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FELIX and the SW ROD: the ATLAS readout system for the next decade

Over the next decade, the ATLAS experiment will be required to operate in an increasingly harsh collision environment. To maintain physics performance, the ATLAS experiment will undergo a series of upgrades during major shutdowns. A key goal of these upgrades is to improve the capacity and flexibility of the detector readout system. To this end, the Front-End Link eXchange (FELIX) system was developed as the new interface between the data acquisition; detector control and TTC (Timing, Trigger and Control) systems; and new or updated trigger and detector front-end electronics.

FELIX functions as a router between custom serial links from front end ASICs and FPGAs to data collection and processing components via a commodity switched network. The serial links may aggregate many slower links or be a single high bandwidth link. FELIX also forwards the LHC bunch-crossing clock, fixed latency trigger accepts and resets received from the TTC system to front-end electronics. FELIX uses commodity server technology in combination with FPGA-based PCIe I/O cards.

FELIX servers run a software routing platform serving data to network clients. Commodity servers connected to FELIX systems via the same network run a new multi-threaded software infrastructure (known as the Software ROD) for event fragment building, buffering and detector-specific processing to facilitate online selection. The network itself is implemented using RDMA over Converged Ethernet (RoCE) to maximise throughput and minimise overheads.

After an initial deployment for the upcoming LHC Run 3, FELIX and the SW ROD will play an expanded role in the High Luminosity (HL-LHC) era. Development of these updated systems is now well advanced, with performance and integration testing with detector electronics under development for HL-LHC.

This presentation will cover the design of FELIX and the Software ROD for LHC Run 3, as well as the RoCE implementation underpinning high throughput communication between the two systems. Results will also be shown from the latest commissioning and integration activities in ATLAS, as 2021 has seen the transition to a full time operational system taking place. Finally, designs and test results for LHC Run 4 will also be shown, demonstrating how FELIX and the SW ROD will scale to meet the upcoming challenge.

Significance

References

Speaker time zone

No preference

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