Editorial: Third Quarter 2013, IEEE Communications Surveys & Tutorials

Ekram Hossain, *Editor-in-Chief*

I WELCOME you to the third issue of ComST in 2013. I am very pleased to let you know that according to the 2012 Journal Citation Reports recently released by the Thomson Reuters, IEEE Communications Surveys and Tutorials (ComST) ranks 2nd among all IEEE publications in terms of its impact factor (which is 4.818) and 5-year impact factor (which is 6.348). This is indeed great and makes us all proud of the journal. I would like to thank all the authors, the members of the editorial board, and the IEEE ComSoc editorial staff.

This issue includes twenty five articles covering different aspects of communication networks. In particular, issues related to energy efficient multimedia transmission, interference coordination in cellular networks, resource allocation and reservation, game theoretic approaches for spectrum access via carrier sensing, cognitive networks, biologically inspired algorithms for computer networking, stochastic geometry modeling for cellular and cognitive wireless networks, human activity recognition via wearable sensors, intrusion detection in sensor networks, source location privacy in sensor networks, indoor inertial position systems, cloud computing for smart mobile devices, content delivery in mobile networks, power savings in data centers, mobile social networks, vehicular networks, protocol stack for the Internet of Things, transition from IPv4 to IPv6, active queue management, Ethernet security, and context provisioning. A brief account for each of the articles included in this issue is given below.

WIRELESS SYSTEMS AND NETWORKS

The high power consumption in wireless networks contributes to an increased CO_2 emission and hence causes harm to our environment. Therefore, greening the wireless networks has become a critical research agenda worldwide. However, incorporating energy efficiency aspects in the design of wireless networks makes the modeling and design more challenging. The challenges become even more acute for multimedia transmissions over wireless networks due to the delay and bandwidth constraints. Motivated by these challenges, the first paper of this issue titled "A Survey of Energy-Efficient Compression and Communication Techniques for Multimedia in Resource Constrained Systems" by Tao Ma, Michael Hempel, Dongming Peng, and Hamid Sharif reviews the literature related to energy efficient multimedia transmission. The authors classify the literature into two main groups, namely, the transmission techniques and the compression techniques. The authors also point out future research directions.

Interference has always been a performance limiting parameter in wireless networks. Moreover, the increased capacity demand along with the scarce spectrum motivates universal frequency reuse in cellular networks which highly increases inter-cell interference and may degrade the overall network performance. Inter-cell coordination and cooperation are envisioned to be the key solutions to mitigate the inter-cell interference and maintain a high spectrum utilization. The paper titled "On Interference Avoidance Through Inter-Cell Interference Coordination (ICIC) Based on OFDMA Mobile Systems" by Chrysovalantis Kosta, Bernard Hunt, Atta UI Quddus and Rahim Tafazolli reviews the literature related to interference coordination techniques in OFDMA mobile systems.

A tractable yet precise and rigid modeling technique that is able to characterize interference in cellular wireless networks is required for engineering such networks. However, the coexistence of multiple network tiers consisting of heterogeneous types of base stations (BSs) such as the macro, micro, prico, and femto BSs in the different tiers significantly increases the complexity of modeling interference in modern cellular networks. In this context, the paper titled "Stochastic Geometry for Modeling, Analysis, and Design of Multi-Tier and Cognitive Cellular Wireless Networks: A Survey" by Hesham ElSawy, Ekram Hossain, and Martin Haenggi surveys the stochastic geometry modeling techniques for multi-tier cellular and cognitive wireless networks. The theory of point processes in the stochastic geometry provides an elegant mathematical way to characterize interference which is helpful to understand the performance behaviour of multi-tier cellular and cognitive networks. The authors provide a taxonomy based on the used point process, the target network model, and interference modeling technique. The authors also discuss open research challenges and point out future research directions in this area.

The inefficiency of static resource allocation and fixed pricing in wireless networks motivates a dynamic allocation and pricing scheme that can meet the demand-supply requirements and reflect the market demand and competition. Auction theory provides techniques to model and analyze the problem of dynamic resource allocation and pricing. The paper titled "Auction Approaches for Resource Allocation in Wireless Systems: A Survey" by Yang Zhang, Chonho Lee, Dusit Niyato, and Ping Wang reviews the existing literature on auction-based resource allocation for wireless networks. The authors also outline open challenges and future research directions.

Resource reservation is a key solution for providing a guaranteed quality-of-service (QoS) in the IEEE 802.11 standard-based networks. The QoS-sensitive applications can be pro-

vided sufficient resources so that they can achieve their required performance. The paper titled "Resource Reservation Schemes for IEEE 802.11-Based Wireless Networks: A Survey" by Xiaobo Yu, Pirabakaran Navaratnam, and Klaus Moessner reviews the literature related to resource reservation schemes for the IEEE 802.11 networks. The authors summarize and classify the related literature and point out future research directions.

Game theory provides a set of mathematical tools to model the interactions in multi-agent systems and enables optimization of the individual or sum utility of the agents. Carrier sense multiple access (CSMA) systems involve interactions among the competing radio transmitters during the process of spectrum access. CSMA networks can be modeled, analyzed, and optimized by using the results from the game theory. The paper titled "Game Theory Applications in CSMA Methods" by Mahdieh Ghazvini, Naser Movahedinia, Kamal Jamshidi, and Neda Moghim surveys the literature related to the game theoretic approaches in the CSMA networks. The authors discuss different games proposed in the literature to model the CSMA networks and point out their advantages and shortcomings. The authors also point out future research directions.

Cognitive Networks

It is well established that rigid spectrum allocation significantly degrades the utilization of radio spectrum. Therefore, opportunistic spectrum access via cognitive radio techniques has been a hot field of research. Spectrum sensing is a fundamental problem in cognitive radio (CR) networks to determine the activity of licensed users and estimate the spectrum availability. The paper titled "Spectrum Decision in Cognitive Radio Networks: A Survey" by Moshe Timothy Masonta, Mjumo Mzyece, and Ntsibane Ntlatlapa surveys the literature related to spectrum decision in cognitive radio networks. The authors highlight the key open research challenges and discuss practical implementations of spectrum decision methods in several CR platforms.

Interference mitigation between cognitive radio users as well as between cognitive and licensed users is a key challenge to improve the performance of cognitive radio networks. In this context, the paper titled "Spectrum Assignment in Cognitive Radio Networks: A Comprehensive Survey" by Elias Z. Tragos, Sherali Zeadally, Alexandros G. Fragkiadakis, and Vasilios A. Siris reviews the literature related to spectrum assignment techniques used to mitigate interference in cognitive radio networks. The authors highlight open challenges and future research directions in this area.

As has been mentioned before, detection of the activity of licensed users and predicting the activity pattern are essential for cognitive radio communication. In this context, concepts from artificial intelligence and machine learning are very useful and can be applied by cognitive radios in order to improve their opportunistic spectrum access performance. The paper titled "A Survey on Machine-Learning Techniques in Cognitive Radios" by Mario Bkassiny, Yang Li, and Sudharman K. Jayaweera surveys the machine learning techniques proposed for cognitive radio systems.

Motivated by the techniques used by the living organisms to organize their lives and deal with their problems, biologically inspired algorithms have been designed to solve the computer networking related problems. In this context, the paper titled "A Survey on Biologically Inspired Algorithms for Computer Networking" by Chenyu Zheng and Douglas C. Sicker reviews the literature related to biological inspired algorithms proposed for computer networking. The paper provides a taxonomy of the algorithms proposed in the literature based on the biological source, mathematical model, major application, advantages, and limitations. The authors also point out future research directions.

Sensor Systems and Networks

A precise and robust human activity recognition system is necessary for numerous types of applications including healthcare, security, and entertainment. In this context, the paper titled "A Survey on Human Activity Recognition using Wearable Sensors" by Óscar D. Lara and Miguel A. Labrador presents a survey on wearable sensors used for human activity recognition. The authors provide a taxonomy based on the learning approach and response time. The authors also discuss open research challenges and highlight future research directions.

Due to the dense nature of the wireless senor networks used for tracking applications, single node-based tracking systems involve redundant sensing, processing, and data communication which highly reduce the energy efficiency. Therefore, collaborative target tracking where the network parameters (communication range, sensing rage, sampling rate, wakeup period, etc.) are optimized based on the target dynamics (i.e., position, velocity, and direction) is envisioned to be a key solution to improve the energy efficiency of tracking applications. In this context, the paper titled "On Energy Efficiency in Collaborative Target Tracking in Wireless Sensor Network: A Review" by Oualid Demigha, Walid-Khaled Hidouci, and Toufik Ahmed presents a survey on energy efficiency of target tracking applications in wireless sensor networks.

Intrusion detection is the first line for defence against security attacks. Provisioning of security is a significant challenge in wireless sensor networks, especially those deployed in hostile environments. The paper titled "On the Vital Areas of Intrusion Detection Systems in Wireless Sensor Networks" by Abror Abduvaliyev, Al-Sakib Khan Pathan, Jianying Zhou, Rodrigo Roman, and Wai-Choong Wong presents a survey on intrusion detection systems in wireless sensor networks. The authors classify the literature into three main categories, namely, anomaly detection, misuse detection, and specification-based detection. The authors highlight the major shortcomings of the presented intrusion detection techniques and point out future research directions.

In wireless sensor networks, to ensure security and privacy, hiding the location of the source nodes that detect/monitor an event is essential in some applications. The paper titled "Providing Source Location Privacy in Wireless Sensor Networks: A Survey" by Mauro Conti, Jeroen Willemsen, and Bruno Crispo reviews the techniques and algorithms related to hiding and protecting the locations of the source nodes in wireless

sensor networks. The authors show the limitations of each of the presented algorithms, classify the solutions based on the approaches taken, and provide an overview of the assumptions on the adversarial capabilities related to each solution.

Location awareness via global positioning system (GPS) is an enabling technology for many outdoor applications such as those providing local news and weather, directing users to the nearest facility or a specific landmark, and navigating vehicles around traffic. However, since the GPS system requires a clear line of sight with the satellite, it cannot be used to provide location awareness for indoor environments. Instead, inertial positioning systems are exploited to enable many indoor applications that require location awareness. The paper titled "A Survey of Indoor Inertial Positioning Systems for Pedestrians" by Robert Harle provides a survey on indoor positioning systems used for pedestrians. The authors provide a taxonomy of the related literature, discuss the open research problems, and point out future research directions.

Mobile Cloud Computing and Networks

Due to their relatively limited processing capabilities and limited battery life time, offloading computation intensive applications from smart mobile devices to clouds/data centres is a hot topic of research. The paper titled "A Review on Distributed Application Processing Frameworks in Smart Mobile Devices for Mobile Cloud Computing" by Muhammad Shiraz, Abdullah Gani, Rashid Hafeez Khokhar, and Rajkumar Buyya reviews the literature related to distributed processing in smart mobile devices via cloud computing. The authors provide a taxonomy of the related literature, discuss open research problems, and point out potential future research directions.

Due to the scarce wireless spectrum, limited bandwidth, and unreliable wireless channel, multi-media transmissions over mobile networks may encounter high delay. Therefore, there have been extensive efforts invested by the industry and academia to accelerate the content delivery in mobile networks. In this context, the paper titled "On Accelerating Content Delivery in Mobile Networks" by Tao Han, Nirwan Ansari, Mingquan Wu, and Heather Yu presents a survey on the efforts invested to accelerate the content delivery in mobile networks.

The global trend to reduce the CO_2 emissions in order to maintain a greener environment has increased the energy efficiency awareness in the design and operation of data centers. Instead of reducing the power consumption in individual data centers, the current trend is to design practical power-saving techniques in content delivery networks which contain thousands of data centers. The paper titled "A Survey of Power-Saving Techniques on Data Centers and Content Delivery Networks" by Chang Ge, Zhili Sun, and Ning Wang reviews the efforts invested in the literature to increase power-saving in the data centers and content delivery networks. The authors categorize the literature according to their scopes and research directions, discuss open research issues, and highlight potential research directions.

Since mobile users' behaviours and interactions are affected by their social backgrounds, mobile social networks can describe and model the communication networks used by people.

Mobile social networks account for the social backgrounds and the needs of the users. The paper titled "Mobile Social Networks: Architectures, Social Properties, and Key Research Challenges" by Nikolaos Vastardis and Kun Yang reviews the literature related to mobile social networks. The authors discuss open research problems and point out future research directions.

Reducing the power consumption is essential to achieve a greener environment. Therefore, there is a significant demand for novel ideas that can reduce power consumptions in our life. In this context, the paper titled "Vehicular Networks for a Greener Environment: A Survey" by Maazen Alsabaan, Waleed Alasmary, Abdurhman Albasir, and Kshirasagar Naik explores how a network of vehicles can be exploited to enhance total fuel and power consumption, gas emissions, and budgets. The paper surveys the efforts invested in the literature to use vehicular networks to achieve a greener environment. The authors discuss open research issues and highlight potential future research directions.

Protocols and Middleware for the Internet

With the fast revolution of the smart phones, tablets, and notebooks with ubiquitous Internet connectivity along with the expected ability of all machines and every day objects to communicate over the internet, the concept of Internet of Things (IoT) has emerged in the literature. There is a demand to standardize a protocol stack for the IoT that gives a unified definition and a concrete structure for the IoT. The paper titled "Standardized Protocol Stack for the Internet of (Important) Things" by Maria Rita Palattella, Nicola Accettura, Xavier Vilajosana, Thomas Watteyne, Luigi Alfredo Grieco, Gennaro Boggia, and Mischa Dohler proposes a unified standard protocol stack for the IoT. The authors also highlight possible future research directions in this area.

The transition from IPv4 to IPv6 is a significant milestone in the evolution of the Internet. IPv6 is the key solution to the incapability of IPv4 to cope with the increased demand for a larger address space. In this context, the paper titled "Transition from IPv4 to IPv6: A State-of-the-Art Survey" by Peng Wu, Yong Cui, Jianping Wu, Jiangchuan Liu, and Chris Metz reviews the literature related to the transition from IPv4 to IPv6. The paper discusses the compatibility issues between IPv4 and IPv6 and addresses the basic problems and key difficulties in IPv4 to IPv6 transition.

Congestion control is essential to increase the utilization of network resources and decrease the packet loss and delay. In the context of IP networks, active queue management has been introduced to complement the Transmission Control Protocol (TCP) to improve the network performance. The paper titled "Active Queue Management: A Survey" by Richelle Adams reviews the literature related to congestion control via active queue management in IP networks since its introduction in 1993 up to 2011.

Due to its simplicity and reliability, the Ethernet technology has survived many evolutions of the IP networks and is still of great interest. However, the security of the Ethernet technology has to evolve and cope with the ever increasing security threats and sophisticated techniques of attack by the adversaries. The

paper titled "A Survey of Ethernet LAN Security" by Timo Kiravuo, Mikko Särelä, and Jukka Manner reviews the literature related to security in the Ethernet. The authors present the Ethernet related threats and discuss existing solutions. The authors also highlight potential future research directions.

Context awareness is essential to provide proactive user support in different network applications such as health care, e-learning, tourism, advertising, e-commerce and entertainment, and social community applications. Middlewares are proposed to overcome the problems related to network and application heterogeneity and provide transparent interface between the applications and the context parameters. The paper titled "Survey of Context Provisioning Middleware" by Michael Knappmeyer, Saad Liaquat Kiani, Eike Steffen Reetz, Nigel Baker, and Ralf Tönjes surveys the literature related to middlewares proposed for context provisioning. The authors discuss open research issues and highlight potential future trends.

I hope that you enjoy reading this issue and find the articles useful. Last but not the least, I highly encourage you to submit your work which fit within the scope of ComST. For detailed instructions on the preparation and submissions of manuscripts to ComST, please check the URL below:

http://dl.comsoc.org/livepubs/surveys/.

I will be happy to receive your comment and feedback on our journal.

Ekram Hossain, Ph.D., P. Eng.
Editor-in-Chief
IEEE Communications Surveys & Tutorials
Email: Ekram.Hossain@ad.umanitoba.ca
Web: http://www.ee.umanitoba.ca/~ekram