CMS

May 3 2006, S. Cittolin

DAQ status and plans

DAQ baseline structure
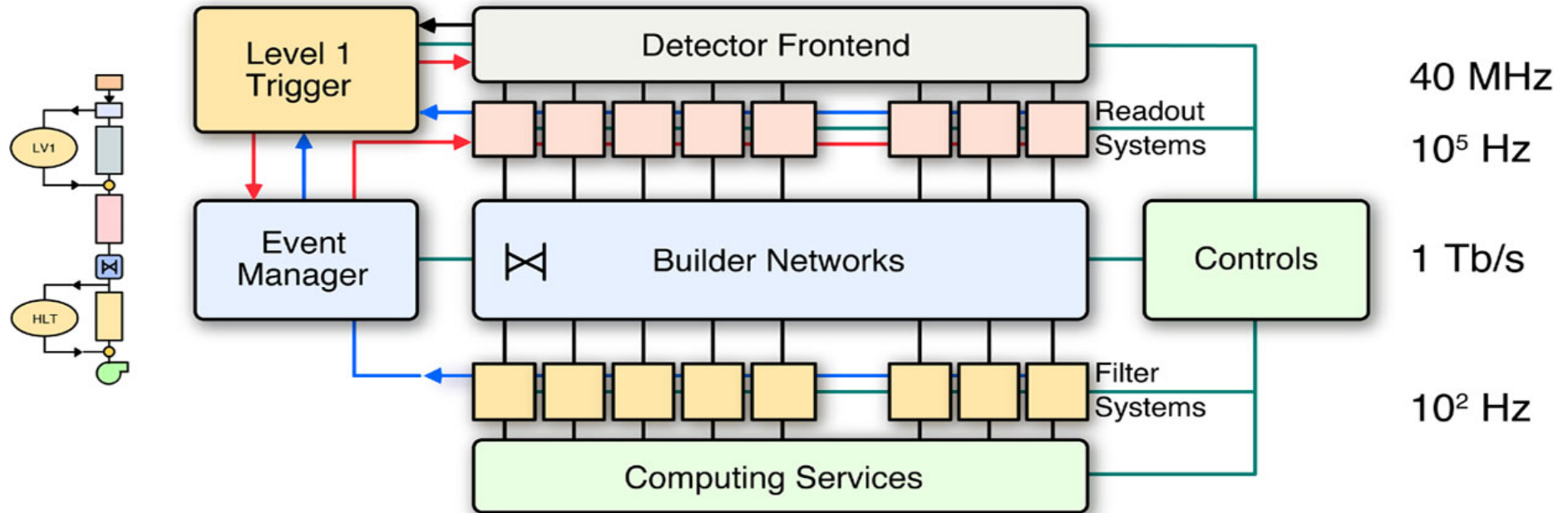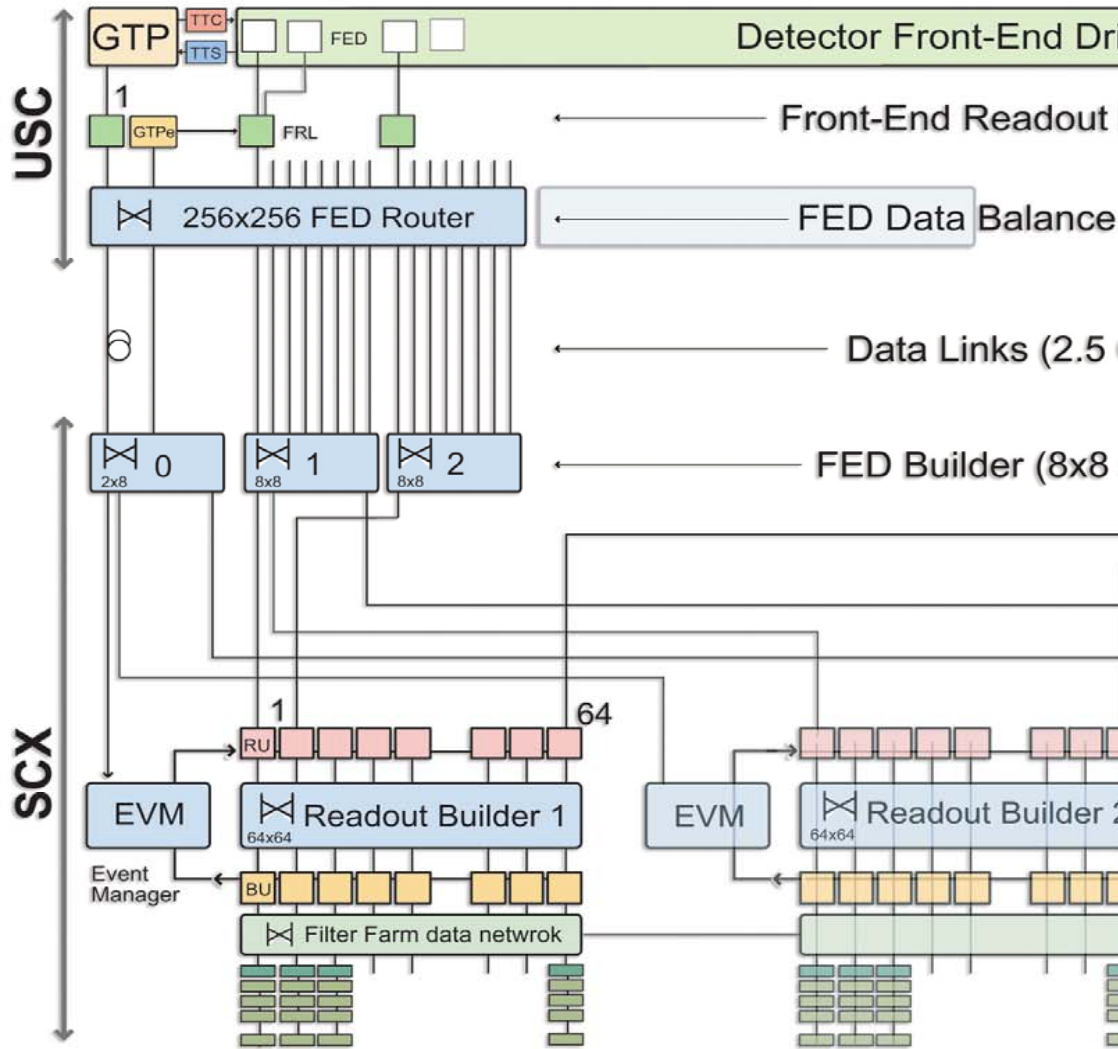

Collision rate	40 MHz	No. of In-Out units	**512**
Level-1 Maximum trigger rate	**100 kHz**	**Readout network bandwidth**	**≈ 1 Terabit/s**
Average event size	**≈ 1 Mbyte**	**Event filter computing power**	**≈ 10^6 SI95**
Event Flow Control	≈ 10^6 Mssg/s	Data production	≈ Tbyte/day
		No. of PC motherboards	≈ Thousands

DAQ structure&layout

CMS/SC TriDAS Reviw AR/CR05

12.5 kHz   +12.5 kHz
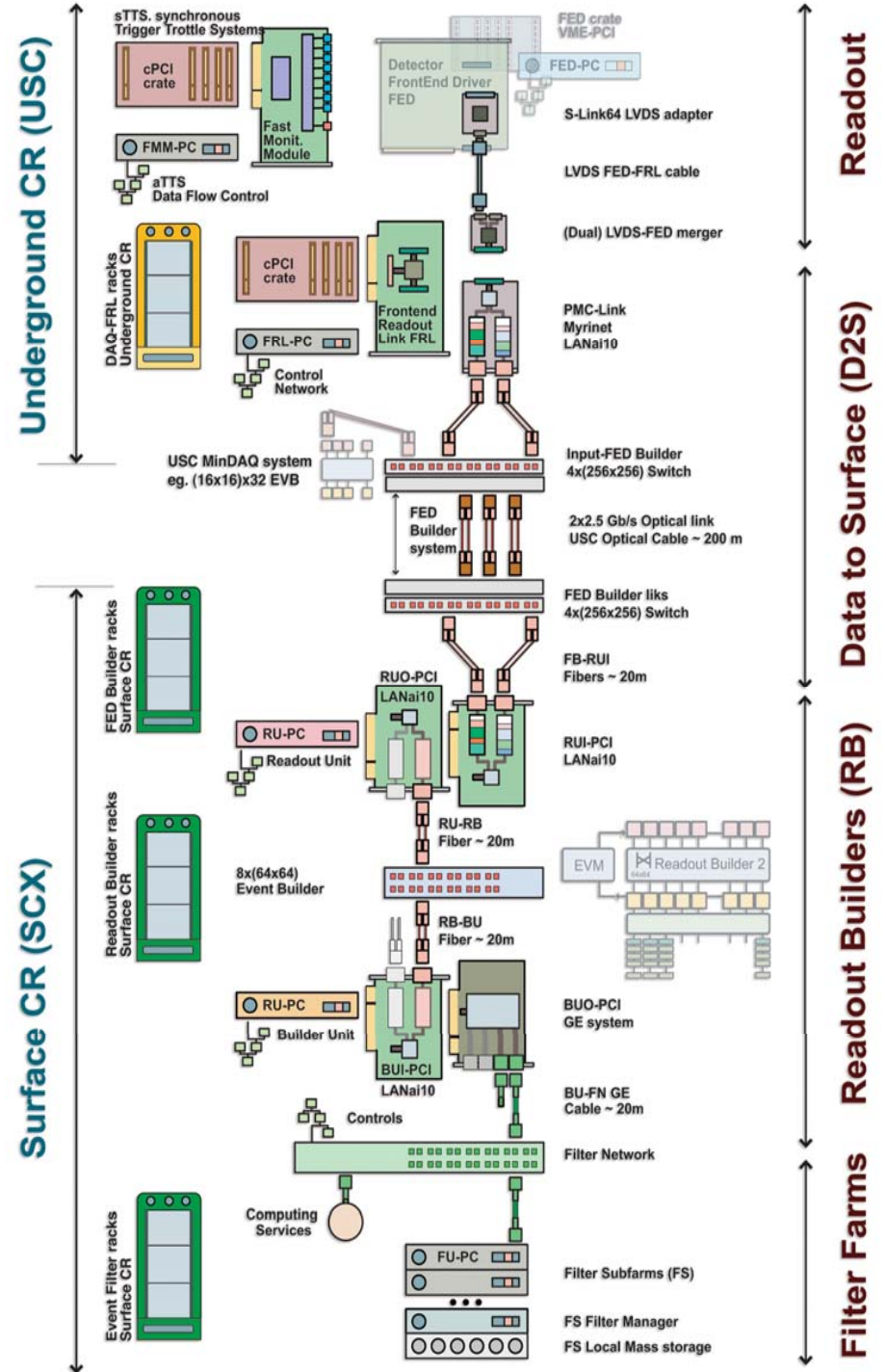
DAQ 2005-07 activities

1. **Production**

   Readout systems: Slink (720), FRL(560), FMM(50) modules, cables (800) and crates(60)

2. **Procurement & Installation**

   Pre-series scale 1:10 DAQ system for development and integration

   USC DAQ control PCs(80): FRL, FMM, FED, FEC, DCS, VME-PCs (180),

   D2S Data to Surface Myrinet links(1024), FED Builder switches(12), Fibers(2048)

   SCX Readout Builders: Racks(120), DAQ PCs (600 RU-BU), EVB (2000 ports), HTL (800 PCs)

3. **Commissioning**

   USC DAQ racks, FRL/FMM crates, PCs

   D2S Data to Surface Myrinet links, FED Builder switches, Fibers

   SCX Readout Builders: Racks, DAQ farms (RU-BU), EVB switch, Filter Farm

4. **MTCC integration**

   Pre-series DAQ for final detector readout : Slink, FRL, FMM modules, cables and crates

5. **TriDAS integration**

   Detector readout systems: Slink, FRL, FMM modules, cables and crates

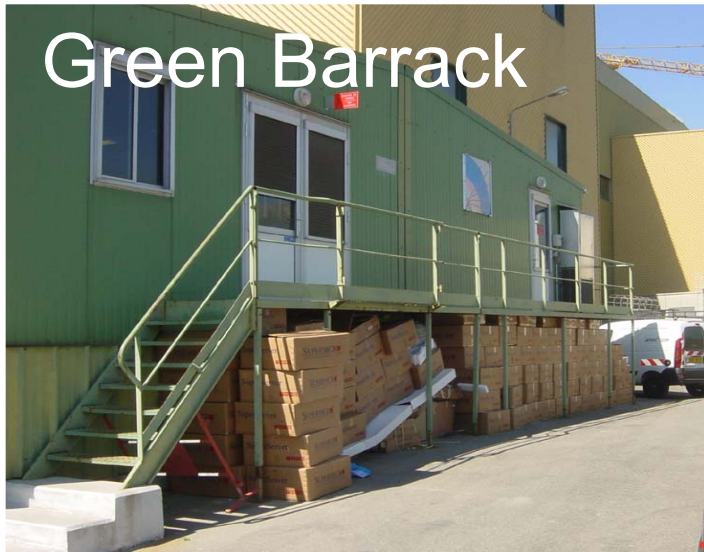6. **Development&Consolidation**

   Frameworks: XDAQ, RCMS, FF-HTL. Interfaces: XDAQ-DB, PVSS

   Applications: RB(EVM/RU/BU), FMs, Configurator, DAQ Monitor, Flow controllers, DQM, DBs

   Online software releases: MTCC May 2006, First Run Jan 2007

Integration: Pre-series

Green Barrack

Current activities

- **DAQ integration and MTCC**
- **Online services pre-series**
- **Detector readout integration**
- **First Run EVB technologies**
  GbE with a FORCE10 E1200 switch

Readout Builder PCs

- 64 dual Xeon 2.6 GHz RU-BU PCs
- Myrinet +GbE interfaces
- 16 dual Xeon 2.6 GHz Filter nodes
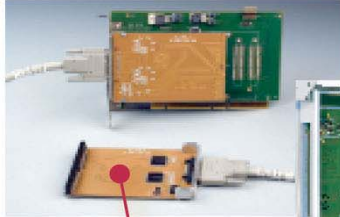- OS Linux 2.4

Scale:	
Structure	1:8
Functionality	1:1
Performances	1:4

Pre-series: Hw&Sw integration

32 GIII FED emulators

64 FRLs
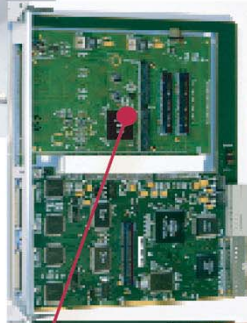
4 FRL crates

200m fibers
Data links

8 8x8 FED builders

64x64 RU builders
16 FUs Filter SF

Up to 32 detector FED

Magnet Test
Cosmic Challenge

GIII GTP/FED emulators

FED prototypes

FRL cPCI crate

eFED
LVDS
FRL

FB

RU

EVB

BU

FU
FS

8x24 FilterNet

Force10 E1200
GBE Event Builder

64x64 Readout Builder

FED Builder

RU-BU PC

RURU, BUBU, RUBU
PC configurations

Detector readout integration

http://cmsdoc.cern.ch/cms/TRIDAS/DAQIntegration/subDet/doc/html/index.html

Integration schedule

Detector / SLINK-Host	Date	location	test chain	remark/status
CSC	3rd October 2005	Cessy	**Detector-FU**	**completed**
Tracker (p 1)	18th November 2005	Cessy	FED-FU	completed
DTTF	20th October 2005	bat 40	pdFED-FBO(RUI)	ongoing
ECAL	21st October 2005	Cessy	pdFED-FBO(RUI)	ongoing
RPC	5th December 2005	Cessy	pdFED-FU	ongoing
HCAL	December 2005	Cessy		ongoing
LTC	January 2006	Cessy	LTC-BU	ongoing
DT	February 2006	b40-3	ROS-FED-FRL	ongoing
Tracker (p 2)	5th December 2005	Cessy		scheduled
Pixel	16th March 2006	Cessy	FED-BU	scheduled
GTP	?			
CSC Trackfinder		?		
GCT	?			
Preshower	very late			

Pre-series system integrations

- **MTCC DAQ system:**
  - 6 TTC partitions, single DAQ partition
  - Single RU Builder and FED builder (as in final CMS)
  - 7x8 RU Builders and 7 times FB N x1
  - Filter Farm 16 FUs available
  - 10 Central/Local DCS servers
- **MTCC Data bases**
  - Data base server (oracle 10G)
- **MTCC Event data storage**
  - Server 900 Gbyte (to be doubled) (network write around 50 MB/s)
- **First run EVB and PC technologies evaluation (Jul 2006)**
  - Force 10 GBE switch (RU to multiple BU EVB etc..)
  - Multi Core 64 bit next generation PCs, Multi-GBE network interfaces
- **Service Network**
  - Same structure as for CMS (final specification ready for installation):
  - CERN GPN and private network for all DAQ
  - Head nodes (aka application servers, aka proxy nodes) in between
  - Connection Cessy - CERN backbone is 1 Gbps
- **System admin**
  - Linux SLC3
  - Few windows-XP nodes (for DCS)
  - Services: NFS server, DHCP, LDAP, ..
  - Nodes on private network must be centrally administered

SCX surface computing room

Apr 2006   110 racks installed

Jul 2006   technical network infrastructure

Aug 2007   Ready for PC installation

DAQ configuration for first run

Subsystem   **Nominal Ready**

2005 Pre-series   **Development and Magnet Test**   **100%**
32x32x2 EVB, 16FU FF

2006 D2S   **Procurement and production**   **100%**
FRL/FMM, PC control, FED Builders, Fibers

Readout Builders

2006-07   **Infrastructure**   **>50 %**

Racks, Control, Networks, Remote

2007 Readout   **4x (64x64) EVB full installation**   **50% (50 kHz**
500 Gb/s switch, Local Storage
June 2006 600 DAQ-PCs and EVB switch

2008-9 Filter Farm incremental   **10-30% (*)**
Dec 2007 800 FU-PCs and Filter farm Switch

*) The 4 RBs readout network (GBE or Myrinet) allows the global DAQ system be reconfigured with part of BUs becoming FUs so LV1 maximum rate can be adjusted to fit the available Filter Farm selection power

20.. DAQ completion (<u>not funded</u>, 8 slices, 100 kHz...) 100%
Infrastructures, xy1800 FU-PCs, EVB and FF Switches
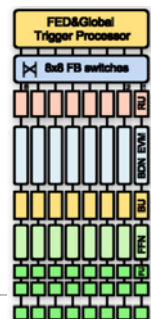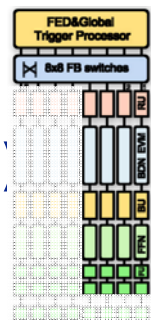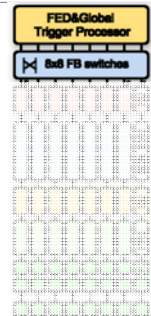
DAQ PC/GBE material profile

	Dec. 05	Dec 06	Dec 07	Jun 08	Dec 08	Jun 09
D2S	**Completed 100 kHz readout**					
DAQ RU-BU		**600 PCs** Market Mar 06 Tender Jul 06			**600 PCs**	
Networks EVB		**2000 GBE** 50 kHz EVB			**2000 GBE** 100 kHz EVB	
Filter Farm				**0-900 PCs** 50 kHz HLT		**0-900 PCs** 100 kHz HLT

First run (technical)
- Up to 50 kHz readout
- HTL power limited
DAQ-FF PCs can be reconfigured to fit optimum HLT rate

Second run (physics)
- Up to 50 kHz HTL

High-Lum runs
Up to 100 kHz HTL

DAQ 05-07: plans&milestones

- ✓ **Apr 05** — **DAQ Pre-series DAQ completed. Integration started**
- ✓ **Aug 05** — **D2S Myrinet links and switches procured**
- ✓ **Jan 05** — **D2S FRL/FMM systems produced and tested**
- **May 06-Jun 06** — **USC FRL/FMM crates, Cables, Fibers and PCs installed**
- **Jul 06-Dec 06** — **USC FED/FRL/FMM readout commissioning**
  - FED-FRL cables and interfaces auto-test, USC FED Builder Myrinet test
  - USC-miniDAQ (8x8) sub-detector global DAQ commissioning
- **May 06-Aug 06** — **Preseries integration: MTCC multi-detector full chain DAQ**
- **Aug 06-Feb 06** — **SCX DAQ GBE&PCs procurement and installation**
  - DAQ PCs (600) and 2000 port GBE switch procurement
  - USC-SCX links: Test SCX FED builders and run SCX-miniDAQ (8x8)
  - Install 4 Readout Builders (512 PCs) with GBE-EVB (2000 ports
- **Oct 06-May 07** — **USC-SCX Central DAQ commissioning**
  - GTPe, FRL-eFED central DAQ auto test mode.
  - Full DAQ integration (EVB,FF, DQM,Local storage)
  - Central RCMS/DCS, DBs and Connection with remote data storage
  - Multiple Readout Builders and multiple TTC/DAQ Partitions
- **Feb 06-Aug 07** — **TriDAS system commissioning**
  - SCX miniDAQ Trigger and DAQ integration (TTC/TTS)
  - Multiple Readout Builders and Trigger Partitions
  - Regular dry runs and training sessions
- **Aug 07** — **Ready for first collision data taking**
  - Variable configuration from 50 kHz (10% Filter Farm), 15 kHz (100% Filter Farm)
- **Jan 08-……** — **First phase DAQ completed (3 slices) for physics runs**
  - HLT PCs procurement and installation: 36kHz and 100% HTL, 100 Hz on tape

DAQ hardware&infrastructure
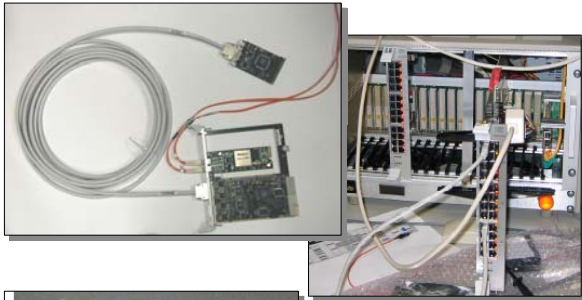
- **Front-end readout**
  - FED SLINK64-LVDS interface (CMC)
  - Front-end Readout Link (FRL)
  - Fast Monitor Module (FMM)
  - FRL and FMM crates
  - FRL and FMM control PCs
  - Myrinet LANai 2XP data link

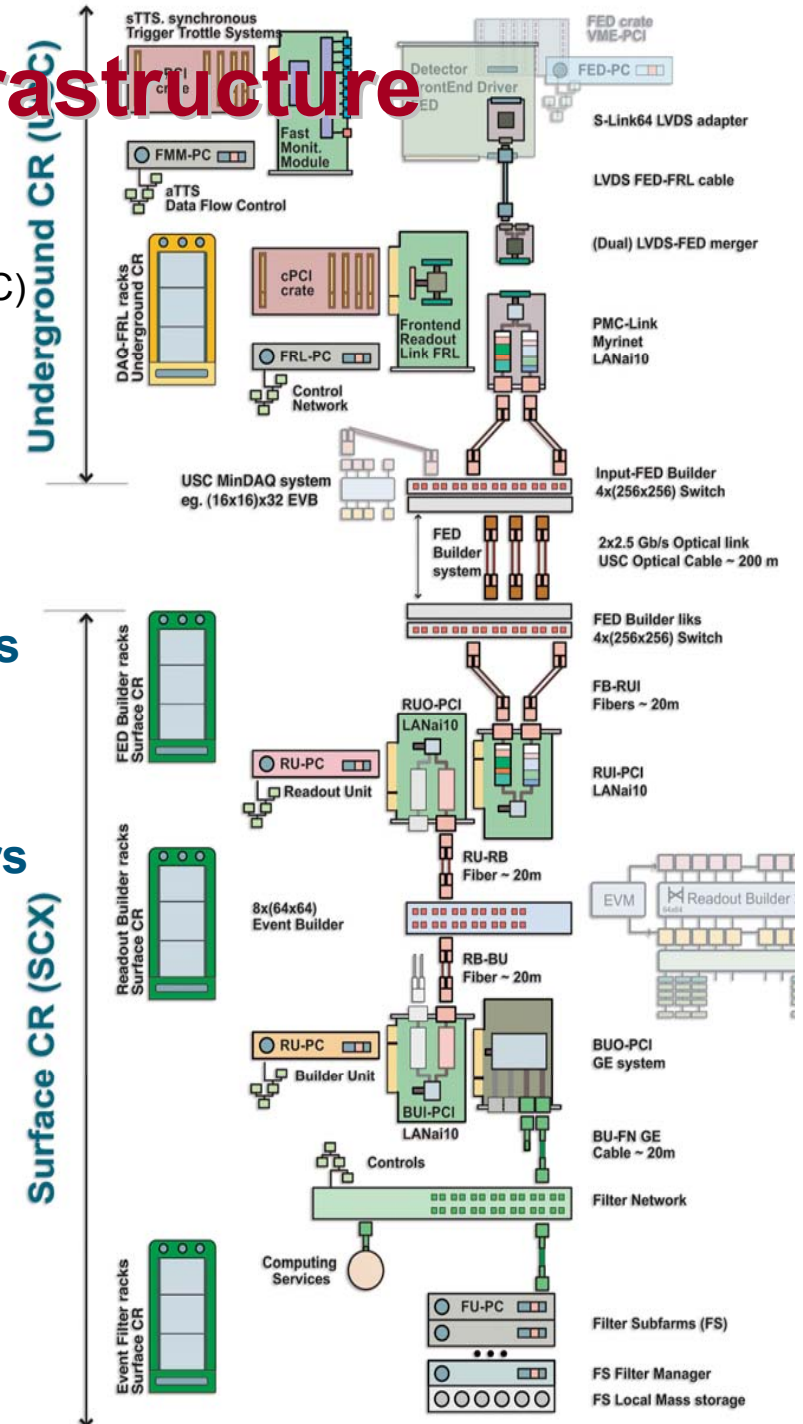- **FED Builders and optical links**
  - Myricom 256 port switches
  - Myricom LANai 2XP (FRL-RUI)

- **Surface SCX Readout Builders**
  - DAQ RU/BU PC farms
  - Event Builder switches
  - Filter Farms
  - Local/Remote data storage

- **USC/SCX DAQ Infrastructure**
  - Counting rooms networks
  - D2S Optical cables
  - Water cooled PC racks

DAQ software

- ## Core framework and components
  - System and communication services
  - Hardware access facilities and device drivers
  - Interface to external systems (e.g. DCS, computing services)
  - Basic configuration and control facilities (GUI, script)
  - Benchmarking and testing software
  - Re-usable DAQ modules (e.g. event builders, FED readout)
  - DAQ monitoring

- ## Run Control and Monitor System
  - Configuration, control and monitoring
  - Interface to operators (GUI, script)
  - Interface to DCS

- ## Databases
  - Persistency technology
  - Data categories
  - Data access tools
  - Administration

- ## Detector Controls
  - Detector DCS coordination. Common tools development&support
  - Framework and central DCS system
  - DAQ infrastructure controls

DAQ first run configuration

Data to Surface 100% produced, procured and installed
Slink (720), FRL(560), FMM(50) modules, cables (800) and crates(60)
Myrinet (1024 LanAI X), 12 Clos-Crates

Fibers to surface 100% procured (installation in Aug. 2006)

Readout Builder 40% founded for first run
Procurement   Aug 2006
Installation   Oct 2006-Dec 2006, May 2008
Commissioning   Oct 2006-May 2007

+12.5 kHz   +12.5 kHz