Remote Network Bottleneck
Diagnosis

Billy Byler
Nathan Campbell
Earl Eiland
Harley Kozushko
Liang Xiaoguang
Problem

• Networks are highly distributed systems.
  – Nodes and subnets in any one system may be great distances apart.
Problem

- Channels connecting these diverse system components are often owned and administered by third parties.
Problem

- Gaining info on remote system components relies on co-operation with others at these remote sites.
Problem

- However, third party vendors may be reluctant to share information they feel is proprietary or increases their exposure to attack.
Problem

- Then there is the issue of data reliability.
  - Can data not directly collected be trusted?
Project Goal

- To create a method of independently and remotely gathering and/or verifying network performance data.
  - Thereby minimizing these system management challenges.
Network Spectroscopy (1)

- **Definition:** A branch of Internet science that deals with object identification on the basis of delay, period, and frequency spectra.
- **Used to identify quantitative features that are impossible to determine with available IP-level measurement.**
- **Information extracted from:**
  - Packet timing jitters
  - Fine-grained delay unitization
Network Spectroscopy (2)

- Packet inter-arrival times
  - Packet travel time affected by many obstacles
    - Switches
    - Input/output buffers
    - Forwarding engines
    - Protocol characteristics
  - Packet delay at destination is an aggregation of all obstacle delays
Delay distributions have many uses
- Verifying statistical theories and models of the Internet
- Illustrate basic requirements
  - Router buffer memory
  - Link rates
  - Multiplexing schemes
  - Connection topology
Network Spectroscopy Ex. (1)

Example #1 [3]
- Analyzing the spectroscopy of update packets to DNS private (RFC 1918) blocks

Results:
Number of Updates by DNS Zone
Start: 01-Jun-2002 06:28:35.835
End: 04-Jun-2002 20:58:34.648

<table>
<thead>
<tr>
<th>DNS zone</th>
<th>#Updates</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>168.192.in-addr.arpa</td>
<td>35055154</td>
<td>68.3%</td>
</tr>
<tr>
<td>10.in-addr.arpa</td>
<td>12391040</td>
<td>24.2%</td>
</tr>
<tr>
<td>16.172.in-addr.arpa</td>
<td>3834284</td>
<td>7.5%</td>
</tr>
</tbody>
</table>
Network Spectroscopy Ex. (2)

Updates per minute to private in-addr zones at DNS root server
Sat 2002-06-01, 06:28...Tue 06-04, 20:58. 51.4M upd.

#updates per minute

1 2 3 4 5

168.192 in 35M
10.in-addr 12.4M
16-31.172 in 3.8M

time, day in June, 2002, PDT. 1=Sat...4=Tue

Link…
Example #2 [1]
- Analysis of DSL modem traffic from many sources
- ATM transport layer protocol
- Active measurements technique involved time stamped UDP packets
- Passive measurements from traffic monitor on OC48 link
Network Spectroscopy Ex. (4)

Active Measurement Packet Interarrival Distribution
La Jolla PacBell DSL - Mng.caida.org (sending approx. unif(0-50ms))

http://www.caida.org/~ryanking/SPECT/dsl.html
Network Spectroscopy Ex. (5)

PacBell DSL SNFC Interarrival Distribution
MFN OC-48, 2002-03-05, 07:06 PST, 39 min dir 1

- 40byte 221105 pkts
- 1500byte 43946 pkts

http://www.caida.org/~ryanking/SPECT/dsl.html
Network Spectroscopy Ex. (6)

UDP Packet Interarrival Distribution.
1us bins, Pacbell DSL - Mag 1500B, 10 back to back, sleep 2 sec

http://www.caida.org/~ryanking/SPECT/dsl.html
Network Spectroscopy Ex. (7)

http://www.caida.org/~ryanking/SPECT/dsl.html
Network Spectroscopy Ex. (8)

PacBell DSL Radon Transform (Average Spike)

http://www.caida.org/~ryanking/SPECT/dsl.html
Network Spectroscopy Ex.

Example #3

- Packet inter-arrival times can be used to draw inferences about connection bandwidth and degree of multiplexing at potentially multiple bottleneck links
- Infer bottleneck capacity from location and gaps between spikes and bumps in inter-arrival times
Works Cited