Ad Hoc Wireless Networks

Architectures and Protocols

C. Siva Ram Murthy and B. S. Manoj

Prentice Hall Communications Engineering and Emerging Technologies Series
Theodore S. Rappaport, Series Editor

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To my wife, Sharada,
my son, Chandrasekhar,
and my daughter, Sarita.

C. Siva Ram Murthy

To my wife, Swapna,
and my daughter, Gouri.

B.S. Manoj

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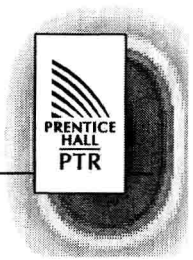

PREFACE

In the last few years, there has been a big interest in ad hoc wireless networks as they have tremendous military and commercial potential. An ad hoc wireless network is a wireless network, comprised of mobile computing devices that use wireless transmission for communication, having no fixed infrastructure (a central administration such as a base station in a cellular wireless network or an access point in a wireless local area network). The mobile devices also serve as routers due to the limited range of wireless transmission of these devices, that is, several devices may need to route or relay a packet before it reaches its final destination. Ad hoc wireless networks can be deployed quickly anywhere and anytime as they eliminate the complexity of infrastructure setup. These networks find applications in several areas. Some of these include: military communications (establishing communication among a group of soldiers for tactical operations when setting up a fixed wireless communication infrastructure in enemy territories or in inhospitable terrains may not be possible), emergency systems (for example, establishing communication among rescue personnel in disaster-affected areas) that need quick deployment of a network, collaborative and distributed computing, wireless mesh networks, wireless sensor networks, and hybrid (integrated cellular and ad hoc) wireless networks.

The purpose of this book is to provide students, researchers, network engineers, and network managers with an expert guide to the fundamental concepts, design issues, and solutions to the issues — architectures and protocols — and the state-of-the-art research developments in ad hoc wireless networking. A unique feature of the book is that it deals with the entire spectrum of issues that influence the design and performance of ad hoc wireless networks, and solutions to the issues, with easy-to-understand illustrative examples highlighting the intuition behind each of the solutions.

This book, organized into fourteen chapters, each covering a unique topic in detail, first presents (in Chapters 1-4) the fundamental topics involved with wireless networking such as wireless communications technology, wireless LANs and PANs, wireless WANs and MANs, and wireless Internet. It then covers all important design issues (in Chapters 5-11) — medium access control, routing, multicasting, transport layer, security, quality of service provisioning, energy management — in ad hoc wireless networking in considerable depth. Finally, some recent related important topics covered in this book (in Chapters 12-14) include wireless sensor networks,

hybrid wireless architectures, pricing in multihop wireless networks, ultra wideband technology, Wi-Fi systems, optical wireless networks, and Multimode 802.11.

The book is intended as a textbook for senior undergraduate and graduate-level courses on ad hoc wireless networks. It can also be used as a supplementary textbook for undergraduate courses on wireless networks, wireless/mobile communications, mobile computing, and computer networks. The exercise problems provided at the end of each chapter add strength to the book. A solutions manual for instructors is available from Prentice Hall. The book is a useful resource for the students and researchers to learn all about ad hoc wireless networking and further their research work. In addition, the book will be valuable to professionals in the field of computer/wireless networking.

We owe our deepest gratitude to Karthigeyan, Jayashree, and Archana for reading line by line all the chapters and suggesting ways to correct technical and presentation problems. We wish to express our thanks to the following HPCN lab students who have contributed mightily to this book writing project: Archana, Bhaya Gaurav Ravindra, Bheemarjun, Jagadeesan, Jayashree, Karthigeyan, Rajendra Singh Sisodia, Srinivas, Subir Kumar Das, Vidhyashankar, and Vyas Sekar. Raj Kumar drew all the illustrations and we thank him for his excellent work. We appreciate the efforts of Steven M. Hirschman, Irving E. Hodnett, and Shivkumar Kalyanaraman in reviewing our draft manuscript and suggesting improvements. We would like to gratefully acknowledge the help rendered by the Indian Institute of Technology (IIT), Madras, especially for creating an excellent working environment, the Department of Science and Technology, New Delhi, and the Curriculum Development Cell of the Centre for Continuing Education, IIT Madras for providing the financial aid for writing this book. Infosys Technologies Ltd., Bangalore, provided financial support to the second author for wireless networking research over the last four years, and he is indebted to Infosys for the same. We are thankful to Bernard Goodwin and his colleagues at Prentice Hall for their excellent work in producing this book. Last though not least, we acknowledge the love and affection from our families. This project would never have been successfully completed but for their understanding and patience.

We have taken reasonable care in eliminating typographical or other errors that might have crept into the book. We encourage you to send your comments and suggestions to us via email. We appreciate your feedback and hope you enjoy reading the book.

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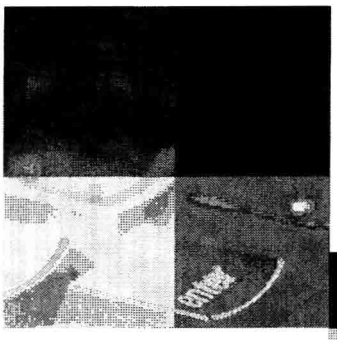

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