Remote setting of LHC BLM thresholds?

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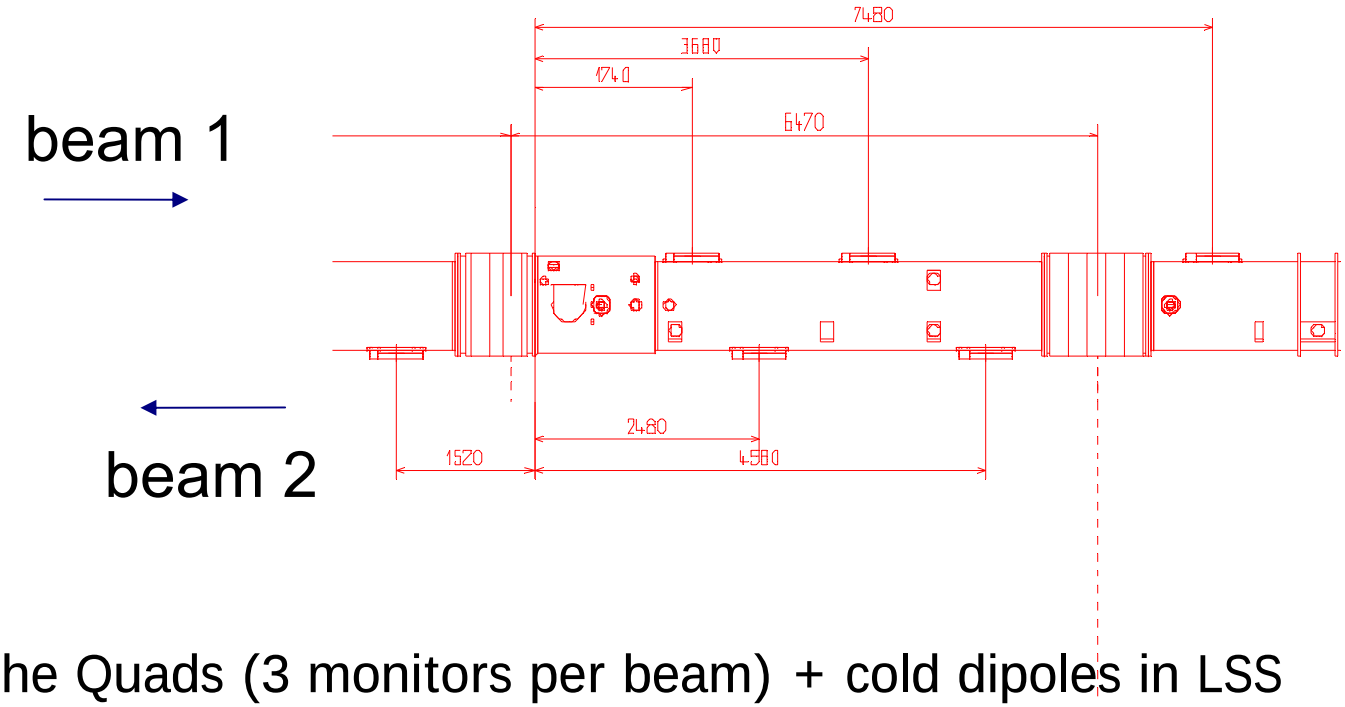
Outlines

- Overview of the system
- Need of changing the thresholds
- Proposed solution
- conclusions

1. Recall: overview of the system

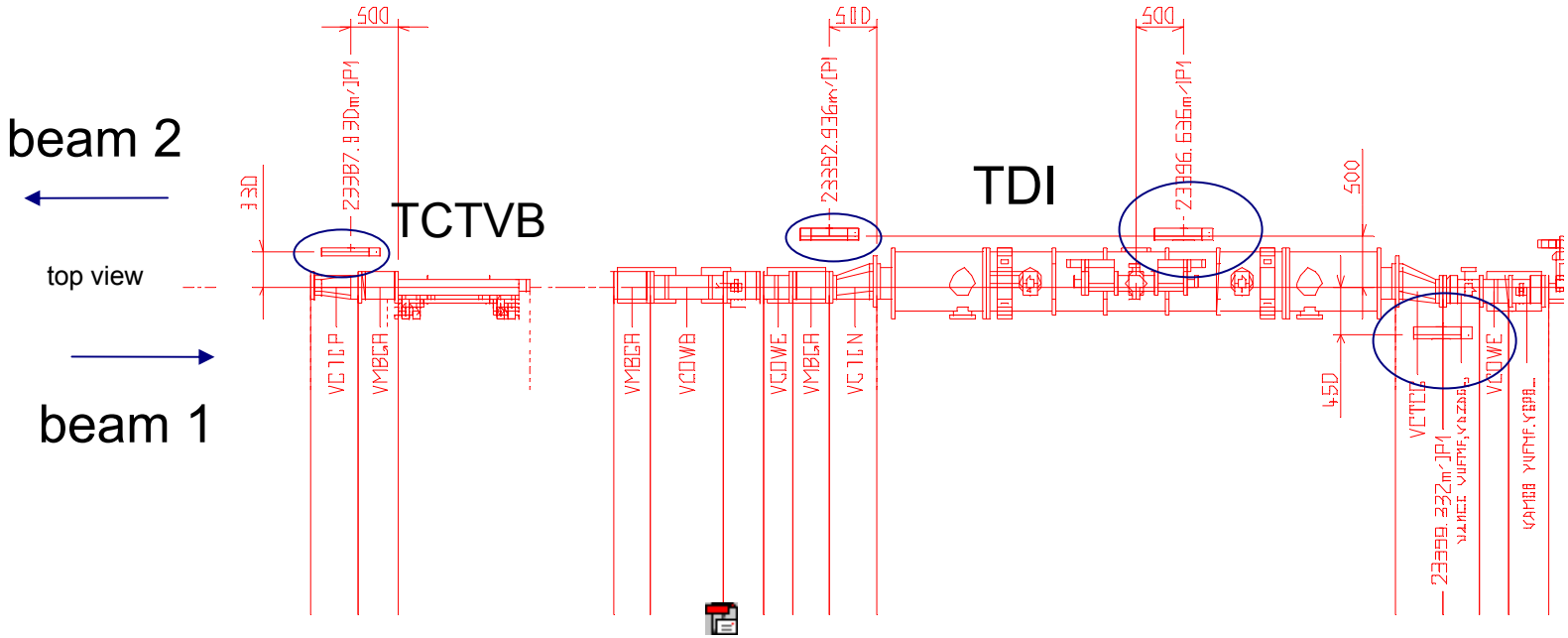
- Some 4000 monitors: mainly ionization chambers + SEM (for higher beam loss intensities)
- All BLMs are interlocked and send a beam dump request if signal over threshold via the BIS
- 12 running sums (time windows) and 32 energy levels per monitor to cover the different loss durations
- Speaking about changing thresholds, I would distinguish 2 main BLMs families:
  - BLM on cold element for quench protection (quad, main dip)
  - BLM on warm elements (for coll, injection, dump system...)

BLMs for quench protection



- BLMQI at the Quads (3 monitors per beam) + cold dipoles in LSS
- Beam dump threshold set to 30 % of the quench level (to be discussed with the uncertainty on quench level knowledge)
- Thresholds derived from loss maps (coll. team), secondaries shower simulations (BLM team), quench level simulations and measurements (D. Bocian)

BLMs for warm elements



- BLM in LSS :at collimators, warm magnets, MSI, MSD, MKD,MKB, all the masks...
- Beam dump threshold set to 10 % of equipment damage level (need equipments experts to set the correct values

2. Remotely changing the thresholds?

Questions addressed for preliminary discussions:

1. reasons to change the thresholds?
2. How often do we expect to have to change?
3. What can be implemented?
4. Consequences on the system reliability?
5. Who can do the change?

=> First set of comments are presented in the following

Reasons to change the thresholds? How often?

1) to check Machine Protection functionalities of BLMs (interlocks):
decrease the thresholds in order to provoke a dump with low intensity

- frequency: during the commissioning, after each shut-down (?), for a set of detectors
- Will be a planned procedure

2) study/check of quench levels ("quench and learn" strategy?):

implies dedicated MD time, post-mortem data analysis, could be related to check the correct setting of the thresholds

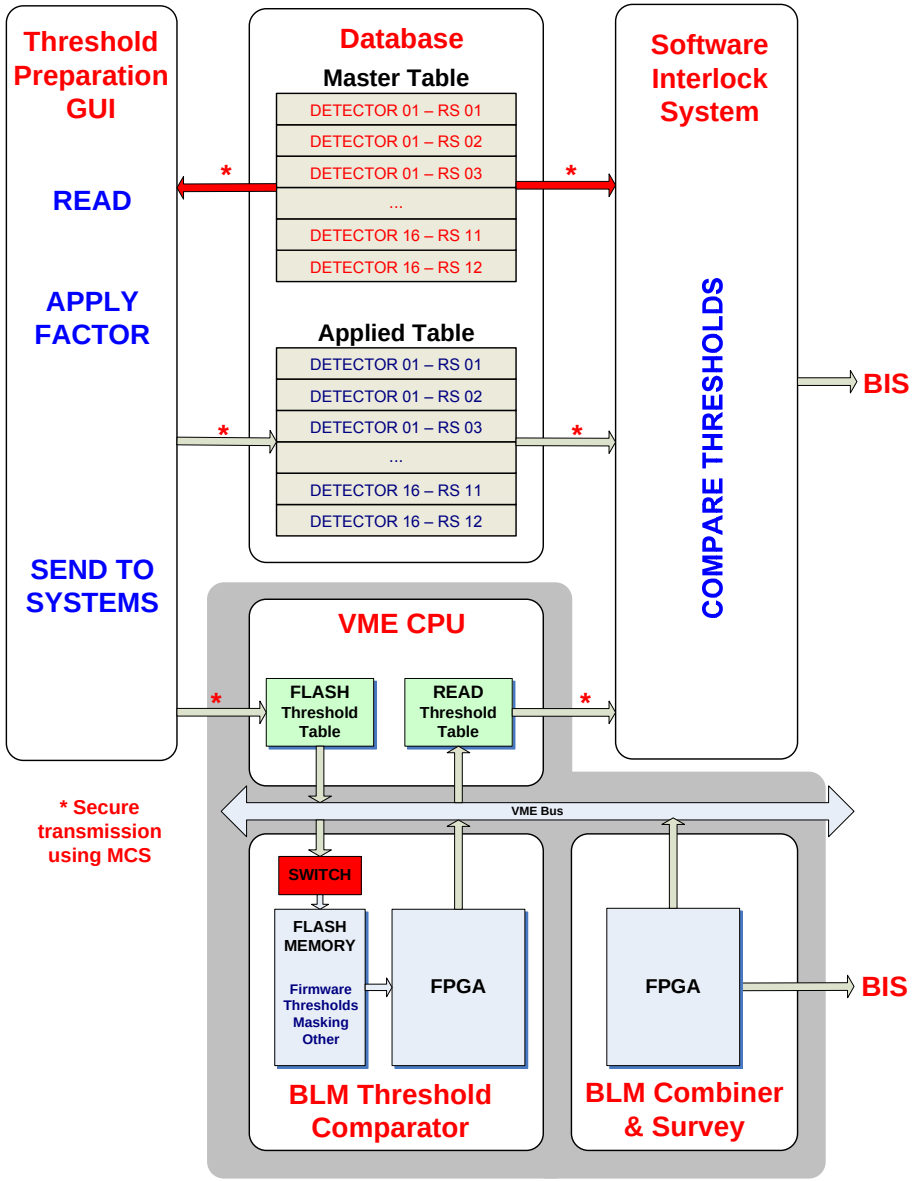
- Frequency : ? Probably during shut-down
- Note :for HERA, only one change since the start-up

3) commissioning of individual systems (MSI, LBDS, collimators) : to get a loss picture of a region, to give “warning” levels
   - adjust thresholds after studies of the systems to optimize the operational efficiency vs. the irradiation level
   - frequency : 1 or 2 iterations after determination of the thresholds and localized in space (injection region, IR7…)

4) To match quench level during commissioning (operational efficiency):
   - Probably few iterations

➔ the needed flexibility is for decreasing thresholds
➔ would help operation but is it an absolute need ?

3. Proposed implementation



- Threshold GUI
  - Reads the “master” table
  - Applies a factor (<1)
  - Saves new table to DB
  - Sends new table to CPU
- CPU flashes table if allowed (on-board switch)
- Thresholds are loaded from the memory on the FPGA at boot.
- Combiner initiated test allows CPU to read ‘current’ table.
- SIS receives all tables
  - Compares tables
  - Notifies BIS (if needed)

Note: possible upgrade by adding a comparison with master table on the board BUT feasibility and reliability have to be checked

Consequences on the reliability of the system?

- We can chose to open/close the switch
  - If we choose to have remote loading of the table, what does it mean for reliability?
  - what about access to maskable/unmaskable table, enable/disable monitors

=> Problem of disabling monitors if no flexibility on thresholds adjustment

4. Conclusions

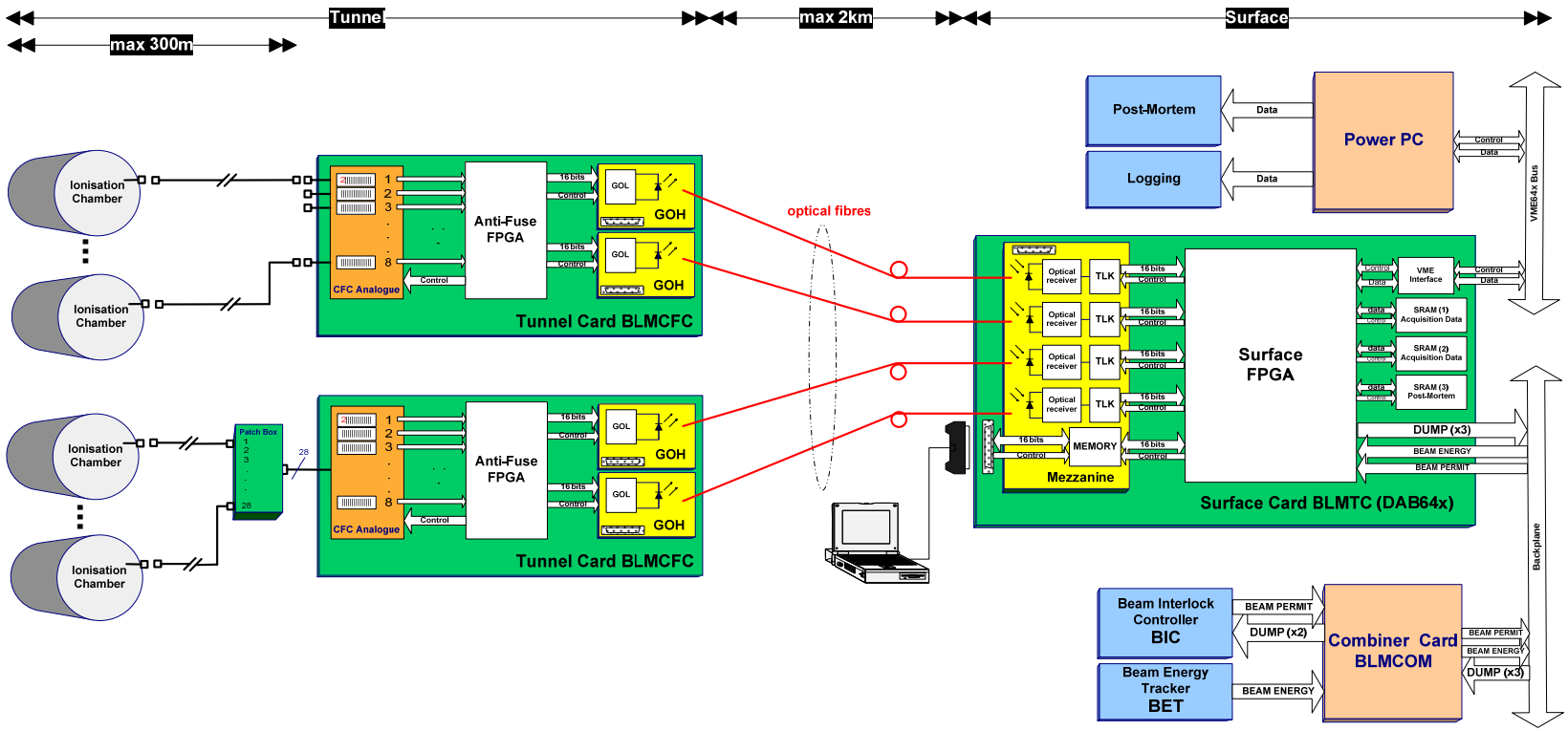
- Flexibility given by changing remotely the thresholds has to be balanced with the loss of reliability of the system
- The proposed implementation allows both possibilities
- But the remote access will have to be validated by machine protection experts when more detailed implementation of MCS and comparator are available (by the beginning of summer?).

Systematic Uncertainties at Quench Levels

	relative accuracies	Correction means
Electronics	< 10 %	Electronic calibration
Detector	< 10 – 20 %	Source, sim., measurements
Radiation & analog elec.	about 1 %	
fluence per proton	< 10 - 30 %	sim., measurements with beam (sector test, DESY PhD)
Quench levels (sim.)	< 200 %	measurements with beam (sector test), Lab meas., sim. fellow)
Topology of losses (sim.)	?	Simulations

B. Dehning, LHC Radiation Day, 29/11/2005

Thresholds and interlocks



- 12 running sums for 32 energy levels for each channel, 16 channels per card, 345 surface cards. → table of 2 millions values!
- Any of this signal over the thresholds generate a beam dump request via the BIC