TRACK FINDING PROCESSOR FOR THE CMS ENDCAP LEVEL 1 MUON TRIGGER

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A fast three-dimensional Track-Finding Processor was designed for the Level-1 trigger of the CMS endcap muon system. The Track-Finding Processor is implemented as 12 Sector Processors (SP), each of which identifies up to three best muons in a 60-degree azimuthal sector [1]. The purpose of the Track-Finding Processor is to link trigger primitives (track segments) from individual muon stations (four endcap stations ME1-4 and two barrel overlap regions MB1-2) into complete tracks, measure the transverse momentum P_t from the sagitta induced by the magnetic bending, and report the number and quality of tracks to the Level-1 Muon Trigger. The maximum number of track segments collected by one SP is 15 per 25 ns bunch crossing.

Block diagram of the SP logic in Fig. 1 includes:

1. Sector Receiver (SR), which receives local charge track information for 15 muons via optical links. This information is then synchronized and reformatted within the SR (*via* look-up tables) into angular variables for the muons: azimuthal angle φ, local bent angle in φ (φb) and pseudo-rapidity η.

2. Five Extrapolation Units (EU), where all possible pairwise combinations of track segments are tested for consistency with a single track. Each EU takes spatial information from two track segments in different stations and tests if those two segments are compatible with a muon originating from the nominal collision vertex with a curvature consistent with magnetic bending in that region.

3. Three Track Assembly Units (TAU) to examine all outputs of the EUs and determine if any two track segment pairs belong to the same muon. If so, those segment pairs are combined and rank is assigned based on the muon stations involved. For this SP design, stations ME2 and ME3 are the key stations. A valid trigger in the end-cup region must have a hit in one of these two stations. The output of the EUs can be separated into three streams: two for patterns keying off ME2 and ME3 in the end-cup region, and one for pattern keying off ME2 in the end-cup or/and barrel overlap region. Up to three tracks may be found per data stream, nine tracks in total for all three streams.

4. Final Selection Unit, which selects the best three muon candidates. It also features cancellation logic for redundant tracks.

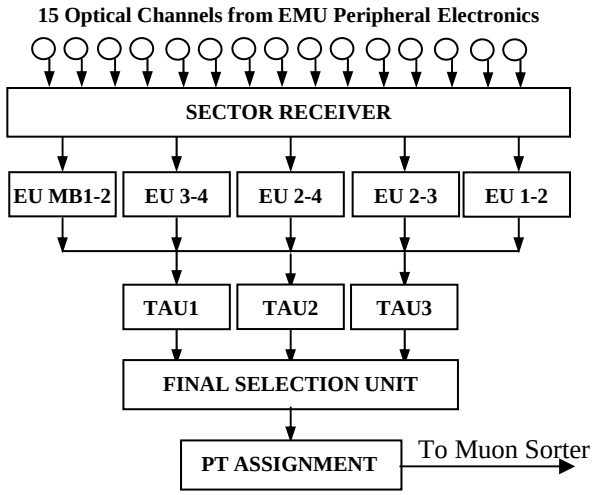

Fig. 1. Sector Processor block diagram

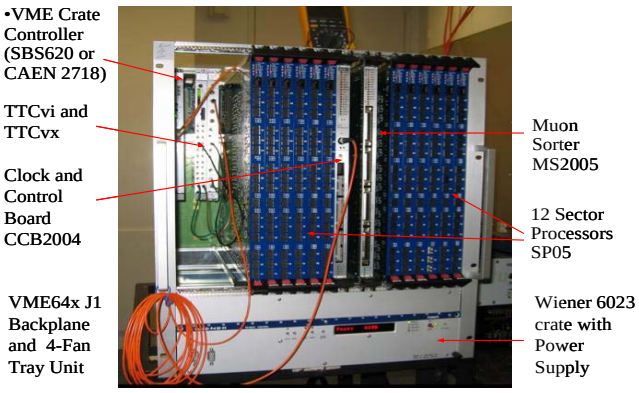

Fig. 2. Track-Finding Crate

5. Assignment Unit, which measures the track parameters of the best three selected muon candidates.

Finally, the best three muon candidates are sent to the Muon Sorter that in turn selects the best four candidates within all tracks of the 12 Sector Processors and sends them to the Global L1 Muon Trigger.

Figure 2 shows a fully assembled Track-Finding Crate with 12 Sector Processors and Muon Sorter.

References

1. D. Acosta *et al.*, Nucl. Instr. Meth. A **496**, 64 (2003).