
March 10th 2011, OSG All Hands Meeting, Network Performance

Jason Zurawski – Internet2

# OWAMP

# Agenda

- Tutorial Agenda:
  - Network Performance Primer - Why Should We Care? (**15 Mins**)
  - Getting the Tools (**10 Mins**)
  - Use of the BWCTL Server and Client (**30 Mins**)
  - Use of the OWAMP Server and Client (**30 Mins**)
  - Use of the NDT Server and Client (**30 Mins**)
  - Diagnostics vs Regular Monitoring (**30 Mins**)
  - Network Performance Exercises (**1 hr 30 Mins**)

# OWAMP: What is it

- OWAMP is:
  - Command line client application
  - Policy and scheduling daemon
  - Used to determine ***one way*** latencies between hosts.
- Implementation of the OWAMP protocol as defined by http://www.rfc-editor.org/rfc/rfc4656.txt
  - Command Protocol to speak between client and server, server and server
  - Test protocol
- Different attempts to do this in the past:
  - Surveyor
  - RIPE

# Why *One Way* Latency?

- Passive Measurements (e.g. SNMP)
  - Higher polling interval may mask queue depths
  - Active probing gives a better picture of *real* traffic
- Round Trip Measurements:
  - Hard to isolate the direction of a problem
  - Congestion and queuing can be masked in the final measurement
  - Can be done with a single ‘beacon’ (e.g. using ICMP responses)
- One Way Measurements:
  - Direction of a problem is implicit
  - Detects asymmetric behavior
  - See congestion or queuing in one direction first (normal behavior)
  - Requires ‘2 Ends’ to measure properly

# OWAMP Control Protocol

- Supports authentication and authorization of the users that will test
- Used to configure the parameters of a test
  - 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 in the event of a failure

# OWAMP Test Protocol

- "*Lightweight*" compared to the control protocol
- Uses UDP as the transport protocol, since the protocol needs to be able to measure individual packet delivery times
- Supports varying packet sizes
- Data needed to calculate experimental errors on the final result is in every packet
- Packets can be "open", "authenticated", or "encrypted"

# Sample Implementation

- Applications
  - Daemon (owampd)
  - Clients (owping, powstream)
- Open Source License & Development
  - Modified BSD (http://www.internet2.edu/membership/ip.html)
  - Mailing lists for developer communication – come join us!
- Protocol Abstraction Library
  - Will support development of new clients
  - Add custom 'hooks' into the policy (e.g. add authentication via OpenID or similar)

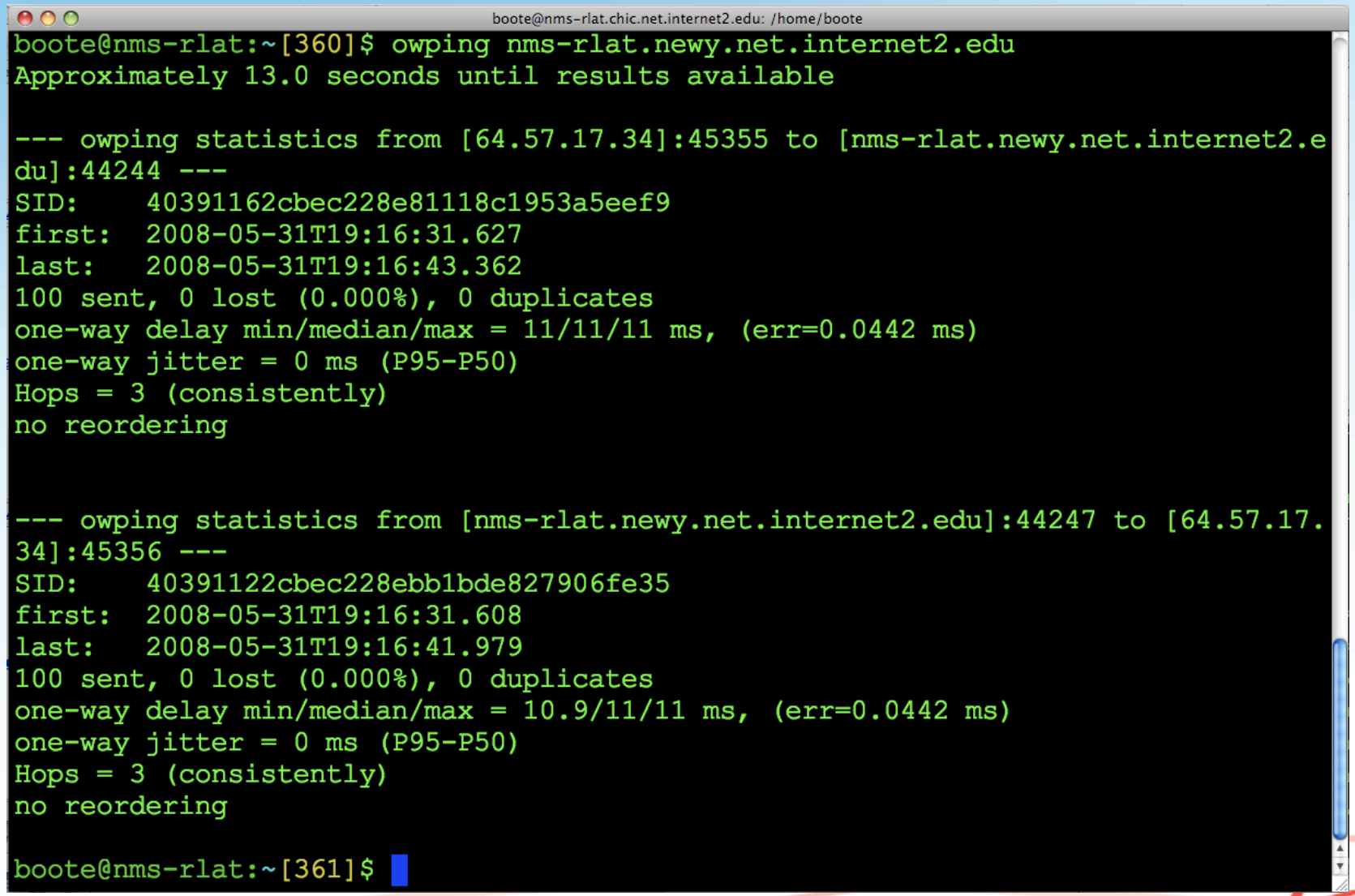
# Functionality (owping client)

- Meant to operate like traditional “ping”
- owping client requests OWD tests from an OWAMP server (owampd)
- Client can be ‘sender’ or ‘receiver’
  - Both directions are tested unless otherwise specified
- Communication can be “open”, “authenticated”, or “encrypted”
- Supports the setup of many tests concurrently
- Supports the storage of results on the server for later retrieval

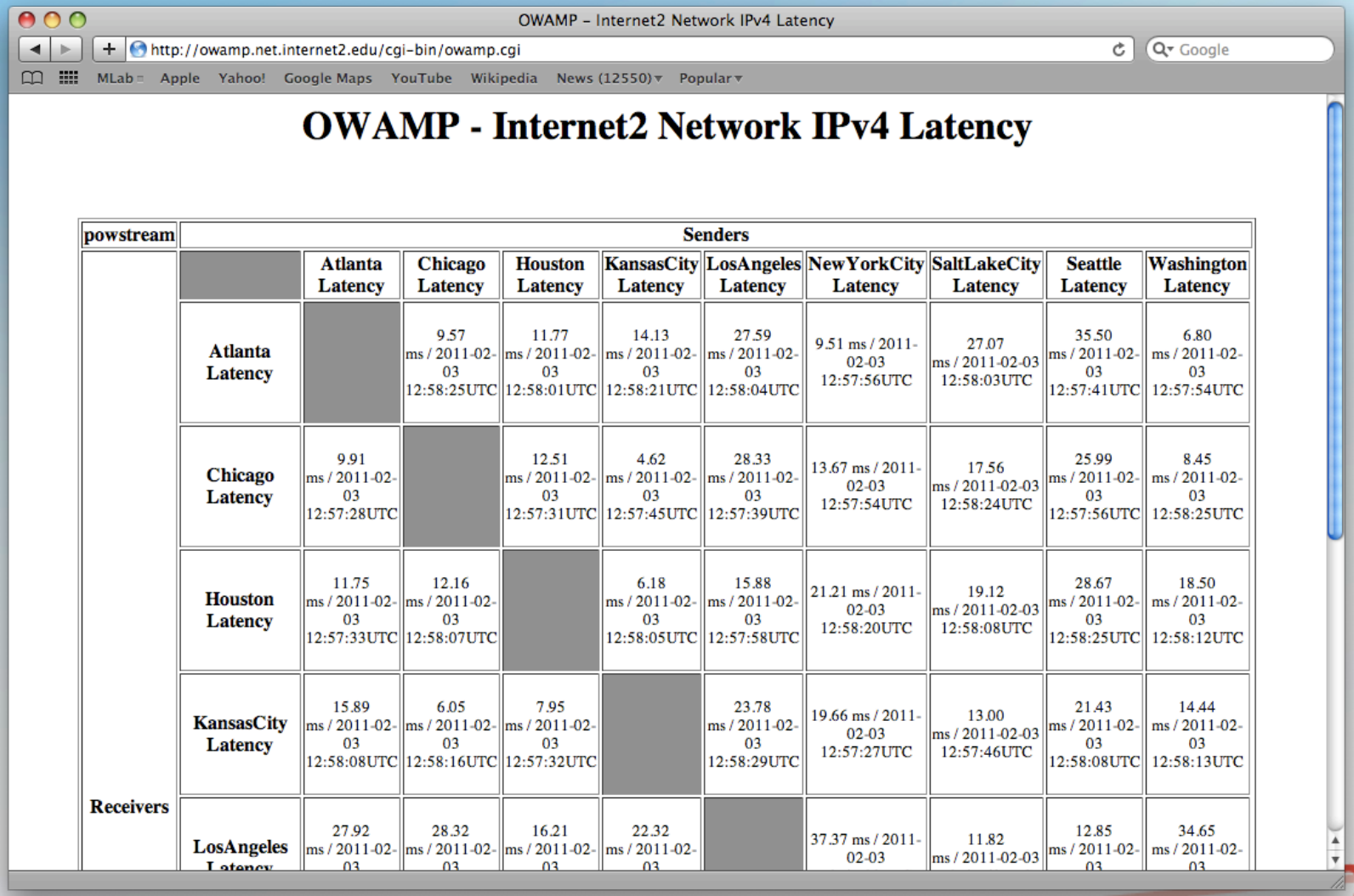
# Functionality (owampd server)

- 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



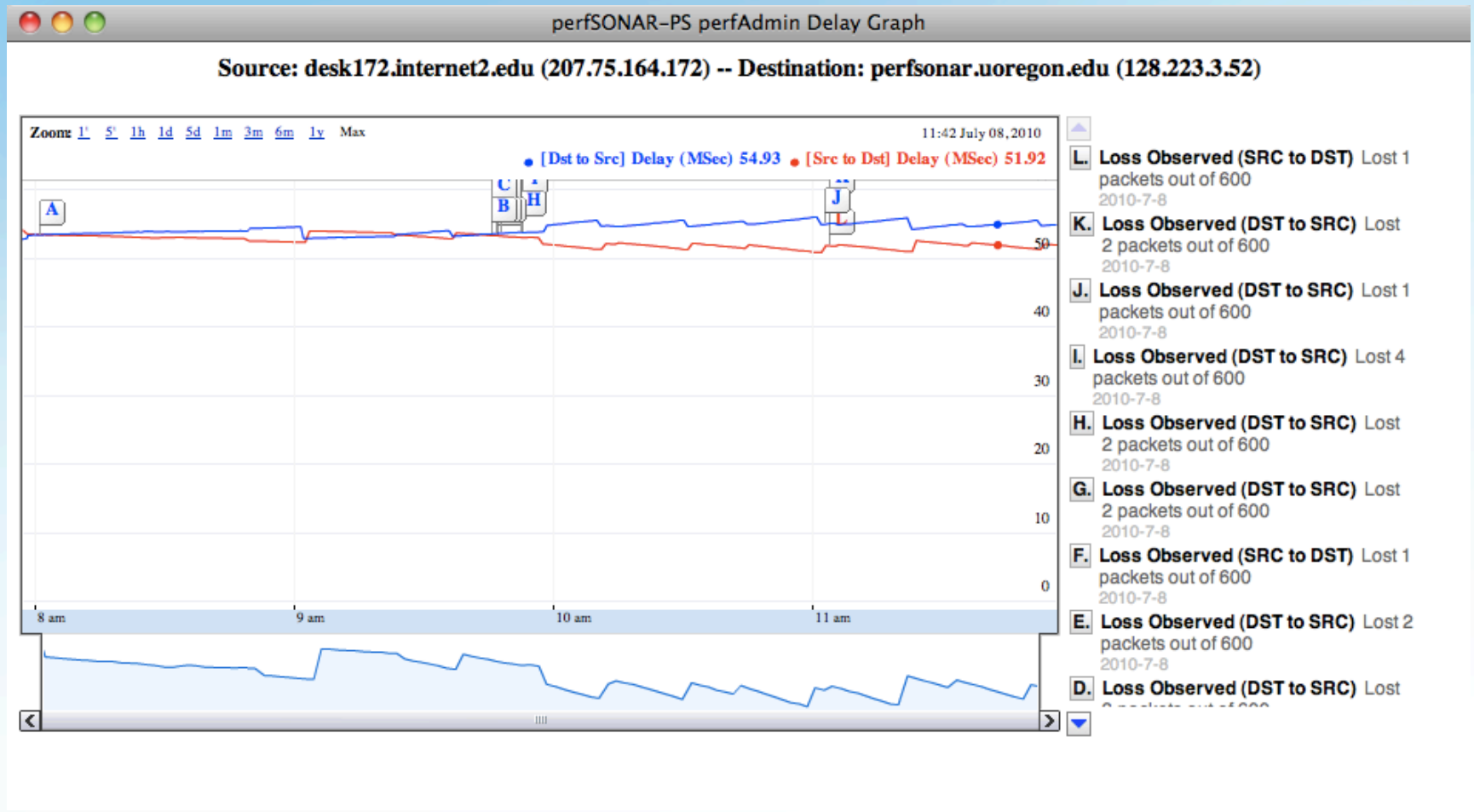
# OWAMP GUIs - Mesh



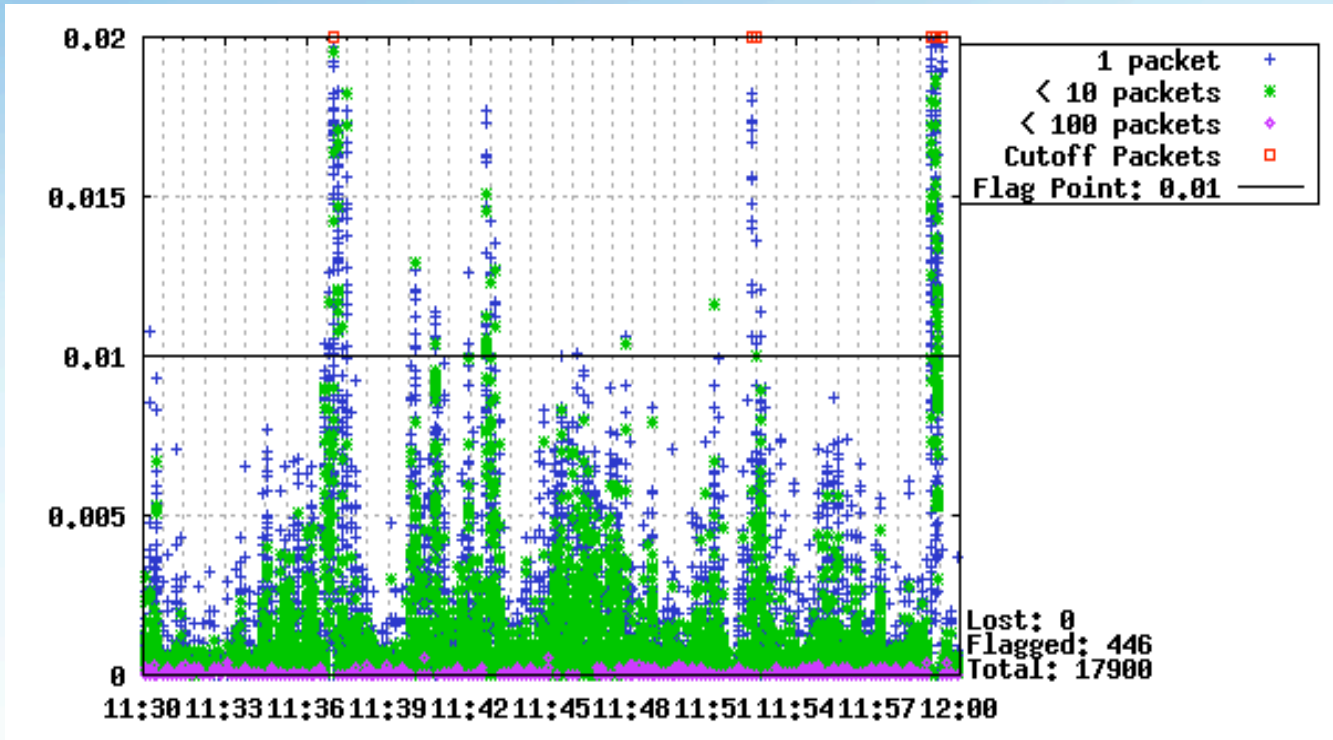

## OWAMP - Internet2 Network IPv4 Latency

| powstream | Senders | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Atlanta Latency | Chicago Latency | Houston Latency | KansasCity Latency | LosAngeles Latency | NewYorkCity Latency | SaltLakeCity Latency | Seattle Latency | Washington Latency |
| Receivers | Atlanta Latency | | 9.57 ms / 2011-02-03 12:58:25UTC | 11.77 ms / 2011-02-03 12:58:01UTC | 14.13 ms / 2011-02-03 12:58:21UTC | 27.59 ms / 2011-02-03 12:58:04UTC | 9.51 ms / 2011-02-03 12:57:56UTC | 27.07 ms / 2011-02-03 12:58:03UTC | 35.50 ms / 2011-02-03 12:57:41UTC | 6.80 ms / 2011-02-03 12:57:54UTC |
| | Chicago Latency | 9.91 ms / 2011-02-03 12:57:28UTC | | 12.51 ms / 2011-02-03 12:57:31UTC | 4.62 ms / 2011-02-03 12:57:45UTC | 28.33 ms / 2011-02-03 12:57:39UTC | 13.67 ms / 2011-02-03 12:57:54UTC | 17.56 ms / 2011-02-03 12:58:24UTC | 25.99 ms / 2011-02-03 12:57:56UTC | 8.45 ms / 2011-02-03 12:58:25UTC |
| | Houston Latency | 11.75 ms / 2011-02-03 12:57:33UTC | 12.16 ms / 2011-02-03 12:58:07UTC | | 6.18 ms / 2011-02-03 12:58:05UTC | 15.88 ms / 2011-02-03 12:57:58UTC | 21.21 ms / 2011-02-03 12:58:20UTC | 19.12 ms / 2011-02-03 12:58:08UTC | 28.67 ms / 2011-02-03 12:58:25UTC | 18.50 ms / 2011-02-03 12:58:12UTC |
| | KansasCity Latency | 15.89 ms / 2011-02-03 12:58:08UTC | 6.05 ms / 2011-02-03 12:58:16UTC | 7.95 ms / 2011-02-03 12:57:32UTC | | 23.78 ms / 2011-02-03 12:58:29UTC | 19.66 ms / 2011-02-03 12:57:27UTC | 13.00 ms / 2011-02-03 12:57:46UTC | 21.43 ms / 2011-02-03 12:58:08UTC | 14.44 ms / 2011-02-03 12:58:13UTC |
| | LosAngeles Latency | 27.92 ms / 2011-02-03 | 28.32 ms / 2011-02-03 | 16.21 ms / 2011-02-03 | 22.32 ms / 2011-02-03 | | 37.37 ms / 2011-02-03 | 11.82 ms / 2011-02-03 | 12.85 ms / 2011-02-03 | 34.65 ms / 2011-02-03 |

# OWAMP GUIs – Delay/Loss Plot



# OWAMP GUIs - Jitter

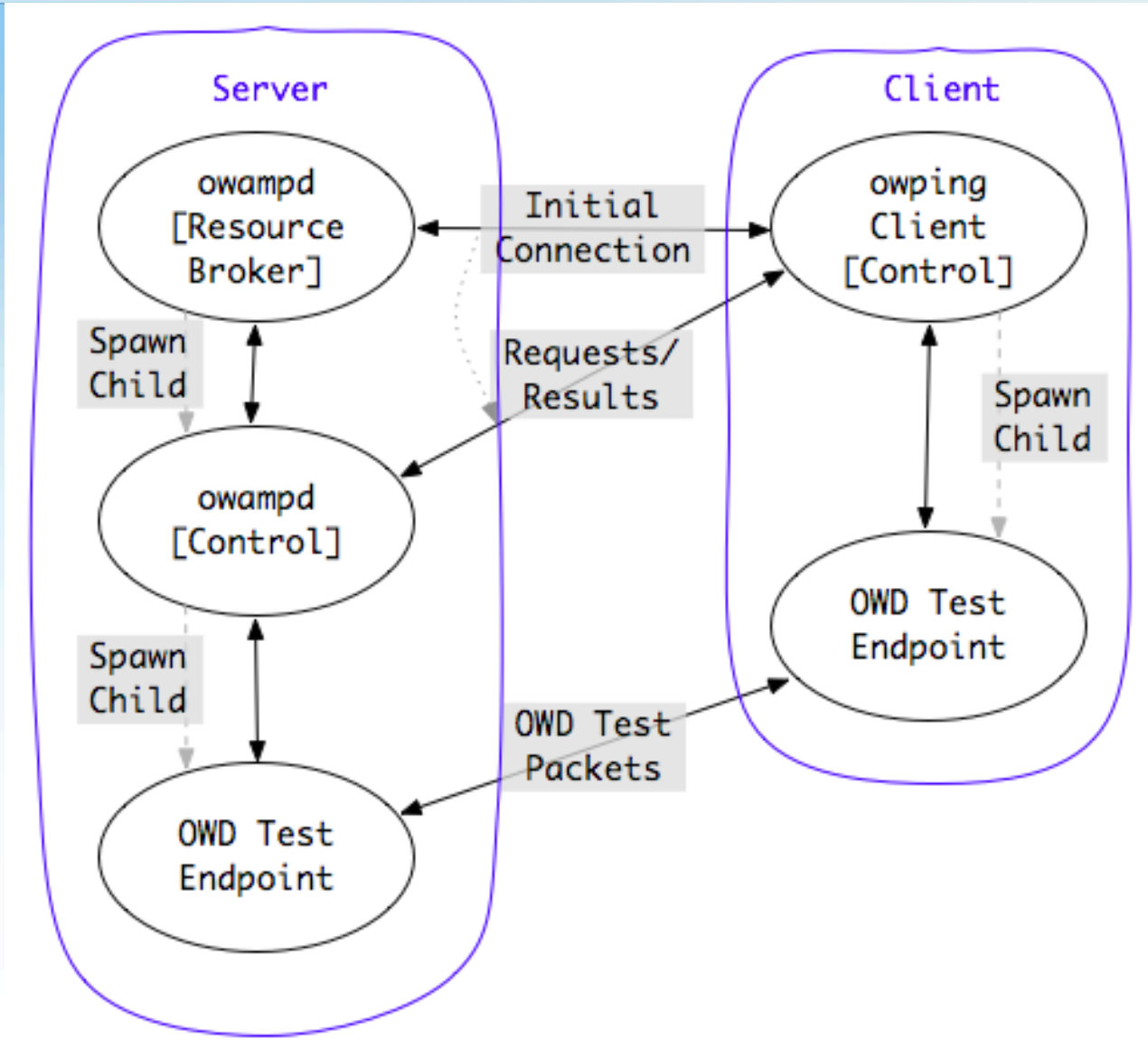


# Resource Allocation

- 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



# OWAMP Requirements

- Clock requirement is the strongest
  - Doesn't work well in virtualized environments
  - Doesn't work well when machine is doing heavier testing (e.g. BWCTL), results may be suspect
- 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

# General Requirements – Time Source

- NTP (ntpd) synchronized clock on the local system
  - Configure NTP properly (don't rely on system defaults!)
  - Strictly speaking, owamp will work without NTP. However, your results will be meaningless in many cases
  - More info here: http://www.internet2.edu/performance/owamp/details.html#NTP

# General Requirements – Support

- Source Code
  - All modern Unix distributions (Free BSD/Linux)
  - OS X
- Packages
  - Support for CentOS 5.5 (x86)
  - Packages have been shown to operate on similar systems (CentOS, Fedora, RHEL, and x86_64 architecture)

# Hardware

- "Bare Metal" – virtualization is tricky
- Stable System Clock
  - Temperature controlled environment
  - No power management of CPU
  - Reduction of "background" services – may institute noise
- 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
  - Compromised server may send packets to other locations.
- DoS target
  - Excessive traffic will harm measurement results
  - Someone might attempt to affect statistics web pages to see how much impact they can have
- Resource consumption
  - Time slots
  - 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://www.internet2.edu/performance/owamp
  - http://www.software.internet2.edu
- Mail lists:
  - https://lists.internet2.edu/sympa/info/owamp-users
    - owamp-users@internet2.edu
  - https://lists.internet2.edu/sympa/info/owamp-announce
    - owamp-announce@internet2.edu

# Hands On

- Testing OWAMP:
  - Log on to testbed
  - Test from one host to another:
    - owping HOSTNAME
  - Try different hosts. Try longer tests. What happens when we use:
    - -c (number of packets to send, try 1000)
    - -t (test to HOSTNAME only)
    - -f (test from HOSTNAME only)

# OWAMP

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