EUROPEAN SPALLATION SOURCE

Motion Control at ESS: An overview

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Motion Control at ESS

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- Green field site: No legacy
- Aim for a high range solution to use as many neutrons as possible
- Collect experience from other facilities
- Prefer “of the shelf” over “home made”
- Prefer proven SW vs ”develop from scratch”

The way forward

- Which way forward ?

Motion control platform

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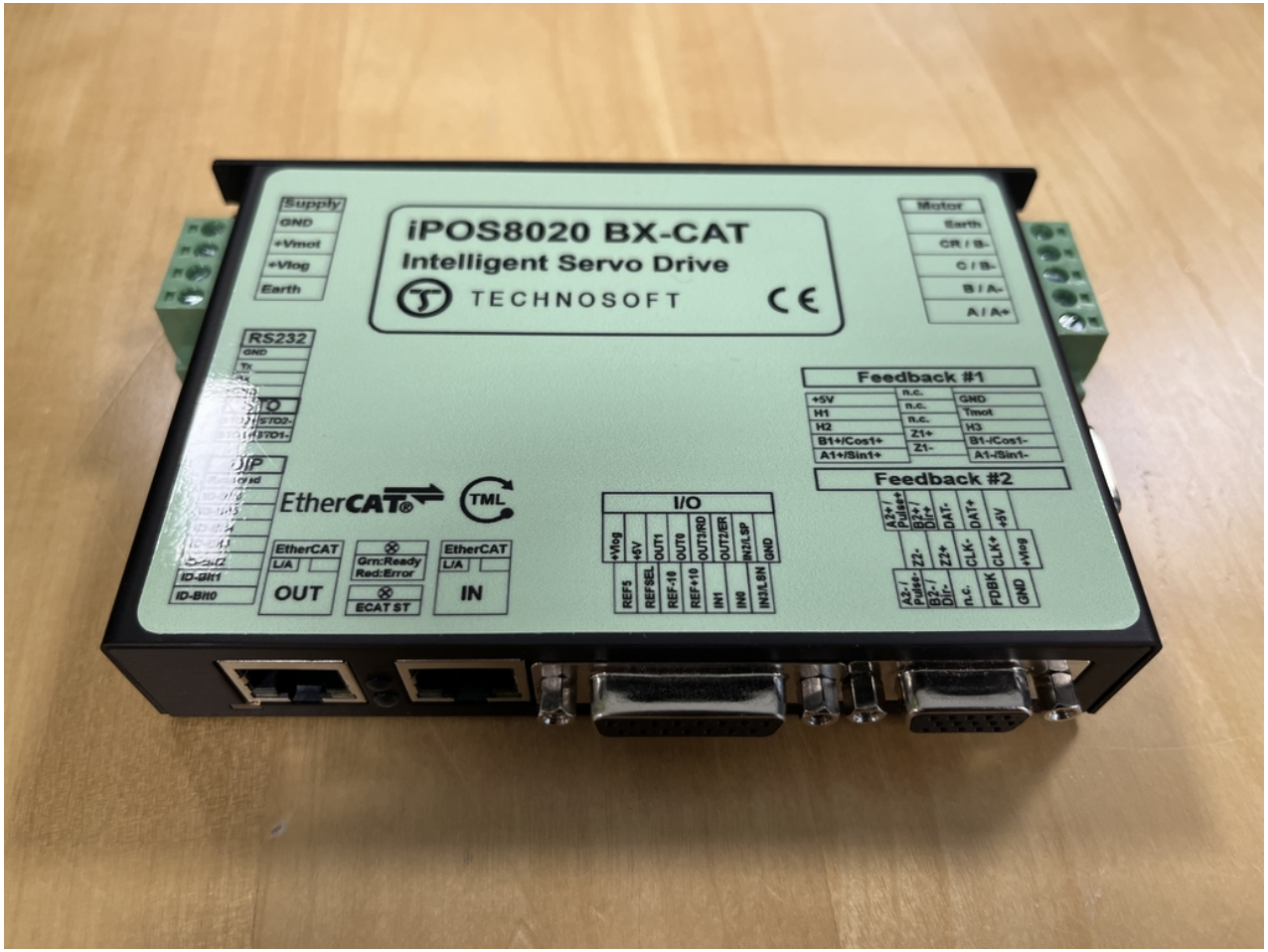
- Different motion controllers evaluated
- Did we found the golden bullet ?
- Facility is build while we speak

EtherCAT

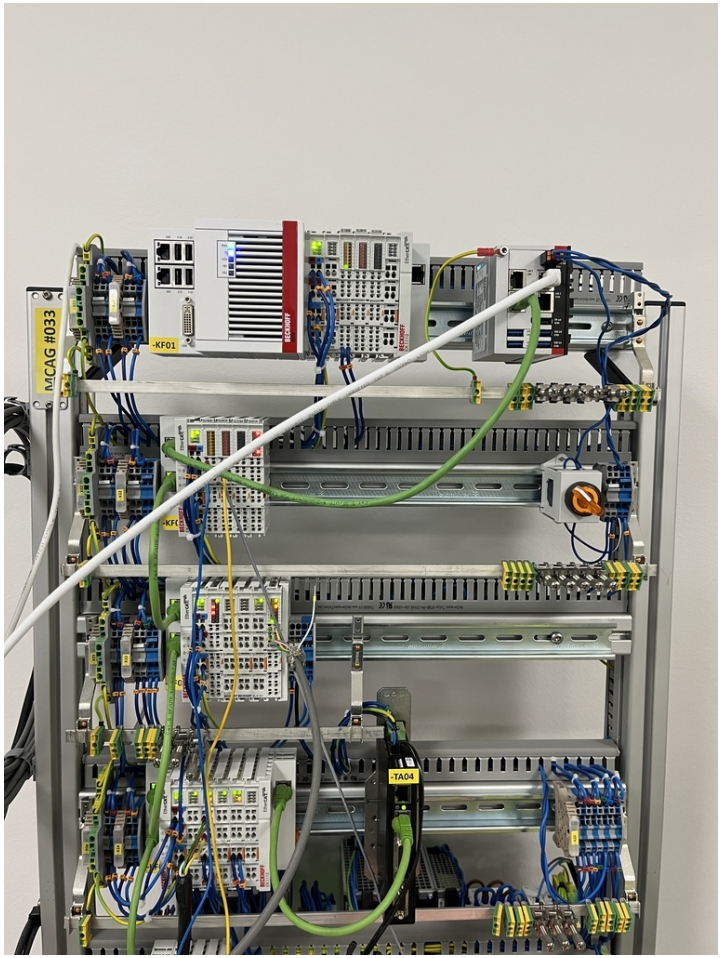
- EtherCAT (fieldbus):
- Slower than a digitizer card (µTCA card)
- Faster than a slow control PLC (1Hz vacuum)
- 1kHz..10kHz, realtime capabilities
- - Motion Control
- - medium range data acquisition

EtherCAT terminals for stepper motors: EL704x

EtherCAT terminal for Servos

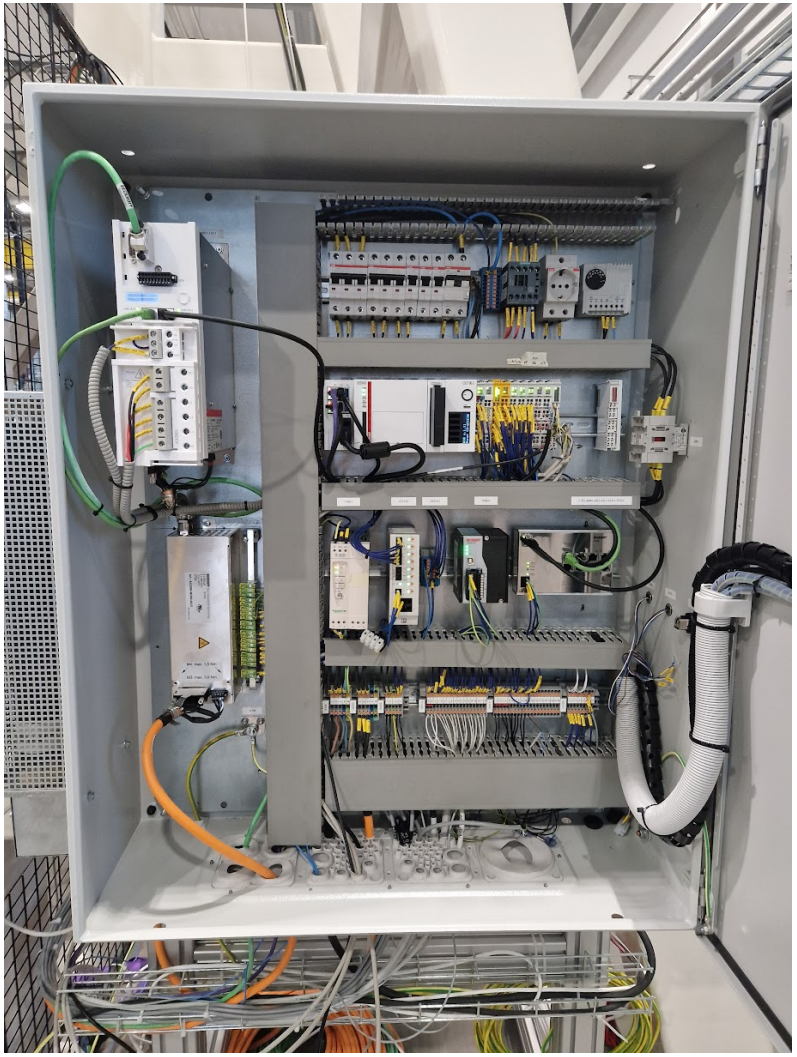


Test stand in the lab



Vertical Handling Test Stand (“gamma shutter”, Light Shutter System)
Photos: Markus Kristensson

Electrical Cabinet for LSS
Photo: Markus Kristensson

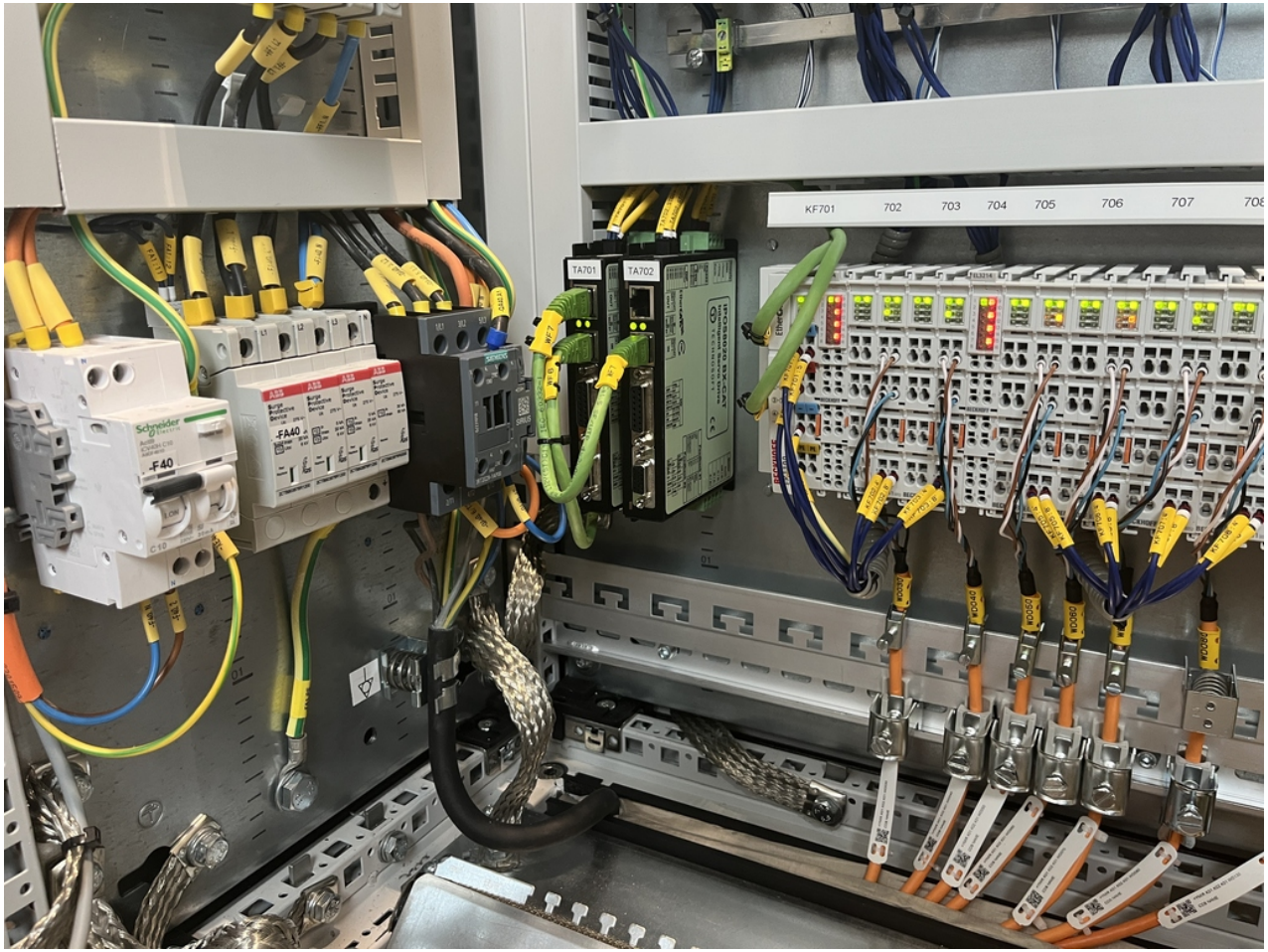


Motion control cabinet for neutron instruments

Motion control cabinet for neutron instruments

Motion control cabinet for neutron instruments

Motion control cabinet



Software

- 1 hardware platform: EtherCAT
- 2 Software platforms:
- ecmc (open source)
- TwinCAT (commercial)

Which way to go ?

ecmc

- ecmc (EtherCAT Motion Control)
  https://github.com/epics-modules/ecmc
- Fully open source, Linux based, Git friendly
- Good if:
  - you can work without a mouse
  - need advanced motion trajectories
  - love open source
  - need to deploy many systems (all text files)

ecmc

- Used at ESS in the accelerator:
  - iris for iron source
  - wirescanners
  - cavity tuners
  - temperature sensors all along the tunnel
- CLS
- PSI: Major upgrade of SLS (SLS2)
- Other facilities and companies

TwinCAT

- Good if:
  - you need lots of PLC code
  - need to use a mouse
  - good debugging facilities (scope, break points, single step)
  - commercial courses and support
  - Target systems can now run under BSD (TC/BSD); Linux upcoming for Arm

TwinCAT

- Used at ESS:
  - Target station
    target wheel itself, vibration sensors,
    lubrication (ppt exists, 60 min)
  - Light shutter systems (servo)
  - (heavy ?) shutter systems (pneumatic)
  - neutron instruments (mainly stepper)
  - rotary tomography with sync to ESS timing system

TwinCAT

- Used at SLAC:
  - vacuum, motion, sample delivery
  - Equipment Protection Systems
  - Machine Protection Systems
  (own ppt, 60 minutes)
- FRM2, XFEL (non EPICS)
- Anybody interested in experience exchange?

TwinCAT ”first generation”

- FB_DriveVirtual
  https://bitbucket.org/europeanspallationsource/tc_lab_mcu010-fb_drivevirtual/
- Good if:
  - start and want to learn
  - want re-use vacuum or
    other cool stuff from SLAC:
  https://github.com/pcdshub/

TwinCAT ”second generation”

- Developped with inkind partners
  https://gitlab.esss.lu.se/mcag/sources/tc_generic_structure
- Good if:
  - you want more features
  - latest and greatest
  - we have a commissioning workflow
  - control pneumatic shutters

Other highlights

- Increasing interest in automated testing, pytest
- ethercatmc
  - System test: Whole HW/SW stack (P4P, EPICS, ethercatmc, TwinCAT SW)
  - motorRecord state machine (simulator)
  - real hardware (move with max velocity)

  https://github.com/EuropeanSpallationSource/m-epics-ethercatmc/tree/master/test/pytests36
- motion-tests
  - TwinCAT without EPICS (via pyads)
  - TwinCAT with EPICS
  - ecmc with EPICS

  https://gitlab.esss.lu.se/mcag/sources/motion-tests
- Generation of opi files:

  https://github.com/EuropeanSpallationSource/m-epics-ethercatmc/blob/master/ethercatmcExApp/op/Boy/tools/Makefile

Summary

- EtherCAT based motion control used
  - in accelerator (wire scanner, cavity tuner, iris)
  - the target station
  - neutron instruments
- Non-EtherCAT, so far:
  - piezo
  - Hexapods delivered via in-kind partners

That’s it

- Danke
- Tack
- Thanks