TSN Testbed in Augsburg

Labs Network Industrie 4.0 e.V.
and
BMWi Competence Center 4.0 Augsburg
Introduction to LNI 4.0 e.V. and BMWi Competence Center 4.0 Augsburg
Plattform Industrie 4.0

Working groups

- 400 participants
- Relevant stakeholders in Germany

Representatives from business, trade union, academia, political integration

WG1: Reference architectures, standards and norms
WG2: Research and innovation
WG3: Security of networked systems
WG4: Legal Framework
WG5: Work, education and training
LNI4.0 founders

Our network feels connected to the entire German industry!

In cooperation with:
Industrie 4.0 Stakeholders

Expert community from industry and academia

Digital Transformation

Input

Output
Process for Standardization

1. Pre-check
2. Review
3. Evaluation
4. Decision
5. Standardization process
6. Validation

Top down
Bottom up

Steering Committee

Industrie 4.0 Standards

 storage

STANDARDIZATION COUNCIL INDUSTRE 4.0
Testlabs

- 30 test lab cooperation
- High availability
- Regional distribution
- Local contacts
- Broad technology mix
- VDMA labs
- International cooperation
Partner und Aufteilung der Schwerpunktthemen

- Logistik
- Arbeit 4.0
- Geschäftsmodelle
- Produktionsautomatisierung

Nürnberg
Augsburg
München/Garching

Fraunhofer IIS
Fraunhofer ICGV
cluster mechatronik & automation
TUM fortiss
VDMA
Industrial TSN Testbed
Testbed: Initiative of German Plattform Industrie 4.0 WG 1
Mittelstand 4.0-Truck and Shopfloor

- Ability to customize the truck with TSN Testbed and different usecases
- Visit of trade fairs, conferences and on-site training courses for SMEs
TSN partners (22)

- 5Analytics
- ABB
- ANALOG DEVICES
- assystem
- B&R
- ESR Pollmeier GmbH Servo-Antriebstechnik
- EXOR embedded
- Festo
- Hilscher
- HIRSCHMANN
- Belden
- HUAWEI
- Intel
- KUKA
- Microsoft
- Mitsubishi Electric
- Phoenix Contact
- PILZ
- Renesas
- Schmersal
- SICK
- Siemens
Overall TSN Testbed Goal

- Purely industrial testbed to host several usecases
- Continuous plug-festival
- TSN product development of each company in protected environment on neutral ground (BMWi Competence Center 4.0 Augsburg)
- TSN testbed creates input and validation for standardization (SCI4.0)
- Usecases covered: controller to controller communication over OPC UA @ TSN
TSN Testbed Organization

- Group 1: Robotics
- Group 2: Controllers
- Group 3: Network, Architecture
- Group 4: Cloud
TSN Technology

- **Synchronization**
- **Low Latency**
- **Robustness**
- **High Availability**

- TSN several IEEE standards
  - IEEE 802.1ASbt, IEEE 802.1Qbu, IEEE 802.1Qbv, IEEE 802.1Qca, IEEE 802.1CB, IEEE 802.1Qcc
TSN using OPC UA

Two aspects:

- **Horizontal** (Controller to Controller): OPC UA for communication
- **Vertical** (Controller to MES, Cloud, C2C...)

TSN: “…a collection of features in IEEE 802.1xxx that focus on latency as the primary performance metric.”

Source: IEEE P802.1Qcc
TSN Configuration Models

System Configuration IEEE 802.1

**Fully Distributed Model, or Centralized Network / Distributed User Model:**
UNI interface located at network edge to hide internal network.

**Fully Centralized Model:**
UNI interface located between CUC and CNC

UNI = User-Network Interface
Centralized network, distributed user model with UNI

• Applications can be unknown
• No config of network
• ad-hoc connections
• Central component necessary
• Large industrial networks with many config

UNI = User-Network Interface
Target TSN Configuration 2 (Augsburg Testbed)

Fully distributed model with User Network Interface

Plug von zentral konfigurierten Geräten

UNI = User-Network Interface

Fully distributed model

- Applications can be unknown
- No config of network
- ad-hoc connections
- Central component NOT necessary
- Small industrial networks with little config

Figure 99-1 — Fully Distributed Model
### TSN Config Models (IIC Testbed)

<table>
<thead>
<tr>
<th>Fully centralized model</th>
<th>Fully centralized model</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Alle Applikationen müssen vorher bekannt sein</td>
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**UNI = User-Network Interface**

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**Diagram:**

- Fully centralized model
- UNI = User-Network Interface
- FOCUS
- Nicht im IIC
First TSN Use case (Mechanics)
LNI4.0 Test Project Example

VALIDATION OF THE CONCEPT OF INDUSTRIE 4.0 COMPONENTS

- **Solution approach**
  - Implementation of the administration shell for Industrie 4.0 components.
  - Using openAAS to validate selected RAMI4.0 concepts in an existing environment.
  - Browse through the relevant openAAS objects and their contents.

- **Project procedure**
  - Combines a physical flexible transportation system (Multi-Carrier-System) and a virtualized production plant.
  - Both are connected to a cloud to analyze usage and energy consumption data.
  - Several use cases will result in appropriate standardization activities.
  - Presentation of the results at the 2017 Hannover Fair.
Conclusion TSN Testbed

- Industrial Testbed driven by Industrie 4.0-Usecases
- Plug&Work @ TSN (decentral configuration concept)
- SME can access testbed without obstacles (member fees,...)
- Direct access to SCI 4.0 and associations (VDMA, ZVEI, BITKOM,...) which take care internationally (IEEE,...)
- Synergy effects with already ongoing LNI4.0 usecases
- Liaison with OPC Foundation is planned
- Link to PNO and IIC given by partners
Thank you!

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