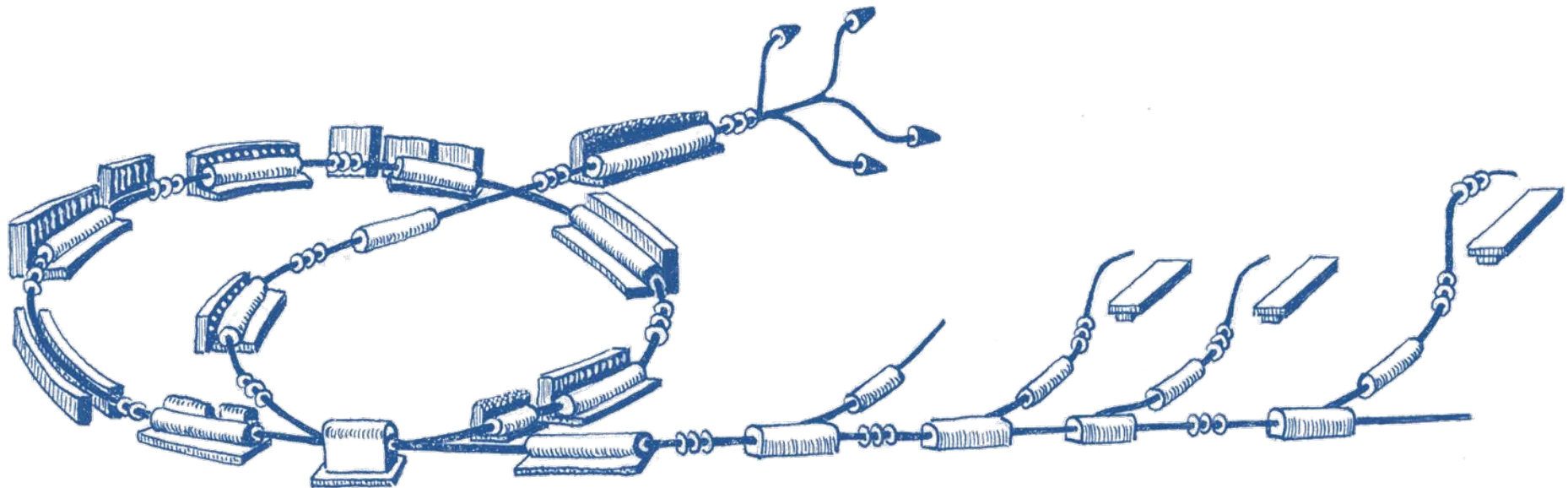
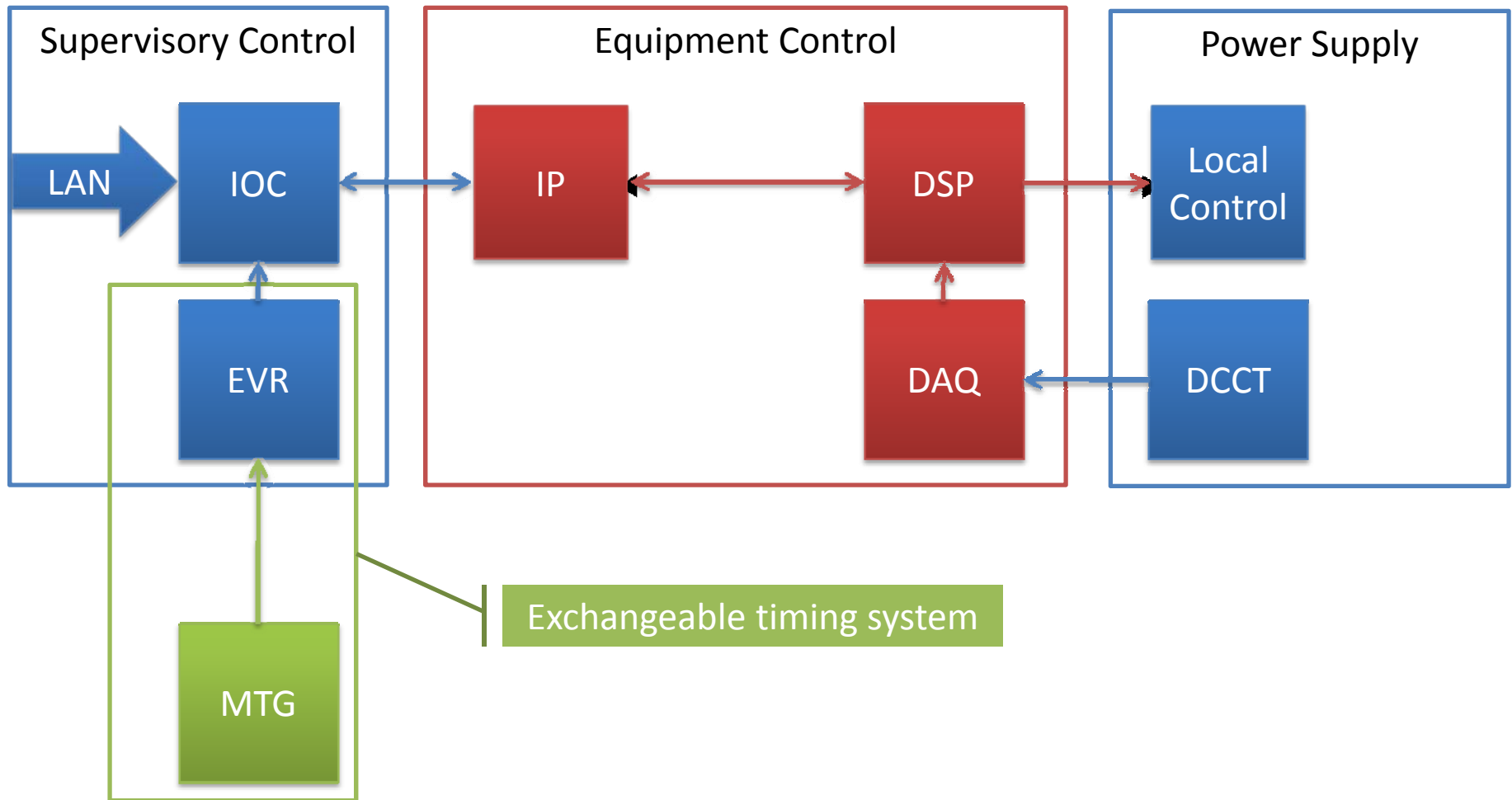


PSI Power Supply Controls

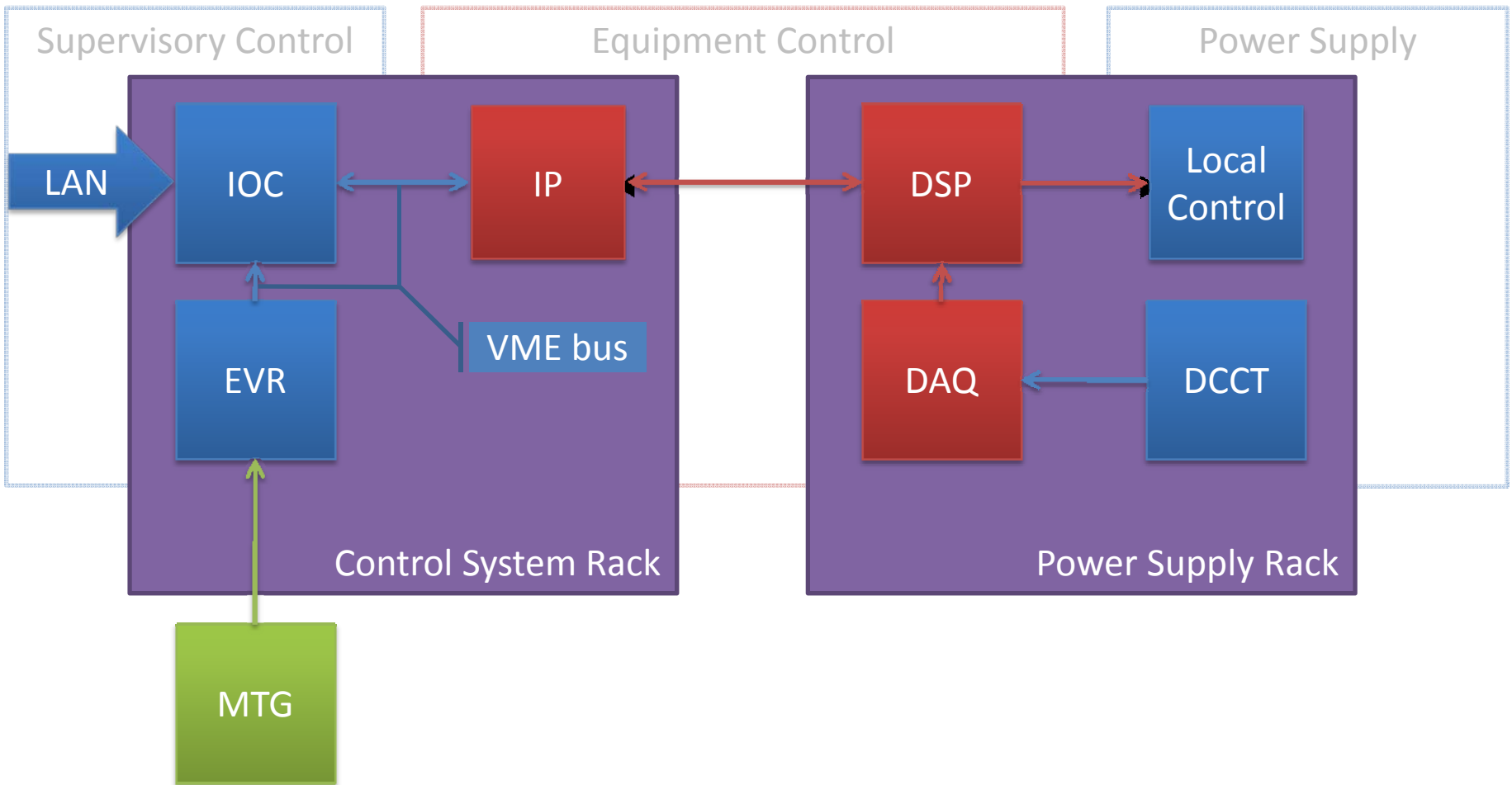
MedAustron Controls Workshop 1



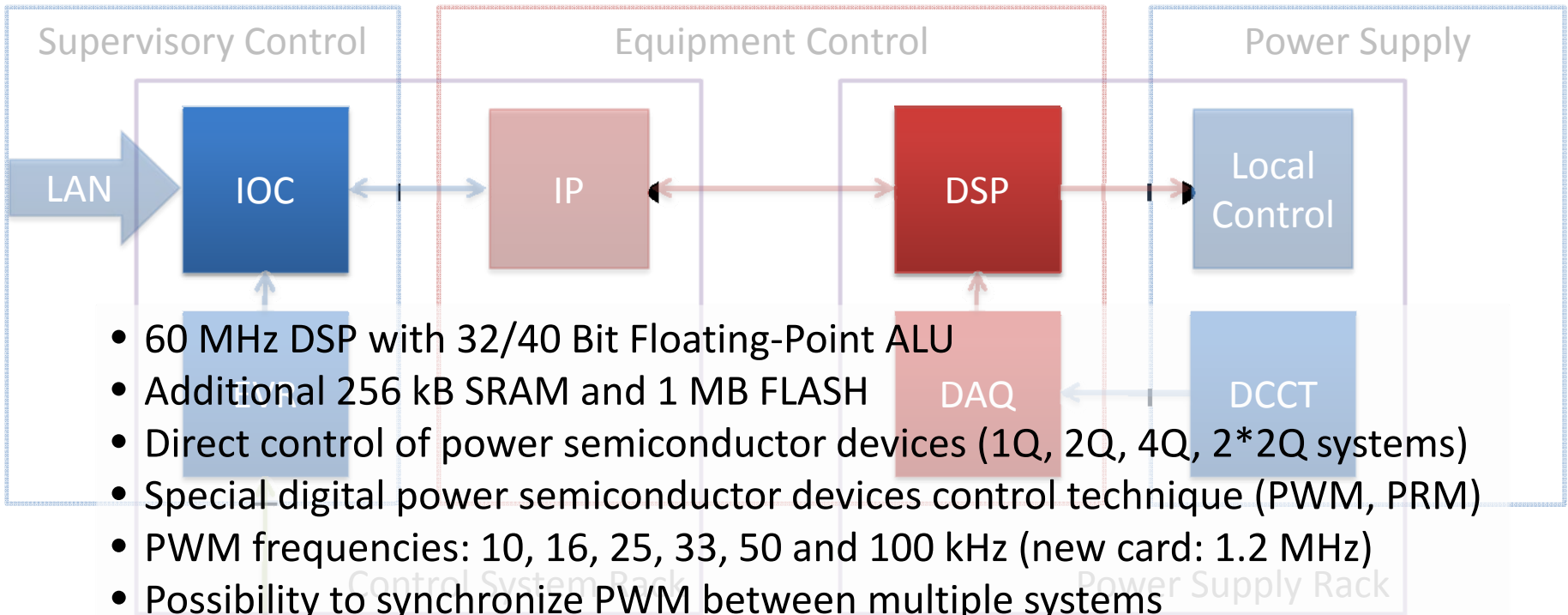
Logical Architecture



Physical Architecture

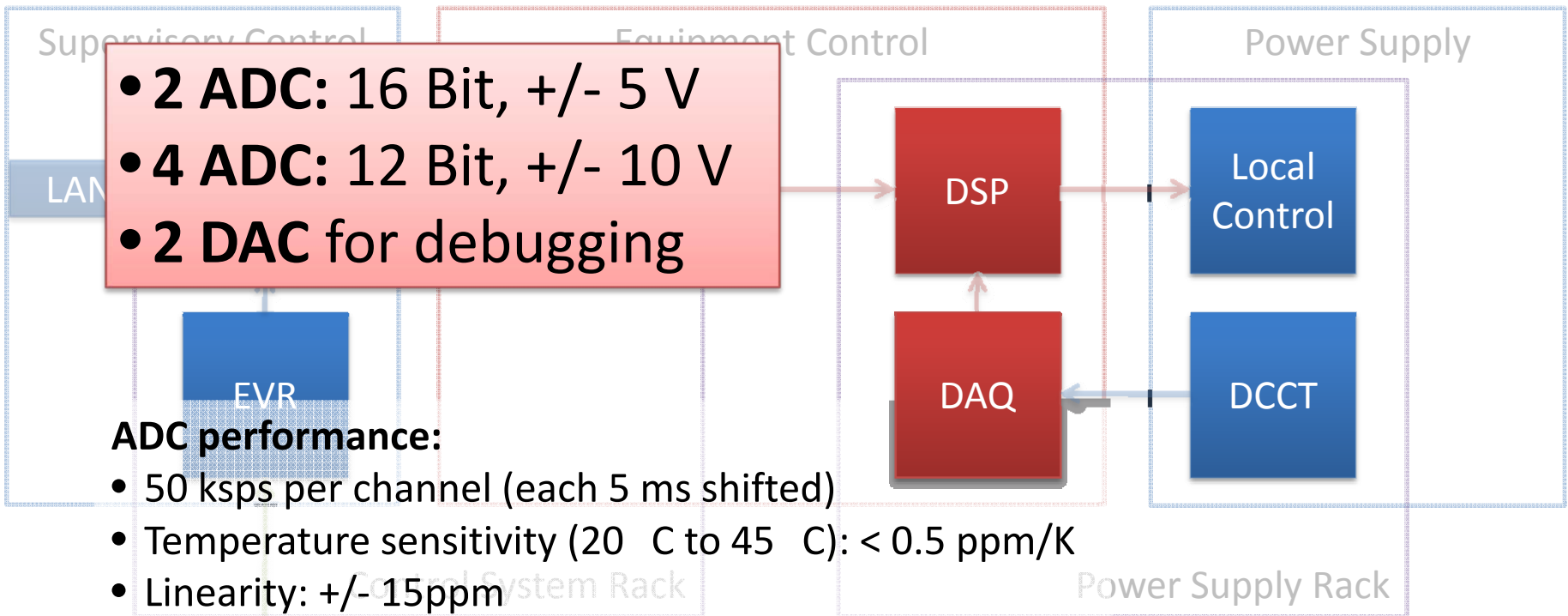


DSP-FPGA controller card



- 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 μ sec steps \rightarrow > 1 second waveform
- Graphical configuration- and user software

ADC/DAC card

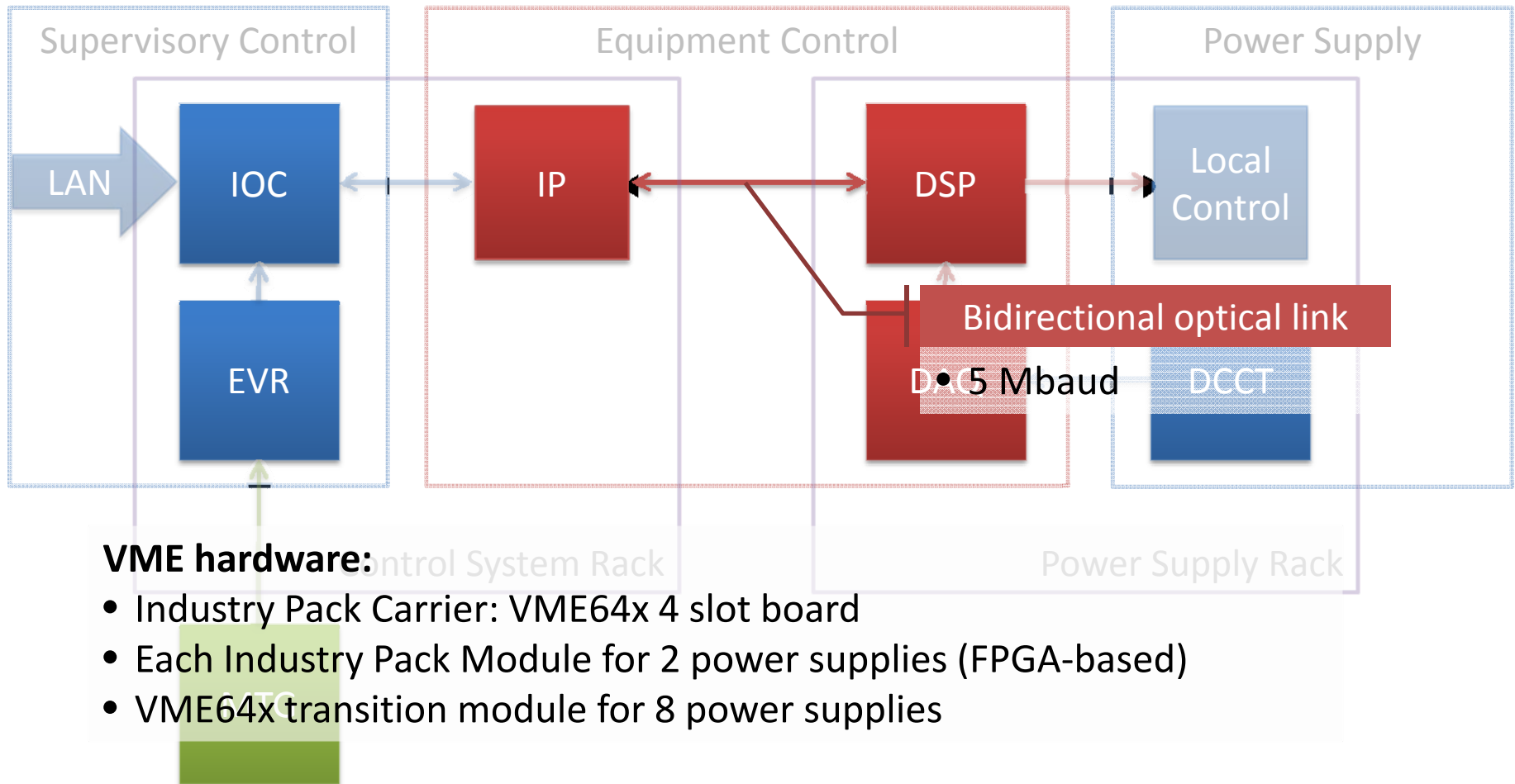


- **2 ADC:** 16 Bit, +/- 5 V
- **4 ADC:** 12 Bit, +/- 10 V
- **2 DAC** for debugging

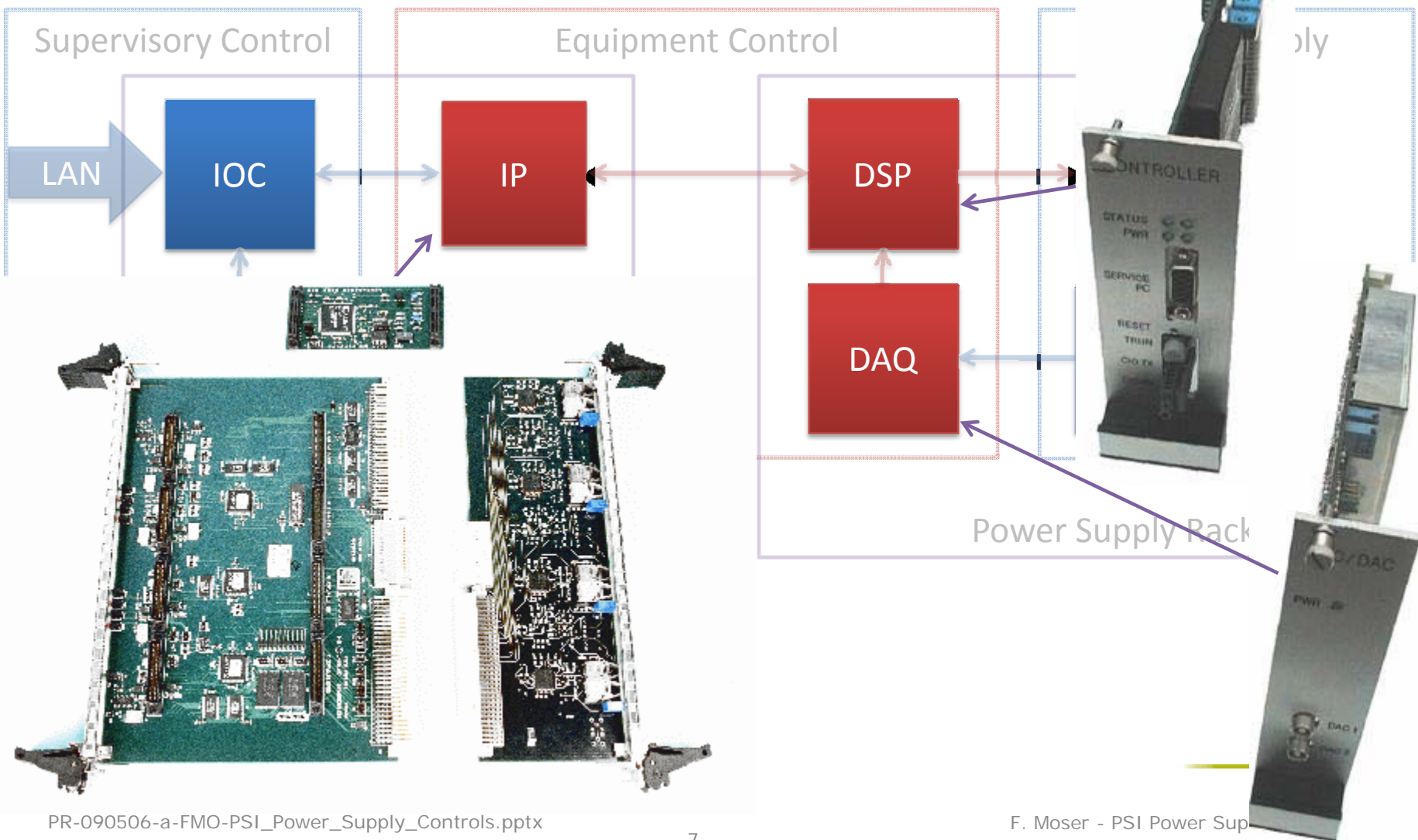
ADC performance:

- 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



Hardware pictures



EPICS device/driver

The screenshot shows the ARIMA-QD-fam.prc@panel 5.0 /dev/ interface. A table lists magnet parameters and their status. The ARIMA-QLD:I-SET magnet is highlighted with a red box around its read-back value of 65.8892 A, which is significantly different from its setpoint of 79.0538 A. A diagnostic dialog box for ARIMA-QLD is open, showing 'Mode of all PS: DIVERSE' and 'Panel for Family Members: Start'. A red callout box at the bottom left states 'Identical control of families and single magnets'.

| Device Name | Setpoint (A) | Read-back (A) | Status |
|--------------------|--------------|---------------|---------|
| ARIMA-QLAN:I-SET | +59.5749 | 59.5749 | ON |
| ARIMA-QLAW:I-SET | +59.9309 | 59.9309 | ON |
| ARIMA-QLD:I-SET | +79.0538 | 65.8892 | DIVERSE |
| ARIMA-QL E:I-SET | +0.4565 | 0.4565 | ON |
| ARIMA-QLG:I-SET | +84.6543 | 84.6543 | ON |
| ARIMA-QMAN:I-SET | +5.0000 | 5.0000 | ON |
| ARIMA-QMAW:I-SET | +5.0000 | 5.0000 | ON |
| ARIMA-QMD:I-SET | +8.0000 | 8.0000 | ON |
| ARIMA-QME:I-SET | +4.0000 | 4.0000 | ON |
| ARIMA-QLD-01:I-SET | +78.9875 | 0.0000 | OFF |
| ARIMA-QLD-04:I-SET | +79.0646 | 79.0646 | ON |
| ARIMA-QLD-05:I-SET | +79.0667 | 79.0667 | ON |
| ARIMA-QLD-08:I-SET | +79.0595 | 79.0595 | ON |
| ARIMA-QLD-09:I-SET | +79.1364 | 79.1364 | ON |
| ARIMA-QLD-12:I-SET | +79.0083 | 79.0083 | ON |

Read-back value

Magnet control by optic parameters

The screenshot shows the ARIMA-PARAM interface with various energy and tuning parameters. Below it, the ARIMA-OPTIC.prc@panel 5.0 interface displays a table of optic parameters for the D2BR optic.

| Parameter | Value |
|-----------------------|-------------|
| Used Optic Name | D2BR |
| Set Energy (E-QS) | +2.4000 GeV |
| Bend Energy (E-B) | 2.39991 GeV |
| Use Energy from | E-R |
| Energy Scaling Factor | 0.99 |
| Hor. Tune Shift | -0.0000 |
| Ver. Tune Shift | +0.0000 |
| Hor. Chrom. Shift | +2.0000 |
| Ver. Chrom. Shift | -0.0000 |
| Sextupol Scaling | +1.0000 |

| Parameter | Value |
|-----------------------|------------|
| Name of the Optic | D2BR |
| Nominal Energy | 2.4000 GeV |
| Nominal hor. Tune | 20.378 |
| Nominal ver. Tune | 8.134 |
| Nominal hor. Chromat. | 1.000 |
| Nominal ver. Chromat. | 1.000 |

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?
- ...

