ME1/a: Ganged Readout?

- Descoping of ME1/a is being discussed to save money
- Background:
  - Other studies show ME1/a triggering is not essential.
  - ME1/a readout is useful for improving data for, e.g., “4th muon”, at least for redundancy
  - One can eliminate cathode readout and just have anode readout, but no momentum measurement and there are high backgrounds
  - Intermediate possibility: 3x ganging of ME1/a readout?
- Conclusion: 3x ganging works very well
  - The only electronics needed is the on-chamber CFEB board
  - Simulation studies* show that cathode LCT information can reduce data rate by up to factor of 12
  - Therefore, recommend to include the cable to the TMB allowing CLCT pattern information

*Based on “CSC Trigger Primitive Rates in ORCA”, CMS note in preparation, by Jason Mumford and Slava Valouev
ME1/1 and ME1/a

On-chamber electronics

Peripheral Crate electronics

ALCT

CFEB

DMB

DAQ

LCT*L1A

TMB

Trigger
ME1 Sectors

- One peripheral crate per sector
- All ME1 chambers subtend 10°
- New scream requires 30° sectors
- Nice feature: extra CFEB connects to empty spigots on peripheral electronics
- Re-scope will be difficult because it requires 20° sectors, hence:
  - More crates
  - More cards
  - Re-cabling
  - New daisy chain for ALCT signals
  - New ME1 backplane

<table>
<thead>
<tr>
<th>Previous ME1/a</th>
<th>Descoped ME1/a</th>
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<tbody>
<tr>
<td>20° sectors</td>
<td>30° sectors</td>
</tr>
<tr>
<td>2 x ME1/3</td>
<td>3 x ME1/3</td>
</tr>
<tr>
<td>2 x ME1/2</td>
<td>3 x ME1/2</td>
</tr>
<tr>
<td>2 x ME1/1</td>
<td>3 x (ME1/1+ME1/a)</td>
</tr>
<tr>
<td>2 x ME1/a</td>
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<table>
<thead>
<tr>
<th>VME Crate Slots</th>
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<tbody>
<tr>
<td>8 x DMB</td>
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<tr>
<td>8 x TMB</td>
</tr>
<tr>
<td>1 CCB</td>
</tr>
<tr>
<td>1 MPC</td>
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<tr>
<td>1 VME controller</td>
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<tr>
<td>19 cards total</td>
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<tr>
<td>9 x DMB</td>
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<tr>
<td>9 x TMB</td>
</tr>
<tr>
<td>1 CCB (clocking)</td>
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<tr>
<td>1 MPC (trigger out)</td>
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<tr>
<td>1 VME controller</td>
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<tr>
<td>21 cards total - FULL</td>
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DMB (DAQ MotherBoard) Readout Scheme

- CSC cathode readout is initiated by time coincidence of local trigger signal (LCT) and Level 1 accept (L1A)
- Presently use CLCT*L1A coincidence
- Could use ALCT*L1A but rates may be high
- ORCA simulation shows:
  - ALCT rate in ME1/a is 180 kHz per chamber
  - If L1 rate is 75 kHz and time coincidence window 100ns, then ALCT*L1A minimum (no correlations) DAQ rate is 1.34 kHz/chamber
  - At 3 kB per LCT, ALCT*L1A gives 300 Mbyte/sec data volume (50% of all CSC)
- New result:
  - High-momentum muons populate only straightest cathode trigger patterns
  - Cutting on cathode pattern eliminates most low-momentum backgrounds
  - Reduces DAQ volume by up to 14x
  - Recommend to allow CLCT*L1A readout in ME1/a
Cathode (CLCT) Trigger Patterns Used

- Half-strip units for high-Pt trigger
- Simultaneously, di-strip units for low-Pt trigger
- 7 patterns of each type (fix middle at 4th layer):

1 (straight)  2 (top-)  4 (bottom-)  6 (steep-)

(3, 5, 7 are Mirror reflections of 2, 4, 6)

3 (bottom+)  5 (top+)  7 (steep+)
Minimum Bias CLCT Patterns

- Minimum Bias data sample:
  - More di-strip patterns than half-strip
  - Small number (8.5%) of nearly-straight CLCTs
  - Note that distrip CLCT about 4x the half-strip CLCT rate

- High-Pt (>10 GeV/c) muon sample:
  - 97% in central peak
Finally

• Normally CLCT patterns are seamless at 16-strip boundaries due to cables between CFEB cards carrying comparator signals
• Ganging of strips affects this at strip 16-17 and strip 32-33 boundaries (out of 48 strips)
• Can connect comparator signals from one side of CFEB card to the other side of the same card and CLCT pattern-finding is again seamless
• 3x ganging has been implemented as an ORCA option (Rick Wilkinson)
• More simulation studies (with 3x backgrounds, CLCT performance on high-Pt LCTs only) are underway (Slava Valouev)