

COMSOC EMERGING TECHNOLOGIES

The IEEE Communications Society (ComSoc) Emerging Technologies Committee (ETC) is responsible for identifying and nurturing new technology directions through various activities including the formation of initiatives in areas that are of high interest to ComSoc members. In this issue of the President's Page, I am pleased to introduce Zhisheng Niu, the Chair of ETC for 2022–2023 to share with you the ongoing activities.

ZHISHENG NIU graduated from Beijing Jiaotong University, China, in 1985, and got his M.E. and D.E. degrees from Toyohashi University of Technology, Japan, in 1989 and 1992, respectively. During 1992–1994, he worked for Fujitsu Laboratories Ltd., Japan, and in 1994 joined with Tsinghua University, Beijing, China, where he is now a professor at the Department of Electronic Engineering. During 1997–1998, he visited Hitachi Central Research Laboratory as a HIVIPS senior researcher. His major research interests include queueing theory and traffic engineering, wireless communications and mobile Internet, vehicular communications and smart networking, and green communication and networks. He has been serving IEEE Communications Society since 2000, first as Chair of Beijing Chapter (2000–2008) and then as Director of Asia-Pacific Board (2008–2009), Director for Conference Publications (2010–2011), Chair of Emerging Technologies Committee (2014–2015), Director for Online Contents (2018–2019), and currently Chair of Emerging Technologies Committee (2022–2023). He has also served as editor of *IEEE Wireless Communications* (2009–2013) and associate Editor-in-Chief of IEEE/CIC joint publication *China Communications* (2012–2016), and Editor-in-Chief of *IEEE Trans. Green Commun. & Networks* (2020–2022). He received the Outstanding Young Researcher Award from Natural Science Foundation of China in 2009, Best Paper Awards from IEEE Communication Society Asia-Pacific Board in 2013 and from *Journal of Communications and Information Networks (JCIN)* in 2019, Distinguished Technical Achievement Recognition Award from IEEE Communications Society Green Communications and Computing Technical Committee in 2018, and Harold Sobol Award for Exemplary Service to Meetings & Conferences from IEEE Communication Society in 2019. He was selected as a distinguished lecturer of IEEE Communication Society (2012–2015) as well as IEEE Vehicular Technologies Society (2014–2018). He is a fellow of both IEEE and IEICE.

It is my great pleasure to showcase the activities of the ETC which was formed in 2006 to identify and nurture new technology directions in the broad field of communications and networking areas. As communications and networking become more pervasive and interdisciplinary, the ETC's goal is to bring these cutting-edge technologies under the purview of ComSoc. Members with a common interest in a new technology are strongly encouraged to form an Emerging Technical Initiatives (ETIs) so that the new technology can be promoted by organizing a wide range of activities such as seminars, workshops, distinguished lecturer tours, etc. The ETIs may also serve as technical cosponsors for ComSoc conferences and publications, or organize a special e-issue of JSAC to showcase the emerging technologies.



Xuemin (Sherman) Shen



Zhisheng Niu

In the following, I will highlight the 8 current ETIs within the ETC. More detailed information, in particular the most recent activities of each ETI, can be found from <https://www.comsoc.org/about/committees/emerging-technologies-initiatives>.

1. Backhaul/Fronthaul Networking & Communications

Founded in 2015, this ETI create a forum for researchers, developers and practitioners from both academia and industry to identify and discuss the backhaul/fronthaul requirements, challenges, recent development and smart end-to-end solutions pertaining to fifth-generation (5G) and beyond of mobile communication networks. It is anticipated that future networks will evolve from today's separate and incompatible fronthaul and backhaul into an integrated flexible smart wireless backhauling/fronthauling infrastructure that will support future cellular and ad hoc networks e.g., 4G/5G and 6G, Wi-Fi, IoT and emerging technologies such as driverless cars, autonomous vehicles or flying platforms, robotic control, smart buildings, and remote condition monitoring networks, etc.

2. Quantum Communications & Information Technology

Founded in 2015, this ETI aims at fostering engineering in the newly upcoming quantum technology by applying ComSoc's technical knowledge in areas like RF technology, coding theory, communications and information theory, photonic communications technology, interconnection and

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

3. Network Intelligence

Founded in 2017, this ETI is to support and endorse researches to embed Artificial Intelligence (AI) in future networks, which will provide greater level of automation and adaptiveness, enabling faster deployment (from months down to minutes), dynamic provisioning adapted to the nature of network functions, and end-to-end orchestration for coherent deployment of IT and network infrastructures and service chains. It will also result in higher resiliency and better availability of future networks and services.

4. Machine Learning for Communications

Founded in 2018, this ETI is to foster research and innovation surrounding the use of machine learning (ML) for the physical (PHY) and medium access control (MAC) layers for all types of communication systems, such as wireless, optical, satellite, and molecular. It also works on establishing common data sets and related benchmarks and inviting authors to open-source their code for reproducible research.

5. Aerial Communications

Founded in 2019, this ETI focus on aerial communications from all different perspectives (vehicles, electronics, communications & networking, services), including aspects related to both aerial users and networks, as well as computational resource migra-

tion towards “portable” and flying platforms. One of the main considered domains is public safety, i.e., aerial communications with drones or balloons to deliver additional cellular coverage (for example during emergency situations) or to help first responders while providing advanced services.

6. Reconfigurable Intelligent Surfaces (RIS)

Founded in 2020, this ETI explores and supports a wide variety of research directions and standardization opportunities that rely on RIS as groundbreaking technology that will have the potential of fundamentally changing how generic wireless networks are designed and optimized today and is expected to have a big impact on the future (6G and beyond) communication solutions’ design and implementation. Such a new concept has been recently proposed for a variety of applications, ranging from secure communications, non-orthogonal multiple access, millimeter-wave and terahertz communications, vehicular/aerial communications, and over-the-air-computation to improving the energy efficiency and capacity of wireless networks.

7. Integrated Sensing and Communications (ISAC)

Founded in 2021, this ETI is to explore and support a wide variety of research directions and standardization opportunities related to Integrated Sensing and Communication (ISAC), including vehicular network, environmental monitoring, remote sensing, IoT, smart city as well as indoor services such as human activity and gesture recognition. More importantly, ISAC has been recently identified as an enabling technology for B5G/6G, and the next-generation Wi-Fi system.

8. Next Generation Multiple Access (NGMA)

Founded in 2022, this ETI provides a research and networking platform for researchers to collaborate, exchange ideas, and promote initiatives on Next Generation Multiple Access

(NGMA) in wireless networks. The scope of possible candidates for this ETI includes: (1) nonorthogonal multiple access in both power and code domain as well as its joint design with large-scale antenna systems; (2) massive grant-free access schemes, including random access schemes and the related signal processing techniques; (3) efficient bidirectional schemes for multiple access that include transmission of control information and data in the downlink, in addition to the uplink; (4) native AI-enabled multiple access schemes, and other possible multiple access candidates for new application scenarios such as large scale distributed machine learning; (5) other emerging multiple access schemes.

Emerging technologies are generally unknown, unproven, and risky, and therefore difficult to manage. As a result, IT organizations like ComSoc are facing with the task of not only identifying relevant emerging technologies, but also developing their organizational awareness and motivation to nurture them. In this context, the ETC has been working with the TC Restructuring Ad Hoc Committee to determine a new framework for TCs/ICs/ETIs and the migration approaches. We are also working closely with ComSoc’s TE&I (Technology Evolution & Initiatives) Committee to strengthen the tie with external initiatives, i.e. those originated from IEEE-level or multi-Society initiatives. As the first trial, we will co-organize a session with TE&I at IEEE Globecom 2022 in Rio de Janeiro, Brazil, to introduce TE&I and ETIs activities to broader members.

Looking forward, we would like to encourage all ComSoc members to widen your eyes across all the potential fields linked directly or indirectly to the discipline of communications and to propose new ETIs accordingly. We also encourage all readers to contact us if you have other ideas about how ComSoc can promote and participate in emerging technologies, which will further enhance its leadership and vision in the field of communications and networking. Thank you.