PROMOTING EMERGING TECHNOLOGIES WITHIN COMSOC

BY ANDREA GOLDSMITH

It is my great pleasure to write this first annual article showcasing the Emerging Technologies Committee (ETC) within ComSoc. The ETC was formed in 2006 to identify and promote new technology directions in the broad field of communications and related areas. Indeed, as communications becomes more interdisciplinary and its applications more diverse, the ETC's goal is to bring these cutting edge technologies under the purview of ComSoc through a wide range of activities.

ETC's primary activity is the formation of and support for subcommittees in emerging technology areas. Members with a common interest in a new technology area are strongly encouraged to form an Emerging Technical Subcommittee. These subcommittees may form for just a few years around a "hot" short-lived topic or may evolve into a ComSoc Technical Committee for areas with a long time-horizon of interest and development. Unlike Technical Committees, subcommittees within the ETC are meant to be nimble and dynamic: on an annual basis several new ones may form while some existing ones may disband or merge into another subcommittee or Technical Committee with related interests. The subcommittees organize a range of activities to promote their technical area and may also serve as technical co-sponsors for ComSoc conferences and publications. The ETC organizes a special e-issue of JSAC annually to showcase emerging technologies. This journal is meant to serve as a unique publication for research that does not quite "fit" into other journals due to its cutting edge nature and/or interdisciplinary focus. Articles for this journal are by invitation only and primarily come from within the subcommittees under the ETC's purview.

The 14 subcommittees within the ETC span a very broad range of areas which I will describe briefly here.

Autonomic Communications: Communication networks today operate in complex, dynamic, and heterogeneous environments. Moreover, the applications and services running over the top of such networks are also increasing in complexity as well as performance demands. The Autonomic Communications subcommittee focuses on research and development of self-configuring, self-organizing, self-optimizing, and self-healing network control to meet these challenges in next-generation networks. These autonomic techniques will allow networks to learn and adapt to their environment as well as to the demands of evolving applications and services, thereby providing significantly greater flexibility and robustness in network control and management than exists in networks today.

Cable Networks and Services: The mission of this subcommittee is to develop next-generation cable network technology from the creation of new applications to improving performance of the transport layer. The subcommittee also provides a platform for constituents from industry, academia and research communities to exchange ideas and develop solutions around these technical challenges. Some of the emerging technologies this subcommittee champions include software-defined networks, cloud services, virtualization, and next-generation DOCSIS, and Heterogenous Networks (HetNets) encompassing cable as well as WiFi and/or cellular networks. In addition to research and development, a major goal of this subcommittee is to forge connections between ComSoc and the broad, diverse, and vibrant cable industry, which serves a multi-billion dollar market.

Cloud Communications and Networking: Cloud-based technology holds the promise of ubiquitous, scalable, on-demand computing and storage resources across applications and services. This technology area, which lies at the intersection of computers and communications, has taken the high-tech industry as well as the research community by storm. In response, ComSoc formed the Cloud Communications and Networking Subcommittee around this broad technology area in 2013, and hence it is one of the newest Emerging Technical Subcommittees. Its mission is to lead and coordinate ComSoc's efforts in research and development of the communications and networking technologies required to support Cloud Computing. This subcommittee will also contribute to IEEE-wide activities in this area, in particular the IEEE Cloud Computing Initiative, which is developing new conferences, journals, and standards devoted to this broad and interdisciplinary topic.

Green Communications and Computing: Information and Communication Technology consumes a large and growing fraction of available energy and other environmental resources. Formed to address this important challenge, this subcommittee focuses on research, development, and standardization of green, communications and computing related to energy efficiency, resource efficiency, and environmental maintainability. The subcommittee addresses all aspects of this broad and interdisciplinary field, including green optical, wireless, and ad-hoc network design; energy-efficient circuits, devices and terminals; green data centers and cloud computing; energy-harvesting, hierarchical and distributed techniques for energy distribution and management, and smart grid technologies. The subcommittee also studies the environmental footprint of existing communication and computing systems to characterize their energy and other resource consumption as a starting point for drastically reducing it.

Human Centric Sensing and Communications: This subcommittee promotes the paradigm shift from machine-centered to human-centric communications that is transparent to the end user. Human-centric communications encompasses the design of pervasive and seamless communication systems as well as naturalized human-human/machine/data interactions. The goal of this subcommittee is to provide a platform for its members, and the human centric networking and communications research, development, and standardization community at large, to identify and solve major research and development challenges.

Innovation and Standards in Information and Communication Technologies: The transfer of technology from research to practice is fraught with obstacles. The goal of this subcommittee is to foster and promote research related to the theory and methodology of innovation and standardization in information and communication technologies. The subcommittee also actively seeks innovative contributions from the research community and then promotes them within global standards bodies. Through such activities, the subcommittee fosters greater collaboration between researchers and practitioners, and serves as a catalyst for greater innovation in technology development.

Integrated Fiber and Wireless Technologies: This subcommittee addresses architectures, techniques, and interfaces

for the integration of fiber and wireless network segments into a unified wired-wireless infrastructure. The objective of this integration is to enhance interoperability and resource sharing among wired and wireless segments. As a result, mixed wired and wireless networks will be able to provide better support for converged multimedia services irrespective of users' locations, terminal device capabilities, and access media.

Internet of Things: It is predicted that more than 30 billion devices will be wirelessly connected to the Internet (Internet of Things) by 2020. The objective of this subcommittee is to define the Internet of Things (IoT) architecture and governance, investigate the sensitive security and privacy issues, and explore the different technology scenarios and impacts when enabling Internet protocols over the emerging generations of IoT devices and networks. The subcommittee pursues collaboration with both IEEE and non-IEEE organizations from academia and industry, including industrial alliances such as the IPSO and Open Mobile Alliance, as well as standardization groups such as ETSI M2M, oneM2M and IETF. The goal of this multidisciplinary collaboration is to help forge a common understanding and convergence around technology, governance, integration and security of the Internet of Things.

Nano-Scale, Molecular and Quantum Networking: This subcommittee focuses on communication technology at the nano-scale enabled by media such as carbon nanotubes, quantum dots, and biological structures. Moreover, the subcommittee also explores the advantages of quantum and hybrid classical/quantum effects for security and coding, smart materials, nano-scale bio-medical applications, and nano-robotics. Broadly speaking, this subcommittee exists to support the emerging community of engineers, academics, scientists and others who are developing communications on the nano-scale.

Peer-to-Peer Networking: Peer-to-peer (P2P) communication technologies transcend multiple levels of the network protocol stack. This subcommittee promotes research, development and standardization around this broad topic. The technical issues addressed by the subcommittee includes all aspects of P2P networking and communications related research issues, including P2P overlay networks, P2P content access and distribution, P2P media streaming, and P2P security issues. Implementation challenges, industry standardization activities, and economic considerations are also under the purview of this subcommittee.

Situation Management: The aim of this subcommittee is to sponsor research, engineering, and standards activities in support of collaborative man-machine systems whose behaviors depend on real-time situations, events and goal-directed actions. Examples of such systems include complex terrestrial, marine and satellite communication networks, physical and cyber security systems, humanitarian assistance and disaster recovery systems, Earth observation and operations support systems, intelligent transportation systems, and tactical battlefield command and control systems. Common to these systems is the need to adequately sense, perceive, reflect and act according to the situational changes that are happening in the surrounding environment and within the systems themselves. The subcommittee's mission is to foster cross-domain ideas and solutions among different scientific and engineering communities, including situation awareness, decision support, cognitive situation modeling, situation control, semantic information fusion, human factors modeling, and social networking.

Smart Grid Communication: The objective of this subcommittee is to champion ComSoc's position in the development and promotion of Smart Grid related technologies and, in particular, ensure that ComSoc plays a decisive technological role in the development of Smart Grid communications. The transformation of the electricity grid into a smart grid is perhaps the most extensive and ambitious undertaking in electrical engineering today. Information and communication technologies are the essential enablers of such a transformation, yet they face a vast set of new challenges posed by the smart grid. In the context of the electricity grid, communication systems need to be seen as part of a larger system of systems, including the energy, control, and information processing systems. Smart grid communication systems have stringent performance requirements for low-latency real-time reliable communication, scalability to massive numbers of sensor and actuators, tight interaction with computing and control, robust security, as well as efficient support of the complex system and market operation that are evolving to support renewable energy sources as well as variable and unpredictable consumer demand.

Social Networks: Communication networks and human social networks are converging. Online social sites support massive communication and storage that capture human social activities. Through a better understanding of these social networks, more efficient communication networks can be designed along with new paradigms for services and applications. The goal of this subcommittee is to bridge the fields of social and communications networks through interdisciplinary research across social science, information theory and computer science. The subcommittee considers both the convergence of communication networks and human social networks as well as the new applications and services that could result from this convergence.

Vehicular Networks and Telematics Applications: This subcommittee addresses the confluence of transportation technologies with communications technologies. It actively promotes technical activities in the field of vehicular networks (vehicle-to-vehicle, vehicle-to-road, and vehicle-to-infrastructure communications), vehicular network standards, communications-enabled road and vehicle safety, real-time traffic monitoring, intersection management technologies, and future telematics applications and communication-based services. There is great potential for improved efficiency, safety, and user-experience through intelligent vehicular networks enabled by communications technology, and this subcommittee will help realize that potential through its activities.

I hope this brief journey through the various Emerging Technical Subcommittees provides a compelling view of their diverse, innovative, and exciting technology areas. In closing, I would like to encourage all ComSoc members to participate in ETC subcommittees that intersect with their interests, and to propose new ones associated with emerging technologies in the field of communications and related disciplines. I also encourage all readers to contact me if you have other ideas about how ComSoc can promote and participate in emerging technologies, which will help to maintain its leadership and vision in the field of communications.