Management of Critical Settings

MCS (SSM? SILM??)

Summary of present thinking concerning **requirements** and **scope**

This is not yet about implementation!

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Software needed **to manage interlock levels** of safety-critical equipment, and some parameters

Assume **HW limits are "hard-coded"** in equipment front-ends and cannot be changed without local reprogramming

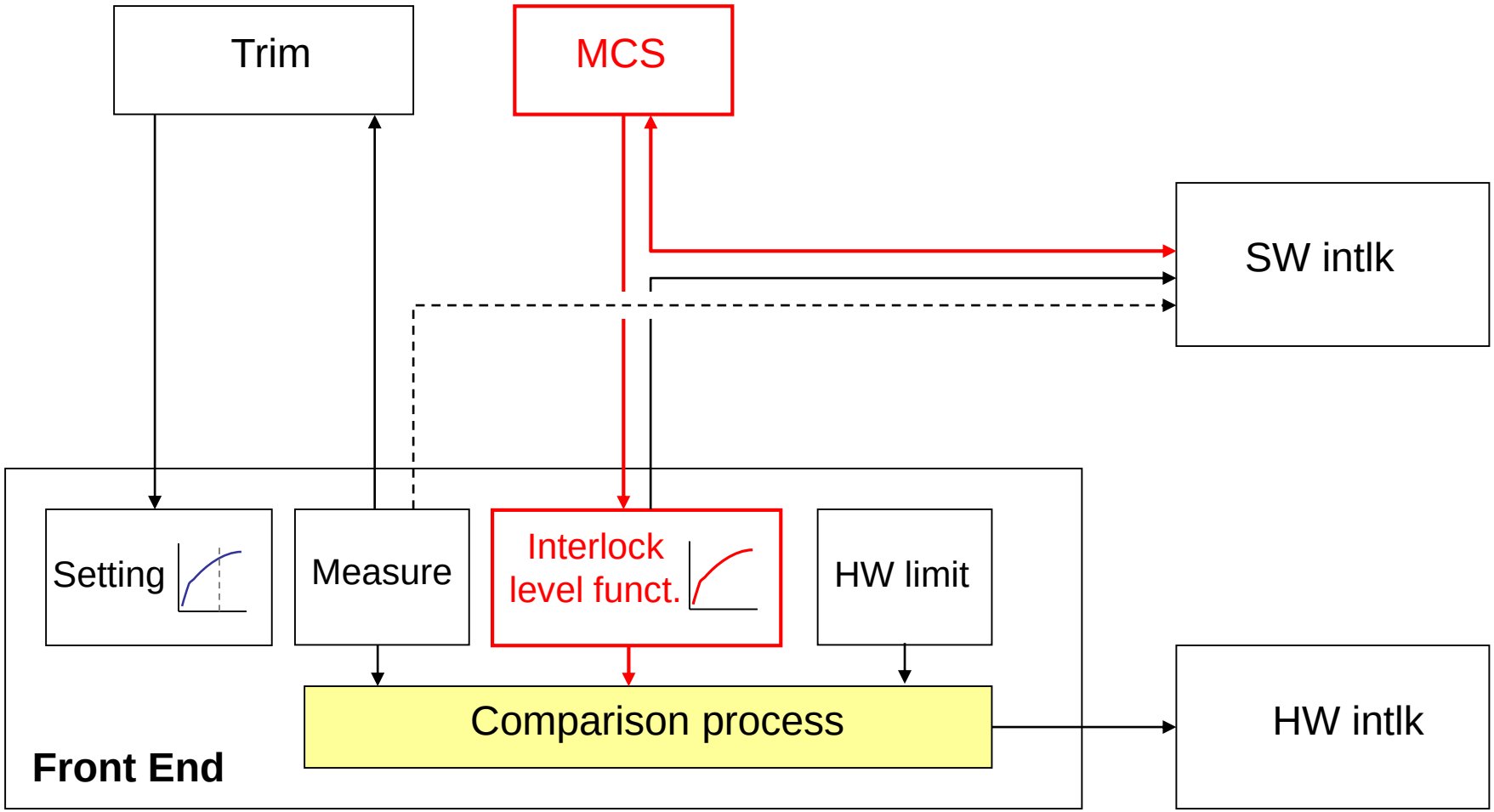
Also have many limits *resident in the equipment front ends*, used to generate HW interlocks, but which might need to be changed occasionally, e.g:

- Reference position for bumped beam position in SPS BPCE
- MKE/MKI PFN charging voltage
- MSE/MSI current
- Safe beam intensity
- SPS extraction BLM thresholds

General requirements for managing such interlock levels are:

- Very well defined (and limited!) scope
- "Secure" management (i.e. NOT via standard LSA TRIM functionality)
- Recording of all changes, with reason for change and person responsible

Simple context diagram



Specifics: Reference functions

Some systems require reference **functions**, since the interlock level will change (according to LHC mode, energy, β^* or time):

- TDI/TCLI jaw positions (for injection protection)
- TCDQ jaw positions (for asynch. dump protection)
- Collimator jaw positions (for aperture limit definition)
- LHC beam loss levels

For collimators and protection devices, expect that the solution used to produce the MCS reference will be the same as that used to drive the equipment setting

I. Conventional “FGC + timing” (or equivalent) approach ?
II. Configurable function of LHC mode, energy and β^* ?

For BLMs, system already foresees a variant of II, with LHC energy input to generate interlock reference function.

Specifics: Cycle / configuration dependence

Some systems require different references according to SPS/LHC cycle or mode, since interlock levels change on systematic basis:

- BPCE position (CNGS/LHC)
- MKE, MSE, bumper & TT40 magnets (CNGS/LHC)
- MSI/MKI/sep./Xing bumps (experiment polarity reversal)
- TOTEM operation…?

Different sets of references / functions will need to be maintained in MCS, for different LHC configurations/SPS cycles

SPS, fast cycle changes mean different references must reside in FE

LHC, **to be decided** between:

I. download new functions every time we change the configuration',
II. the different functions are FE resident, need to only supply the LHC configuration.

Probably simpler to start with variant I…

Specifics: Interlock level generation

Equipment parameter or physics parameter for the interlock level?

For protection devices, choice is between:

I. Interlock level for jaw position in mm

II. Interlock level for jaw setting in sigma (needs orbit, β and ε as dynamic input)

Presently, for maximum simplicity, assume variant I:

- Needs stable LHC conditions (orbit, optics)
- Verification with pilot beam to allow high intensity operation
- Some flexibility within allowed tolerance – but not much
- Changes to interlock references can be made if needed, using MCS
- Impact on orbit correction freedom at protection devices?

Specifics: MDs and non-standard operation

To change unmaskable equipment settings for MD / commissioning without generating an interlock would mean changing the interlock levels in MCS.

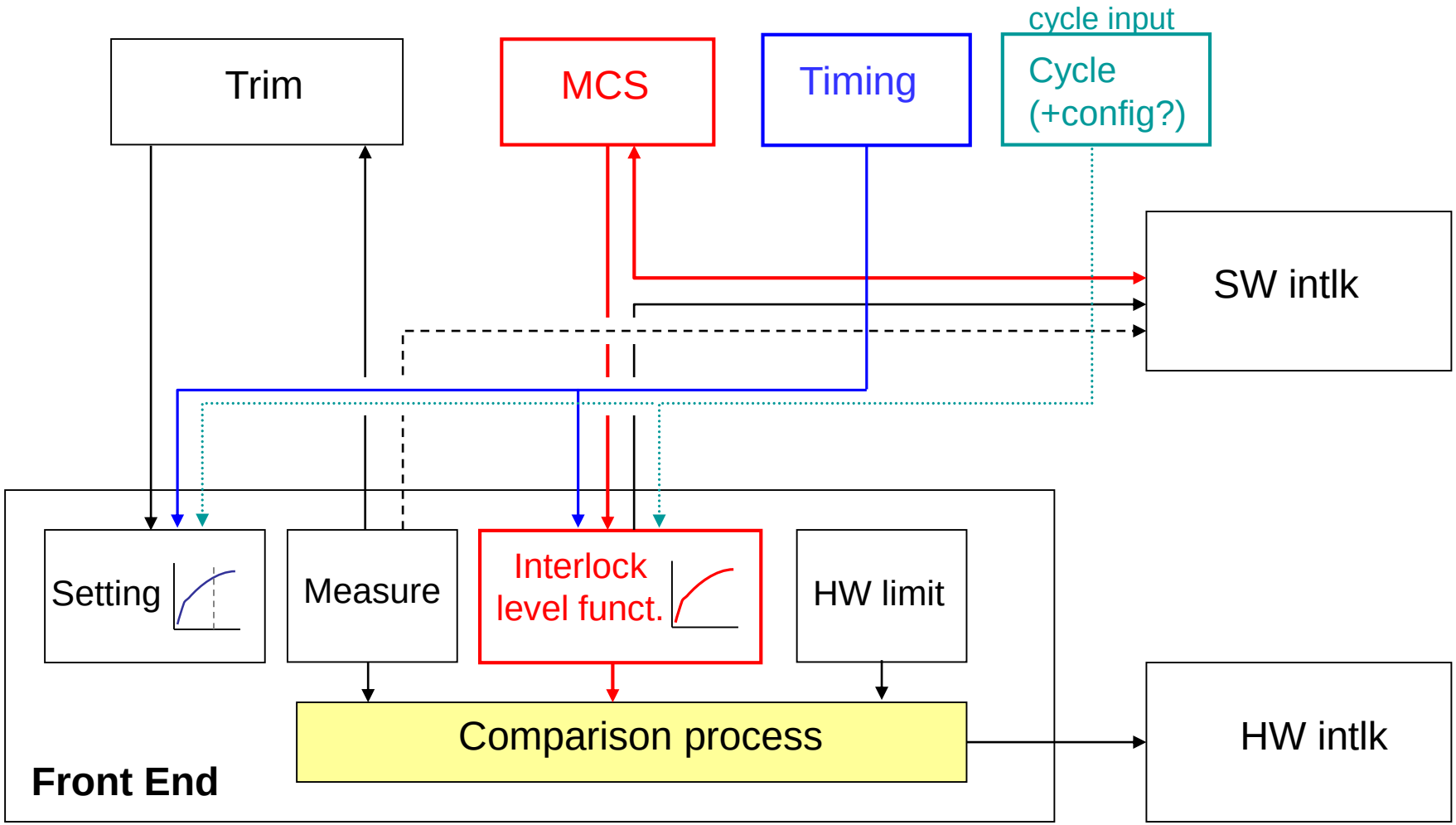
- **Unsafe**; need extra ad-hoc precautions to limit beam intensity….
- NOT needed, if adequate definition of maskable/unmaskable inputs

Switch to operation with unsafe beam in conditions outside the defined interlock levels will not be possible !

- Check carefully that proposed tolerances allow enough freedom:
  - Normal operations (obit correction, steering of collision point, …)
  - High-intensity MD (but note that this is one of the most dangerous situations, where limiting the flexibility is essential!!!).

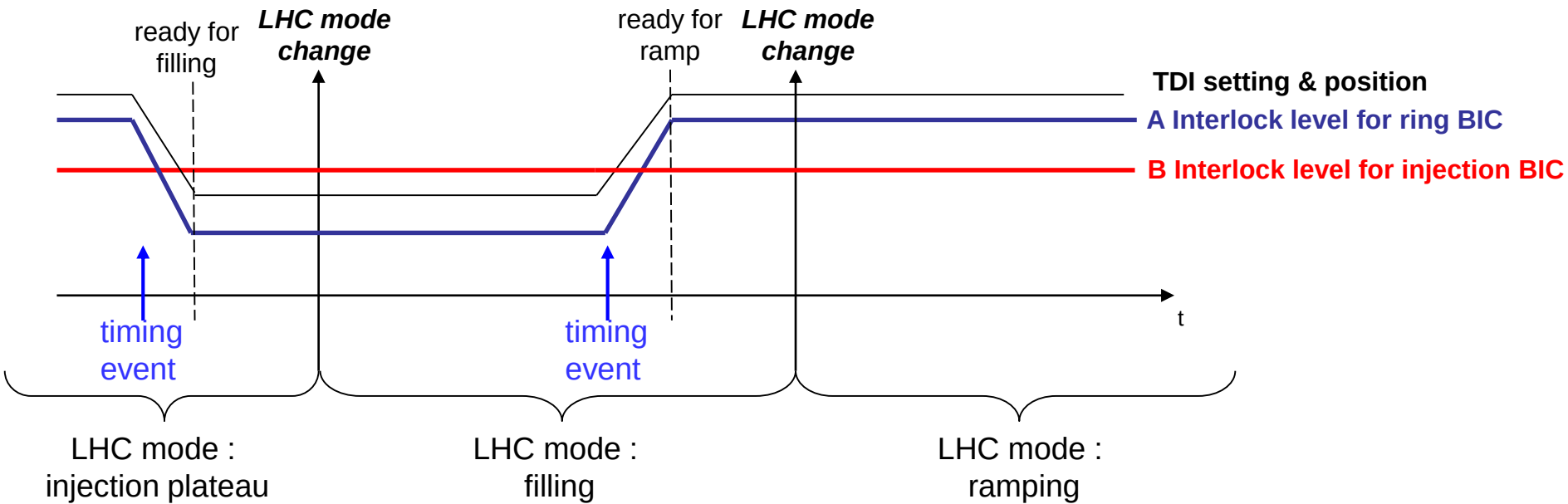
To change interlock levels, commissioning with safe beam imposed before high-intensity operation allowed

Context diagram (assuming use of FG+timing)



Example: TDI jaw position Y_{TDI}

- beam permit : TRUE if $Y_{TDI} > A$
- injection permit : TRUE if $Y_{TDI} < B$
  - No LHC mode information required
  - To accomplish state transitions, changes in A and Y_{TDI} must be synchronised (e.g. functions + timing…)
  - Protection limit B could be fixed….
    - injection permit automatically removed when $Y_{TDI} > B$



Summary

- MCS system to allow the interlock levels of equipment and critical parameters to be changed securely.
  - Strict definition of functionality and scope
  - Absolute interlock levels are downloaded to equipment as values or functions (of time, or of other parameters).
  - In first instance, don’t foresee dynamic adaptation e.g. to orbit and beta for moveable devices –no on-line settings generation
  - different sets of interlock levels for different SPS cycles/ LHC configurations
- New LHC operating ranges or regimes must be formally commissioned!
  - Need when adjusting setting beyond tolerance
  - Flexibility during MD provided by safe beam and maskable inputs
- Effective use will depend on software interlocking and sequencing

Issues and next steps

- Agree and formalise requirements and scope
  - Client lists, with interlock and tolerance levels
  - Required functionality (security, rollback, ID, …)
  - Handling of different LHC configurations t.b.d.
  - Prepare and circulate FS with/to all involved parties
- Functions – handling t.b.d. (collimator jaws)
  - Will depend on collimator positioning control solution: independent ordinate (E, β^*, …) or “FGC” + timing?
- Investigate flexibility for operation (especially orbit)
- Define interplay with LHC sequencing & SPS cycles
- Plan for first version to be used in 2006
  - CNGS commissioning and other 2006 beam tests

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  - Protection limit B could be fixed….
    - injection permit automatically removed when $Y_{TDI} > B$
  - …or change B with function
    - ALWAYS remove injection permit (even if TDI jaw does not move)