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Science & Technology Facilities Council
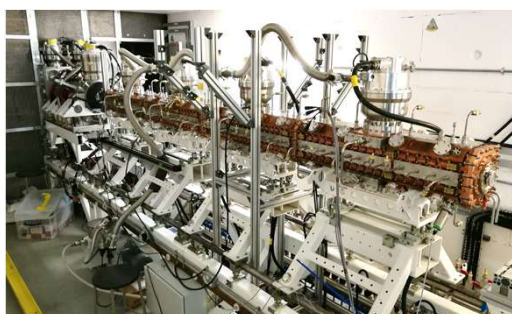**ISIS Neutron and Muon Source**

Evaluating VISTA and EPICS With Regard to Future Control Systems Development at ISIS
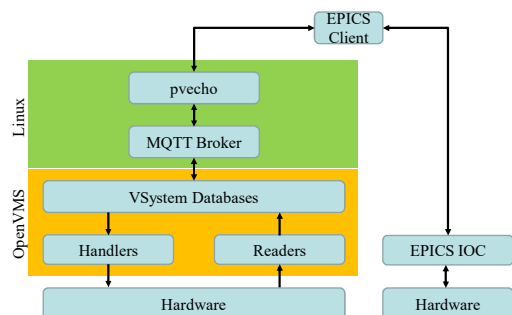

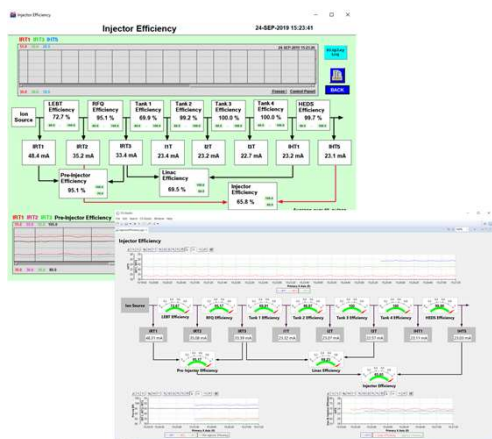ISIS Facility

Front End Test Stand

ISIS Controls CPS Crate

Vsystem/EPICS bridge

Vsystem (upper) and EPICS Boy (lower) control screens

Purpose

ISIS Accelerator Controls currently uses the Vista Controls System software product Vsystem (colloquially known as **Vista**) to monitor and control over 29,000 channels (equivalent to EPICS process variables) at the ISIS spallation neutron source. This is the second control system used to control the ISIS accelerators, the controls software having migrated from GRACES / BABBAGE in the early 2000s.

We are conducting an evaluation of the Experimental Physics and Industrial Control System, **EPICS**, to determine the advantages and costs of another controls system software migration. (Note: EPICS is already in use at the Diamond Light Source on the same site as ISIS, and on the ISIS beamline instrumentation.)

Front End Test Stand

Separate from ISIS operational hardware, the Front End Test Stand (FETS) makes an excellent testbed for our EPICS evaluation. FETS is a hardware development and research collaboration to develop new drivers for future accelerators. It consists of a Penning ion source, a magnetic low energy beam transport (LEBT) to focus the ion beam, a Radio Frequency Quadrupole accelerator (RFQ) to bunch and accelerate the beam, and a medium energy beam transport and a chopper line (MEBT) to increase the separation of the bunches ready for injection into a synchrotron.

Mixture of Hardware

Like ISIS as a whole, FETS uses a mixture of off-the-shelf and custom controls hardware. Specifically, FETS is controlled by a mixture of CSS and CPS crates (roughly generations 2 and 3 of the controls systems hardware on ISIS). No pre-made IOCs exist for these systems.

While IOCs could be developed for this hardware, another approach is possible. The hardware is already controlled and monitored via Vsystem. We can therefore enable EPICS monitoring and control by creating a bridge between the two controls systems.

Vsystem/EPICS Bridge

Our existing Vsystem software runs on OpenVMS, which is not one of the EPICS supported operating systems. Porting EPICS to a new OS presents an unknown quantity of work. This a barrier to the bridge approach. Fortunately, we have already deployed a system written in Python which uses the MQTT messaging protocol and Vsystem's events architecture to transmit all changes in channel values to a MQTT broker. This same system also allows the values of channels to be set. This allowed us to develop the EPICS bridge on the supported Linux OS, rather than OpenVMS.

Called pvecho, the bridge was written in C++ with EPICS 7, using only the standard libraries and Boost as well as a headers-only MQTT library. Additional attributes describing the channels – such as units, limits, and alarm values – were drawn from a CouchDB database developed for another project. The bridge was written to make use of EPICS pvDatabaseCPP, and thus uses the newer EPICS 4 style process variables. Since we have no legacy IOCs, and there is an easy bridge to EPICS 3 style channel access variables, this approach allows us the maximum future design freedom.

Advantages of combining the Bridge and standard EPICS IOCs

An important result of developing the Vsystem/EPICS bridge is that we may decouple the migration of the UI (i.e. controls screens) from the migration of hardware (i.e. IOCs). Each can be done at their own pace without, for example, converting all Target 2 controls screens and hardware to EPICS simultaneously.

Additionally, at a large mature facility like ISIS obsolescence planning is an important reality. We still have first generation controls hardware (MPX) from the 1980s in daily use. The bridge method allows us to continue to use the Vsystem interfaces to this hardware, and allow obsolescence to remove the need to ever develop IOCs with scarce developer effort. However, we do plan to develop and deploy EPICS IOCs to our CPS crates as part of the evaluation.

Demonstration

At left is shown the Vsystem injector efficiency screen in daily use in the Main Control Room (MCR) at ISIS, and the equivalent screen in EPICS (CS Studio BOY) with data from the Vista/EPICS bridge.