



Canadian Centre
Light de rayonnement
Source synchrotron

Canadian Light Source - Phase II Beamline Control System Status Update

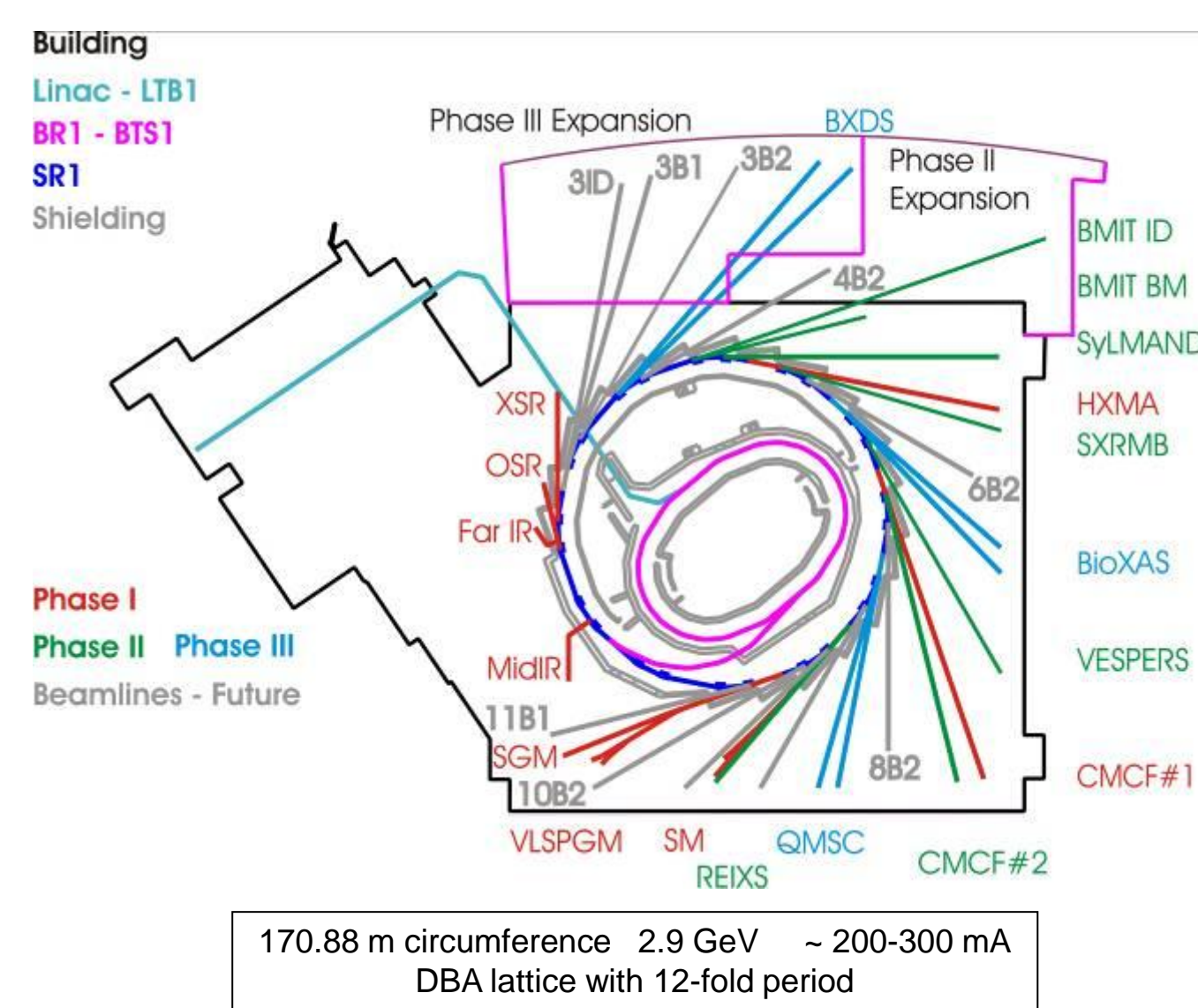
(D. Beauregard, R. Berg, G. Black, W. Dolton,
R. Igarashi, E. Matias, T. Wilson, and G. Wright)



Abstract: The Canadian Light Source is in the final commissioning stages of its six Phase II beamlines. These beamlines make use of both EPICS based control as well as experiment data acquisition using a common underlying framework. This paper outlines the approach adopted in deploying control system on this phase of beamlines. The beamline control system make extensive use of QT toolkit and EDM for operation screens and the CERN ROOT package for data visualization.

The phase II beamlines include:

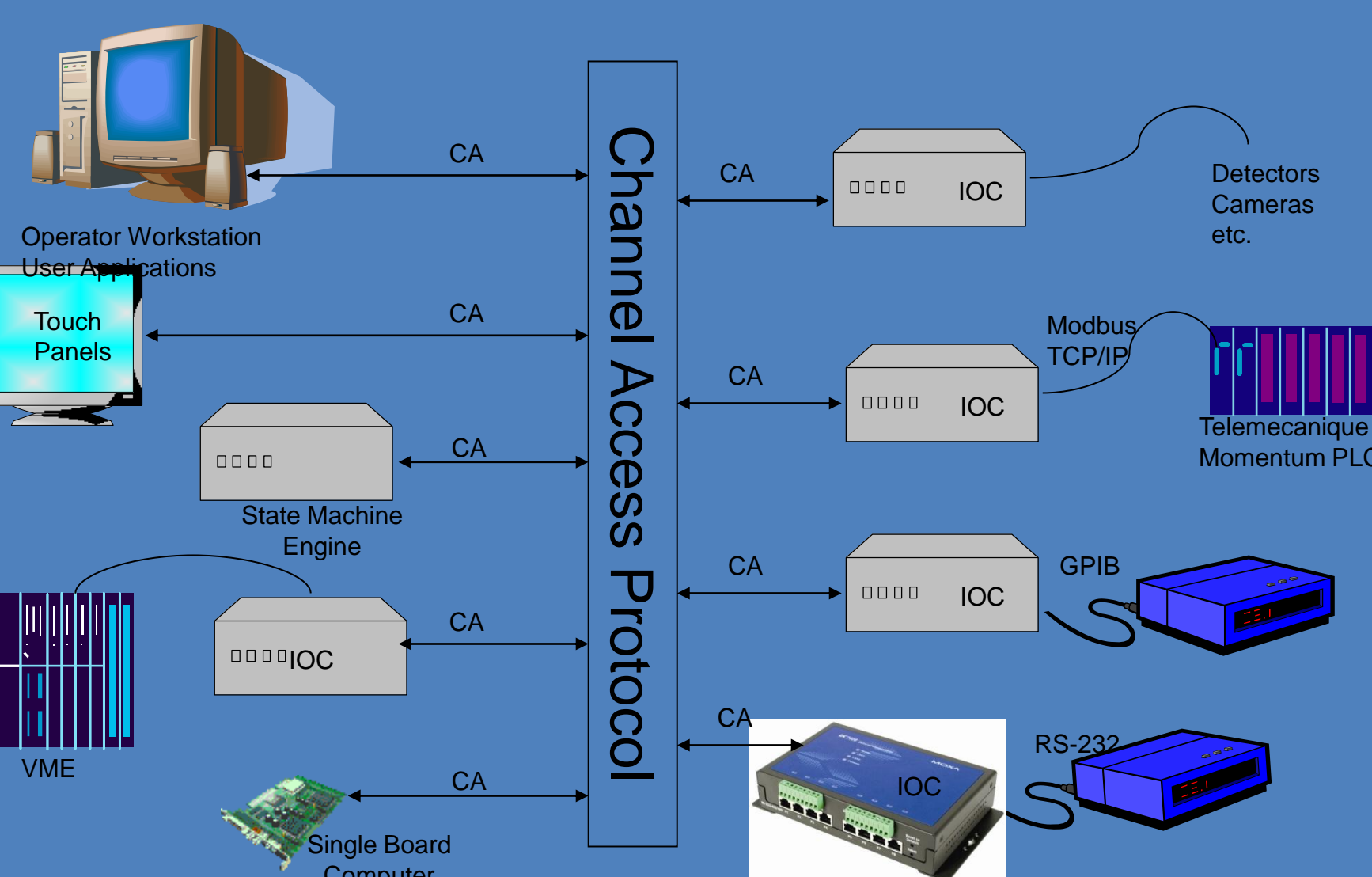
- BioMedical Imaging and Therapy (BMIT)
- Canadian Macromolecular Crystallography Facility II (CMCF II)
- Resonant Elastic and Inelastic X-ray Scattering (REIXS)
- Soft X-ray Microcharacterization Beamline (SXMB)
- Synchrotron Laboratory for Micro And Nano Devices (SyLMAND)
- Very Sensitive Elemental and structural probe employing Radiation form a synchrotron (VESPERS)



The CLS has adopted a common approach to beamline and accelerator control across the facility based on EPICS. The control systems on all CLS beamlines make use of the same basic architecture and share the following traits:

- Machine protection is implemented using Telemecanique Momentum PLC equipment. The CLS has been effectively using the Momentums in this application since 2000. The EPICS interface to the PLC utilizes Modbus over TCP/IP.
- Personal Safety Systems (Lockup and Oxygen Level Monitoring) is implemented using the Siemens S7/400 PLC platform in a IEC 61508 compatible configuration.
- Serial device monitoring is implemented using the Moxa Linux based computers running EPICS.
- Motion control is implemented using VME crates with optical links and the ProDex MaxV or OMS58 motion control card. The majority of motion control applications are implemented using stepper motors, while servo motors are used in special applications.
- Several different VME boards are used for data acquisition, however the SIS 3820 scalar is the most common in use.
- Operator screens are developed using the EPICS EDM window manager form Oak Ridge. Operator workstations are Scientific Linux based.
- A suite of standard EPICS drivers have been developed and shared across various beamline and accelerator applications.
- Common server applications such as EPICS gateways, data archiving, analysis software are hosted on VMware virtual machines.

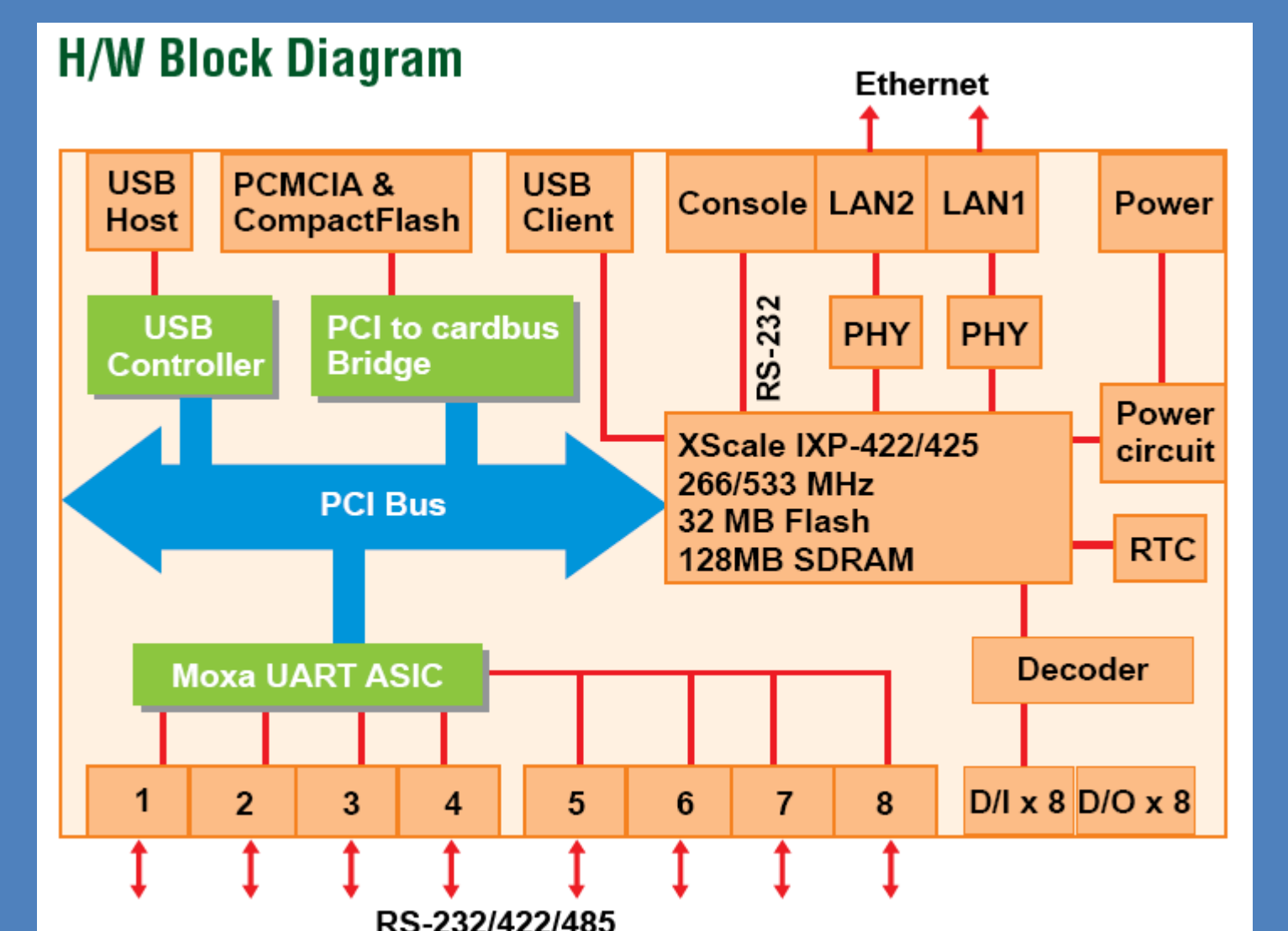
Typical System Architecture



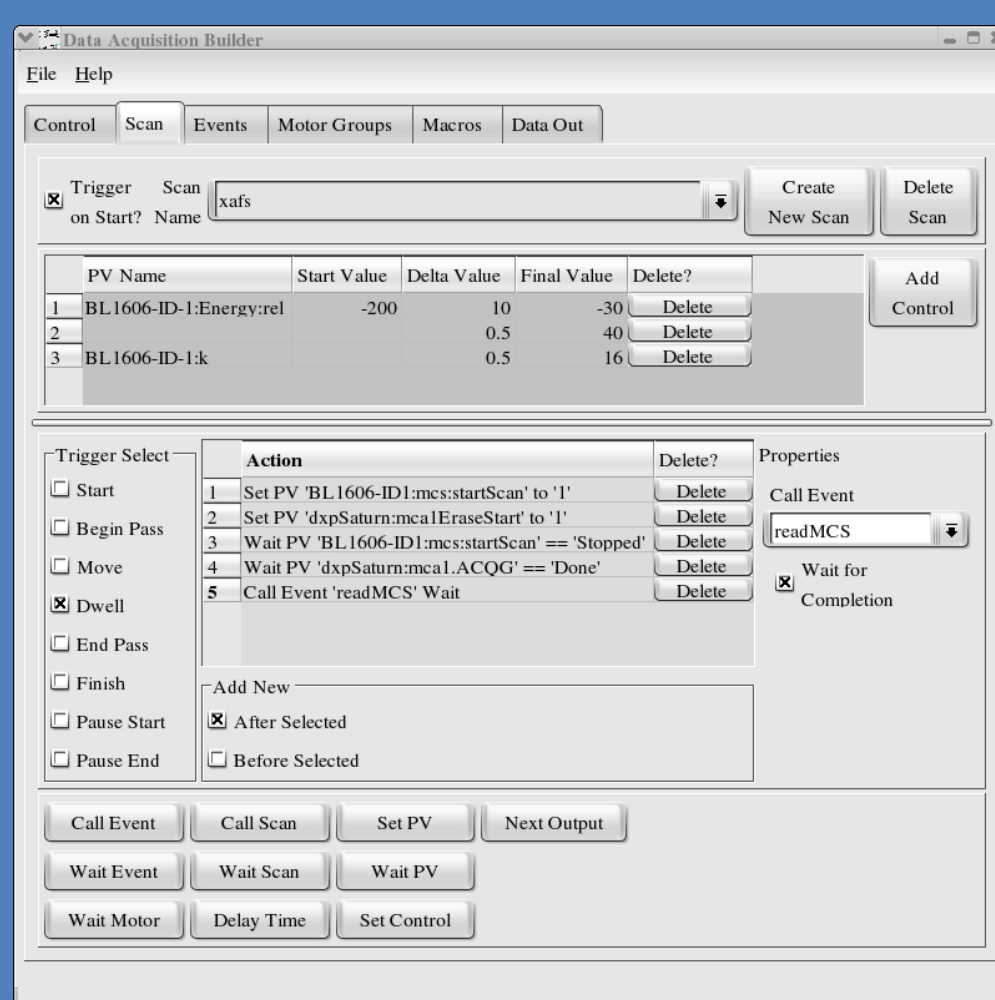
Serial Device Interface



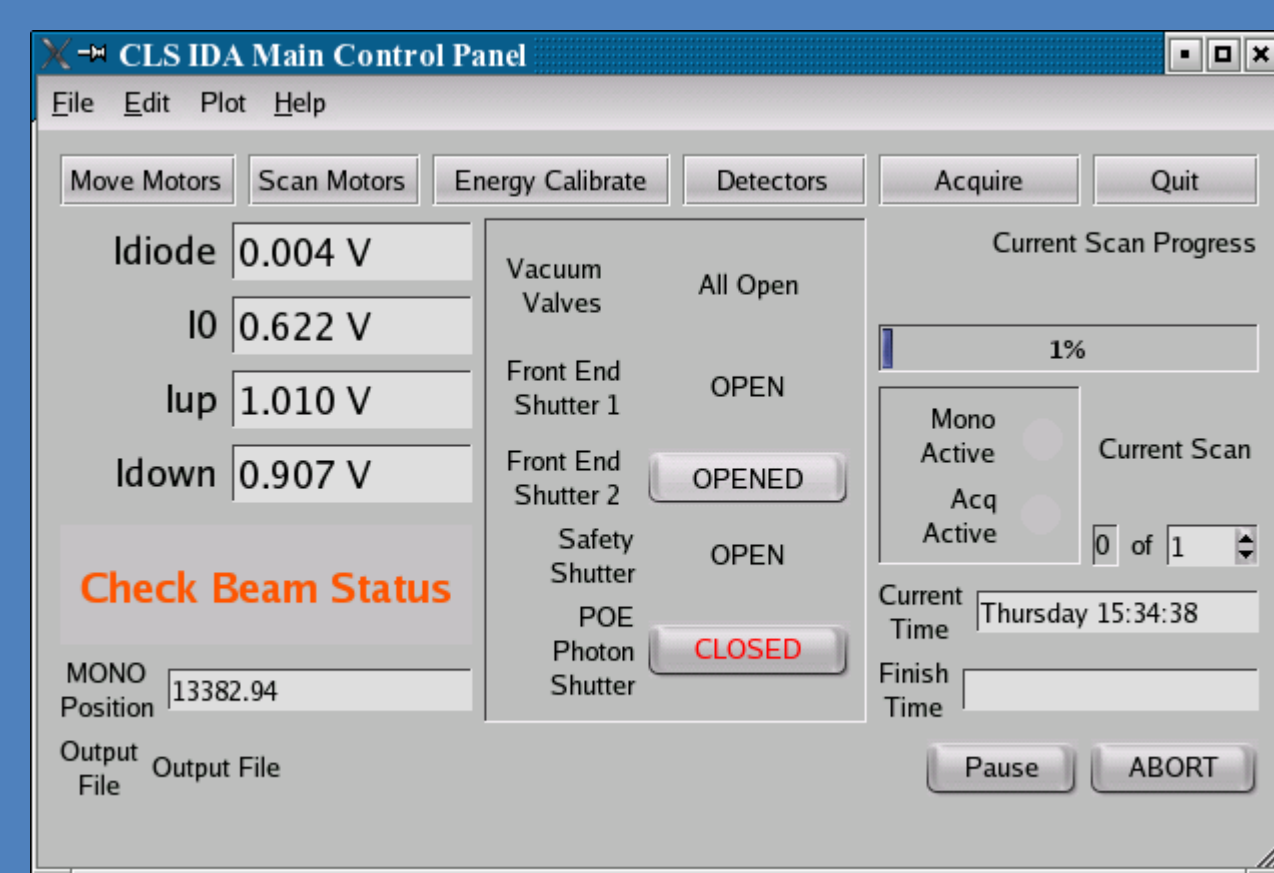
IOC running EPICS on the MOXA UC-7408 are used extensively for serial and Ethernet based devices. Drivers are developed based on the APS asyn libraries with EPICS software NFS mounted.



Data Acquisition Interface



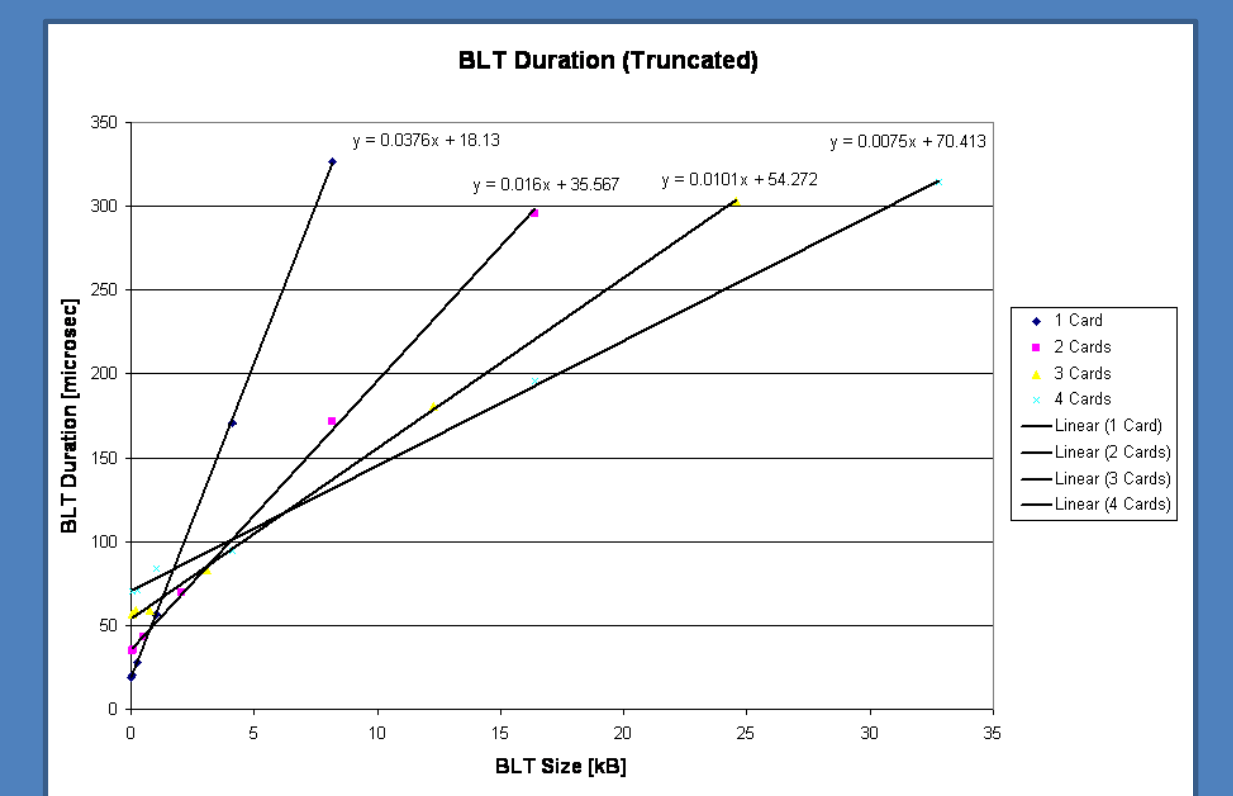
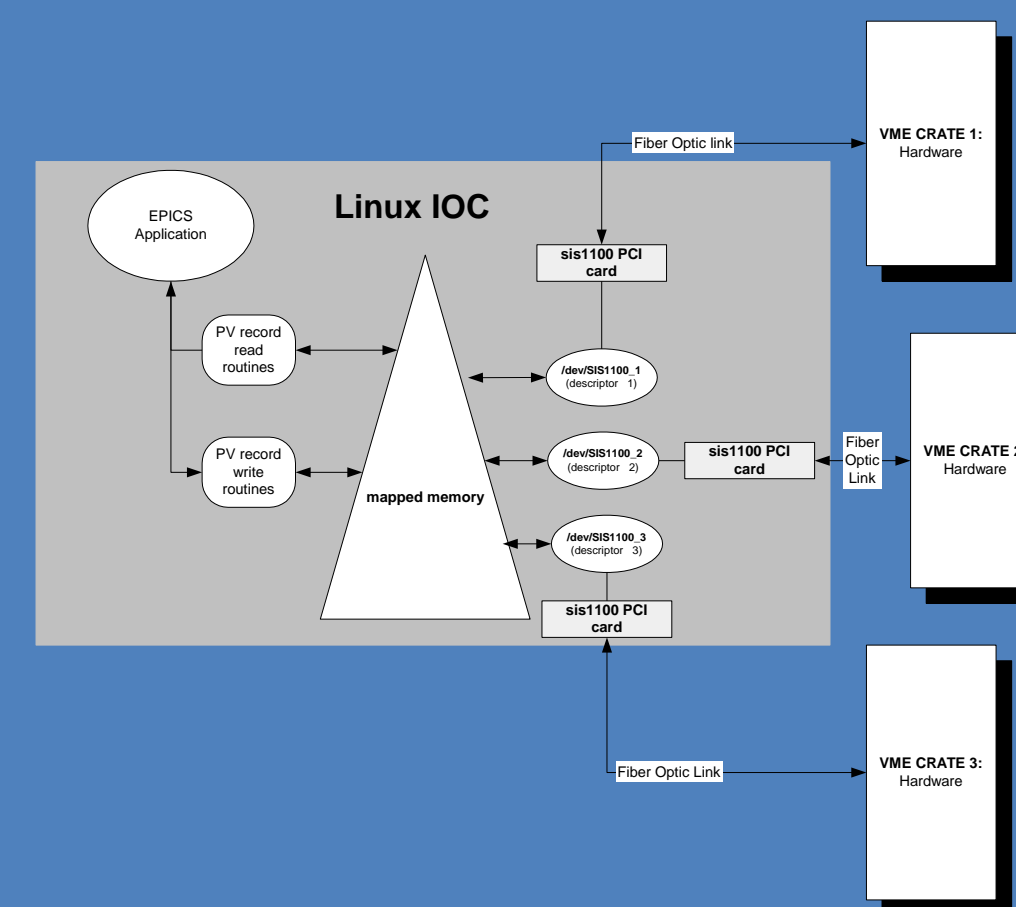
Scanning Configuration Utility



Typical QT based beamline interface.

A common library of data acquisition and EPICS channel access routines were originally developed for the phase I beamlines. This library has QT C++ and CERN ROOT interface classes, allowing easy integration of EPICS controls into custom graphical user interfaces. This builds on existing features such as nested and parallel scans, highly configurable action sequences (e.g. delays, monitored waits), and highly configurable readout lists. As part of phase II recent changes include dynamic loading and registration of output functions, allowing custom data output format and media without rebuilding the calling application. Further work is underway to use the library with Java.

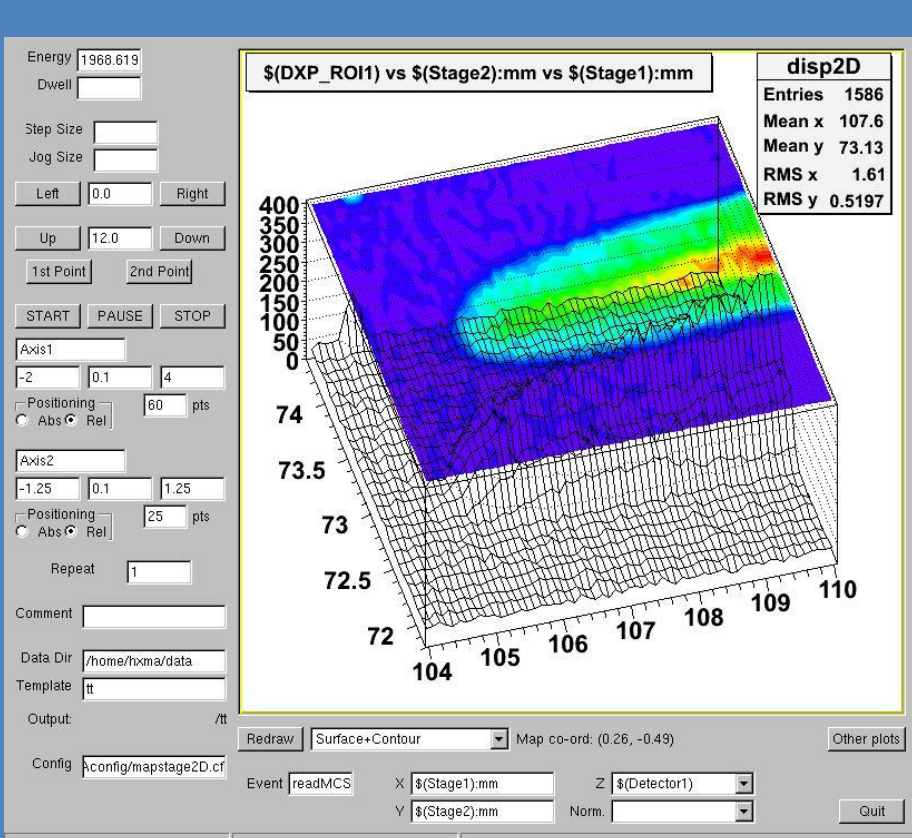
VME



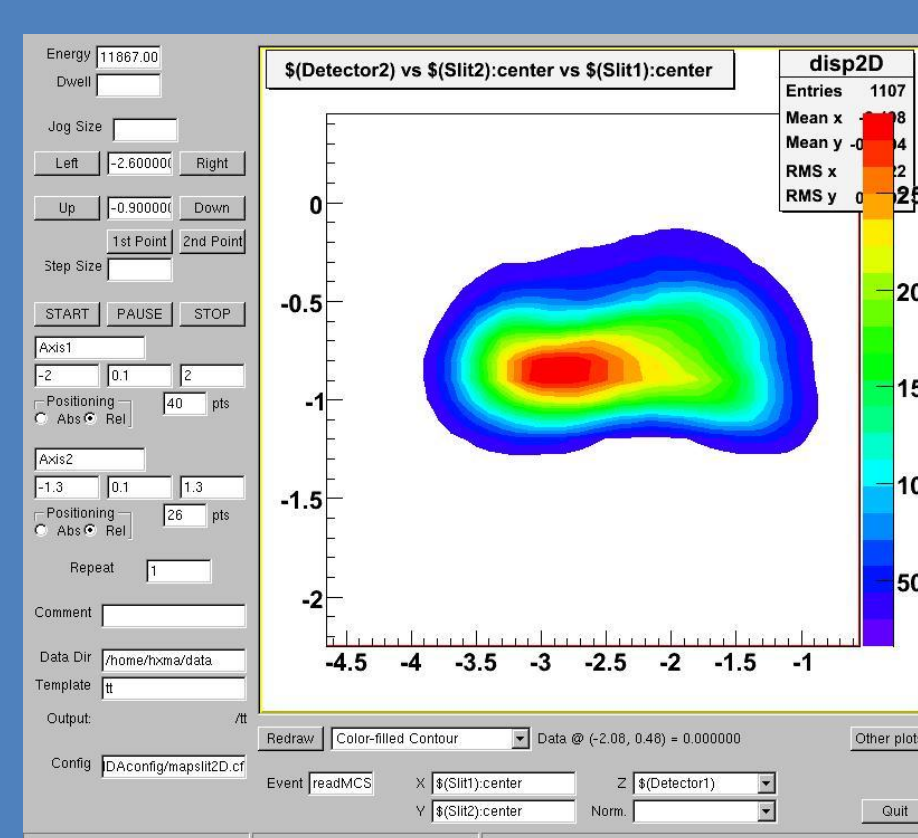
Number of ADC cards	BLT Rate (Mb/s)	BLT Minimum Cost (µs)
1	26.6	18.1
2	62.5	35.6
3	99.0	54.3
4	132.0	70.4

VME 64x is used for motion control and data acquisition, with SIS 3100/1100 optical links to the EPICS IOCs. Deepening on application a Linux or RTEMS target OS is used. Using multiple optical links to a single RTEMS based IOC we are able to sustain an adequate block transfer rates (BTR).

Visualisation Software

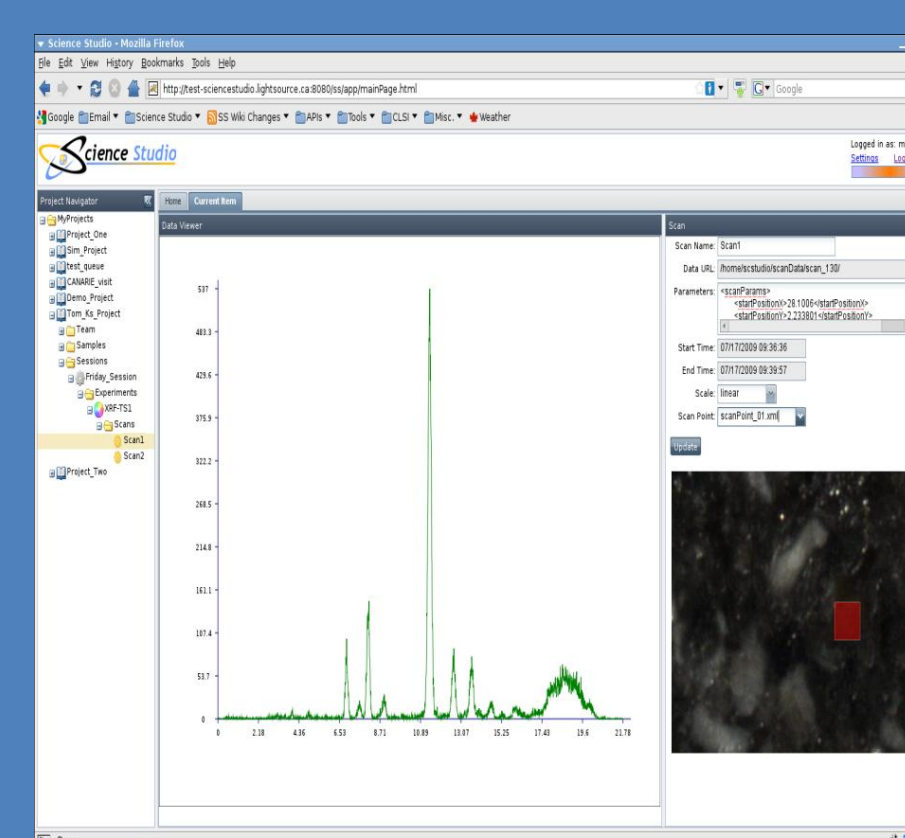


Raster scan with fluorescence spectroscopy of a pine needle contaminated with arsenic. The technique allows multiple elements to be detected simultaneously at each point of the raster. These images show distributions of arsenic, iron, and manganese, respectively, near the tip. The highest intensity displays in red, lowest in blue. Custom on-line plotting application scripted in CERN Root, with data stream from the CLS data acquisition application.



Cross section views of the beam spot intensity distribution for varying degrees of monochromator detuning (50-80%). (Only one image shown).

Web Interface



Initially developed for the VESPERS beamline, ScienceStudio is an SOA based framework that integrates remote control, online data analysis, Cell cluster based data analysis and some user office functionality. ScienceStudio is based on J2EE using AJAX, IBATIS (object/relational mapping), JSecurity, Tomcat and MySQL.



For the CMCF beamline, work is under way to permit users to submit their setup data, approve strategies, and review results over a web interface. The interface between the web application and the beamline executive is through a relational database and FTP. This simplifies providing remote users with a consistent interface for configuring experiments while providing flexibility in changing the beamline software. Implementation is done in python.