CSC Track Finder: Hardware Status

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EMU and CMS Week
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• Completed a conceptual design
  CMS Note :
  http://www.phys.ufl.edu/~acosta/cms/sp_design.pdf

• Internal review on the design in July at FermiLab
CSC Muon Trigger Scheme
CSC Track-Finder

- CSC Track-Finder consists of 12 Sector Processors (SP) that cover CSC and CSC/DT overlap. Each SP handles track primitives (LCTs) in $\Delta \phi = 60^\circ$ and $1.0 < |\eta| < 2.4$
- Link LCTs into tracks (3-D algorithm)
- Measure Pt, $\phi$ and $\eta$
- Send 3 best track candidates to the Muon Sorter
Simplified Sector Processor Layout for Endcap + Overlap Regions

- All components in a 9U VME board
- Signals from Sector Receiver (SR) are sent across a point-to-point backplane to the SP
- DT track segments are delivered to SP via a transition board on the back of the crate
- **Two Bunch Crossing Analyzer**: Analyze LCTs received in two different bunch crossings
- **Extrapolation Unit (EU)**: Links LCTs in two CSC stations together
- **Track Assembler Unit (TAU)**: Use extrapolation results to form tracks
- **Final Selection Unit (FSU)**: Selects 3 best track candidates
• **Assignment Unit**: Determines the $P_t$, $\phi$, $\eta$ of the selected track candidates

• *Latency expected to be 14 BX*
Extrapolation Unit

Endcap

- Perform all combinations of extrapolations:
  \[ E_{1i} \leftrightarrow E_{2k}, \ E_{1i} \leftrightarrow E_{3k}, \ E_{2i} \leftrightarrow E_{3k}, \ E_{2i} \leftrightarrow E_{4k}, \ E_{3i} \leftrightarrow E_{4k}, \]
  no \( E_{1i} \leftrightarrow E_{4k} \) (to save logic and reduce random coincidences)

Overlap

- Perform all combinations of extrapolations:
  \[ B_{1i} \leftrightarrow E_{2k}, \ B_{2i} \leftrightarrow E_{2k} \]
Extrapolation Unit in Detail

- Track primitives are matched in $\eta$ (Endcap only)
- Assign coarse Pt (Low Pt, Medium Pt, High Pt)
- $\phi$ road finder: match $\Delta \phi$ with $\phi_b$ of the two LCTs
- Results of extrapolations are in form of quality codes
Data Streams to Track Assembler Unit (TAU)

- Results from extrapolations are sent to TAU in 3 Streams
  - Stream 1: E1 ↔ E2, E2 ↔ E3, E2 ↔ E4 (Endcap)
  - Stream 2: E1 ↔ E3, E2 ↔ E3, E3 ↔ E4 (Endcap)
  - Stream 3: B1 ↔ E2, B2 ↔ E2 (Overlap)
Track Assembler Unit (TAU)

From Extrapolation Units

- ME3, ME4
- ME3, ME2
- ME3, ME1
- ME1
- ME2
- ME3
- ME4
- MB2
- MB1
- ME1
- ME2
- MB2
- MB1
- ME1
- ME2
- MB2
- MB1

To Final Selection Unit

- LINK 33
- LINK 32
- LINK 31
- LINK 23
- LINK 22
- LINK 21

6 bit Ranking &
9 bit hit i.d.

SRAM 256Kx16 IDT

Endcap:
3 bits for ME1
2 bits for ME4
Overlap:
2 bits for ME2
2 bits for ME3
2 bits for MB1
2 bits for MB2
3 bits for ME1
2 bits for ME2
• TAU implemented as 9 static RAM memories for Endcap and Overlap

• Each Link unit handles all extrapolations to a single LCT in station 2 and 3. Successful extrapolations are used to form the best track pattern.

• Id of the track segments and the quality of the assembled track are sent to the Final Selection Unit (FSU)
Compare the qualities of the tracks and the ID of the LCTs that form the tracks to

- cancel redundant tracks
- select 3 best distinct tracks
**Assignment Unit**

- Determines the $\phi$, $\eta$, Pt of the selected 3 best muon candidates

**Pt Assignment**

- Determines Pt using $\phi$, $\eta$ measurements from 2 or 3 stations

- $\sigma_{Pt}/Pt \sim 30\%$ with only 2 stations

- $\sigma_{Pt}/Pt \sim 20\%$ with 3 stations
  \[ \Rightarrow \text{improve rate reduction at Level 1} \]
Plans

- Custom backplane design has started. Prototype board will be ready by late October.
- SP board layout has started
- Begin prototype production in Spring 2000
- Test SP + backplane + SR in Summer, finish by Fall
Board Layout of the Sector Processor (endcap + overlap region).