



IECON 2022

48th Annual Conference of the
IEEE Industrial Electronics Society
October 18-21, 2022 | Brussels



Workshop Chairs:

Zhibo Pang (ABB, Sweden):
Rick Candell (NIST, USA):
Kang Lee (NIST, USA)
Kim Fung Tsang (CityU, HK)

Sponsored by

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Informatics

IES Technical Committee on Building
Automation, Control & Management

The Workshop: October 17, 2022

Purpose

The purpose of this workshop is to provide an opportunity for representatives from industry, academia, and government to work closely together to update to this research community on the latest progresses, emerging use cases, future roadmaps, open challenges, and promising research directions. The output of this workshop will, on one hand, help technology vendors to develop better wireless technologies that meet the industrial specific needs, and on the other hand, it will help system integrators and users to determine which wireless technology is suitable for which use cases with which level of performances, and how to deploy, integrate, and engineer the wireless systems properly in challenging industrial environments with e.g., many potential physical obstructions and sources of interferences.

Registration

- Workshop Only (1 day registration): €200.00
- Full IECON Conference (includes Workshop): Full Conference Fee

Workshop Program*

October 17, 2022

8:30 – 11am

Registration

Session on open and converged networks for Industry 4.0

9:00 – 9:10am

Welcome Remarks

9:10 – 10:00am

Keynote: Prof. Thilo Sauter, TU Wien

10:00 – 10:30am

Dr. David Luo, Huawei Technologies

10:30 – 10:50am

Coffee Break

10:50 – 11:20am

Dr. Suresh Kalyanasundram, Intel Research

11:20 – 11:50am

Dr. Ingrid Moerman, IMEC and UGhent

12noon – 1pm

Lunch

Session on Industrial Wireless – Trends and Future Perspectives

1:00 – 1:10pm

Welcome Remarks

1:10 – 2:00 pm

Keynote: Dr. Chih-Lin I, Chief Scientist, China Mobile Research Institute

2:00 – 2:30pm

Dr. Zhibo Pang, ABB

2:30 – 3:00pm

Dr. Hans-Peter Bernhard, Silicon Austria Labs

3:00 – 3:20pm

Coffee Break

3:20 – 3:50pm

Dr. Richard Candell, National Institute of Standards & Technology (NIST)

Panel Discussion

3:50 – 4:30pm

Speakers of AM and PM sessions

Working Group Meeting of IEEE P1451.5p

4:30 – 5:30pm

Sub-working group progresses and proposals
Review, decision, planning, Group photo

Fees

- Workshop-ONLY: €200.00. All registered for the workshop only will be provided with coffee breaks, lunch, and WiFi access.
- Full Conference (Workshop included): Full Conference Fee

*Full Speaker abstracts and biographies starting page 5.



Organizers/Chairs

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Background

Manufacturers applying wireless technologies in new or existing automation systems for sensing, monitoring, and controlling equipment and processes can reap benefits by eliminating costly cabling and enabling mobility and deployment flexibility. Meanwhile, using wireless technologies can improve factory-floor operating conditions, performances, and efficiency. It is envisioned that the industrial wireless infrastructure will become a common infrastructure for communication, computing, and even sensing. The industrial use cases are also among the drivers of the evolution of cellular, Wi-Fi, and even satellite networks. In the recent years, technology vendors are achieving significant progresses while the expectations from system integrators and users are increasing even more rapidly, which means many challenges are being solved while many new ones are being brought up.

Topics to be addressed

- Wireless technologies e.g., 5G/6G, WiFi6/7, Wireless TSN, satellite, LPWAN (LoRa, Sigfox, NB-IoT), UWB, etc. for Industrial IoT
- Emerging techniques to achieve high-reliability, low-latency, secure, and safe wireless systems
- Wireless use cases and requirements for industrial applications such as robotics, mobile platforms, automation, UAV, motion control, healthcare, smart buildings, product safety, etc.
- Security, blockchain technologies and networks for industrial IoT applications
- Source of interference and coexistence of wireless technologies
- Approaches for spectrum monitoring and interference management in Industrial IoT

- Wireless-aware Industrial IoT applications such as industrial AI, monitoring and maintenance, closed-loop control, functional safety
- Systems engineering approach and processes for applying wireless technologies
- Convergence of wireless and wired protocols and networks in Industrial IoT
- Convergence of wireless communication with edge computing in Industrial IoT
- Convergence of wireless communication with artificial intelligence in Industrial IoT
- Needs for standardization of protocols, practices, and guidelines

Who Should Attend/Stakeholders

Industrial wireless technology developers, system integrators, device manufacturers, end-users, standardization initiatives, and researchers are invited to speak and participate in this workshop/panel discussion for establishing guideline and research direction.

Benefits

The results of the workshop will help develop guideline, standard, and future research direction, which will help manufacturers, users, and their technology suppliers to design, assess, select, and deploy wireless platforms that perform dependably in their industrial settings and conditions.

List of talks, Abstracts, Biographies and photos of the Speakers

KEYNOTE: “Safety and Security in Industrial Automation: The Need for a Holistic View” – Prof. Thilo Sauter, TU Wien and University of Continuing Education Krems, Austria

Abstract:

Pending

Biography:



Dr. Thilo Sauter (M’93–SM’09–F’14) received the Dipl.-Ing. and Ph.D. degrees in electrical engineering from TU Wien, Vienna, Austria, in 1992 and 1999, respectively. Until 2003, he led the Factory Communication Group at the Institute of Computer Technology. From 2004 to 2013, he was the Founding Director of the Institute for Integrated Sensor Systems at the Austrian Academy of Sciences. Since 2013, he has been with the Department of Integrated Sensor Systems at the Danube University Krems, Austria, and a tenured Associate Professor for automation technology at TU Wien since 2014. His expertise and research interests include embedded systems and integrated circuit design, smart sensors, and automation and sensor networks with a focus on real-time, security, interconnection, and integration issues relevant to cyberphysical systems and the Internet of Things in various application domains such as industrial and building automation, smart manufacturing, or smart grids.

Dr. Sauter is the Vice President of the Austrian Association for Instrumentation, Automation, and Robotics, member of the Board of the Austrian Electrotechnical Association, Senior AdCom Member of the IES, and Treasurer of the IEEE Austria Section. He is currently Vice-President for Publications of the IES and past Editor-in-Chief of Industrial Electronics Magazine. He has been involved in the standardization of industrial communication systems for more than 25 years.

KEYNOTE: “TBD” – Dr. Chih-Lin I, Chief Scientist, China Mobile Research Institute

Abstract:

Pending

Biography:



Dr. Chih-Lin I – Bio Pending

“Deterministic Industrial Networks and Communications Enabling Edge Control” – Dr. David Zhe Lou, Huawei Technologies

Abstract:

Pending

Biography:



Dr. David Lou graduated as Ph.D. in Electronic Engineering at Ghent University in 2005. In the same year he joined the Alcatel-Lucent Bell Labs as an Innovation Researcher. He had a leading involvement and management role in several European and national research projects (Giant, Smart Touch, Metaverse1, Mistra, Shift-TV, etc.), and standardization bodies (MPEG). In 2016 he joined Huawei Technologies as a Chief Researcher based in Munich, Germany. He is responsible for defining the research strategy, steering disruptive network innovation and coordinating collaboration with industrial and academic partners. He is also leading the standardization activities in various SDOs (e.g. ITU-T, IETF, ETSI, etc.) His interests mainly covers IoT/IIoT/I4.0, next generation industrial networking architecture, deterministic communication, network security and privacy, video streaming and transportation, and immersive communication. He is the co-chair of the IIC Networking Task Group & Edge Computing Task Group and has been actively involved in relevant industrial development activities.

“Latest progress in WiFi6 and WiFi7 towards Wireless Time Sensitive Networking” – Dr. Suresh Kalyanasundaram, Intel Research, Germany

Abstract:

Pending

Biography:

Dr. Suresh Kalyanasundaram – Bio Pending.



“On a journey towards a flexible WiFi TSN Chip” – Dr. Ingrid Moerman, IMEC and UGhent, Belgium

Abstract:

Since the 1980s, Ethernet has been the standard technology for exchanging time-critical data such as, for instance, required for industrial process automation. Ethernet-based Time-Sensitive Networks (TSNs) are very robust, but also have a major drawback: with cables running everywhere, rearranging a factory’s production floor becomes quite a challenge. The manufacturing industry and other time-critical application domains are therefore calling for the installation of wireless TSNs, unhindered by the rollout of cables.

In 2020, openwifi has been released as the first open-source full-stack Wi-Fi implementation, combining low-level FPGA functionalities with an embedded Linux driver. With full control over all design aspects, openwifi yields excellent opportunities for customization. One such opportunity is the realization of a Wi-Fi TSN chip. During this talk, we will

elaborate on some of the design challenges in adding TSN capabilities to openwifi and achieving integration with wired TSN, and report on its performance in supporting time-critical control loops. We will show how PROFINET when integrated with a time-sensitive Wi-Fi network is capable to achieve a deterministic communication latency for safety-related applications and provide safety integrity levels (SIL) up to grade 4. These findings will be used to draw conclusions about the role of Wi-Fi in TSN and its positioning against 5G.

Biography:



Dr. Ingrid Moerman has received her degree in Electrical Engineering (1987) and the Ph.D. degree (1992) from the Ghent University, where she became a part-time professor in 2000. She is a staff member at IDLab, a core research group of imec with research activities embedded in Ghent University and University of Antwerp. Ingrid Moerman is coordinating the research activities on intelligent wireless networks at Ghent University, where she is leading a team of about 35 researchers. Ingrid Moerman is also Program Manager of the 'Deterministic Networking' track, part of the CONNECTIVITY program at imec, and in this role she coordinates research activities on end-to-end wired/wireless networking solutions driven by professional and mission-critical applications that have to meet strict Quality of Service requirements in terms of throughput, bounded latency, reliability, availability, etc. in smart application areas like industrial automation, vehicular networks, safety-critical operations, professional entertainment, etc.

Ingrid Moerman has a longstanding experience in running and coordinating national and EU research funded projects. At the national level, she is particularly active in demand-driven research with small, medium and large Flemish enterprises. At the European level, she has coordinated multiple FP7/H2020 projects and is currently involved in several H2020 and Horizon Europe projects related to 5G/6G (5G-MOBIX, 5G-CARMEN, 5G-Blueprint, DEDICAT-6G, HEXA-X-II, TrialsNet). Ingrid Moerman is further highly active in several European discussion groups that drive the 6G roadmap.

“Latency Measurement and Analysis of wireless networks in time sensitive applications” – Dr. Zhibo Pang, ABB Corporate Research Sweden/ Royal Institute of Technology (KTH)

Abstract:

Pending

Biography:



Dr. Zhibo Pang, PhD & MBA, is currently a Senior Principal Scientist at ABB Corporate Research Sweden, and Adjunct Professor at the University of Sydney and the Royal Institute of Technology (KTH). He is a Senior Member of IEEE and Co-Chair of the Technical Committee on Industrial Informatics. He is Associate Editor of IEEE TII, IEEE JBHI, and IEEE JESTIE. He was General Chair of IEEE ES2017 and General Co-Chair of IEEE WFCS2021 and Invited Speaker at the Gordon Research Conference AHI2018. He was awarded the “Inventor of the Year Award” by ABB Corporate Research Sweden, three times in 2016, 2018, and 2021 respectively. He works on enabling technologies in communication, computing, and intelligence for Industry4.0 and Healthcare4.0.

“What If We Design a Next G” – Dr. Hans-Peter Bernhard, Silicon Austria Labs

Abstract:

Why not regard “Next G” as human-like communication? Human communication is not only reduced to the exchange of data, humans speak and simultaneously perceive the environment and observe the reaction of the communication partners.

Communication is somehow multidimensional when we communicate one to one and one to many. Dependability, needed in a factory, is supported by this multidimensionality, e.g., we use visual perception to focus hearing towards a specific spatial direction. It is clear that, “Next G” is about enhancing communication and extending the view of communication to sensing and integrating the world of sensors to improve communication reliability for industrial use cases. So, one thing is really missing for the “Next G”, a standard or procedure that allows combining independent sources of information to improve communication dependability. We discuss topics in relevant fields that must be prepared for the benefit of wireless communication in the factory. 5G is not fully rolled out, but we have to use the results we gained from 5G so far to head to the Next G. We see in 5G new benefits such as edge computing, integrated localization, dependable communication needed for functional safety support and have to evolve them for our vision of a wireless work cell.

Biography:



Dr. Hans-Peter Bernhard is Principal Scientist, Head of Research Unit Wireless Communications and 6G Research at Silicon Austria Labs and Senior Scientist at the Institute of Communications and RF Systems at the Johannes Kepler University Linz, Austria. Hans-Peter Bernhard holds a Master’s degree in electrical engineering in 1991 and a PhD in Technical Sciences from the Technical University Vienna in 1997. He was Assistant Professor at TU-Vienna until 1998 and joined the JKU as Lecturer in 1999. From 1992 to 2018, he owned and operated a health IT company focused on people with physical and mental disabilities. In 2014 Hans-Peter Bernhard joined Johannes Kepler University Linz as a Senior Scientist and Silicon Austria Labs in 2018. He was Guest Researcher at the Prague Academy of Science and at the University of Cambridge. His research interests include the design and

analysis of time-sensitive communication systems with a focus on dependable solutions. He has given several invited talks on various aspects of the wireless factory and sensor communications. He has organized/co-organized several special sessions at ETFA2019, WFCS2020, NOMS2020, IEEE-IM 2021, WF-IoT 2021, and served as conference General Chair for WFCS2021, and Organizing Chair for EWSN2022. He is an active member of the IEEE P1451 standard technical committee, IES TC-II, IES TC-FA, IEEE Senior Member and guest editor of IEEE Transactions on Industrial Informatics and IEEE Access.

“Time-Sensitive Networking in Industrial Wireless Applications” – Dr. Richard Candell, NIST

Abstract:

Making wireless a primary mode of communications for industrial applications requires improvements in communications link reliability and latency determinism. Time-sensitive networking (TSN) emerges as a means for both improving reliability and meeting the latency requirements of certain time-critical industrial applications. As an example, in collaborative robotics applications, tight time synchronization is required to perform coordinated robotic tasks for which competitive channel access schemes with a heterogeneous mix of information flow tend to degrade the synchronization of the robotic applications. TSN allows for the partitioning of the channel into windows for particular applications thus greatly improving on-time reliability. In this presentation, Dr. Candell will present a sample case in which Transmission Control Protocol (TCP)-based communication of a collaborative robotic leader-follower use case is accommodated with an 802.1Qbv schedule, thereby minimizing the amount of channel dead time and maximizing bandwidth for other applications such as IIoT sensing and video.

Biography:



Dr. Richard Candell has over twenty years of experience in wireless systems engineering with extensive experience in the design and evaluation of wireless communications systems. Dr. Candell spent twelve years developing, testing, and deploying secure wireless technologies for commercial and defense applications. He served as the lead systems engineer in developing spread spectrum interference cancellation and performance evaluation strategies for satellite ground stations and mobile phased array beam steering transceivers. He holds patents in successive interference cancellation and transmission burst detection applied to spread-spectrum satellite communications signals. He holds a Ph.D. in Computer Science from the University of Burgundy, Dijon, France. He also holds a BS and MS degree in Electrical Engineering from The University of Memphis. Dr. Candell joined the National Institute of

Standards and Technology (NIST) in the US in 2014 where he leads the Industrial Wireless Systems research laboratory. He is a member of the IEEE Industrial Electronics Society and the Robotics and Automation Society. His current research interests include the performance of mobile robotic, manufacturing, and safety applications when deployed with wireless networks as the primary mode of communications. Dr. Candell was the primary contributing author of the Guide to Industrial Wireless Systems Deployments (NIST AMS 300-4) and he serves as the Chair of the IEEE P1451.5p Wireless Performance Assessment and Measurement Working Group and the NIST Industrial Wireless System technical interest group.