# mpls for dummies

**mpls for dummies** can demystify a complex networking technology for anyone looking to understand how data travels efficiently across networks. This article will break down Multiprotocol Label Switching (MPLS) into easily digestible concepts, covering its core functionality, the benefits it offers to businesses, and how it operates. We'll explore the fundamental principles behind MPLS, its advantages over traditional routing, and the common use cases that make it a cornerstone of modern wide area networks. Whether you're a small business owner, an IT professional new to networking, or simply curious about how the internet and private networks handle large volumes of traffic, this guide aims to provide clarity and a solid foundational understanding of MPLS technology.

## What is MPLS and Why Should You Care?

MPLS, or Multiprotocol Label Switching, is a high-performance routing technique for scalable telecommunications networks. Unlike traditional IP routing, which examines the destination IP address in each packet header to determine the next hop, MPLS utilizes short path labels to forward data. This method significantly speeds up and simplifies traffic flow within a network. For businesses, understanding MPLS is crucial as it often underpins the reliable and efficient delivery of their critical data. It's a technology that bridges the gap between the flexibility of IP routing and the speed and predictability of circuit-switched networks.

## The Core Problem MPLS Solves: Network Congestion and Complexity

As networks grow and the volume of data traffic increases, traditional IP routing can become a bottleneck. Each router along the path must perform a deep inspection of the packet header, which consumes processing power and time. This can lead to delays, packet loss, and a less predictable network experience. MPLS was designed to overcome these limitations by introducing a layer of abstraction. Instead of relying solely on IP addresses, MPLS adds a small label to each packet. This label acts as a shortcut, allowing routers to forward packets much more quickly based on the label's value rather than the full IP address lookup. This streamlined approach is particularly beneficial for complex enterprise networks and service provider infrastructures.

## Understanding the "Multiprotocol" Aspect of MPLS

The "Multiprotocol" in MPLS signifies its ability to carry various types of network traffic, not just IP packets. While it's most commonly used for IP traffic, MPLS can also switch packets from technologies like

Asynchronous Transfer Mode (ATM) and Frame Relay. This inherent flexibility makes MPLS a versatile solution for integrating different network technologies and protocols. It allows organizations to build a unified network fabric that can handle diverse traffic requirements without needing separate infrastructures for each protocol type. This unification simplifies network management and reduces operational costs.

# How Does MPLS Work? The Mechanics of Label Switching

At its heart, MPLS operates by assigning labels to data packets and then using these labels for forwarding decisions. This process involves several key components and stages that work in concert to ensure efficient data transport.

## Label Edge Routers (LERs) and Label Switching Routers (LSRs)

The MPLS network is comprised of two main types of routers: Label Edge Routers (LERs) and Label Switching Routers (LSRs). LERs reside at the edge of the MPLS network. When a packet enters the MPLS domain, the ingress LER analyzes its destination IP address. Based on this analysis and the defined forwarding rules, the LER assigns a label to the packet. This labeled packet then enters the core of the MPLS network. LSRs are the routers within the MPLS core. Unlike traditional routers, LSRs do not perform IP lookups for every packet. Instead, they examine the label attached to the packet. Based on the label and their internal Label Information Base (LIB), LSRs perform a simple label swap or pop operation, forwarding the packet to the next hop. When a packet exits the MPLS domain, the egress LER removes the label, and the packet continues its journey as a standard IP packet.

## Label Distribution Protocol (LDP) and its Role

Labels are not assigned randomly. A sophisticated mechanism is required to distribute these labels throughout the MPLS network and ensure that all routers agree on the labels and their corresponding forwarding paths. This is where the Label Distribution Protocol (LDP) comes into play. LDP is used by LSRs to communicate and exchange label mappings. It allows routers to learn about the labels that other routers have assigned to specific destinations or forwarding equivalence classes (FECs). This dynamic label distribution ensures that the MPLS network can adapt to changes and maintain accurate forwarding information. Other protocols like Border Gateway Protocol (BGP) can also be used to distribute labels, especially in more complex scenarios, to provide traffic engineering capabilities.

## Forwarding Equivalence Classes (FECs)

A Forwarding Equivalence Class (FEC) is a group of IP packets that are treated the same by the MPLS network and are forwarded along the same path. Essentially, all packets belonging to the same FEC will receive the same label assignment and follow the same label-switched path (LSP). FECs are typically defined based on destination IP address prefixes, but can also be based on other criteria. By grouping packets into FECs, MPLS can reduce the number of labels that need to be managed, simplifying the routing tables and improving performance. This concept is fundamental to how MPLS achieves efficient packet forwarding.

# Key Benefits of MPLS for Businesses

MPLS offers a compelling set of advantages that make it a preferred choice for businesses seeking robust, reliable, and secure network connectivity. These benefits translate directly into improved operational efficiency and cost savings.

## Enhanced Performance and Reduced Latency

One of the most significant benefits of MPLS is its ability to provide faster packet forwarding than traditional IP routing. By using labels for quick lookups instead of complex IP address lookups, MPLS reduces processing overhead on routers. This results in lower latency, meaning data packets travel across the network more quickly. For applications that are sensitive to delay, such as voice over IP (VoIP) and video conferencing, this reduction in latency is critical for ensuring a smooth and high-quality user experience. The predictable nature of MPLS paths also contributes to consistent performance, even during periods of high network traffic.

## Improved Network Reliability and Resilience

MPLS networks can be designed with built-in redundancy and automatic failover capabilities. If a link or router fails, MPLS can quickly reroute traffic along alternative paths. This inherent resilience ensures that critical business operations can continue with minimal disruption. The ability to pre-define backup paths and quickly switch to them when issues arise makes MPLS a highly reliable solution for mission-critical applications. This level of uptime is invaluable for businesses that cannot afford to have their networks go down.

## Enhanced Security Features

MPLS inherently provides a degree of network segmentation and security. By creating private, virtual paths (Label Switched Paths or LSPs) between locations, MPLS traffic is kept separate from other traffic on the provider's network. This isolation acts as a security barrier, making it much harder for unauthorized access. For businesses that handle sensitive data, this built-in security is a significant advantage. While not a replacement for encryption, MPLS provides a strong foundation for secure data transmission across wide area networks.

## Traffic Engineering Capabilities

MPLS empowers network administrators with sophisticated traffic engineering capabilities. This means they can actively manage and control the flow of traffic across the network, directing it along specific paths to optimize bandwidth utilization, avoid congestion, and meet specific Quality of Service (QoS) requirements. For example, if a particular link is experiencing heavy traffic, administrators can use MPLS traffic engineering to reroute less critical traffic onto less congested links. This proactive management ensures that the network performs optimally under various conditions and that the most important applications receive the necessary resources.

## Quality of Service (QoS) Guarantees

MPLS is excellent at supporting Quality of Service (QoS). This allows businesses to prioritize certain types of traffic over others. For instance, voice and video traffic can be given higher priority than email or file transfers, ensuring that real-time applications have the bandwidth and low latency they need to function properly. MPLS achieves this by classifying traffic and assigning different levels of priority and resources to different FECs or LSPs. This granular control over traffic ensures a better experience for end-users and supports the performance demands of modern business applications.

# Common MPLS Use Cases in Business

The versatility and robust features of MPLS have made it a popular choice for a wide range of business networking needs. Its ability to provide reliable, secure, and high-performance connectivity makes it ideal for several key applications.

## Private Wide Area Networks (WANs)

One of the most common applications for MPLS is the creation of private WANs for businesses with multiple branch offices. MPLS allows organizations to connect their geographically dispersed locations securely and efficiently over a service provider's network. This creates a virtual private network that offers the performance and security benefits of a dedicated private line, but often at a more cost-effective price point. This is crucial for businesses that need to share data, applications, and resources between their offices seamlessly.

## Connecting to Cloud Services

As more businesses adopt cloud computing, MPLS plays a vital role in providing reliable and secure access to cloud-based applications and data centers. MPLS can offer predictable performance and enhanced security for traffic destined for the cloud, overcoming some of the inherent limitations of the public internet. This ensures that cloud services perform as expected and that sensitive data transmitted to and from the cloud remains protected.

## Voice and Video Conferencing Solutions

The Quality of Service (QoS) capabilities of MPLS make it an excellent choice for supporting real-time communication applications like VoIP and video conferencing. By prioritizing voice and video packets, MPLS ensures that these latency-sensitive applications receive the necessary bandwidth and experience minimal jitter and delay. This leads to clear, uninterrupted conversations and high-quality video, which are essential for modern business collaboration.

## Data Center Interconnect (DCI)

For organizations with multiple data centers or those looking to interconnect their on-premises infrastructure with cloud provider data centers, MPLS offers a robust and scalable solution. MPLS can provide high-bandwidth, low-latency connectivity between data centers, enabling efficient data replication, disaster recovery, and distributed application deployment. Its ability to handle large volumes of traffic reliably makes it well-suited for the demanding requirements of DCI.

# Frequently Asked Questions

## What is MPLS and why would a 'dummy' need to know about it?

MPLS stands for Multi-Protocol Label Switching. Think of it as a super-efficient postal service for data packets on a network. Instead of looking at the full address on every single envelope (like traditional IP routing), MPLS attaches a short, colored label. This label tells the network exactly where to send the packet next, making data travel much faster and more predictably. A 'dummy' (meaning someone new to networking) might need to know because it's a foundational technology powering many modern business networks and cloud services, impacting speed and reliability.

## How is MPLS faster than regular IP routing?

Traditional IP routing involves routers looking at the full destination IP address of each packet and consulting large routing tables to decide the next hop. This is like a post office worker having to read the complete address on every single letter. MPLS simplifies this by using short labels. Routers (called Label Switch Routers or LSRs) only need to look at the label. The path is pre-determined, so the router quickly swaps the incoming label for an outgoing one and forwards the packet. This 'label swapping' is much faster than complex IP lookups.

## What are the main benefits of using MPLS?

MPLS offers several key advantages. Firstly, it provides improved performance due to faster packet forwarding. Secondly, it offers enhanced Quality of Service (QoS), allowing businesses to prioritize critical traffic (like voice or video) over less time-sensitive data. Thirdly, it can create secure and private connections over a shared network infrastructure (like a VPN). Finally, it simplifies network management by providing predictable traffic paths.

## Is MPLS only for big companies, or can smaller businesses use it?

While MPLS has historically been associated with larger enterprises, its accessibility has grown significantly. Many Internet Service Providers (ISPs) offer MPLS services, and they often bundle it with other connectivity solutions, making it more affordable and manageable for small to medium-sized businesses (SMBs). The benefits of predictable performance and traffic prioritization can be valuable for any organization with growing network needs.

## What's the difference between MPLS and a regular VPN?

Both MPLS and VPNs can create secure connections. A VPN (Virtual Private Network) typically encrypts data and tunnels it over the public internet. It's like sending a locked box through a public courier. MPLS, on the other hand, creates a private, virtual path within the provider's network. It's more like having your own dedicated lane on a highway. While MPLS can be used to build VPNs, it offers benefits like guaranteed performance and QoS that are harder to achieve with a standard internet-based VPN.

## If MPLS is so great, why isn't everyone using it?

MPLS has traditionally been more complex and costly to implement and manage than basic internet connectivity. Historically, it required specialized hardware and expertise. However, the rise of Software-Defined Networking (SDN) and cloud-based MPLS offerings are making it more accessible. Also, for very simple internet browsing or basic connectivity, the overhead of MPLS might not be necessary. Emerging technologies like SD-WAN are also offering alternative ways to achieve similar benefits to MPLS, often with more flexibility.

# Additional Resources

Here are 9 book titles and descriptions related to "MPLS for Dummies":

1. *MPLS for Mere Mortals*
This book breaks down the complex world of Multiprotocol Label Switching into easily digestible concepts. It assumes no prior networking knowledge and guides beginners through the fundamental principles of MPLS, from its basic operations to its core advantages. Readers will understand why MPLS is a crucial technology for modern networks and how it facilitates efficient data transport.

2. *The Absolutely Essential MPLS Handbook*
Forget the jargon; this handbook makes MPLS accessible to everyone. It focuses on the practical applications and benefits of MPLS, demystifying terms like LDP, LDP, and VPNs. This guide is perfect for IT professionals who need to grasp MPLS quickly without getting lost in technical minutiae.

3. *MPLS Made Simple: Your First Steps into Label Switching*
This introductory guide serves as your entry point into the realm of MPLS. It explains the "why" behind MPLS and its role in improving network performance and scalability. The book uses clear analogies and straightforward language to explain how labels enable faster forwarding and support for various traffic types.

4. *Your Personal MPLS Navigator*
Navigate the complexities of Multiprotocol Label Switching with this user-friendly guide. It focuses on the foundational concepts, explaining how MPLS operates at a high level. The book is designed for individuals who need to understand the basic architecture and benefits of MPLS without needing to configure it themselves.

5. *The Layman's Guide to Understanding MPLS*
Demystifying Multiprotocol Label Switching, this guide is written for those with limited or no technical networking background. It covers the essential building blocks of MPLS, explaining its purpose and how it differs from traditional IP routing. Readers will gain a solid conceptual understanding of what MPLS is and why it's important for efficient network management.

6. *MPLS for the Curious Beginner*
If you've heard of MPLS and want to know what it's all about, this book is for you. It provides a gentle introduction to the technology, explaining its key components and how they work together. The focus is on building intuition and understanding the benefits of label switching in a clear and accessible manner.

7. *An Introduction to MPLS: Beyond the Basics (for Beginners)*
This book bridges the gap between not knowing anything about MPLS and understanding its core functionalities. It introduces the fundamental concepts of label-switched paths (LSPs) and the control plane mechanisms that make MPLS work. While it touches upon advanced ideas, the primary goal is to build a strong foundation for beginners.

8. *MPLS Explained: From Zero to Understanding*
This title promises a journey from complete ignorance to a solid grasp of MPLS. It breaks down the technology into manageable chunks, explaining the purpose of labels and the advantages of MPLS in modern networks. The book is perfect for anyone who needs to understand the "what" and "why" of MPLS without getting bogged down in advanced configuration details.

9. *The Uncomplicated MPLS Primer*
This primer strips away the complexity to reveal the core essence of MPLS. It uses simple language and relatable examples to explain how MPLS revolutionizes network traffic forwarding. The book is ideal for individuals who are new to networking concepts and want a straightforward introduction to label switching technology.

## Mpls For Dummies



# MPLS for Dummies

Author: Network Nerd

Ebook Outline:

Introduction: What is MPLS? Why should I care?
Chapter 1: Understanding MPLS Fundamentals: Label Switching, VPNs, and Basic Architecture.
Chapter 2: MPLS in Action: Common Use Cases: Connecting Branch Offices, Internet Access, and Disaster Recovery.
Chapter 3: Key MPLS Components: Labels, Label Switching Routers (LSRs), Label Distribution Protocols (LDPs).
Chapter 4: MPLS VPNs (VPNs): Securing Your Network with MPLS.
Chapter 5: Troubleshooting MPLS Networks: Common Problems and Solutions.

# MPLS for Dummies: A Comprehensive Guide

## Introduction: What is MPLS and Why Should You Care?

Multiprotocol Label Switching (MPLS) might sound intimidating, but at its core, it's a sophisticated method for moving data across a network more efficiently and securely than traditional routing protocols. Imagine a highway system: traditional routing is like using a GPS to navigate every single street; MPLS is like using expressways that bypass smaller roads, delivering your data packets faster and with less congestion. This is especially relevant in today's complex networks, where businesses need to move vast amounts of data quickly and reliably. Whether you're managing a small business network or a large enterprise, understanding the basics of MPLS can be crucial for optimizing performance, enhancing security, and making informed technology decisions. This guide will demystify MPLS, providing you with a clear understanding of its core concepts and practical applications.

## Chapter 1: Understanding MPLS Fundamentals: Label Switching, VPNs, and Basic Architecture

MPLS works by assigning "labels" to data packets. These labels are short, unique identifiers that guide the packets across the network. Instead of examining the entire packet header at each hop (like traditional routing), routers using MPLS only look at the label to determine the next hop. This "label switching" significantly speeds up the forwarding process. Think of it as using a shortcut: instead of reading the entire address on every street corner, you only need to follow the signs.

MPLS also allows for the creation of Virtual Private Networks (VPNs). An MPLS VPN creates a secure, isolated network over a shared infrastructure. This is particularly useful for businesses that need to connect multiple branch offices securely over a public network like the internet. The architecture typically involves Label Switching Routers (LSRs) at each network edge and core. These LSRs handle the label assignment, switching, and forwarding processes.

## Chapter 2: MPLS in Action: Common Use Cases

MPLS finds application in numerous scenarios:

Connecting Branch Offices: MPLS VPNs provide secure and efficient connections between geographically dispersed branch offices, enabling seamless data exchange and collaboration.
Internet Access: MPLS can provide high-bandwidth, reliable internet access, especially beneficial for businesses with stringent network performance requirements.
Disaster Recovery: MPLS can be used to create redundant network paths, ensuring business continuity in the event of a disaster or outage.
Carrier Ethernet Services: MPLS is often used to deliver Ethernet services over long distances, offering a cost-effective solution for high-bandwidth applications.
Voice over IP (VoIP): MPLS provides the quality of service (QoS) necessary for real-time voice communication, ensuring clear and uninterrupted calls.

## Chapter 3: Key MPLS Components: Labels, Label Switching Routers (LSRs), Label Distribution Protocols (LDPs)

Understanding the components of an MPLS network is crucial to grasping its functionality:

Labels: These are short, unique identifiers attached to data packets. They are the key to fast forwarding within the MPLS network.
Label Switching Routers (LSRs): These are the routers that perform the label switching operations. They are the backbone of the MPLS network. There are edge LSRs (at the network's edge) and core LSRs (in the network's core).
Label Distribution Protocols (LDPs): These protocols are responsible for the exchange of label information between LSRs. LDP is a common protocol used to set up and maintain the label mappings within the MPLS network. Other protocols like RSVP-TE (Resource Reservation Protocol – Traffic Engineering) can also be employed for more advanced traffic engineering needs.

## Chapter 4: MPLS VPNs (VPNs): Securing Your Network with MPLS

MPLS VPNs provide a secure and isolated network over a shared infrastructure. This is critical for protecting sensitive data and maintaining confidentiality. MPLS VPNs use labels to segregate traffic from different customers or departments, ensuring that only authorized users can access specific data. This is a significant advantage over traditional VPNs, which rely on encryption alone. The security is layered: the physical separation provided by the MPLS labels enhances the security of the encryption methods employed within the VPN.

## Chapter 5: Troubleshooting MPLS Networks: Common Problems and Solutions

Troubleshooting MPLS networks can be challenging due to its complex architecture. However, understanding common issues and their solutions can significantly improve network uptime and performance. Common problems include label swapping failures, LDP adjacency issues, and QoS problems. Effective troubleshooting involves using network monitoring tools, analyzing logs, and employing techniques like traceroute and ping.

## Chapter 6: MPLS vs. Other Technologies: Comparing MPLS to Alternatives

MPLS is not the only option for network connectivity. Comparing MPLS to other technologies, such as Software-Defined Networking (SDN) and IP/MPLS VPNs, helps businesses make informed decisions about which technology best suits their needs. The choice depends on factors like budget, scalability requirements, and the desired level of security. SDN offers greater flexibility and programmability, while IP/MPLS VPNs provide a more traditional approach.

## Chapter 7: The Future of MPLS: Evolution and Emerging Trends

While newer technologies are emerging, MPLS remains relevant. Its evolution includes integration with SDN and NFV (Network Functions Virtualization). This allows for greater automation, flexibility, and cost savings. The future of MPLS likely involves a hybrid approach, combining its strengths with the agility of SDN and the cost-effectiveness of NFV.

## Conclusion: Recap and Next Steps

MPLS provides a robust and efficient way to transport data across networks. Understanding its fundamentals and applications empowers you to make informed decisions regarding network design, security, and performance optimization. This guide has provided a foundational understanding of MPLS; further exploration of specific areas like LDP configuration, VPN setup, and troubleshooting techniques will enhance your expertise.

# FAQs

1. What is the difference between MPLS and traditional routing? MPLS uses labels for fast forwarding, while traditional routing examines the entire packet header at each hop.

2. Is MPLS secure? MPLS itself doesn't provide security; however, it can be used to create secure MPLS VPNs.

3. What are the benefits of using MPLS? Improved performance, enhanced security, scalability, and cost-effectiveness.

4. What are the limitations of MPLS? Complexity, cost of implementation, and potential vendor lock-in.

5. How does MPLS handle Quality of Service (QoS)? MPLS can prioritize certain types of traffic, ensuring that time-sensitive applications receive the necessary bandwidth.

6. What is an LSR? A Label Switching Router; the core component of an MPLS network.

7. What is LDP? Label Distribution Protocol; a protocol used to exchange label information between LSRs.

8. How can I troubleshoot MPLS issues? Using network monitoring tools, analyzing logs, and employing techniques like traceroute and ping.

9. Is MPLS still relevant in the age of SDN? Yes, MPLS continues to be relevant, often integrated with SDN for enhanced flexibility and programmability.

# Related Articles:

1. MPLS VPN Configuration: A step-by-step guide to setting up an MPLS VPN.
2. MPLS Troubleshooting Techniques: Advanced troubleshooting methods for MPLS networks.
3. MPLS and QoS: A Deep Dive: A detailed explanation of Quality of Service in MPLS networks.
4. Comparing MPLS and SDN: A comprehensive comparison of MPLS and Software-Defined Networking.
5. MPLS Security Best Practices: Strategies for securing your MPLS network.
6. The Future of MPLS in Cloud Environments: How MPLS is adapting to cloud computing.
7. MPLS Cost Optimization Strategies: Tips for reducing the cost of your MPLS network.
8. Understanding MPLS Label Switching: A detailed explanation of the label switching process.
9. Case Studies of MPLS Implementation: Real-world examples of MPLS deployments in various industries.

**mpls for dummies:** CISSP For Dummies Lawrence C. Miller, Peter H. Gregory, 2007-04-02 The fun and easy way® to pass the CISSP exam and get certified Cramming for the CISSP exam? This

friendly test-prep guide makes studying a snap! Prepared by two CISSP-certified experts, it gets you up to speed on the latest changes to the exam and gives you proven test-taking tips. You&'ll find complete coverage of all ten domains of the (ISC)2 Common Body of knowledge to help you pass with flying colors.

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**mpls for dummies: JUNOS OS For Dummies** Walter J. Goralski, Cathy Gadecki, Michael Bushong, 2011-10-18 Here's just what you need to get your network running smoothly and securely on Janos. This guide will help you configure, add key services, enhance security, and make your network more efficient --

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**mpls for dummies: The Real Internet Architecture** Pamela Zave, Jennifer Rexford, 2024-08-06 This book offers a description of the architecture of the Internet as it actually exists now. It is a revolutionary description, based on a completely new model of network architecture, explaining how the Internet has evolved from its origins and how it is still evolving, and exposing previously unarticulated patterns and trends in network architecture. Essentially all discussion of the Internet is still dominated by the classic (five-layer) model put forth by its originators. This model is so outdated that it is a hindrance to understanding Internet evolution, as well as to teaching and doing effective research on networking. This book replaces it with a new model of networking called compositional network architecture. This model has been formalized, but the book does not use the formal model; rather, the book relies on the model's accuracy and precision as a foundation for a convincing informal explanation, accessible to a much broader audience than a formal model would be (the formal model will be available on a companion website, along with teaching material). Many scholars and practitioners, seeing the Internet only through the lens of the classic Internet architecture, complain that the Internet has not evolved past its original architecture. Compositional network architecture is a general model for describing many architectures, and it shows clearly how the Internet has evolved since the early 1990s, and how it continues to evolve. Though the book is

based on a conceptual model and is therefore a relatively abstract treatment, it is illustrated with hundreds of contemporary Internet examples, so there is no lack of concrete detail or grounding in reality. Compared to older works on networking, the book is also more concerned with network services-how a network helps users communicate. This is a natural outgrowth of the Internet as subject matter. Performance and scalability are the usual themes of Internet literature, as they were certainly the most important challenges of the Internet's early years. Since the 1990s, however, progress on performance and scalability has been steady and incremental. The major motivation for Internet evolution since then has been the need for enhanced services, including mobility, multicast, security, privacy, reliability, and support for content distribution, and the book will engage with these themes. It will serve as a reference for anyone dealing with internet architecture, and as a graduate textbook for networking courses--

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**mpls for dummies:** *An Introduction to LTE* Christopher Cox, 2014-05-12 Following on from the successful first edition (March 2012), this book gives a clear explanation of what LTE does and how it works. The content is expressed at a systems level, offering readers the opportunity to grasp the key factors that make LTE the hot topic amongst vendors and operators across the globe. The book assumes no more than a basic knowledge of mobile telecommunication systems, and the reader is not expected to have any previous knowledge of the complex mathematical operations that underpin LTE. This second edition introduces new material for the current state of the industry, such as the new features of LTE in Releases 11 and 12, notably coordinated multipoint transmission and proximity services; the main short- and long-term solutions for LTE voice calls, namely circuit switched fallback and the IP multimedia subsystem; and the evolution and current state of the LTE

market. It also extends some of the material from the first edition, such as inter-operation with other technologies such as GSM, UMTS, wireless local area networks and cdma2000; additional features of LTE Advanced, notably heterogeneous networks and traffic offloading; data transport in the evolved packet core; coverage and capacity estimation for LTE; and a more rigorous treatment of modulation, demodulation and OFDMA. The author breaks down the system into logical blocks, by initially introducing the architecture of LTE, explaining the techniques used for radio transmission and reception and the overall operation of the system, and concluding with more specialized topics such as LTE voice calls and the later releases of the specifications. This methodical approach enables readers to move on to tackle the specifications and the more advanced texts with confidence.

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