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Status Report on the Advanced Light Source Control System, 1993

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Abstract

The Advanced Light Source (ALS), under construction for the past seven years, has become operational. The accelerator has been successfully commissioned using a control system based on hundreds of controllers of our own design and high performance personal computers which are the operator interface. The first beamlines are being commissioned using a control system based on VME hardware and the Experimental Physics and Industrial Control System (EPICS) software. The two systems are being integrated, and this paper reports on the current work being done.

I. Accelerator and Beamline Status

The Advanced Light Source (ALS) is a 1.5 GeV synchrotron radiation source which is designed to generate beams of very bright light in the far ultraviolet and soft x-ray regions of the spectrum. The accelerator is composed of a linac, booster ring, and storage ring. The first two insertion devices (out of ten possible) have been installed in the storage ring. The first five beamlines (out of forty possible) are being installed.

II. The Accelerator Control System

The accelerator control system [1] is based on ~600 Intelligent Local Controllers (ILCs) which interface directly to the individual device instrumentation. A global database (data pool) of all the ILC real-time databases is kept in the Collector Micro Module (CMM), which polls the ILCs across a fiber optic network. The CMM shares this global database with the Display Micro Module (DMM) via a Multibus I to Multibus II bus converter. Each CPU in the DMM is connected via an RS485 link to a Personal Computer (PC).

III. The Beamline Control Systems

The control system for all of the beamlines has a three layer architecture [2]:

1. Radiation Safety System (RSS), innermost layer, implemented in relays
2. Equipment Protection System(EPS), implemented in Programmable Logic Controllers
3. Instrument Control System (ICS), outermost layer, implemented in various ways

Each instrument is controlled directly by only one of these layers. Requests for control and status are passed from the outer layers to the inner layers. A clean interface has been defined between the EPS and ICS, as well as between the accelerator control system and the beamline ICS. Each beamline is allocated its own routed subnet.

The beamlines which are not owned by the ALS facility have implemented their Instrument Control Systems according to their owners' choosing. The beamlines which are owned by the ALS facility have been implemented using the Experimental Physics and Industrial Control System (EPICS) [3].

IV. Integration - Work in Progress

Integration of the accelerator control system and the ALS beamline control system has been motivated by several reasons:

1. Accelerator operators would like status information from each beamline.
2. Experimental users of insertion device beamlines would like to set the insertion device gap from their computers.
3. The growing EPICS application software base is of use for accelerator controls.
4. The storage ring longitudinal feedback system, built by SLAC [4], is controlled by EPICS and should be integrated into the accelerator control system.
5. EPICS is based on commercial hardware which provides an easy upgrade path if needed.

The cornerstone of our integration effort has been to use the Bit 3 Multibus I to VME bus converter, such that the global accelerator database is shared with an EPICS I/O Controller (IOC). The data channels then appear to be from instrumentation which is directly interfaced to the IOC.

Although all of the EPICS client applications can now be used from a Unix and X-based workstation, a further component of our integration is to have these applications show up on our accelerator operator control consoles, which are Microsoft Windows-based PCs. We use the Hummingbird Exceed X server, so that the applications run on our Sun workstations but show up on our PCs, along side our native Microsoft Windows applications.

This addresses items 3-5 above. Items 1-2 are addressed by providing a gateway computer for each sector (10 total) which authenticates the requestor and the request such that a user in a given sector cannot set an insertion device gap in any other sector except his/her own. Also that user can set the insertion device gap but cannot set a magnet power supply set point. Besides the authentication logic, the mechanism used is a selec-

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tive rebroadcast of a standard EPICS lookup request which allows it to go across the network router.

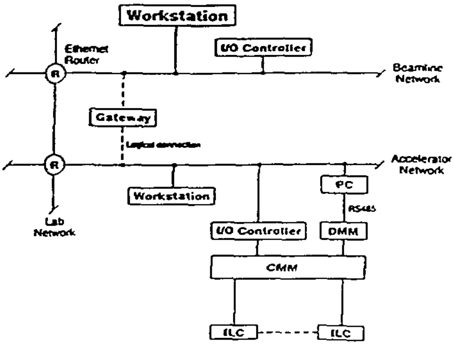

FIGURE 1. ALS Control System Network Architecture

V. Interfacing to Experimental User Computers

Another area of work has been to define a clean interface to the experimental users. We anticipate that these users will bring their own computers to the ALS, and there is a need for them to control the beamlines (and accelerator, via the gateway described above) from their own computers. We plan to provide initially an RS-232 and later an RPC interface to the ALS beamlines ICS. There will initially be a simple, synchronous, channel read/write interface [5] and later a more efficient, asynchronous interface (full blown EPICS Channel Access).

VI. Future Plans

We will continue to explore ways of integrating our control systems. In particular, current applications which access the ILCs via the RS-485 link to the DMM will be routed over the Ethernet through the IOC and the performance will be examined. We plan to investigate running the EPICS applications on Unix workstations along side of Microsoft Windows applications running on top of the Windows Application Binary Interface (WABI). Conversely, we would also like to port EPICS applications to Windows NT.

There is also much work to be done in automating control of the accelerator by writing more sophisticated control applications and diagnostics.

A final major area of work is the photon beam fast feedback system which will be needed to stabilize the insertion device light beams to within a micron

VII. Acknowledgment

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VIII. References

[1] S. Magyary et al., "Status Report on the Advanced Light Source Control System", Proceedings of ICALEPCS '91, Tsukuba-shi, Ibaraki, Japan, 11-15 November, 1991, pp.11-13.

[2] C. Cork and J. Young, "ALS Beamline Control System Architecture", ALS engineering note LSBL-151, October, 1992.

[3] L. R. Dalesio, M. R. Kraimer, A. J. Kozubal, "EPICS Architecture", Proceedings of ICALEPCS '91, Tsukuba-shi, Ibaraki, Japan, 11-15 November, 1991, pp. 278-282.

[4] G. Oxoby, et al., "Bunch by Bunch Feedback for PEP-II", SLAC-PUB-6035, January, 1993, and Tsukuba B Factories 1992:167-174 (QCD183:I792:1992).

[5] A. K. Biocca, Lawrence Berkeley Laboratory, "Simple Channel Access Protocol", Gammasphere engineering note, July, 1993.