L1 Rates Estimation for 2015 (Legacy System)

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Today's presentation

Topics

- L1 Rates Estimation for 2015 with the legacy system
- Problems and issues found.

Neutrino Gun

Base idea

For studying of L1T Rates the normal procedure is using neutrino gun samples. :

- Hard process is invisible (only a neutrino is fired through the experiment)
- Event consists only of PU (overlapped Minimum/Zero bias events)
- Recreated the vast majority of events at the fire the L1T
- Caveat: Does not contain any real hard scattering events therefore HLT studies cannot be done with them.

Method

- Determine algorithm event selection efficiency, this will be the probability of a bunch firing.
- Each bunch firing will represent 11246 Hz, so we apply efficiency and obtain rate per bunch.
- We multiply per number of bunches on the machine to obtain algorithm pure rate (no overlapping with other algorithm)

Neutrino Gun - Efficiency per bunch

L1T

L1T Algo	PU20bx25	PU40bx50	PU40bx25
L1_ETM30	0.010484	0.048612	0.099137
L1_ETM36	0.003417	0.018527	0.044528
L1_ETM50	0.000418	0.002087	0.006257
L1_ETM70	0.000058	0.000193	0.000427
L1_ETM100	0.000009	0.000023	0.000027

HLT (Just for indicative purposes)

HLT Algo	PU20bx25	PU40bx50	PU40bx25
HLT_DiPFJet40_PFMETnoMu65_MJJ800VBF_AllJets_v	0.000003	0.000008	0.000034
HLT_DiPFJet40_PFMETnoMu65_MJJ600VBF_LeadingJets_v	0.000004	0.000012	0.000060
HLT_DiJet20_MJJ650_AllJets_DEta3p5_HT120_VBF_v	0.000141	0.000422	0.000247
HLT_DiJet30_MJJ700_AllJets_DEta3p5_VBF_v	0.000093	0.000238	0.000118
HLT_DiJet35_MJJ650_AllJets_DEta3p5_VBF_v	0.000095	0.000224	0.000131
HLT_DiJet35_MJJ700_AllJets_DEta3p5_VBF_v	0.000076	0.000176	0.000093
HLT_DiJet35_MJJ750_AllJets_DEta3p5_VBF_v	0.000064	0.000148	0.000072

We can already notice at L1 that there is a significant increase in efficiency from 50 ns to 25 ns with PU 40. More in next slides...

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Neutrino Gun - Rate per bunch

L1T

L1T Algo	PU20bx25	PU40bx50	PU40bx25
L1_ETM30	117.9057	546.6908	1114.890
L1_ETM36	38.4230	208.3502	500.7619
L1_ETM50	4.706185	23.47229	70.36284
L1_ETM70	0.649494	2.175597	4.799815
L1_ETM100	0.102957	0.263129	0.304293

HLT (Just for indicative purposes)

HLT Algo	PU20bx25	PU40bx50	PU40bx25
HLT_DiPFJet40_PFMETnoMu65_MJJ800VBF_AllJets_v	0.028866	0.092095	0.382027
HLT_DiPFJet40_PFMETnoMu65_MJJ600VBF_LeadingJets_v	0.041375	0.130368	0.671807
HLT_DiJet20_MJJ650_AllJets_DEta3p5_HT120_VBF_v	1.580916	4.744692	2.777506
HLT_DiJet30_MJJ700_AllJets_DEta3p5_VBF_v	1.046888	2.673150	1.324180
HLT_DiJet35_MJJ650_AllJets_DEta3p5_VBF_v	1.069019	2.514077	1.476450
HLT_DiJet35_MJJ700_AllJets_DEta3p5_VBF_v	0.858294	1.978251	1.048176
HLT_DiJet35_MJJ750_AllJets_DEta3p5_VBF_v	0.718773	1.661300	0.808579

Here we can see that difference int the rate per bunch which at ETM30 doubles the rate and at ETM100 give an 15% increase.

Neutrino Gun - Maximum Pure Rate

We can now apply the maximum number of bunch for each configuration which is 2808 for 25 ns and 1380 for 50 ns and calculate maximum pure

L1T

L1T Algo	PU20bx25	PU40bx50	PU40bx25
L1_ETM30	331079.35	754433.44	3130611.86
L1_ETM36	107892.05	287523.31	1406139.58
L1_ETM50	13214.97	32391.76	197578.86
L1_ETM70	1823.78	3002.32	13477.88
L1_ETM100	289.10	363.12	854.46

HLT (Just for indicative purposes)

HLT Algo	PU20bx25	PU40bx50	PU40bx25
HLT_DiPFJet40_PFMETnoMu65_MJJ800VBF_AllJets_v	81.06	127.09	1072.73
HLT_DiPFJet40_PFMETnoMu65_MJJ600VBF_LeadingJets_v	116.18	179.91	1886.43
HLT_DiJet20_MJJ650_AllJets_DEta3p5_HT120_VBF_v	4439.21	6547.67	7799.24
HLT_DiJet30_MJJ700_AllJets_DEta3p5_VBF_v	2939.66	3688.95	3718.30
HLT_DiJet35_MJJ650_AllJets_DEta3p5_VBF_v	3001.80	3469.43	4145.87
HLT_DiJet35_MJJ700_AllJets_DEta3p5_VBF_v	2410.09	2729.99	2943.28
HLT_DiJet35_MJJ750_AllJets_DEta3p5_VBF_v	2018.32	2292.59	2270.49

Since rates at 25 ns are already higher with a higher number of bunches the rate explodes. Notice that our triggers at HLT level at 25 ns just with neutrino guns all pass 1 kHz.

Understanding higher rates from 25 to 50 ns

I have identified several possible reason for this higher rates

HLT

- Higher out of time pile up (OOT PU) due to higher bunch density and bunch to bunch interaction which will add events to calorimeters
- Saturation of ECAL or HCAL primitives and/or RCT zones
- High integration times by HCAL or ECAL systems (more OOT PU recorded or even more bx)

Most like likely a combination of all of this effects.

Steps taken

- Contacted HCAL and Trigger Calorimeter experts and indeed we integrate for 50ns the energy so energy on the next event at 25 ns will be in pratice OOT PU always...
- Recent studies have showed (see 2 weeks ago L1 DPG meeting) HCAL, ECAL or RCT saturation is now an issue and will generate ETM.
- I am in contact with people upgrading algorithms so we can profit from this.

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Summary and next steps

Summary:

- A study for rates with the legacy system is underway and already can see 25 ns will present some difficulties. Similar effects already observed in the signal efficiency study.
- Several issue contribute to make rates explode specially for 25 ns.

Next Steps:

- Finish L1 legacy study and do HLT full study
- Do UCT study
- Include new features for future HLT Paths (PU subtracting, etc)

Backup Slides