TRIUMF

Canada's National Laboratory for Particle and Nuclear Physics
Laboratoire national canadien pour la recherche en physique nucléaire et en physique des particules

ARIEL CONTROL SYSTEM AT TRIUMF - STATUS UPDATE

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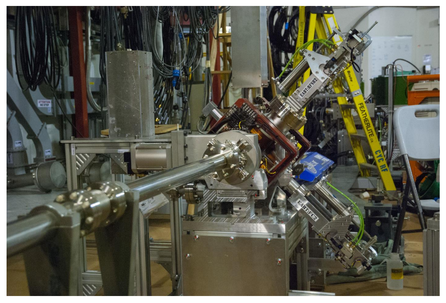
Abstract

The Advanced Rare Isotope & Electron Linac (ARIEL) facility at TRIUMF has now reached completion of the first phase of construction; the Electron Linac. A commissioning control system has been built and used to commission the electron gun and two stages of SRF acceleration. Numerous controls subsystems have been deployed including beamlines, vacuum systems, beamline diagnostics, machine protect system interfaces, LLRF, HPRF, and cryogenics. This paper describes some of the challenges and solutions that were encountered, and describes the scope of the project to date. An evaluation of some techniques that had been proposed and described at ICALEPCS 2013 are included.



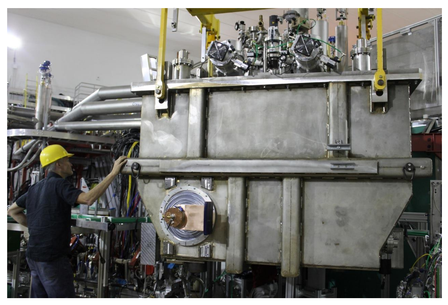
Beam Optics & Diagnostics:
VME IO, GalII motors, TCP LAN power supplies

Vacuum & Gas Control:
Modbus PLCs

Devices under control	1160
Discrete IO Points	11155
EPICS IOCs	22
IOC Hosts	16
EPICS Device Support types	24

Control system scale

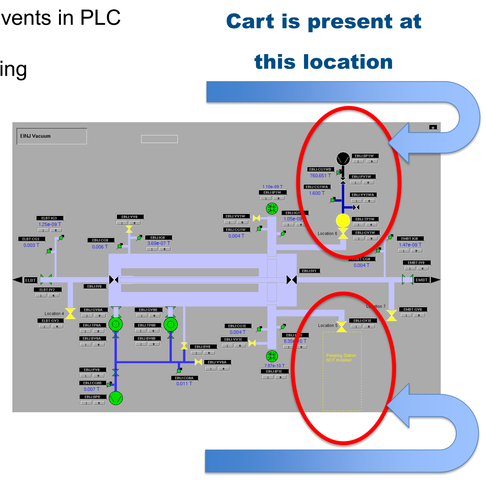
LLRF:
TCP LAN + In-house



Cryogenics and Cold Distribution:
Modbus PLCs & Siemens PLCs

Mobile Vacuum Pumping Carts

- **Turbo Pumps connect any of 27 beamline ports**
- Automatic detection of connect & disconnect events in PLC
- EPICS EDM displays automatically reflect changing geographic locations of two carts
- Driven by economics and space constraints:
  1. Saving of CDN $27000 vs dedicated PLC IO
  2. Saving of 10,000 m of cable
  3. Reduced congestion in cable passageways
  4. Reduced congestion around beamlines

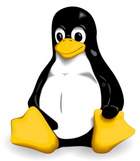


Linux OS Everywhere

EPICS IOC hosts use diskless Linux
- Compact In-house Linux 'distribution'
- Customized for local controls requirements
- Follows historical model of diskless vxWorks IOCs
- Permits easy distribution of changes
- Fast loading, small memory footprint
- Currently on x86 PC and x86 VME CPUs

File servers, user hosts, and Control Room consoles use Debian Linux
- NFS, TFTP (PXE), DHCP and SSH
- EPICS extensions: EDM, ALH, StripTool, etc

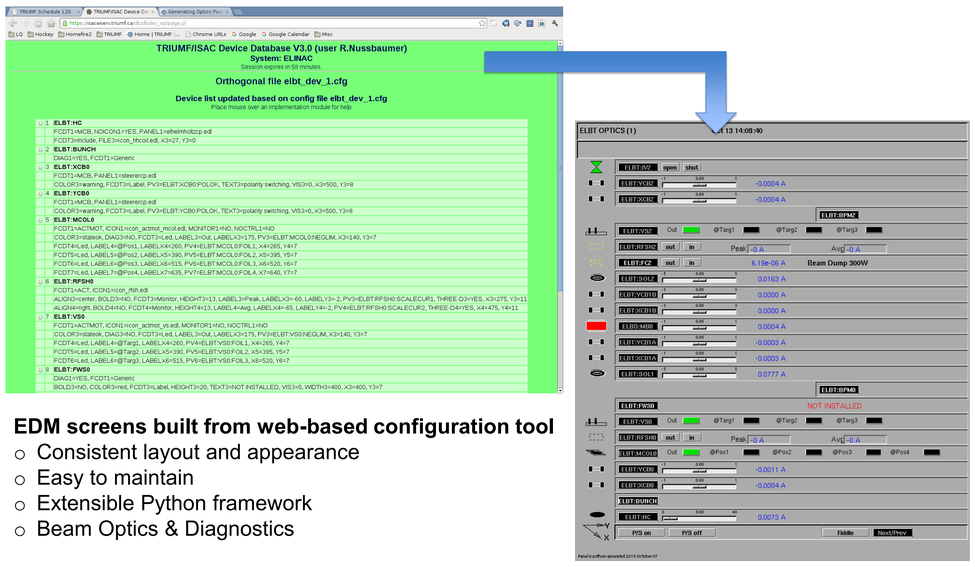
Development hosts use Debian Linux
- Native compiler toolchain used to build OS components and EPICS components
- Planned cross-native toolchain development to remove development host dependencies



IOC Hosts provide services to Fieldbus Ethernets
- DHCP Servers for Ethernet devices under control
- NAT firewall to expose PLCs to programming tools

EPICS Applications specified in PXE Bootloader configuration
- Bootloader specifies kernel arguments
- Kernel ignores arguments it doesn`t know, but userspace still has access
- Scripts read arguments to configure IOC host and launch IOC applications
- IOC application shells launched in sharable multi-user *GNU screen* sessions

Automated Generation of Synoptic Displays



EDM screens built from web-based configuration tool
- Consistent layout and appearance
- Easy to maintain
- Extensible Python framework
- Beam Optics & Diagnostics

Ethernet as a Field Bus

Many devices use Ethernet as Control System interface
- Three tiers of ethernet:
  1. Control System Backbone
  2. Device Field Buses
  3. Modbus PLC Field Buses

Segregation is good
- Easier troubleshooting
- Less shared traffic
- Reduced overlap of functionality
- Local administration of LAN IPs

Linux IOC hosts provide NAT Firewall
- access devices from development network.
- Schneider Unity PLC programming software access to PLCs