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Towards a heterogeneous High Level Trigger farm for CMS

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The CMS experiment has been designed with a two-level trigger system: the Level 1 Trigger, implemented on custom-designed electronics, and the High Level Trigger (HLT), a streamlined version of the CMS offline reconstruction software running on a computer farm. A software trigger system requires a trade-off between the complexity of the algorithms running on the available computing resources, the sustainable output rate, and the selection efficiency.

During its "Phase 2" the LHC will reach a luminosity of $7{\times}10^{34}\mathrm{cm}^{-2}\mathrm{s}^{-1}$ with a pileup of 200 collisions. To fully exploit the higher luminosity, the CMS experiment will increase the full readout rate from 100 kHz to 750 kHz. The higher luminosity, pileup and input rate present an unprecedented challenge to the HLT, that will require a processing power larger than today by at least a factor 20. This exceeds by far the expected increase in processing power for conventional CPUs, demanding an alternative approach.

Industry and HPC have been successfully using heterogeneous computing platforms, that can achieve higher throughput and better energy efficiency by matching each job to the most appropriate architecture.

The reliable use of a heterogeneous platform at the HLT since the beginning of Phase 2 requires the careful assessment of its performance and characteristics, which can only be attained by running a prototype in production already during Run 3. The integration of heterogeneous computing in the CMS reconstruction software depends upon improvements to its framework and scheduling, together with a tailoring of the reconstruction algorithms to the different architectures.

This R&D work began in 2017, and by the end of 2018 produced a demonstrator working in realistic conditions. This presentation will describe the results of the development and the characteristics of the system, along with its future perspectives.

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