# Exploring Browser Frameworks: A Comparative Analysis and Deployment Demo

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Accelerator Controls Operations Research Network (ACORN)

- The ACORN Project is a DOE O413 project that will modernize the laboratory's **accelerator control system** and replace end-of-life **accelerator power supplies**.

- Approve Mission Need (CD-0) was approved August 28, 2020.

- Approve Alternate Selection and Cost Range (CD-1) is projected to occur Q2 FY24 (March 2024).

- Total Project Cost (TPC) range: 100 – 142M$

- Project Completion (CD-4): 2028 – 2030

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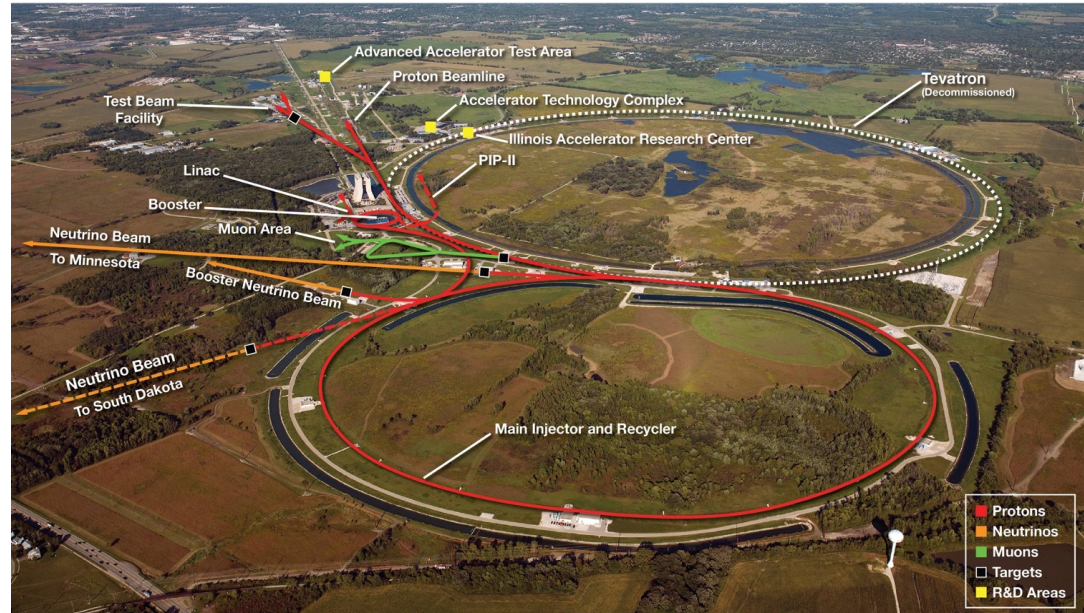
ACORN Mission Need Statement (CD-0)

ACORN received CD-0 approval August of 2020.

Mission Need Statement identified the following:

- ACNET (current control system) was developed four decades ago and uses hardware that is no longer available and software that is no longer maintainable.
- Many of the accelerator power supplies that drive the accelerator complex have exceeded their useful life, are not designed to modern safety standards, and cannot be controlled with the speed and precision needed for future accelerator operations.

Mission Need Statement
Accelerator Controls Operations Research Network

Submitted by:

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Date: 8/6/20

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ACORN Mission Need, capability gaps

The capability gaps for the control system were noted by the laboratory's external Accelerator Advisory Committee (AAC) in its December 2018 report:

The existing lab-wide accelerator control system has aging and heterogeneous front-end hardware, multiple different frameworks and network protocols, 1980s era network services and a collection of generic functionalities. The top level is a mix of high-level software some of which is using obsolete frameworks. Recent targeted modernization has included rather specific, targeted initiatives. Major issues include: lots of old hardware; lots of old software, and an aging and declining in strength work force (no software development related hires since 2001 for instance).

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ACNET control system history of upgrades

- The accelerator control system has been essential to scientific discoveries at Fermilab for decades.
- System upgrades have been occurring throughout its history without causing major beam downtimes:
    - Upgrading from PDP-11 to VAX
    - Moving from VAX to Linux servers
    - Transitioning from a proprietary database to a commercial database
    - Moving from a commercial database to an open-source database
    - Introduction of Java Controls for central services, applications, and data acquisition.
    - Development and expansion of the Data Pool Manager central service
    - Countless fieldbus hardware upgrades (CAMAC module development, IRM/HRM, BSSB/MFTU)
- The ACORN project represents the first major overhaul of the accelerator control system in the past 40 years. The scale of this project requires it to be a DOE O413 project.

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Existing Application Development Tools and Processes

- Complex user interfaces that require extensive training or are difficult to navigate, resulting in user frustration and errors.

- Inconsistent design across different applications or within the same application, leading to confusion and reduced efficiency.

- Poor readability due to small or low-contrast fonts, color schemes that strain the eyes, or lack of visual hierarchy.

- Overwhelming or cluttered interfaces that present too much information at once, making it difficult for users to find what they need.

- Insufficient feedback, such as a lack of confirmation messages or visual cues, leaving users uncertain whether their actions were successful or not.

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ACORN Requirements Structure

- Requirements derived from use cases

  Used missing use cases and requirements to highlight requirements that needed more work

  Derived new requirements to fill gaps in requirements

- Created levels which correspond to the use case levels

  Going from top level to low levels answers "How?"

  Going from low levels to top level answers "Why?"

- The use case number used to derive the requirement is included in the requirement's record along with a link to the specific use case.

  Can trace the requirement all the way back to the recording of the interview if desired

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ACORN Requirements

ACORN System Requirements

Set • View details

[Add ▼] [Trace view] [Export ▼]

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		Project ID	Name	Description	Status	Use Case Number	Category
☐		ACORN-ACORN_SYS-17	Limit Data Acquisition Interfaces	The control system shall limit the number of interfaces for data acquisiti…	Draft	UC-02300.001	Development
☐		ACORN-ACORN_SYS-18	Expose Data Acquisition Interfaces	The control system shall expose standard interfaces for data acquisitio…	Draft	UC-02300.002	Development
☐		ACORN-ACORN_SYS-24	Personnel Safety Interlocks System Interface	The control system shall interface with the Personnel Safety Interlocks …	Draft	UC-02250.001	Interfaces
☐		ACORN-ACORN_SYS-25	Building Automation Systems Interface	The control system shall interface to the Metasys facilities managemen…	Draft	UC-01960.001	Interfaces
☐		ACORN-ACORN_SYS-26	Beam Instrumentation Data Acquisition	The control system shall support data acquisition at rates relevant to b…	Draft	UC-02130.001	Interfaces
☐		ACORN-ACORN_SYS-27	Machine Protection	The control system shall allow external systems to inhibit beam.	Draft	UC-02380.001	Interfaces
☐		ACORN-ACORN_SYS-55	Non-Expert Displays	The control system shall provide the tools for a non-expert user to dev…	Draft	UC-01600.001	User Interface
☐		ACORN-ACORN_SYS-56	Accelerator Dashboard	The operations interface shall provide an initial screen providing a das…	Draft	UC-01720.001	User Interface
☐		ACORN-ACORN_SYS-57	Create User Displays	The control system shall let expert users create displays.	Draft	UC-01730.001	User Interface
☐		ACORN-ACORN_SYS-58	Customize User Displays	The control system shall let expert users customize displays.	Draft	UC-01730.002	User Interface
☐		ACORN-ACORN_SYS-59	Unlimited Screens and Applications	The control system's user interface shall not explicitly limit the amount …	Draft	UC-02350.006	User Interface
☐		ACORN-ACORN_SYS-60	Control System Index	The control system shall provide an index of programs, scripts, and too…	Draft	UC-01740.001	User Interface
☐		ACORN-ACORN_SYS-61	Browser Access	The control system shall be accessible via browsers.	Draft	UC-02110.001	User Interface
☐		ACORN-ACORN_SYS-67	Beam Loss Visualization	The control system shall let operators visualize where beam loss is ha…	Draft	UC-01240.002	User Interface
☐		ACORN-ACORN_SYS-70	Mobile Device Access	The control system shall support access from mobile devices.	Draft	UC-02110.002	User Interface
☐		ACORN-ACORN_SYS-76	Vacuum Systems Interface	The control system shall provide an interface to vacuum systems.	Draft	–	Interfaces
☐		ACORN-ACORN_SYS-77	Cooling Water Interface	The control system shall provide an interface to cooling watersystems.	Draft	–	Interfaces
☐		ACORN-ACORN_SYS-78	Building Utility Interface	The control system shall provide an interface to building utility systems.	Draft	–	Interfaces
☐		ACORN-ACORN_SYS-79	Tunnel Utility Interface	The control system shall provide an interface to tunnel utility systems.	Draft	–	Interfaces

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Reasons we are pursuing to browser applications

- Cross-platform

  - This is not free, but it's work in every ecosystem. We believe that developing for the browser, we limit the context switching for developers.

- Progressive Web Apps (PWAs), native-feel browser applications

- User Familiarity

- Support for mobile without cross-compilation

- Growing developer pool

- Usability tools and Human Factors compliance
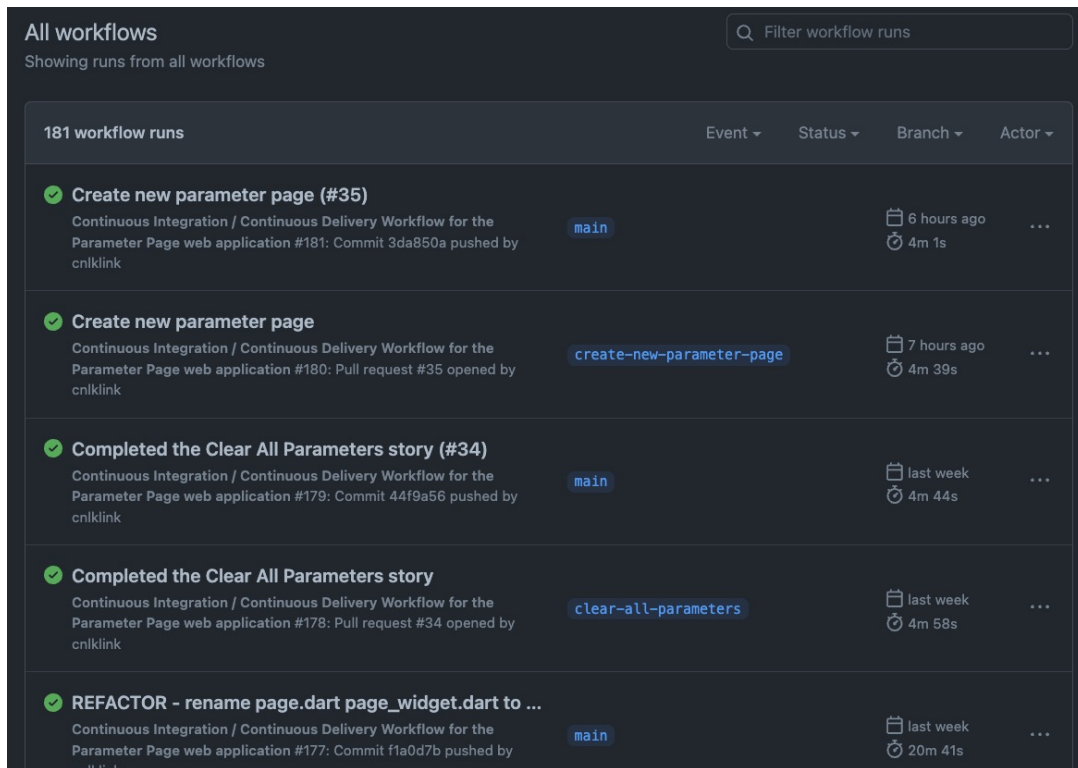
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Architecture Influence
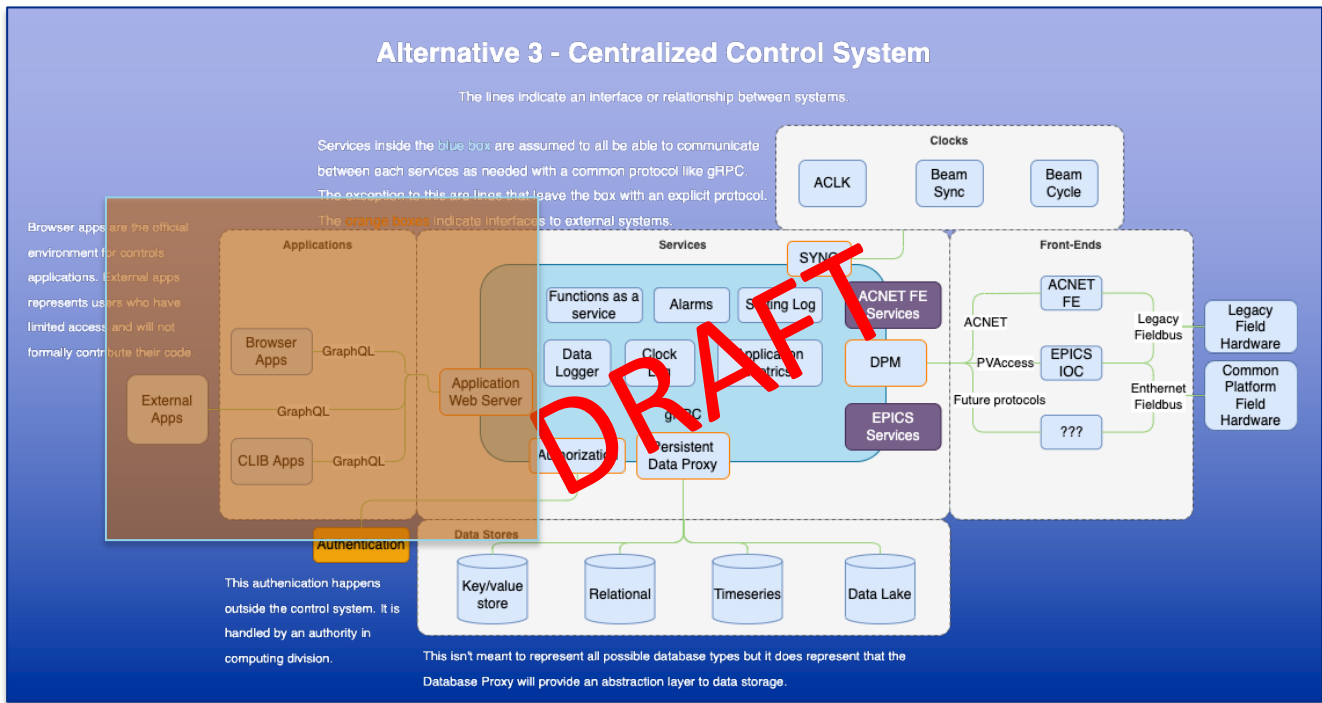
Application Status

- Browser framework exploration (Dec 22-Feb23)

    - Developers chose interesting frameworks with the goal of sharing developer experience

- Prototyping critical applications

    - Parameter page – in progress

    - Plotting

    - Alarms
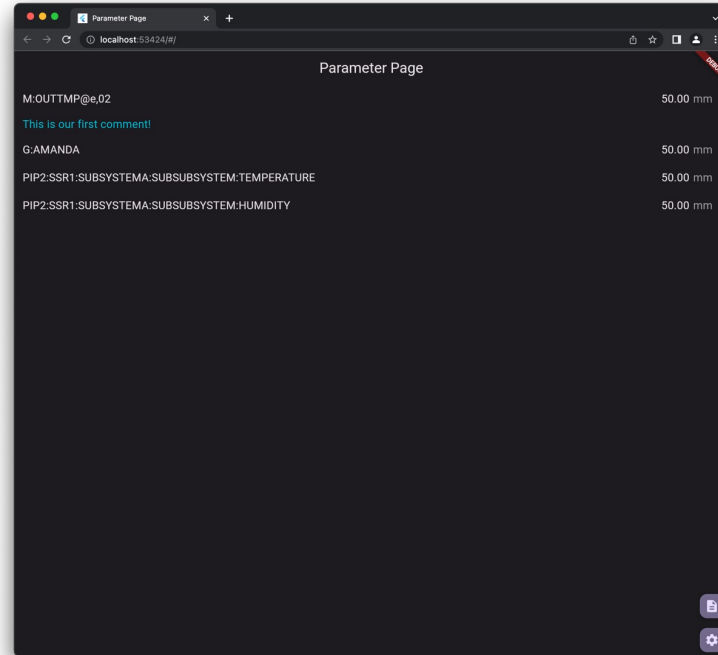
https://github.com/fermi-controls/parameter_page_app

New development and deployment pipelines

- We've adopted GitHub Actions for our continuous integration platform.

- After successful tests, the build is bundled into a container image and installed in our local image repository.

- We use Flux to monitor the image tags and build the newest version.

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More Information

- Design Philosophy for Accelerator Control Rooms

  - https://www.osti.gov/biblio/1960279

- Style guide – coming soon

- Beau Harrison, ACORN User Applications L2 – beau@fnal.gov

- Rachael Hill, ACORN Human Factors Expert – rachael.hill@inl.gov

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Thank you

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Question prompts

- Why are there many solutions to applications?
- Can we agree that 20 to 30-year-old user applications aren't supportable?
  - Is it possible to separate slowly-changing logic from the fast-changing user needs?
- Are the Fermi user application requirements common across facilities?
  - If not, is there a common set of requirements that make sense for EPICS users?
- If we agree on a common set of requirements, is there interest in sharing the development load through open-source development?
  - If so, what are the next steps?
- What can be shared across accelerators, others?
  - Human Factors research results?
  - Style guides?
  - Application frameworks?
  - Applications?

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