LHC Clock Distribution & Monitoring Beam Phase and Intensity

- Already presented quality of timing - clock stability and beam behaviour :
  - December 2001
  - May 2004 with proposal for a Beam Phase and Intensity Monitor (first design)
- Today: current status
  - Up to know low-priority activity…

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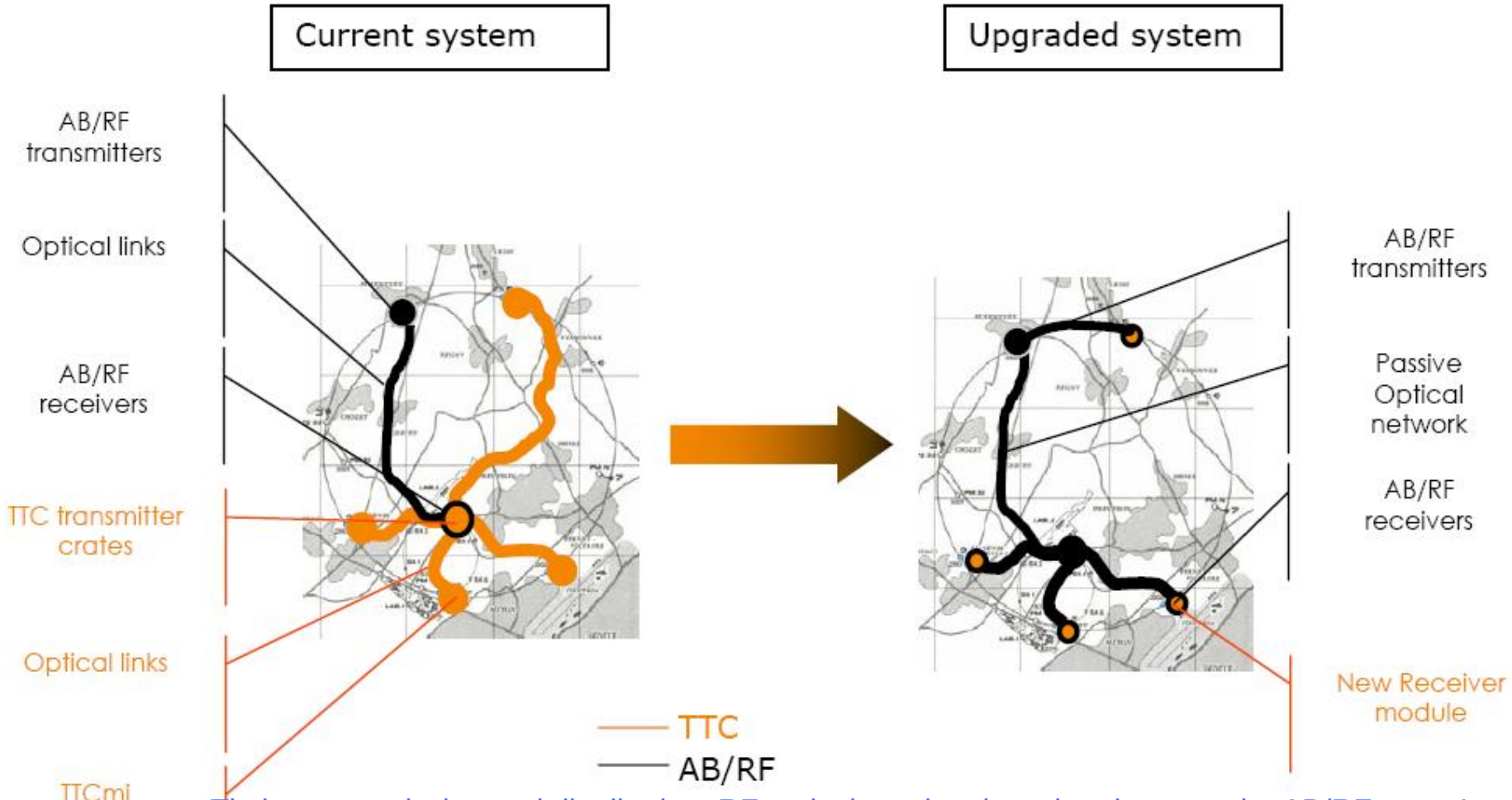
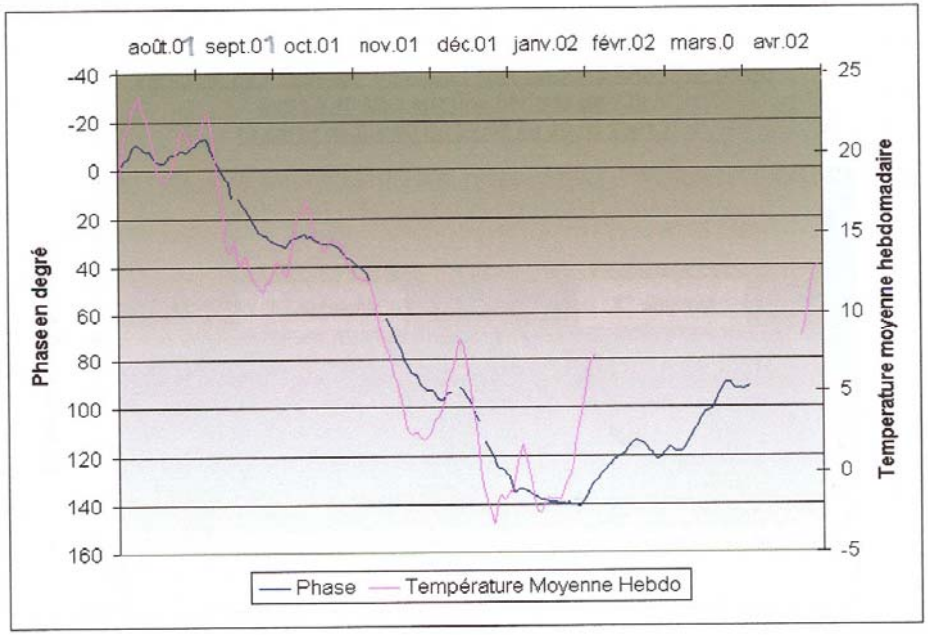
New LHC clock distribution



- Timing transmission and distribution, RF optical receiver board and support by AB/RF group!
- RF2TTC receiver board being developed and supported by PH/ESS! (Sophie Baron et al.)
  - Replaces TTCmi (old system kept until new system well-proven to work and kept for test beams)!
  - Same interfaces for clock and orbit but with remote control and monitoring

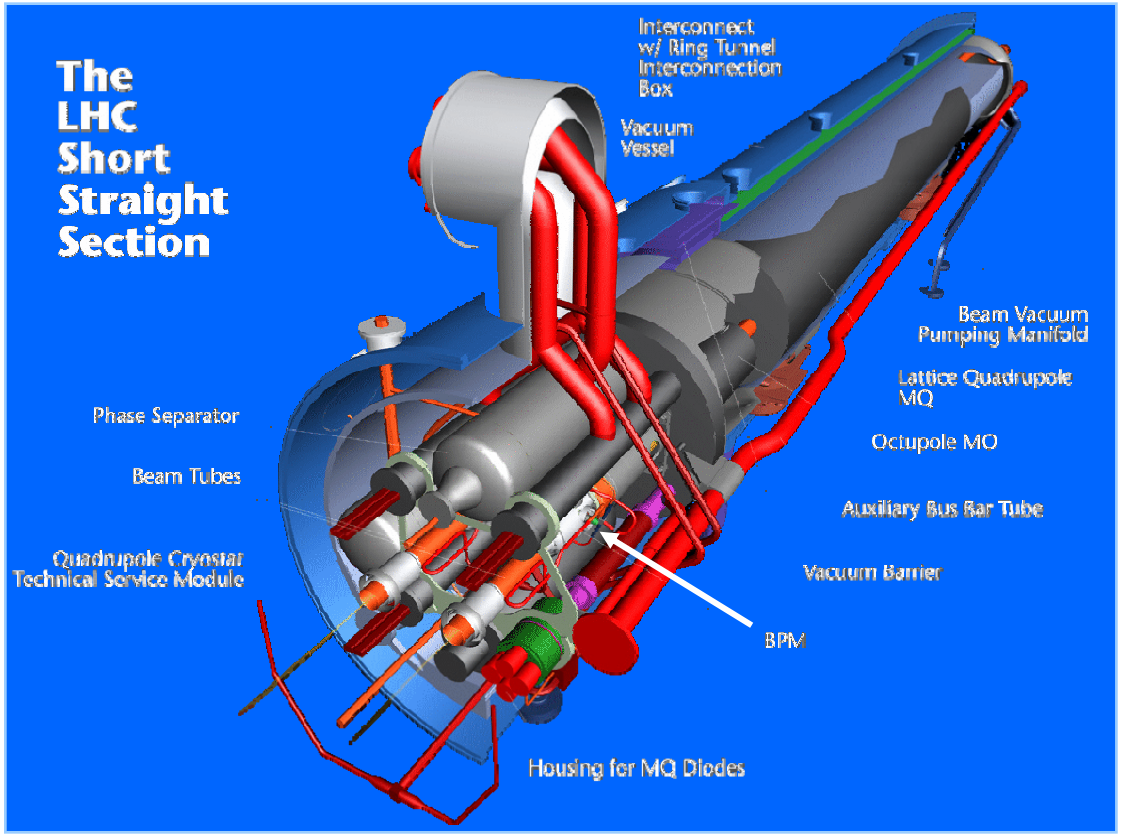
LHC Clock Phase Stability

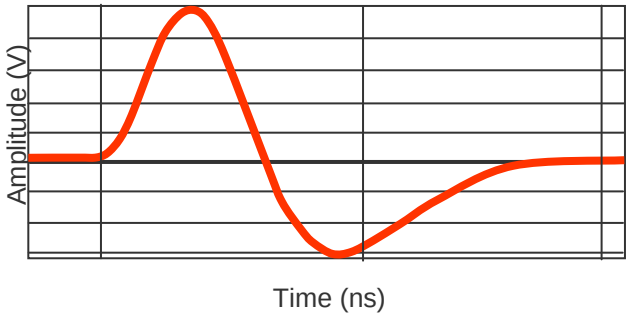
- Effect of temperature variations on distribution fibres
- Miss-management as I see it: we have lost the temperature-stabilized fibres between SR4 and CCC
- LHCb: 14.1 km of fibre between SR4 and PA8 at a depth of ~1m
  - Estimated max. diurnal drift 150 ps
  - Estimated max. seasonal drift 7ns



Beam Monitoring at IP

>1000 Beam Position Monitors (BPMs) of the Button Electrode type





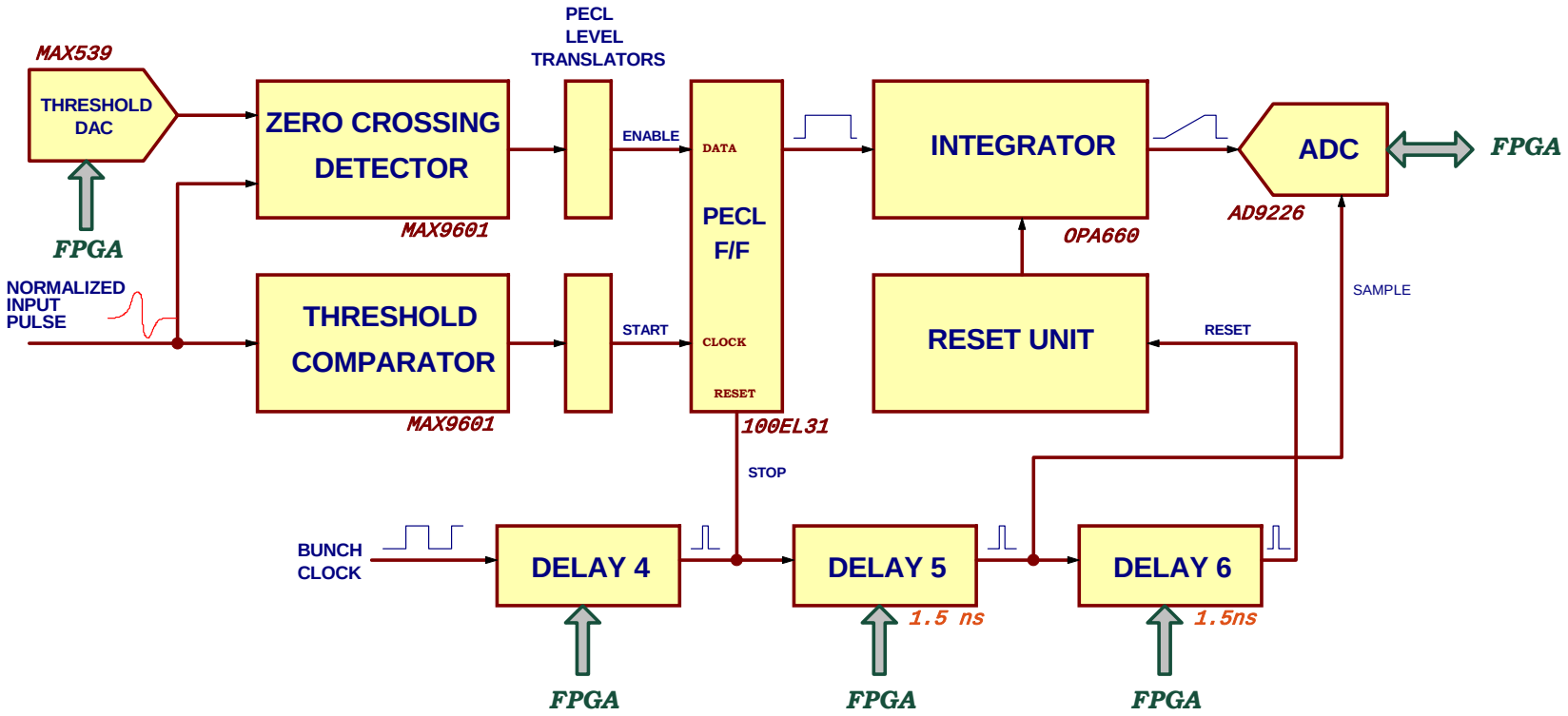
- Signal cables installed to TFC rack in counting rooms
  - ½" Sucofeed corrugated 50-ohm coaxial cable
- Peak voltage (one button) of ~5V after 200m of cable for nominal bunch
  - Sum voltage from all buttons ➔ ~Independent of position

LHCb Beam Phase and Intensity Monitor

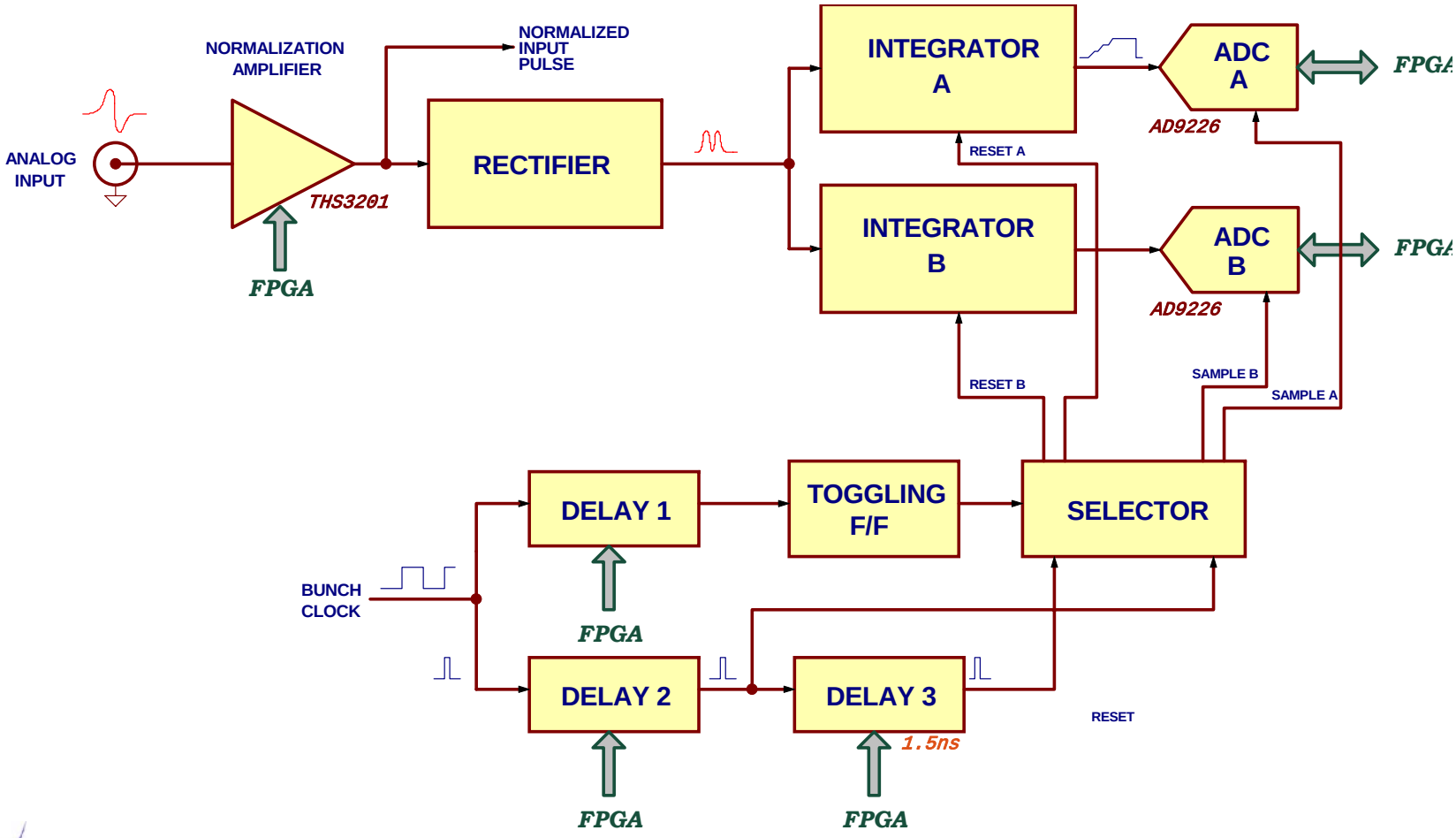
- BPIM specifications:
  - Input signal processing:
    - Programmable amplification
    - Programmable threshold
  - Measuring beam intensity (~current)
    - Integrate pulse per bunch and averaging them
    - Resolution of intensity measurement - 8 bits
    - Intensity per bunch as function of bunch crossing -> LHC bunch structure
    - Outputting intensity measurement at 40 MHz via LVDS interface
  - Measuring phase between incoming bunch signal and bunch clock
    - Resolution of phase measurement ~50ps
    - Collecting phase measurement for every bunch and averaging them
    - Average phase per bunch crossing as function of bunch crossing
  - Digital approximation of converter characteristics
  - Data processing in FPGA
  - CCPC based control interface
  - Board form-factor 6U or 9U?
    - Measure both beams on one board?

Phase Measurement

- Revise the first design
  - Low-pass filter in LHC summing electronics
  - Improve the design and more modern chips



Intensity Measurement



BPIM Development

- Design in progress
  - The entire analog part is in PSpice schematics
  - Lot of simulation ahead
  - Digital part is relatively straight forward (“cut and paste”…)
  - Other activities in parallel
  - First tests can be done with existing beam pick-up emulator
  - Prototype will be connected up to real device on PS or SPS summer 2006 for tests