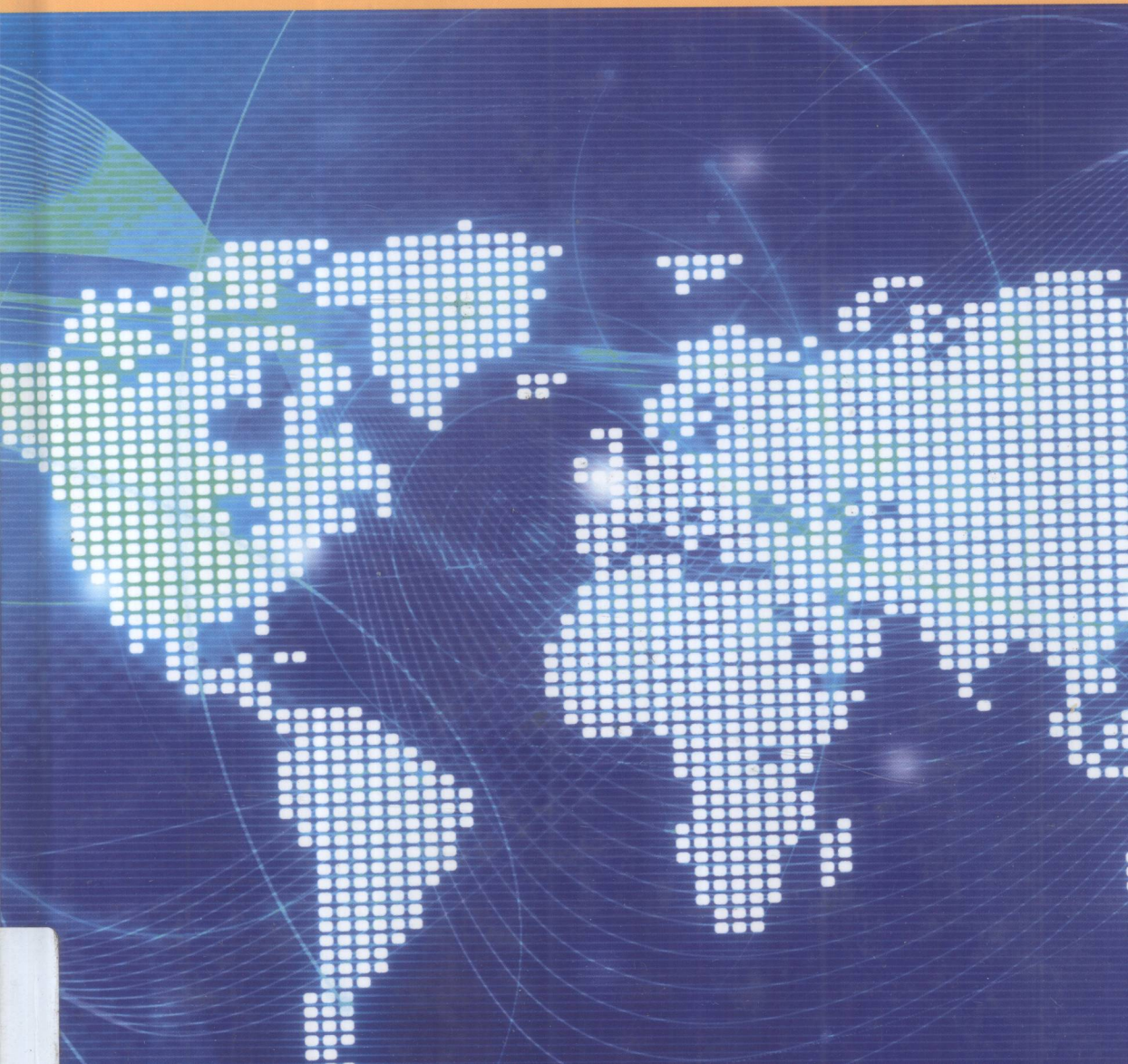


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# Preface

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This book mainly targets high-speed packet networking. As Internet traffic grows exponentially, there is a great need to build multi-terabit Internet protocol (IP) routers. The forwarding engine in routers is the most important part of the high-speed router.

Packet forwarding technologies have been investigated and researched intensively for almost two decades, but there are very few appropriate textbooks describing it. Many engineers and students have to search for technical papers and read them in an *ad-hoc* manner. This book is the first that explains packet forwarding concepts and implementation technologies in broad scope and great depth.

This book addresses the data structure, algorithms, and architectures to implement high-speed routers. The basic concepts of packet forwarding are described and new technologies are discussed. The book will be a practical guide to aid understanding of IP routers.

We have done our best to accurately describe packet forwarding technologies. If any errors are found, please send an email to [wuweidong@wust.edu.cn](mailto:wuweidong@wust.edu.cn). We will correct them in future editions.

## Audience

This book can be used as a reference book for industry people whose job is related to IP networks and router design. It is also intended to help engineers from network equipment and Internet service providers to understand the key concepts of high-speed packet forwarding. This book will also serve as a good text for senior and graduate students in electrical engineering, computer engineering, and computer science. Using it, students will understand the technology trend in IP networks so that they can better position themselves when they graduate and look for jobs in the high-speed networking field.

## Organization of the Book

The book is organized as follows:

Chapter 1 introduces the basic concept and functionalities of the IP router. It also discusses the evolution of the IP router and the characteristics of its key components.

Chapter 2 explains the background of IP-address lookup by briefly describing the evolution of the Internet addressing architecture, the characteristics of the routing table, and the complexity of IP-address lookup. It discusses the design criteria and the performance requirements of high-speed routers.

Chapter 3 introduces basic schemes, such as linear search, cache replacement algorithm, binary trie, path-compressed trie, dynamic prefix trie, and others. We describe the problems of the algorithms proposed before 1996.

Chapter 4 discusses the multibit trie, in which the search operation requires simultaneous inspection of several bits. We describe the principles involved in constructing an efficient multibit trie and examine some schemes in detail.

Chapter 5 discusses the pipelined ASIC architecture that can produce significant savings in cost, complexity, and space for the high-end router.

Chapter 6 discusses the dynamic data structure of the bursty access pattern. We examine the designs of the data structure and show how to improve the throughput by turning it according to lookup biases.

Chapter 7 introduces the advance caching techniques that speed up packet forwarding. We discuss the impact of traffic locality, cache size, and the replacement algorithm on the miss ratio.

Chapter 8 discusses the improved hash schemes that can be used for Internet address lookups. We examine the binary search of hash tables, parallel hashing, multiple hashing, and the use of Bloom filter.

Chapter 9 discusses the forwarding engine based on TCAM. We examine route update algorithms and power efficient schemes.

Chapter 10 discusses the partitioning techniques based on the properties of the forwarding table.

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# About the Author

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Weidong Wu received his PhD in electronics and information engineering from Huazhong University of Science and Technology, China. In 2006, he joined Wuhan University of Science and Technology. His research involves algorithms to improve Internet router performance, network management, network security, and traffic engineering.

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