Internet Policy and Independent Network Performance Measurement

Collin Anderson

BEREC Expert Workshop on IP Interconnection



Overview of Measurement Lab



International Collaboration, Modern Research

Interdisciplinary, Open, Reviewed



M-Lab's Global Footprint

Servers on Every Continent, Infrastructure Diversity

Throughput Measurements

- M-Lab hosts two active throughput measurements:
 - Network Diagnostic Tool (NDT)
 - BISmark
- NDT is integrated with numerous applications and receives about 100,000 tests per day.
- Nearly every country is wellcovered.

YOUR TEST RESULTS

UPLOAD SPEED 15.68 mb/s

DOWNLOAD SPEED 12.53 mb/s

Network latency: 26 msec round trip time Jitter: 40 msec



How Does M-Lab Collect Its Data?

Measurement Clients

Performance measurement clients for informing users of their network capacity. NDT Mobile Client (beta 2)

YOUR TEST RESULTS

UPLOAD SPEED 15.68 mb/s

DOWNLOAD SPEED 12.53 mb/s

Network latency: 26 msec round trip time Jitter: 40 msec



Software Integrations

Providing network information to software to enable better user experience.

Torrent Setup Guide µTorrent will test your netw	ork and configure itself for b
Bandwidth	Greece, Athens
Results: Upload: 209	.71 kbit/s (25.5 kB/s) Dov
(Alternate speed test a	t <u>dslreports</u>)
Your Upload Speed:	Test Result (209.71 kbit/s
µTorrent Bandwidth Co	onfiguration
Upload Limit:	17.0 kB/s
Connections (per-tor	rent): 55
Max active torrents:	1
V Network	
Results: Port is open. \	our network is properly con
Current Port: (0:rando	m) 36379 🔽 🗛
<u>C</u> ancel	Run Tests

Partnerships with Regulatory Agencies

Monitoring the progress of broadband deployment for policy-making.



Consumer Measurement and Policy Case Study

Interconnection Disputes in the United States

The Regulator's Problem

- Utilization and performance data is proprietary and hidden from the public.
- User collected information is often unreliable, incomparable, methodologically inconsistent and narrowly scoped.
- Longitudinal data is rare, so is comparative measurement.
- Independent data is expensive, collection efforts are burdensome.



Network Diagnostic Tool

- M-Lab's most popular hosted test, tens of thousands of measurements daily.
- Simple test of bulk transfer capacity.
- Multiple NDT implementations available, across different languages and for diversity of purposes.
- All implementations share the same methodology and are inter compatible.





Measuring Performance

Bulk Transfer Capacity

Methodology

Inferring the Source of Congestion





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 and Across Interconnections



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)

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)

Not Limited to Throughput

Latency Sensitive Applications Affected



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

Not Limited to One Transit Provider

Level 3 and Verizon



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

Congestion is Continuing

Congestion as of Q4 2014

Public Interest Data

- Interconnection Study results were referred to in filings to United States regulator agency since the start of this year alone.
- M-Lab data has been used by public interest organizations, private companies and individual citizens representing all sides of the debate.
- Cited in dozens of media articles in interconnection.

Furn Highlighting On		
	Proceeding Number Type 09-158 63 NOTICE OF EXPA 98-170 57 COMMENT 04-36 55 LETTER 12-264 27 SUBMISSION FOR 09-51 26 REPLY TO COMMENT	
Proceeding	Name of Filer	
14-28	Open Technology Institute New America	
10-127	Open Technology Institute New America	
14-28	Larry Downes	
09-191	Larry Downes	
10-127	Larry Downes	
14-28	Computer & Communications Industry Association	
10-127	Computer & Communications Industry Association	
10-127	Open Technology Institue and Measurement-Lab	
14-28	Open Technology Institute and Measurement-Lab	
14-57	Open Technology Institue and Measurement-Lab	
14-57	Cogent Communications Group, Inc.	
14-57	Rosemary Williams	
14-28	Christopher Henry	
14-28	Clay Hansen	
14-28	Open Technology Institute - New America	
10-127	Open Technology Institute - New America	
14-107	Wireless Telecommunications Bureau	
14-126	Open Technology Institute - New America	
12-268	GE Healthcare	
10-127	New America - Open Technology Institute	
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9 recults (0 115 seconds)

Next Steps for Measurement Lab

Measurement Volume and Site Expansion

Measurements Per Day



Day

Partners and Integrations

Increased Test Volume



New Sites in Europe

Increased Test Volume

MLAB

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