

# Network Performance Tools

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# Overview

- BWCTL
- OWAMP
- NDT/NPAD

# BWCTL: What is it?

A resource allocation and scheduling daemon  
for arbitration of iperf tests

# Problem Statement

- Users want to verify available bandwidth from their site to another.

## Methodology

- Verify available bandwidth from each endpoint to points in the middle to determine problem area.

# Typical Solution

- Run “iperf” or similar tool on two endpoints and hosts on intermediate paths

# Typical road blocks

- Need software on all test systems
  - Need permissions on all systems involved (usually full shell accounts\*)
  - Need to coordinate testing with others \*
  - Need to run software on both sides with specified test parameters \*
- (\* BWCTL was designed to help with these)

# Implementation

## Applications

- bwctld daemon
- bwctl client

Open source license and development

Built upon protocol abstraction library

- Supports one-off applications
- Allows authentication/policy hooks to be incorporated

# Functionality (bwctl)

bwctl client application makes requests to both endpoints of a test

- Communication can be “open”, “authenticated”, or “encrypted” (encrypted reserved for future use)
- Requests include a request for a time slot as well as a full parameterization of the test
- Third party requests
- If no server is available on the localhost, client handles test endpoint
- \*Mostly\* the same command line options as iperf (some options limited or not implemented.)



# Functionality (bwctld)

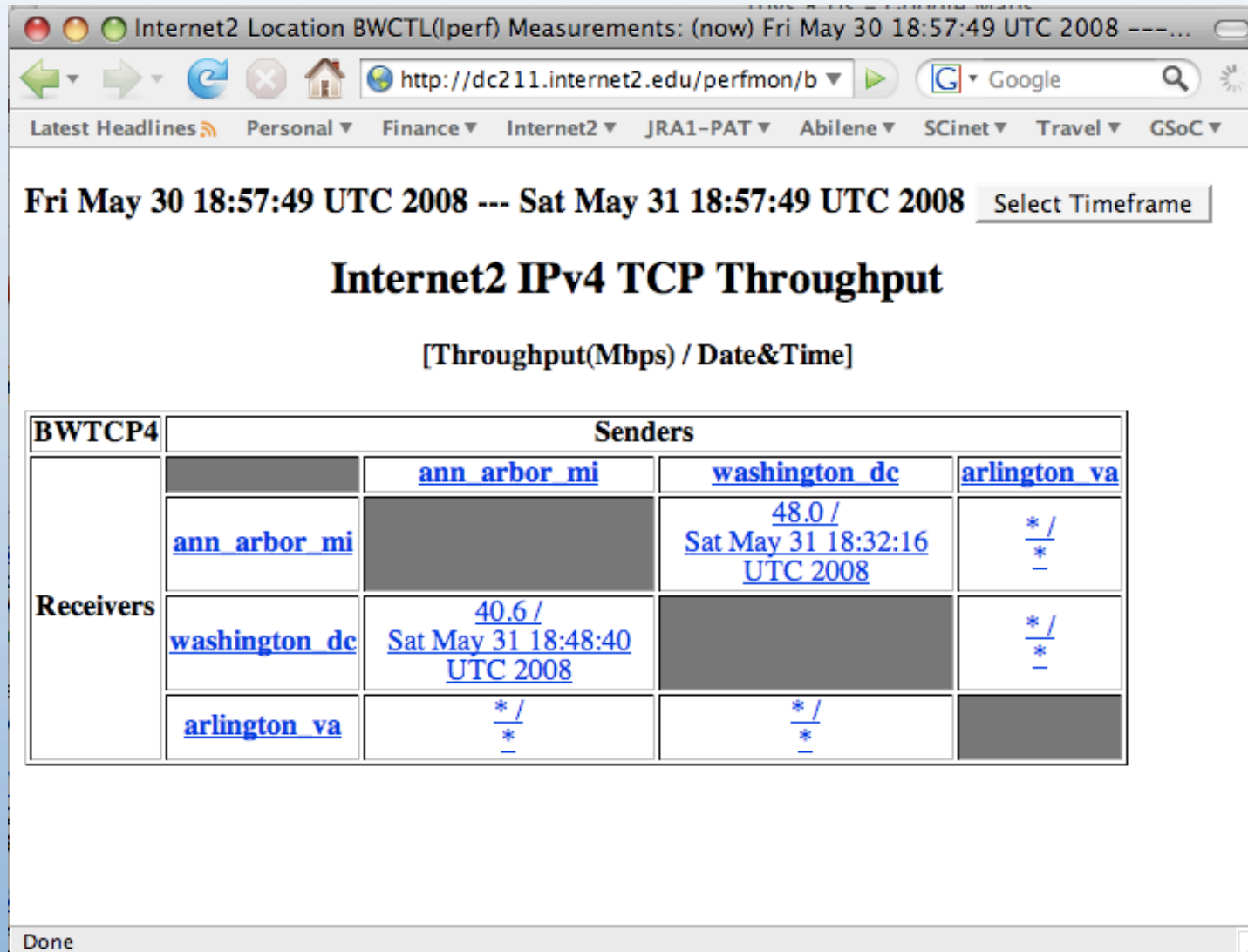
## bwctld on each test host

- Accepts requests for “iperf” tests including time slot and parameters for test
- Responds with a tentative reservation or a denied message
- Reservations by a client must be confirmed with a “start session” message
- Resource “Broker”
- Runs tests
- Both “sides” of test get results

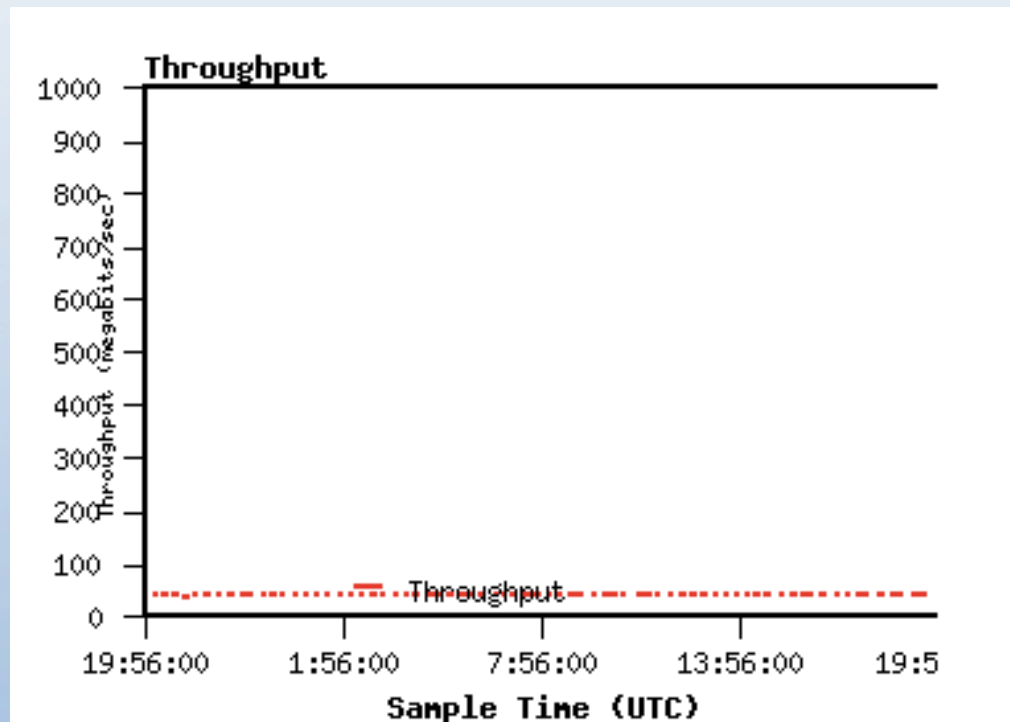
# BWCTL Example

```
boote@nms-rthr2:~  
[boote@nms-rthr2 ~]$ bwctl -x -s bwctl.kans.net.internet2.edu  
bwctl: 19 seconds until test results available  
  
RECEIVER START  
3421251446.646488: iperf -B 2001:468:9:100::16:22 -P 1 -s -f b -m -p 5  
001 -t 10 -V  
-----  
Server listening on TCP port 5001  
Binding to local address 2001:468:9:100::16:22  
TCP window size: 87380 Byte (default)  
-----  
[ 14] local 2001:468:9:100::16:22 port 5001 connected with 2001:468:4:  
100::16:214 port 5001  
[ 14] 0.0-10.2 sec 1193058304 Bytes 939913512 bits/sec  
[ 14] MSS size 8928 bytes (MTU 8968 bytes, unknown interface)  
  
RECEIVER END  
  
SENDER START  
3421251448.787198: iperf -c 2001:468:9:100::16:22 -B 2001:468:4:100::1  
6:214 -f b -m -p 5001 -t 10 -V  
-----  
Client connecting to 2001:468:9:100::16:22, TCP port 5001  
Binding to local address 2001:468:4:100::16:214  
TCP window size: 87380 Byte (default)  
-----  
[ 7] local 2001:468:4:100::16:214 port 5001 connected with 2001:468:9  
:100::16:22 port 5001  
[ 7] 0.0-10.0 sec 1193058304 Bytes 951107779 bits/sec  
[ 7] MSS size 8928 bytes (MTU 8968 bytes, unknown interface)  
  
SENDER END  
[boote@nms-rthr2 ~]$
```

# BWCTL Data (Dash-Board)



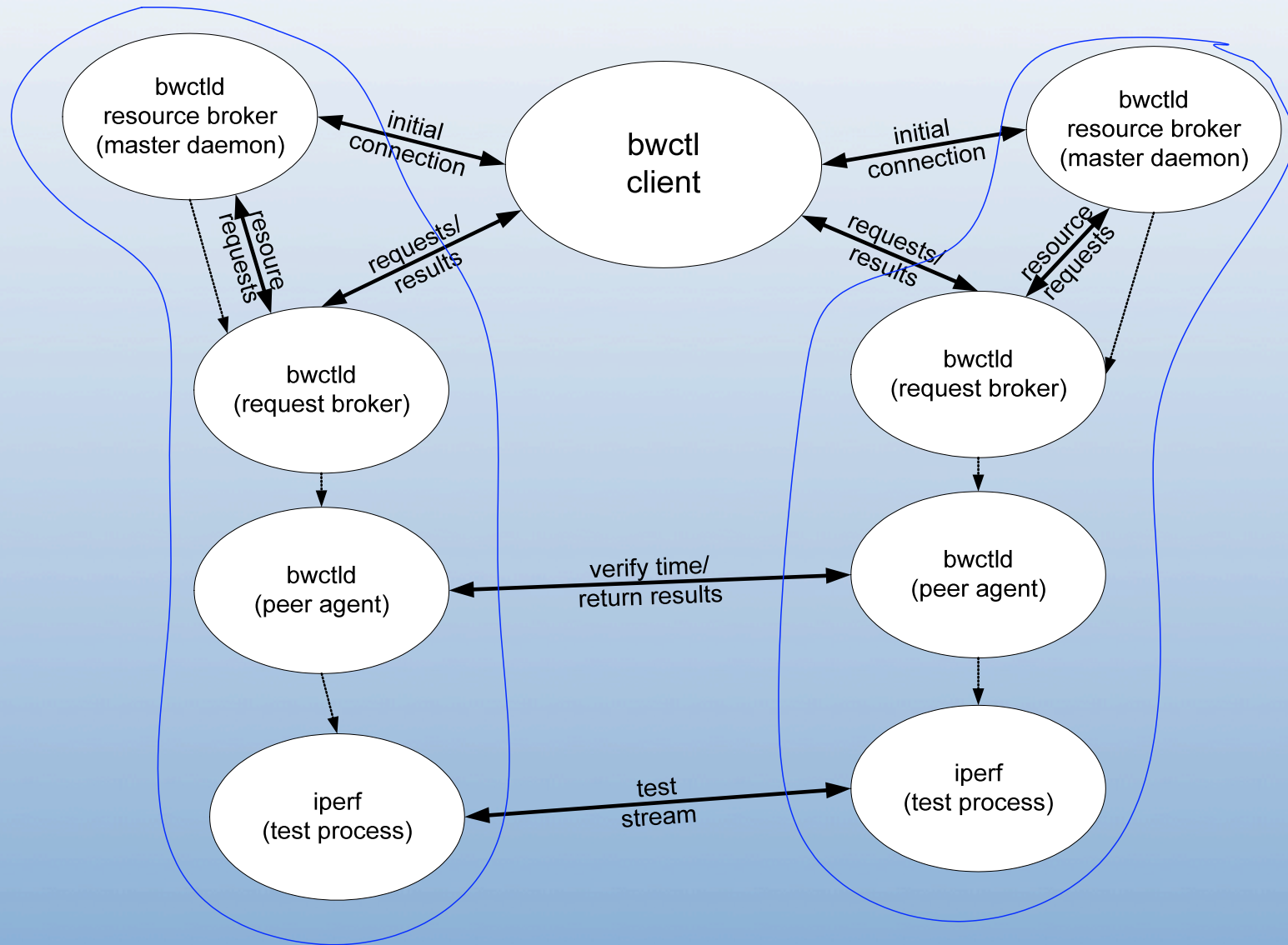
# BWCTL Data – Path History



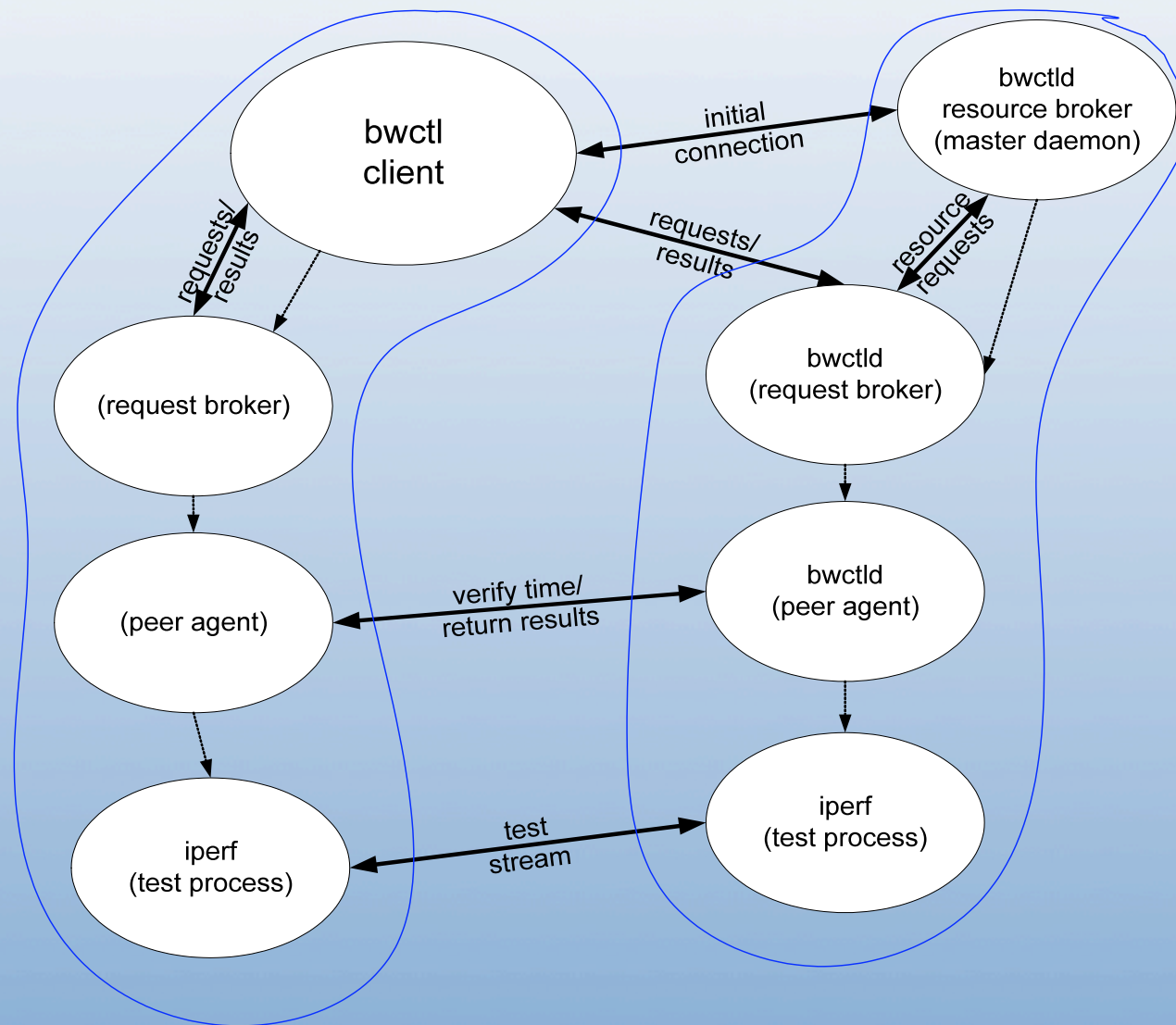
# Resource Allocation (bwctld)

- Each connection is “classified” (authentication)
- Each classification is hierarchical and has an associated set of hierarchical limits:
  - Connection policy (allow\_open\_mode)
  - Bandwidth (allow\_tcp,allow\_udp,bandwidth)
  - Scheduling (duration,event\_horizon,pending)
    - A time slot is simply a time-dependent resource that needs to be allocated just like any other resource. It therefore follows the resource allocation model.

# BWCTL: 3-party Interaction



# BWCTL: No Local Server





# Tester Applications

- Iperf is primary “tester”
  - Well known – widely used
- Problems integrating exec'd tool
  - Server initialization (port number allocation)
  - error conditions
  - No indication of partial progress (How full was the send buffer when the session was killed?)
- thrulay/nuttcp are available in latest ‘RC’ version of bwctl



# General Requirements

- Iperf version 2.0 and 2.0.2
- NTP (ntpd) synchronized clock on the local system
  - Used for scheduling
  - More important that errors are accurate than the clock itself
- Firewalls:
  - Lots of ports for communication and testing
- End hosts must be tuned!

[http://www.psc.edu/networking/perf\\_tune.html](http://www.psc.edu/networking/perf_tune.html)

<http://www-didc.lbl.gov/TCP-tuning/buffers.html>

# Supported Systems

- FreeBSD 4.x, 5.x
- Linux 2.4, 2.6
- (Most recent versions of UNIX should work)

# Policy/Security Considerations

- DoS source

- Imagine a large number of compromised BWCTLD servers being used to direct traffic

- DoS target

- Someone might attempt to affect statistics web pages to see how much impact they can have

- Resource consumption

- Time slots
- Network bandwidth

# Policy Recommendations

- Restrictive for UDP
- More liberal for TCP tests
- More liberal still for “peers”
- Protect AES keys!

# Availability

- Currently available

<http://e2epi.internet2.edu/bwctl/>

Mail lists:

- bwctl-users@internet2.edu
- bwctl-announce@internet2.edu

<https://mail.internet2.edu/wws/lists/engineering>

# OWAMP: What is it?

OWD or One-Way PING

- A control protocol
- A test protocol
- A sample implementation of both

# Why the OWAMP protocol?

- Find problems in the network
  - Congestion usually happens in one direction first...
  - Routing (asymmetric, or just changes)
  - SNMP polling intervals mask high queue levels that active probes can show
- There have been many implementations to do One-Way delay over the years (Surveyor, Ripe...)
  - The problem has been interoperability.
  - <http://www.ietf.org/rfc/rfc4656.txt>

# OWAMP Control protocol

- Supports authentication and authorization
- Used to configure tests
  - Endpoint controlled port numbers
  - Extremely configurable send schedule
  - Configurable packet sizes
- Used to start/stop tests
- Used to retrieve results
  - Provisions for dealing with partial session results



# OWAMP Test protocol

- Packets can be “open”, “authenticated”, or “encrypted”

# Sample Implementation

## Applications

- owampd daemon
- owping client

Open source license and development

Built upon protocol abstraction library

- Supports one-off applications
- Allows authentication/policy hooks to be incorporated

# Functionality (owping client)

- owping client requests OWD tests from an OWAMP server
- Client can be sender or receiver
- Communication can be “open”, “authenticated”, or “encrypted”
- Supports the setup of many tests concurrently
- Supports the buffering of results on the server for later retrieval

# Functionality (owampd)

## owampd

- Accepts requests for OWD tests
- Responds with accepted/denied
- Tests are formally started with a StartSessions message from the client.
- Runs tests
- Sessions with packets received at the server are buffered for later retrieval

# OWPING Example

```
boote@nms-rlat.chic.net.internet2.edu: /home/boote
boote@nms-rlat:~[360]$ owping nms-rlat.newy.net.internet2.edu
Approximately 13.0 seconds until results available

--- owping statistics from [64.57.17.34]:45355 to [nms-rlat.newy.net.internet2.e
du]:44244 ---
SID:      40391162cbec228e81118c1953a5eef9
first:    2008-05-31T19:16:31.627
last:     2008-05-31T19:16:43.362
100 sent, 0 lost (0.000%), 0 duplicates
one-way delay min/median/max = 11/11/11 ms, (err=0.0442 ms)
one-way jitter = 0 ms (P95-P50)
Hops = 3 (consistently)
no reordering

--- owping statistics from [nms-rlat.newy.net.internet2.edu]:44247 to [64.57.17.
34]:45356 ---
SID:      40391122cbec228ebb1bde827906fe35
first:    2008-05-31T19:16:31.608
last:     2008-05-31T19:16:41.979
100 sent, 0 lost (0.000%), 0 duplicates
one-way delay min/median/max = 10.9/11/11 ms, (err=0.0442 ms)
one-way jitter = 0 ms (P95-P50)
Hops = 3 (consistently)
no reordering

boote@nms-rlat:~[361]$
```

# OWAMP Data (Dash-Board)

OWAMP Grid: (now) Sat May 31 18:57:01 UTC 2008 --- Sat May 31 19:12:01 UTC 2008

http://owamp.net.internet2.edu/owamp\_grid.cgi

Latest Headlines Personal Finance Internet2 JRA1-PAT Abilene SCinet Travel GSoC

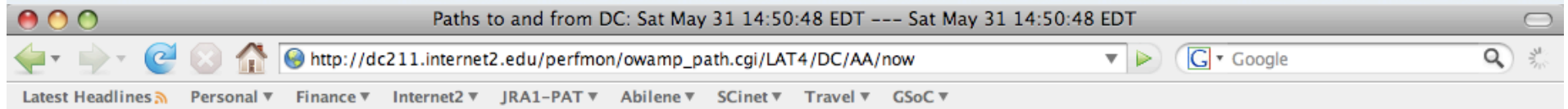
## OWAMP Data

[Latency (ms) / Packet Loss (%)]

OWAMP GRID	Receivers										
	Location	ISP	Atlanta	Chicago	Houston	KansasCity	LosAngeles	NewYorkCity	SaltLakeCity	Seattle	Washington
Senders	Atlanta	IPv4 Latency	0.010 / 0.00	9.872 / 0.00	12.218 / 0.00	15.288 / 0.00	28.318 / 0.00	9.435 / 0.00	27.427 / 0.00	* / *	6.816 / 0.00
	Atlanta	IPv6 Latency	0.010 / 0.00	9.878 / 0.00	12.224 / 0.00	15.294 / 0.00	28.333 / 0.00	9.443 / 0.00	27.436 / 0.00	* / *	6.821 / 0.00
	Chicago	IPv4 Latency	9.624 / 0.00	0.009 / 0.00	12.676 / 0.00	5.507 / 0.00	28.772 / 0.00	10.970 / 0.00	17.646 / 0.00	* / *	8.348 / 0.00
	Chicago	IPv6 Latency	9.631 / 0.00	0.010 / 0.00	12.685 / 0.00	5.512 / 0.00	28.789 / 0.00	10.978 / 0.00	17.653 / 0.00	* / *	8.353 / 0.00
	Houston	IPv4 Latency	11.298 / 0.00	12.004 / 0.00	0.010 / 0.00	6.901 / 0.00	16.164 / 0.00	20.665 / 0.00	19.041 / 0.00	* / *	18.049 / 0.00
	Houston	IPv6 Latency	11.303 / 0.00	12.012 / 0.00	0.011 / 0.00	6.907 / 0.00	16.173 / 0.00	20.675 / 0.00	19.047 / 0.00	* / *	18.057 / 0.00
	KansasCity	IPv4 Latency	14.812 / 0.00	5.280 / 0.00	7.347 / 0.00	0.010 / 0.00	23.438 / 0.00	16.149 / 0.00	12.309 / 0.00	* / *	13.527 / 0.00
	KansasCity	IPv6 Latency	14.818 / 0.00	5.285 / 0.00	7.354 / 0.00	0.006 / 0.00	23.444 / 0.00	16.158 / 0.00	12.313 / 0.00	* / *	13.532 / 0.00
	LosAngeles	IPv4 Latency	27.589 / 0.00	28.270 / 0.00	16.370 / 0.00	23.202 / 0.00	0.011 / 0.00	36.962 / 0.00	11.611 / 0.00	* / *	34.351 / 0.00
	LosAngeles	IPv6 Latency	27.601 / 0.00	28.279 / 0.00	16.378 / 0.00	23.217 / 0.00	0.011 / 0.00	36.977 / 0.00	11.612 / 0.00	* / *	34.356 / 0.00
	NewYorkCity	IPv4 Latency	9.375 / 0.00	10.998 / 0.00	21.523 / 0.00	16.404 / 0.00	37.625 / 0.00	0.010 / 0.00	28.544 / 0.00	* / *	2.630 / 0.00
	NewYorkCity	IPv6 Latency	9.382 / 0.00	11.008 / 0.00	21.533 / 0.00	16.412 / 0.00	37.632 / 0.00	0.010 / 0.00	28.553 / 0.00	* / *	2.634 / 0.00
	SaltLakeCity	IPv4 Latency	27.122 / 0.00	17.589 / 0.00	19.656 / 0.00	12.479 / 0.00	12.312 / 0.00	28.459 / 0.00	0.012 / 0.00	* / *	25.838 / 0.00
	SaltLakeCity	IPv6 Latency	27.129 / 0.00	17.595 / 0.00	19.663 / 0.00	12.483 / 0.00	12.319 / 0.00	28.468 / 0.00	0.012 / 0.00	* / *	25.844 / 0.00
	Seattle	IPv4 Latency	35.465 / 0.00	25.917 / 0.00	29.182 / 0.00	20.794 / 0.00	13.220 / 0.00	36.793 / 0.00	8.401 / 0.00	* / *	34.183 / 0.00
	Seattle	IPv6 Latency	35.472 / 0.00	25.949 / 0.00	29.189 / 0.00	20.796 / 0.00	13.224 / 0.00	36.800 / 0.00	8.404 / 0.00	* / *	34.194 / 0.00

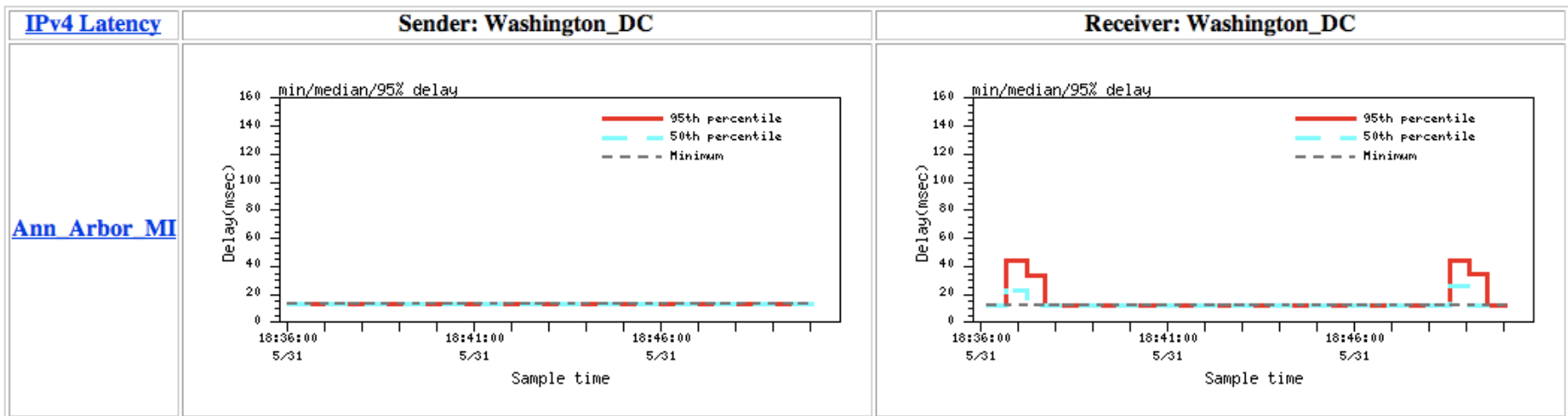
http://owamp.net.internet2.edu/owamp\_path.cgi/LAT6/ATLA/ATLA/now

# OWAMP Data (Path)



## OWAMP (network latency)

Paths to and from Washington\_DC: Sat May 31 14:50:48 EDT --- Sat May 31 14:50:48 EDT





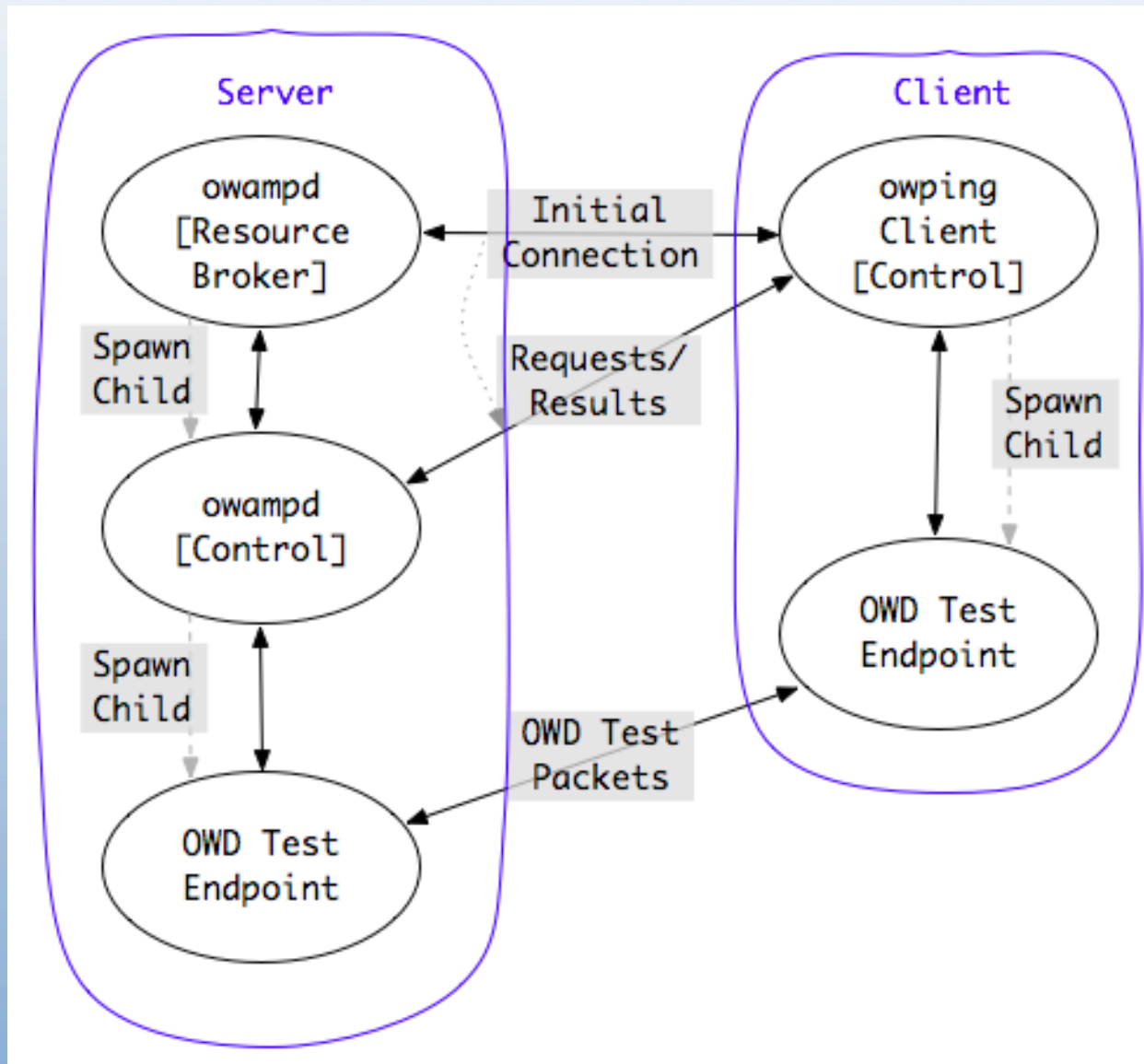
# Resource Allocation

- Each connection is “classified” (authentication)
- Each classification is associated with a set of hierarchical limits
  - Bandwidth (bandwidth)
  - Session buffer (disk)
  - Data retention (delete\_on\_fetch)
  - Connection policy (allow\_open\_mode)

(no time dependent dimension to resource allocation in owampd)



# Architecture



# General Requirements

- NTP (ntpd) synchronized clock on the local system
  - Specific configuration requirements as specified in NTP talk...
  - Strictly speaking, owamp will work without ntp. However, your results will be meaningless in many cases
- gnumake for build process

# Supported Systems

- FreeBSD 4.7+, 5.x, 6.0 (64-bit)
- Linux 2.4, 2.6 (64-bit)
- MacOS X 10.4.X
- Solaris 10.4.5
- (Most recent versions of UNIX should work)

# Recommended Hardware

- Stable System Clock
  - Temperature controlled environment
  - No power management of CPU
- No strict requirements for CPU, Memory, Bus speed
  - More tasking schedules will require more capable hardware

# Operational concerns

## Time:

- NTP issues predominate the problems
- Determining an accurate timestamp “error” is in many ways more difficult than getting a “very good” timestamp
- Working as an “open” server requires UTC time source (For predefined test peers, other options available)

## Firewalls:

- Port filter trade-off
  - Administrators like pre-defined port numbers
  - Vendor manufactures would probably like to “prioritize” test traffic
  - Owampd allows a range of ports to be specified for the receiver

# Policy/Security Considerations

- Third-Party DoS source
- DoS target
- Resource consumption
  - Memory (primary and secondary)
  - Network bandwidth

# Policy Recommendations

- Restrict overall bandwidth to something relatively small
  - Most OWAMP sessions do not require much
- Limit “open” tests to ensure they do not interfere with precision of other tests

# Availability

- Currently available

<http://e2epi.internet2.edu/owamp/>

Mail lists:

- owamp-users@internet2.edu
- owamp-announce@internet2.edu

<https://mail.internet2.edu/wws/lists/engineering>



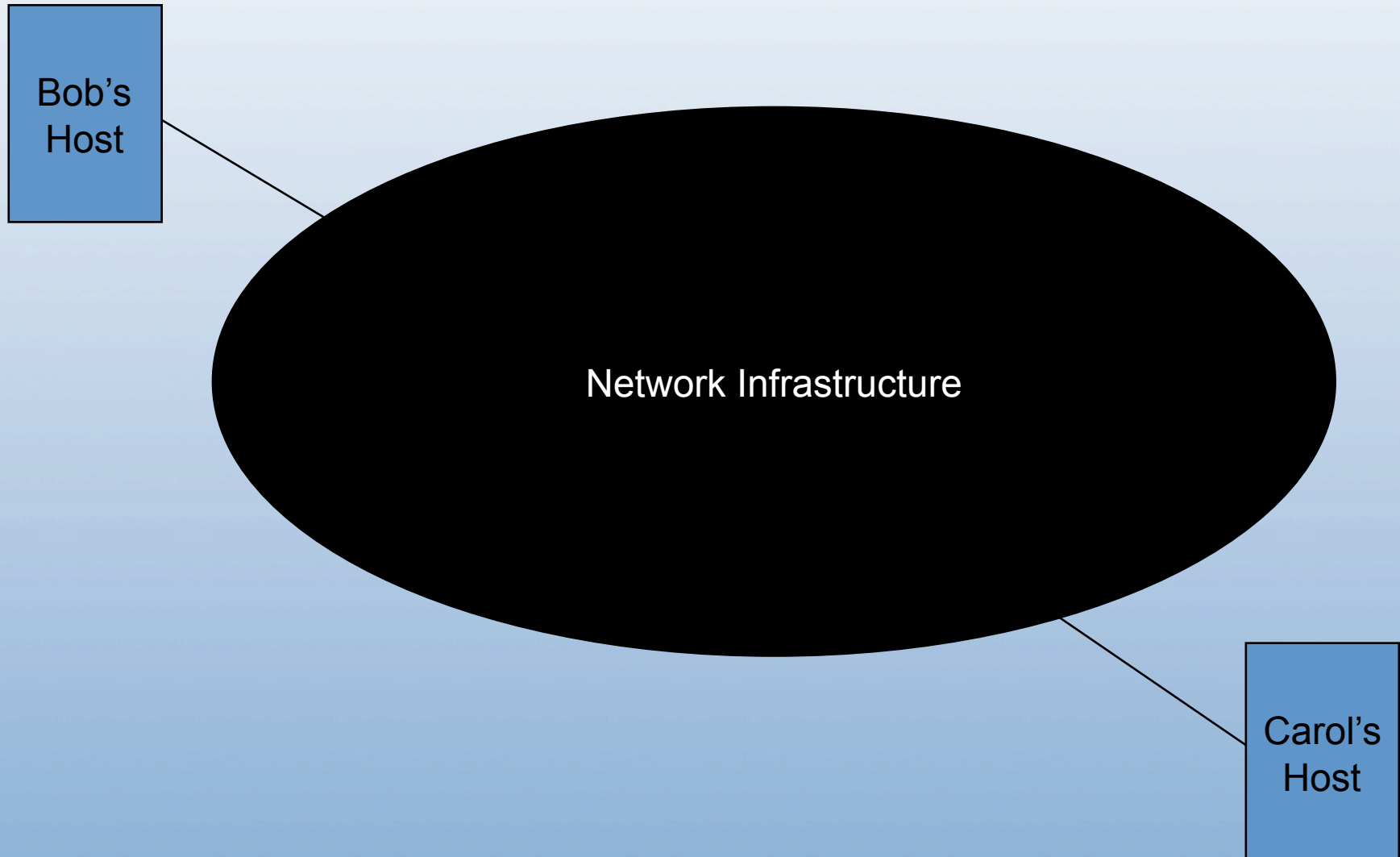
# Advanced user tools

- NDT
  - Allows users to test network path for a limited number of common problems
- NPAD
  - Allows users to test local network infrastructure while simulating a long path

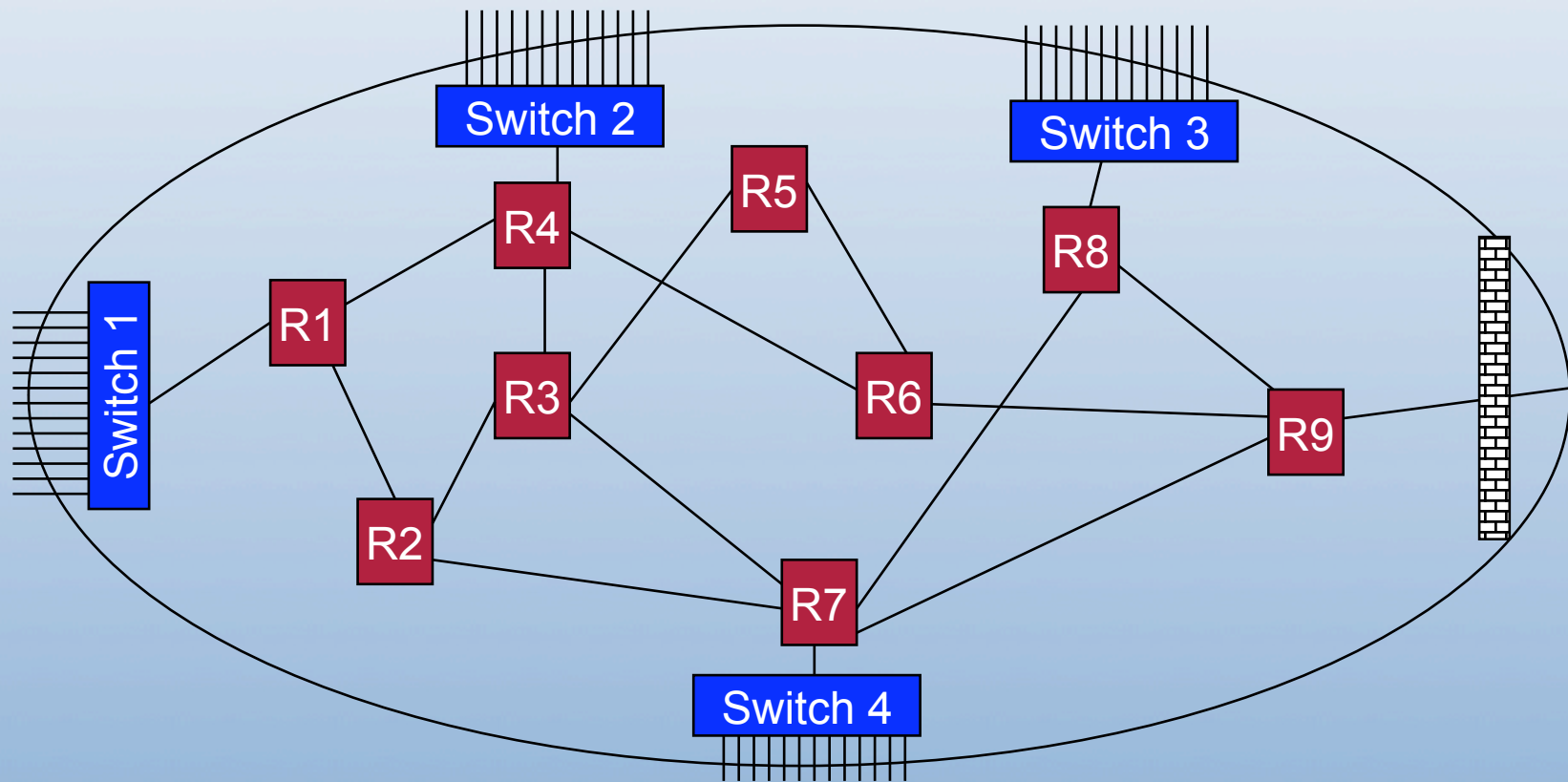
# Underlying User Assumption

- When problems exist, it's the networks fault!

# Simple Network Picture



# Network Infrastructure



# NDT: What is it?

Web browser invoked advanced user based diagnostics

- Allows users to test a network path for a limited number of common problems – from their desktop
- NDT allows user to give the network administrator a detailed view of exactly what the users host is doing
- Allows the user to be an active participant in the debugging process – allows them to more directly see how host configuration effects performance

Attempts to answer the questions:

What performance should a user expect?

What is the limiting factor?

# NDT Goals

- Identify real problems for real users
  - Network infrastructure is the problem
  - Host tuning issues are the problem
- Make tool simple to use and understand
- Make tool useful for users and network administrators

# NDT user interface

- Web-based JAVA applet allows testing from any browser
- Command-line client allows testing from remote login shell

# NDT sample Results

File Edit View Go Bookmarks Tools Help

http://207.75.164.80:7123/ Go

Getting Started Latest Headlines

**Located at Seattle - WA; 1000 Mbps (Gigabit Ethernet) network connection**

This java applet was developed to test the reliability 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

# Finding Results of Interest

- 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

# Finding NDT Servers

E2Epi | NDT Servers - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

http://e2epi.internet2.edu/ndt-server-list.html

Go

>web100srv(8)  
>fakewww(8)

**E2E PIPES**  
>piPES Software  
>>BWCTL  
>>OWAMP  
>>NDT  
>>ThruRay  
>Global PMP Directory  
>Testing to Abilene  
>>BWCTL  
>>OWAMP  
>Abilene Results

**WORKING GROUPS & COLLABORATIONS**  
> Working Groups  
> Collaborations

### NDT Servers

Abilene - <http://e2epi.internet2.edu/ndt/>

Location	Host	Interface	Online Stats
Indianapolis	<a href="http://ndt-indianapolis.abilene.ucaid.edu:7123">http://ndt-indianapolis.abilene.ucaid.edu:7123</a>	GigE	<a href="http://ndt-indianapolis.abilene.ucaid.edu:7123/admin.html">http://ndt-indianapolis.abilene.ucaid.edu:7123/admin.html</a>
New York	<a href="http://ndt-newyork.abilene.ucaid.edu:7123">http://ndt-newyork.abilene.ucaid.edu:7123</a>	GigE	<a href="http://ndt-newyork.abilene.ucaid.edu:7123/admin.html">http://ndt-newyork.abilene.ucaid.edu:7123/admin.html</a>
Seattle	<a href="http://ndt-seattle.abilene.ucaid.edu:7123">http://ndt-seattle.abilene.ucaid.edu:7123</a>	GigE	<a href="http://ndt-seattle.abilene.ucaid.edu:7123/admin.html">http://ndt-seattle.abilene.ucaid.edu:7123/admin.html</a>
Sunnyvale	<a href="http://ndt-sunnyvale.abilene.ucaid.edu:7123">http://ndt-sunnyvale.abilene.ucaid.edu:7123</a>	GigE	<a href="http://ndt-sunnyvale.abilene.ucaid.edu:7123/admin.html">http://ndt-sunnyvale.abilene.ucaid.edu:7123/admin.html</a>
Washington DC	<a href="http://ndt-washington.abilene.ucaid.edu:7123">http://ndt-washington.abilene.ucaid.edu:7123</a>	GigE	<a href="http://ndt-washington.abilene.ucaid.edu:7123/admin.html">http://ndt-washington.abilene.ucaid.edu:7123/admin.html</a>

**PMP Equipment Used for Abilene:**

- Intel SCB2 motherboard,
- 2 x 1.266 GHz PIII, 512 KB L2 cache, 133MHz FSB,
- 2 x 512MB ECC registered RAM (one/slot to enable interleaving),
- 2 x SEAGATE 18GB SCSI (ST318406LC)
- Primary NIC: SysConnect Gigabit Ethernet SK-9843 SX
- Secondary NIC Inter Ethernet Pro 10/100+ (i82555)

**Other Available Servers:**

Location	Host
ANL	<a href="http://miranda.ctd.anl.gov:7123/">http://miranda.ctd.anl.gov:7123/</a>
Swiss Education and Research Network (Switzerland)	<a href="http://cemp1.switch.ch/network/performance/web100/tcpbw100.html">http://cemp1.switch.ch/network/performance/web100/tcpbw100.html</a>
University of Michigan (Flint)	<a href="http://speedtest.umflint.edu/">http://speedtest.umflint.edu/</a>
UCal Santa Cruz	<a href="http://nitro.ucsc.edu/">http://nitro.ucsc.edu/</a>
Thomas Jefferson National Accelerator Facility	<a href="http://jlab4.jlab.org:7123/">http://jlab4.jlab.org:7123/</a>
Stanford University	<a href="http://netspeed.stanford.edu/">http://netspeed.stanford.edu/</a>
NSF (Arlington, VA)	<a href="http://ciseweb100.cise-nsf.gov:7123">http://ciseweb100.cise-nsf.gov:7123</a>
University of Hawaii (Honolulu)	<a href="http://farnsworth.uhnet.net:7123/">http://farnsworth.uhnet.net:7123/</a>
St. Mary's College of Maryland (Maryland)	<a href="http://ndt.smc.edu:7123/">http://ndt.smc.edu:7123/</a>

**NDT** 28 May, 2004

The original idea and implementation of the web-based testing server was designed and implemented by Tom Dunnigan from Oak Ridge National Laboratory. It has been extensively modified by Rich Carlson and changed to perform the current functions. This material is based on work supported [in part] by the Office of Science, U.S. Department of Energy under Contract W-31-109-ENG-38 and Argonne National Laboratory.

Done

# NPAD/pathdiag: What is it?

- Web browser invoked advanced user based diagnostics
  - Allows users to test a limited portion of the network path looking for problems that would adversely effect longer paths
  - Attempts to answer the questions:
    - What performance should a user expect?
    - What is the limiting factor?

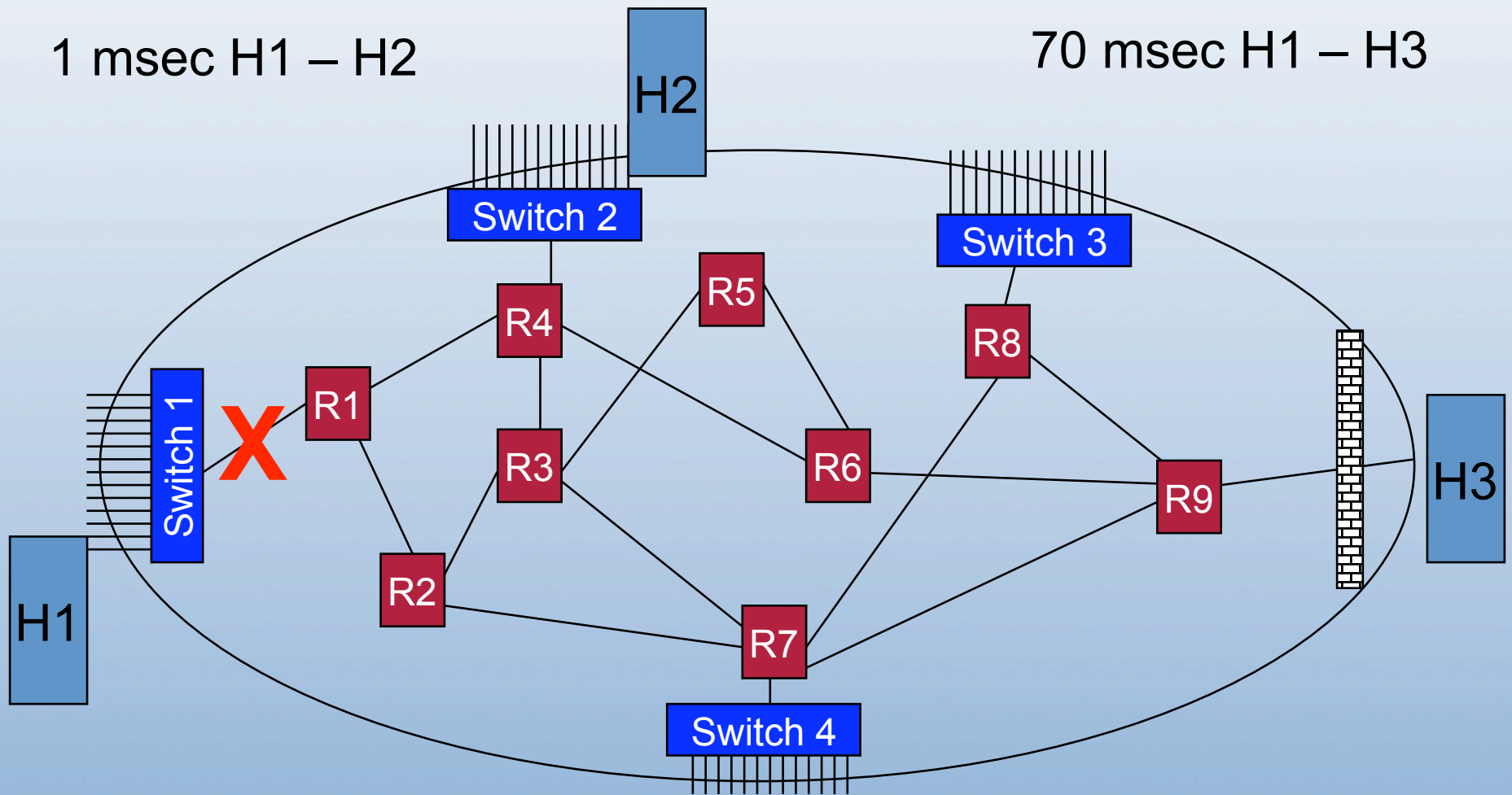
# NPAD/pathdiag

- A new tool from researchers at Pittsburgh Supercomputer Center
- Finds problems that affect long network paths
- Uses Web100-enhanced Linux based server
- Web based Java client

# Long Path Problem

1 msec H1 – H2

70 msec H1 – H3



# Long Path Problem

- E2E application performance is dependant on distance between hosts
- Full size frame time at 100 Mbps
  - Frame = 1500 Bytes
  - Time = 0.12 msec
  - In flight for 1 msec RTT = 8 packets
  - In flight for 70 msec RTT = 583 packets

# TCP Congestion Avoidance

- Cut number of packets by  $\frac{1}{2}$
- Increase by 1 per RTT
  - LAN (RTT=1msec)
    - In flight changes to 4 packets
    - Time to increase back to 8 is 4msec
  - WAN (RTT = 70 msec)
    - In flight changes to 292 packets
    - Time to increase back to 583 is 20.4 seconds



# NPAD Server main page

The screenshot shows a Mozilla Firefox browser window titled "NPAD Diagnostics at Internet2 (Ann Arbor - MI)". The address bar displays "http://web100.internet2.edu:8200/". The page has a dark red header with the "NPAD" logo and the text "One-click network diagnostics". To the right of the header, it says "Server located at Internet2 in Ann Arbor - MI". Below the header, there are links for "Documentation", "Results Summary", and "About NPAD". A paragraph describes NPAD as a tool for diagnosing network performance problems. A section titled "Brief instructions" contains a bulleted list of guidelines for using the tool. Below this, a link points to "NPAD Documentation". Another bulleted list provides links to "NPAD Diagnostic Procedure", "Theory and Method", and "Outcomes". A central box titled "Test from server web100.internet2.edu to this machine" contains input fields for "Round Trip Time (msec)" (with the value 22) and "Target Rate (Mbps)" (with the value 7), along with a "Start Test" button. Below the input fields is a "Log:" section with a scrollable text area. At the bottom of the page, a footer contains a request for comments and suggestions, along with an email address "RACarlson <rcarlson@internet2.edu>". The status bar at the very bottom indicates "Applet DiagClient started".

NPAD Diagnostics at Internet2 (Ann Arbor - MI) - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

http://web100.internet2.edu:8200/ Go

## NPAD

One-click network diagnostics

Server located at Internet2 in Ann Arbor - MI

[Documentation](#) | [Results Summary](#) | [About NPAD](#)

NPAD (Network Path and Application Diagnosis) is designed to diagnose network performance problems in your end-system (the machine your browser is running on) or the network between it and your nearest NPAD server. For each diagnosed problem, the server prescribes corrective actions with instructions suitable for non-experts.

### Brief instructions

- The test results are most accurate over a short network path. If this NPAD server (located at Internet2 in Ann Arbor - MI) is not near you, look for a closer server from the list of [Current NPAD Diagnostic Servers](#).
- Have an end-to-end application performance goal ([target round-trip time](#) and [target data rate](#)) in mind. Enter the parameters on the form below and click **Start Test**. Messages will appear in the log window as the test runs, followed by a diagnostic report.
- In the diagnostic report, failed tests ([in red](#)) indicate problems that will prevent the application from meeting the end-to-end performance goal. For each message, a question-mark link ([?](#)) leads to additional detailed information about the results.
- Every test is fully logged and test results are [public](#). We use the logs and results to further refine the software.

For more information, see the [NPAD Documentation](#), especially the sections:

- [NPAD Diagnostic Procedure](#) - the full instructions.
- [Theory and Method](#) - why the tests work.
- [Outcomes](#) - what to do next in the broader debugging context.

Test from server web100.internet2.edu to this machine

Round Trip Time (msec):

Target Rate (Mbps):

[Start Test](#)

Log:

Please send comments and suggestions about the server to [RACarlson <rcarlson@internet2.edu>](mailto:RACarlson@internet2.edu).

Applet DiagClient started

# NPAD Sample results

Test Results - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

http://web100.internet2.edu:8200/ServerData/c-24-15-178-61.hsd1.il.comcast.net:2007-01-18-23:15:48.html

Go

### Test conditions

Tester: (none) (207.75.164.80) [?]  
Target: (none) (24.15.178.61) [?]  
Logfile base name: c-24-15-178-61.hsd1.il.comcast.net:2007-01-18-23:15:48 [?]  
This report is based on a 7 Mb/s target application data rate [?]  
This report is based on a 22 ms Round-Trip-Time (RTT) to the target application [?]  
The Round Trip Time for this path section is 21.048524 ms.  
The Maximum Segment Size for this path section is 1460 Bytes. [?]

### Target host TCP configuration test: Warning! [?]

Warning: TCP connection is not using RFC1323 timestamps. [?]  
Diagnosis: The target (client) is not properly configured. [?]  
Warnings reflect problems that might not affect target end-to-end performance. [?]  
> See TCP tuning instructions at <http://www.psc.edu/networking/projects/tcptune/> [?]

### Path measurements [?]

#### Data rate test: Pass! [?]

Pass data rate check: maximum data rate was 8.969226 Mb/s [?]

#### Loss rate test: Pass! [?]

Pass: measured loss rate 0.035214% (2839 packets between loss events). [?]  
FYI: To get 7 Mb/s with a 1460 byte MSS on a 22 ms path the total end-to-end loss budget is 0.282486% (354 packets between losses). [?]

### Suggestions for alternate tests

FYI: This path may even pass with a more strenuous application: [?]  
Try rate=7 Mb/s, rtt=62 ms  
Try rate=8 Mb/s, rtt=48 ms  
Or if you can raise the MTU: [?]  
Try rate=7 Mb/s, rtt=383 ms, mhu=9000 bytes  
Try rate=8 Mb/s, rtt=299 ms, mhu=9000 bytes

### Network buffering test: Pass! [?]

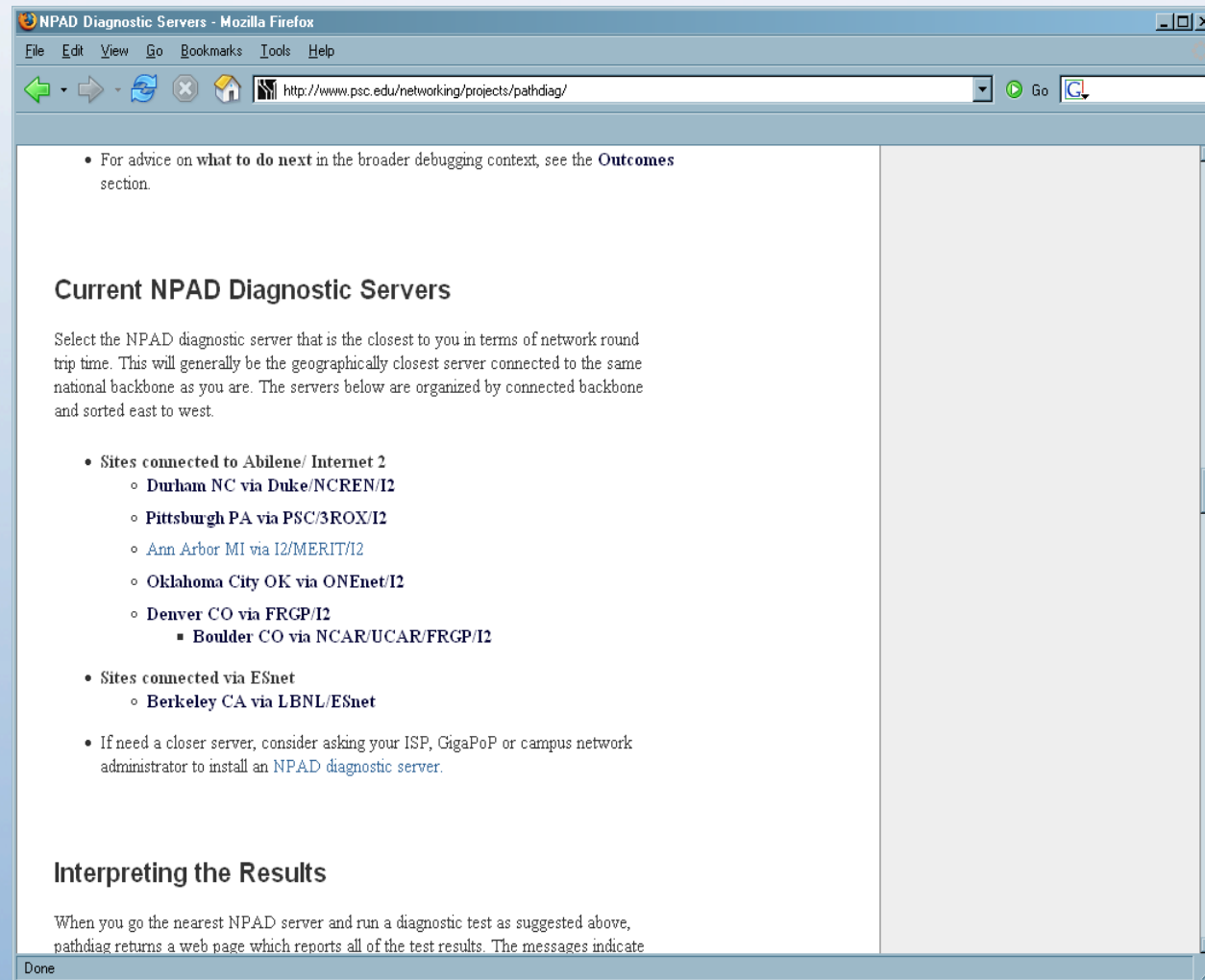
Pass: The network bottleneck has sufficient buffering (queue space) in routers and switches. [?]  
Measured queue size, Pkts: 36 Bytes: 52560 [?]  
This corresponds to a 48.333600 ms drain time. [?]  
To get 7 Mb/s with on a 22 ms path, you need 19250 bytes of buffer space. [?]

The network path passed all tests! [?]

### Tester validation: Pass! [?]

Done

# Finding NPAD servers



# Try these tools

## Network Performance Toolkit

<http://e2epi.internet2.edu/network-performance-toolkit.html>

Knoppix disk (OS on a CD) that has:

lperf, thrulay, bwctl, owamp, NDT, NPAD, reverse-traceroute/ping...

Questions?

[www.internet2.edu](http://www.internet2.edu)

