

ABSTRACT

Fieldbuses and Industrial Ethernet networks are extensively used for the control of fast-pulsed magnets at CERN. With the ongoing trend to develop increasingly more complex low-level intelligent controllers near to the actuators and sensors, the flexibility to integrate these within different control architectures grows in importance. In order to reduce development efforts and keep the fieldbus choice open, a multi-network fieldbus technology has been selected for the network-interfacing part of the controllers. The integration of various fieldbus interfaces within the controller and the required embedded software / gateway to manage the network communication are presented. The gain in flexibility, modularity and openness obtained through this approach is also reviewed.



MOTIVATIONS

- Integrate real-time fast control functionalities within industrial based control architecture for diagnostic and monitoring
- Embed field-bus based communication functionalities directly within in-house designed hardware
- Reduce the use of departed I/O to gain space and flexibility
- Open communication layer for modification of data frame
- Decrease cabling cost
- Keep hardware design open to multi-network field-bus technology
- Optimize communication bandwidth

INTEGRATION EXAMPLES



Capacitor charger/discharger HV power supply

- Full digital control of capacitor charger/discharger high voltage power supplies for the powering of the Proton Synchrotron Booster (PSB) injection transverse painting bumpers.
- Communication module directly integrated within the power supply via HMS Anybus-IC PROFINET module.
- No need of embedded processor at the power supply level for implementation of communication functionalities.
- Kunbus PROFINET interface used for integration within a PXI controller with real-time software and FPGA for communication with the power supplies.

Power Trigger Controller

- Used for post-mortem analysis of LHC's Beam Dumping System (LBDS) power triggering system.
- PROFIBUS-DP integration within a SIEMENS PLC architecture, based on HMS Anybus CompactCom M40 module.
- FPGA-based card (Xilinx Spartan-7) with an ARM Cortex-M3 softcore to control the Anybus module.
- Hardware ready for upgrade to PROFINET during the CERN third long shutdown in 2023 without gateway or software modification.



GTO Stack Surveillance system

- Measures the anode-cathode voltage of each Gate Turn-On (GTO) in a stacked solid-state based high voltage switch.
- Integration based on HMS Anybus-IC PROFINET.
- FPGA-based receiver card connected to SIEMENS PLC via hardwired interlock signal for safety, and via PROFINET interface for communication.