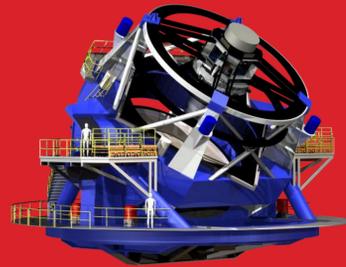
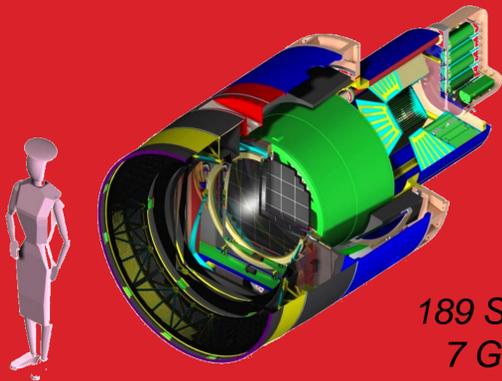


Data Acquisition at the Cosmic Frontier

Dark Energy: Multicast Technology at LSST

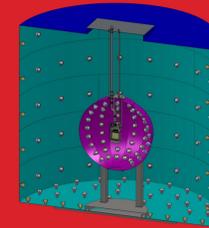
Dark Matter: HPC technology at DarkSide-50

LSST Camera

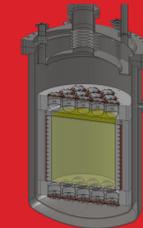


LSST Telescope

189 Science CCDs,
7 GB per image



DarkSide Detector



50 Kg LAr TPC

250 MHz
Digitizers

300 us Sampling
Windows at 50Hz

Digitizer
Group (1)

Digitizer
Group (2)

Digitizer
Group (5)

40 Total Digitizer Channels

5 Network Links,
Total 300 MB/s

Compute Cluster

Time sorting and aggregation
of signals within windows
across detector

Algorithmic framework to
process signals within windows
(e.g. calibration, pulse finding,
compression)

Out to storage
system

Challenge: Determine the best method to efficiently transfer image data from summit to base facility for real-time analysis.

Can any DDS implementation be used to reliably transfer 7 GB of image segments in 2 seconds to analysis tasks?

The DDS standard defines a real-time publish/subscribe messaging system. This system is also used within Fermilab's Intensity Frontier experiment NOvA.

Challenge: Perform real-time signal analysis of data directly fed from an instrument using an HPC cluster

Can HPC tools and networks be used to perform functions that are typically done in hardware and firmware?

Fermilab develops algorithmic frameworks using C++ to allow experimenters to easily add new algorithms to the processing stream.

Can an HPC cluster be used to emulate data flow, predict performance, and test reliability of the fully populated systems?

ATCA Chassis

RTEMS with
TCP/IP
networking



100 Gbit/s capacity,
10G ethernet

>3000 CCD segments
published on multicast
channels

50 km from summit
to base facility

DDS protocol
(OpenSplice, OpenDDS)

>3000 multicast
channel subscriptions



~6000 Core Linux Cluster
Real-time image analysis include
transient object ID

ATCA: Advanced Telecommunications Computing Architecture
DAQ: Data Acquisition
DDS: Data Distribution Service
RTEMS: Real-time operating system
LAr TPC: Liquid Argon Time Projection Chamber