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Acceleration of Cherenkov angle reconstruction with the new Intel Xeon/FPGA compute platform for the particle identification in the LHCb Upgrade.

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The LHCb experiment at the LHC will upgrade its detector by 2018/2019 to a 'triggerless' readout scheme, where all the readout electronics and several sub-detector parts will be replaced. The new readout electronics will be able to readout the detector at 40MHz. This increases the data bandwidth from the detector down to the event filter farm to 40TBit/s, which also has to be processed to select the interesting proton-proton collision for later storage. The architecture of such a computing farm, which can process this amount of data as efficiently as possible, is a challenging task and several compute accelerator technologies are being considered for use inside the new event filter farm.

In the high performance computing sector more and more FPGA compute accelerators are used to improve the compute performance and reduce the power consumption (e.g. in the Microsoft Catapult project and Bing search engine). Also for the LHCb upgrade the usage of an experimental FPGA accelerated computing platform in the event building or in the event filter farm (trigger) is being considered and therefore tested. This platform from Intel hosts a general CPU and a high performance FPGA linked via a high speed link which is for this platform a QPI link. On the FPGA an accelerator is implemented. The used system is a two socket platform from Intel with a Xeon CPU and an FPGA. The FPGA has cache-coherent memory access to the main memory of the server and can collaborate with the CPU.

As a first step, a computing intensive algorithm to reconstruct Cherenkov angles for the LHCb RICH particle identification was successfully ported to the Intel Xeon/FPGA platform and accelerated by a factor of 35. Also other FPGA accelerators, GPUs, and High Energy Physics trigger algorithms were tested for performance and power consumption. The results show that the Intel Xeon/FPGA platforms, which are built in general for high performance computing, are also very interesting for the High Energy Physics community. Furthermore, the new Intel Xeon/FPGA with Arria10 will be tested.

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