Building Next-Generation Converged Networks: Theory and Practice

Editors

Al-Sakib Khan Pathan, International Islamic University Malaysia, Malaysia
Muhammad Mostafa Monowar, King AbdulAziz University, Saudi Arabia
Zubair Md. Fadlullah, Tohoku University, Japan

List of Authors/Contributors

Abdelgadir Tageldin Abdelgadir, International Islamic University Malaysia, Malaysia
Ahmed Shawish, Ain Shams University, Egypt
Akbar Ghaffarpour Rahbar, Sahand University of Technology Tabriz, Iran
Al-Sakib Khan Pathan, International Islamic University Malaysia, Malaysia
Anand Srinivasan, EION Inc, Canada
Andreas P. Fatouros, National Technical University of Athens, Greece
Antonio F. Gómez Skarmeta, University of Murcia, Spain
Athanasios D. Panagopoulos, National Technical University of Athens, Greece
Bhed Bahadur Bista, Iwate Prefectural University, Japan
Cesar Vargas-Rosales, ITESM-Monterrey, Mexico
Changcheng Huang, Carleton University, Canada
Chaynika Taneja, Directorate of Management Info. Systems and Tech., DRDO Hqrs, New Delhi, India
Chhagan lal, Malaviya National Institute of Technology, Jaipur, India
Cristiano Cervellera, National Research Council of Italy (CNR), Italy
Danda B. Rawat, Eastern Kentucky University, USA
Deni Torres-Román, CINVESTAV-IPN Unidad Guadalajara, Mexico
Diallo Abdoulaye Kindy, CustomWare, KL Sentral, 50470, Kuala Lumpur, Malaysia
Dimitris E. Charilas, National Technical University of Athens, Greece
Eirini Karapistoli, CONTA Lab, UoM, Thessaloniki, Greece
Félix J. García Clemente, University of Murcia, Spain
Georgios Baltoglou, KTH, Stockholm, Sweden
Gongjun Yan, Indiana University, USA
Gregorio Martínez Pérez, University of Murcia, Spain
Homero Toral-Cruz, University of Quintana Roo, Mexico
Ioannis C. Fousekis, National Technical University of Athens, Greece
Jesús D. Jiménez Re, University of Murcia, Spain
Jorge Bernal Bernabé, University of Murcia, Spain
José M. Alcaraz Calero, Cloud and Security Lab Hewlett-Packard Laboratories, United Kingdom
Juan M. Marín Pérez, University of Murcia, Spain
Julio Ramírez-Pacheco, University of Caribe, Mexico
Kashif Saleem, King Saud University, Saudi Arabia
Luca Caviglione, National Research Council of Italy (CNR), Italy
M. Abdullah-Al-Wadud, Hankuk University of Foreign Studies, South Korea
M.S.Gaur, Malaviya National Institute of Technology, Jaipur, India
Maria Salama, British University in Egypt, Egypt

Dedicated to …

"*All the seekers of knowledge and truth alongside my family.*"
– Al-Sakib Khan Pathan

"*My parents to whom I owe a lifetime.*"
– Muhammad Mostafa Monowar

"*My loving family. Their consistent support is an endless bounty from the Almighty, to Whom I am ever grateful.*"
– **Zubair Md. Fadlullah**

Preface

The telecommunications industry has seen a rapid boost within the last decade. New realities and visions of functionalities in various telecommunications networks have brought forward the concept of NGN (Next Generation Network). The competitions among the operators for supporting various services, lowering of the cost of having mobile and cellular phones and smart-phones, increasing demand for general mobility, explosion of digital traffic, and advent of convergence network technologies added more dynamism in the idea of NGN. In fact, facilitating convergence of networks and convergence of various types of services is a significant objective of NGN.

Although there is a considerable amount of research efforts underway to define the boundary and standards of NGNs, a proper boundary is yet to be finalized. NGN is used to label the architectural evolutions in telecommunications and access networks. The term is also used to depict the shift to higher network speeds using broadband, the migration from the Public Switched Telephone Network or PSTN to an Internet Protocol (IP)-based network, and a greater integration of services on a single network, and often is representative of a vision and a market concept. NGN is also defined as "*broadband managed IP networks*". IP address is sometimes used as it is built around the Internet Protocol. From a more technical point of view, NGN is defined by the International Telecommunication Union (ITU) as a "*packet based network able to provide services including telecommunication services and able to make use of multiple broadband, QoS-enabled transport technologies and in which service related functions are independent from underlying transport-related technologies*". NGNs offer access by users to different service providers, and support "*generalized mobility which will allow consistent and ubiquitous provision of services to users*". (ITU-T Recommendation Y.2001, approved in December 2004).

The Objective of this Book and its Structure

The main goal of this book is to compile various works that contribute to the development of NGN networks and technologies. We understand that the future is still looking hazy as blending of different technologies take the definition of NGN towards different directions. However, considering the gravity of the dynamism involved in this technology theme, we have divided the entire book into five major parts. The first part deals with the works on multimedia streaming in the networks in future. The chapters include some basic information for general readers as well as in-depth information for the experts in the relevant areas. As we are now moving towards 4G and 5G or '*So-and-So'*G networks, multimedia streaming will play a very distinctive role in the future network settings. Not only high speed of multimedia traffic is needed but also high definition and resolution will be expected by the users. Hence, the first part addresses the critical aspects associated with these issues. In the second part, we have placed some chapters dealing with safety and security issues in networking. Also, basic Internet and Cyber-security are considered that will also be relevant in any future network. In part three, network management and traffic engineering issues are touched upon. This part may require some expertise or background knowledge as some mathematical modeling based works are included.

In part four, we integrate the concept of Cloud computing with general information infrastructure. It is expected that in the NGN, the information flow and pattern of information exchange will be different than those being currently employed. Hence, this part could give the readers some knowledge about the past achievements, present conditions, and future expectations in the information infrastructure related areas. Finally, the part five contains some chapters dealing with various aspects of wireless networking. As many networks have now got wireless versions instead of the fixed wired connections, wireless

networking will be an integral part of NGN. Hence, this part could give the readers some flavor of wireless networking technologies without going into too much depth but keeping it relevant to NGN technologies.

What to Expect from the book?

The book is mainly written for graduate researchers, students, regular industry researchers, university academics, and general networking readers. There is a combination of "easy-to-follow" chapters as well as the chapters requiring some prior knowledge or expertise. Hence, the book could be a good reference item for the MS or Ph.D. level students for gaining basic and in-depth knowledge on various issues of NGN development.

What Not to Expect from the book?

The book is not written in a text-book style. Hence, the presented information is based often on the latest and most up-to-date research findings. It could be used for post-graduate level classroom teaching but as the research fields demand, something *latest* today, may not remain *latest* tomorrow. So, the basic standardized information presented in the book could be used with certainty but the research findings or results may have some uncertainty factor involved with them.

Special Thanks

First of all, as always, we are very thankful to the Almighty for giving us courage, strength, time, and physical fitness to complete this work. We would like to thank heartily all the authors who contributed to this book for its successful completion. A total number of 56 authors from 16 different countries around the globe contributed to this book; without whose active support and brainstorming, the work would not have taken this current shape. The authors' cooperation in various cases, their timely responses and adhering to the given guidelines for manuscript preparation are really praiseworthy. We hope that our work will be beneficial not only for the contributing authors for their careers but also for the wide variety audience related to the research topics and issues addressed in this book.

Dr. Al-Sakib Khan Pathan, International Islamic University Malaysia, Malaysia
Dr. Muhammad Mostafa Monowar, King AbdulAziz University, Saudi Arabia
Dr. Zubair Md. Fadlullah, Tohoku University, Japan