LHC BLM SYSTEM:

TECHNICAL DETAILS AND PLAN FOR THE MODIFICATIONS TO FORCE TRUE THE BEAM PERMIT SIGNAL AT INJECTION

(aka Injection Interlock Inhibit)

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Some reminders to ease the discussion on the modifications

CURRENT ARCHITECTURE

Current LHC BLM Design

In order to provide a failsafe design, among others, the following rules have been used:

- No mode or function can force the beam permit to true.
- The complete acquisition and processing chain does not have any other mode than the operational.
- Signal can be added but not subtracted.

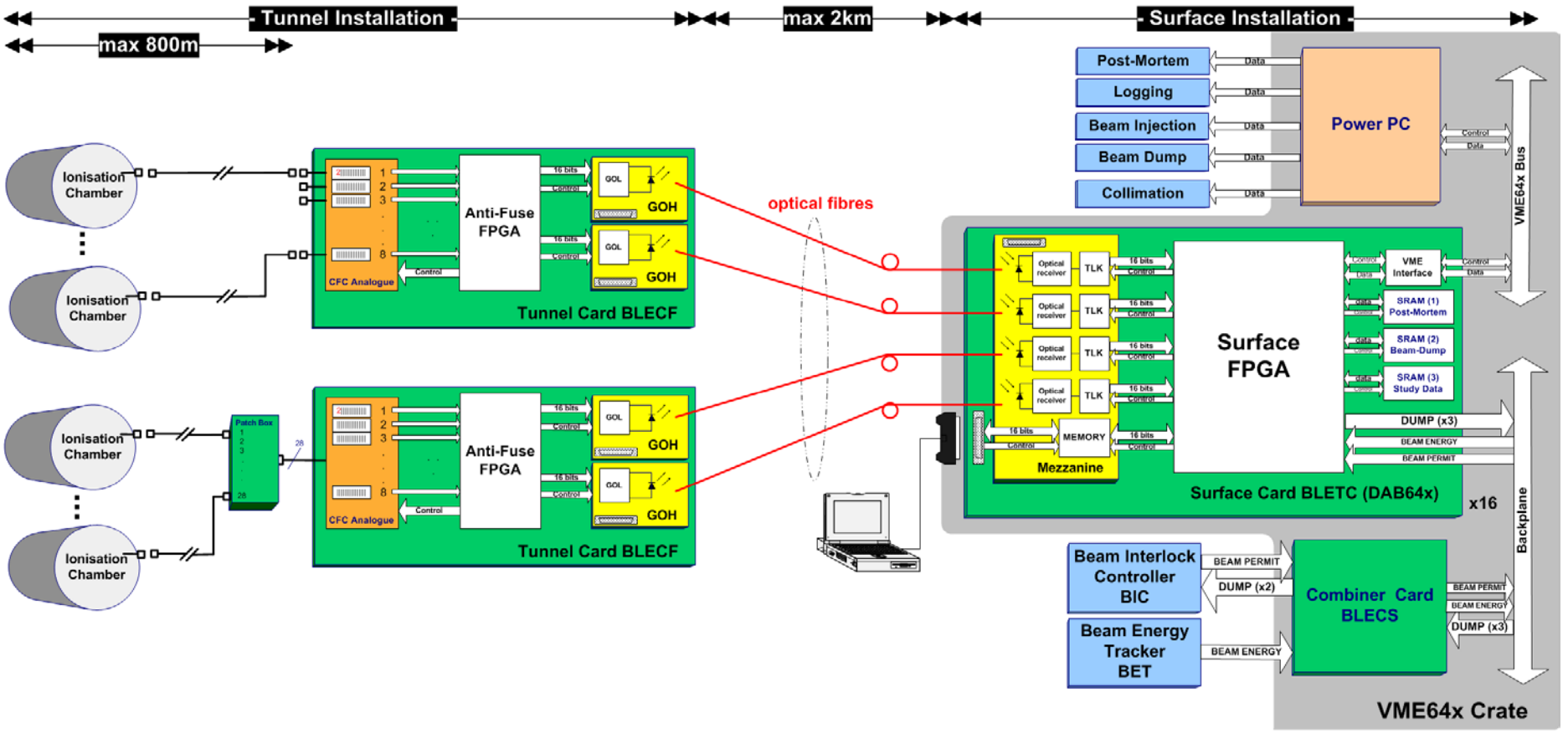
Prerequisites for any modification

- Minimum impact on SIL and avoid branching
- Keep testability and traceability
- As few as possible changes in the system

Therefore:

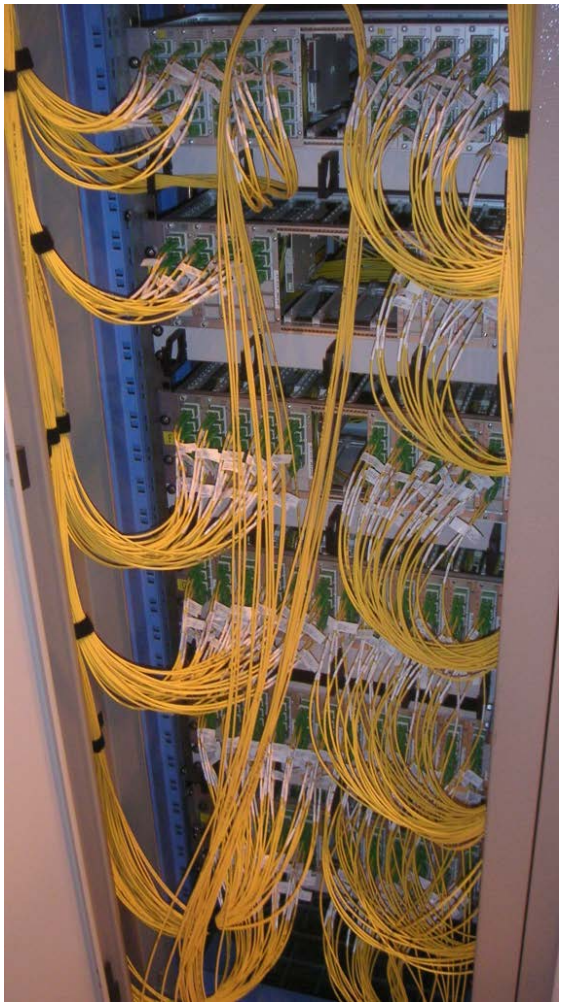
- Connectivity check (part of the System Sanity checks) should be still possible.
- FPGA Firmware modifications should be applicable globally – maintain one firmware for all crates.
- Expect notification signal to be of high dependability.

System Overview



Surface Installation

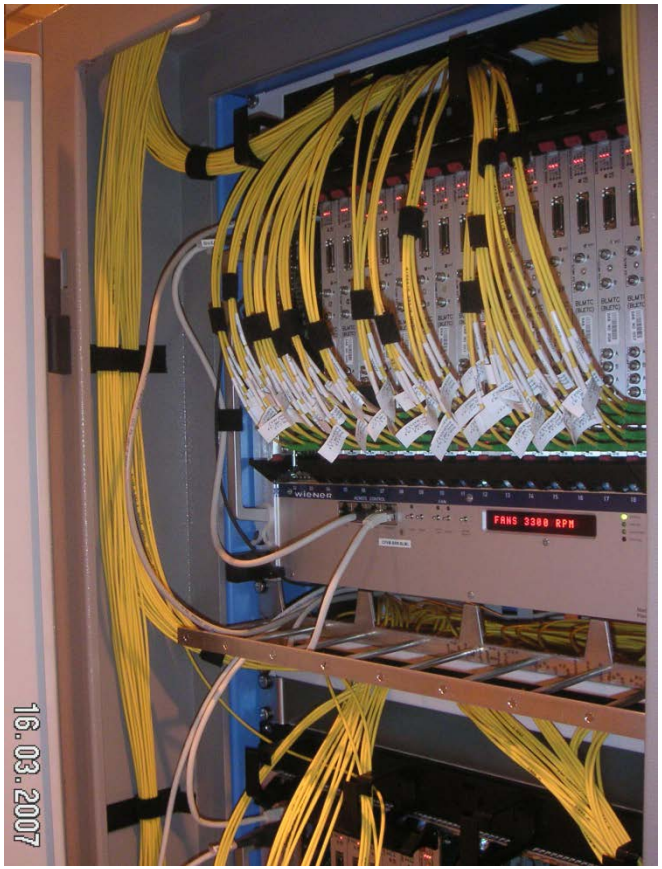
- From each LHC point the fibres arrive to one service room at SR buildings
- Approx. 1600 fibres in total, i.e. 2 from each acquisition module
- All the fibre minitubes (1-2 km) arrive to a distribution rack in the surface.
- Patchcords (5-7 m) are used to connect to the cards in the crates.

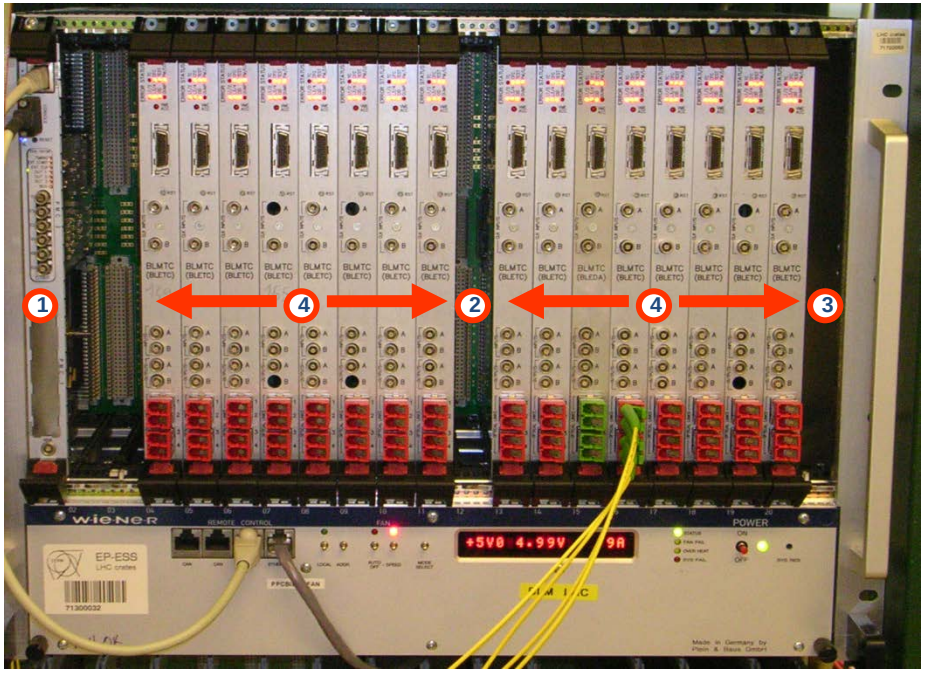


Fibre distribution Rack

Processing Rack

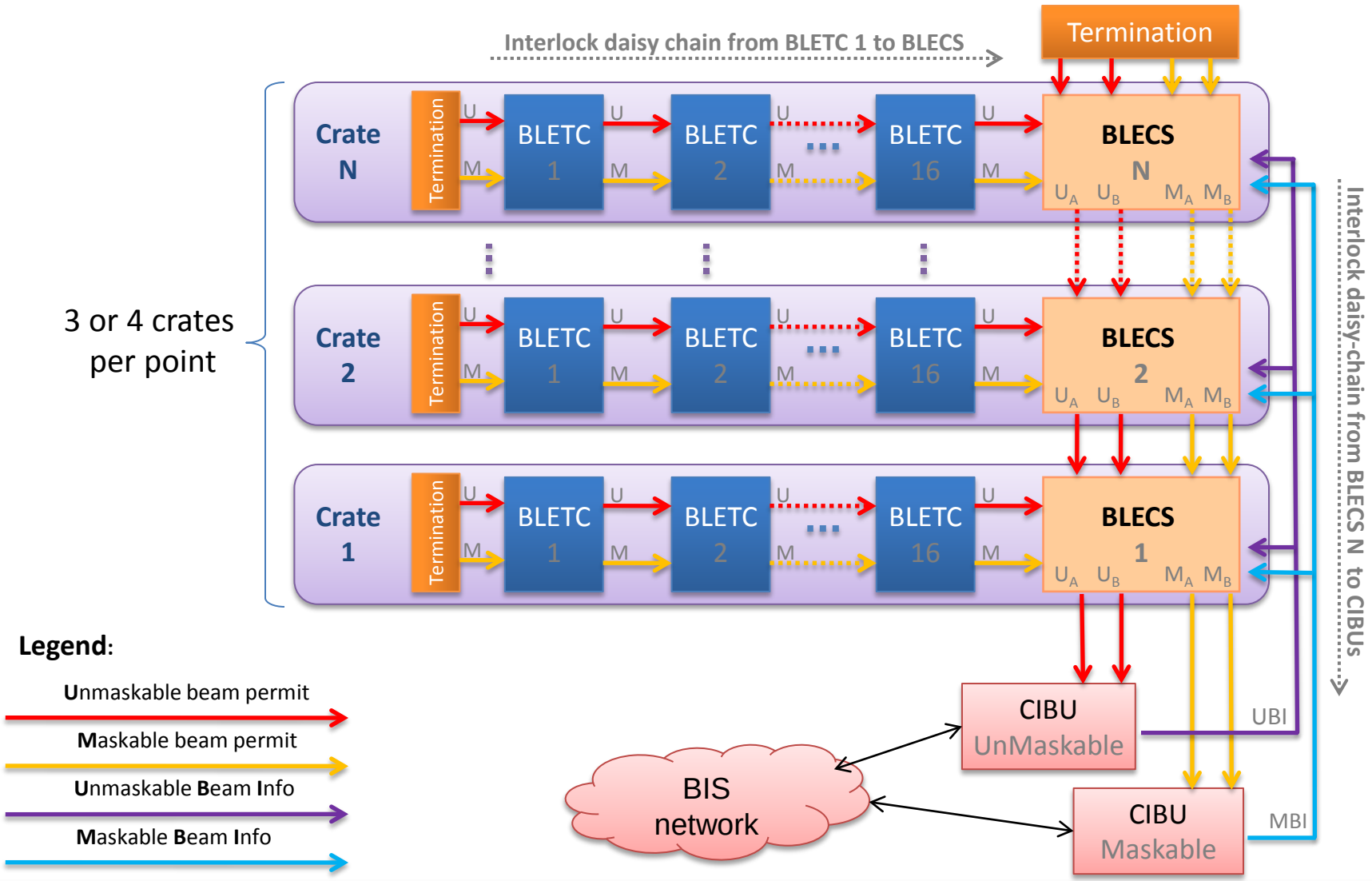
Processing Crates





1) **FEC/CTRP** – CPU / GMT timing
2) **BOBR** – BST timing
3) **BLECS** - Combiner & Survey
4) **BLETC** – Threshold Comparator

Beam Permit Signals Distribution



Details on the modifications proposed and the new functionality

MODIFICATION PROPOSAL

Modifications: Installation

- Move relevant detectors to separate acquisition cards
  - See ECR for injection BLMs for the list of monitors involved.
  - Re-cabling of signal and power distribution is necessary for some.

  - Note: we asked initially the current grouping of monitors to **not** be broken. This was later agreed to be an unrealistic demand.

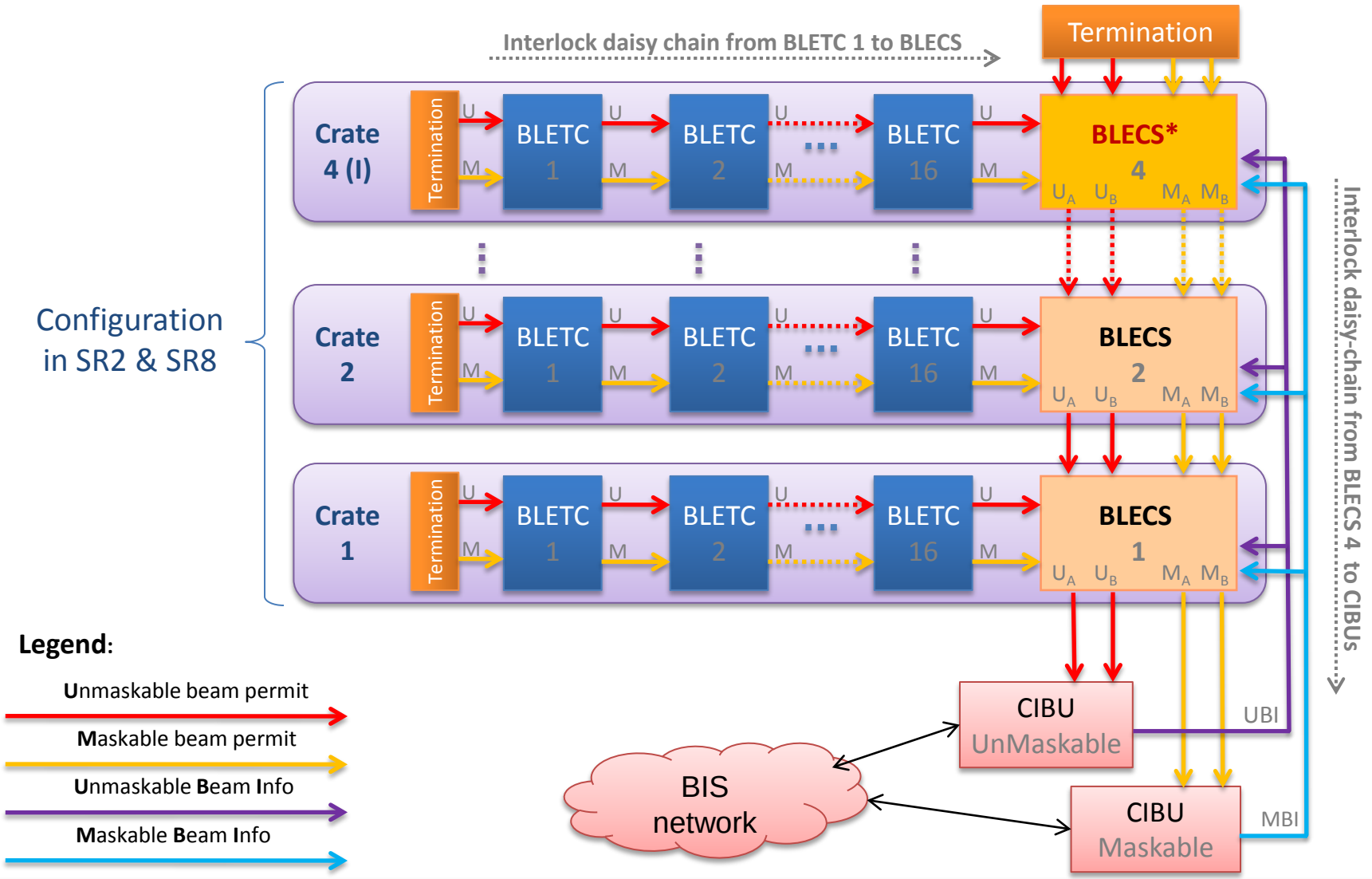
- Add two new processing crates
  - Connect to the standard interlock daisy chain between crates
  - Will be the last in the chain to avoid inhibiting other crates' interlocks

- Add new processing modules and connect fibres.

- Update the MTF, LAYOUT and LSA databases with this configuration.

All to be completed during LS1

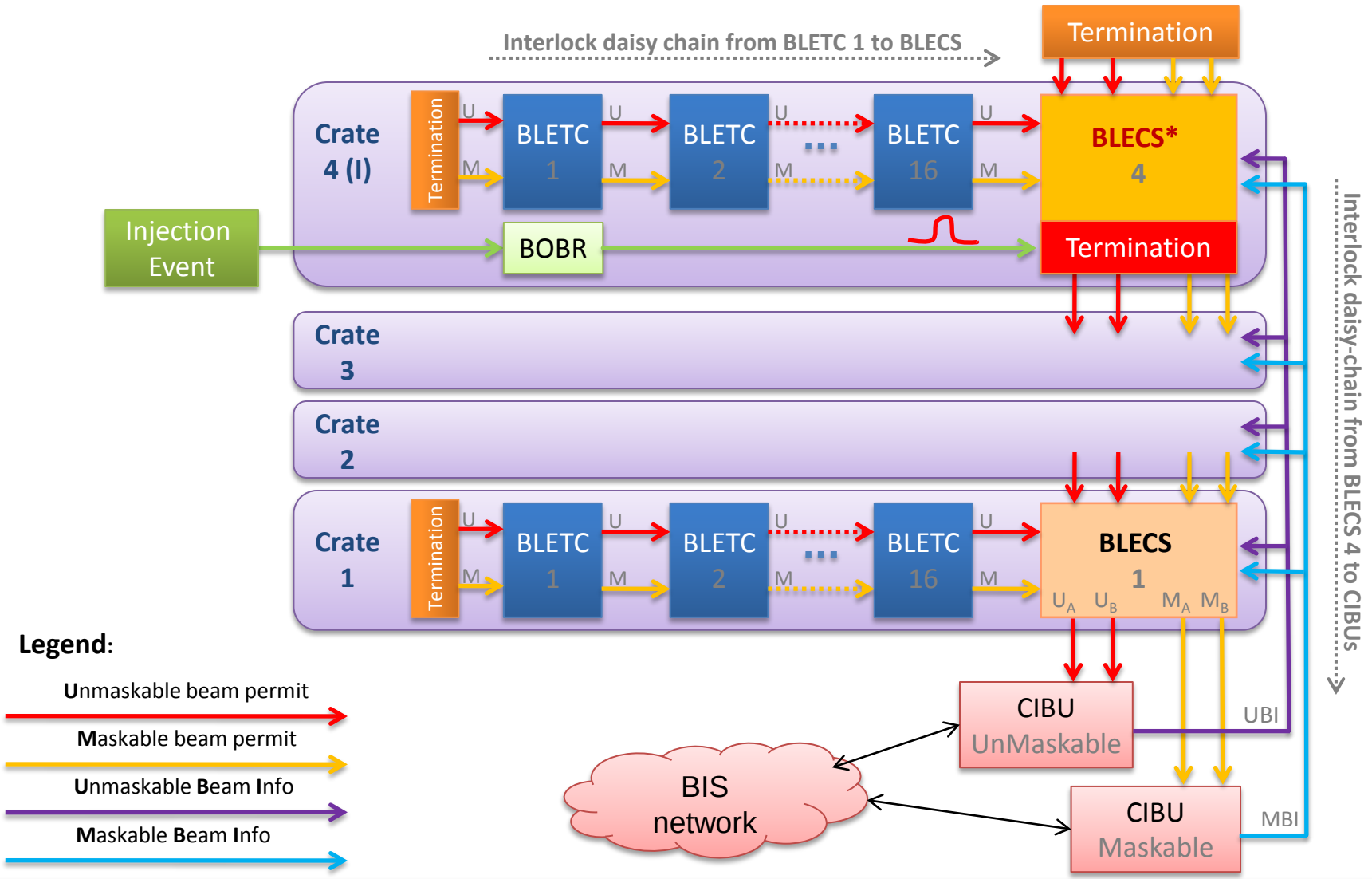
Configuration in SR2 & SR8



Modifications : Hardware

- Modify the BOBM (BST master) configuration to forward a timing event related to the injection
  - There are several to choose from,
    e.g. HIX.FW-CT, HIX.W100-CT, HIX.W20-CT, HIX.AMC-CT.
- Modify the BOBR (BST receiver) configuration to distribute the timing event in the backplane of the crate.
  - A pulse is broadcasted to all cards through a dedicated line of the VME64x P0 connection whenever the event is received
- Modify the BLECS firmware to force the Beam Permit line for a fixed period of time when it receives the injection signal and certain other conditions are satisfied.
  - Persistent FESA settings per crate will (in the future can become part of the MCS parameters):
    - Activate/Disactivate the inhibit functionality.
    - Define the time the beam permit is forced to TRUE
  - Inhibit of the output will happen only under certain conditions:
    - during injection,
    - energy is 450 GeV,
    - …

Interlock Inhibit Functionality



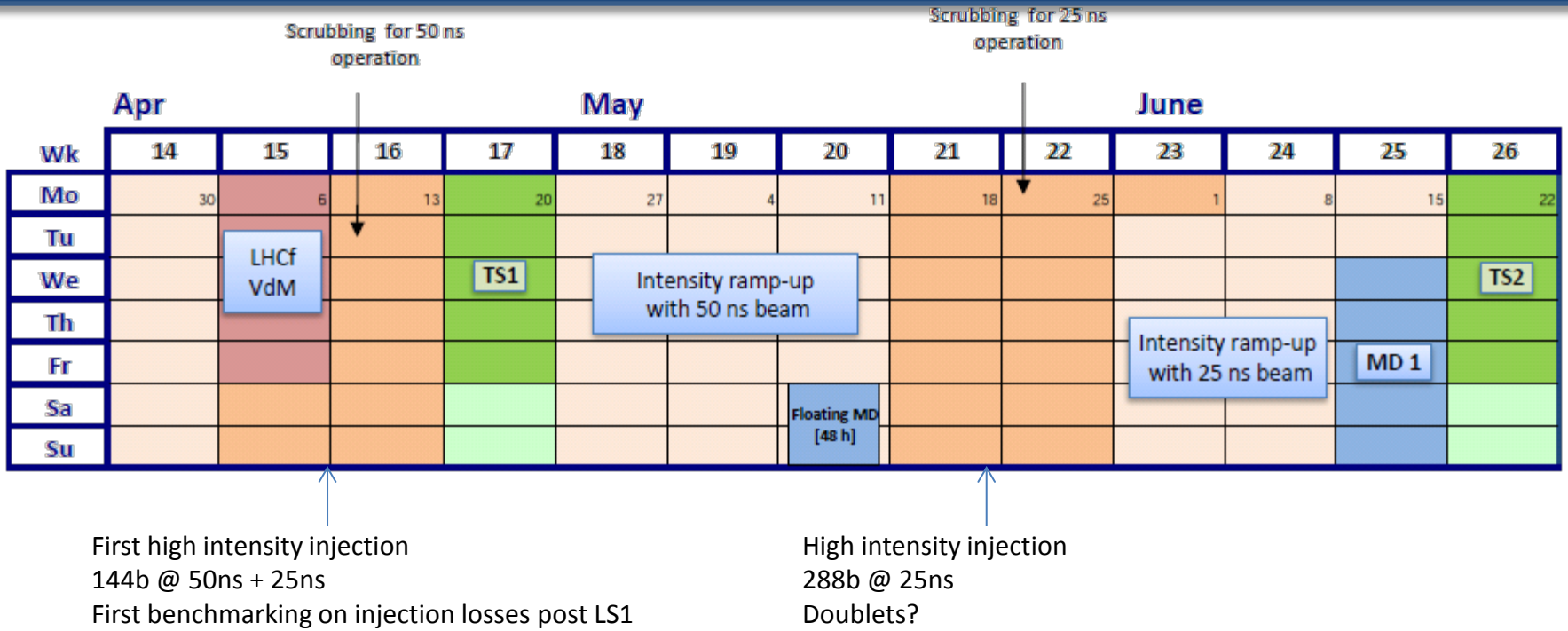
Additional information

- The modified firmware, at this time, cannot affect the total reliability of the system but it can affect its availability, i.e. false dumps.
- Measurement or threshold values will not be modified at any time, i.e. no blinding.
- Interlocks by channels over threshold values will always be logged.
  - For all channels and all integration periods at 1 Hz
  - Though, it will be not possible to know when exactly or how many times inside the 1 s the interlock occurred.

Strategy proposed for the deployment and future upgrades

PLANNING PROPOSAL

Planning (proposed by MPP)



- Deploy BLM interlock inhibit at injection for potential use in TS1 (to avoid slow down of scrubbing and initial intensity ramp-up).
  - Special version ONLY on blind-able crates.
  - Commission blinding with timing signal but **INITIALLY DO NOT BLIND** in order to allow assessment of post LS1 situation.
- Prepare **for full deployment** if need confirmed in **TS2**.

Strategy Proposed

- At TS1 deploy special BLECS firmware on new crates
  - separate crates have been installed
  - detector distribution (+use of LICs) has been done
  - new functionality only on the two new injection crates
  - injection signal via the BOBR (via backplane)
- During 2015 maintain two BLECS firmware
  - evaluate the need of the inhibit functionality
  - discover the optimal settings and safeguards required (deadtime, max. repeat, checks etc.)
  - modify further firmware and deploy as necessary (MPP has accepted reduced reliability for these two crates)
- At WTS 2015, depending on outcomes,
  - decide if functionality is needed
  - deploy common firmware to all BLECS modules
  - move FESA settings to DB parameters with MCS

THANK YOU