TSN/A CONFERENCE
TECHNOLOGY & APPLICATIONS
7 - 8 October 2020
Virtual Conference
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Dear TSN/A 2020 participant,

We are very pleased to welcome you again to the Time-Sensitive Networks and Applications (TSN/A) Conference, which is purely virtual for the first time due to the ongoing pandemic.

Although, each participant is in front of her or his own screen, we have made significant effort to make the conference highly interactive; arranged various opportunities for follow-on discussions among participants and presenters. Please join and add your unique perspective to the group discussions.

Open standards like TSN promise great benefits for providers and end users, and their success requires the collaboration of all participants in the value chain: from silicon, software and network switches to compute endpoints and sensors/actuators; from providers to system integrators and end customers. We can all play a role in transforming industries towards a vision of intelligent things that are interconnected and share information to increase productivity, improve efficiency, reduce our footprint, and improve the lives of people around the world.

This year we will take a look at the development of the technology in light of current and emerging use cases and deployment scenarios, including the application of time-sensitive wireless technology (especially 5G/URLLC) that promise “untethered” access to more data and improved communication with mobile devices. We will also discuss what lessons we can already learn from current testbeds and experiment; furthermore, how we can learn and benefit from each other across industries - from industrial automation to automotive and beyond. Thank you for joining us at TSN/A 2020!

Warm regards from your conference and program chairs,
Kevin, Meinrad & Janos
### Wednesday | 07 October

#### 14:30 Welcome Hallway Discussion

#### 15:00 Opening remarks
- Meinrad Happacher, Computer&AUTOMATION; Kevin Stanton, Intel; Janos Farkas, Ericsson

#### 15:10 Keynote: Industry 4.0 and its Eco-Systems – State of Play
- Volker Bibelhausen, Weidmüller Interface

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<td>Dr. Janos Farkas, Ericsson; Ludwig Winkel, L.A.N. Winkel; Gino Masini, Ericsson; Craig Gunther, Craig Gunther Consulting</td>
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#### 17:00 BUSINES BREAK AND NETWORKING

##### Session 2 | 5G & Wireless

- **17:30** Deployment Scenarios of 5G with Time-Sensitive Networking for Smart Manufacturing
  - Dr. Joachim Sachs, Ericsson

- **18:00** TSN over 5G: A working testbed and lessons learnt from it
  - Dr. Fatih Ulupinar, Qualcomm Technologies

- **18:30** Time-Sensitive Networking over 5G Campus Networks for Industrial Use Cases
  - Dr. Alexander Willner, Fraunhofer FOKUS

##### Session 3 | Software, Systems, & Open Source

- **17:30** A roadmap to a mature open source ecosystem for TSN
  - Mohan Karthik, Analog Devices

- **18:00** TSN-Endpoints Revisited – Enable your Applications with TSN Using Free Open Source Solutions
  - Philipp Neher, Institute for Control Engineering of Machine Tools and Manufacturing Units (ISW)

- **18:30** Cost-optimized TSN platform for aerospace applications based on RTEMS OS
  - Jorge Sanchez Garrido, University of Granada; Rafael Rodriguez, Seven Solutions

- **19:00** Wireless TSN: Opportunities, Challenges, and Industry Benefits of Extending TSN Capabilities over Wireless Networks
  - Dave Cavalcanti, Intel/Avnu Alliance

- **19:30** Software, Systems, & Open Source Hallway Discussion

### Thursday | 08 October

#### 14:30 Generic Hallway Discussion

#### 15:00 Status of OPC UA over TSN Standardization
- Peter Lutz, OPC Foundation; Alexander Ziegler, Siemens

#### 15:30 Backbones in flexible TSN networks
- Christian Liss, InnoRoute

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<td>Lukas Wüstney, Hirschmann Automation and Control; Alen Mehmedagic, Schneider Electric</td>
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#### 17:30 Comparing the adoption of TSN between automotive and non-automotive networks.
- Avik Bhattacharya, Keysight Technologies

#### 18:00 Taking benefit from TSN in Automotive and in Time-aware Wireless set-ups
- Dr. Armando Astarloa, SoC-e

#### 18:30 TSN Security: Detecting and Preventing attacks on time synchronization
- Alon Regev, Keysight Technologies

#### 19:00 TSN across Markets: The Core Benefits of ‘One TSN’
- Greg Schlechter, Intel/Avnu Alliance; Tom Weingartner, Analog Devices; Henning Kaltheuner, dBb audiotechnik

#### 19:30 Closing remarks

#### 19:40 Industrial Hallway Discussion
The media brand Computer&AUTOMATION reaches and creates a link between the automation-and the manufacturing- and processing-industries. The classic themes of automation, such as control technology, sensor technology, drive technology and networking find a place here in the reporting of trends: Industry 4.0, IIoT, human-robot cooperation, safety and security, big data and real-time Ethernet (TSN).

The reporting is user-oriented, illustrating the value and benefits of technologies in a neutral, sophisticated and independent manner. Parallel to the coverage in print and online, the automation community can find out about the professional events of Computer&AUTOMATION. The intensive training seminars for professionals, the safety and security forum, Automation 4.0 Congress in conjunction with the SPS IPC Drives are a few examples of the face-to-face offerings.

Elektronik automotive

Elektronik automotive – world of solutions

Focused on the really relevant topics of the automotive industry – autonomous driving, electromobility, connected car, services & shared mobility and alternative drives – the monthly electronic automotive magazine covers a wide spectrum along the value chain from individual components to system solutions and software engineering. With top-class events on top topics of the industry and a wide-ranging independent website in the business network elektroniknet with a weekly newsletter, Elektronik automotive offers a technically sophisticated, cross-media platform. Elektronik automotive, a media brand for efficient and effective market communication in automotive electronics: Print - Online - Event.

The Avnu Alliance is a community creating an interoperable ecosystem of low-latency, time-synchronized, highly reliable networked devices using open standards. Avnu creates comprehensive certification programs to ensure interoperability of networked devices. The foundational technology enables deterministic synchronized networking based on IEEE Audio Video Bridging (AVB) / Time Sensitive Networking (TSN) base standards.

The Alliance, in conjunction with other complimentary standards bodies and alliances, develops complete solutions in professional AV, automotive, industrial control and consumer segments. For more information about Avnu Alliance, please visit http://www.Avnu.org
Intel is enabling a more intelligent Internet of Things (IoT), supporting enterprises that are moving to the edge so they can capture more data, analyze it faster, and act on it sooner. With Intel as your IoT partner, you can take advantage of our broad portfolio of technology, solutions, and tools to facilitate more strategic decision-making, operational advancements, and industry-defining disruption.

IEEE Standards Association (IEEE SA), a globally recognized standards-setting body within IEEE, develops consensus standards through an open process that engages industry and brings together a broad stakeholder community.
INTEL

Supporting the convergence of industrial workloads and edge use cases

Computing and networking products from Intel help the industry develop and build next-generation industrial control solutions for Industry 4.0. Using new levels of integration, we deliver:

1. Powerful CPU performance
2. Real-time capabilities
3. Higher integration to support workload consolidation
4. Fast graphics and media/image processing
5. Security

11th Gen Intel® Core™ Processors

Intel® Core™ processors integrate up to 4 high-performance cores with Intel® Deep Learning Boost, new Intel® Time Coordinated Computing (Intel® TCC) and IEEE time-sensitive networking (TSN) technologies. Intel® Iris® Xe graphics, FuSa collateral support. Extended Temp: up to -40C to +100C.

Intel® Cyclone® FPGA

Choice between FPGA + included IEEE TSN IP or off-the-shelf solutions. Device drivers and Linux S/W support. Switched end point capable.

Intel Atom® x6000E Processor Series

Intel Atom x6000E processors—up to four cores—integrate new Intel TCC and TSN, support for functional safety (FuSa) with Intel® Safety Island. Extended Temp: up to -40C to +110C.

Partnering on Industry Standards/Initiatives

Collaboratively working with the Industrial Ecosystem towards Industry 4.0. Engagements include: The Open Group, OPC Foundation, OSADL, AVNU, IEEE, IETF, open62541.org, Linux Foundation Edge.

Intel® Ethernet Controller I225–IT

Intel silicon supporting IEEE time-sensitive networking technologies. 2.5GbE MAC/PHY, PCIe v3.1, gen 2x1 (7x7mm).

Edge Controls for Industrial

Software reference platform enabling software-defined solutions optimized for Intel silicon that integrates real-time compute, standards-based connectivity, safety, virtualization, orchestration, and IT manageability.

Learn more: intel.com/iot

1- Not all skus have industrial features: Refer to Intel product guides for detail. 2- Commercial availability Q1 2021. 3- Intel® Time Coordinated Computing technology and IEEE time-sensitive networking (TSN) reduce latency and minimize jitter for synchronous process control and real-time computing—technologies that improve deterministic behavior within individual processors by synchronizing data, communications, and executions across networks of IoT devices. 4- Supports commercial and open source operating systems: Windows 10 IoT Enterprise, Yocto Project Linux distribution with TSN Reference Software including open62541 Pub/Sub; Wind River Real-Time Systems real-time operating systems; Linux LTS kernel, Android. 5- Industrial Version Q4, 2020.

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As the world leader in secure connectivity solutions for embedded applications, NXP is driving innovation in the automotive, industrial & IoT, mobile and communication infrastructure markets that make lives easier, better and safer.

Spirent provides customers with an unmatched range of solutions for testing in-vehicle and V2X connectivity to help them ensure that their new systems conform to regulations, meet customer expectations, and deliver market-leading performance.

TSN Systems are experts for Time Sensitive Networking for Automotive, Industrial and AV applications. Since 2008 we provide holistic measurement and analysis tools for deterministic systems that are always reliable. Time Matters.

TTTech Industrial develops innovative computing and connectivity solutions that help customers to modernize automation systems and become IoT leaders in their field.

CAST develops, sells, and supports silicon IP cores for ASIC and FPGA design. CAST’s products include: automotive busses controllers, microprocessors, peripherals, compression and encryption engines.

The Fraunhofer IPMS is part of the Fraunhofer-Gesellschaft, the leading organization for applied research and development in Europe. Fraunhofer IPMS is a technology partner of CAST, Inc. and develops TSN IP Cores for different applications.
TSN IP CORE SOLUTIONS OFFERS A EASE WAY TO LINK ENDPOINT AND SWITCHED ENDPOINT DEVICES TO ETHERNET NETWORKS USING TSN.

FEATURES:
- Supports time synchronization (IEEE 802.1AS)
- Supports traffic scheduling (802.1Qav and 802.1Qbv)
- Supports frame preemption (IEEE 802.3br & IEEE 802.1Qbu)
- Supports Ethernet communication on MAC level (IEEE 802.3)

NXP SOLUTIONS FOR TIME-SENSITIVE NETWORKING

NXP's product portfolio and its industrial partner ecosystem help enable the design of next-gen automation applications to meet the challenges of the Fourth Industrial Revolution. The industrial Internet of Things (IIoT) aims overall to build distributed autonomous systems in order to bring more agility to manufacturing systems and meet demand while adjusting to environmental condition changes in real time.

Time-sensitive networking (TSN) is a major building block in the next wave of technological change bringing this vision to life. Several NXP products now offer built-in TSN capabilities. Ranging from MCUs with single TSN MACs to full MPUs with multi-port TSN switches, these products include:

• Highly integrated Layerscape® LS1028A SoC
  – Integrated 3D GPU for HMI
  – Support for TSN in the integrated Ethernet switch and independent Ethernet controllers
• i.MX RT1170 crossover MCU
  – Multicore Arm® Cortex® M7 and Cortex-M4 at 400 MHz
  – Integrates 2 x Gbit Ethernet with 1 MAC supporting TSN capabilities for industrial endpoint applications

NXP's industrial automation expertise and innovative spirit address the challenges of IIoT and help enable you to meet the highest expectations of industry 4.0 and industrial IoT markets. Our industrial solutions are usually made available to our customers for at least 15 years after market introduction.

Join NXP’s on-demand webinar, read the complete article and learn more on NXP Solutions for Factory Automation:
Recognize and solve TSN testing challenges.

Spirent’s comprehensive test solutions help you accelerate the deployment of TSN in industrial automation, 5G, automotive, aerospace, or pro AV networks and applications.

spirent.com/tns

Time Matters.

Test Systems for Time Sensitive Networks

www.tsn.systems
We bring determinism to Ethernet, without adding complexity.

- TSN switch IP and software
- TSN network planning software
- TSN integration with OPC UA

Find out more at tttech-industrial.com/slate
**KEYNOTE SPEAKER**

**Volker Bibelhausen**
Weidmüller Interface

Wednesday, 07. October 2020
Keynote: Industry 4.0 and its Eco-Systems – State of Play

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**SESSION SPEAKERS**

**Dr. Armando Astarloa**
System-on-Chip engineering

Thursday, 08. October 2020
Taking benefit from TSN in Automotive and in Time-aware Wireless set-ups

**Avik Bhatiyaria**
Keysight Technologies

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Comparing the adoption of TSN between automotive and non-automotive networks.

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**Dave Cavalcanti**
Intel/Avnu Alliance

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Wireless TSN: Opportunities, Challenges, and Industry Benefits of Extending TSN Capabilities over Wireless Networks

**Reiner Duwe**
Real-Time Innovations (RTI)

Thursday, 08. October 2020
Building DDS systems on top of TSN: best practices, successes and challenges

**Dr. Janos Farkas**
Ericsson

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Standards (IEEE 802.1 update, IEC/IEEE 60802 update, P802.1DG update, 3GPP update)

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**Jorge Sanchez Garrido**
University of Granada

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Cost-optimized TSN platform for aerospace applications based on RTEMS OS

**Craig Gunther**
Craig Gunther Consulting

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Standards (IEEE 802.1 update, IEC/IEEE 60802 update, P802.1DG update, 3GPP update)

**Henning Kaltheuner**
d&b audiotechnik

Thursday, 08. October 2020
TSN across Markets: The Core Benefits of ‘One TSN’

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**SPEAKERS**

www.tsnaconference.de
Kurt Kanzenbach
Linutronix
Wednesday, 07. October 2020
Architecture of Switched Endpoints in Linux

Mohan Karthik
Analog Devices
Wednesday, 07. October 2020
A roadmap to a mature open source ecosystem for TSN

Christian Liss
InnoRoute
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Backbones in flexible TSN networks

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OPC Foundation
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Alen Mehmedagic
Schneider Electric
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Philipp Neher
ISW
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Hirschmann Automation and Control  
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**Alexander Ziegler**  
Siemens  
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