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5G Technologies: Insights, Opportunities & the Future

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Panel

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ABSTRACT

The advances in fifth-generation (5G) cellular technologies have shown much potential in this transformational technology which has been critical in driving economic development via numerous opportunities and applications. 5G technology is integral to realizing the full potential of the Internet of Things, edge computing, and artificial intelligence technologies in the real world. The purpose of this panel is to disseminate multi-faceted perspectives on 5G in order to more holistically understand it, such as diverse spectrum, network slicing, edge computing, cloud radio access network (C-RAN), various industries and use cases, business model, deployment, vulnerabilities; and to stimulate an engaging discussion on 5G. Three executives with expertise in the telecom industry, along with three academicians knowledgeable in the 5G and wireless telecom field, will share their perspectives and insights on 5G. They will also discuss the research agenda in the Information Systems field.

Keywords

Fifth generation (5G), Internet of Things, Network Slicing, Artificial Intelligence (AI), edge computing, Cloud Radio Access Network (RAN), Security, Deployment.

INTRODUCTION

Fifth Generation (5G) is being hyped as the Fourth Industrial Revolution (4IR). 5G speeds and low latencies evolve the orthogonal frequency division multiplexing (OFDM) of 4G into flexible and scalable waveform framework optimized. 5G technology will reveal a new set of breakthrough use cases for consumers and businesses that are not possible with current networks. Realizing the full benefits of 5G requires a virtualized cloud-based network infrastructure which is fundamental to realizing 5G network services delivery aligned with customer and service provider expectations. It also allows for an unprecedented level of cognitive automation, enabling 5G networks to conduct intelligent, agile, responsive network and service operations. The 5G speeds and low latencies are essential to meet the connectivity requirements in high reliability and low latency services. These connectivity requirements include aspects of extended reality, autonomous vehicles, drones network, smart agriculture, smart cities, and wireless robotics. Network slicing for enhanced mobile broadband, ultra-reliable low-latency communications, and massive machine-type communications are key technologies for 5G.

As Klaus Schwab pointed out, "the changes are so profound that, from the perspective of human history, there has never been a time of greater promise or potential peril" (Schwab, 2016). The industry will need to explore these great promises and/or potential perils more as we usher in the 4IR. Governance for managing 5G use cases, application risk, 5G ecosystem, and infrastructure vulnerabilities should be explored. The panel discussion will focus on multi-faceted perspectives on 5G, such as diverse spectrum, network slicing, various industries and use cases, business model, deployment, and vulnerabilities. New opportunities, challenges, and the future, as well as the best actions will be addressed.

PANEL OVERVIEW: POSITIONS AND EXPLORATION

The panel will use a virtual roundtable discussion format to seek new insights about 5G in the information

systems field. The moderator (J.P. Shim) will take 5 to 7 minutes to deliver an overview, and the current status on 5G. The primary purpose of this panel is: 1) to disseminate new points of view and multi-faceted perspective on 5G; and 2) to stimulate an engaging discussion and/or a healthy debate on potentially controversial topics. The panel will provide a fruitful and informative dialogue to the audience. Following an introduction by the moderator, the panelists will be given about 25 minutes to share their views and to provide an opposing or supporting view on the issues. The panel will be asked to draw on their expertise to address the initial question, which is as follows:

- How can 5G transform business and society in the future (including IoT, edge computing, business model, cybersecurity, applications, and deployment)?

After the discussion induced by this framing question, the audience will be invited to voice their opinions in response to the panelists' remarks or questions about the topic for about 7 minutes. After the first round of questions and comments from the audience, the panelists will draw on their expertise and knowledge on 5G to address the second round of questions for roughly 10 minutes, followed Q&A from the audience for another 7 minutes. The question for this portion of the panel discussion will be as follows:

- What research questions for 5G as it relates to Information Systems (IS) discipline and Telecom industry sector?

Ramping up Edge Computing and AI in 5G

5G is one of a set of technologies coming together to kick off a new chapter in the history of telecommunications. Another essential technology that helps fundamentally transform telecommunications is edge computing. Without edge computing, 5G applications and services will rely upon connecting to centralized cloud resources for storage and computing, losing much of the positive impact of the latency reduction enabled by 5G. With edge computing, these tasks can be executed closer to the network edge, significantly reducing network congestion and latency. Industry digitalization, the increasing number of connected devices, and the demand for immersive experiences will require more processing power at the network edge. AI has become the key driver for the adoption of edge computing. Locating AI close to the edge is crucial for applications where near-real-time actions are crucial, such as for machine control, equipment monitoring, and remote surgery. While the blending of 5G, edge computing, and AI creates groundbreaking opportunities in both the consumer and enterprise space, it also introduces new challenges such as standards, regulations, support systems, security, and business models.

5G Cloud RAN and Core: Technology and Business Models

Cloud Radio Access Network (C-RAN) is a centralized radio access network architecture model based on cloud computing. The core network can be based on cloud (C-Core), too. Both support current mobile communication systems and future wireless standards. In the traditional radio architecture model, the processor resources of base stations cannot be shared which wastes invaluable resources while C-RAN is a cost-efficient, centralized base station deployment model relying on data center infrastructure. This model also provides 5G operators with access to the high-performance cloud baseband unit pool. The concept includes dynamic resource sharing in multi-vendor, multi-technology environments which support enhanced business models. The C-RAN connects to the service-oriented C-Core network. The C-Core network has various tasks such as composable control function that manages mobility, services, policies, security, and user data. Both C-RAN and C-Core offer various technical benefits as the resources can be optimized. They also extend operational models and provide new stakeholders with mutual business benefits, e.g., mobile network operators (MNOs) can expose functions of their core network to external service providers who can better develop and deploy services for the end-users.

The 5G Opportunity: New Risks call for New Approaches to Cybersecurity

5G extends the current 3G/4G LTE environment. With that brings the vulnerabilities of the old, and zero-day vulnerabilities of the new. 4IR brings massive numbers of machines, autonomous vehicles, and factory floor industrial automation controls. The attack surface expanded, and hackers could use this newfound attack surface as never witnessed before. The industry will need to further explore these elements as we usher in the next Industrial Revolution; 1) Governance for managing 5G use cases and application risk, 2) 5G ecosystem and subsystem & infrastructure vulnerabilities, and 3) Consideration of zero-day vectors and its implications. On the most basic level, 5G faces the same security pitfalls that its predecessors faced, including issues around authentication, confidentiality, authorization, availability and data security (Seals, 2019). What makes 5G newly dangerous is not likely the protocol itself, which may be more secure than 4G (Slayton, 2019). Rather, the new danger lies in using 5G to control massive numbers of machines, such as autonomous vehicles and factory processes, which means hackers exploit these vulnerabilities in 5G or the equipment used to control such systems, doing much more damage than is now possible.

Panel Participants

Dr. J. P. Shim is CIS faculty and KABC Director at Georgia State U. He is Professor Emeritus and was Professor/Notable Scholar/John Grisham Professor at Mississippi State U. He received his MBA from Seoul National U and his PhD from U of Nebraska-Lincoln and completed IT Executive Education at Harvard Business School. He received grants on telecom/RFID/e-business from NSF, Microsoft, U.S. SBA, and Mississippi IHL. He has published books and 100+ articles. He was visiting faculty at New York University, Chinese U of HK, and Georgia Tech. He is WTS/IEEE Program Chair.

Dr. Rob van den Dam is the Global Industry Leader, Telecommunications, Media and Entertainment, IBM Institute for Business Value. He has over 25 years of experience in the industry and has worked in many advisory and implementation roles. He is a recognized speaker at all major industry conferences, such as TMForum, ITU and GSMA. He authored 100 reports and articles in Annual Review of Communications, Journal of Telecom Management, Forbes, Total Telecom Magazine, European Communications and Telecom Asia Magazine.

Mr. Sam Aiello has worked in the IT industry for more than 30 years, and 20 of those years includes experience in the field of telecom and info security as a practitioner and manager. He has been involved in the project management of convergence & security software implementations, development and integration of information security policy, product training, and pre and post sales consulting for global and US enterprises. He has guest lectured at Georgia State University in IT courses and presented at various ISSA, ISACA, and InfraGard events.

Dr. Jyrki T. J. Penttinen obtained his MSc (E.E.) degree from the Helsinki University of Technology and DSc (Tech) degree from Aalto University. After working on 1G and 2G networks with Telecom Finland, he joined 3G operator Xfera Spain. He also worked in Spain, Mexico and the USA in a variety of mobile communications projects with Nokia and G+D Mobile Security. Since 2018, he has worked for GSMA North America as Senior Technology Manager assisting operator members with the adoption, design, development, and deployment.

Dr. Ramesh Sharda is Vice Dean for Research and Graduate Programs in the Spears School of Business at Oklahoma State University. His research has been published in journals, including Management Science, Operations Research, Information Systems Research, Decision Support Systems, Decision Science. He has coauthored two textbooks. He serves as the Faculty Director of Teradata University Network, a worldwide portal for sharing teaching and learning resources in analytics. He has been inducted as a Fellow of INFORMS and AIS.

Dr. Aaron M. French was Associate Professor of Management Information Systems at the University of New Mexico, before joining Kennesaw State University this Fall. He received his PhD in Business Information Systems at Mississippi State University. He is active in software development and the evaluation emerging technologies. His research has been published in the Journal of Information Technology, Information & Management, Decision Support Systems, Behaviour & Information Technology, Journal of CIS, and Communications of the AIS.

CONCLUSION

The 5G deployment will roll out gradually. Prior to introducing Standalone (SA) 5G network, the 3GPP specifications define several intermediate deployment scenarios, providing the MNOs with the opportunities to expedite the roll-out. The selection of the most adequate option is an essential task as the right approach can impact the investment and technical performance. Although global economic problems and societal effects such as the COVID-19 pandemic have also resulted in delays of continued deployment of 5G networks and services (Cellan-Jones, 2020), the deployment of 5G networks and services will continue to have a leapfrog momentum in the new "Normal" activity in the long run.

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