

## Mpls Technology And Applications

Infrastructure for Homeland Security Environments Wireless Sensor Networks helps readers discover the emerging field of low-cost standards-based sensors that promise a high order of spatial and temporal resolution and accuracy in an ever-increasing universe of applications. It shares the latest advances in science and engineering paving the way towards a large plethora of new applications in such areas as infrastructure protection and security, healthcare, energy, food safety, RFID, ZigBee, and processing. Unlike other books on wireless sensor networks that focus on limited topics in the field, this book is a broad introduction that covers all the major technology, standards, and application topics. It contains everything readers need to know to enter this burgeoning field, including current applications and promising research and development; communication and networking protocols; middleware architecture for wireless sensor networks; and security and management. The straightforward and engaging writing style of this book makes even complex concepts and processes easy to follow and understand. In addition, it offers several features that help readers grasp the material and then apply their knowledge in designing their own wireless sensor network systems: \* Examples illustrate how concepts are applied to the development and application of \* wireless sensor networks \* Detailed case studies set forth all the steps of design and implementation needed to solve real-world problems \* Chapter conclusions that serve as an excellent review by stressing the chapter's key concepts \* References in each chapter guide readers to in-depth discussions of individual topics This book is ideal for networking designers and engineers who want to fully exploit this new technology and for government employees who are concerned about homeland security. With its examples, it is appropriate for use as a coursebook for upper-level undergraduates and graduate students.

MPLS Technology and Applications Morgan Kaufmann

Selecting MPLS VPN Services helps you analyze migration options, anticipate migration issues, and properly deploy IP/MPLS VPNs. Detailed configurations illustrate effective deployment while case studies present available migration options and walk you through the process of selecting the best option for your network. Part I addresses the business case for moving to an IP/MPLS VPN network, with a chapter devoted to the business and technical issues you should review when evaluating IP/MPLS VPN offerings from major providers. Part II includes detailed deployment guidelines for the technologies used in the IP/MPLS VPN.

With a foreword by Yakov Rekhter "Here at last is a single, all encompassing resource where the myriad applications sharpen into a comprehensible text that first explains the whys and whats of each application before going on to the technical detail of the hows." —Kireeti Kompella, CTO Junos, Juniper Networks The authoritative guide to MPLS, now in its Third edition, fully updated with brand new material! MPLS is now considered the networking technology for carrying all types of network traffic, including voice telephony, real-time video, and data traffic. In MPLS-Enabled Applications, Third Edition, the authors methodically show how MPLS holds the key to network convergence by allowing operators to offer more services over a single physical infrastructure. The Third Edition contains more than 170 illustrations, new chapters, and more coverage, guiding the reader from the basics of the technology, through all its major VPN applications. MPLS Enabled-Applications contains up-to-date coverage of: The current status and future potential of all major MPLS applications, including L2VPN, L3VPN, pseudowires and VPLS. A new chapter with up to date coverage of the MPLS transport profile, MPLS-TP. MPLS in access networks and Seamless MPLS, the new architecture for extending MPLS into the access, discussed in depth for both the unicast and the multicast case. Extensive coverage of multicast support in L3VPNs (mVPNs), explaining and comparing both the PIM/GRE and the next generation BGP/MPLS solutions, and including a new chapter on advanced topics in next generation multicast VPNs. A new chapter on advanced protection techniques, including detailed discussion of 50 ms end-to-end service restoration. Comprehensive coverage of the base technology, as well as the latest IETF drafts, including topics such as pseudowire redundancy, VPLS multihoming, IRB and P2MP pseudowires. MPLS-Enabled Applications will provide those involved in the design and deployment of MPLS systems, as well as those researching the area of MPLS networks, with a thoroughly modern view of how MPLS is transforming the networking world. "Essential new material for those trying to understand the next steps in MPLS." —Adrian Farrel, IETF Routing Area Director "MPLS-Enabled Applications takes a unique and creative approach in explaining MPLS concepts and how they are applied in practice to meet the needs of Enterprise and Service Provider networks. I consistently recommend this book to colleagues in the engineering, education and business community." —Dave Cooper, Chief IP Technologist, Global Crossing Ltd

Master the design of IP and MPLS fault-tolerant network architectures.

A comprehensive introduction to all facets of MPLS theory and practice Helps networking professionals choose the suitable MPLS application and design for their network Provides MPLS theory and relates to basic IOS configuration examples The Fundamentals Series from Cisco Press launches the basis to readers for understanding the purpose, application, and management of technologies MPLS has emerged as the new networking layer for service providers throughout the world. For many service providers and enterprises MPLS is a way of delivering new applications on their IP networks, while consolidating data and voice networks. MPLS has grown to be the new default network layer for service providers and is finding its way into enterprise networks as well. This book focuses on the building blocks of MPLS (architecture, forwarding packets, LDP, MPLS and QoS, CEF, etc.). This book also reviews the different MPLS applications (MPLS VPN, MPLS Traffic Engineering, Carrying IPv6 over MPLS, AToM, VPLS, MPLS OAM etc.). You will get a comprehensive overview of all the aspects of MPLS, including the building blocks, its applications, troubleshooting and a perspective on the future of MPLS.

The last two years have seen significant developments in the standardization of GMPLS and its implementation in optical and other networks. GMPLS: Architecture and Applications brings you completely up to date, providing the practical information you need to put the growing set of GMPLS-supported services to work and manage them effectively. This book begins by defining GMPLS's place in a transport network, leveraging your knowledge of MPLS to give you an understanding of this radically new control plane technology. An overview of GMPLS protocols follows, but the real focus is on what comes afterwards: in-depth examinations of the architectures underpinning GMPLS in real-world network environments and current and emerging GMPLS applications. This one-of-a-kind resource delivers immensely useful information for software architects, designers and programmers, hardware developers, system testers, and network

operators--and also for managers and other decision-makers. Written by two industry researchers at the forefront of the development of GMPLS. Provides a practical look at GMPLS protocols for signaling, routing, link and resource management, and traffic engineering. Delves deep into the world of GMPLS applications, including traffic engineering, path computation, layer one VPNs, point-to-multipoint connectivity, service management, and resource protection. Explores three distinct GMPLS control plane architectures: peer, overlay, and hybrid, and explains the GMPLS UNI and NNIs. Explains how provisioning challenges can be met in multi-region networks and details the provisioning systems and tools relied on by the GMPLS control plane, along with the standard MIB modules used to manage a GMPLS system.

How can you make multivendor services work smoothly on today's complex networks? This practical book shows you how to deploy a large portfolio of multivendor Multiprotocol Label Switching (MPLS) services on networks, down to the configuration level. You'll learn where Juniper Network's Junos, Cisco's IOS XR, and OpenContrail, interoperate and where they don't. Two network and cloud professionals from Juniper describe how MPLS technologies and applications have rapidly evolved through services and architectures such as Ethernet VPNs, Network Function Virtualization, Seamless MPLS, Egress Protection, External Path Computation, and more. This book contains no vendor bias or corporate messages, just solid information on how to get a multivendor network to function optimally. Topics include: Introduction to MPLS and Software-Defined Networking (SDN) The four MPLS Builders (LDP, RSVP-TE, IGP SPRING, and BGP) Layer 3 unicast and multicast MPLS services, Layer 2 VPN, VPLS, and Ethernet VPN Inter-domain MPLS Services Underlay and overlay architectures: data centers, NVO, and NFV Centralized Traffic Engineering and TE bandwidth reservations Scaling MPLS transport and services Transit fast restoration based on the IGP and RSVP-TE FIB optimization and egress service for fast restoration

"Written by two of the foremost experts on the subject who illustrate concepts with practical examples of their application. The most authoritative text on MPLS. Highly Recommended!" -Daniel Awduche Distinguished Technical Member UUNET (MCI Worldcom) "At last a comprehensive presentation of MPLS reflecting its development and usage, this book is a MUST for any Network Engineering Manager contemplating the deployment of MPLS." -Monique Jeanne Morrow IP Engineering Manager Swisscom AG "Davie and Rekhter provide a detailed and unbiased chronology of the evolution of MPLS. Their scientific approach to decomposing various protocols into their fundamental elements is interwoven with a more pragmatic compilation of diagrams, typical networking scenarios, and applications. Provides a solid knowledge base for researchers and operators dedicated to MPLS and its future." -Eric Dean Senior Director, Internetwork Engineering Global One Multiprotocol Label Switching (MPLS) is now a widely deployed technology, which addresses a variety of issues, including traffic engineering, Quality of Service, Virtual Private Networks, and IP/ATM integration. MPLS: Technology and Applications is the first book that provides a detailed analysis of the architecture, protocols, and application of MPLS. Written by experts who personally authored key parts of the standard, this book will enable network operators and designers to determine which aspects of networks would benefit from MPLS. It is also a definitive reference for engineers implementing MPLS-based products. Features: Covers major applications of MPLS: traffic engineering, VPNs, IP/ATM integration, and QoS Describes all the major protocols that comprise MPLS, including LDP, RSVP, and CR-LDP Goes beyond the RFCs to explain how and why key design decisions were made Provides a complete discussion of constraint-based routing

Provides the most thorough examination of Internet technologies and applications for researchers in a variety of related fields. For the average Internet consumer, as well as for experts in the field of networking and Internet technologies.

"Provides detailed information on existing Multicast and MVPN standards, referred to as Next-Generation Multicast based standards, Multicast Applications, and case studies with detailed configurations"--Provided by publisher.

Rick Gallahers MPLS Training Guide introduces readers to mpls concepts, installation, migration, operation, inspection, and troubleshooting. It discusses specific router and switch platforms and includes such topics as frame-mode mpls, cell-mode mpls, label distribution protocol, tag distribution protocol, label distribution protocol migration, mpls configuration, traffic engineering, mpls vpns, mpls vpn deployment models, mpls vpn routing protocol support, multi-protocol bgp, mpls vpn configurations, mpls vpn integration, and mpls vpn management. Readers will find complete ready-to-use configurations for routers Shows how to implement MPLS traffic engineering on a core network and optimize traffic Great for users studying for Cisco's Implementing Cisco MPLS exam, 640-910 and written by a Cisco internetworking expert who knows everything about MPLS Includes coverage of Cisco Systems' newly released (October 7, 2002) Multiprotocol Label Switching (MPLS) Bandwidth Protection software package. The new architecture uses MPLS Traffic Engineering Fast Reroute and an offline application called Tunnel Builder Pro to increase resiliency at a network-wide level Includes updated coverage of MPLS and GMPLS

Multi-Protocol Label Switch (MPLS) and Generalized MPLS (GMPLS) are key technologies for next-generation IP backbone networks. Until now, however, engineers have been forced to search for technical papers on this subject and read them in an ad-hoc manner. At last there is a book that explains both MPLS and GMPLS concepts in a systematic way. GMPLS Technologies: Broadband Backbone Networks and Systems addresses the basic concepts, network architectures, protocols, and traffic engineering needed to operate MPLS and GMPLS networks. The book begins with an introduction of the nature and requirements of broadband networks. It describes the basics of control-oriented networks and Internet Protocol (IP). The text then examines the fundamentals of MPLS, explaining why MPLS is preferable to IP packet-based forwarding. This volume covers MPLS applications, details IP router structures, illustrates GMPLS, and explores important studies on traffic engineering in GMPLS Networks. The text concludes with a description of IP, MPLS, and GMPLS standardization topics. Network equipment design engineers and network service provision engineers can reference this book to understand the crucial techniques for building MPLS/GMPLS-based networks. Features Addresses the basic concepts, network architectures, protocols, and traffic engineering needed to operate MPLS and GMPLS networks Covers the fundamentals of connection-oriented networks including TCP/IP, flow control mechanism, and ATM protocol Analyzes MPLS issues and applications, such as label switched paths (LSPs) and VPNs Highlights IP router structures, examining technologies of data path function - switch architecture, packet scheduling, and forwarding engine Explores multi-layer traffic engineering, survivable networks, and wavelength-routed optical networks Demonstrates GMPLS-based routers



The digital subscriber line (DSL) industry is expanding rapidly and a technology once thought to be only transitional will soon clear \$100 billion in total annual service revenue. From the world's leading DSL experts, Implementation and Application of DSL Technologies builds upon the theory presented in Fundamentals of DSL Technologies to address issues fundamental to the success of DSL technology, including those that sustain DSL development, constraints, and challenges. This highly practical text peers into the blossoming sub-industries, all born of the DSL. The editors lead with a discussion on splitter circuits and micro-filters and continue by addressing digital chipsets and the capabilities required to mix and match them with various other components. Since testing has become an industry in its own, several chapters describe the various types of testing necessary for service qualification, the evolution of testing and provisioning of services from plain old telephone service, loop qualification, and regulator's decree of spectrum management. The book gives adequate coverage of DSL technology and describes networks for multiple applications in video, telephony, and Internet data areas and the associated network architectures. In addition, a section on security discusses packet transfer mechanism and voice-over DSL. Offering a vast array of information not currently in the public domain, Implementation and Application of DSL Technologies provides a rigorous survey of DSL applications that illustrates the profound effect this technology is having on the communications industry. When combined with Fundamentals of DSL Technology, this is the most comprehensive and authoritative source of information on DSL.

Master advanced MPLS VPN deployment solutions to design, deploy, and troubleshoot advanced or large-scale networks. This title builds on the bestselling success of the first volume with more advanced features to get more out of a network.

Field-proven MPLS designs covering MPLS VPNs, pseudowire, QoS, traffic engineering, IPv6, network recovery, and multicast Understand technology applications in various service provider and enterprise topologies via detailed design studies Benefit from the authors' vast experience in MPLS network deployment and protocol design Visualize real-world solutions through clear, detailed illustrations Design studies cover various operator profiles including an interexchange carrier (IXC), a national telco deploying a multiservice backbone carrying Internet and IP VPN services as well as national telephony traffic, an international service provider with many POPs all around the globe, and a large enterprise relying on Layer-3 VPN services to control communications within and across subsidiaries Design studies are thoroughly explained through detailed text, sample configurations, and network diagrams Definitive MPLS Network Designs provides examples of how to combine key technologies at the heart of IP/MPLS networks. Techniques are presented through a set of comprehensive design studies. Each design study is based on characteristics and objectives common to a given profile of network operators having deployed MPLS and discusses all the corresponding design aspects. The book starts with a technology refresher for each of the technologies involved in the design studies. Next, a series of design studies is presented, each based on a specific hypothetical network representative of service provider and enterprise networks running MPLS. Each design study chapter delivers four elements. They open with a description of the network environment, including the set of supported services, the network topology, the POP structure, the transmission facilities, the basic IP routing design, and possible constraints. Then the chapters present design objectives, such as optimizing bandwidth usage. Following these are details of all aspects of the network design, covering VPN, QoS, TE, network recovery, and—where applicable—multicast, IPv6, and pseudowire. The chapters conclude with a summary of the lessons that can be drawn from the design study so that all types of service providers and large enterprise MPLS architects can adapt aspects of the design solution to their unique network environment and objectives. Although network architects have many resources for seeking information on the concepts and protocols involved with MPLS, there is no single resource that illustrates how to design a network that optimizes their benefits for a specific operating environment. The variety of network environments and requirements makes it difficult to provide a one-size-fits-all design recommendation. Definitive MPLS Network Designs fills this void. "This book comes as a boon to professionals who want to understand the power of MPLS and make full use of it." -Parantap Lahiri, Manager, IP Network Infrastructure Engineering, MCI Includes a FREE 45-Day Online Edition This book is part of the Networking Technology Series from Cisco Press®, which offers networking professionals valuable information for constructing efficient networks, understanding new technologies, and building successful careers.

MPLS enables network managers to control the route of information through a network, allowing re-routing around congestion "hot spots", resulting in networks with lower latency and greater scalability. This guide is the first book to discuss the implementation of MPLS, taking the reader through the history and making the technology understandable, then showing readers how to implement it.

MPLS holds the key to network convergence "Here at last is a single, all-encompassing resource where the myriad applications sharpen into a comprehensible text." Kireeti Kompella, Juniper Fellow, Juniper Networks "This should be the textbook for MPLS courses, both for training of experienced networking professionals and for universities." Loa Andersson, Acreo AB, IAB-member and IETF MPLS working group co-chair "MPLS-Enabled Applications is a must-read for anyone involved in enterprise or service-provider networks." Dave Cooper, Sr. Manager IP Engineering, Global Crossing, Ltd. The capability of Multiprotocol Label Switching (MPLS) to identify traffic based on its label at forwarding time, coupled with its ability to force traffic down pre-established paths, has created a whole range of new applications while enabling scaling of existing applications. To highlight the emerging developments, Ina Minei and Julian Lucek cover traffic engineering, L3VPNs (Layer 3 Virtual Private Networks), pseudowires, VPLS (Virtual Private LAN Service), and much more. They methodically illustrate how MPLS holds the key to network convergence by allowing operators to offer more services over a single physical infrastructure and how it can reduce the cost of the network by streamlining operations. With over a hundred illustrations and thirteen in-depth chapters MPLS-Enabled Applications documents why MPLS is now considered the networking technology for carrying all types of network traffic, including voice telephony, real-time video, and the many types of data traffic. MPLS-Enabled Applications: Provides an authoritative, comprehensive overview of the current status and future potential of MPLS applications, including the latest IETF drafts. Examines all the major applications, including L3VPN, L2VPN, VPLS and pseudowires. Explains how to apply MPLS and tailor it to fit specific scenarios. Examines the scaling requirements of equipment at different points in the network under different deployment scenarios. Offers inclusive coverage of point-to-multipoint label switched paths, DiffServ-aware traffic engineering and QoS, inter-domain traffic engineering and path computation elements, route target filtering, and the latest developments in multicast support for L3VPNs. Covers the management and troubleshooting of MPLS networks and associated services, to enable high availability. MPLS-Enabled Applications will provide

those involved in the design and deployment of MPLS systems, as well as those researching the area of MPLS networks, with a thoroughly modern view of how MPLS is transforming the networking world.

MPLS-enabled networks are enjoying tremendous growth, but practical information on managing MPLS-enabled networks has remained hard to find. Until now. *MPLS Network Management: MIBs, Tools, and Techniques* is the first and only book that will help you master MPLS management technologies and techniques, as they apply to classic MPLS networks, traffic-engineered networks, and VPNs. Written by the co-author of most current MPLS management standards, it provides detailed, authoritative coverage of official MIBs, examining key topics ranging from syntax to access levels to object interaction. It also offers extensive consideration of third-party management interfaces, including tools for metering traffic and predicting traffic growth and behavior. If you're a network operator, network device engineer, or MPLS application developer, you need this book to get all you can out of all of MPLS's many capabilities. \* The only book devoted entirely to the tools and techniques for controlling, monitoring, debugging, and optimizing MPLS-enabled networks. \* Authoritative information from the co-author of most IETF MIBs relating to MPLS and GMPLS, PWE3, and PPVPN. \* Covers both standards-based and proprietary management technologies. \* Includes interviews with seminal figures in the development of MPLS. \* Via a companion web site, provides information on late-breaking developments in MPLS management and links to additional resources. \* To be followed by a second volume presenting best-practice case studies dealing with how real companies approach the management of their MPLS networks.

This volume provides solutions for common network management problems such as scalability and increased technology mix. The book explores the use of MPLS in network management, which is used to improve the overall quality of service.

A complete guide to understanding, designing, and deploying Layer 2 VPN technologies and pseudowire emulation applications Evaluate market drivers for Layer 2 VPNs Understand the architectural frame-work and choices for Layer 2 VPNs, including AToM and L2TPv3 Grasp the essentials of Layer 2 LAN and WAN technologies Examine the theoretical and operational details of MPLS and LDP as they pertain to AToM Understand the theoretical and operational details of Layer 2 protocols over L2TPv3 in IP networks Learn about Layer 2 VPN bridged and routed interworking and Layer 2 local switching Understand the operation and application of Virtual Private LAN Services (VPLS) Learn about foundation and advanced AToM and L2TPv3 topics through an extensive collection of case studies The historical disconnect between legacy Layer 2 and Layer 3 VPN solutions has forced service providers to build, operate, and maintain separate infrastructures to accommodate various VPN access technologies. This costly proposition, however, is no longer necessary. As part of its new Unified VPN Suite, Cisco Systems® now offers next-generation Layer 2 VPN services like Layer 2 Tunneling Protocol version 3 (L2TPv3) and Any Transport over MPLS (AToM) that enable service providers to offer Frame Relay, ATM, Ethernet, and leased-line services over a common IP/MPLS core network. By unifying multiple network layers and providing an integrated set of software services and management tools over this infrastructure, the Cisco® Layer 2 VPN solution enables established carriers, IP-oriented ISP/CLECs, and large enterprise customers (LECs) to reach a broader set of potential VPN customers and offer truly global VPNs. *Layer 2 VPN Architectures* is a comprehensive guide to consolidating network infrastructures and extending VPN services. The book opens by discussing Layer 2 VPN applications utilizing both AToM and L2TPv3 protocols and comparing Layer 3 versus Layer 2 provider-provisioned VPNs. In addition to describing the concepts related to Layer 2 VPNs, this book provides an extensive collection of case studies that show you how these technologies and architectures work. The case studies include both AToM and L2TPv3 and reveal real-world service provider and enterprise design problems and solutions with hands-on configuration examples and implementation details. The case studies include all Layer 2 technologies transported using AToM and L2TPv3 pseudowires, including Ethernet, Ethernet VLAN, HDLC, PPP, Frame Relay, ATM AAL5 and ATM cells, and advanced topics relevant to Layer 2 VPN deployment, such as QoS and scalability.

Best-practice QoS designs for protecting voice, video, and critical data while mitigating network denial-of-service attacks Understand the service-level requirements of voice, video, and data applications Examine strategic QoS best practices, including Scavenger-class QoS tactics for DoS/worm mitigation Learn about QoS tools and the various interdependencies and caveats of these tools that can impact design considerations Learn how to protect voice, video, and data traffic using various QoS mechanisms Evaluate design recommendations for protecting voice, video, and multiple classes of data while mitigating DoS/worm attacks for the following network infrastructure architectures: campus LAN, private WAN, MPLS VPN, and IPsec VPN Quality of Service (QoS) has already proven itself as the enabling technology for the convergence of voice, video, and data networks. As business needs evolve, so do the demands for QoS. The need to protect critical applications via QoS mechanisms in business networks has escalated over the past few years, primarily due to the increased frequency and sophistication of denial-of-service (DoS) and worm attacks. *End-to-End QoS Network Design* is a detailed handbook for planning and deploying QoS solutions to address current business needs. This book goes beyond discussing available QoS technologies and considers detailed design examples that illustrate where, when, and how to deploy various QoS features to provide validated and tested solutions for voice, video, and critical data over the LAN, WAN, and VPN. The book starts with a brief background of network infrastructure evolution and the subsequent need for QoS. It then goes on to cover the various QoS features and tools currently available and comments on their evolution and direction. The QoS requirements of voice, interactive and streaming video, and multiple classes of data applications are presented, along with an overview of the nature and effects of various types of DoS and worm attacks. QoS best-practice design principles are introduced to show how QoS mechanisms can be strategically deployed end-to-end to address application requirements while mitigating network attacks. The next section focuses on how these strategic design principles are applied to campus LAN QoS design. Considerations and detailed design recommendations specific to the access, distribution, and core layers of an enterprise campus network are presented. Private WAN QoS design is discussed in the following section, where WAN-specific considerations and detailed QoS designs are presented for leased-lines, Frame Relay, ATM, ATM-to-FR Service Interworking, and ISDN networks. Branch-specific designs include Cisco® SAFE recommendations for using Network-Based Application Recognition (NBAR) for known-worm identification and policing. The final section covers Layer 3 VPN QoS design-for both MPLS and IPsec VPNs. As businesses are migrating to VPNs to meet their wide-area networking needs at lower costs, considerations specific to these topologies are required to be reflected in their customer-edge QoS designs. MPLS VPN QoS design is examined from both the enterprise and service provider's perspectives. Additionally, IPsec VPN QoS designs cover site-to-site and teleworker contexts. Whether you are looking for an introduction to QoS



principles and practices or a QoS planning and deployment guide, this book provides you with the expert advice you need to design and implement comprehensive QoS solutions.

Computer Networks: A Systems Approach, Fifth Edition, explores the key principles of computer networking, with examples drawn from the real world of network and protocol design. Using the Internet as the primary example, this best-selling and classic textbook explains various protocols and networking technologies. The systems-oriented approach encourages students to think about how individual network components fit into a larger, complex system of interactions. This book has a completely updated content with expanded coverage of the topics of utmost importance to networking professionals and students, including P2P, wireless, network security, and network applications such as e-mail and the Web, IP telephony and video streaming, and peer-to-peer file sharing. There is now increased focus on application layer issues where innovative and exciting research and design is currently the center of attention. Other topics include network design and architecture; the ways users can connect to a network; the concepts of switching, routing, and internetworking; end-to-end protocols; congestion control and resource allocation; and end-to-end data. Each chapter includes a problem statement, which introduces issues to be examined; shaded sidebars that elaborate on a topic or introduce a related advanced topic; What's Next? discussions that deal with emerging issues in research, the commercial world, or society; and exercises. This book is written for graduate or upper-division undergraduate classes in computer networking. It will also be useful for industry professionals retraining for network-related assignments, as well as for network practitioners seeking to understand the workings of network protocols and the big picture of networking. Completely updated content with expanded coverage of the topics of utmost importance to networking professionals and students, including P2P, wireless, security, and applications Increased focus on application layer issues where innovative and exciting research and design is currently the center of attention Free downloadable network simulation software and lab experiments manual available

Comprehensive coverage of IP/MPLS/Ethernet backhaul technologies and solutions for 3GPP mobile network systems such as LTE, HSPA and GPRS Focusing on backhaul from a radio network viewpoint, Mobile Backhaul combines perspectives on mobile networks and transport network technologies, focusing on mobile backhaul specific functionalities, which are essential in building modern cost efficient packet networks for mobile systems, IP, MPLS and Carrier Ethernet. The key functions required for this process, Synchronization, Resiliency, Quality of Service and Security, are also explained. The reader benefits from a view of networking technology from a radio network viewpoint, which is specific to this application, as well from a data centre and more IT-oriented perspective. The book bridges the gap between radio and backhaul viewpoints to provide a holistic understanding. Organized into two parts, the book gives an advanced introduction to the principles of the topic before moving on to more specialized areas. Part 1 gives a network level overview, with the purpose of presenting the mobile network application, its protocols, interfaces and characteristics for the backhaul. This section also presents the key packet networking technologies that are most relevant for the radio network. Part 2 offers selected case studies in Synchronization, Resiliency, QoS and Security and gives example solutions for mobile operator owned and leased mobile backhaul cases building on the network view given in Part 1. Both radio network experts and IP networking experts will benefit from the treatment of essential material at the borderline between the radio and backhaul technologies. Key features: Unique view and coverage of both the radio network and the packet mobile backhaul Includes a view into the economic motivation for a packet based mobile backhaul and discusses scenarios of a migration to the new technology Covers 2G, 3G, HSPA, HSPA+ and LTE in radio technologies as well as MWR, Sonet/SDH, Ethernet, Carrier Ethernet, MPLS and IP in networking technologies

"Here at last is a single, all-encompassing resource where the myriad applications sharpen into a comprehensible text." Kireeti Kompella, Juniper Fellow, Juniper Networks. The authoritative guide to MPLS, now in its second edition, fully updated with brand new material! Multiprotocol Label Switching (MPLS) is now considered the networking technology for carrying all types of network traffic, including voice telephony, real-time video, and data traffic. In MPLS-Enabled Applications, the Second Edition, the authors methodically show how MPLS holds the key to network convergence by allowing operators to offer more services over a single physical infrastructure. The Second Edition contains more than 150 illustrations, new chapters, and more coverage, guiding the reader from the basics of the technology, including signaling protocols, traffic engineering and fast reroute, through all its major applications. MPLS Enabled-Applications, Second Edition, contains comprehensive up-to-date coverage of: the current status and the future potential of all major MPLS applications, including L3VPNs (Layer 3 Virtual Private Networks), L2VPNs (Layer 2 Virtual Private Networks), pseudowires and VPLS . (Virtual Private LAN Service). extensive discussion of multicast support over MPLS, including a new chapter dedicated to multicast in VPNs, explaining both the PIM/GRE (Protocol Independent Multicast / Generic Routing Encapsulation) and the next generation BGP/MPLS solutions, new material on support of multicast in VPLS, a much-expanded chapter on MPLS multicast and a section operations and management (OAM) tools for point-to-multipoint LSPs. a new chapter on MPLS in access networks, as well as coverage of the use of MPLS in mobile and data communication networks. interoperation of LDP(Label Distribution Protocol) and BGP (Border Gateway Protocol) based VPLS. comprehensive coverage of the base technology, as well as the latest IETF drafts With a foreword by Yakov Rekhter

Understand the business case for deploying MPLS-based services and solutions \* Provides network managers and architects a precise MPLS primer \* Defines MPLS service problems and their associated solutions \* Includes ROI models for MPLS-based solutions \* Discusses pros and cons of various options for each MPLS service Network managers often question the value that MPLS brings to their business environment. This book provides them with a precise guide for evaluating the benefits of MPLS-based applications and solutions. The book guides the network manager through the business case for MPLS by exploring other technology alternatives, including their applications, benefits, and deficiencies. Understanding the service creation process as the basis for MPLS-based solutions is pivotal when describing the benefits that MPLS offers. Furthermore, the book explores MPLS technology and its components, providing an overview of the architecture necessary to reap the true advantages that MPLS brings to a service provider or enterprise network. These advantages include new revenue opportunities and a total cost of ownership reduction that positively impacts a company's bottom-line. ROI models and case study examples further confirm the business impact and help decision-makers create a blueprint for MPLS service creation. Specific aspects such as security, network management, advanced services and the future of the technology complete the book, helping decision makers assess MPLS as a candidate for implementation. In short, you can use this comprehensive guide to understand and build a business case for the inclusion of MPLS in your network.

Network Routing: Fundamentals, Applications and Emerging Technologies serves as single point of reference for both advanced undergraduate and graduate students studying network

routing, covering both the fundamental and more moderately advanced concepts of routing in traditional data networks such as the Internet, and emerging routing concepts currently being researched and developed, such as cellular networks, wireless ad hoc networks, sensor networks, and low power networks.

Design, configure, and manage MPLS TE to optimize network performance Almost every busy network backbone has some congested links while others remain underutilized. That's because shortest-path routing protocols send traffic down the path that is shortest without considering other network parameters, such as utilization and traffic demands. Using Traffic Engineering (TE), network operators can redistribute packet flows to attain more uniform distribution across all links. Forcing traffic onto specific pathways allows you to get the most out of your existing network capacity while making it easier to deliver consistent service levels to customers at the same time. Cisco(r) Multiprotocol Label Switching (MPLS) lends efficiency to very large networks, and is the most effective way to implement TE. MPLS TE routes traffic flows across the network by aligning resources required by a given flow with actual backbone capacity and topology. This constraint-based routing approach feeds the network route traffic down one or more pathways, preventing unexpected congestion and enabling recovery from link or node failures. Traffic Engineering with MPLS provides you with information on how to use MPLS TE and associated features to maximize network bandwidth. This book focuses on real-world applications, from design scenarios to feature configurations to tools that can be used in managing and troubleshooting MPLS TE. Assuming some familiarity with basic label operations, this guide focuses mainly on the operational aspects of MPLS TE-how the various pieces work and how to configure and troubleshoot them. Additionally, this book addresses design and scalability issues along with extensive deployment tips to help you roll out MPLS TE on your own network. Understand the background of TE and MPLS, and brush up on MPLS forwarding basics Learn about router information distribution and how to bring up MPLS TE tunnels in a network Understand MPLS TE's Constrained Shortest Path First (CSPF) and mechanisms you can use to influence CSPF's path calculation Use the Resource Reservation Protocol (RSVP) to implement Label-Switched Path setup Use various mechanisms to forward traffic down a tunnel Integrate MPLS into the IP quality of service (QoS) spectrum of services Utilize Fast Reroute (FRR) to mitigate packet loss associated with link and node failures Understand Simple Network Management Protocol (SNMP)-based measurement and accounting services that are available for MPLS Evaluate design scenarios for scalable MPLS TE deployments Manage MPLS TE networks by examining common configuration mistakes and utilizing tools for troubleshooting MPLS TE problems "Eric and Ajay work in the development group at Cisco that built Traffic Engineering. They are among those with the greatest hands-on experience with this application. This book is the product of their experience." -George Swallow, Cisco Systems, Architect for Traffic Engineering Co-Chair, IETF MPLS Working Group Eric Osborne, CCIE(r) #4122, has been doing Internet engineering of one sort or another since 1995. He joined Cisco in 1998 to work in the Cisco Technical Assistance Center (TAC), moved from there to the ISP Expert team and then to the MPLS Deployment team. He has been involved in MPLS since the Cisco IOS(r) Software Release 11.1CT days. Ajay Simha, CCIE #2970, joined the Cisco TAC in 1996. He then went on to support tier 1 and 2 ISPs as part of Cisco's ISP Expert team. Ajay has been working as an MPLS deployment engineer since October 1999, and he has first-hand experience in

A comprehensive guide to implementing QoS in IP/MPLS networks using Cisco IOS and Cisco IOS XR Software Understand IP QoS architectures and how they apply to MPLS Take a detailed look at traffic management using policing, shaping, scheduling, and active queue management Study Cisco QoS behavioral model and the modular QoS command-line interface (MQC) Learn the operation of MPLS TE with its DiffServ extensions and applicability as a traffic-protection alternative Find multiple configuration and verification examples illustrating the implementation of MPLS TE, DS-TE, and FRR Review the different designs, ranging from a best-effort backbone to the most elaborate scenarios combining DiffServ, DS-TE, and FRR Quality of service (QoS) plays a key role in the implementation of IP and MPLS networks today. However, QoS can be one of the most complex aspects of networking. The industry efforts to achieve convergence have generated a need for increased levels of traffic differentiation. Today's networks need to meet an array of QoS requirements to support distinct applications (such as voice, video, and data) and multiple network services (such as IP, Ethernet, and ATM) on a single converged, multiservice network. QoS has therefore become an integral part of network design, implementation, and operation. QoS for IP/MPLS Networks is a practical guide that will help you facilitate the design, deployment, and operation of QoS using Cisco® IOS® Software and Cisco IOS XR Software. The book provides a thorough explanation of the technology behind MPLS QoS and related technologies, including the different design options you can use to build an MPLS network with strict performance requirements. This book discusses MPLS Traffic Engineering (MPLS TE) as a tool to complement MPLS QoS and enhance the performance characteristics of the network. You'll learn technology, configuration, and operational details, including the essential facts about the behavior and configuration of the rich MPLS QoS and related MPLS TE functionality. To get the most out of this book, you should have a basic understanding of both IP and MPLS, including the basics of IP addressing and routing and the basics of MPLS forwarding.

The only complete source of information on IP switching and routing technologies A master at distilling complex need-to-know networking technologies into a clear, to-the-point narrative, proven author Stephen Thomas now tackles IP switching and routing--the backbone of all Internet communications. He presents all the relevant technologies in the context of real-world applications, offering concise explanations and over 150 illustrations that make complex topics easy to understand. An invaluable resource for network managers and service provider professionals, this book delivers complete coverage of routing technologies--distance vector, link state, and path vector--as well as the full roster of Internet standard routing protocols: Routing Information Protocol (RIP), Border Gateway Protocol (BGP), and Open Shortest Path First (OSPF). The text then documents advances that enable Multi Protocol Label Switching (MPLS), including the MPLS architecture, its interaction with standards routing protocols, Constraint-Based Label Distribution Protocol (CR-LDP), and traffic engineering extensions to the Resource Reservation Protocol (RSVP-TE).

bull; Master advanced optical network design and management strategies bull; Learn from real-world case-studies that feature the Cisco Systems ONS product line bull; A must-have reference for any IT professional involved in Optical networks

A detailed guide for deploying PPTP, L2TPv2, L2TPv3, MPLS Layer-3, AToM, VPLS and IPSec virtual private networks.

This book constitutes the refereed proceedings of the workshops held at the 17th Asia-Pacific Web Conference, APWeb 2015, in Guangzhou, China, in September 2015. The 15



full papers were carefully reviewed and selected from various submissions. The volume presents the papers that have been accepted for the following workshops: Big Data Applications in Telecoms, BDAT 2015, Big Social Data, BSD 2015, and Web Data Mining and Applications, WDMA 2015. The papers cover various issues in the area of the World Wide Web with the underlying technologies and applications.

Advanced MPLS Design and Implementation enables you to: Understand MPLS through a detailed analysis of MPLS architecture and operation Design and implement packet-based MPLS Virtual Private Networks (VPNs) using label switching routers (LSRs) Design and implement ATM-based MPLS VPNs using WAN-switched ATM LSRs Implement MPLS traffic engineering on your core network and optimize traffic flows dynamically Implement MPLS QoS and provide hard service guarantees with multiple classes of service Acquire practical design and implementation knowledge of real-world MPLS VPNs, TE, and QoS through case studies and configuration examples Multiprotocol Label Switching (MPLS), intended for internetwork engineers and administrators who are responsible for designing, implementing, and supporting service provider or enterprise MPLS backbone networks, is a highly scalable, high-performance forwarding technology that has multiple applications in the service provider and enterprise environment. Use this book, which contains MPLS theory, design, configuration, and various case studies, as a reference and a guide for designing, implementing, and supporting an MPLS network. Even if you are not using Cisco equipment, this book can increase your awareness and understanding of MPLS technology, as well as provide you with detailed design concepts and rules for building scalable MPLS networks.

Today, the internet and computer networking are essential parts of business, learning, and personal communications and entertainment. Virtually all messages or transactions sent over the internet are carried using internet infrastructure- based on advanced internet protocols. Advanced internet protocols ensure that both public and private networks operate with maximum performance, security, and flexibility. This book is intended to provide a comprehensive technical overview and survey of advanced internet protocols, first providing a solid introduction and going on to discuss internetworking technologies, architectures and protocols. The book also shows application of the concepts in next generation networks and discusses protection and restoration, as well as various tunnelling protocols and applications. The book ends with a thorough discussion of emerging topics.

Multiprotocol Label Switching (MPLS) is a data plane and control technology that is used in packet (that is Internet Protocol) networks. Now over ten years old, it has taken root firmly as a fundamental tool in many service provider networks. The last ten years have seen a considerable consolidation of MPLS techniques and protocols. This has resulted in the abandoning of some of the original features of MPLS, and the development of other new features. MPLS has moved from a prospective solution, to a grown-up technology. Now that MPLS has reached this level of maturity, these new tools and features allow more sophisticated services to the users of the network. These tools and features are discussed within various contexts throughout several networking-related books published by MK and this presents us with a unique publishing opportunity. The proposed book is a best-of-the-best collection of existing content from several books MK has published in recent years on MPLS technology (multi-label protocol switching). Individual chapters on MPLS technology are derived from a handful of MK books and are combined in one new volume in a way that makes sense as a reference work for those interested in new and developing aspects of this technology, i.e., network operators and designers who need to determine which aspects of their networks would benefit from MPLS technology and applications. It also serves as a definitive reference for engineers implementing MPLS-based products. This book represents a quick and efficient way to bring valuable content together from leading experts in the field while creating a one-stop-shopping opportunity for customers to receive the information they would otherwise need to round up from separate sources. Suitable and current content will be collected from the following titles: Evans, Deploying IP and MPLS QoS (2006); Farrel, GMPLS (2005); Ash, Traffic Engineering (2006); Vasseur, Network Recovery (2005); Farrel, The Internet and Its Protocols (2004); Nadeau, MPLS Management (2003); and Davie, MPLS Technology and Applications (2000). These chapters will be updated where necessary and two new chapters will be added at the beginning and the end of the book to bring the content into focus and discuss next generation developments. Coverage of major applications of MPLS such as traffic engineering, VPNs, IP integration, GMPLS, and QoS written by leading experts in the field contributes to your practical knowledge of this key technology Shows you how to implement various MPLS applications that will result in saving your organization time and money Shows you how you can evaluate MPLS applications and techniques in relation to one another so you can develop an optimum network design A complete configuration manual for MPLS, MPLS VPNs, MPLS TE, QoS, Any Transport over MPLS (AToM), and VPLS Understand the crucial Cisco commands for various MPLS scenarios Understand fundamentals of MPLS operation and learn to configure basic MPLS in Frame Relay and ATM-based environments Master fundamentals of MPLS VPN operation including Multiprotocol BGP (MBGP) operation, VPNv4 route exchange, and basic MPLS VPN configuration in the provider network Understand and configure various PE-CE routing protocols in MPLS VPN networks Understand MPLS VPN provisioning in an Inter-provider VPN (Inter-AS) and Carrier Supporting Carrier (CSC) environment Learn MPLS TE and its advanced features Examine AToM with configuration examples for like-to-like and any-to-any L2 VPN implementations and VPLS components and operation, VPLS configuration and verification, and VPLS topologies Learn about MPLS QoS, including configuration and implementation of uniform and short pipe modes MPLS Configuration on Cisco IOS Software is a complete and detailed resource to the configuration of Multiprotocol Label Switching (MPLS) networks and associated features. Through its practical, hands-on approach, you'll become familiar with MPLS technologies and their configurations using Cisco IOS® Software. MPLS Configuration on Cisco IOS Software covers basic-to-advanced MPLS concepts and configuration. Beyond its emphasis on MPLS, you'll learn about applications and

deployments associated with MPLS, such as traffic engineering (TE), Layer 2 virtual private networks (VPN), and Virtual Private LAN Service (VPLS). You'll receive practical guidance and deployment scenarios that can be enhanced by re-creation of the setups and configurations demonstrated within this book. You'll move quickly from a brief overview of MPLS technology and basic MPLS configuration on Cisco® routers to more advanced topics. Several chapters provide instruction on VPN connectivity options, including implementing Border Gateway Protocol (BGP) in MPLS VPNs. You'll receive configuration guidelines for advanced MPLS implementations such as MPLS TE, quality of service (QoS), and extranet VPNs. You'll learn about implementation of Layer 2 VPNs versus Layer 3 VPNs with Cisco Any Transport over MPLS (AToM). And you'll see demonstrations of implementing VPLS on Cisco routers complete with the configurations and platform support. "I highly recommend MPLS Configuration on Cisco IOS Software as required reading for those in search of practical guidance of the technology and nuances of configuring MPLS for next-generation networks for voice, video, data, and application service offerings across a wide variety of deployment scenarios." --Carlos Dominguez, Senior Vice President, Worldwide Service Provider Operations, Cisco Systems® This book is part of the Networking Technology Series from Cisco Press®, which offers networking professionals valuable information for constructing efficient networks, understanding new technologies, and building successful careers.

This book is a compilation of works presenting recent advances and progress in optical fiber technology related to the next generation optical communication, system and network, sensor, laser, measurement, characterization and devices. It contains five sections including optical fiber communication systems and networks, plastic optical fibers technologies, fiber optic sensors, fiber lasers and fiber measurement techniques and fiber optic devices on silicon chip. Each chapter in this book is a contribution from a group of academicians and scientists from a prominent university or research center, involved in cutting edge research in the field of photonics. This compendium is an invaluable reference for researchers and practitioners working in academic institutions as well as industries.

An introduction to Multi-Protocol Label Switching (MPLS) and related technologies for the network administrator. It provides the key definitions and terminology relating to MPLS and explains the technologies that have come together to create MPLS.

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