



LOI Content: Electronics and DAQ

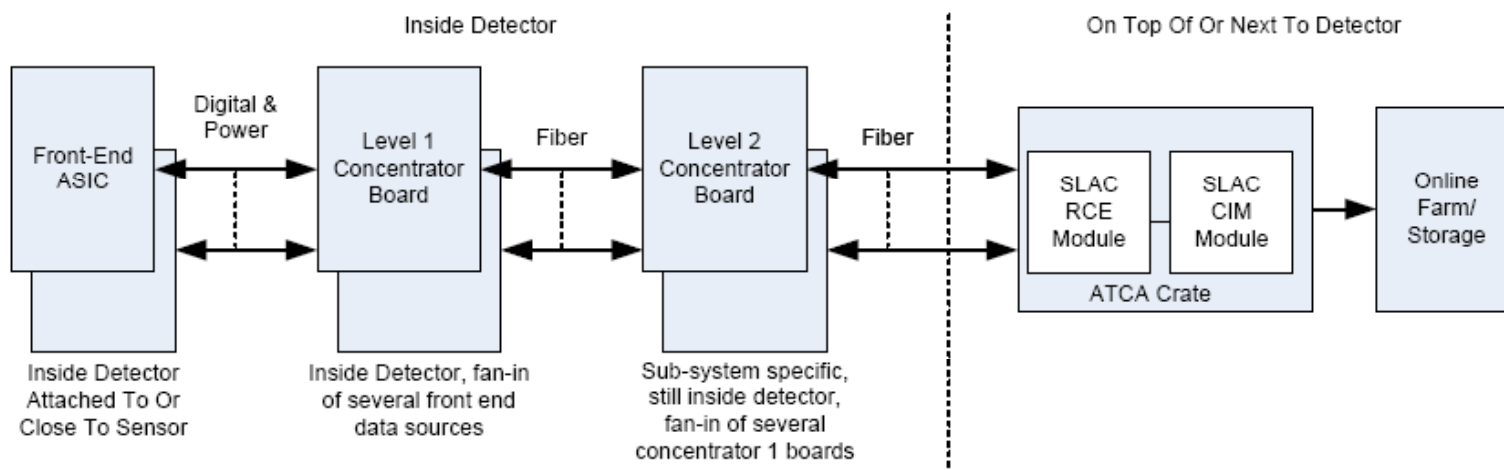
Gunther Haller

Research Engineering Group
Particle Physics and Astrophysics Division
SLAC-Stanford University

March 2, 2009



Overall Architecture



- SiD has a coherent approach to the electronics architecture that seems to fit all the baseline subsystems. Figure 1 shows the simplified block diagram for the data-acquisition from the front-end electronics to the online-farm and storage system. The subsystems with the exception of the Vertex detector (for which the sensor technology is not yet selected) and the FCAL (which has approximately unit occupancy) are read out by variants of KPiX as the front-end Application-Specific Integrated Circuit (ASIC).



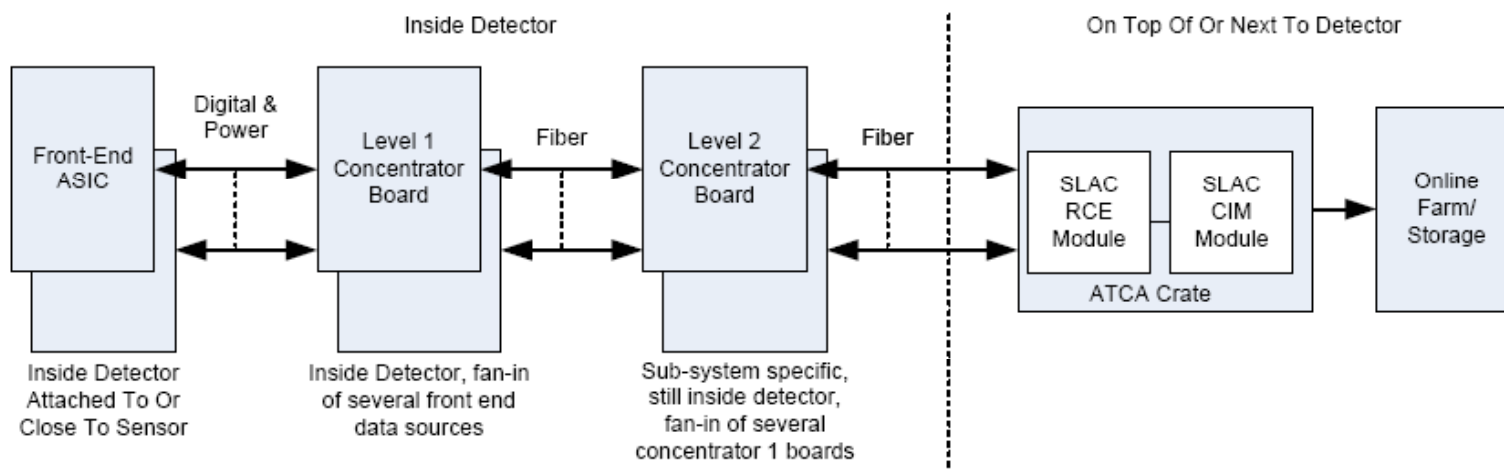
Number of KPIX

Sub-System	KPiX Count	Channels/KPiX
Tracker	22066	1024
EMCAL	99076	1024
HCAL	35412	1024
Muons	8834	64
Total	165388	

- Table 1 lists the number of KPiX ASICs for each sub-system. Tracker, EMCAL, and HCAL use 1,000-channel ASICs while the Muon sub-system uses a 64-channel version.



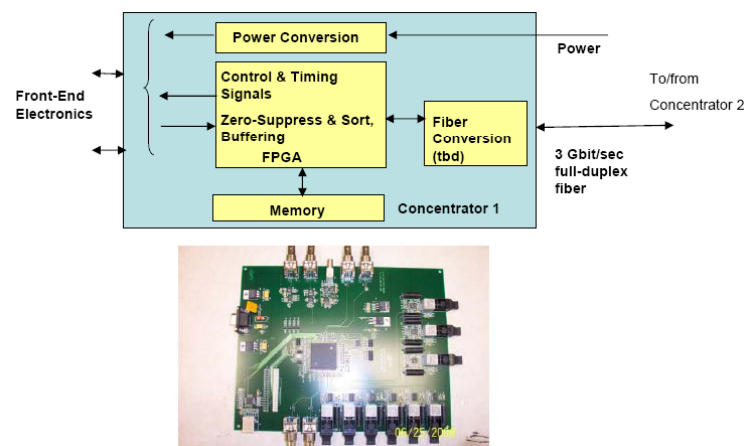
Overall Architecture



- As illustrated in Figure 1, several front-end ASICs (KPiX, FCAL or Vertex ASICs) are connected to a Level-1 Concentrator (L1C) board using electrical LVDS. The concentrator board main functions are to fan out upstream signals to the front-end modules, to fan-in data from the front-end modules for transmission to the Level 2 Concentrator (L2C) boards, and to perform zero-suppression and sorting of the event data. Just as an example, for the EMC Barrel a total of 96 1,000-channel KPiX chips would be connected from 8 front-end cables with 12 KPiX's each to one Level-1 Concentrator board. The number of Level 1 concentrator boards in the detector depends on the sub-system, e.g for the EMC Barrel there would be 821 L1C boards and 52 L2C boards (80k KPiX, 96 KPiX for each L1C board, 16 L1C boards for each L2C board)



Level 1 and Level 2 Concentrators

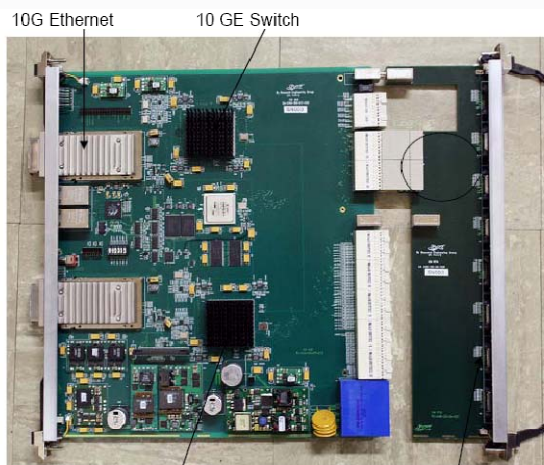


- The Level 1 Concentrator boards are in turn connected via 3-Gbit/sec fibers to the Level-2 Concentrator boards. These are similar to the Level 1 Concentrator boards. They fan out and fan in signals to/from the Level 1 Concentrator boards. In addition the data-streams of sorted event data received from each Level 1 Concentrator board are merged and sorted before transmission to the off-detector processor boards. The Level 2 boards are either located inside the detector or outside, depending on the sub-system. E.g. for the EMC Barrel there are 36 of such boards inside the detector volume.
- Level 2 Concentrator boards are connected to ATCA modules

ATCA DAQ Modules



Rear Transition Module Reconfigurable Cluster Element Module



10G Ethernet 10 GE Switch
Management Processor Ethernet on Rear-Transition Board



- Front-end data sorted in Level 1 and Level 2 concentrator modules
- Two SLAC custom modules in ATCA with functionality described in the LOI
- Note that the event data is zero-suppressed in the sub-systems without the need for a global trigger system. All data produced in the front-ends above a programmable threshold is read out. For diagnostics and debugging, the DAQ includes the ability to assert calibration strobe and trigger signals, transmitted to the front-ends via the Level-2 and Level-1 Concentrator boards using the fibers shown in Figure 1. The fiber transports encoded command, clock, and synchronization to all the front-ends



Power & Environmental Monitoring

- Power Conversion circuits on the Level 2 and Level 1 Concentrator boards supply the power to the front-ends, starting with 48V or higher voltages from off-detector supplies. Alternatively, serial powering architectures are also under consideration. The power supplies are located in several racks on or next to the detector.
- Environmental and health monitoring circuits are also included on the concentrator boards. In addition there may be additional monitoring boards in the detector, connected to RCE fiber interfaces. In addition there are crates of monitoring modules mounted in several racks on or next to the detector.