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Operation of the upgraded ATLAS Level-1 Central Trigger System

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The ATLAS Level-1 Central Trigger system is responsible for forming the level-1 trigger decision based on the information from the calorimeter and muon trigger processors. It has undergone a major upgrade of its key components to cope with the increase of luminosity and physics cross-sections in Run 2. In this presentation, we give an overview of the commissioning and the overall performance of this upgraded system with the first LHC beams. We also discuss all challenges which had to be overcome to provide a reliable, robust and flexible system in time for the first collisions.

Summary

The ATLAS Level-1 Central Trigger (L1CT) system is responsible for forming the level-1 trigger decision based on the information from the calorimeter and muon trigger processors. In order to cope with the increase of luminosity and physics cross-sections in Run 2, several components of this system have been upgraded. A new firmware operates the trigger path backplane with double data rate (80 MHz) in order to double the number of usable inputs to 320. The upgraded hardware can receive additional direct inputs from the new topological processor and can form 512 trigger items, instead of 256 items in Run 1. It also provides extended monitoring capabilities and allows concurrent running of up to 3 different sub-detector combinations which is particularly useful for commissioning, calibration and test runs. The software has also undergone a major upgrade to take advantage of all these new functionalities.

In this presentation, we give an overview of the commissioning and the operation of the upgraded L1CT system with the first LHC beams. We discuss all challenges which had to be overcome to provide a reliable, robust and flexible system in time for the first collisions. To reach this goal, a coherent set of software applications has been developed to display and record all relevant informations needed for the monitoring and operational debugging of the system. For instance, trigger and dead-time rates are monitored at different stages of the processing and are logged by the online computing system for further use by physics analysis and data quality assurance. The bunch-by-bunch trigger information is also used to ensure a proper timing of the ATLAS sub-detectors with respect to the LHC machine. We will also present the overall performance of the system during the first months of collisions in 2015.

Author: MARZIN, Antoine (CERN)

Presenter: MARZIN, Antoine (CERN)

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