# Detector Controls for the NOνA Experiment Using ACSys-In-A-Box

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Fermilab

What is NOνA ?

NOνA (NuMI Off-Axis ν Appearance) is a long-baseline neutrino experiment to study neutrino physics, addressing questions about neutrino oscillation and mass hierarchy, and matter to antimatter asymmetry. It has two detectors: a 200 ton Near Detector at Fermilab and a 14000 ton Far Detector in Minnesota.
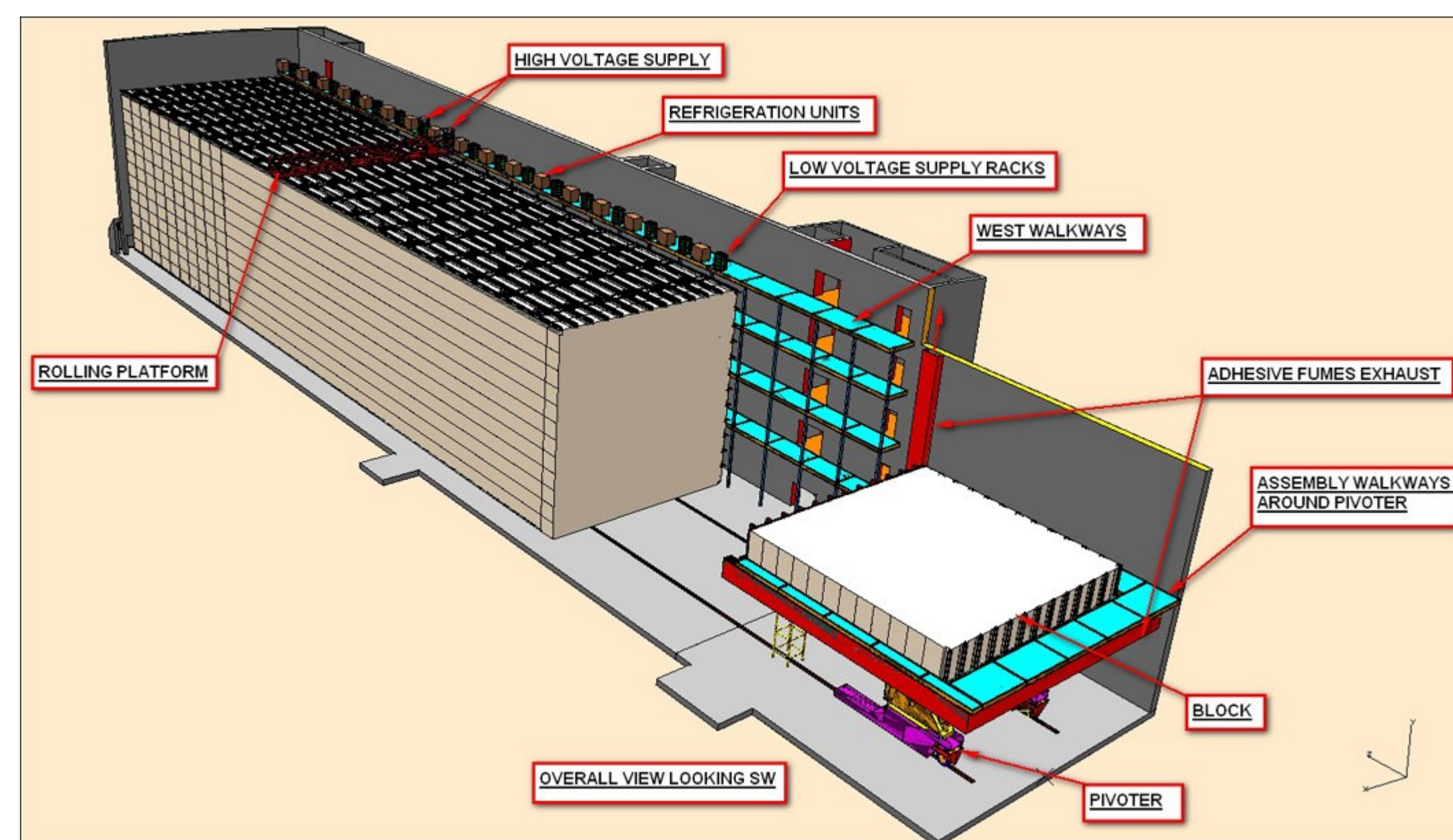
The NOνA Far Detector

Why Off Axis?

NOνA 's detectors are positioned slightly off-center of the beam-line to take advantage of a narrow peak in the beam energy spectrum at that location, which reduces backgrounds.

What is ACSys-In-A-Box?

We've encapsulated Fermilab's ACNET control system so all of its parts can run on a single CPU if needed. At the Fermilab accelerator chain, ACNET is spread across many single-purpose nodes. For the Far Detector, we're condensed into 4 nodes.
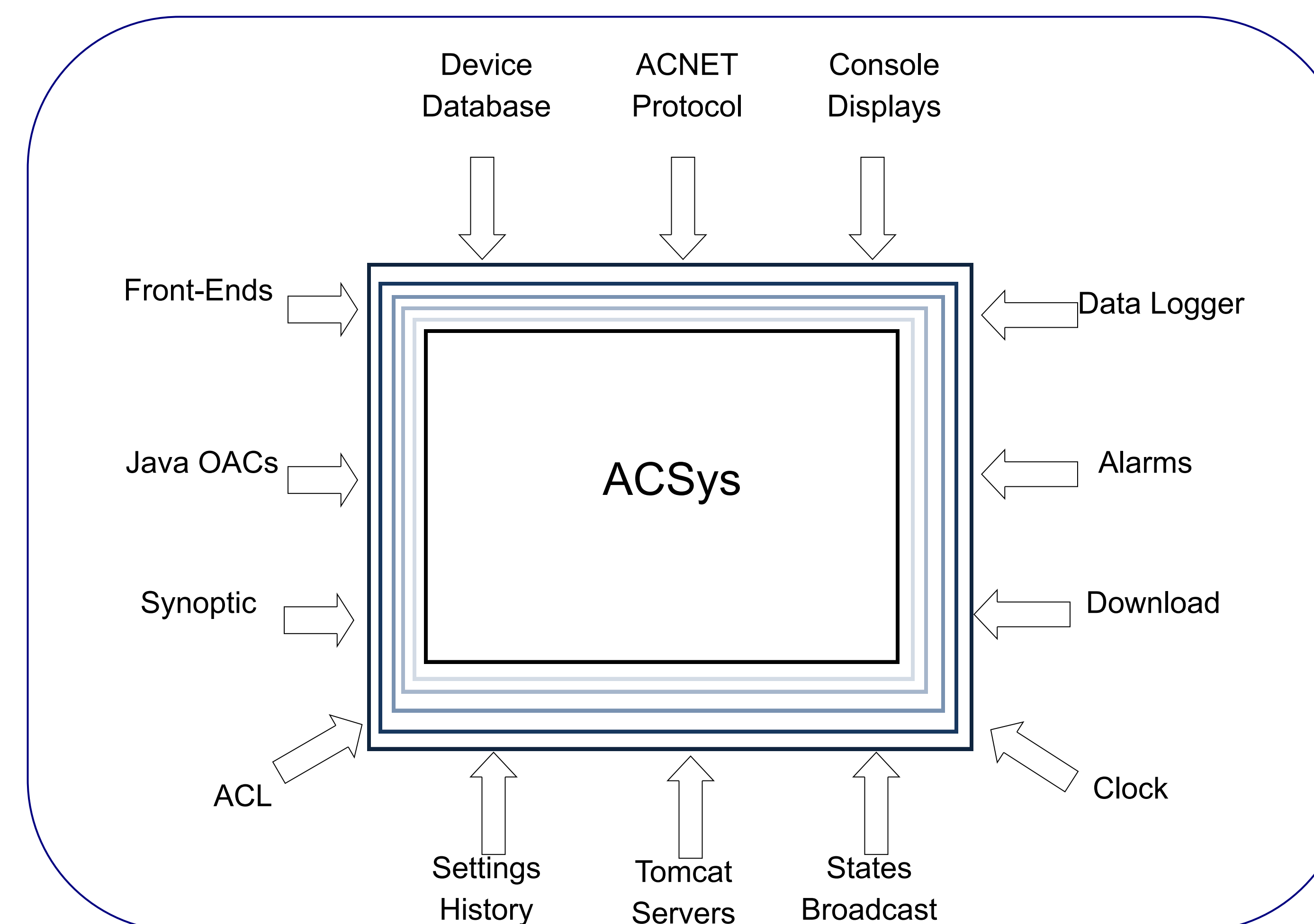
What does ACSys Control/Monitor at NOνA ?

- Power Supplies
  - 56 low & medium voltage crates and 2 high voltage crates
- Position and Strain Gauges
  - Track the long-term state of the detector's PVC blocks
- Rack Monitors
  - Monitor temperature, airflow, and status of relay racks
- HVAC Environment
  - Siemens PLC interface with OPC protocol
- Dry Gas PLC System
  - Monitor gas dryer to prevent damage to thermo-electrically cooled APDs
- Data Acquisition Control System
  - Transfer information between EPICS IOCs controlling the scientific data acquisition hardware.

Why is this a Big Deal?

1. We've enabled the NOνA experiment to begin by providing needed controls functionality
2. Its deployment at the NOνA Far Detector is the fist instance of ACSys-in-a-Box for an experiment not on the Fermi campus.
3. We've proven ACSys is flexible and portable enough to be used in an off-site experiment.
4. The experience has made ACSys better, both at the Far Detector and for the local Fermilab accelerators.

Improvements

Meeting NOνA's requirements led to several upgrades to our control system, both at the Far Detector and at Fermilab:

1. Vitualization of Nodes — allowing us to map any service to any computer, including multiple on the same computer.
2. Hierarchical Alarm Trees
3. Rolling-out acnetd (common protocol infrastructure).
4. Synoptic Improvements (alarm and data logger data display)

Challenges

1. Remoteness of a new site (power, networking prone to outages)
2. Less control over computing infrastructure (computers and network are purchased, installed, and maintained by others).
3. Synchronizing local changes with the remote installation.
4. Original intent of ACSys-in-a-Box was a stripped down Acnet, but we wound up needing nearly every feature we use at home.