Contribution ID: **126**   Type: **oral presentation**

ATLAS High Level Trigger Infrastructure, RoI Collection and EventBuilding

Tuesday 14 February 2006 17:00 (25 minutes)

The ATLAS experiment at the LHC will start taking data in 2007. Event data from proton—proton collisions will be selected in a three level trigger system which reduces the initial bunch crossing rate of 40 MHz at its first level trigger (LVL1) to 75 kHz with a fixed latency of 2.5 µs. The second level trigger (LVL2) collects and analyses Regions of Interest (RoI) identified by LVL1 and reduces the event rate further to ˜3 kHz with an average latency of tens of ms. Subsequently the EventBuilder collects the data from all readout systems and provides fully assembled events to the the Event Filter (EF), which is the third level trigger. The EF analyzes the entirety of the event data to achieve a further rate reduction to ˜200 Hz, with a latency of a few seconds. While LVL1 is based on custom hardware, LVL2, EventBuilder and EF are based on compute farms of O(3000) PCs, interconnected via Gigabit Ethernet, running Linux and multi-threaded software applications implemented in C++. This note focuses on the common design and implementation of the High Level Trigger Infrastructure, RoI Collection and the EventBuilding.

Both LVL2 and EF (collectively called High Level Trigger) use online software for the control and data collection aspects, but the actual trigger selection is developed and tested using the offline software environment. A common approach of the LVL2 Processing Unit and the EF Processing Task for the steering, seeding and sequential processing of the selection algorithms has been developed.

Significant improvements and generalization of the system design, allow for complex data flow functionality steered by the results of the event selection at LVL2 and EF. This allows the handling of events in parallel data streams for physics, calibration, monitoring or debug purposes. The possibility for event duplication, partial Event Building and data stripping are currently under development. Insight in special features of the system, such as load balancing of the various compute farms, traffic shaping and garbage collection will also be given.

The HLT and EventBuilder are being integrated with the LVL1 trigger and the ATLAS subdetectors and will be operated with cosmic events as part of the commissioning in the 2nd half of 2006.

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Session Classification: Online Computing

Track Classification: Online Computing