# Remote Network Bottleneck Diagnosis

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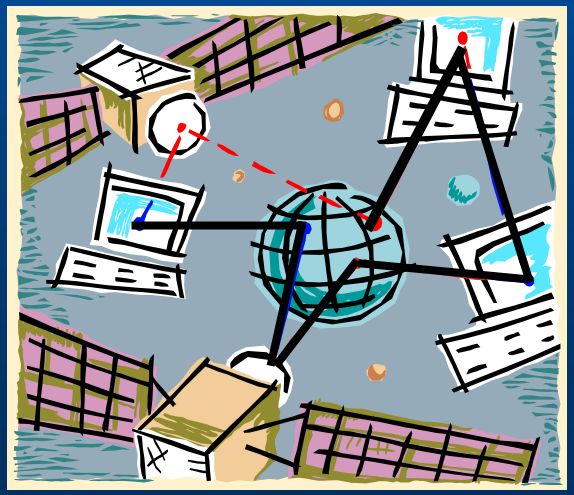
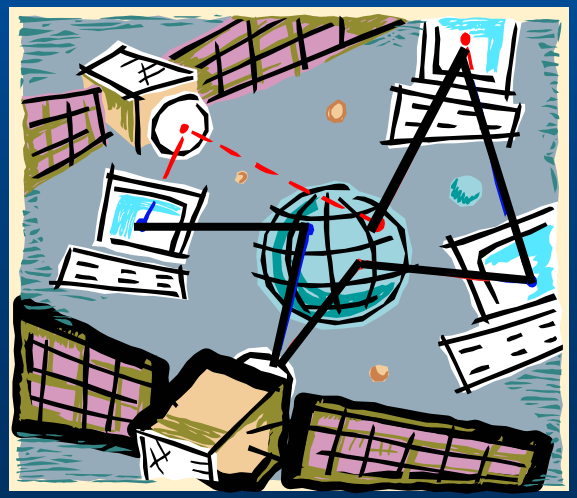
# Problem

- **Networks are highly distributed systems.**
  - **Nodes and subnets in any one system may be great distances apart.**



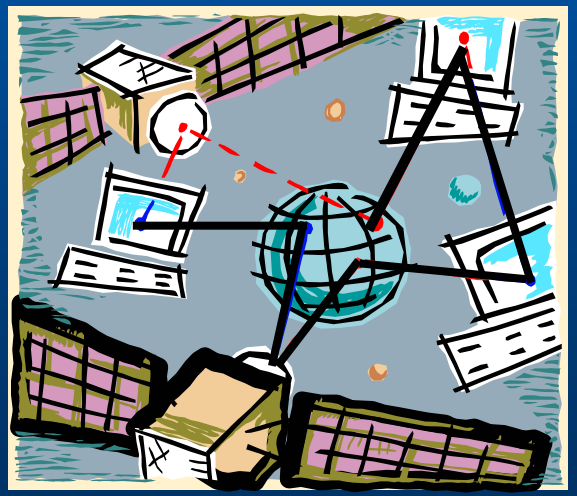
# Problem

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



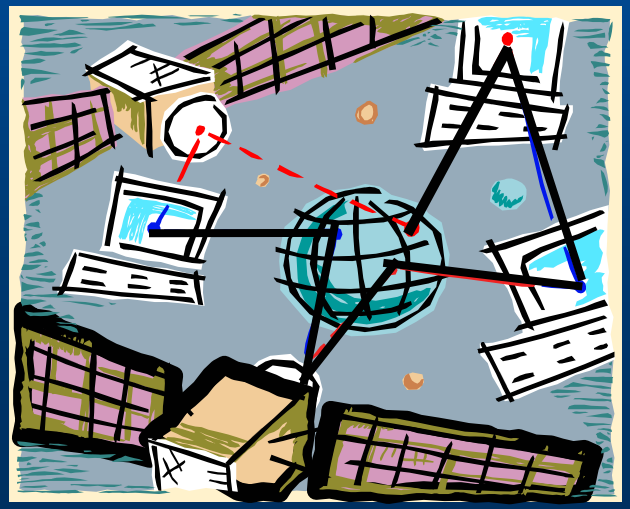
# Problem

- **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**

# Network Spectroscopy (3)

- **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:**

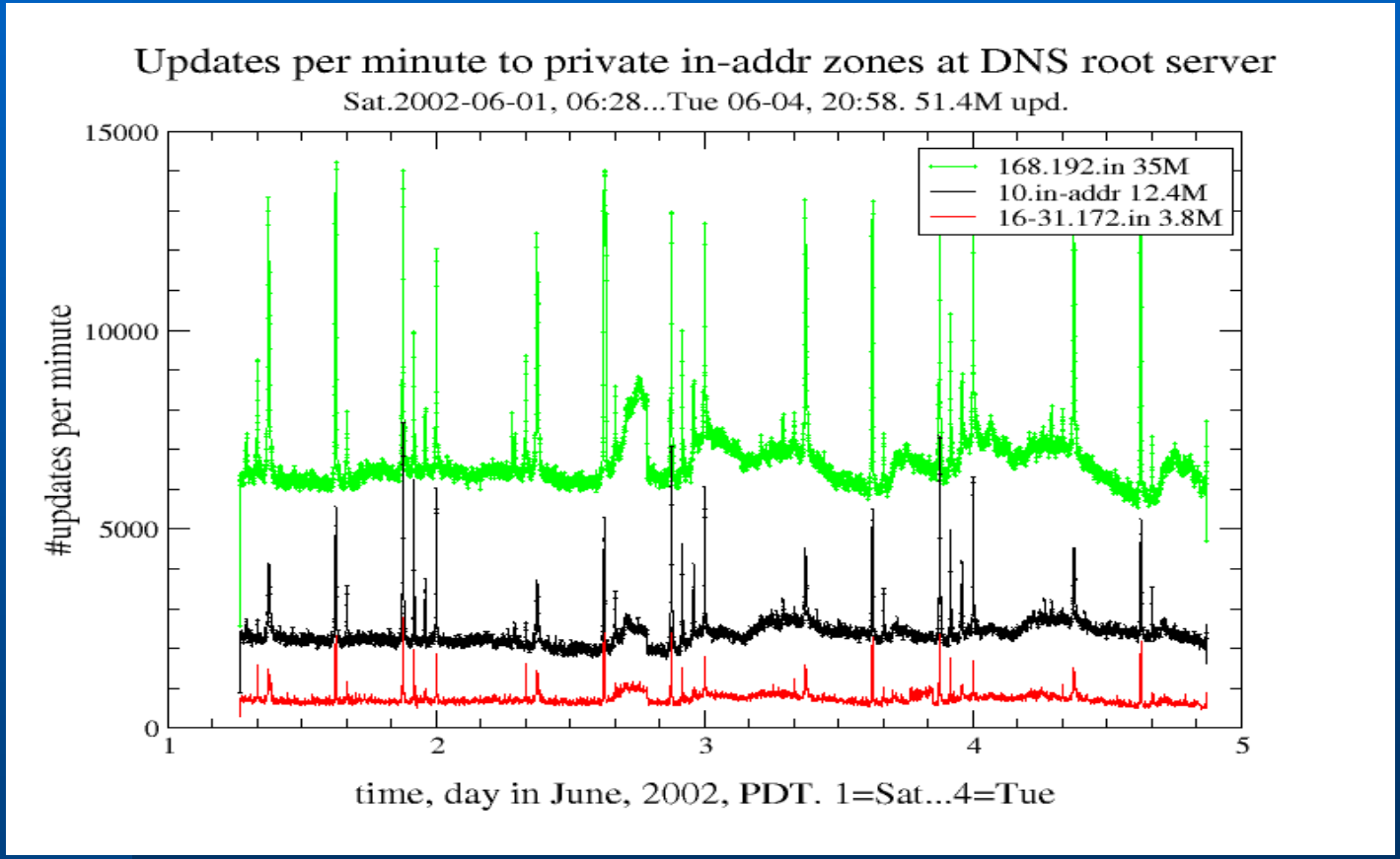
**Number of Updates by DNS Zone**

**Start: 01-Jun-2002 06:28:35.835**

**End: 04-Jun-2002 20:58:34.648**

| DNS zone | #Updates | Percentage |
|---|---|---|
| 168.192.in-addr.arpa | 35055154 | 68.3% |
| 10.in-addr.arpa | 12391040 | 24.2% |
| 16.172.in-addr.arpa | 3834284 | 7.5% |

# Network Spectroscopy Ex. (2)

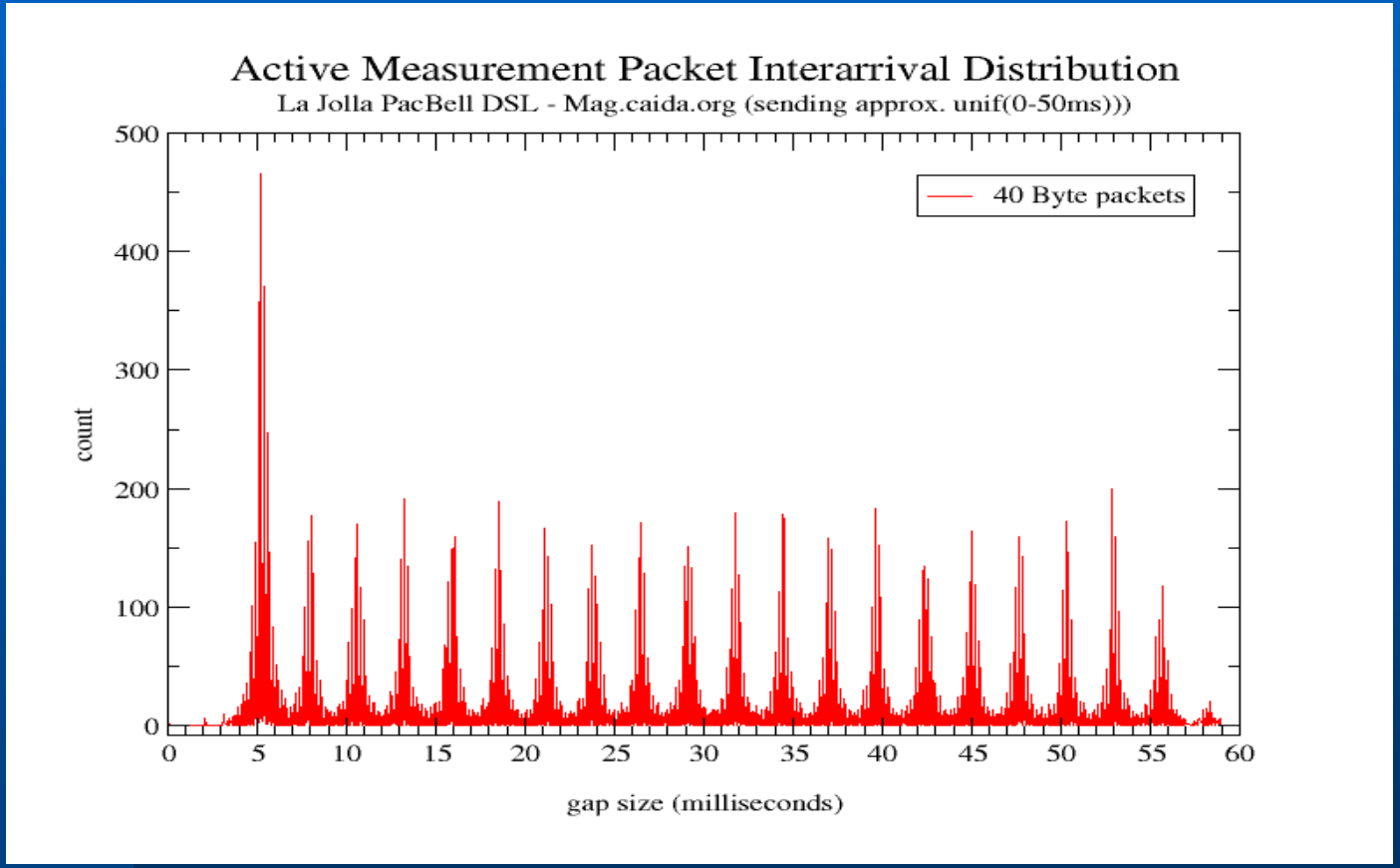



Link…

# Network Spectroscopy Ex. (3)

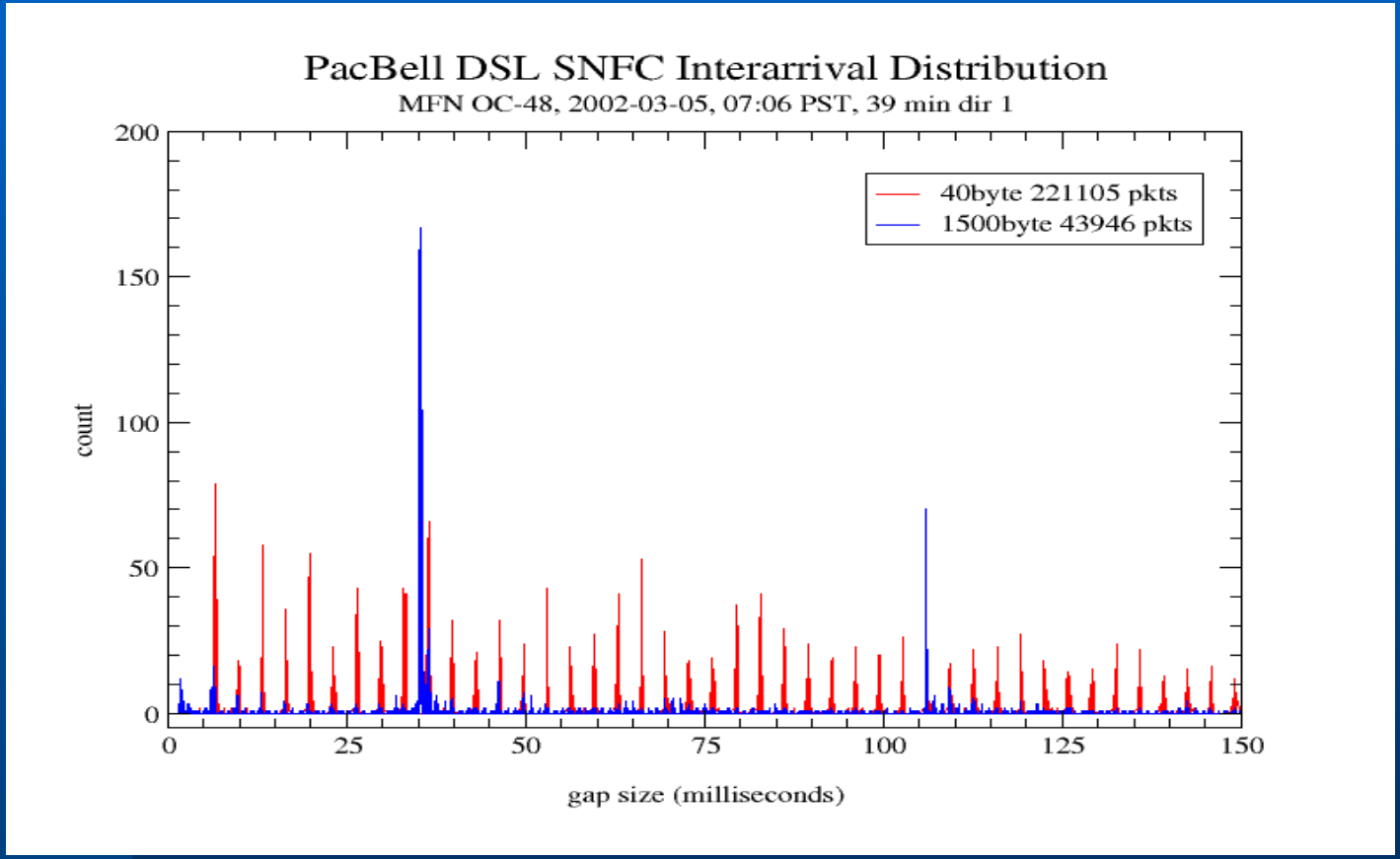
- **Example #2 [1]**
  - **Analysis of DSL modem traffic from many sources**
  - **ATM transport layer protocol**
  - **Active measurements technique involved time stamped UDP packets**
  - **Passive measurements from traffic monitor on OC48 link**

# Network Spectroscopy Ex. (4)



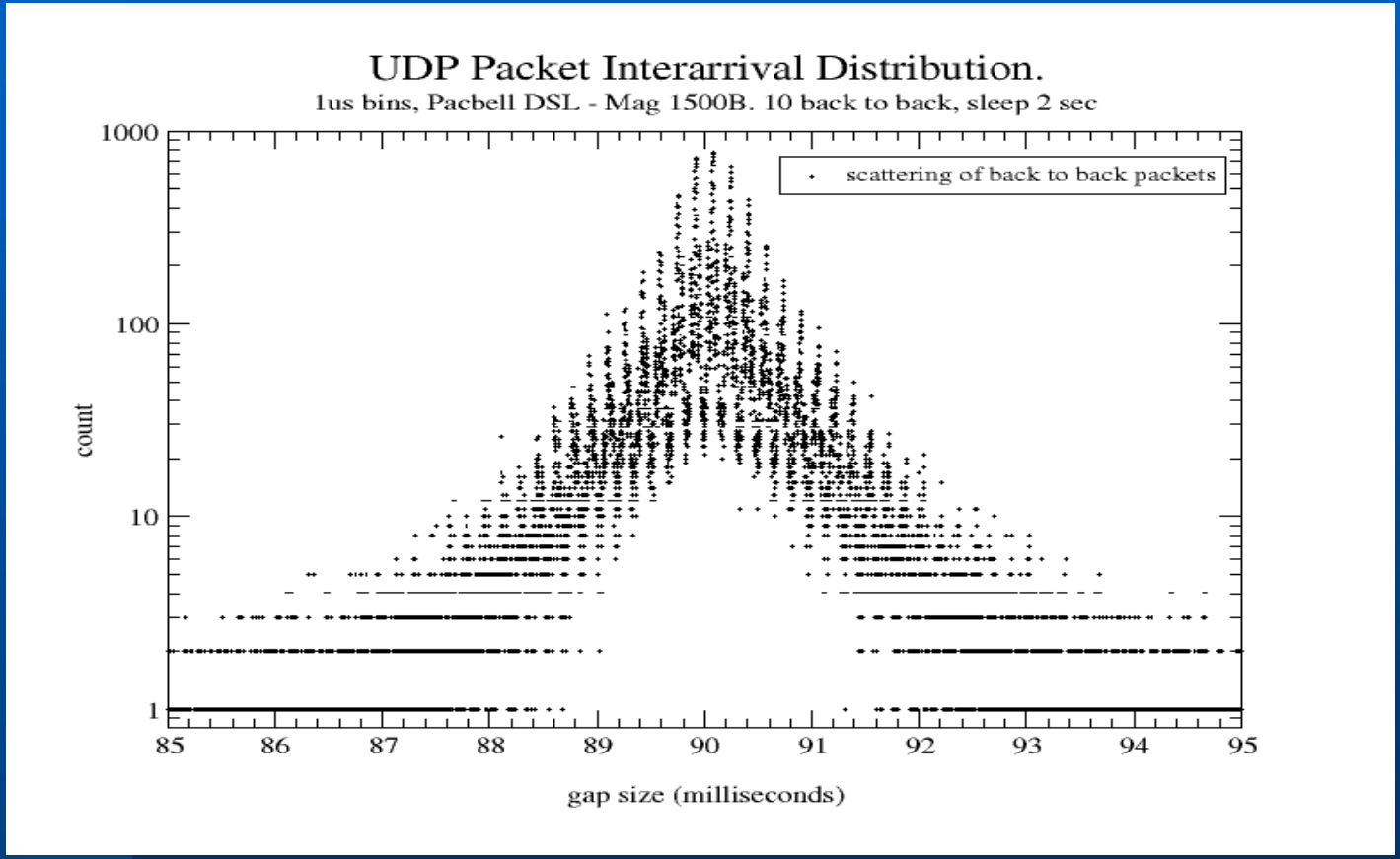

**http://www.caida.org/~ryanking/SPECT/dsl.html**

# Network Spectroscopy Ex. (5)



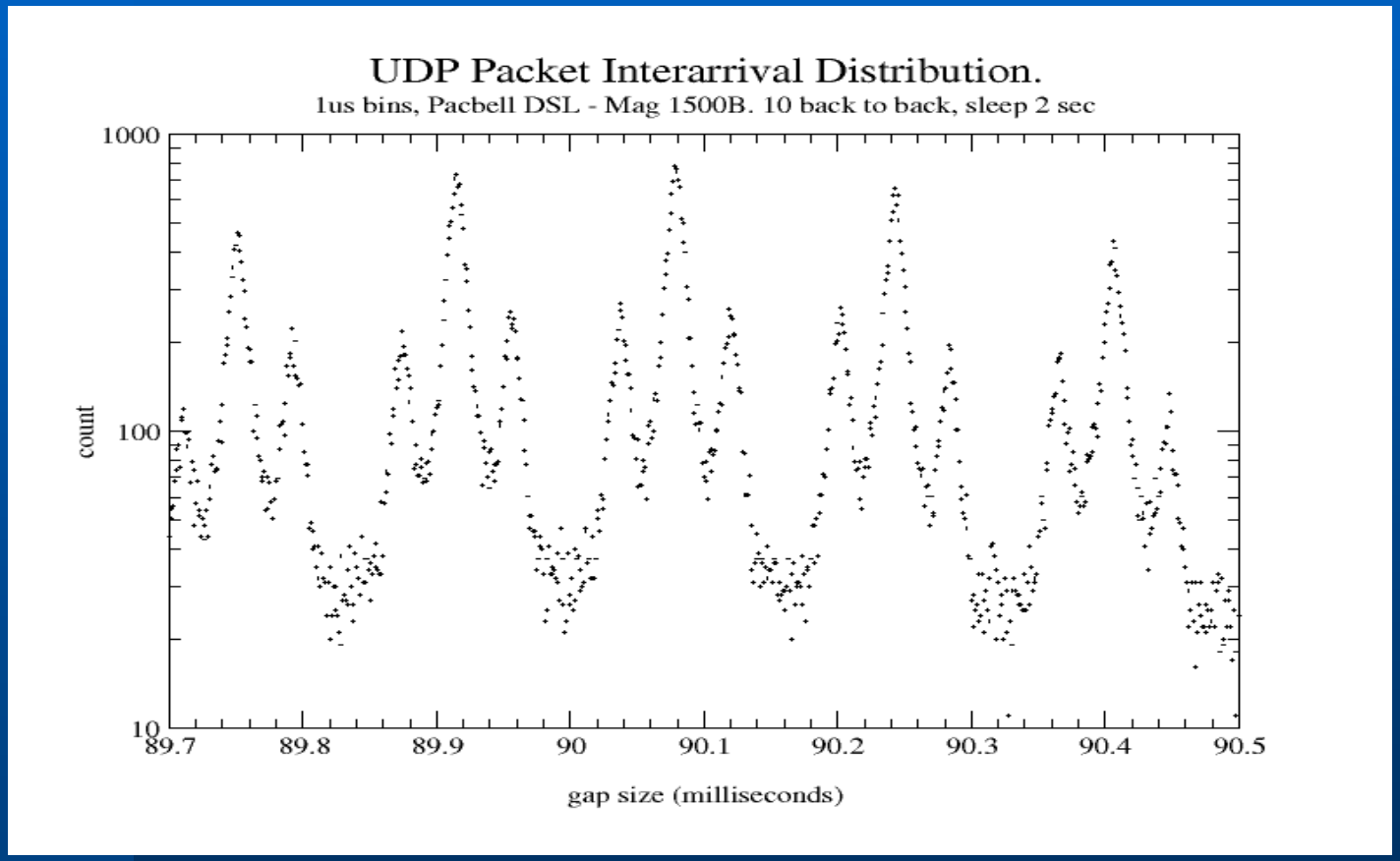

**http://www.caida.org/~ryanking/SPECT/dsl.html**

# Network Spectroscopy Ex. (6)



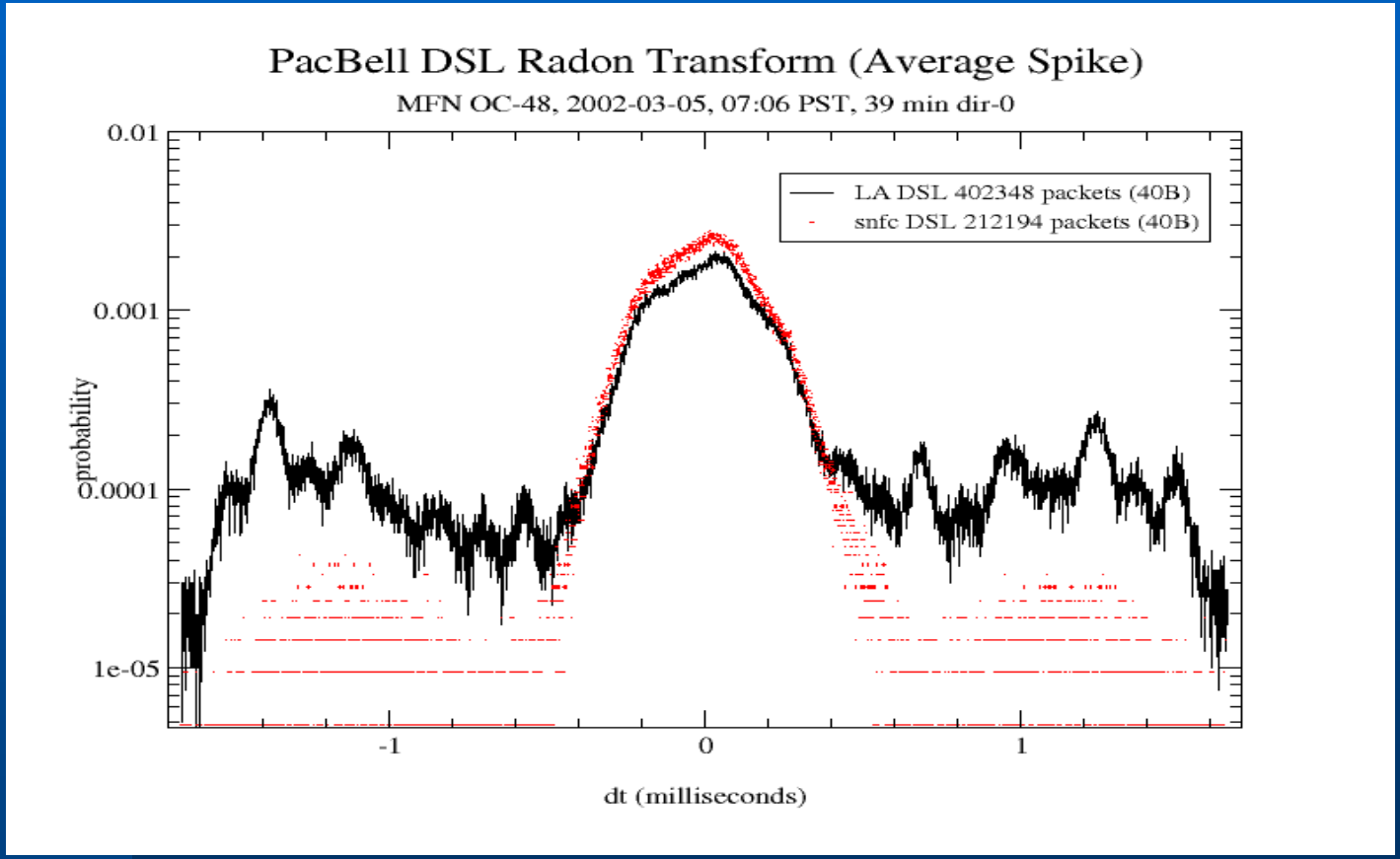

**http://www.caida.org/~ryanking/SPECT/dsl.html**

# Network Spectroscopy Ex. (7)




**http://www.caida.org/~ryanking/SPECT/dsl.html**

# Network Spectroscopy Ex. (8)




**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


[1] ***ATM Inducted Quantizati of Delay in DSL Modem traffic.*** **http://www.caida.org/~ryanking/SPECT/dsl.html**

[2] **Broido, A, et al.** ***Radon spectroscopy of packet delay.***

[3] **Katabi, D., Blake, C.** ***Inferring Congestion Sharing and Path Characteristics from Packet Interarrival Times.***