Synchronously Driven Power Converter Controller Solution for MedAustron

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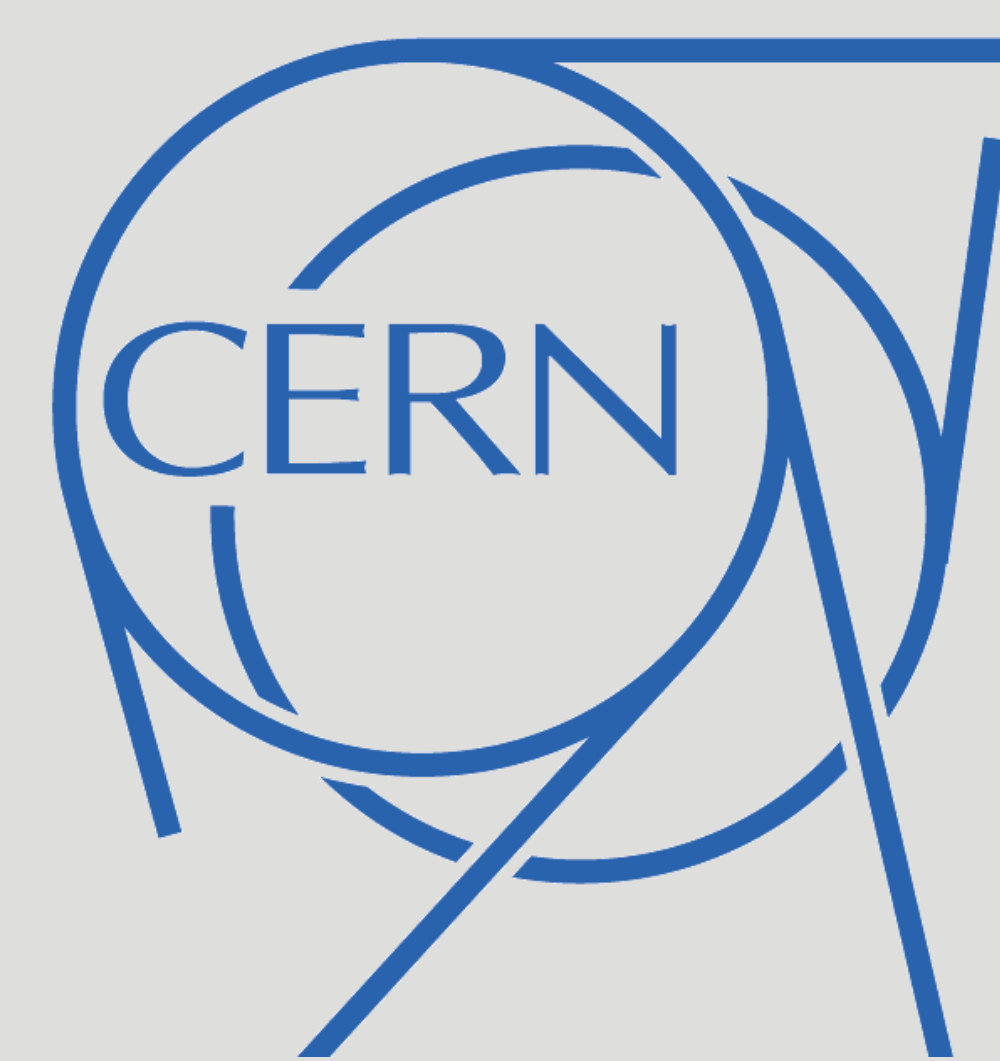
MedAustron

MedAustron - ion beam cancer therapy and research centre in Wiener Neustadt, Austria.

- ☑ Clinical and non-clinical research
- ☑ Medical treatment of cancer
- ☑ Synchrotron based accelerator
- ☑ Protons and carbon ions

Cosylab and MedAustron work closely together on MedAustron Control System (MACS).

Power Converter Controller (PCC) Solution

- ☑ PCC controls 260 power converters (power supplies) in MedAustron's accelerator
- ☑ Power converters deliver power to magnets, in order to steer, focus and extract the beam
- ☑ PCC applies output values to power converters and acquires measurements in precise points in time
- ☑ Integrated with the timing system for synchronous operation
- ☑ Controls power converters with an accuracy of 1 microsecond or better

Generic Design and Simplified Integration

- ☑ Front End Device hardware is generic and modular
  - ✔ Easy support for new types of power converter interfaces (only design a new baseboard)
  - ✔ FED board is generic and always stays the same

- ☑ Software support for power converters
  - ✔ New power converter type requires implementation of a new driver
  - ✔ API is fixed around the driver, implementation requires minimal effort

- ☑ API developed within the control system framework

Conclusion

- ☑ PCC allows control of arbitrary number of power converters
- ☑ Synchronous control with an accuracy of 1 us or better
- ☑ Simplified integration of new types of power converters

Technology Behind the Power Converter Controller
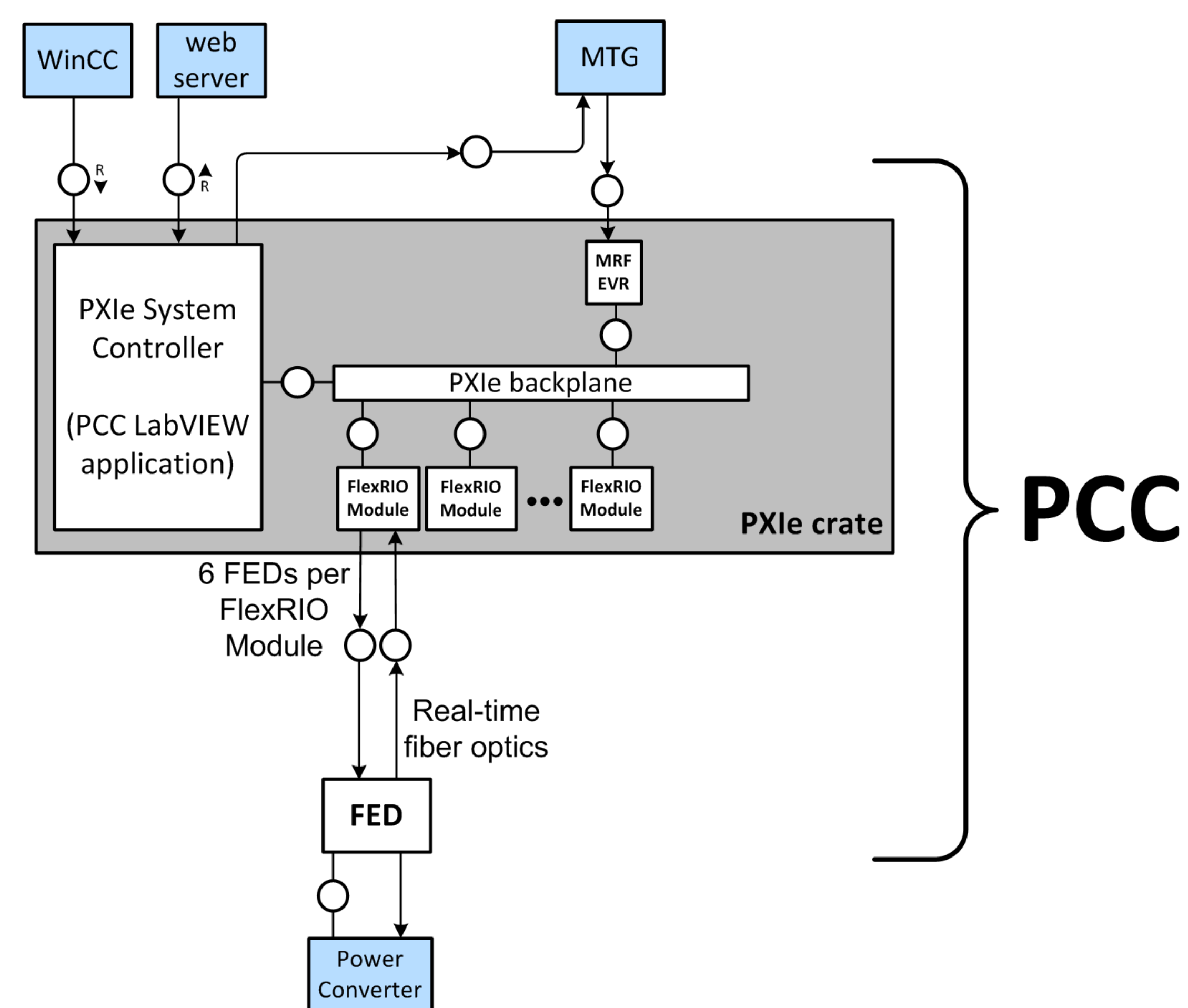
- ☑ Distributed system based on PXIe crates and custom developed front end devices
- ☑ COTS PXIe crates and controllers from National Instruments
  - ✔ PCC control system software is implemented in LabVIEW
  - ✔ Each crate can control up to 90 power converters
- ☑ Time-critical tasks handled by FPGA-based FlexRIO Module cards
  - ✔ Transmission of (output values) voltage levels to power converters
  - ✔ Acquisition and buffering of measurements
- ☑ Custom developed FlexRIO Adapter Module with generic optical interfaces
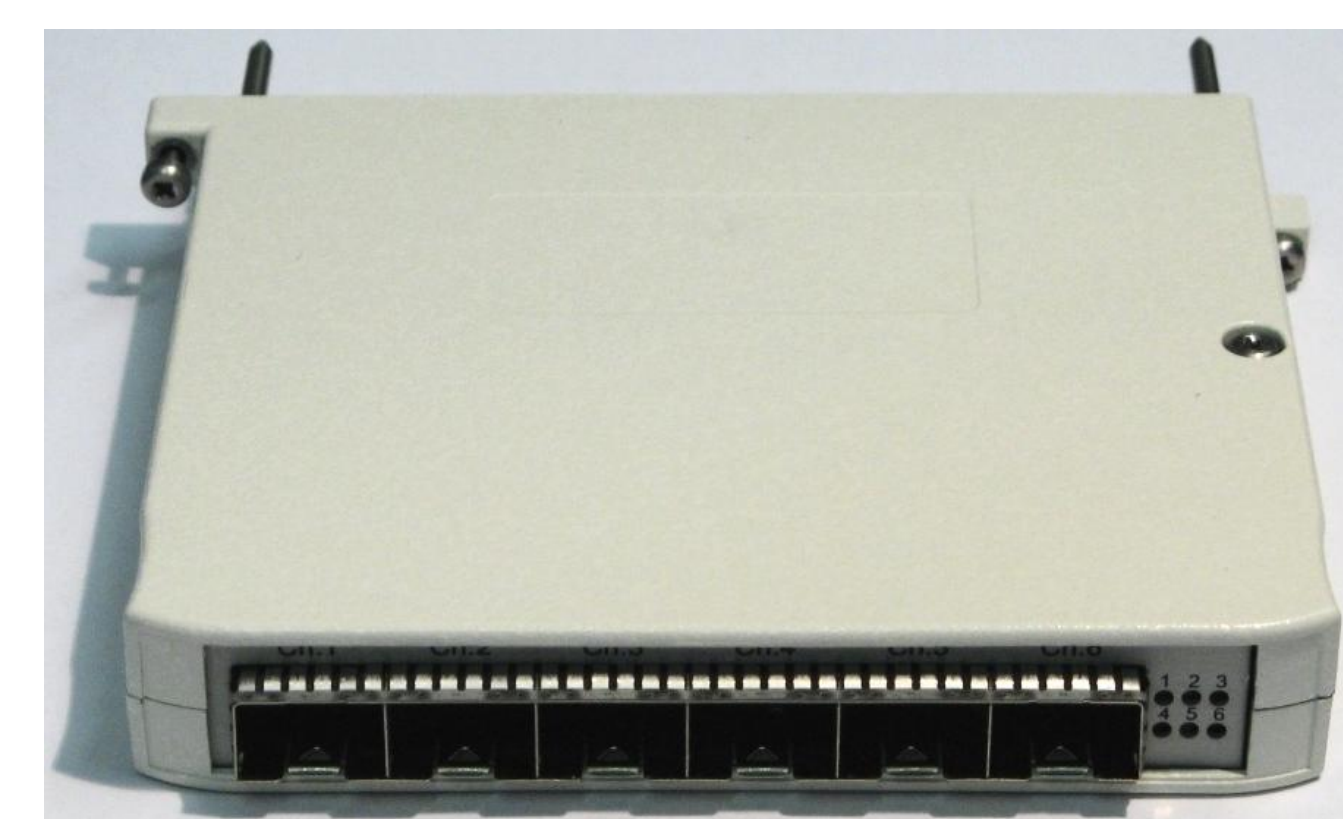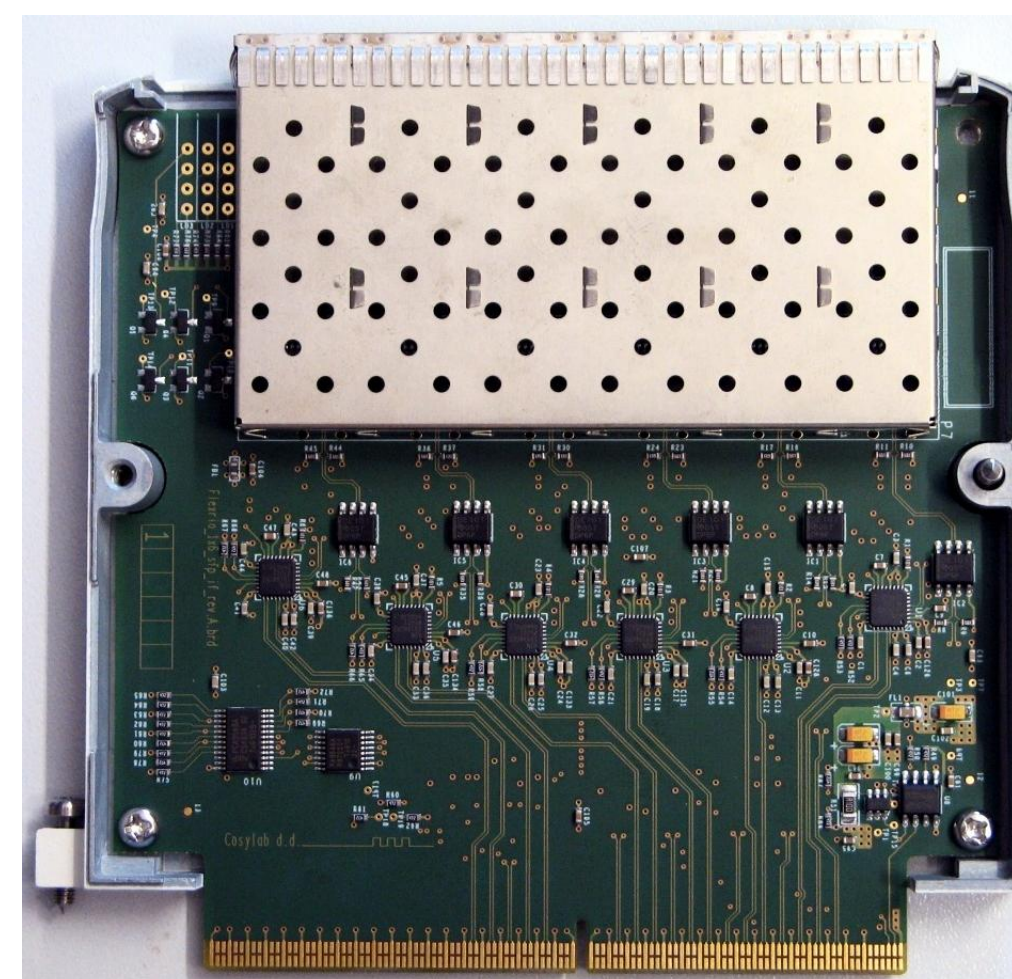
- ✔ FlexRIO Adapter plugs into the FlexRIO Module
- ✔ Provides 6 generic optical connectors to interface front-end devices
- ✔ Custom designed real-time fibre link @ 100 Mbit/s

- ☑ Front End Device (FED) :
  - ✔ Custom developed FPGA-based board which connects directly to the power converter
  - ✔ Optical interface, serial interface (RS-422), parallel UHPI, GPIOs
  - ✔ FED can be located a few hundred meters away from PXIe crate
- ☑ Baseboard, DSP board
  - ✔ FED plugs onto a baseboard or DSP board
  - ✔ Baseboard provides additional connectors
  - ✔ In-house designed DSP board implements regulation logic