# Security of Self-Organizing Networks

## MANET, WSN, WMN, VANET

Edited by Al-Sakib Khan Pathan

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AN AUERBACH BOOK

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# Preface

Various types of wireless networks and their applications can be seen in many places nowadays. With the increase in the number of Internet users, with the aid of wireless communications and demand of flexible anytime, anywhere networking, self-organizing wireless networks have already gained huge popularity among users. For wider support of wireless connectivity and developing easy-to-use technologies, substantial efforts are underway to reduce human intervention in the configuration, formation, and maintenance processes of these networks. This book is an attempt to address the security issues of four types of self-organizing networks (SONs): the Wireless Mobile *Ad hoc* Network (MANET), Wireless Sensor Network (WSN), Wireless Mesh Network (WMN), and Vehicular *Ad hoc* Network (VANET). Although various issues of these networks have been addressed extensively in different literature and numerous researchers around the globe are working on different aspects, here we have mainly focused on various facets of security in these networks.

As in an SON, hundreds and thousands of wireless devices can participate in a limited area with wireless communications but the information exchange among the devices needs appropriate privacy-, authenticity-, availability-, and nonrepudiation-ensuring mechanisms. Without proper security policy, any type of SON is exposed to a wide variety of security vulnerabilities and threats. Other than data security in such types of networks, there are also multiple factors that should be considered for ensuring overall security. For example, physical security of wireless devices is one of the important issues especially for WSNs and VANETs. Severe limitation of available device-resources (e.g., energy, radio, storage, processing, etc.) is a critical point for some networks. Again, security measures should be employed based on the special characteristics of a particular SON. All these issues related to security, problems, challenges, hopes, and solutions are discussed in various chapters of this book.

## About the Contents of the Book

There are a total of 23 chapters in this book, which is divided into four parts. Different chapters in different parts address various security issues of SONs from different angles. The first part deals with general security topics. This part sets the base for the following chapters. Many terms are introduced in the chapters under Part I so that later they become easily accessible to readers. Part II deals with different security issues in MANETs and VANETs. For some of the chapters, the authors have proposed specific solutions to specific security problems. As VANET is a special class of MANET, we have included both of these networks under the same part. Part III discusses critical issues of

WSN security, and Part IV briefly touches on the security issues of WMNs. Most of these chapters are written in a tutorial manner. However, for some of the chapters, mathematical equations and detailed analysis are used for advanced readers. Hence, this book talks about relatively easier issues as well as analyzes some security-related issues in depth. Although in some cases, the contents of a chapter may overlap with some of the contents of another chapter, the repeated information might be helpful in clarifying specific points dealt with in that particular chapter. This is also useful in the sense that different people think of the same point from different perspectives. We hope that the book will really be helpful in giving a thorough and wide picture of the security aspects of MANETs, WSNs, WMNs, and VANETs.

## What Not to Expect from the Book

This book is a not a basic tutorial on the security issues of SONs. Hence, it does not have detailed introductory information about security. Although some chapters contain some elementary information, those should not be considered adequate for a beginner. Users/readers need to have at least some basic knowledge about security in networking. Again, this book should not be taken as a detailed research report. Some chapters simply present a specific problem and its solution that might be helpful for graduate students, some talk about elementary information that might be useful for general readers, some discuss in-depth security issues that might be helpful for advanced readers, and some chapters talk about the latest updates in a particular research area that might assist researchers in determining their future research objectives.

## Target Audience

The book is very useful for Master's- or PhD-level students working on security issues in these networks, for researchers, for faculty members at the university level, and for some industry professionals. Questions and their sample answers have been provided with each chapter so that the readers' understanding from a chapter can be tested. Supplementary materials have been provided so that each chapter can be taught in a classroom environment with presentation slides. The book's chapters have been placed in such a sequence that it can be helpful to readers if they are read sequentially or to other readers who skip some of the chapters as they like. Overall, this book can guide readers to the latest trends, issues, and aspects of security of MANETs, WSNs, WMNs, and VANETs.

**Dr. Al-Sakib Khan Pathan**

# Acknowledgments

I am very much thankful to the Almighty for giving me strength, keeping me fit, and giving me this time to accomplish this work. My sincere thanks to the authors of different chapters of this book without whose invaluable contributions, this project could not be completed. All the authors have been cooperative on different occasions during the submission, review, and editing process of the book. I am very thankful to Richard O'Hanley who helped me at each step of the publication process. I express my earnest gratitude to him for giving me this opportunity to edit such a book. Also thanks to him for his contribution to this book of choosing a timely, concise, and catchy title. Finally, I would like to thank my parents; Abdus Salam Khan Pathan, Delowara Khanom, my loving wife Labiba Mahmud, my younger brother Dr. Mukaddim Pathan, and my elder sister Tahmina A. Khanam for their continuous support and encouragement while preparing the book.

**Dr. Al-Sakib Khan Pathan**

# Editor

**Al-Sakib Khan Pathan** is an assistant professor at the Computer Science and Engineering Department of Bangladesh Rural Advancement Committee (BRAC) University, Bangladesh. He worked as a researcher at the Networking Lab, Department of Computer Engineering in Kyung Hee University, South Korea, where he received his PhD in 2009. He received his BSc degree in computer science and information technology from the Islamic University of Technology (IUT), Bangladesh, in 2003. He has served as a chair, organizing committee member, and technical program committee member in several international conferences/workshops such as HPCS 2010, ICA3PP 2010, WiMob'09 and 08, HPCC'09, IDCS'09 and 08. He is currently serving as an area editor of *IJCNIS*, associate editor of IASTED/ACTA Press *IJCA*, guest editor of several international journals, including Elsevier's *Mathematical and Computer Modelling*, and editor of a book. He also serves as a referee of a few renowned journals such as the *IEEE Transactions on Dependable and Secure Computing* (*IEEE TDSC*); the *IEEE Transactions on Vehicular Technology* (*IEEE TVT*); the *IEEE Communications Letters*; Elsevier's *Computer Communications, Computer Standards and Interfaces*; the *Computers & Electrical Engineering* journal; the *Journal of High Speed Networks* (*JHSN, IOS* Press); the *EURASIP Journal on Wireless Communications and Networking* (*EURASIP JWCN*); and the *International Journal of Communication Systems* (*IJCS*, Wiley). He is a member of IEEE and several other international organizations. His research interest includes wireless sensor networks, network security, and e-services technologies.

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# Contents

# I

# GENERAL TOPICS—SECURITY OF WIRELESS AND SELF-ORGANIZING NETWORKS

# Chapter 1

# Secure Device Association
## *Trends and Issues*

Yasir Arfat Malkani, Dan Chalmers, and Ian Wakeman

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