

Overview of Control System Software used in the Physics Division

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This note presents an overview of the backbone of the control system software used in the Physics Division—the Experimental Physics and Industrial Control System (EPICS), which is a collection of software that makes a complete architecture.

Generally, EPICS can be thought to be client applications and servers that speak via the Channel Access (CA) network protocol. The servers give clients access to named process variables (PVs), which in turn have many attributes in addition to the value itself; e.g. a PV could hold the temperature of a sensor along with what units the sensor is in, what operating range, and what alarm values.

The Channel Access Server (CAS) is the software that handles the PVs, but in order to populate them an input/output controller (IOC) is required. The IOC can be either hardware, e.g. a single-board computer (SBC) in a crate, or software (SoftIOC) that runs on a standard workstation. These IOCs have the device and driver support for the various hardware that will be used. A hardware IOC could be a VME crate with a VxWorks SBC that is reading from ADC cards; a software IOC could be a Linux machine using the serial port to talk to an instrument.

One advantage of using EPICS is that much of the I/O devices that are commonly used already have device and/or driver support written for them. In addition, a device that uses a bus or communication protocol—RS-232, GPIB, VME, Ethernet—and has already been implemented usually requires less effort to get into a working state. The total number of bus types available is close to 100. There is also soft support available from within an IOC.

While there are many clients, the important ones are the GUI screens that provide easy access to PVs, the alarm monitoring functionality, as well as data archiving. Historically, the clients used by the halls have been Web Extensible Display Manager (WEDM) for GUI screens, Alarm Handler (ALH) for alarm monitoring, and Channel Archiver for storing data. Recently the software has moved to Control System Studio (CSS) with BOY (Best OPI Yet) for the GUI screens (called OPIs or Operator Interfaces), BEAST (Best Every Alarm System Toolkit), and Mya (MySQL Archiver) for storing data.

CSS was developed to provide a common platform for control system applications as prior to its development most OPIs were individual applications usually targeted for unix-like systems. CSS uses Eclipse for the framework base, which in turn is written in Java, allowing it to run on any machine that has Java Virtual Machine available. CSS comprises two main parts: the core plug-ins and application plug-ins. Core plug-ins implement common features—data types and managing CSS instances. Application plug-ins customize CSS, most notably are BOY and BEAST, but there are also applications that allow for logbook viewing/writing and save-restore.

CSS BOY is both the development and runtime environment for OPI screens, both of which are a general GUI but endowed with the ability to connect directly to live data. The BOY development is done via a WYSIWYG editor that allows for drag-and-drop creation of screens. The output is an XML file that can be edited manually. There are additional features that allow BOY to connect to multiple data sources, not just EPICS PVs, but also local sources allowing for testing completely within CSS itself.

The IOC handles access security to protect the IOC database from unauthorized clients. The security can be based on the following criteria:

- WHO: the userid of the client (used to grant/deny certain users access)
- WHERE: the hostid of where the client exists (the machine where the client exists)
- WHAT: individual fields of a PV can be protected
- WHEN: rules can be based on calculations.

Each criterion gives appropriate access depending on the situation. The user criterion is most often used to give experts additional access while limiting access of regular users. The host criterion gives access based on the computer, such as shifters in a control room getting additional access that a user from their office would not be granted. The “when” criterion could be used to grant access when a PV reached a certain value or when an alarm condition occurs. All of the access security is optional and not applied to local clients or the IOC console. Each of the four physics halls has their own set of subnets that cannot talk to one another except via the hall gateway, which provides the network access protection.

Since EPICS is a collection of software, it has allowed for an upgrade path for the various components with no effect on the currently running setups. As long as the software can communicate via Channel Access it will be able to be integrated into the existing controls system. Having a common set of software allows fewer experts to handle additional systems.