IPv6 Deployment Monitoring: Internet metrics

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Foreword

- Many thanks to all people involved in monitoring IPv6 and making these numbers public
- The presented sites are my own selection but there are many others
- Graphics dated 30th of July 2013

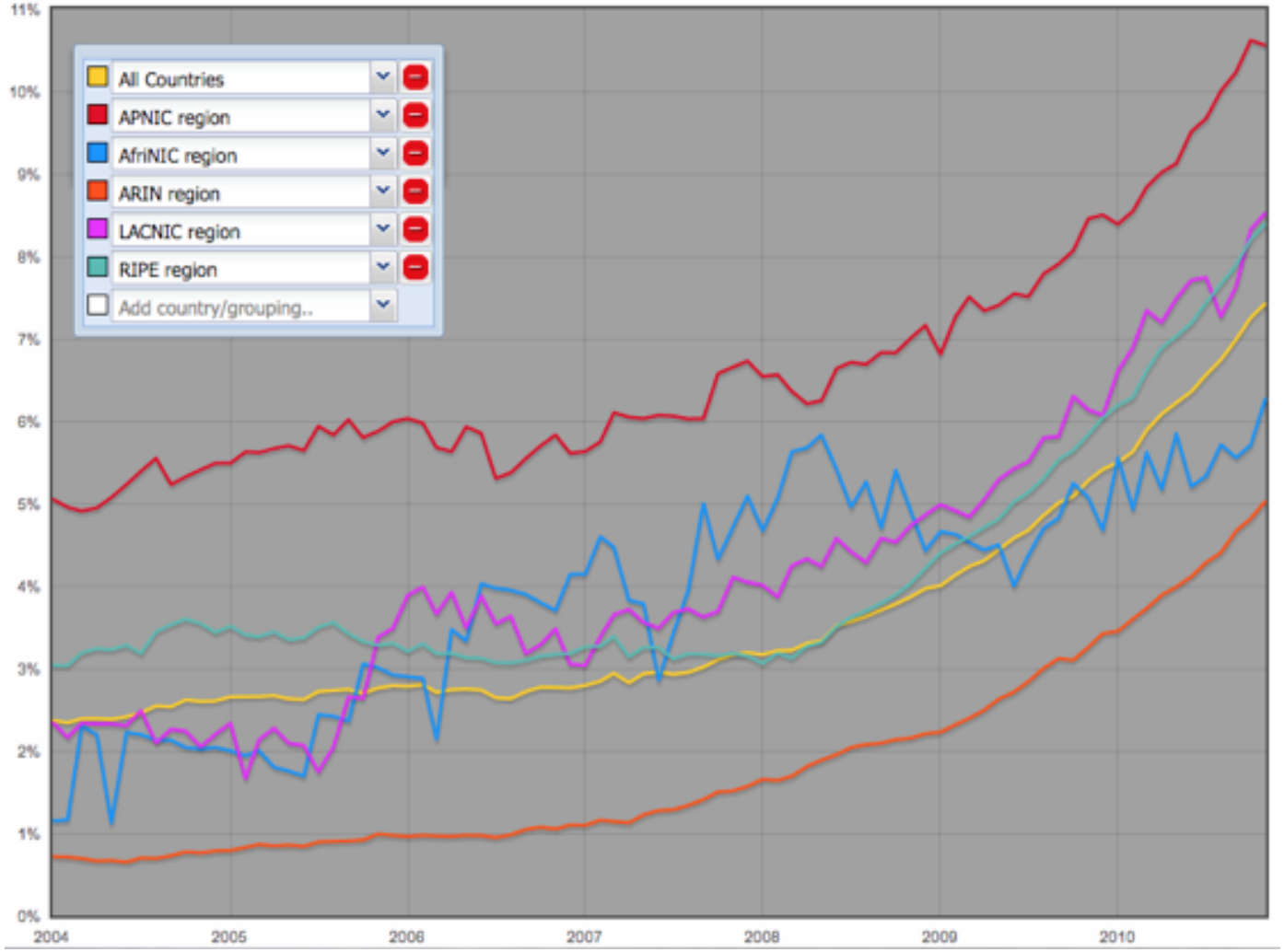
1000 EUR Question
How to monitor deployment?

- Looking at future?
  - Interviews
  - Monitoring ‘precursors’ (IPv6 prefixes, devices, ...)
- Looking at current state of the Internet
  - Open metrics => open results
  - Worldwide view

Measuring ISP Deployments

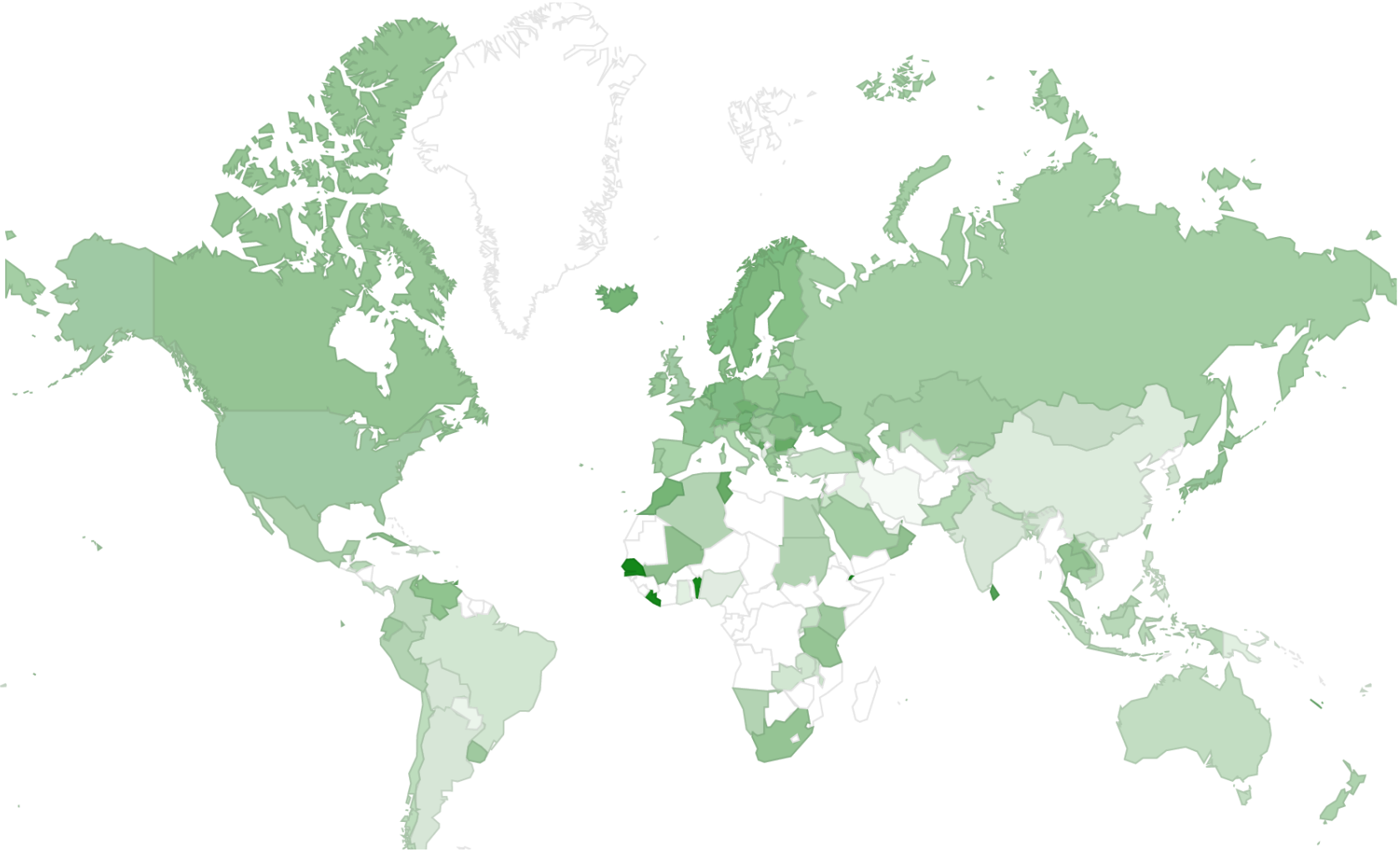
- Regional Internet Registries (RIPE, ARIN, ...)
  - Which ISP has IPv4 and IPv6 prefixes (precursor)
- Internet routing tables (openroute, ...)
  - Which ISP has at least an IPv6 router
- Traffic seen from this prefix
  - Using techniques described later
  - This is alive prefixes

Per RIR IPv6 Autonomous Syst.



http://www.ipv6actnow.org/info/statistics/

European IPv6 Prefixes



Source: http://6lab.cisco.com

IPv6-enabled ISP Subscribers

- Measure the web traffic
  - Using a small web bug (1x1 pixel transparent GIF)
    - Used by Google, and others
    - Can precisely measure IPv4, IPv6 and dual-stack
    - E.g. http://www.vyncke.org/countv6/
  - Web servers log files
    - Easier but cannot check IPv4, IPv6
  - Google Ads
    - Used by APnic
    - All ads are in flash and flash can try to download IPv4, IPv6, dual-stack and report
- Participate in dual-stack peer-to-peer networks such as BitTorrent

More on Web bug

- By inserting a 1x1 pixel transparent image (or IFRAME)

  Or even better 3 images:

  IPv4-only

  IPv6-only

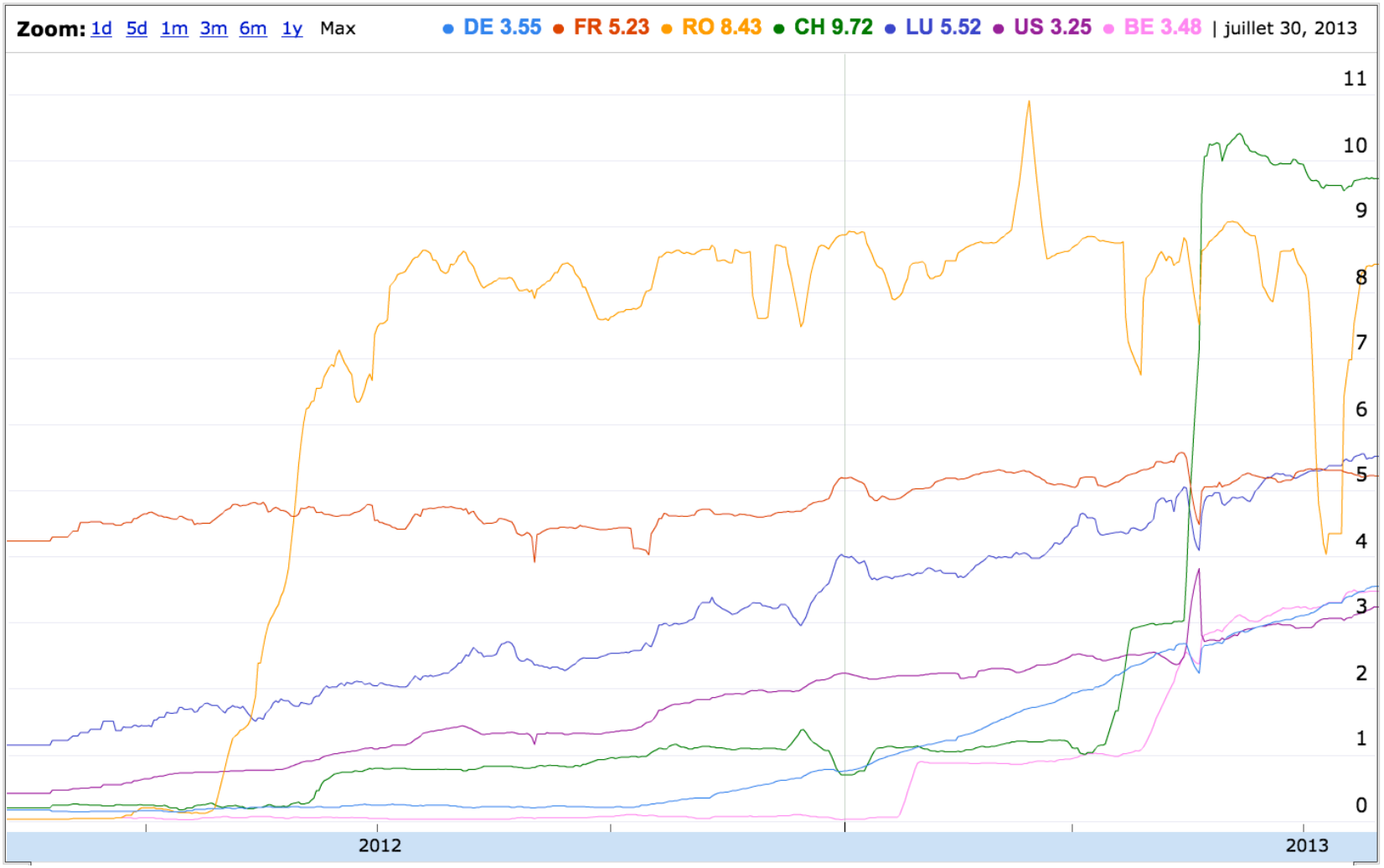
  Dual-stack then check whether IPv4 or IPv6 was preferred

- IPv6 brokenness (old 6to4 CPE mainly): can reach IPv4-only but not dual-stack (because IPv6 was preferred but broken), cfr Tore Anderson's experiment
- IPv6 non-managed tunnels (Sixxs, Gogonet, Hurricane Electric) because the AS is different between IPv4 and IPv6
- Can generate a lot of data and CPU load => sampling on large sites

Worldwide IPv6 Users
The “mother” of deployment measures

http://www.google.com/ipv6/statistics.html

IPv6 Google Users Evolution



http://www.vyncke.org/ipv6status/compare.php?metric=p&countries=de,fr,ro,ch,lu,us,be

Monitoring IPv6 Web Content

- Simple and easy
- Try to connect to www.example.org over IPv6

  Make a AAAA DNS request

  Then try to connect to it by TCP on port 80
- But, also try www6.example.org IPv6.example.org, ...

  This is an indicator of 'IPv6 under test' or 'IPv6 pilot'
- Can be extended to measure email and DNS servers of a domain

www.alexa.com is your friend

- List of most visited web sites
- Freely available top-1-million

  == Which are popular sites visited by the whole Internet

  Then class by country top level domain: .be, .ch, .lu

  Issues:

  www.ice-watch.com is actually in Belgium

  www.youtu.be is actually outside of Belgium

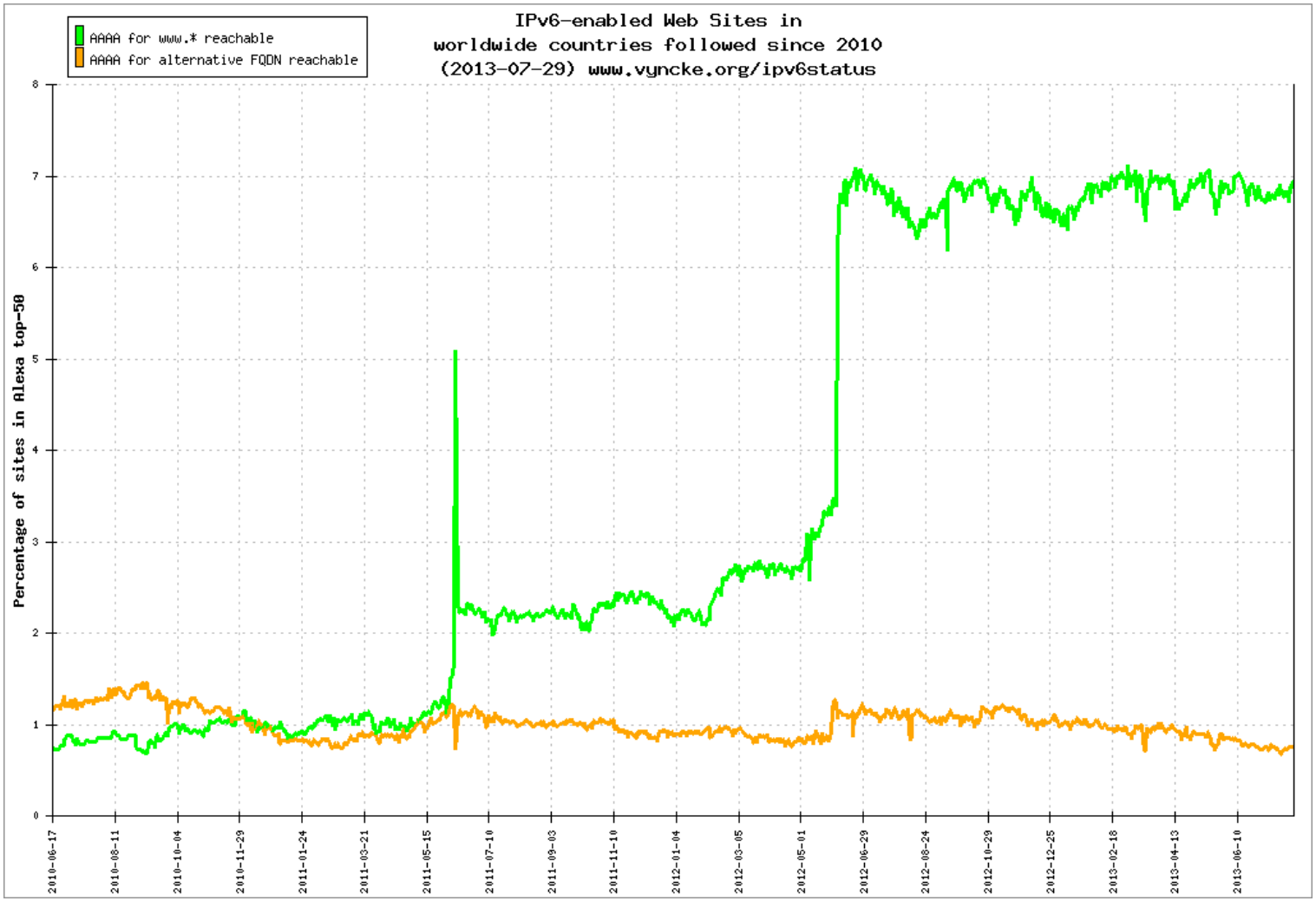
  Estimation of IPv6-readiness of a country
- Paying list of visited web sites by country

  == Which are popular sites actually visited by users of this country

  E.g. google.ch, facebook.com, google.com, live.com, ...

  Assuming a long-tail distribution, can estimate the amount of IPv6 traffic IF all subscribers were dual-stack

Worldwide IPv6 Web Servers



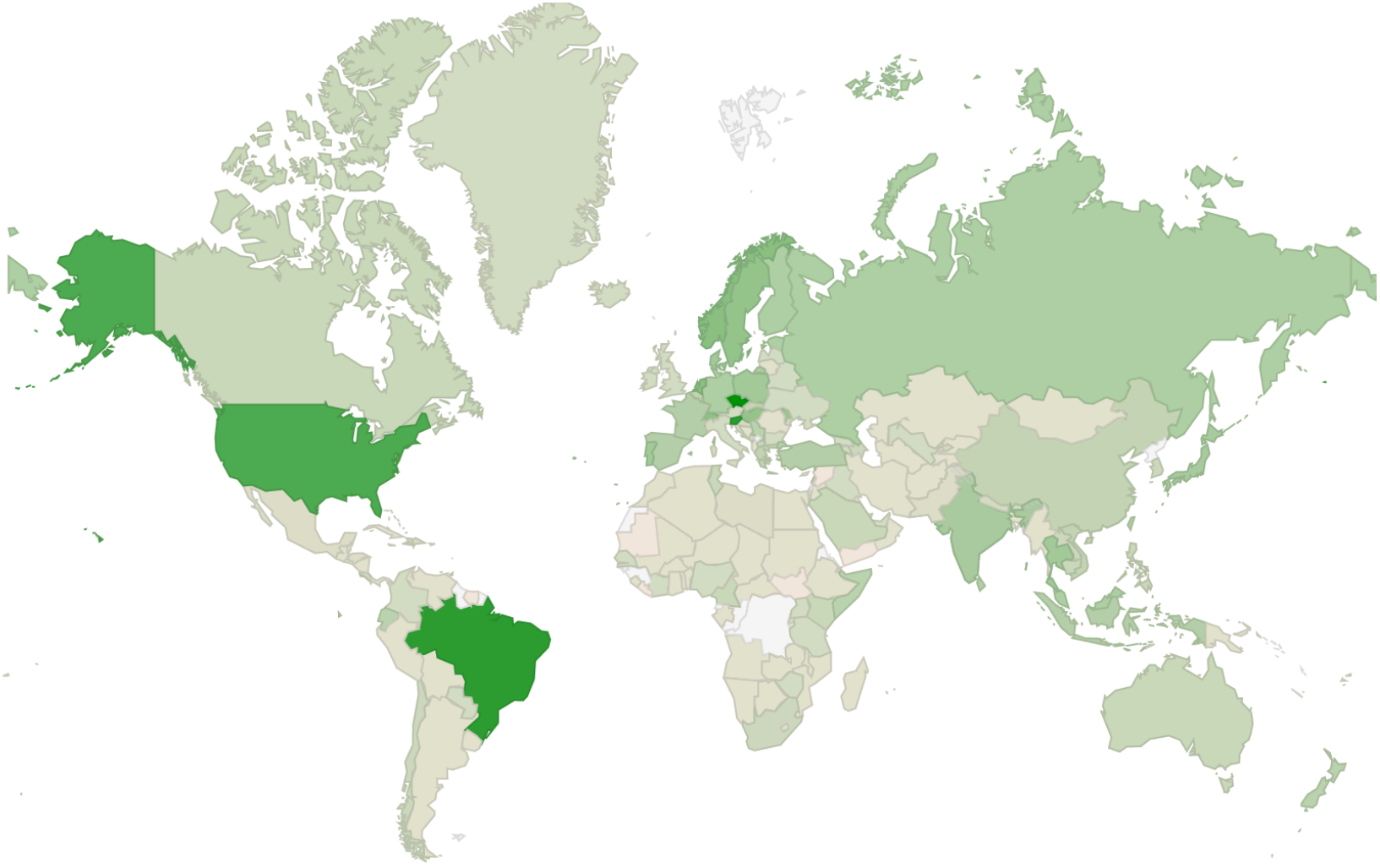
http://www.vyncke.org/ipv6status/worldwide-W-legacy.png

Web Servers Location

Rank	Country	Sample	Green	Orange
1	Czech Republic	50	36.0% (18)	0.0% (0)
2	Brazil	50	30.0% (15)	0.0% (0)
3	Slovenia	50	30.0% (15)	0.0% (0)
4	Maldives	11	27.3% (3)	0.0% (0)
5	United States of America	50	24.0% (12)	2.0% (1)
6	Singapore	50	22.0% (11)	0.0% (0)
7	Haiti	12	16.7% (2)	0.0% (0)
8	Netherlands	50	14.0% (7)	4.0% (2)
9	Norway	50	14.0% (7)	4.0% (2)
10	Switzerland	50	14.0% (7)	2.0% (1)

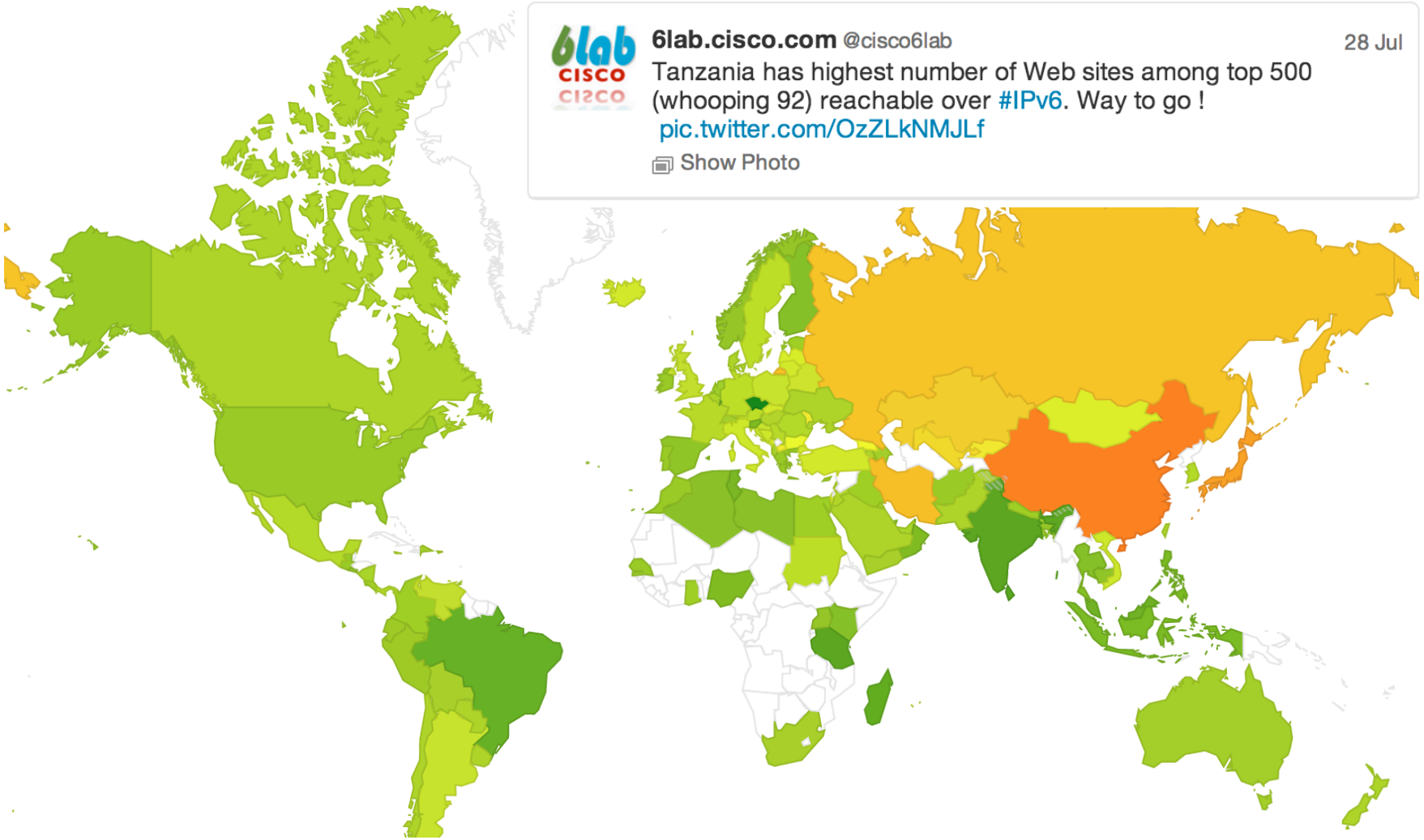
http://www.vyncke.org/ipv6status/index.php

IPv6 Web Servers Location



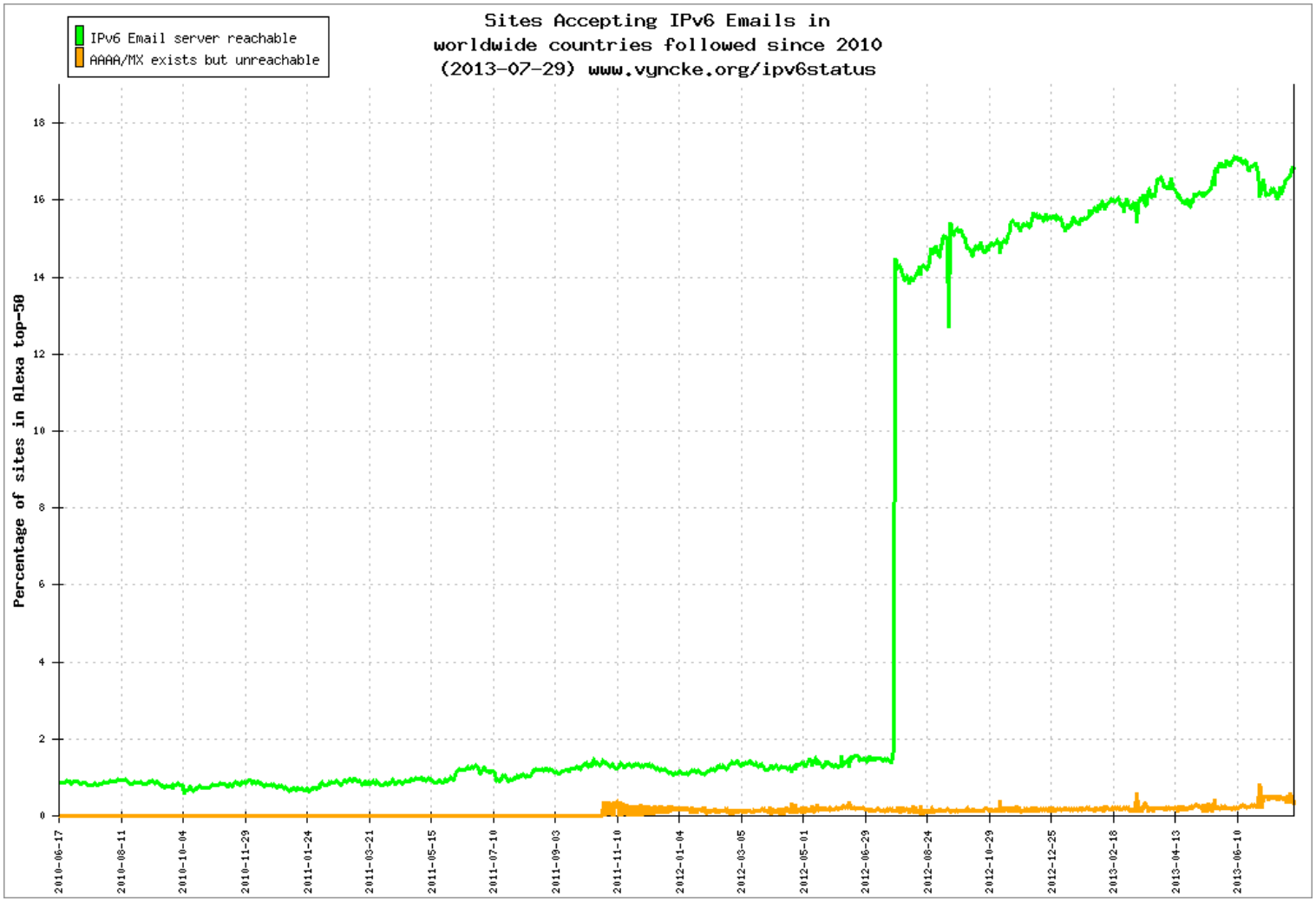
http://www.vyncke.org/ipv6status/gmap.php?metric=w

IPv6-Ready Web Traffic



http://6lab.cisco.com/stats/index.php

Worldwide IPv6 Email Servers

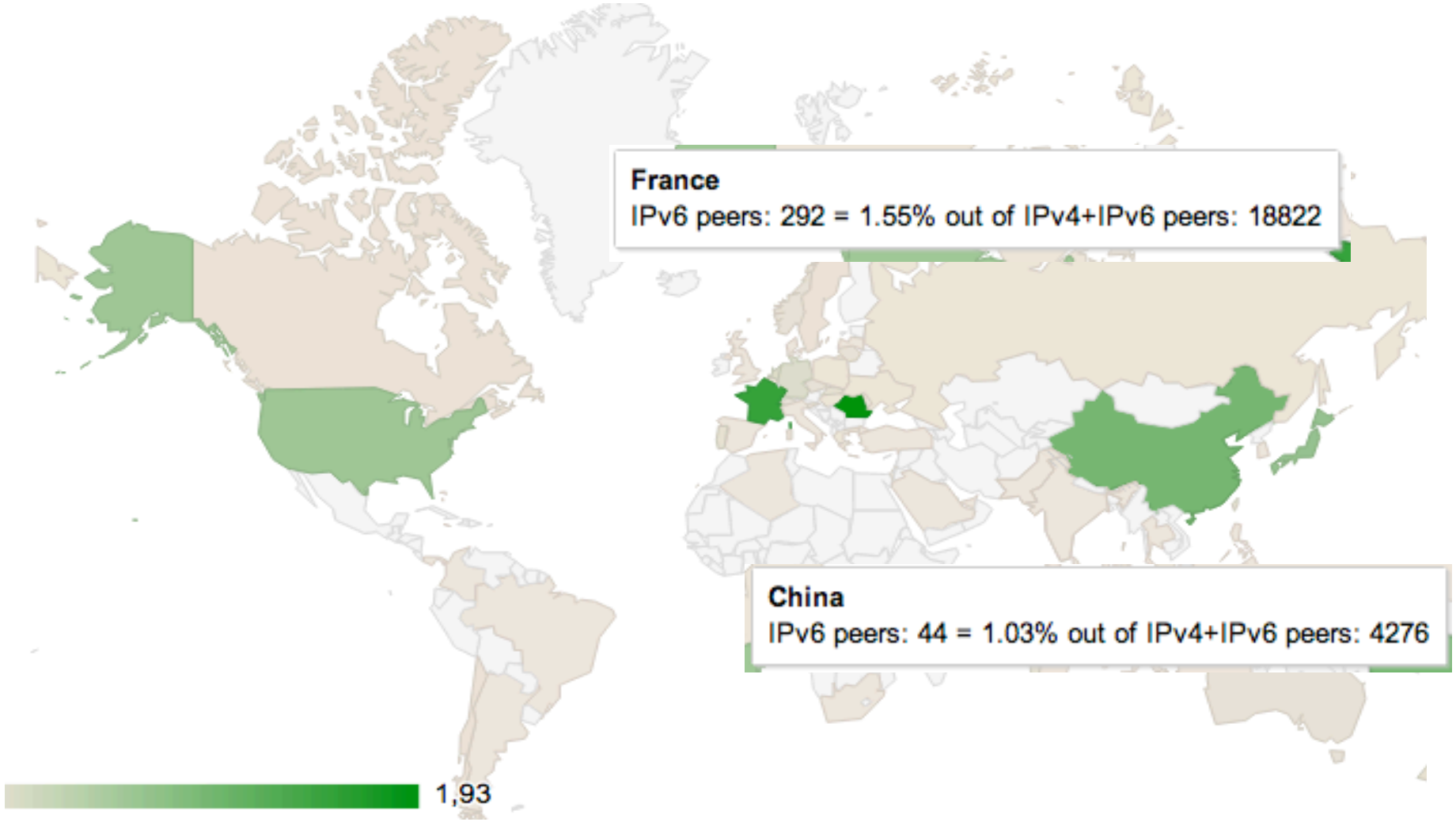


http://www.vyncke.org/ipv6status/worldwide-E-legacy.png

More on BitTorrent

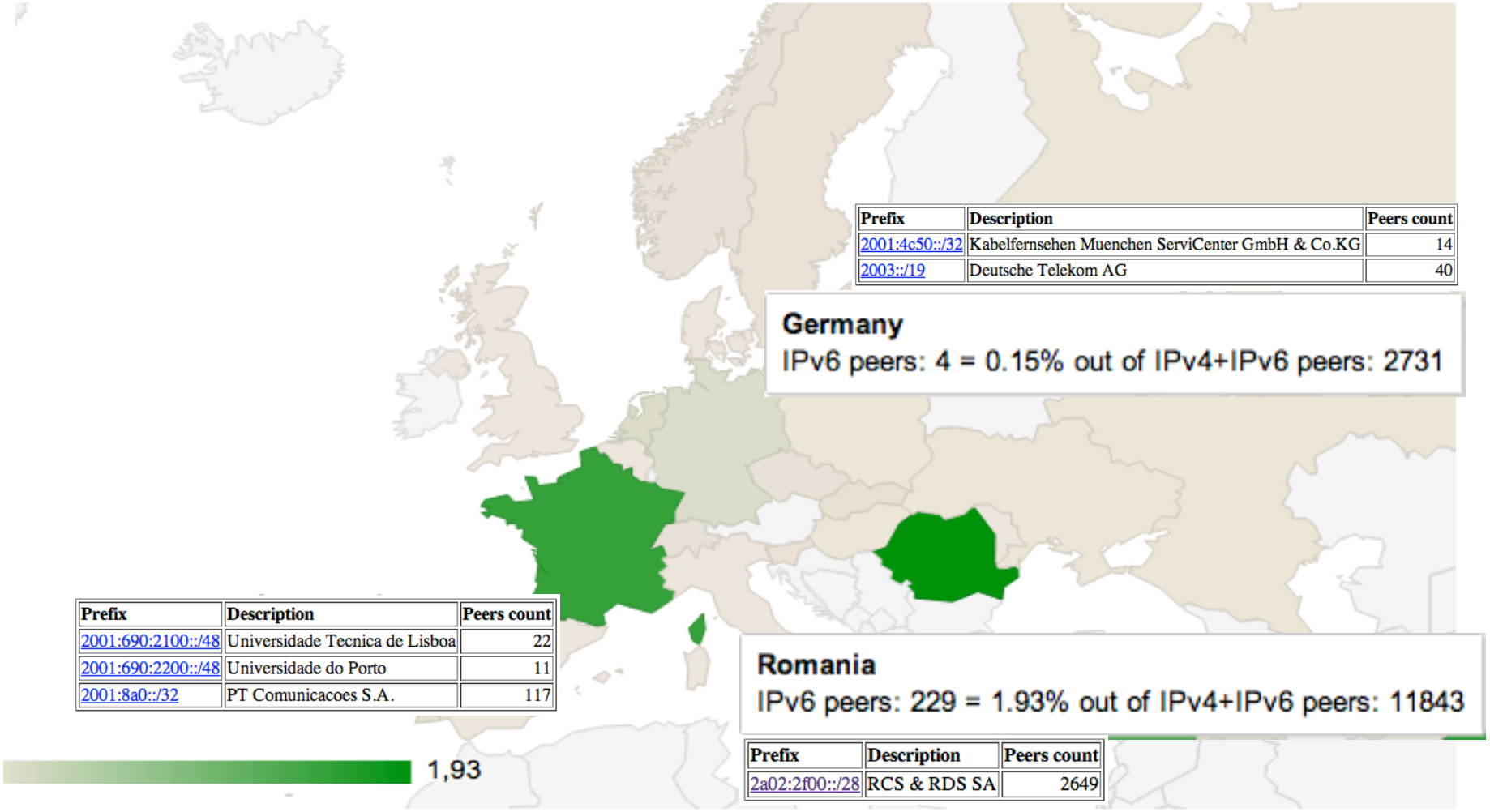
- BitTorrent is a dual-stack peer-to-peer file exchange
  - Some trackers have dual-stack peer lists
  - Private Exchange is also dual-stack
  - Distributed Hash Table does not appear to be dual-stack
- draft-vyncke-ipv6-traffic-in-p2p-networks
- Of course, only pretend to have the file, do not upload/download it

Worldwide BitTorrent Dec-2012



http://www.vyncke.org/ipv6status/p2p.php

European BitTorrent Dec-2012



Prefix	Description	Peers count
2001:4c50::/32	Kabelfernsehen Muenchen ServiCenter GmbH & Co.KG	14
2003::/19	Deutsche Telekom AG	40

Prefix	Description	Peers count
2001:690:2100::/48	Universidade Tecnica de Lisboa	22
2001:690:2200::/48	Universidade do Porto	11
2001:8a0::/32	PT Comunicacoes S.A.	117

Prefix	Description	Peers count
2a02:2f00::/28	RCS & RDS SA	2649

http://www.vyncke.org/ipv6status/p2p.php?date=2012-12-28&region=150&ipv6=native

Mixing up all metrics

- Getting a 100 score based on

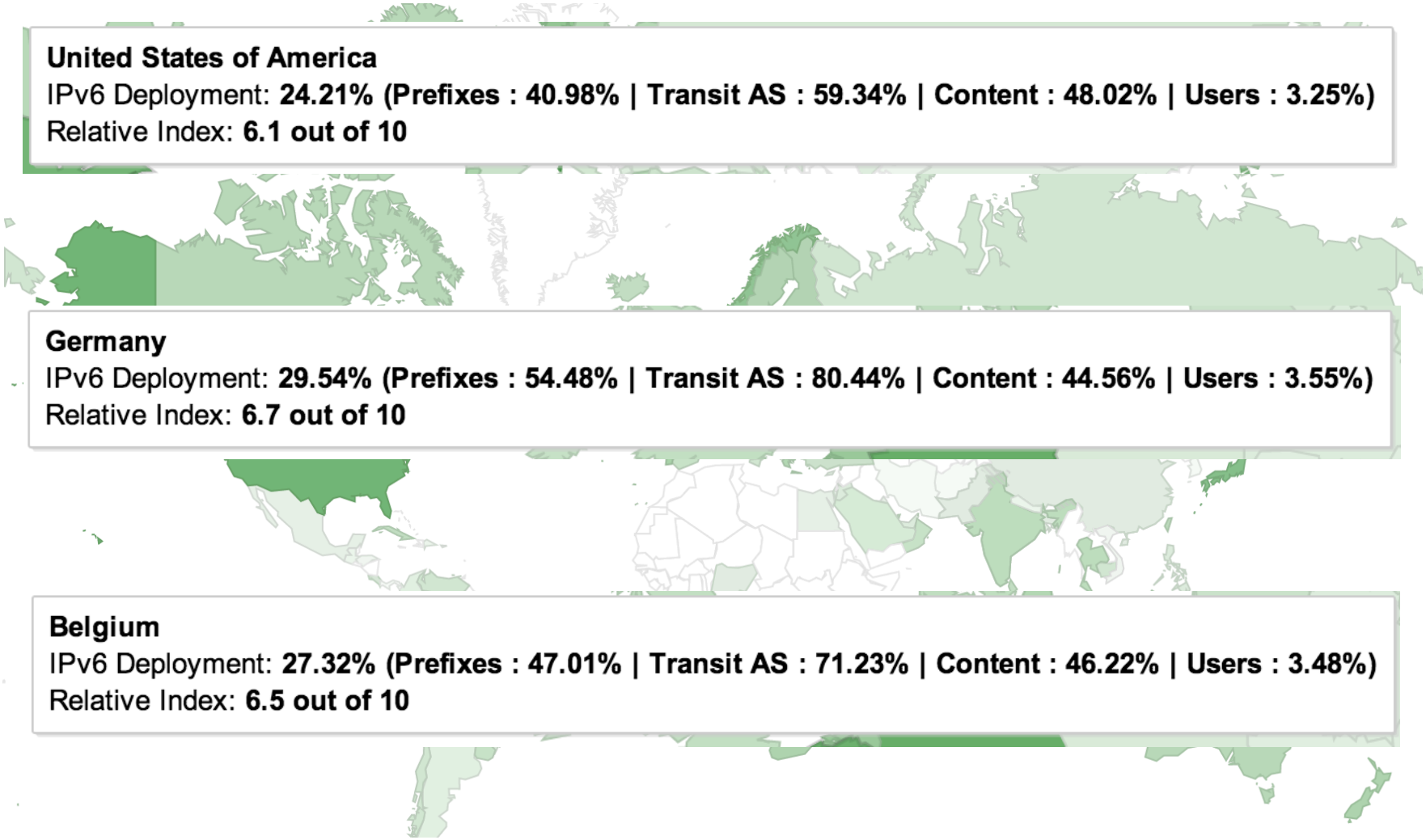
  % IPv6 enabled transit AS : 25 %

  Geometric mean of (content, user): 75%

- Getting a relative index based on content/user/transit relative position with 10 if a country is the top performer in each metric
- Note: this weighting has recently changed....

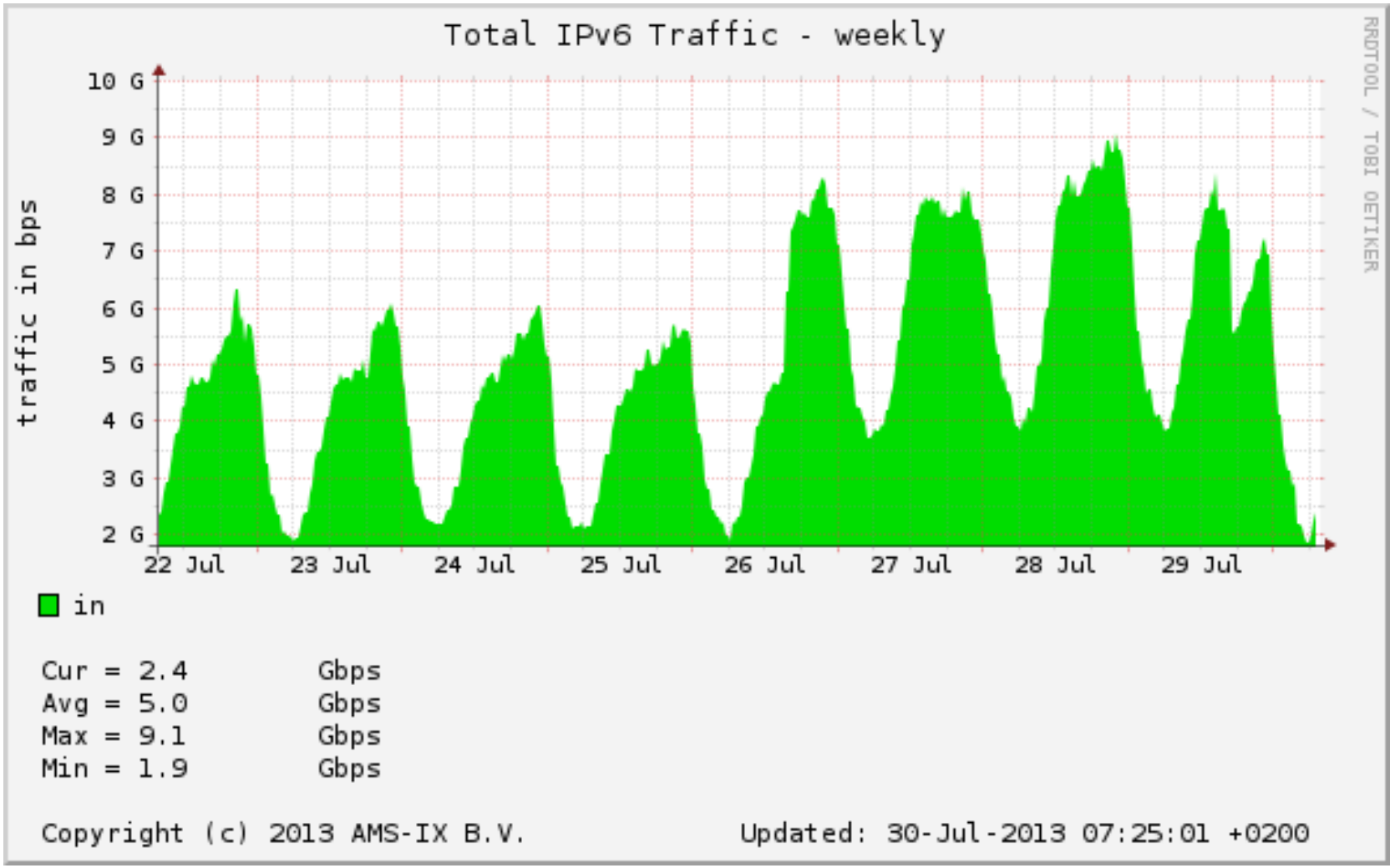
  http://6lab.cisco.com/stats/information.php

Compounded Measurements



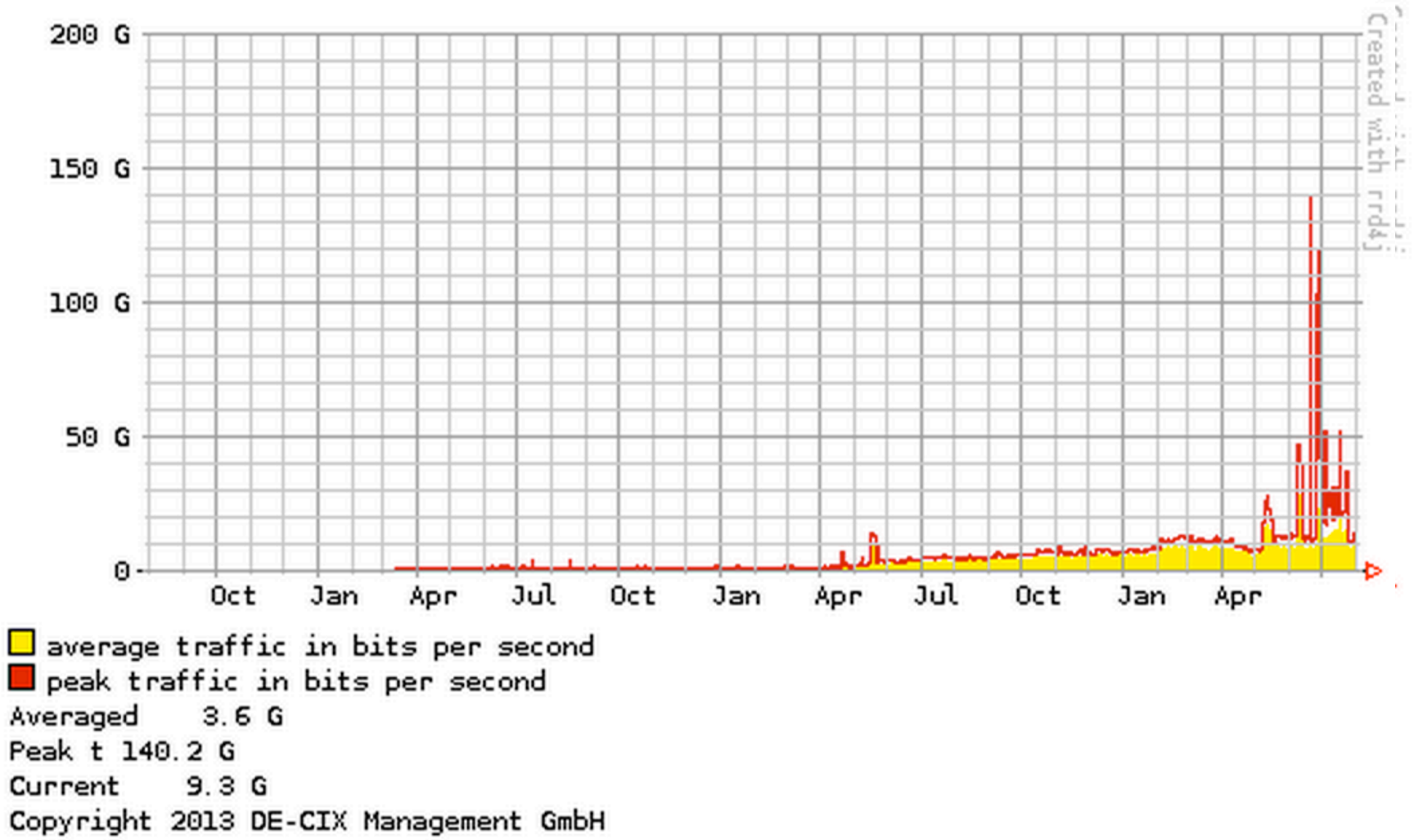
http://6lab.cisco.com/stats/index.php

Simple IPv6 Traffic Stats at IXP



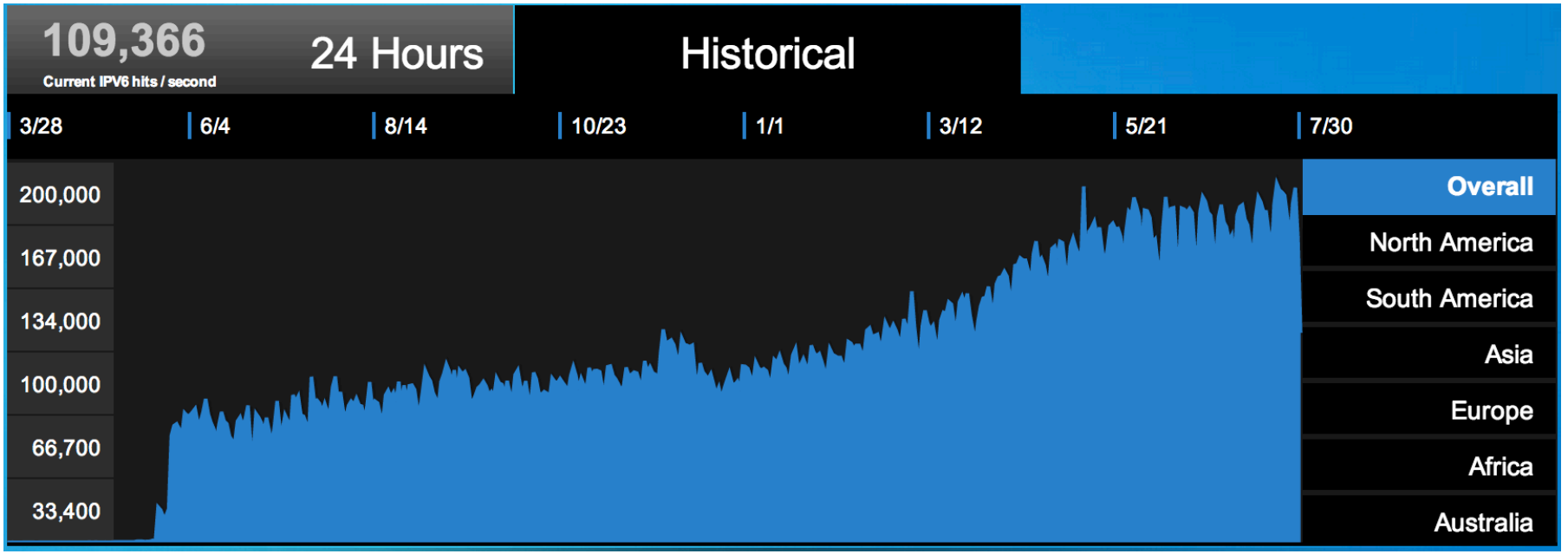
https://www.ams-ix.net/technical/statistics/sflow-stats/ipv6-traffic

Another IPv6 at DE-CIX



http://www.de-cix.net/about/statistics/

Or at Akamai for the World



http://www.akamai.com/ipv6

References and sources

- http://www.ipv6observatory.eu/stats/
- http://6lab.cisco.com/stats/index.php
- http://www.vyncke.org/ipv6status/
- http://www.ipv6actnow.org/info/statistics/
- http://labs.apnic.net/dists/v6dcc.html
- http://www.google.com/ipv6/statistics.html
- http://www.worldipv6launch.org/measurements/
- http://www.de-cix.net/about/statistics/
- http://www.akamai.com/ipv6
- http://www.ipv6actnow.org/info/statistics/

Some nice browser tools

- For Chrome: IPvFoo
- For Firefox: IPvFox

Summary

- Monitoring can be done on the current & past
- How to measure is usually easy
- What to measure is trickier and how to predict is even wizardry
- Predicting positive exponential trends
- One step at the time but a single ISP/content can have an impact

Parts	Ready?
Core of the Internet	Ready
Residential subscribers	0,01% to 10% (Switzerland & Romania)
Web content	Up to 59% (Czech Republic)

Questions?

Thank you.