ControlView to EPICS Conversion of the TRIUMF TR13 Cyclotron Control System

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Original System

Hardware Options for Upgrade

- Ethernet Coprocessor
- No room without shifting modules, would require PLC program changes
- Serial Port to DH+ module

Multiple masters cause conflicts
- Replace with ControlLogix or other PLC
- Rewrite not allowed
- Data Link Ethernet to DH+ Module

Speed limitations, limited use of translation blocks
- Replace PLCs with Ethernet enabled units

No changes to PLC/OIS hardware

Parallel deployment of EPICS with existing OPI
Fast private communication, standard architecture

Original Console Displays

- Keyboard oriented
- Limited windows
- Multiple monitors
- Color rules buried in display code

EDM Replacement Displays

- Mouse oriented
- Windows unlimited
- Multiple monitors/remote access

Atom based Linux IOC Target

- Small low power fanless computer for Linux
- Dual Ethernet for firewall
- Multiple serial ports, parallel port
- PCI slot for other field busses
- Small Linux distribution for easy management

EPICS Device Support

- Standard driver layout – device support, driver support, low level communication via Ethernet
- Designed for reserved communication block in PLC memory, with command word overwrite if externally changed by PLC
- TR13 command bits do not follow pattern, with command bits, status bits, internal and one-shot bits combined into words. The EPICS driver would detect changes in a word and overwrite the full word, resulting in unexpected behaviour.
- Rewrite to incorporate single word and bit access, optional scanning of word and bit changes.
- Timer and Counter read functions added
- Enhanced diagnostics
- Still to do: Reconnection of closed pipes from a PLC reset or power loss.

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System Summary

- 10 subsystems, 103 schematics, 92 symbols, 2831 EPICS records
- 29 edm main screens, 88 device panels, 153 screens total
- 13 automation scripts
- 2 main consoles

Acknowledgments

- John Sinclair – SNS – PLC 5 Device Driver and much advice
- TRIUMF Applied Technology Group – PLC setup and debugging
- ISAC Controls Group – TRIUMF – patience
- Nuclear Medicine Group – TRIUMF – even more patience

PLC System Mockup

- Build equivalent hardware system for lost EPICS replacement
- Recycled parts from Hermes experiment gas system
- E-Bay for missing low cost parts – non production
- Cost ~ $2500
- LadderLogics (DOS based) did not support Ethernet enabled PLCs
- WinLogix (Windows 98 based) used for testing mockup and EPICS interface
- RSLogix (Windows XP) purchased in 2004, year and used for monitoring and maintenance

Original Console Displays

- Site Ethernet displayed inside
- Control PLC PCL-5/32
- Control IO

EDM Replacement Displays

- Multiple monitors
- Limited windows
- Keyboard oriented

System Problems

- No communication in control panel
- No USB 2.0 in model 2000
- Using 1.1 interface
- Obsolete development tools

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