IPv6 OBSERVATORY

# IPv6 Observatory

## Outcomes after 2 years of monitoring IPv6 deployment

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IPv6 Observatory workshop

Brussels, 17 December 2013

# Agenda

1. Introduction
2. Actuals outcomes
3. IPv4 shortage: side effects
4. Conclusions

# Introduction

The **IPv6 Observatory** is a study financed by the European Commission that aims at **monitoring the worldwide deployment of IPv6**, through a wide set of indicators.

The study started in January 2012 and will last for 2 years.

**http://www.ipv6observatory.eu/**

# Consortium

**inno**, www.inno-group.com

**University of Luxembourg**, www.uni.lu

**GNKS Consult**, www.gnksconsult.com

**BII**, www.biigroup.com

The study is also supported by an expert group.

# Study objectives

- 2 years monitoring of IPv6 deployment
  - Develop a methodology for and conduct regular specific IPv6 implementation measure for all or representative EU Member States in 2013 and 2013, respectively.
  - Use available statistics and appropriate metrics to assess the global deployment of IPv6 and compare the differences in the various regions
  - Identify critical gaps and bottlenecks in IPv6 deployment,
  - Propose recommendations for EC future actions

# Indicators

**How to assess the IPv6 deployment?**

IPv6 deployment is monitored through **a wide set of indicators**, covering network, softwares, skills, ...

Indicators are classified according to the following categories:

- Naming service availability
- IPv6 support at Internet Exchange Points (IXP)
- IPv6 addresses allocations
- IPv6 addresses announced
- IPv6 in mobile networks
- Software/Hardware IPv6 compliant
- Operating systems IPv6 support
- Skills availability
- End-to-end native IPv6 connectivity
- IPv6 certifications (skills, devices, SW...)
- Public policies

**Those indicators help in analyzing the current deployment status and forecasting trends**

# IPv6 at every layer

IPv6 Infrastructure readiness

| | |
|---|---|
| Competences | Skilled people |
| Service offers | ISP (for business and individuals) |
| Services and applications | Websites, MX, gov. services… |
| Hosting and related services | Dedicated/shared server, CDN… |
| Hardware | Set-top boxes, load balancers… |
| Network | Allocation, trafic.. |

# Tools

The **v6DEMON tool** (v6 DEployment MONitor) has been developed for the study. Its main goals are to:

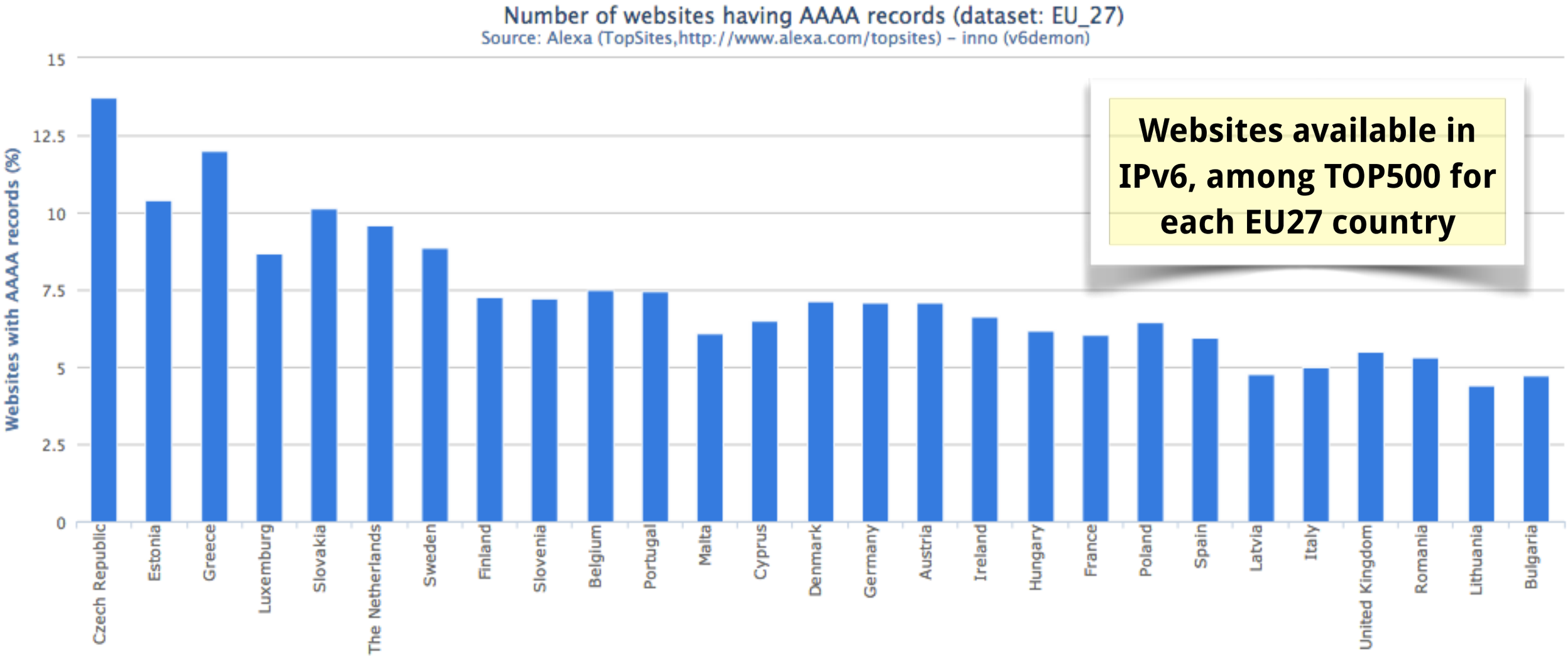
- Check IPv6 support in DNS servers, MX servers, websites
- Compare latency on HTTP requests (IPv4 versus IPv6)
- Collect statistical data from other monitoring tools/websites (RIPE NCC, IPv6 forum, ...)
- Analyze end-users connectivity
- Access web clients connectivity
- Produce detailed graphs
- Export data for the EC Digital Scoreboard (IPv6 indicator)
- Available at: **http://v6demon.ipv6observatory.eu/**

# IPv6 Observatory

## Trends we have observed

Data from 9/12/2013

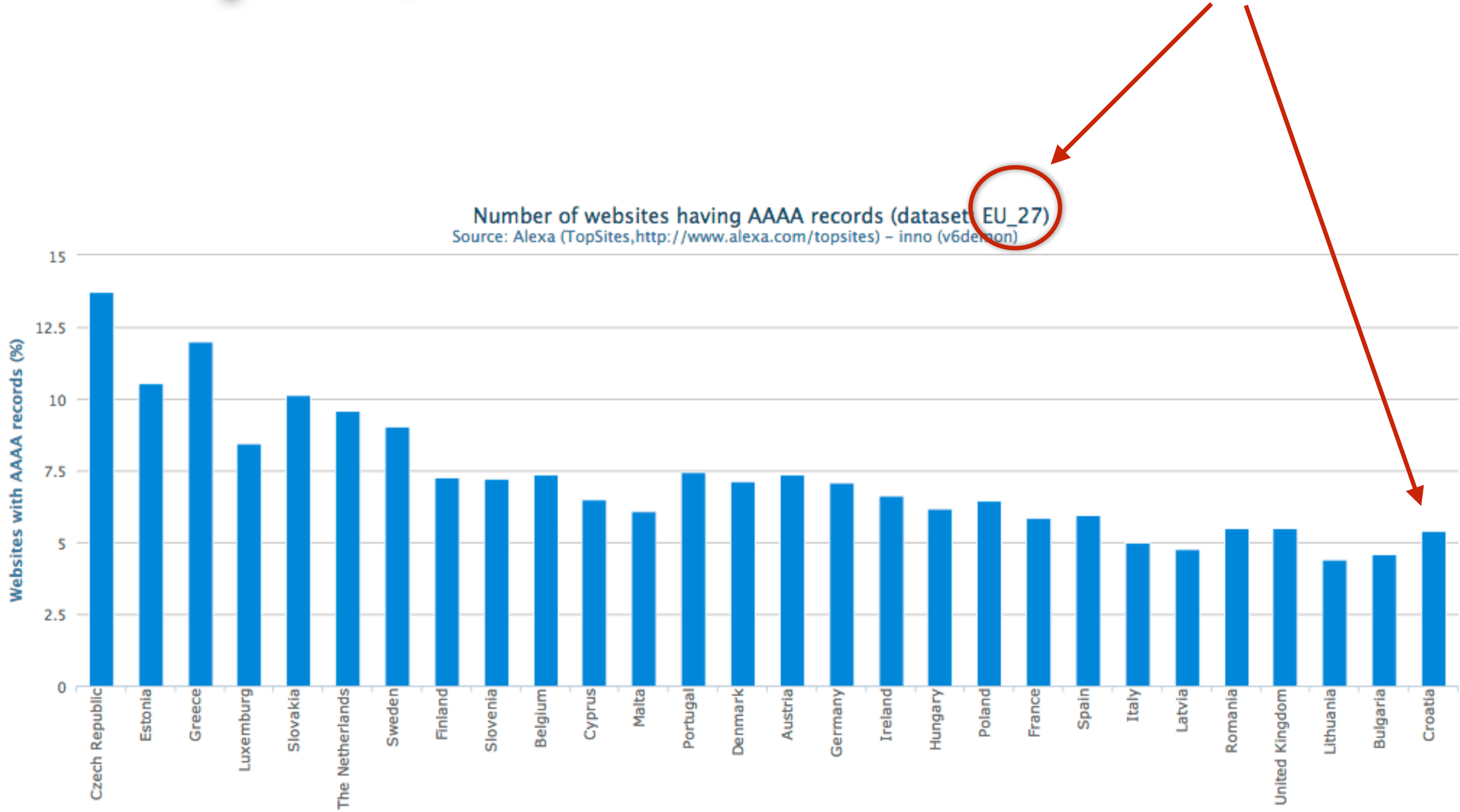
# AAAA - EU27



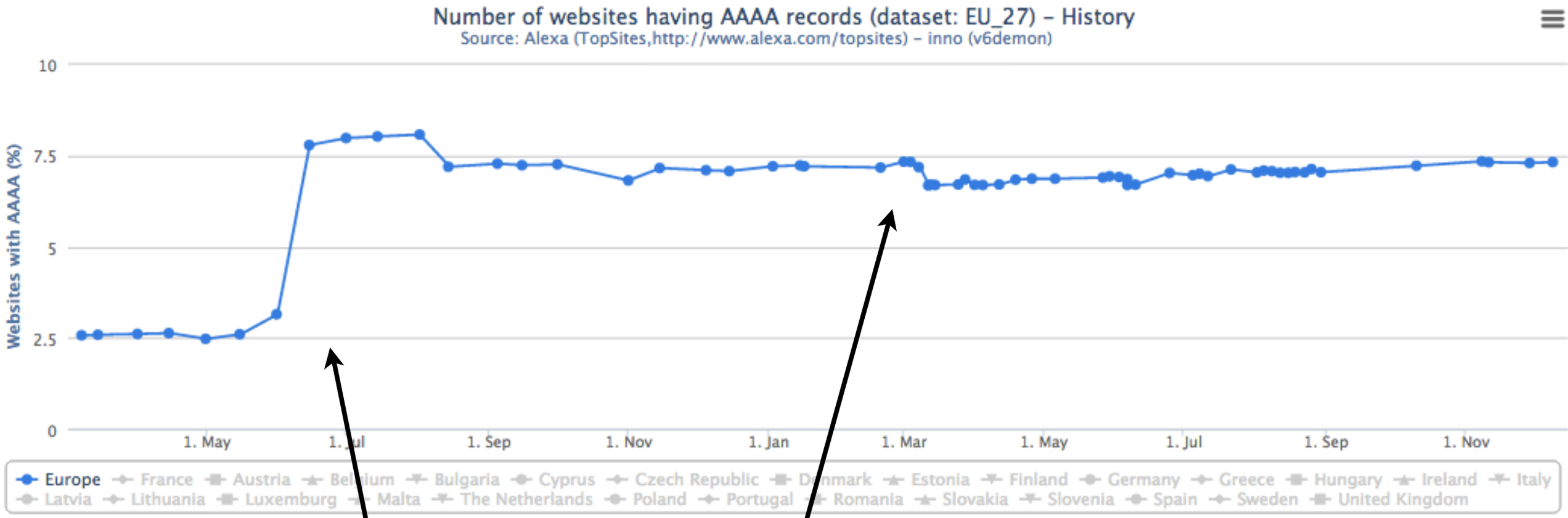

**Websites available in IPv6, among TOP500 for each EU27 country**

# Update 16/12

**Croatia** added. Dataset to become **eu_28**



# AAAA EU27 - Evolution (1/2)

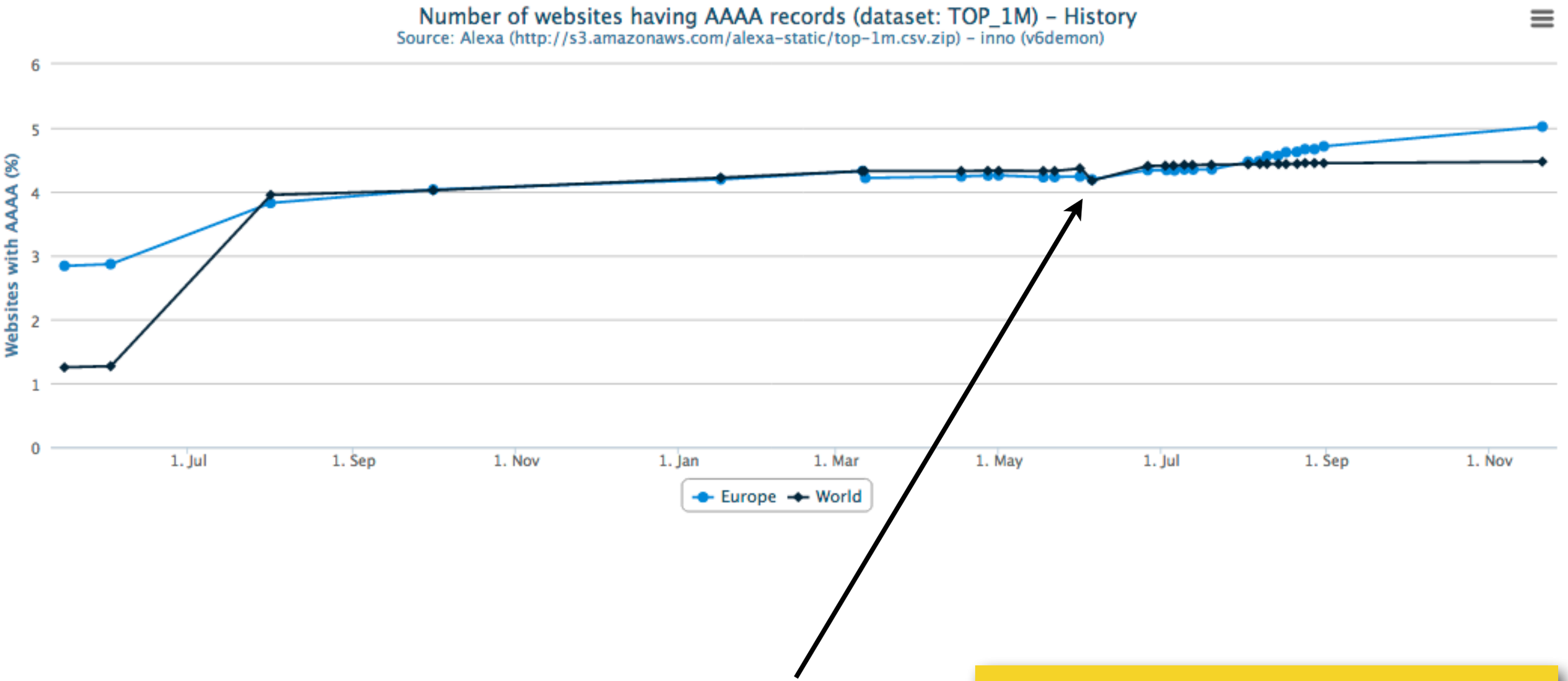



**IPv6 day (same trend for every country)**

**Dataset updated**

Good indicator but most top-500 websites are in a foreign country (ex. Google, Facebook, Twitter...)

# AAAA - TOP1M



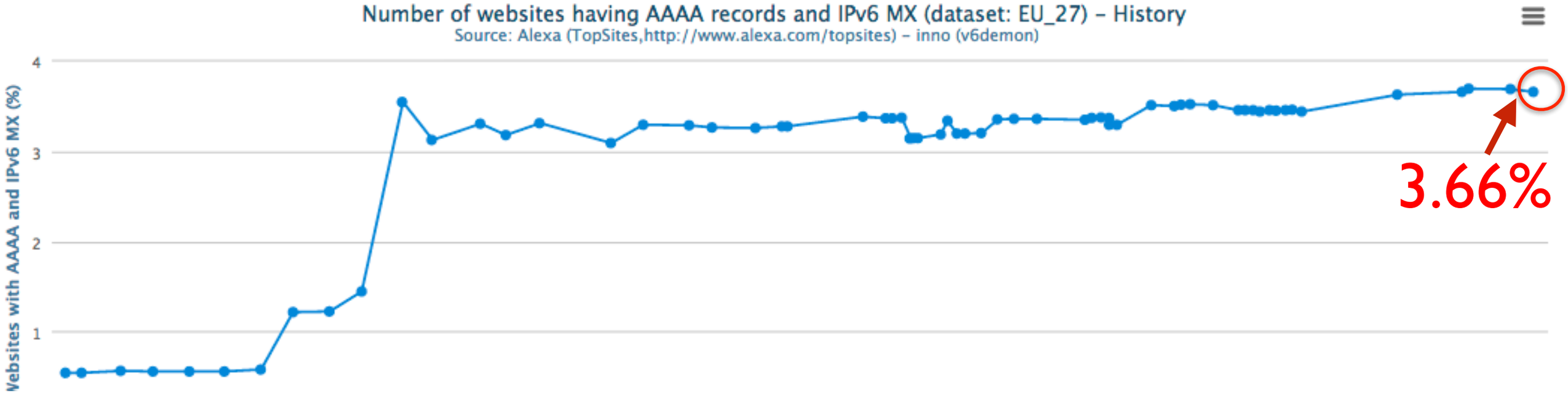

**Since end of May, the top 1M follows Alexa updates: new entrants are not IPv6-enabled**

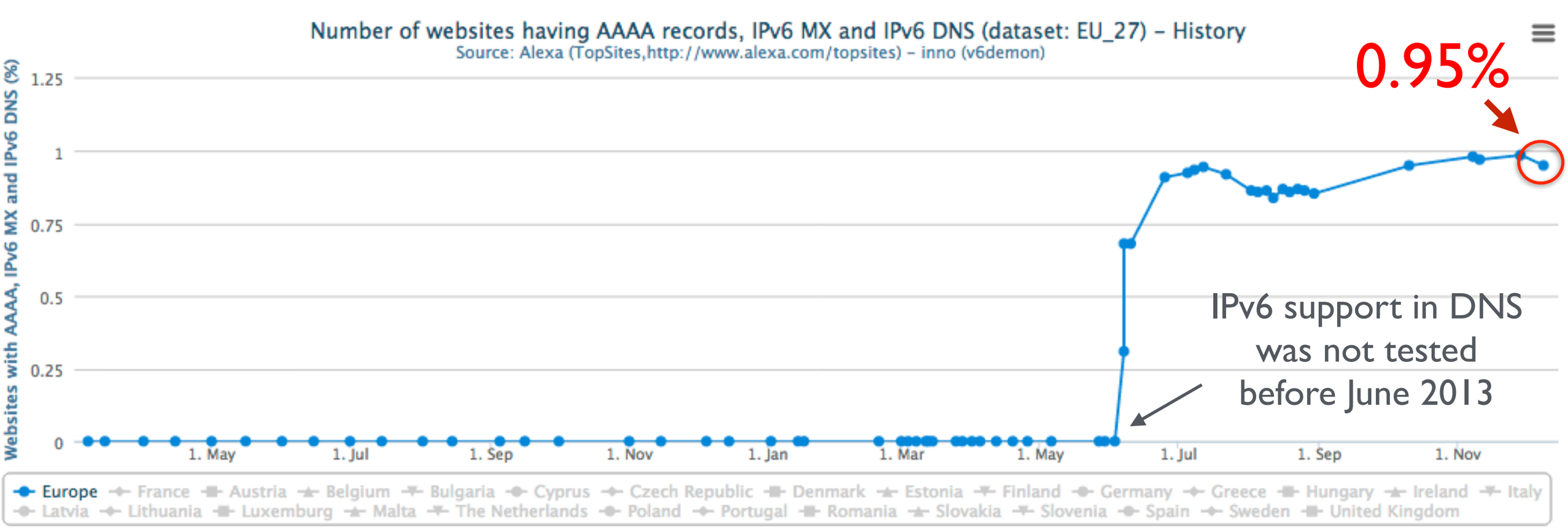
Websites have been geo-localized to get their location.

# Mail and name servers

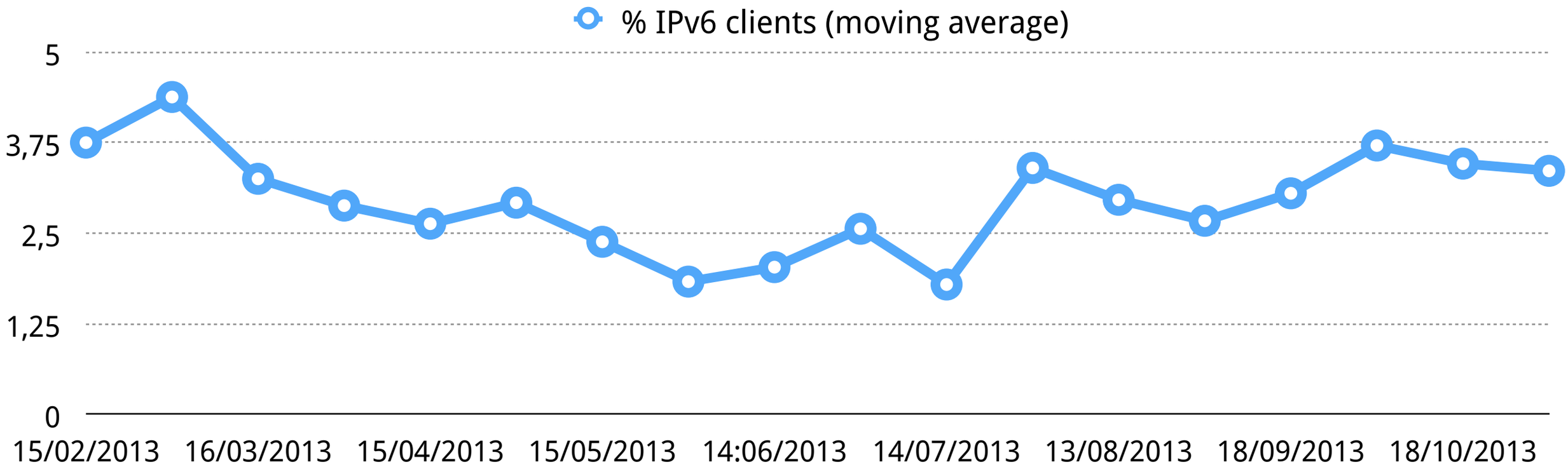
- But IPv6 deployment is not limited to web servers
- What about:
  - Name servers (DNS)?
  - Mails servers (MX)?

# EU27 - AAAA + MX + DNS

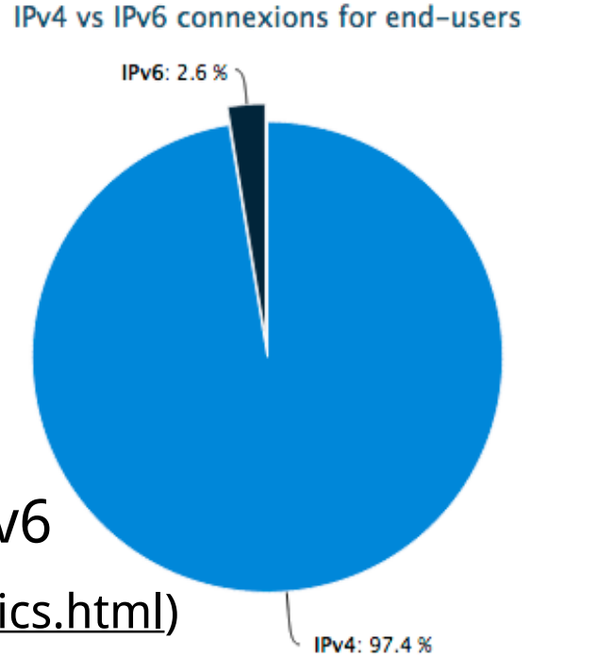


# ISP & IPv6 (1/5)




- Testing web browsers
- Between February and October 2013, ~600k requests
- **Biais: users are mainly located in France**
- Shows over time between 3 and 4% of users connected through IPv6
- Results similar to those done by Google (http://www.google.fr/ipv6/statistics.html)



# ISP & IPv6 (2/5)

- Benchmark during 2013
  - Information very hard to find (IPv6 is not a commercial argument)
  - 68 major operators (in 12 countries) evaluated
- Methodology:
  - Selection of well known, visible commercial ISP
  - Gather information from multiple sources
  - Analyze information

# ISP & IPv6 (3/5)

- For each ISP, try to evaluate:
  - IPv6 offering visibility (website, forum...)
  - Availably on commercial offers
  - Additional cost: does IPv6 mean additional cost for the end-user
  - Diff. between B2B and B2C offers
  - IPv6 deployed by default?
  - If available, what kind of connectivity?

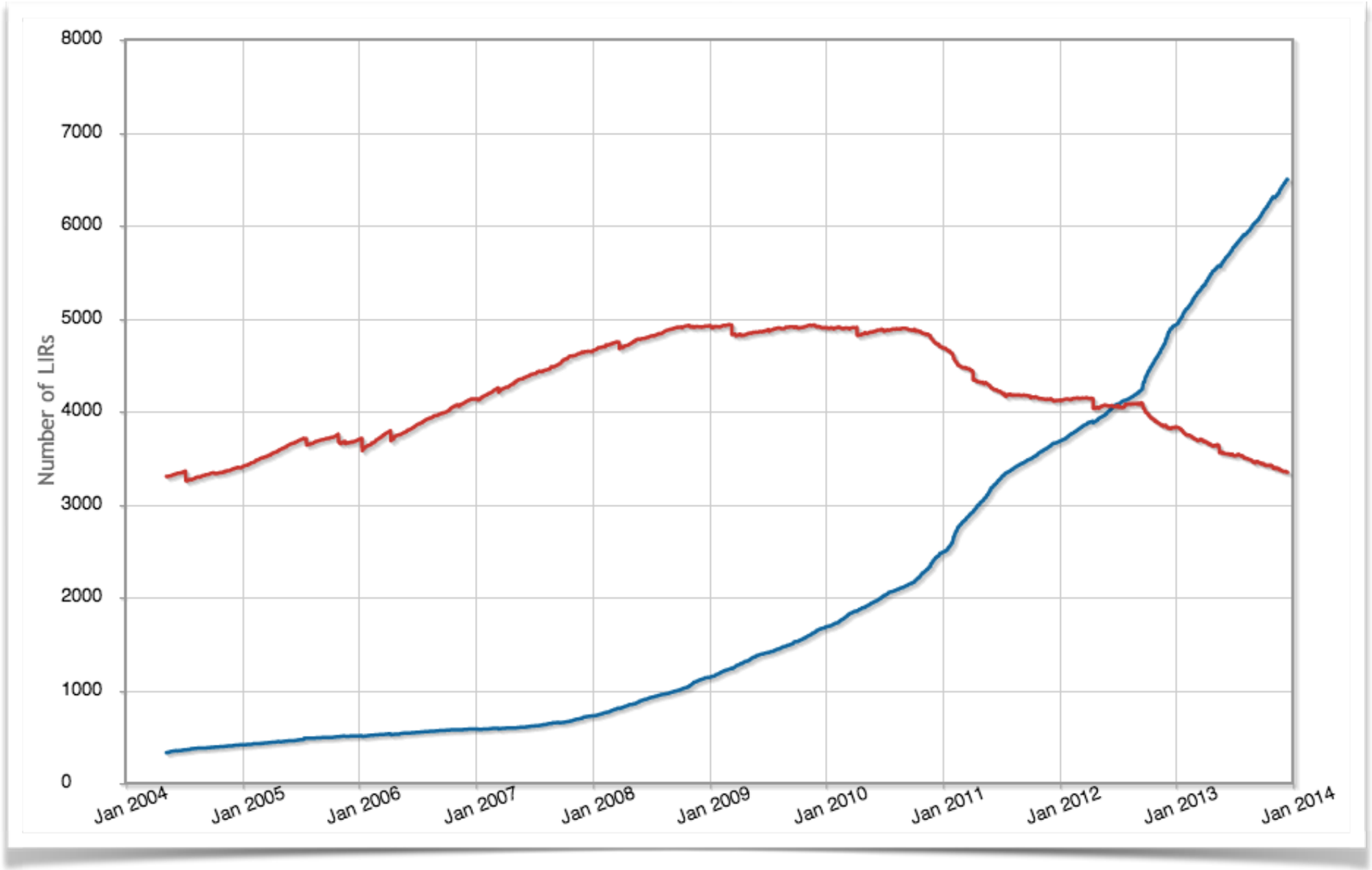
# IPv6 & ISP (4/5)

- IPv6 in commercial offers is slowly starting
- Core networks are mostly ready
- ISPs are concentrating on enabling core network
- When available, IPv6 comes with no additional cost

| Country | Global Note | ISP Evaluated | Average Note |
|---|---|---|---|
| Germany | 55 | 4 | 13,8 |
| Netherlands | 49 | 5 | 9,8 |
| France | 39 | 5 | 7,8 |
| Luxembourg | 21 | 3 | 7,0 |
| Italy | 37 | 6 | 6,2 |
| Ireland | 20 | 4 | 5,0 |
| Belgium | 28 | 6 | 4,7 |
| United Kingdom | 22 | 5 | 4,4 |
| Greece | 17 | 5 | 3,4 |
| Denmark | 38 | 16 | 2,4 |
| Portugal | 7 | 4 | 1,8 |
| Spain | 2 | 5 | 0,4 |

- Some ISPs (mobile/fixed) are deploying CGN technologies to overcome that IPv4 addresses shortage
- Full report: http://www.ipv6observatory.eu/?post_type=report&p=1142

# IPv6 & ISP (5/5)

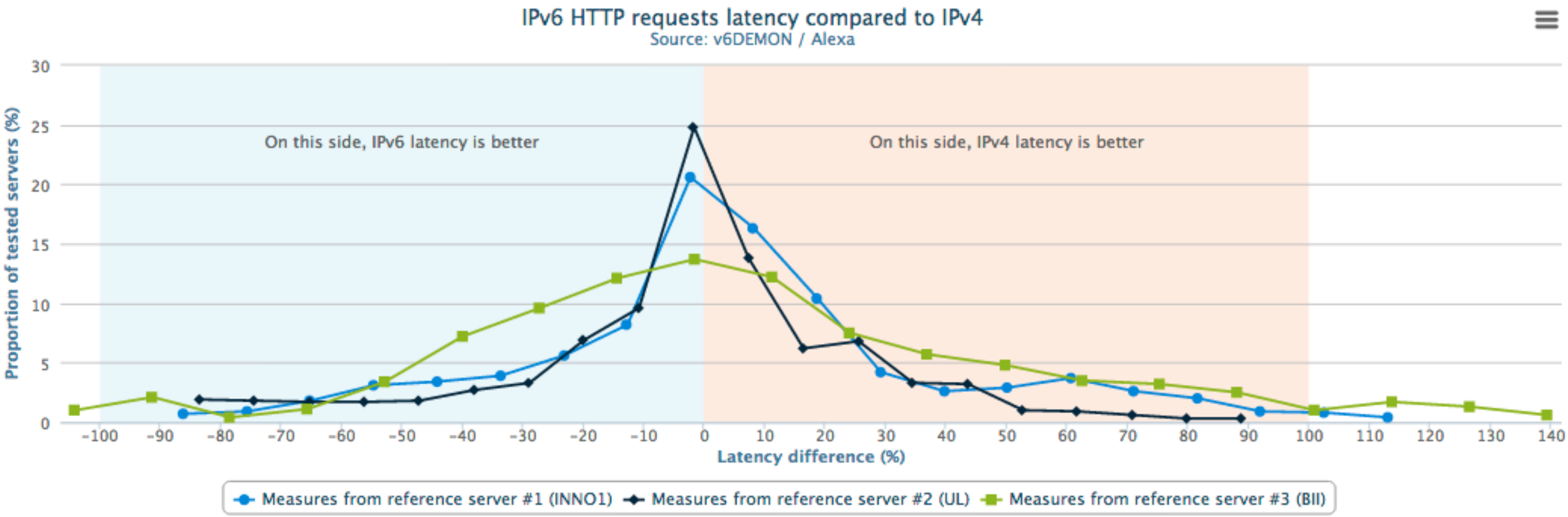



Number of LIRs in the RIPE NCC service region that have an IPv6 allocation

Number of LIRs in the RIPE NCC service region that do not have an IPv6 allocation

Source: RIPE NCC (https://labs.ripe.net/statistics/lirs-with-and-without-ipv6)

# Quality of service



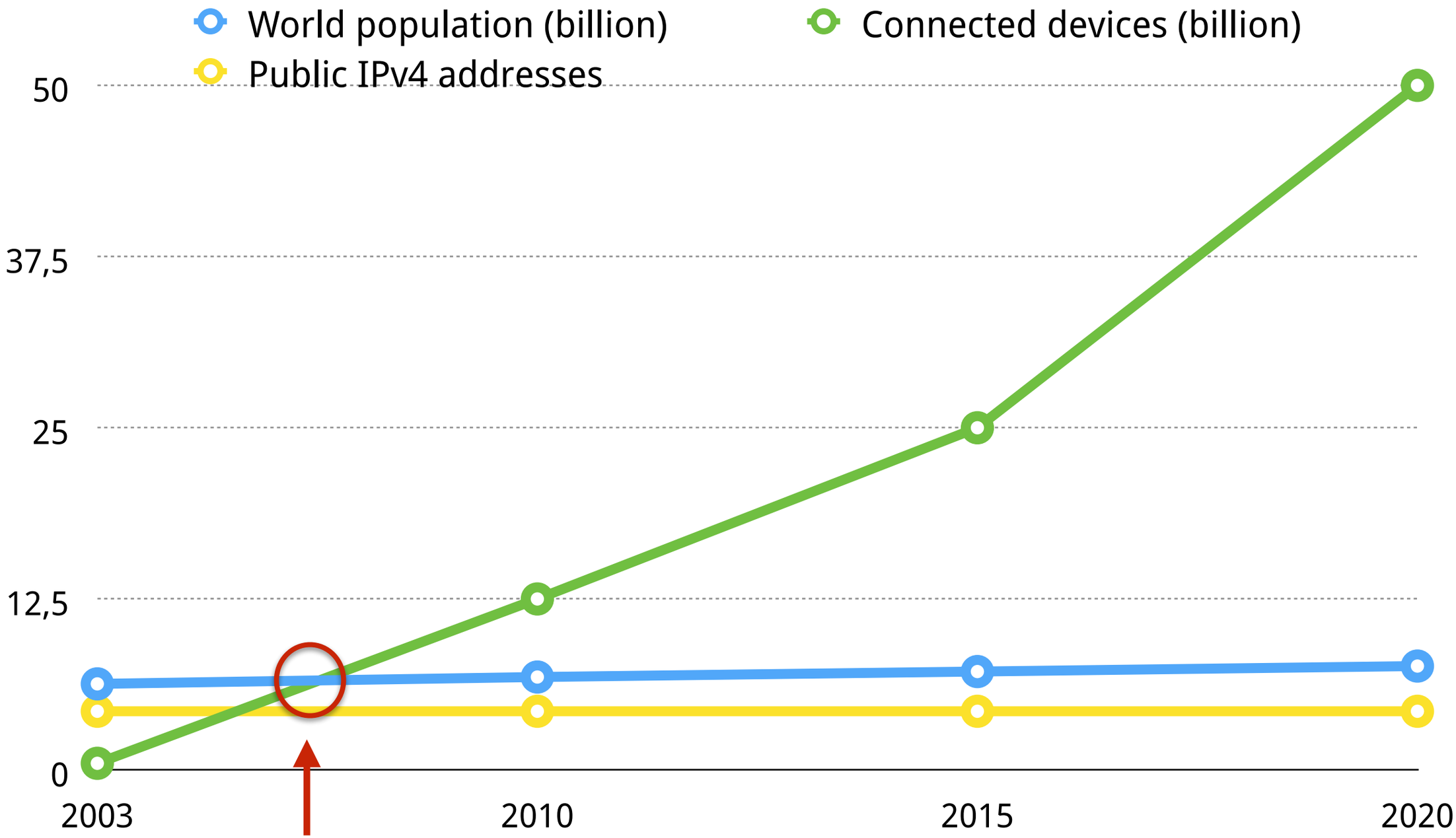

- When testing latency against web servers (HTTP) that present both IPv4 and IPv6 connectivity
  - No real difference between both protocol
  - Behavior constant over time

# Trafic

- IPv6 trafic at Amsterdam IX still negligible (as compared to IPv4)
  - January 2013: **0.45%**
  - December 2013: **~0.65%**

- Numbers from December 2013
  - Average IPv6 was 8.8 Gigabit/second over last month (https://www.ams-ix.net/technical/statistics/sflow-stats/ipv6-traffic)
  - Average all traffic was 1.339 Terrabit/second over last year (https://www.ams-ix.net/technical/statistics)

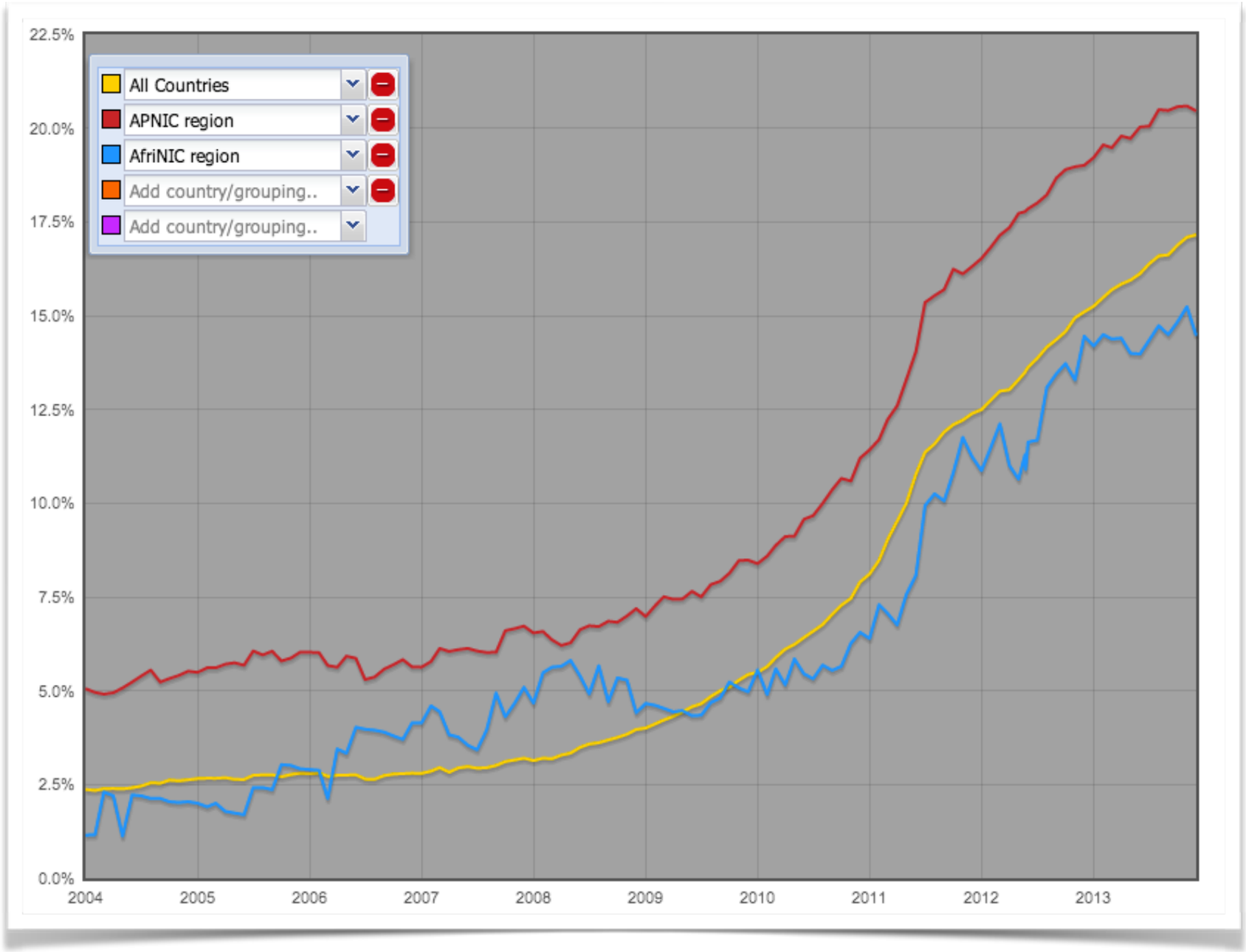
# Adresses allocation (1/2)




Number of connected devices > Number of available IPv4 addresses

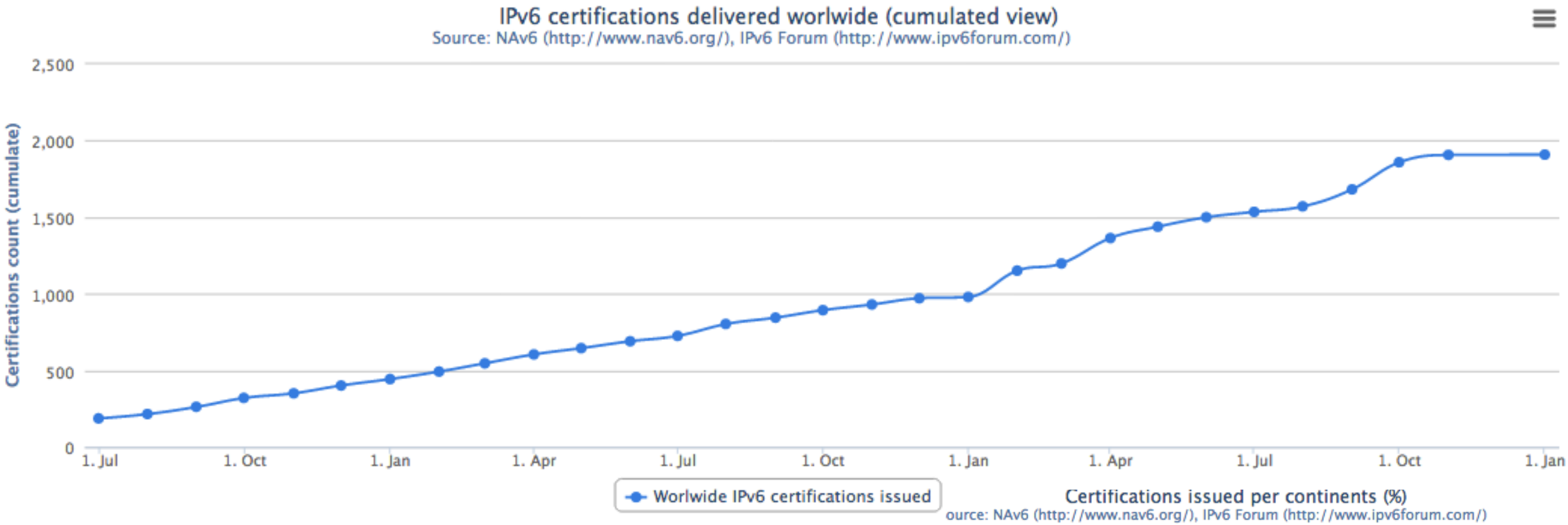
Source: Cisco IBSG, April 2011

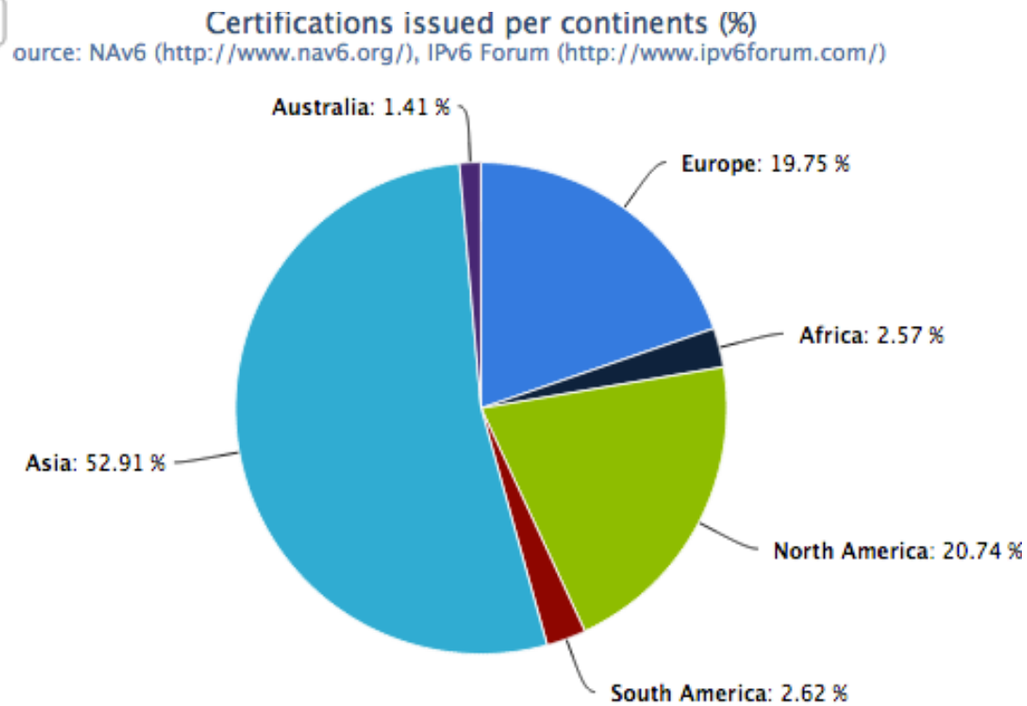
# Adresses allocation (2/2)




Source: RIPE NCC (http://v6asns.ripe.net/v/6?s=_ALL;s=_RIR_APNIC;s=_RIR_AfriNIC)

# Certifications

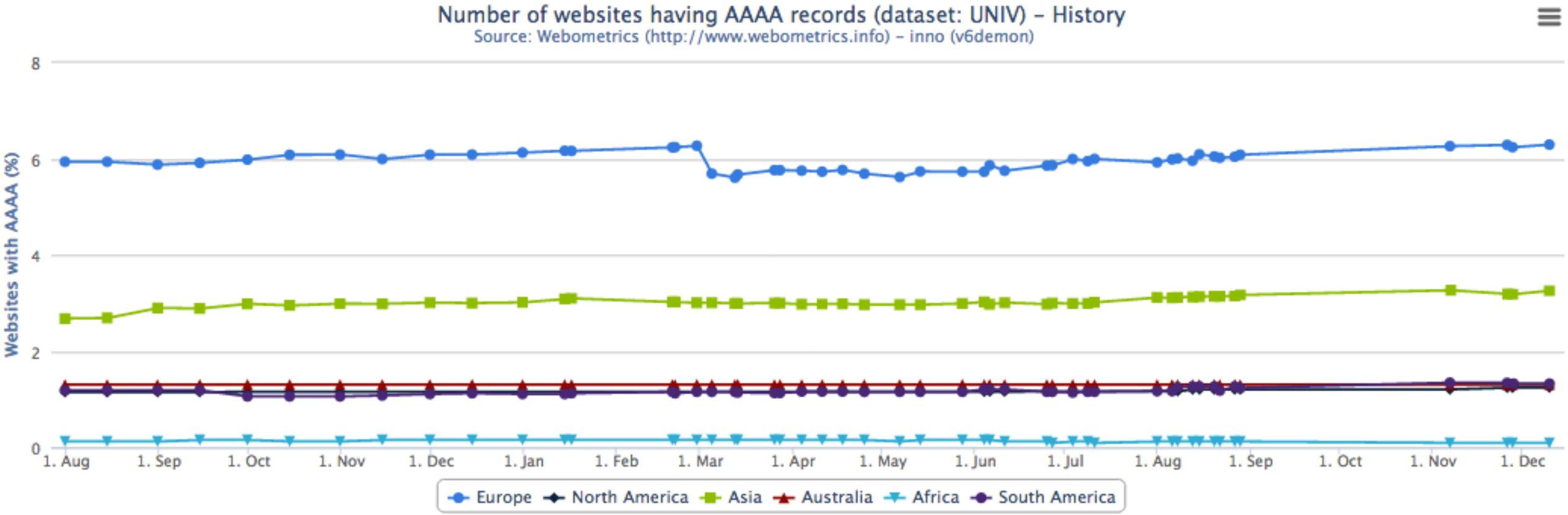



- Certifications issued by the IPv6 Forum
- All programs (people, hardware, websites) are increasing in terms of certifications

But many engineers still see IPv6 as a simple address update of IPv4 and miss the potential of IPv6: this highlights the need for stronger IPv6 education of IT personal

# Universities - AAAA

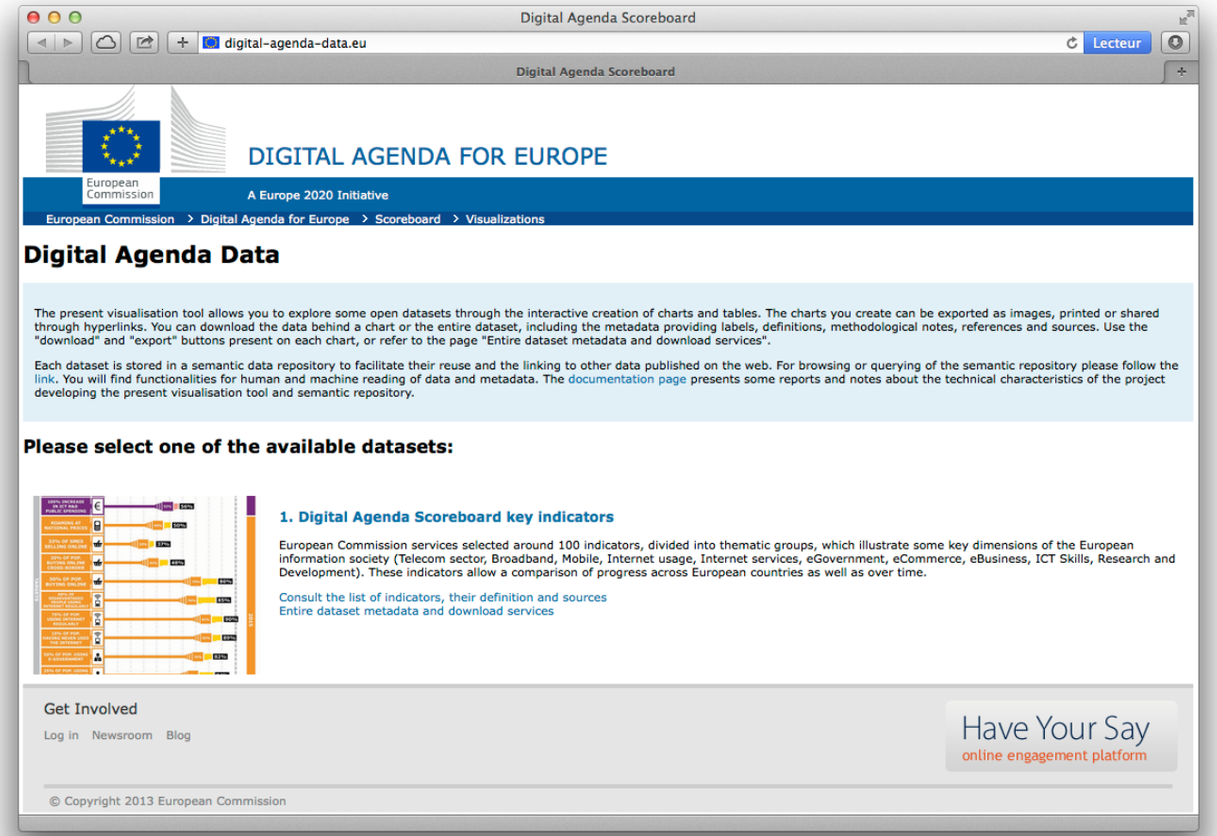



- European schools and universities have better deployed IPv6 on their websites

- As most of the time universities are operating their own network, this highlights the fact that IPv6 is better deployed in Europe rather in the rest of the world

# IPv6 Observatory

## IPv6 in the Digital Agenda Scoreboard

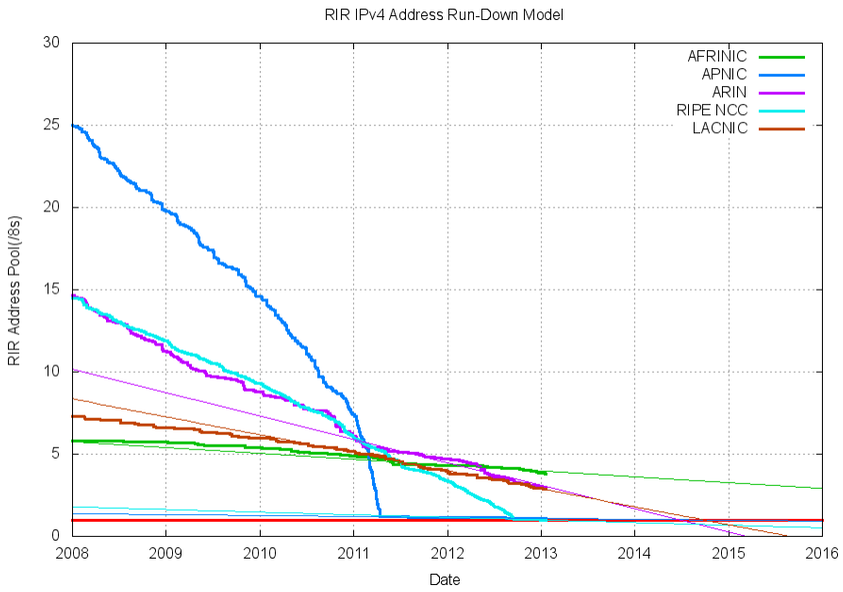


# The digital agenda & IPv4

## Objectives

- the entire EU to be covered by broadband by 2013.
- the entire EU to be covered by broadband above 30% by 2020
- 50 % of the EU to subscribe to broadband above100 Mbps by 2020
- 50 % of the population to buy online by 2015
- 20 % of the population to buy online cross-border by 2015
- 33 % of SMEs to make online sales by 20155
- the difference between roaming and national tariffs to approach zero by 2015
- to increase regular internet usage from 60 % to 75 % by 2015, and from 41 % to 60 % among disadvantaged people.
- to halve the proportion of the population that has never used the internet from 30 % to 15 % by 2015
- 50 % of citizens to use eGovernment by 2015, with more than half returning completed forms
- all key cross-border public services, to be agreed by Member States in 2011, to be available online by 2015
- etc.

## Pool IPv4...



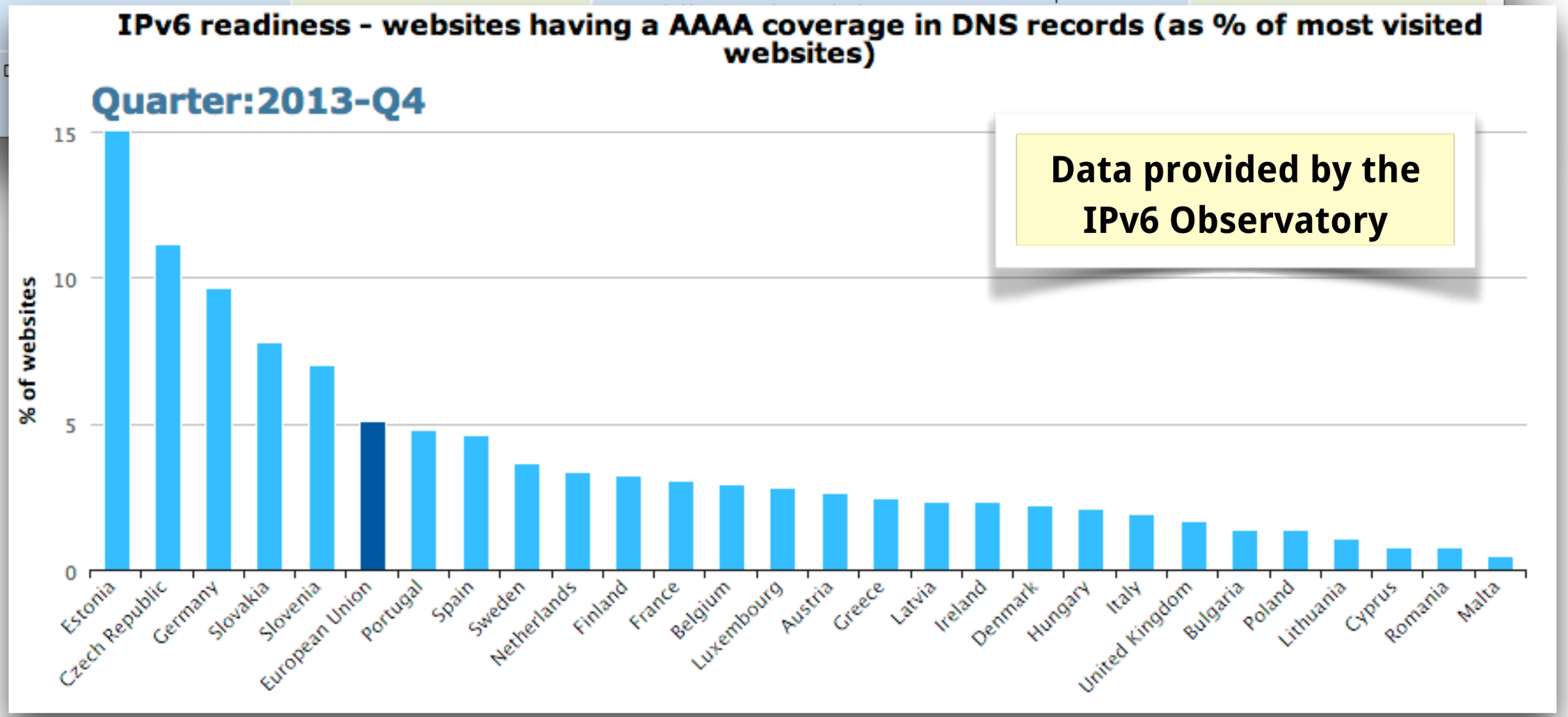

## = IPv6

# IPv6 scoreboard

Digital Agenda Scoreboard

digital-agenda-data.eu/datasets/digital_agenda_scoreboard_key_indicators/indicators#Internet-usage

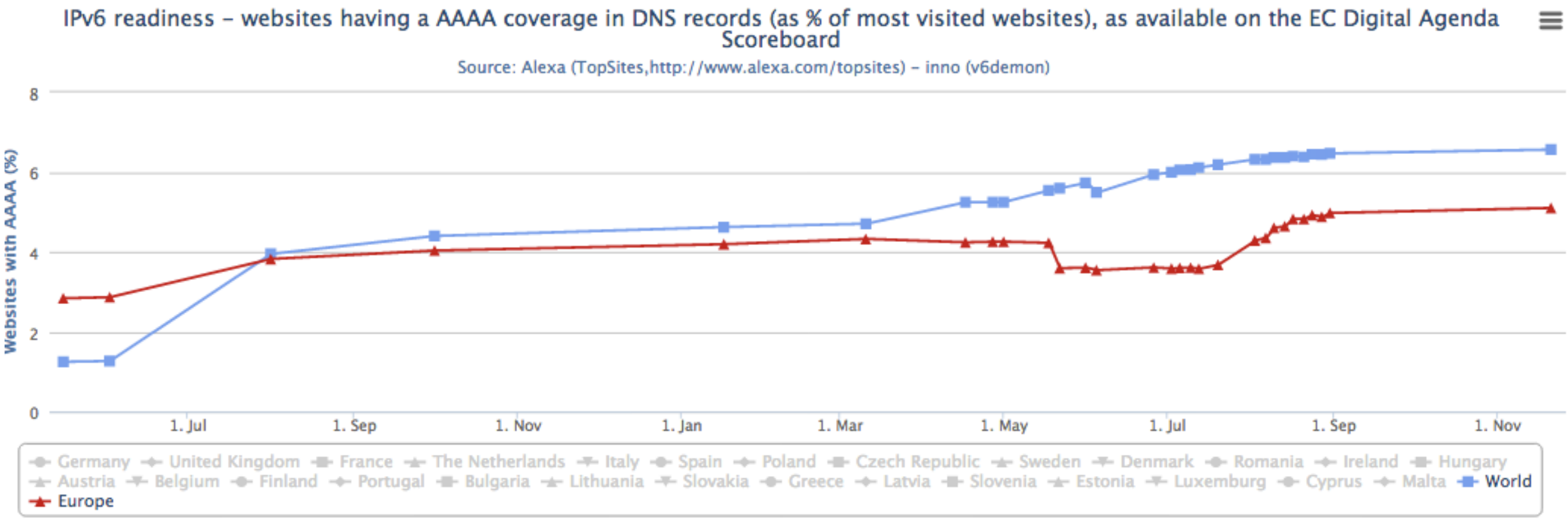
| | | | |
|---|---|---|---|
| | cards/modems/keys only | **Notes:** null | |
| **Internet usage** | | | |
| IPv6 readiness of most visited websites | IPv6 readiness - websites having a AAAA coverage in DNS records (as % of most visited websites) | **Definition:** IPv6 ready websites are those having at least one AAAA in their DNS records (means the website is visible/can reply to users having an IPv6 connectivity). Tests are done every trimester through a script run by the IPv6 Observatory study on the 1 million most visited websites list provided by Alexa. Websites are attributed to countries on the basis of their main operation location | EC - IPv6 Observatory |




**Data provided by the IPv6 Observatory**

Source : http://digital-agenda-data.eu

# IPv6 scoreboard (evolution)




**Built using a geocoded version of Alexa Top1M ranking (same figure available on v6DEMON)**

# CGN (1/3)

- Carrier Grade NAT is positioned between a private and public IP network and uses non global, private IP addresses and a public IP address for translation.

- Main and only avantage:

  - CGN allows sharing addresses among a large pool of addresses of internet  consumers.

  - However, some applications and services might not function correctly or might even break behind CGN.

# CGN (2/3): impacts

| Minimal impacts | Average impacts | Significant impacts |
|---|---|---|
| Mail | Advanced Internet apps (HTML5 APIs, Google Maps...) | IoT, Cloud |
| Web browsing (simpe websites | Voice over IP | End-to-end apps |
| Social networking services | Instant messaging | Multiplayers games |
| Single player games | | Access to home resources (media, PVR...) |

*This table is not exhaustive, but gives a few examples of CGN impacts*

# CGN (3/3): cost

CGN introduce a high cost on every layer: hardware, maintenance, support…

| Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | |
|---|---|---|---|---|---|
| $18,000 | $18,000 | $18,000 | $18,000 | $18,000 | CAPEX (depreciation) |
| $10,000 | $10,000 | $10,000 | $10,000 | $10,000 | OPEX |
| $18,280 | 0 | 0 | 0 | 0 | Customer support |
| $365,600 | $365,600 | $365,600 | $365,600 | $365,600 | Lost revenue |
| $411,880 | $393,600 | $393,600 | $393,600 | $393,600 | **TOTAL: $1,986,280** |

Source: « Internet Access Pricing in a Post-IPv4 Runout World ». Lee Howard, Time Warner Cable

« For an ISP whose typical support call cost is $20, the increased support cost of CGN is $18,280 per 10,000 users. For an ISP whose average revenue per unit (ARPU) is $400/year, the total revenue lost to CGN is $365,600 per year per 10,000 users. »

# Side effects

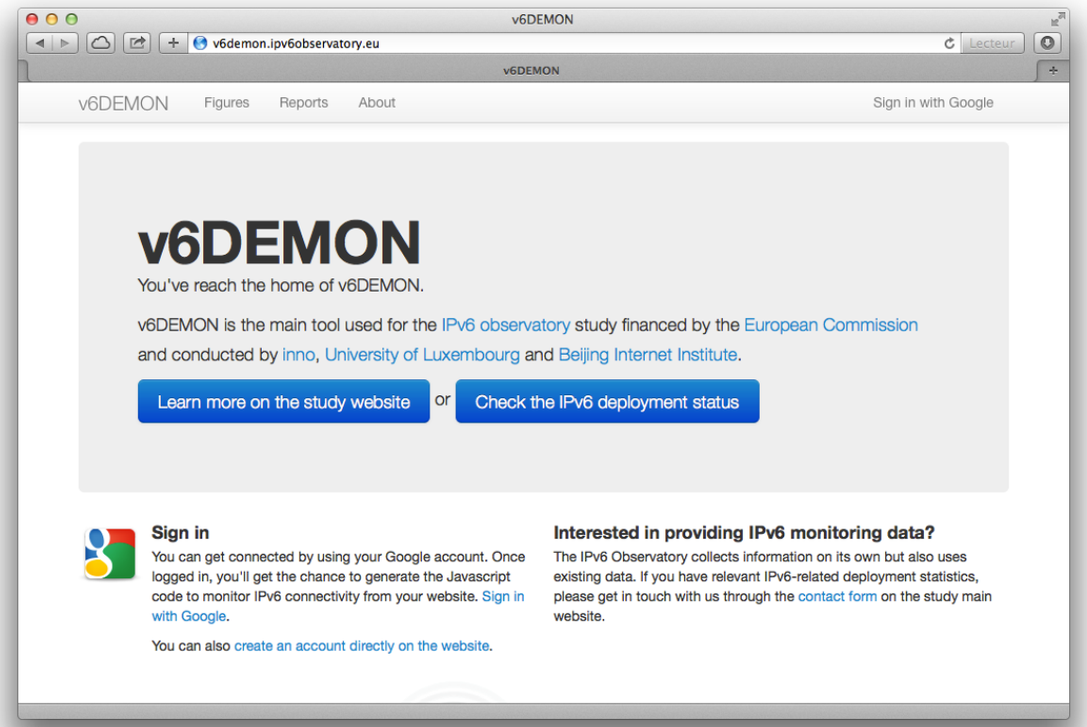
- Positive
  - Gandi, a French hosting companies, provides IPv6-only server with a 17% discount (as compared to server with IPv4 and IPv6)
  - Market places for IPv4 addresses brokerage
- Negative
  - SA46T-AS add IPv4 address sharing function to SA46T. So, SA46T-AS enable many host to share single IPv4 global address.
  - CGNs

# Conclusions

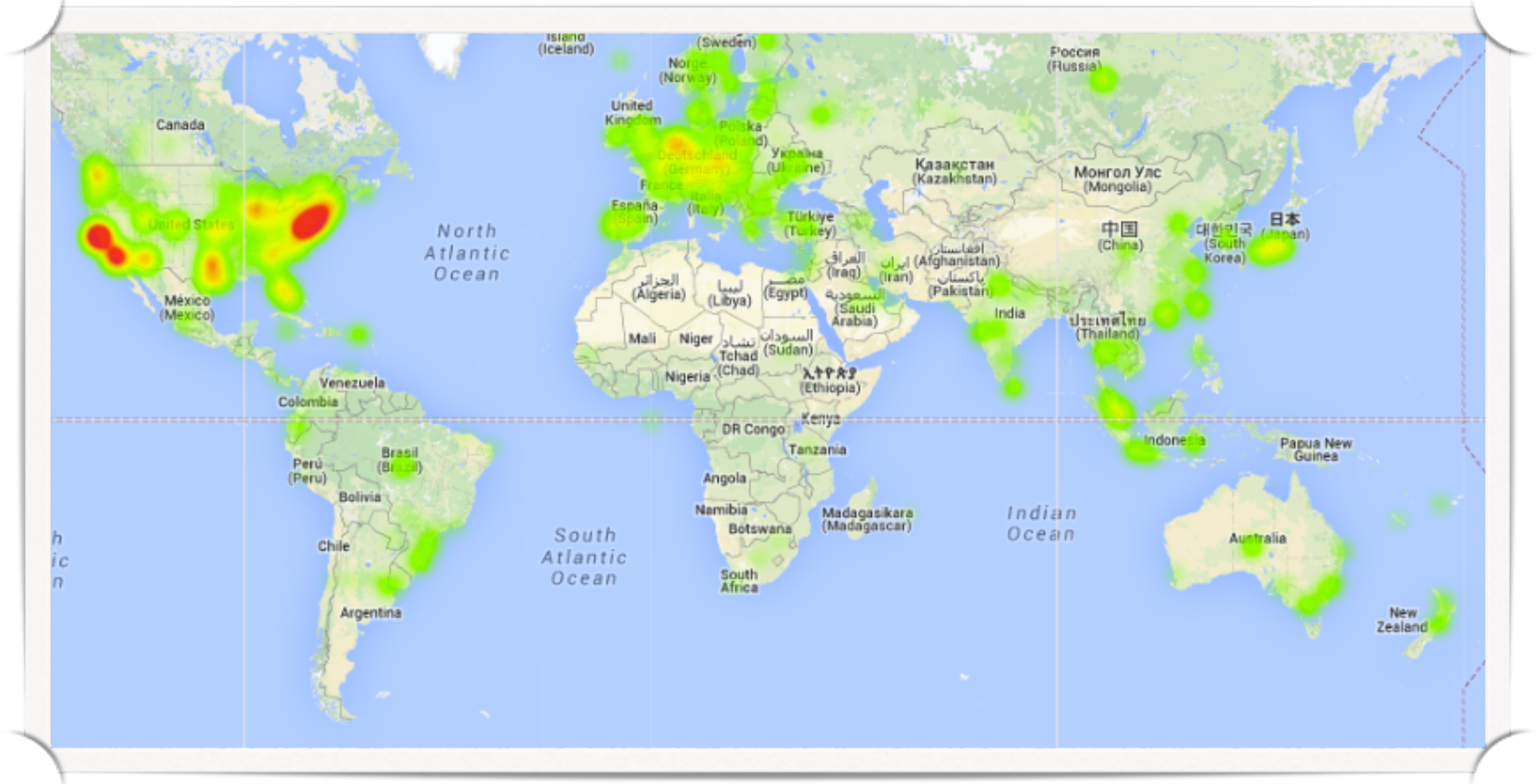
- Now all actors are convinced about the need to move forward in deploying IPv6
- IPv6 deployment:
  - is still low but progresses can be clearly seen
  - real usage remains negligible in comparison with IPv4 (and prompted by US companies)
  - when looking beyond AAAA monitoring, figures are very low
- On the ISP side
  - IPv6 is present in the core networks but difficulties arise on the access part
  - ISP are internally deploying IPv6
- Pool of trained people (with IPv6 competences) exists
- IPv4 shortage brings side-effect (positive and negative, some unforeseen)

# More information

- Study's website: **http://www.ipv6observatory.eu**
- Monitoring tool: **http://v6demon.ipv6observatory.eu**

# Questions?




# Thanks!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