Event Filter Monitoring with the ATLAS Muon Spectrometer

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The ATLAS detector is one of the major experiments at the CERN Large Hadron Collider (LHC) that will provide proton-proton collisions at an unprecedented center-of-mass energy of 14 TeV. The complete ATLAS detector comprises roughly 140 millions electronic channels registering collisions at the LHC's bunch crossing of 40 MHz. A three stage trigger system will reduce the number of processed events from 10^5 events/sec at the first level up to the 200 events/sec finally written to tape storage. In order to ensure that only good data quality is saved, various monitoring systems are deployed at different levels of the online data-flow to detect potential problems as soon as possible already at the trigger level. During the offline reconstruction, more complex analysis of physics quantities is performed by Data Quality Monitoring, and the results are used to assess the quality of the reconstructed data.

The Event Filter (EF) is the final trigger level and has access to the complete event information and conditions databases. Monitoring installed at this levels is the only trigger monitoring system capable of performing detector and data quality control on complete and calibrated physics events. Both individual subdetector as well as global reconstruction quantities can be monitored at this level, using the same code base as used in offline reconstruction.

The EF monitoring system is based on a monitoring framework [2] interacting with Online Monitoring Services as well as with some other Online Services, provided as part of the ATLAS TDAQ Software infrastructure (Fig.1).

The Lecce ATLAS group is involved in both Online and Offline Monitoring for Muon Trigger at the Event Filter.

In Online the selection of histograms accessible though the Online Histogram Presenter during data taking enables the shifter to assess the quality of the recorded data. Malfunctioning parts can be identified and pointed out to expert for a more detailed analysis.

The specific tasks of our group are the definition and the retrieval of Monitoring observables for the Muon Event Filter, the construction of suitable histograms, as well as the extraction of reference histograms and the implementation of monitoring algorithms which raise an alarm automatically if a monitored observable deviates significantly from its reference value.

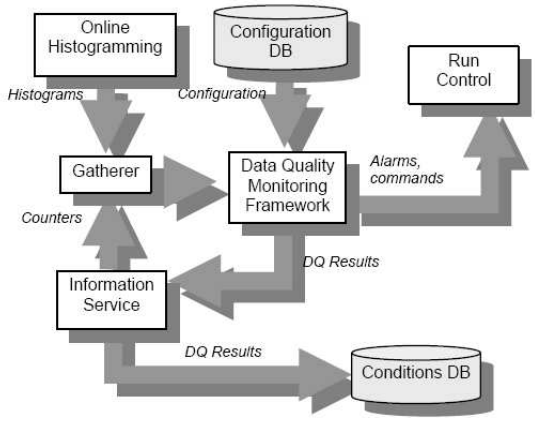

Figure 1. Data Quality Monitoring Framework (DQMF) interaction with the online services. The Information Service (IS) is used to retrieve the required monitoring data and to publish the Data Quality analysis results. Via the Gatherer the histograms are collected from different Online Histogramming Nodes. Messages can be sent to the Trigger/Data Acquisition (TDAQ) system in order to avoid taking faulty data. Condition Database is used to store/retrieve results on Data Quality.

The histograms, displayed to the shifter with an high-level Graphical User Interface (GUI), are flagged with different colours according to the status of the analysis response.

The Event Filter Monitoring has been successfully deployed in the Muon Spectrometer during cosmic runs. Aspects of the muon signal ranging from the readout channel level to quantities related to completely reconstructed muon tracks have been monitored. In Fig. 2 a screenshot of a Monitored observable is shown.

The Muon Event Filter Monitoring has the ca-

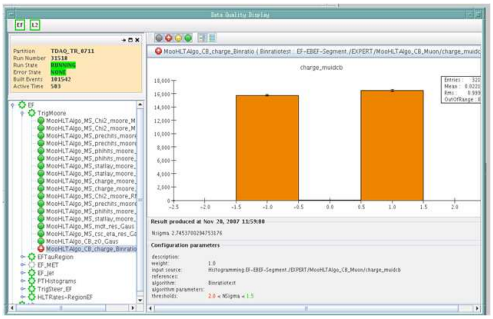

Figure 2. An Online Histogram Presenter screenshot from the Cosmic runs showing the Charge Observable

pability of monitoring reconstructed physics objects, typically constructed by applying pattern recognition algorithms used in the offline to a subsets of data. Clearly a direct comparisons with offline reconstruction is a powerfull tool to assess and define the quality of monitoring.

The Offline Data Quality Assesment is performed in calibration runs on the express stream of physics runs and it is crucial for the elaboration of the go/no-go decision and to update the detector conditions before the bulk recostruction starts. The decision must be taken within 24 hours from the end of the run and it involves both data and detector status.

In order to maximize their effectiveness, both monitoring and Data Quality Monitoring Framework run, with different strategies, in two different computing centers: the main CERN computing center (TIER0) and at the CERN Analysis Facility (CAF).

The offline monitoring at the computing center give the unique opportunity to have a complete analysis of the trigger Data Quality. Here a full comparison with the offline reconstructed physical objects is possible.

In the commissioning phase, when High Level Triggers will not be fully integrated in the Data Acquisition, the emulation of the running of High Level Triggers will be done offline. A crucial role for the start up phase of the experiment is then to be given to the offline monitoring.

At TIER0 express stream the monitoring histograms are filled with High Level Trigger content of online result, the full reconstruction is performed in sequence.

Calibration stream is instead processed at CAF and more refined analysis eventually comprensive of reprocessing of HLT can be performed there. Also at CAF the reconstruction is performed subsequently, on a subsample of data sets.

REFERENCES

1. ATLAS Collaboration is made of about 2500 Physicists coming from 167 Institutions of the following countries: Argentina, Armenia, Australia, Austria, Azerbaijan, Belarus, Brazil, Canada, Chile, China, Colombia, Czech Republic, Denmark, France, Georgia, Germany, Greece, Israel, Italy, Japan, Morocco, Netherlands, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Taiwan, Turkey, UK, USA, CERN, JINR.
2. A.Corso-Radu *et al.*, "Data Quality Monitoring Framework for the ATLAS Experiment at the LHC", IEEE Trans. on Nucl. Science, Vol.55, No.1, February 2008, 417-420.