Preface

This book contains articles from the four issues of Volume 3 of the International Journal of Interdisciplinary Telecommunications and Networking (IJITN). As has been the case with our previous two books containing articles from IJITN, this book reflects the journal’s mission of publishing high-quality original interdisciplinary academic and practitioner research, surveys, and case studies that address telecommunications and networking issues, answer telecommunications and networking questions, or solve telecommunications and networking problems. The articles also reflect the journal’s objective of covering a wide variety of topics related to telecommunications and networking technology, management, policy, economics, and social impact from a diversity of disciplinary viewpoints, including electrical engineering, computer science, operations research, business, and law.

The first article of Volume 3, Issue 1, “Maximizing the Flow Reliability in Cellular IP Network Using PSO,” is by Mohammad Anbar and Deo Prakash Vidyarthi. In cellular networks the geographical area covered by the network is divided into cells serviced by base stations at the center of the cells. In cellular IP networks the base stations serve as access points and routers for the IP packets in the network. Since two critical factors in a network’s performance are its response time and reliability, the performance in a cellular IP network can be enhanced by minimizing the time required for the base stations to process the packets and route them as well as decreasing the probability that the network will fail. Particle Swarm Optimization (PSO), a tool based on the behavior of social insects such as bird flocks and fish schools in which individuals mimic the behavior of their neighbors, can be used to solve difficult optimization problems. In their paper the authors develop a model using PSO to reduce the flow processing time in the base stations’ router to improve the reliability of the network. Simulation results indicate that PSO can increase the cellular network’s reliability.

Cognitive systems can learn. The second article of this issue, “Cognitive Aeronautical Communication System,” by Jamal Haque, M. Cenk Ertuk, Huseyin Arslan, and Wilfrido Moreno, investigates cognitive aeronautical radio systems, which can learn the aeronautical environment for various locations and altitudes. Such systems face a number of difficult issues, including channel impairments, Doppler effects, and spectrum bandwidth use and frequency band allocation in changing geographical, political, and regulatory environments. The paper proposes an intelligent self-configurable hardware and software system, whose heart is a data base updated after each aircraft’s flight. The data, which is collected by the aircraft’s navigation and radar system during the flight and downloaded to the data base afterwards, includes the route traversed, wireless links available, frequency band, bandwidth, data rate, wireless standard and signal quality. The authors believe that such a system will result in an efficient use of the spectrum and a high data rate for global connectivity.
One of the engines behind the proliferation of video services is digital compression. The third article of the issue, “Best Approach for Video Codec Selection Over VoIP Conversation Using Wireless Local Area Network” by Mohd Nazri Ismail, evaluates the performance over VoIP on a campus WLAN of three audio/video codec pairs: G.722/MP4V-ES; G276 (16)/H.261; and G.726 (24)/H.264. Four factors are considered in the analysis: Mean Opinion Score (MOS); packet delay; jitter; and packet loss. In the experiment a soft phone is used to transmit audio and video; performance is monitored using network management software. The results indicate that the G.722/MP4V-ES pair possesses the least delay, the best video quality, and the least jitter.

Accounting for Quality of Service (QoS) in a mobile ad hoc network (MANET) is more difficult than in other networks since the network topology changes as the nodes move. In the fourth article of this issue, “Fuzzy QoS Based OLSR Network” by G. Uma Mahewswari, a QoS routing protocol is developed based on Optimized Link State Routing (OLSR) with a fuzzy logic algorithm relating bandwidth and delay. Simulation results indicate the performance of the OLSR routing protocol with this QoS particular enhancement is superior to the existing OLSR protocol using QoS.

The fifth and final article of Volume 2, Issue 2 is “Development of a Complex Geospatial/RF Design Model in Support of Service Volume Engineering Design” by Erton Boci, Shahram Sarkani, and Thomas Mazzuchi. The article deals with the design in the U.S. of the terrestrial radio station infrastructure of the Automatic Dependent Surveillance – Broadcast (ADS-B) system, the first building block of the FAA’s Next Generation Air Transportation System. The design must optimize system performance, safety, and security at a minimum cost. In particular, the article examines the model-centric approach adopted by the Service Volume (SV) Engineering design team to capture, manage, and distribute its design and configuration data. The CORE software package that the team employed provides a customizable, collaborative entity-relationship-attribute environment with a single database repository. The article describes the steps the team took in formulating the data model and implementing it with CORE software.

In order to efficiently establish any service in a PCS network, the location of the mobile terminal (MT) must be clearly identified. A strategy for accomplishing this can be found in the IS-41 and GSM standards. In the first article of Volume 2, Issue 2, “Location Management in PCS Networks Using Base Areas (BAs) and 2 Level Paging (2LP) Schemes” by Hesham Ali, Ahmed Saleh, and Mohammed Ali, present a different location management strategy than that found in the IS-41 and GSM standards. Their novel strategy is based on restructuring the cells into smaller areas, moving MT registration from the master home location register (HLR) to the MT’s HLR, using caching to reduce unwanted database updates, and two-level paging. Experimental results indicate that location costs decrease and network response improves when the proposed strategy is introduced.

In turbo processes the channel decoder and receiver demodulator exchange extrinsic information. Turbo codes have excellent performance, especially at low and medium signal-to-noise ratios, and can be found in many international standards, including the 3G standard UMTS and the DVB-T digital broadcasting standard. The second article in Volume 3, Issue 2, “Application of Extrinsic Information Transfer Charts to Anticipate Turbo Code Behavior” by Izabella Lokshina, presents a method based on the extrinsic information transfer (EXIT) chart for estimating the convergence properties of the iterative decoding process associated with a given turbo coding scheme. Compared with other methods for generating EXIT functions, the suggested approach provides insight into the iterative behavior of linear turbo systems while substantially reducing numerical complexity.

The advent of femtocells provides mobile operators with a new architectural solution for improving signal quality in critical areas. Compelling business cases can be made for replacing landlines entirely
with femtocellular technology as well as for using it in fixed/mobile network infrastructural solutions. The third article of Volume 3, Issue 2, “A Femtocellular-Cabled Solution for Broadband Wireless Access: A Qualitative and Comparative Analysis” by Dario Di Zenobio, Massimo Celidonio, Lorenzo Pulcini, and Arianna Rufini, presents a solution to broadband wireless access based on integrating an “enhanced” femtocell with a cable distribution network. Simulation results indicate that the solution can be cost-effective with enhanced QOS performance when providing IMT-Advanced services to users in digital divide areas.

In the fourth article in Volume 3, Issue 2, “Data Transmission Oriented on the Object, Communication Media, Application, and State of Communication Systems,” Mike Sabelkin and Francois Gagnon propose a communication system architecture based on the object, communications media, application, and state of the communication system. In particular, the authors focus their architecture on wireless communications media and consider a scenario where a gray scale image is transmitted losslessly over a wireless line-of-sight channel. Simulation results validate use of the architecture and compare the proposed system with other alternatives.

The next phase of mobile growth is expected to occur in machine-to-machine (M2M) communication. The fifth article in Volume 3, Issue 2, “Machine-to-Machine Communications and Security Solution in Cellular Systems” by Mahdy Saedy and Vahideh Mojtahed, introduces a model of M2M based on 4G cellular networks. The efficient model assumes that M2M terminals will use 4G cellular network resources if they are located in the 4G coverage area, but far from other terminals, and ad hoc mode if they are close to other terminals. The model incorporates a simplified protocol stack and various measures to secure communications, a critical concern for M2M networks.

In order to discharge their responsibilities, agencies charged with preparing and protecting the public require an ongoing flow of accurate and precise environmental data from human and non-human sensors. Advances in sensing technologies along with a proliferation of sensor data have increased the need for data integration and a flexible architecture for acquiring the data. In the sixth and final article of Volume 3, Issue 2, “Sensing Technologies for Societal Well-Being: A Needs Analysis,” Elizabeth Avery Gomez suggests how this might be done using lean application programming protocols through services such as SMS. While the author views her research as a vehicle for discussion and feedback on the alignment of sensor data acquired through information and communications technologies and sustainable business processes needed for response readiness and crisis management, she believes that it can have applicability in day-to-day sustainable systems for overall social well-being and in global initiatives to tackle environmental issues.

The third issue of the calendar year 2011 included four papers, three of which were based on research conducted at U.S. universities. The first of these articles, “Modeling and Simulation of Traffic with Integrated Services at Media Gateway Nodes in Next Generation Networks” by Izabella Lokshina of SUNY College at Oneonta, represents a mathematical approach to the problem of dealing with varying types of traffic in network nodes. The approach utilizes the characterization of traffic represented as independent Poisson processed and Markov processes with constant intensity and random input streams.

The future of telecommunications and networking lies in the growth of mobile devices and their capabilities. One only has to remember the large awkward mobile phones of the early 1990’s and their limited analog voice – only communications capabilities to realize that the world of telecommunications and networking has come a long way. It is not coincidence that the growth of the Internet has corresponded with the growth of mobile device capabilities and usage. One of the key issues addressed in this work is dealing with the Quality of Service (QoS) aspects of various types of network traffic. One
of the problems of today’s networks that is becoming more acute is the variation in the types of traffic that share a given network. If the broader network can be considered a collection of heterogeneous networks and sources of traffic, then the amalgamation of such in the next generation of overall networks will only be faced with greater variations in traffic, demand, and heterogeneity of its infrastructure. Dr. Lokshina’s work in this article focuses on how this variety can be dealt with “media gateway nodes” in such networks. Such nodes require the sharing of bandwidth between multiple types of multimedia traffic from various sources and destined for various nodes. Each individual piece of the traffic “pie” must be given some sort of priority with respect to the other pieces while seeking to still provide overall efficiency and minimizing delays in the network. The notion of QoS grew out of work in the 1990’s on Asynchronous Transfer Mode (ATM) and has evolved to define the nature of all broadband networks where some time time-sensitive traffic such as real time video must share bandwidth with less time-sensitive traffic such as email; yet all must be served in an efficient manner. Lokshina’s approach in this work takes a probabilistic traffic modeling point of view stressing traffic compression in order to achieve optimal throughput and reduce the blocking probability for traffic arrivals.

The second article of this issue is “A Complete Spectrum Sensing and Sharing Model for Cognitive Radio Ad Hoc Wireless Networks Using Markov Chain State Machine” by three researchers at the University of Texas at San Antonio. This work also takes a probabilistic approach to modeling network traffic, but with strictly wireless ad hoc networks in mind. Wireless ad hoc networks, having no fixed infrastructure to rely on for services, have their own set of unique and difficult problems to deal with to ensure network efficiency. In this work, the authors deal with ad hoc networks that rely on cognitive radio. Cognitive radio allows more general mobile devices to be programmed to be used on a particular network without “hardwiring” them to work only on a given network or set of frequencies. It allows for adaptive capabilities for devices to work across networks, which becomes important for mobile devices in certain situations. One scenario in which cognitive radio would be useful includes so-called battlefield networks where soldiers and their associated means for transport and weaponry form their own ad hoc networks in a given area and as others move from group to group, their devices should be able to adapt to the network being used in a given area. Cognitive radio, with its ability to program devices to sets of frequencies, also offers the ability to more efficiently utilize bandwidth in a given region. Typically, there is a limited amount of bandwidth that must be shared by mobile devices operating in half duplex or full duplex mode. The ability to utilize more of the available bandwidth or spectrum can allow for greater numbers of nodes to operate in a region or allow segmentation of traffic. This segmentation may even result in the creation of several independent ad hoc networks operating simultaneously.

The next article of this issue is “A Novel Approach to Avoid Mobile Phone Accidents While Driving and Cost-Effective Fatalities” by two authors from AMa University in India. This work truly displays the applied and interdisciplinary nature of the work published in the journal. Distractions while driving have been proven to increase accidents and ultimately fatalities and costly injuries. Although governments are starting to intervene with restrictions on mobile device use while driving, developments from the mobile network providers and their associated application developers have also come to the forefront in trying to limit these unwanted consequences of device use while in an automobile or similar moving vehicle.

The authors discuss two types of “events” for mobile phones while driving: incoming calls and outgoing calls; both of which involve slightly different kinds of distractions for drivers. The authors then proceeded to develop an application that could handle both types of events while the vehicle is in motion. Consequently, the proposed application includes a mechanism for locating a mobile user and
measuring their speed in the vehicle. The motivation for their approach, while obviously including the
notion of saving lives through accident reduction, was the mitigation of risk involved and economic
impact associated with driver-distracted mobile-phone related accidents.

The final article of this issue is entitled “A Study of Speed Aware Routing for Mobile Ad Hoc Net-
works” written by Kirthana Akunuri, Ritesh Arora and Ivan G. Guardiola, all of the Missouri Univer-
sity of Science and Technology in the U.S. This article examines how speed of movement and general
mobility affects the topology for a Mobile Ad Hoc Network (MANET). One of the motivating factors
for this research, as explained in the article, is that the effects of mobility on routing have been studied
less than other aspects of MANET network performance. The authors propose a Speed-Aware Routing
Protocol (SARP) that essentially ignores nodes traveling at too great a speed from initial route discovery.
Essentially, packets from a high speed node are dropped due to the fact that maintaining a route related
to that node is not a worthwhile endeavor. Part of the protocol involves the determination of a link
expiration time (LET) which essentially predicts the period of time that a route will be feasible. Thus,
some minimum threshold level is set for a LET and ones below a threshold force the exclusion of nodes
generating these values to be excluded from the routing process in the immediate future. The key to this
approach is the identification and exclusion of “fast moving” nodes. Thus the approach is sacrificing
the ability to deal with such nodes in an equal fashion for greater stability in the route determination
process. The authors used simulation to display the advantages of their routing approach.

The fourth issue of the calendar year 2011 included four articles on a wide variety of telecommu-
ications-related topics. The first of these, “A Survey of Cloud Computing Challenges from a Digital
Forensics Perspective” by Gregory H. Carlton and Hill Zhou, both of the California State Polytechnic
University, focused on the problem of cloud computing-stored information and obtaining digital forensic
information on it. Cloud computing describes the process by which information is stored on servers on
the greater Internet and not locally. Since information is not stored in-house, gathering forensics that pass
legal muster is a challenge since the information is somewhat controlled externally, yet was placed there
by an internal source. The authors begin by providing an overview of cloud computing that leads into
discussion of the implications for digital forensics. In today’s digital society, the ability to document
the sources of digitally stored information and other key metadata provides the foundation for modern
criminal law enforcement and also some civil litigation such as copyright infringement.

The second article of this last issue is entitled “Value Creation in Electronic Supply Chains by Adop-
tion of a Vendor Managed Inventory System.” This article, written by Yasanur Kayikci of the Vienna
University of Economics and Business, is a very “applied” one in that it focused on a specific application
of Internet-based technologies and telecommunication networks, utilizing them for electronic supply
chains in which a supplier manages a retailer’s inventory. This is a very unique application of networks
and one that has grown in notoriety over the past few years as companies focus on increasing efficiency
and reducing inventory costs. The author looks at factors that influence the adoption of such technolo-
gies. In particular, the work looked at an industry that has made such technology a strategic priority, the
automotive industry.

The third article, written by Paramesh C. Upadhyay and Sudarshan Tiwari of India, details a distrib-
uted and fixed mobility management system for IP-based mobile networks. This work bases mobility
management on mobile device user history and not other more traditional metrics. Signaling cost in their
approach revolves around an analytical model utilizing Markov chains and random walk modeling. The
approach utilizes both a micro-registration model as well as a macro-registration model (in other words
mobile devices register at two different layers). Their approach was test for varying distances from a
mobile host and performed in a robust fashion.
The final article of this issue, “The Media Gatekeeping Model Updated by R and I in ICTs: The Case of Wireless Communications in Media Coverage of the Olympic Games” is a unique look at the impact of telecommunication and networking technologies on media coverage for the Olympic games. Since 2012 was an Olympic year with the summer games being hosted in London, this work is ever more topical and interesting. In contrast to most of the published work in the journal, this paper takes a broader perspective that focuses on the impact of the technologies rather than the technologies themselves. In particular, the globalization of mass media has transformed the way most populaces view world events. This globalization has taken place through the evolution of telecommunication and networking technologies and has accordingly transformed the “gatekeeping” model described by Cossiavelou, Bantimaroudis, Kavakli, and Illia in this article.

I would like to now elaborate a bit on an important aspect of telecommunication and networking technologies that is growing in its importance and one in which I, Michael Bartolacci, am engaged. This is the application of wireless technologies to the field of disaster planning and management for China. Whether or not you personally believe in global warming or feel that the earth is undergoing a rapid change in climate, one cannot debate the tremendous impact of natural disasters such as hurricanes and tornado have had in recent history. Add to these the unpredictable nature of other types of natural disasters such as earthquakes and volcano eruptions and the need to both prepare for such events and to have systems in place for managing the human and natural damage that occurs during them is apparent. China, due to its large land area size (third in terms of land area trailing only the Russian Federation and Canada and just ahead of the United States) and population (currently over 1.3 billion by some conservative estimates) presents an enormous challenge in preparing for and dealing with natural and manmade disasters. In this context, Bartolacci and fellow researchers explore the applications of telecommunications technologies for disaster planning and management there.

Disaster management systems in China still have some problems to overcome in order to improve their effectiveness. In general, these problems lie primarily in their ability to disseminate information, in other words, in their ability to communicate. The following statistic discourages improvement and greater development of such systems; 57.7% of China’s population and about 60% poorer population live in rural areas which has a tremendous impact on the nature of emergency management. Such people are more vulnerable due to their limited resources and these vulnerable groups are become more fragile when confronting disasters. Disaster planners should use this critical piece of information as they identify relevant preparedness actions. However, the management of natural disaster emergencies is different in various regions. The level of study and management in regions with relatively developed economies is higher than that in regions with relatively undeveloped economies. Poor and remote rural areas must receive the same level of attention in the process of disaster management to be able to reduce their vulnerability. China has no real “teeth” to its goals with respect to wireless rural deployment or even universal service access and therefore has a mish mash of wireless infrastructure that could support disaster management and to assist the rural disadvantaged in times of need and even in day to day existence.

Wireless communications in China, much like its landlines, lagged behind more industrialized countries until the early 1990’s. The Chinese government, in an attempt to introduce free market competition into what was traditionally a state run service (under the auspices of the Ministry of Posts and Telecommunications), created the incentives for the development of a duopoly in the mobile telecommunications market for China. Although state-controlled for the most part, both companies sought global partners and had ambitious goals for growth and profitability. Both China Unicom and China Mobile focused their efforts on serving the growing industrialized urban markets of Eastern China. Very large cities and their
surrounding areas such as Shanghai, Beijing, and Shenzhen were profitable markets where the companies made extensive investments in infrastructure in order to satisfy the ever-growing demand for wireless voice and data communications with China’s rapidly expanding economy. This focus on the profitable Eastern markets was in direct contrast to the overall goals set forth by the Chinese government of providing universal telephony service for its populace. By 2004, China had enacted the “Village Access Project” (VAP) with the goal of connecting all rural villages to the rest of the country with some form of telephone service, be it via landlines, satellites, or mobile telephony. While this effort met with some success in that many rural villages were given access to some form of telephony, there was no universal service regulatory regime associated with the overall project. Under the auspices of the VAP, companies that sought to maximize their profit were faced with rather expensive network expansions to reach small and seemingly unprofitable market regions. No direct monetary or regulatory incentives beyond the mere existence of the project spurred carriers into investing in such connections for the long term. Local, regional and national governmental aspects and control of the overall project sometimes conflicted in their tone, focus, and commitment. This mandate without a clear overall regulatory unit policing it soon led to unwanted behavior by China’s telecommunications companies including the wireless carriers. It is clear that China is not really prepared to implement wireless technologies to their best advantage in the context of disaster planning and management. This discussion of ongoing research highlights the ever-growing importance of telecommunications technologies play in our world.

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