Title: The NOvA Data Acquisition System: A highly distributed, synchronized, continuous readout system for a Long Baseline Neutrino Experiment.
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The NOvA experiment at Fermi National Accelerator Lab, has been designed and optimized to perform a suite of measurements critical to our understanding of the neutrino's properties, their oscillations and their interactions. NOvA presents a unique set of data acquisition and computing challenges due to the immense size of the detectors, the data volumes that are generated through the continuous digitization of the frontend systems, and the need to buffer the full data stream to allow for highly asynchronous triggering and extraction of physics events. These challenges are compounded by the stringent timing and synchronization requirements that are placed on the acquisition systems by the need to precisely correlate information between the accelerator complex and the remote detector locations.

The NOvA Data Acquisition system has been designed and built to meets these challenges. The system utilizes a highly modular, novel acquisition and event building scheme, which has been deployed on a large hierarchical organization of both custom and commodity computing. This system is coupled with highly optimized software and firmware to aggregate over 350,000 continuously sampled, readout channels into arbitrary length time windows, which are buffered in large compute farms for analysis. These windows allow the experiment to perform not only standard event-trigger based data analysis, but also permit non-traditional searches for macroscopic phenomena, such as core collapse supernova, whose time scales and event signatures are uncharacteristic of the ranges that are addressable by most high energy physics experiments.

In this paper we cover the overall design of the NOvA DAQ system and its capabilities. We present results from its initial deployment with our Near Detector in a surface configuration, and from its deployment on the first blocks of our far detector. We also discuss the planned upgrades to this system that expand its capabilities and allow the experiment to address other topics in high energy physics.