Lab Course (Preliminary Session)

Deterministic Networking Lab

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What They Have in Common ...

Reliable Network Infrastructure (Time-Triggered Ethernet)
Requirements on Communication Infrastructure

1. Real-time Communication
2. Fault Tolerance Approaches
3. Low Cost (Limited Budget)
4. Low Power (Limited Resources)
5. Low Size (Limited Space)
Failure in Communication Infrastructure

1. Loss of Life
2. Loss of Economic Assets
3. Loss of Research Achievements

“DISASTER”
Open Vs. Closed Communication Infrastructure

**Open Communication**

- **No Performance Guarantees:**
  Best Effort

- **Standards:**
  Ethernet, TCP/IP, UDP, FTP, SSH,…

- **Applications:**
  Multimedia, audio & video, Internet, Web,…

- **Validation and Verification:**
  No Certification, test, simulation,…

- **Low Cost**

**Closed Communication**

- **Performance Guarantees:**
  Real-time, dependability, safety,…

- **Standards:**
  ARINC 664, TTP, MOST, FlexRay, CAN, LIN,…

- **Applications:**
  Flight Control, Powertrain, Automotive,…

- **Validation and Verification:**
  Certification, formal analysis

- **High Cost**
In Reality: Mixed-Criticality Systems

Main goal is to share system resources and partition critical and non-critical distributed functions over the network

Same Physical Network for Data Flows from Both Side of Infrastructure

Time Triggered Ethernet
Motivation for Ethernet

- Lower Price of Ethernet Hardware
- Well-Established Open-World Standard and Scalable
- Possibility of Building a Well-Structured Classification of Concepts on Top of Ethernet (OSI Model)
- Cost-Efficient diagnosis Tool

Ethernet Compatibility Enables the Usage of Technology that is Established, Tested and Verified
Deterministic Networking Lab

Course Structure
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1. Introduction and Basics
2. Theoretical (A&B)
3. Practical
4. Grading
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1- Introduction and Basics

- Deterministic Networking / Basics and Requirements
- Hard Real Time Requirements
- Introduction to the Working Lab and Hardware

Many virtual links with different CoS can be defined for one Ethernet network.
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2- Theoretical – Phase A

- Study Materials Will be Distributed

- A Comparison Will be Performed Between POWERLINK and:
  - PROFINET
  - TSN
  - CANopen
  - EtherCAT
  - Ethernet/IP
  - SAEJ1939
  - DeviceNet

- Presentation and Open Discussion on the Comparisons

2- Theoretical – Phase B

- “openPOWERLINK” in Deep:
  - POWERLINK Data Link Layer (DLL)
  - Supported Platforms by POWERLINK
  - Developing openPOWERLINK

- Objectives:
  - Identifying Responsible Modules for Different Parts of the Protocol
  - Identifying the Portable and Platform Dependent Parts of the Stack
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3- Practical

• **Goal:** Implementing openPOWERLINK Stacks on a Table Demonstrator with Real Data Streams

• **Objectives:**
  ✓ Customizing the openPOWERLINK Stack
  ✓ Controlling the I/O of an Industrial Module Using POWERLINK
  ✓ Wireshark Tracing
  ✓ Getting Familiar with:
    ▪ Cyclic POWERLINK Operation
    ▪ openPOWERLINK Development Toolchain (XDD files/openCONFIGURATOR/CDC/etc.)
3- Practical Cont.

• **Goal:** You Will Get a Basic Understanding on How POWERLINK Works

• **Main Tasks:**
  - Cyclic POWERLINK Operation
  - openPOWERLINK Development Toolchain
  - Porting openPOWERLINK to New Platforms
  - Tracing POWERLINK with Wireshark
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Grading

- 40% of Final Grade → Theoretical Sessions

- 40% of Final Grade → Practical Sessions

- 20% of Final Grade → Final Representation of Work
Note

- Number of Participants: 10
- Master and Bachelor Students Are Welcomed

- Background (Nice to Have):
  - Basic Knowledge of Embedded Systems/Devices
  - Basic Knowledge in TCP/IP Networking
  - Background in Network Monitoring (Wireshark)
  - Background in Working with Linux (Debian)
  - Knowledge in Python / C
  - Background in Sensor Data Acquisition
If You Plan to Register

- Registration Via Matching System

- Send an Email to Shafaei@in.tum.de with Title “DetNet1718” by 30th of July
- Mention:
  1. Name and the Current Semester (Master Or Bachelor)
  2. One of Your Reasons to Participate in this Lab Course
  3. Your Background According to slide 21