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The CMS Global Muon Trigger upgrade

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To continue triggering with the current performance in the LHC Run 2 the Global Muon Trigger (GMT) of the CMS experiment will be reimplemented in a Virtex-7 card utilizing the uTCA architecture. The thus available high-capacity input as well as increased logic could be used to migrate the final sorting stage of each subsystem to the GMT. Additionally the GMT will calculate a muon's isolation using energy information received from the calorimeter trigger which will be propagated to the Global Trigger.
A summary of the current status of the future GMT's development will be given.

Summary

The Level-1 Trigger of the CMS experiment is responsible for reducing the rate of events to be read out from 40 MHz (the bunch crossing frequency) to 100 kHz, which will be then further reduced by the High-Level Trigger. A key component of the Level-1 Trigger is the Global Muon Trigger (GMT). It receives data from the regional muon triggers, which are processed and merged to produce muon candidates. These candidates are checked for so-called ghosts (i.e. two tracks from different subsystems corresponding to the same particle), merged appropriately, and then sorted in two stages before a set of best muons is finally sent to the Global Trigger (GT).
The upgrade of the LHC for Run 2 will require the L1 Trigger to cope with higher multiplicities due to the increased luminosity of the accelerator. This will require the GMT to increase the number of muons sent to the GT from currently four to eight as well as increase the resolution of the muon information. Furthermore the complete system will be upgraded to use high-bandwidth optical links as well as powerful FPGAs. Additionally, a new track finder dedicated to the overlap region shared between endcaps and barrel will be introduced, augmenting the barrel and endcap track finders and providing additional inputs to the GMT.
To comply with these requirements the upgraded GMT will be implemented in a Virtex-7-based card within the uTCA architecture. Currently the MP7 card developed by Imperial College is being targeted which will offer 72 input and 72 output links at 10 Gb/s. The thus available high-capacity inputs as well as increased logic will allow to move the final sorting stage of each subsystem to the GMT. This will mean 36 muons to be received from each of the three track finders which will require half the available input bandwidth. Initially the sorting would still be done separately for each subsystem, however in the future it may be possible to implement more ambitious algorithms if these improve the GMT's performance and resources permit it. An immediate benefit of the integration of the final sorters into the GMT is the possibility of doing ghost-busting between the track finders'muons at an earlier stage, thus reducing the probability of replacing a true muon with a ghost that will only later be canceled. Additionally the GMT will be able to calculate a muon's isolation using energy information obtained via optical links from the calorimeter trigger. The isolation information will then be propagated to the GT together with the muons'other information.
As the future GMT should be able to flexibly adapt to changing physics requirements, a further requirement for its development is the provision of significant spare logic capacity. If the need arises the GMT can in this way be reconfigured to provide extended functionality without large changes to the hardware.
We report on design studies and the current status of the firmware implementation.

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