SPEAR FOFB

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Overview

- SPEAR machine parameters

- Orbit Feedback System Overview

- BPMs

- Correctors, Power Supplies

- Communication

- Feedback

- Conclusion

SPEAR

- 3 GeV / 500mA, 3rd. gen. Machine, reusing existing tunnel, parts of the control system.

- Run existing booster at 3Gev (future top-up mode)

- 476.3 MHz RF

- nx 14.19, ny 5.23

- 18nm-rad emittance

- Cu vacuum chamber (Cu-Ni inlays underneath the corrector magnets; field penetration up to ~120Hz)

- Submicron stability (34 mm x 86 mm vac. ch.) desired

System Overview

- 96 BPMs (54 Bergoz, 24 digital RX)

- 108 correctors

- 4kHz clock / timestamp and event distribution

- 4kHz streamed data over dedicated PtP ethernet

- Central feedback CPU (350MHz PPC)
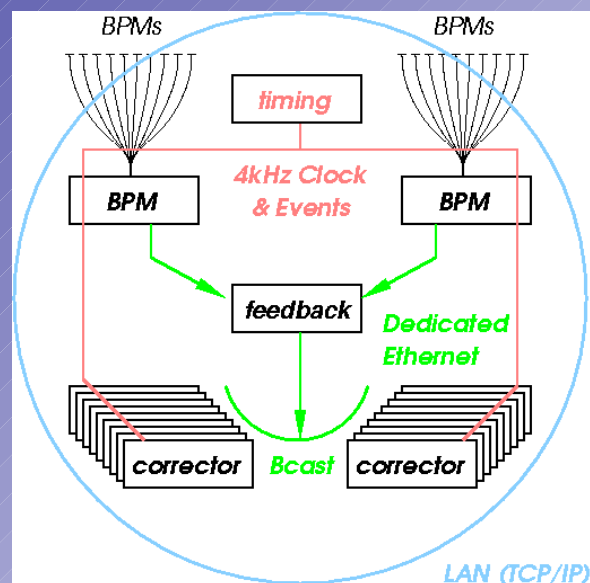
Analog BPM Electronics

- Bergoz modules with custom mods. (external mux. Clock, ext. LO)

- Acquisition of multiplexed baseband signal with a single ADC. Software demux, delta/sum.

- Fewer channels

- Cancel ADC gain + offset

- Diagnostic info (a-b+c-d)
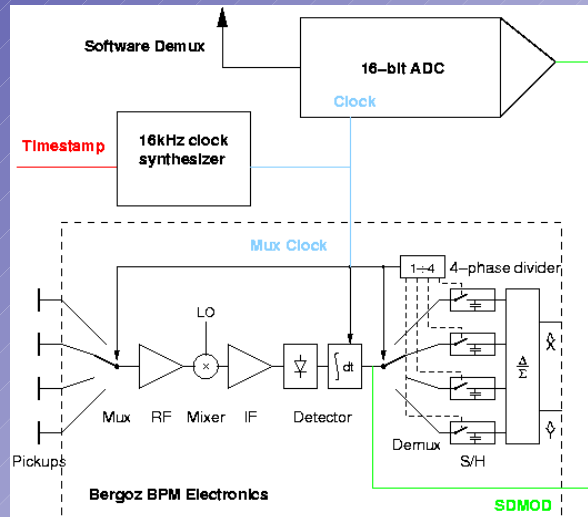
Digital BPMs

- 4-channel parallel system
  - First turn
  - Turn-by turn (into 128kS FIFO, offline analysis)
- 476MHz -> 16.7MHz RF-IF frontend
- ADC Clock RF subharmonic (64MHz)
- Echotek digital receiver (VME) with 2 RX chips per ADC
- Injection of calibration signal (½ frev apart, synced)
- Tune 1 RX to input signal, the other to cal. tone (future)

MCOR-30 Corr. PS

- Beefed-up PEP2 design (30A, 4kHz small-sig BW)

- 8 analog channels, 24bit DACs, shunts.

- Off-the shelf VME CPU controller

- "Frankenstein"-board bridges VME to proprietary backplane

- EPICS IOC on RTOS (setpoint scheduler)

Communication Channel

- Dedicated PtP Ethernet links

- Use raw ethernet packets, no collisions

- Broadcast setpoints to correctors (hub not switch)

- Cheap, off-the shelf hardware

- Simple software

- DMA+MMU = ``poor man's reflective memory''; fast with low CPU overhead

- Open standards technology

(Planned) FOBF

- Global orbit feedback @4kHz, locked to RF

  - CAVEAT: total ``pipeline delay'' (acquisition + communication + processing + distribution time) is a critical parameter, not just clock frequency.

- Aim at closed-loop BW of 100Hz

- PID controller in central VME CPU (RTOS, EPICS IOC)

  - Locking to RF could affect 60Hz notch

- Future incorporation of Photon BPMs

- Online reconfiguration (select BPMs, correctors, upload response matrix or ``inverse'' [SVD])

Conclusion

- There's nothing new under the sun...