The D0 Level 3
Data Acquisition System

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For the D0 L3DAQ Group
Brown University
University of Washington
D0 Data Acquisition System

Detector Component Data

Analog L1 buffer

Digital L2 buffer

Level 1 Trigger

Level 2 Trigger

Custom hardware

Level 3 Trigger

Online Host Collector/ DLogger

Tape Storage

Commodity processor farm (full event available, offline-like algorithms)

Commodity hardware

Level 3 DAQ

250kB / event

2.5MHz

5kHz

1kHz

50Hz
L3DAQ Requirements

Total of 63 VME Readout Crates
- 1-10 vme modules / crate
- 1-20kB total/crate

1KHz 250kB/event

L3 Trigger Processor Farm
(currently 82 nodes)
Commodity-Based System

All ethernet TCP/IP

CISCO 6509 Ethernet Switch

Supervisor CPU

COOR

Farm CPU

Farm CPU

Offline Storage

Currently 82 farm nodes

Global Trigger Framework (TFW)

Routing Master CPU

Single board VME computers (SBC)

ethernet concentrator

Gb fiber

100Mb

Doug Chapin (Brown University)  DAQShifter Tutorial, 18 May 2004
Communication Flow

Features
- Backpressure through TFW interface
- Multiple simultaneous runs (D0 requirement)
- Farmnode degeneracy

Software
- Linux
- TCP/IP implemented via ACE communication and utility library
  - Open and multi-platform
  - All commodity hardware
Network Switch and Farmnodes

Network
- CISCO 6509
  - One Gb fiber module (16 ports)
  - Two 48-port 100Mb modules
- Concentrators in MCH
  - 100Mb -> Gb fiber
  - 100Mb/s ethernet in SBCs

Farmnodes
- Dual Processor
  - AMD 2000 and PIII 1GHz flavors
- Dual ethernet (100MB/s)

Note: farmnodes are located in FCH2
VME Readout Crate

Typically one to ten data cards per crate (1 to 20kB total)

- Data Card
- Data Card
- SBC
- Ethernet
- VME block transfer(s)
- SBC-initiated
- ctrl reg programming (VME)
- CPU Card
- Controller Card
- L2 Accept From TFW
- Slave Ready
- J3
- Done

Note: SBC programming is volatile! After a reboot, ctrl reg programming is needed for some crates: reinit VME (CFT, SMT, L1CAL) start_readout (MUO)
Single Board Computer

VMIC-7750
PIII 933MHz
128MB RAM

Dual
100Mb/s
ethernet
(24MB/s)

Reset
Button

Custom 9U
extender

128MB Flash Disk

Tundra Universell
PCI<->VME

PMC Digital IO Card

Custom Driver
- IO card
- J3 handshake
- VME transfers
- Event fragment buffering (12MB)
Routing Master

**Operation**
- Dedicated SBC
- Routing decision
  - Based on run configuration and L2 trigger decision
- Sent to SBCs and target nodes
- Apply backpressure to TFW when too few farmnode buffers (L3 Disable)

**Note:**
RM SBC is located in MCH1 Rack 100
**SBC Operation**

**SBC process**
- Compare head event frag with head route tag
  - send fragment if transfer number matches
  - otherwise drop fragment or route tag (automatic resync)
- Sent fragments are buffered (in TCP send window)
  - fragments dropped if no connection to farmnode

Note: mismatched transfer numbers typically indicate a problem upstream of the SBC.
**Event Builder and Filtershell**

**EVB**
- Event fragments from SBCs
- Crate list from RM
- Free buffer message to RM
- Complete Event Queue
- To Filtershells

**Filtershell** *(Scriptrunner)*
- Two processes per node
- Each processes one event at a time

Note: if events are dropped due to missing fragments, farmnode will be red in fûMon. Associated missing crates will be red in üMon.
Monitoring

**Clients**
- SBCs
- Farm nodes
- TCC1
- TCC2
- Util Clients

**Monitor Server**
- Pulls from clients
- Responds to display queries
- All data cached

**Displays**
- üMon
- füMon
- Offline Relay
- L2 GUI
- ...daqdialog and others

Monitoring Server...
Mon Details

Farmnode Connections

Route Queue Depth

Event Queue Depth

VME event rate

Connection issues. Depending on number of bad connection, restart/reboot SBC or restart farmnode processes.

Yellow block at top of strip chart: No monitor information available.

Note: Full route queue AND empty event queue is typically a component readout problem.
**fűMon Details**

- **Advertised Buffers**
- **Filtershell States**
- **EVB Input Rate**
- **Filtershell Pass Fraction**
- **In Progress**
- **Complete**
- **Send**
- **Flatten**

**Missing fragment(s)**

**WAIT**

**Stuck Sending to Collector**
- Collector problem?
- Event size too big?
- Output rate too high?
SBC Hammers

Small hammer
• restart SBC processes
  • via SBC manager
  • or command line: l3xdaq_reset x52

Medium hammer
• soft reboot of SBC
  • via SBC manager
  • or command line: l3xdaq_reboot x52

Big hammer
• hard reboot
  • press RST button on SBC

Note: the RM is also an SBC. Reset it with “l3xdaq_reset RM” or “l3xdaq_reset d0sbc001b”
<table>
<thead>
<tr>
<th>RM (d0sbc001b)</th>
<th>L1</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x10 (d0sbc018b)</td>
<td>0x11 (d0sbc072b)</td>
</tr>
<tr>
<td>0x14 (d0sbc077b)</td>
<td>0x16 (d0sbc039b)</td>
</tr>
<tr>
<td>0x19 (d0sbc074b)</td>
<td>0x1f (d0sbc008b)</td>
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<table>
<thead>
<tr>
<th>L2</th>
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<tbody>
<tr>
<td>0x20 (d0sbc033b)</td>
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<tr>
<td>0x24 (d0sbc078b)</td>
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<table>
<thead>
<tr>
<th>MUO</th>
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<tbody>
<tr>
<td>0x30 (d0sbc040b)</td>
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<tr>
<td>0x34 (d0sbc012b)</td>
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<td>0x38 (d0sbc045b)</td>
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<tr>
<td>0x40 (d0sbc070b)</td>
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<tr>
<td>0x44 (d0sbc030b)</td>
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<tr>
<td>0x48 (d0sbc067b)</td>
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<tr>
<td>0x4c (d0sbc013b)</td>
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<table>
<thead>
<tr>
<th>CFT</th>
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<td>0x50 (d0sbc006b)</td>
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**Actions:**
- Reboot!
- Stop Processes
- Restart Processes
Farmnode Hammers

Small hammer
- Restart farmnode processes
  - via Node Manager
  - or command line: l3xreset 04

Medium hammer
- Stop farmnode processes
  - via Node Manager
  - or command line: l3xstop 04

Big hammer
- Power off farmnode (in FCH2)
  - use power button on front of node
  - unplug the power cord if needed

Note: the Supervisor can get confused by a misbehaving farmnode. After the farmnode has been taken down, a PAUSE/RESUME of the run may be needed for the Supervisor to realize that the farmnode is gone.
<table>
<thead>
<tr>
<th>Linux Network Nodes</th>
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<tbody>
<tr>
<td>001 (d0lx001)</td>
<td>002 (d0lx002)</td>
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<td>005 (d0lx005)</td>
<td>006 (d0lx006)</td>
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<td>045 (d0lx045)</td>
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### ACTION
- **Stop**
- **Restart**
Other Hammers

**Supervisor**
- Restart supervisor process (runs on d0lxmast)
  - command line: start_daq l3supervisor

**Monitor Server**
- Restart monitor server process
  - command line: start_daq l3ms

**Monitor Server Utils**
- Support programs for L2 GUI, daqdiallog, and daqAI
  - command line: start_daq l3ms_util_clients

Note: problems with Monitor Server Utils historically follow an L2 software upgrade
Resources

L3DAQ webpage
- üMon and füMon documentation
- What-to-do-When
  - common problems and solutions
- Node and SBC manager pages
- SBC and Supervisor Logfiles
- On-call list

http://www-d0ol/www/groups/l3daq/

L3DAQ Experts
- Doug Chapin, Gordon Watts,
  Aran Garcia-Bellido, Thomas Gadfort
- Phone us!
  - even with general üMon or füMon questions
Template

• Text