SPECIAL ISSUE BOOK REVIEW

EDITED BY FATOS XHAFA AND LEONARD BAROLLI

Ad Hoc Networks: Technologies and Protocols
Editors: Prasant Mohapathra, Srikanth V. Krishnamurthy
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1. Introduction. The book AD HOC NETWORKS: Technologies and Protocols is targeted to engineers, researchers, advanced level students in the areas of ad hoc wireless networks. Special attention is placed on each building block, as well as, design challenges that need to be addressed with care when designing ad hoc networks. The main topics are related with the issues with the medium access protocols (802.11), routing protocols, multicast communications, transport layer protocols, energy conservation, QoS issues, and security.

The book communicates to the reader well and keeps the focus on the essential concepts and principles of ad hoc networking. The authors keep the reader engaged and facilitate the understanding process via use of several applications. After the reader has finished the book, the reader will be able to design complex ad hoc networks, pose new research questions, or tackle the research questions provided on future works at the end of each chapter.

2. Book Structure and Blow-by-Blow Review. The book starts with an excellent introduction by Professor Mario Gerla. First, Professor Gerla presents the main characteristics of ad hoc networks, including mobility, multihopping, self-organization, energy conservation, scalability, and security. Second, the author describes the design challenges of ad hoc networks, including cross layer interactions, mobility, and scalability.

Third, the author provides several examples of the ad hoc networks. For example, Figure 2.1[1] shows an example of the opportunistic ad hoc network. The example illustrates one scenario of the urban grid, which represents vehicle communications in an urban environment. While the cars connect to the cellular system, the applications of the ad hoc networks will span from the need of within the car communication or with other cars on the road.

Lastly, the author provides an overview of the chapters in the book. The book topics include: Mac Layer Issues and Protocols, Routing Protocols, Transport Layer Protocols, Multicasting, QoS issues, Energy Conservation, Directional Antennas, and Security issues. We present here a summary of the rest of the chapters.

Chapter 2: Collision Avoidance Protocols in Ad Hoc Networks. The chapter addresses the issues of designing effective MAC protocols that regulate the access of the wireless nodes to the shared channel, under scarce channel bandwidth that constrains ad hoc networks. They address sender-initiated collision avoidance schemes and show that they are more efficient that the traditional carrier sense multiple access schemes. In additions, the authors reveal the fairness problem in IEEE 802.11 and how to address the problem by using a topology aware fair access scheme.

For example, the authors compare via simulation studies (Please refer to Figure 2.2[2]) the throughput of the collision avoidance vs. CSMA, under different parameters. The experiments showed that the throughput of the CSMA is lower than RTS/CTS protocols under different parameters.

Chapter 3: Routing in Ad Hoc Networks. The chapter classifies the routing protocols in four main groups and describes the design details. We summarize in Table 2.1 the protocol classification.

Specifically, it discusses the location assisted routing protocols, which are important in the urban grid environment. They illustrate the protocol building blocks by using as examples the LAR and DREAM protocols. They provide an in-depth discussion on the flooding mechanism, as well as, other important protocol features, including route request, route error, and route reply.

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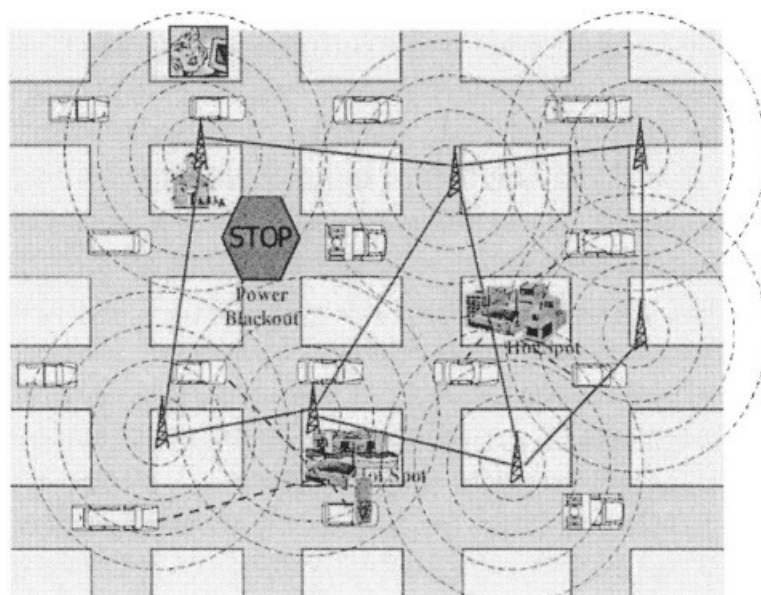
Fig. 2.1. *Opportunistic Ad Hoc Networks.*

Table 2.1
*Routing Protocol Classification.*

Classifications	Routing Protocols
Proactive	DSDV, OLSR,TBRPF
Reactive	DSR, AODV
Hybrid	ZRP
Location Assisted	GPSR, LAR, DREAM

Chapter 4: Multicasting in Ad Hoc Networks. This chapter provides a survey of the literature on the multicast protocols, which represent the property of broadcasting the data or video to all users that are part of the same mission. First, MAODV and ODMRP that are the most popular multicast protocols are described. Then, the authors, also, review the other protocols, i. e., MCEDAR, AMRoute, Geocast, and Gossip.

Chapter 5: Transport Layer Protocols in Ad Hoc Networks. This chapter addresses the main reasons on the performance degradation of ad hoc networks under TCP. For example, the focus is placed on packet loss, which can be caused due to congestion, jamming, or route breaks. However, the main issue is the inability to differentiate between the packet loss and congestion. Therefore, the authors present several feedback schemes to differentiate between the congestion and packet loss. For example, the Explicit Link Failure Notification is used as a feedback method to notify TCP of the link failures. In addition, other feedback methods are described in the chapter (ATRA and ATP).

Chapter 6: Energy Conservation. In the urban grid the energy conservation is not a major issue, however it is an important issue to be addressed in the applications of small hand held mobile wireless devices. The focus on this chapter is placed on the applications that involve sensors and pedestrian grids. The authors provide a survey of the energy conservation methods: power and topology control, energy routing, and coordinated sleep, and power save management. One example is using scheduling techniques for the powered up wireless devices in such a way that the interaction is most effective for a given recharge cycle.

Chapter 7: Use of Smart Antennas in Ad Hoc Networks. First, an overview of directional antennas and the reasons for using the directional antennas are provided. The directional antennas extend range, fold jamming attacks, and reduce the probability of detection. Second, it describes the smart antennas, which transmit simultaneously on multiple beams. Lastly, it shows the interaction between the antenna directionality, MAC, and the Routing protocols.
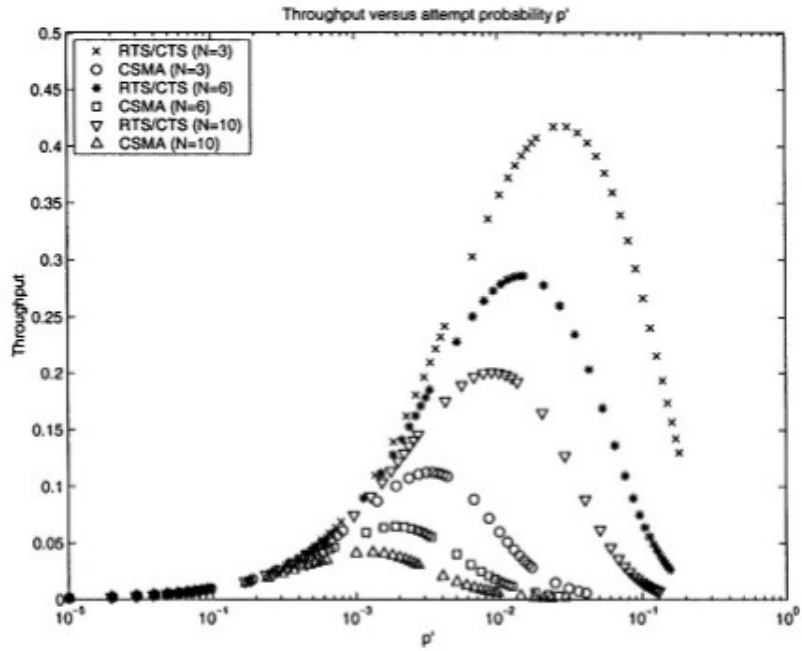
(a) long data packet: $l_{data} = 100\tau$
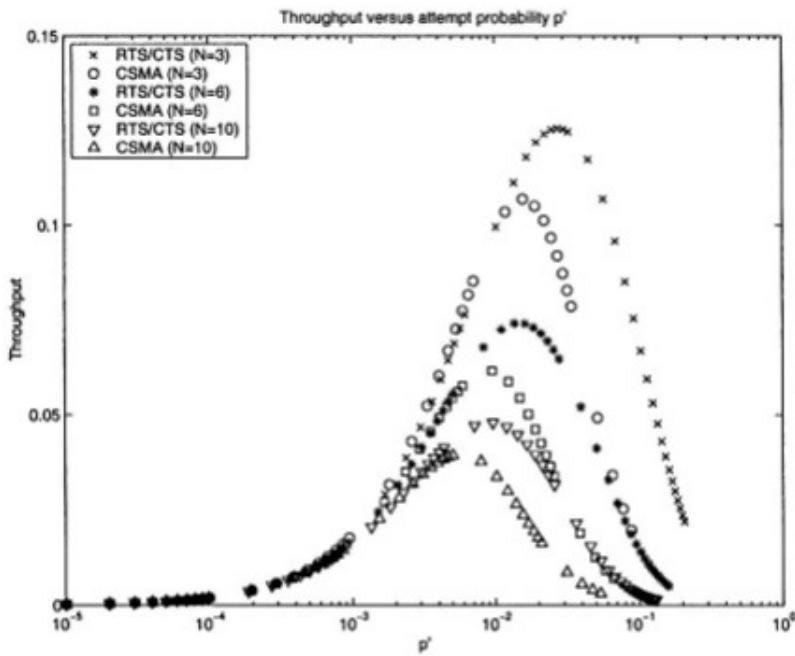
(b) short data packet: $l_{data} = 20\tau$

FIG. 2.2. *Throughput Comparison.*

Chapter 8: QoS Issues in Ad Hoc Networks. Given the bandwidth constraints and mobility in ad hoc networks, the QoS requirements of delay, latency, jitter, and packet loss need to be addressed with care. The authors first provide an overview of the guaranteed QoS in the wired environment and its differences in the wireless case. The author presents QoS techniques based on each layer. In the physical layer they address how ARF, RBAR,and OAR impacts QoS. Then, they move to the improvements on the MAC layer and demonstrate how the methods of PCF Schedule and ITC can be modified to meet QoS requirements. Lastly, they move to the QoS routing by ensuring Call acceptance control and/or service service negotiations.

Chapter 9: Security in mobile Ad Hoc Networks. Due to the open wireless medium, non-infrastructure nature that disables centralized certificate authority and key exchange, and the mobility of roaming nodes are some of the main reasons that make the security of ad hoc networks a challenging task. The authors provides an excellent summary of the potential attacks on the routing layer, i. e., dissemination of false routing information (via Route Request, Route Reply, Route Error), altering the path, or falsifying the sequence numbers.

The authors provide a list of examples that were collected as a result of the literature review:
- Impersonating another node to spoof messages
- Modifying Route Reply message to inject a false route
- Generating bogus Route Error to disrupt a working route
- Suppressing Route Error to mislead other
- Wormwhole attacks
- Rushing Attacks
- Sybil Attacks

In addition, it presents a MANET architecture with an Intrusion Detection System, which uses co-operative node methodologies and places agents at the monitoring nodes. Lastly, it talks about the passive attacks, i. e., position and privacy attacks.

3. Does the book keep its promises?. This is an excellently written book, which covers the major design issues in ad hoc networks. The use of examples makes the book easy to read, follow, and comprehend. The book is aimed for advanced networking people, thus would not be an easy read for a novice reader on the field. In addition, the book can serve as a reference material to the new wireless researchers to understand the current state of the field and lead them to the future research directions that still need to be addressed.

4. Personal reading experience. I have been working on the field of ad hoc networks for three years now and have come to realize that the book AD HOC NETWORKS: Technologies and Protocols has provided me with a solid background and knowledge of the field. The book has been a self-study guide and I felt that was being taught the field, without a teacher; however, given the in-depth treatment of each building block of ad hoc networks, the teacher was not necessary. This book covers and expands on the major design issues in ad hoc networks.

Arta Doci,
Colorado School of Mines,
Colorado, USA
E-mail: `adoci@mines.edu`