EUROPEAN SPALLATION SOURCE

EtherCAT and EPICS

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Overview

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- Welcome everyone
- EtherCAT/TwinCAT and EPICS
- Open source solutions and EPICS
- EtherCAT train
- ADS demystified
- EtherCAT Motion Control and more: ecmc
- Much stuff: fasten seat belts

ESS

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- Green field site: No legacy
- Use hard- and software that is still modern when neutron production starts
- EPICS: Yes
- PLCs: Yes
- Fast hardware: µTCA
- EtherCAT: gaining interest

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- So what is EtherCAT ?
- One short answer: A field bus

Field bus in Sweden

Swedish fält buss

- 100km/h
- 54 people
- Can go to may places
- No realtime
- Different vendors
- Some operators

EtherCAT field bus

- Standard ethernet technology, IEEE 802.3
- Fast: 100Mbit/second (even EtherCAT G)
- Realtime
- Re-using protocol standards; e.g. CAN over EtherCAT. Servo drive (Sercos) for motion.
- One Master device, many Slave devices, Now call Main device and Sub devices
- Many vendors: ethercat.org

EtherCAT in the hardware zoo

- Among other HW technologies: where is EtherCAT in terms of performance ?

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- ESS Hardware platforms

10 MHz

1 MHz

Digital Controls Platform

MicroTCA® is a modular, open standard for building high performance switched fabric computer systems in a small form factor. Because of its modularity and flexibility, MicroTCA is well-suited for industrial control and automation systems. MicroTCA defines fully redundant redundant system configurations including power budgeting, hot-swap, complete component and system management that allows failure detection and isolation. This greatly improves system reliability and availability.

100 kHz

10 kHz

1 kHz

EtherCAT

EtherCAT is a modern high-speed industrial automation system standard which enables faster data interchange with deterministic timing and higher processing power than traditional industrial automation systems. EtherCAT systems at ESS are connected to the EPICS control layer.

100 Hz

10 Hz

1 Hz

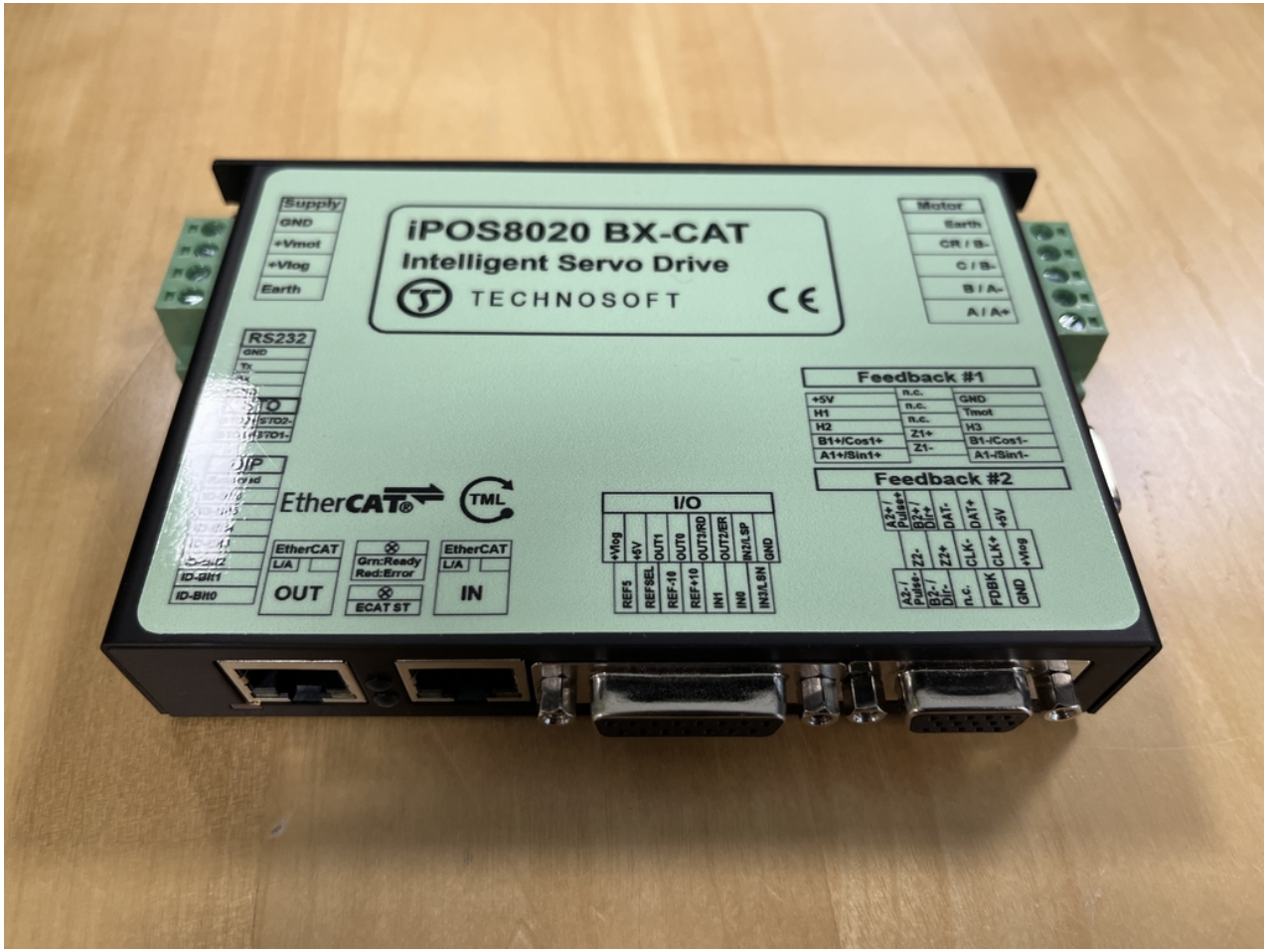
Industrial automation (PLC)

Slower signals are handled by industrial automation (PLC) for reliability and cost reasons. The standardised platform for ESS applications comes from Siemens.

0.1 Hz

EtherCAT terminals for stepper motors: EL704x

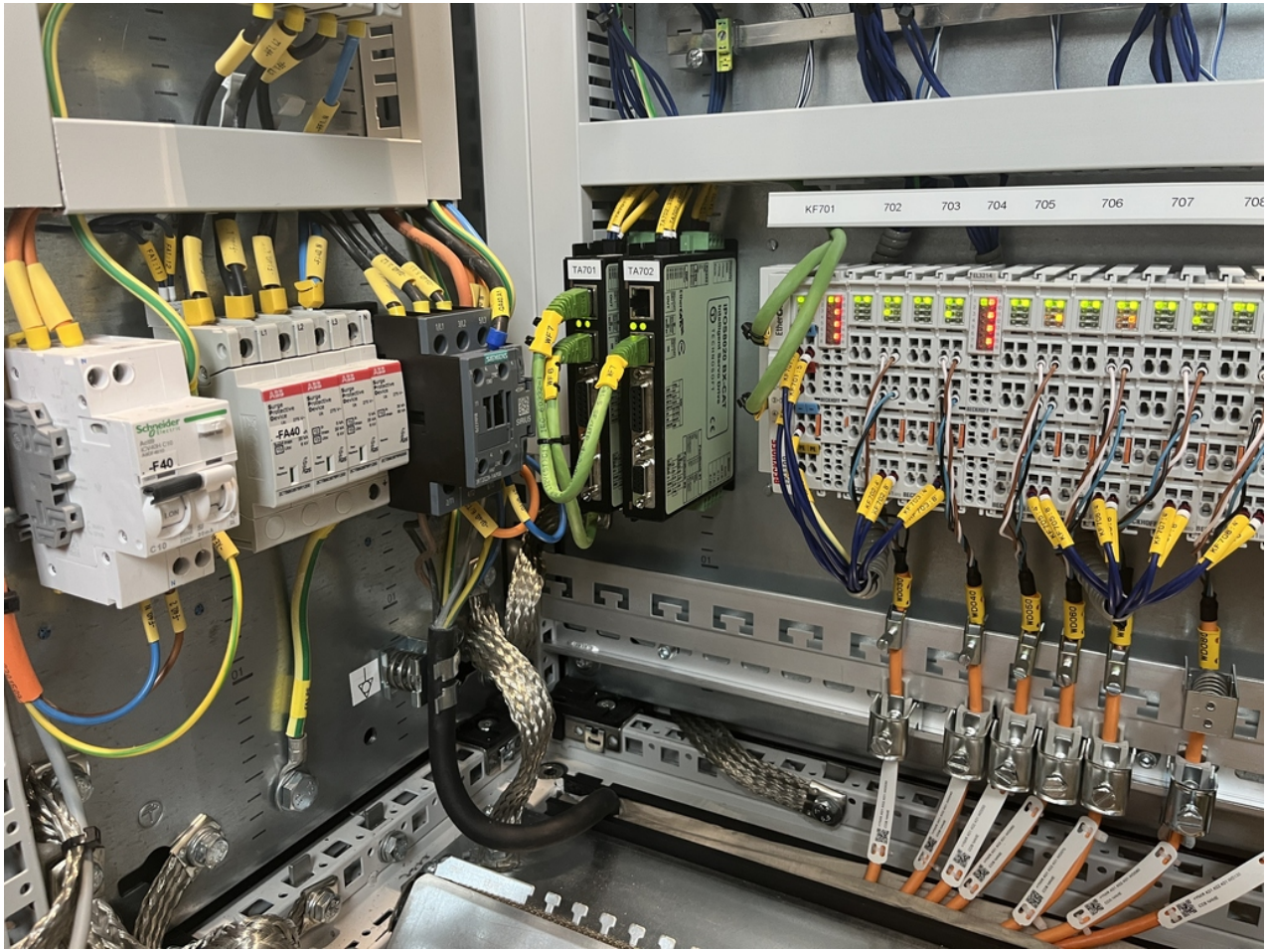
EtherCAT terminal for Servos



Motion control cabinet

Motion control cabinet

Motion control cabinet



Software

- Different software platforms:
- TwinCAT:
  - write PLC code
  - different solutions interface to EPICS
- open source: many projects
  (We look deeper at ecmc later)

Software

- Software: Which way to go ?

Software

- TwinCAT from Beckhoff:
  - Industrial proven
  - Soft PLC (with a cycle time)
  - Hard-realtime kernel
  - Timing <1 µsec possible (Distributed Clock)
  - IEC 61131-3: Feature-rich PLC language
  - OOP concepts
  - C++
  - IDE (TwinCAT.exe)
  - And more good stuff

Communication

- Communication TwinCAT - EPICS
  - ASCII (epics com module)
  - Modbus/ TCP/IP
  - Siemens s7
  - MQTT
  - OPC UA
  - Beckhoff ADS

TwinCAT

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- TwinCAT:
- May (and must) write PLC code yourself
- Common code base for ”our” code:

  github.com/europeanspallationsource/tc_mca_std_lib/
- Focus on motion control, contribution from ESS (Sweden), ISIS (UK), JCNS (Germany)
- Other known: SLAC

Open source (2500l/sec)

ecmc

- Fully open source package
  Linux based (No Windows !)
- https://github.com/epics-modules/ecmc
- Used in accelerator @ ESS
- Used by other facilities (PSI, CLS)
- Next half session: Anders Sandström

End of intro

- Short questions: here and now
- We have an unregular zoom meeting:
  EtherCAT experience exchange.
  If of interest: Email
  torsten.bogershausen@ess.eu
- Over to ADS demystified

Software

- From epics-controls.org:
- https://git.ligo.org/cds/software/tcIocMore SW
- https://github.com/EuropeanSpallationSource/MCAG_Base_Project
- https://github.com/slac-epics/ek9000
- https://github.com/DiamondLightSource/ethercat

- Not on epics-controls
- https://github.com/tecki/ebpfcat
- https://github.com/Cosylab/adsDriver
- https://github.com/epics-modules/twincat-ads