SLHC Workshop

Barrel Muon DT Electronics

General Considerations

Electronics lifetime obsolescence:

- After 10 years of LHC operation a large fraction of the electronics lifetime will have already been used.

Radiation tolerance

- All electronics to be placed in the cavern has been tested with a safety margin of a factor 10.

- Would this electronics survive SLHC radiation environment?

FE

- Front-end can stand hit rates up to 1 MHz.
- Safety factors for TID and SEU are >100.

Readout

Present design is based in the following requirements:

- 40 MHz clock
- 1 kHz tracks/channel
- 10 kHz background/channel (10 Hz/cm^2)
- 100 kHz trigger rate

SLHC design parameters:

- 80 MHz bunch crossing
- 10 kHz tracks/channel
- 100 kHz background/channel
- >100 kHz trigger rate (?)

Readout (cont)

Comments:

- Clock: Is it possible run electronics at 40 MHz and still tag events to appropriate bunch crossing?

- Hit rates: in principle this should not be a big issue. HPTDC is designed for much higher hit rates. RO buffers would reach “buffer almost full” warning condition more often (rare).

HV Power Supplies

- HV power supplies are designed for LHC background with a safety factor of 3.

- At least MB1 and possible MB2 chamber will demand higher currents than available.

Trigger (M. Dallavalle)

DT Local Trigger in SLHC environment ?

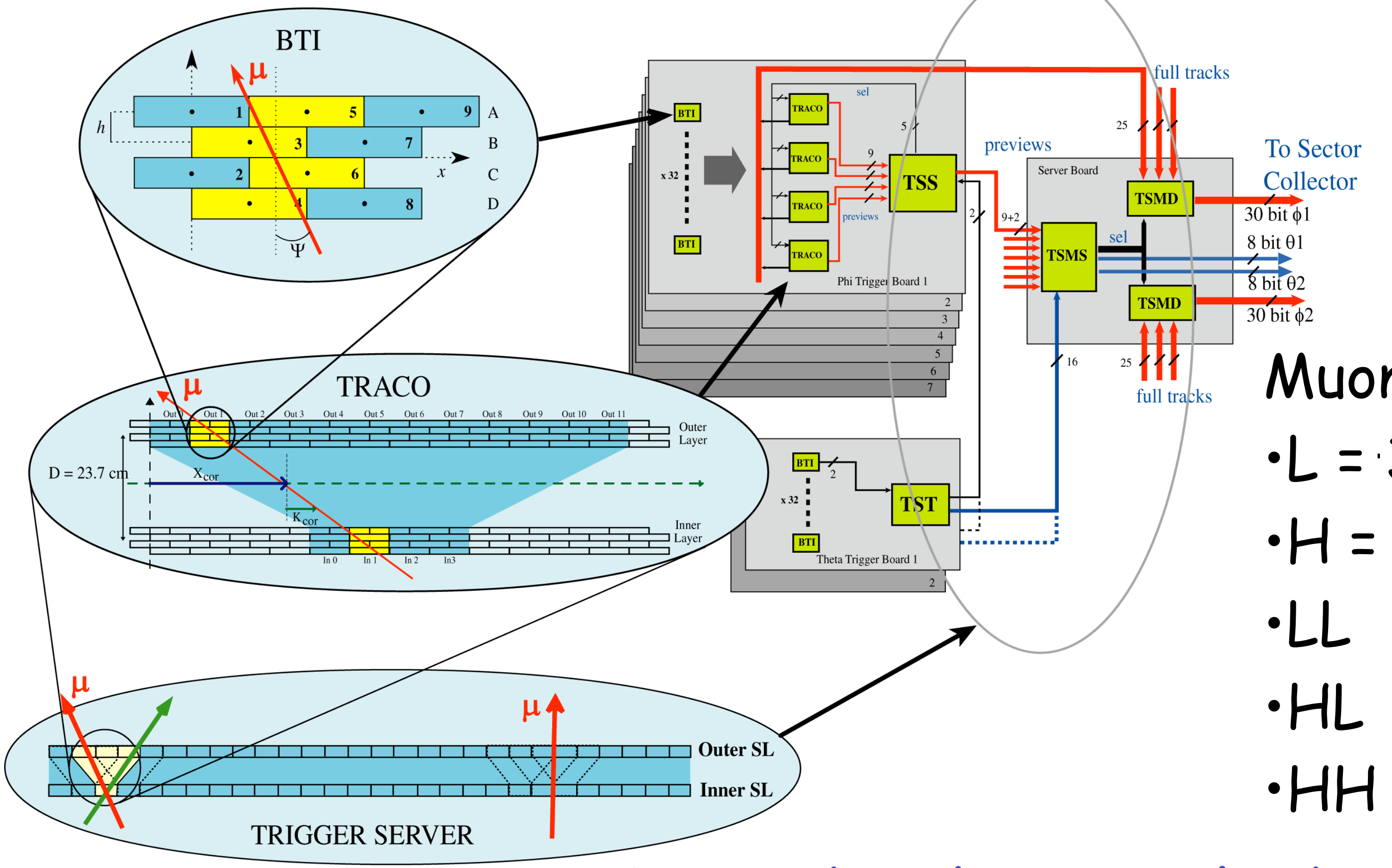
Assuming the DriftTubes chambers of the barrel muon detector are used when SLHC turns on

- how the DT local trigger electronics copes with it ?
- which modifications would be required ?

Working Hypothesis:

- SLHC:
  - Lumi 10*(LHCmax)
  - 80 MHz BX
  - Turn-on 2013

DT Local Trigger: an Overview



Muon segment:

- L = 3 hits in a SL
- H = 4 hits in a SL
- LL
- HL
- HH

Trigger boards are on-chamber (in MiniCrates)

- Two best muon segments on output from each chamber:
  - Higher quality
  - Higher Pt
- Output at fixed latency after the "parent" BX: **BX id**

DT Local Trigger: limitations

The system cannot run at 80 Mhz:

- A single large synchronous digital system
  - over 55000 ASICs in 250 chambers
    - Chips designed in 1994-98 (0.5 to 0.35 μm techn)
  - Pipeline limit freq. 43-44 MHz
- Intrinsic fuzziness of the "parent" BX:
  - Signal propagation over DT anode wire (BTI input) takes □10 ns end to end

DT Local Trigger: time-frame tag

The system can run at 40 MHz even when SLC 80 MHz, however:

•"time-frame" tag of 2 BXs, instead of BX id

• by design, the system checks hits alignment in a SL at 40 MHz with a 12.5 ns resolution, i.e.

- •In bunch 2, the fraction of L type segments (H being sampled at wrong time) will strongly increase; furthermore this trigger type is undistinguishable from L type system ghosts; with opportune phase tuning, some H-trigger efficiency could be recovered (not clear how much)
- •In bunch 1, when accepting only HH + H(SLinner)+H(SLouter), trigger efficiency can be □80%

• dimuons vs fakes & overlaps?

- •Dimu tag becomes unreliable. Need detailed simulation.

DT Local Trigger: radiation tolerance

Assume neutron flux (E>20MeV) /cm2/sec at SLHC = 10*LHC

Extrapolations of SEE measurements at PSI and UC Louvain show that for the trigger electronics installed in an MB1 of wheel 0:

- Trigger board TRB MTBF = 1.5 SLHC years
- Control/Server Board SB/CB MTBF = 1.1 SLHC years

DT Local Trigger in SLHC environment: a summary

- barrel DT chambers are intrinsecally difficult to use in the LV-1 trigger when BX freq 80 MHZ
  - Upgrade of the trigger electronics seems meaningless

- The DT local trigger electronics can not run at 80 MHz
- The DT local trigger system can run at 40 MHz when SLHC 80 MHz:
  - Time-frame tag of 2 BXs
  - low efficiency
  - unreliable dimu tag
- Radiation tolerance in SLHC environment looks marginal

Conclusions

- It looks like SLHC would require a full redesign of the trigger and readout electronics, in new technologies to cope with radiation environment, and to be able to operate at 80 MHz.

- HV PS system would require some upgrading.