Libera

FOFB for TPS using GDX module

Aleš Bardorfer, Libera Workshop, October 2012, Solkan

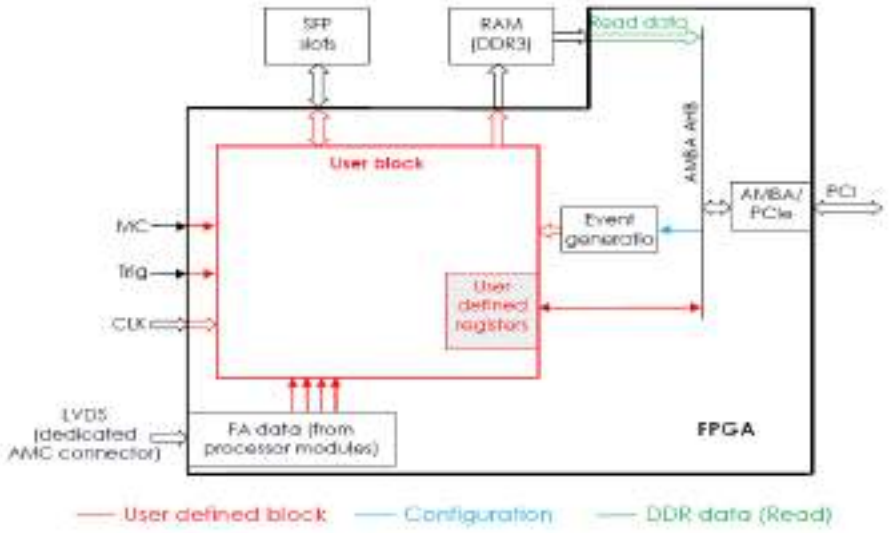
Introduction

- Gigabit Data eXchange module
  - HW
  - FDK/SW
- Taiwan Photon Source (TPS)
  - Status
  - FOFB
- Fast Orbit Feedback @ TPS
  - Low latency
  - 100% in FPGA

Gigabit Data eXchange (GDX) module

- MTCA based
- Xilinx Virtex-6 (XC6VLX240T)
- Four independent 6.5 Gbps communication channels
- SFP modular
- High BW LVDS connection to/from processor modules (ADC/BPM)
- Large history buffer on board (1 GB)

GDX FPGA Development Kit (FDK)

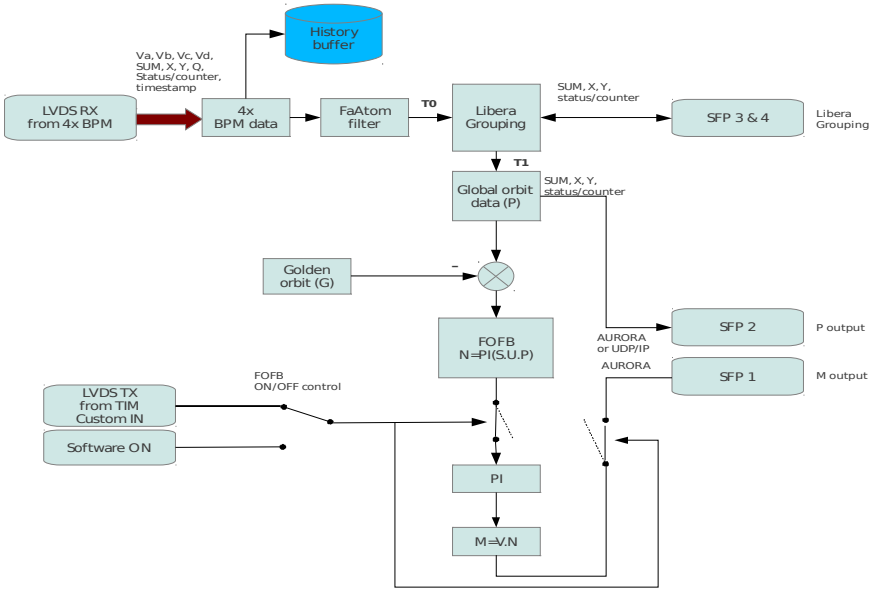


- Libera BASE enabled:
  - HB signals readout
  - I-reg
- Userblock free:
  - FA data delivered
  - DDR ready for signals
  - SFPs
  - Clocks & triggers

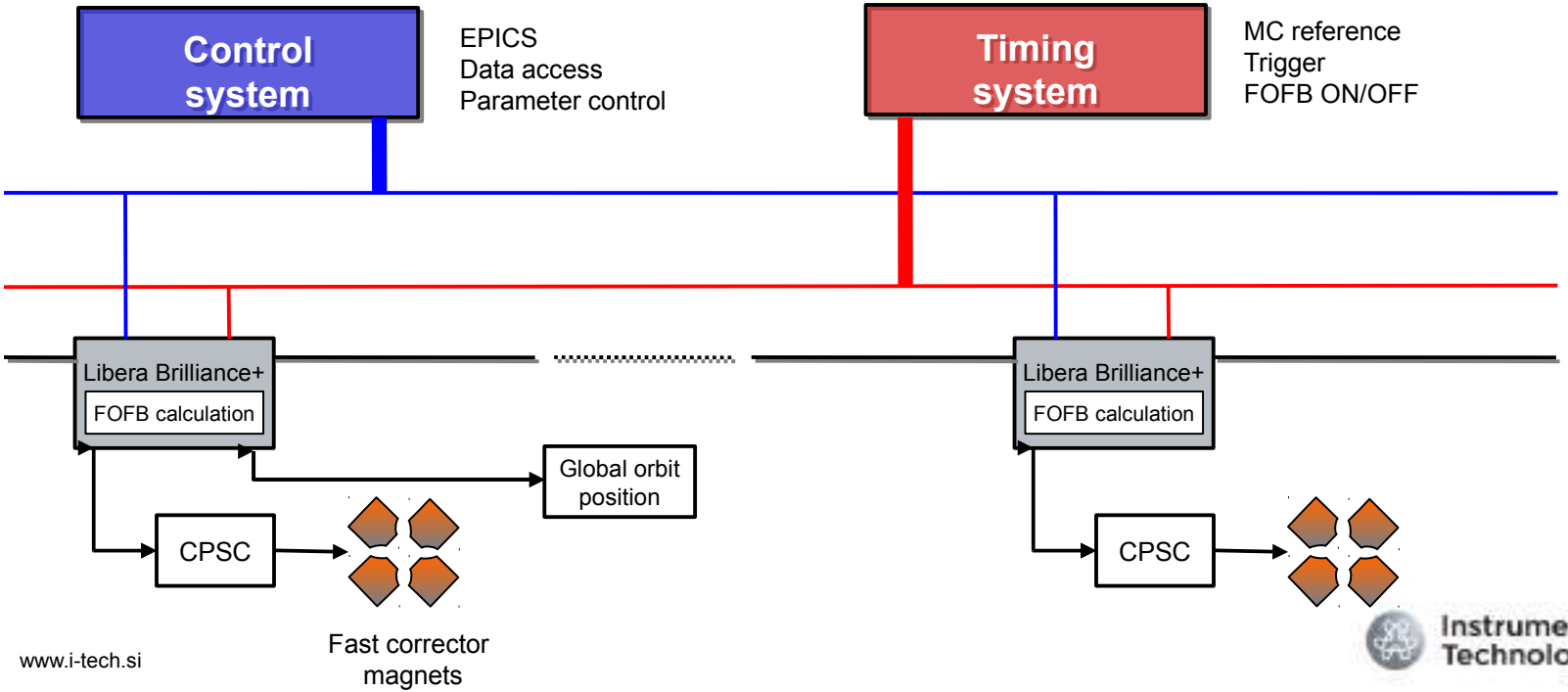
Taiwan Photon Source

- Under construction
  - ~500m SR circumference
- Expected due dates:
  - System integration in 2013
  - Commissioning in 2014
- Fully equipped with Libera Brilliance+ units
- Fast Orbit Feedback planned

Fast Orbit Feedback @ TPS

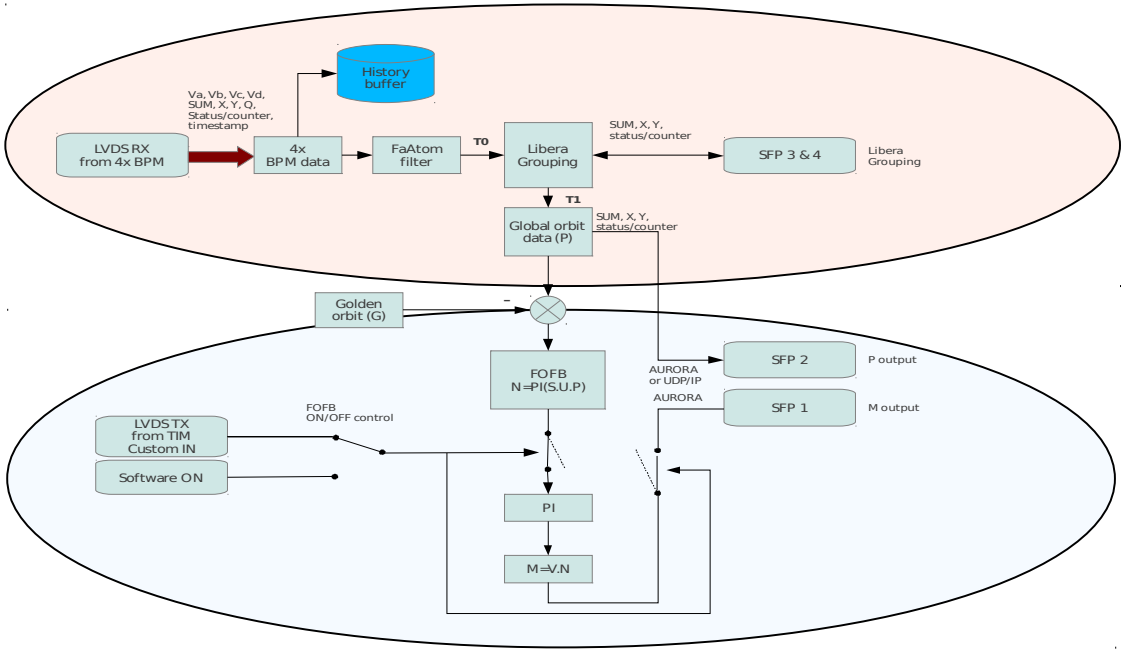


FOFB topology @ TPS



Instrumentation Technologies

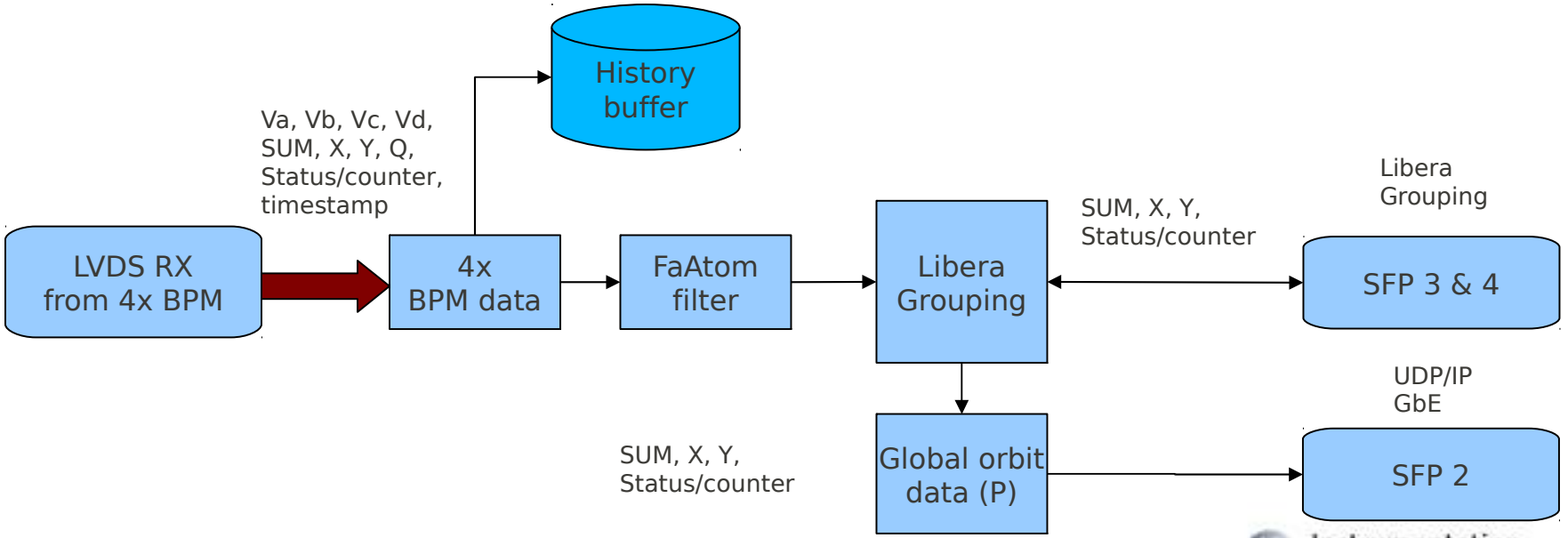
FOFB block scheme



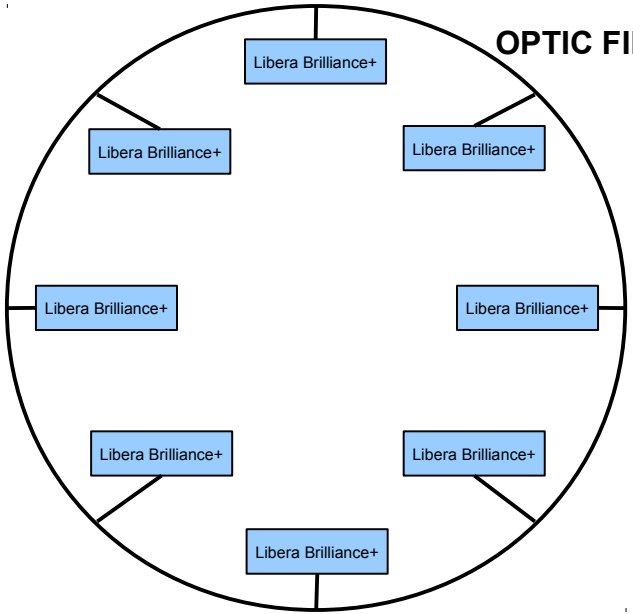
Data concentration

Magnet corrector computation

FOFB – data concentration

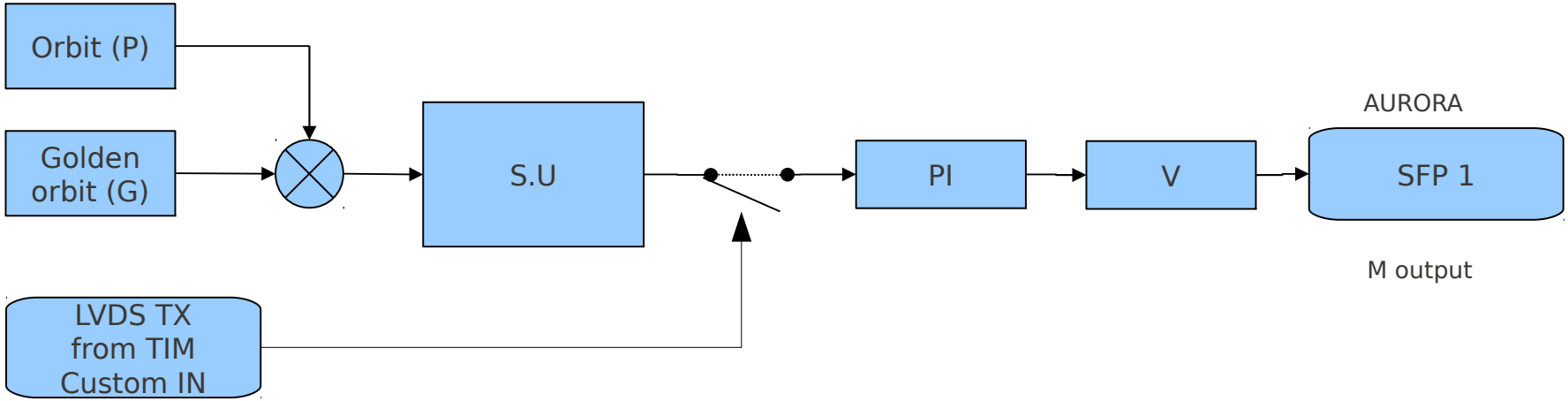


FOFB – data concentration



- Uses 6.5 Gbps optical links
- 2-way redundant links
- Communication latency:
  - 150 ns/BPM
  - + longer cables...
- 3x improvement over Platform A Libera Grouping

FOFB – Magnet corrector computation



FOFB matrix – parallel implementation

$$M_{cx1} = V_{cxe} . PI_{ex1} \left(S^{-1}_{mxn} . U^{T}_{nxn} . dP_{nx1} \right)$$

- Utilizes ~500 Xilinx DSP48 “cores”
- Matrix dimensions up to:
  - 256 BPMs
  - 128 Eigenmodes
  - 128 Magnet correctors
- FOFB matrix latency: 1.7 µs

Conclusion

- GDX module allows for much faster communication compared to Platform A
- GDX module enables:
  - High data throughput
  - Massively parallel hard-real-time computing
  - Low latency
- FOFB application in modal-space implemented
- Testing in Taiwan next week. Expected results:
  - Overall comm + compute + magnet comm latency: ~30-40 μs
  - Potential to increase the FA rate above 10 kHz