End to End Methods for Measuring and Improving Internet Performance

Cross Industry Working Team

Plenary Meeting

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Overview

- Motivation for Measuring Internet Performance
- Basic Methodology
- Implementation Details:
    - Imeter
    - Timeit
- Issues
- Future
- Conclusion

Motivation for Measuring Internet Performance

- The Internet is becoming an important business tool (approaching the phone).
- Without objective measurements, there is little hope for management or improvement.
- To manage and improve the Internet experience, Internet performance must be measured.
- Once measurements are made, actions must follow.

Basic Methodology

- Goals of End to End Monitoring
- Performance Control Algorithm
- Key Metrics
- Determining Action Limits
- Measurement Methodology

Goals of End to End Monitoring

- End to end performance monitored to hosts selected by an IP Provider's customer.
- Immediately implementable metrics not requiring IP Provider or target intervention.
- Detection of assignable causes for departure from expected performance.
- Identification of probable causes from departure from expected performance.

Performance Control Algorithm

- Collect data.
- Apply analysis algorithm on data.
- Generate knowledge from algorithm.
- Take actions based on knowledge.

Measurement Methods Used for Data Collection

- ICMP Echo (Imeter)
  - Delay
  - Packet loss
  - Unreachable
- HTTP Get (Timeit)
  - Time to perform DNS
  - Time to connect
  - Rate of delivery
  - Errors

Summary Statistics Applied to Data Collected

- Median (50th percentile)
- Interquartile Range (IQR) or 75th percentile
- Error Percentages

Determining Action Limits - Three Action Limit Algorithms

- Action limits need to objectively indicate when something has changed.
- Action limits need to value detected change against cost to act.
- Types of action limits:
    - Static Value: compare to static value; well controlled environment
    - Delta Fraction: % change; poorly controlled environment.
    - Delta Shift: change of constant amount; moderately controlled environment.

Take Action When "Important" Change Detected

Traceroute from multiple egress points to host or group of hosts showing problem.

Open trouble ticket(s) with IP provider(s) including traceroute information.

Fix internal network infrastructure.

Keep internal network services groups informed to address customer/employee calls.

Maintain database of trouble spots or providers.

Implementation Details

☐ Discussed general performance control method.

☐ Implementation details on production use of ICMP Echo and HTTP Get data.

Note: these methods are applied to intranets, too.

Imeter

- Implementation overview
- Examples of Imeter use

Imeter Implementation

Ping set of Internet "landmarks"

Plot on intranet graph the following:

- Delay (round trip)
- Percentage unreachable
- Packet loss

Source available at:

- ftp://ftp.intel.com/pub/ietf/ippm/Imeter-1.1.tar.Z

Examples of Imeter Use

- Detection of change
  - repair of service component
- Start and end of planned service event
  - relation of change in performance to exact time of event
  - immediate communication of service restoration to network service personnel

PACKET LOSS FOR TODAY
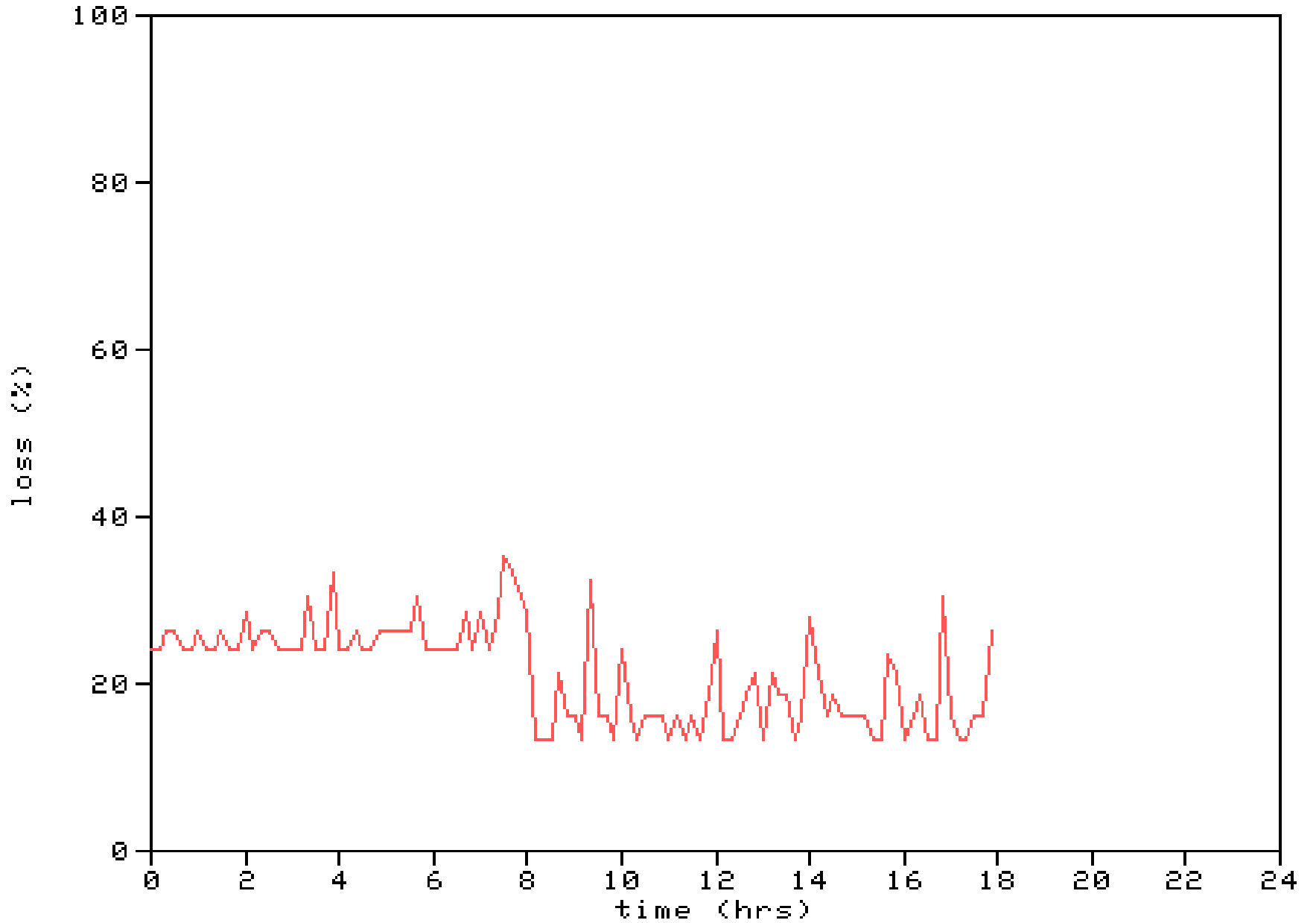
NETWORK DELAY FOR LAST WEEK
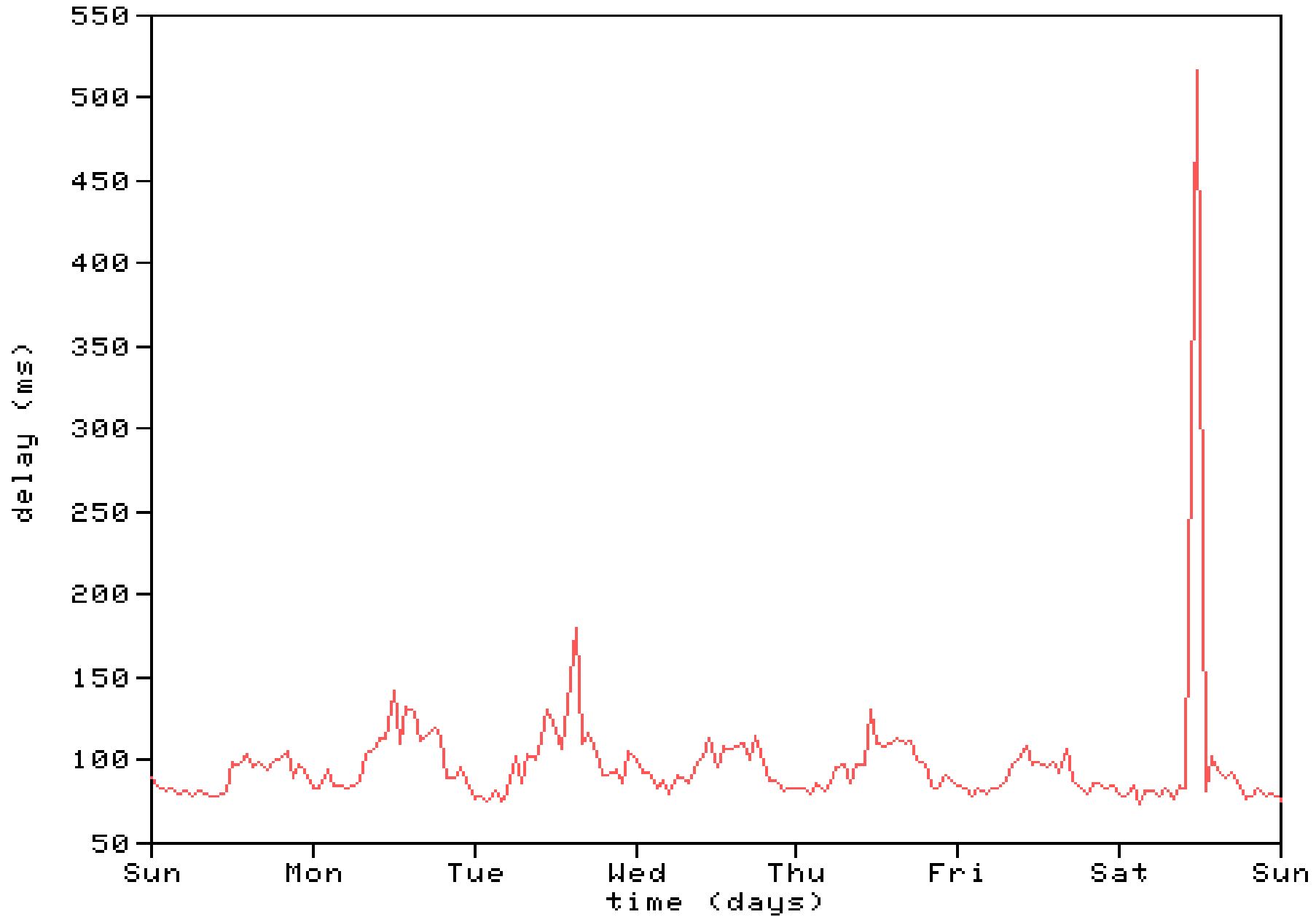
HTTP Get (or "Timeit")

- Implementation overview
- Examples of Timeit use

Timeit Implementation

- Complete automated HTTP Get to a set of URLs.
  - Aggregated by company type, country and/or geographic region.
- Plot on intranet graph for each Intel gateway.
  - DNS lookup time (seconds)
  - Connect time (seconds)
  - Delivery rate (bytes/second)
  - Fraction Error
- Source available at:
  - ftp://ftp.va.pubnix.com/pub/uunet/timeit-2.1.tar.gz
  - Intel modifies this code to our specific environment

Current Use of Timeit

- grep out errors esp. "no route" to detect ISP problems and fixes.
    - combine with traceroute to determine cause of problem.
- Address specific internal customer complaints of performance problems to an important URL.
- Provide marketing assessment of performance.
- Select new and improve current ISPs.
- Justify expenditures to improve internal and external customer WWW performance.
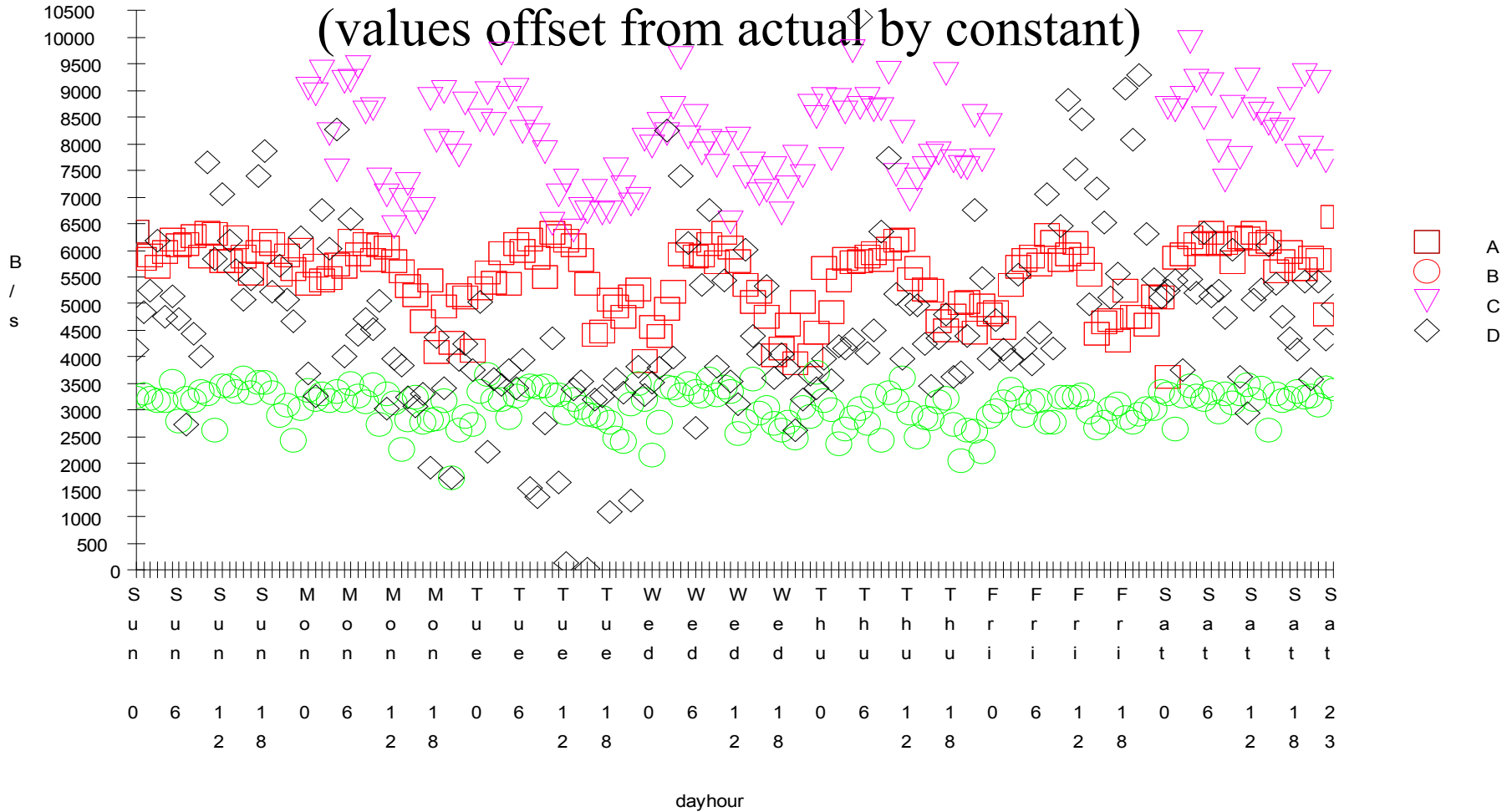- Experimental designs to compare configs of proxy, DNS, routers, etc.

Examples of Timeit Use

- Comparison of performance at different IP. Providers' POP to the same URL list during the same time interval.
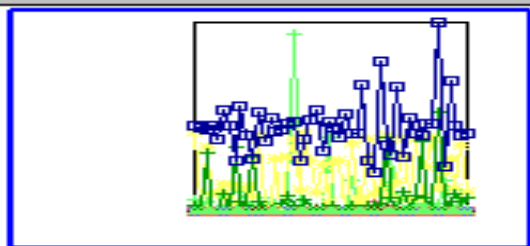- Last weeks assessment of Internet health egressed from different Intel gateways.

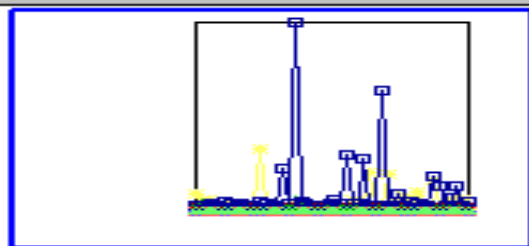# 75% of URL requests are this fast or faster for US ISP list
(values offset from actual by constant)
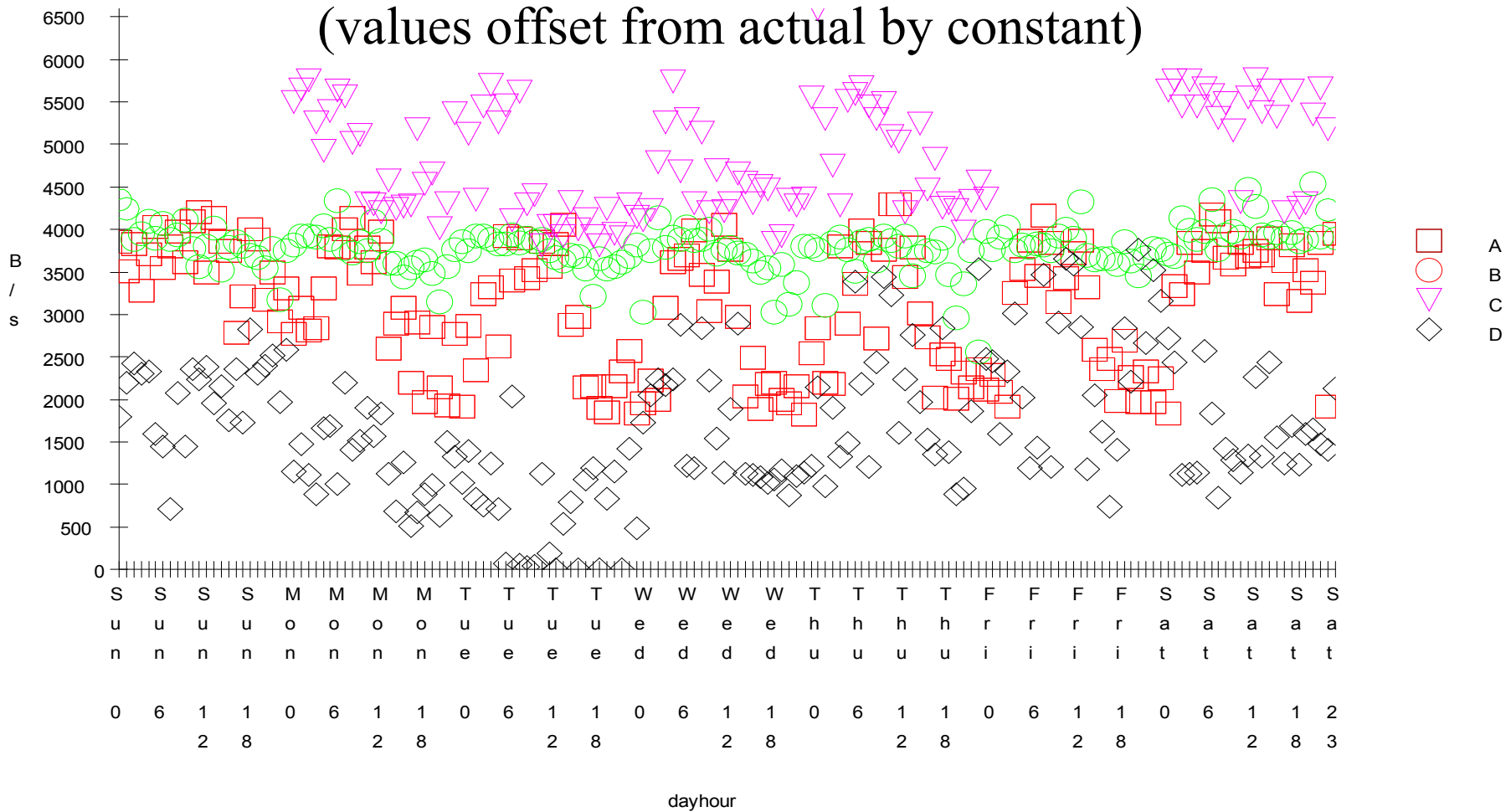
Data source: timeit prgm
Graphic: Bickerstaff
2/4/97
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50% of URL requests are this fast or faster for US ISP list
(values offset from actual by constant)

Legend:
- A (red square)
- B (green circle)
- C (magenta triangle)
- D (black diamond)

B/s vs dayhour

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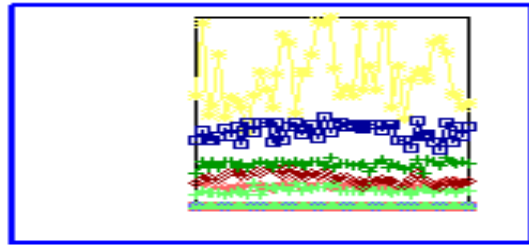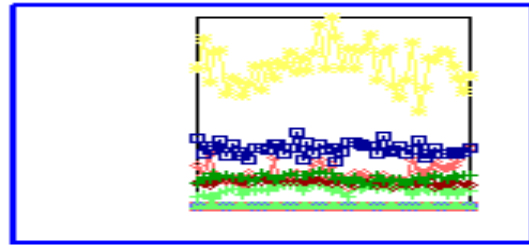File   Edit   View   Go   Bookmarks   Options   Directory
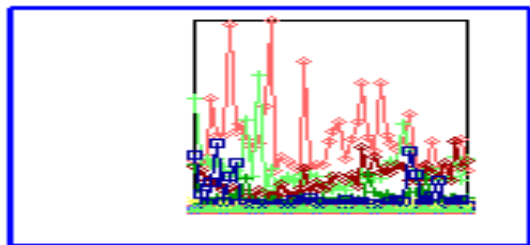
Window   Help

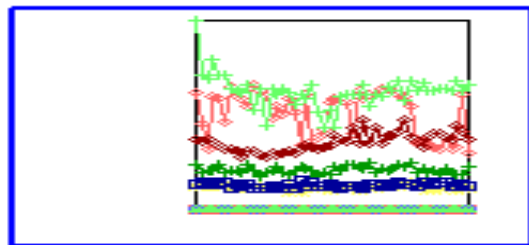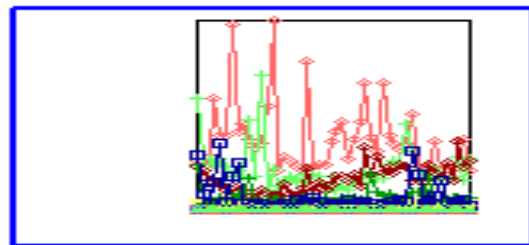

DNS IQR

DNS median
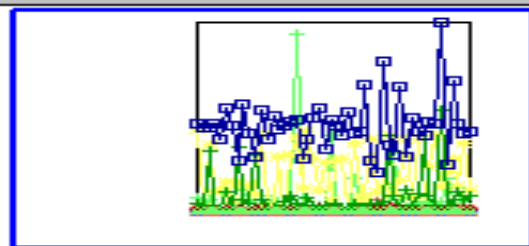
DNS p75
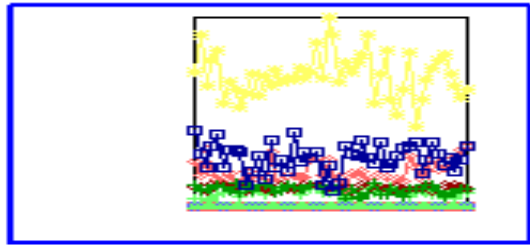
Rate IQR

Rate median

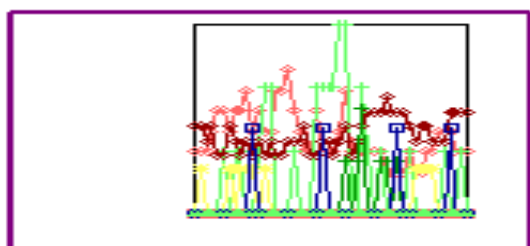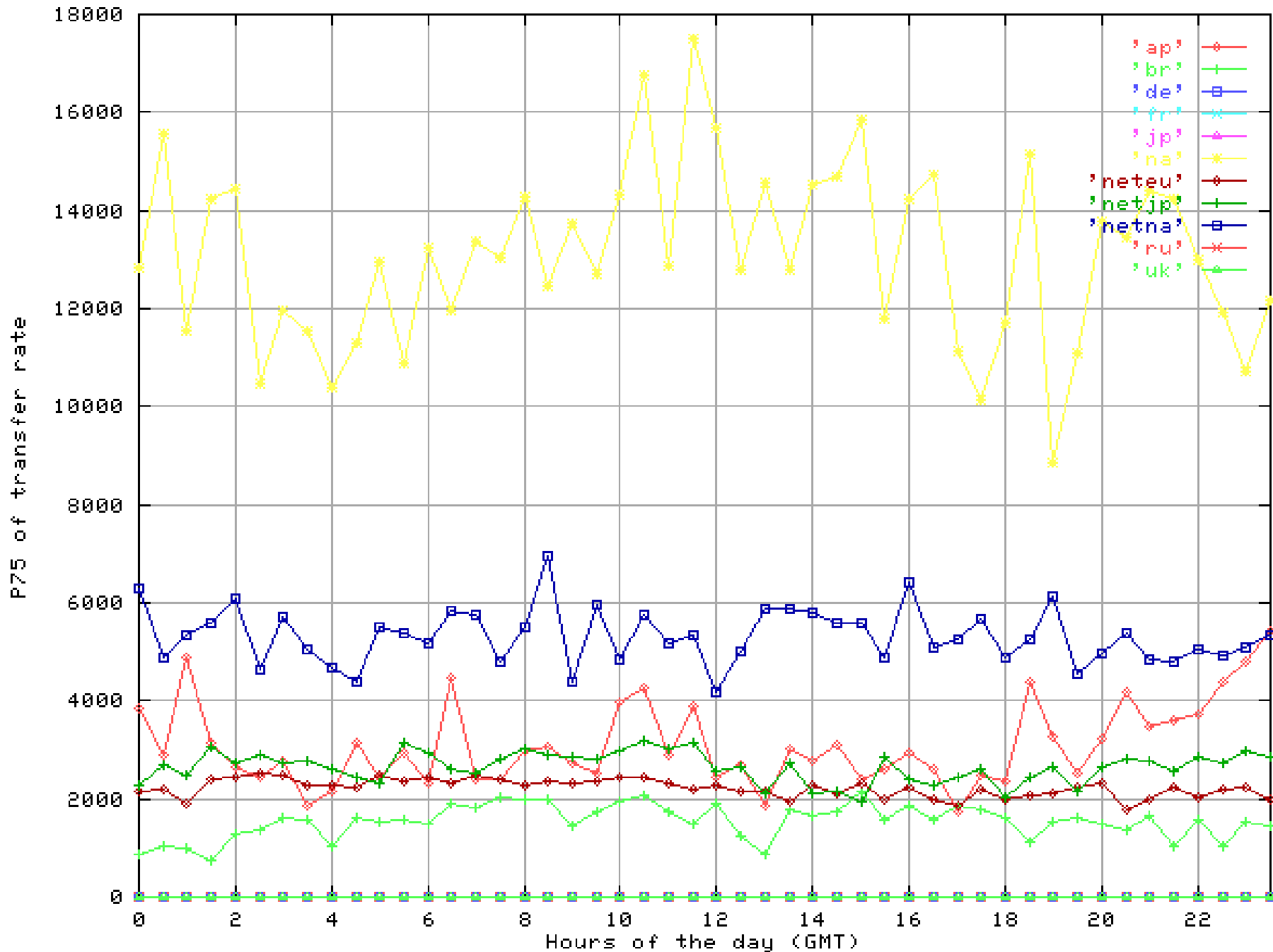Rate p75

Setup IQR

Setup median

Setup p75

Percent Error

Document: Done

P75 of transfer rate over time

Issues

- Firewalls blocking ICMP (Imeter).
- Need to modify timeit for those servers wanting a browser type.
- Need to implement automatic algorithmic processing of data.
- Refinement of landmark selection.
- Be aware of maintaining sampling frequency below annoyance levels.
- Be aware that these measurements add traffic load and are non-value added.

Futures

- Algorithmic detection of action limits and automated alerts.
  - including regular monthly review of time trends by gateway by engineering staff.
- Analysis of outliers.
- Aggregation by geographies of interest for Imeter.
- Analysis of internal proxy data for performance results (in-situ measurement) in lieu of additional Imeter/Timeit.

Outcome of IP Performance Data Collection

- ISPs cooperated and were interested in results interpretation.
- ISPs used data to detect, debug and fix problems then demonstrated improvement.
- ISPs we've worked with plan to continue using data for problem solving.
- Results used and believed by internal customers who sign and authorize $$ expenditure for Internet services.

Conclusions

- The generic performance control algorithm (data/algorithm/knowledge/action) can be and has been applied to the Internet performance space.
- The measurement methods described for data collection require no additional Internet infrastructure.
- The tools and algorithms described are available and can be implemented by any company with Internet access.

    (also applicable to intranets.)