Technical Review: DAQ/Online

Paul Dauncey

Imperial College London

Items for discussion

1. Firmware
2. Software upgrade release
3. ECAL/AHCAL integration
4. Trigger distribution
5. Slow data handling
6. TCMT and DHCAL commissioning support
7. Beam line equipment integration
8. CRC reliability
9. Cables
10. Schedule

N.B. Only considering issues for 2006 here

1. Firmware

- Two major pieces of work needed
  - Buffering 2000 events, not 500
  - Storing trigger data for buffered access, not only read during spill
- Other more minor changes will be needed
  - (DHCAL use is major but not considered here…)
- Slow progress due to level of effort
  - First limited by engineer retiring but now new person has picked it up
  - Second limited by (excellent) engineer being wanted by lots of projects!
- Lack of spill structure at DESY makes neither critical immediately
  - Must have both to run efficiently at CERN
- Hope to have both upgrades by early 2006
  - Should be fine as long as no more manpower problems (or in their other experiments)

2. Software upgrade release

- Major restructuring of online software since DESY run
  - Many reasons…
- True offline only (supposed to be) used for LCIO conversion
  - Basic data access unchanged
  - Actual data format changed to some extent
  - Can convert old data "on the fly" to be closer to new format
  - LCIO conversion is "intelligent" to allow LCIO format not to change
- Other uses only for DAQ systems
  - Much larger changes: users working at the "bleeding edge"
    - ECAL/DAQ test stand at Imperial = me
    - AHCAL test stand and beam test system at DESY = very patient people!
  - But soon to be TCMT test stand at FNAL (and DHCAL test stand at ANL?)
- Need to complete and release by end of year
  - Completely paced by small amount of effort (= me)

3. ECAL/AHCAL integration

- Main issue is system connectivity
  - Cannot test until ECAL equipment brought to DESY ~Dec 05
- Need to read ECAL and AHCAL is parallel for 100Hz event rate
  - Two PCI cards read by two processes in one PC
  - Two PCs running synchronised state machines
- Two PCI cards in one PC is totally stand-alone system
  - Independent of external networking
  - But contention on PCI bus might degrade performance…
  - …or even cause corruption?
- Two PCs can run completely in parallel
  - Confident each will achieve 100Hz internally
  - But might be limited by low network bandwidth between them
- Must test this to understand limitations of two PCI cards
  - Also investigate if a dedicated network connection is feasible

4. Trigger distribution

- Trigger distributed within crate over custom backplane on J0
  - Passive board manufactured at Imperial
  - Cable/connector version also exists
- DESY beam test used cable/connector
  - Backplane not thoroughly tested
  - Cannot use at Imperial as (borrowed) crate there is not LHC standard
- Also need to transfer trigger from one crate to the other
  - Enough outputs exist but not tested at all over ~10m
  - Then distributed over second crate via copy of backplane
- After arriving at DESY, need to
  - Test backplane
  - Make second copy
  - Test inter-crate connections
- Worst case: crates may need to be next to each other

5. Slow data handling

- Several sources of slow control and data
  - CRCs, ECAL stage, ECAL control PC, AHCAL control PC
- Left in an ill defined state at the last Technical Review
  - Recommend that all data goes through the DAQ/online system…
  - …and all collected by AHCAL slow controls/monitoring system
- Duplication of effort and data; both lead to confusion
  - Need to streamline
- My opinion is
  - Use AHCAL system for immediate monitoring of their data
    - Very nice system for displaying values, etc.
    - But do not save data for long-term storage
  - Gather data from all sources into DAQ
    - Consistent access, consistent timestamping, embedding within contiguous data.
    - Also allows DAQ-dependent control, e.g. AHCAL stage motion during run

6. TCMT and DHCAL commissioning support

- TCMT doing first tests at DESY very soon
  - Equivalent electronically to AHCAL
  - Should be straightforward from DAQ perspective
- By Jan 2006, hope to have test system running in FNAL
  - Will need CRC, VME crate and VME readout system
  - Will need online software and help to run it
- VME readout system not yet in hand; try to beg/steal/borrow
  - All other VME systems supported by CERN HAL software
  - If TCMT controller is not, then significant extra software effort needed
- DHCAL will also want a test system sometime in 2006
  - If using CRC, help needed to install and run it in online system
  - If some other backend readout card is used, support and significant software effort needed to interface to online system
- Small effort available spread very thinly; need new expert

7. Beam line equipment integration

- DESY runs
  - Drift chambers used flammable gas; 24 hour shift coverage
    - Can we use non-flammable gas? Who can commission this?
  - PMT pulse height can discriminate against multiple synchronous electrons
    - Should we read this out? Via CRC (as done for AHCAL data) or purchase a commercial multi-channel ADC with large on-board memory?

- CERN runs
  - Need all readout modules consistent with our requirements; >1kHz trigger during spill, >100Hz readout after spill
  - Does this require us to provide another (the same?) ADC module?
  - How do we time into the beam/spill structure? How do we test this before we get to CERN?

- FNAL runs
  - Exactly the same issues hold here too

8. CRC reliability

- Total number of CRCs needed is 13
  - ECAL: 6, AHCAL: 5, TCMT: 1, trigger: 1
- Have 9 in hand, another 7 within weeks = 16 total
  - Apparently 3 spares, but cannot be sure yet that 7 new CRCs will be usable
- AHCAL use has found faults can develop
  - Both production boards they have used now have problems (but not prototypes)
  - Consistent with broken traces; some may be fixable, some not
  - Long term reliability might be an issue?
- Mitigation possibilities
  - Try to repair breaks if accessible
  - Avoid bad inputs: 4 unused connectors in TCMT, 3 in ECAL, 8 in trigger, but at least one fault in area common to whole board
  - Firmware cludges to work around breaks

9. Cables

- Total count needed is 148:
  - ECAL: two per layer = 60
  - AHCAL: two per layer = 80
  - TCMT: equivalent to four AHCAL layers = 8
- 70 cables (60 plus spares for ECAL) purchased in 2004
  - These are not halogen-free so "cannot" be used at CERN
- Length should be as short as possible
  - Signal quality
  - Trigger latency
- Main limitation is mechanical
  - Need to decide crate location to define length
- Need to order 160 in time for CERN beam tests ~Aug 2006
  - Delivery time around one month; maybe order by Apr/May 2006?
  - Cables are around 100euros each; who can contribute?

10. Schedule

- Many significant efforts will (hopefully) come to fruition in 2006
  - ECAL second DESY run
  - AHCAL commissioning and DESY run
  - TCMT commission at FNAL
  - ECAL/AHCAL/TCMT CERN run
  - DHCAL testing at ANL/FNAL
- DAQ/online is common factor to all
  - Also, number of CRCs to cover all these activities is tight
- Need to schedule carefully and minimise changes
  - DAQ equipment has to be available and in the right place at the right time
- Do we need to build more CRCs?
  - Probably only sensible if DHCAL definitely using them