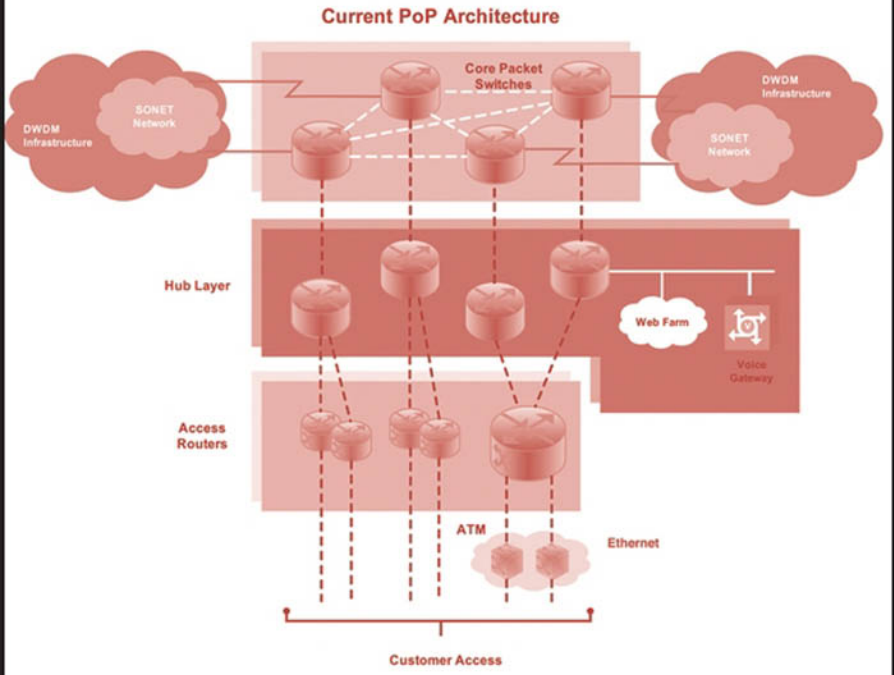
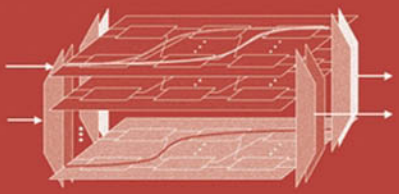


HIGH PERFORMANCE SWITCHES AND ROUTERS



H. JONATHAN CHAO AND BIN LIU

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HIGH PERFORMANCE SWITCHES AND ROUTERS

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CONTENTS

PREFACE

As increasing voice, audio, video, TV, and gaming traffic is carried over IP, Internet traffic continues to grow rapidly. Many network-related applications are emerging for portable devices. As smart cellular phone technology advances, the price decreases, and the infrastructure to support wireless applications (voice, data, video) is being deployed ubiquitously to meet unprecedented demands from users. All of these fast-growing services translate into the high volume of Internet traffic, stringent quality of service (QoS) requirements, large number of hosts/devices to be supported, large forwarding tables to support, high speed packet processing, and large storage capability. When designing/operating next generation switches and routers, these factors create new specifications and new challenges for equipment vendors and network providers.

Jonathan has co-authored two books: *Broadband Packet Switching Technologies—A Practical Guide to ATM Switches and IP Routers* and *Quality of Service Control in High-Speed Networks*, published by John Wiley in 2001. Because the technologies in both electronics and optics have significantly advanced and because the design specifications for routers have become more demanding and challenging, it is time to write another book. This book includes new architectures, algorithms, and implementations developed since 2001. Thus, it is more updated and more complete than the two previous books.

In addition to the need for high-speed and high-capacity transmission/switching equipment, the control function of the equipment and network has also become more sophisticated in order to support new features and requirements of the Internet, including fast re-routing due to link failure (one or more failures), network security, network measurement for dynamic routing, and easy management. This book focuses on the subsystems and devices on the data plane. There is a brief introduction to IP network management to familiarize readers with how the network is managed, as many routers are interconnected together.

The book starts with an introduction to today's and tomorrow's networks, the router architectures and their building blocks, examples of commercial high-end routers, and the challenging issues of designing high-performance high-speed routers. The book first covers the main functions in the line cards of a core router, including route lookup, packet classification, and traffic management for QoS control described in Chapters 2, 3, and

4, respectively. It then follows with 11 chapters in packet switching designs, covering various architectures, algorithms, and technologies (including electrical and optical packet switching). The last chapter of the book presents the state-of-the-art commercial chipsets used to build the routers. This is one of the important features in this book—showing readers the architecture and functions of practical chipsets to reinforce the theories and conceptual designs covered in previous chapters.

A distinction of this book is that we provide as many figures as possible to explain the concepts. Readers are encouraged to first scan through the figures and try to understand them before reading the text. If fully understood, readers can skip to the text to save time. However, the text is written in such a way as to talk the readers through the figures.

Jonathan and Bin each have about 20 years of experience researching high-performance switches and routers, implementing them in various systems with VLSI (very-large-scale integration) and FPGA (field-programmable gate array) chips, transferring technology to the industry, and teaching such subjects in the college and to the industry companies. They have accumulated their practical experience in writing this book. The book includes theoretical concepts and algorithms, design architectures, and actual implementations. It will benefit the readers in different aspects of building a high-performance switch/router. The draft of the book has been used as a text for the past two years when teaching senior undergraduate and first-year graduate students at the author's universities. If any errors are found, please send an email to chao@poly.edu. The authors will then make the corresponding corrections in future editions.

Audience

This book is an appropriate text for senior and graduate students in Electrical Engineering, Computer Engineering, and Computer Science. They can embrace the technology of the Internet so as to better position themselves when they graduate and look for jobs in the high-speed networking field. This book can also be used as a reference for people working in the Internet-related area. Engineers from network equipment vendors and service providers can also benefit from the book by understanding the key concepts of packet switching systems and the key techniques of building high-speed and high-performance routers.

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