Modernization Plans for Fermilab's Accelerator Control System

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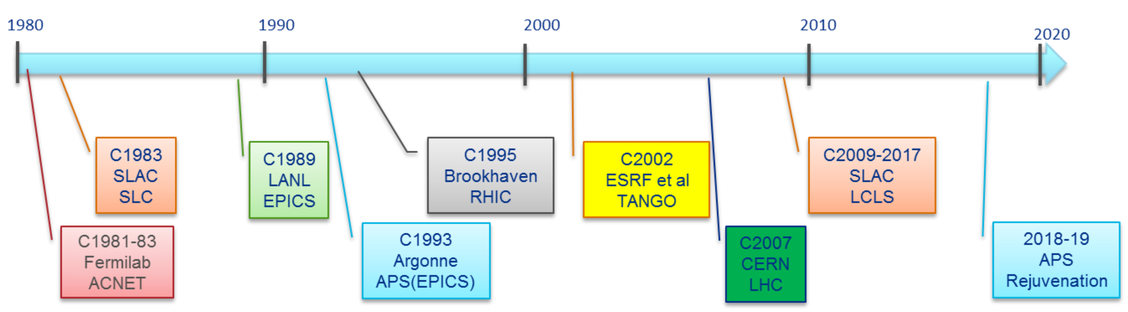
Abstract

The control system, ACNET, for Fermilab's accelerator complex has enabled the lab's scientific mission for decades. ACNET has evolved over the years to incorporate new technologies. However, as Fermilab prepares to enter a new era with its PIP-II superconducting linear accelerator, ACNET is at a crossroads. There are several components that are either obsolete or outdated, or certainly will be over the long lifetime of PIP-II. We have begun a plan to modernize our accelerator control system. This paper discusses some of the obsolete hardware and software that needs to be replaced and lays out options and technologies that we might adopt as part of this modernization effort.

We're Due for an Update

Fermilab's accelerator control system has been in place without a significant upgrade longer than any other major accelerator system.



Obsolete Hardware

- CAMAC — Fermilab has 275 crates of CAMAC hardware, providing the basis for controls for much of our accelerator complex. CAMAC hasn't been commercially available for ~20 years and we can no longer buy chips/parts for our custom cards.
- 68040 VME processor cards — this hardware has proven very durable. But the 68040 came out in 1990. The cards' limited memory and lack of support for modern compiler options affect our ability to deploy new features in our data acquisition framework.
- Custom Vacuum crate electronics. Found in our Booster/MI/ Switchyard areas. Again, obsolete, difficult to replace hardware
- Somewhat newer but beyond end-of-life processor cards such as MVME2400 series. Working fine, but getting old.
- Central computing nodes — the servers for our central console software are due for replacement
- VME architecture — with hundreds of VME front-ends, wholesale replacement of VME probably isn't practical but we are investigating new architectures.
- High power power supplies. Fermilab has 181 supplies over 35 years old. These were built to 1960s-1970s standards. Replacements would have modern safety standards.
- Networking — improvements in switches and fiber to support 10GB

Obsolete Software

- PSOS Operating System — 125 frontends (~half in linac).
- X-Windows based user interface — 500 applications
- Sybase — expensive annual license, converting to open source PostgresSQL
- VxWorks — not obsolete, but we see little value for the cost of out development license and have begun using Linux

"Soft" Reasons

Besides practical reasons for replacing obsolete systems, there are also some human factors that add to our desire to upgrade at this time. One factor, is that having more modern platforms makes us a more desirable workplace from a recruitment/retention standpoint, and enables us to find candidates already familiar with the technologies. Also, working in outdated technologies makes it difficult to find support through online communities, isolating our engineers, and reducing opportunities for informal

Enter EPICS

- Fermilab has decided to use Epics for the control system of PIP-II, our new superconducting linac.
- We need to continue operations of the current accelerator chain during PIP-II development
- It is desireable to have one unified control system after the connection to PIP-II
- We are looking to move ACNET closer to EPICS over the next several years. This includes:
  - Investigating EPICS applications/clients that will be useful to use
  - Building bridges between the two systems, for instance modifying the middle layers of ACNET to be control system agnostic, or implementing ACNET protocol plug-ins for EPICS clients where appropriate.

Scope of ACNET

To give an idea of how much work would be involved in just wholesale conversion from ACNET to EPICS, the below table summarizes the approximate number of lines of code in various parts of ACNET.

Core Libraries	3234k
Console Apps	4122k
SA Applications	264k
Console Service	251k
Java Inf &Apps	1841k
Erlang Frontend	89k
VME Frontend	2993k
IRM VME FE	221k
EE Support FE	105k
Linac VME FE	140k

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