B3 Control System Framework & Applications

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Advanced Light Source
Outline

Control System Development @ BCSB

Design and Implementation of B3

Related Software Projects

Hardware Development
Evolution of BCSB Control Software

2001 Distributed Control System - DCS
   Carl Cork, Earl Cornell & Arthur Jones.

2006 Beamline Operation System - BOS

2011 B3 Server & Modified BOS Gui
   Yun Zhou

2013 B3 Client
DCS

Wanted SSRL BLU-ICE
Utilized "protocol adapters" to allow different clients to communicate
DCS - The good and the bad

Design
- Users can "edit" robot protocols

Implementation
- Single Threaded
- Multiple languages C/C++/Java/R?
- Many forms of Unix interprocess Communication
- Non standard network protocols

Configuration
- Generic database that you can put any name value pair
BOS Application

Complete redesign but client looks similar to BLU-ICE

Emphasis on reliability and ease of development.

All Java.
  RMI - Big API. Lots of functions calls.
  Swing

Jython interface for scripting.

LDAP integration.
BOS Architecture

Simple SSL/RMI Service-based
B3 Framework

Emphasis on tighter integration with hardware and performance. C++

Another redesign.
  Framework vs Application
  "Thin" communication api. Parameterized Set/Get
  Internal device cache for high speed state reads.
  Monolithic Server

Internal Python script processing.
Easy XML Configuration.
B3 Framework

Middleware helps simplify network programming. Internet Communication Engine - ICE - www.zeroc.com
It has bindings for many languages
Very high performance
B3 Framework

Server utilizes "manager" objects. Including
Session - Authorizes
Event - Manages Command Queue.
Device - Manages Devices and Cache.
Process - TaskQ, Robot, Snap and Scan
Configuration - Manages XML config file
B3 Configuration

<ccdSnap>
  <gonioXDevice>gonioX</gonioXDevice>
  <gonioYDevice>gonioY</gonioYDevice>
  <gonioZDevice>gonioZ</gonioZDevice>
  <collectionProgram>phiScan</collectionProgram>
  <phiDevice>gonioPhi</phiDevice>
</ccdSnap>

<ccdSnap>
  <gonioXDevice>MD2gonioX</gonioXDevice>
  <gonioYDevice>MD2gonioY</gonioYDevice>
  <gonioZDevice>MD2gonioStageY</gonioZDevice>
  <collectionProgram>MD2phiScan</collectionProgram>
  <phiDevice>MD2gonioPhi</phiDevice>
</ccdSnap>
Philosophy

Simplify whenever possible.
Move realtime functions onto dedicated hardware that can be managed and monitored.
Utilize any hardware optimizations.
   DPRAM (X100)
Robust error handling.
Provide feedback to user.
Leverage standards.
   ICE, LDAP & SQL
Additional Software

BDXV

SIL Server
   Modification to Web-Ice SIL server to use MySQL

BUDS - BCSB User Database System.
   Web-based. LAMPJ.
   Provides access point for user and beamtime info.
   Interacts with other services. Google Calendar, HRIS.
New B3 Development

Gigabit Ethernet Cameras
- Developing standalone server.

New B3 Gui
- Simplify interface to service multiple collection modes.
- Separate video windows to utilize desktop.

Refactored Task Queue
- Make taskQ more transparent and generalized.
Hardware Development:

BOSMon
Crystal Washer
Universal Pucks & Plate
Big Dewar
Bumpers
Linear Motors
Sector 5 Gripper Swap
Dry Cold Nitrogen Collets
Motivations for BOSMon

Previous Configuration:
- BOS Server
  - Limited Java SDK
  - Third Party Windows Based Controller
  - Mitsubishi Controller
    - Limited List of Running Programs
    - ~12 Kinds of Errors

New Setup:
- BOS Server
  - Limited Java SDK
  - Third Party Windows Based Controller
  - Mitsubishi Controller
    - LMON
    - Parser
    - ~400 Error Types
    - UNLIMITED LIST OF RUNNING PROGRAMS

Lantronix + Serial Connection
Crystal Washer
(developed by Anthony Rozales)
Bumpers
Small Move Linear Motor
Big Dewar

- 14.5” OD
- 12.5” (Min) ID
- 6” Deep
- 7.5” Tall
- Less than 1.5” Long
- Less than 40mm OD Pipe
Sector 5 Gripper Swap
Conclusion

Questions?

We are always looking for collaborators.

Thanks for coming!

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