

# WTS 2020

## Wireless Telecommunications Symposium 2020

*Global Wireless Communications: A  
Washington, DC Perspective*

**April 21 - 24, 2020**



**California State Polytechnic University, Pomona**

## **WELCOME TO WTS 2020**

Welcome to the nineteenth annual Wireless Telecommunications Symposium, WTS 2020, “Global Wireless Communications: A Washington, DC Perspective.” Although the coronavirus pandemic has necessitated our meeting virtually, rather than in Washington, DC, we hope that WTS 2020 will be a stimulating and rewarding experience for you. During the next three days of invited speakers’ presentations, accepted paper sessions, workshops, tutorials and a panel discussion, WTS 2020 will explore a wide range of multidisciplinary wireless communications, mobile computing, and related topics in depth.

The WTS 2020 Technical Program Committee received paper submissions from authors around the world, covering a wide area of topics. We thank all the authors who submitted papers and proposals to WTS 2020, the many reviewers who reviewed them, and the co-chairs, mini-symposium chairs, track chairs and technical program committee members for coordinating the paper and proposal evaluation and selection process. We also thank the WTS support personnel for their tireless efforts and contributions behind the scene. Producing an event like WTS 2020 is not an easy task, and they did a masterful job. In addition, the WTS Committee is grateful to the IEEE Communications Society, and its Communications & Information Security Technical Committees for their technical support for WTS 2020, and to the distinguished invited speakers representing the global wireless telecommunications industry for having taken time to participate in the conference and help us organize it.

Many organizations have contributed to the conference or lent it financial support. Notable among the contributors and donors are Cal Poly Pomona’s College of Business Administration and College of Engineering, and Cal Poly Pomona’s Computer Information Systems and Electrical & Computer Engineering Departments.

Finally, special thanks go the members of the WTS Committee who spent many hours over the past couple of months converting WTS 2020 to a virtual conference, the first virtual conference in the history of WTS.

On behalf of the WTS 2020 Committee -- Welcome to WTS 2020!

Dr. Steven Powell, WTS General Chair

Dr. Thomas Ketsoglou, WTS Assistant Chair

## WTS 2020 Program April 21-24, 2020

Tuesday, April 21	
12:00 pm – 2:00 pm	WTS Organizers' Meeting
Wednesday, April 22	
8:00 am - 9:00 am	Registration
9:00 am – 9:05 am	Welcoming Remarks
9:05 am – 10:15 am	Tutorial "From 5G to 6G" <b>Dr. Thomas Ketseoglou</b> Professor, ECE Department, Cal Poly Pomona
10:15 am – 10:30 am	Break
10:30 am – 11:15 am	"Telecom's 5G Future" <b>Dr. Rob van den Dam</b> Global Telecommunications Industry Leader, Institute for Business Value, IBM
11:15 am – 12:00 pm	"An Overview of US Telecom Policy and Regulation" <b>Andrew D. Lipman</b> Partner, Morgan Lewis
12:00 pm – 2:00 pm	Lunch

2:00 pm – 2:45 pm	<b>Congressman Andy Biggs</b> 5 <sup>th</sup> District of Arizona
2:45 pm – 3:15 pm	Break
3:15 pm – 4:45 pm	<b>Panel Discussion:</b> “Intelligent Connectivity, Convergence, and Cybersecurity of 5G NR, AI, IoT, and XR”  Panel Moderator: <b>Dr. J. P. Shim</b> , Georgia State University  Panelists include: <b>Dr. Rob van den Dam</b> , IBM <b>Dr. Ehsan Sheybani</b> , University of South Florida <b>Dr. Habib Riazi</b> , Corning Optical Communications Wireless Inc. <b>Dr. Giti Javidi</b> , University of South Florida
4:45 pm – 5:30 pm	Doctoral Students’ Session
5:30 pm – 9:00 pm	Welcoming Reception & Dinner WTS Organizer Recognition Ceremony
<b>Thursday, April 23</b>	
9:00 am – 10:00 am	“Radio Access System Engineering for 5G and Beyond, What Has Changed?” <b>Dr. Habib Riazi</b> , Corning Optical Communications Wireless Inc.
10:00 am – 10:15 am	Break
10:15 am – 11:00 am	<b>Dr. H. Vincent Poor</b> Michael Henry Strater University Professor at Princeton University

11:00 am – 12:00 pm	<b>Dr. Robert E. Kahn</b> Internet Pioneer Chairman, CEO, and President of the Corporation for National Research Initiatives(CNRI)
12:00 pm - 2:00 pm	Lunch
2:00 pm – 2:45 pm	<b>Dr. Jon Peha</b> Professor, Dept. of Engineering and Public Policy and the Dept. of Electrical and Computer Engineering Carnegie Mellon University Former Chief Technologist of the U.S. Federal Communications Commission
2:45 pm – 3:15pm	Break
3:15 pm – 4:45 pm	“Mobile Applications Security” <b>Dr. Francois Cosquer</b> CTO Security, Nokia Software
4:45 pm - 5:30 pm	Poster Paper Session
5:30 pm – 9:30 pm	Dinner and Coach Tour
<b>Friday, April 24</b>	
8:10 am – 10:10 am	Paper Presentation Session (I)
10:10 am – 10:20 am	Break
10:20 am – 12:00	Paper Presentation Session (II)

noon	
12:00 noon – 1:10 pm	Lunch Best Paper Awards Ceremony
1:10 pm – 3:10 pm	Paper Presentation Session (III)
3:10 pm – 3:30 pm	Break
3:30 pm – 5:30 pm	Paper Presentation Session (IV)

## **Panel Discussions, Workshops & Tutorials**

### **WTS 2020 Tutorial**

#### **WTS 2020 Tutorial - Wireless Telecommunications Systems: From 5G to 6G**

Presenter: Dr. Thomas Ketseoglou, California State Polytechnic University, Pomona

#### **Abstract**

As 5G deployment is underway, some new developments such as Artificial Intelligence (AI), Big Data, as well as, physical

layer (PHY) issues, pave the way for the next, 6G wireless system design. In this tutorial, the following issues will be covered:

1. Introduction and historical perspective:
  - a. 1G to 4G
  - b. 5G to 6G
2. Needs & Requirements for 6G:
  - a. Why is 6G needed?
  - b. What would be reasonable requirements for 6G?
3. Prevailing technologies for 6G:
  - a. Physical Layer: what is going to be in 6G, what is different than 5G?
  - b. Higher Layers: how is the proliferation of AI in wireless communications going to affect the higher layers?
4. Applications for 6G:
  - a. The connection between applications and AI
  - b. The need for additional service/network/user flexibility
5. Conclusions

### **Speaker's Biography**

Thomas Ketseoglou (S.85-M.91-SM.96) received the B.S. degree from the University of Patras, Patras, Greece, in 1982, the M.S. degree from the University of Maryland, College Park, Maryland, USA, in 1986, and the Ph.D. degree from the University of Southern California, Los Angeles, California, USA, in 1990, all in electrical engineering. He worked in the wireless communications industry, including senior level positions with Siemens, Ericsson, Rockwell, and Omnipoint. From 1996 through 1998 he participated in TIA TR45.5 (now 3GPP2) 3G standardization, making significant contributions to the cdma2000 standard. He has been inventor and co-inventor in several essential patents in wireless communications. Since September 2003 he has been with the

Electrical and Computer Engineering department of the California State Polytechnic University, Pomona, California, USA, where he is a professor. He spent his sabbatical leave in 2011 at the Digital Technology Center, University of Minnesota, Minneapolis, Minnesota, USA, where he taught digital communications and performed research on network data and machine learning techniques. He is a part-time lecturer at the University of California, Irvine. His teaching and research interests are in wireless communications, signal processing, and machine learning, with current emphasis on MIMO, optimization, localization, and link prediction.

## **WTS 2020 Panel Discussion**

### **Intelligent Connectivity, Convergence, and Cybersecurity of 5G NR, AI, IoT, and XR**

#### **Abstract**

The intelligent connectivity and convergence of emerging technologies, such as the emerging Fifth Generation (5G) New Radio (NR), Artificial Intelligence (AI), Internet of Things (IoT), and Extended Reality (XR), introduce greater efficiency and determine the top factors that drive the digital economy in various industries. 5G NR, AI, IoT, and XR are in position to make a huge impact on the world and will influence all aspects of the societal framework -- from the way consumers, businesses, and governments interact with each other in the digital world as well as the physical ecosystem. Cyber-physical systems and industrial IoT cybersecurity have become buzzwords in today's IT security world. The panel will cover the current status and future of each technology. Numerous opportunities and challenges will be explored and discussed with the synergy of 5G NR, AI, IoT, and XR.



The 'fireside chats' and panel will address the following questions to the audience for the intelligent connectivity, convergence, and cybersecurity via 5G NR, AI, IoT, and XR.

- What connectivity issues are experienced with 5G NR, AI, IoT, and XR?
- What role does cybersecurity play in AI, IoT, and XR?
- What benefits, privacy concerns, compliances, and ethical issues can we expect with 5G NR, AI, IoT and XR?
- What are research opportunities in 5G NR, AI, IoT, XR, and Cybersecurity?

**Panel Moderator:** Dr. J. P. Shim, Georgia State University

**Panelists include:**

- Dr. Rob van den Dam, IBM
- Dr. Ehsan Sheybani, University of South Florida
- Dr. Habib Riazi, Corning Optical Communications Wireless Inc.
- Dr. Giti Javidi, University of South Florida

### **Speakers' Biographies**

**Dr. J. P. Shim** is a faculty of Computer Information Systems and Executive Director of KABC at Robinson College of Business at Georgia State University. Before joining at GSU in 2011 as a faculty, he was professor of BIS, Larry and Tonya Favreau Notable Scholar, John Grisham Professor, and IBSP Director at Mississippi State University. During the past twenty-seven years at MSU, he was a seventeen-time recipient of outstanding faculty awards. He received his Ph.D from University of Nebraska-Lincoln and completed Harvard Business School's Executive Education Program. He has published several books and over 100 papers, such as *Journal of AIS*, *Communications of the ACM*, *Journal of Strategic*

*Information Systems, European Journal of Information Systems, Decision Support Systems, Information & Management, Interfaces, Journal of Information Technology, Sloan Management Review, Journal of Operational Research Society, Computers & Operations Research, Omega, Academy of Management Proceedings, and ICIS Proceedings.* He served on 2013 AMCIS Program Co-chair and was the principal investigator on several National Science Foundation grants and has received numerous funding from organizations. He has been interviewed by the media (CBS TV, AP, The Clarion-Ledger, AJC, Global Atlanta) and worked as a consultant for Booz Allen, U.S. EPA, and Kia Motors Manufacturing Georgia.

**Dr. Ehsan Sheybani** has earned three degrees in Electrical Engineering: a BS from University of Florida, an MS from Florida State University and a PhD from University of South Florida. His main research area has been applications of communication, signal processing and data analysis. He has been involved in teaching, practicing, researching and consulting applications of DSP in technology, system analysis and data sciences for the past 20 years. He has a long list of publications and research grants including projects with NASA, NSF, NIH, DoD, DED and industry partners.

**Dr. Giti Javidi** received her BS from University of Central Oklahoma and MS and PhD from University of South Florida, Tampa. Prior to joining academia as a faculty, she worked for industry for several years including IBM as a software engineer. Dr. Javidi has more than 18 years of experience in teaching, research, industry and consulting services. Dr. Javidi's research cuts across several disciplines within computer science, information technology, and education. Her research interests include human-computer interaction, user interface design, information visualization, and educational data mining. A unifying theme of her research

is the focus on computer science and IT education. As a leader in STEM education research, she has received several prestigious awards. She was awarded the 2017 Women of Influence and 2018 Women in Leadership and Philanthropy award for her research. Dr. Javidi has been featured in Harold Tribune, Sarasota Magazine, Florida High Tech Corridor and several other venues. Her scholarly research has been published in peer-reviewed national and international journals and she has presented at several conferences and summits as an invited speaker. Dr. Javidi has been the recipient of a number of NSF, NASA, Google and Microsoft grants. She has also been a long time member of ACM and IEEE among a number other national and international organizations.

## WTS 2020 Paper Presentation Program

### Wednesday, April 22

#### Doctoral Students' Session

4:45pm  
–  
5:30pm

*Identifying Distinct Features based on Received Samples for Interference Detection in Wireless Sensor Network Edge Devices*  
George Daniel O'Mahony (University College Cork, Ireland); Philip Harris (United Technologies Research Center Ireland, Ireland); Colin Murphy (University College Cork, Ireland)

### Thursday, April 23

#### Poster Paper Session

4:00pm  
–  
4:45pm

*Hybrid Zero-Forcing Precoder for Multiuser MIMO Systems*  
Heon Huh (Korea Polytechnic University, Korea (South))

### Friday, April 24

<p>8:10 am – 10:10 am</p>	<p>I-A IEEE Xplore Papers</p> <p><i>Preventing Session Hijacking using Encrypted One-Time-Cookies</i> Renascence Prapty (Bangladesh University of Engineering and Technology, Bangladesh); Shuhana Azmin (Bangladesh University of Engineering and Technology, Bangladesh); Md Shohrab Hossain (Bangladesh University of Engineering and Technology, Bangladesh); Husnu S Narman (Marshall University, USA)</p> <p><i>A Queue-Length Based Approach to Metropolized Hamiltonians for Distributed Scheduling in Wireless Networks</i> Taha Ameen ur Rahman (American University of Sharjah, United Arab Emirates); Mohamed S. Hassan (American University of Sharjah, United Arab Emirates); Mahmoud H. Ismail (American University of Sharjah, United Arab Emirates)</p> <p><i>Optimal Fractal Antenna for In-Vehicle Entertainment Application</i> Ioannis P. Gravas (Aristotle University of Thessaloniki, Greece); Nikandros Sifakis (Aristotle University of Thessaloniki, Greece); Zaharias D Zaharis (Aristotle University of Thessaloniki, Greece); Pavlos Lazaridis (University of Huddersfield, United Kingdom (Great Britain)); Thomas Xenos (Aristotle University of Thessaloniki, Greece)</p>
<p>8:10 am – 10:10 am</p>	<p>I-B IJITN Papers</p> <p><i>SDN Simulator for Multi-Domain Heterogeneous Network</i> Gyu-min Lee (Ajou University, Korea (South)); Byeong-hee Roh (Ajou University, Korea (South)); Yunhwan Jeong (Ajou University, Korea (South)); Cheol-Woong Lee (Ajou University, Korea (South)); Gyudong Park (Agency for Defense Development, Korea (South)); Dong Kuk Ryu (Agency for Defense Development, Korea (South))</p> <p><i>Power Allocation Adapted with Coherence Time for Non-Orthogonal Multiple Access on Downlink Transmission</i> Jia-Chin Lin (National Central University, Taiwan)</p> <p><i>Stretchable Square Inverted Cone Antenna (SICA) for Ultra-Wide Band Radar Application</i> Yusnita Rahayu (Universitas Riau, Indonesia); Muclas Syahputra (Universitas Riau, Indonesia)</p> <p><i>Non-Invasive Cylicon(Cylinder and Cone) Antenna for Blood Glucose Monitoring</i> Yusnita Rahayu (Universitas Riau, Indonesia); Wahid Nugraha (Universitas Riau, Indonesia)</p>

10:10  
am –  
10:20  
am

Break

II-A  
IEEE Xplore Papers

*A Buffer-Based Rate Adaptation Approach for Video Streaming Over HTTP*

Ahmed El Meligy (American University of Sharjah, United Arab Emirates); Mohamed S. Hassan (American University of Sharjah, United Arab Emirates); Taha Landolsi (American University of Sharjah, United Arab Emirates)

10:20  
am –  
12:00  
pm

*Modified Active Constellation Extension Algorithm for PAPR Reduction in OFDM Systems*

Yasser Samayoa (Gottfried Wilhelm Leibniz Universität Hannover, Germany); Joern Ostermann (Leibniz Universitaet Hannover, Germany)

*Electric Field and SAR Estimation for Multiple Wireless Device Usage in Capsule Environment*

Louis-Ray Harris (University of the West Indies, Mona, Jamaica)

*REBUF: Jam Resistant BBC based Uncoordinated Frequency Division Multiplexing*

Jaemin Ashley (United States Military Academy, USA); Joshua B Groen (United States Military Academy, USA); Michael Collins (Laboratory for Advanced Cybersecurity Research, USA)

II-B  
IJITN Papers

*A novel zone walking protection for secure DNS Server*

Arnob Paul (Bangladesh University of Engineering and Technology, Bangladesh); Md. Hasanul Islam (Bangladesh University of Engineering and Technology, Bangladesh); Md Shohrab Hossain (Bangladesh University of Engineering and Technology, Bangladesh); Husnu S Narman (Marshall University, USA)

10:20  
am –  
12:00  
pm

*Transmit Power and Rate Control for Spatial Reuse in Dense Wireless LANs*

Michael Knitter (University of Dortmund, Germany); Wolfgang Endemann (University of Dortmund, Germany); Ruediger Kays (University of Dortmund, Germany)

*A simple infrastructure modification for smart intersections for integration in semi-/full-autonomous vehicle systems in multiple*

	<p><i>municipality domains</i> Zory Marantz (NYC College of Technology, USA)</p> <p><i>Method of Combining Cryptography and LDPC Coding for Enhanced Privacy</i> Bradley Comar (US DoD, USA)</p>
12:00 pm – 1:10 pm	<p><b>Lunch</b> <b>Best Paper Awards Ceremony</b></p>
1:10 pm – 3:10 pm	<p>III-A IEEE Xplore Papers</p> <p><i>A New Frequency Hopping Scheme to Secure the Physical Layer of The Internet of Things (IoT)</i> Ali ALSadi (University of Arkansas at Little Rock &amp; Al-Nahrain University, USA); Seshadri Mohan (University of Arkansas at Little Rock, USA)</p> <p><i>Locating Gateways for Maximizing Backhaul Network Capacity of 5G Ultra-Dense Networks</i> Mital Raithatha (Carleton University, Canada); Aizaz U Chaudhry (Carleton University, Canada); Roshdy H Hafez (Carleton University, Canada); John Chinneck (Carleton University, Canada)</p> <p><i>On the Interference Range of Small Cells in the Wireless Backhaul of 5G Ultra-Dense Networks</i> Aizaz U Chaudhry (Carleton University, Canada); Namitha Jacob (Carleton University, Canada); Dils George (Carleton University, Canada); Roshdy H Hafez (Carleton University, Canada)</p> <p><i>Ethics of Big Data: Privacy, Security, and Trust</i> Randall Joyce (Murray State University, USA); Abdulrahman Yarali (MSU, USA); Brandon Dixon (Murray State University, USA) <i>Queue-aware QoE-based Rate and Power Adaptation Over Underlay Cognitive Radio Networks: Cross-Layer Design</i> Fateme Shah-Mohammadi (Rochester Institute of Technology, USA); Ankita Tondwalkar (Rochester Institute Of Technology, USA); Andres Kwasinski (Rochester Institute of Technology, USA); Brandon Dixon (Murray State University, USA)</p>
1:10 pm – 3:10 pm	<p>III-B IJITN Papers</p> <p><i>A Low Complexity Non-Distortion Clipping Technique PAPR Reduction of MIMO-OFDM Systems</i></p>

Tahreer Mahmood (Electrical/Computer Engineering & University of Arkansas at Little Rock USA, USA); Seshadri Mohan (University of Arkansas at Little Rock, USA)

*Real-Time V2V Communication with a Machine Learning-based System for Detecting Drowsiness of Drivers*

Ahmed Awad (University of Arkansas at Little rock, USA); Seshadri Mohan (University of Arkansas at Little Rock, USA)

*Enable 5G and IoT: In Search of More Spectrum to Connected Devices*  
Evariste Some (University of Colorado, USA)

*MMSE Indicator Error Rate Performance on MIMO When Increasing Modulation Order*  
Evariste Some (University of Colorado, USA)

*Securing the Physical Layer in the OFDM based Internet of Things (IoT) by using Frequency Hopping Technique*

Ali Alsadi (University of Arkansas at Little Rock & Al-Nahrain University, USA); Seshadri Mohan (University of Arkansas at Little Rock, USA)

3:10  
pm –  
3:30  
pm

**Break**

IV-A  
IEEE Xplore Papers

*Fast Learning Cognitive Radios in Underlay Dynamic Spectrum Access: Integration of Transfer Learning into Deep Reinforcement Learning*

Fatemeh Shah-Mohammadi (Rochester Institute of Technology, USA); Andres Kwasinski (Rochester Institute of Technology, USA)

3:30  
pm –  
5:30  
pm

*Codeword Generation for a Combined Cryptography and LDPC Coding System*

Bradley Comar (US DoD, USA)

*Compression of Gait IMU signals Using Sensor Fusion and Compressive Sensing*

Seyed Alireza Khoshnevis (University of South Florida, USA); Sai Bharadwaj Appakaya (iCONS Lab, University of South Florida, USA); Ehsan Sheybani (University of South Florida, USA); Ravi Sankar (University of South Florida, USA)

*A novel pitch cycle detection algorithm for tele monitoring application*

Sai Bharadwaj Appakaya (iCONS Lab, University of South Florida,

USA); Seyed Alireza Khoshnevis (University of South Florida, USA); Ravi Sankar (University of South Florida, USA); Ehsan Sheybani (University of South Florida, USA)

*Enterprise Information systems in the cloud: Implications for risk management*

Benjamin KS Khoo (New York Institute of Technology & IEEE, USA)

IV-B

IEEE Xplore Papers

*Maximizing the AWGN-Channel Capacity of the GQAM Constellation with Two Degrees of Freedom*

Brett Wiens (Simon Fraser University, Canada); Daniel Lee (Simon Fraser University, Canada)

*A Novel Anomaly Detection Framework for LTE/VoLTE/VoWiFi Performance at Device-model Level*

Zhengyao Yu (Verizon Wireless, USA); Le Su (Verizon Wireless, USA); Daniel deWolfe (Verizon Wireless, USA); Dandan Wang (Alcatel-Lucent, USA)

3:30  
pm –  
5:30  
pm

*On-Road Performance Evaluation of IEEE 802.11p/WAVE in BSM Signalling and Video Streaming using WSMP*

Htoo Aung Win (University of North Texas, USA); Ram Dantu (University of North Texas, USA); Pradhumna L Shrestha (University of North Texas, USA)

-----  
IJITN Papers

*RAODV Routing Protocol for Congestion Detection and Relief in Ad Hoc Wireless Networks*

Xiaojie Liu (University of Auckland, New Zealand); Ulrich Speidel (University of Auckland, New Zealand)

## Speaker Biographies



**Congressman Andy Biggs** is an Arizona native and currently serving his second term in the U.S. House of Representatives, representing Arizona's Fifth District. He lives in Gilbert with his wife of 38 years, Cindy. They have six children and six grandchildren.

Congressman Biggs received his bachelor's degree in Asian Studies from Brigham Young University; his M.A. in Political Science from Arizona State University; and his J.D. degree from the University of Arizona. He is a retired attorney, who has been licensed to practice law in Arizona, Washington, and New Mexico.

Before being elected to Congress, Congressman Biggs served in the Arizona Legislature for 14 years – the last four as the Arizona Senate President.

Congressman Biggs is a member of the House Judiciary and Science, Space, and Technology committees. He is chairman of the House Freedom Caucus, co-chair of the Border Security Caucus, co-chair of the War Powers Caucus, and Chief Regulatory Reform Officer of the Western Caucus.

Congressman Biggs has a lifetime rating of 100% with the Club for Growth, 98% lifetime score with FreedomWorks, 95% lifetime score with Heritage Action, 100% rating in the 116th Congress for National Right to Life, and a 99% career grade from NumbersUSA. The Arizona Republic named Congressman Biggs as one of its "10 Arizona people you'll want to watch in 2019," arguing that "Biggs makes the public case for the conservative position and often in defense of the Trump administration. He's very good at it. His advocacy tends to be well-reasoned and persuasive, not inflammatory...To keep an eye on what congressional conservatives are thinking and advocating, Biggs is increasingly one to watch."

**Dr. François Cosquer** is CTO Security for Nokia Software business group. He has also served as Head of Solutions Security for the Alcatel-Lucent Corporate Solutions organization and as CTO Security and Technology Strategist for the Alcatel-Lucent Enterprise Business Group. Over the past 20 years, he has held senior positions with research institutions, equipment vendors and telecommunications operators. He draws on extensive experience in security architecture, networking, operating systems, middleware, and multimedia applications. He has been speaker, panelist, and chair at key industry events and conferences.

François graduated in Electronics and Computing and holds an MSc in Computer Science and a Ph.D. in Computer Engineering. He currently serves as Adjunct Professor at the Faculty of Engineering and Computer Science, University of Concordia, Montreal.

**Dr. Robert E. Kahn** is Chairman, CEO and President of the Corporation for National Research Initiatives (CNRI), which he founded in 1986 after a thirteen year term at the U.S. Defense Advanced Research Projects Agency (DARPA). CNRI was created as a not-for-profit organization to provide leadership and funding for research and development of the National Information Infrastructure.

After receiving a B.E.E. from the City College of New York in 1960, Dr. Kahn earned M.A. and Ph.D. degrees from Princeton University in 1962 and 1964 respectively. He worked on the Technical Staff at Bell Laboratories and then became an Assistant Professor of Electrical Engineering at MIT. He took a leave of absence from MIT to join Bolt Beranek and Newman, where he was responsible for the system design of the Arpanet, the first packet-switched network. In 1972 he moved to DARPA and subsequently became Director of DARPA's Information Processing Techniques Office (IPTO). While Director of IPTO he initiated the United States government's billion dollar Strategic Computing Program, the largest computer research and development program ever undertaken by the federal government. Dr. Kahn conceived the idea of open-architecture networking. He is a co-inventor of the TCP/IP protocols and was responsible for originating DARPA's Internet Program. Dr. Kahn also coined the term National Information Infrastructure (NII) in the mid 1980s which later became more widely known as the Information Super Highway.

In his recent work, Dr. Kahn has been developing the concept of a digital object architecture as a key component of the NII. This notion is providing a framework for interoperability of heterogeneous information systems and is being used in many applications such as the Digital Object Identifier (DOI). He is a co-inventor of Knowbot programs, mobile software agents in the network environment.

Dr. Kahn is a member of the National Academy of Engineering and the National Academy of Sciences, a Fellow of the IEEE, a Fellow of AAAI, a Fellow of ACM and a Fellow of the Computer History Museum. He is a member of the State Department's Advisory Committee on International Communications and Information Policy and is Chair of the non-profit DONA Foundation based in Geneva.

He is a recipient of the AFIPS Harry Goode Memorial Award, the Marconi Award, the ACM SIGCOMM Award, the President's Award from ACM, the IEEE Koji Kobayashi Computer and Communications Award, the IEEE Alexander Graham Bell Medal, the IEEE Third Millennium Medal, the ACM Software Systems Award, the Computerworld/Smithsonian Award, the ASIS Special Award and the Public Service Award from the Computing Research Board. He has twice received the Secretary of Defense Civilian Service Award. He is a recipient of the 1997 National Medal of Technology, the 2001 Charles Stark Draper Prize from the National Academy of Engineering, the 2002 Prince of Asturias Award, and the 2004 A. M. Turing Award from the Association for Computing Machinery. Dr. Kahn received the 2003 Digital ID World award for the Digital Object Architecture as a significant contribution (technology, policy or social) to the digital identity industry. In 2005, he was awarded the Townsend Harris Medal from the Alumni Association of the City College of New York, the 2004 Presidential Medal of Freedom, and the C & C Prize in Tokyo, Japan in 2005. He was inducted into the National Inventors Hall of Fame in May 2006 and awarded the Japan Prize for his work in "Information Communication Theory and Technology" in 2008. He received the Harold Pender Award from the University of Pennsylvania in 2010, the Queen Elizabeth Prize for Engineering in 2013 and the Benjamin Franklin Medal in 2018.

Dr. Kahn has received honorary degrees from Princeton University, University of Pavia, ETH Zurich, University of Maryland, George Mason University, the University of Central Florida, The City College of New York, and the University of Pisa, and an honorary fellowship from University College, London.

**Thomas Ketseoglou** (S.85-M.91-SM.96) received the B.S. degree from the University of Patras, Patras, Greece, in 1982, the M.S. degree from the University of Maryland, College Park, Maryland, USA, in 1986, and the Ph.D. degree from the University of Southern California, Los Angeles, California, USA, in 1990, all in electrical engineering. He worked in the wireless communications industry, including senior level positions with Siemens, Ericsson, Rockwell, and Omnipoint. From 1996 through 1998 he participated in TIA TR45.5 (now 3GPP2) 3G standardization, making significant contributions to the cdma2000 standard. He has been inventor and co-inventor in several essential patents in wireless communications. Since September 2003 he has been with the Electrical and Computer Engineering department of the California State Polytechnic University, Pomona, California, USA, where he is a professor. He spent his sabbatical

leave in 2011 at the Digital Technology Center, University of Minnesota, Minneapolis, Minnesota, USA, where he taught digital communications and performed research on network data and machine learning techniques. He is a part-time lecturer at the University of California, Irvine. His teaching and research interests are in wireless communications, signal processing, and machine learning, with current emphasis on MIMO, optimization, localization, and link prediction.

**Andrew D. Lipman** is a partner at Morgan Lewis and the leader of the firm's Telecommunications, Media and Technology Practice. He practices in most aspects of communications law and related fields, including regulatory, transactional, litigation, legislative, and land use. Andy's clients in the private and public sectors include those in the areas of local, long distance, and international telephone common carriage; Internet services and technologies; conventional and emerging wireless services; satellite services; broadcasting; competitive video services; telecommunications equipment manufacturing; and other high-technology applications. Additionally, he manages privatizations of telecommunications carriers in Europe, Asia, and Latin America.

To open the US local telephone market to competition, Andy has been involved in most new legal and regulatory policies at the Federal Communications Commission, at state public service commissions, in Congress, and before courts. He helped shape crucial provisions of the Telecommunications Act of 1996 and used similar approaches to promote the opening of foreign markets. He also obtained one of the first competitive local service and interconnection agreements in continental Europe and the first competitive fiber network application in Japan. Andy's practice includes strategic analysis of companies' telecom user agreements, renegotiating existing agreements, and negotiating new, more favorable telecom user agreements.

For nearly a decade, Andy served as senior vice president, legal and regulatory affairs, for MFS Communications, the nation's largest competitive local services provider. One of the founders of MFS, Andy helped guide the company from startup to its eventual sale for \$14.4 billion to WorldCom.

Frequently writing and speaking on telecommunications, Andy's work encompasses more than 170 articles and five books, including two Dow Jones books on telecommunications. He occasionally appears on National Public Radio, C-SPAN, Bloomberg News Network, and ABC News, and he served on the editorial advisory boards of Phillips Publishing Company,

Internet Law and Regulation, Telecommunications Alert, Telecommunications Reports, Telecommunications Regulatory Monitor, and The Satellite Compendium.

Andy served as general counsel to the International Teleconferencing Association and as legislative/regulatory counsel to the International Satellite Users Association. He sits on the board of directors of five public companies trading on the NYSE, NASDAQ, and Toronto Stock Exchange. Additionally, he co-founded the Association of Local Telecommunication Services (ALTS)—the national trade association for competitive telecommunications carriers—and served as its first chairman.

Prior to joining Morgan Lewis, Andy was a partner in the corporate practice of another international law firm, where he was also a member of the executive board and leader of the telecommunications, media and technology practice. Before entering private practice, he participated in the legal honors program at the US Department of Transportation and served in the Office of the Secretary of Transportation. He also served as an extern law clerk to Judge Raymond Sullivan of the California Supreme Court.

Andy was awarded a Bachelor of Arts, Summa Cum Laude from the University of Rochester in 1974 and Juris Doctor for Stanford Law School in 1977.

In 2017 he was named to The Legal 500 Hall of Fame and in 2018 its Leading Lawyer Media, technology and telecoms: Telecoms and broadcast: transactional.

Andy is admitted to practice in the District of Columbia.

**Jon Peha** is a Professor at Carnegie Mellon University with experience in industry, government, and academia. In government, he served at the Federal Communications Commission as Chief Technologist, in the White House as Assistant Director of the Office of Science & Technology Policy, in the House Energy & Commerce Committee where he was responsible for telecom and e-commerce, and at USAID where he helped launch and led a US Government interagency program to assist developing countries with information infrastructure. In industry, he has been Chief Technical Officer for three high-tech companies, and a member of technical staff at SRI International, AT&T Bell Labs, and Microsoft. At Carnegie Mellon, he is a Full Professor in the Dept. of Engineering & Public Policy and the Dept. of Electrical & Computer Engineering, and former Associate

Director of the university's Center for Wireless & Broadband Networking. His research spans technical and policy issues of information and communications technology, including spectrum, broadband Internet, wireless networks, communications for emergency responders and disaster resilience, universal service, privacy and cybersecurity, secure Internet payment systems, online dissemination of copyrighted material, vehicular networks and intelligent transportation systems, smart cities. Dr. Peha holds a PhD in electrical engineering from Stanford, and a BS from Brown. He is an IEEE Fellow and an AAAS Fellow, and was selected by AAAS as one of 40 "Featured AAAS Science and Technology Policy Fellows" of the last 40 years ("40@40"). He is member of the National Academy of Science's Disaster Resilience Roundtable, and the U.S. State Department's Advisory Committee on International Communications and Information Policy. Dr. Peha has received the FCC's "Excellence in Engineering Award," the IEEE Communications Society TCCN Publication Award for career contributions, and the Brown Engineering Medal.

**Dr. H. Vincent Poor** is the Michael Henry Strater University Professor at Princeton University, where he has been on the faculty since 1990, working in the areas of wireless networks, energy systems and related fields. During 2006 – 2016 he served as Dean of Princeton's School of Engineering and Applied Science, and he has also held visiting positions at several other universities, including most recently at Berkeley and Cambridge. Dr. Poor is a member of the National Academy of Engineering and the National Academy of Sciences and is a foreign member of the Royal Society and other national and international academies. Recent recognition of his work includes the 2017 IEEE Alexander Graham Bell Medal, the 2109 ASEE Benjamin Garver Lamme Award, and honorary doctorates and professorships from several universities, including a D.Sc. honoris causa from Syracuse in 2017 and a D.Eng. honoris causa from the University of Waterloo in 2019.

**Dr. Habib Riazi** has been a contributor to the telecom industry for more than 30 years. He has been the RF and Systems Engineering Director at Corning Optical Communications Wireless Ltd, a major manufacturer of active Distributed Antenna System (DAS). His previous tenure includes positions at both wireless service providers and equipment manufacturers. Prior to Corning, Habib was the Technology Strategist at Nextel, Sprint, and Clearwire, where he was responsible for assessing and recommending Radio Access Technology and products for network deployment. Prior to Nextel, he led the team for system design and simulation of the Satellite Digital Audio Receiver, now a commercially available product, at Bell

Labs Advanced Technologies. Prior to Bell Labs, Habib served as the Radio Access Network Manager for Verizon for one of the first CDMA commercial network deployments. Habib did doctoral studies in Electrical Engineering at the George Washington University in Washington DC. He is a life senior member of IEEE ComSoc, a registered Professional Engineer in the state of Virginia, has served on Virginia State University Industrial Advisory Board, and holds a number of US and EU patents.

**Dr. Rob van den Dam** is the Global Telecommunications Industry Leader at the IBM Institute for Business Value. He is responsible for developing and deploying strategic thought leadership in telecommunications and as such contributor to IBM's global telecom strategy. In this role he develops future agendas, industry outlooks and business value realization studies. He has 20 years' experience in the telecom industry and has worked in a range of advisory and implementation roles for major telecommunications, media and government organizations.

Prior to joining IBM he worked for Data Sciences where he was Senior Principal and one of the founders of Data Sciences' telecommunications practice. He started his career 30 years ago at the National Aerospace Industry where he worked in both national and international projects. Rob graduated at the Delft University in Aerospace Engineering (with honours), where he received a PhD.

Recent work includes future scenario planning, big data, Cloud, social business, and Internet of Things. Rob periodically presents or participates in panel sessions at major industry conferences, such as World Future Trends Summit, ITU World, GSMA Mobile Asia Conference, Total Telecom World, World Telecom Council, CommunicAsia, Broadband World Forum, and Asian Carriers' Conference. He has published multiple articles in, amongst others, Total Telecom Magazine, Telecom Asia magazine, European Communications, Mobile Europe, Annual Review of Communications and Journal of Telecommunications Management.

## ***Co-Sponsors***

---

California State Polytechnic University, Pomona

College of Business Administration: Computer Information  
Systems Department

College of Engineering: Electrical & Computer Engineering  
Department



## ***Technical Co-Sponsors***

---

IEEE Communications Society



in cooperation with the IEEE Communications Society Technical  
Committees on Communications & Information



## › **Wireless Telecommunications Symposium Committees**

---

### **WTS Committee**

#### **WTS Committee Chairs:**

Dr. Steven Powell, General Chair, Cal Poly Pomona, USA  
Dr. Thomas Ketsseoglou, Assistant Chair, Cal Poly Pomona, USA  
Dr. Zory Marantz, TPC Administration Chair, New York City College of Technology  
Dr. J.P. Shim, Program Chair, Georgia State University, USA  
Dr. Ehsan Sheybani, Tutorial & Workshops Chair, University of South Florida, USA

#### **WTS Program Committee:**

Roger Achkar, American University of Science & Technology, Beirut  
Ender Ayanoglu, UC Irvine  
Michael Bartolacci, Penn State  
Balazs Benyo, Budapest Univ. of Tech. & Econ. Gregory Carlton, Cal Poly Pomona  
Gregory Carlton, Cal Poly Pomona  
Francois Cosquer, Nokia  
Vassiliki Cossiavelou, Aegean University  
Homero Toral Cruz, University of Quintana Roo  
Vivek Deshpande, MIT, India  
Peter Farkas, Slovak University of Technology  
Ivan Guardiola, Missouri Univ. of Science & Tech.  
Ruth Guthrie, Cal Poly Pomona  
Roger Pierre Fabris Hoefel, Universidade Federal do Rio Grande do Sul  
Jan Holub, Czech Technical University  
Giti Javidi, University of South Florida  
Drew Hwang, Cal Poly Pomona  
Benjamin Kok Khoo, NYIT  
Abdullah Konak, Penn State University  
Cees Lanting, Centre Suisse d'Electronique et de Microtechnique SA  
Kin Leung, Imperial College of London  
Izabella Lokshina, SUNY Oneonta Carlos Navarrete, Cal Poly Pomona  
James McGee, NUWC  
Albena Mihovska, Aarhus University  
Seshadri Mohan, UALR

Mohamed Moustafa, Arab Information Union  
Peter Mueller, IBM Research  
Carlos Navarrete, Cal Poly Pomona  
Willie Ofose, Penn State  
Eli Olinick, SMU  
Ye Ouyang, Verizon Wireless  
Katia Passerini, NJIT  
Milica Pejanovic-Djurisic, University of Montenegro  
Muttukrishnan Rajarajan, City University London  
Gee Rittenhouse, Cisco  
Salam Salloum, Cal Poly Pomona  
Ravi Sankar, University of South Florida  
Ehsan Sheybani, University of South Florida  
Jacqueline Stewart, Athlone Institute of Technology  
Robert Stewart, Athlone Institute of Technology  
Yan Sun, Queen Mary University of London  
Rob van den Dam, IBM  
Upkar Varshney, Georgia State University  
William Webb, Weightless SIG  
Stephen Weinstein, Columbia University  
Roger Whitaker, University of Cardiff  
Qing-An Zeng, North Carolina A&T State University

### **WTS Administration & Operations:**

Kathleen Pettengill, Administrative Coordinator, Cal Poly Pomona  
Kathy Byrum, Administrative Coordinator, Cal Poly Pomona  
Kristin Files, Administrative Coordinator, Cal Poly Pomona  
Drew Hwang, Webmaster, Cal Poly Pomona  
Carlos Navarrete, Co-Sponsorships, Cal Poly Pomona

### **WTS 2020 Technical Program Committee & Reviewers**

### **WTS 2020 Technical Program Committee Chairs:**

Dr. Ehsan Sheybani, University of South Florida, USA  
Dr. Pavlos Lazaridis, University of Huddersfield, UK

## **WTS 2020 Technical Program Committee Members & Reviewers:**

Qasim Ahmed, University of Huddersfield, UK  
Vishwa Alaparthy, Duke University, USA  
Hadi Alasti, IPFW  
Niloofar Bahadori, North Carolina A&T State University  
Michael Bartolacci, Penn State University  
Balazs Benyo, Budapest Univ. of Tech. & Econ  
Gregory Carlton, Cal Poly Pomona  
Edward Chlebus, Illinois Institute of Technology  
Theofilos Chrysikos, University of Patras, Greece  
Ruslan Dautov, Rochester Institute of Technology  
Mesut Günes, Otto von Guericke University Magdeburg  
Mohamed Hassan, American University of Sharjah, United Arab Emirates  
Jan Holub, Czech Technical University, Czech Republic  
ASM Delowar Hossain, City University of New York  
Mahmoud Ismail, American University of Sharjah  
Giti Javidi, University of South Florida  
Salim Kahveci, Karadeniz Technical University  
Thomas Ketseoglou, Cal Poly Pomona  
Natalia Kryvinska, University of Vienna, Austria  
Yovannes Kulhandjian, California State University, Fresno  
Pavlos Lazaridis, University of Huddersfield  
Izabella Lokshina, SUNY Oneonta  
Zory Marantz, New York City College of Technology  
Albena Mihovska, Aarhus University, Denmark  
Milica Pejanovic-Djurisic, University of Montenegro & Research Centre for ICT, Montenegro  
Chaudhry Mujeeb, Singapore Univ. of Technology & Design, Singapore  
Willie Ofosu, Penn State University  
Vladimir Poulkov, Technical University of Sofia  
Steven Powell, Cal Poly Pomona  
Neeli Rashmi Prasad, ITU, Center for TeleInFrastructure (CTIF), USA  
Cong Pu, Marshall University  
Salam Salloum, Cal Poly Pomona  
Yannick Saouter, Telecom-Bretagne  
Ehsan Sheybani, University of South Florida  
JP Shim, Georgia State University  
Rana Pratap Sircar, Ericsson  
Mehdi Sookak, Arizona State University  
Jacqueline Stewart, Athlone Institute of Technology  
Yan Sun, Queen Mary University

Hengky Susanto, Hong Kong University of Science and Technology  
Eric Tutu Tchao, Kwame Nkrumah University of Science and Technology  
Anurag Thantharate, University of Missouri Kansas City  
Pedro Tonhozi de Oliveira, Western Kentucky University  
Jin-Yuan Wang, Nanjing University of Posts and Telecommunications  
Lin Wang, Xiamen University, P.R. China  
Yue Wang, George Mason University  
Julian Webber, Advanced Telecommunications Research Institute  
International, Japan  
Zaharias Zaharis, Aristotle University of Thessaloniki, Greece  
Qing-An Zeng, NCA&T State University  
Zhiyuan Zheng, Texas A&M University  
Lidong Zhu, University of Electronic Science and Technology of China