

## Real-Time Ethernet Solutions Workshop

### Abstract

*PROFINET IO* and *EtherCAT* are two of the leading industrial Ethernet solutions. Like many other so-called Real-Time-Ethernet protocols they are defined in IEC 61158 / IEC 61784-2 and are used in various practical applications in industrial automation. *PROFINET IO* is supported by the PROFIBUS organization and due to its association with Siemens, the world's largest supplier of PLC's which will integrate *PROFINET* as a standard, expected to become a key market player in the next few years. *PROFINET* is a relatively complex protocol which combines three separate "brand names" with many common features but differences in performance.

*EtherCAT* is currently a market leading technology in the Real-time Ethernet domain offering high real-time performance combined with a wide set of functionality. The initiator and main developer has been the company Beckhoff which have become a significant vendor of advanced equipment for industrial automation. The *EtherCAT* technology now has broad support and involvement by many companies.

Both the *PROFINET IO* and the *EtherCAT* technologies continuously evolve and add features and functionality. This workshop will aim at providing an updated status on these two main competing technologies. Both protocols have many interesting features around issues such as time synchronization, determinism, efficiency, redundancy, integration etc. and have a lot of potential for applied and derived research. Besides presenting the technologies in detail another goal of the workshop is to discuss and point at areas where the academic community can contribute to further development.

Specifically the workshop will look at the following topics:

- *Overview of the PROFINET IO-System:* *PROFINET I/O* covers RT and IRT technologies. Like most RTE protocols *PROFINET* is composed of several "parts". The first is bandwidth management (layer1-layer2) the second is the layer3-7 software that handles connection and session management as well as application interfacing. This section will also detail *PROFINET IRT* including its latest performance enhancing optimizations.
- *Solutions for plant-control applications/machine-control applications:* With the different "branding" within *PROFINET* comes different application domains, this section will detail the plant-control and machine control domains. Of interest to all researchers is the interaction with wireless technologies which will be covered here as well
- *Solutions for motion-control applications:* Motion control applications require higher performance than machine/plant control applications.
- *Overview of the EtherCAT technology:* This section will present the *EtherCAT* technology in detail with special focus on how the real-time performance has been realized. The various types of functionality found in *EtherCAT* will be presented. New developments within the technology will also be covered.

A comparison between *PROFINET* and *EtherCAT* will be done covering determinism and performance aspects as well as issues such as synchronization, configuration and integration.

The second goal is to encourage debate and research on various topics in the research community pertaining to both RTE in general and PROFINET and EtherCAT in particular. To this end the presenters will detail the current research landscape – what has been the current focus and what could be focused in the coming years. Whilst the final list of debatable topics is not finished the authors have identified various areas which need to be looked at more closely. These include the varying scheduling systems amongst RTE systems; Scheduling is often done on proprietary tool level – suited to machine and factory floor systems but not necessarily for the use of these protocols in other areas of industry and not necessarily amenable to ad-hock adaptation. A set of acceptable performance indicators need to be defined – a difficult task since not only do commercial aspects have to be taken into account but also the relevance and scope of possible indicators needs to be carefully considered. Further the presenters will identify other pertinent topics and put them forward for debate.

### Organizers

- ✓ *Hans Dermot Doran*, Institute of Embedded Systems, Zurich University of Applied Sciences, Switzerland
- ✓ *Max Felser*, Laboratory of industrial Networks, Bern University of Applied Sciences, Burgdorf, Switzerland
- ✓ *Gunnar Prytz*, Manager Network Technologies group, ABB Corporate Research, Norway

### Date

16<sup>th</sup> September.

### Duration

Full day.

### Agenda

Time	Title/Speaker(s)
09:00 – 10:30	<b>Overview of Real-Time Ethernet solutions</b> IEC Standards, Short overview of Ethernet Powerlink, SERCOS III and EtherNet/IP <i>Max Felser, Hans Doran, Gunnar Prytz</i>
	<b>Overview of PROFINET IO System</b> Application Classes, Application Relations and Communication Relations, integration of wireless <i>Max Felser</i>
10:30 – 11:00	Coffee Break
11:00 – 12:30	<b>Solutions for motion-control applications</b> Synchronization of time, Isochronous Real-Time (IRT), Framing, Optimisations and their implementations <i>Hans Doran</i>
12:30 – 13:30	Lunch Break
13:30 – 15:00	<b>EtherCAT</b> Principles, Features, Performance, Market status and applications, Recent development <i>Gunnar Prytz</i>



Time	Title/Speaker(s)
15:00 – 15:30	Coffee Break
15:30 – 17:00	<b>Comparing PROFINET and EtherCAT with other RTE protocols</b> Synchronisation, RT performance, Asynchronous performance <i>Max Felser, Hans Doran, Gunnar Prytz</i>
	<b>Open session with presentation of relevant research topics and debate on various issues</b> <i>Max Felser, Hans Doran, Gunnar Prytz</i>