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FPGA-based 10-Gbit Ethernet Data Acquisition Interface for the Upgraded Electronics of the ATLAS Liquid Argon Calorimeters

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The readout of the trigger signals of the ATLAS Liquid Argon (LAr) calorimeters is foreseen to be upgraded in order to prepare for operation during the first high-luminosity phase of the Large Hadron Collider (LHC). Signals with improved spatial granularity are planned to be received from the detector by a Digitial Processing System (DPS) in ATCA technology and will be sent in real-time to the ATLAS trigger system using custom optical links. These data are also sampled by the DPS for monitoring and will be read out by the regular Data Acquisition (DAQ) system of ATLAS which is a network-based PC-farm.

The bandwidth between DPS module and DAQ system is expected to be in the order of 10 Gbit/s per module and a standard Ethernet protocol is foreseen to be used. DSP data will be prepared and sent by a modern FPGA either through a switch or directly to a Read-Out System (ROS) PC serving as buffer interface of the ATLAS DAQ.

In a prototype setup, an ATCA blade equipped with a Xilinx Virtex-5 FPGA is used to send data via an ATCA switch to a server PC which has 10 Gbit dual-port Myricom network interface cards installed. The FPGA is implementing a 10 Gbit Ethernet with a XAUI interface and UDP protocol. After tuning of the network parameters, transfer speeds of up to 9.94 Gbit/s were achieved. The 10 Gbit Ethernet link is also used for configuration of the FPGA. Data is stored in a ring-buffer on the server PC for further random access by the DAQ system according to a trigger ID.

The talk presents the overall concept of a 10 Gbit Ethernet readout link between a FPGA-based Data Processing System and a PC-based buffer and DAQ system, compatible with the existing ATLAS DAQ. Experience from the prototype system in ATCA technology will be reported including performance and technical implementation, which may also be useful for other DAQ applications of particle detectors.

Summary

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