BPM Processing Meeting 29-01-2013 - Agenda

Objective

To obtain relative costs/timescales for various BPM signal processing options.

1) Establish bunch structure through BPM; bandwidth required; BPM type; expected BPM signal level; position resolution required
2) Discuss BPM signal processing options – cost, resolution, complexity etc
    a. Fast scope with onboard signal processing
    b. PXI System and Digitizer card with signal processing
    c. Homodyne mixing (baseband) with two filters
        i. LP above 324MHz for output to fast scope to view signals (pulse to pulse)
        ii. LP at few MHz then digitized to get averaged bunch position
    d. Heterodyne mixing to few MHz then scope/PXI acquisition
        i. Can be COTS or self-made using connectorized elements
        ii. Scope data to PC for signal processing
        iii. PXI does signal processing
    e. Sample and Hold and digitize the held value (PXI DAQ)
    f. Diode rectification (envelope detection) then digitized at few MHz
    g. Mixing to tens MHz, FPGA processing on FlexRIO with 100MSa/s/chan FE
3) Obtain preferred option before 13th Feb 2013

Notes

Button vs Stripline – Button unipolar signal, Stripline Bipolar signal.

Ideally keep each BPM processing the same, rather than a mix of scope, PXI, HW etc

Processing is mainly FFT, filtering and arithmetic. FFT requires processing power – min number of multiplications = (34/9) N $\log_2$N.

Fast scopes (> few GSa/s) often run Win/Linux and can do some processing onboard. Slow scopes generally have to ship data across network to PC for processing.

PXI system consists of various DAQ, Digitizing, Timing cards with a processing card (CPU, HDD, connectivity etc) running WinXP/Win7. Very effective trigger distribution & delays available.

Mixing systems require a LO, calibration signal and various RF elements (amplifiers, attenuators, mixers, filters) to work. The LO cost is a function of frequency of phase noise (jitter), but will provide a signal for any number of BPMs. Heterodyning has homodyne mixing as its final stage.

A FPGA with high-speed DAQ front-end could provide few µs bunch processing time (NI 5751 16ch 50MSa/s 16ch FE; NI PXI-7954R Virtex-5 LX110 128MByte FPGA). Solution in excess of £10k for acquisition and FPGA but can provide fast feedback if required.

Use EPICS IOC to serve position data from PXI/scope/PC. EPICS Clients can log data, display data online via local console, display data on remote console.

Typical RF suppliers: www.hittite.com; www.minicircuits.com