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NOvA Event Building, Buffering, and Filtering within the DAQ System

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The NOvA experiment at Fermi National Accelerator Lab features a free running, continuous readout system without dead time, which collects and buffers time-continuous data from over 350,000 readout channels. The raw data must be searched to correlate it with beam spill events from the NuMI beam facility. They are also analyzed in real-time to identify event topologies of interest. The analysis results then are fed back into the experiment's triggering systems to form data-driven decisions.

The NOvA event building layer is designed to continuously process data at full sampling rate from the NOvA detectors using commodity networking and computing equipment. For the far detector, custom designed upstream hardware delivers fragments of data in 5ms time slices to more than 180 multicore commodity buffering nodes using standard gigabit ethernet switches. The fragments are assembled into full time-synchronized windows and indexed to allow for efficient search and delivery to downstream applications upon receipt of positive trigger broadcasts. The system can sustain a raw data input rate of greater than 2GB/s and buffer in excess of 20 seconds worth of data. The buffer management software feeds all raw time slices into an event processing framework that is common with the offline production. This framework runs analysis modules that examine each slice and generates positive trigger decisions in real-time causing windows of raw data to be transferred to downstream subsystems using global trigger messages.

This paper will describe the system architecture and software processes constructed to perform the buffering and filtering operations within the NOvA DAQ system. The paper will also describe the advantages of the data driven triggering model and the physics potential that it provides.

Summary

The NOvA DAQ event building, buffering, and filtering system are described in this paper.

Primary authors: NORMAN, Andrew (Fermilab); Dr PATERNO, Marc (Fermilab); RECHENMACHER, Ronald (Fermi National Accelerator Lab. (Fermilab))

Co-author: KOWALKOWSKI, Jim (Fermi National Accelerator Laboratory (FNAL))

Presenter: NORMAN, Andrew (Fermilab)

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