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## The DAQPATH readout system of the Serenity boards for the CMS Phase-II Upgrade

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The Serenity boards are ATCA-format boards used in the readout of the CMS High-Luminosity upgrade detector, use up to 144 optical (up to 10 Gb/s) input links to transfer data from the front-end (FE) where they will be properly formatted by high-performance FPGAs, and eventually routed via 4 output optical 25 Gb/s links to other BE boards.

We will present the architecture and behavior of the system that handles these data from the FE to the final Data Acquisition system (DAQ) of CMS: the DAQPATH.

After the L1-accept, data from the FE are received in input buffers. When all data of the current event are present, the DAQPATH uses a main FSM with a token ring architecture that starts sequentially the buffer readout and merges them into data packets in output buffers that feed the 25 Gb/s output links. The DAQPATH system has a modular and parametric structure: each DAQPATH module feeds one output link with data from a programmable number of sources. Different sizes of input data are allowed. Input channels can be organized in groups and pipelined to meet timing requirements.

The DAQPATH firmware has been validated through extensive functional simulations. It has been implemented in different configurations in the Xilinx Kintex Ultrascale+ FPGA housed in the Serenity board and successfully tested on hardware at the Tracker Integration Facility at CERN, at the required core frequency of 360 MHz.

The Extensible Modular Processor (EMP) is the common framework for the development of DAQ, trigger and control firmware in the CMS experiment. EMP provides a flexible platform that allows sharing of firmware modules and compatibility with FPGA devices housed in the different boards. The DAQPATH firmware has been successfully integrated in the EMP framework and it is now available to CMS firmware developers.

### Collaboration

CMS

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