August 9th 2011, OSG Site Admin Workshop

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Performance Measurement Tools

Agenda

- Tutorial Agenda:
  - Network Performance Primer - Why Should We Care? (**30 Mins**)
  - Introduction to Measurement Tools (**20 Mins**)
  - Use of NTP for network measurements (**15 Mins**)
  - Use of the BWCTL Server and Client (**25 Mins**)
  - Use of the OWAMP Server and Client (**25 Mins**)
  - Use of the NDT Server and Client (**25 Mins**)
  - perfSONAR Topics (**30 Mins**)
  - Diagnostics vs Regular Monitoring (**20 Mins**)
  - Use Cases (**30 Mins**)
  - Exercises

Basic Premise

- Use of the network should meet user expectations.
  - See Examples from earlier
  - When things don't look right, time to explore 'why'
- If they don't, user has the right to complain!
  - Will you listen? ☺
  - Learn how to complain effectively
    - Produce results
    - Isolate problem
  - 'The network is slow' is not how to complain effectively

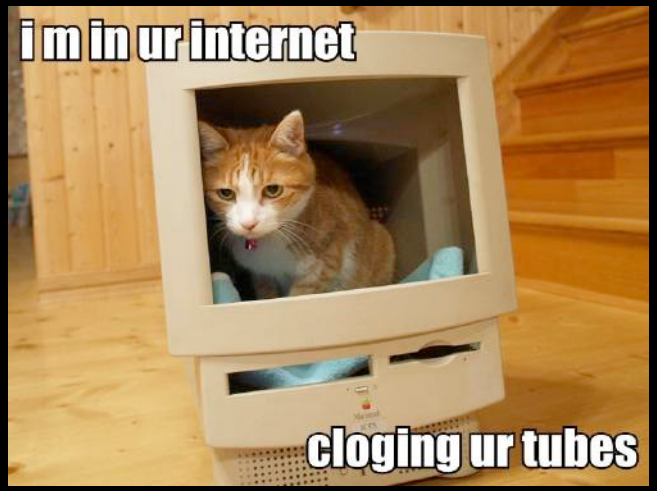
Underlying Assumption

- When problems exist, it's the networks fault!
  - Easy to blame a resource, but where else could a problem be when transferring large data sets?
    - Host (Disk, CPU, Kernel, NIC Drivers)
    - Network Interface Cards
    - Routers/Switches, Routing and Configuration
    - Physical Infrastructure
    - Protocols
- The network is viewed as a single resource in many cases
  - Reality – complex series of components
  - Multiple vendors/technologies
  - Multiple configuration options
  - Crossing administrative domains

Network View (Layman's Terms)

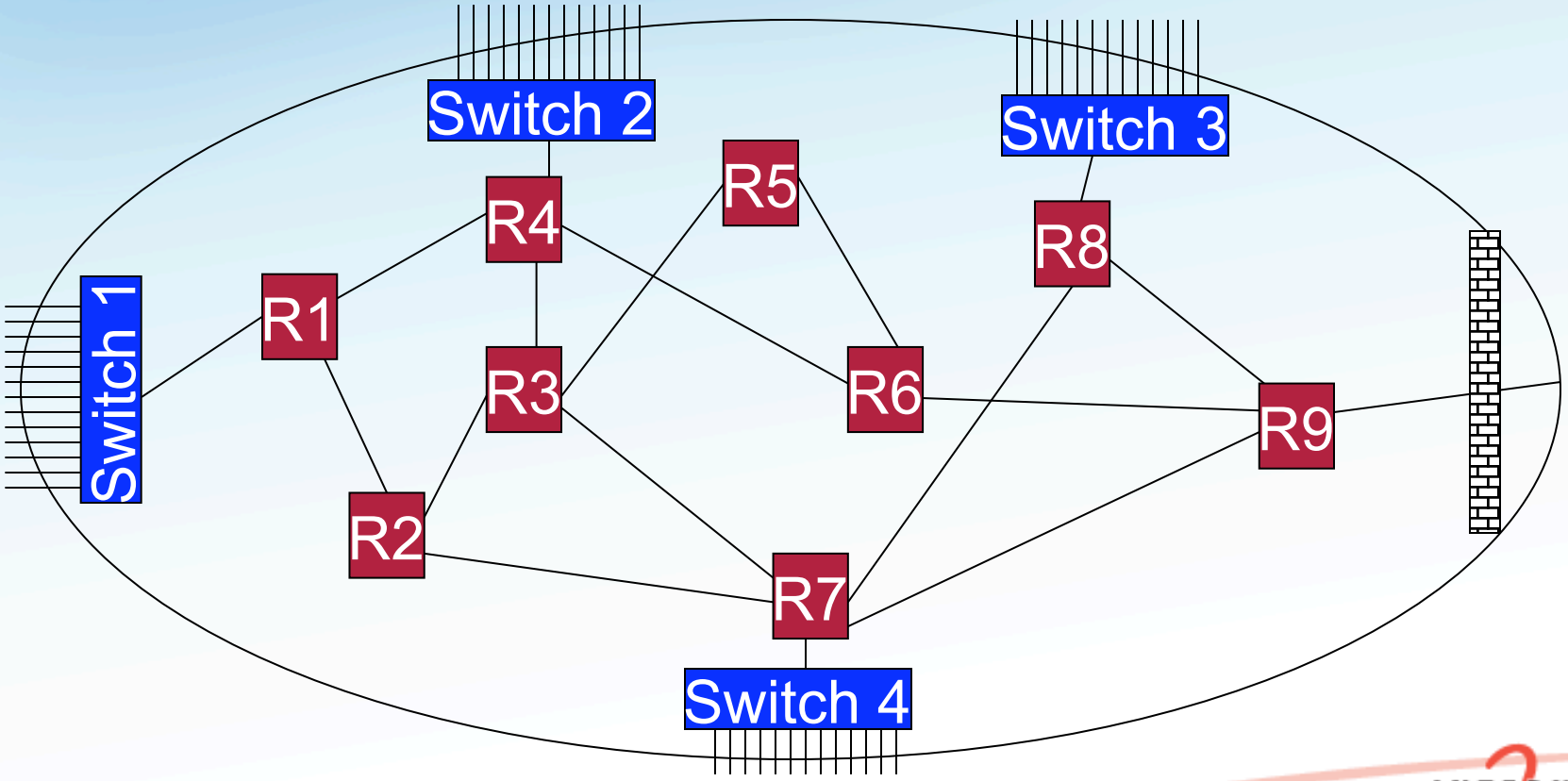
Bob's Host

"The Internets"



Carol's Host

Network View (Actual)



Addressing a Performance Discrepancy

- What are the first steps to address problems related to network performance?
  - Try a Tool
- What tools are out there
  - Numerous
  - Different metrics (measurements) available
  - How to interpret the results?

Tools, Tools, Tools

- Ping
- Traceroute
- Iperf
- Tcpdump
- Tcptrace
- BWCTL
- NDT
- OWAMP
- AMP
- Advisor
- Thrulay
- Web100
- MonaLisa
- pathchar
- NPAD
- Pathdiag
- Surveyor
- Ethereal
- CoralReef
- MRTG
- Skitter
- Cflowd
- Cricket
- Net100
- Pathload
- Pathchrip
- MRTG
- Cacti
- Smokeping
- PingER
- FDT
- perfSONAR
- Nagios
- Ganglia
- Thurlay
- Etc. etc. etc.

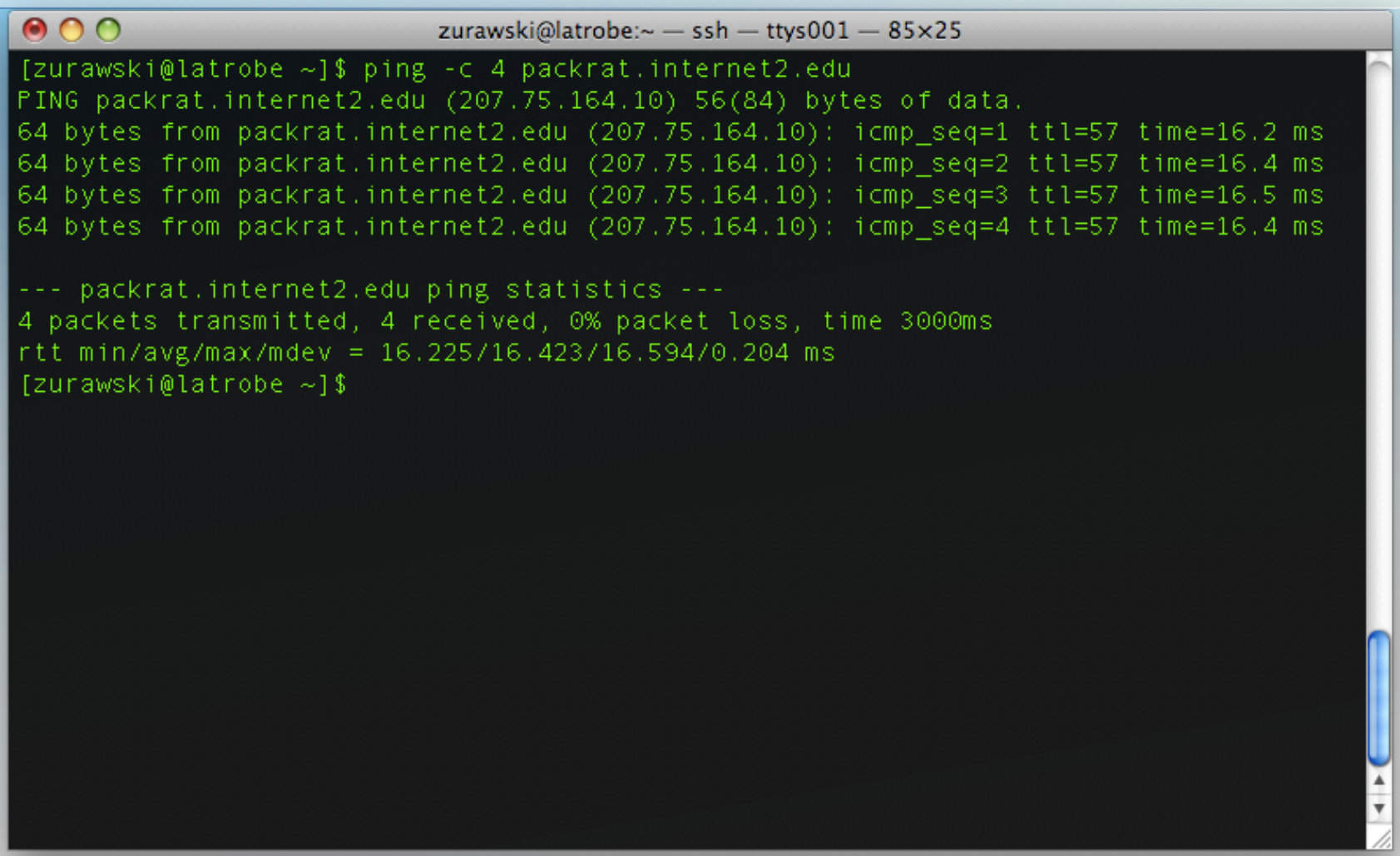
Highlighting some Interesting Tools

- Focus on 3 Types of tools (for now)
  - Basic Diagnostics
    - Ping, Traceroute
  - Advanced User Tools
    - NDT
  - Network Admin Focused
    - OWAMP, BWCTL
- What about the others?
  - Try them out, learn how they work.
  - Most tools are designed to solve a specific problem and they may add value to your organization
- Integration of multiple solutions
  - Measurement frameworks integrate use of tools (operation, collecting results) along with analysis and presentation
  - perfSONAR

Basic Diagnostic Tools

- Ping
  - Round Trip (e.g. source to destination, and back)
  - Confirms that remote host is ‘up’
  - Some network operators block these packets
    - Play w/ command options to see if that will change anything
- Traceroute
  - Identifies the routers along the path
  - Same blocking problem as above
  - Routers treat TR packets with lower priority
    - See presentation from prior JTs:
    - http://www.internet2.edu/presentations/jt2009jul/20090722-litvanyi.pdf

Ping Output

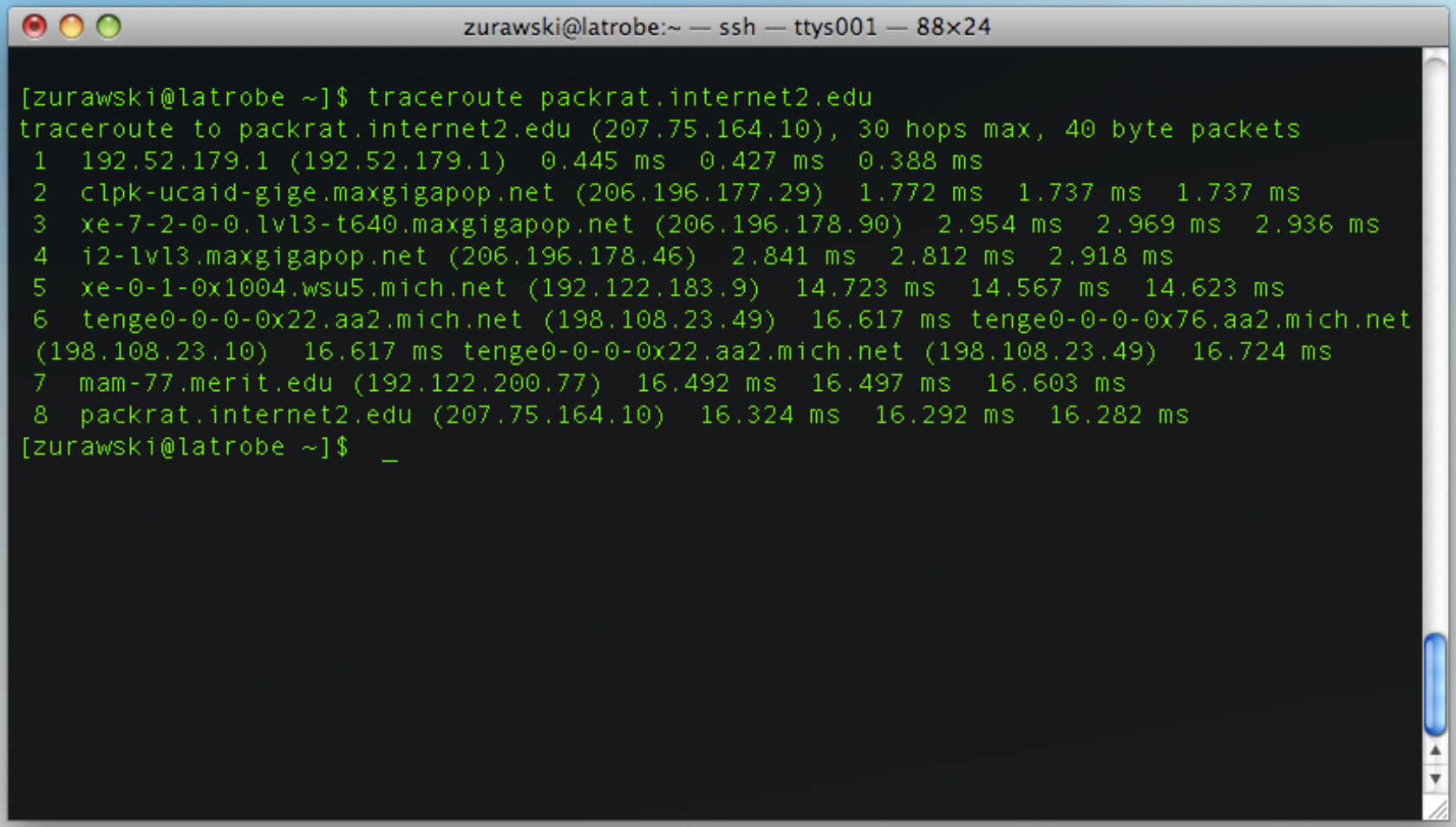

zurawski@latrobe:~ — ssh — ttys001 — 85×25
[zurawski@latrobe ~]$ ping -c 4 packrat.internet2.edu
PING packrat.internet2.edu (207.75.164.10) 56(84) bytes of data.
64 bytes from packrat.internet2.edu (207.75.164.10): icmp_seq=1 ttl=57 time=16.2 ms
64 bytes from packrat.internet2.edu (207.75.164.10): icmp_seq=2 ttl=57 time=16.4 ms
64 bytes from packrat.internet2.edu (207.75.164.10): icmp_seq=3 ttl=57 time=16.5 ms
64 bytes from packrat.internet2.edu (207.75.164.10): icmp_seq=4 ttl=57 time=16.4 ms
--- packrat.internet2.edu ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3000ms
rtt min/avg/max/mdev = 16.225/16.423/16.594/0.204 ms
[zurawski@latrobe ~]$

Ping Output

- Intro message
  - Identifies remote host name and IP address
  - States size of packets being sent
    - Setting larger sizes may reveal hidden problems
- Output lines
  - Who responded, and the RTT, maybe other details
- Summary lines
  - Number of packets sent/received/lost
  - RTT statistics min/average/max

N.B. 1 msec RTT = ~50 miles of between hosts

Traceroute Output



Traceroute Output

- Intro messages
  - Name and address of remote host
  - Maximum number of link before giving up
- Status messages
  - One line per router in path
  - ‘*’ indicates router didn’t respond
  - Routers usually rate limit replies
  - No name indicates DNS entry is missing
  - Hops required to reach remote host or max number from above

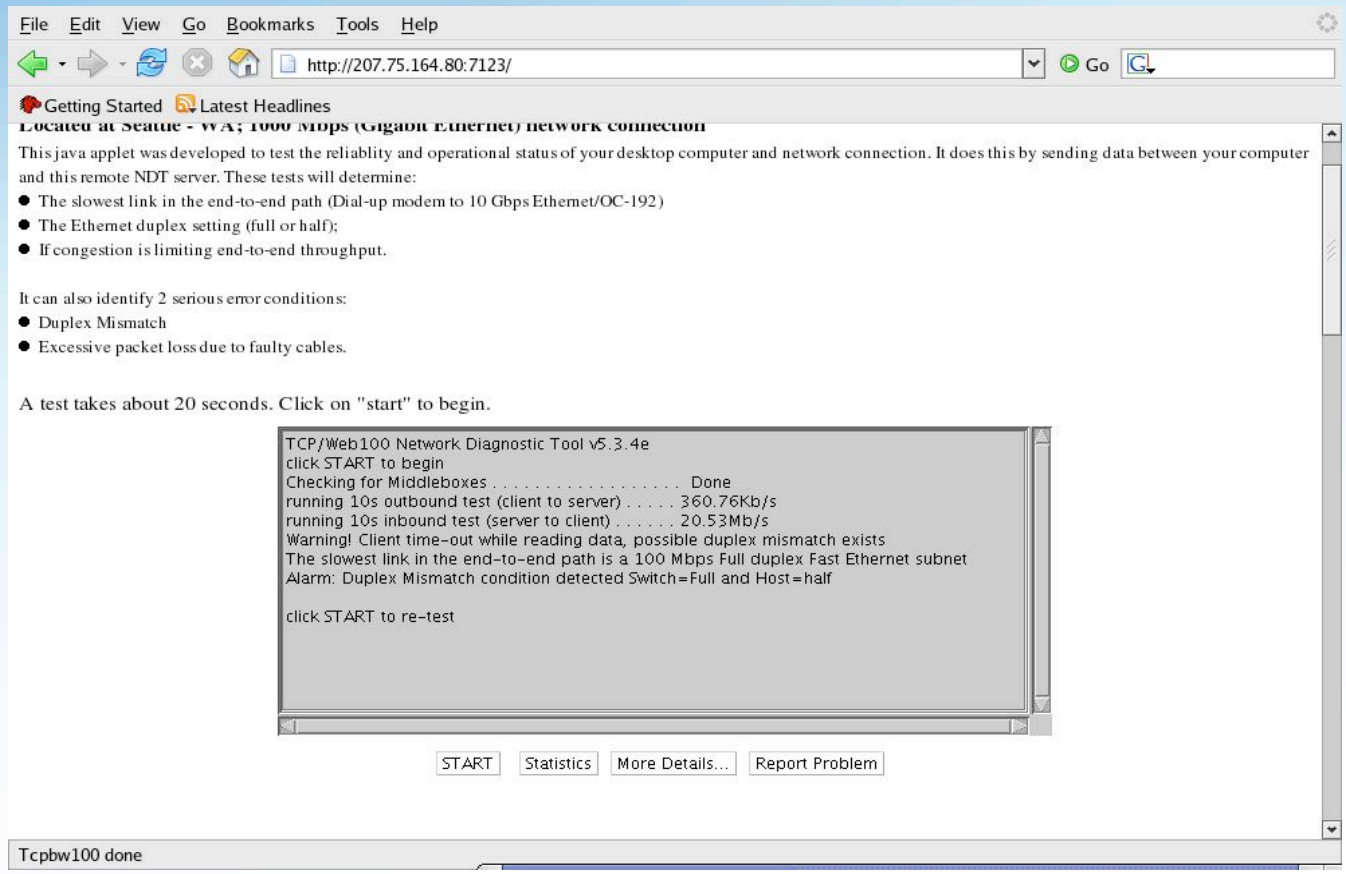
Advanced User Tool - NDT

- NDT = Network Diagnostics Tool
- Measure performance to users desktop
- Identify real problems for real users
  - Network infrastructure could be the problem
  - Host tuning issues could be the problem
- Make tool simple to use and understand
  - Presentation in a method almost all users can access: web browser
- Make tool useful for users and network administrators
  - Variables for many aspects of host, protocol, and network performance

NDT User Interface

- Web-based JAVA applet allows testing from any browser
  - One Click testing
  - Option to dig deep into available results
  - Send report of results to network administrators
- Command-line client allows testing from remote login shell
  - Same options available
  - Client software can be build independent of server software

NDT Results


File Edit View Go Bookmarks Tools Help
http://207.75.164.80:7123/
Go
Getting Started
Latest Headlines
This java applet was developed to test the reliablity and operational status of your desktop computer and network connection. It does this by sending data between your computer and this remote NDT server. These tests will determine:
The slowest link in the end-to-end path (Dial-up modem to 10 Gbps Ethernet/OC-192)
The Ethernet duplex setting (full or half);
If congestion is limiting end-to-end throughput.
It can also identify 2 serious error conditions:
Duplex Mismatch
Excessive packet loss due to faulty cables.
A test takes about 20 seconds. Click on "start" to begin.
TCP/Web100 Network Diagnostic Tool v5.3.4e
click START to begin
Checking for Middleboxes . . . . . Done
running 10s outbound test (client to server) 360.76Kb/s
running 10s inbound test (server to client) 20.53Mb/s
Warning! Client time-out while reading data, possible duplex mismatch exists
The slowest link in the end-to-end path is a 100 Mbps Full duplex Fast Ethernet subnet
Alarm: Duplex Mismatch condition detected Switch=Full and Host=half
click START to re-test
START
Statistics
More Details...
Report Problem
Tcpbw100 done

Finding Results of Interest

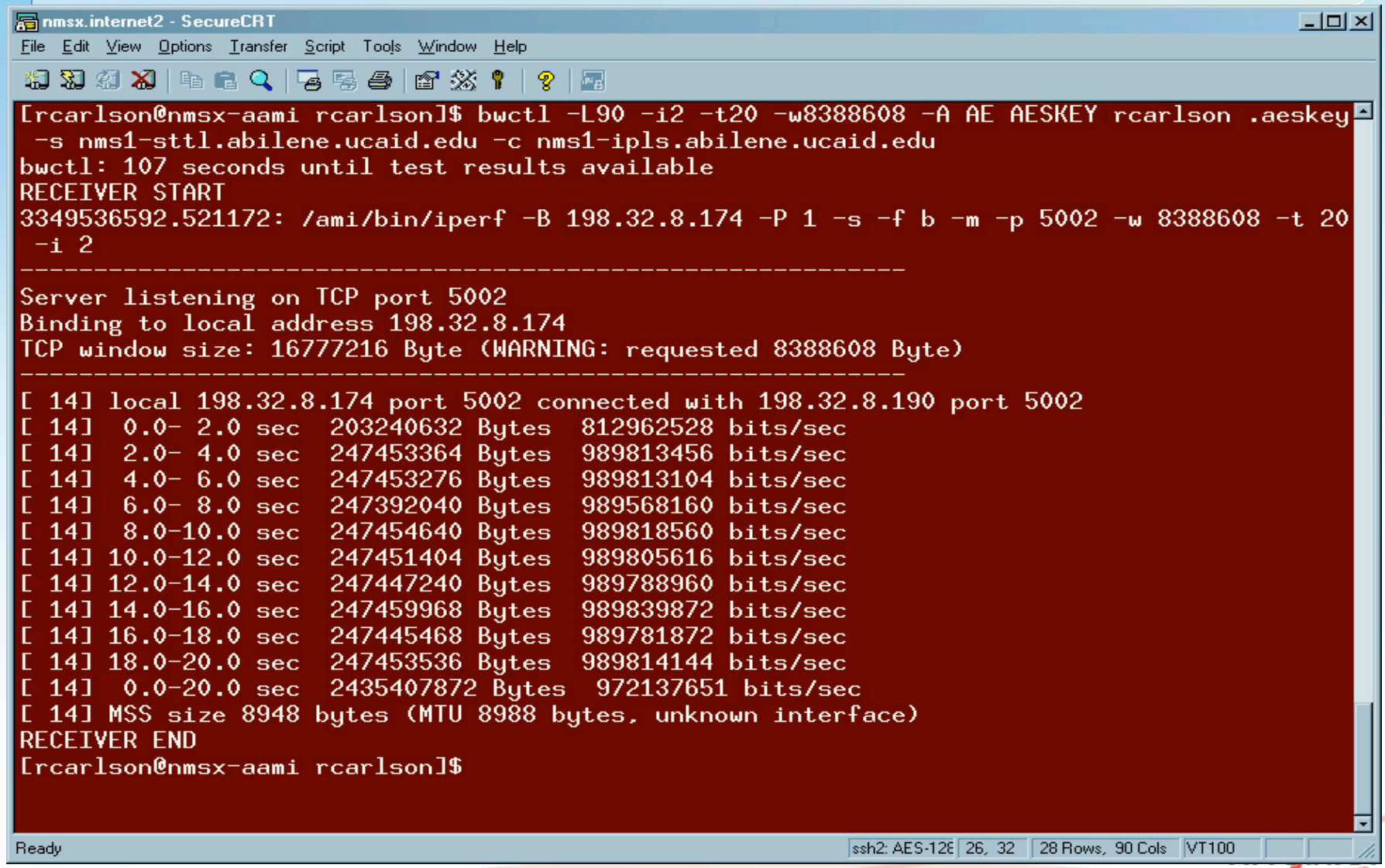
- Duplex Mismatch
  - This is a serious error and nothing will work right. Reported on *main* page, on *Statistics* page, and **mismatch:** on *More Details* page
- Packet Arrival Order
  - Inferred value based on TCP operation. Reported on *Statistics* page, (with loss statistics) and **order:** value on *More Details* page
- Packet Loss Rates
  - Calculated value based on TCP operation. Reported on *Statistics* page, (with out-of-order statistics) and **loss:** value on *More Details* page
- Path Bottleneck Capacity
  - Measured value based on TCP operation. Reported on *main* page

Network Administration Tools

- BWCTL – Bandwidth Control
  - Allows single person operation over wide area testing environment
  - Runs NLANR ‘iperf’ program
    - Support for Thrulay, nuttcp

- OWAMP – One way Delay Measurement
  - Advanced ‘ping’ command
    - One way vs round trip
  - Allows single person operation over wide area testing environment

BWCTL Sample Results



BWCTL Highlights

- You must pre-install BWCTL software package
  - Server/Client required for ends of a test
- Internet2 default permission: TCP test from any member
  - UDP available on request
- Sites can restrict access to ‘known’ remote users
  - Rich set of permissions and limitations

BWCTL Commands

bwctl -L90 -i2 -t20 -c bwctl.losa.net.internet2.edu

bwctl -L90 -i2 -t20 -s bwctl.newy.net.internet2.edu

- Bwctl = name of program
- L90 = wait up to 90 seconds for a test
- i2 = report intermediate results every 2 seconds
- t20 – run test for 20 seconds
- s name = remote end will send data to you
- c name = you will send data to the remote host

BWCTL 3rd Party Testing

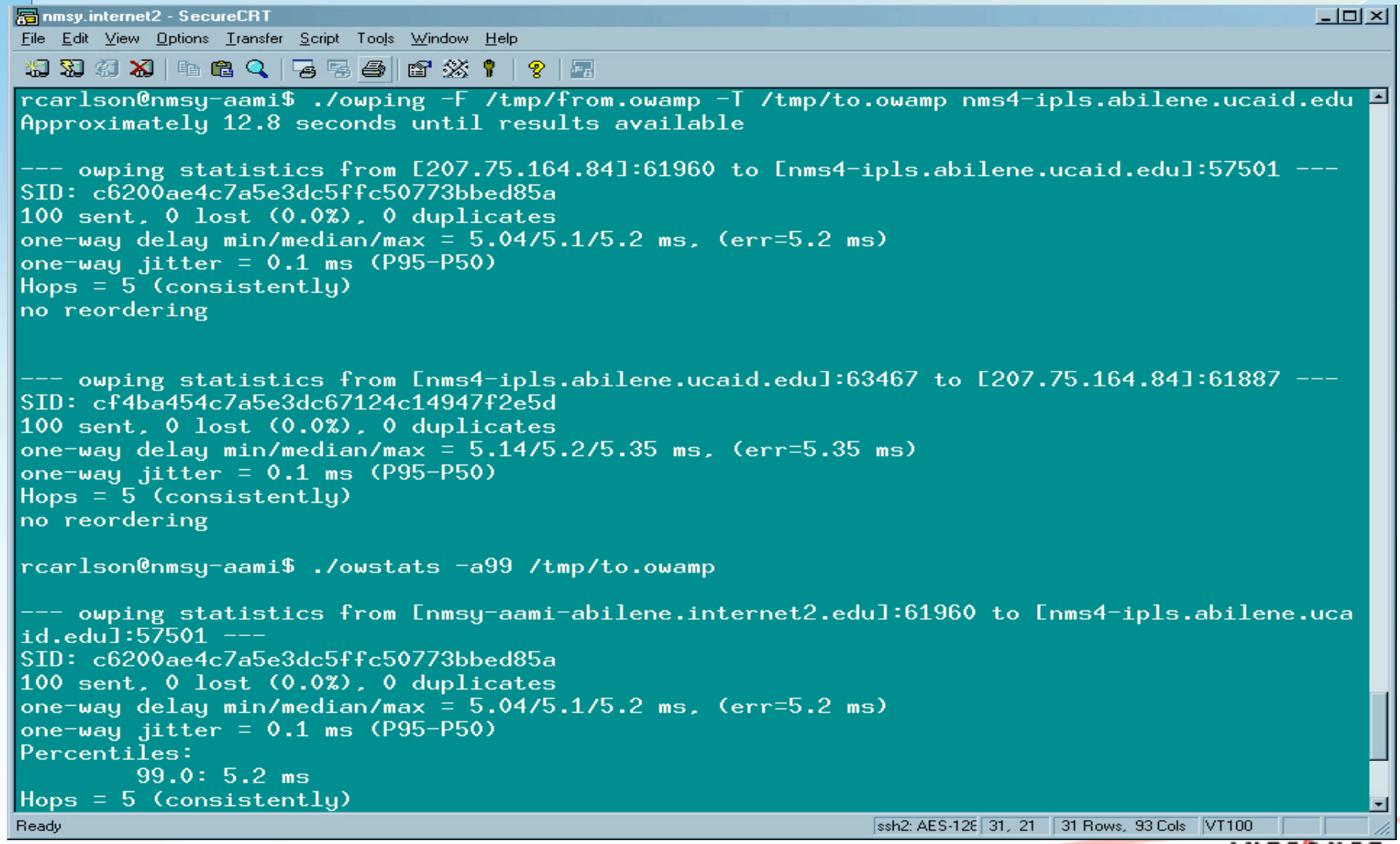
bwctl -L90 -i2 -t20

-c bwctl.salt.net.internet2.edu

-s bwctl.atla.net.internet2.edu

- User can run a test between 2 remote hosts

OWPing Results



OWAMP Results

- You must pre-install OWAMP software package
- User program is called ‘owping’
- Internet2 default permissions: basic test from any member
  - Other options (e.g. longer test, more data sent) available on request
- Sites can restrict access to ‘known’ remote users
  - Similar rich set of permissions to BWCTL

Using OWPing

- owping owamp.salt.net.internet2.edu
  - owping = program name
  - owamp… = name of server
- Output results
  - Separate statistics for both directions
  - Number of packets sent and lost
  - One-way delay statistics min/median/max
  - Number of IP hops in path
  - Number of packets that arrives out-of-order

Software Availability

- Source Packages (Client and Server)
  - http://software.internet2.edu/sources/
  - Typical 'configure/make/make install'
- RPM Installation (CentOS 5.5 Supported):
  - Install our RPM package to enable the Internet2 Repository
  - See instructions here: http://software.internet2.edu/
  - Support for YUM and APT-RPM
- pS Performance Toolkit ISO
  - All tools, pre-installed and configured
  - More info: http://psps.perfsonar.net/toolkit/
- Others Notes:
  - Other RPM based distros (Fedora/RHEL) may work with packaged RPMs … YMMV
  - To install on Debian, consider source. Alien conversions of RPMs may be problematic

Conclusions

- Primary tools still useful
  - Know the tool
- Advanced tools are being developed all the time
- Installation using simple methods (e.g. RPM based package managers)

Performance Measurement Tools

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For more information, visit http://www.internet2.edu/workshops/npw