



RIPE NCC
RIPE NETWORK COORDINATION CENTRE

Measuring IPv6 Adoption

What is the status?

Measurement Types



- Passive Measurements
 - Registry data
 - Routing Information System (RIS)
- Active Measurements
 - RIPE Atlas
 - APNIC Google ad measurements
 - Google IPv6
 - Cisco IPv6
 - Maxmind IPv6 geolocation
 - Alexa

Registry Data



- RIPE Database
 - Allocation and assignment information
 - Resources in Israel:

IPv6 68
IPv4 449



<https://stat.ripe.net/IL#tabId=database>

Country Resource List (IL)

Date: 2016-09-07

ASN	IPv4	IPv6
Show 10 entries		
Search:		
2001:40a8::/32		
2001:4cd0::/32		
2001:4d10::/32		
2001:57c:1150::/48		
2001:57c:1738::/48		
2001:57c:2590::/48		
2001:57c:2840::/48		
2001:57c:2dbc::/48		

Registry Data



- RIPE Database
 - Allocation and assignment information
 - Resources in Israel:

IPv6 68
IPv4 449

15%

Registry Data



- RIPE Database

- Allocation and assignment information
- Resources in Israel:

IPv6 68

IPv4 449

15%

- Registered space in Israel:

4,194,305,792 IPv6 (/56)

7,607,040

IPv4

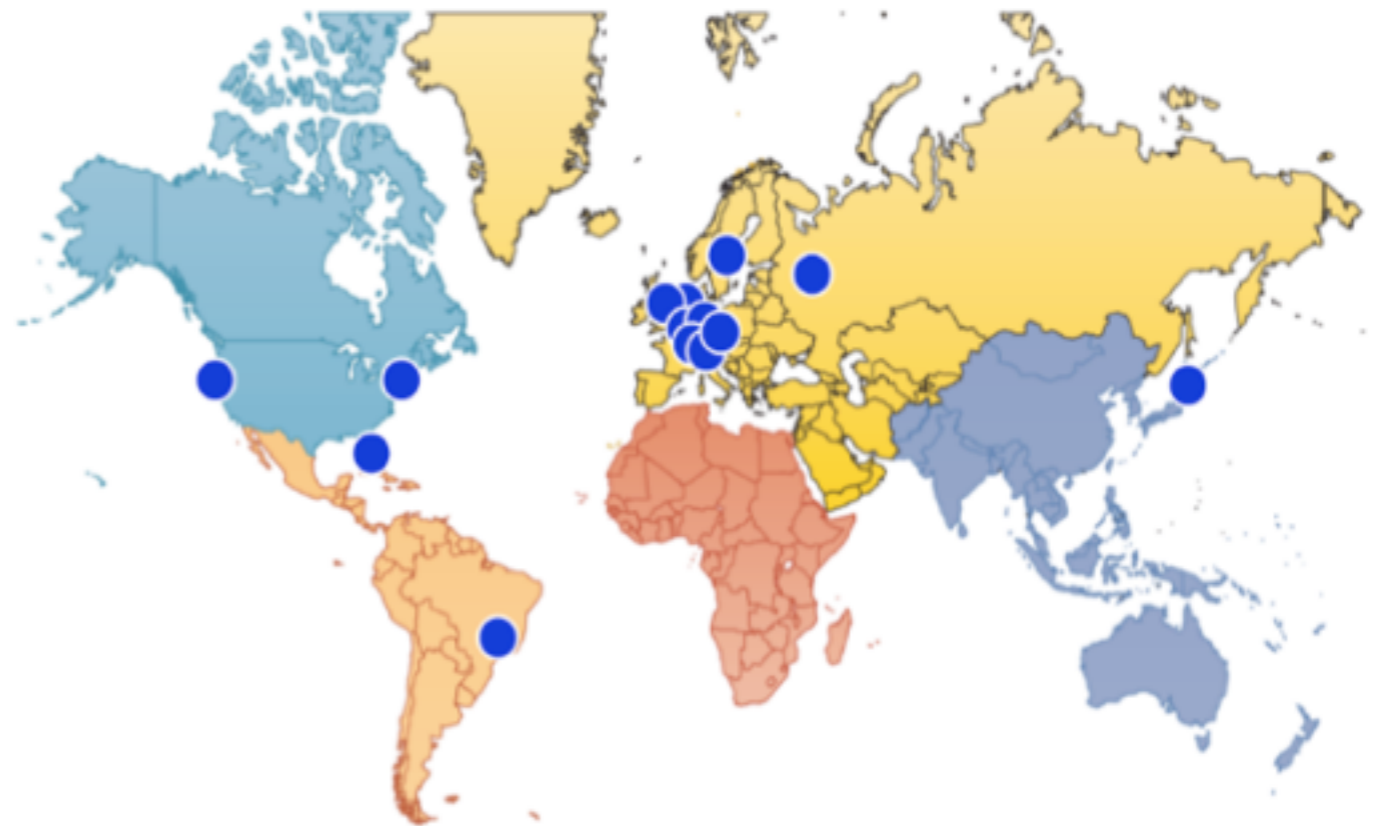
550%

Routing Information



- RIS

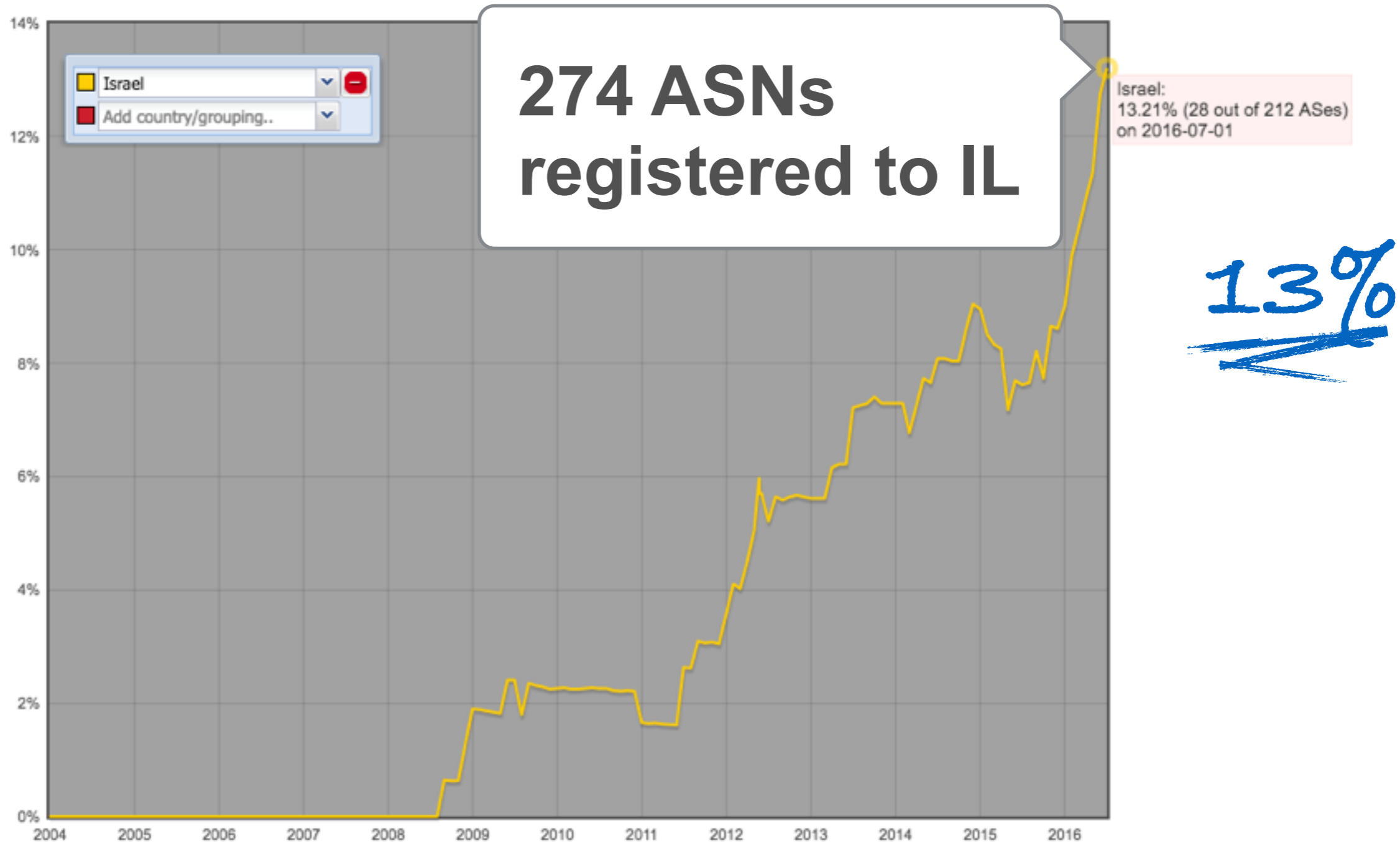
- The RIPE NCC has been collecting BGP information since 1999
- 18 collectors
- 160+ full-feed peers
- <http://ris.ripe.net>



Routing Information



- <http://v6asns.ripe.net/v/6?s=IL>



Routing Information



- RIS
 - Resources globally seen from Israel



6%



<https://stat.ripe.net/IL#tabId=routing>

RIPE Atlas



- A brief introduction
 - Global network for Internet measurements

The screenshot displays the RIPE Atlas web interface. On the left, a 'Statistics' panel shows:

Statistics	
Probes connected to RIPE Atlas	9151
Measurements currently running	12172
Results collected per second	3895

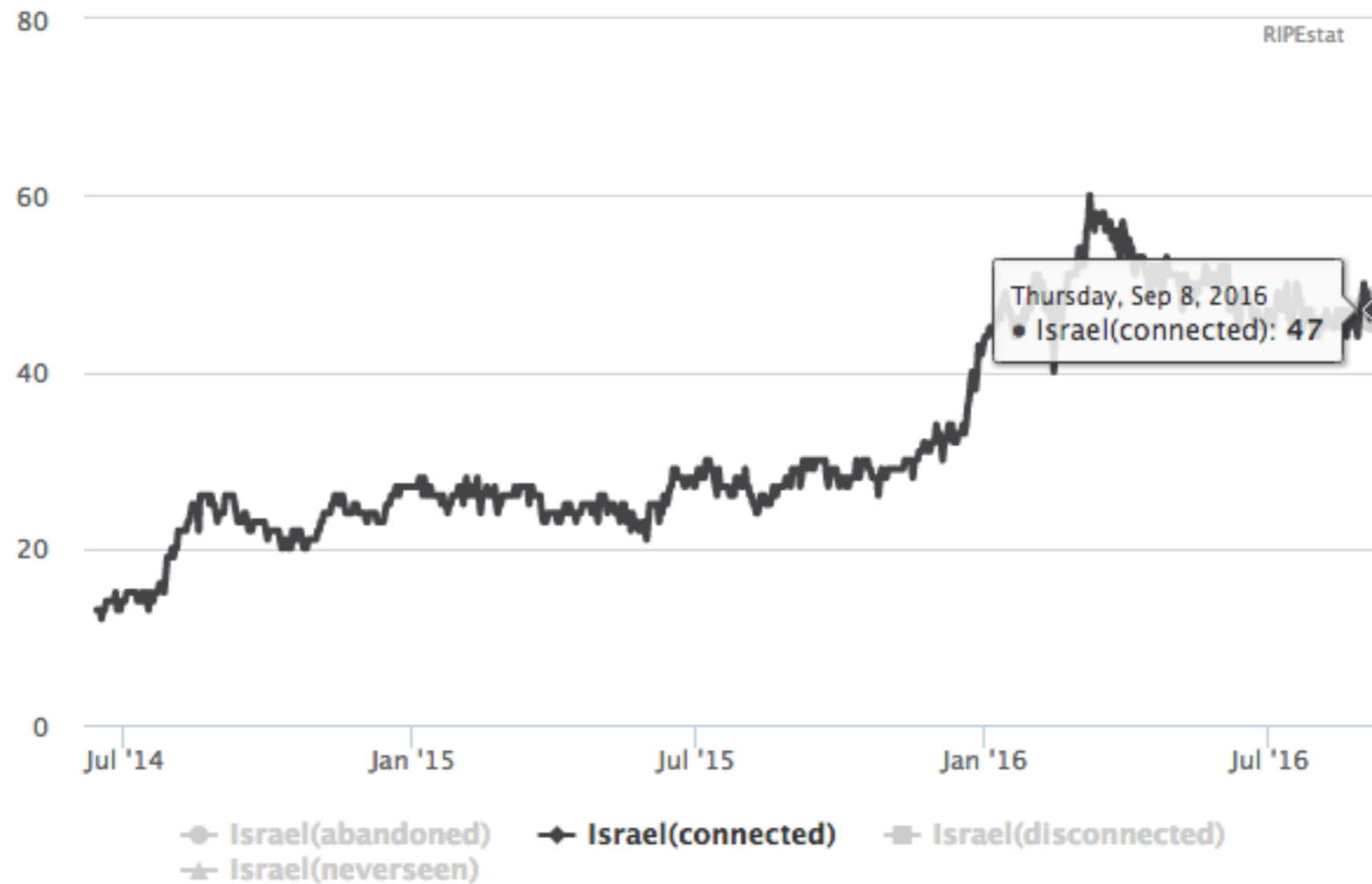
The main area features a world map with numerous colored dots representing probes. A legend at the bottom indicates: Connected: 9147 (green), Disconnected: 2518 (yellow), Abandoned: 4671 (red).

Overlaid on the map is a 'Create a New Measurement' dialog box. It has a title bar and a 'Step 1 Definitions' section. The text inside reads: 'Please select the type of measurement you want to create'. Below this text are six buttons: '+ Ping', '+ Traceroute', '+ DNS', '+ SSL', '+ HTTP', and '+ NTP'.

RIPE Atlas



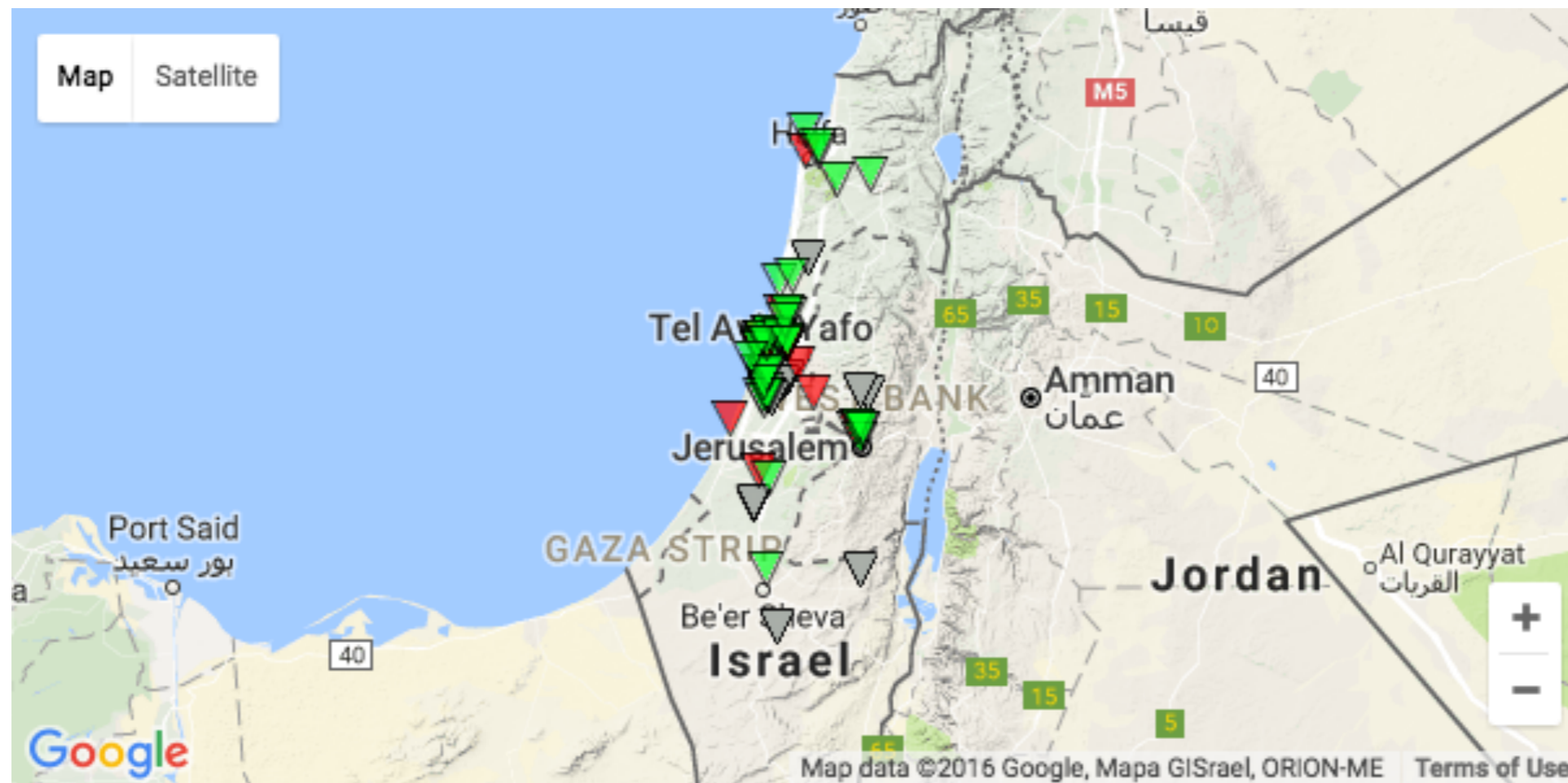
- RIPE Atlas in Israel



RIPE Atlas



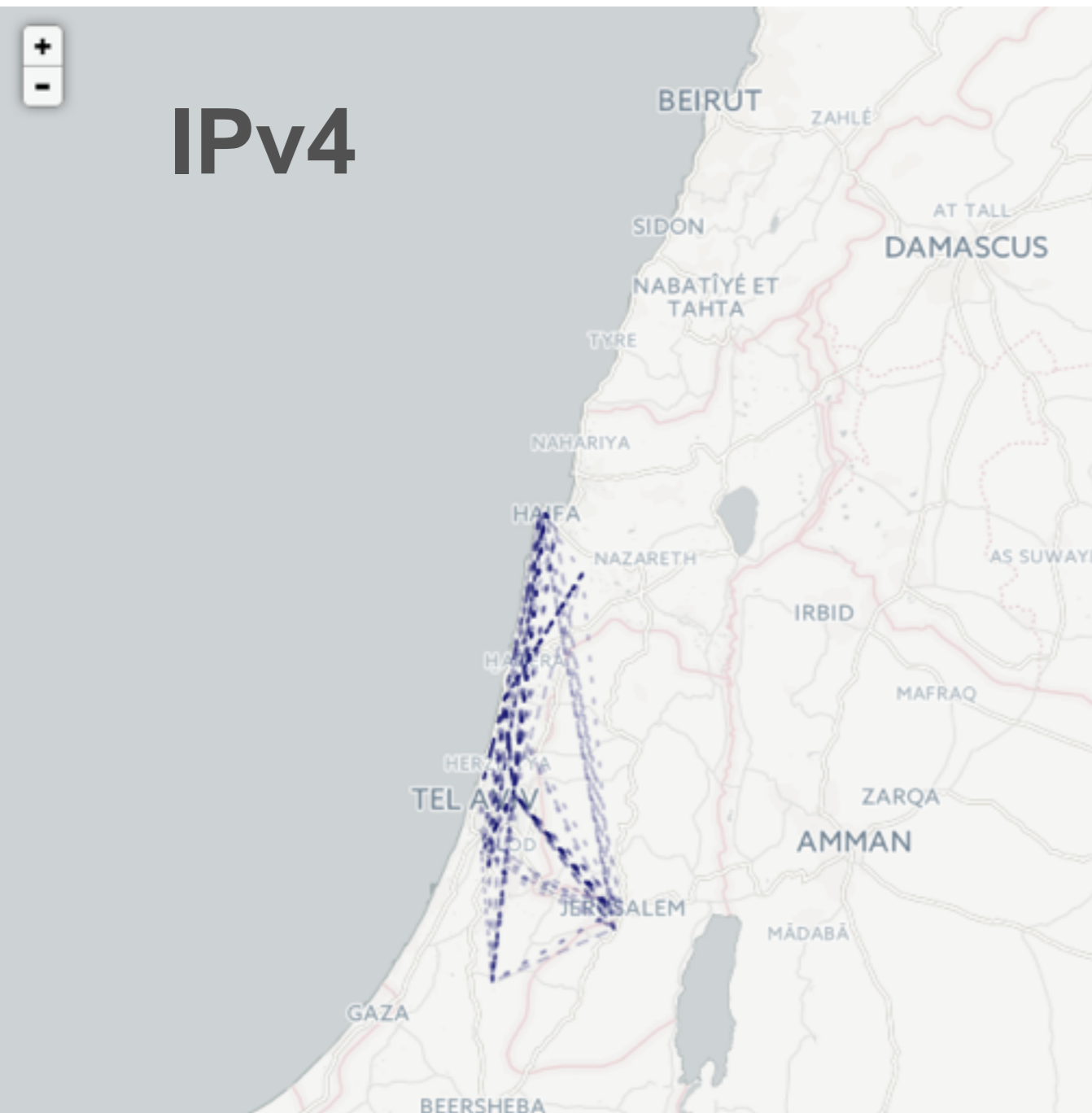
- RIPE Atlas in Israel



RIPE Atlas



- IXP-Country-Jedi

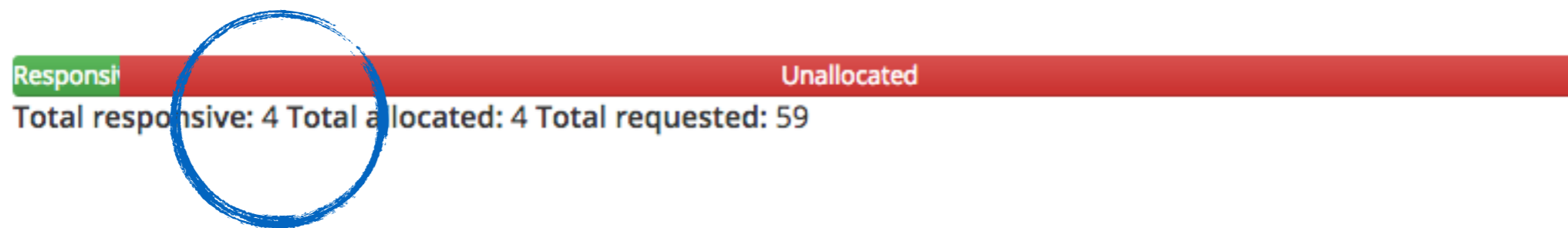


RIPE Atlas



- A closer look at the probes in Israel
 - Test with a simple measurement

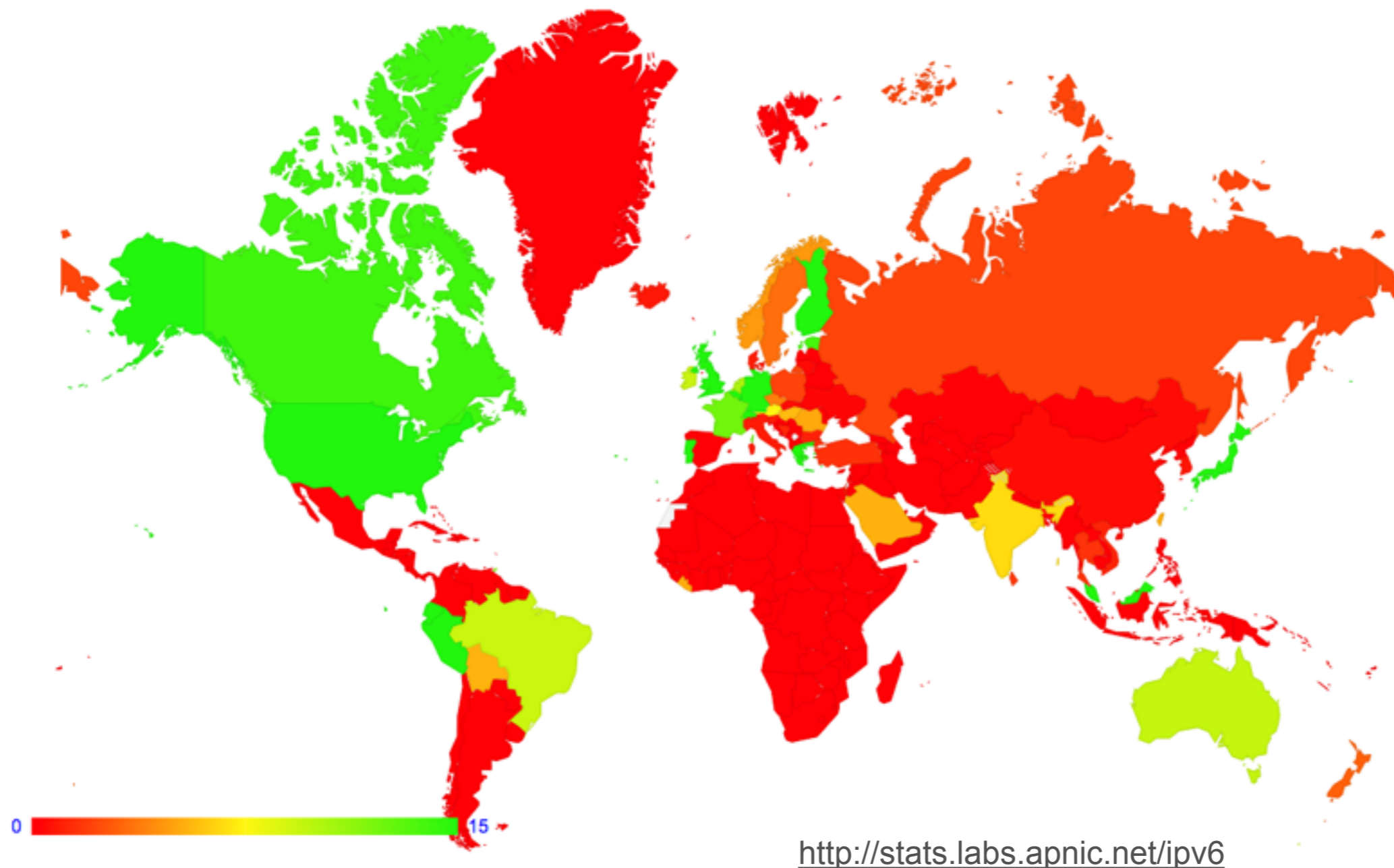
Specification <input type="checkbox"/>	Number of Probes <input type="checkbox"/>	Include probe tags <input type="checkbox"/>	Exclude probe tags <input type="checkbox"/>
Country: IL	59	system: IPv6 Works	system: IPv6 Doesn't Work



APNIC IPv6 Measurements



- Based on Google advertisements

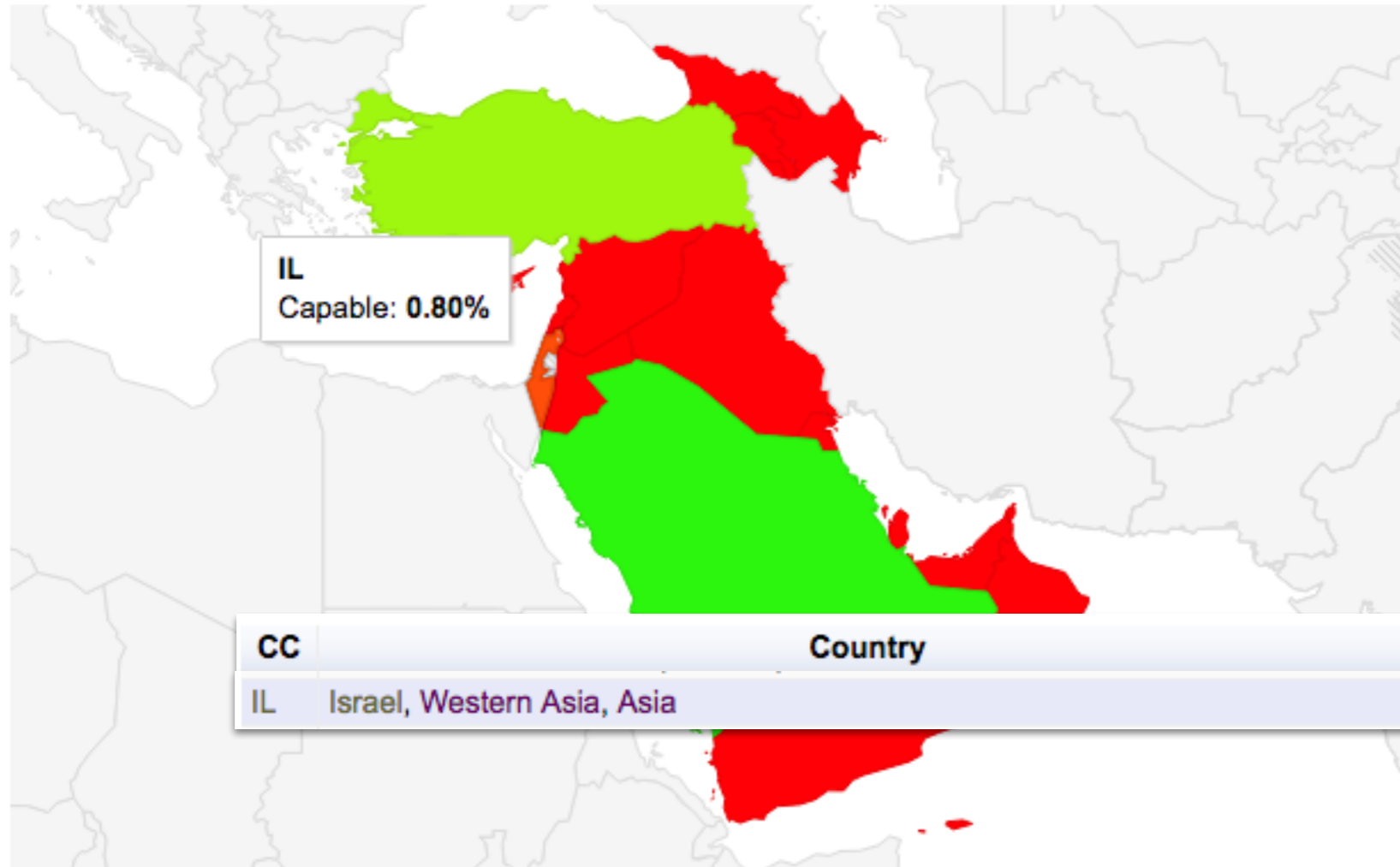


APNIC IPv6 Measurements



- Results for Israel

<http://stats.labs.apnic.net/ipv6/IL>

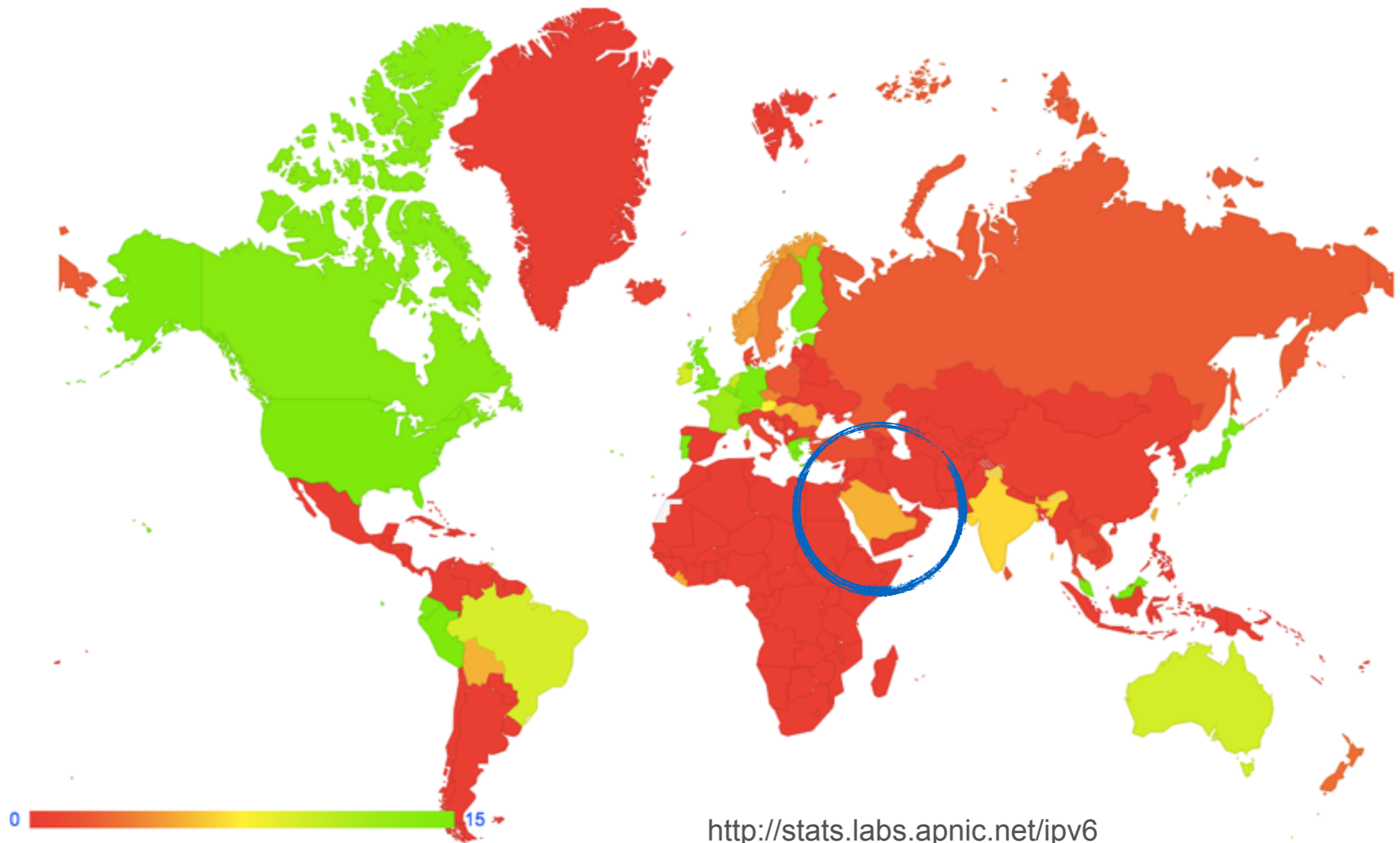


0.8%

APNIC Measurements



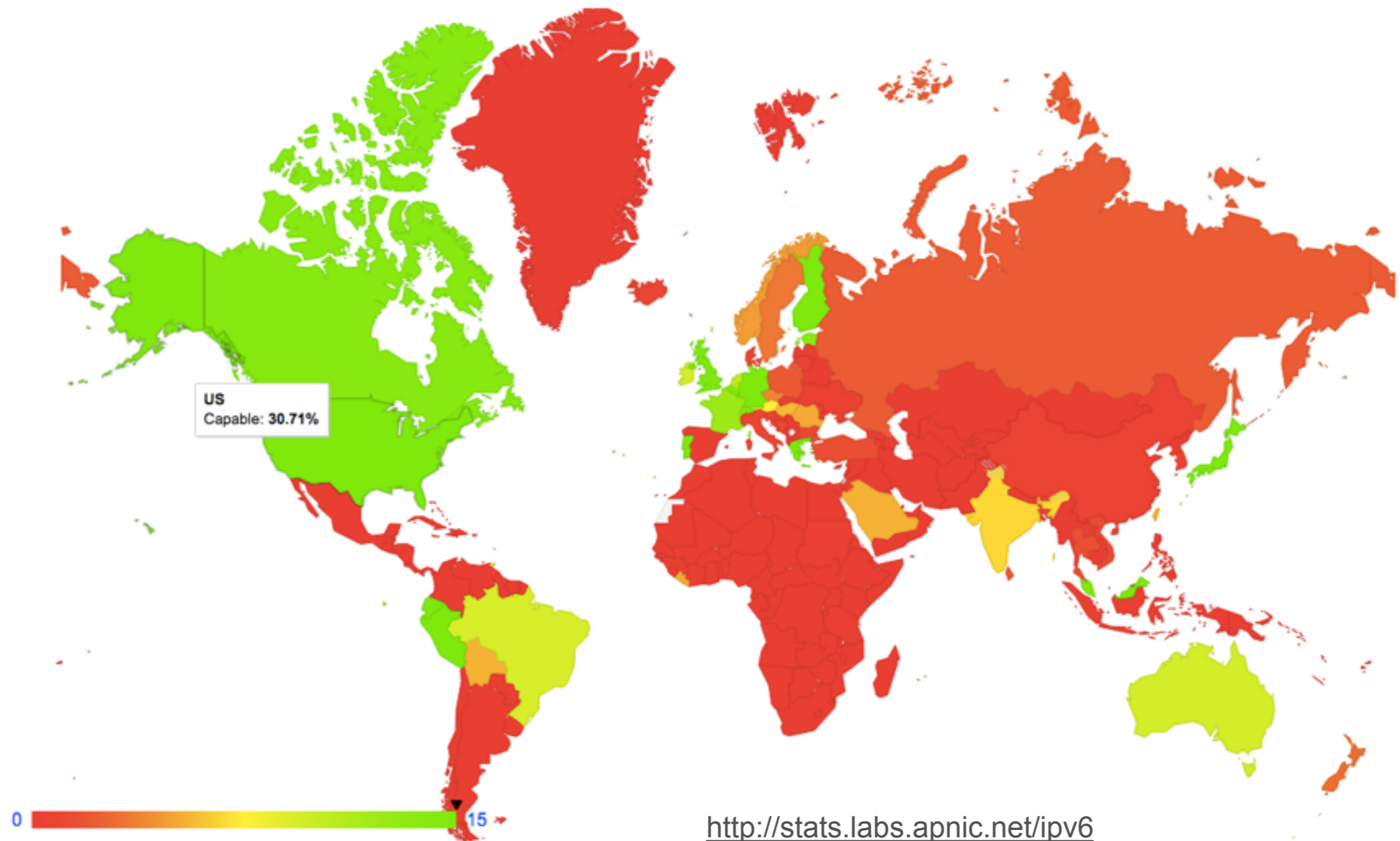
- World map again



APNIC Measurements



- World map again

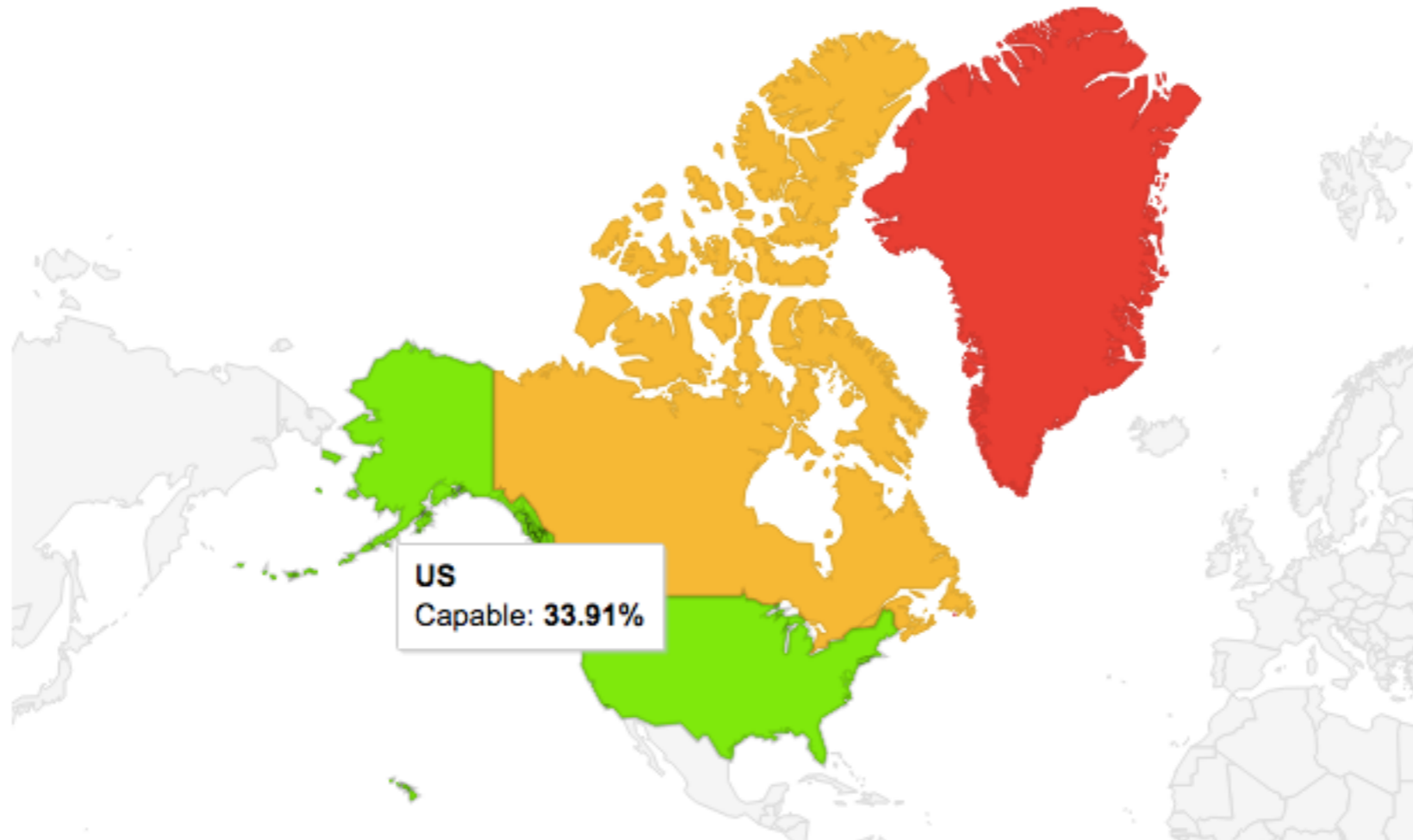


APNIC Measurements



- Results for the US

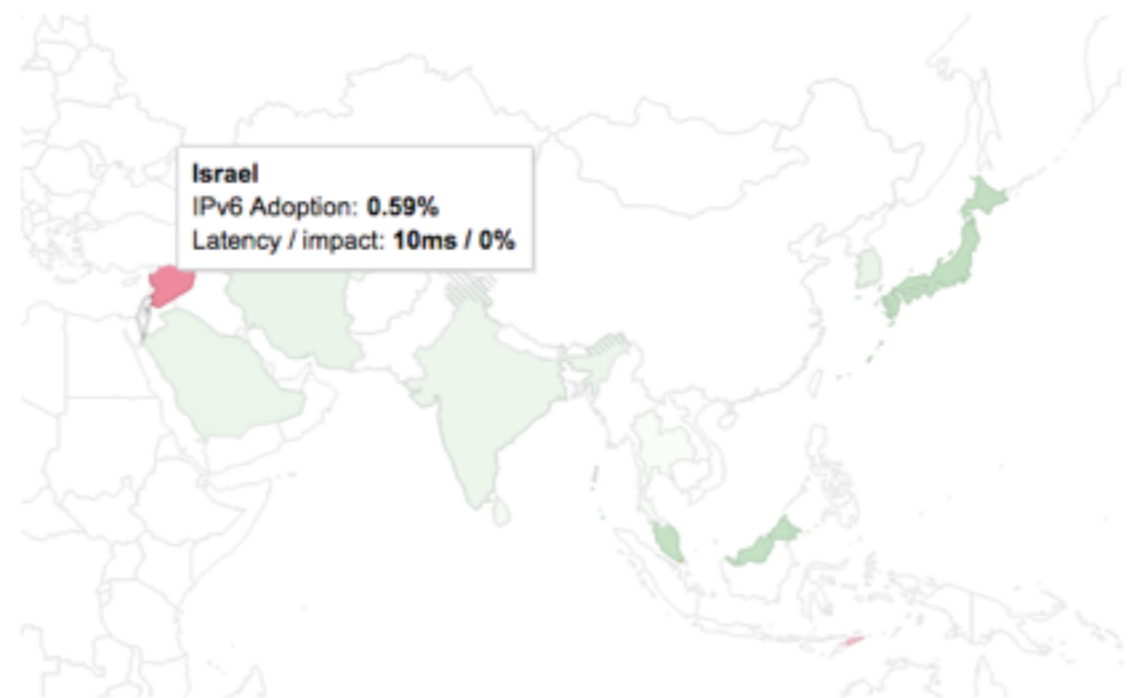
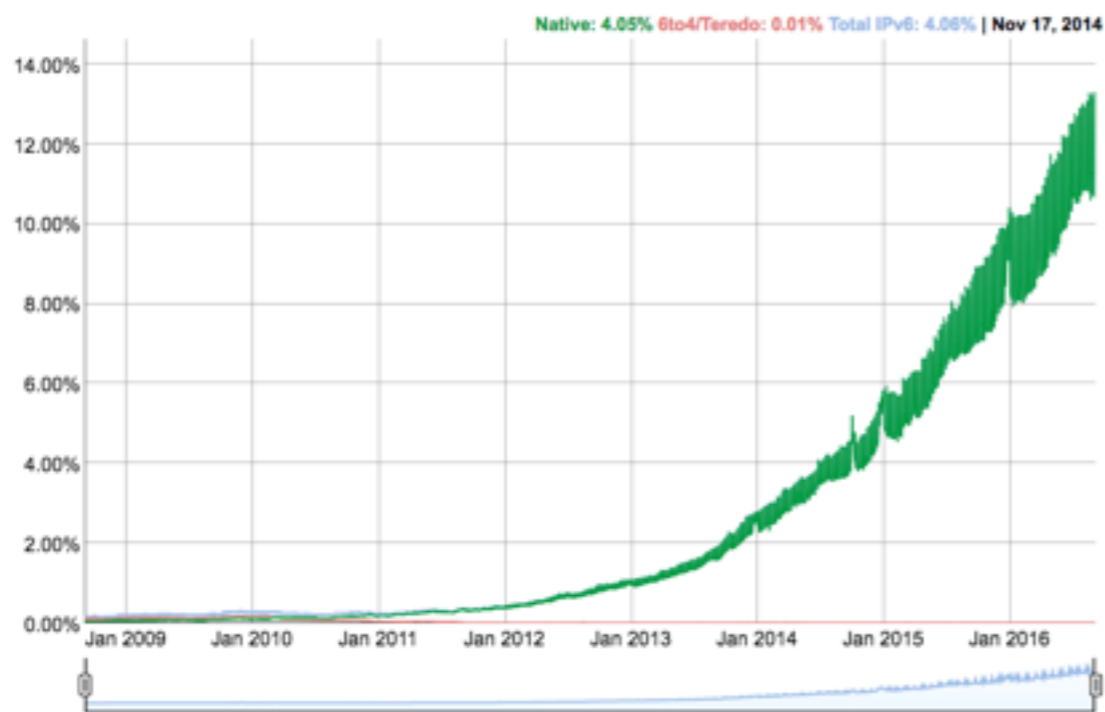
<http://stats.labs.apnic.net/ipv6/US>



Google IPv6 Statistics



- Based on Google's view of the Internet
 - <https://www.google.com/intl/en/ipv6/statistics.html>

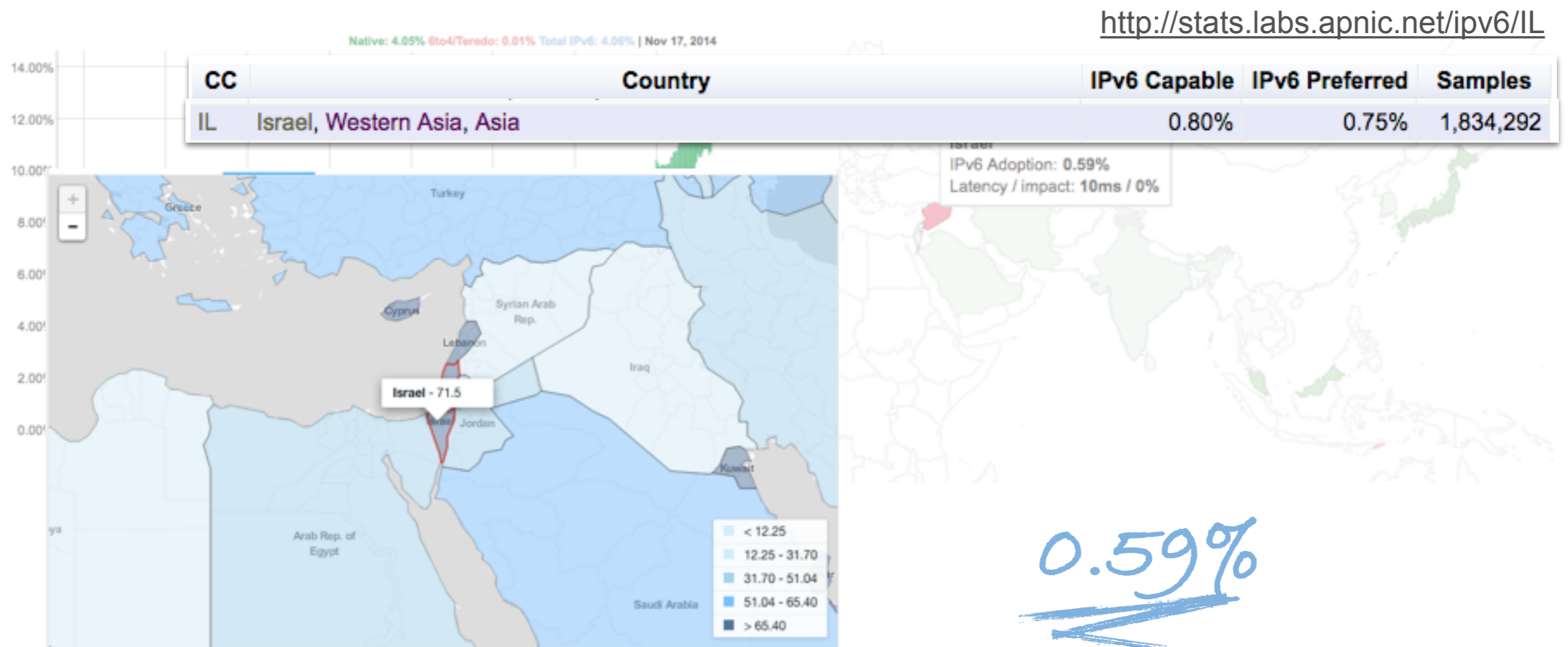


0.59%

Google IPv6 Statistics



- Based on Google's view of the Internet
 - <https://www.google.com/intl/en/ipv6/statistics.html>



<http://http://data.worldbank.org/>

Cisco IPv6 Lab



- <http://6lab.cisco.com/>

- Based on data from:

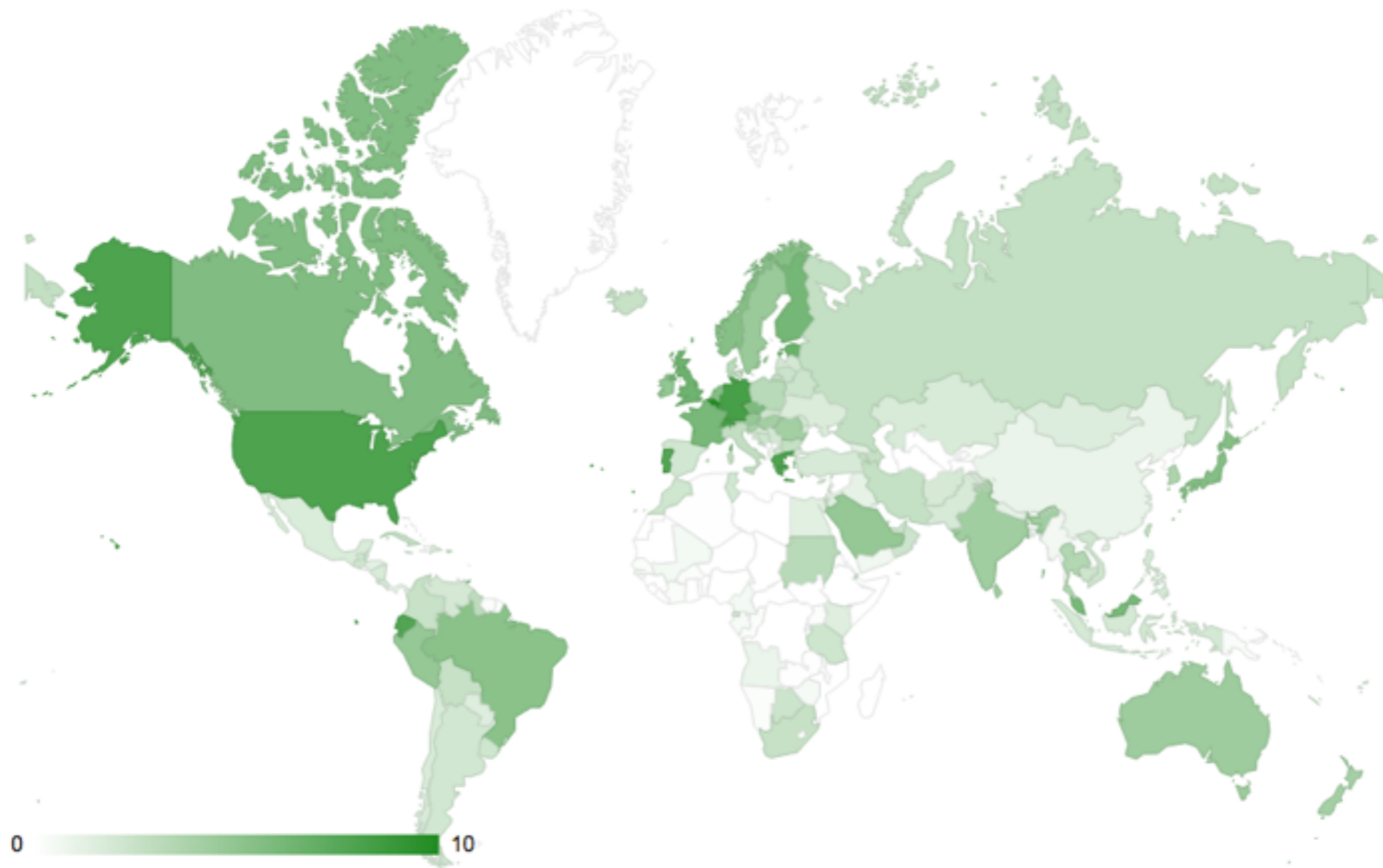
- RIRs
- routeviews
- Alexa
- Google
- ITU
- APNIC



Cisco IPv6 Lab



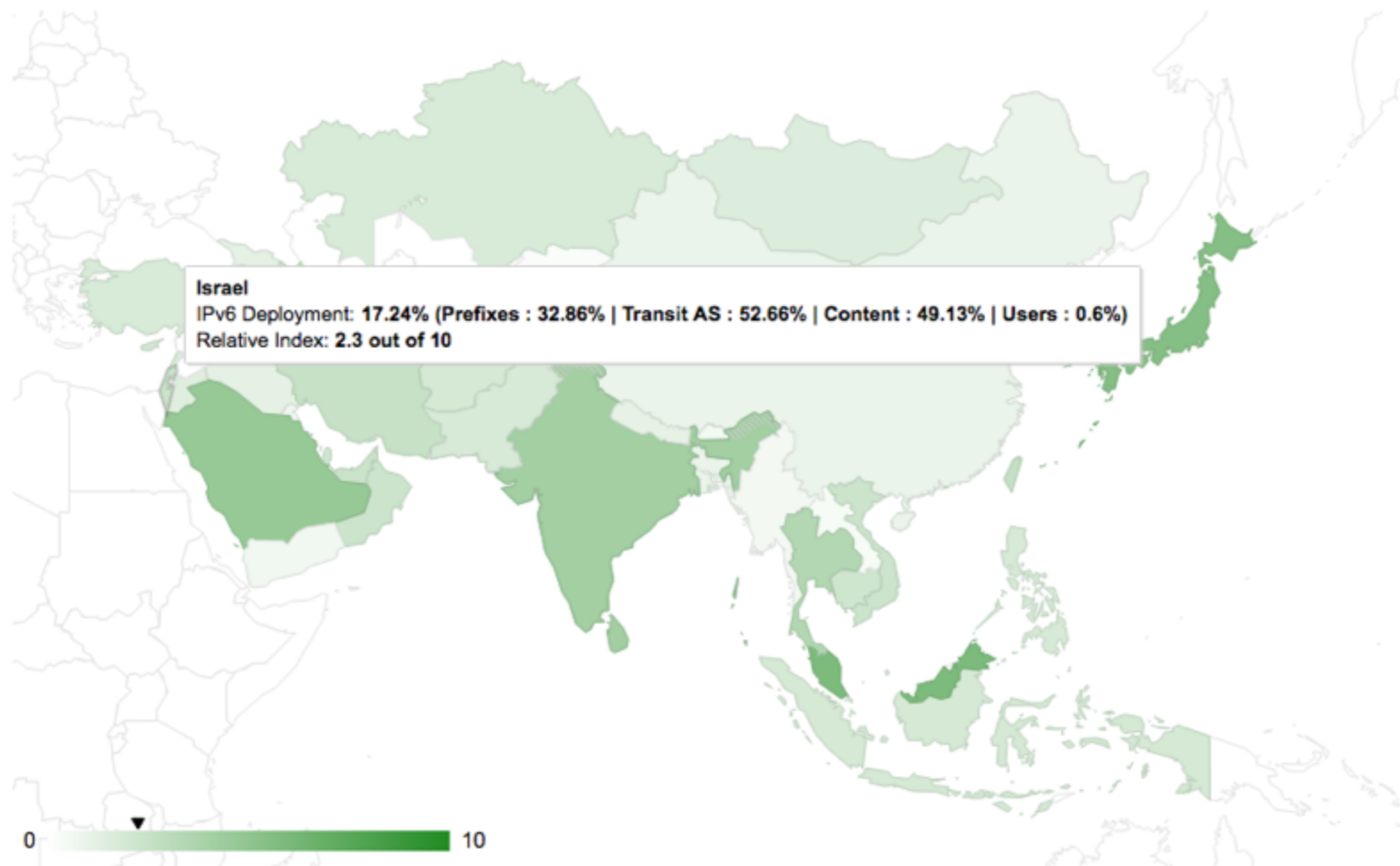
- World Map



Cisco IPv6 Lab



- Zoom into Israel



Cisco IPv6 Lab



- <http://6lab.cisco.com/stats/search.php>

General Data

IPv6 Deployment ⓘ : 17.24% (Prefixes : 32.86% | Transit AS : 52.66% | Content : 49.13% | Users : 0.6%)

Relative Index ⓘ : 2.3 out of 10

Ipv6 Prefixes

Ratio of routable IPv6 prefixes ⓘ : 32.86%

Ratio of allocated IPv6 prefixes / ratio of alive allocated IPv6 prefixes ⓘ : 15.59% / 44.29%

Transit AS

IPv6 transit AS ⓘ : 51.18%

IPv6 enabled transit AS ⓘ : 58.58%

Cisco IPv6 Lab



- <http://6lab.cisco.com/stats/search.php>

Content

% of Web pages available over IPv6 ⓘ : 49.13% | number of working IPv6 sites: 62/500
In development/test ⓘ : 0.08% (2/500) | Failing IPv6 sites: 0.19% (2/500) | Not V6 enabled: 50.64% (434/500)

Users

Google Search / APNIC data ⓘ : 0.6% / 1.03%
Estimation ⓘ : 37 K IPv6 users

$$DeploymentRatio = \frac{\%TransitAS + 3 \times \sqrt{\%content \times \%user}}{4}$$

17.24%

Active Measurements



- Alexa
 - Data from sink via Alexa toolbar (25k users)
 - Data from source with Alexa script running onsite
 - Measures are relative over time period (three months or one)
 - Methodology: **unique visitors & page views**



Active Measurements



- Alexa
 - “.il” domains out of 1 million
 - 1,575 domains (as of 2016-09-08)
 - Results of DNS resolution:

1,543 resolved to an A record (IPv4)

57 resolved to an AAAA record (IPv6)

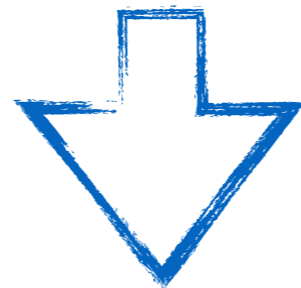
3.6%

Maxmind



- Geolocation database
 - IPv6 data set filtered for country Israel:

1,688 IPv6 location blocks



4,194,251,392 IPv6 space (/56)

Remember: IPv6 allocation space is

4,194,305,792 (/56) in Israel.

Difference is 54,400!

What's the Takeaway?



- We face data sets with varying quality and purpose
- Data is not wrong but be careful when it comes to interpretation
- Statistical methods can help to deal with uncertainty

RIPEness: The Fifth Star



- Measurement of actual IPv6 deployment at the edge (/LIR)
- Access (eyeballs) networks
 - APNIC Google ad measurements
 - Monthly and half-yearly aggregates
- Content networks
 - Alexa
 - Weighted by inverse of rank ($1/\langle \text{rank} \rangle$)

RIPEness: The Fifth Star



- Issues

- Measurement bias
- Large organisations with multiple LIRs

- Threshold

- 2012: 1% > 2013: 2% > 2014: 4% > 2015: 8% > 2016: 16%



Questions



christian.teuschel@ripe.net
@cteuschel