# L3DAQ

An Introduction

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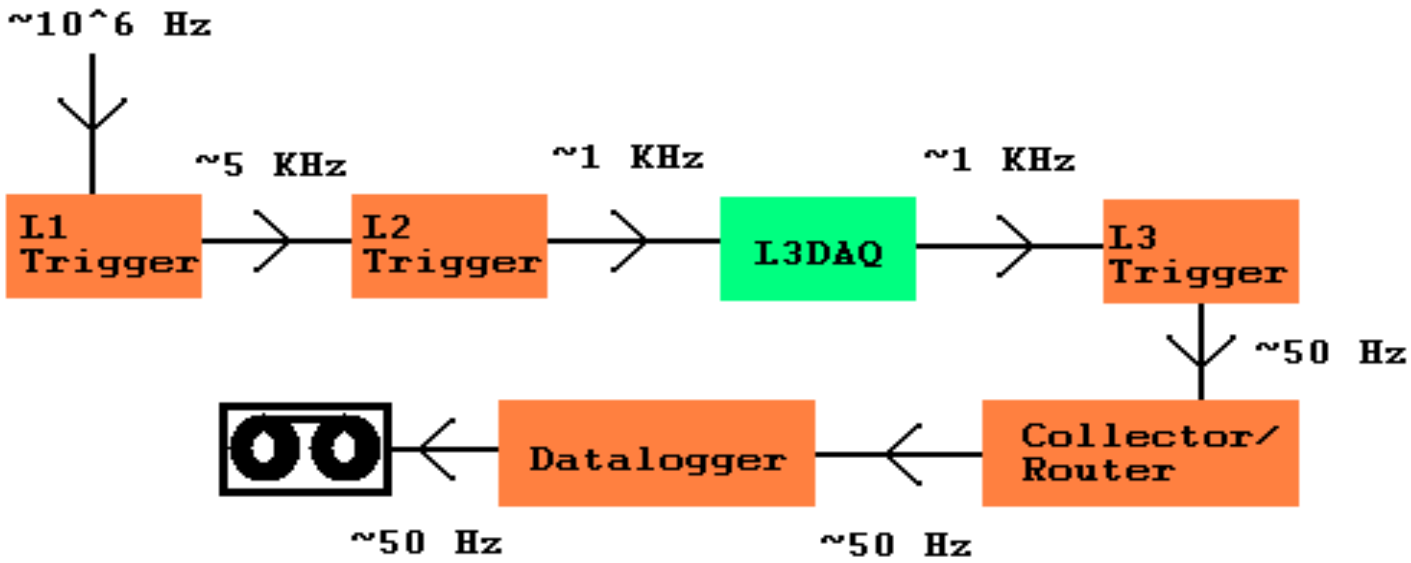
# A Quick Glance

- The DZero DAQ
- L3DAQ components
- L3DAQ communication
- An in depth look at monitoring

# Dzero DAQ




- 63 readout crates in DAQ
- 0-20 kb/crate/event
- Maximum events size ~250kb

# The Players…. L3DAQ Components

**L3 is comprised of both hardware and software components**

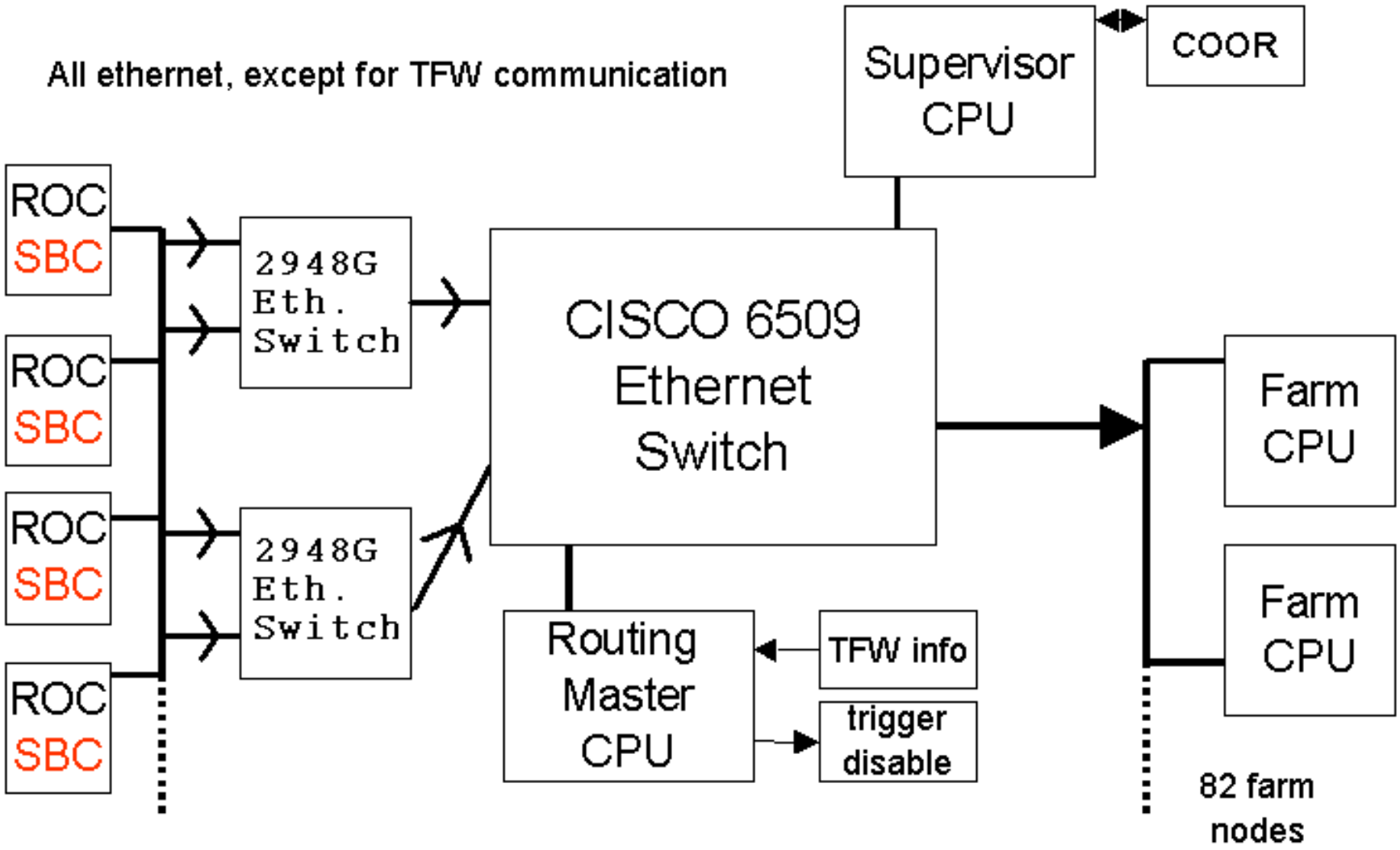
**Hardware**

- SBC
- 2948G Ethernet Switches
- 6509 Ethernet Switch
- Farm Nodes

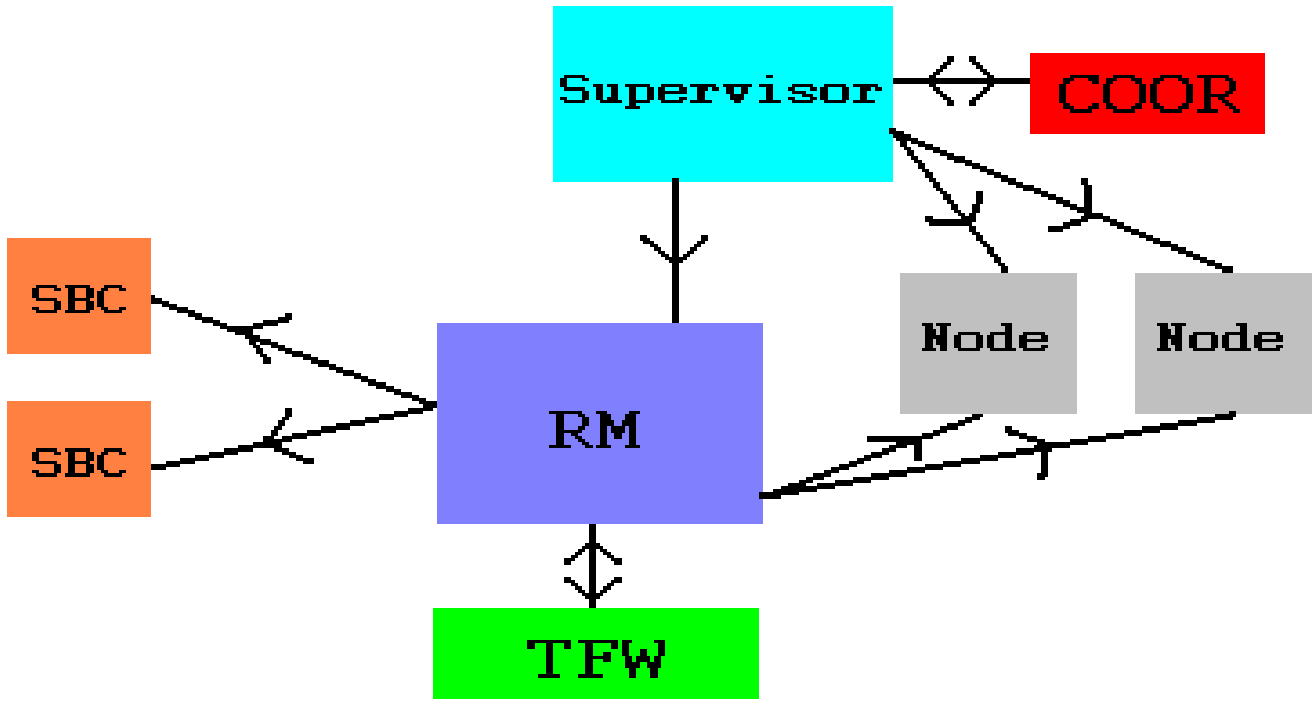
**Software**

- Routing Master
- Supervisor
- Node Processes
- SBC Processes
- Monitoring

# L3DAQ - Overview



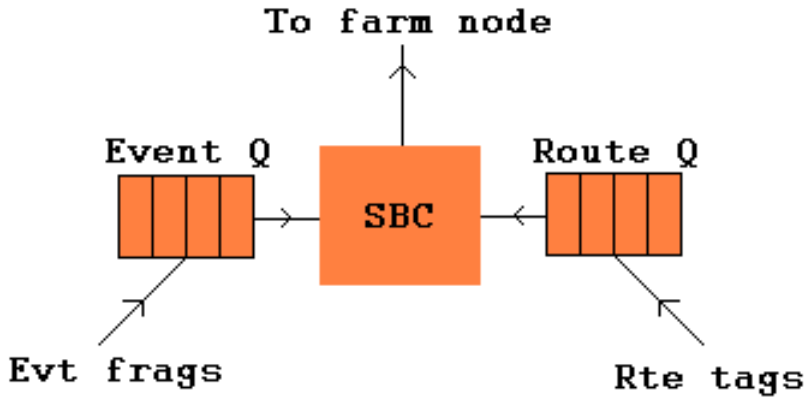
# L3DAQ – Communication Flow



# SBC – Single Board Computer

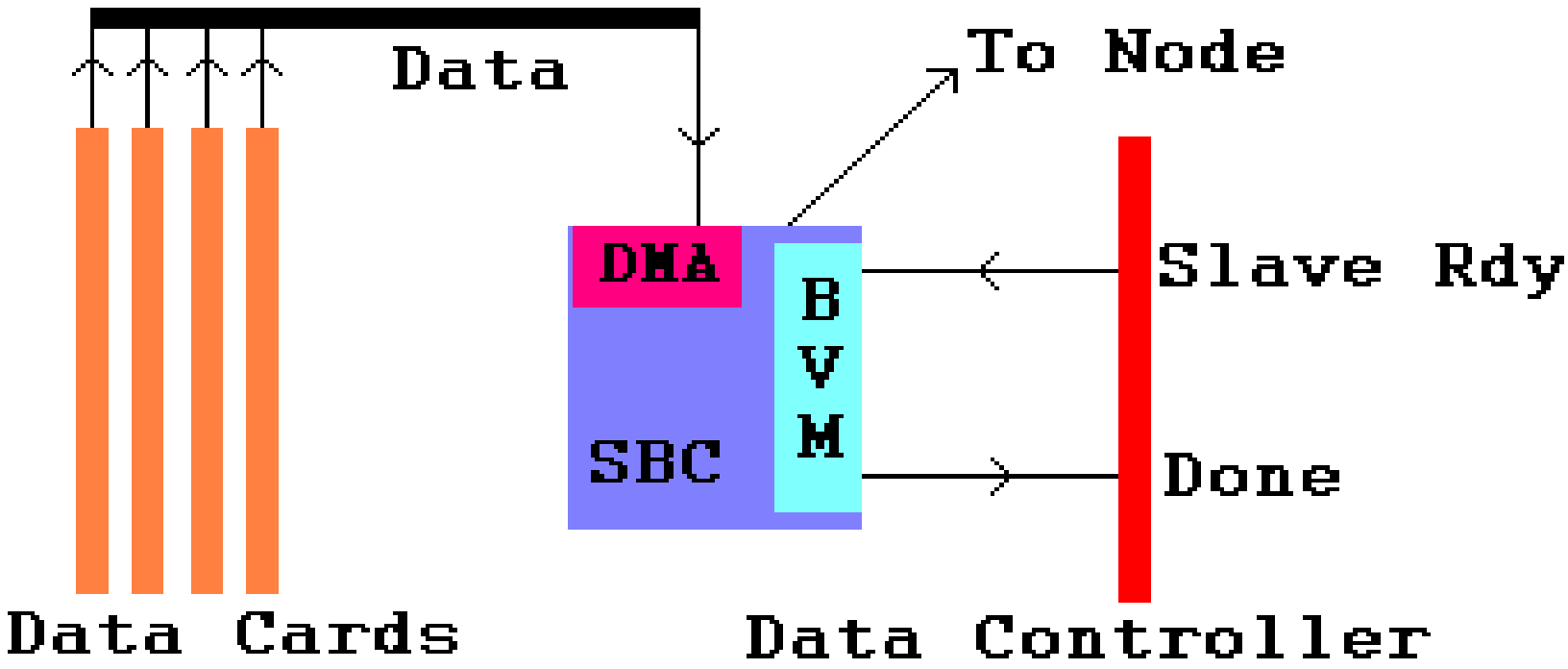
- 2 main functions
  - Readout controller for event data (many instances)
  - Routing master (1 instance)
- PIII 933Mhz, 128Mb RAM, 128Mb flash, 2 100 Mb/s Ethernet ports
- Tundra Universe II chip as VME-PCI interface
  - Programmable DMA controller
- PMC expansion slot
  - Holds BVM DIO module responsible for VME readout over J3 backplane

# SBC – Logic & Operation




- Event fragment thrown out after 1s if still waiting for route tag
- Route tags thrown out after several seconds if no event fragment
- If evt# in event fragment > evt# in route tag, throw out route tag
- If evt# in event fragment < evt# in route tag, throw out fragment

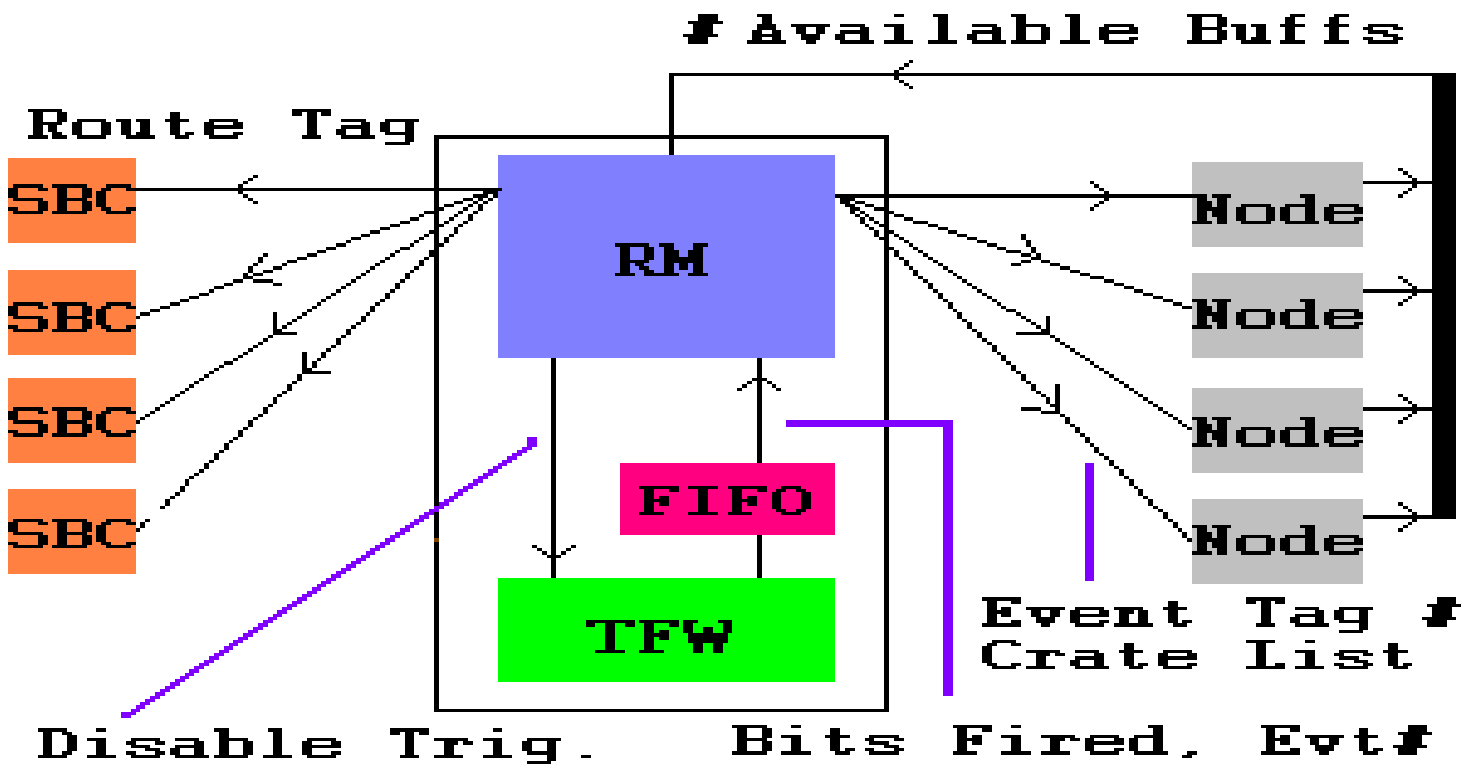
# SBC – How a Crate Reads Out



# SBC – Routing Master Basics

- Receives crate list per bit and list of farm nodes from Supervisor
- Receives bits fired, event number from TFW
- Chooses which nodes to send event for filtering
- Sends routing info to SBCs based on event #
- Sends crate info to nodes based on event#
- Receives number of available buffers from nodes
- If number of available buffers in the farm becomes to low, RM can disable triggers allowing farm can catch up

# SBC – Routing Master Comm. Flow



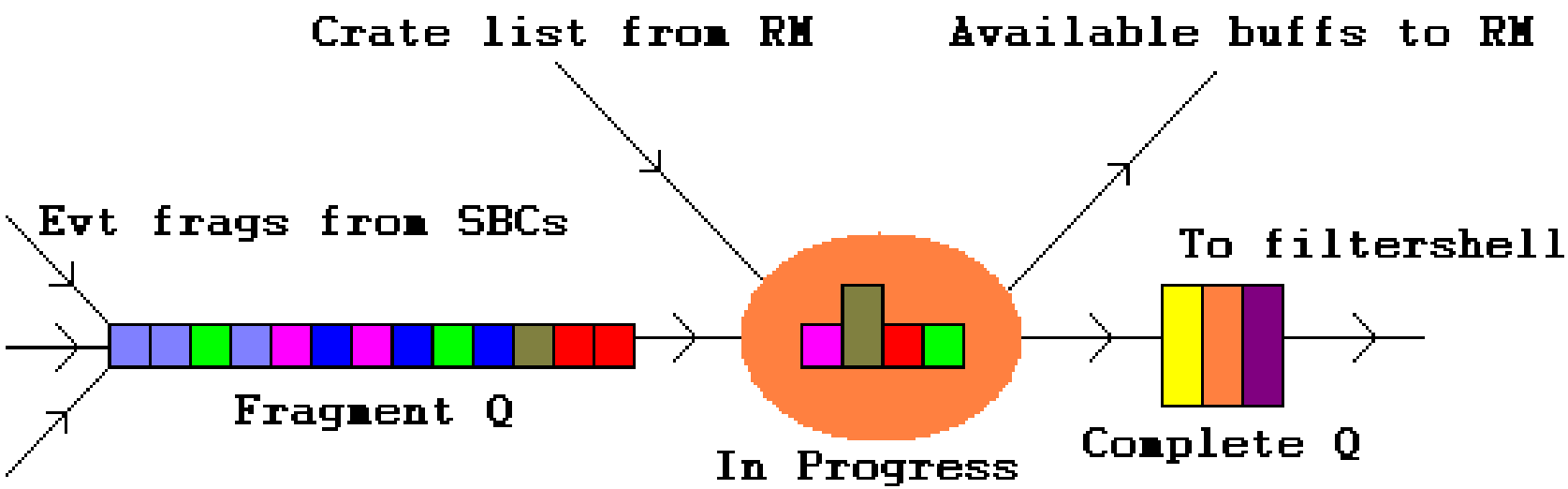
# Ethernet Switches

- 2984G switch
  - Concentrates signal from up to 10 100Mb/s connections to 1Gb/s optical line
  - Limits number of 100Mb/s connections to prevent network congestion
- 6509 switch
  - Receives the Gigabit links and connects to the L3 nodes

# L3 Farm Nodes

- 48 Dual PIII 1GHz, 1GB RAM
- 34 Dual AMD Athlon 2GHz, 1GB RAM
- Dual Ethernet ports
  - One dedicated to online system
  - One dedicated to L3DAQ
- Runs several processes
  - Event builder (EVB)
  - Filtershell process (actually 2 running instances)

# Node – Event Builder

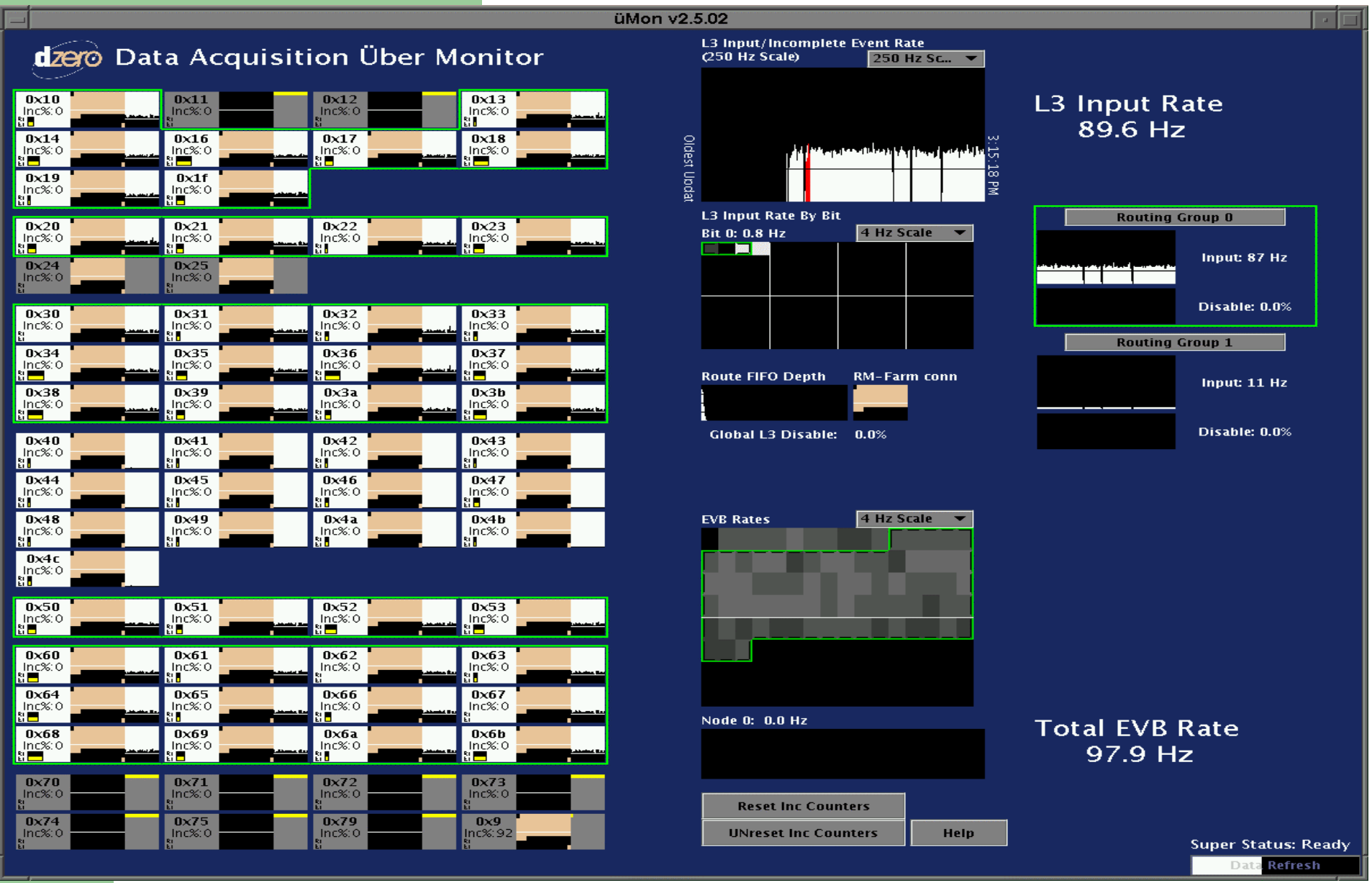



- Always connected to all SBCs (including RM)
- In-progress has a 1s timeout, resulting in incomplete event
- Max of 3 buffers advertised to RM to limit data flow into 6509

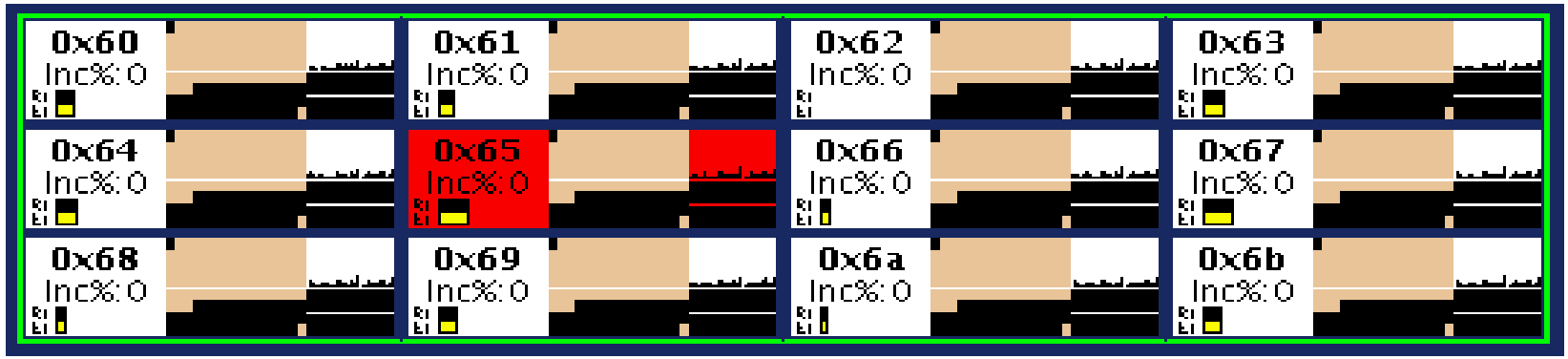
# Supervisor

- Primary function is L3 interface to COOR
- Communicates with ScriptRunner and RM
  - No communication with SBCs or EVB
- Sends RM crate list per bit and node info
  - RM complains if nodes/SBCs not connected
- Sends trigger programming to ScriptRunner when a trigger download is performed

# uMon


üMon v2.5.02
dzero Data Acquisition Über Monitor
0x10 Inc%: 0
0x11 Inc%: 0
0x12 Inc%: 0
0x13 Inc%: 0
0x14 Inc%: 0
0x16 Inc%: 0
0x17 Inc%: 0
0x18 Inc%: 0
0x19 Inc%: 0
0x1f Inc%: 0
0x20 Inc%: 0
0x21 Inc%: 0
0x22 Inc%: 0
0x23 Inc%: 0
0x24 Inc%: 0
0x25 Inc%: 0
0x30 Inc%: 0
0x31 Inc%: 0
0x32 Inc%: 0
0x33 Inc%: 0
0x34 Inc%: 0
0x35 Inc%: 0
0x36 Inc%: 0
0x37 Inc%: 0
0x38 Inc%: 0
0x39 Inc%: 0
0x3a Inc%: 0
0x3b Inc%: 0
0x40 Inc%: 0
0x41 Inc%: 0
0x42 Inc%: 0
0x43 Inc%: 0
0x44 Inc%: 0
0x45 Inc%: 0
0x46 Inc%: 0
0x47 Inc%: 0
0x48 Inc%: 0
0x49 Inc%: 0
0x4a Inc%: 0
0x4b Inc%: 0
0x4c Inc%: 0
0x50 Inc%: 0
0x51 Inc%: 0
0x52 Inc%: 0
0x53 Inc%: 0
0x60 Inc%: 0
0x61 Inc%: 0
0x62 Inc%: 0
0x63 Inc%: 0
0x64 Inc%: 0
0x65 Inc%: 0
0x66 Inc%: 0
0x67 Inc%: 0
0x68 Inc%: 0
0x69 Inc%: 0
0x6a Inc%: 0
0x6b Inc%: 0
0x70 Inc%: 0
0x71 Inc%: 0
0x72 Inc%: 0
0x73 Inc%: 0
0x74 Inc%: 0
0x75 Inc%: 0
0x79 Inc%: 0
0x9 Inc%: 92
L3 Input/Incomplete Event Rate
(250 Hz Scale)
250 Hz Sc...
Oldest Update
3:15:18 PM
L3 Input Rate
89.6 Hz
L3 Input Rate By Bit
Bit 0: 0.8 Hz
4 Hz Scale
Routing Group 0
Input: 87 Hz
Disable: 0.0%
Routing Group 1
Input: 11 Hz
Disable: 0.0%
Route FIFO Depth
RM-Farm conn
Global L3 Disable: 0.0%
EVB Rates
4 Hz Scale
Node 0: 0.0 Hz
Total EVB Rate
97.9 Hz
Reset Inc Counters
UNreset Inc Counters
Help
Super Status: Ready
Data Refresh

# uMon – Front End Crates

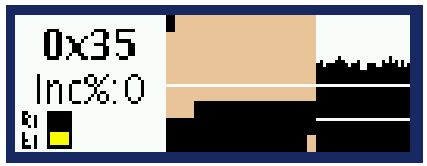



- uMon monitors from the Routing Masters perspective!
- When crate color is….
  - Red: At least one event fragment from the crate did not reach the farm. Included in a run.
  - Yellow: Monitoring information is not available for the crate. Included in a run.
  - White: Included in a run and experiencing no problems .
  - Grey: Crate not included in a run.

# uMon – Front End Crates, Part 2

•"Inc%: XX" monitors the percentage of events from a crate that have been missing.

- •This is a running total. Hitting the "Reset Inc Counters" button will reset this total to zero. To go back to the running total simply hit the "Unreset Inc Counters"

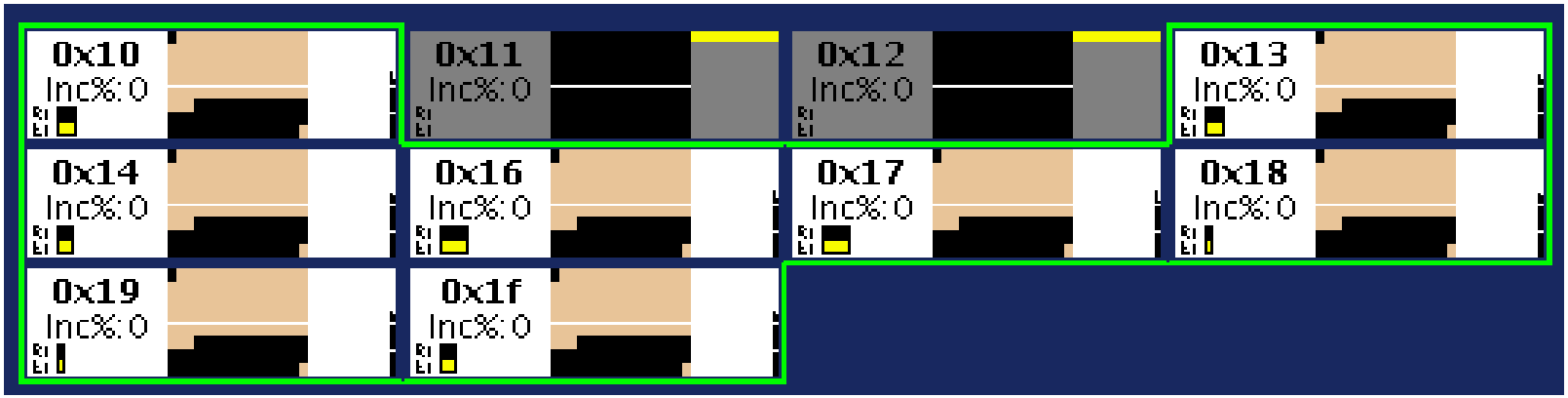




•Live SBC connections to the farm nodes are shown as beige boxes, otherwise black. The uppermost left box is node 0 (which does not exist and is therefore always black), next is node 1 and so forth. The lowermost right box is the SBCs connection to the Routing Master (beige connected, black not).

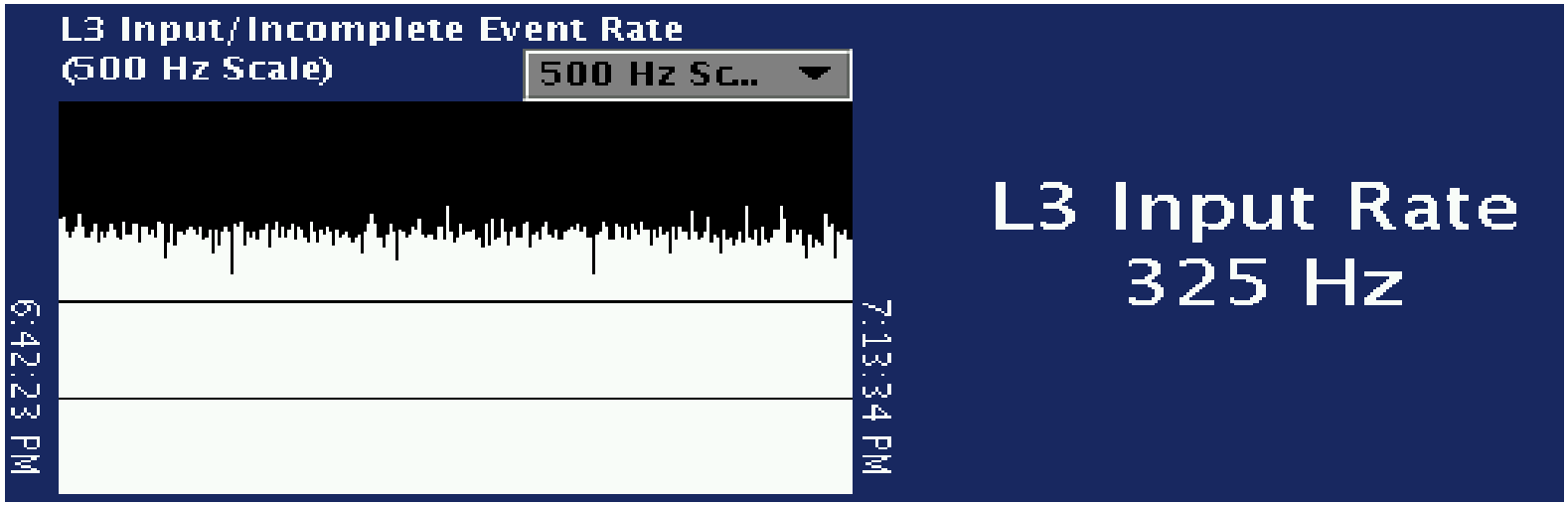
•The strip chart is the rate which the SBC is reading from crate electronics.

# uMon – Front End Crates, Part 3



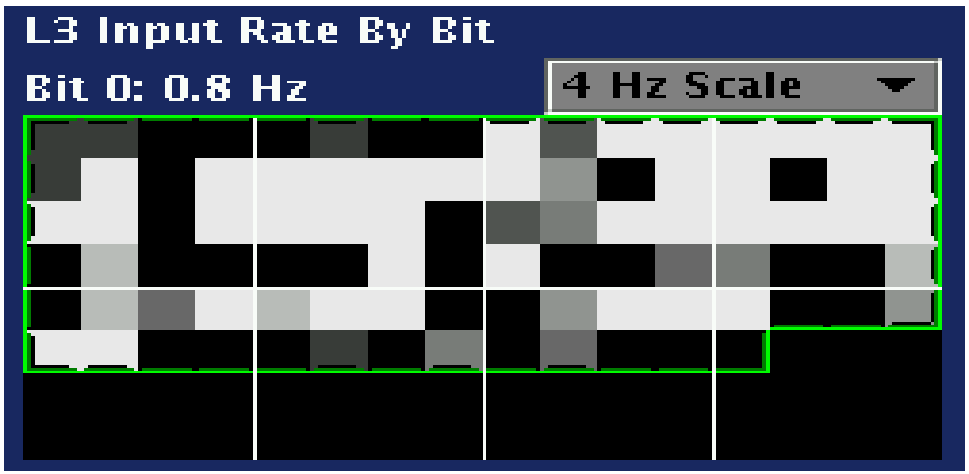

- Yellow block on the strip chart indicates no monitoring info from SBC
- Route Q bar chart:
  - Fractional use of route Q
- Event Q bar chart:
  - Fractional use of event Q
- Both charts utilize yellow on black background
- Route Q should be nearly empty and event Q should be < 2/3

# uMon – L3 Input/Inc. Event Rate



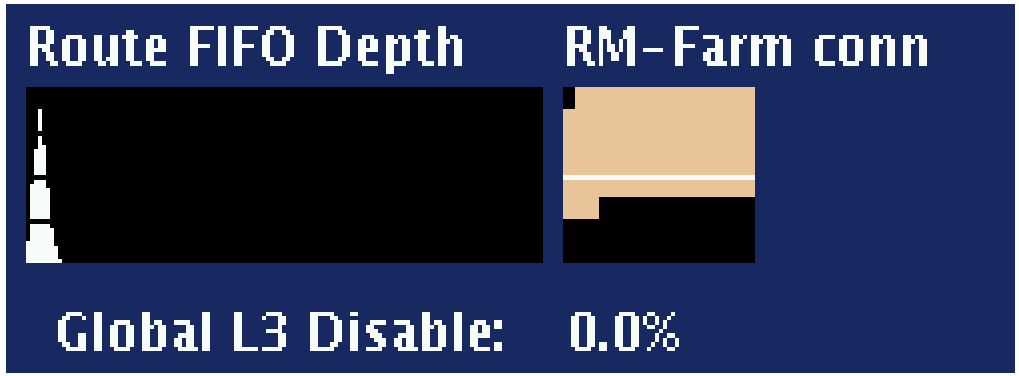

- Strip chart shows the rate at which the RM is receiving/sending event tags
- The "L3 Input Rate" is just the instantaneous rate
- Pull down list allows the vertical scale of the chart to be changed
- A yellow bar at the top of the strip chart indicates that there is not monitoring information available.

# uMon – L3 Input Rate By Bit



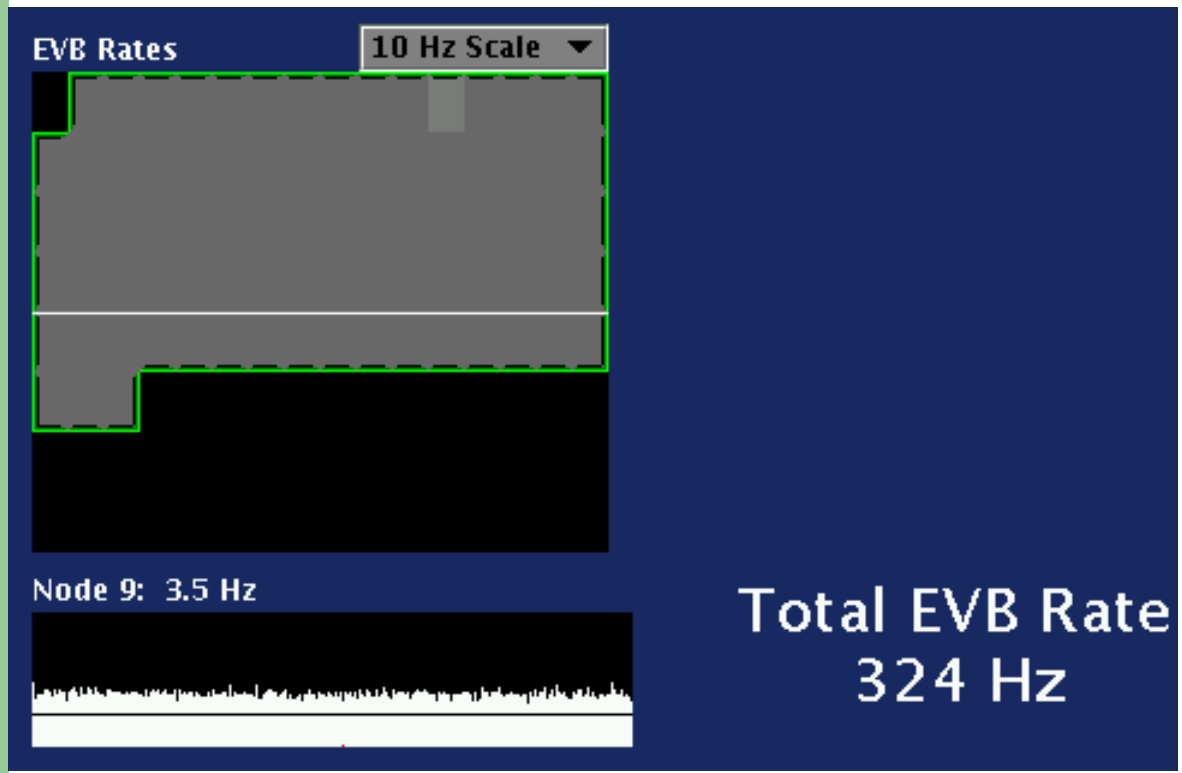

- Blocks, going from left to right, correspond to L1/L2 trigger bits 0 to 127
- The grayscale of each block represents the rate of the particular trigger with black being 0 Hz and white maximum rate.
- Clicking on a block will display the corresponding bit and its current rate
- Scale may be selected from drop down menu

# uMon – Route Fifo Depth




- "Global L3 Disable" gives the fraction of time since the last update that the Routing Master has disabled triggers.
- "Route FIFO Depth" histogram shows the number of events in the TFW FIFO as determined by polls from RM conducted every 10ms.
- "RM-Farm conn" shows the RM connections to the farm nodes.

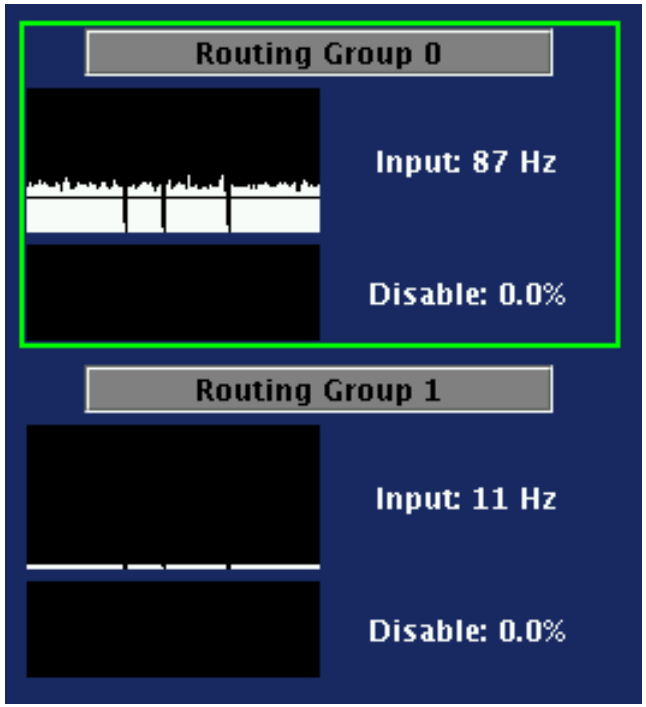
# uMon – EVB Rates




- "EVB Rates" shows the EVB input rate into each individual node. Missing event rate as fraction of the total for a node will show as a red bar chart on top of the bin.
- "Node" strip chart shows the EVB rate of the chosen node over a period of ~20 minutes

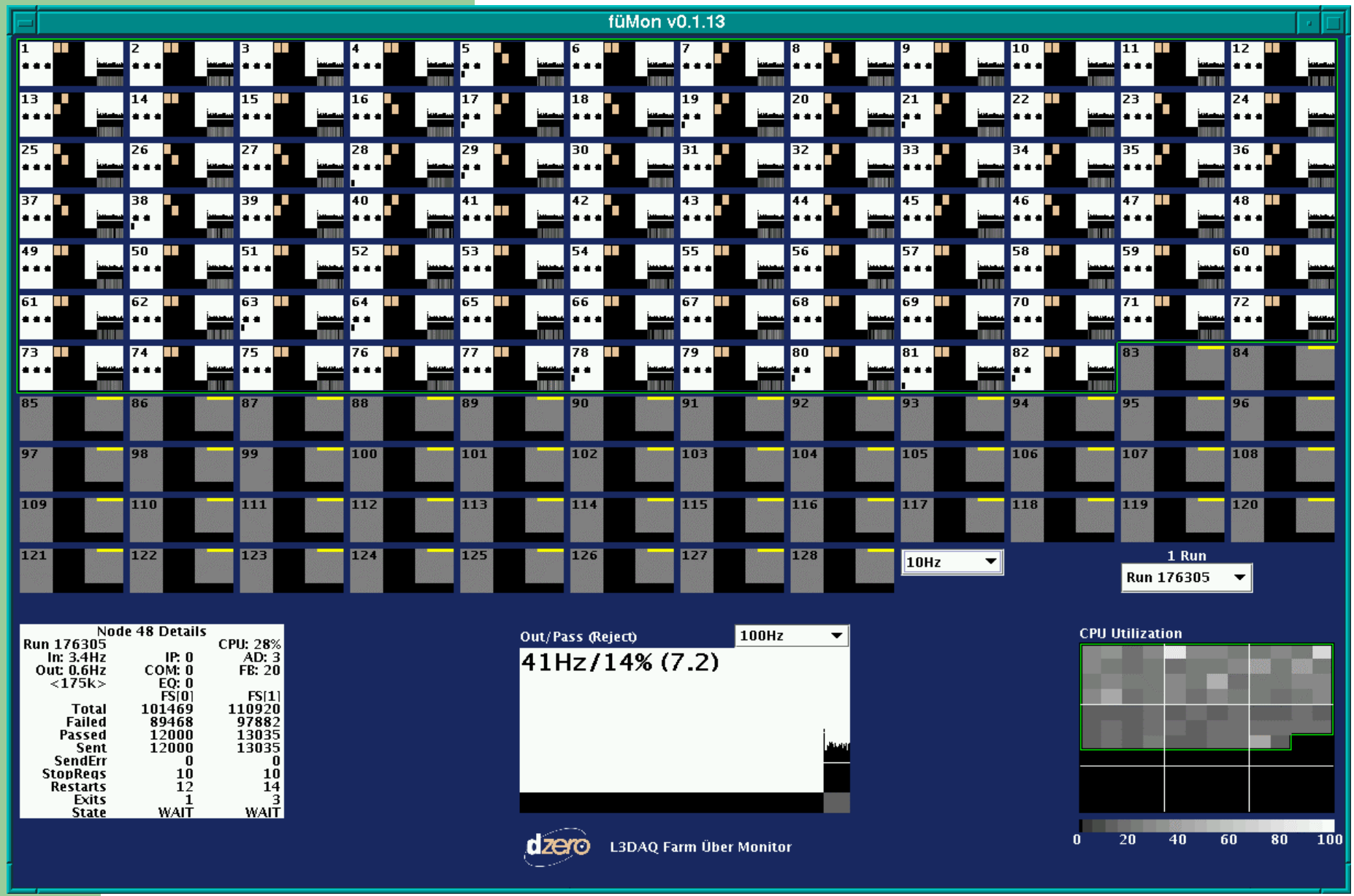
- "Total EVB Rate" shows the input rate into all EVB processes on L3 farm.

# uMon – Routing Groups

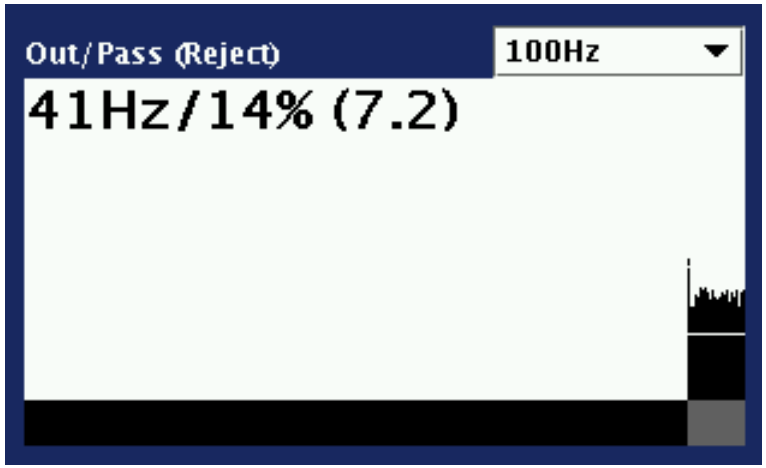



- Selecting a routing group will highlight all crates associated with that group.
- Input is given for each group
- Disable fraction is given for each group

# fuMon

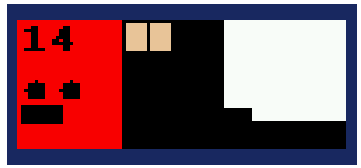

füMon v0.1.13
1 2 3 4 5 6 7 8 9 10 11 12
13 14 15 16 17 18 19 20 21 22 23 24
25 26 27 28 29 30 31 32 33 34 35 36
37 38 39 40 41 42 43 44 45 46 47 48
49 50 51 52 53 54 55 56 57 58 59 60
61 62 63 64 65 66 67 68 69 70 71 72
73 74 75 76 77 78 79 80 81 82 83 84
85 86 87 88 89 90 91 92 93 94 95 96
97 98 99 100 101 102 103 104 105 106 107 108
109 110 111 112 113 114 115 116 117 118 119 120
121 122 123 124 125 126 127 128
10Hz
1 Run
Run 176305
Node 48 Details
Run 176305 CPU: 28%
In: 3.4Hz IP: 0 AD: 3
Out: 0.6Hz COM: 0 FB: 20
<175k> EQ: 0
FS[0] FS[1]
Total 101469 110920
Failed 89468 97882
Passed 12000 13035
Sent 12000 13035
SendErr 0 0
StopReqs 10 10
Restarts 12 14
Exits 1 3
State WAIT WAIT
Out/Pass (Reject)
100Hz
41Hz/14% (7.2)
CPU Utilization
0 20 40 60 80 100
dzero
L3DAQ Farm Über Monitor

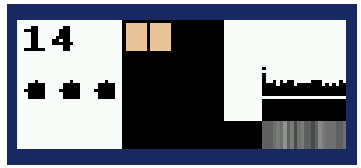
# fuMon – Output/Pass Rate

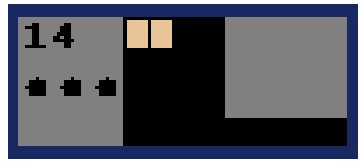



- fuMon monitors from the nodes perspective!
- Main strip chart shows total output rate of the farm
- Smaller chart shows pass fraction as grayscale bars
- Scale may be changed by drop down menu
- Reject is the ratio of input_events/sent_events over entire farm

# fuMon - Nodes



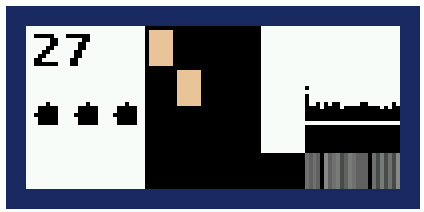





- When the color is…
  - Orange: 10 or more complete EVB buffers waiting for processing by FS
  - Red:  One or more events were incomplete and dropped by EVB
  - White: In a run and experiencing no problems
  - Grey: Not in a run.

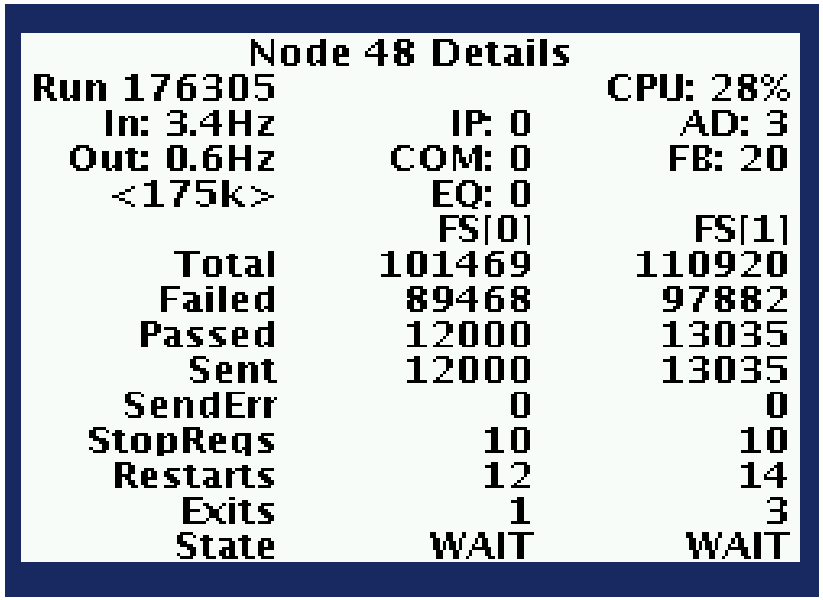
- Three black dots represent # of advertised free buffers to RM
- First bar chart represents in process EVB buffers
- Second bar chart represents complete EVB buffers

# fuMon – Nodes, Part 2



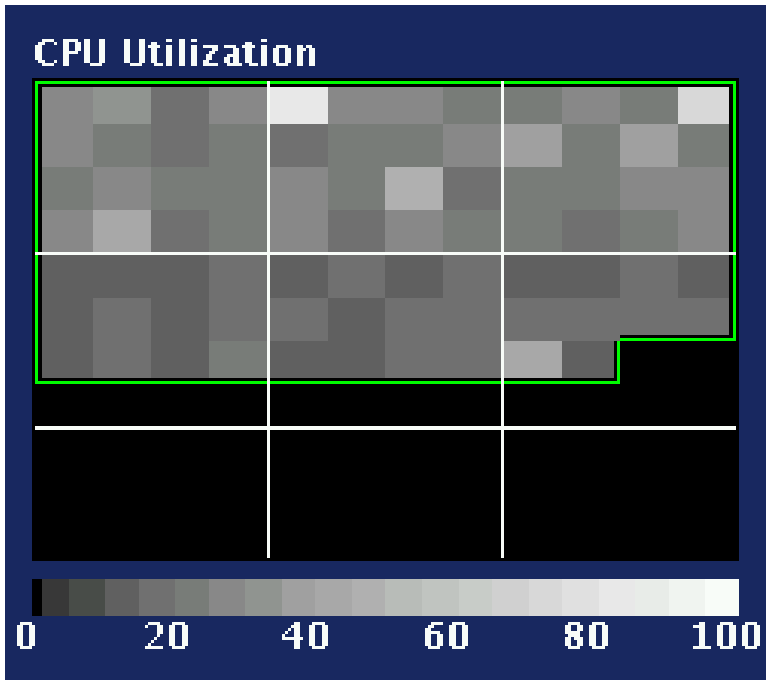

- 2 beige boxes in the middle represent the state of the two filtershell processes running on the node.
  - 1st (highest) position: WAIT
  - 2nd position: FILTER
  - 3rd position: FLATTEN
  - 4th position: SEND
- Top strip chart shows the event rate into the filtershell processes
- Bottom strip chart shows the pass fraction for the filtershell processes
- A yellow bar on the top of the strip chart indicates there is no monitoring info

# fuMon – Node Details




- Clicking on a particular node will give you detailed instantaneous information about that node.

# fuMon – Node CPU Usage




- "CPU Utilization" shows what fraction of the nodes total processing power is being consumed.

# DAQ Dialog


DAQ_Dialog
13
100
xv controls
DAQ_Dialog
DAQ is Good
No crates are >10% FEB at this time :)

# Typical Problems

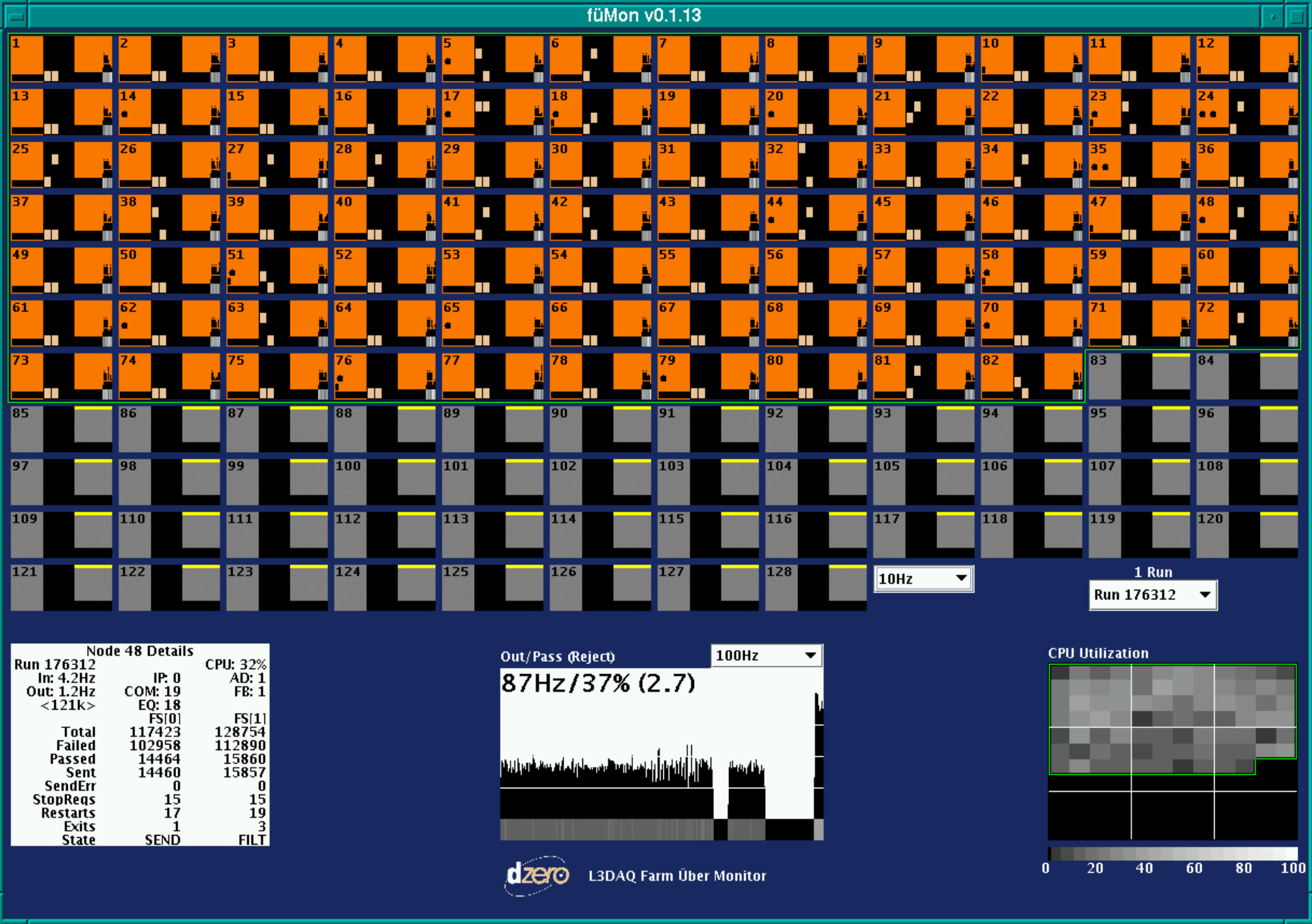
- Not enough nodes in run
  - Symptom: L3 disables, nodes in FILTERING
  - SMT/CFT/CAL in full-readout mode?
- Collector Router backed up
  - Farmnodes orange (SENDING) in fuMon
  - L3 output rate too high or event size too large
  - Farmnodes wont respond to Super when SENDING
    - Supervisor appears hung
    - Must PAUSE and wait OR restart farmnodes and Super
- Crate 100% missing
  - Almost always a component problem
  - Check Route and Event queue state in uMon

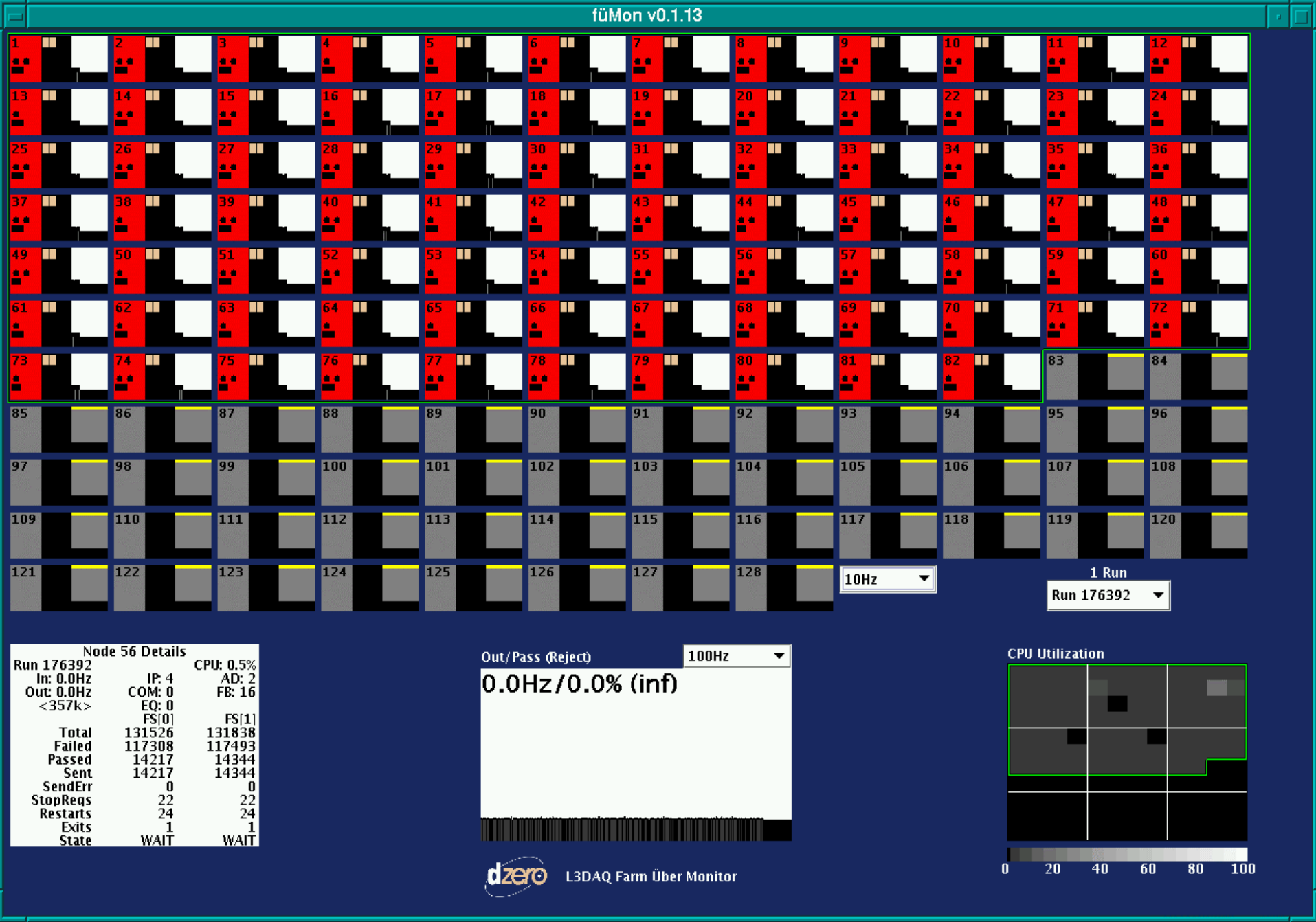
# Some Useful Scripts

- Supervisor
  - start_daq l3supervisor
- Nodes
  - l3xreset  <node>, or l3xreset to reset entire farm
- Monitor server
  - l3xdaq_monitor_server
- SBC
  - l3xdaq_reset <sbc>
- SBC scripts
  - is_crate_requesting_readout.sh (SlaveReady asserted?)
  - getInfo.sh  (sbc driver stats and status)
  - sbc_config_rdwr (VME targets and modes)
  - reset_all.sh (restarts processes)

# Website

- http://www-d0online.fnal.gov/www/groups/l3daq/default.html
  - Documentation for all monitoring packages
  - This and previous Level 3 talks and papers
  - “What to do when” page for troubleshooting L3 problems
  - Log files for the SBCs, Supervisor, Monitor Server, & daqAI
  - On call expert list


füMon v0.1.13
1 2 3 4 5 6 7 8 9 10 11 12
13 14 15 16 17 18 19 20 21 22 23 24
25 26 27 28 29 30 31 32 33 34 35 36
37 38 39 40 41 42 43 44 45 46 47 48
49 50 51 52 53 54 55 56 57 58 59 60
61 62 63 64 65 66 67 68 69 70 71 72
73 74 75 76 77 78 79 80 81 82 83 84
85 86 87 88 89 90 91 92 93 94 95 96
97 98 99 100 101 102 103 104 105 106 107 108
109 110 111 112 113 114 115 116 117 118 119 120
121 122 123 124 125 126 127 128
10Hz
1 Run
Run 176312
Node 48 Details
Run 176312 CPU: 32%
In: 4.2Hz IP: 0 AD: 1
Out: 1.2Hz COM: 19 FB: 1
<121k> EQ: 18
FS[0] FS[1]
Total 117423 128754
Failed 102958 112890
Passed 14464 15860
Sent 14460 15857
SendErr 0 0
StopReqs 15 15
Restarts 17 19
Exits 1 3
State SEND FILT
Out/Pass (Reject)
100Hz
87Hz/37% (2.7)
CPU Utilization
0 20 40 60 80 100
dzero
L3DAQ Farm Über Monitor


füMon v0.1.13
1 2 3 4 5 6 7 8 9 10 11 12
13 14 15 16 17 18 19 20 21 22 23 24
25 26 27 28 29 30 31 32 33 34 35 36
37 38 39 40 41 42 43 44 45 46 47 48
49 50 51 52 53 54 55 56 57 58 59 60
61 62 63 64 65 66 67 68 69 70 71 72
73 74 75 76 77 78 79 80 81 82 83 84
85 86 87 88 89 90 91 92 93 94 95 96
97 98 99 100 101 102 103 104 105 106 107 108
109 110 111 112 113 114 115 116 117 118 119 120
121 122 123 124 125 126 127 128
10Hz
1 Run
Run 176392
Node 56 Details
Run 176392 CPU: 0.5%
In: 0.0Hz IP: 4 AD: 2
Out: 0.0Hz COM: 0 FB: 16
<357k> EQ: 0
FS[0] FS[1]
Total 131526 131838
Failed 117308 117493
Passed 14217 14344
Sent 14217 14344
SendErr 0 0
StopReqs 22 22
Restarts 24 24
Exits 1 1
State WAIT WAIT
Out/Pass (Reject)
100Hz
0.0Hz/0.0% (inf)
dzero
L3DAQ Farm Über Monitor
CPU Utilization
0 20 40 60 80 100

# Missing Node Info