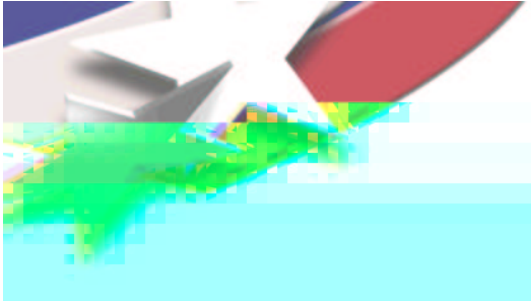# A Visualization Tool for Analyzing Cluster Performance Data

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Sandia National Laboratories[*]

Motivation

Support for

- Problem Analysis
  - hardware
  - software
  - operational
- Configuration Analysis
- Resource Utilization

in a large cluster environment

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Visualization Support for Data Discovery

- Organize and manage display of data

- Display data in the context of cluster architecture

- Provide flexible data input

Organization and Management of Data Display

- Provide larger context through use of
  - color instead of text
  - 3-D

- Display related data together
  - functionally related
    - processor
    - network
    - job related
  - spatially related

Organization and Management of Data Display (cont.)

- User interaction capabilities
  - rotate, zoom, translate
  - animation
  - turn display objects on/off
  - set thresholds
  - select objects
  - display routes

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Displaying Data in Context of Cluster Architecture

- Use of cluster interconnect model to determine display layout

- Tie performance data to display objects

- Use of routing information to display paths between nodes
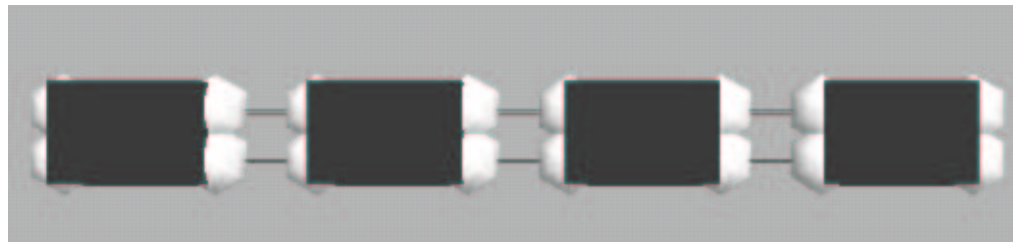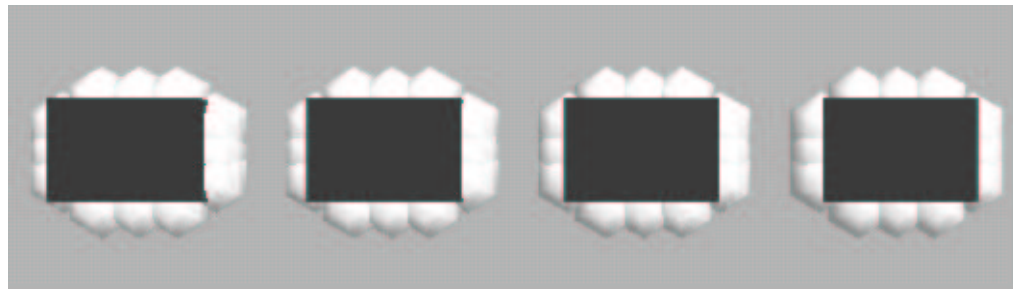
Visualization Tool Model

- Basic unit is a switch containing 16 ports

- Defines the number of switches in the x, y, and z dimensions

- Defines port configurations for switches
  - port order
  - processor vs network
  - network connectivity
  - node order
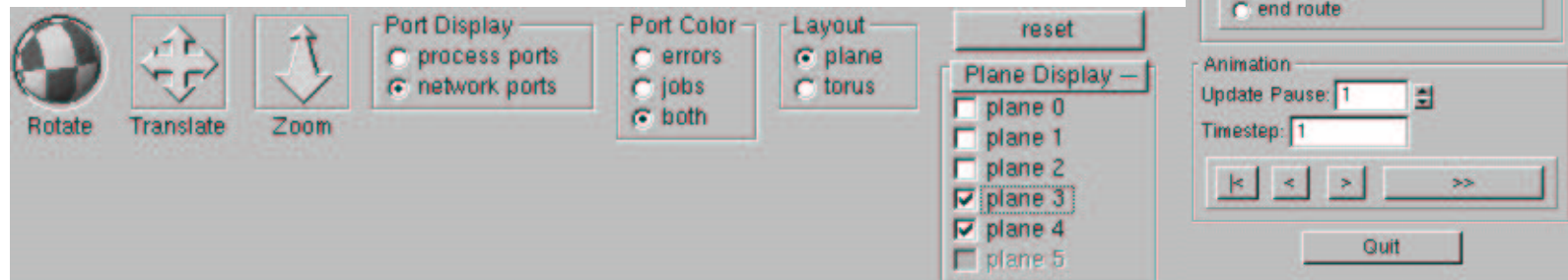
- Defines switch and port labels
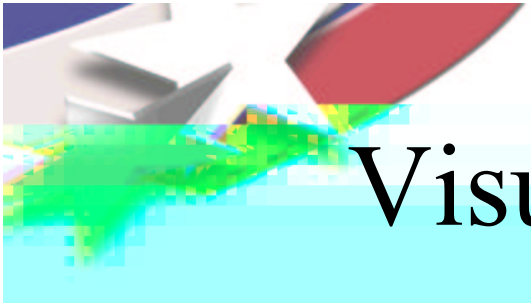
Visualization Tool Switch Display

- Is composed of 3-D cubes with port objects distributed on the six faces

- Divided into processor and

- network displays

Visualization Tool GUI

- Developed using GLUI
  (http://www.cs.unc.edu/~rademach/glui)
  library of graphics primatives
- provides selection, animation, and view
  control

Flexible Data Input

- Integer values tagged with port identifier

- Timesteps

```
plane-0.sw-1.V7.Port-0.SU-58        162       162       105
plane-0.sw-1.V7.Port-7.SU-58        174       174       113
plane-0.sw-1.T0.Port-7.SU-48     250817    239923    147194
plane-0.sw-1.T0.Port-8.SU-48        174       174       113
lane-0.sw-1.T0.Port-11.SU-48      14473      3096      2388
plane-0.sw-1.T0.Port-12.SU-48    104873     98134     61598
plane-0.sw-1.T0.Port-13.SU-48      1092       792       612
plane-0.sw-1.T0.Port-14.SU-48      1276       828       720
plane-0.sw-1.T1.Port-0.SU-48        348       348       226
plane-0.sw-1.T1.Port-7.SU-48        162       162       105
```

- Separate job data

Display Ports Colored to Show Performance Data

- Based on minimum and maximum threshold values

- Default color for values below minimum is black

- Default color for values above maximum is yellow

- Values between minimum and maximum ramp from blue to purple to red

- Job data are colored randomly using a Hilbert curve algorithm
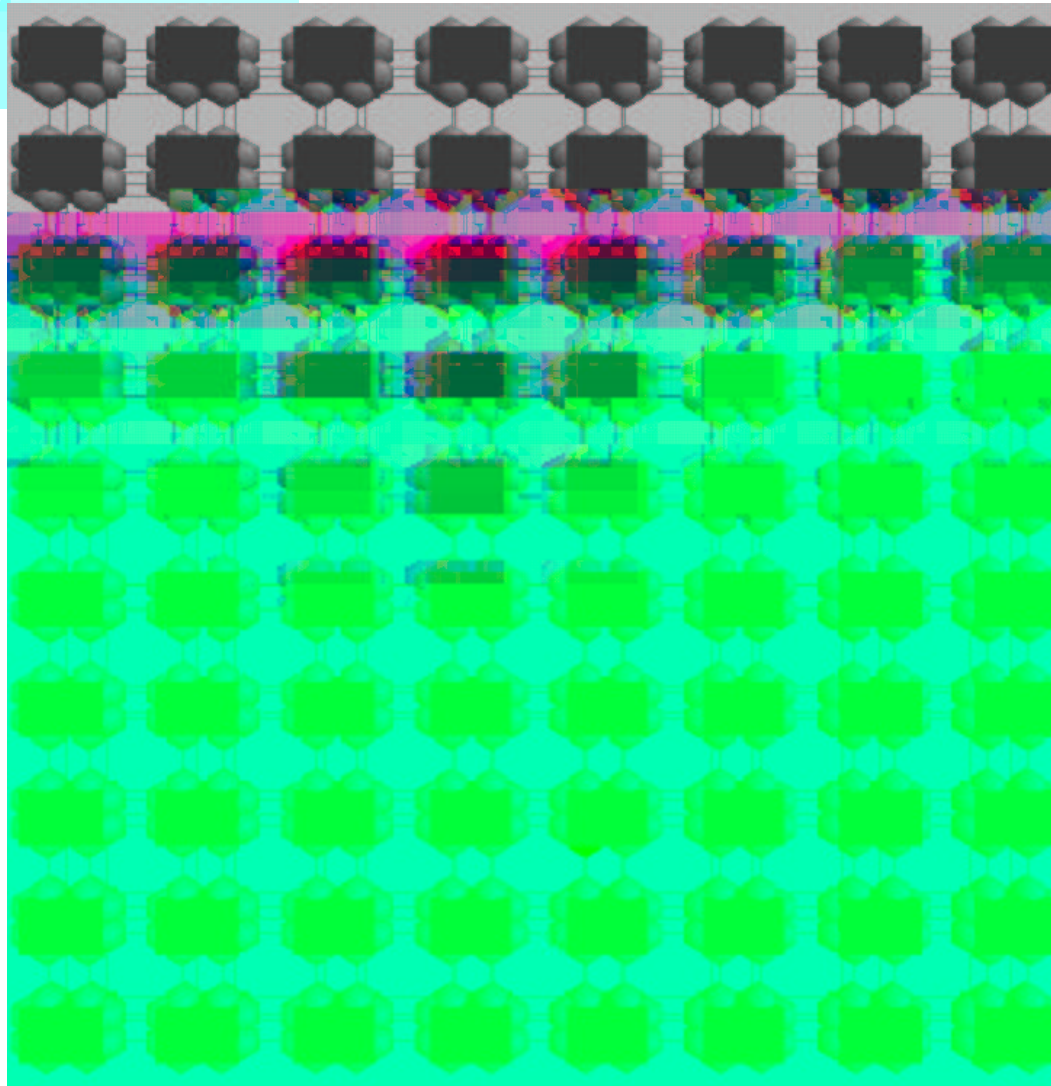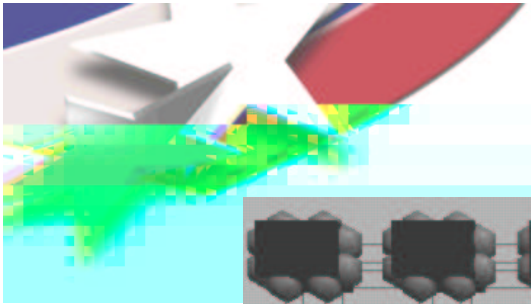
Faulty Cable:
Network view
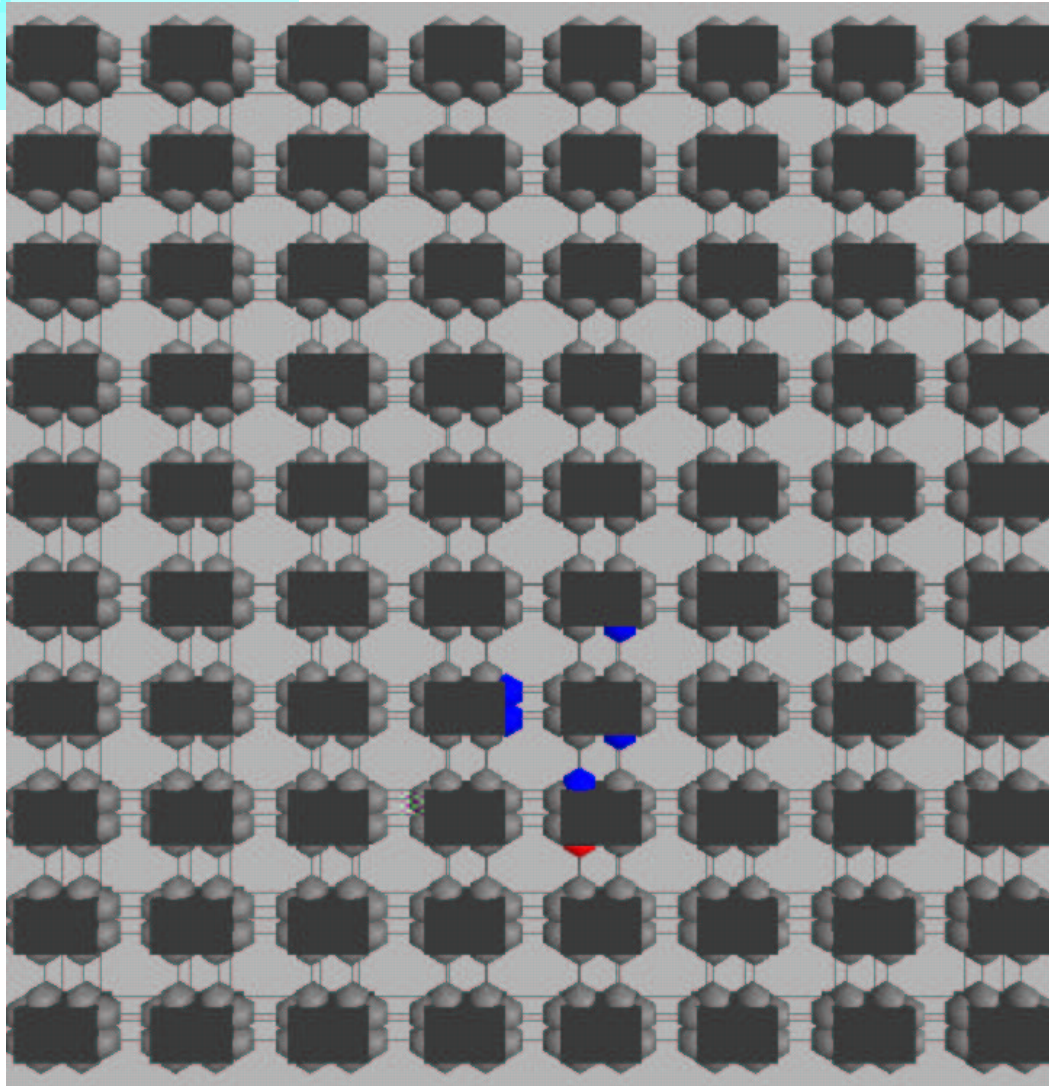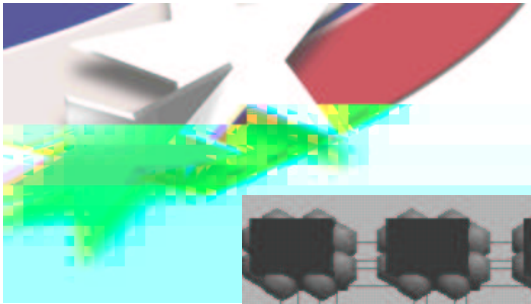Time step 1
Bad Packets

Legend
■ < 1
■ = 1
■ between 1 and 4000
■ >= 4000

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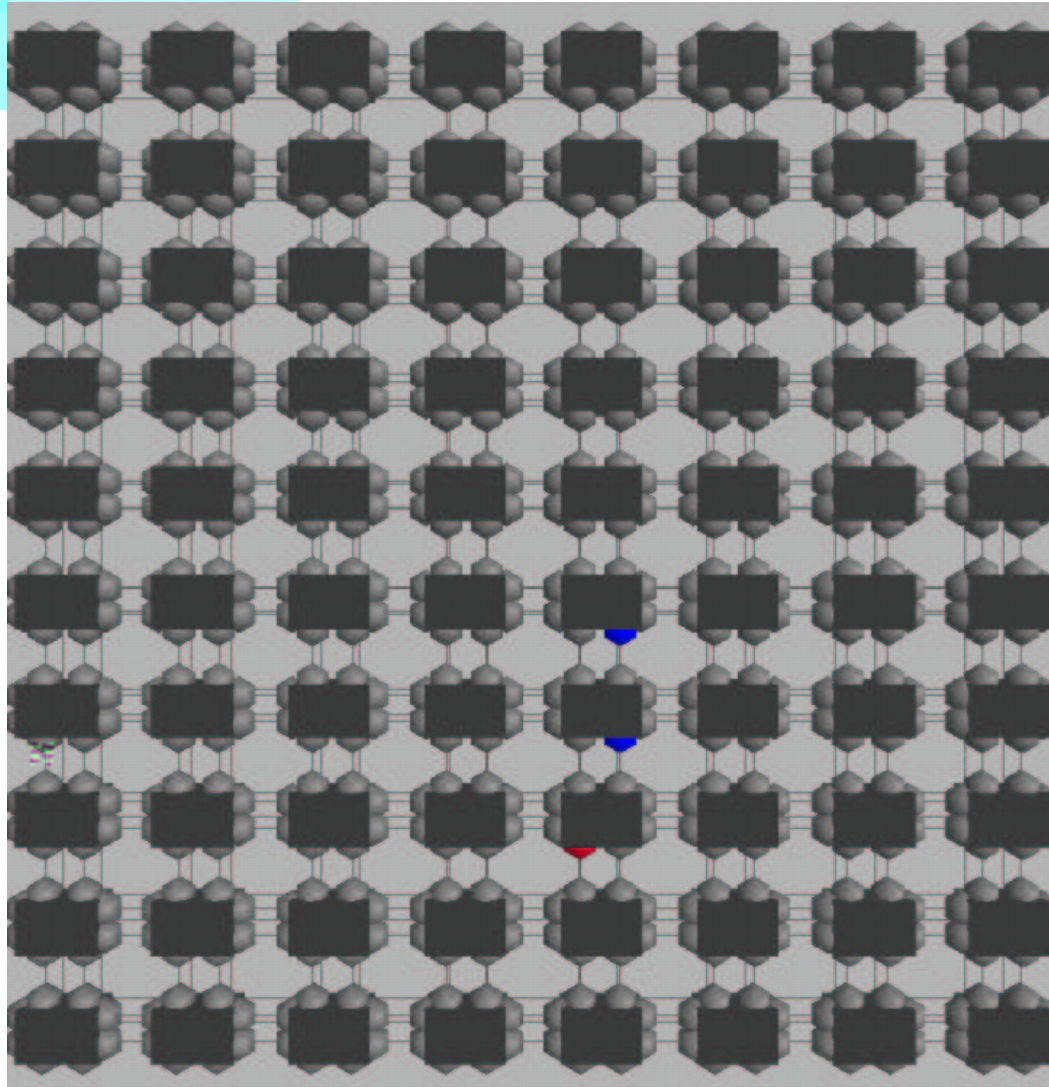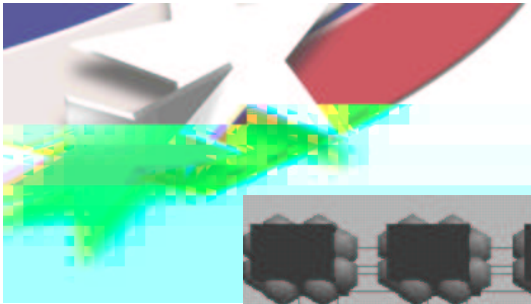
Faulty Cable
Network view
Time step 3
Bad Packets

Legend
■ < 1
■ = 1
■ between 1 and 4000
■ >= 4000
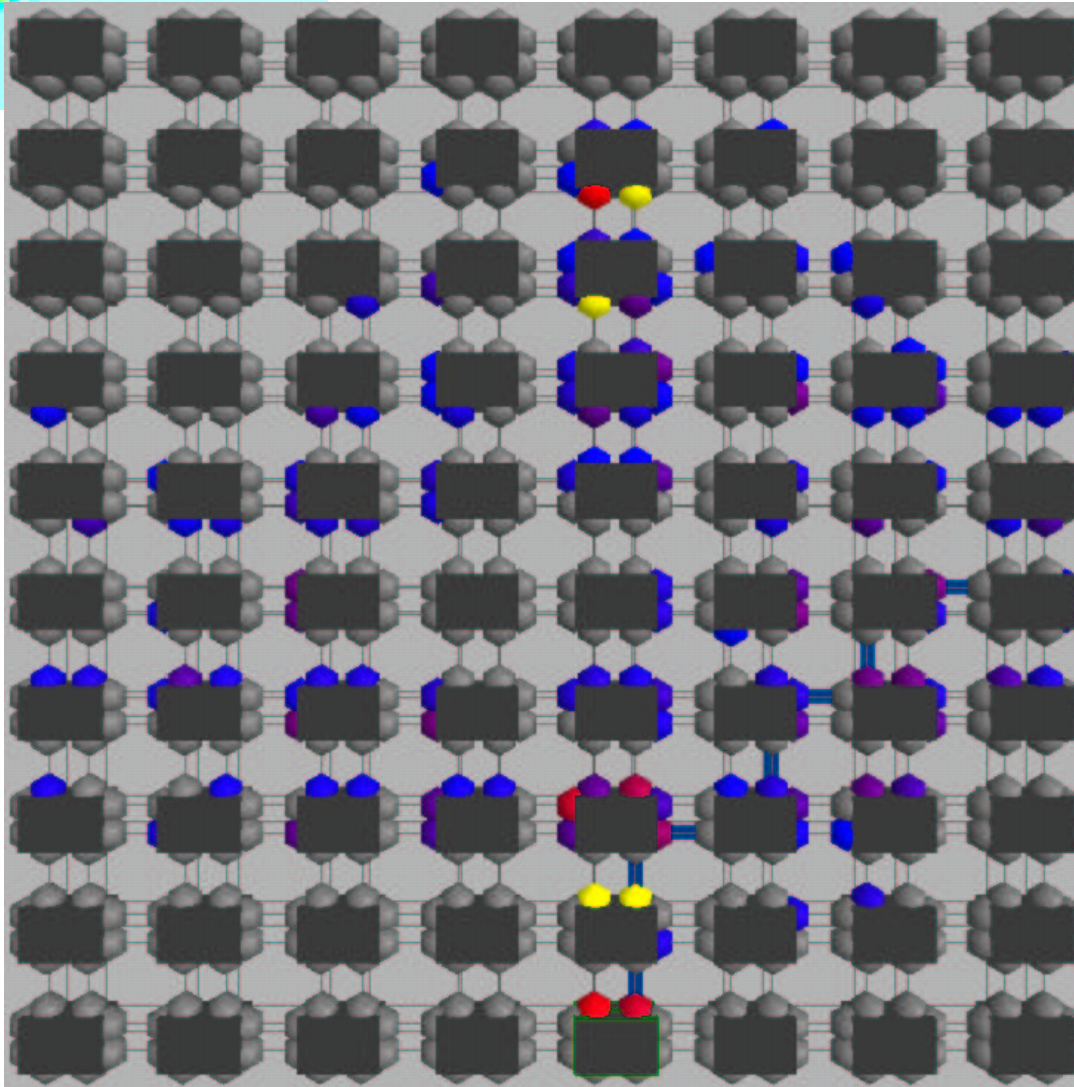
Faulty Cable
Network view
Time step 5
Bad Packets

Legend
■ < 1
■ = 1
■ between 1 and 4000
■ >= 4000

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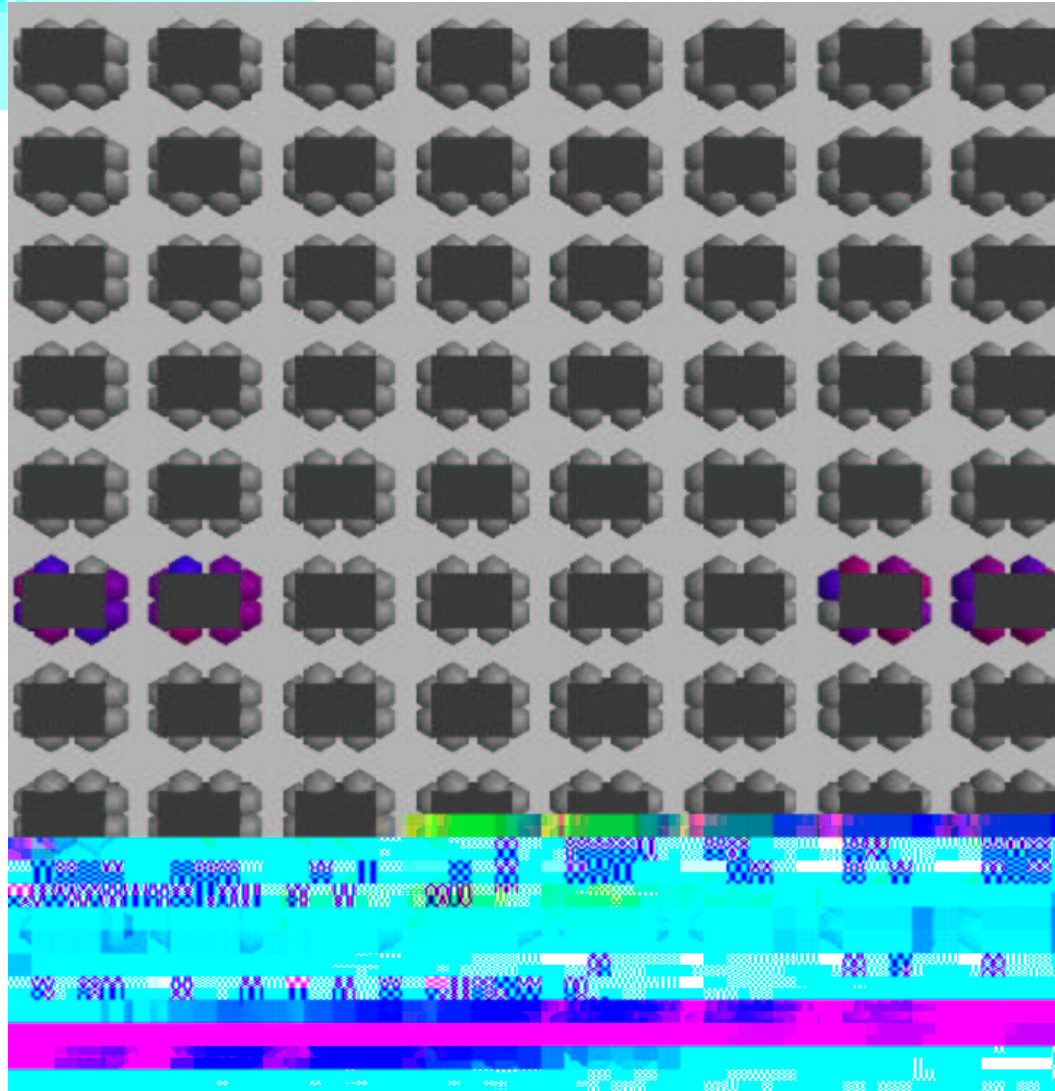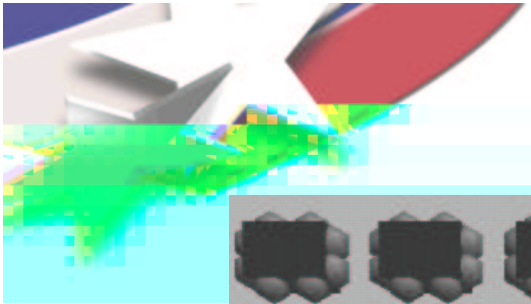
Operational Analysis:
VM reboot
Processor view
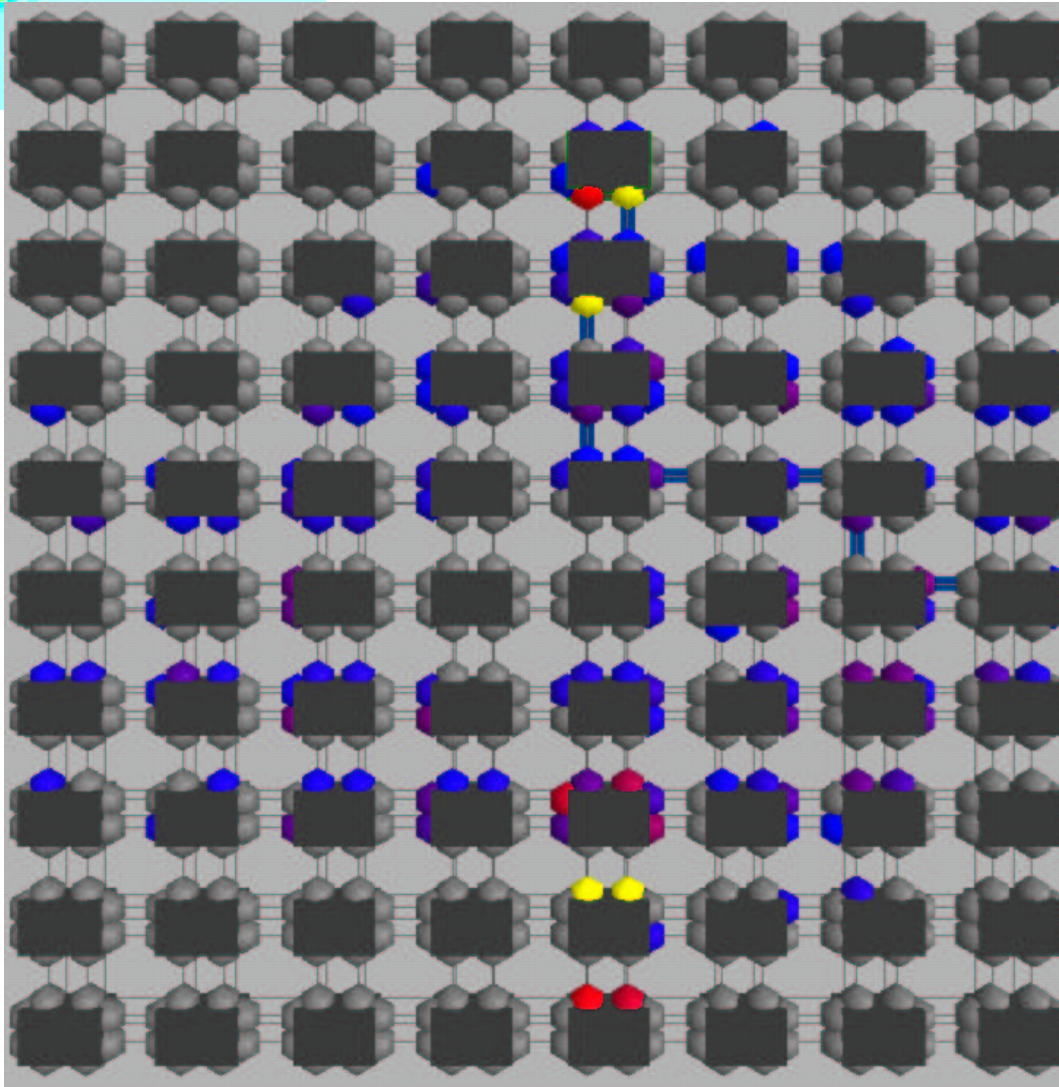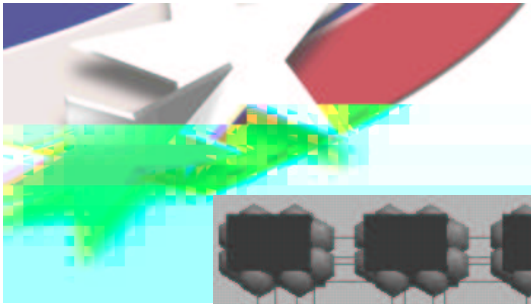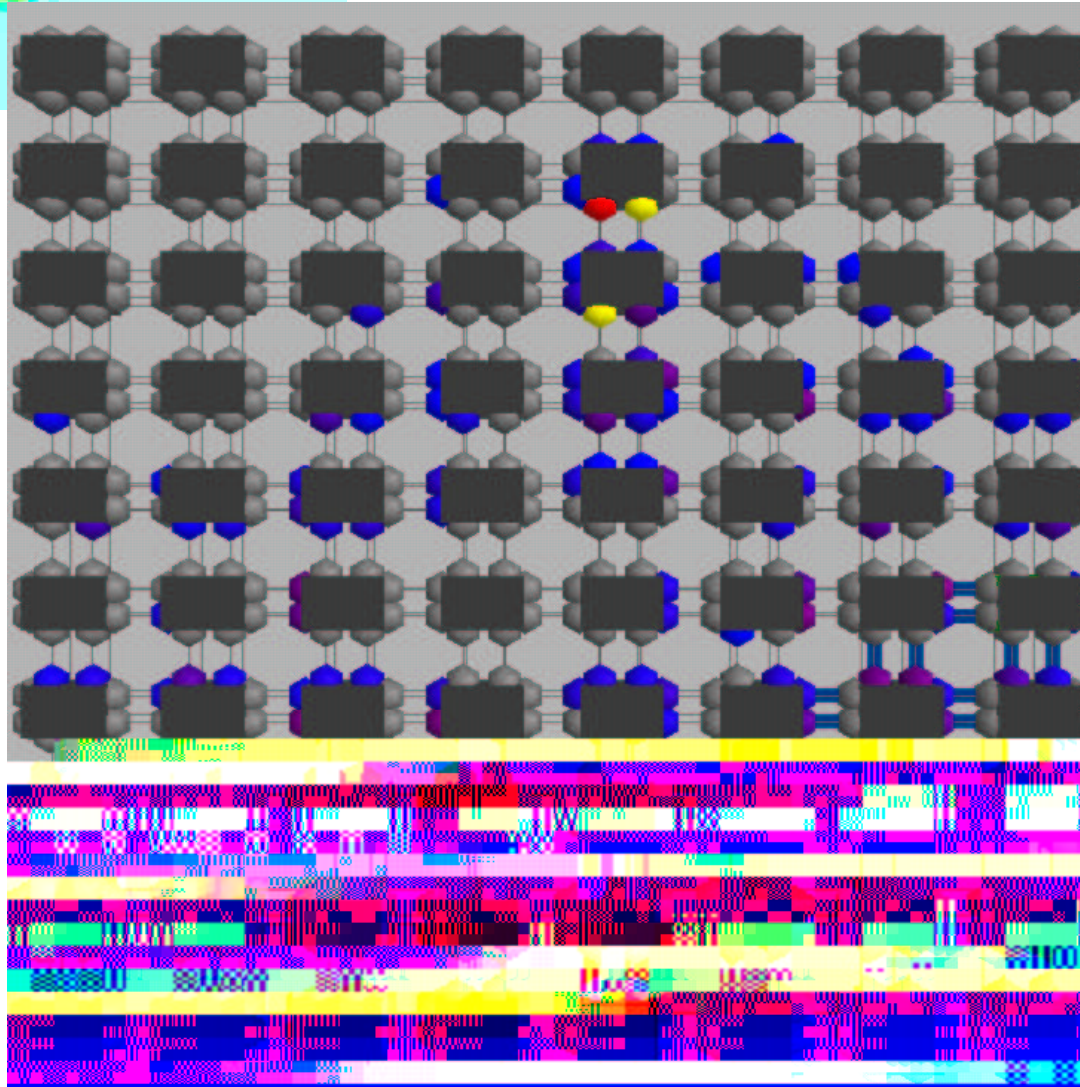Bad Packets

Legend

■ < 4

■ = 4
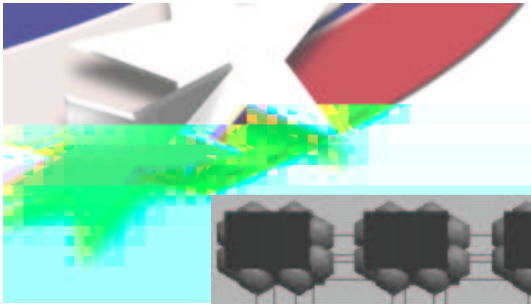
■ between 4 and 50
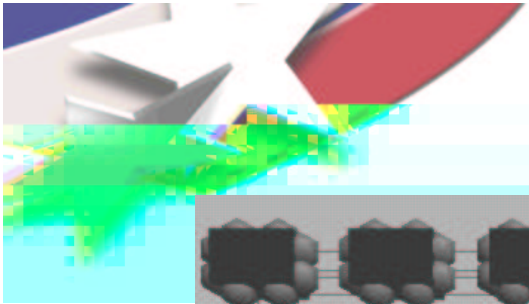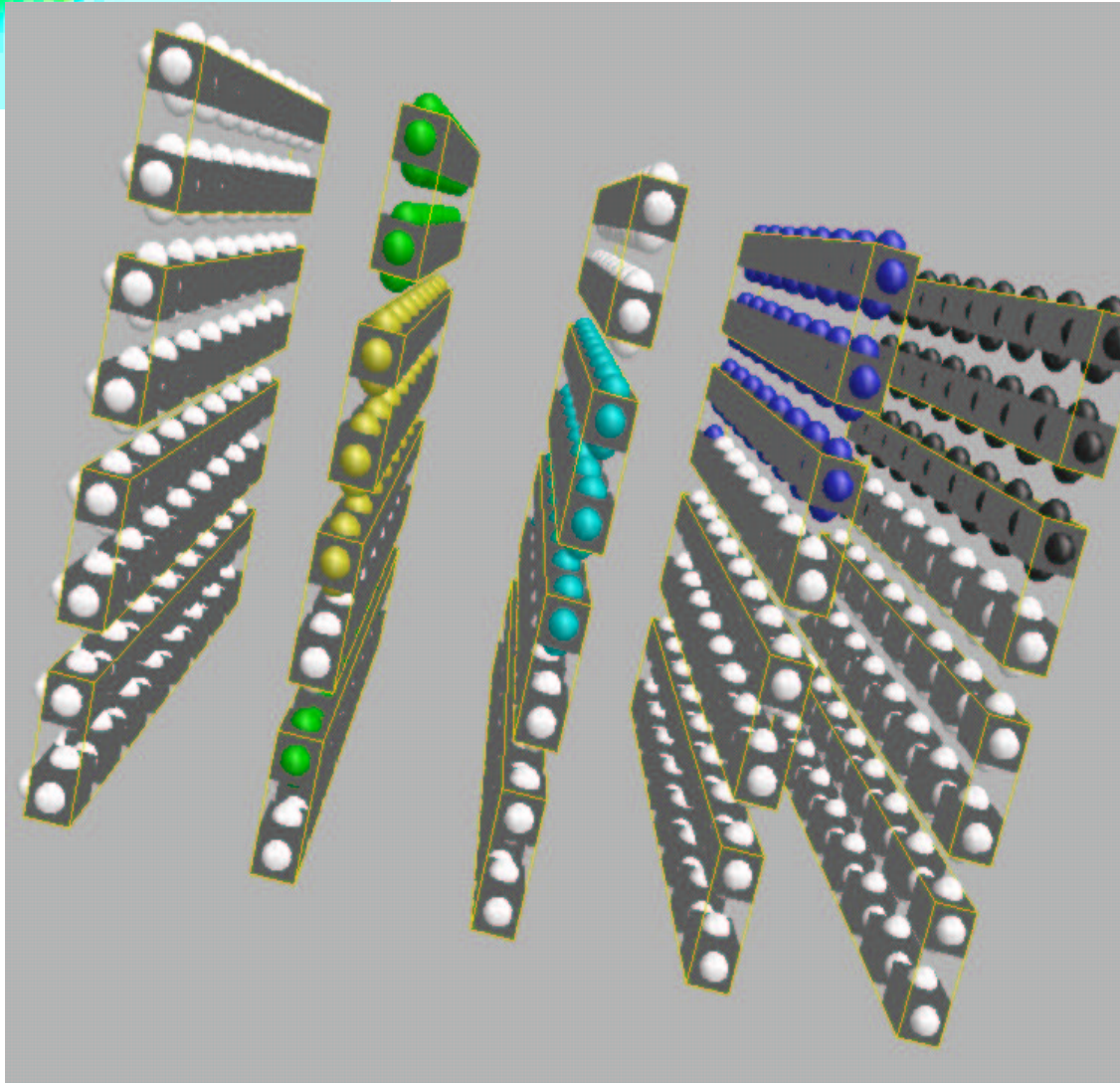
■ = 50

■ > 50

Operational Analysis:
VM reboot
Network view
Bad Packets + Route

Legend
■ < 4
■ = 4
■ between 4 and 50
■ = 50
■ > 50

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Operational Analysis:
VM reboot
Network view
Bad Packets + Route

Legend
■ < 4
■ = 4
■ between 4 and 50
■ = 50
■ > 50

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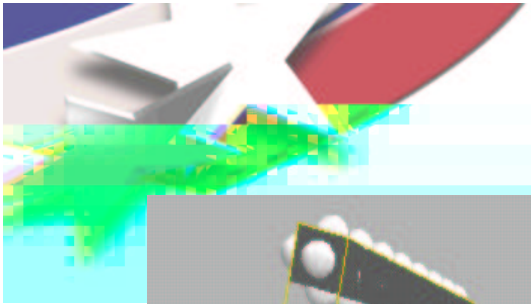National
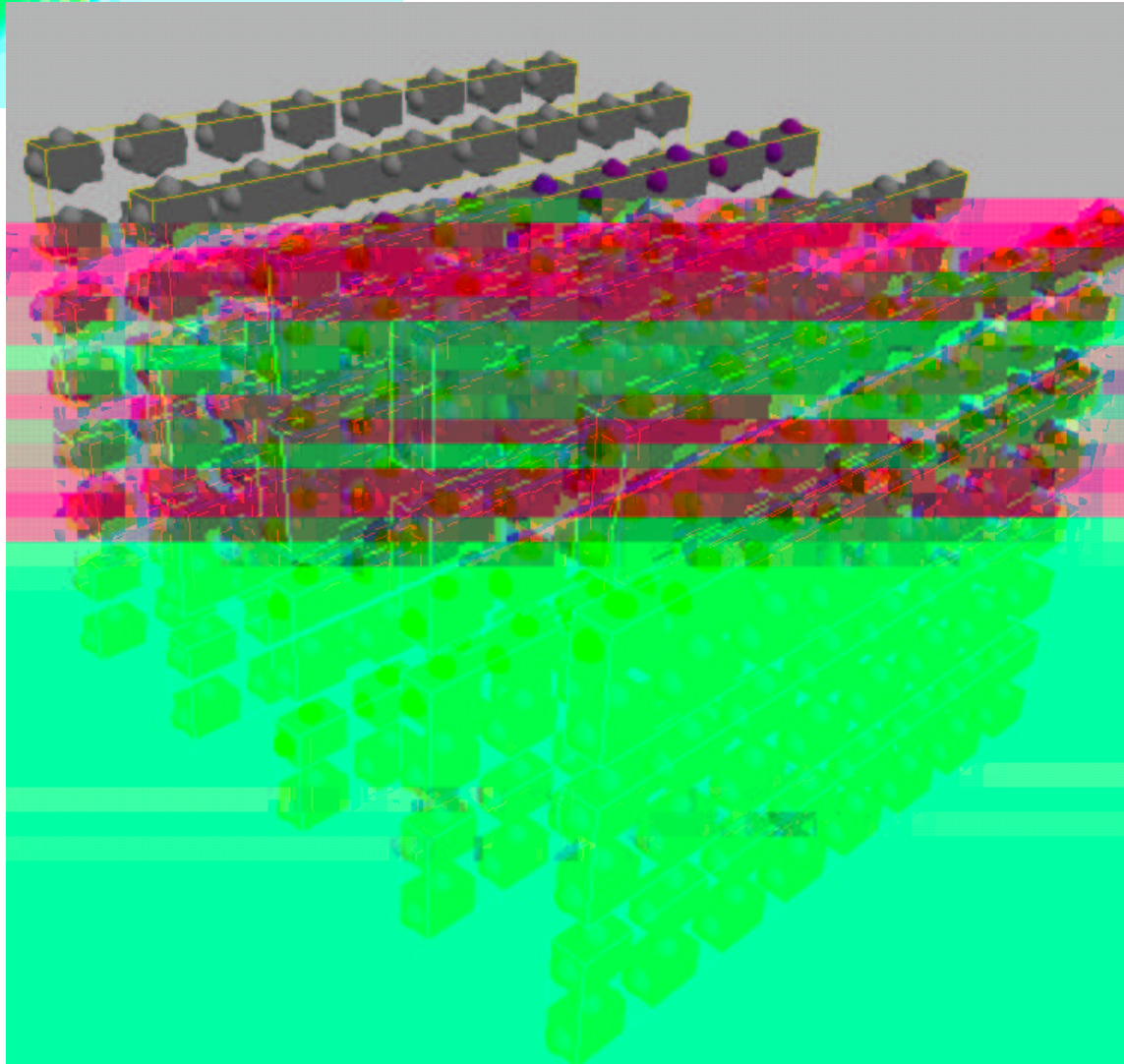Laboratories

Operational Analysis:
VM reboot
Network view
Bad Packets + Route

Legend
■ < 4
■ = 4
■ between 4 and 50
■ = 50
■ > 50

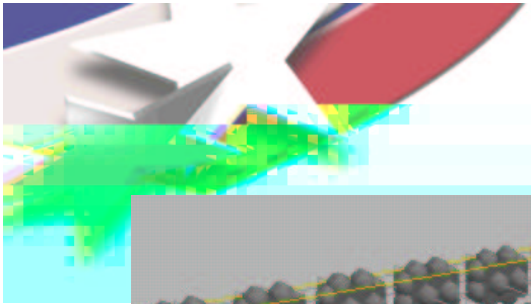Traffic Analysis:
Processor Display
Job Distribution

Traffic Analysis:
Processor Traffic
Good Packets

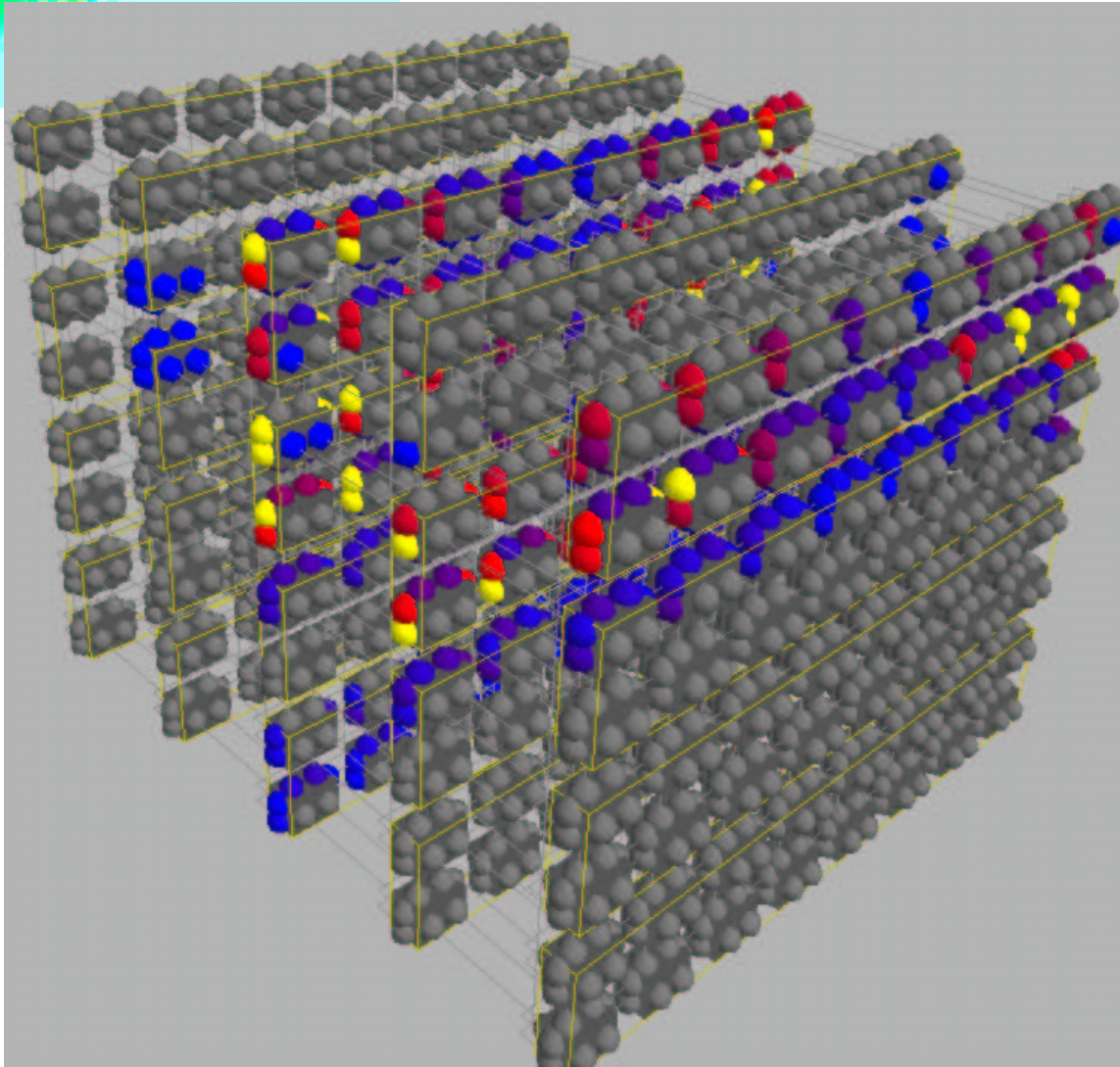Legend
■ < 2000
■ = 2000
■ between 2000 and 9,000,000

■ = 9,000,000

■ > 9,000,000

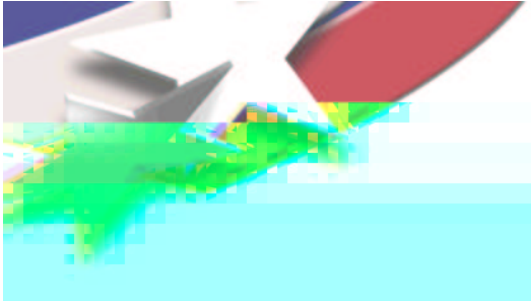Traffic Analysis:
Network Traffic
Good Packets

Legend
█ < 2000
█ = 2000
█ between 2000 and 9,000,000
█ = 9,000,000
█ > 9,000,000

Conclusions

- Visualization tool has been successful in isolating problems that appear to be system wide.

- Visualization tool provides a system view of Sandia's CPLANT™ clusters.

- Analysis is only as good as input data

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