER-LSP): Basics, example, advantages
- Hop-by-Hop vs. explicit routing
- **MPLS Architecture**
  - Design of MPLS networks
  - MPLS operation
  - MPLS node architecture
  - MPLS elements
  - Loop survival, detection, and prevention in MPLS
- **Virtual Private Networks (VPNs) and MPLS**
  - Overview of VPNs
  - Connection-oriented VPNs
  - Connectionless VPNs
  - Comparison of VPN technologies
  - MPLS VPN operation
  - Layer 1 MPLS VPNs (circuit emulation)
  - Layer 2 MPLS VPNs (point-point, multipoint)
  - Layer 3 MPLS VPNs
  - Route reflectors
  - Trace route enhancements
  - Advantages of MPLS VPNs
  - MPLS VPN management
- **MPLS Traffic Engineering**
  - Need for traffic engineering on Internet and other IP-based networks
  - Unequal cost load balancing via metric manipulation
  - Advantages of MPLS traffic engineering

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- Basic concepts of MPLS traffic engineering
- MPLS traffic engineering elements (dynamic/static LSPs)
- MPLS traffic engineering configuration
- Resource Reservation Protocol for Traffic Engineering (RSVP-TE)
- Configuration case study of an MPLS traffic-engineered network: Intermediate System-Intermediate System (IS-IS)
- Configuration case study of an MPLS traffic-engineered network: Open shortest path first (OSPF)
- **MPLS and Quality of Service (QoS)**
  - Introduction to Quality of Service (QoS)
  - Overbuild versus preferential treatment of packets
  - Quality of Service (QoS) vs. Class of Service (CoS)
  - Integrated services
  - IP precedence
  - Differentiated Services (DiffServ)
  - Modular QoS Command Line Interface (CLI)
  - MPLS implementation of DiffServ
  - MPLS VPN support of QoS
  - MPLS QoS implementation
  - Configuring QoS for MPLS VPNs
  - MPLS QoS case study
- **MPLS Design**
  - MPLS VPN design and topologies
  - Designing MPLS networks
  - Additional MPLS design considerations

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- Generalized MPLS (GMPLS) and Multi-Protocol Lambda Switching
  - Using packet-switch ideas in all-optical world
  - Differences between lambda (wavelength) switching and conventional packet switching
  - Basics of GMPLS
  - Transitioning to GMPLS
- Multicast L2/L3
  - Mcast backbone requirements
  - Point to multipoint (P2MP) LSPs
  - P2MP Pseudowire emulation (PW)
  - BGP P2MP
  - Mobile VPN (mVPN)
- Inter-AS/CSC
  - Inter-carrier requirements
  - MPLS-Inter-carrier-connect (ICI)
  - Multi-segment PW
- Circuit Emulation
  - Structure-Agnostic Time Division Multiplexing (TDM) over Packet (SAToP)
  - Circuit Emulation Switched Virtual Circuit (SVC) over Packet Switched Network (CESoPSN)
  - TDM over IP Gateways (TDMoIP)
  - Circuit Emulation (CEM)
- Hierarchical LSPs
  - Route aggregation and H-LDP
  - Hierarchical resource reservation
- MPLS Resilience and OAM

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- Need for network protection
- MPLS error detection
- Thrashing links
- Practical applications
- Node/network level recovery
- LSP/PW ping/traceroute
- Virtual Circuit Connection Verification (VCCV)
- PW redundancy
- Master Controller-Layer 2 Access Concentration (MC-LAC)
- MPLS/Ethernet OAM interworking
- Cisco's Tunnel Builder vendor solution
- **MPLS and Advanced or Emerging Technologies**
  - Control planes and MPLS
  - Fixing the problems of SONET
  - Generalized MPLS (GMPLS) and Automatic Switched Optical Network (ASON)
  - Separation of connectivity and services: Next Generation Network (NGN)
  - Getting rid of SONET: MPLS and Optical Transport Network (OTN)
  - MPLS and emerging very high speed Ethernet (>100 Mb/s)
  - New architectures for layer 2 functionality
  - Virtualization and Software Defined Networking (SDN)
  - Network Functions Virtualization (NFV) and MPLS
- **MPLS VPN Marketing**
  - Who: The user perspective
  - What: The money
  - How: Approaches to marketing and sales

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- Market planning overview
  - Case example
  - Challenges
  - Case study
- Wrap-up: Course Recap, Discussion, and Evaluation

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**About Eogogics:** Founded in 2005 and located in Washington, DC, Eogogics offers technology and soft skills training and consulting to organizations worldwide.

**Our Skillset:** Wireless (2G to 5G+, Bluetooth, WiFi), RF, Microwaves, Spectrum Management, SATCOM, Telecom (IP Networks, Intelligent Networks, SONET/SDH, DWDM, backhaul, tmforum™ courses, Defense/Security/Public Safety related, Telecom for Non-engineers), Technologies (Mechanical Engineering/Manufacturing, Reliability, Software/Systems, Cloud Computing, SDN, NFV, Technical and Project Management), Leadership/Management, Soft Skills.

**About the Eogogics Team:** Eogogics is led by KK Arora, formerly Founder and Managing Director, Wireless Institute and Vice President, Human Capital Management, LCC International. A wireless telecom industry pioneer, award winning teacher, and author with 25 years of executive experience, he leads a team of highly accomplished professionals who rank at the top of their chosen fields and who have earned many distinctions including patents, publications, awards, and honors. Our five-person leadership team collectively offers: 106 years of technology experience (91 years in telecom, 66 years in wireless), 156 years in training (106 years in technology training, 50 years in soft skills training), and 101 years in consulting (61 years in technology, 40 years in soft skills).

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