



Internet Measurement
& Analysis (IMA)

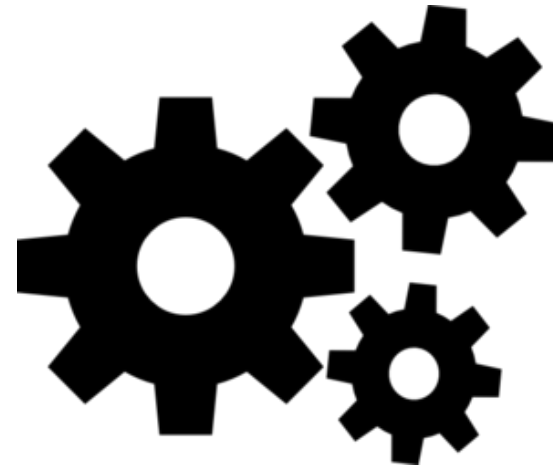
Tools for Measuring the Expanding Internet Topology

ISP and IXP Topologies

Prof. Georgios Smaragdakis, Ph.D.

Hands-on Exercise

Tools and Public Vantage Points for Active and Vantage Measurements



Looking Glasses

- Remote servers run on routers that allow to use them as vantage point for active measurements
- Many Networks provide such looking glasses
- Each Network may have a looking glass at different locations
- There are available lists, e.g.,

<http://www.traceroute.org>

<http://lookingglass.org/>

BGP Looking Glasses

- Remote servers run on routers or receive BGP feed from routers and can be used to query the BGP routing table (we will revisit this in the next lecture)
- Many Networks provide such looking glasses
- Each Network may have a looking glass at different locations

For a list see:

<http://www.bgplookingglass.com/>

Example: Hurricane Electric LG



<https://lg.he.net/>

Looking Glass

Welcome to Hurricane Electric's Network Looking Glass. The information provided by and the support of this service are on a best effort basis. These are some of our routers at core locations within our network. We also operate a public route server accessible via telnet at route-server.he.net.

Routers

Europe

- ☐ NIKHEF Amsterdam
- ☐ Equinix BA1, Barcelona
- ☐ Telenor, Belgrade
- ☐ IPB CarrierColo Berlin
- ☐ Sitel, Bratislava
- ☐ Interxion Brussels
- ☐ NXDATA-1, Bucharest
- ☐ CE Colo Victor Hugo 1
- ☐ Interxion Copenhagen
- ☐ Interxion Dusseldorf
- ☐ Equinix Dublin (DB2)
- ☐ Interxion Frankfurt
- ☐ Equinix Geneva (GV1)
- ☐ GlobalConnect, Hamburg
- ☐ Digita Datacenter 2
- ☐ NewTelco Ukraine
- ☐ Equinix LS1, Lisbon
- ☐ Telehouse Docklands East
- ☐ Equinix London (LD8)
- ☐ Telehouse Docklands North
- ☐ LuxConnect DC1.1
- ☐ Interxion Madrid
- ☐ Equinix MA1, Manchester
- ☐ Interxion Marseille
- ☐ Equinix Munich (MU1)
- ☐ MIX Milan Via Caldera
- ☐ Enter Milan
- ☐ Digiplex Norway, Oslo

- Amsterdam, NL 
- Barcelona, ES 
- Belgrade, RS 
- Berlin, DE 
- Bratislava, SK 
- Zaventem, BE 
- Bucharest, RO 
- Budapest, HU 
- Copenhagen, DK 
- Düsseldorf, DE 
- Dublin, IE 
- Frankfurt, DE 
- Geneva, CH 
- Hamburg, DE 
- Helsinki, FI 
- Kiev, UA 
- Prior Velho, Lisbon, PT 
- London, UK 
- London, UK 
- London, UK 
- Bettembourg, LU 
- Madrid, ES 
- Manchester, UK 
- Marseille, FR 
- München, DE 
- Milan, IT 
- Milan, IT 
- Oslo, NO 

Commands

- ☐ Ping
- ☒ Traceroute
- ☐ BGP Route
- ☐ BGP Summary (IPv4)
- ☐ BGP Summary (IPv6)

Arguments

IP/Hostname:

☐ Raw output (no tables)


Probe

Clear

BGP Looking Glasses Databases

BGP Looking Glass

[BGP Looking Glass Database](#)[List of Autonomous System Numbers](#)[List of Autonomous System Numbers - 2](#)[4-byte ASN Names List](#)[IXP Database](#)[IXP Database 2](#)[Mac Address Vendor Lookup](#)[Mac Address Vendor Lookup 2](#)[Mac Address Vendor Lookup 3](#)[Mac Address Vendor Lookup 4](#)




BGP Looking Glass Database

[BGP](#)[looking glass](#)


Welcome to the biggest and most updated **BGP Looking Glass and Traceroute list** in internet You'll find out **1150** Looking Glass Servers updated at **03/01/2018**. If you find a broken link, or you want to announce a new looking glass site, please feel free to send us an email to info@bgplookingglass.com.


Looking Glass Database		
Name of ISP	ASN	Looking Glass
Looking Glass University of California, Berkeley AS25	25	https://nettools.net.berkeley.edu/pubtools/
Looking Glass Packet Clearing House AS42	42	https://www.pch.net/tools/looking_glass
Looking Glass University of Wisconsin Madison AS59	59	https://www.net.wisc.edu/cgi-bin/public/lg-as59.pl
Looking Glass University of Washington AS73	73	https://netman.cac.washington.edu/lookingglass/
Looking Glass Princeton AS209	88	https://www.net.princeton.edu/traceroute.html



Intelligent Routing Platform

What BGP Looking Glass servers are and how network administrators use them
BGP Network Monitoring and Troubleshooting

[MULTIHOMING - a complete step-by-step guide](#) 

[BGP in Large Networks - Scaling BGP across multiple locations](#) 

Source: <https://peeringdb.com/>

PeeringDB provides links for LGeS



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Global System Statistics

12460 Peering Networks
630 Public Exchange Points
23510 Unique Public Exchange Presences
2794 Private Facilities
21280 Private Facility Presences

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Source: <https://peeringdb.com/>

Traceroute using Hurricane Electric's Looking Glass



Looking Glass

Welcome to Hurricane Electric's Network Looking Glass. The information provided by and the support of this service are on a best effort basis. These are some of our routers at core locations within our network. We also operate a public route server accessible via telnet at route-server.he.net.

Routers

North America

- ☐ Equinix Ashburn (DC2)
- ☐ Digital Realty / Telx Atlanta (ATL1), 56 Marietta
- ☐ Neutral Path MSP1, Belle Plaine
- ☐ One Summer Boston
- ☐ Datahive Calgary
- ☐ Lumos / DC74 Data Center CLT-2 Charlotte
- ☐ ACT Cheyenne
- ☐ Equinix Chicago (CH1/CH2)
- ☐ Cologix Columbus
- ☐ Equinix Dallas (DA1)
- ☐ CoreSite Denver
- ☐ 123NET Detroit
- ☐ Wolfpaw, Edmonton
- ☐ Hurricane Electric Fremont 1
- ☒ Hurricane Electric Fremont 2

Ashburn, VA, US 
Atlanta, GA, US 
Belle Plaine, MN, US 
Boston, MA, US 
Calgary, AB, CA 
Charlotte, NC, US 
Cheyenne, WY, US 
Chicago, IL, US 
Columbus, OH, US 
Dallas, TX, US 
Denver, CO, US 
Southfield, MI, US 
Edmonton, AB, CA 
Fremont, CA, US 
Fremont, CA, US 

Commands

- ☐ Ping
- ☒ Traceroute
- ☐ BGP Route
- ☐ BGP Summary (IPv4)
- ☐ BGP Summary (IPv6)

Arguments

IP/Hostname:

- ☐ Raw output (no tables)



Looking Glass

Welcome to Hurricane Electric's Network Looking Glass. The information provided by and the support of this service are on a best effort basis. These are some of our routers at core locations within our network. We also operate a public route server accessible via telnet at route-server.he.net.

[Show options](#)

core3.fmt2.he.net> traceroute 216.58.213.196 source 216.218.252.191 numeric				
Target		216.58.213.196		
Hop Start		1		
Hop End		30		
Hop ↕	Packet 1 ↕	Packet 2 ↕	Packet 3 ↕	Hostname ↕
1	20 ms	1 ms	<1 ms	100ge14-2.core1.sjc2.he.net (72.52.92.246)
2	<1 ms	13 ms	4 ms	eqixsj-google-gige.google.com (206.223.116.21)
3	1 ms	1 ms	1 ms	108.170.242.253
4	1 ms	1 ms	11 ms	66.249.94.29
5	46 ms	49 ms	50 ms	72.14.239.63
6	100 ms	147 ms	93 ms	216.239.43.220
7	49 ms	50 ms	48 ms	209.85.247.4
8	63 ms	72 ms	111 ms	216.239.59.1
9	140 ms	159 ms	202 ms	172.253.65.167
10	159 ms	135 ms	175 ms	209.85.245.230
11	142 ms	147 ms	262 ms	172.253.66.31
12	172 ms	146 ms	152 ms	172.253.50.111
13	145 ms	157 ms	201 ms	216.239.54.169
14	170 ms	145 ms	156 ms	108.170.253.49
15	144 ms	203 ms	371 ms	209.85.251.207
16	325 ms	179 ms	232 ms	ham02s15-in-f4.1e100.net (216.58.213.196)

Entry cached for another 59 seconds.

2019-04-25 06:35:25 UTC

Traceroute using Deutsche Telekom's Looking Glass



Deutsche Telekom - Route Information Service

Networking tools - Traceroute

Looking glass

Networking tools

Traceroute

Ping

Whois

Traceroute destination	Number of hops	Protocol	Location
216.58.213.196	15	IPv4 ↕	Frankfurt (DE) (IPv4/IPv6) ↕

Selection of server to execute traceroute.


Output:

```
traceroute to 216.58.213.196 (216.58.213.196), 15 hops max, 60 byte packets
 1 f-ea2.f.de.net.dtag.de (194.25.0.217)  3.906 ms  3.897 ms  3.888 ms
 2 217.5.118.142 (217.5.118.142)  1.088 ms  1.081 ms  1.078 ms
 3 217.239.51.58 (217.239.51.58)  1.043 ms  1.041 ms  1.033 ms
 4 80.150.170.30 (80.150.170.30)  0.952 ms  0.958 ms  0.950 ms
 5 108.170.251.208 (108.170.251.208)  0.953 ms  108.170.252.18 (108.170.252.18)  0.956 ms  108.170.252.83 (108.170.252.83)  1.103 ms
 6 209.85.252.214 (209.85.252.214)  1.800 ms  2.231 ms  2.217 ms
 7 72.14.234.10 (72.14.234.10)  8.260 ms  8.252 ms  216.239.56.131 (216.239.56.131)  9.436 ms
 8 172.253.50.101 (172.253.50.101)  12.142 ms  172.253.50.215 (172.253.50.215)  13.102 ms  13.101 ms
 9 108.170.225.179 (108.170.225.179)  21.092 ms  216.239.63.48 (216.239.63.48)  12.654 ms  216.239.54.170 (216.239.54.170)  12.645 ms
10 108.170.253.33 (108.170.253.33)  12.040 ms  11.969 ms  108.170.253.49 (108.170.253.49)  14.480 ms
11 209.85.251.131 (209.85.251.131)  12.025 ms  209.85.251.207 (209.85.251.207)  11.903 ms  209.85.251.131 (209.85.251.131)  12.226 ms
12 ham02s15-in-f196.1e100.net (216.58.213.196)  12.219 ms  12.078 ms  12.047 ms
```

RIPE Atlas

<https://atlas.ripe.net/>



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With your help, the RIPE NCC is building the largest Internet measurement network ever made. RIPE Atlas employs a global network of probes that measure Internet connectivity and reachability, providing an unprecedented understanding of the state of the Internet in real time.



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Measurements


+ Create a Measurement

Search by target Search... Any Status IPv4/v6 All types Of all time  

Mine Favourites Hidden Ping Traceroute DNS HTTP SSL NTP WiFi Built-in Anchoring

ID	Type	Target	Description	Probes	Interval	Time (UTC)	Status
12455098	Traceroute	8.8.8.8 (AS15169)	Traceroute measurement to 8.8.8.8	10	one-off	2018-05-03 04:10 2018-05-03 04:20	  
2457698	Traceroute	213.52.177.20 (AS15830)	Traceroute measurement to 213.52.177.20	1	one-off	2015-09-28 19:55 2015-09-28 20:05	  
2457697	Traceroute	185.55.52.246 (AS32421)	Traceroute measurement to 185.55.52.246	1	one-off	2015-09-28 19:45 2015-09-28 19:50	  
2457694	Traceroute	72.38.238.90 (AS7992)	Traceroute measurement to 72.38.238.90	1	one-off	2015-09-28 19:07 2015-09-28 19:15	  

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Create a New Measurement

Step 1 Definitions

Traceroute measurement to 8.8.8.0

Target*:

An IP address or hostname

Address Family*:

Timeout (ms):

Description:

Protocol*:

Interval:

How often this should be done (seconds between samples). Note that this value is ignored for one-off measurements.

+ Ping

+ Traceroute

+ DNS

+ SSL

+ HTTP

+ NTP

Step 2 Probe Selection

Worldwide 10

+ New Set - wizard

+ New Set - manual

+ IDs List

+ Reuse a set from a measurement

13

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Mine	Favourites	Hidden	Ping	Traceroute	DNS	HTTP	SSL	NTP	WiFi	Built-in	Anchoring
------	------------	--------	------	------------	-----	------	-----	-----	------	----------	-----------

ID	Type	Target	Description	Probes	Interval	Time (UTC)	Status
20959692	Traceroute	8.8.8.0	Traceroute measurement to 8.8.8.0	5	900 s	2019-04-25 06:27 Never	

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Probe	ASN (IPv4)	ASN (IPv6)		Time (UTC)	RTT		Hops	Success	
12796	6848			2019-04-25 06:30	17.538		15		
13457	62007								No recent report available
15779	3320	3320		2019-04-25 06:31	29.807		15		
19619	5089			2019-04-25 06:33	19.710		17		
24408	39532								No recent report available
29036	2907			2019-04-25 06:32	44.654		17		
30527	33915								No recent report available
30718	15735			2019-04-25 06:31	61.581		19		
31949	6830								No recent report available
34762	19108			2019-04-25 06:32	19.271		16		

RIPE Atlas

Mine	Favourites	Hidden	Ping	Traceroute	DNS	HTTP	SSL	NTP	WiFi	Built-in	Anchoring
ID	Type	Target	Description				Probes	Interval	Time (UTC)	Status	
20959692	Traceroute	8.8.8.0	Traceroute measurement to 8.8.8.0				5	900 s	2019-04-25 06:27 Never		

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Latest Results

Measurements

Probe	ASN (IPv4)	ASN (IPv6)	Country	AS
12796	6848		FR	
13457	62007		IT	
15779	3320	3320	DE	
19619	5089		UK	
24408	39532		NO	
29036	2907		JP	
30527	33915		NL	
30718	15735		FR	
31949	6830		FR	
34762	19108		US	

Latest Traceroute Result for Measurement #20959692

2019-04-25 06:30 UTC

Traceroute to 8.8.8.0 (8.8.8.0), 48 byte packets

1	94.226.232.1	94-226-232-1.access.telenet.be	AS6848	7.276ms	9.195ms	5.793ms
2	213.224.200.121	dD5E0C879.access.telenet.be	AS6848	8.032ms	7.726ms	10.027ms
3	213.224.250.109	dD5E0FA6D.access.telenet.be	AS6848	8.901ms	7.827ms	9.904ms
4	213.224.125.3	dD5E07D03.access.telenet.be	AS6848	13.021ms	11.484ms	13.731ms
5	108.170.241.205	AS15169		12.776ms	11.186ms	11.858ms
6	216.239.43.27	AS15169		11.571ms	11.773ms	13.663ms
7	172.253.66.13	AS15169		15.127ms	15.358ms	17.92ms
8	216.239.47.52	AS15169		15.203ms	15.78ms	15.948ms
9	216.239.40.123	AS15169		17.438ms	19.727ms	17.538ms
10	***					
11	***					
12	***					
13	***					
14	***					
255	***					