.konig

EtherCAT® backbone for automotive testing

Gerhard Spiegel

Manager KÖNIG Prozessautomatisierungs GmbH

Member of EtherCAT® Technology Group

Content

- **Requirements**
- What is EtherCAT?
- EtherCAT's strength
- Demo
- König

.konig

Requirements of measurement-/automation-systems

- **High amount** of data
- **High bandwidth**
- **Deterministic** timing
- **One bus** only

.konig

Content

- Requirements
- **What is EtherCAT?**
- EtherCAT’s strength
- Demo
- König

What is EtherCAT?

is

Real Time Ethernet

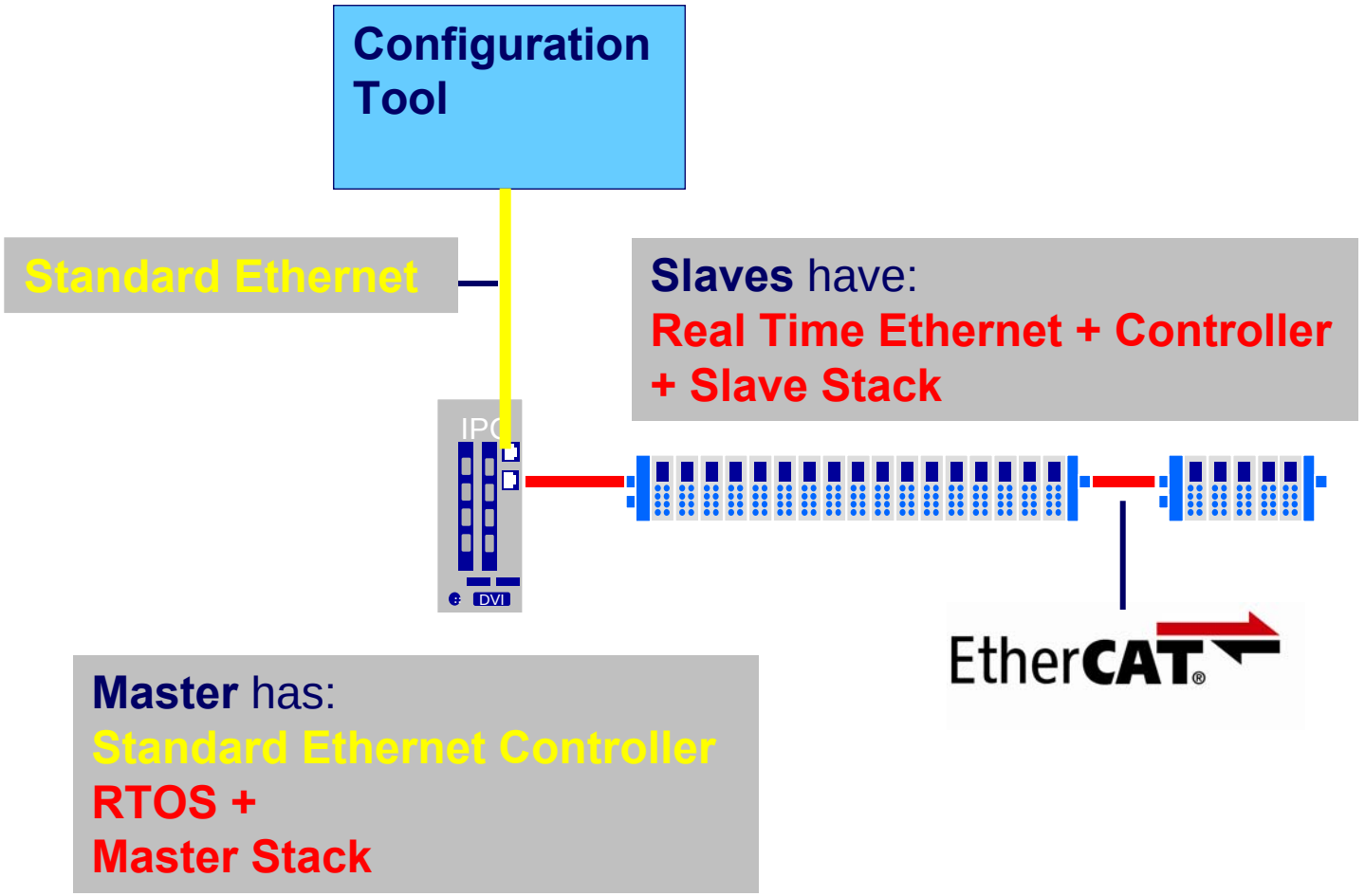
developed by

BECKHOFF

Configuration tool + Master + Slaves

.konig

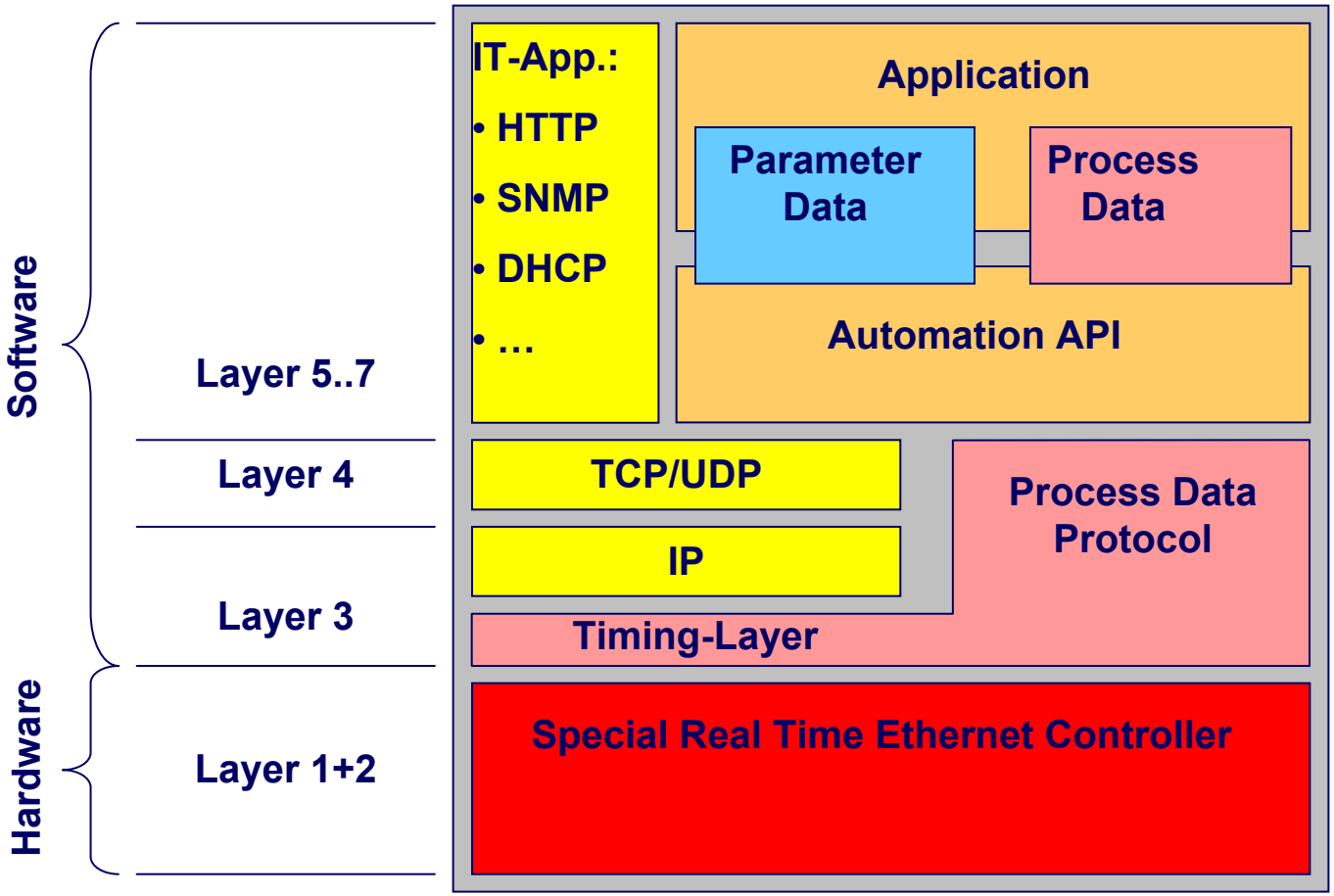
3 items



.kenig

Ethernet
+
Real Time

7 Layer Structure with Real Time extensions

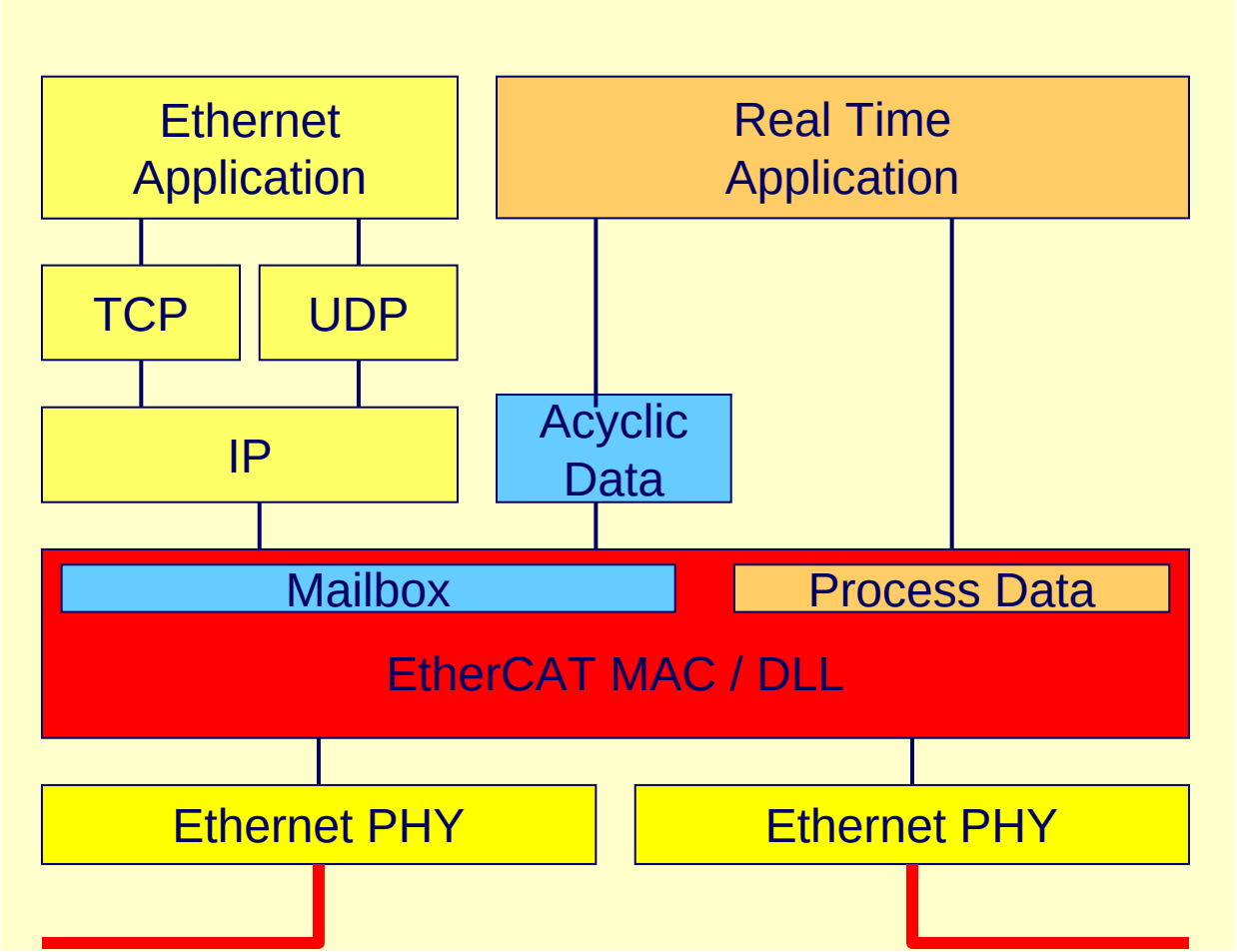


.konig

Real Time Ethernet Controller

EtherCAT technology.

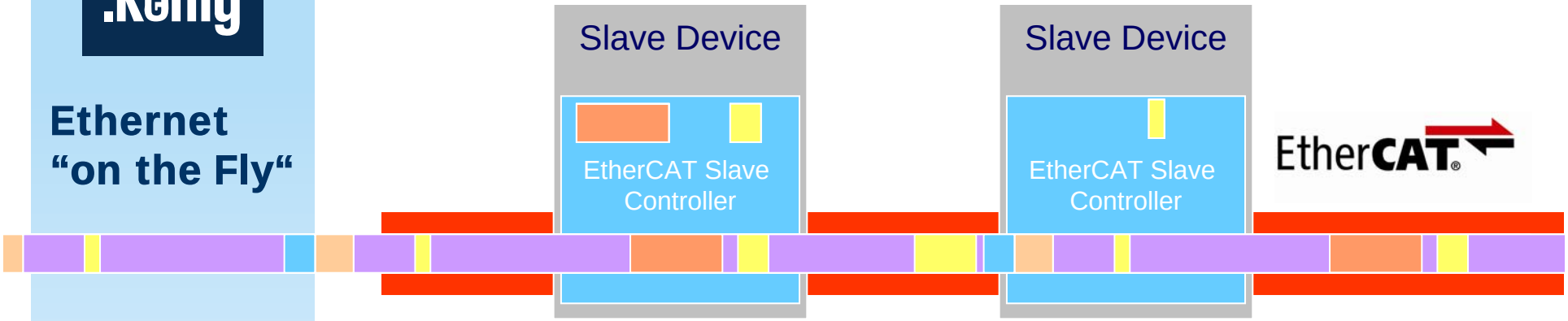
EtherCAT Slave *(taken from ETG)*



EtherCAT technology. Data exchange *(taken from ETG)*

.konig

Ethernet “on the Fly“



- Process data is extracted and inserted on the fly
- Frames return on the far end (full duplex)
- Higher bandwidth than Ethernet due to collision avoidance
- Deterministic behavior based on RTOS of **master**

- 100 MBd – not being the end for Ethernet - is
  - **8** times more than **Profibus**
  - **10** times more than **flexray**
  - **100** times more than **CAN**

Content

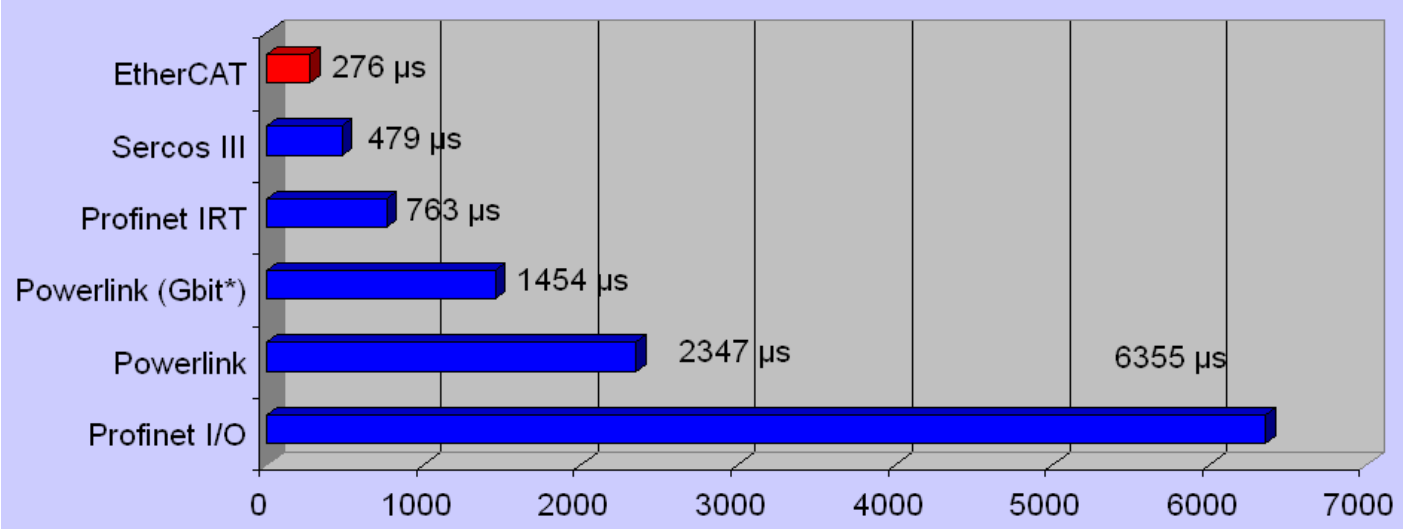
- Requirements
- What is EtherCAT?
- **EtherCAT's strength**
- Demo
- König

.konig

Comparison

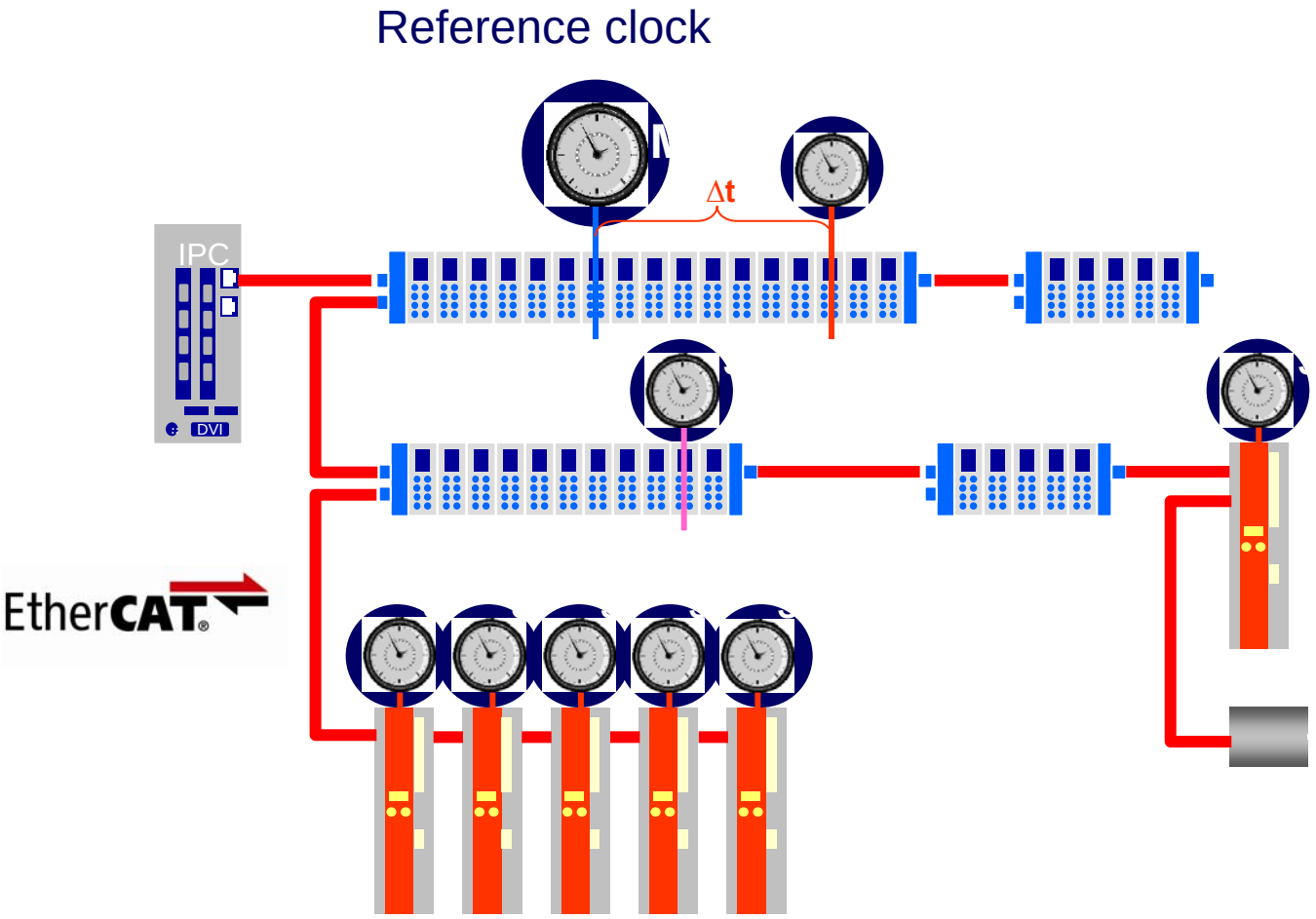
EtherCAT technology.
High speed *(taken from ETG, adapted to testing)*

- 2000 Digital I/O ➔ 250 Byte
- 300 Analog In ➔ 600 Byte
- 300 Analog Out ➔ 600 Byte
- 1 Byte = 80ns
- 1514 * 80ns ➔ Telegram length 122µs
- 600 slaves, 500m cable
- Frame Cycle Time 276µs ➔ 44% Bus load



EtherCAT technology. Synchronous *(taken from ETG)*

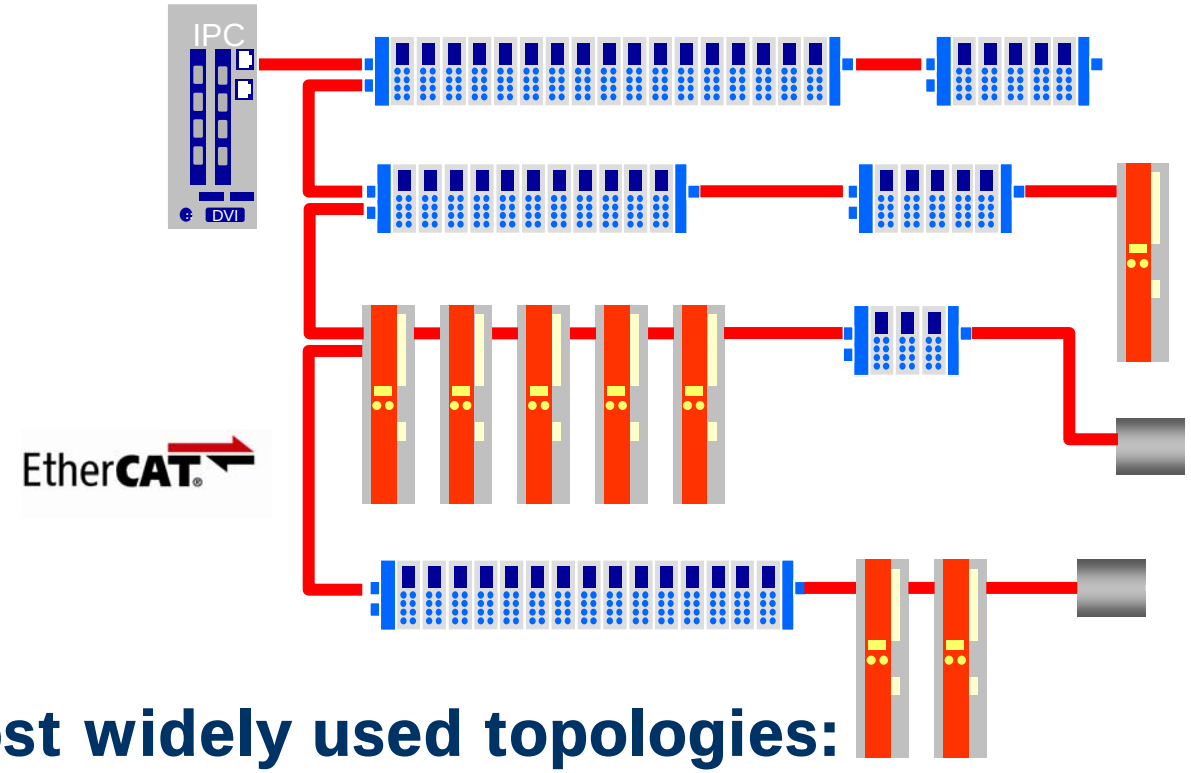
Precise timing (<< 100ns!)



EtherCAT technology. Topology *(taken from ETG)*

Topology type:

“Daisy Chain” with Drop Lines



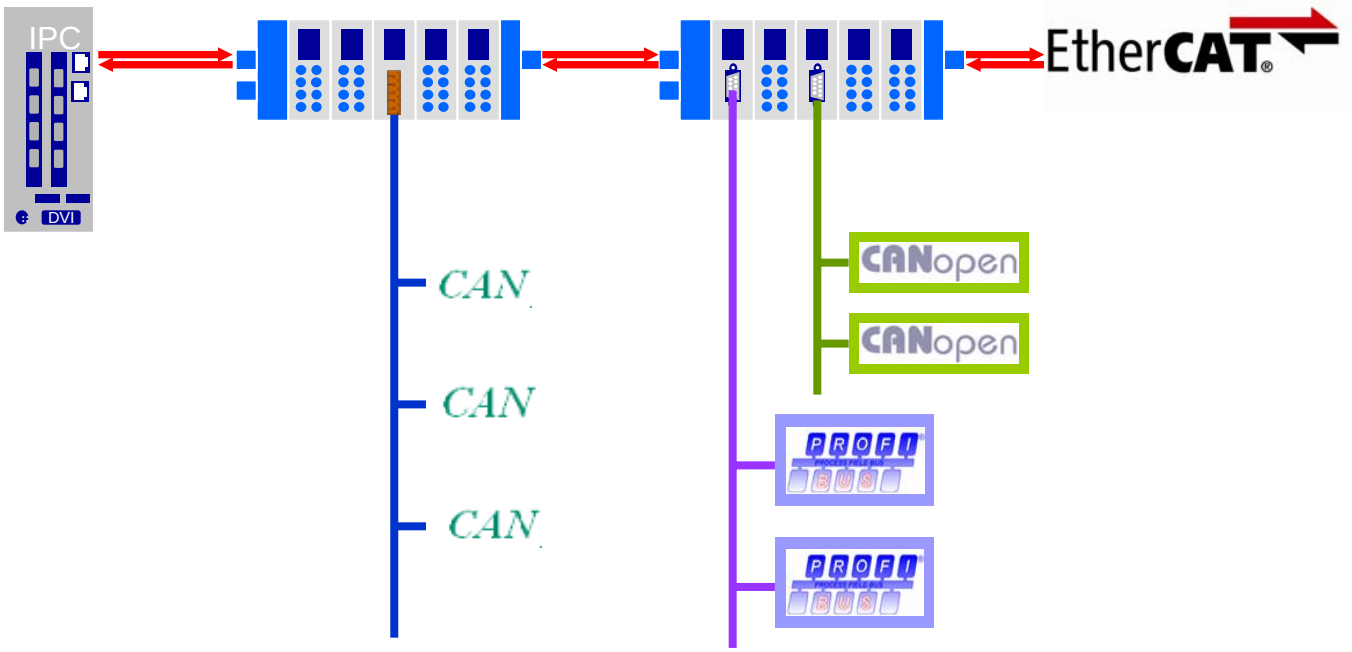
Most widely used topologies:

- line (up to 65.536 nodes)
- tree
- drop lines
- ring

.konig

Gateways

EtherCAT technology. Topology *(taken from ETG, CAN extended)*



CAN

- for using AK Protocol.
- configuration via DBC-files.

EtherCAT technology.
Low costs *(taken from ETG)*

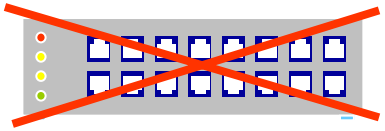
.konig

Cheapest master and infrastructure

- **Master:**
  no dedicated plug-in card (co-processor), on-board Ethernet Port is fine

- **Slave:**
  - **low-cost Slave Controller**
  - **FPGA, IP-Core or ASIC**
  - **for communication**
    no powerful µC needed

- **Infrastructure:**
  - **no Switches/Hubs required**
  - **Standard Ethernet cables + connectors**



.konig

Standard

EtherCAT technology. Openness *(taken from ETG)*

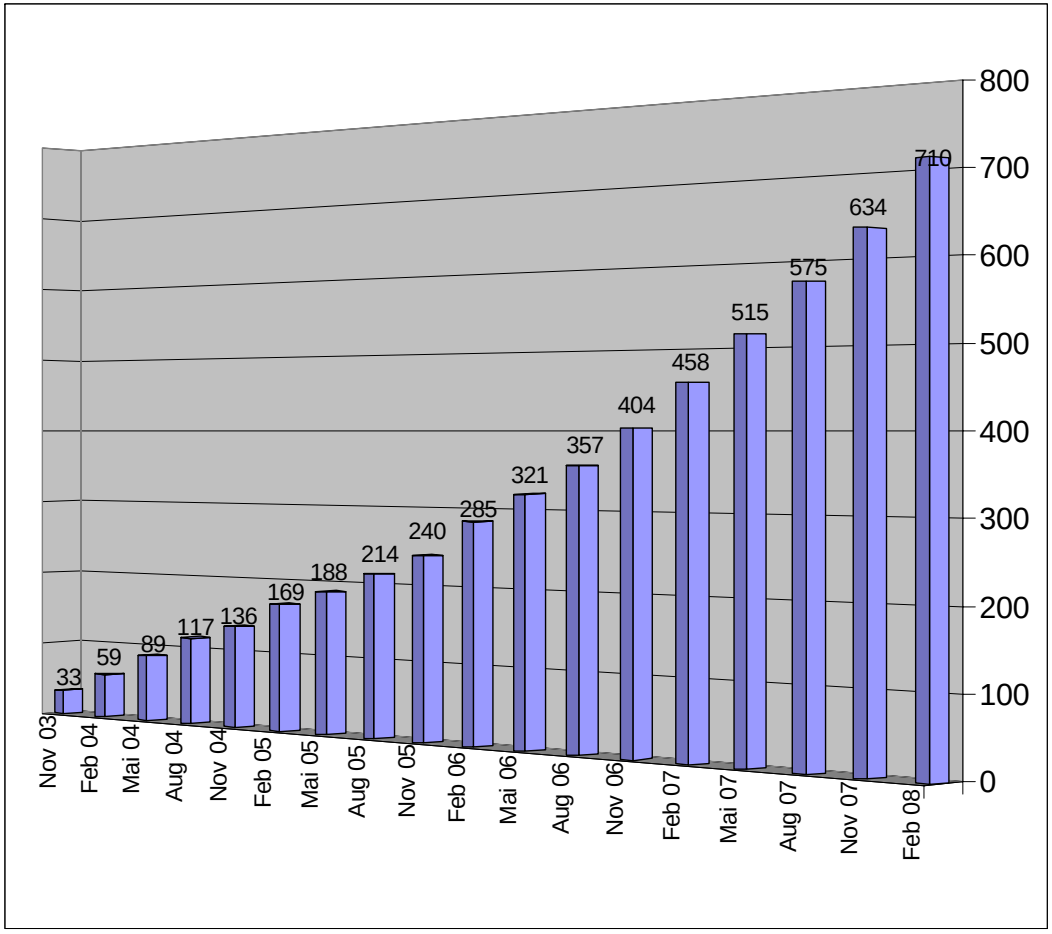
- EtherCAT is IEC and ISO Standard (IEC 61158, IEC 61784-2, ISO 15745-4)

IEC Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия ISO

- Slave Controller from several sources
- Master Stacks for various RTOS from several providers
- ETG organizes „Plug-Fests“ and prepares Conformance Test

EtherCAT technology. Openness *(taken from ETG)*

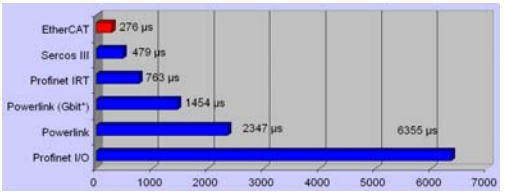
Greatest community
739 members
(Status April 2008)



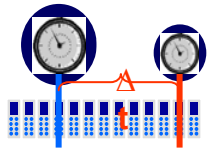
.konig

High lights

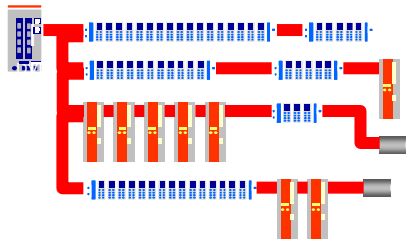
EtherCAT technology. Summary



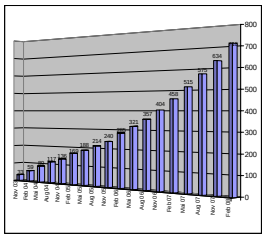
- High-speed
- Deterministic timing behavior



- Different topology types



- Low cost for
  slave, infrastructure, master
  (in comparison with other RT Ethernet)



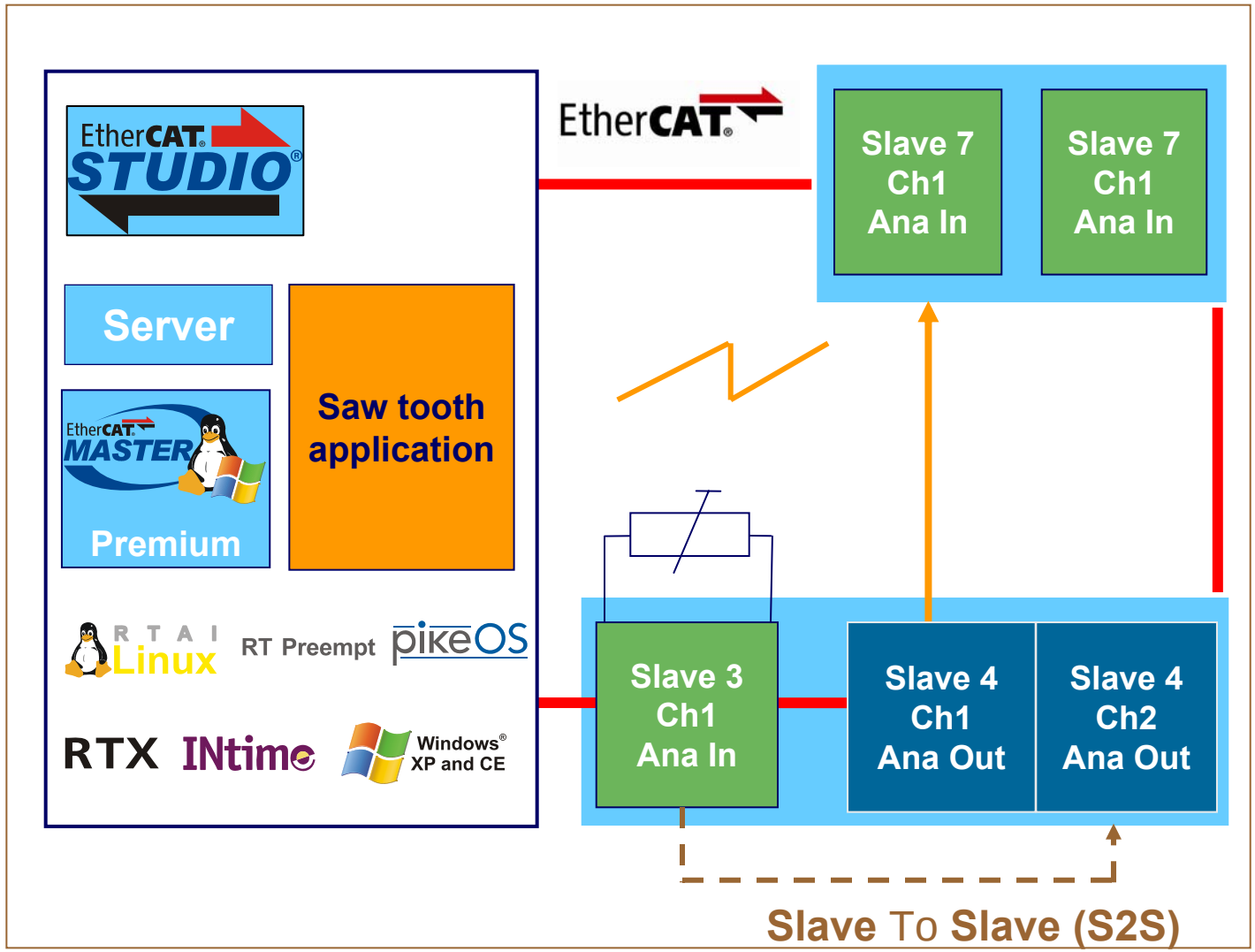
- Openness

.konig

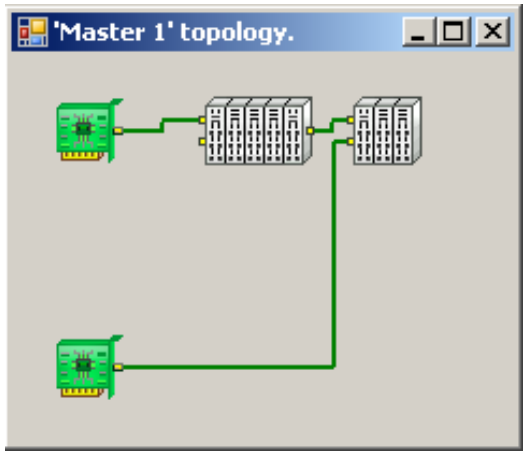
Content

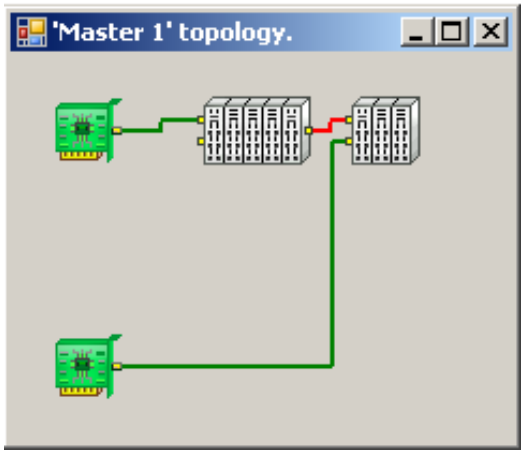
- Requirements
- What is EtherCAT?
- EtherCAT’s strength
- **Demo**
- König

Demo.
Redundancy, Hot Plug, Slave 2 Slave



Demo. Redundancy



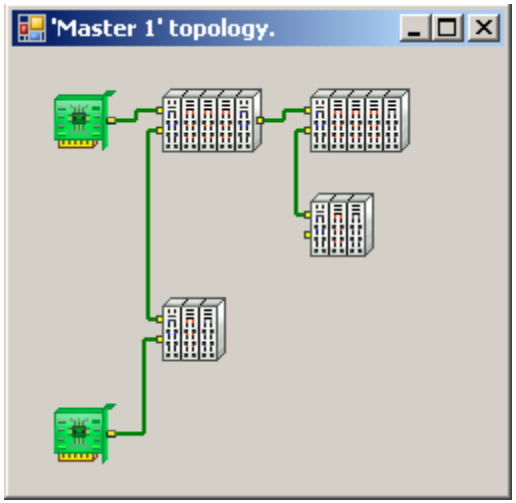


Topology

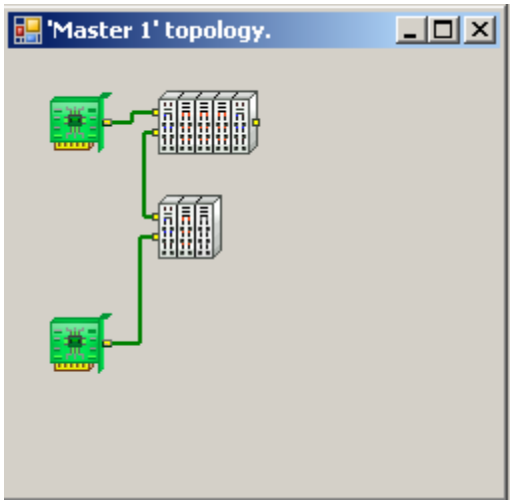
- Cable break detection
- Click on slave to see its settings

Demo. Hot-plug

- Mark slaves as “pluggable”
- Give them an unique address
- Connect/disconnect even during “Operational”

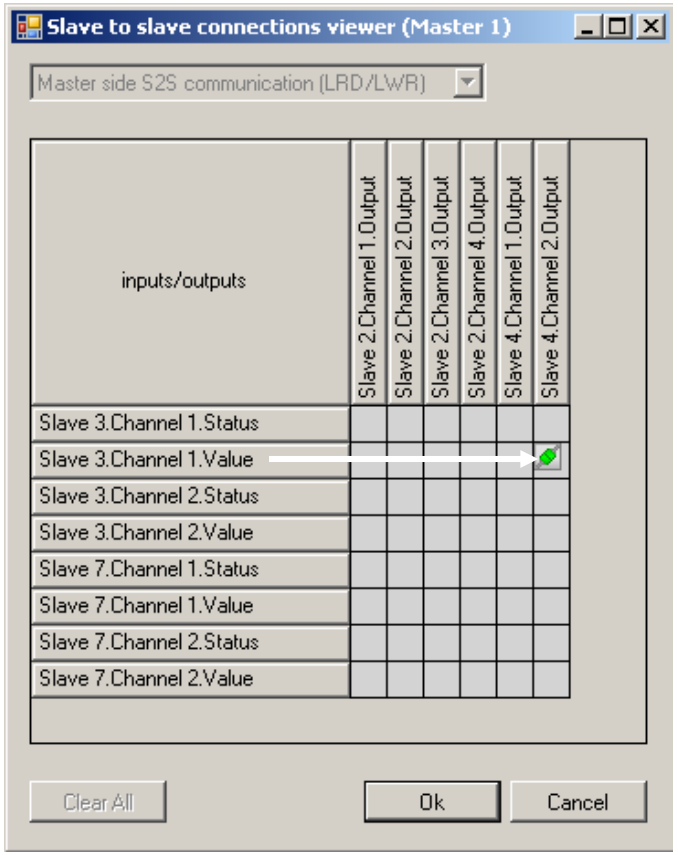


Hot-pluggable slave plugged



Hot-pluggable slave **unplugged**

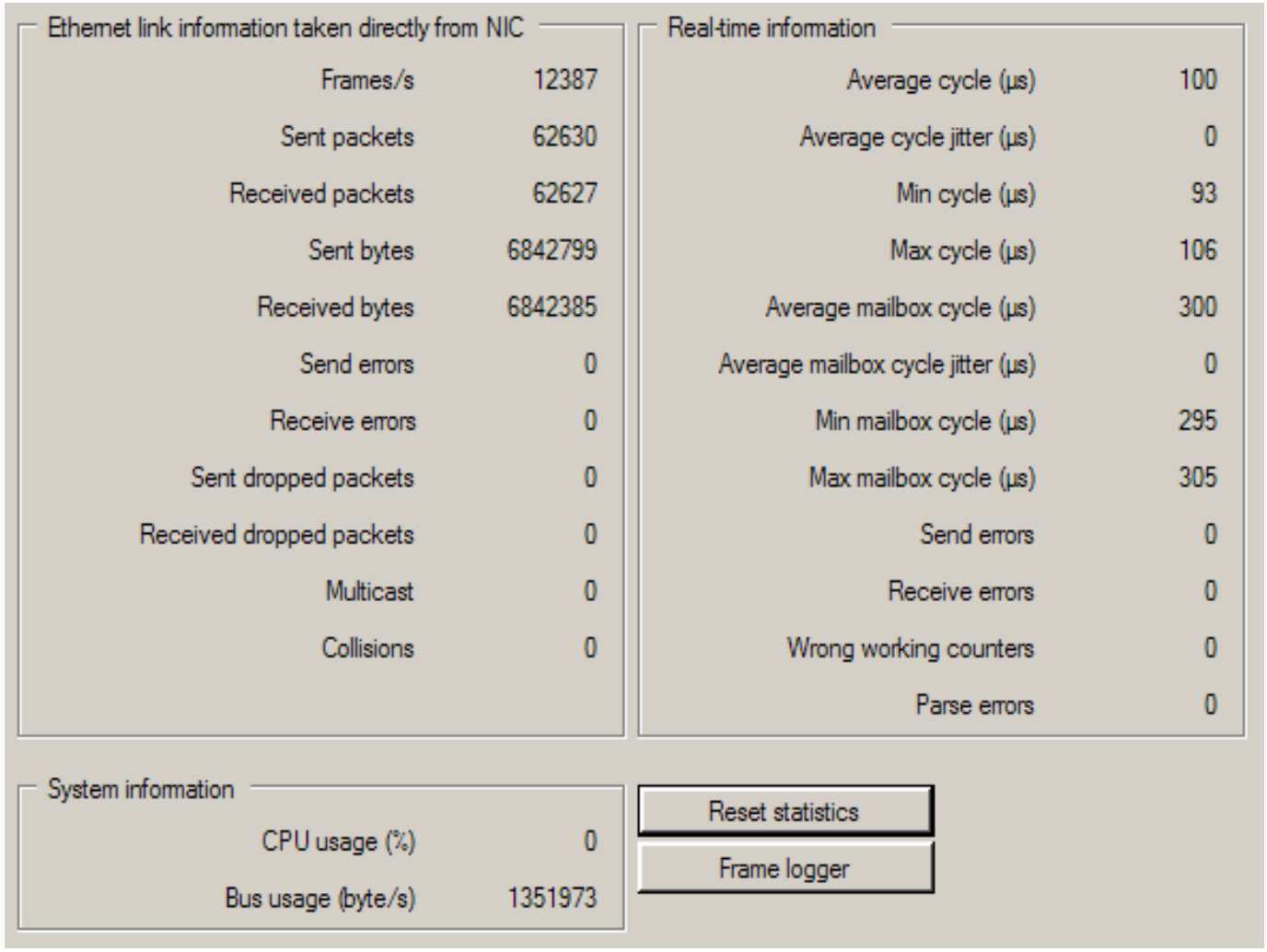
Demo.
Slave-to-Slave communication



- Outside PLC: **output** passes its value to **input(s)**
- Inside PLC: **input** passes its value to **output(s)**

.kenig

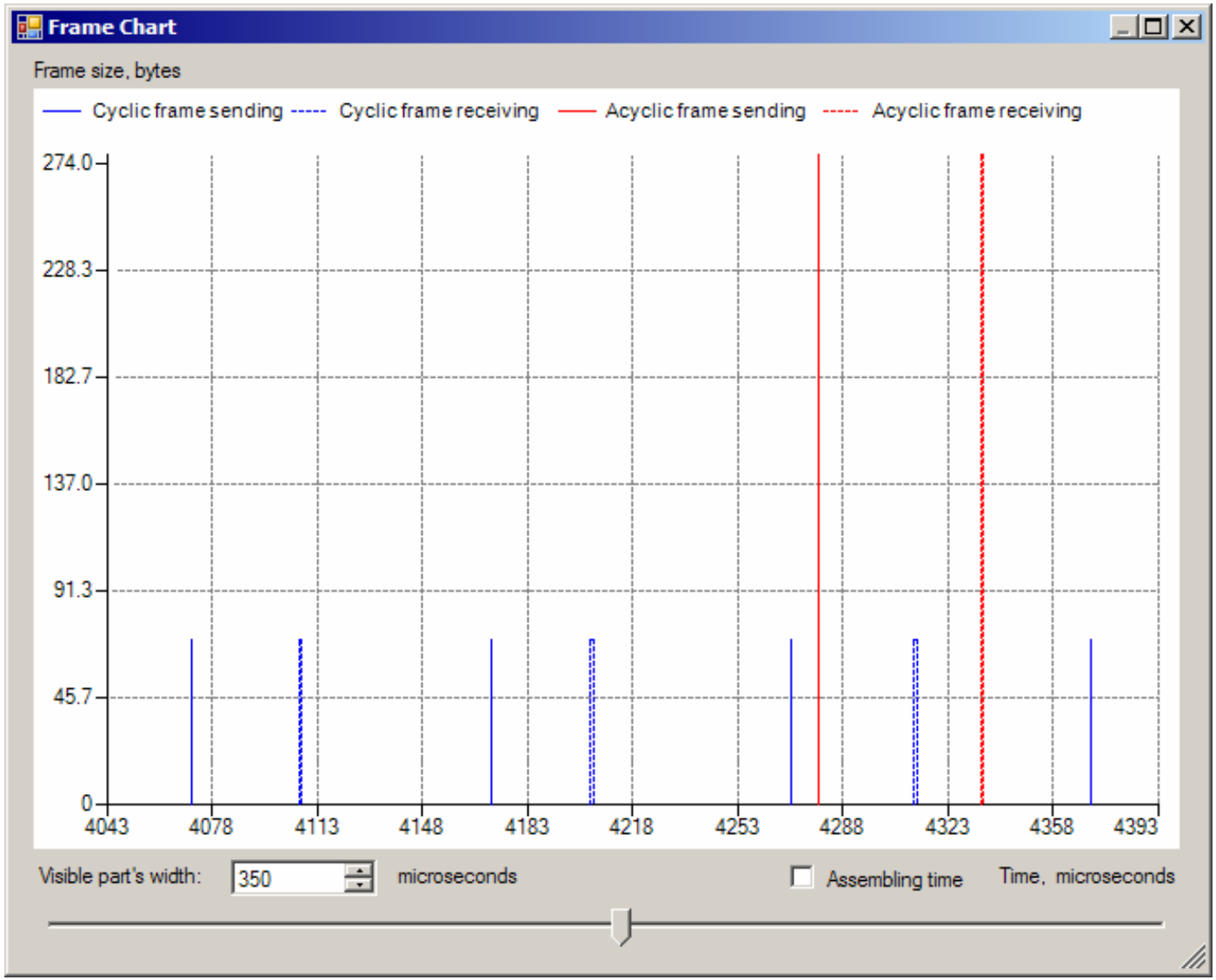
Demo.
100µs cycle, 17 byte, <1% CPU
(Intel Pentium dual CPU E2180 2.0 GHz)



.konig

Live demo. frame chart

every 3rd cycle one acyclic exchange



.konig

Content

- Requirements
- What is EtherCAT?
- EtherCAT strength
- Demo
- **König**

“EtherCAT company”

Products
+
Services

1. EtherCAT Studio
   configuration & diagnostic tool
2. König EtherCAT master
   adaptation and extension
3. EtherCAT slaves
   design and prototyping
4. EtherCAT consultancy
   concepts for implementations
   application architectures
5. EtherCAT trainings

Company. EtherCAT team

.konig

EtherCAT team

Management
Sales, PM, Marketing
Gerhard Spiegel

Development
Operating manager deputy
Alexander Saposhnikov

Support & Training & Documentation

Victor Vysotski

Alexander Mashentsev

Vitaly Bondarchuk

Alexandra Pavlova

Studio and Master

Anton Tarasevich

Dmitry Minich

Sergey Peniaz

Dmitry Markovich

Michail Kolesov (st)

QA

Andrey Druk

Valeria Kravchenko

Ivan Konoplyanik (st)

Slave- development and -project management

Pavel Osinenko

Jury Tsybulka

Andrey Zakrevski

Bakhur Sergey

.konig

Automotive customers

Customers in automotive testing

d2t

AVL

Gantner instruments

BMW

SIEMENS

HBM

IPG

.konig

Profile

Company. Profile

- Since **1986**
- About **60**
  engineers, IT scientists, mathematicians
- Planning/Service in Feucht near **Nuremberg**, Germany
- Development/Test in **Minsk**, Belarus
- Industrial **communication** (Profibus, CAN, EtherCAT)
- Working in a tight cooperation with main customer **Atotech** (subsidiary of Total)

.konig

PCB lines with SCADA

Company. Production for printed circuit boards

ATOTECH

SCADA with worldwide software-installations from KÖNIG

.konig

Activities

Company. Activities

- **SCADA** systems for copper deposition on Printed Circuit Boards (PCB)
- **Soft PLCs** according to IEC 61131-3
- Pulse reverse power supplies with digital control
- **Vision control** systems
- Worldwide **installations**
- **Configurators** for (semi)-automatic creation of
  - electro-schemas
  - quotes

.konig

Highlights

High lights of EtherCAT for automotive testing

- Redundancy in wiring
- Hot plug of devices
- Slave to Slave communication
- Raw CAN gateway
- Remote configuring of devices
- Different scan rates

.konig

Thank you!