IEEE Summit on Communications Futures
16 & 17 January 2021

Program – Updated

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Day 1

Speaker Name	Talk Title and Link to Access
Rob Fish, Chair, IEEE Industry Engagement Committee, Past-President of the IEEE Standards Association, and Faculty Member, Department of Computer Science, Princeton University	**Welcome Remarks**
Roberto Saracco, Master Course, Technology Forecasting and Market Impact, the University of Trento and Co-Chair of the IEEE Digital Reality Initiative	**Keynote 1: Digital Transformation: When Atoms and Bits Go Hand in Hand** The Digital Transformation is ongoing and as a matter of fact, it will take several more years to be completed. The acceleration seen in 2020, courtesy of the pandemic, looks more -in several areas; like the adoption of a digital crutch rather than a true digital transformation. The talk will start by addressing what a true Digital Transformation looks like, the change of business values, the transformation of the value chain, the servitisation of products and the leverage of bits to flank the atoms. It will then discuss the use of Digital Twins and how these could play the role of a bridge between atoms and bits leveraging on Virtual and Augmented Reality. Interestingly, Digital Twins may become a significant player

in the creation of the future communication fabric at the core of 6G. To conclude, a few examples drawn from Industry 4.0 and Healthcare will be presented. An ebook is freely available to get an in depth view of the expected evolution of the Digital Transformation in this decade: Megatrends 2021-2030.

Session 1 : Mixed and Immersive Reality

Mixed and Immersive Reality (including AR/VR, Machine Learning, etc.) are entering the main stream as primary key enablers of Digital Transformation. Example applications include digital twins, remote vehicle tele-operation and robotic tasking. The Cloud/Fog/Edge continuum provides an important foundation for implementing this New Reality. This session will focus on the current state in the context of the New Reality.

Mixed & Immersive Reality: Novel Uses / Novel Challenges

Nicholas Napp, Co-Founder, Xmark Labs, LLC

This talk will present some novel and emerging uses of mixed and immersive reality. We'll look at some of the advantages this new medium presents, while highlighting some of the inherent challenges.

Bringing Automated Driving to Reality with Vehicle Teleoperation

Tao Zhang, Manager, Emerging Network Technologies, National Institute of Standards and Technology (NIST)

Recently, vehicle teleoperation has been gaining momentum in the industry, with a wide range of applications (e.g., in robotics, mining, delivery, trucking, fleets, and helping self-driving cars) delivering value that today's self-driving cars cannot offer. Future teleoperation systems, powered by AI and advanced networks, such as 5G, can allow some automated driving intelligence to be off-loaded from the vehicle into the cloud to enable new automated driving solutions that are not feasible by placing all such intelligence on the vehicle. This talk will present a vision of such intelligent teleoperation and discusses its benefits and challenges.

Ask Me Anything Q/A Session: Attendees will have an opportunity to email questions for speakers, with answers returned by email.

Session 2 : Lighting the Way to the Future

The days of incandescent lighting seem to be fading. Lighting technology has become smarter, starting with LED bulbs that can be controlled by software and communicate (e.g., LiFi), but by smart control of the new lighting technologies in homes, buildings, campuses and even cities. This session will illuminate the current state and offer a vision of the "smart lighting" future.

Toward Lighting the 4.0 Era – The "Right Smart Lighting" Challenge

Georges Zissis, Professor, The University of Toulouse

Artificial light production absorbs around 2900 TWh corresponding 16.5% of the world's electricity annual production. Historically speaking, past century's research and development focused on single energy efficacy enhancement. The only massive adoption of SSLs during the next years can contribute to harness electricity use for lighting, up to 4% by 2030. Today, we are witnessing a transition from the conventional "analogue" lighting technologies to "digital" lighting. The objective is switching to smart human-centric lighting driven by both "application efficiency" and "quality of light." Next Gen lighting systems should provide the "Right Light" with the best efficiency and quality, when and where it is needed.

Multi-Gigabit/s LiFi Networking for 6G

Harald Haas, Distinguished Professor of Mobile Communications, The University

In this talk, we will review light sources, detectors, and transmission techniques for LiFi. Moving on we will present networking architectures based on a grid-of-

of Strathclyde/Glasgow	beam approach to achieve 10s of gigabit/s user data rate in LiFi multiuser networks. We will discuss advantages of the proposed system such as enhanced physical layer security and moot existing challenges.

Ask Me Anything Q/A Session: Attendees will have an opportunity to email questions for speakers, with answers returned by email.

Session 3 : Optical Communications on a Global Scale

The New Reality will continue to be built upon a foundation of optical communication. This session addresses the latest challenges for an ever expanding global infrastructure, including the important role of standards evolving through IEEE, ITU-T and other standards development organizations.

	The Future of Optical Ethernet
David Law, Distinguished Technologist, Hewlett Packard Enterprise	The IEEE 802.3(TM) Ethernet Standard is updated and maintained by the IEEE 802.3 Ethernet Working Group. In this talk, we will review planned and proposed updates to the Ethernet Standard related to optics including Multi-Gigabit Optical Automotive Ethernet PHYs, Bidirectional Optical Access PHYs, Increased-reach Ethernet optical subscriber access (Super-PON), Ethernet operation over DWDM systems and the recently formed IEEE 802.3 beyond 400 Gb/s Ethernet Study Group.
	Always On, Always More, Everywhere for Everybody and Then . . . . We Want More
Nigel Bayliff, CEO, Aqua Comms	This presentation will look at the macro trends as perceived by the SubSea sector; to consider the growth in capability in spectral efficiency & subsea system design; to explain the patterns of growth globally and what this means for system routing; and to understand how the technology deployment will need to adapt to deliver the statements in the title.

Ask Me Anything Q/A Session: Attendees will have an opportunity to email questions for speakers, with answers returned by email.

Session 4 : Future Networks: 6G and Beyond

Now that 5G has entered the implementation phase, the key bodies involved with Future Network evolution have shifted their focus to 6G and Beyond. This session gives a vision of those future networks and points to some of the key hardware and software challenges.

	Embodies Intelligence in Electronics: A New Era in High Frequency Circuit Design
Linda Katehi-Tseregounis, O'Donnell Endowed Chair, Engineering and a Distinguished TEES Chair Professor of Electronics in the Electrical and Computer Engineering and the Material Science and Engineering departments at Texas A&M, College Station	The future of electronic systems lies in our ability to include intelligence in their design specifications. Incorporating intelligence will demand a change in the way we design electronics. Recent studies on cognition and intelligence have demonstrated that cognitive processes are not disconnected from motor-sensory processes but are directly influenced by the body's interactions with its environment. Intelligence cannot be achieved without a body that can interact with its environment and learn from these interactions. The design of an autonomous system is based on its ability to acquire data via its physical and social interactions with its environment, making mobility and adaptability important physical aspects. An intelligent wireless network of sensors and actuators is a concept that requires a co-design of computer architectures, learning algorithms, materials, robotics, and electronics for sensing and communication. This co-design is not available today but will be needed for the successful

implementation of intelligence in systems that will be part of 5G and beyond. This presentation will discuss all the opportunities for bringing intelligence into design of electronics along with the impacts on existing traditional approaches.

The Role of Advanced Microelectronics for 5G and Beyond

Timothy T. Lee, Technical Fellow, The Boeing Company

The much anticipated 5G rollout is just beginning in 2020 and will continue its trajectory to potentially impact many use cases including mobility, smart factories, AR/VR, IoT and healthcare. 5G supports the decentralization of computing resources by bringing new capabilities to the edge. Through wireless communications that is transitioning from 4G LTE to new 5G bands (low-, mid- and millimeter-waves), we are facing new technical challenges that must be met to make the 5G revolution successful. This talk will summarize recent developments in microelectronics and advanced packaging in near future as well as project considerations for 6G.

Wi-Fi 6 and Beyond

Dorothy Stanley, HPE Fellow and Head of Standards Strategy, Aruba Networks

This presentation describes Wi-Fi 6, Wi-Fi 6E and the IEEE 802.11 technologies which are being deployed to enable global innovation and expanded Wi-Fi use cases and markets. New IEEE 802.11 standards under development and applications including sensing and broadcast services are highlighted.

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Keynote 2: Hawaii Broadband Hui – Creating a Collaborative Movement

Burt Lum, Strategy Officer, Hawaii Broadband Initiative, State of Hawaii

In early 2020, the COVID-19 pandemic forced everyone to work, learn, access healthcare and government services all from home. Issues of broadband access and digital inequity were brought into the spotlight. This talk chronicles the 40+ week path to build a broadband movement in Hawaii with a goal to end digital inequity and to build a robust digital economy.

Session 5 : Adventures in the Sky

Satellites, UAVs, airplanes, and even balloons are meeting new and growing needs for integrated end-to-end communications. This session will address adventurous technologies, such as Low Earth Orbit Satellites, and identify the key challenges associated with their implementation.

Multi-Access Edge Computing (MEC): A Booster for Satellite-6G Services

Tomaso de Cola, Team Leader, German Aerospace Center (DLR)

This talk addresses the potentials offered by the MEC paradigm in the context of 6G-satellite integrated networks with respect to enabling new services and consolidating the positioning of satellite networks into 6G ecosystem. In particular this talk will discuss the most important architecture implications and the challenges arising in the task of integrating MEC concepts into satellite-6G systems, especially on the basis of the expected service requirements for 6G and the latest recommendations from ETSI and 3GPP with regard to MEC implementation.

High Altitude Platform Station (HAPS) Networks of 2030s

Halim Yanikomeroglu, Professor, Department of Systems and Computer Engineering at Carleton

There is a rapidly growing interest in non-terrestrial networks (NTN) within the framework of a futuristic integrated satellite-aerial-terrestrial network architecture. In particular, satellite mega-constellations (primarily SpaceX's Starlink) have been receiving great attention in both social and traditional media. In this talk, we will focus on a particular type of aerial node, high altitude

University, Canada	platform station (HAPS). The aim is an integrated vertical heterogenous network (VHetNet) with terrestrial small and macro BSs compounded with aerial HAPS-based super macro BSs. The super macro BSs are envisioned not only for connectivity, but also for edge computing, caching, and sensing. The forward-looking HAPS networks are mainly for densely populated urban and suburban (metro) areas and have the potential of being transformative and disruptive in 2030s.

Ask Me Anything Q/A Session: Attendees will have an opportunity to email questions for speakers, with answers returned by email.

Session 6 : The Path to Industry 4.0

The fourth "Industrial Revolution" is upon us as Industry 4.0. This session will address its telecom foundations, including Industrial IoT and progress being made through relevant industry consortia and enterprises.

Stan Schneider, CEO, Real-Time Innovations	**Data-Centric Communications Architecture for Autonomy** The Industrial IoT is not one market. Rather, it can be thought of as three classes of applications: device monitoring, analytical optimization, and edge autonomy. Of these, edge autonomy is the most transformative, as it will allow vast new frontiers of intelligent infrastructure across industries. Autonomy works by sharing data in real time between sensors, devices, algorithms, and oversight operations. This talk explores the new "data centric" architectures that build around this data, rather than by connecting active entities such as objects or servers.
Dennis Brophy, Director of Strategic Business Development, Siemens EDA	**Industry 4.0 and Industry Internet of Things** This talk looks at the evolution to industry 4.0 in production and the future of design.
Adam Drobot, Chairman, OpenTechWorks Inc	**The Internet of Things and Industry 4.0** Details matter, and yes, it is complex! The Internet of Things (IoT) and Industry 4.0 are terms that many technologists identify with and at the same time each Vertical market's view of what these terms mean differs greatly. In looking at patterns of adoption, there are several characteristics of IoT and Industry 4.0 that stand out and are likely to have a profound impact on the future of communication. The first is the dimension of ***timescales*** involved in Industrial applications ranging from real-time control (milliseconds) to decision making (seconds to hours) and finally lifecycle activities (days to years). The second is the ***intertwining*** of considerations that are involved such as computing, storage, sensors, actuators, human interfaces, and domain specific technologies that create new challenges for effective communication architectures and place a premium on systems thinking. The third is the emergence of new **business models** and the reliance on multiple infrastructures requiring a high degree of collaboration with the IoT and Industry 4.0 ecosystem. Lastly is the dominant importance of ***data and analytics*** which promise to deliver much of the value but also pose some of the biggest challenges. The talk will offer a view of why investments in the Industrial sector will drive the evolution of future communication systems and why the four aspects mentioned above will dramatically alter the communication services that providers deliver.

Ask Me Anything Q/A Session: Attendees will have an opportunity to email questions for speakers, with answers returned by email.

Session 7 : Technology in the Food Supply Chain, from Soil to Table

Technology has been a key enabler of "smart agriculture," touching on all elements of the food supply chain, from soil to table. This session shares the "smart agriculture" vision and gives a glimpse of the technologies emerging to make smart agriculture even smarter.

John Verboncoeur, Associate Dean for Research and Graduate Studies, College of Engineering; Professor, Electrical and Computer Engineering; Professor, Computational Mathematics, Science, and Engineering, Michigan State University	**The Internet of Food** When we started IEEE SmartAg in 2016, we saw it spread through academia, funding agencies and foundations, industry, and technical societies and councils. This led to development of a number of digital component technologies in the food supply chain. Here, we will present the vision for tying those component technologies together into an ecosystem connect by data and communications.

Ask Me Anything Q/A Session: Attendees will have an opportunity to email questions for speakers, with answers returned by email.

Day 2

Speaker Name	Talk Title
Rob Fish, Chair, IEEE Industry Engagement Committee, Past-President of the IEEE Standards Association, and Faculty Member, Department of Computer Science, Princeton University	**Welcome Remarks**
Su Shin, President and General Manager, Hawaiian Telcom	**Keynote 3: Committed to Hawaii – Investing in Our Islands** From its investments in updating and expanding its statewide fiber network to deploying broadband infrastructure to hundreds of thousands of locations across the state, including unserved and underserved rural areas on the neighbor islands, Hawaiian Telcom is ready to adapt to quickly-changing customer needs. Learn how Hawaiian Telcom's commitment to Hawaii's digital transformation prepared the company to respond to the COVID-19 pandemic.

Session 1 : Telecom Regulation and Economics

Regulation and economics are inseparable from running a telecom business. This session addresses spectrum considerations, competitive impacts and impact on "the bottom line."

Michael Marcus, Director, Marcus Spectrum Solutions LLC	**Key Spectrum Policy Issues for the Technical Community** This talk will address both possible reforms to decision making processes used in US for spectrum policy decisions to prevent controversies like those of 2019 as well as some new concepts for spectrum management that might improve availability of spectrum for new technology. **World Radiocommunication Conferences (WRC-23): Implications for Our Wireless Future** World Radiocommunication Conferences (WRCs) revise the international

Mohamed El-Moghazi, Acting Executive Director of National Spectrum Affairs, NTRA of Egypt

Radio Regulations (RR) and address any radiocommunication matter of worldwide or regional character. The forthcoming WRC-23 will address several agenda items to cope with the development in wireless technologies. This presentation will shed the light on some of these topics including the future use of the UHF band, High Altitude IMT Base Stations (HIBS), fixed IMT and the use of 6 GHz for IMT.

Ask Me Anything Q/A Session: Attendees will have an opportunity to email questions for speakers, with answers returned by email.

Session 2 : Operating in the New Reality: Systems, Networks and Services

The New Reality will require new types of services implemented through softwarized and virtualized systems and networks, as well as the Cloud and Fog/Edge architectures. This session will discuss the underlying technologies and they will impact operations in the New Reality.

Traffic Classification in the New Reality of an Encrypted Internet

Raouf Boutaba, University Chair Professor and Director, David R. Cheriton School of Computer Science, University of Waterloo

Traffic classification is essential in network management for operations ranging from capacity planning, performance monitoring and resource provisioning, to anomaly detection and security. Recently, it has become increasingly challenging with the widespread adoption of encryption in the Internet, e.g., as a de-facto in HTTP/2 and QUIC protocols. This talk will describe how Deep Learning techniques can be leveraged for encrypted traffic classification.

Software Innovations in DCI Transport: The Current Frontier of Fiber Communication

Loukas Paraschis, Senior Director, Cloud Transport System Engineering for Internet and Content Providers, Infinera

In this talk we review the most important system innovations motivated by the evolution of DCI transport. State-of-the-art coherent WDM transmission is exceeding 8 b/s/Hz in transatlantic deployments. At the same time, the adoption of software innovations in programmability and abstraction, which DCI pioneered in transport networks, has substantially simplified operations and enabled the emergence of open disaggregated transport architectures. Moreover, combining these advances with emerging network analytic frameworks enables further exciting innovations in network management automation and optimization.

Ask Me Anything Q/A Session: Attendees will have an opportunity to email questions for speakers, with answers returned by email.

Session 3 : Building the New Reality: Practical Applications

Deploying the New Reality requires a keen understanding of user applications and technology capabilities. This session focuses on the communications and networking deployment aspects associated with “New Reality” applications.

Beyond the Handset – Opportunities and Challenges of 5G

David Witkowski, CEO, Oku Solutions LLC and Executive Director, Civic Technologies Initiatives at Joint Venture Silicon Valley

5G is the first generation of cellular communication designed to enable more than phones and tablets. Indeed, the stories of how 5G will be used are as-yet unwritten, but we can make educated guesses regarding how 5G will enable the future of wireless for both people, devices, and computing systems. At the same time, the expansive nature of 5G’s potential creates new cultural and policy challenges that must be addressed before it can be widely deployed.

Distributed SDN in an Intelligent Edge for the future 6G Network

Stephen B. Weinstein, Independent Consultant and T. Russell Hsing, Honorary Chair Professor, National Chiao Tung University

Sixth generation wireless communication will integrate and deploy many existing or developing communications and software technologies to realize extremely high data rates and exceptionally low latency. It will make extensive use of an AI-powered network edge platform with storage, communications, control and processing resources, which this talk describes at an easily understood conceptual level. An extended, more distributed SDN (software defined network) is likely to be an important element of this infrastructure, optimizing the use of network resources and managing tradeoffs among competing flows. It will accommodate user-specific needs in the fog/edge platform, keep track of networking transactions and resource use, and support the entrepreneurial development of new network modalities and applications meeting the needs of network operators, service providers, and end users.

Ask Me Anything Q/A Session: Attendees will have an opportunity to email questions for speakers, with answers returned by email.

Session 4 : Learning and Working in the New Reality

The Covid-19 pandemic has jump started the need for remote living and working. This session addresses the limitations of current technologies and offers a vision of what's needed to keep up with the needs of this "new reality."

Towards Personalized Life Long Learning for More than One Job

Witold Kinsner, Professor, Department of Electrical and Computer Engineering, University of Manitoba

There is a fundamental shift in education from the one-fits-all model to a personalized education and learning. The traditional one-fits-all model of education evolved after the first Industrial Revolution when similar knowledge and skills were required for replaceable workforce on assembly lines and when the acquired knowledge lasted for a lifetime. The recent transition to more personalized education and learning is motivated by the need to prepare students and young professionals for more than one job in a lifetime, and to retrain seasoned professionals for emerging occupations. This talk will include a concept of cognitive digital twins.

Why Go To School if You Can Send an AI?

Robby Robson, CEO, Eduworks Corporation

New communication technologies from writing and the printing press to computers and the Internet have drastically changed how people learn, but none has had the capacity to learn and act for them – until now. This presentation considers what learning, education and training might look like as intelligent agents become coworkers, co-learners and co-teachers, and what that means in a world where, to paraphrase a famous cartoon, in an online class no one knows you are an AI.

Ask Me Anything Q/A Session: Attendees will have an opportunity to email questions for speakers, with answers returned by email.

Keynote 4: 5G+ – Towards an Integrated Open Edge

Mung Chiang, John A. Edwardson Dean of the College of Engineering and the Roscoe H. George Distinguished Professor of Electrical and Computer Engineering at Purdue University

Integrated Open Networks provide an architectural innovation to support edge computing and industrial applications of 5G. This talk overviews the promises and challenges facing this evolution of wireless networks, along with possible theoretical foundations and experimental testbeds.

Session 5 : Public Safety in the New Reality

Modern public safety has been increasingly challenged by using “old” technologies. New technologies, such as 5G Wireless, offer an opportunity to improve situation awareness, response, mitigation, restoration, recovery and other key aspects of emergency management. This session offers a view of current challenges and the emerging technologies that hold promise for overcoming those challenges.

Positioning Public Safety for the New Reality

Narendra Mangra, Principal, GlobeNet LLC

Public safety and public protection and disaster recovery (PPDR) require differentiated prevention, protection, mitigation, response and recovery capabilities across multiple ecosystems. 5G and future networks promise to play a vital role in shaping the public safety/PPDR functions to increase the breadth and depth of mission area capabilities. These capabilities include increased awareness, threat identification, situational awareness, force multipliers, restoration, long-term recovery and much more. A dynamic applications and services framework that addresses functions within the public safety/PPDR domain, spans adjacent ecosystems, and enable multi-jurisdictional governance functions facilitates public safety/PPDR roadmap development, smart cities / regions, and complex initiatives such as public health and pandemic planning. This talk will address 5G and future networks within the dynamic applications and services framework, public safety/PPDR functions, challenges, and emerging technologies for public safety/PPDR users.

Amateur Radio Emergency Communications in the Network Era

Orv Beach, Retired Linux System Administrator, ARRL Santa Barbara Section Technical Specialist and Amateur Radio Emergency Data Network (AREDN) Ambassador

Orv will discuss some technical aspects of deploying an IP network in the amateur radio bands, and how the network is being integrated into amateur radio EmComm.

Ask Me Anything Q/A Session: Attendees will have an opportunity to email questions for speakers, with answers returned by email.

Session 6 : Connecting the Unconnected

The world is becoming increasingly dependent on everyone – and everything – being connected. However, there are large portions of the planet lacking connectivity for geographic, economic, regulatory or other reasons. This session covers recent strides in “connecting the unconnected.”

Connecting the Unconnected in 5G and Beyond

Abhay Karandikar, Director, Indian Institute of Technology (IIT) Kanpur

In this talk, we review the challenges in connecting the unconnected and argue on rethinking the requirements of 5G and beyond systems. We propose an architecture called “Frugal 5G” for affordable broadband access and IEEE P2061. We discuss the architectural elements of Frugal 5G and its implementation within 3GPP 5G framework. Specifically, we present an OpenFlow based RAN architecture which enables unified access control at the edge. Finally, we show how by using Software Defined Networking and Network function virtualization, we can realize the architecture for providing affordable connectivity.

The Need for Community Networks for Last Mile Connectivity

Sarbani Banerjee Belur, Asia Regional Coordinator for the Association for Progressive Communications (APC) and Senior Research Scientist, Indian Institute of Technology Bombay, Mumbai

In my talk, I will be discussing about how community networks can be seeded to enable meaningful sustainable solutions to connectivity in remote rural areas. In the current times, connectivity is a lot about using it for meaningful purposes and facilitating rural livelihoods. Community Networks not only bridge digital divides but also works as a good catalyst

to narrow social barriers of gender, caste, class and indigenous knowledge.

Community Learning and Earning Digital Ecosystem

Mei Lin Fung, Co-Founder and Chair, People Centered Internet

How can many more people in the world benefit from our Communications innovations?
We can engineer a tsunami of enterprise on two levels (Lifelong Learning and Lifelong Earning) and IEEE members are and will be an integral part of this.

Featured Speaker

The Mechanisms for Building Resilient Communities

Vinton G. Cerf, Vice President and Chief Internet Evangelist, Google, Co-Founder of the Internet and Co-Founder of the People Centered Internet

The Internet is an engineering marvel, but it is work-in-progress. Vint Cerf, co-author of the TCP/IP specification, reflects on the protocols and norms needed to address the unforeseen consequences that have arisen, including the events in the US on January 6 2021 storming of Capitol Hill. What are the mechanisms and measurements we need to take forward the Internet so that we build resilient communities?

Ask Me Anything Q/A Session: Attendees will have an opportunity to email questions for speakers, with answers returned by email.

Ashutosh Dutta, Senior Scientist and 5G Chief Strategist, Johns Hopkins University Physics Laboratory (JHU/APL)

Subir Das, Chief Scientist, Perspecta Labs

Join us at 9 AM HST on 17 January 2021 for the Live Panel Session: Security and Privacy for Future Communications Networks

Michael Enright, CEO and President, Quantum Dimension, Inc.

Eman Hammad, Interdisciplinary Researcher, University of Texas A&M

Rob Fish, Chair, IEEE Industry Engagement Committee, Past-President of the IEEE Standards Association, and Faculty Member, Department of Computer Science, Princeton University

Closing Remarks