Beam Interlock System v2: Interface to actuators

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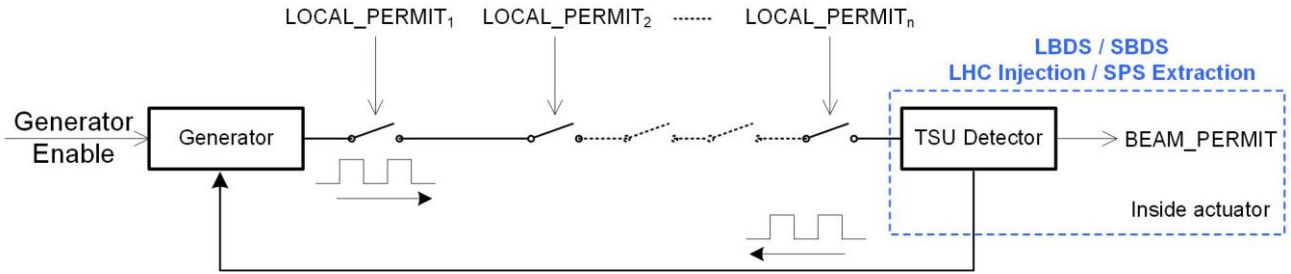
Outline

- Present situation
- Motivation to upgrade the interface to actuators
- Proposed solution
- Next steps

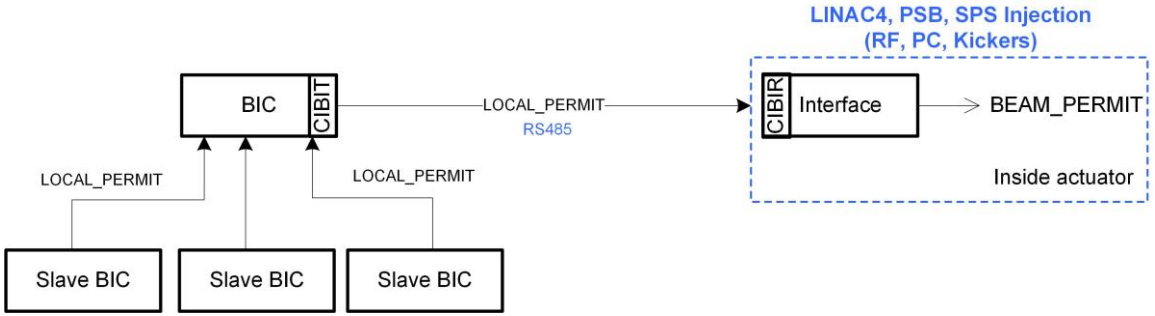
Present situation (1/2)



Optical Interface

- Redundant, fast and reliable communication
- Adequate for long distance transmission
- Immune to Electromagnetic Interference (EMI)
- Adequate for multiple actuators
- Frequency decoding to derive Beam Permit status under actuator's responsibility
- Diagnostics under actuator's responsibility
- Regular campaigns to measure optical budget available

Present situation (2/2)



Differential Signaling Interface

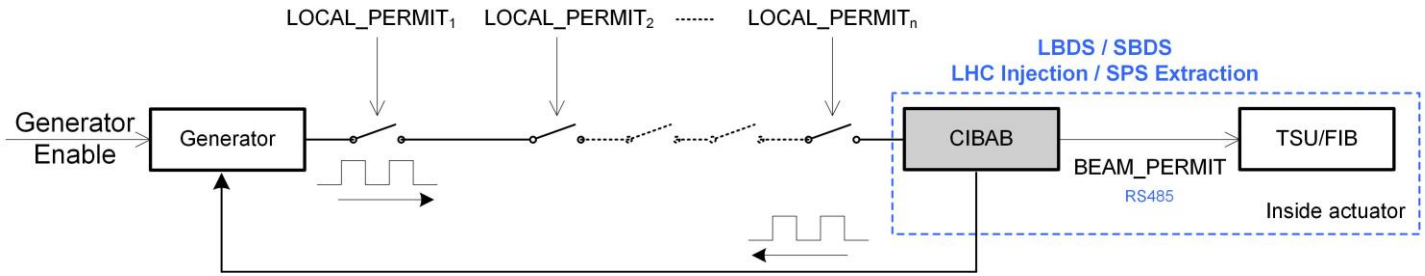
- Redundant, fast and reliable communication (based on fail-safe RS485 transceivers)
- Resistant to Electromagnetic Interference (EMI)
- Limited number of actuators
- Simple interface, no decoding required
- Diagnostics under actuators's responsibility

Motivation to upgrade the interface

TE-MPE proposes to **standardize the interface between the BIS and actuators**

- **Common hardware interface with the actuators** (i.e. as done for the user inputs with the CIBU)
- **Common algorithm to decode the Beam Permit frequencies** (i.e. avoids different implementations and detection criteria across different groups and machines)
- **Redundant implementation to ensure the required level of dependability** (i.e. independent interface boards to decode A and B channels)
- **Enhanced diagnostics of the Beam Permit Loops** (i.e. full monitoring of the Beam Permit Loops up to actuator's crate)
- **Easy maintenance of the optical infrastructure** (i.e. no longer need to disconnect optical fibres to perform optical measurements)

Proposed solution – Actuator board CIBAB



Optical Interface with Actuator Board (CIBAB)

CIBAB responsable for decoding the Beam Permit frequencies
CIBAB provides Beam Permit via differential pairs using fail-safe RS485 transceivers
CIBAB redundant boards (i.e. 1 board for loop A and 1 board for loop B)

Actuator board - CIBAB

- Form factor:
  - **VME64x board** (redundant configuration - 1 for A loop, 1 for B loop)
- Front panel:
  - **2x 1-pin LEMO: PPS**, **PM** trigger
  - **1x SFP transceiver**: Rx/Tx Beam Permit Loop frequencies
  - **2x 4-pin LEMO**: Beam Permit to Actuator and Beam Permit feedback from Actuator
- Back panel:
  - **4x pins on J2**: Beam Permit to Actuator and Beam Permit feedback from Actuator
- Diagnostics:
  - **FESA class** for monitoring/control (BPL frequency/state, SFP diagnostics, History Buffer)

Interface between CIBAB and TSU-FIB

- **Option 1**: The **CIBAB would be deployed in the TSU-FIB crate** and would deliver the Beam Permit status via the VME rear interface (P2 connector). This option would be the preferred one for TE-MPE as it is considered the best in terms of reliability. Nevertheless, this would require a new design of the TSU/FIB.

- **Option 2**: The **CIBAB would be deployed in a new crate** (next to the TSU-FIB crate) and would deliver the Beam Permit status via the front panel (LEMO connector). This solution is a good compromise in terms of reliability but crossing of A and B triggers cannot be excluded. Preferred option by SY-ABT (see slides from Nicolas and Pieter).

- **Option 3**: **Do not use the CIBAB at all**. In this case, the TSU/FIB would receive the Beam Permit Frequencies via the CIBSFP mezzanine board (https://edms.cern.ch/item/EDA-03463-V2-0/0). This configuration was already tested in the LHC SFP testbed. This option would not require any hardware modification on the TSU/FIB, just a firmware upgrade.

Next steps

- If proposal is endorsed by the MPP:
  - Q1 2024 - Launch **CIBAB hardware and firmware** design
  - Q2 2024 - **Build prototype** and test in the lab
  - Q4 2024 - **Launch design review** (both firmware and hardware)
  - YETS 2024/25 - **Test-platform deployment** in LHC (use LHC SFP testbed infrastructure)
  - LS3 - **Deployment in the SPS, SPS TLs and LHC**

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