Description and status of the EMCI-EMP interface

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A novel DCS front-end interface for slow control, composed of two devices, the Embedded Monitoring and Control Interface (EMCI) and the Embedded Monitoring Processor (EMP), is presented. The EMCI, based on the lpGBT and the VTRx+, is placed in a radiation hard environment and is connected to multiple front-ends via eLinks. Up to 12 different EMCIs can transmit data via optical fibre to a single EMP, placed in the back-end in a radiation soft area. The EMP, based on commercial MPSoC module, is configured for data processing and monitoring and is accessible from the network via Ethernet.

Summary (500 words)

The importance of an efficient and reliable DCS increases with the complexity of the high-energy physics experiments. The High Luminosity upgrade of the LHC increases the requirements on the level of radiation tolerance of the detectors and relevant control systems. To fulfil these requirements, a new system based on two devices, the EMCI and the EMP, is being proposed.

The aim of the EMCI, which is usually placed in a radiation environment, is to work as an interface for the control and monitoring data signals going in between multiple front-ends (FE) and the DCS system, while keeping a small factor form (9 cm x 7.5 cm). It is based on the lpGBT, which combines all the signals of the FEs, called eLinks, in one bidirectional channel and interfaces with the VTRx+, the optical transceiver, which transmits the data through a high-speed optical link. The transmission rate towards the back-end (uplink) is 10.24 Gbps and towards the front-end (downlink) is 2.56 Gbps. A single FMC connector integrates all the eLink differential signals to the FEs, as well as additional digital and analog interfaces and power input to the board. After having established a link with the back-end, the EMCI can be remotely re-configured to serve multiple configurations of the front-end.

The EMP is primarily meant to serve as an interface between the EMCI and the distributed back-end of the experiment control system within a commodity Local Area Network. The EMP serves as an optical link transceiver module for non-radiation areas such as counting rooms, supporting the connection of multiple Versatile Link+ (VL+) compatible optical fibres towards the detector front-end and an Ethernet interface towards the back-end. As the EMP is based on a highly flexible System-On-Chip module (Zynq Ultrascale+) with digital and analog interfaces, it may also serve as a general-purpose I/O concentrator with integrated processing platform. The EMP allows running Linux-based software applications, facilitating integration within the control system back-end.

Technical specifications of EMCI are available and several prototypes have already been assembled. A specifically designed test bench is under construction to fully validate the design. The EMP hardware is under design, although two commercial MPSoC modules are currently being evaluated and used to implement a firmware and software solution to serve as an example for specific user designs.

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