Connection-Oriented Networks: SONET/SDH, ATM, MPLS, and Optical Networks

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The book presents a unique perspective on the various flavors of connection-oriented networks. Connection orientation can be realized in both circuit-switched and packet-switched networks. Thus, one would expect some treatment of the legacy telephone network; however, the author focuses on more recent technologies. Within the realm of circuit-switched networks, the book explores two technologies: synchronous optical network (SONET) and its counterpart, synchronous digital hierarchy (SDH), and optical wavelength-routed networks. For packet-switched networks, the book focuses on asynchronous transfer mode (ATM) and its IP-based counterpart, multiprotocol label switching (MPLS).

The book is divided into three logical sections. The first two sections concentrate on connection-oriented technologies mainly at the core of the network, while the last section discusses services. The first section consists of Chapters 2, 8, 9, and 10, and covers the connection-oriented circuit-switching technologies SONET/SDH and wavelength-routed networks. The second section consists of Chapters 3–7, and provide comprehensive coverage of ATM and MPLS. The last section, containing Chapters 11 and 12, concentrates on services that can be offered over the various connection-oriented network technologies explored earlier in the book. In particular, it tackles topics such as asymmetric digital subscriber line (ADSL), cable-based access networks such as DOCSIS, ATM passive optical network (ATM PON), and finally, voice over ATM and MPLS.

The author writes in a very eloquent and expressive yet concise style. The treatment of the subjects is comprehensive and interesting. Each chapter is accompanied by a set of mainly conceptual and sometimes quantitative problems. This makes the book a good textbook. In addition, some chapters are accompanied by simulation projects that can be used to gain deep insight into the associated technical subjects. Additionally, the extensive list of acronyms and rich bibliography with each chapter are very useful.

The book is well-suited for a "special topic" second-level undergraduate course or graduate course. Moreover, the author provides his video-streamed lectures for the course he taught at North Carolina State University using the material in the book. Also, rich Powerpoint presentations for the contents of each chapter are available for download from the book's Web site.

Chapter 1 is a gentle "Introduction" to switching and networking. It also sets the stage for the whole book and orients the reader to the rich contents that lie ahead.

Chapter 2 is "SONET/SDH and the Generic Frame Procedure (GFP)." It first starts with a description of T1 and E1, and then presents in detail the SONET/SDH protocol architecture, devices, and networks. The chapter concludes with a description of the increasingly important topics of generic framing procedure (GFP) and data over SONET/SDH (DoS).

Chapter 3 is on the ATM protocol network architecture. The ATM shared memory switch architecture is also presented. Subsequently, the book covers three ATM adaptation layers and the transport of IP over ATM. Chapter 4 is on congestion control in

ATM networks, covering connection admission control (CAC) and bandwidth enforcement. It also presents the parameters used to characterize ATM traffic, the quality of service parameters, and the ATM quality of service categories. Chapter 5 is on signaling in ATM networks covering permanent virtual connections (PVCs) and switched virtual connections (SVCs). The signaling protocol Q.2931 used to set up an SVC is explored along with a presentation of the various ATM addressing schemes.

Building on ATM concepts, MPLS was devised to support ATM-like behavior in connectionless IP networks. This is covered in Chapter 6. Chapter 7 is on the MPLS label distribution protocols, in essence the signaling protocols used for the establishment of a label switched path (LSP). The book covers both Label Distribution Protocol (LDP) and Resource Reservation Protocol with traffic engineering (RSVP–TE).

Chapter 8 is "Optical Fibers and Components." It gives a general overview of WDM optical networks and optical fiber transmission systems. The chapter also includes treatment for the components used in WDM optical networks, such as lasers, optical amplifiers, 2 ¥ 2 couplers and star couplers, and optical crossconnects (OXCs). This is followed by Chapter 9, "Wavelength Routing Optical Networks." The concepts of a lightpath and traffic grooming are presented. The chapter also discusses the protection and restoration schemes used to provide carrier grade reliability. The International Telecommunication Union — Telecommunication Standardization Sector (ITU-T) G.709 standard for traffic encapsulation and the control plane protocols, generalized MPLS (GMPLS) architecture, and OIF user–network interface (UNI) are presented. No treatment would be complete without covering the important technology of optical burst switching (OBS), which is the subject of Chapter 10. OBS is well suited for the transmission of bursty traffic over optical networks. The main features of OBS are presented along with the related signaling protocols.

The book then moves to the "services" part. Chapter 11, "Access Networks," concentrates on ADSL, cable networks (DOCSIS), and APON. The last chapter covers voice over ATM and MPLS. The chapter covers ATM circuit emulation services and ATM trunking using AAL 2 for narrowband services. For MPLS, the chapter covers circuit emulation services over MPLS using AAL1 and the transport of voice over MPLS using AAL 2.