Broadband Internet Performance: A View from the Gateway

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What Affects Broadband Performance?

- Important for regulators, consumers, ISPs
- Notion of performance is fuzzy
  - What metrics should we measure?
  - How to measure them?
Accurate Measurements are Difficult

Home Network: AT&T DSL
6 Mbps Down, 512 Kbps Up

Last Mile

ISP Network

speedtest.net: 4.4 Mbps, 140 Kbps
Netalyzr: 4.8 Mbps, 430 Kbps

End host measurements are not continuous, and affected by *confounding factors*
The Case For the Gateway

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6 Mbps Down, 512 Kbps Up

Last Mile

ISP Network

speedtest.net: 4.4 Mbps, 140 Kbps
Netalyzr: 4.8 Mbps, 430 Kbps
Gateway: 5.6 Mbps, 460 Kbps

Gateway enables periodic measurements, and can account for confounding factors
The Deployments

- **Breadth:** The FCC/SamKnows study
  - 4,000 gateways, 16 ISPs, multiple service plans
- **Depth:** The BISmark study
  - 16 gateways in Atlanta, on-demand measurements
- **Duration:** Dec 2010 – Jan 2011
Results: Overview

• Throughput measurement technique depends on usage scenario
• Traffic shaping is highly variable across users
• Access link characteristics affect performance
• Modem buffers induce high latency
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Interpreting Throughput Results

Different techniques measure different aspects of throughput
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Traffic Shaping: PowerBoost

- Cable companies advertise “PowerBoost”
  - Short bursts of high bandwidth
- Non-existent in DSL
Traffic Shaping Varies Across Users

Short-term throughput significantly different from sustainable throughput
Results: Overview

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Latency Measurements

<table>
<thead>
<tr>
<th>Parameter</th>
<th>What it captures</th>
</tr>
</thead>
<tbody>
<tr>
<td>End-to-end</td>
<td>Latency to nearby server</td>
</tr>
<tr>
<td>Last-mile</td>
<td>Latency to edge of ISP network</td>
</tr>
<tr>
<td>Under Load</td>
<td>Buffer delays due to cross traffic</td>
</tr>
</tbody>
</table>
DSL last-mile latencies can be very high

Impact of Last-mile on Latency

DSL last-mile latencies can be very high

Cable ISPs

DSL ISPs
Example: Latency-Throughput Tradeoff

Both users have the same service plan:
- User 1: low latency, high loss
- User 2: high latency, low loss

Interleaving decreases loss, increases latency, improves throughput.

Interleaving creates a trade-off between latency and throughput.
Results: Overview

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Modem Buffers are Too Large

Service plans can interact badly with modem buffers
Conclusion

• The gateway provides unique insight into home network
• Throughput measurements are affected by measurement technique, shaping
• Latency is affected by last-mile, buffering
Discussion

• Limitation and Weakness
  ❖ Evolution (Change in performance over time)
  ❖ One server for US
  ❖ They did not talk about the wire part of the path (routing), as different ISPs have different policy, topology, and peering point

• Very interesting data set and measurement deployment
  ❖ Openflow Programmable Gateway