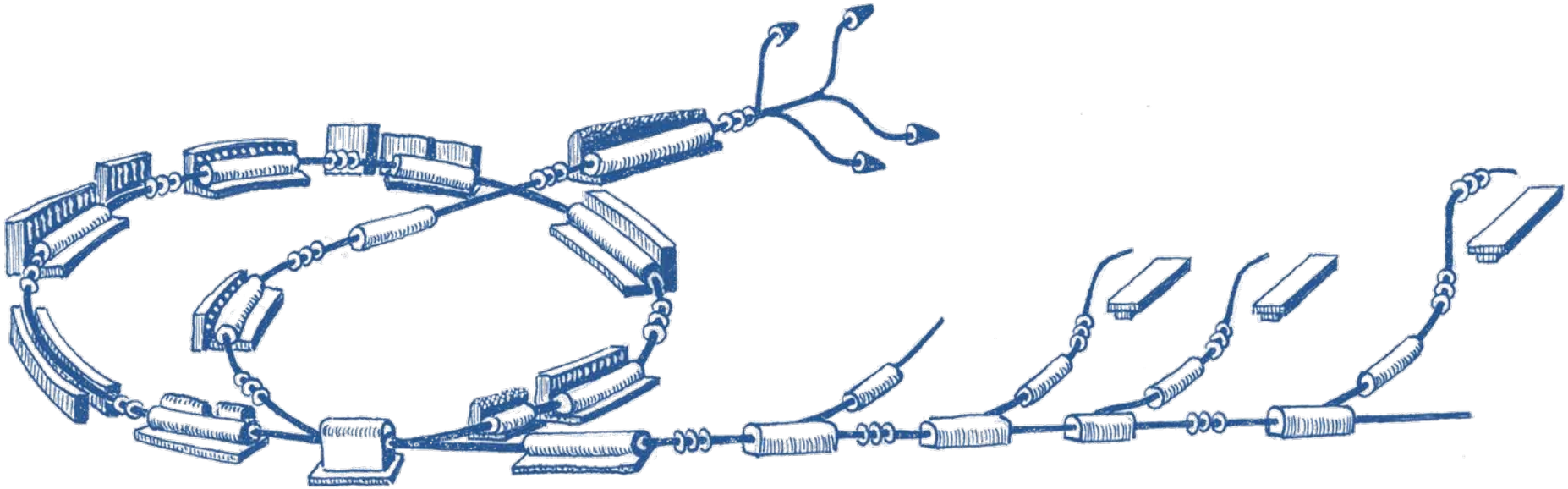
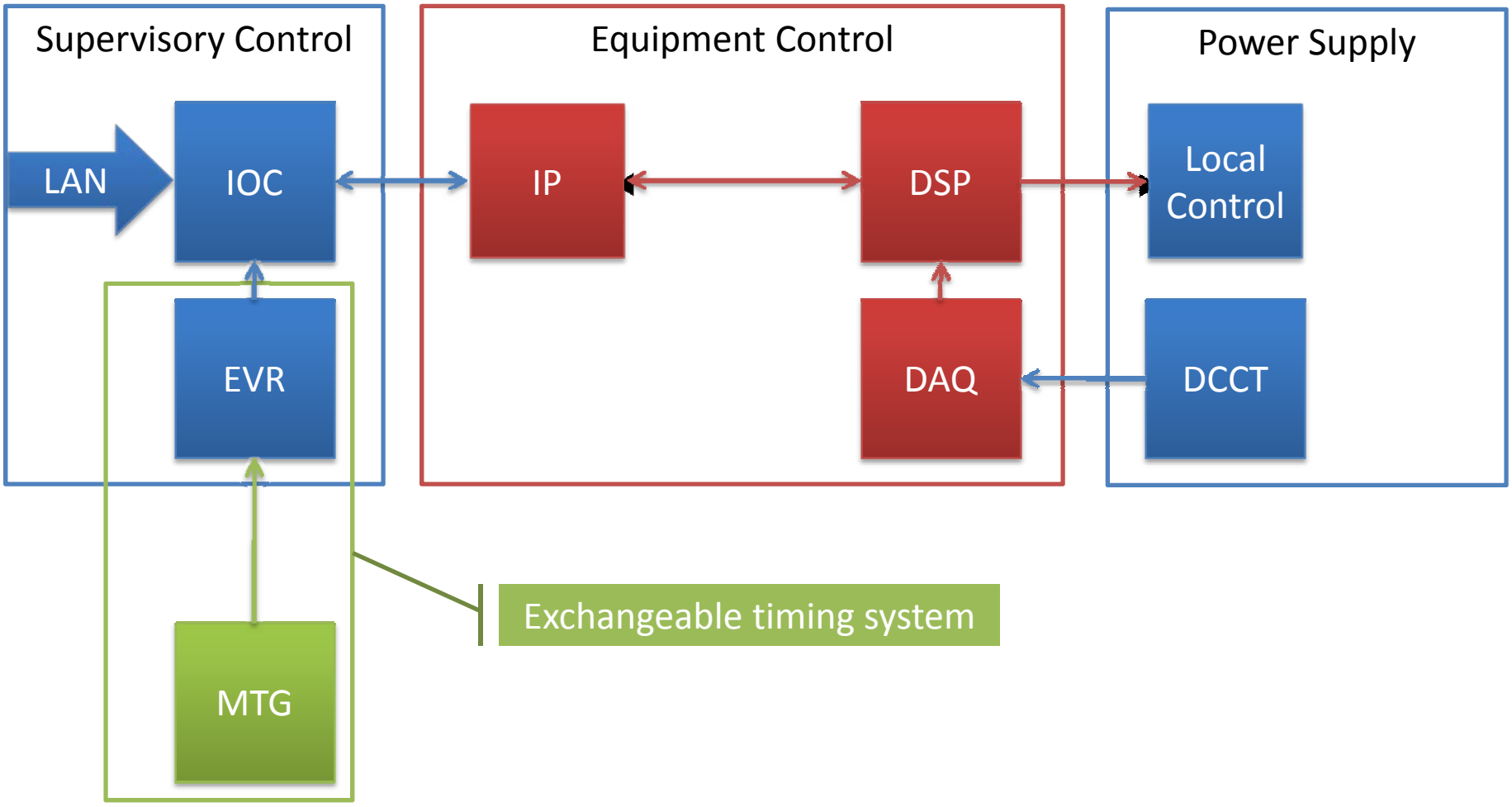
PSI Power Supply Controls

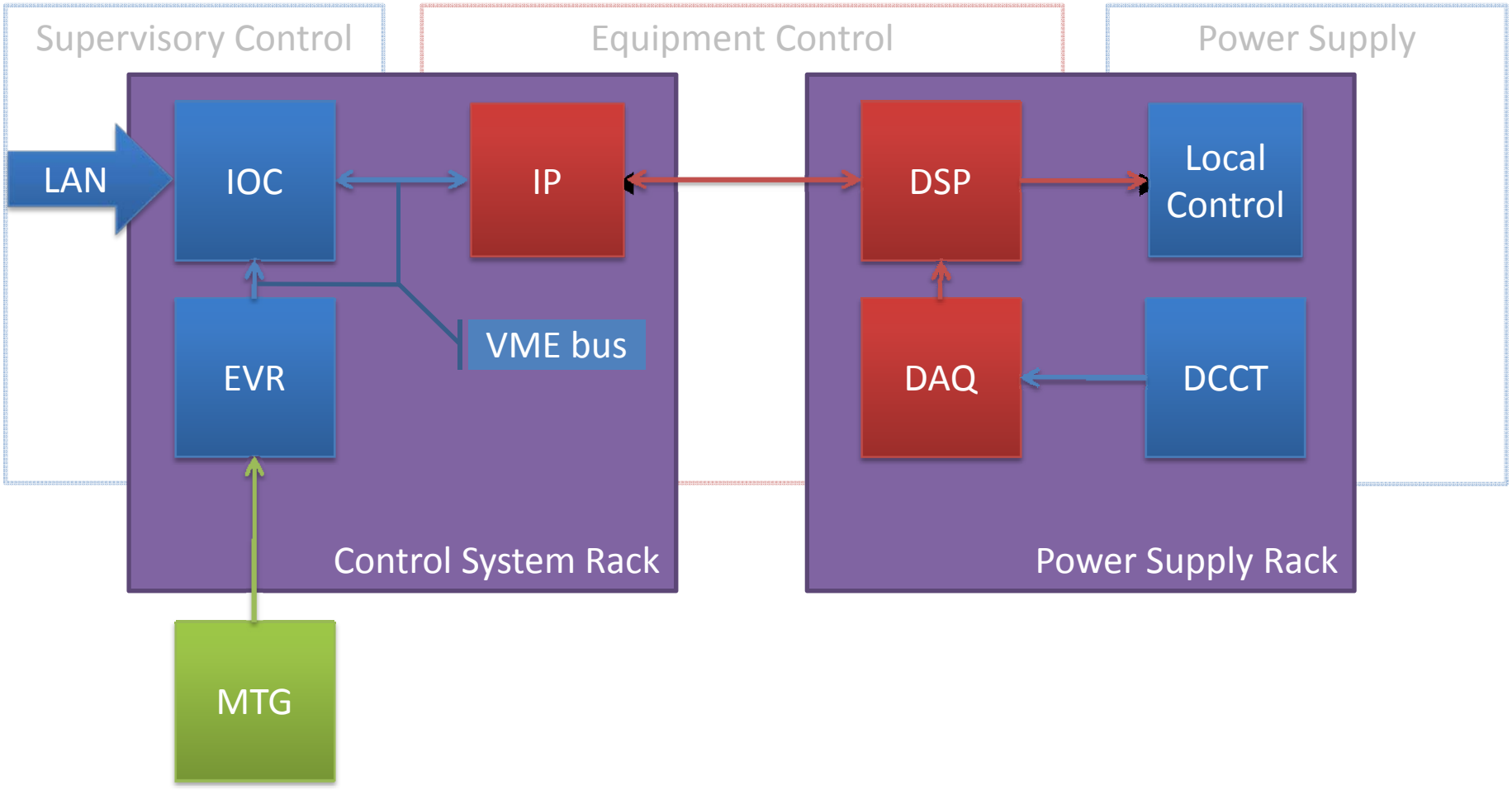
MedAustron Controls Workshop 1



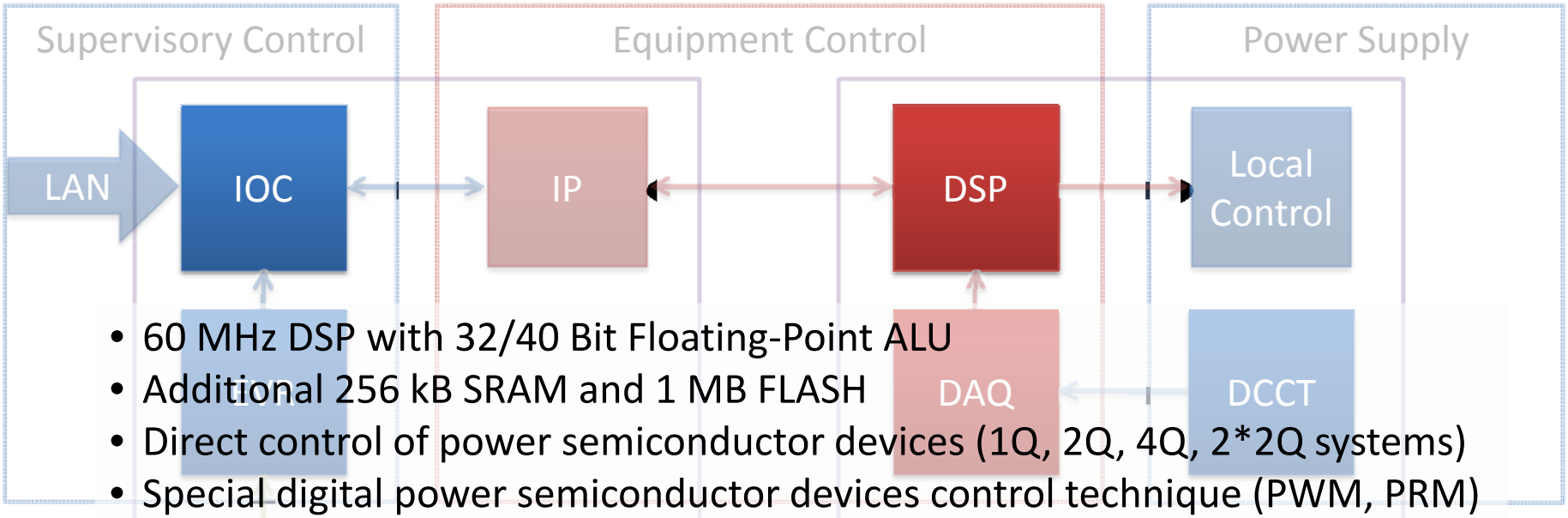
Logical Architecture



Physical Architecture

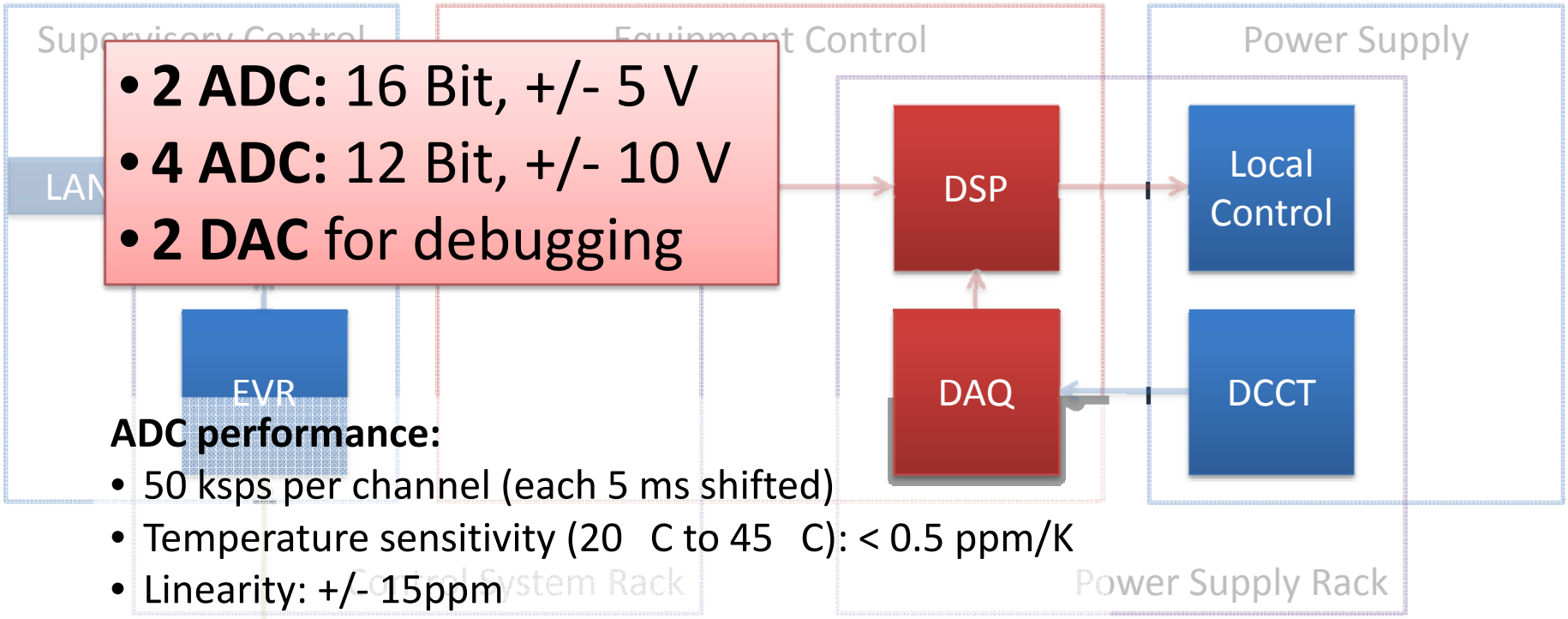


DSP-FPGA controller card



- 60 MHz DSP with 32/40 Bit Floating-Point ALU
- Additional 256 kB SRAM and 1 MB FLASH
- Direct control of power semiconductor devices (1Q, 2Q, 4Q, 2*2Q systems)
- Special digital power semiconductor devices control technique (PWM, PRM)
- PWM frequencies: 10, 16, 25, 33, 50 and 100 kHz (new card: 1.2 MHz)
- Possibility to synchronize PWM between multiple systems
- Latency between data acquisition and control < 35ms
- Triggered current waveform (DSP ramp): scalable, arbitrary waveform with 16000 times 80 µsec steps → > 1 second waveform
- Graphical configuration- and user software

ADC/DAC card

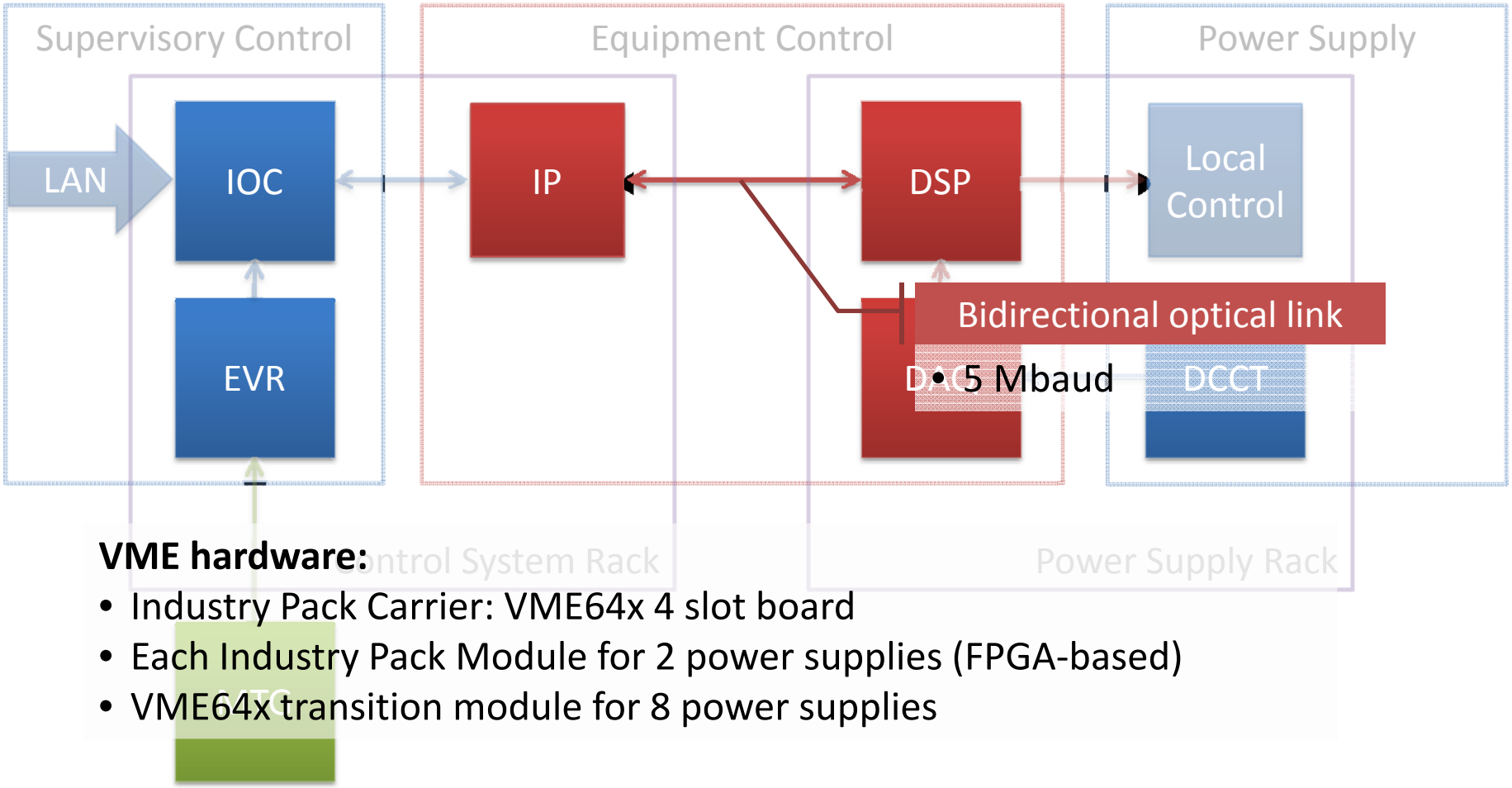


- **2 ADC:** 16 Bit, +/- 5 V
- **4 ADC:** 12 Bit, +/- 10 V
- **2 DAC** for debugging

ADC performance:

- 50 ksps per channel (each 5 ms shifted)
- Temperature sensitivity (20 C to 45 C): < 0.5 ppm/K
- Linearity: +/- 15ppm
- Resolution up to 1 ppm
- Stability (<60s) better than 10 ppm
- Accuracy (1000h) better than 30 ppm
- Reproducibility better than 30 ppm

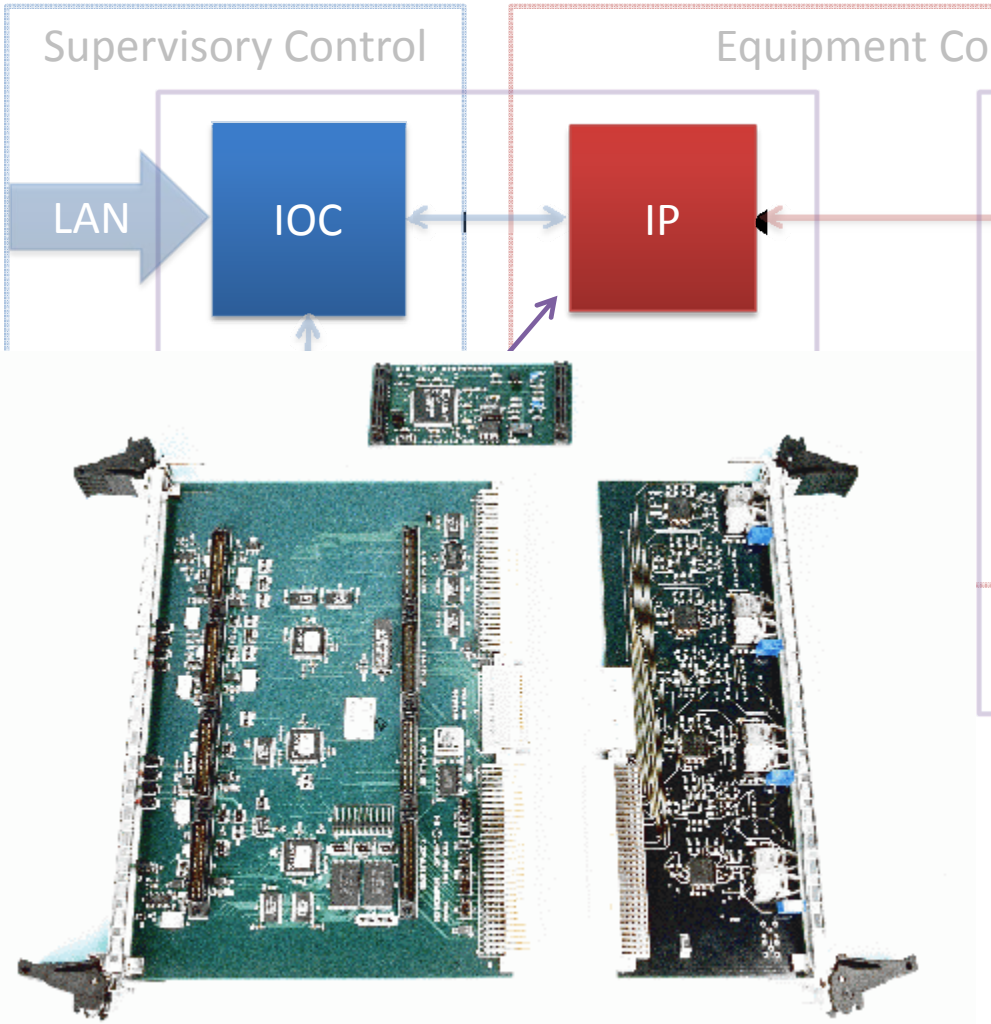
Industry Pack module



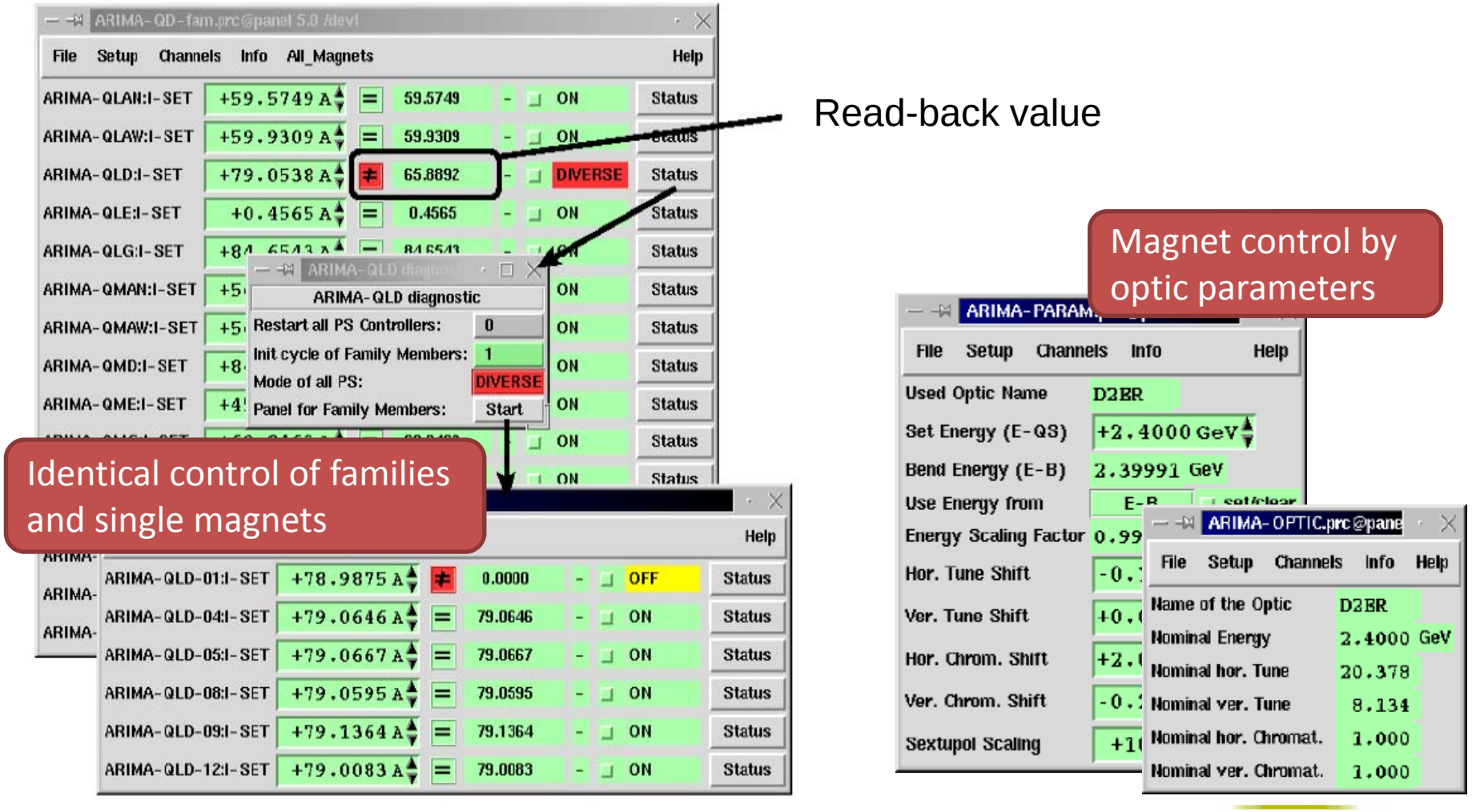
VME hardware:

- Industry Pack Carrier: VME64x 4 slot board
- Each Industry Pack Module for 2 power supplies (FPGA-based)
- VME64x transition module for 8 power supplies

Hardware pictures



EPICS device/driver



Advantages

- Waveform and set point operation
- High speed/accuracy control and feedback
- EPICS integration device drivers
- No dedicated timing system interface in the power supply rack (only one link)
- No expensive crate in the PS (custom backplane)
- Operated by different accelerators
  - Distributed expertise, well-proven system, adaptable
- Continuously maintained and improved by PSI
- Price for DSP+DAQ set: CHF 3000

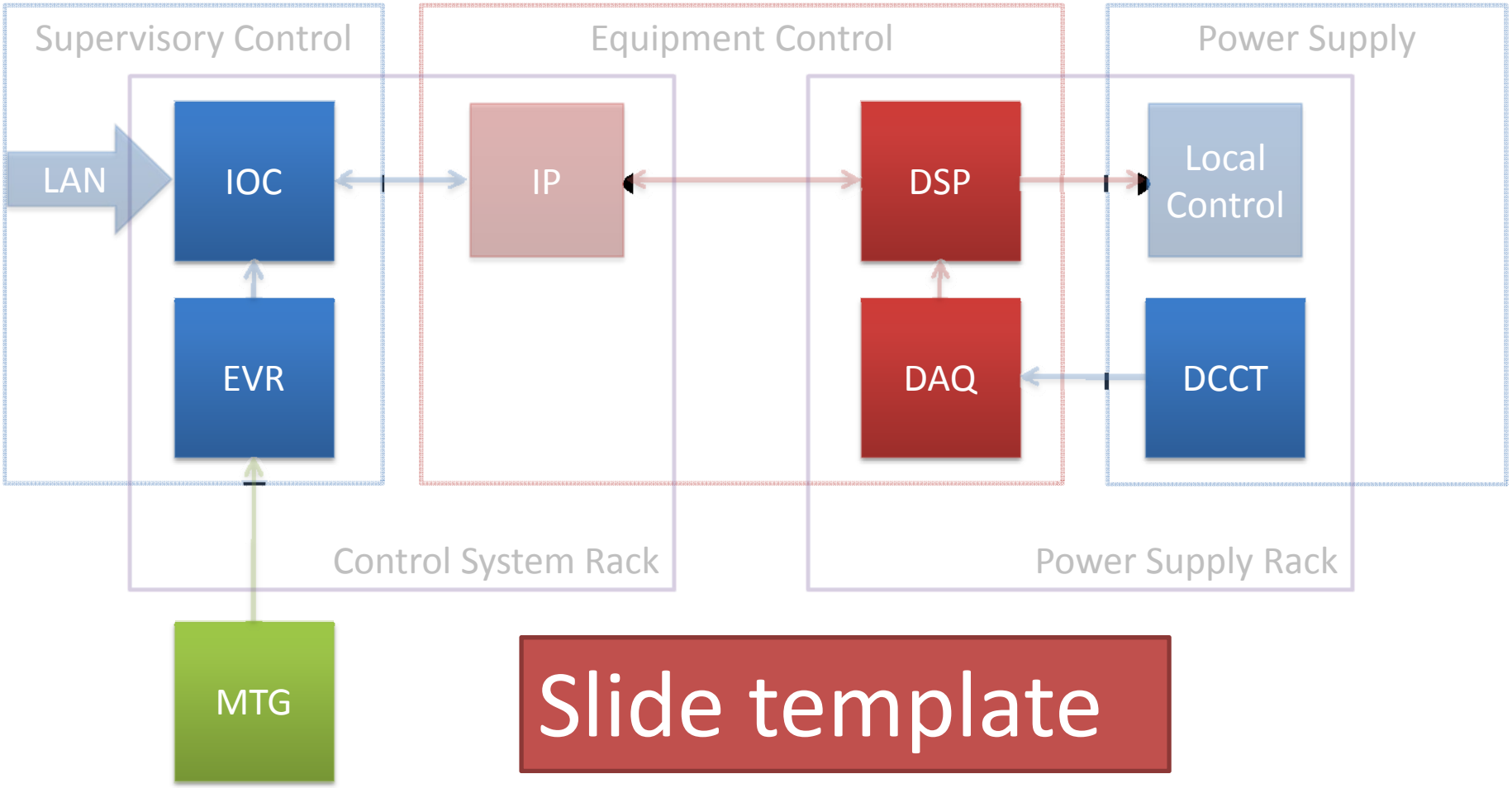
Disadvantages

- No established commercial deployment
- Currently only used with VME carrier for Industry Packs
- No existing graphical waveform editor known
- Currently used mainly at Light Source-type accelerators which have different cycle characteristics than a medical accelerator
- No local B-train interface/input

Yet to be clarified

- Usability with RF systems as well?
- How to introduce B-train functionality?
- Industry Pack modules also work on non-VME carriers?

- ...


Supervisory Control
Equipment Control
Power Supply
LAN
IOC
IP
DSP
Local Control
EVR
DAQ
DCCT
Control System Rack
Power Supply Rack
MTG
Slide template