



**RIPE NCC**  
RIPE NETWORK COORDINATION CENTRE

# IPv6 Country Statistics

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# 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 Macedonia:

**IPv6 21**  
**IPv4 117**



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

Country Resource List (IL)

Date: 2016-09-07

ASN IPv4 IPv6

Show 10 entries Search:

|                    |
|--------------------|
| 2001:40a8::/32     |
| 2001:4cd0::/32     |
| 2001:4df0::/32     |
| 2001:67c:1150::/48 |
| 2001:67c:1738::/48 |
| 2001:67c:25f0::/48 |
| 2001:67c:2840::/48 |
| 2001:67c:2dbc::/48 |

# Registry Data



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

**IPv6 21**  
**IPv4 117**

17.9%

# Registry Data



- RIPE Database

- Allocation and assignment information
- Resources in Macedonia:

**IPv6 21**

**IPv4 117**

17.9%

- Registered space in Macedonia:

**1,577,058,304 IPv6 (/56)**

**681,728 IPv4**

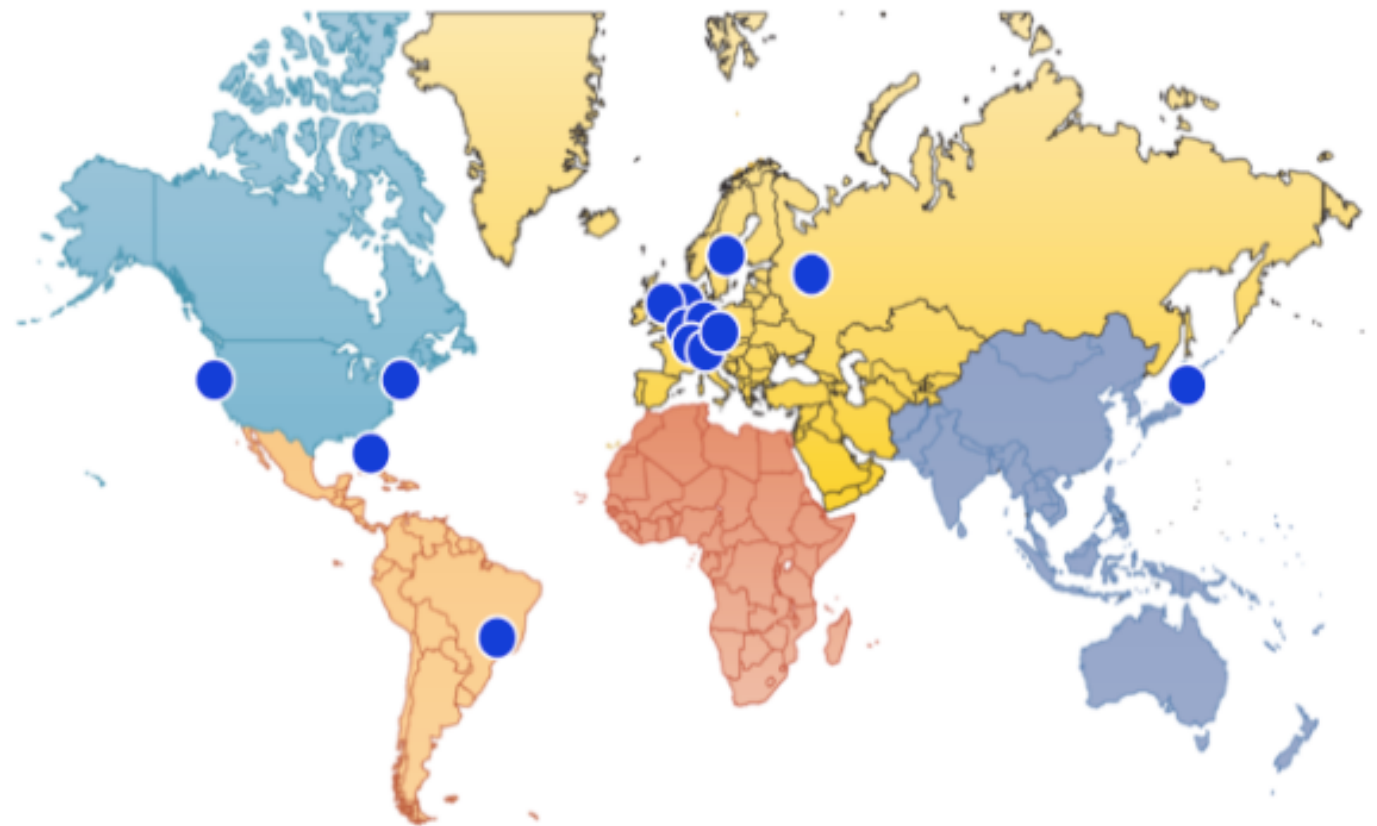
2300%

# Routing Information



- RIS

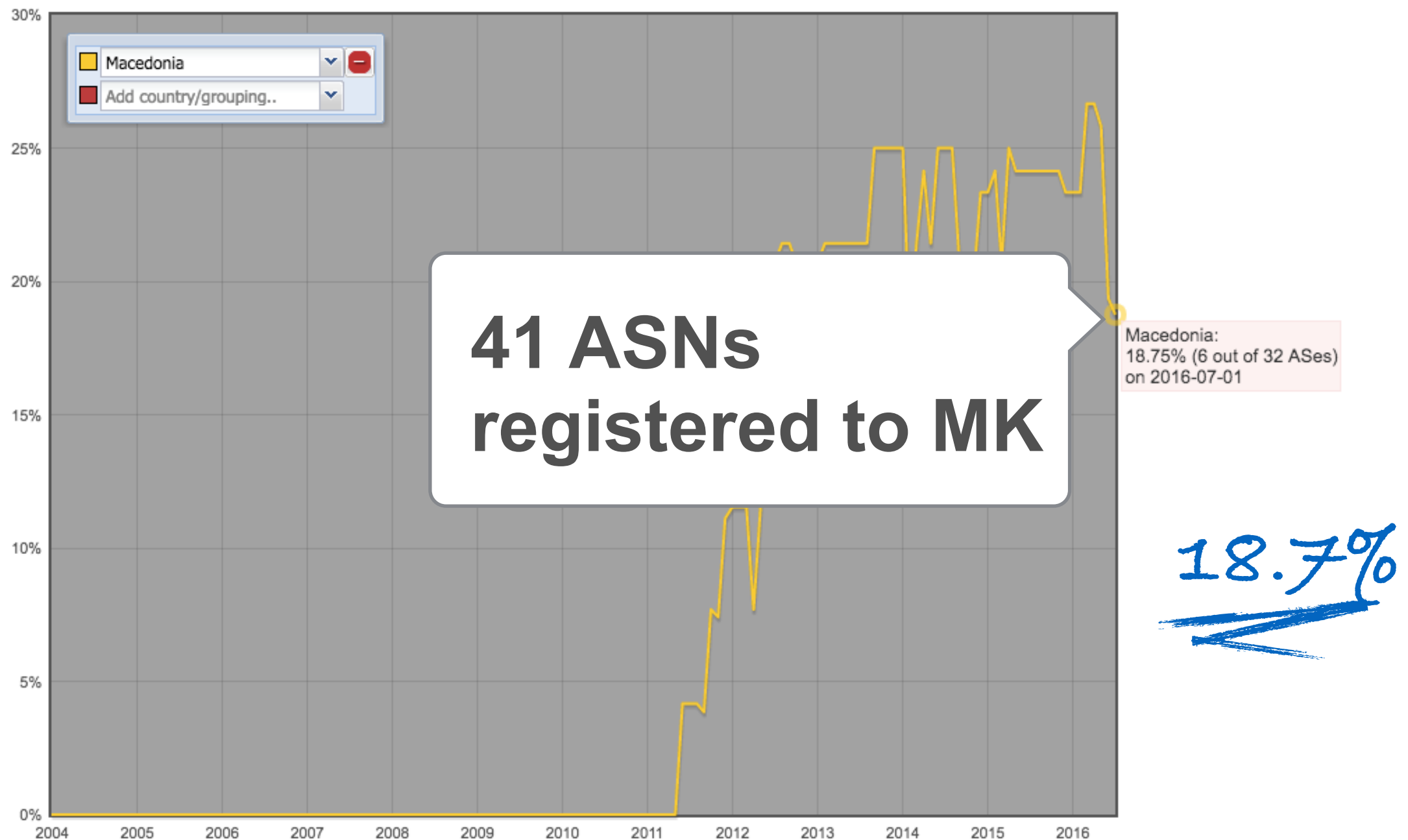
- The RIPE NCC has been collecting BGP information since 1999
- 18 collectors
- 160+ full-feed peers
- <http://ris.ripe.net>



# Routing Information



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

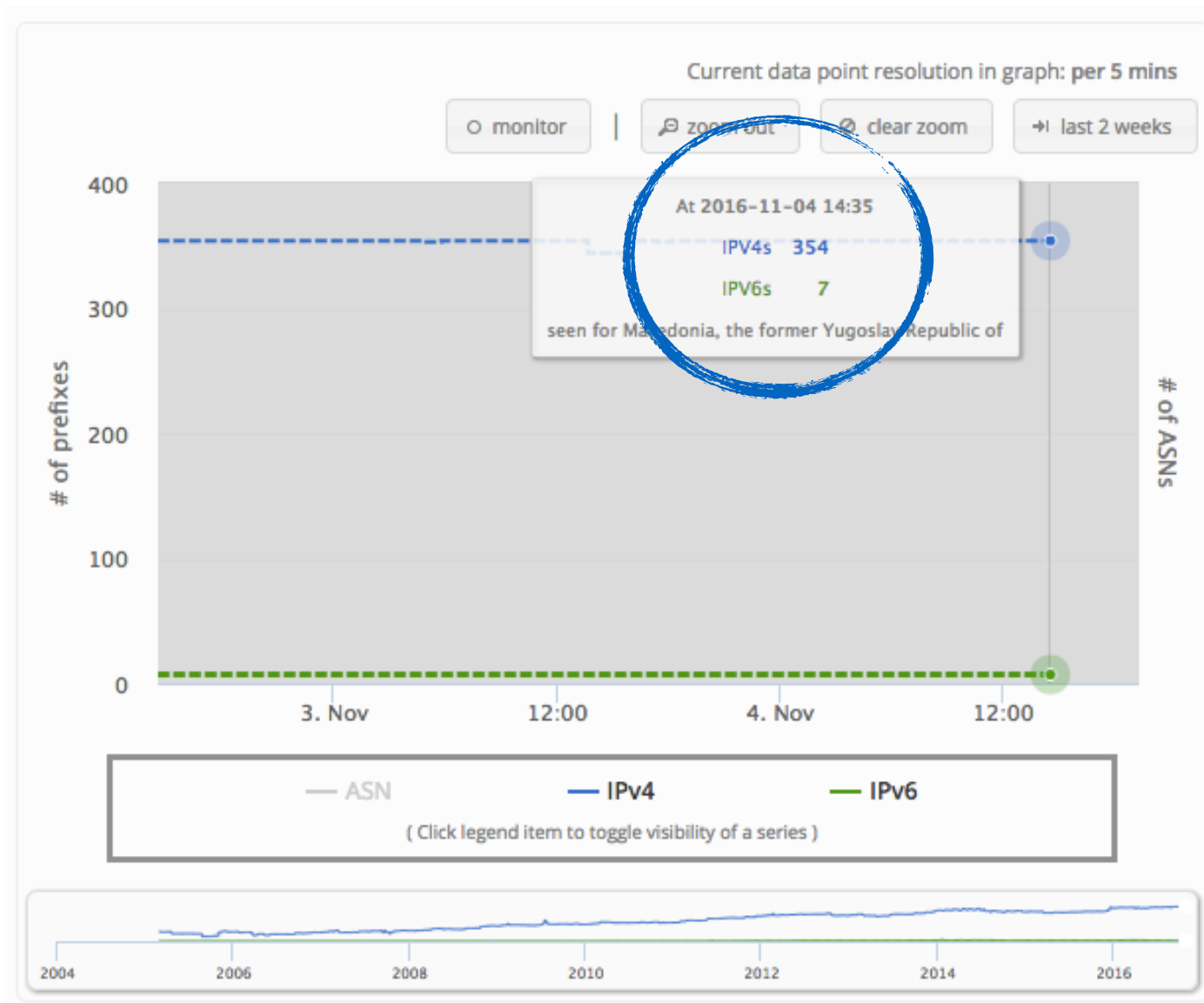


# Routing Information



- RIS

- Resources globally seen from Macedonia



1.9%



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



# RIPE Atlas



- A brief introduction
  - Global network for Internet measurements

**Statistics**

|                                |       |
|--------------------------------|-------|
| Probes connected to RIPE Atlas | 9375  |
| Measurements currently running | 12044 |
| Results collected per second   | 4087  |

**Create a New Measurement**

**Step 1 Definitions**

Please select the type of measurement you want to create

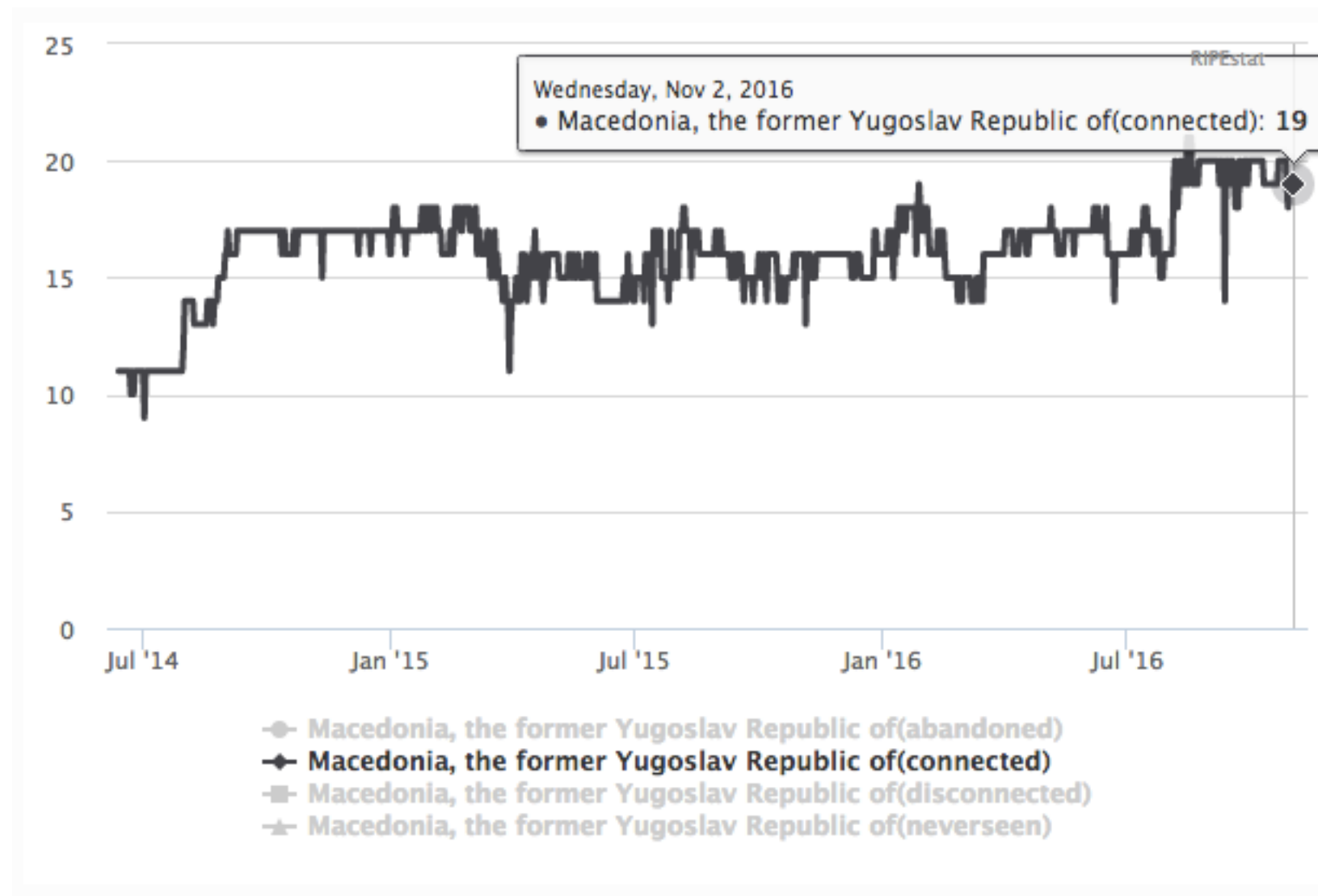
+ Ping + Traceroute + DNS + SSL + HTTP + NTP

Connected: 9147 Disconnected: 2518 Abandoned: 4671

# RIPE Atlas



- RIPE Atlas in Macedonia



# RIPE Atlas



- RIPE Atlas in Macedonia





# RIPE Atlas



- IXP-Country-Jedi



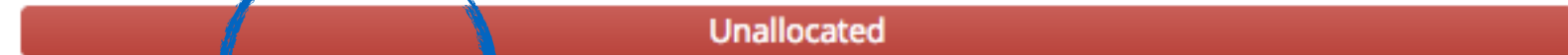
# RIPE Atlas



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

| When                 | Action | Specification | Number of Probes | Include probe tags | Exclude probe tags        |
|----------------------|--------|---------------|------------------|--------------------|---------------------------|
| 2016-11-04 14:59 UTC | Add    | Country: MK   | 23               | system: IPv6 Works | system: IPv6 Doesn't Work |

Probe Fulfilment



Total responsive: 0 Total allocated: 0 Total requested: 23

Costs



# RIPE Atlas



- A closer look at the probes in Macedonia
  - Tabular view of the probes country map

Switch to map view

Show 10 entries Search:

| Probe ID | Country | IPv4           | IPv6            | ASN(v4/v6)        | Status    |
|----------|---------|----------------|-----------------|-------------------|-----------|
| 10116    | MK      | 89.31.154.6    | 2a01:5b8:fee... | AS16333 / AS16333 | Abandoned |
| 4573     | MK      | 217.16.82.210  | 2a01:5b8:b1:... | AS16333 / AS16333 | Connected |
| 4360     | MK      | 89.205.61.31   | 2001:470:1f0... | AS41557 / AS6939  | Connected |
| 773      | MK      | -              | -               | - / -             | Abandoned |
| 1220     | MK      | -              | -               | - / -             | Abandoned |
| 4471     | MK      | -              | -               | AS41557 / -       | Connected |
| 10113    | MK      | 194.149.129.1  | -               | AS5379 / -        | Connected |
| 10117    | MK      | 89.185.216.158 | -               | AS39766 / -       | Connected |
| 10118    | MK      | 62.162.212.170 | -               | AS6821 / -        | Connected |
| 10119    | MK      | 89.205.127.226 | -               | AS41557 / -       | Connected |

Showing 1 to 10 of 43 entries

# APNIC IPv6 Measurements



- Based on Google advertisements

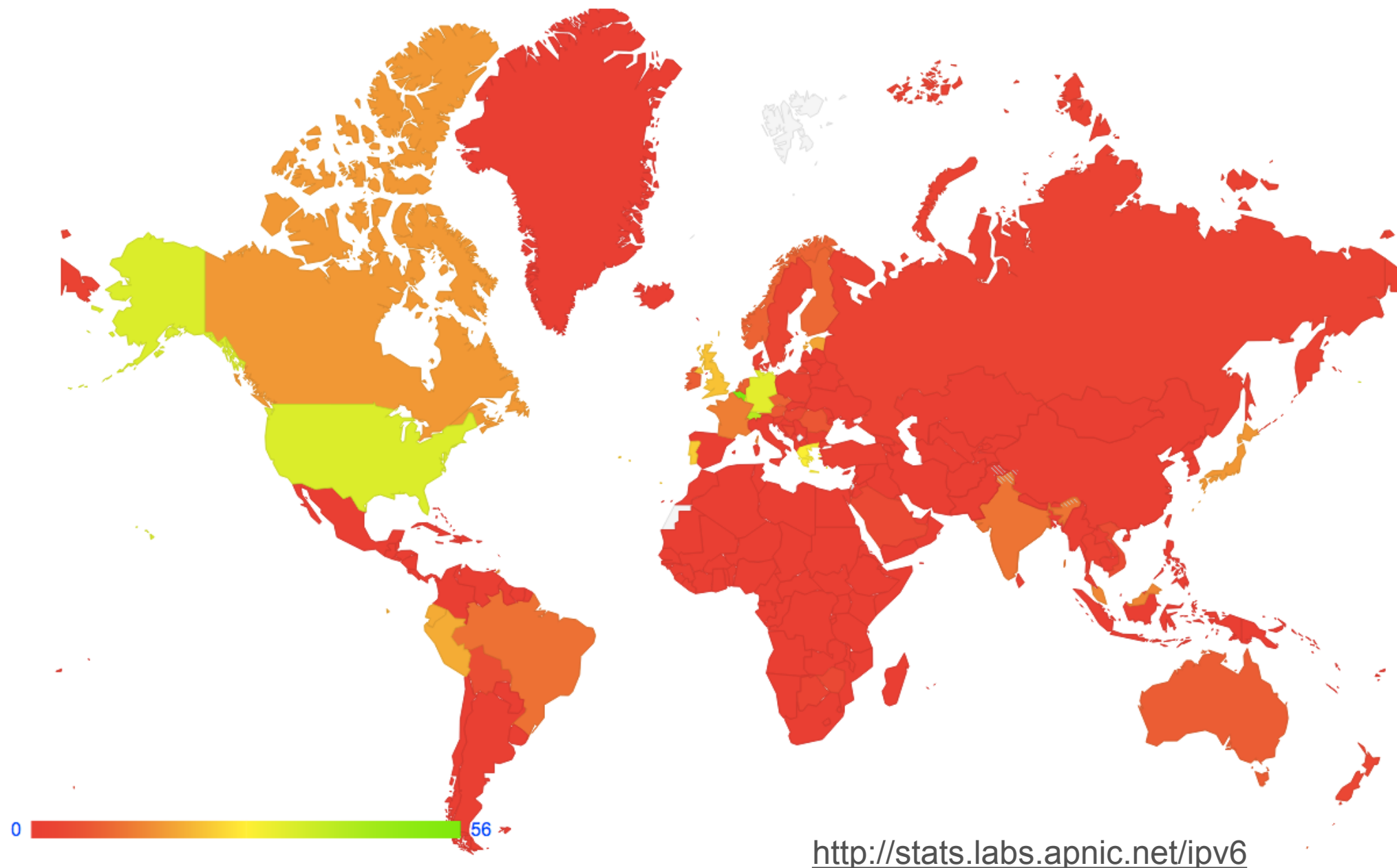




# APNIC IPv6 Measurements



- Based on Google advertisements

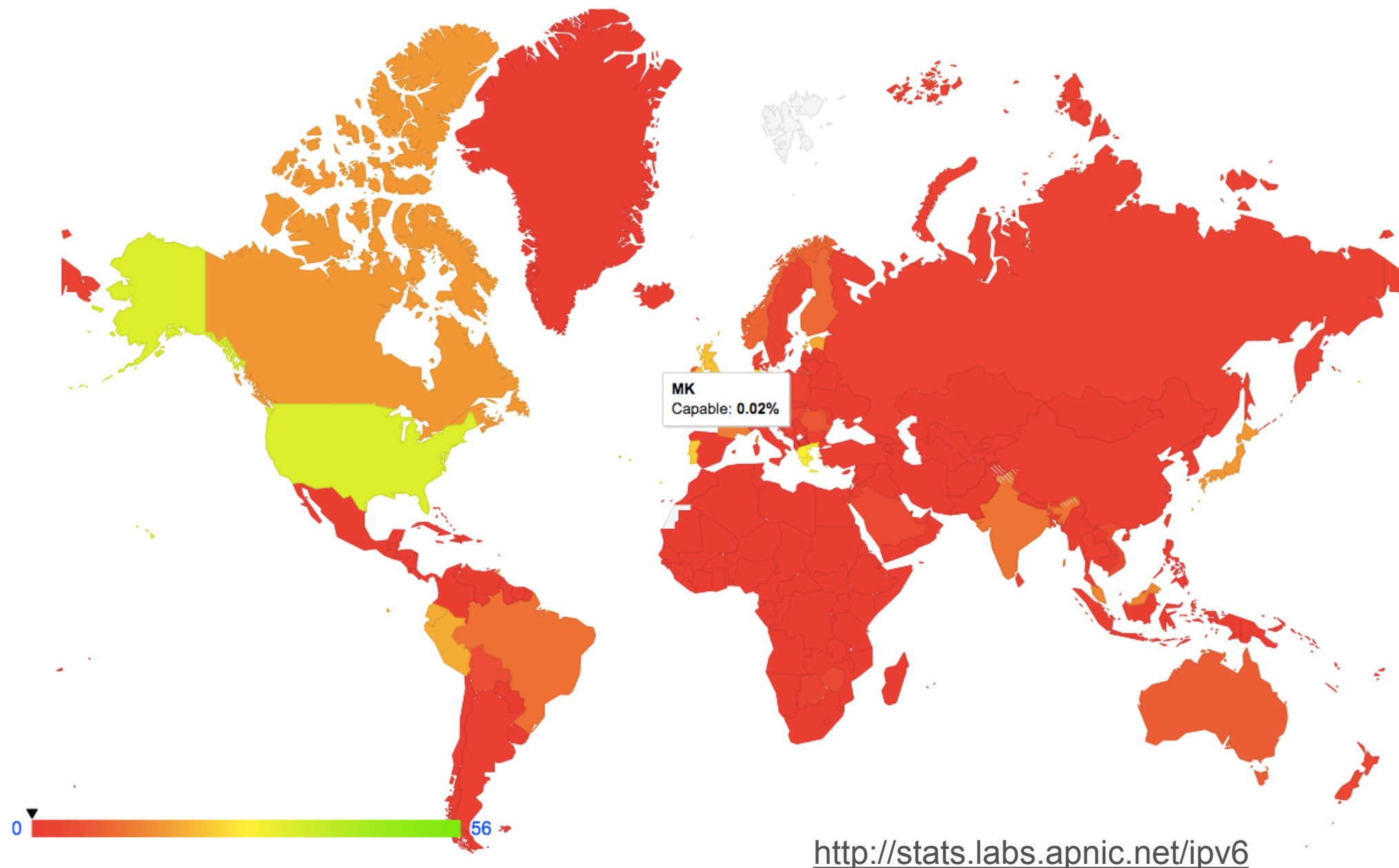




# APNIC IPv6 Measurements



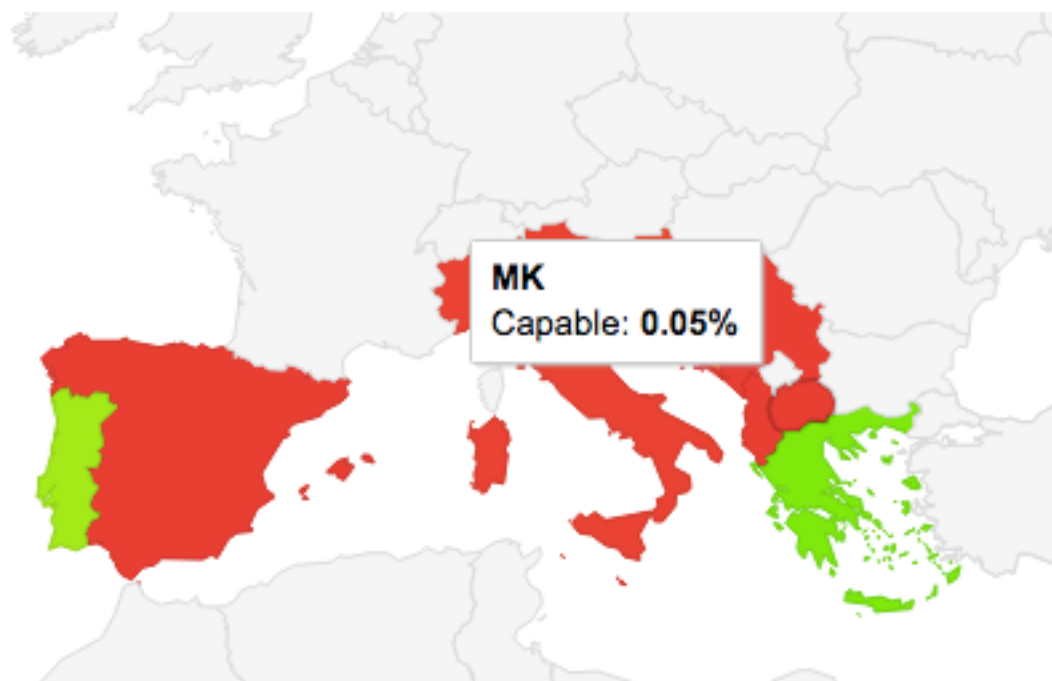
- Based on Google advertisements



# APNIC IPv6 Measurements



- Results for Macedonia



| CC | Country  | IPv6 Capable | IPv6 Preferred | Samples   |
|----|--|--------------|----------------|-----------|
| MK | The former Yugoslav Republic of Macedonia, Southern Europe, Europe | 0.05%        | 0.04%          | 1,765,778 |

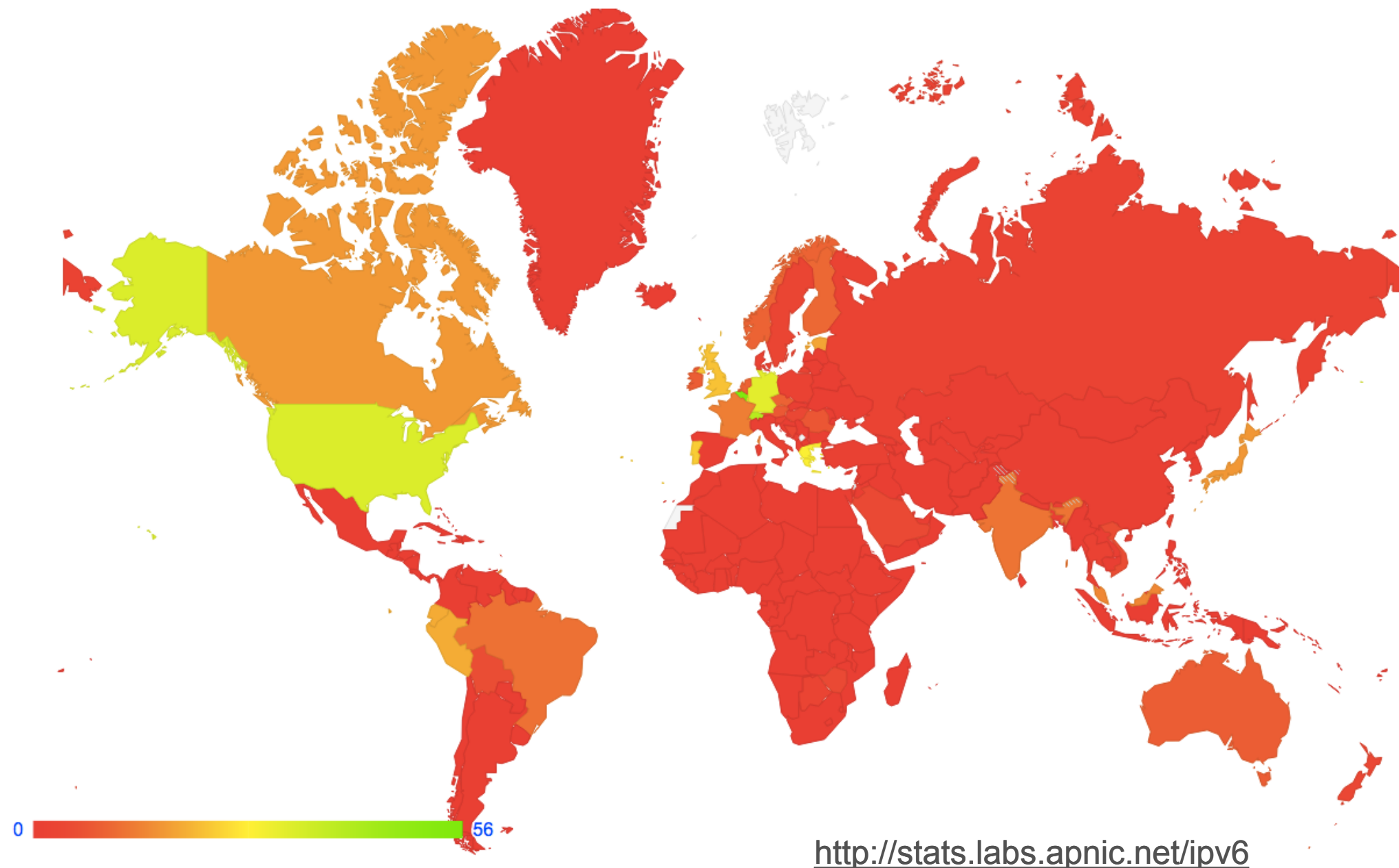
| ASN      | AS Name   | IPv6 Capable | IPv6 Preferred | Samples |
|----------|---|--------------|----------------|---------|
| AS47212  | UGD-AS Republic of Macedonia State University GOCE DELCEV Stip                  | 87.29%       | 87.16%         | 771     |
| AS5379   | MK-UKIM-AS Univerzitet Sv. Kiril i Metodij                                      | 5.53%        | 5.53%          | 1,898   |
| AS9172   | MK-MOL-AS Company for Computer Services and Trade MOL KOMUNIKACII DOOEL Skopje  | 0.30%        | 0.00%          | 659     |
| AS48057  | ITVNET-AS Company for interactive technologies ITV NET Ltd.                     | 0.13%        | 0.03%          | 7,950   |
| AS200899 | INTERSPACE-MK INTERSPACE DOOEL Skopje   | 0.03%        | 0.03%          | 3,664   |
| AS43612  | BLIZOO Blizoo DOOEL Skopje  | 0.01%        | 0.00%          | 304,353 |
| AS41557  | TELEKABEL-AS Trgovsko radiodifuzno drustvo kablovska televizija ROBI DOOEL Stip | 0.01%        | 0.00%          | 161,618 |
| AS39766  | NETKABEL-AS Net Kabel Broadband Network   | 0.01%        | 0.00%          | 23,651  |

0.05%

# APNIC Measurements



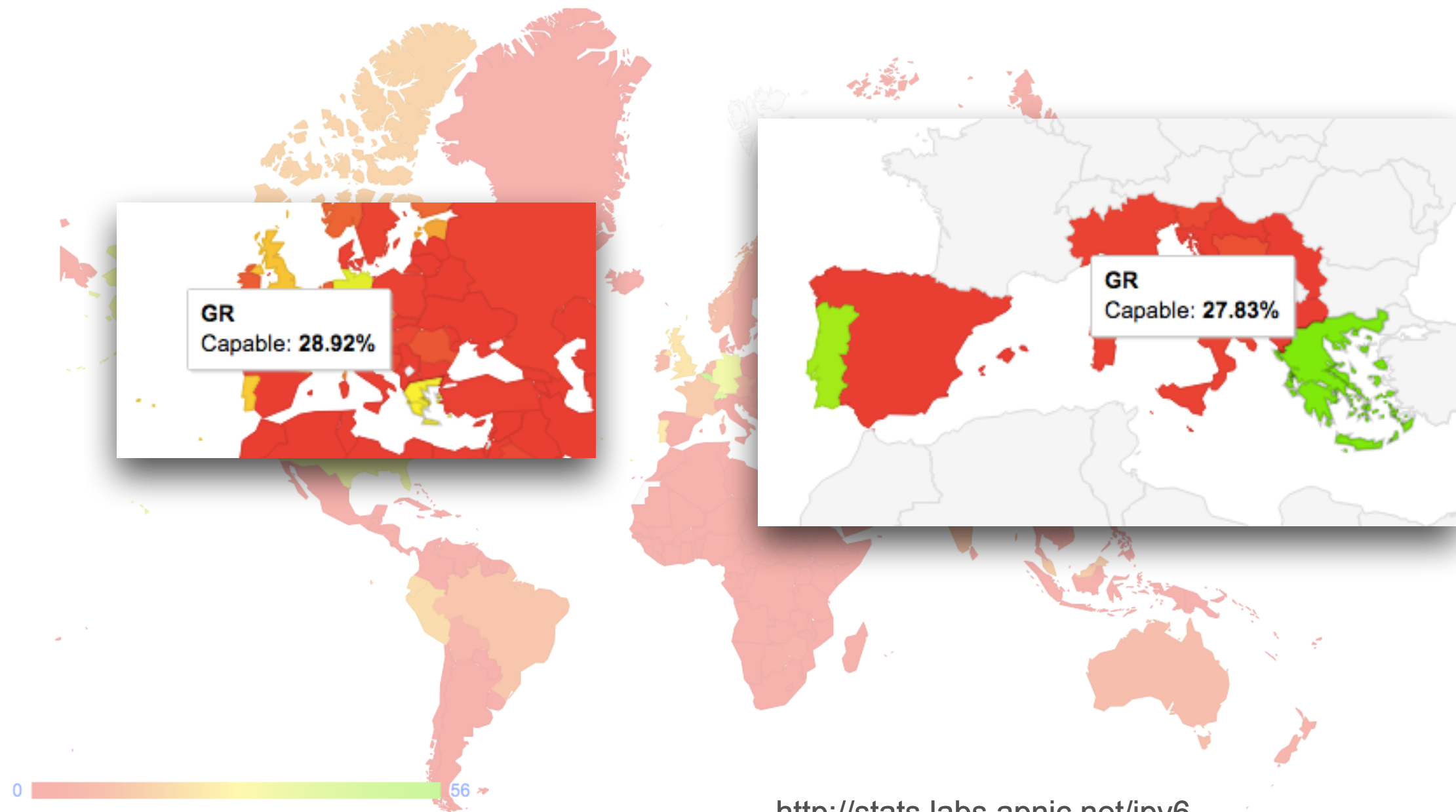
- World map again



# APNIC Measurements



- World map again

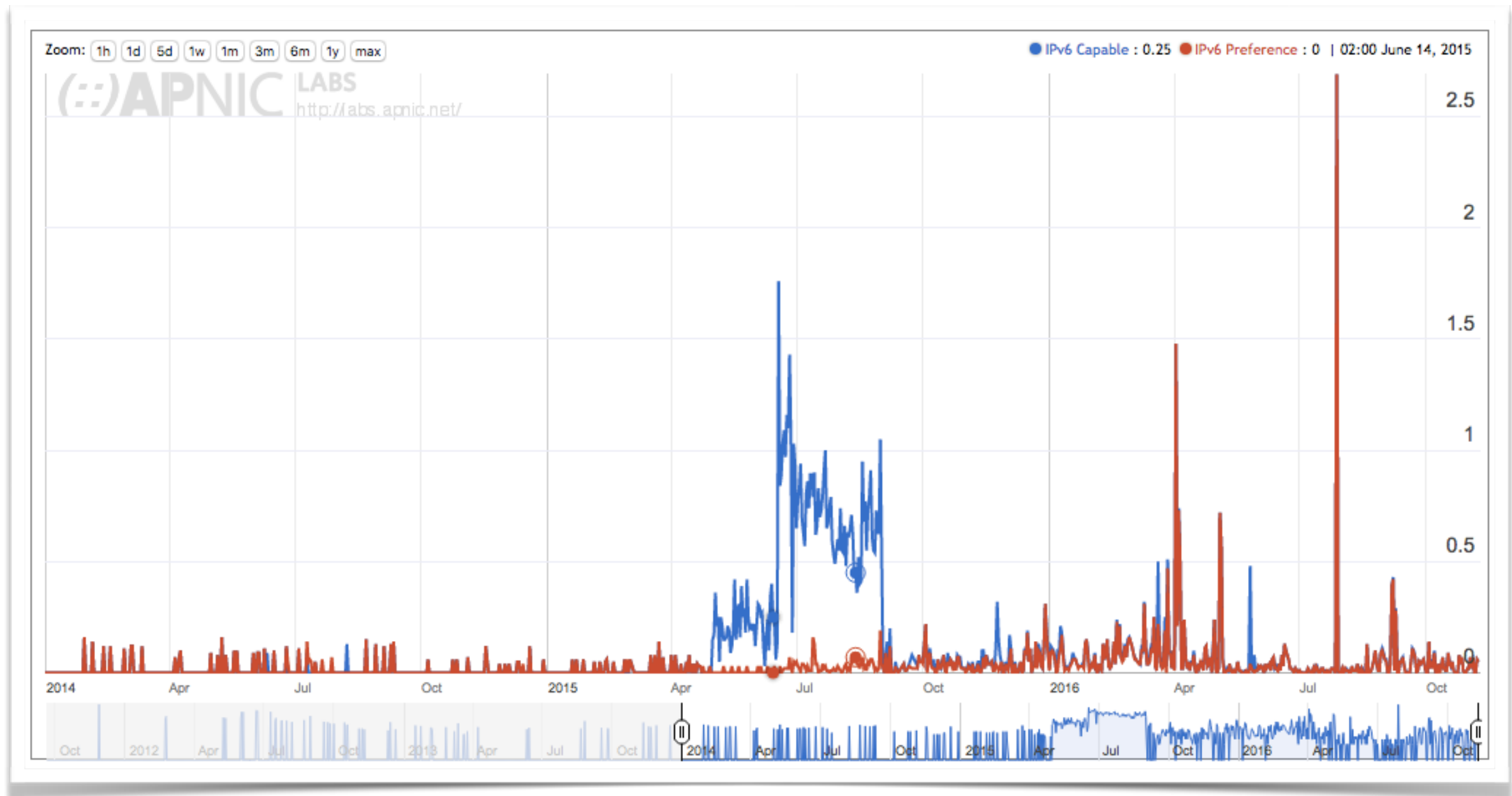


<http://stats.labs.apnic.net/ipv6>

# APNIC Measurements



- Macedonia again

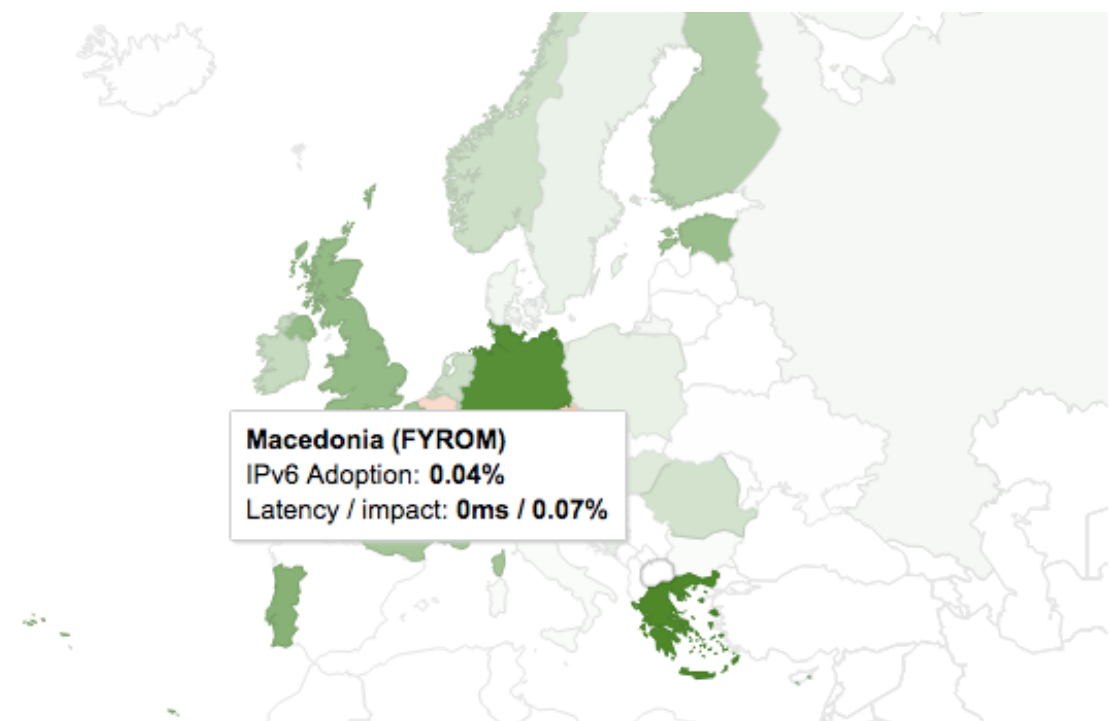
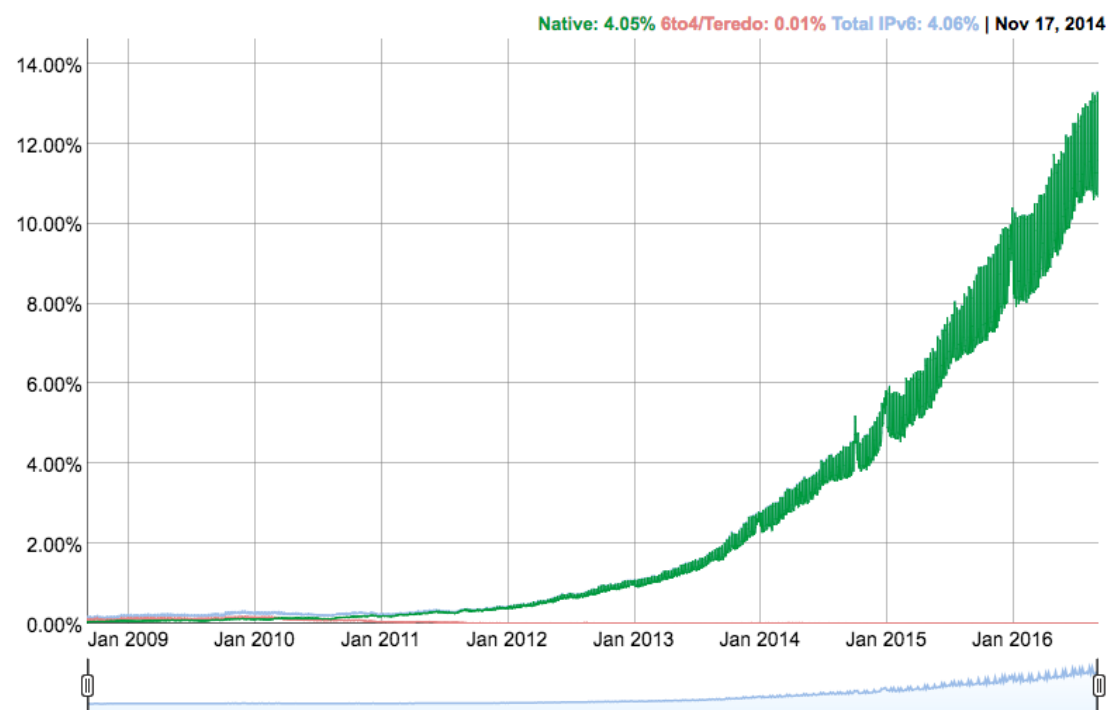


<http://stats.labs.apnic.net/ipv6>

# Google IPv6 Statistics



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



0.04%



# Cisco IPv6 Lab



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

- Based on data from:

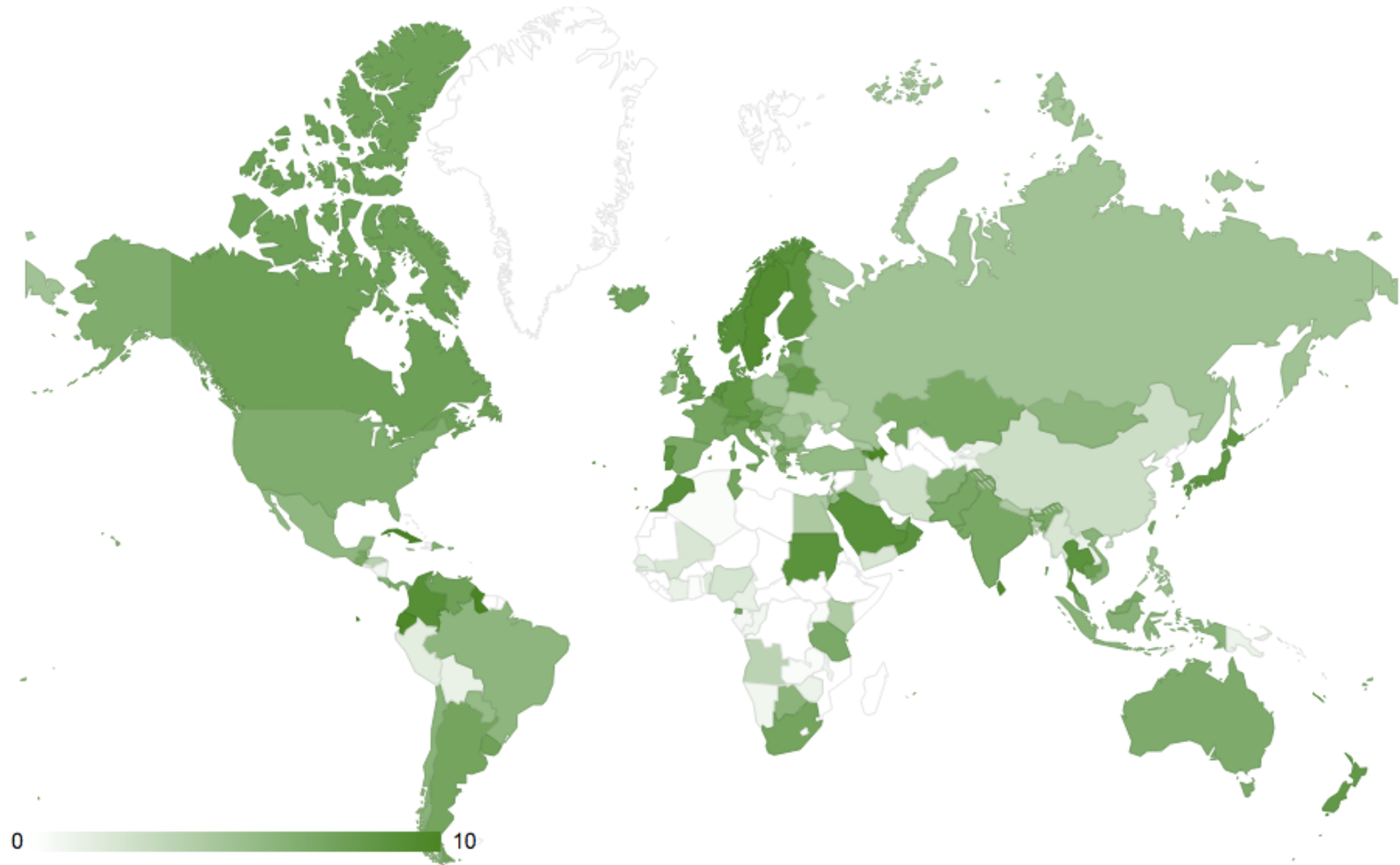
- RIRs
- routeviews
- Alexa
- Google
- ITU
- APNIC



# Cisco IPv6 Lab



- World map



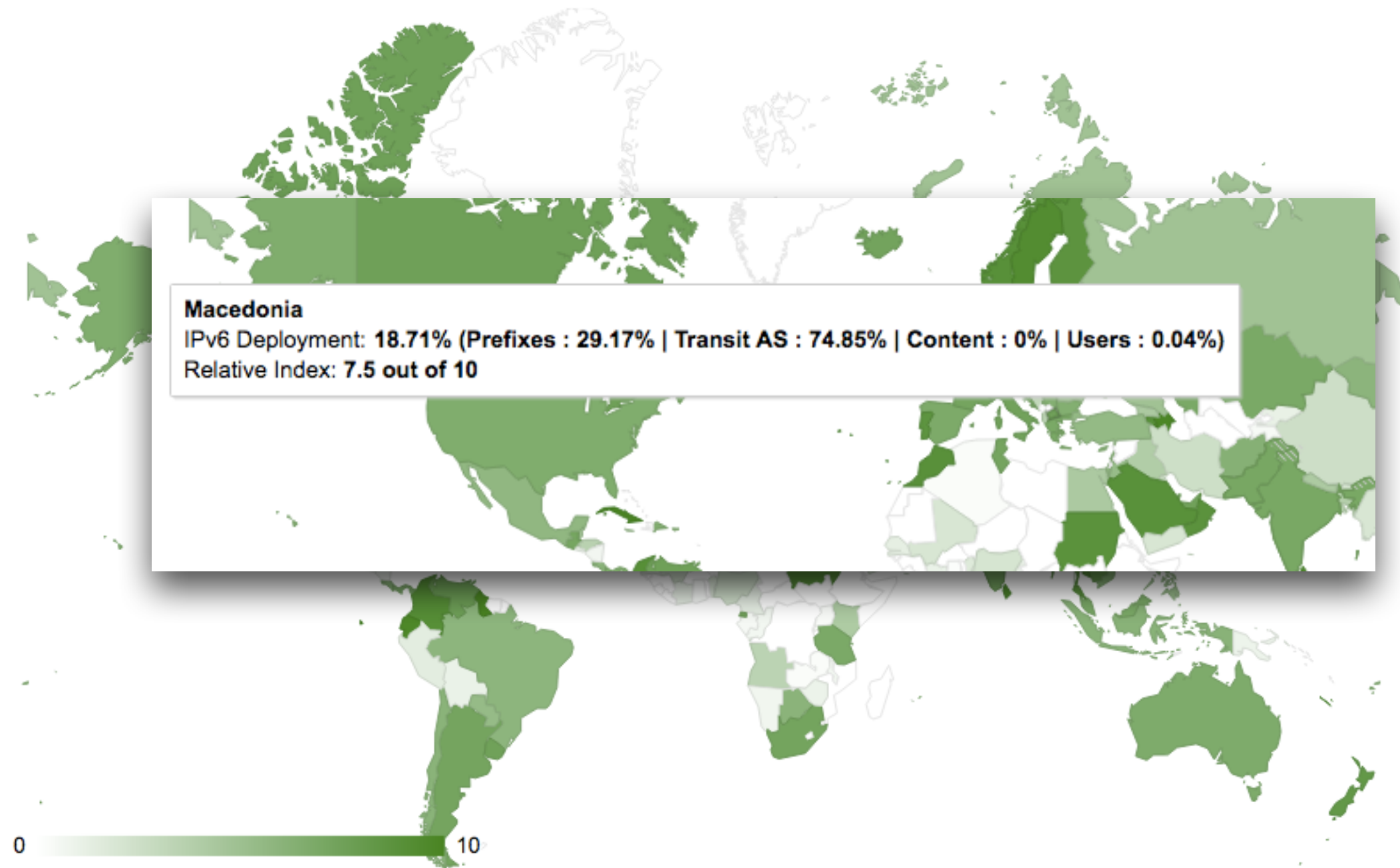
<http://6lab.cisco.com/>



# Cisco IPv6 Lab



- Zoom into Macedonia



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

# Cisco IPv6 Lab



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

General Data ▼

IPv6 Deployment ⓘ : 18.71% (Prefixes : 29.17% | Transit AS : 74.85% | Content : 0% | Users : 0.04%)  
Relative Index ⓘ : 7.5 out of 10

Ipv6 Prefixes ▼

Ratio of routable IPv6 prefixes ⓘ : 29.17%  
Ratio of allocated IPv6 prefixes / ratio of alive allocated IPv6 prefixes ⓘ : 20.51% / 12.5%

Transit AS ▼

IPv6 transit AS ⓘ : 74.02%  
IPv6 enabled transit AS ⓘ : 78.17%

# Cisco IPv6 Lab



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

Content

% of Web pages available over IPv6 ⓘ : 0% | number of working IPv6 sites: 111/500  
In development/test ⓘ : 0% (1/500) | Failing IPv6 sites: 0% (1/500) | Not V6 enabled: 0% (387/500)

Users

Google Search / APNIC data ⓘ : 0.04% / 0.03%  
Estimation ⓘ : 0 K IPv6 users

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

18.71%

# 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 and page views**



# Active Measurements



- Alexa
  - “.mk” domains out of one million
  - 238 domains (as of 2016-11-04)
  - Results of DNS resolution:

**235 resolved to an A record (IPv4)**

**35 resolved to an AAAA record (IPv6)**

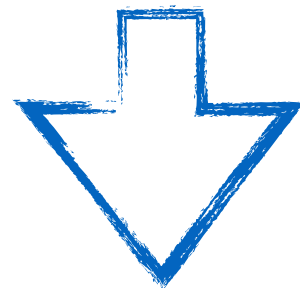
14.9%

# Maxmind



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

**56 IPv6 location blocks**



**1,577,058,305 IPv6 space (/56)**

*Remember: IPv6 allocation space is  
1,577,058,304 (/56) in Macedonia.*

*Difference is -1!*

# What's the Takeaway?



- We face datasets 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%

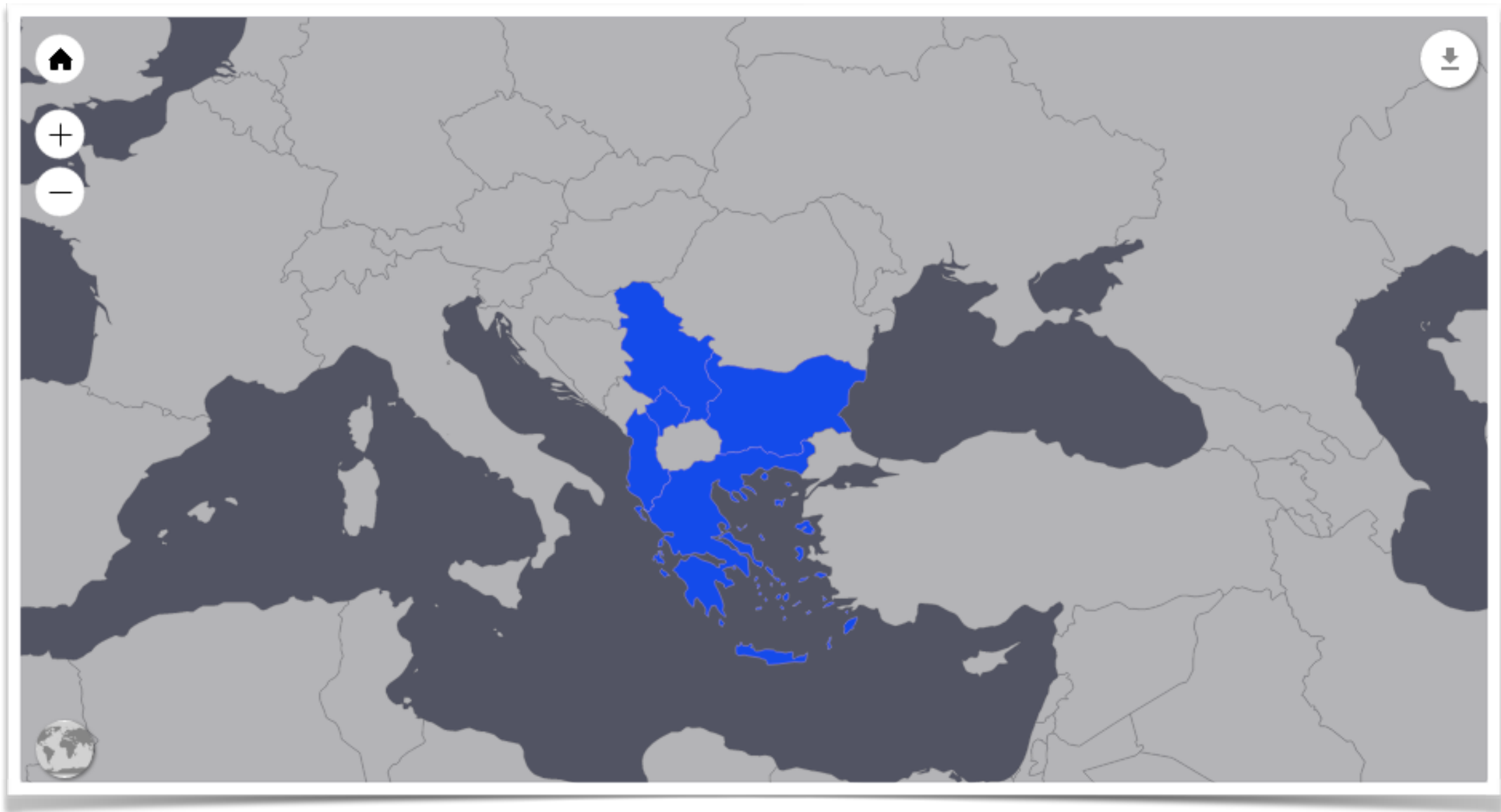


# Neighbours

# Neighbours and IPv6

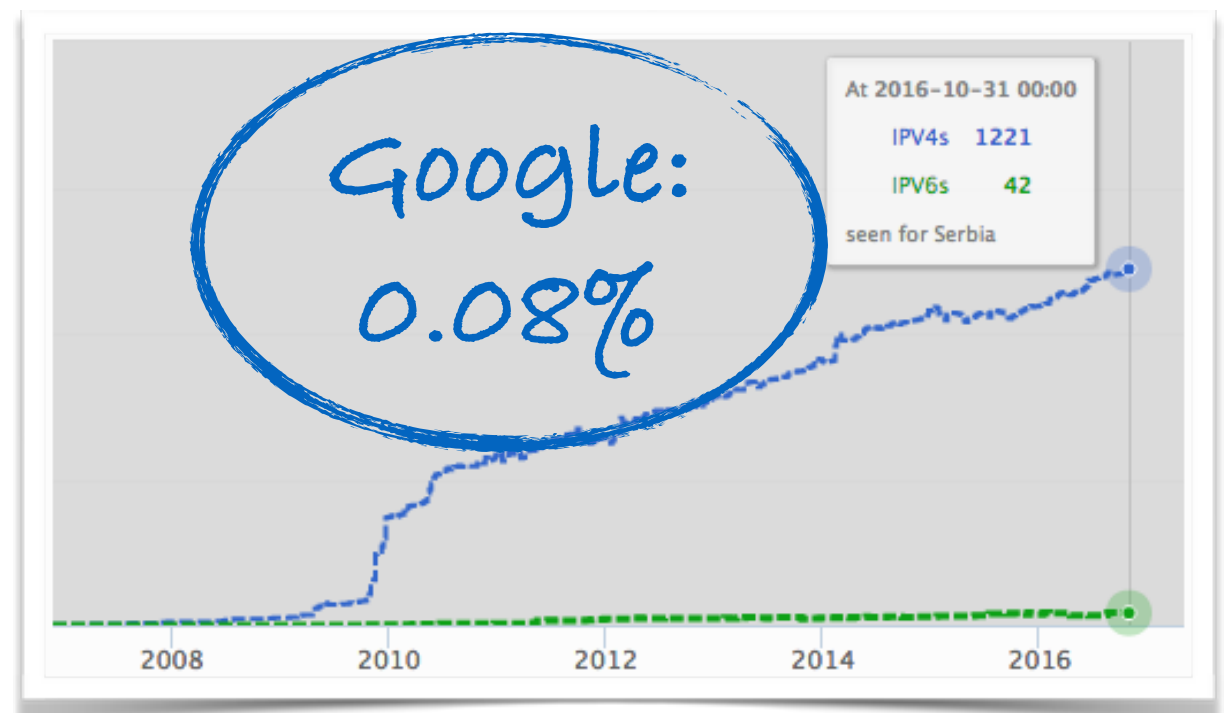
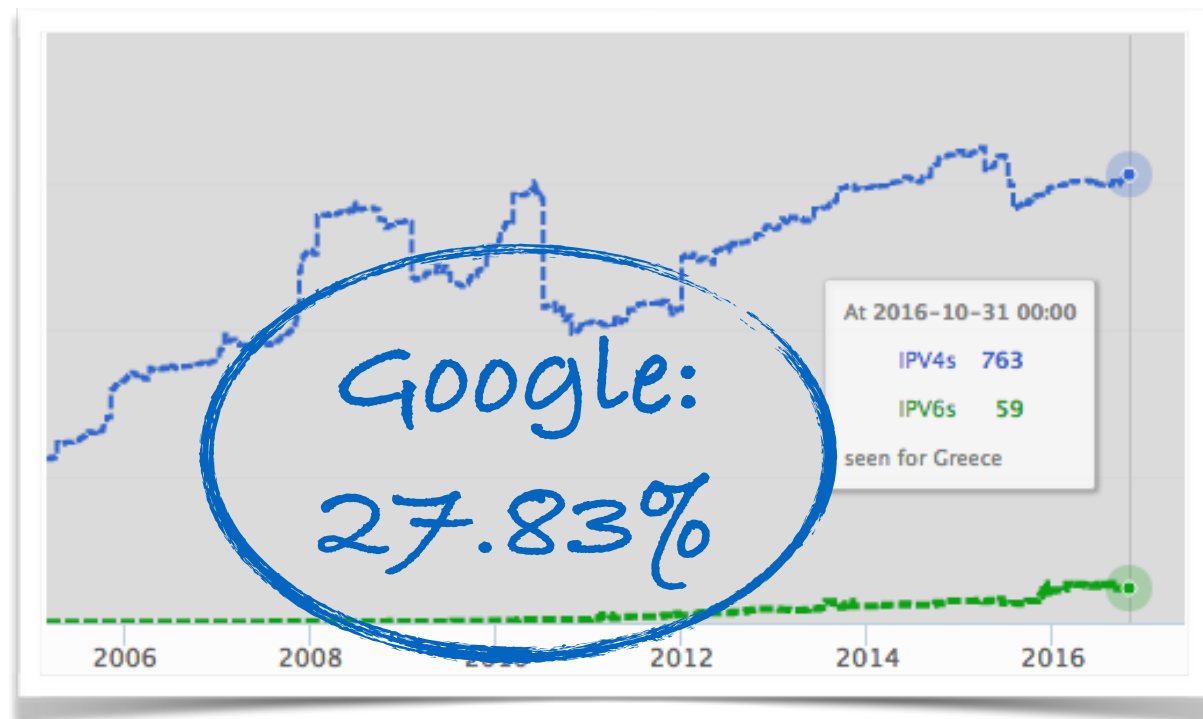
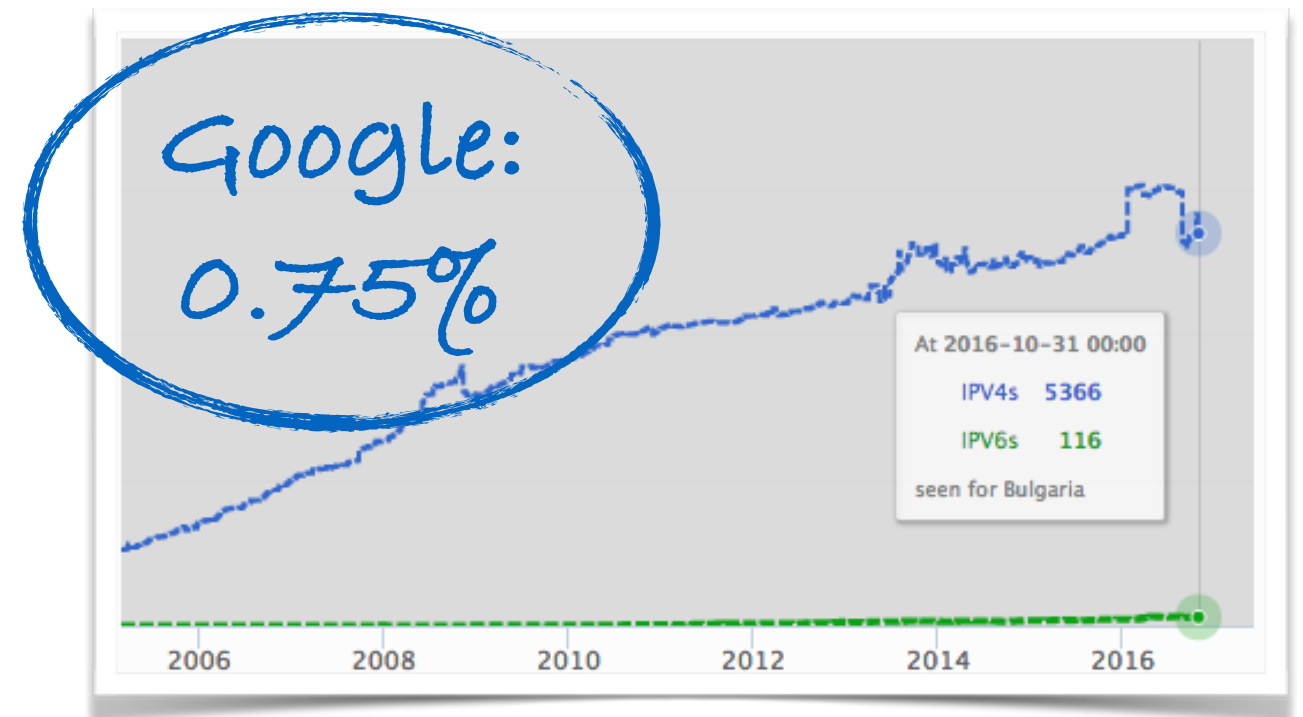
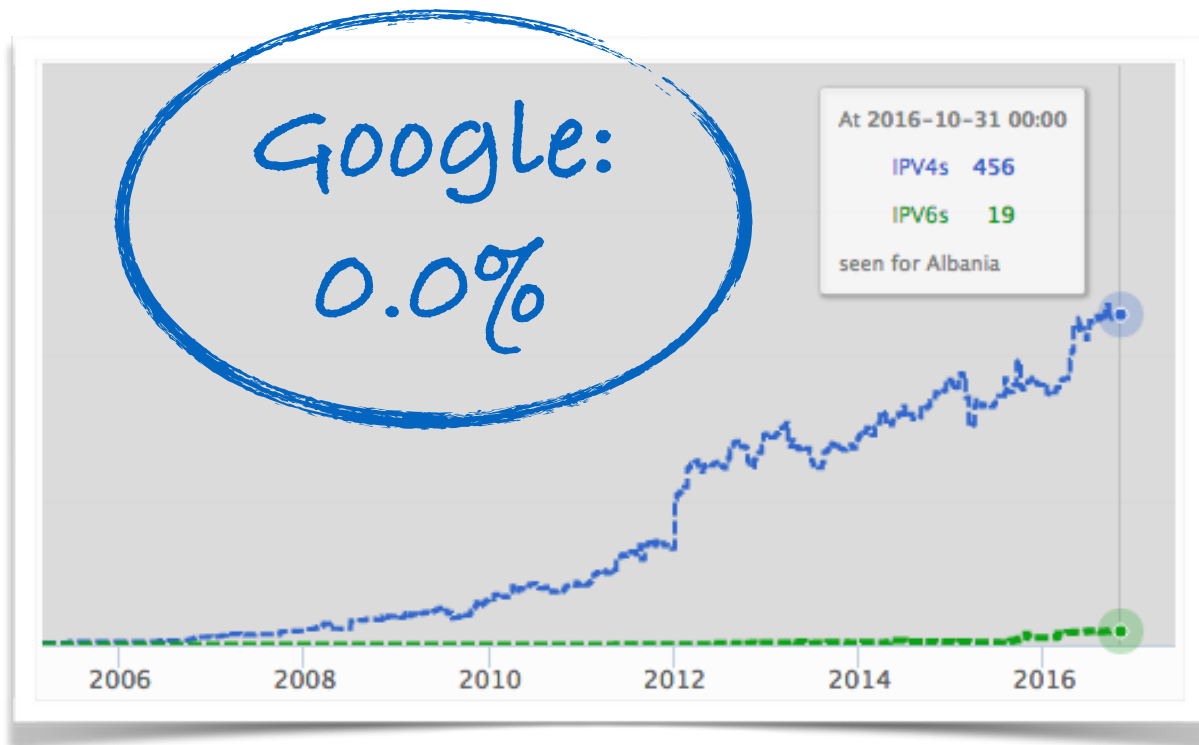


- Albania, Bulgaria, Greece, Kosovo & Serbia



[https://www.amcharts.com/visited\\_countries/#AL,BG,GR,RS,XK](https://www.amcharts.com/visited_countries/#AL,BG,GR,RS,XK)

# Neighbours and IPv6



# Neighbours and IPv6





# Questions



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