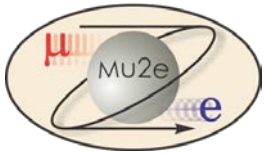
Fermilab

U.S. DEPARTMENT OF ENERGY Office of Science

Trigger & DAQ

Mu2e Independent Cost Estimate

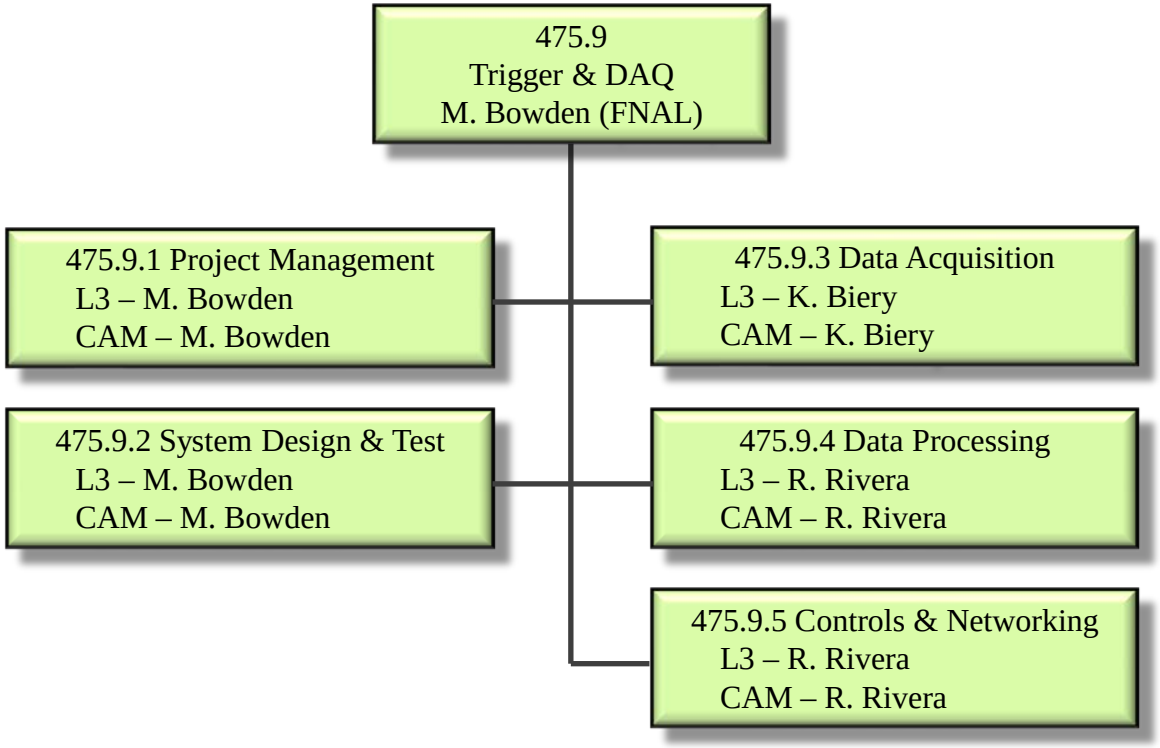


M. Bowden

Trigger & DAQ L2 Manager

8/26/2014

Organization



Requirements

- Trigger & DAQ requirements are described in Mu2e-docdb 1150.
- Science requirements are described in Mu2e-docdb 4381.
- General Requirements
  - Collect data from the Tracker, Calorimeter, CRV, Extinction and Stopping Target Monitors.
  - Provide online filtering to reduce data volume by ≥ 99%.
  - Provide global system timing synchronization.
  - Provide connections to offline storage, processing and site networking.
  - Provide control room/operator interfaces.

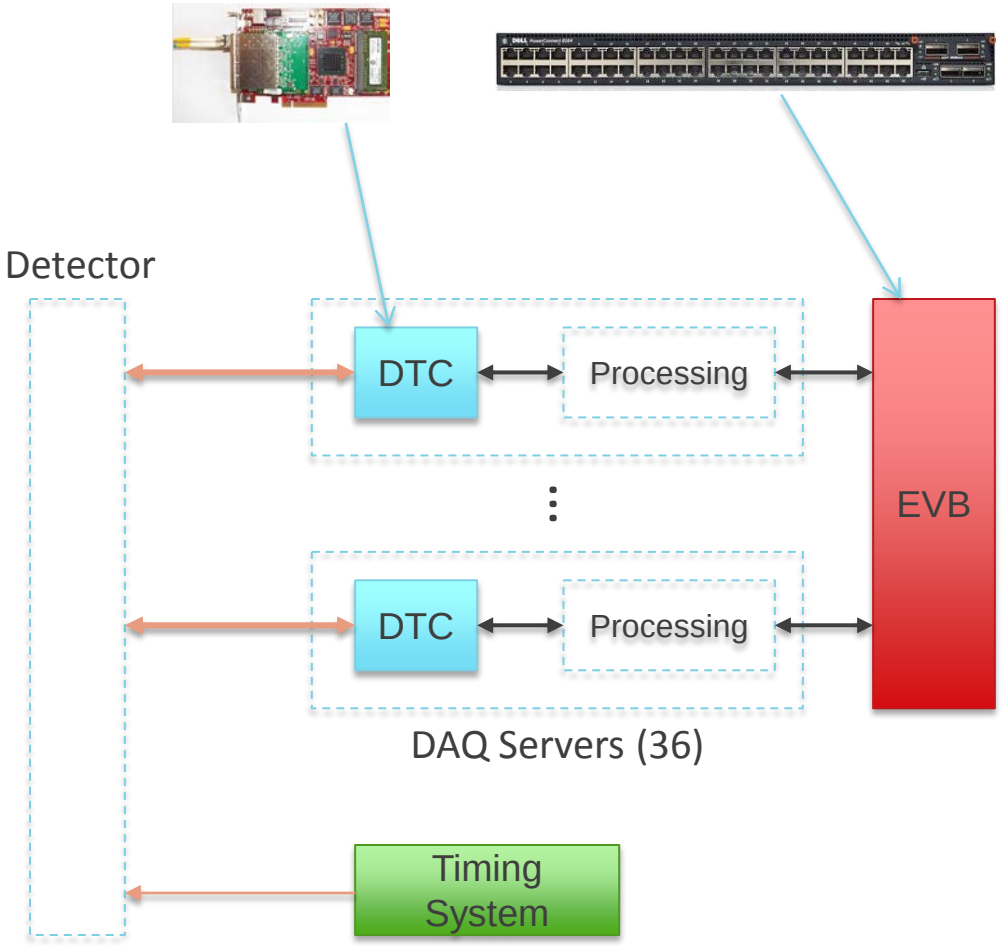
Scope

- 9.1 Management ($1165k)
  - general project management
- 9.2 System Design & Test ($361k)
  - high level system architecture
  - detector integration tests and final system test
- 9.3 Data Acquisition ($1825k)
  - data collection and management
- 9.4 Data Processing ($858k)
  - online data analysis and filtering
- 9.5 Controls & Networking ($580k)
  - control room, general-purpose controls and networking

Scope

- 475.9.3 Data Acquisition

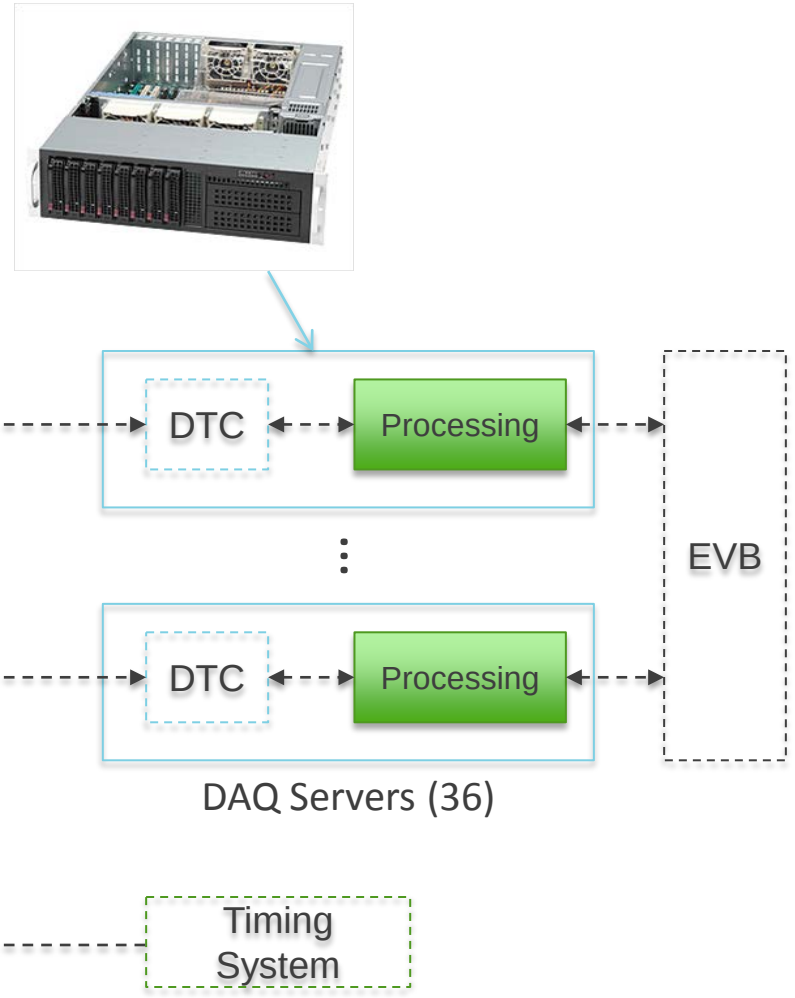
- Data Transfer Controllers (DTCs) and firmware
- Optical Links connecting DTCs to Detector
- Event Building Network (EVB)
- Timing System
- Data Acquisition software running on DAQ Servers and Run Control Host
- Infrastructure (racks, cable trays)



Scope

- 475.9.4 Data Processing

- DAQ Servers
- Data Logger, DCS Host & Run Control Host
- Data Processing software running on DAQ Servers
- Online data filters and analysis



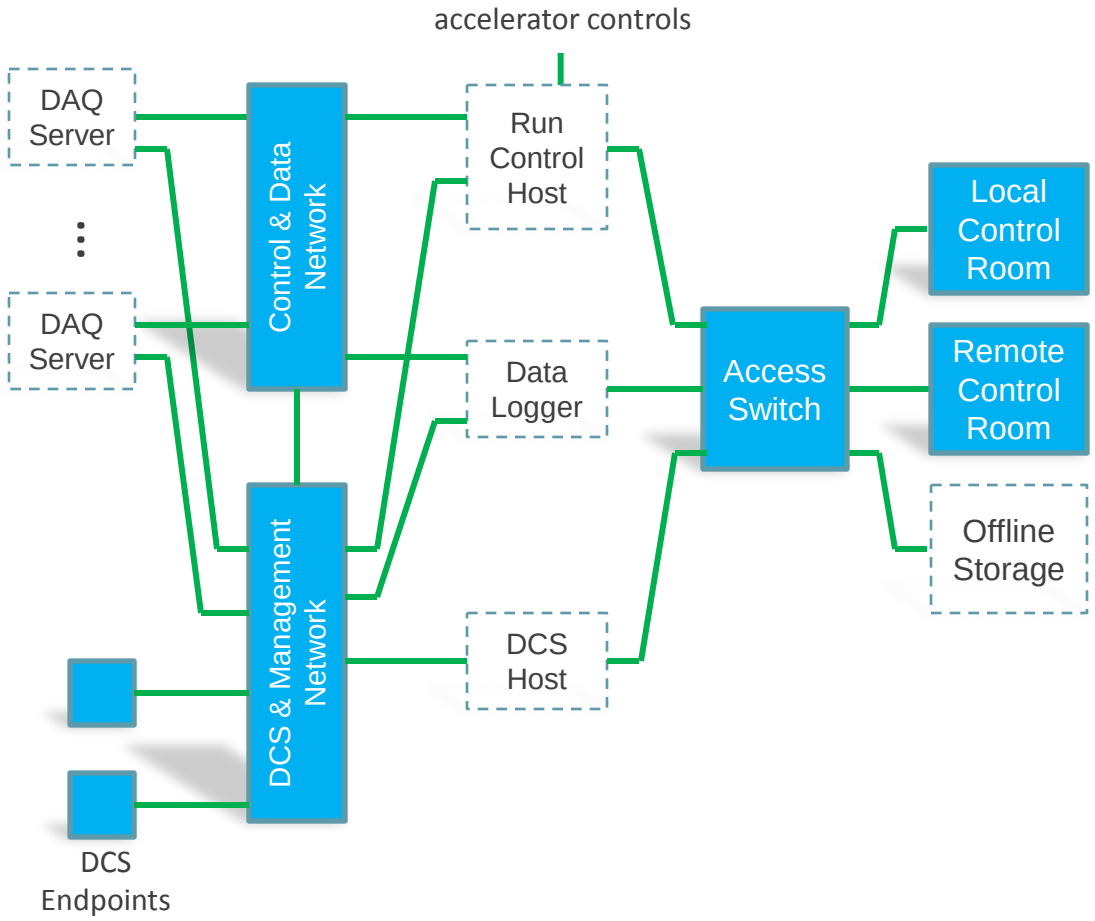
Scope

- 475.9.5 Controls & Networking

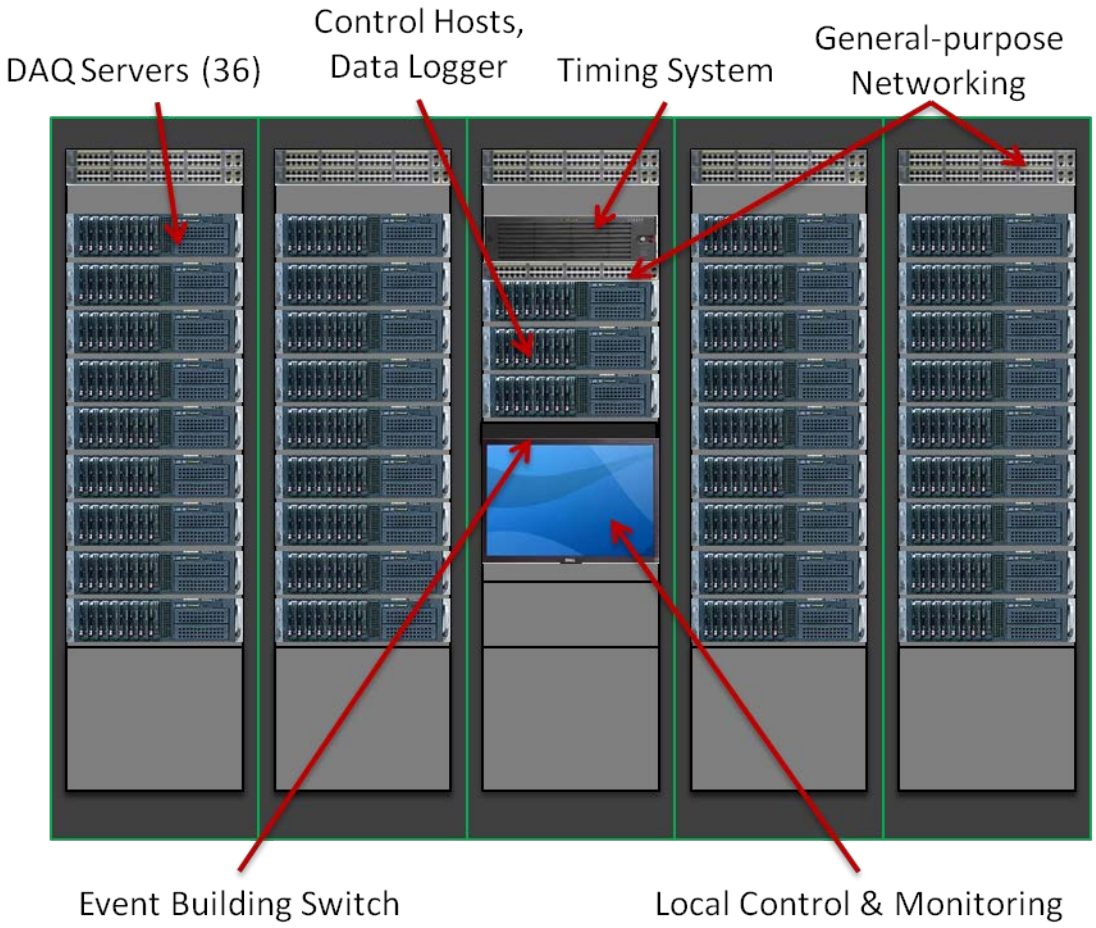
- Control Room

- General-purpose Networking

- Detector Control System (DCS) (lower speed data acquisition and control for environmental data, power supplies, accelerator status, etc)



Scope


DAQ Servers (36)
Control Hosts,
Data Logger
Timing System
General-purpose
Networking
Event Building Switch
Local Control & Monitoring

WBS 475.9.3 Data Acquisition

- Purchase data acquisition electronics, develop data acquisition firmware and software.
  - 475.09.03.02 Pilot System ($545k)
  - 475.09.03.03 Production System ($901k)

WBS 475.9.3 Data Acquisition

- Basis of Estimate
  - 80% of DAQ costs are labor, mainly related to software and firmware development
  - software is always difficult to estimate
  - labor estimates use a top-down approach and are based on a recent project (NOvA) of similar scope and complexity
    - significant overlap in labor resources and software
    - NOvA effort involved both hardware and firmware development, Mu2e is firmware only (reduced engineering cost)
    - Mu2e makes greater use of existing software developed for NOvA and other experiments (reduced software development cost)
  - M&S estimates are based on current catalog pricing

Risks

- TRIG-128: Insufficient manpower for DAQ software
  - Cause: uncosted labor resources may not be available when needed for scheduled tasks
  - Mitigation strategy: use additional costed labor (~$500k)
  - Probability: Moderate (most tasks can be rescheduled to match available resources, good experience with use of scientific labor resources in NOvA software development, increasing university participation in DAQ)

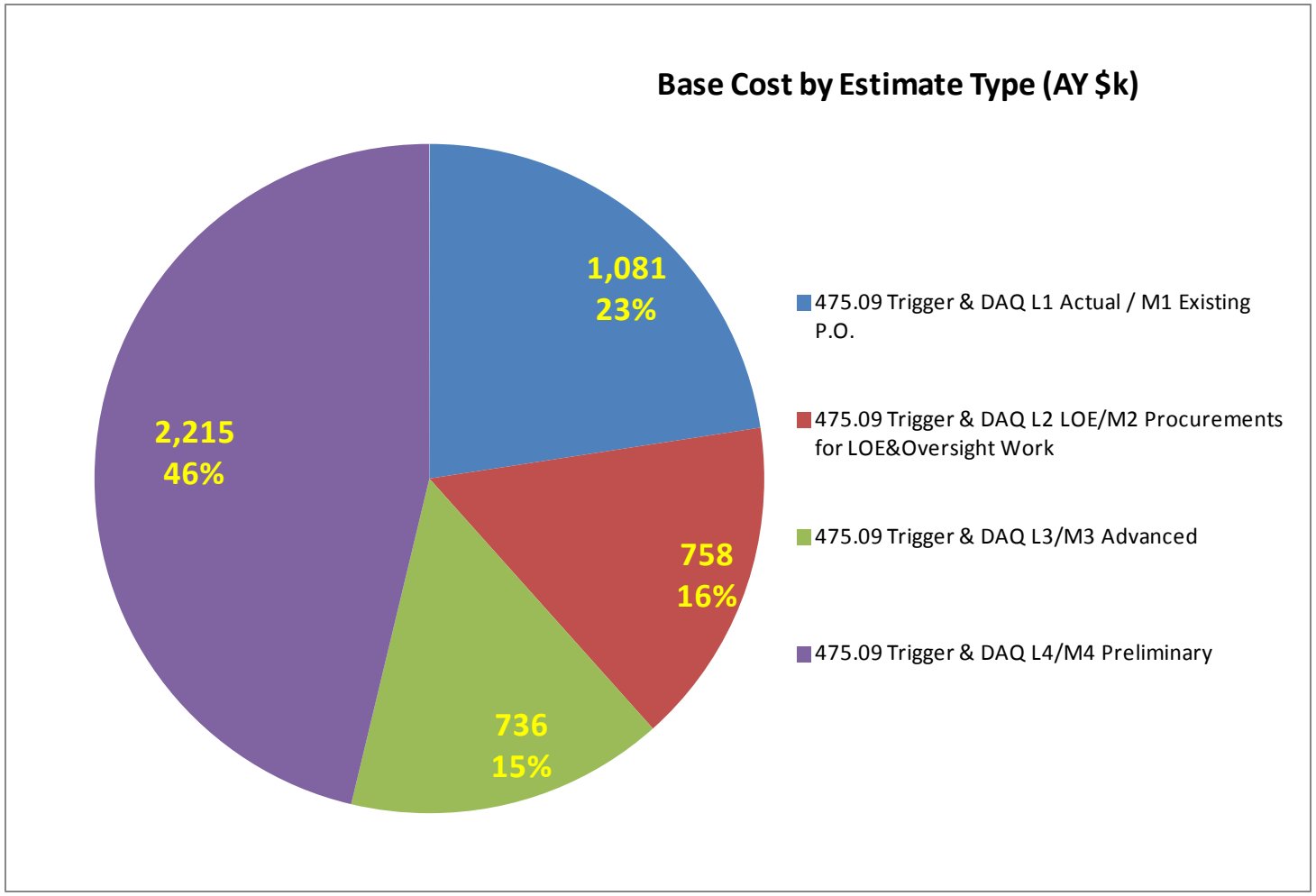
Cost

WBS 9 Trigger & DAQ

Costs are fully burdened in AY $k

	M & S	Labor	Base Cost	Estimate Uncertainty	% Contingency on ETC	Total
475.09.01 Project Management	3	1,162	1,165	119	21%	1,284
475.09.02 System Design and Test		361	361	23	35%	384
475.09.03 Data Acquisition	317	1,508	1,825	457	32%	2,282
475.09.04 Data Processing	310	549	858	207	29%	1,065
475.09.05 Controls and Networking	125	456	581	154	31%	734
475.09.99 Risk Based Contingency				273		273
Total	755	4,035	4,790	1,233	38%	6,023

Quality of Estimate



Summary

- Estimates for Trigger & DAQ are complete
  - costs understood at the Preliminary Design level or higher
- Risks understood, mitigated where possible. Cost set aside as contingency to cover residual risks.
- Estimates are traceable
  - Comprehensive set of BOEs and backup information developed