August 10th 2010, OSG Site Admin Workshop - Network Performance

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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**)
  - BREAK (**15 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
  - owampd daemon
  - owping client

- Open source license and development
- Built upon protocol abstraction library
  - Supports *one-off* applications
    - E.g. "powstream" is a client that sends a constant stream of measurement packets.
  - Allows authentication/policy hooks to be incorporated

Functionality (owping client)

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

Functionality (owampd server)

- owampd
  - Accepts requests for tests
  - Responds with a message: *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 GUIs - Mesh

BWCTL – Internet2 Network IPv4 TCP Throughput

http://owamp.net.internet2.edu/cgi-bin/bwctl.cgi?name=I2OBSBWTCP4

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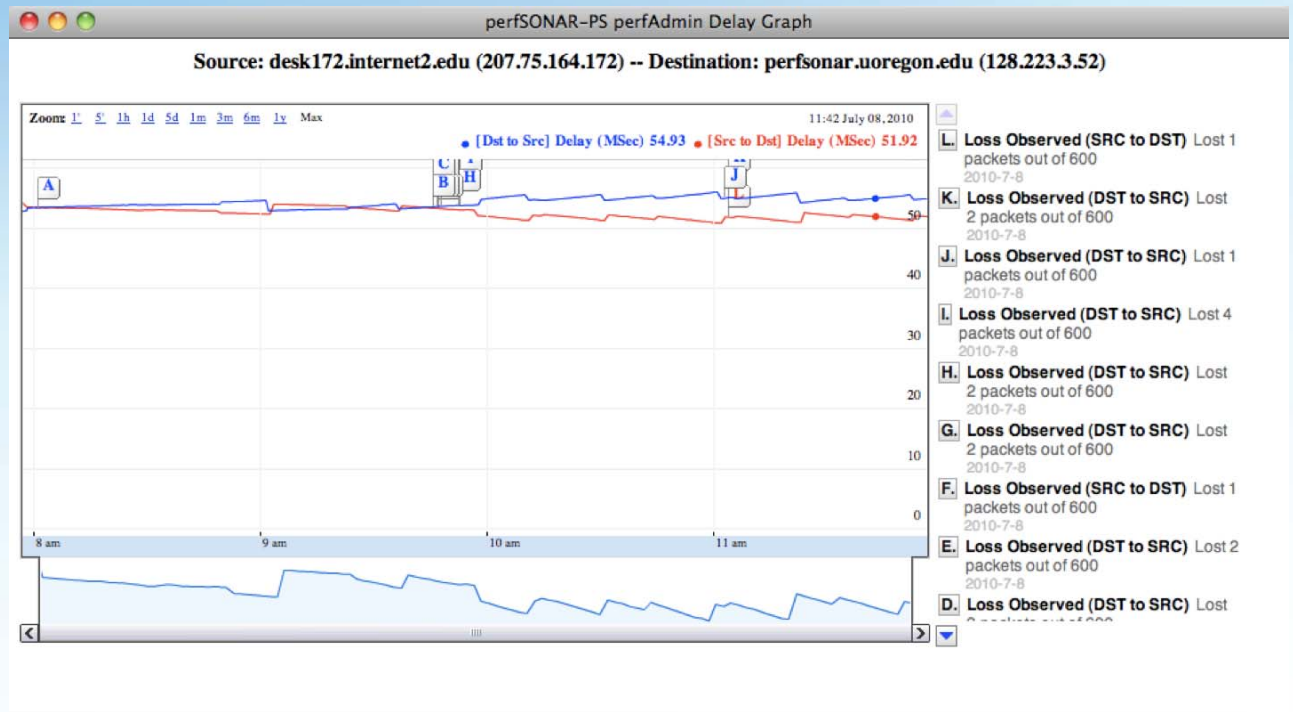
BWCTL – Internet2 Network IPv4 ...

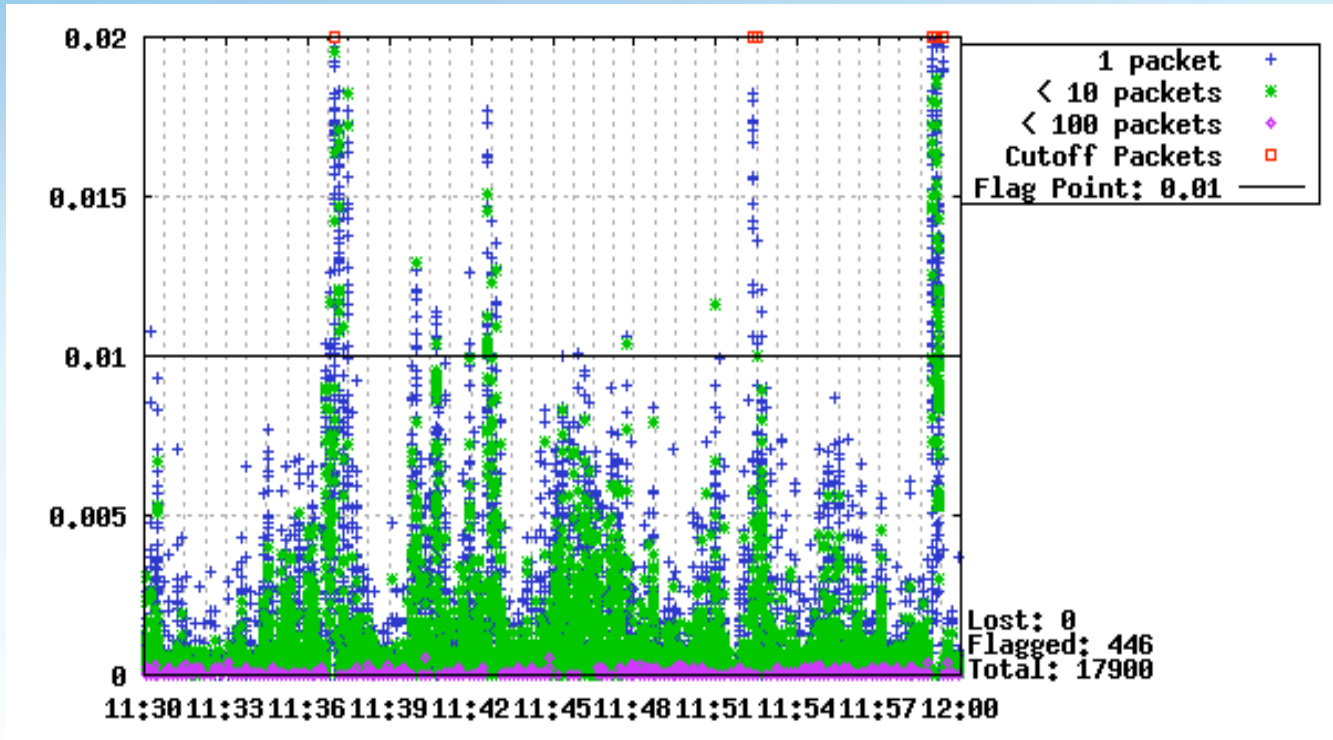
BWCTL - Internet2 Network IPv4 TCP Throughput

bwctl/iperf		Senders								
		Atlanta	Chicago	Houston	KansasCity	LosAngeles	NewYorkCity	SaltLakeCity	Seattle	Washington
Receivers	Atlanta		942.05 Mbps / 2010-08-04 15:23:38UTC	941.71 Mbps / 2010-08-04 15:48:27UTC	940.73 Mbps / 2010-08-04 15:19:23UTC	739.21 Mbps / 2010-08-04 15:30:09UTC	942.13 Mbps / 2010-08-04 15:53:04UTC	750.63 Mbps / 2010-08-04 15:03:04UTC	584.82 Mbps / 2010-08-04 15:37:41UTC	942.48 Mbps / 2010-08-04 14:52:52UTC
	Chicago	941.89 Mbps / 2010-08-04 15:29:03UTC		941.59 Mbps / 2010-08-04 15:42:01UTC	943.05 Mbps / 2010-08-04 15:51:53UTC	725.54 Mbps / 2010-08-04 15:50:49UTC	941.10 Mbps / 2010-08-04 15:12:53UTC	940.02 Mbps / 2010-08-04 15:20:24UTC	790.14 Mbps / 2010-08-04 15:10:29UTC	941.85 Mbps / 2010-08-04 15:30:09UTC
	Houston	941.38 Mbps / 2010-08-04 15:05:15UTC	941.39 Mbps / 2010-08-04 15:18:16UTC		942.66 Mbps / 2010-08-04 15:46:36UTC	940.46 Mbps / 2010-08-04 15:11:47UTC	939.01 Mbps / 2010-08-04 15:37:40UTC	939.52 Mbps / 2010-08-04 15:19:20UTC	718.16 Mbps / 2010-08-04 15:09:22UTC	934.40 Mbps / 2010-08-04 15:35:30UTC
	KansasCity	940.56 Mbps / 2010-08-04 15:56:17UTC	943.04 Mbps / 2010-08-04 15:21:29UTC	942.87 Mbps / 2010-08-04 15:57:21UTC		877.98 Mbps / 2010-08-04 15:06:01UTC	939.68 Mbps / 2010-08-04 15:18:17UTC	941.40 Mbps / 2010-08-04 15:40:55UTC	939.17 Mbps / 2010-08-04 15:29:02UTC	938.64 Mbps / 2010-08-04 15:52:57UTC
	LosAngeles	739.23 Mbps / 2010-08-04 15:09:21UTC	724.58 Mbps / 2010-08-04 14:58:16UTC	940.67 Mbps / 2010-08-04 15:49:32UTC	877.70 Mbps / 2010-08-04 15:42:00UTC		563.14 Mbps / 2010-08-04 15:44:25UTC	941.55 Mbps / 2010-08-04 15:45:29UTC	941.33 Mbps / 2010-08-04 15:22:34UTC	593.10 Mbps / 2010-08-04 15:12:51UTC

OWAMP GUIs – Delay/Loss Plot



OWAMP GUIs - Jitter

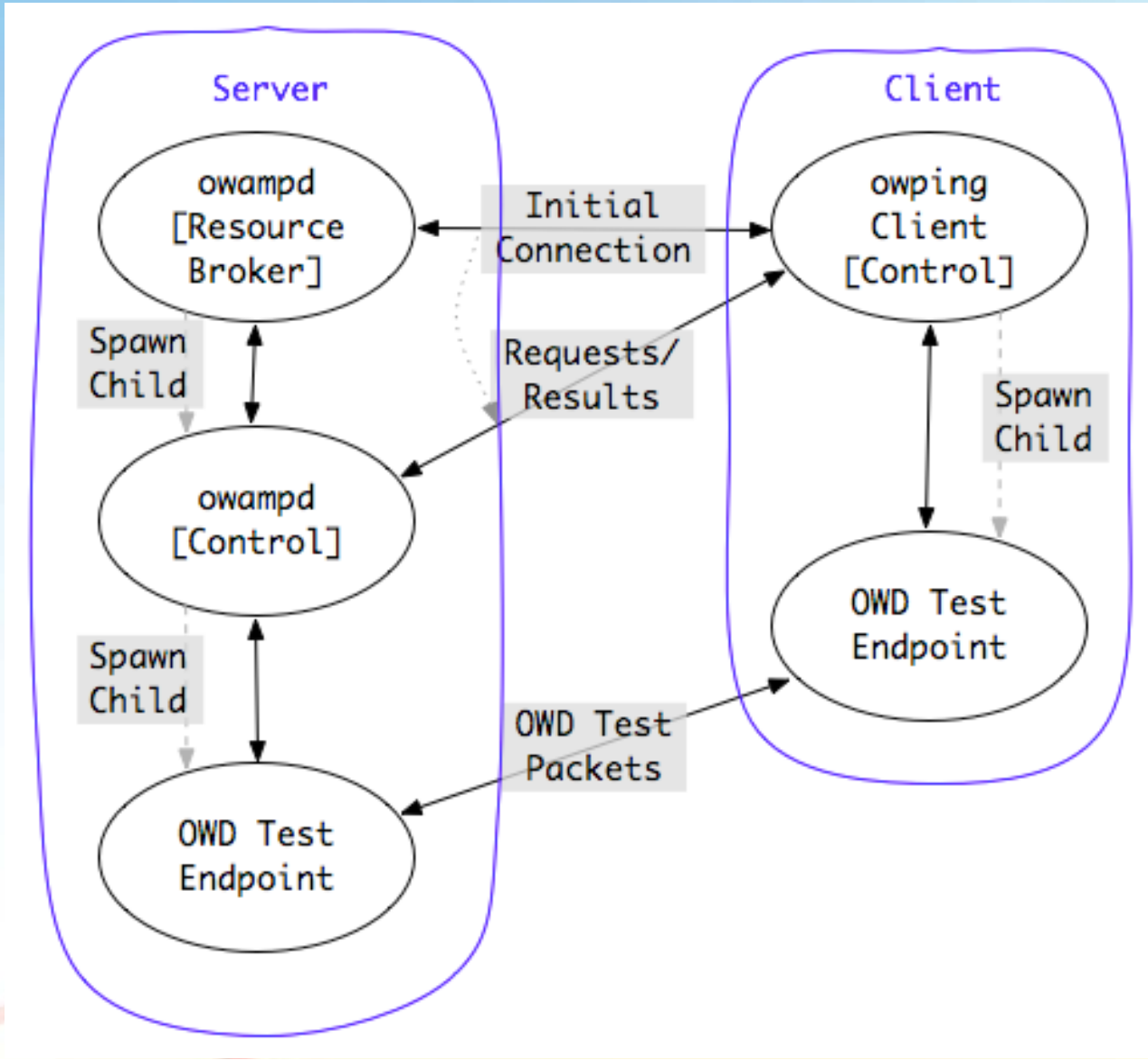


Resource Allocation

- 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



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INTERNET 2

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 should compile for all modern *NIX
  - *BSD, Linux, OS X
  - configure/make/make install
- RPMs compiled specifically for CentOS 5.x
  - May work with other RPM based systems (Fedora, RHEL)

Hardware

- Stable System Clock
  - Temperature controlled environment
  - No power management of CPU
  - "Smart" or "Green" CPUs/Cores may degrade performance to save energy – this may cause jitter in the measurements
- 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
  - Read documentation for more details

Policy/Security Considerations

- Third-Party DoS source
  - Compromised server may send packets to other locations.
- DoS target
  - Excessive traffic will harm measurement results
- 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

- Main Page:
  - http://www.internet2.edu/performance/owamp
- Mailing lists:
  - owamp-users@internet2.edu
  - 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)

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