Silicon Trigger Cluster Card

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STC Functionality

• **What are we expected to do?**

  – Find clusters in the Silicon detector associated with the outer track

  • **Inputs:**
    – receive SMT data
    – receive L1CTT roads

  • **Functionality:**
    – find hit clusters
    – filter axial hits in track roads

  • **Data output**
    – send filtered hits to TFC
    – send ALL hits to L3
    – send 90° hits to ZVC
    – collect stats for monitoring
    – send all internal info for unbiased events
Where do we fit in?

**Six fold STT symmetry ⇒ 9 STC cards in each crate (72 SMT ladders on 36 fibers)**

Current cabling scheme suggests 6 out of 36 fiber will have data mixed across 30° sectors.
Implementation

From FRC

To TFC

To ZVC

Initialization and Monitoring

From SMT (4 fibers)
SMT Data Input Stage

- Read in SMT strip information
- suppress bad channels
- apply gains and pedestal corrections (by chip)

Send data to cluster finder

Raw/corrected data available for L3 readout on unbiased events

2/21/00

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Clustering Stage

- Combine contiguous strips above a threshold into clusters
- Compute cluster centroid based on peak with the highest pulse height and its $\pm 2(1)$ neighbours
  - Centroids sent to Hit Filter and L3 FIFO
- Compute dE/dx thresholds
Clustering & Centroid Algorithm

- Keep L2STT clustering same as Offline
- Limit centroid calculation to 5 *central strips*

Resolution for offline algorithm

Resolution for 5 strip centroid algorithm
Clustering & Centroid Algorithm

- Resolution for clusters with hits from multiple tracks

Resolution for offline algorithm

Resolution for 5 strip centroid algorithm
Event Controller and Hit Filter

- **Event Controller read in data from FRC**
  - Event information
    - (Evt #, SCL info, Level1 Qualifiers)
  - Read L1CTT tracks
    - (send necessary info to hit filter)

- **Hit Filter**
  - convert L1CTT road to SMT roads
  - collect all centroids in a given road
  - send centroids in road to TFC
## Data Output

<table>
<thead>
<tr>
<th>Data type</th>
<th>L3 (normal)</th>
<th>L3 (unbiased)</th>
<th>TFC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected</td>
<td></td>
<td>1 of 8</td>
<td></td>
</tr>
<tr>
<td>Cluster (incl strips)</td>
<td></td>
<td>1 of 8</td>
<td></td>
</tr>
<tr>
<td>Centroids Axial, 2-deg, 90-deg</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Centroids In roads</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>L1CTT info</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bytes/event</td>
<td>160</td>
<td>630</td>
<td>136</td>
</tr>
</tbody>
</table>
Configuration and Monitoring

- **Monitor**: (on CollectStatus L1_QUAL send the following to the CPU)
  - error counts for all 8 STC channels/card
  - 8-bit histogram of channel hit
  - Total # of axial/ 2°/ 90° centroids for each channel
  - Time spent in various processing states
  - # of hits transferred to TFC

- **Configuration**:
  - look up tables
    - gains, pedestal, road conversion, various thresholds
  - `begin run’ download:
    - bad channel list
    - L3 and monitor readout data-type
Functional Simulation

• clustering algorithm and centroid computation
  (June’99 version)

  – Resource allocation for device EPF10K50EQC208-1
    • assume: 1 MHz Clock, Single Chip, No bad/skipped channels
      
      Total logic cells used: 1433/2880  (49%)
      Total embedded cells used: 40/160  (25%)
      Total EABs used: 8/10  (80%)
      Average fan-in: 3.24/4  (81%)
      Total flipflops required: 481

  – Static Timing Analysis of Baseline Design showed 30MHz Maximum Clock Freq
  – Performance limited by Clustering Module.

  – Beginning Revision 2 Design...
    • Add Hit Filter
    • Add 3 or 5 strip cluster finder option
    • Examine PCI bus interface
    • Add L3 buffer/monitoring requirements.
STC development and test platform

PC-MIP card

development platform

PC mother board

commercial adapter board
Summary

• Specifications near completion
• Functional simulation started to assess the timing and resources needed
  • Expect to start layout by 6/1/00
  • Prototype next fall