Review of Poster Sessions:

- DAQ and Data Management

- Front End Electronics

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Some preliminary comments

1. DAQ/Trigger sessions - considerable overlap

2. DAQ Plenary Session (Luciano Ristori)
   - Scanning/measurement of OPERA interactions
   - CDF Trigger evolution with luminosity
   - ATLAS Trigger - commissioning and physics scope
   - Use of FPGA’s for fast 2D cluster reconstruction

   - Choice of major trends
   - CDF talk timely
   - Poster session very complementary

3. Front End Electronics Plenary Session (Geoff Hall)
   - The NA62 Trigger System
   - The ALICE muon trigger
   - The CMS SLHC Upgrade calorimeter trigger
   - 3D ASIC design (pixel trackers)
   - Pushing noise and radiation hardness beyond 0.1μm
   - DEPFET arrays and source follower readout for X-ray astronomy (Asteroid)
   - DEPFET arrays for Belle2

   - Key trigger developments in large multi-purpose experiments
   - Key ASIC technology frontiers (analog and digital)
   - Evolution of pixels on a large scale - influence on DAQ, monitoring and triggering

Comments

- Only limited contributions related to future luminosity upgrades of the ATLAS and CMS detectors
- Almost nothing about tracking triggers at SLHC
- Nevertheless, many key developments - in case of LHC, expect key issues to be power consumption, connectivity, optical links, enormous software overhead
Categories of the 16 DAQ posters

1. ATLAS/CMS/ALICE/LHCb
   - ATLAS - soft real time network alarm messages (G. Darlea)
   - CMS - Manufacture QA of CMS RPC boards (A. Korpela)
     - ECAL Online commissioning software (P. Musella)
     - CMS ECAL DCS and monitoring (W. Hintz)
     - DQ monitoring of the CMS pixel detector (P. Merkel)
     - Historic Plotting Tool for DQ monitoring (M. De Mattia)
   - ALICE - Upgrade of hardware/software for DAQ (F. Costa)
   - LHCb - Monitoring of the LHCb RICH (U. Kerzel)

2. KLOE
   - Gamma-gamma tagging system (F. Achilli)
   - DAQ for gamma-gamma physics at KLOE (L. Iafolla)

3. OTHER
   - Monitoring system of the ARGO-YBJ DAQ (S. Mastroianni)
   - OPERA Global Readout and GPS distribution (J. Marteau)
   - BELLE2 silicon readout (M. Pernicka)
   - SiLiO trigger for Lambda Hyperons at FOPI-GSI (R. Münzer)

1. Generic Development
   - Wide dynamic range DAQ for new detectors (M. Menichelli)
   - FF-Lynx: Fast links for DAQ and timing distribution (G. Magazzu)

Issues and Trends
- Data Quality Monitoring and adaption to new limits of size/complexity/history/speed
- Monitoring the DAQ network itself
- Adapting data management tools to different types of experiment
  - e.g. OPERA, ARGO (size)
  - e.g. SuperBelle, KLOE (readout speed)
- Fast links (improved connectivity)

Comment
- Increasing Use of FPGA'S for intelligent readout
- Intertwining of DCS and DAQ/data management requirements
- The curse of data base technology vs. being user friendly
Categories of the 17 Front-End Electronics posters

1. CMS/ALICE/LHCb/CDF
   - ALICE
     - Integration of Trigger and Sub-Detectors (M. Krivda)
     - The Hierarchical Trigger (H. Müller)
     - Front-End Electronics for the calorimeters (Y. Wang)
   - CMS
     - The Control System of the CMS Level-1 Trigger (M. Jellier)
   - TOTEM
     - The Modular Trigger System (M. Bagliesi)
   - LHCb
     - The FE Electronics of the Straw Tube Tracker (F. Janssen)
   - CDF
     - GigaFitter: the last SVT Upgrade at CDF (M. Bucciantonio)

2. OTHER
   - CUORE: a programmable anti-aliasing filter (A. Giachero)
   - SIMBOL-X/IXO: a fast DEPFET readout circuit (L. Bombelli)
   - ILC: A 3D deep N-well CMOS MAPS for the vertex detector (L. Gaioni)
     (also High rate DAQ system for the SLIM5 beam test (L. Fabbri))

3. Generic Development
   - Design and performance of a compact multichannel readout for single photon detection (P. Musico)
   - CMOS Analog font-end channel for silicon photo-multipliers (F. Corsi)
   - CMOS F/E of SiPM devices aimed at TOF applications with adjustable threshold and high dynamical gain (D. Bardon)
   - Application of the 5GS/s waveform digitising chip DRS4 (R. Dinapoli)
   - GANDALF: high resolution transient recorder (F. Herrmann)
1. Hinz (+ P. Musella)  
2. Merkel  
3. De Mattia

**Monitoring of Large Systems - complexity - data quality**

**CMS Ecal DCS/monitoring - W. Hinz (ETHZ)**

- 75848 PbWO4 scintillating crystals + Si strip preshower
- temperature dependence of light yield
  + photo detector gain (~2.4% per °C)
- water cooling to be controlled/monitored at 18 ± 0.05 °C

The challenge of making large system controllable

Aim - classify problematic channels with a few key tests

SEE the poster of P. Musella (LIP Lisbon) on commissioning

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**Identify 5 key (DQM) runs of all ECAL channels**

1. Pedestal Run (HV on)  
2. Pedestal Run (HV off)  
3. Test Pulse Run  
4. Laser run  
5. Detector Control Run

**Mean/RMS of output from these runs sufficient to ensure quality of operation and data**

Intelligent history and display key issues  
**e.g. Test Pulse amplitudes gain 12**

**ECAL single problematic channels in time (total 75 848)**
1. Hinz
2. Merkel
3. De Mattia

**Monitoring of Large Systems - complexity - data quality**

Data Quality Monitoring for the CMS Pixel Detector - P. Merkel (Purdue)

- The CMS Pixel detector is highly granular (1440 modules containing 66M pixels) and need for automated data quality monitoring (DQM)
- DQM system in the CMS experiment is developed within the CMS software framework
  - **online**: identify major problems in real time for prompt action (use subset of data, ~5Hz)
  - **offline**: detect reconstruction and calibration problems (full statistics, but limited granularity)
- ROOT histograms are filled for a range of quantities. They are subsequently summarized and automatically evaluated. Problems result in warnings and alarms, investigated further by Pixel experts.
- Monitor readout errors, raw charge deposition information, as well as reconstructed hits, both on and off tracks.
- Experience during global cosmic ray data taking showed ability to detect with fast turn-around (online), as well as high precision (offline), data corruption, mis-configuration and mis-calibration of the detector, as well as newly broken modules and dead or noisy pixels.

**Interactive geometrical Maps**

[mean raw charge]

**THE other KEY challenges are data certification and HISTORICAL monitoring**
The size and complexity of the CMS detector makes Data Quality Monitoring (DQM) challenging. A CMS tool allows to monitor the detector performance in real time: the so called History DQM.

**History DQM workflow scheme:**

- Extracts from the DQM histograms summary informations stored in a database.
- Allows their visualization in trend charts.
- Useful tool to asses the data quality.

**Poster content outline:**

- We describe the architecture and implementation of the History DQM tool.
- We report preliminary experience from the Cosmic Data taking of CMS in Autumn of 2008.

Other LHC experiments have developed equivalent monitoring frameworks.

See also LHCb poster (Kurza) for RICH monitoring and calibration.

Expect evolution with real data.
Lavinia Darlea (CERN) - Monitoring the ATLAS TDAQ network

- Proven to be very difficult task: dimensions and complexity.
- Commercial tools (e.g. Spectrum) inadequate
- NSG is new product connecting to Spectrum thru RMI interface
- DNC is new product injecting network alarms directly into TDAQ
  OUTPUT used for actions in case of network failure
  CURRENTLY used for confirmation, rather than diagnosis (because of polling delays
  in SPECTRUM)

TRAFFIC is high and this monitoring is part of continuing development
Monitoring and operation of extended networks

Monitoring of the ARGO-YBJ DAQ - S. Mastroianni (Napoli)

- Stable data taking since Nov. 2007
- Low Multiplicity trigger with 20 fired pads on central carpet
  
  \[ \text{Trigger rate \sim 4 kHz} \]

- Aims: cosmic-ray physics (above \sim 1 \text{ TeV})
  VHE ?-astronomy (above \sim 300 \text{ GeV})

\[ \text{Large channel number} \]
\[ \text{High data transfer peak} \]
\[ \text{Very large dynamics} \]

\[ \text{8 Strips = 1 Pad} \]
\[ \text{10 Pads = 1 RPC} \]
\[ (2.80 \times 1.25 \text{ m}^2) \]

\[ \text{12 RPC = 1 cluster =} \]
\[ \text{1 LS (5.7 \times 7.6 \text{ m}^2)} \]

\[ \text{ADC} \]

\[ \text{Big Pad#0} \]
\[ \text{Big Pad#1} \]

\[ \text{Resolutions:} \]
\[ \text{\gamma, space 6.5 \times 62 cm}^2 \text{ (1 strip)} \]
\[ \text{\gamma, time \sim 1ns} \]

\[ \text{\gamma to distribute timing-critical signals} \]
\[ \text{\gamma to realize a hardware real-time control} \]
\[ \text{without software penalties:} \]
\[ \text{\dagger to monitor the dead time at each DAQ levels} \]
\[ \text{\dagger to optimize the data acquisition} \]
\[ \text{\dagger to troubleshoot the system in case of an error} \]
\[ \text{\dagger to check the event number synchronization} \]

11th. Pisa Meeting 28.05.09
Monitoring and operation of extended networks

Data shifted from the LS propagating through every FIFO element until they reach the L2 controller

The Monitoring System

It works like a logic-analyzer continuously measuring all the Busy duty cycle and frequency for each trigger and writing the results in a FIFO

Test results

A data frame generator with average size of 70 words, feeds 4 buffer channels @ 4kHz in order to reproduce the real experimental setup.

The fifo status depends upon the difference of the flow between the writing and reading!

study of the trend of Busy sources trigger by trigger
study the DAQ data flow in order optimize the overall performance
trigger on a complex Busy pattern by setting a reference range

L1 Busy duty cycle is linear behaviour only one time for each trigger
Monitoring and operation of extended networks

OPERAN - Smart Ethernet with GPS synchronisation - J. Marteau (Lyon)

- Each detector element is a 1 Gb/s ethernet node
- Standard mezzanine embeds FPGA, FIFO, µ-processor with CORBA protocol
- FPGA programmed to each sub-detector
- Individual nodes run a 100 MHz clock generated via 20 MHz synchronization clock locked to GPS
- Commands encoded (e.g. delay etc.)

Full distributed network architecture
 OPERA 1200 sensors

R&D for future - full distributed architecture

- Reduce market dependency
- ACTA gigabit standard
- New synchronization scheme