Data Monitoring with the LIGO DMT

John G. Zweizig
LIGO, Caltech

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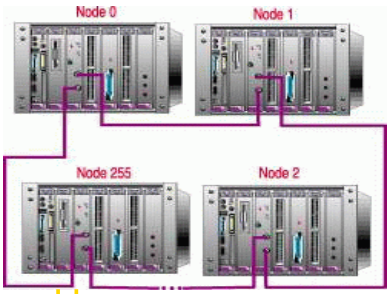
Purpose of Monitors

- Detect and tag known signals and disturbances.
  - Find and record transients
  - Correlate external effects to operational parameters.
- Measure and summarize the running state.
  - How well is everything running?
  - Noise spectra, average power, other operational parameters.
  - Rate and magnitude of known signals
- Notify operators of faults or abnormal conditions.
  - Increases in all or part of noise spectrum
  - Other device specific problems.
- Support interactive testing and diagnosis.

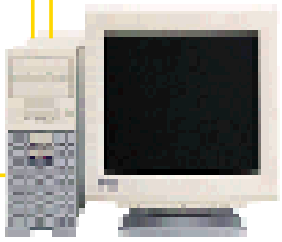
Online Data Access



LIGO DAQ System
Consists of a reflective memory ring linkingVME-based instrumentation crates.

Reflective Memory Loop

CDS Frame Builder
Collects raw data into frames for archival



Frame Broadcaster
Builds frames with raw data and GDS test-point data, and broadcasts them to DMT machines.

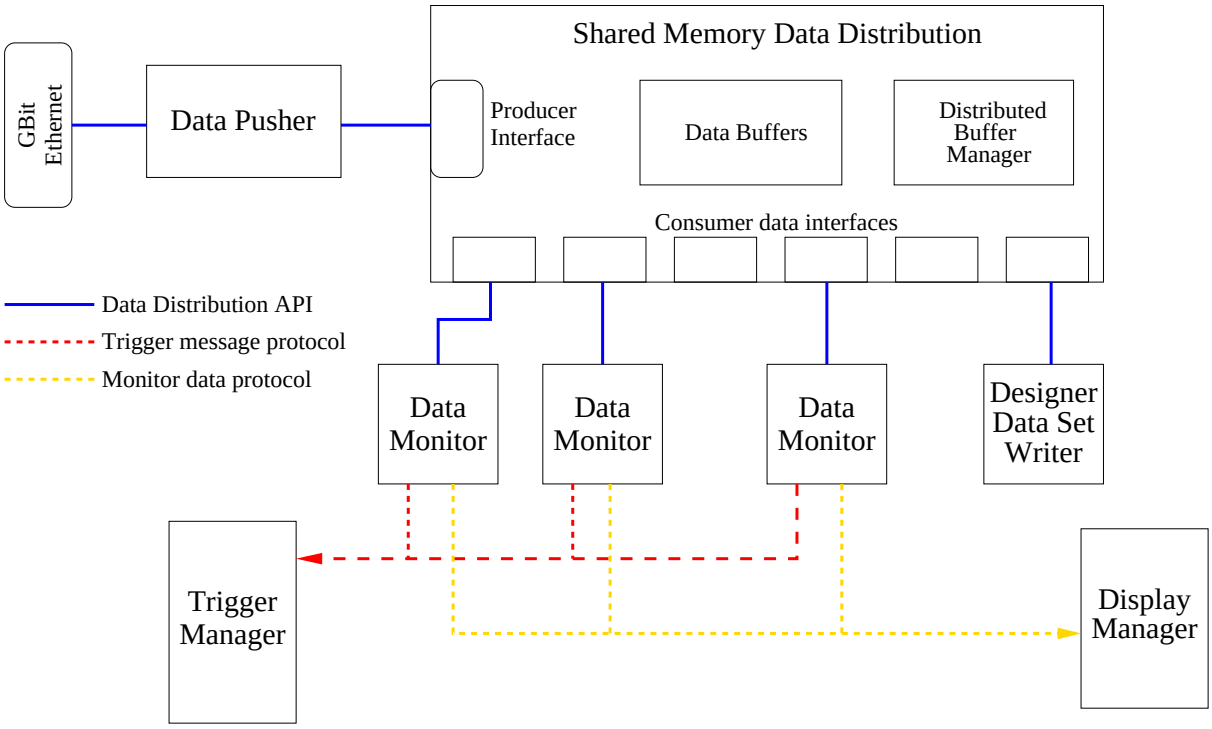
Gigabit Ethernet Hub
Routes data multicasts to all connected hosts

DMT Machines
sand and stone at LHO and delaronde at LLO each have four 400MHz Utra-Sparc II processors and 1GBy of memory.

Analysis Sandbox Machines
fortress at LHO and stephen at LLO provide scientists with online data access and designer data set creation and copying facilities

- GDS frames built by dedicated frame broadcaster.
- Data broadcast over Gbit Ethernet to DMT hosts.

Online Process Model



- Current data distributed via shared memory in each host.
- Any number of monitors access current data independently
- Trigger Manager routes triggers to operators/meta-Database.
- Monitors serve data for Status Reports & Displays.

Output Data

- Triggers
  - Describe transients and noteworthy glitches.
  - Standard fields contain type, start time, duration, significance, etc.
  - Stored in $meta-$Database table (data mining).
- Trend Frames
  - Record average values vs. time.
  - Contains: mean, rms, high, low, N
  - Average over second, minute or arbitrary intervals
- Designer frames
  - Record a few related channels.
  - Fast data access for directed analysis.

Status Reporting, Diagnosis Aids

- Files to Web Pages
  - Text only.
  - Very easy to implement..
- Monitor Display Manager
  - General purpose display program.
  - Data selected from menus of monitors, data objects.
  - Display formatted by macro or point-and-click.
- Specialized Monitor Displays
  - Must be developed in parallel with monitor.
  - Fixed monitor, data names.
  - More flexibility in formatting, data interpretation.

Analysis/Diagnosis Using Root

Root is a Jurassic matlab:

- Less evolved (we must flesh out the signal processing library)
- C^{++} "Scripting" language.

But ...

- Graphical data presentation macros
- Online access to data
- All functions written for DMT are immediately usable in Root.

PSL Monitoring

Some things that a PSL monitor might do.

- Measure operating state (average output power, what else?).
- Collect noise spectra, compare to a standard.
- Correlate noise to known external signals.
- Look for known transients, error modes, etc.
- Provide a status display summarizing recent running state.

What else?