

ICS HW Platform; focus on Imaging

Jeong Han Lee on behalf of ICS

Integrated Control System Division
ESS, Sweden

<https://www.europeanspallationsource.se>
Sep 21, 2016

The Integrated Control System (ICS)

ICS Scope

- ▶ Conventional facilities control integration : power distribution, cooling water, etc
- ▶ The Accelerator control system
- ▶ The Neutron target control system
- ▶ EPICS layer for the neutron instruments (in cooperation with the colleagues from science directorate)
- ▶ Global systems : control network and servers, timing and event systems, and protection & safety systems

Combination of

- ▶ On-site developments
- ▶ In-kind contributions (up to 50% of total value)

EPICS Environment

There is no generic EPICS environment, and each lab has its own environment historically. Historically, many labs use more than one EPICS release and drivers should be built for all EPICS releases in parallel

Loadable Driver Module (LDM) at PSI

- ▶ Build drivers for multiple releases of EPICS, and load drivers dynamically from startup script.
- ▶ is used to run PSI machine since 2005, which is the first presentation in the community.

ESS EPICS Environment

- ▶ has been evolved from LDM in cooperation with Dirk Zimoch at PSI.
- ▶ provides a collection of scripts to develop, build, and deploy an EPICS IOC.
- ▶ provides customized solutions to run different configurations at the same time and in the same machine, to test next releases of IOCs independently, and to switch the old and new versions of an IOC easily and quickly.

HW & IO Strategy

Generic

- ▶ MTCA : High-speed front-end processing & Digital front-end platform
- ▶ EtherCAT : Mid-range, beam synchronized I/O & Distributed I/O & Cross-system integration
- ▶ PLC : Siemens S7-1500 : Industrial, process I/O & Safety systems, high reliability

Specific

- ▶ Timing / Event System : Micro-Research Finland EVM (EVG, Dist) & EVR
- ▶ Motion Control : Beckhoff TwinCAT for coordinated motion & Open source master for single-axis, simple motion
- ▶ Serial & Network-based devices : almost de-facto Standard MOXA
- ▶ Cameras : GigE, 10GB, CameraLink

High-speed Digital Controller Board

- ▶ MTCA.4 AMC, Xilinx FPGA (Kintex Ultrascale), CPU (Freescale QorIQ T2081), and modular (FMC/RTM) interfaces
- ▶ In-kind contribution from Switzerland (PSI) with an industry partner (IOxOS SA)
- ▶ Embedded Linux (ELDK) OS & EPICS software
- ▶ FPGA source code available to all ESS partners and licensees (very liberal but not fully open source)

Supported and Planned Modular Interfaces

- ▶ IOxOS SA : ADC 3110/3111 (8CH, 16bit, 250MSPS)
- ▶ IOxOS SA : ADC 3112 (4CH, 12bit, 900MSPS / 2CH, 12bit, 1800MSPS)
- ▶ IOxOS SA : ADC 3117 (In : 20CH, 16bit, 5MSPS & Out : 2CH, 16bit, 0~ ±10V)
- ▶ d-tAcq Solutions : ACQ420 FMC (4CH, 16~20bit, 1MSPS)
- ▶ Faster Technology : FM-S14 (whereby support is limited due to application-dependent)
- ▶ In-kind project of Estonia : EtherCAT slave FMC

Middle-range I/O

- ▶ High-end platform is expensive and centralized; Use only where needed
- ▶ Some applications still need time synchronization; Especially in a pulsed machine! PLCs are not ideal (asynchronous cycle times)
- ▶ EtherCAT is a good solution for this range

EtherCAT, We

- ▶ can use a typical Ethernet cable and Ethernet switch
- ▶ can run its master on a PC or MTCA IOC
- ▶ can achieve several kHz loop times
- ▶ can reduce cabling (distributed I/O)
- ▶ have many different types of I/O modules

Selected SW Platform

- ▶ CentOS 7 (currently 7.1 1503)
- ▶ Development Machine (EEE, OpenXAL, IPython, CSS)
- ▶ ESS EPICS Environment (Linux Kernel module, EPICS Device support, EPICS IOC)
- ▶ Archiver Appliance for signal archiving
- ▶ Control System Studio (mostly User Interface, but more than)
- ▶ Scripting Environment (Jupyter - planned, IPython - current)

Questions?

Computers are useless. They can only give you answers.

Pablo Picasso

It is not enough for me to ask the question; I want to know how to answer the one question that seems to encompass everything I face: What am I here for?

Abraham Joshua-Heschel

Kiitos!

Tack!

Tak!

감사합니다!

Thank you!

Dankeschön!

