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The LHC Beam Loss Monitoring System's Surface Building Instalation.

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The strategy for machine protection and quench prevention of the Large Hadron Collider (LHC) at the European Organisation for Nuclear Research (CERN) is presently based on the Beam Loss Monitoring (BLM) system. At each turn, there will be several thousands of data to record and process in order to decide if the beams should be permitted to continue circulating or their safe extraction is necessary. The BLM system can be sub-divided geographically to the tunnel and the surface building installations. In this paper the surface installation is explored, focusing not only to the parts used for the processing of the BLM data and the generation of the beam abort triggers, but also to the interconnections made with various other systems in order to provide the needed functionality.

Summary

The strategy for machine protection and quench prevention of the Large Hadron Collider (LHC) at the European Organisation for Nuclear Research (CERN) is presently based on the Beam Loss Monitoring (BLM) system. At each turn, there will be several thousands of data to record and process in order to decide if the beams should be permitted to continue circulating or their safe extraction is necessary.

The BLM system can be easily sub-divided geographically to the tunnel and the surface building installations. It consists of around 4000 detectors, placed at various locations around the ring, tunnel electronics, which are responsible for acquiring, digitising, and transmitting the data, and surface electronics, which receive the data via 2km optical data links, process, analyze, store, and issue warning and abort triggers. The later provides also the connections to the Beam Interlock, the Beam Energy Tracking, the Logging and the Post Mortem systems. In this paper, the surface building's electronics are explored providing details for the different parts combined to provide the needed functionality.

This installation foresees VME crates spread over all of the eight LHC interaction points accommodating the processing modules, a timing card, a CPU card and a Combiner card.

The processing module is comprised by the DAB64x and the BLM Mezzanine cards. The BLM mezzanine card handles the de-serialisation and decoding of four optical gigabit data transmission lines in parallel. This mezzanine provides the received data to a reconfigurable FPGA which is the backbone of the DAB64x card. Each module is able to process in real-time up to 16 detector channels.

The timing card is the Timing Trigger and Control (TTC) card developed by the Beam Instrumentation group. In this application it will provide the Time-Stamp and the Post Mortem triggers.

The CPU is a PowerPC with LynxOS as operating system. Its main purpose is to access periodically the processed data from each processing module, normalise them with their corresponding threshold values and provide them to the Logging system before they are displayed on the fixed displays in the control room. Moreover, it will collect and time-stamp the Post Mortem data, stored on the circular buffers, whenever the relevant trigger arrives.

The final receiver of the beam permit lines is the Combiner card, located at the last slot of the crate. The two beam permit lines are daisy chained through each of the processing modules using a custom-made backplane in the crates. If any of the modules decides to break any of these lines a beam dump request will be given to the LHC Beam Interlock System (BIS). As an additional use, those lines will be used by

the Combiner card to provide a continuous supervision of the operation of the cards in the crate. Thus, it will be able to discover immediately a disconnection from the circuit or a failure and a dump will be requested for any of those cases.

Finally, the system has been designed with reliability and availability in mind. The processing modules can operate independently of CPU and Timing card failures. There is redundancy in the optical transmission with additional powerful error detection. The beam permit lines in the backplane are also redundant and the connection to the BIS is tripled.

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