Welcome
Message from the General Co-Chairs

Welcome to Austin, Texas and the 2014 International IEEE Symposium on Precision Clock Synchronization for Measurement, Control, and Communication (ISPCS).

We are proud that what started as an IEEE 1588 workshop held at NIST in Gaithersburg, Maryland in 2003 has evolved into a prominent IEEE conference, dedicated to all aspects of precise clock synchronization of computer networks. Subsequent events held annually were hosted in Vienna/Austria, Ann Arbor/Michigan, Brescia/Italy, Portsmouth/New Hampshire, Munich/Germany, San Francisco/California, and Lemgo/Germany, respectively. We are especially excited to bring the 8th ISPCS conference to Austin, Texas. Austin, originally named Waterloo, was established as the capital of Texas in 1839. Since then, the population of the Greater Austin area has grown from 839 to over 1.9 million. In recent years, Austin has consistently appeared at the top of numerous "Best Of" lists. From being one of the best cities to start a business, a top city for tech start-ups, and one of the best towns for craft beer, Austin has something for everyone. It's no wonder that in 2012, Forbes ranked Austin as the fastest growing city in the US. With greater than a third of jobs tech related and over one quarter of the economy driven by the tech sector, Austin is considered the technology hub of Texas.

The ISPCS is an outstanding opportunity for attendees to hear about the latest topics, learn about state-of-the-art advancements, and see the current solutions in the area of precise clock synchronization. Additionally, the ISPCS Plugfest gives product developers and researchers the opportunity to perform interoperability testing of diverse hardware and software implementations of the IEEE 1588 standard. This year, we also have a special session focusing on IEEE 1588 New Revision. It is very exciting, as we can use this occasion to introduce important requirements to the new version of the standard from the latest development in industry.

We expect that the work on the IEEE 1588 standard will continue as industry is continuously trying to push the limits of technology. Current deployments of IEEE 1588 within the area of automation and controls, energy distribution systems (smart grids), and telecommunications ensure that the 1588-based technology has a prominent role in governing proper operations of these systems. New opportunities, such as profiles developed for power and sensor networks, and standards like IEEE 802.1 TSN for audio-video and control, sustain further development of the IEEE 1588 standard.

As we have seen with the long-standing history of the ISPCS events, these symposia have always included a number of excellent topics, papers, poster sessions, and keynote speeches. Once again, this year, ISPCS 2014 features an exceptional program, composed of keynotes and presentations delivered by the leaders from industry and academia. We look forward to an excellent conference that gathers us together: researchers, engineers, and users from around the world, presenting their results and development of systems and networks incorporating principles of synchronized clocks.

We would like to take this opportunity to thank the following individuals:

- Program Co-Chairs Radim Bartos, Lee Cosart, and Sebastian Schriegel and the Program Committee for putting together an impressive program of well-coordinated technical sessions,
- Plugfest Co-Chairs Doug Arnold, Heiko Gerstung, Ken Harris, and Jeff Laird for organizing a very successful Plugfest, where more than 30 organizations work together to test the interoperability of their IEEE 1588-based hardware and software products,
- Promotional Partners Chair Hans Weibel for his outstanding work in obtaining the sponsorship of ten companies and organizations, and
- Rick Ratzel, Alejandro Zepeda, Courtney Speck, and the Local Organizing Committee for taking care of the local arrangements and working hard to ensure your comfortable stay in Austin during the conference and Plugfest.

Most importantly, we would like to thank all of you for attending the conference and participating in the Plugfest. Please have a fruitful conference and enjoy your stay in the vibrant city of Austin.

Rodney Greenstreet and Kang Lee
ISPCS 2014 General Co-Chairs

Welcome
Message from the Technical Co-Chairs

On behalf of the Program Committee, we are pleased to welcome you to ISPCS 2014, the eighth IEEE Symposium on Precision Clock Synchronization for Measurement Control and Communication. Following the tradition to alternate meetings between Europe and America, this year's symposium is hosted in Austin, Texas, US.

This year there are two keynote presentations. The first keynote will be given by Dr. James Truchard, CEO of National Instruments. He will give a presentation entitled "How Time Is Revolutionizing Measurement and Control" drawing from his deep expertise in the field of test and measurement. The second keynote will be given by Dr. Han Li, Deputy Director of the China Mobile Research Institute. His presentation, "IEEE 1588 Time Synchronization Deployment for Mobile Backhaul in China Mobile", describes their large IEEE 1588 telecom deployment in China.

The symposium's call for papers resulted in high quality submissions coming from all over the world. Just like the submissions, the members of the program committee formed a geographically diverse group representing both academia and industry. After careful deliberation, the program committee selected 21 papers to be presented at the conference as full papers.

Welcome to ISPCS 2014 and thank you for your attendance and contributions!

Radim Bartos, Lee Cosart, and Sebastian Schriegel
ISPCS 2014 Program Committee Co-Chairs

ISPCS 2014
Symposium Committee

ISPCS 2014 General Co-Chairs:

Kang Lee, National Institute of Standards and Technology

Rodney Greenstreet, National Instruments

ISPCS 2014 Program Co-Chairs:

Radim Bartos, University of New Hampshire

Lee Cosart, Microsemi

Sebastian Schriegel, Fraunhofer IOSB-INA

ISPCS 2014 Plugfest Co-Chairs:

Douglas Arnold, Meinberg

Heiko Gerstung, Meinberg

Ken Harris, Rockwell Automation

Jeff Laird, UNH-IOL

ISPCS 2014 Local Arrangements Co-Chairs:

Rick Ratzel, National Instruments

Alejandro Zepeda, National Instruments

ISPCS 2014 Promotional Partners Chair:

Hans Weibel, Zurich University of Applied Sciences

ISPCS 2014 Program Committee:
Douglas Arnold, Meinberg
Greg Dowd, Microsemi
John Eidson, Calnex Solutions
Pedro Estrela, IMC Financial Markets
Reinhard Exel, Austrian Academy of Sciences
Paolo Ferrari, University of Brescia
Holger Flatt, Fraunhofer IOSB-INA
Geoffrey Garner, Consultant
Nikolaus Kerö, Oregano Systems
Hubert Kirrmann, ABB Switzerland
Kang Lee, NIST
Ya-Shian Li-Baboud, NIST
David Macii, University of Trento
John MacKay, Progeny Systems
Cristian Marinescu, Omicron
Tal Mizrahi, Marvell
Claudio Narduzzi, University of Padova
Karen O'Donoghue, Internet Society
Julien Ridoux, University of Melbourne
Peter Roberts, Alcatel Lucent
David Roe, Semtech
Silvana Rodrigues, Integrated Device Technology
Emiliano Sisinni, University of Brescia
Eugene Song, NIST
Kevin Stanton, Intel
Karim Traore, Microsemi
Albert Treytl, Austrian Academy of Sciences
Henning Trsek, Institute Industrial IT - inIT
Hans Weibel, Zurich University of Applied Sciences
Lukasz Wisniewski, Institute Industrial IT - inIT

ISPCS 2014
Promotional Partners

Platinum Partner:

Gold Partners:

Silver Partners:

Plugfest
Sunday, September 21st - Tuesday, September 23rd

Plugfest Co-Chairs: *Douglas Arnold, Heiko Gerstung, Ken Harris, Jeff Laird*

Sunday, September 21 (open only to Plugfest participants)

13:00	Plugfest registration, setup & open testing
18:00	End of Plugfest activity

Monday, September 22 (open only to Plugfest participants)

08:00	Plugfest registration, setup & open testing
09:00	Test sessions
10:15	Morning break
10:35	Plugfest session
13:00	Lunch
14:00	Test sessions
15:30	Afternoon break
15:50	Test sessions
18:00	End of Plugfest activity

Tuesday, September 23 (open only to Plugfest participants until 15:00)

08:00	Plugfest registration, setup & open testing
09:00	Test sessions
10:15	Morning break
10:35	Plugfest session
13:00	Lunch
14:00	Test sessions
15:30	Afternoon break
15:50	Test sessions
18:00	End of Plugfest activity

Symposium
Wednesday, September 24th

09:00   **Opening session**
Conference General Co-Chair Remarks: *Kang Lee and Rodney Greenstreet*
Local Arrangements Co-Chair Remarks: *Rick Ratzel and Alejandro Zepeda*
Program Committee Co-Chair Remarks: *Radim Bartos, Lee Cosart and Sebastian Schriegel*

09:30   **Keynote Presentation I**
Session Chair: *Rodney Greenstreet (National Instruments, USA)*

How Time Is Revolutionizing Measurement and Control
James Truchard (National Instruments, USA)

10:30   **Morning break**

10:50   **Session I: PTP Protocols and Devices**
Session Chair: *Radim Bartos (University of New Hampshire, USA)*

Improving Syntonization of Synchronous Ethernet Nodes using Multiple Paths
Stefano Rinaldi (University of Brescia, Italy)
Paolo Ferrari (University of Brescia, Italy)
Alessandra Flammini (University of Brescia, Italy)
Daniele Fontanelli (University of Trento, Italy)
David Macii (University of Trento, Italy)

Endlessly Circulating Messages in IEEE 1588-2008 Systems
David Broman (University of California, Berkeley, USA)
Patricia Derler (University of California, Berkeley, USA)
Ankush Desai (University of California, Berkeley, USA)
John C Eidson (University of California, Berkeley, USA)
Sanjit Seshia (University of California, Berkeley, USA)

A New Approach for a Unicast Load Balancing Scheme for IEEE 1588 Increasing scalability and monitoring possibilities without breaking compatibility with existing IEEE 1588 devices
Heiko Gerstung (Meinberg Funkuhren GmbH & Co. KG, Germany)

12:05   **Lunch**

13:15 **Promotional Partner Presentations**
Chair: Hans Weibel *(Zurich University of Applied Sciences, Switzerland)*

Meinberg *(Platinum Partner)*
Kyland *(Gold Partner)*
Siemens *(Gold Partner)*
Calnex *(Silver Partner)*
HMS *(Silver Partner)*
ICAP *(Silver Partner)*
Microsemi *(Silver Partner)*
Napatech *(Silver Partner)*
National Instruments *(Silver Partner)*
Omnicron Lab *(Silver Partner)*
Qulsar *(Silver Partner)*

14:35 **Work in Progress Introductions**
Session Chair: *Radim Bartos (University of New Hampshire, USA)*

Nanosecond Accuracy using SoC Platforms
Naiara Moreira (University of the Basque Country UPV/EHU, Spain)
Jesús Lázaro (University of the Basque Country, Spain)
Armando Astarloa (University of the Basque Country, Spain)
Alain García (System-on-Chip engineering SoCe), Spain)
Sergio Salas (System-on-Chip engineering SoCe, Spain)

14:40 **Afternoon break**

15:00 **Session II: Usage and Research in Cyber Physical Production Systems**
Session Chair: *Douglas Arnold (Meinberg-USA, USA)*

Investigation in Automatic Determination of Time Synchronization Accuracy of PTP Networks with the Objective of Plug-and-Work
Sebastian Schriegel (Fraunhofer IOSB-INA, Germany)
Lukasz Wisniewski (inIT, OWL University of Applied Sciences, Germany)

Communication protocol between MES and OPC UA for Industrial applications
Uzair Saeed (Darmstadt University of Applied Sciences, Germany)
Navjyot Waghmare (Darmstadt University of Applied Sciences Germany, Germany)

Time Synchronization and Controlled Asynchronization of Remote Analog Signals with Sub Nanosecond Resolution
Robert Flake, DSc (The University of Texas at Austin, USA)
Aparna Sripada (The University of Texas at Austin, USA)
Jules Campbell (The University of Texas at Austin, USA)

16:15   **Session III: PTP in Networks and Wireless**
Session Chair: *Silvana Rodrigues (Integrated Device Technology, Canada)*

Inexpensive Time Dissemination Using Magnetically Coupled Resonators
Alessio De Angelis (University of Perugia, Italy)
Marco Dionigi (University of Perugia, Italy)
Antonio Moschitta (University of Perugia, Italy)
Paolo Carbone (University of Perugia, Italy)
Emiliano Sisinni (University of Brescia, Italy)
Paolo Ferrari (University of Brescia, Italy)
Alessandra Flammini (University of Brescia, Italy)
Stefano Rinaldi (University of Brescia, Italy)

On Clock Synchronization over Wireless LAN using Timing Advertisement Mechanism and TSF Timers
Aneeq Mahmood (Donau University Krems, Austria)
Reinhard Exel (Donau University Krems, Austria)
Thomas Bigler (Donau University Krems, Austria)

A Recursive Method for Bias Estimation in Asymmetric Packet-based Networks
MohammadJavad Hajikhani (Carleton University, Canada)
Thomas Kunz (Carleton University, Canada)
Howard Schwartz (Carleton University, Canada)

17:30   **Meinberg Welcome Reception**

Thursday, September 25th

09:00   **Keynote Presentation II**
             Session Chair: *Lee Cosart (Microsemi, USA)*

             IEEE 1588 time synchronization deployment for mobile backhaul in China Mobile
             Han Li (Deputy Director China Mobile Research Institute, China)

10:00   **Session IV: PTP Devices**
             Session Chair: *Sebastian Schriegel (Fraunhofer IOSB-INA, Germany)*

             Direct Measurement of Ingress and Egress latency on 1000Base-T Gigabit Ethernet Links
             Bob Noseworthy (University of New Hampshire InterOperability Laboratory, USA)

             Experimental verification of the egress and ingress latency correction in PTP clocks
             Christian Riesch (OMICRON electronics GmbH, Austria)
             Cristian Marinescu (OMICRON electronics GmbH, Austria)
             Manfred Rudigier (OMICRON electronics GmbH, Austria)

10:50   **Morning break**

11:10   **Session IV (continued): PTP Devices**
             Session Chair: *Sebastian Schriegel (Fraunhofer IOSB-INA, Germany)*

             Kalman filtering for multi-path network synchronization
             Giada Giorgi (University of Padova, Italy)
             Claudio Narduzzi (University of Padova, Italy)

             PPSi - A Free Software PTP Implementation
             Pietro Fezzardi (Università degli Studi di Pavia, Italy)
             Maciej Lipinski (CERN & Warsaw University of Technology, Switzerland)
             Alessandro Rubini (Independent Consultant, Italy)
             Aurelio Colosimo (Independent Consultant, Italy)

             Control Loop Optimization - Knowing Your Environment
             Felix Ring (Donau University Krems, Austria)
             Reinhard Exel (Donau University Krems, Austria)
             Tobias S. Müller (Oregano Systems, Austria)
             Nikolaus Kerö (Oregano Systems, Austria)

             Precise Clock Parameter Estimation and Ground Truth Capture for Clock Error Measurements using FPGAs
             Satyam Dwivedi (KTH Royal Institute of Technology, Sweden)
             Peter Händel (KTH Royal Institute of Technology, Sweden)

12:50   **Lunch**

14:15   **Session V: PTP for the Residence, the Enterprise, and the Power Industry**
Session Chair: *Kang Lee (National Institute of Standards and Technology, USA)*

Using a multi-source NTP watchdog to increase the robustness of PTPv2 in Financial Industry networks
Pedro V. Estrela (IMC Financial Markets, Netherlands)
Sebastian Neusuess (Deutsche Börse AG, Germany)
Wojciech Owczarek (NYSE Euronext, United Kingdom)

Smart Substation Precise Time Research and Analysis
Huang Bing (Shanghai Digigrid Information Technology Co., Ltd., P.R. China)
Zhao Xuyang (Shanghai Digigrid Information Technology Co., Ltd., P.R. China)
Liu Jing (Shanghai Digigrid Information Technology Co., Ltd., P.R. China)

Smart Substation IEC61588 Time Synchronization System and Security
Huang Xin (State Grid Electric Power Research Institute, P.R. China)
Li Wenmeng (State Grid Electric Power Research Institute, P.R. China)
Zhang Daonong (North China Power Engineering Co. LTD, P.R. China)
Yang Song (State Grid Jilin Electric Power Company, P.R. China)
Du Qiwei (State Grid Zhejiang Electric Power Company, P.R. China)

15:30   **Afternoon break**

16:00   **Plugfest Report**

16:30   **ISPCS 2015 Invitation**

18:30   **ISPCS 2014 Conference Dinner at the Bullock Texas State History Museum**
Bus transfer at 18:00 – Hilton 5th Street bus loop
Return buses will be available throughout the evening

Since 2001, The Bullock Texas State History Museum in downtown Austin has been engaging audiences, to interpret for themselves, the continually unfolding "Story of Texas". From the 35-foot-tall bronze star sculpture that greets visitors as they arrive, to the campfire scene in the terrazzo floor in entryway that features a campfire scene with enduring themes from Texas's past, every corner of the Museum proclaims the "Story of Texas" in a bold and new way.

Attendees will enjoy dinner from "The Salt Lick", famous for their world-renowned Bar-B-Que. The Salt Lick began as an open barbeque pit in 1967 and has grown from there. The founding Roberts family now serves mouthwatering barbeque to thousands of folks each week.

Friday, September 26th

09:00 **Session VI: Design, Usage, and Research**
Session Chair: *Geoffrey Garner (Huawei (Consultant), USA)*

A Study of Precision of Hardware Time Stamping Packet Traces
Ying Li (University of New Hampshire, USA)
Bob Noseworthy (University of New Hampshire InterOperability Laboratory, USA)
Jeff Laird (University of New Hampshire InterOperability Laboratory, USA)
Timothy Winters (University of New Hampshire InterOperability Laboratory, USA)
Timothy Carlin (University of New Hampshire InterOperability Laboratory, USA)

Packet Selection Technique for Clock Recovery over Packet Networks
Zdenek Chaloupka (Etisalat British Telecom Innovation Centre, UAE)
Nayef A. Alsindi (Etisalat British Telecom Innovation Centre, UAE)
James Aweya (Etisalat British Telecom Innovation Centre, UAE)

Using Reverse PTP to Distribute Time in Software Defined Networks
Tal Mizrahi (Technion, Israel)
Yoram Moses (Technion, Israel)

10:15 **Morning break**

10:35 **Special Session: IEEE 1588 New Revision**
Session Chair: *John Eidson (Calnex, USA)*

Architecture Subcommittee, *Chair: Doug Arnold*

High Accuracy Subcommittee, *Chair: Maciej Lipinski*

Management Subcommittee, *Chair: Hans Weibel*

Security Subcommittee, *Chair: Karen O'Donoghue*

Upkeep Subcommittee, *Chair: John Eidson*

11:50 **Closing session**