ACCELERATING THE EMERGENCE OF EMERGING TECHNOLOGIES

ZHISHENG NIU
CHAIR, EMERGING TECHNOLOGIES COMMITTEE

Following the first column, "Promoting Emerging Technologies in ComSoc" in October 2013, and the second column, "Nurturing Emerging Technologies in Clouds" in November 2014, this column is aimed at further accelerating the emergence of emerging technologies. Emerging technologies, as the name shows, should still be emerging from, or only recently emerged from, the research base. In other words, emerging technologies, in particular in our information and communication field, should be up-to-date by nature and therefore should not remain in that category for a long time. However, the reality is that the number of ComSoc subcommittees on emerging technologies is growing quite fast, and some of them have been there for quite a long time (e.g., nine years since establishment). On one hand, every year there are new and interesting technical areas being proposed, which leads to increasing numbers of subcommittees. On the other hand, it also leads to more and more overlap with existing committees and/or subcommittees; hence, management of them becomes a challenge. A key question then arises: what is a good number of emerging subcommittees in our field, and how can we better accelerate the emergence of emerging technologies?

In this regard, the Emerging Techology Committee (ETC) has had thorough discussions through the years, and came up with a so-called 2+2 UP-or-DOWN mechanism, which has been approved by the Technical Activities Council in London, United Kingdom. Here, the key points of the mechanism are:

1) ETC opens its door throughout the years to welcome more proposals on any emerging technology areas.
2) In addition to annual reviews, a rigorous review will be made after two years of operation since formation with the recommendation of:
   a) Elevated/merged to a full TC
   b) Continue as a sub-TC
   c) Put on probation
   d) Disband

If it is rated as b) or c), a critical evaluation and final judgment of either "UP" (elevated to or merged with an existing Technical Committee) or "DOWN" (outdated and therefore disbanded) will be made two years later (i.e., four years since formation). In such a way, the subcommittees can be rotated in a healthy fashion, and more emerging technologies can be expected to emerge in a timely manner. The mechanism will be implemented from 2016; that is, the first rigorous review will be executed at the end of 2016. All the subcommittees that have been operating for more than two years have to go through this review.

By the end of 2014, there were 13 Emerging Technologies subcommittees in total, which were highlighted in the previous two columns. Here, I first outline the scope of the four newly established Emerging Technologies subcommittees. Members with a common interest in these technology areas are strongly encouraged to join the subcommittees.

TECHNICAL SUBCOMMITTEE ON BIG DATA, ESTABLISHED IN 2014

The goal of the Technical Subcommittee on Big Data (TSC-BD) is to provide a premier platform for its members, and the research, development, services, applications, and standardization communities of big data processing, analysis, analytics, integration, retrieval, and networking, to interact and exchange technical ideas, identify relevant challenges, and collaborate on and investigate solutions in the development of methodology, and for the science and technologies of big data processing, analysis, analytics, integration, retrieval, and networking.

The technical issues addressed by the subcommittee include all aspects of big data processing, analysis, analytics, integration, retrieval, and related research issues, such as theories, algorithms, solutions, practices, applications, and challenges for big data processing, analysis, analytics, integration, retrieval of information, and communications technologies; machine learning, data mining, web mining, graph mining, and processing; computational intelligence for big data; knowledge discovery for big data; big data for cloud computing and networking; big data for network design and architectures; big data for network protocols; big data for green information and communication technologies; big data for security, privacy, and trust; crowdsourcing and crowd intelligence using big data; big data maintenance; data science; big data platform design; data-intensive workflows; big data benchmarks; reliability for systems with big data; big data for wireless access and mobility; big data for the Internet of Things; big data for software-defined networking; big data for cognitive communications and computing; big data for smart homes; big data for smart sensing; big data for smart grids; big data for relevant signal processing techniques; big data for biomedical and health technologies; big data for social networks; and so on.

TECHNICAL SUBCOMMITTEE ON TACTILE INTERNET, ESTABLISHED IN 2015

The Tactile Internet (TI) subcommittee will focus on exploring and elucidating all facets of the next generation of "tactile Internet" technology, and business and societal gaps and challenges. The objectives of the TI subcommittee are to facilitate the worldwide harmonization of research, pre-standardization, and best practices for deployment user scenarios of the global TI ecosystem; design built-in security and privacy; and explore ways in which tactile technology can be realized in different segments such as in engineering, automobile, transport and logistics, health service, and public service. The TI subcommittee will target understanding the tactile requirements, specification and identification of tactile use cases, defining system specifications to meet these requirements, developing breakthrough technology to the identified challenges of the tactile Internet, and enabling Internet protocols over the next generation of empowered devices in order to reach convergence and end-to-end transparency through IPv6.

TECHNICAL SUBCOMMITTEE ON QUANTUM COMMUNICATIONS AND INFORMATION TECHNOLOGY, ESTABLISHED IN 2015

This sub-TC is aimed at fostering engineering in the newly upcoming quantum technology by applying our (ComSoc's) technical knowledge in areas like RF technology, coding theory, communications and information theory, photonic commu-

nications technology, interconnection and complexity theory, error correction, control instrumentation, modeling and simulation, communication systems architecture and hardware, optimized algorithms, and applications, which are all highly required to drive quantum technology forward and get it ready for applications.

TECHNICAL SUBCOMMITTEE ON BACKHAUL NETWORKING AND COMMUNICATIONS, ESTABLISHED IN 2015

There is considerable market interest in the development of small cell backhaul/fronthaul solutions that are an evolution of the existing backhaul/fronthaul technologies (i.e., SDH, ATM, MPLS, and Ethernet). One of the main considerations operators are faced with today is how to migrate existing backhaul/fronthaul infrastructure toward adaptive and smart backhauling/fronthauling solutions that optimize their operations jointly with the access network for the next generation of cellular technology. The deployment availability, cross-layer convergence, and economics of smart backhauling/fronthauling systems are the most important factors in selecting the appropriate backhaul/fronthaul technologies for multiple networks (cellular, WiFi, WiMax, WiGig, etc.); a variety of cell sizes (macro, micro, pico, femto); and multiple technologies (visible light communications, D2D, distributed antennas, etc.).

The aim of this sub-TC is to put forward IEEE's agenda and contribution to the research and standardization activities on future backhaul/fronthaul communications and networking. This sub-TC will create a forum for researchers, developers, and practitioners from both academia and industry to identify and discuss the backhaul/fronthaul requirements, challenges, recent developments, and smart end-to-end solutions pertaining to fifth generation (5G) mobile communication networks. The sub-TC will serve as a prolific opportunity to educate about, promote, and accelerate the evolution of next generation backhaul/fronthaul networking and communications by fostering technical activities in the related area.

Another way the ETC promotes emerging technologies is the *IEEE Journal on Selected Areas in Communications* bonus issue on Emerging Technologies; the first issue was published in May 2015. The key idea here is to showcase the emerging technologies that are cutting-edge and/or interdisciplinary but have no obvious home in other journals by invitation. It is published once a year; all the papers are by invitation and limited to a relatively small number of cutting edge papers on emerging technologies. ETC is the Editorial Board of each issue and responsible for selecting three to four subcommittees to showcase. The Chairs of the selected subcommittees are then responsible for inviting four to six paper submissions in the corresponding fields. Regardless of their invited nature, all papers go through a normal review process based on the standards of *JSAC*, and final acceptance is made by the ETC. In the May 2015 issue, 10 papers out of 23 submissions from the 4 subcommittees (Internet of Things, Social Networks, Green Communications and Computing, and Innovation and Standards in Communication and Information Technologies) were published. The second issue, which is targeted to be published in the second quarter of 2016, is now in the paper review phase under the Guest Editorship of Shuguang Cui (Texas A&M University, ETC member, lead), Tomohiko Taniguchi (Fujitsu Labs, Japan, ETC member), John Thompson (University of Edinburgh, U.K., ETC member), Andrew Eckford (Chair, Nano-Scale, Molecular & Quantum Networking Subcommittee), Latif Ladid (Chair, 5G Mobile Wireless Internet Subcommittee), Vincent Wong (Chair, Smart Grid Subcommittee), and Jie Li (Chair, Big Data Subcommittee). Their hard work and great contributions are highly appreciated. Thus, the selected subcommittees to be showcased are Nano-Scale, Molecular & Quantum Networking, Smart Grid Communications, 5G Mobile Wireless Internet, and Big Data.

Last but not least, I would like to encourage all ComSoc members to participate in ETC subcommittees that intersect with your 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.