APV25 and its readout

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Readout Systems:
• ARC
• FED/FEC
• Prototype Systems

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ARC

- Used for CMS module qualification
- Standalone system, no external trigger possible
- Labview software (no source code available)
Components of FE Hybrid

- Pitch adapter
- 6 APV25 readout chips
- 4-layer kapton substrat

MUX, PLL, DCU, ceramic carrier, wire bonds

S. Haensel
ARC System in theory

T. Franke
ARC system in our lab
ARCS: ARC Software (Labview)
CMS-like System

FED/FEC

- Front End Driver (Readout) / Front End Controller (control)
- System used for the Tracker readout in the CMS experiment
- Full system with optical transmission, reduced system also used for CMS with electrical FEDs/FECs
FED/FEC electronics (Optical links)
Analog Opto Hybrid

3 Laser Diodes for 3x2 APVs

http://aoh.hephy.at
FED/FEC boards

FED board (9U VME):

FEC board (9U VME):
Software/Hardware interplay

- Grey Boxes: a single VME crate with associated PC
- CMS Tracker:
  - FED: 28 crates, 16 FEDs in each crate
  - FEC: 4 crates, 11 FECs in each crate
- White boxes: Software processes running onto VME-PCs (all clients of XDAQ framework)
XDAQ

• Online software framework for the CMS DAQ system

• Provides
  – fast communication protocol for peer-to-peer messaging between processes registered with the framework
  – a slower communication protocol for configuring processes
  – event builder applications
  – a finite-state machine
  – memory management,… other tools

• XDAQ processes
  – control the trigger system
  – maintains hardware configurations by uploading configuration parameters to the front end electronics
  – are used for event building and data analysis
  – automate run sequences and acquisition loops
Readout modes

- **Zero-Suppressed:**
  - default mode for proton-proton collisions
  - Data is digitized
  - data is processed on the FEDs using firmware within FPGA
  - pedestal and common-mode subtraction
  - cluster finding

- **Processed Raw:**
  - Data is digitized
  - pedestal-subtracted and reordered data
  - not zero-suppressed
  - Default mode for heavy-ion collisions (high occupancies)

- **Virgin Raw:**
  - Data is digitized
  - FEDs simply capture the APV data streams observed within a given time window (of configurable size)
  - Low level debugging

- **Scope mode:**
  - FEDs simply capture the APV data streams observed within a given time window (of configurable size)
  - Low level debugging
Electric FED/FEC electronics

Longterm test of modules in coldbox:
Other prototype systems

E.g. APVDAQ developed in Vienna
Prototype System: APVDAQ

- Compact system (with single PC) for test purposes
- Developed in Vienna by M. Friedl and M. Pernicka
- 1 system exists in Vienna
  - Core System: Single 6U VME board with sequencer logic, ADC memory/readout, I2C etc
  - Connects to 4 APVs via front-end repeater board
  - Several VME modules can be cascaded (via VME backplane) to common Clk/Trg for parallel readout (eg beam test)
  - Labwindows/CVI DAQ system

http://friedl.hephy.at/belle/apvdaq_reference_v0.04.pdf
APVDAQ Components

APVDAQ VME module

AC repeater:
Summary

- Different APV25 readout systems exist
- Not ONE single reference system

- ARC System
  - Compact
  - “closed source”

- CMS-like systems
  - More complex (especially when using optical links)
  - Electrical FED very rarely available
  - Software: a frozen development version of an old XDAQ version

- Other Systems, e.g. APVDAQ
  - Compact and flexible systems
  - APVDAQ developed in Vienna (only one hardware exists)