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# Introduction

The 21<sup>st</sup> century marketscape of the telecommunications industry is undergoing substantial change, more so for service providers than for any other users of communication technology and services. A global technology infusion of IP, optical, and wireless mobility has presented new opportunities for the service delivery of data, voice, and video for communications and computing in real time—anytime, and anywhere. These and other technology innovations are creating a dynamic shift in the number of service substitutions now available across all provider segments. The future of telecommunications has already been inexorably changed, as next-generation network services are capable of reaching markets and customers worldwide. The world has indeed become internetworking-centric and communications service dependent.

Next-generation network services are the collective conduit through which to meet the needs of a technology-enabled culture. More specifically, next-generation network services are the inventive optimization of technology and service platforms to meet a new era of IP-centric networking requirements and customer opportunity. Service is the emphasis, as IP has become a prolific communications portal through which to deliver interactive solutions that improve business execution, tie the individual consumer into commerce, and extend market reach by removing the last barriers of time and distance.

Also evident is a fundamental change in network and systems architectures from vertical silos based on low-layer proprietary systems to horizontal architectures based on higher-layer, open standards such as IP. This is the essential distinction: next-generation network services transcend the physical layer at Layer 1 and move upscale into Layers 2, 3, and beyond. Services are decoupled from transport as a result of IP-based any-to-any networking. Higher-margin services are now easily layered on any type of transport. With IP everywhere, many service providers are wrestling with how to get to a converged IP infrastructure and also how to migrate traditional systems in order to extend their advantages in the new architecture. The challenge becomes how to combine standard building blocks in new ways to create a network and service that can be differentiated from the competition. Time to market and speed of innovation become important factors when every competitor has access to the same raw materials. Deriving service value from provider technology is now a critical skill. Technology-based providers should intensely “service-orient” their offerings, while positioning their solutions appropriately in advance of the customer’s value distinction—becoming experts at the customer’s business. To put it another way, a properly executed transition from *technology push* to *service pull* is in order.

No longer just a communications prop, provider technology has moved center stage. A convergence of networks, services, and providers is occurring. This book increases your knowledge of the expanse of new provider technology and services. The understanding of service-centric, next-generation network technology is paramount, because internetworking innovation is an enabler of convergence, and convergence is a launch pad for services—communications and computing services that increase customer value by magnitudes and enhance that value year after year.

Therefore, next-generation network services are more than connectivity, communication, and collaboration. They are about technology-leveraged, service-centric platforms combined with a service-valued mindset for the purpose of engaging customers on an immersive, interactive level—not only solving their challenges but also anticipating their future dreams regarding business and personal communications.

## Purpose of This Book

Today's service provider segmentation is so wide, and communication technology options so deep, that until now it has been difficult to achieve a contextual equilibrium, at least one that you can hold in one hand. This book consolidates a diverse amount of provider background, networking technology, next-generation services, and even marketing considerations, as applicable to the service provider, large enterprise, or anyone else with an interest in digital communications.

As such, the approach has been an expansive cast of provider technology and service coverage at an introductory to intermediate depth, arming you with the technology talking points and business advantages necessary to understand, research, strategize, evaluate, propose, justify, sell, and consult regarding next-generation network services. With this information, you should be able to

- Understand the dynamics of the new-era service provider market
- Apply service-differentiating techniques to strategic business planning
- Recommend the advantages of service provider solutions
- Select and justify technology and products that leverage your value proposition
- Prepare for marketing opportunities and customer presentations

So, this book is more of a who, what, where, when and why—the business, functional, technical, and educational backdrop that prefaces any implementation. The question posed by many, of “where does a particular technology fit,” is addressed, and the book is also useful for expanding your knowledge of the overall service provider field of play.

This book provides a window to a new era of communication, a door to expanding service value through technology leverage, and a walk through some of the service-oriented technology options now available from Cisco Systems. The intent is to inform, educate, and, most of all, stimulate ideas for new opportunities tomorrow.

## Who Should Read This Book?

Both service provider and information technology fields require a high degree of technical marketing in order to move communication and service innovations into revenue-producing markets. Technical marketing is a “trusted relationship” style of sales model. The sales representative establishes the “relationship,” and the technical marketing professional/engineer supplies the “trust.” This book can help you with both.

Service providers are heavily leveraged technology organizations with the highest per capita of networking-oriented individuals in any sector. As such, this book can benefit a broad audience such as networking visionaries, architects, consultants, product developers, product marketers, project managers, network engineers, presales/systems engineers, sales representatives, and executive management in service provider companies, many of whom are technical marketers, individual contributors, decision makers, and advocates for purchasing or leveraging strategic networking technology.

Large enterprises and aspiring businesses are codependent on network technology for creating innovations and enhancing customer service. This book helps enterprise networking strategists understand network technology options and service provider capabilities.

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Although this isn't a "how to configure it" guide, engineers should read this book, because it exposes them to a comprehensive view of the technology market in which they work. Venture capitalists and technology analysts can also benefit from this book as a broad technical overview of the telecommunications sector.

## How This Book Is Organized

The opening chapter, "Communicating in the New Era," explores the service provider opportunity in the new era, discussing what has changed and why a service-centric focus is the new ascendancy. This is essential information for any provider, enterprise, or network professional. The remaining chapters introduce an extensive portfolio of network technology, with each chapter also discussing the market advantages and service value of the technology, as well as some of the applicable Cisco products and solutions. The text is oriented to an intermediate level of experience but employs both beginner and advanced perspective as necessary.

Chapters 2 through 9 focus on various provider technology topics. The outline of each chapter is purposeful to put provider technology in the appropriate context, and it's evident that some technologies are cross functional. IP networks, multiservice networks, Virtual Private Networks (VPNs), optical networking technologies, metropolitan optical networks, long-haul optical networks, wireline networks, and wireless networks are prime topics, each developing into a comprehensive review of relative subtopics. Chapters 2 through 9 each conclude with a technology brief that you can use as a quick reference for key facts and business motivations related to the particular topic at hand.

This book is flexible as a selective chapter read; a periodic, topical reference; or as a cover-to-cover, comprehensive study. If you decide to read all of the chapters, reading them in sequence is recommended.

Chapters 1 through 9 cover the following topics:

- **Chapter 1, "Communicating in the New Era"**—This chapter introduces a new era of networking influenced by the pervasiveness of IP; the land run of competition; the technical prowess of IP, optical, and wireless mobility; the impact of behavioural change; and the persuasion of the Internet economy.
- **Chapter 2, "IP Networks"**—This chapter covers the rise of IP networks into local (LANs), long (WANs), mobile (wireless IP), and global networking applications. The essential message of IP networks is that IP is today's dynamo of network convergence and service creation, extending productivity benefits, service variety, and innovation into the start of the 21<sup>st</sup> century.
- **Chapter 3, "Multiservice Networks"**—This chapter introduces multiservice network architecture as a next-generation network infrastructure that is essential to delivering service variety and capitalizing on IP services. Purpose-built networks evolve to service prolific networks in the process. This chapter covers next-generation Asynchronous Transfer Mode (ATM), IP/MPLS, Multiservice Provisioning Platform (MSPP), and MSSP platforms.
- **Chapter 4, "Virtual Private Networks"**—VPNs provide a strategic market position through which to harvest new revenues. This chapter starts with where we've been and where we're going with the service pull of IP VPNs. VPN technology is explored through access and intranet VPNs,

as well as extranet VPN major topics. Covered here are IPsec, Secure Socket Layer (SSL), wireless, site-to-site, multicast, multiservice, and Layer 2 and Layer 3 MPLS VPNS, as well as Virtual Private LAN Service (VPLS).

- **Chapter 5, “Optical Networking Technologies”**—Optical fiber is the physical layer medium of choice. As a result, optical networking is the ascendant Layer 1 technology on which to build the new era of networks. This chapter is the first of three core optical networking chapters, serving as an excellent introduction to optical technology components and optical features including SONET/SDH, Resilient Packet Ring (RPR), dense wavelength division multiplexing (DWDM), coarse wavelength division multiplexing (CWDM), optical Ethernet, and IP over optical.
- **Chapter 6, “Metropolitan Optical Networks”**—Metropolitan optical networks are reaching farther to accommodate the broadband communication needs of the sprawling urbanization of people and business. This has impact on the functional infrastructure of the metropolitan area network, and one model of a next-generation metro infrastructure is introduced. In addition, metro-specific network technology is covered here, including metro SONET/SDH, IP, DWDM, Ethernet, reconfigurable optical add/drop multiplexers (ROADMs), CWDM, metro MSPP/MSSP/MSTP platforms, and metro storage networking.
- **Chapter 7, “Long-Haul Optical Networks”**—Long-haul optical networks are at the core of global information exchange. This chapter covers long-haul optical network topics such as the Cisco ONS 15454 MSTP, long-reach DWDM considerations, extended long-haul and ultra long-haul optical networks, submarine optical networks, and optical cross-connects.
- **Chapter 8, “Wireline Networks”**—This chapter covers the fundamentals of wireline networks and is an examination of the latest access layer technologies and services. As such, this subject is related to metropolitan networks where wireline networks are deployed. Topics here include narrowband, ISDN, Frame Relay, Digital Loop Carrier, broadband xDSL and cable, and Ethernet in residential applications.
- **Chapter 9, “Wireless Networks”**—Wireless networks now cover the spectrum from cellular phones to wireless Ethernet PCs and handhelds, to fixed wireless and satellite wireless services. This chapter starts with a review of mobility basics and the digital access technologies of time division multiple access (TDMA), code division multiple access (CDMA), and Orthogonal Frequency Division Multiplexing (OFDM). Cellular standards are reviewed, along with the data overlay technologies of HSCSD, General Packet Radio Service (GPRS), Enhanced Data rates for the GSM Evolution (EDGE), CDMW2000 1x and 1xEV-DO, and wideband CDMA (WCDMA). An extensive coverage of wireless LAN (Wi-Fi) technology is reviewed, along with fixed and satellite wireless.