TUPV037

MODULAR SOFTWARE ARCHITECTURE FOR THE NEW CERN INJECTOR WIRE-SCANNERS

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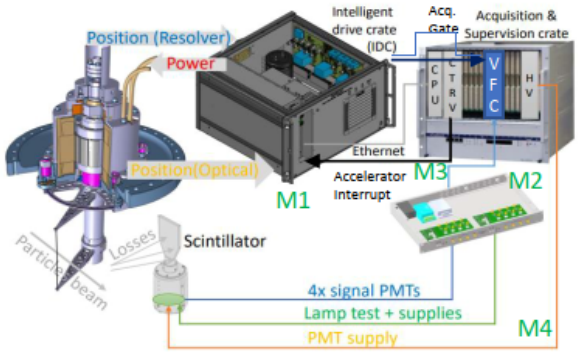


LIU wire-scanner mechanic and electronic system. From left to right, mechanics, secondary particle detector, IDC, digitisers and VME crate containing the different VME acquisition and control boards.

ABSTRACT

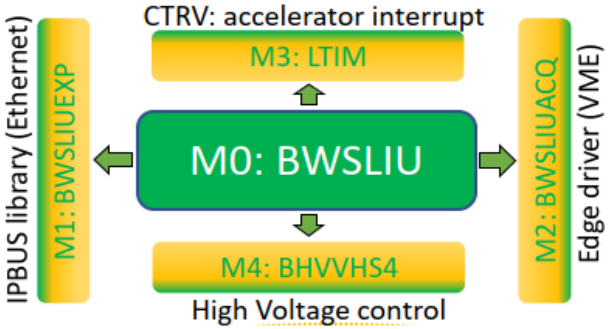
In the scope of the LHC injector upgrade, new wire-scanner devices have been installed in the LHC injector circular accelerators. This paper outlines the software architecture and choices taken in order to provide the scanner experts with comprehensive diagnostics as well as operators with straightforward size measurements. The underlying electronics acquire large amounts of data that need to be accessible for expert and machine development use and need to be processed before being presented for daily operational use, in the shape of a beam profile and its derived size. Data delivery and measurement computation are accomplished by means of a modular structure, using functionally distributed real-time processes that handle the different data views, with minimal interference in the processing, and minimal exchange of data among modules.

The goal of the BWS system is to provide bunch profile and size measurements in accelerator operations. A wire-scanner is generally based on a thin wire traversing circulating particle beams at high-speed. Monitoring turn by turn the distribution of secondary particles generated by the beam-wire interaction as a function of the wire position allows reconstructing the transverse beam profile

M1 Wire Displacement: in charge of starting a scan with or without external synchronisation and of reading, using the IPbus protocol, a bulk of registers with acquired position data, power data and status.

M3 Synchronisation: Trigger programming

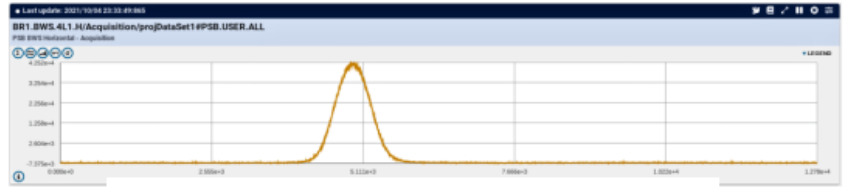
Architecture - FESA Blocks



Central unit FESA class with four satellite FESA classes, each representing a functional module

M4 PMT Gain: the working point of the PMT-filter combination to correctly cover the ranges of energy and intensity, needs tuning only during the commissioning phase

The high degree of independence of the functional modules emerging from the underlying hardware design and the distinct nature of the data produced, allows the implementation of software modularisation where one coordinating unit (**M0**), *the Operational Bunch Profile Measurement module*, orchestrates via a few operation settings, the other four modular components dealing with highly specific tasks. This organisation fits an event-driven architecture.



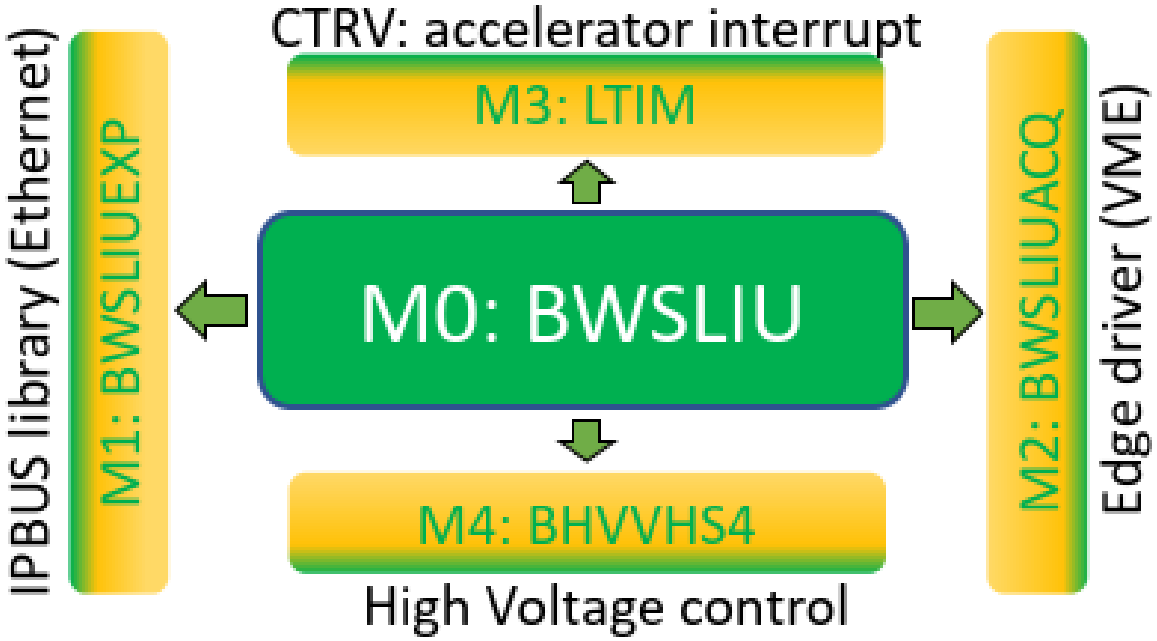
Plot shows profile data.

M2 Bunch Profile Acquisition: deals with the different aspects of the bunch transverse profile construction from the digitised particle shower distribution detected: It prepares the VFC and amplifier stage for acquisition and reads four integrated data streams and the raw data of a non-saturated channel for publication.

Plot shows position data for both in and out scans.

CONCLUSION

The implementation of FESA classes as building blocks in a functionally modular structure, in this case using an event driven architecture, grants high flexibility to the system in terms of prototyping and testing. It also simplifies coding structures that facilitate maintenance, encapsulates data views with extensive diagnostic possibilities and focuses interfaces adapted to the type of user exploiting them.
Following the restart of the LHC injectors the system has been deployed successfully in each of the accelerators. The commissioning was certainly facilitated by this modularisation due to the formerly described assets.



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M1: BWSLIUEXP

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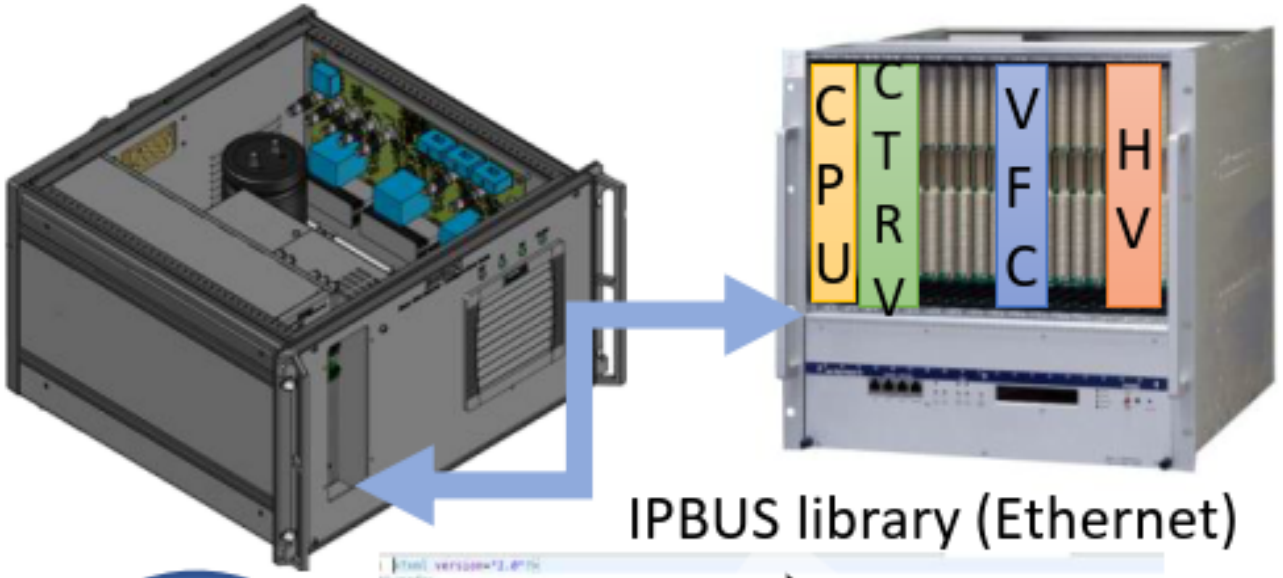
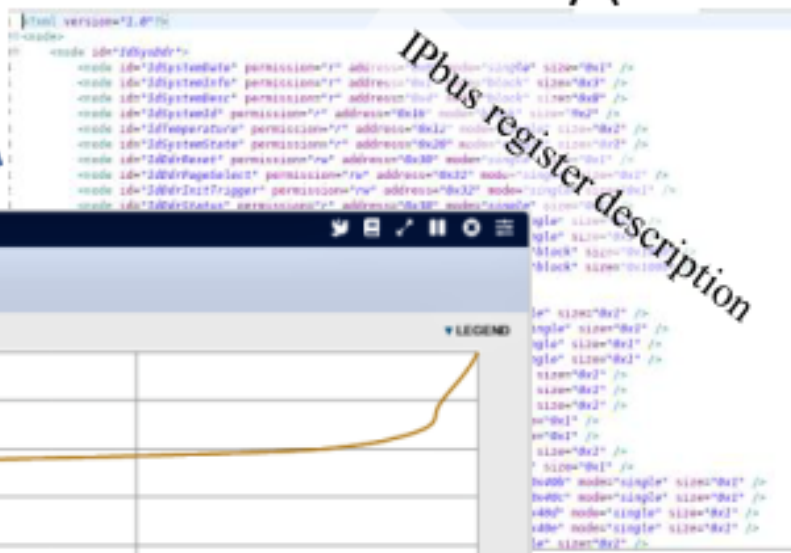
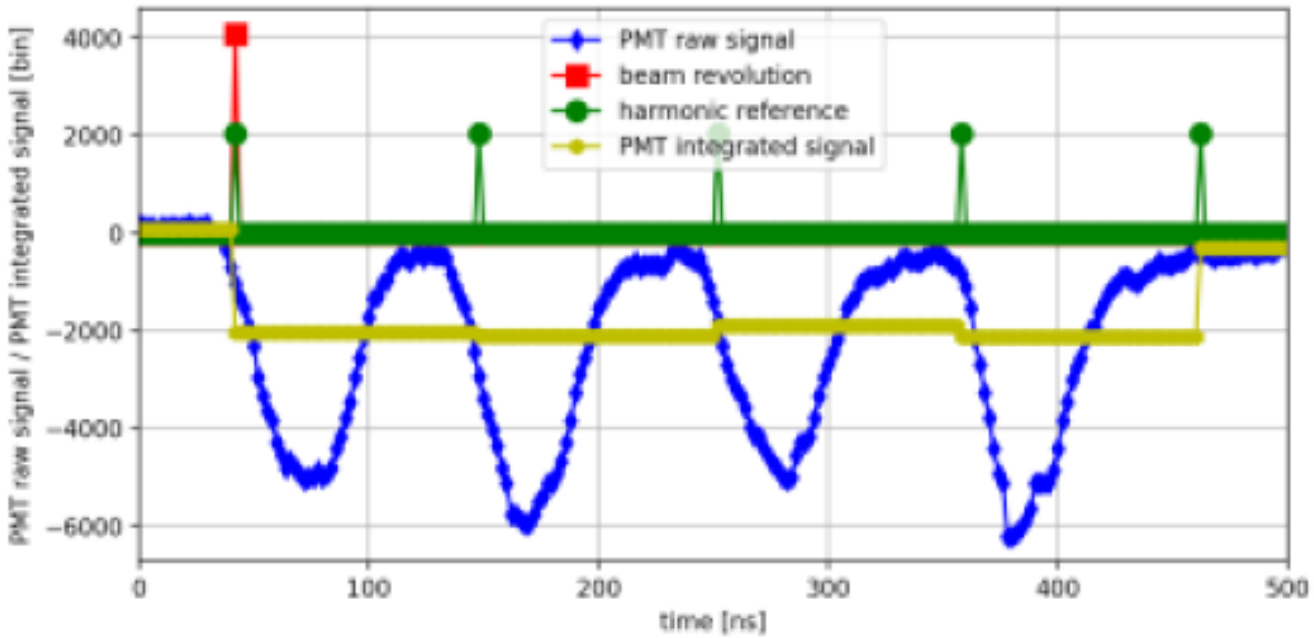


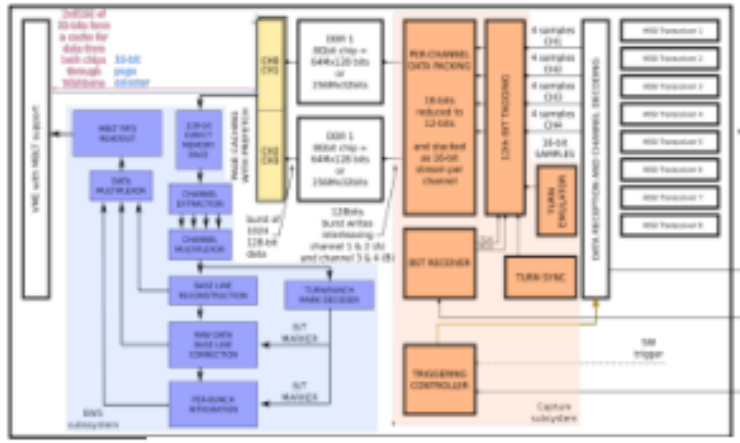


M2: BWSLIUACQ

M2 Bunch Profile Acquisition: deals with the different aspects of the bunch transverse profile construction from the digitised particle shower distribution detected: It prepares the VFC and amplifier stage for acquisition and reads four integrated data streams and the raw data of a non-saturated channel for publication.



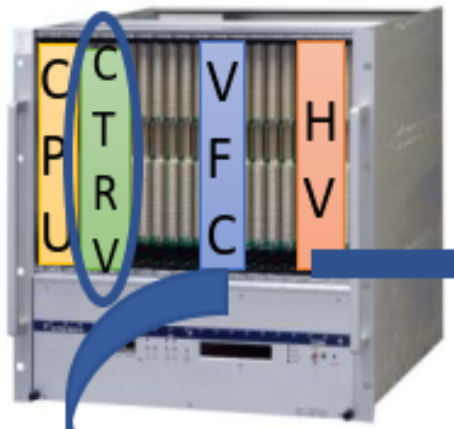
Capture of a four bunched beam (blue trace), bunch profile integrated turn amplitude (yellow trace), turn marker (in red) and bunch marker derived from harmonic reference (in green).

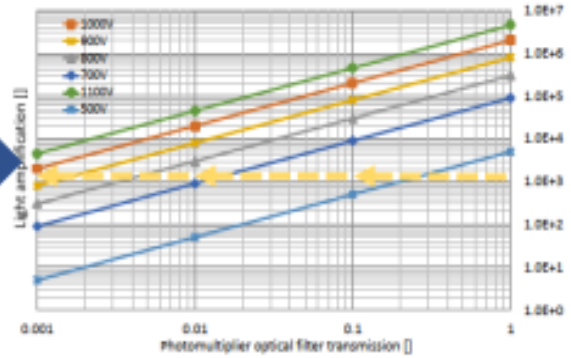


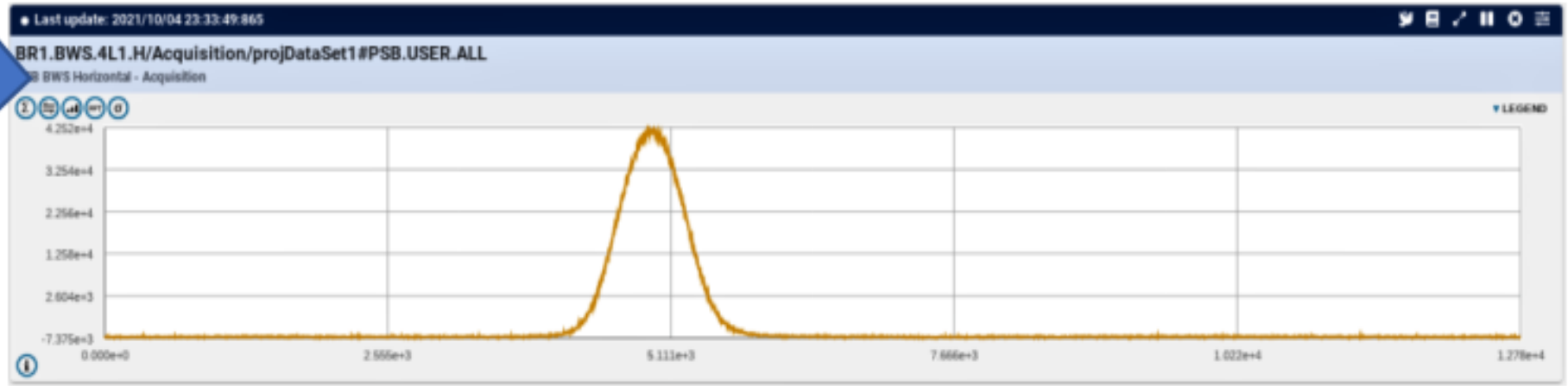
ADC and VFC carrier

M3: LTIM

M3 Synchronisation Trigger programming







M4: BHVHVS4

M4 **PMT Gain:** the working point of the PMT-filter combination to correctly cover the ranges of energy and intensity needs tuning only during the commissioning phase