LHCC Poster Session - CERN, 2 March 2016

The Layer 1 / Layer 2 readout upgrade for the ATLAS Pixel Detector

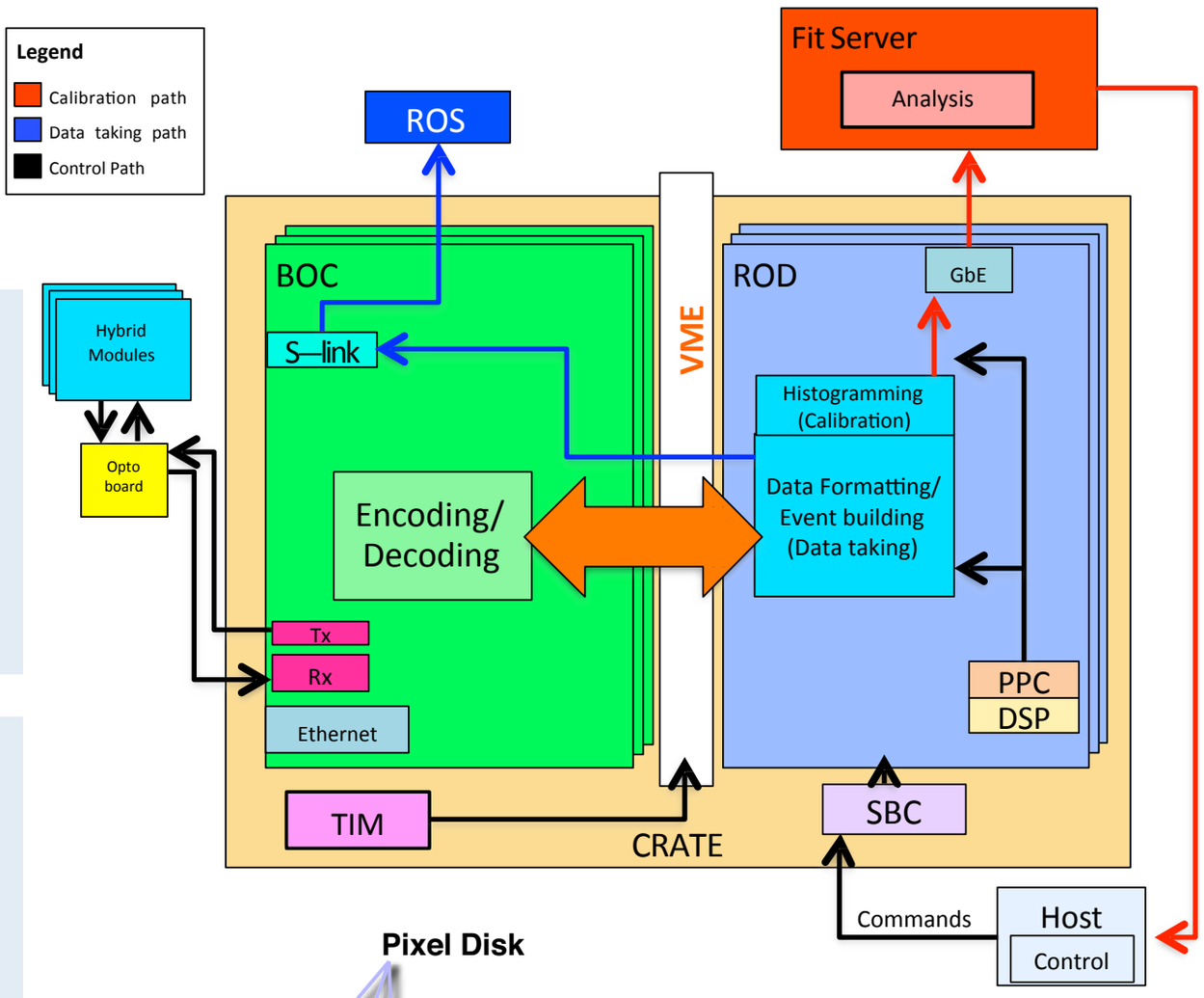
Pixel detector :

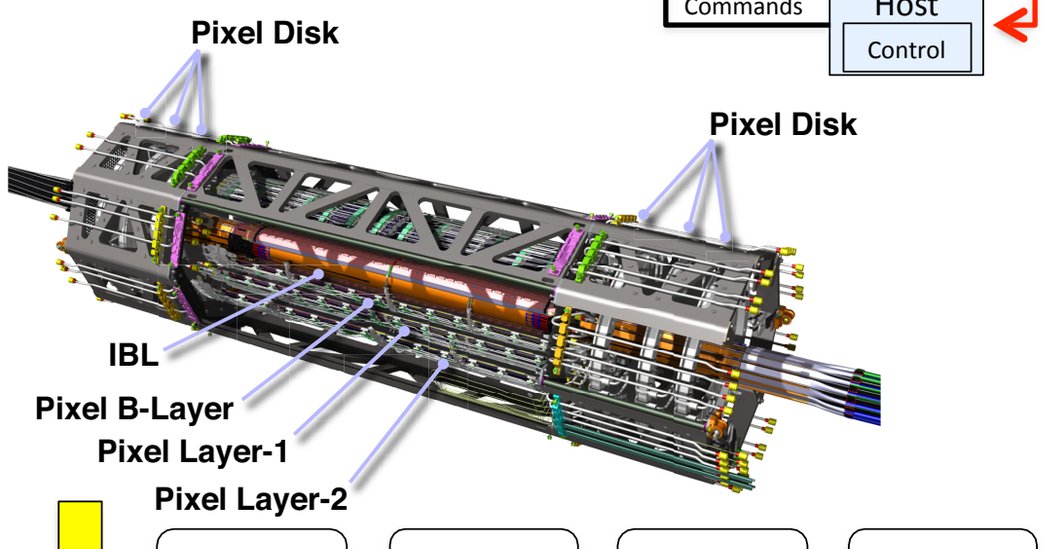
4 Layer precision tracking detector with a resolution of ~10 μm in r–φ coordinates and ~115 μm in z.
Total of 2024 Modules for a grand total of 92 Million pixels.

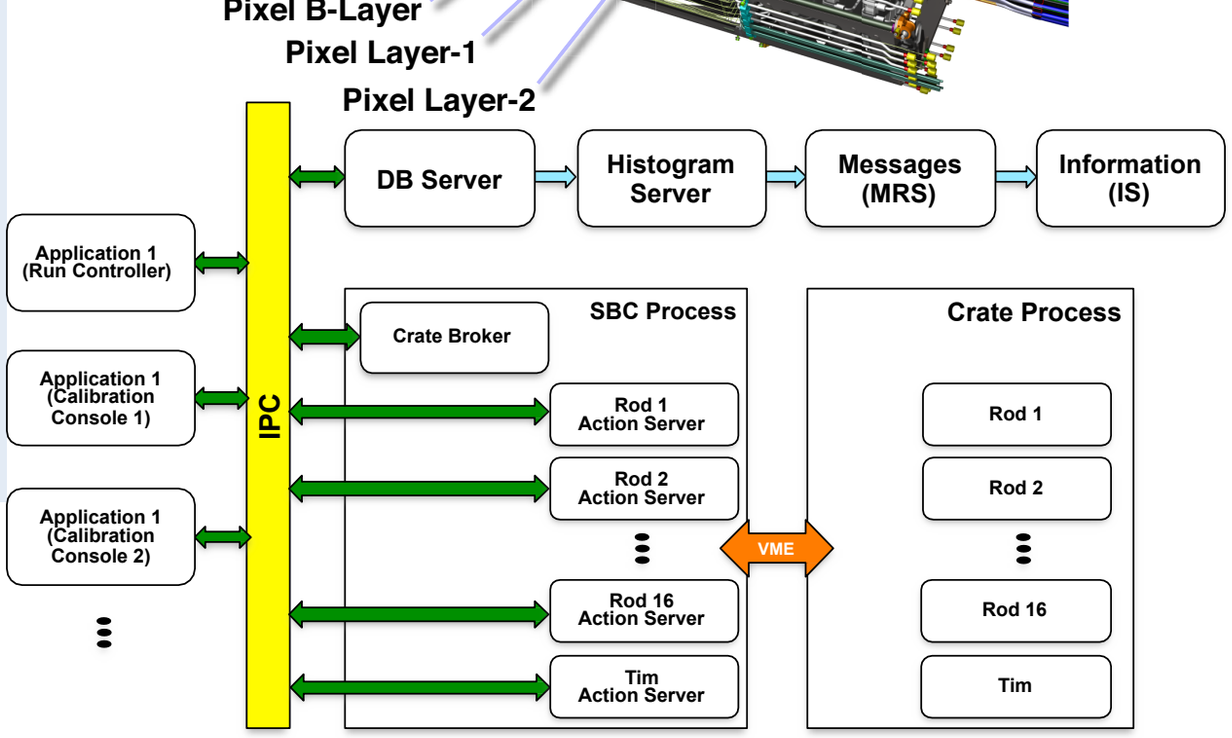
Upgrade actions & motivation :

Readout bandwidth saturation is foreseen for Layer 2 in 2016 and Layer 1 from 2017 onwards given the expected luminosity.

- Replaced Pixel ROD/BOC by IBL cards while **doubling the bandwidth**.
- Profit from **IBL** operational experience from 2015 using **same core firmware and software**.
- Same **IBL hardware**, except the **new receiver plugins** (Rx) that had to be re-designed.
- IBL software features offer **more flexibility** for operation and recovery.







Pixel DAQ :

The pixel modules ship back data optically via "optoboards".
The Back-Of-Crate (BOC) receive and convert signals for the Read-Out-Driver (ROD).
The ROD is the main board, taking care of: data formatting and monitoring, issuing host command and create and send Front-Ends commands.
The Fit Server takes care of calibration data processing.
A Single Board Computer (SBC) controls the ROD-BOC cards.
The Time, trigger and control (TTC) provides through TTC Interface Module (TIM) triggers to ship data back to the higher level read-out (ROS).

Pixel Software:

- Run Controller coordinate all concurrent processes.
- Actions are started by the host and handled by Action Servers on the Single Board Computer (SBC).
- Processes threated in parallel via Inter Process Communication(IPC).
- The coordination via VME is handled by the Crate Broker.
- Adjustments needed to accommodate the differences between the different readout procedures for the different Front-Ends of the Pixel Detector.

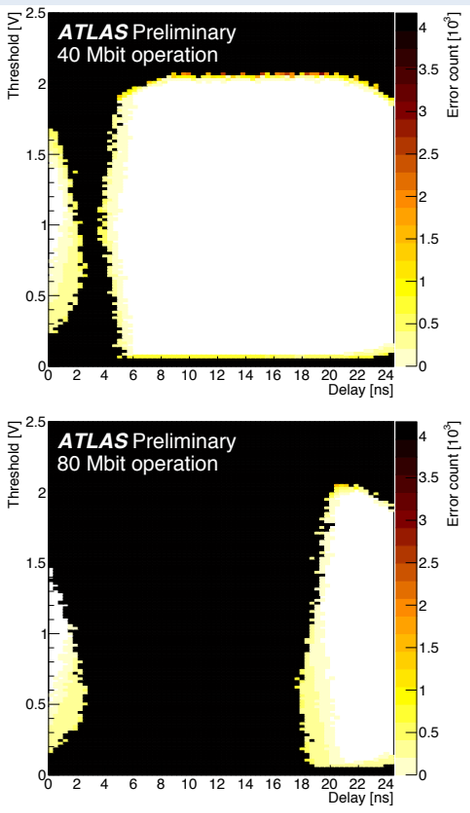


Fig.1 Operation range of the Rx module. In function of threshold from 0 to 2.5V by 190mV step and delay from 0 to 24.5ns by step of 350 ps. The good operating range is shown in white. The reduced range of operation in the 80MHz operation comes from the sampling.

Rx Plugins :

- Working with non return to zero signals up to 160 MHz.
- Operation for L2 and L1 possible at 40 or 80MHz.
- SNAP 12 based plugin.
- Threshold adjustment on per channel basis.
- Excellent operating range as can be seen on Figure 1.
- Aging test at 80°C 80% relative humidity showed a **life expectancy of more than 10 years under normal condition** of 25°C and 20% relative humidity.

Installation done:

- Re-placement of new hardware was completed in January.
- Total of two crates, 32 couples BOC/ROD
- Commissioning the new hardware with the detector was completed and satisfactory.
- All testing performed showed no errors in the recabling procedure.
- New FTK Fibers routing allowing for more flexibility in case of intervention.
- Layer 1 upgrade should take place at the end of 2016.

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ATLAS EXPERIMENT