Presentation of BE-CO solutions for fast interlocks

Participants:
- For TE-MPE: J. Uythoven, R. Mompo, A. Antoine,
- For BE-ICS: J. Ortola, M. Quilichini, E. Blanco, C. Oliveira, B. Schofield, A. Foivos, R. Speroni,
- For BE-CO: S. Deghaye, J. Serrano, G. Daniluk, E. Gousiou

Summary
BE-RF and TE-MPE currently implement interlock systems based on PLCs. However, new requirements for fast reaction time, of the order of 1 µs, are beyond the possibilities of PLC-based system existing at CERN. Following the recommendations from CO3 to look first at the solutions provided by the two central support groups (BE-ICS & BE-CO) and only then look at other solutions at CERN or externally, BE-ICS organized this meeting with the aim of discussing existing possible solutions that may satisfy the requirements from TE-MPE and BE-RF. BE-ICS reported on the plans from Siemens to developed a new generation of modules equivalent in functionality to the Fast Boolean Processors currently in used by TE-MPE. BE-CO presented their solutions for fast interlocks as well as their radiation hard solution. Finally, C. Oliveira presented the results achieved with both B&R and Beckhoff PLCs. Carlos’ results as well as the slides shown by Grzegorz can be downloaded from the agenda page:

https://indico.cern.ch/event/882462/

During the discussion, the following points were raised:
- BE-CO working with EN-SMM to include PXI-Express into their catalog of solutions. No plan to look into cRIO.
- The DI/OT solution is required for HiLumi LHC.
  - Plan is that the users develop their own boards with the functionality required.
  - FPGA (rad-tol) variant can run a user C program in a dedicated core.
- BE-CO’s Proposal for to satisfy the requirements from RF is based on the FEC and consists in a generalization of the WFIP master board to provide Mock Turtle so that users could run their own C code in a dedicated processor.
  - This option would be available for testing now. Only the signal conditioning would have to be developed.
- For RF a second solution based on SOC DI/OT could be also envisaged
- For WIC the recommendation would comprise the usage of Rad-tol DI/OT for underground crates and non-rad tol SOC DI/OT for the surface. Communication via CMW would allow us to keep the WinCC OA interface.
- In terms of availability of buildings blocks, Grzegorz explained that the following components are already available:
  - a DI/OT hardware demonstrator consisting of proof-of-concept versions of the following modules:
    - off-the-shelf DI/OT crate with 2 redundant (non radiation-tolerant) power supplies and fan tray
    - v1 of System Board with radiation-tolerant FPGA
    - FMC nanoFIP - WorldFIP slave interface for DI/OT System Board
    - v1 of WIC I/O Peripheral Board with optocouplers
This is a good start to evaluate DI/OT in the lab environment.

- Currently the following components are being designed for the final DI/OT ecosystem (to be deployed for HL-LHC applications):
  - low cost DI/OT crate with radiation-tolerant power supply and optional fan tray
  - non-radiation-tolerant DI/OT System Board (with System-On-Chip)
  - radiation-tolerant DI/OT System Board (with more modern and larger FPGA than already existing v1 System Board)
  - radiation-tolerant Powerlink / Industrial Ethernet interface for DI/OT System Board

- Another possibility would envisage the usage of a RS485-FIP gateway or to develop a PLC module that would handle the conversion between a Siemens PLC and FIP.

- Action 1: BE-ICS (Jeronimo) to establish the contact between Javier in contact with Siemens to investigate the possibility to develop a new FIP module for Siemens PLC.

- It was acknowledge that the development environment provided by BE-CO needs some effort to make it more user friendly. Action 2: BE-ICS (Jeronimo) to work together with BE-CO.

- Action 3: CO – RF to follow up on the existing FEC solution

- Action 4: ICS to follow up with Siemens (Jeronimo) on the new generation of fast Boolean processors

- Action 5: CO to show a small demo for fast interlocks at the next meeting (Feb/March)