M-Lab Research and Infrastructure for Interconnection Performance Monitoring

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M-Lab: A Collaborative and Growing Network

- Open data and open methodology
- Diversity of tests: throughput, interference, traffic shaping and path data;
- Expansion in the U.S. for Transit ISPs Zayo, Cogent, Tata, Level3 and GTT
- Expansion of M-Lab sites globally to locations in Canada, Africa and Asia



Research Update: ISP Interconnection and its Impact on Consumer Internet Performance











Inferring the Source of Congestion



Access ISP A

Access ISP B



Sufficient Sample

The United States Constitutes the Largest Source of this Data



Median download throughput across Internap in NYC over time from different ISPs (higher is better)

Inferring Sources of Congestion in Practice

Using New York's Comparison



Median download throughput across Cogent to Cablevision in NYC over time (higher is better)

Inferring Sources of Congestion in Practice

Using New York's Comparison



Median download throughput across Cogent in NYC over time from different ISPs (higher is better)

Inferring Sources of Congestion in Practice

US Access ISPs and Cogent (2013-2014)



Median download throughput across Cogent in LA over time from different ISPs (higher is better)

Inferring Sources of Congestion in Practice

US Access ISPs and Cogent (2013-2014)

Internet Performance Varies Significantly Throughout the Day



Median download throughput during the average day between access ISP and transit ISP (higher is better)

Diurnal Patterns Are Instructive

Expectations of Normal Performance



Median download throughput during the average day between access ISP and transit ISP (higher is better)

Diurnal Patterns Are Instructive

Expectations of Congested Performance



Median download throughput during the average day in January 2014 between Cogent and various ISPs in Los Angeles (higher is better)

US/Pacific

Diurnal Cycles In Practice

Peak Hours, Peak Disruption



Median RTT during the average day in October 2013 between Level 3 and Comcast in Atlanta (lower is better)

US/Eastern

Not Limited to Download

Latency Sensitive Applications Affected

Congestion has not been limited to Interconnections with Cogent or Specific Services.



Median download throughput during the average day in January 2014 between XO and Time Warner in Washington D.C. (higher is better)

XO and Time Warner Cable

Not Limited to Cogent



Median download throughput across XO to Time Warner in Washington D.C. over time during peak hours and off-peak hours (higher is better)

XO and Time Warner Cable

Not Limited to Cogent



Median download throughput during the average day in February 2014 between Level 3 and Verizon in Chicago (higher is better)

US/Central

Level 3 and Verizon Not Limited to Cogent



Median download throughput across Level 3 to Verizon in Chicago (higher is better)

Level 3 and Verizon

Not Limited to Cogent



Median download throughput across XO in Washington D.C. for Fall 2014

US/Eastern

Congestion is Continuing

Congestion as of Q4 2014



Comparative Performance across ISPs

No Access ISPs or Transit ISPs Universally Underperforming



Comparative Performance across ISPs

No Access ISPs or Transit ISPs Universally Underperforming



Comparative Performance across ISPs

No Access ISPs or Transit ISPs Universally Underperforming



Serendipitous Discovery



Median download throughput across Cogent in NYC over time from different ISPs (higher is better)

What Happened in Late February?

Cross the Board Increases



Median download throughput across Cogent in Seattle over time from different ISPs (higher is better)

What Happened in Late February?

Cross the Board Increases

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DSCP Changes! Cross the Board Increases

Research Update: Extending the Interconnection Study through Data Extraction Tools

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Measurement Lab: Dependencies	Telescope			

Measurement Lab Telescope

Python to extract M-Lab data



Measurement Lab Observatory

Currently US Only

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Measurement Lab Observatory

Currently US Only

Our data shows that traffic from specific Access ISP customers across interconnections with specific Transit ISPs experienced degraded performance and that this degradation forms a pattern wherever specific Access ISPs and Transit ISPs exchange traffic.

MLAB

There is still much more in Measurement Lab's dataset. Please explore.

<u>measurementlab.net</u> @MeasurementLab