L1Topo Timing (FW 4.4.0)

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30 June 2016

- Summary of changes with recent firmware 4.4.0
  - Higher pt muons fixed (MU6, MU10)
    - Previously these pt bits were shifted to the next BC
    - This caused loss of high pt muons and random presence of late muons
    - Fixing this greatly improves the timing of muon and mu+calo algorithms
  - Various fixes to algorithm threshold mapping
    - Menu XML to VHDL mapping needs automation not manual editing…
    - Meanwhile manual fixes improved statistics of some algorithms

Measuring Topo Timing at CTP

- Strategy: look at TIP bits in L1A +/-1 BCs
  - Pure L1Topo algorithms (no item combinations)
  - No confusion/selection with fill bunches etc
  - See whats really going on
- Can then derive effect on items
  - Could also measure these in the same way with CTP data but its not currently done that way
- Program (topocheck) plus python script (menu stuff)
  - L1Topo monitoring histograms prepared => p1mon some day…
- Criteria:
  - Well timed: 95% in L1A and >10 hits (much the same with >50)
  - Good timing: peak in L1A but <95% or low stats
  - NB JPSI algorithms (1INVM5-EM*-EMall) missing from FW

L1Topo Algorithms Timing

- 65/91 well timed topo TIP bits

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Fairly well timed (few hits or spread outside central slice) algorithms (total 22/91)
 14 (TIP= 28) [ 94%]: 05MINDPHI-EM12s6-XE0
 15 (TIP= 30) [ 94%]: 10MINDPHI-EM12s6-XE0
 27 (TIP= 23) [100%]: NOT-02MATCH-EM10s1-AJj15all.ETA49          *** only 1 hit! ***
 28 (TIP= 25) [ 88%]: 05RATIO-XE0-SUM0-EM10s1-HT0-AJj15all.ETA49
 35 (TIP= 38) [ 50%]: 1DISAMB-J25ab-0DR28-EM15his2-TAU12abi       *** only 2 hits! ***
 39 (TIP= 46) [ 94%]: 5DETA99-5DPHI99-2MU4ab
 64 (TIP= 64) [ 83%]: 05MINDPHI-AJj10s6-XE0
 65 (TIP= 66) [ 79%]: 10MINDPHI-AJj10s6-XE0
 66 (TIP= 68) [ 76%]: 15MINDPHI-AJj10s6-XE0
 73 (TIP= 82) [ 94%]: 0DR24-2CMU4ab
 75 (TIP= 86) [ 77%]: MULT-CMU4ab
 76 (TIP= 88) [ 94%]: MULT-CMU4ab
 77 (TIP= 90) [ 87%]: MULT-CMU6ab
 85 (TIP= 75) [ 79%]: 0DR24-CMU4ab-MU4ab
 86 (TIP= 77) [ 94%]: 1INVM19-CMU4ab-MU4ab
 87 (TIP= 79) [ 94%]: 2INVM8-CMU4ab-MU4ab
109 (TIP=122) [ 90%]: 05RATIO-XE0-HT0-AJj15all.ETA49
110 (TIP=124) [ 90%]: 08RATIO-XE0-HT0-AJj15all.ETA49
111 (TIP=126) [ 93%]: 90RATIO2-XE0-HT0-AJj15all.ETA49
118 (TIP=109) [ 94%]: 2DR99-2MU4ab
119 (TIP=111) [ 94%]: 0DR34-2MU4ab
123 (TIP=119) [ 94%]: 1INVM19-2MU4ab

Unknown timing (no hits seen) algorithms (total 4/91)
 11 (TIP= 22) [  0%]: 1INVM5-EMs1-EMall
 12 (TIP= 24) [  0%]: 1INVM5-EM7s1-EMall
 13 (TIP= 26) [  0%]: 1INVM5-EM12s1-EMall
 23 (TIP= 15) [  0%]: 210RATIO-0MATCH-TAU30si2-EMall
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Poor Timing or Low Stats

- Generally calo based items are very good, except:
  - MINDPHI between J and XE rather poor
    - These items also fail validation - no luck finding FW bug yet
    - Also MINDPHI between EM and XE and the RATIO algorithms are not wonderful
- Items with (almost) no statistics - is this expected?
  - NOT-02MATCH-EM10s1-AJj15all.ETA49
    - Used in L1_W-NOMATCH* items
  - 1DISAMB-J25ab-0DR28-EM15his2-TAU12abi
    - Used in L1_DR-EM15TAU12I-J25
  - 210RATIO-0MATCH-TAU30si2-EMall
    - Not used in any trigger item?
  - NOT-0MATCH-TAU30si2-EMall (bit low stats but well timed)
    - Used in L1_LLP-NOMATCH

L1Topo CTP Items Timing

- 96/127 look well timed
- 3/127 (JPSI) missing from current FW

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Fairly well timed (few hits or spread outside central slice) items (total 28/127)
190: [ 83%] L1_EM15_W-MT35_W-250RO2-XEHT-0_W-05DPHI-JXE-0_W-05DPHI-EM15XE  [ 35MT-EM15s6-XE0,
250RATIO2-XE0-HT0-AJj15all.ETA49, 05MINDPHI-AJj10s6-XE0, 05MINDPHI-EM15s6-XE0 ]
191: [ 83%] L1_EM15_W-MT35_XS60_W-05DPHI-JXE-0_W-05DPHI-EM15XE  [ 35MT-EM15s6-XE0, 05MINDPHI-AJj10s6-
XE0, 05MINDPHI-EM15s6-XE0 ]
192: [ 83%] L1_EM15_W-MT35_XS40_W-05DPHI-JXE-0_W-05DPHI-EM15XE  [ 35MT-EM15s6-XE0, 05MINDPHI-AJj10s6-
XE0, 05MINDPHI-EM15s6-XE0 ]
257: [ 83%] L1_EM15_W-MT35_W-05DPHI-JXE-0_W-05DPHI-EM15XE_XS30  [ 35MT-EM15s6-XE0, 05MINDPHI-AJj10s6-
XE0, 05MINDPHI-EM15s6-XE0 ]
271: [ 83%] L1_EM15_W-MT35_W-05DPHI-JXE-0_W-05DPHI-EM15XE  [ 35MT-EM15s6-XE0, 05MINDPHI-AJj10s6-XE0,
05MINDPHI-EM15s6-XE0 ]
277: [ 90%] L1_W-05RO-XEHT-0                          [ 05RATIO-XE0-HT0-AJj15all.ETA49 ]
279: [ 93%] L1_W-90RO2-XEHT-0                         [ 90RATIO2-XE0-HT0-AJj15all.ETA49 ]
282: [100%] L1_W-NOMATCH                              [ NOT-02MATCH-EM10s1-AJj15all.ETA49 ] **1 hit**
283: [ 88%] L1_W-NOMATCH_W-05RO-XEEMHT                [ NOT-02MATCH-EM10s1-AJj15all.ETA49, 05RATIO-XE0-
SUM0-EM10s1-HT0-AJj15all.ETA49 ]
295: [ 94%] L1_BPH-1M19-2MU4_BPH-0DR34-2MU4           [ 1INVM19-2MU4ab, 0DR34-2MU4ab ]
302: [ 94%] L1_CMU6_2CMU4                             [ MULT-CMU4ab, MULT-CMU6ab ]
303: [ 94%] L1_2MU4-B                                 [ MULT-CMU4ab ]
305: [ 94%] L1_BPH-1M19-2MU4-B_BPH-0DR34-2MU4         [ 1INVM19-CMU4ab-MU4ab, 0DR34-2MU4ab ]
308: [ 94%] L1_BPH-1M19-2MU4-BO_BPH-0DR34-2MU4        [ 1INVM19-2CMU4ab, 0DR34-2MU4ab ]
312: [ 94%] L1_2CMU4                                  [ MULT-CMU4ab ]
314: [ 94%] L1_MU6_2MU4-B                             [ MULT-CMU4ab ]
315: [ 94%] L1_DY-DR-2MU4                             [ 2DR99-2MU4ab ]
316: [ 94%] L1_DY-BOX-2MU4                            [ 5DETA99-5DPHI99-2MU4ab ]
346: [ 50%] L1_DR-EM15TAU12I-J25                      [ 1DISAMB-J25ab-0DR28-EM15his2-TAU12abi ] *1 hit*
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Summary

- Majority of algorithms now well timed
- Some not quite as good but closed
- Problems:
  - MINDPHI and RATIO algorithms?
  - Some muon algorithms just miss a fairly arbitrary 95% cut
  - JPSI currently missing from FW 4.4.0, but previous timing was also not good, large fraction of hits in L1A-1 and L1A+1.
    - Three items with different thresholds: lowest (EM3) -> awful timing, medium (EM7) -> poor timing, highest (EM12) -> still not great
    - NB current JPSI algorithm uses EMall list - potentially 120 EM TOBs which requires a lot of firmware resources. Can this algorithm use an abbreviated list? Even perhaps a special one larger than the standard 10 TOBs?

Miscellaneous

- Odd excess of eta/phi/pt codes 0/0/0
  - Just discovered may be due to missing octant 0 (side?)
- Reminder of L1Calo eta/phi HW coordinates for TOBs
  - HW eta/phi always given as lower left corner (low eta, low phi)
  - TOB (RoI) position also lower left
    - 0.1*0.1 tower of EM/Tau RoI Et maximum area of 0.2*0.2
    - 0.2*0.2 jet element of the RoI Et maximum area of 0.4*0.4
  - TOB centres are offset from this
  - In principle L1Topo uses uniform internal eta/phi mapping for all TOBs (but might still have bugs or unexpected offsets)
  - Some care may be needed when comparing TOB coordinates from various levels of offline objects