

Designing ATM MPLS Networks

Version 0.5.1, Cisco Internal Use Only.

Jeremy Lawrence, Multiservice Switching Business Unit

Note on Versions

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Outline

Multiprotocol Label Switching (MPLS) extends the capabilities of IP routers and ATM switches in several key ways:

- It fully integrates IP Routing control with ATM switches, providing native support of IP services such as IP Class of Service and IP Multicast on ATM switches as well as routers.
- It provides support for scalable and flexible IP Virtual Private Network (VPN) services on both switches and routers.
- It provides support for IP Traffic Engineering, which is the fine-grained adjustment of IP traffic flows according to the resources in a network.

This version of *Designing ATM MPLS Networks* concentrates on the fundamentals of ATM MPLS network design. These fundamentals apply to all ATM MPLS networks, irrespective of the services being offered on them:

- Choosing MPLS equipment
- IP+ATM: concepts and equipment
- Designing and dimensioning ATM MPLS points of presence
- Dimensioning MPLS network links
- IP routing in ATM MPLS networks
- Dimensioning MPLS Label VC requirements
- Ongoing network design
- Migrating ATM networks to MPLS

Open Issues

Specific Comments & Errata

- 3.1: In Figure 4c it's not clear that the data flow is CPE -- MGX -- eLSR -- MPLS cloud. A revised version of the diagram would make this clearer.
- 3.4: The equations are either correct or "safe" over-estimates. However some slightly tighter limits apply to the edge LSRs in networks with switches which use unpaired cross-connects, namely the LS1010, 6400 and 8540 MSR. These should be mentioned.

Design Guide Designing Atm Mpls Networks Mik

Jim Guichard



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Subject Guide to Books in Print, 2001 Advanced MPLS Design and Implementation Vivek Alwayn, 2001 An in depth guide to understanding advanced MPLS implementation including packet based VPNs ATM based VPNs traffic engineering and quality of service 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 is a highly scalable high performance forwarding technology that has multiple applications in the service provider and enterprise environment This book is intended for internetwork engineers and administrators who are responsible for designing implementing and supporting service provider or enterprise MPLS backbone networks It contains a broad range of technical details on MPLS and its associated protocols packet based MPLS ATM based MPLS MPLS traffic engineering MPLS QoS MPLS design and advanced MPLS architectures This book contains MPLS theory design configuration and various case studies Use this book as a reference and guide for designing implementing and supporting an MPLS network Even if you re not using Cisco r 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 Advanced MPLS Design and Implementation is your guide to understanding designing and implementing MPLS VPNs WAN switched MPLS VPNs MPLS traffic engineering and MPLS QoS **Advanced MPLS Design and Implementation** Vivek #2995, 2001 An in depth guide to understanding advanced MPLS implementation including packet based VPNs ATM based VPNs traffic engineering and quality of service 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 is a highly scalable high performance forwarding technology that has multiple applications in the service provider and enterprise environment This book is intended for internetwork engineers and administrators who are responsible for designing implementing and supporting service provider or enterprise MPLS backbone networks It contains a broad range of technical details on MPLS and its associated protocols packet based MPLS ATM based MPLS MPLS traffic engineering MPLS QoS

MPLS design and advanced MPLS architectures This book contains MPLS theory design configuration and various case studies Use this book as a reference and guide for designing implementing and supporting an MPLS network Even if you are not using Cisco's 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 Advanced MPLS Design and Implementation is your guide to understanding designing and implementing MPLS VPNs WAN switched MPLS VPNs MPLS traffic engineering and MPLS QoS

Designing ATM Switching Networks Mohsen Guizani, Ammar Rayes, 1999 A comprehensive professional guide to designing ATM networks No technology is more critical to modern communications than Asynchronous Transfer Mode ATM This fast packet switching method maximizes bandwidth capacity reduces technical and performance problems in networks and functions across any line twisted pair coaxial cable or fiber optic In this superb guide from two leading experts you will find complete topnotch help with every step in the design selection and application of ATM switching in broadband networks Clearly written and fully illustrated this book clarifies every aspect of this complex and important field You get step by step guidance on maximizing performance in any network environment efficiently managing traffic and capacity analyzing comparing and selecting routing policies use of traffic models for network dimensioning describing switches from Nortel ATM reducing cell loss and cell error probability cascading ATM switches in parallel for Gibbs speed No matter what your ATM question Designing ATM Switching Networks has the answer

ATM & MPLS Theory & Application: Foundations of Multi-Service Networking David E. McDysan, Dave Paw, 2002-09-26 Solve all your networking problems and improve overall performance using this detailed guide to ATM and IP technologies You will get full coverage of circuits multiplexing switching frame relay bridging routing signaling and much more This practical guide also covers ATM hardware software and high layer protocols

ATM Technology and Services Delivery M. R. Karim, 2000 Not just a guide to the technology and standards a real implementer's guide Extensive real world examples and details interworking with LANs IP xDSL multimedia wireless and much more Advanced ATM applications wireless ATM CDMA integration Multi Protocol Label Switching MPLS and more Finally there is an ATM guide that doesn't just catalog the technology and standards but also demonstrates exactly how to design today's most important real world ATM applications Start with an expert introduction to ATM technology protocols call control procedures switching traffic management and network management Next and most importantly review the key design challenges tradeoffs and best solutions associated with each of today's most important ATM applications Master LAN emulation over ATM classical IP over ATM and multi protocol over ATM and delivering multimedia services over ATM Finally discover the state of the art in emerging ATM technologies and standards including multi protocol label switching MPLS and other approaches to wireless ATM The book is replete with detailed design examples focused on helping engineers create high performance cost effective ATM systems and services that succeed in the marketplace For any engineer involved with delivering ATM products and services including

hardware manufacturers designers of network management systems customer network engineers and architects

Definitive MPLS Network Designs Jim Guichard,François Le Faucheur,Jean-Philippe Vasseur,2005-03-14 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

ATM Networks Othmar Kyas,Gregan Crawford,2002 ATM Networkscombines a complete description of ATM standards with practical solutions for the challenges of ATM network implementation and management

Clear concise and fully up to date it covers every element and variant of current ATM networks presenting best practices for design testing deployment and troubleshooting It covers the latest standards from Loop Emulation Service over AAL 2 and frame based ATM to ATM over plastic and offers exceptionally detailed guidance on securing ATM networks

MPLS-Enabled Applications Ina Minei, Julian Lucek, 2010-12-10 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 Communications Networking : Atm & Mpls And Theory Application Foundations Of Multi-Service Networking, The Ultimate Reference David E. Mcdysan, Et. Al, Solve all your networking problems and improve overall performance using this detailed guide to ATM and IP technologies You ll get full coverage of circuits multiplexing switching frame relay bridging routing signaling and much more This practical guide also covers ATM hardware software and high layer protocols Tap into the power of ATM and MPLS technology with this definitive guide Focusing on practical application over theory this book combines background

information with detailed treatment of all key areas of ATM and MPLS technology making this an essential resource You ll find details on the topologies protocols and services used in today s digital communications networks and read provocative predictions about how ATM and MPLS might evolve Detailed informative and comprehensive this is the ultimate resource for understanding and working with this essential and powerful networking technology

Design of Nonblocking ATM Networks J. Andrew Fingerhut,1996 Abstract This paper considers the problem of designing ATM networks that are nonblocking with respect to virtual circuit requests subject to specified constraints on the traffic In this paper we focus on global traffic constraints that simply limit the total entering and exiting traffic at each switching system After reviewing prior results for linear link costs we introduce a more realistic link cost model and develop a number of results using it We also describe a technique for converting tree structured networks to nonblocking hierarchical networks satisfying limits on the capacity of any single switch

MPLS and VPN Architectures: MPLS-based Virtual Private Networks. Ch. 7. Virtual Private Network (VPN) Implementation Options. Ch. 8. MPLS Jim Guichard,2001 MPLS and VPN Architectures provides the first in depth discussion particular to Cisco s MPLS architecture This book covers MPLS theory and configuration network design issues and case studies as well as one major MPLS application MPLS based VPNs The MPLS VPN architecture and all of its mechanisms are explained with configuration examples suggested design and deployment guidelines and extensive case studies MPLS and VPN Architectures is your practical guide to understanding designing and deploying MPLS and MPLS based VPNs Book Jacket

The Design and Modeling of Input and Output Modules for an ATM Network Switch Darin Murphy,1997 ABSTRACT The purpose of this thesis is to design model and simulate both an input and an output module for an ATM network switch These devices are used to interface an ATM switch with the physical protocol that is transporting data along the actual transmission medium The I O modules have been designed specifically to interface with the Synchronous Optical Network SONET protocol This thesis studies the ATM protocol and examines the issues involved with designing and ATM I O module chipset A model of the design was then implemented in both C and VHDL These models were simulated in order to verify functionality and document performance The intent of this work is to provide the background and models necessary to aid in the further study and development of entire ATM switch architectures The input and output modules are only two functional pieces of a complete ATM switch The software models that have been implemented by this thesis can be integrated with the other necessary functional blocks to form a complete model of a working ATM switch These functional blocks can then be rearranged and altered to assist in the study of how different switch architectures can effect overall network performance and efficiency The input and output modules have been designed to be as flexible as possible in order to easily adapt to future modifications

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