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Implementation of the data acquisition system for the Overlap Modular Track Finder in the CMS experiment

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The Overlap Muon Track Finder (OMTF) is the new system developed during the upgrade of the CMS experiment. It uses the novelty approach to find muon candidates basing on data received from three types of detectors: RPC, DT and CSC. The upgrade of the trigger system requires also upgrade of the associated Data Acquisition (DAQ) system, that must transmit the data from the RPC detector, but for continuous monitoring of the OMTF, it should also transmit the data from the CSC and DT detectors. The paper describes the technical concepts and solutions used in the currently developed OMTF DAQ system.

Summary

The CMS experiment is currently undergoing the upgrade of its trigger, including the Level-1 muon trigger. In the barrel-endcap transition region the Overlap Muon Track Finder (OMTF) combines data from three types of detectors (RPC, DT, and CSC) to find the muon candidates.

To monitor the operation of the OMTF, it is important to receive the data which were the basis for the trigger decision. This task must be performed by the Data Acquisition (OMTF DAQ) system.

The new MTCA technology applied in the updated trigger allows implementation of the OMTF DAQ together with the OMTF trigger in the MTF7 board. Further concentration of data is performed by standard AMC13 boards.

The proposed data concentration methodology assumes parallel filtering and queuing of data arriving from all input links (24 RPC, 30 CSC, and 6 DT).
The data are waiting for the trigger decision in the input buffers. The triggered data are then converted into the intermediate 72-bit format and put into the sorter queues.
The block responsible for the building of events receives data originating from the particular Bunch Crossing (BX) from the consecutive sorter queues, converts them to the 64-bit AMC payload words, and puts them into the output queue. That block also generates the AMC header at the beginning and the AMC trailer at the end of the event data.

The system is implemented in a flexible way, and handling of a new data source requires implementation of two specialized blocks: the input data formatter to translate the link data into the sorter queue data and the output data formatter to translate the sorter queue data into the AMC payload.
The AMC payload format used by the OMTF DAQ provides bit field allowing the context-free detection of the data source.

The system may send data not only from the bunch crossing (BX) in which the L1 trigger was generated but also from a configurable number of BXs before the trigger (up to 3) and after the triger (up to 4).
Therefore, according to the current trigger rules, it is possible that the data from a certain BX may belong to two different events.
To handle such cases the OMTF DAQ system uses two output queues alternately for assembling the consecutive events.
It is easily possible to increase the number of output queues if a single BX may belong to a higher number of events due to the change of the trigger rules or number of BX-es transmitted before or after the trigger.

The system in current state handles the RPC data. The data handlers for CSC and DT detectors are being developed. The presented methodology may be reused for other triggered DAQ systems concentrating data from various sources with different formats.

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