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Evaluating a File-Based Event Builder to enhance the Data Acquisition in the CMS Experiment

The event builder in the Data Acquisition System (DAQ) of the CMS experiment at the CERN Large Hadron Collider (LHC) is responsible for assembling events at a rate of 100 kHz during the current LHC run 3, and 750 kHz for the upcoming High Luminosity LHC, scheduled to start in 2029. Both the current and future DAQ architectures leverage on state-of-the-art network technologies, employing Ethernet switches capable of supporting RoCE protocols. The DAQ Front-end hardware is custom-designed, utilizing a reduced TCP/IP protocol implemented in FPGA for reliable data transport between custom electronics and commercial computing hardware.

An alternative architecture for the event builder, known as the File-based Event Builder (FEVB), is under evaluation. The FEVB comprises two separate systems: the Super-Fragment Builder (SFB) and the Builder File-based Filter Farm (BF³).

A super-fragment consists of the event data read by one or more Front-End Drivers and corresponding to the same L1 accept, and the SFB constructs multiple super-fragments corresponding to the number of Read-Unit (RU) machines in the DAQ system, storing them in local RAM disks. Subsequently, the BF³ accesses super-fragments from all RU machines via the Network File System (NFS) over Ethernet and builds complete events within the High Level Trigger process.

This paper describes the first prototype of the FEVB and presents preliminary performance results obtained within the DAQ system for LHC Run 3.

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