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n Source Tools

Publicly Available Open Data

Why Are They Using It?

In other words, this is an excellent testing tool and infrastructure.

Analyzing the publically available data from this test [M-Lab's NDT] has been very helpful in advancing our own understanding of the performance bottlenecks on today's broadband networks.

Understanding Broadband Speed Measurement
Clark, Bauer, and Lehr (June 2010)
Massachusetts Institute of Technology
http://mitas.csail.mit.edu/papers/Bauer Clark Lehr Broadband Speed Measurements.pdf

What Makes M-Lab Unique?

Open Platform

Open Source Tools

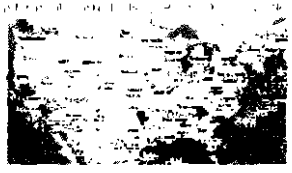
Publicly Available Open Data

An Open Platform

The M-Lab platform makes available to tool developers a large number of purpose-built and well-connected measurement servers in strategic locations around the globe.

Where is M-Lab

MLab 1 Nodes
mlab1.sea01.measurement-lab.org
mlab1.nuq01.measurement-lab.org
mlab1.lax01.measurement-lab.org



What's at a Site?

Each Site is composed of 3 identical servers (Nodes) for redundancy and load balancing. Nodes are all "server-class" and well

Where is M-Lab

Current Node List

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mlab1.dfw01.measurement-lab.org
mlab1.ord01.measurement-lab.org
mlab1.lga01.measurement-lab.org
mlab1.lga02.measurement-lab.org
mlab1.atl01.measurement-lab.org
mlab1.mia01.measurement-lab.org
mlab1.lhr01.measurement-lab.org
mlab1.ams01.measurement-lab.org
mlab1.ams02.measurement-lab.org
mlab1.par01.measurement-lab.org
mlab1.ath01.measurement-lab.org
mlab1.ham01.measurement-lab.org
mlab1.syd01.measurement-lab.org
MLab 2 Nodes
mlab2.sea01.measurement-lab.org
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mlab2.ord01.measurement-lab.org
mlab2.lga01.measurement-lab.org
mlab2.lga02.measurement-lab.org
mlab2.atl01.measurement-lab.org
mlab2.mia01.measurement-lab.org
mlab2.lhr01.measurement-lab.org
mlab2.ams01.measurement-lab.org
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MLab 3 Nodes
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mlab3.lga01.measurement-lab.org
mlab3.lga02.measurement-lab.org
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mlab3.mia01.measurement-lab.org
mlab3.lhr01.measurement-lab.org
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mlab3.ath01.measurement-lab.org
mlab3.ham01.measurement-lab.org
mlab3.syd01.measurement-lab.org

What's at a Site

Each Site is comp
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Hardware
At least three e
- 8x CPU Cores
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- Built-in remot
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or OpenIPMI, Inte

IP Addresses
A /26 of IPv4 add
support a site wit
connectivity is a p

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The minimum requ
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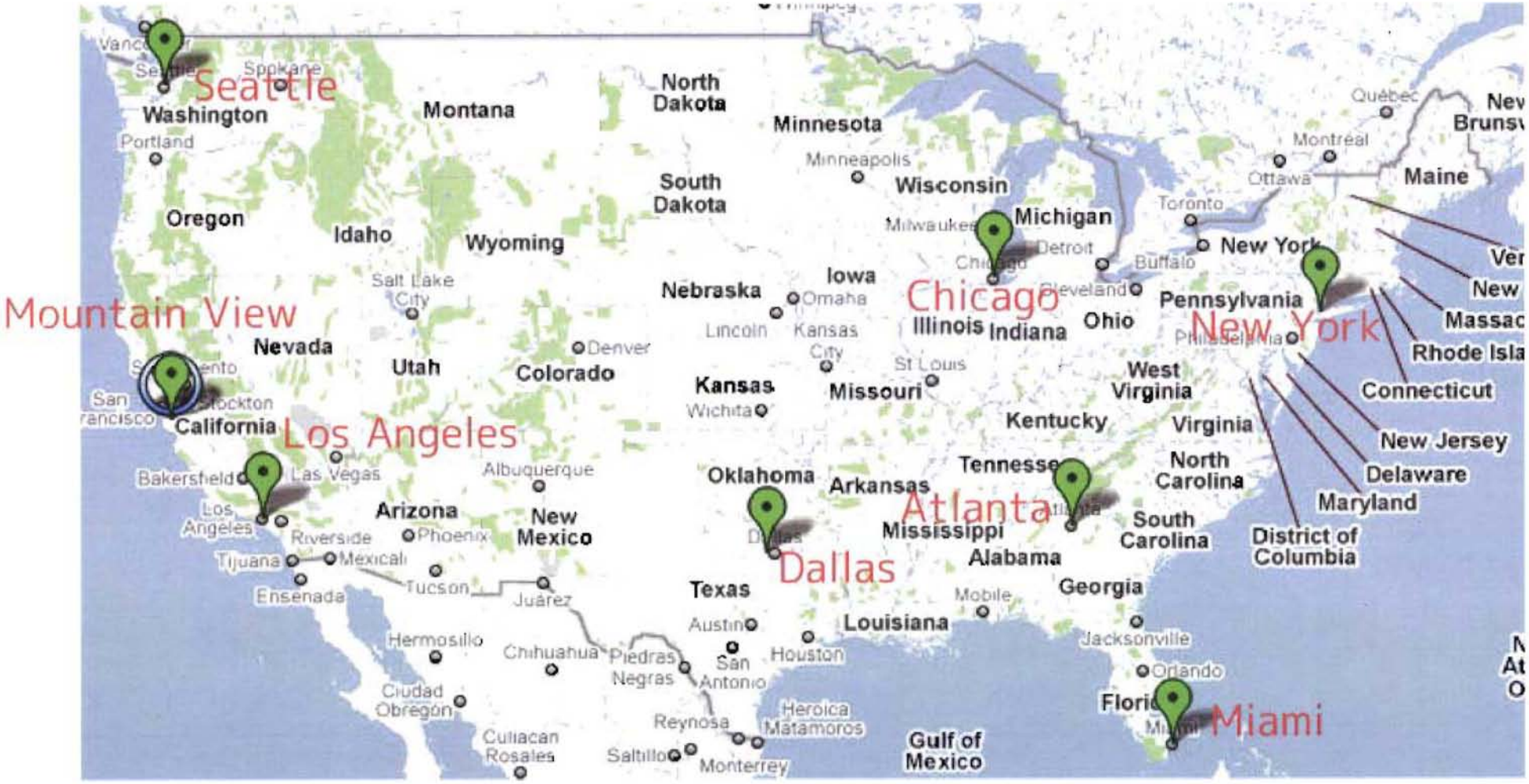
J.S. 8 National Traffic Exchange Points, 9 sites, 27 Node



E.U. 4 Locations, 6 sites, 18 Nodes

S.E. Asia, S. Pacific 1 Location, 1 Site, 3 Nodes

Where is M-Lab

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mlab2.ord01.measurement-lab.org
mlab2.lga01.measurement-lab.org
mlab2.lga02.measurement-lab.org
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mlab2.mia01.measurement-lab.org
mlab2.lhr01.measurement-lab.org
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mlab3.ord01.measurement-lab.org
mlab3.lga01.measurement-lab.org
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mlab3.atl01.measurement-lab.org
mlab3.mia01.measurement-lab.org
mlab3.lhr01.measurement-lab.org
mlab3.ams01.measurement-lab.org
mlab3.ams02.measurement-lab.org
mlab3.par01.measurement-lab.org
mlab3.ath01.measurement-lab.org
mlab3.ham01.measurement-lab.org
mlab3.syd01.measurement-lab.org

What's

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What's at a Site?

Each Site is composed of 3 identical servers (Nodes) for redundancy and load balancing. Nodes are all "server-class" and well provisioned for conducting high-bandwidth measurements at large scale.

Hardware

At least three enterprise-class servers

provisioned for conducting high-bandwidth measurements at large scale.

Hardware

At least three enterprise-class servers

- 8x CPU Cores
- 8GB RAM (or 8GB for 64-bit systems)
- dual 100+GB Disks
- 1 Gbps Ethernet Network Adapter
- Built-in remote diagnostic, configuration, & power reset interface (such as Dell DRAC, HP iLO or OpenIPMI, Intel AMT, etc)

IP Addresses

A /26 of IPv4 address space is required to support a site with three servers. IPv6 connectivity is a plus.

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- c2ssp
  Ping,
  SACKs
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Inside an M-Lab Node

Each node's base is a custom Open Source Linux Operating System maintained by PlanetLab. This system makes use of the Web100 instruments in the Linux TCP/IP stack to expose over a 150 network related variables for hosted measurement tests.

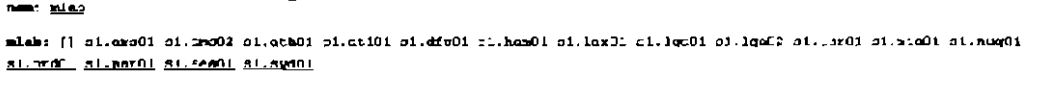
- c2sspd, s2cspd, CurRwinRcvd, MaxRwinRcvd, loss, Ping, MaxRTT, avgrtt, jitter, CurRTO, WaitSec, SACKsRcvd, host, osVer, osName, osArch, javaVer, mismatch, Bad_cable, congestion, cwndtime, AccessTech, pctRcvrLimited, optimalRcvrBuffer, clientIP

A current list of variables:
http://web100.org/download/kernel/2.5.28/tcp-kis.txt

A current list of variables:
http://web100.org/download/kernel/2.5.28/tcp-kis.txt

PlanetLab is the primary node maintainer
- Core node operations
- Assists in creating new measurement environments
- M-Lab nodes are not available to all PlanetLab Researchers

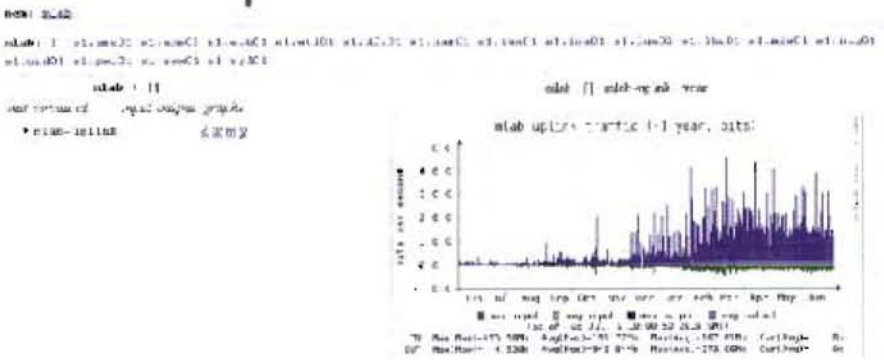
Operational Tools



The most interesting destinatic

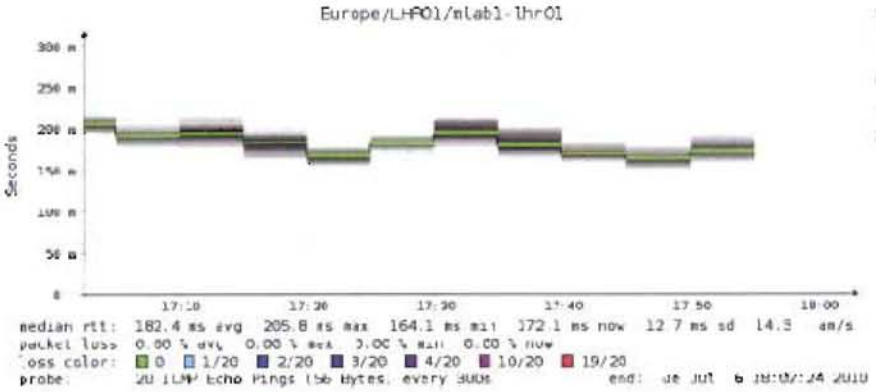
Top Standard Deviation

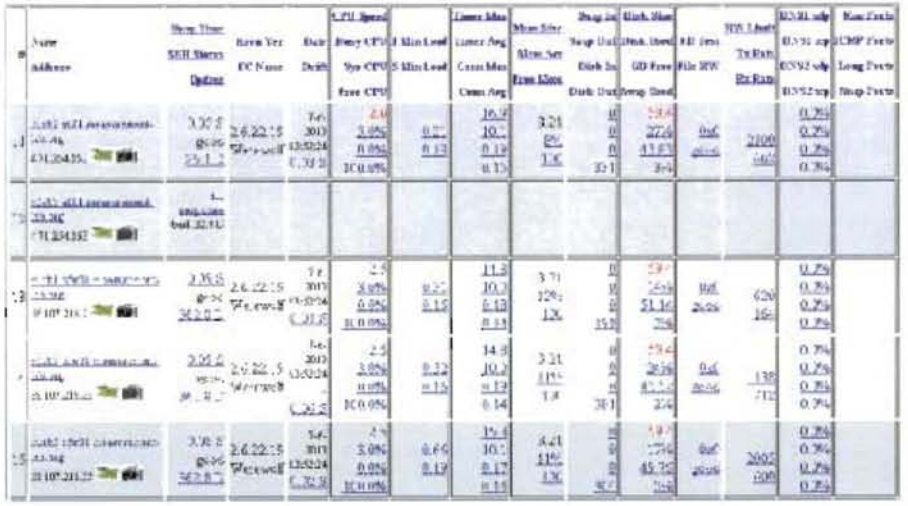
Operational Tools



The most interesting destinations

Top Standard Deviation





Operational Tools

nem: mlab

mlab: [] s1.ams01 s1.ams02 s1.ath01 s1.atl01 s1.dfw01 s1.ham01 s1.lax01 s1.lga01 s1.lga02 s1.lhr01 s1.mia01 s1.nuq01 s1.ord01 s1.par01 s1.sea01 s1.svd01

mlab · []

inst circuit id	*input output graphs*
* mlab-uplink	d w m y

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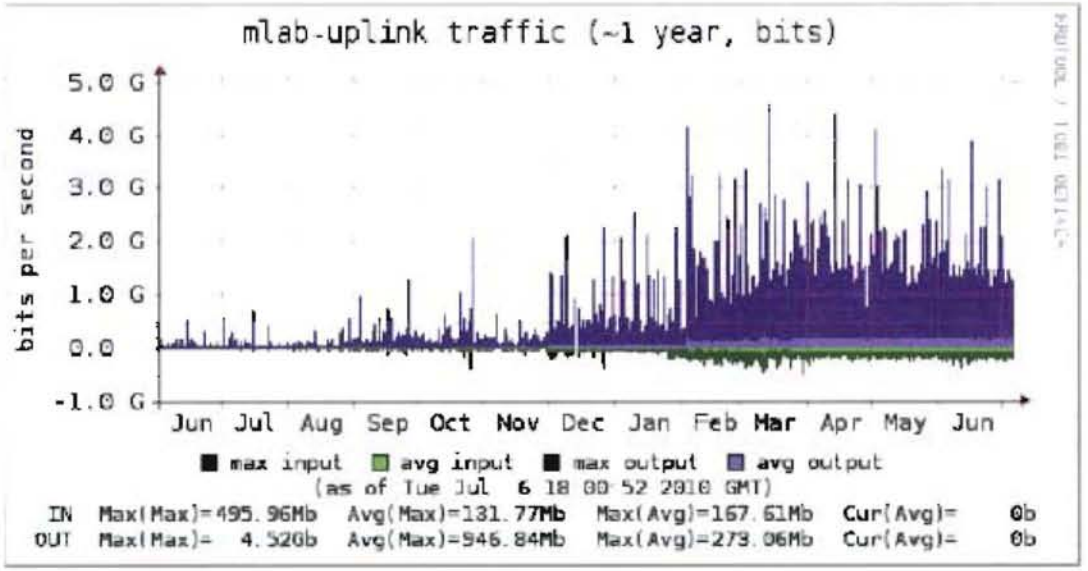


Nagios

General
- Home
- Documentation

Monitoring
- Tactical Overview
- Service Detail
- Host Detail
- Hostgroup Overview
- Hostgroup Summary
- Hostgroup Grid
- Servicegroup Overvie
- Servicegroup Summa
- Servicegroup Grid
- Status Map
- 3-D Status Map
- Service Problems
  - Unhandled
- Host Problems
  - Unhandled
- Network Outages

Show Hosts:

- Comments
- Downtime
- Process Info
- Performance Info
- Scheduling Queue

Reporting
- Trends

Service Overview For All Service Groups

all drac services (_all-drac-services)

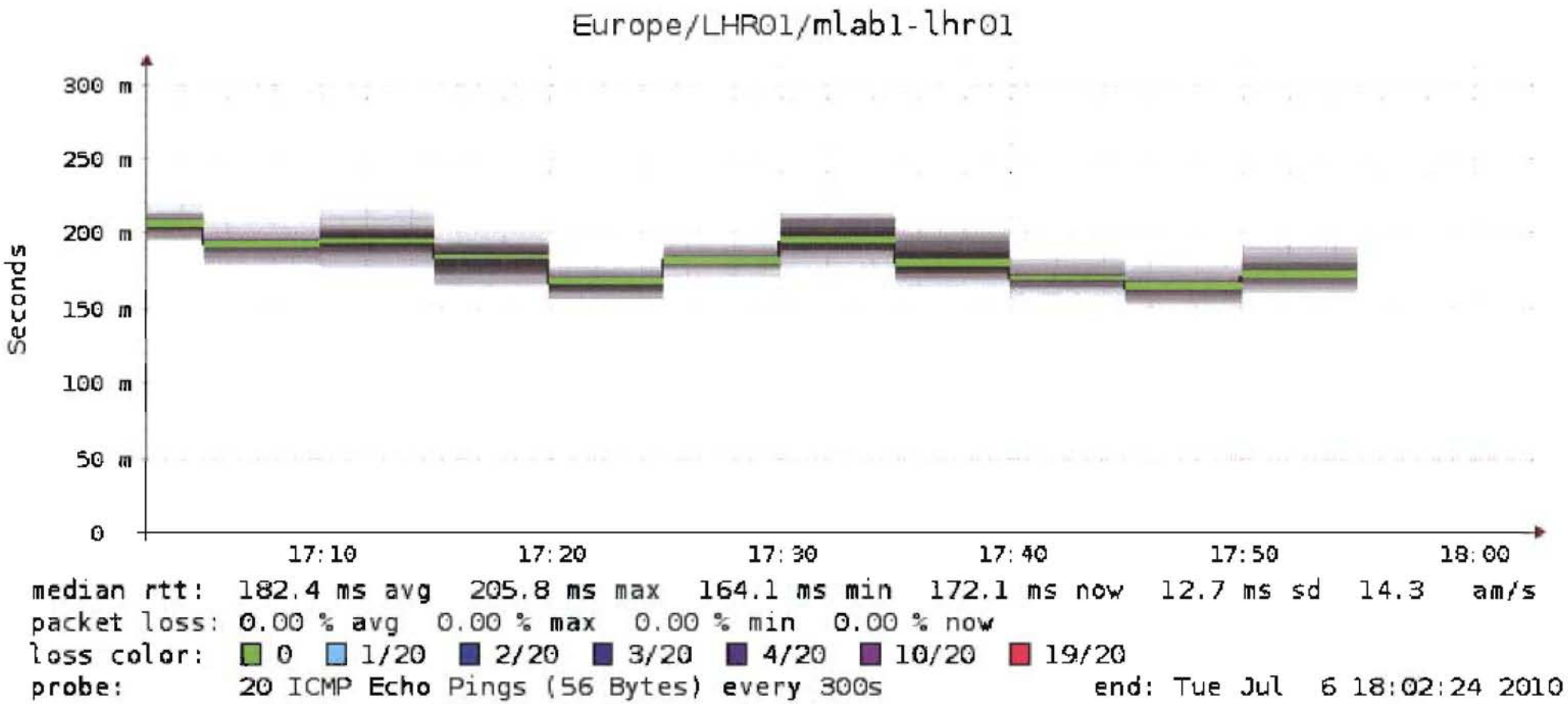
Host	Status	Services	Actions
mlab1d.ams01.measurement-lab.org	UP	1 OK	
mlab1d.ams02.measurement-lab.org	UP	1 OK	
mlab1d.ath01.measurement-lab.org	UP	1 OK	
mlab1d.atl01.measurement-lab.org	UP	1 OK	
mlab1d.dfw01.measurement-lab.org	UP	1 OK	
mlab1d.ham01.measurement-lab.org	UP	1 OK	
mlab1d.lax01.measurement-lab.org	UP	1 OK	
mlab1d.lga01.measurement-lab.org	UP	1 OK	
mlab1d.lga02.measurement-lab.org	UP	1 OK	

all gatech services (_all-gatech-services)

Host	Status	Services	Actions
partha.ct.mlab1.lga01.measurement-lab.org	UP	2 OK	
partha.ct.mlab1.nuq01.measurement-lab.org	UP	3 OK	
partha.ct.mlab1.ord01.measurement-lab.org	UP	2 OK	
partha.ct.mlab1.sea01.measurement-lab.org	UP	2 OK	
partha.ct.mlab2.lga01.measurement-lab.org	UP	2 OK	
partha.ct.mlab2.nuq01.measurement-lab.org	UP	3 OK	
partha.ct.mlab2.ord01.measurement-lab.org	UP	2 OK	
partha.ct.mlab2.sea01.measurement-lab.org	UP	2 OK	
partha.ct.mlab3.lga01.measurement-lab.org	UP	2 OK	
partha.ct.mlab3.nuq01.measurement-lab.org	UP	3 OK	
partha.ct.mlab3.ord01.measurement-lab.org	UP	2 OK	
partha.ct.mlab3.sea01.measurement-lab.org	UP	2 OK	

The most interesting destinations

Top Standard Deviation



20 ICMP Echo Pings (56 Bytes) every 300s end: Tue Jul 6 18:02:24 2010

#	Name Address	Resp Time SSH Status Uptime	Kern Ver FC Name	Date Drift	CPU Speed Busy CPU Sys CPU Free CPU	1 Min Load 5 Min Load	Timer Max Timer Avg Conn Max Conn Avg	Mem Size Mem Act Free Mem	Swap In Swap Out Disk In Disk Out	Disk Size Disk Used GB Free Swap Used	FD Test File RW	BW Limit Tx Rate Rx Rate	DNS1 udp DNS1 tcp DNS2 udp DNS2 tcp	Raw Ports ICMP Ports Long Ports Snap Ports
11	mlab2.atl01.measurement-lab.org 4.71.254.150	0.05 S good 25.1 D	2.6.22.19 Werewolf	7-6-2010 13:52:24 0.03 S	2.0 3.0% 0.0% 100.0%	0.21 0.18	16.9 10.1 0.19 0.15	3.21 8% 100	0 0 0 331	59.4 27% 43.83 3%	0x0 good	2100 662	0.0% 0.0% 0.0% 0.0%	
12	mlab3.atl01.measurement-lab.org 4.71.254.163	no response bad: 32.4 D												
13	mlab1.dfw01.measurement-lab.org 38.107.216.9	0.09 S good 362.8 D	2.6.22.19 Werewolf	7-6-2010 13:52:24 0.01 S	2.5 3.0% 0.0% 100.0%	0.31 0.16	14.8 10.0 0.18 0.14	3.21 12% 100	0 0 0 199	59.4 14% 51.14 2%	0x0 good	620 164	0.0% 0.0% 0.0% 0.0%	
14	mlab2.dfw01.measurement-lab.org 38.107.216.22	0.09 S good 361.8 D	2.6.22.19 Werewolf	7-6-2010 13:52:24 0.06 S	2.5 3.0% 0.0% 100.0%	0.32 0.16	14.8 10.0 0.19 0.14	3.21 11% 100	0 0 0 381	59.4 24% 45.52 2%	0x0 good	1138 712	0.0% 0.0% 0.0% 0.0%	
15	mlab3.dfw01.measurement-lab.org 38.107.216.35	0.08 S good 362.8 D	2.6.22.19 Werewolf	7-6-2010 13:52:24 0.02 S	2.5 3.0% 0.0% 100.0%	0.66 0.19	15.3 10.1 0.17 0.14	3.21 11% 100	0 0 0 304	59.4 17% 49.76 2%	0x0 good	2005 600	0.0% 0.0% 0.0% 0.0%	

Closest Node

M-Lab tools have access to DONAR.

- A distributed system that provides name resolution and server selection for replication services.
- Dynamic mapping policies direct users based on geographic location and platform load distribution.

http://donardns.org

ement-lab.org
ment-lab.org
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ement-lab.org

Virtualization

Slices are created on each node to allocate specific resources for each tool.

- Implemented as Linux-Vservers, which implements both namespace and performance isolation among slices on a single machine
- Network virtualization is implemented using VNET
- Tests show insignificant virtualization overhead (about 1-2%)

PlanetLab Architecture Overview:
https://www.planet-lab.org/doc/guides/user

The M-Lab Platform

Using only 1% of total resources

An overprovisioned, extensible, scalable, robust open platform for open measurement tools

M-Lab Node

base is a custom Open Source Linux
ystem maintained by PlanetLab. This

ates & Territories

National Governments

Open Source Measurement Tools

NDT

- Advanced Network Diagnostic Tool
- Report measured upload & download speeds
- Determine what problems are limiting speed i.e. client computer, home network, provider network, or testing server
- Identify if the network connection is behind a NAT
- Detect Firewall and possible end-to-end network settings.

http://e2epi.internet2.edu/ndt

User Results

Researcher Results

NPAD

Advanced Diagnostic tester

- Analyze host configuration and network path
- Identify if routers/switches would impact WAN performance
- Web-based output simplifies problem reporting

http://www.psc.edu/networking/projects/pathdiag/

Glasnost

Determine if an ISP is blocking email, HTTP or SSH transfer, Flash video, and P2P apps including BitTorrent, eMule and Gnutella.

http://broadband.mpi-sws.org/transparency/bttest_mlab.php

Pathload2

Measures available bandwidth

- Reports "Raw" bps capacity independent of transport or application protocol

http://www.cs.umd.edu/Faculty/Constantinos Dovrolis/Papers/NetDyn0248.pdf

Sidestream

- Collect TCP details (with 100 variables) from regular web traffic on a client computer
- Collect information on a representative of general client network usage
- Initiate test stream requests
- Analyze, compare, and validate inter active test results

http://www.measurementlab.net/news/2010/aug/19/side-stream-experiment

Windrider

Attempts to detect whether your mobile broadband provider is performing application or service specific differentiation, i.e. prioritizing or slowing traffic to certain websites, applications, or content

http://www.cs.northwestern.edu/~ct992/mobile.htm

Test Client Interfaces For Users

In Web Browser

Mobile Device

ShaperProbe

Detects whether your ISP performs "traffic shaping" in either the upload or download direction. In the event of shaping, ShaperProbe reports the shaping rate and the "maximum burst size" before shaping begins.

http://www.cc.gatech.edu/fac/Constantinos.Dovrolis/shaperprobe.html

M-Lab Hosted Tools

Enabling deep critcal data analysis
transparent and open source tools
methodologies

Open Source Measurement Tools

- All tools are created by individual researchers, not M-Lab itself
- All researchers are required to publish client and server software source code to allow for 3rd party review
- All researchers' tools must be operated and licensed in such a way as to allow 3rd parties to develop client-side software for measurements

ic Tool

NPAD