

v6 switch

No v4 switch anymore @ Cloudflare
(and other items)

Martin J. Levy @ Cloudflare, Inc.

AS13335 / Cloudflare

- 6 Million customers
- 4.8 Million HTTP requests/sec
- 1.2 Million DNS queries/sec
- 111+ data centers (all v4/v6!)



What are we going to talk about today?

1. Backstory behind the IPv6 switch at Cloudflare
2. IPv6 data
3. A very serious discussion about DNS in a v6 world
4. Removing the switch!

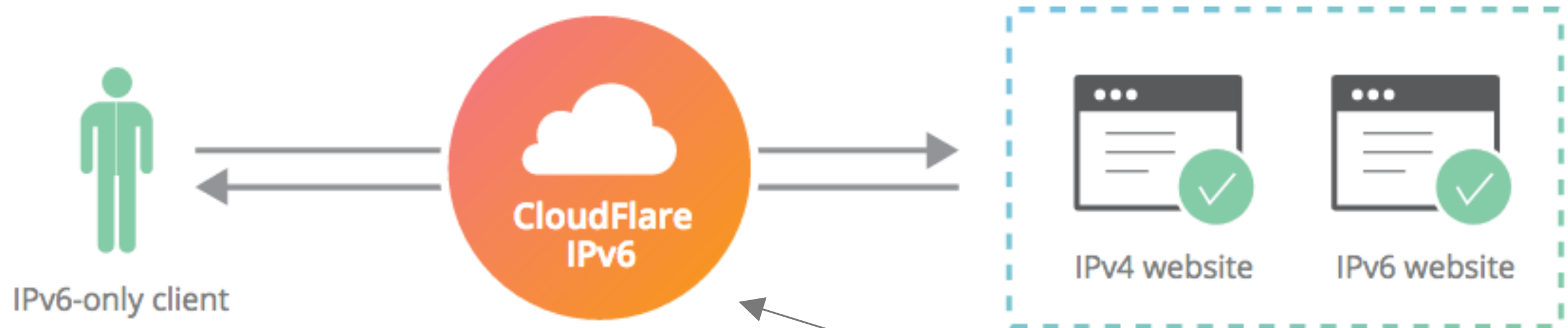
IPv6 @ Cloudflare is so

2606:4700::5ca1:ab1e:6810:4737

Cloudflare can be a “bridge” to IPv6



Cloudflare can be an IPv6 “bridge”



IPv6 Compatibility

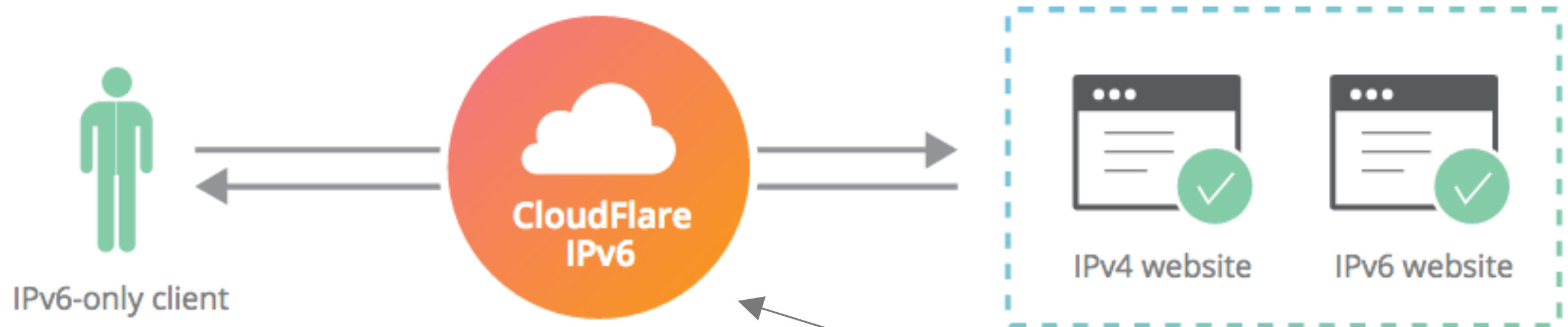
Enable IPv6 support and gateway.

This setting was last changed a few seconds ago

On

[Help](#) ▶

Cloudflare can be an IPv6 “bridge”



IPv6 Compatibility

Enable IPv6 support and gateway.

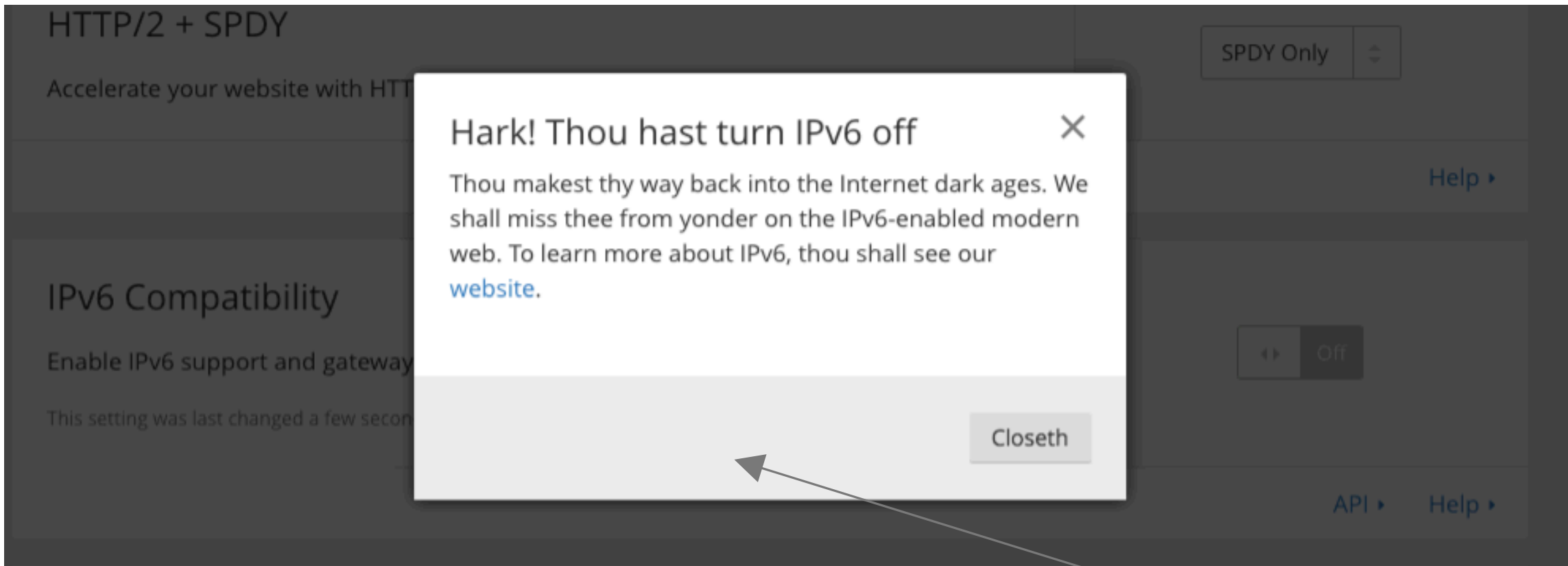
This setting was last changed a few seconds ago

Off



[Help](#)

Cloudflare can be an IPv6 “bridge”



IPv6 Compatibility

Enable IPv6 support and gateway.

This setting was last changed a few seconds ago



[Help](#) ▶

Flipping the switch!

Flipping the switch on every domain/zone

- Nearly five million zones on Cloudflare (at this point)
- If the user had never touched the IPv6 switch; then flip it on!
- Slow start; then running faster (around ~100,000 zones per day)

2 pull requests **MERGED**

Updated 19/Aug/16 8:13 AM

```
for zone in all_zones:
    if zone.ipv6.value == False:
        if zone.ipv6.date == None:
            zone.ipv6.value = True
            zone.ipv6.date = Now()
        sleep()
```

People (and you know who they are) noticed!

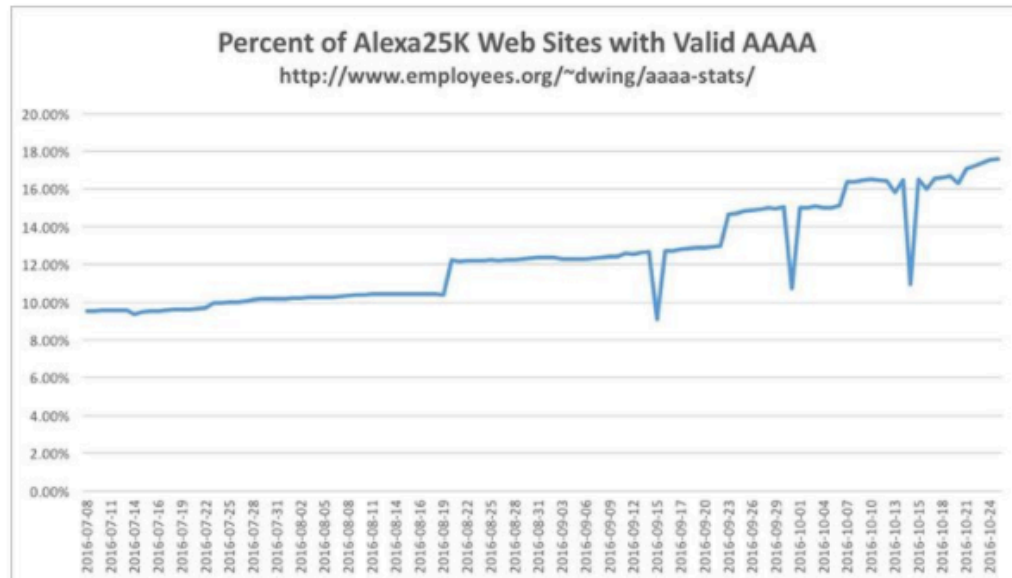


Lee Howard

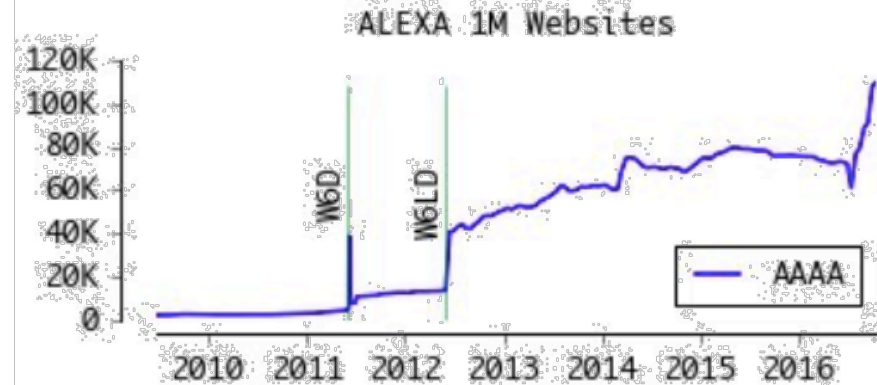
October 25 at 12:26pm

Somebody's been enabling IPv6 on lots of web sites in the past few months. From 10% to 17% in just three months.

<http://www.employees.org/~dwing/aaaa-stats/>



48 Likes 16 Comments 4 Shares



Vaibhav Bajpai

@bajpaivaibhav

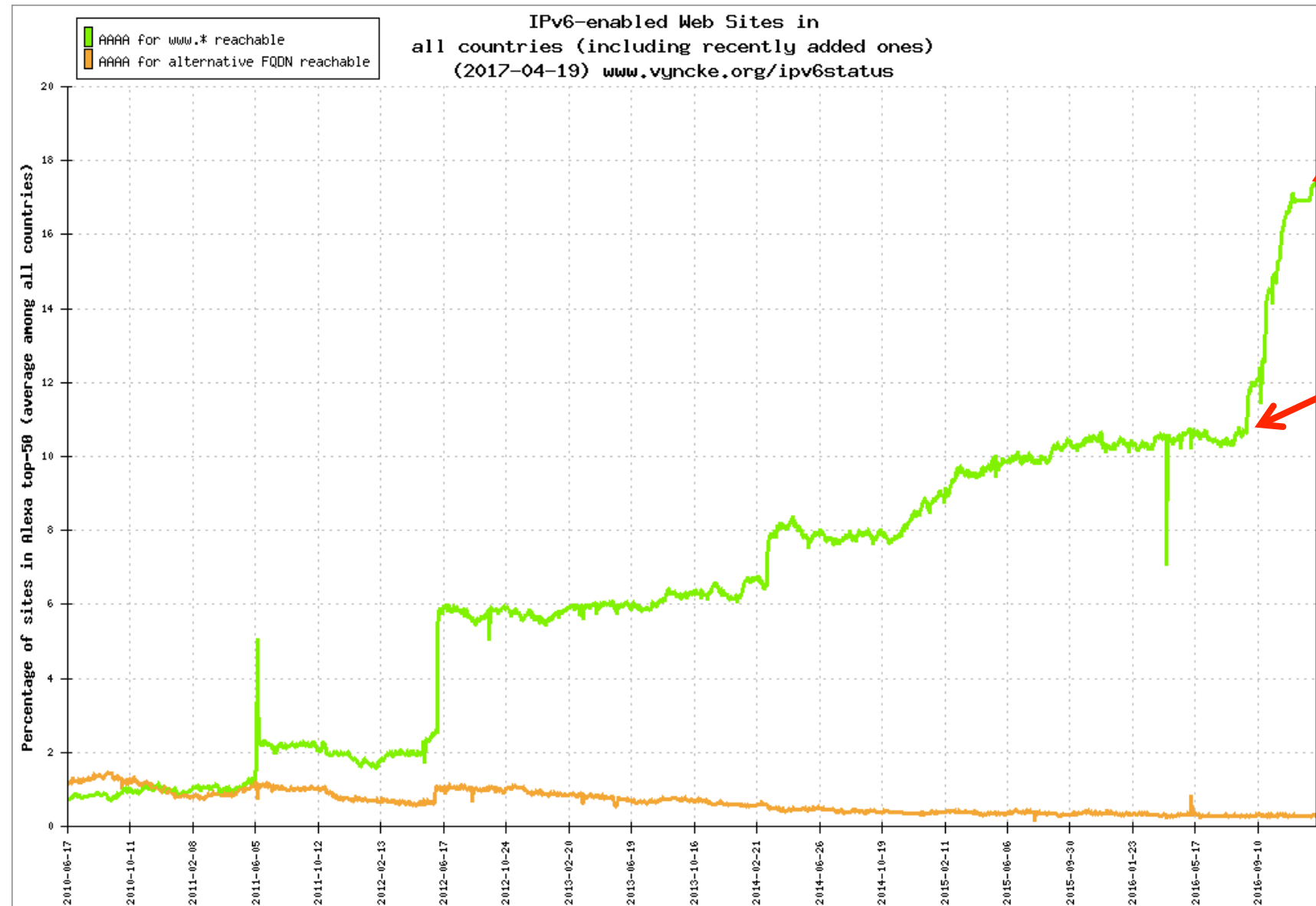
[Follow](#)

there is rapid growth in number of AAAA websites from 76K (08/2016) to 109K (10/2016) (source [@dan_wing](#) dataset: goo.gl/An3iPX)

12:35 AM - 26 Oct 2016

5 6

Eric Vyncke's graph is it's full glory!



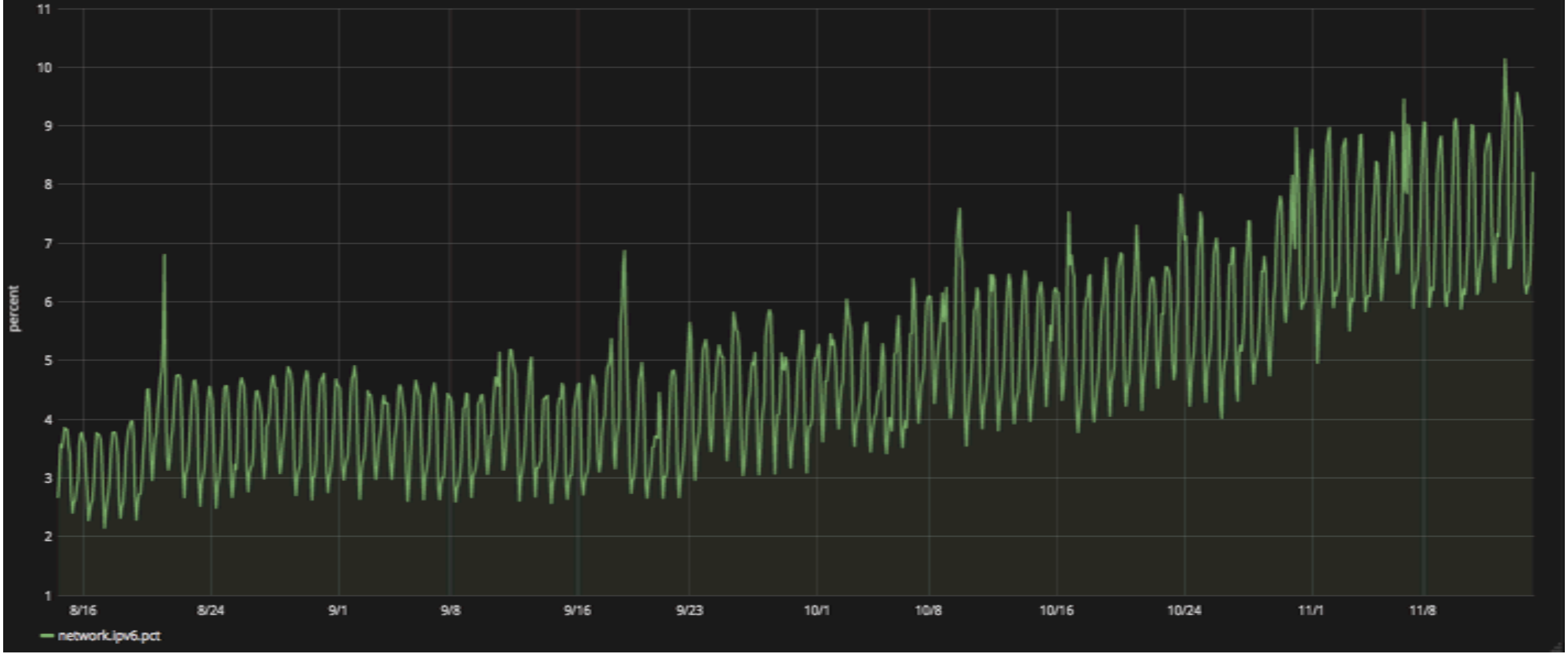
Cloudflare hits 98.01%

Cloudflare starts process



<https://www.vyncke.org/ipv6status/>
<https://blog.cloudflare.com/98-percent-ipv6/>

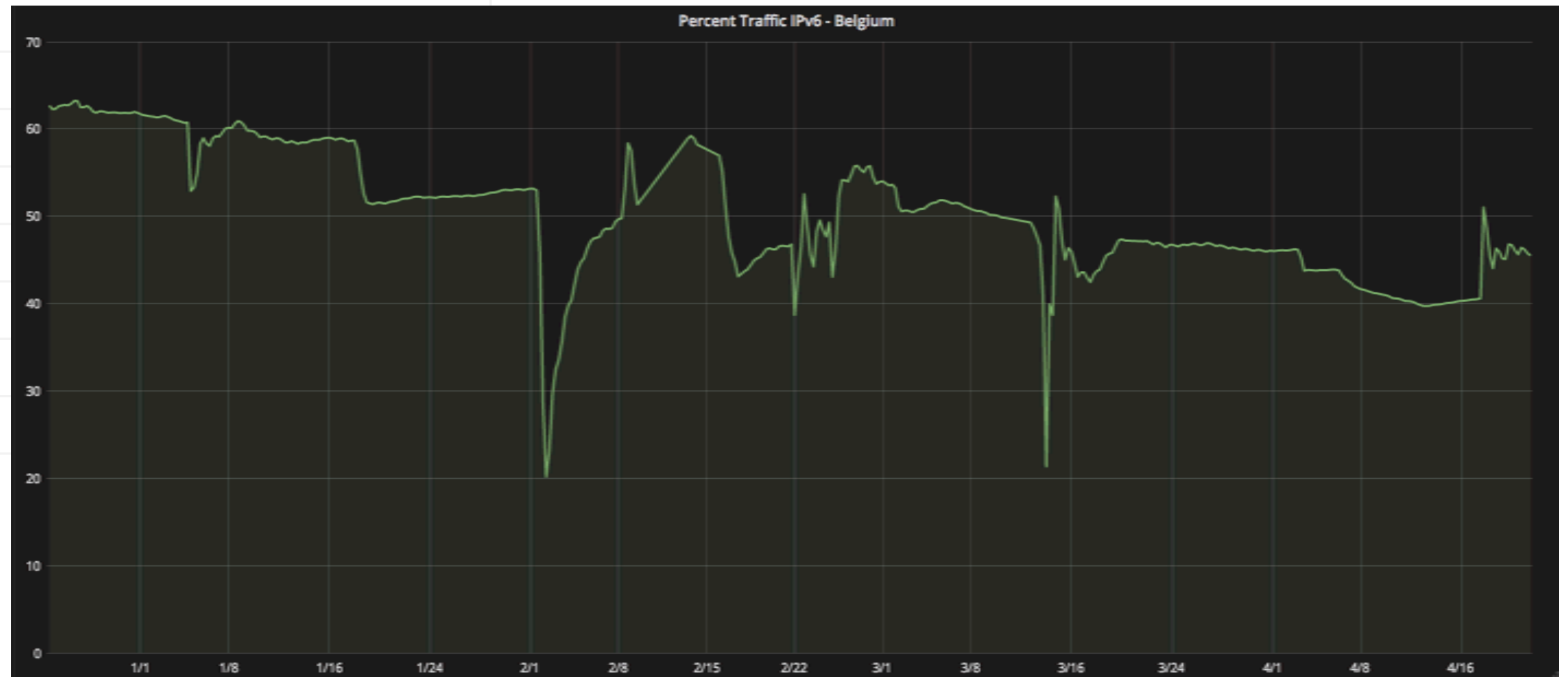
Global IPv6 percentage




























Who and what is driving IPv6?

Top IPv6 Countries – Belgium

Country	Percent Bytes IPv6
Ireland	46.40%
Belgium	46.08% ←
Greece	24.20%
Mauritius	20.80%
India	19.16%
Luxembourg	17.46%
Estonia	16.22%
Japan	14.71%
Switzerland	13.90%
Ecuador	12.38%



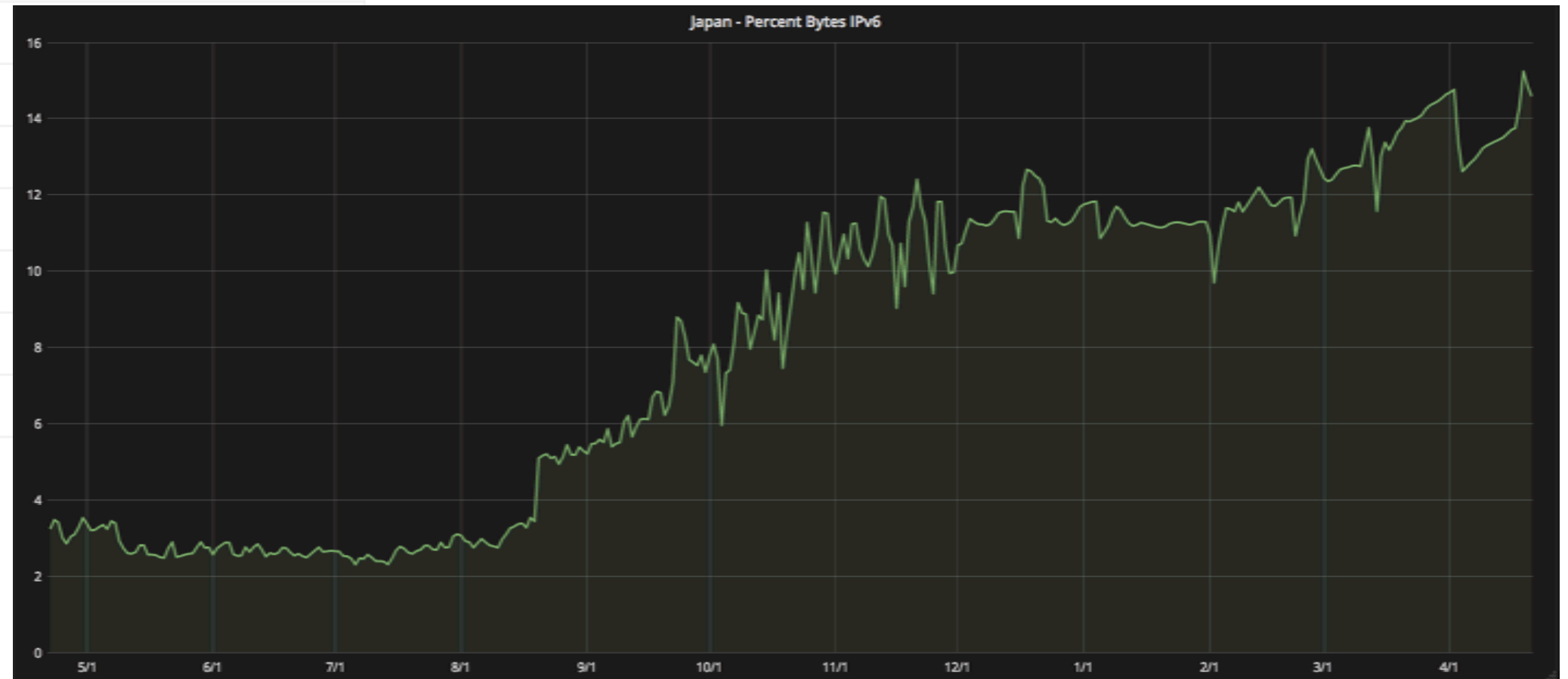
Top IPv6 Countries – Ireland (kinda)

Country	Percent Bytes IPv6			
Ireland	46.40%	←		
Belgium	46.08%		2a03:2880:ffff::/48	Facebook Ireland Ltd 
Greece	24.20%		2a03:2880:ffe::/48	Facebook Ireland Ltd 
			2a03:2880:f22b::/48	Facebook Ireland Ltd 
Mauritius	20.80%		2a03:2880:f22a::/48	Facebook Ireland Ltd 
			2a03:2880:f229::/48	Facebook Ireland Ltd 
India	19.16%		2a03:2880:f228::/48	Facebook Ireland Ltd 
			2a03:2880:f227::/48	Facebook Ireland Ltd 
Luxembourg	17.46%		2a03:2880:f226::/48	Facebook Ireland Ltd 
			2a03:2880:f224::/48	Facebook Ireland Ltd 
Estonia	16.22%		2a03:2880:f222::/48	Facebook Ireland Ltd 
			2a03:2880:f221::/48	Facebook Ireland Ltd 
Japan	14.71%		2a03:2880:f21f::/48	Facebook Ireland Ltd 
			2a03:2880:f21c::/48	Facebook Ireland Ltd 
Switzerland	13.90%		2a03:2880:f21b::/48	Facebook Ireland Ltd 
			2a03:2880:f21a::/48	Facebook Ireland Ltd 
Ecuador	12.38%		2a03:2880:f219::/48	Facebook Ireland Ltd 
			2a03:2880:f216::/48	Facebook Ireland Ltd 
			2a03:2880:f215::/48	Facebook Ireland Ltd 
			2a03:2880:f213::/48	Facebook Ireland Ltd 
			2a03:2880:f212::/48	Facebook Ireland Ltd 
			2a03:2880:f211::/48	Facebook Ireland Ltd 
			2a03:2880:f210::/48	Facebook Ireland Ltd 
	2a03:2880:f20f::/48	Facebook Ireland Ltd 		
	2a03:2880:f20e::/48	Facebook Ireland Ltd 		
	2a03:2880:f20d::/48	Facebook Ireland Ltd 		

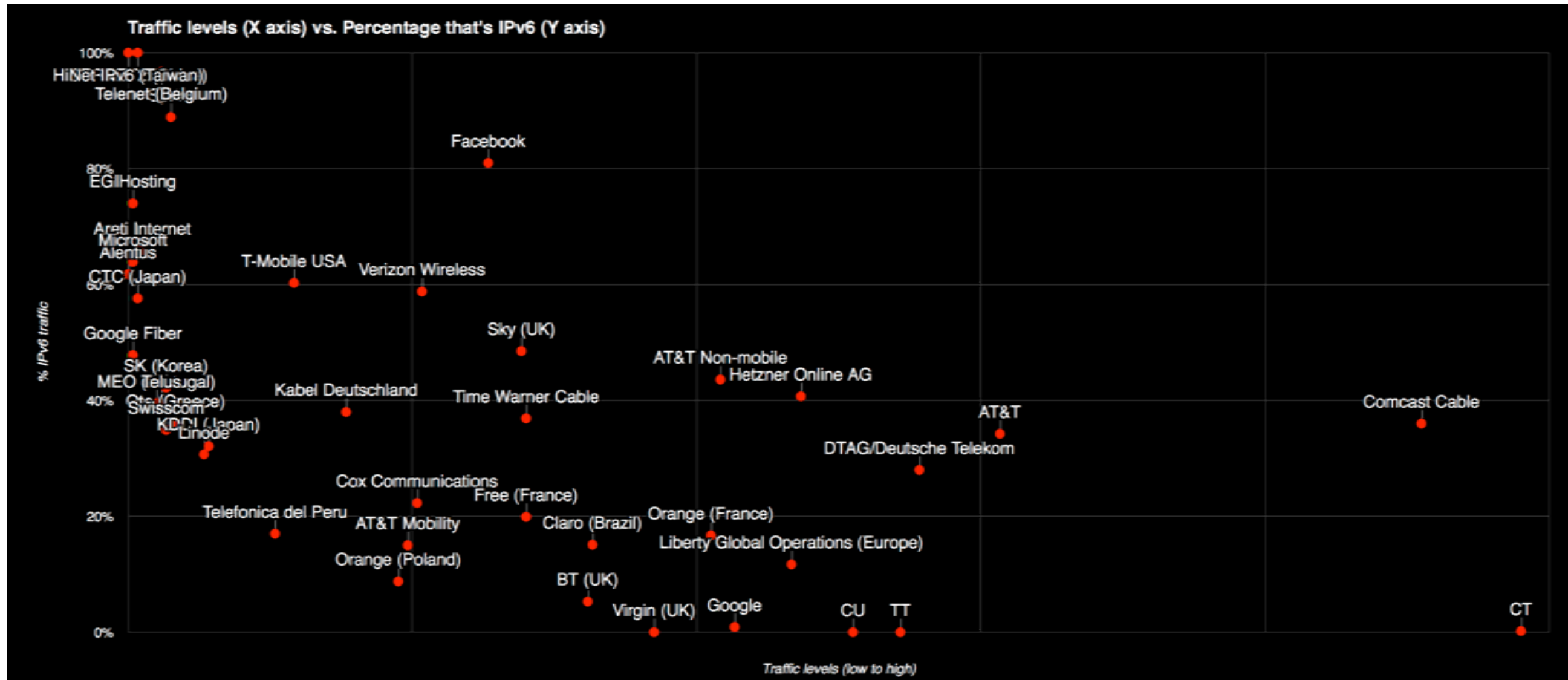
81% of Facebook (crawl) traffic from Cloudflare is IPv6-based

Top IPv6 Countries – Japan

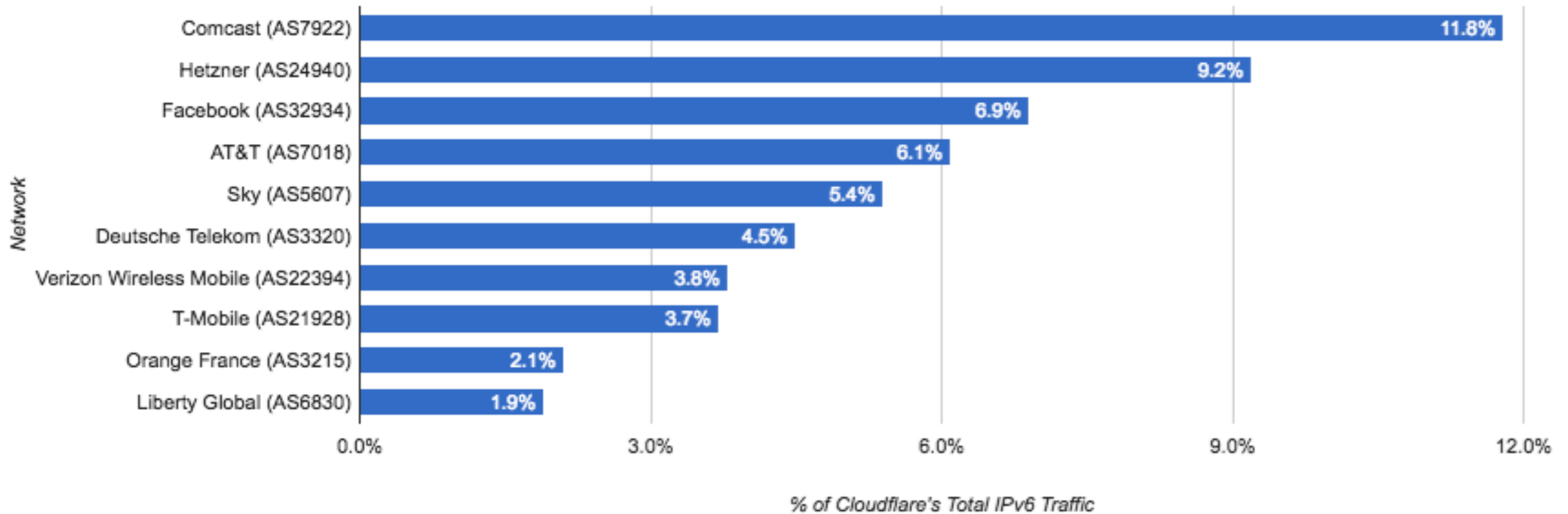
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Switzerland	13.90%
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Percentage of IPv6 vs. bandwidth per network



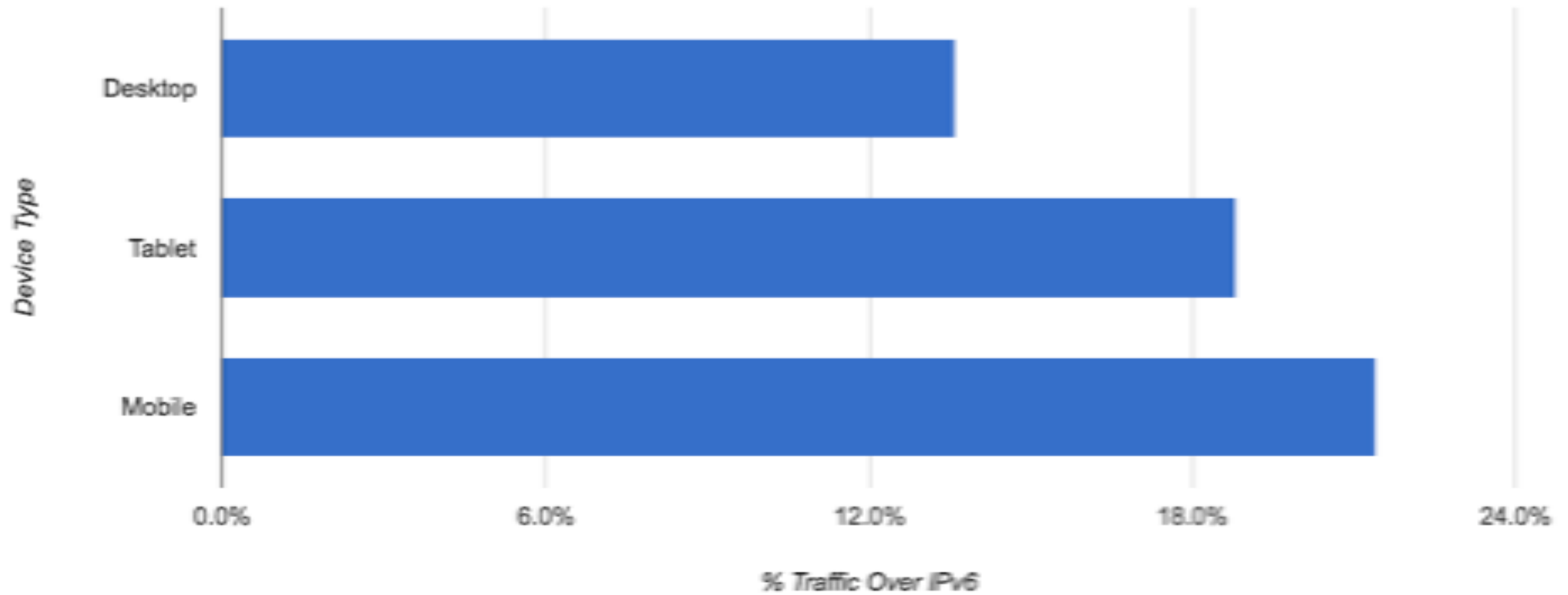
Top 10 IPv6 (~55% of Cloudflare IPv6 Traffic)



1	100.0%	Orange Polska
2	100.0%	China Next Generation Internet CERNET2
3	100.0%	HiNet IPv6 (Taiwan)
4	96.8%	Telenet (Belgium)
5	91.5%	Time Warner Cable
6	88.9%	Sprint
7	81.0%	Facebook
8	74.0%	EGIHosting
9	65.9%	Areti Internet
10	63.9%	Microsoft

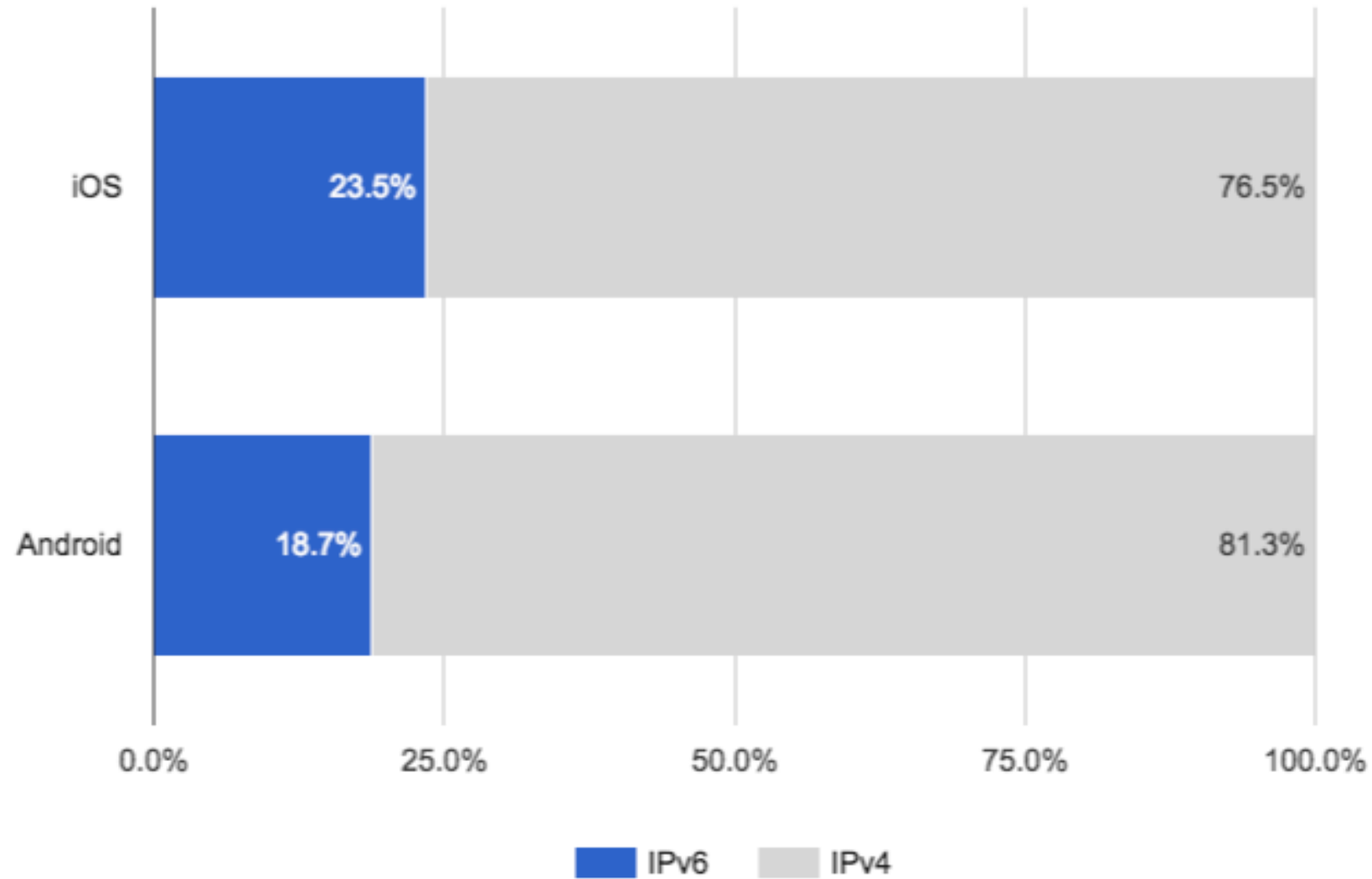
11	61.8%	Alentus
12	60.3%	T-Mobile USA
13	58.8%	Verizon Wireless
14	57.6%	Chubu Telecommunications Company
15	48.5%	Sky (UK)
16	47.8%	Google Fiber
17	44.6%	AIS Fibre (Thailand)
18	43.6%	AT&T
19	43.3%	Hughes Network Systems
20	43.2%	wilhelm.tel GmbH Norderstedt

IPv6 by Device Type

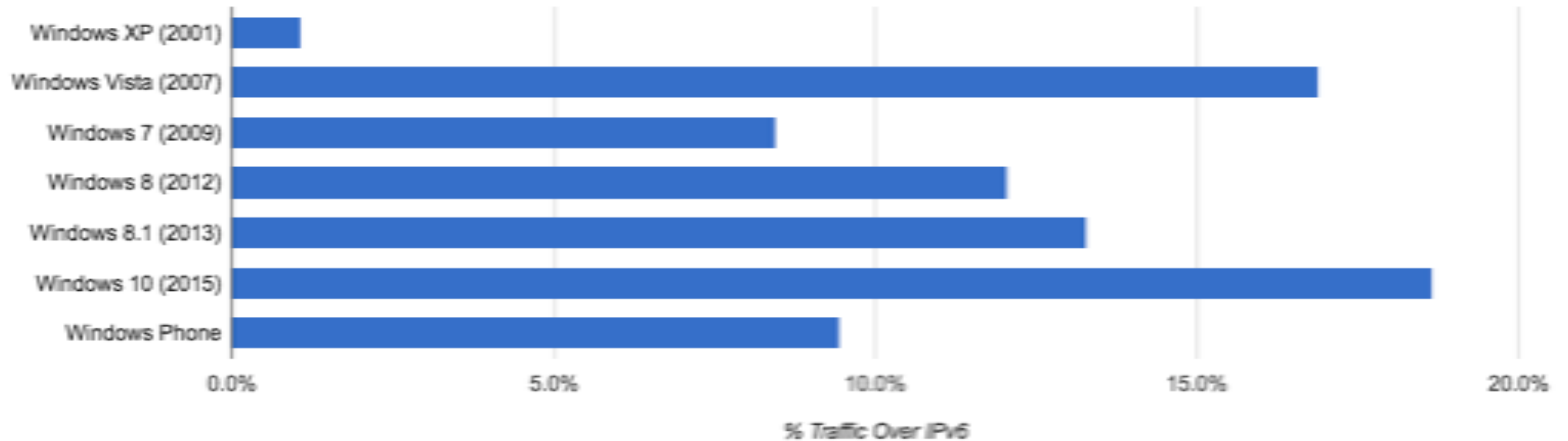


iOS vs Android

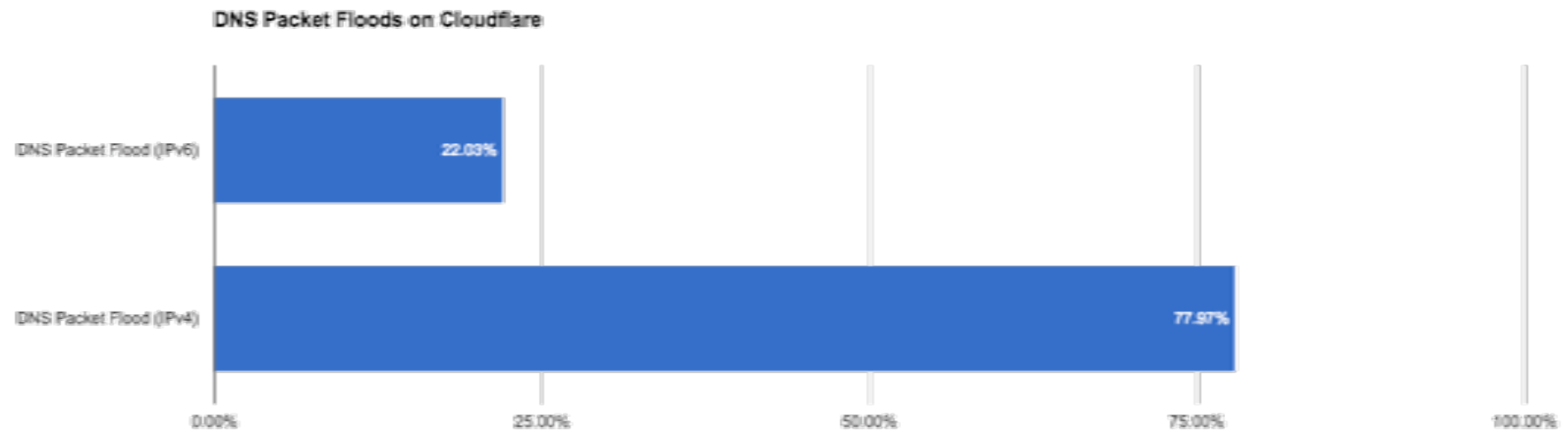
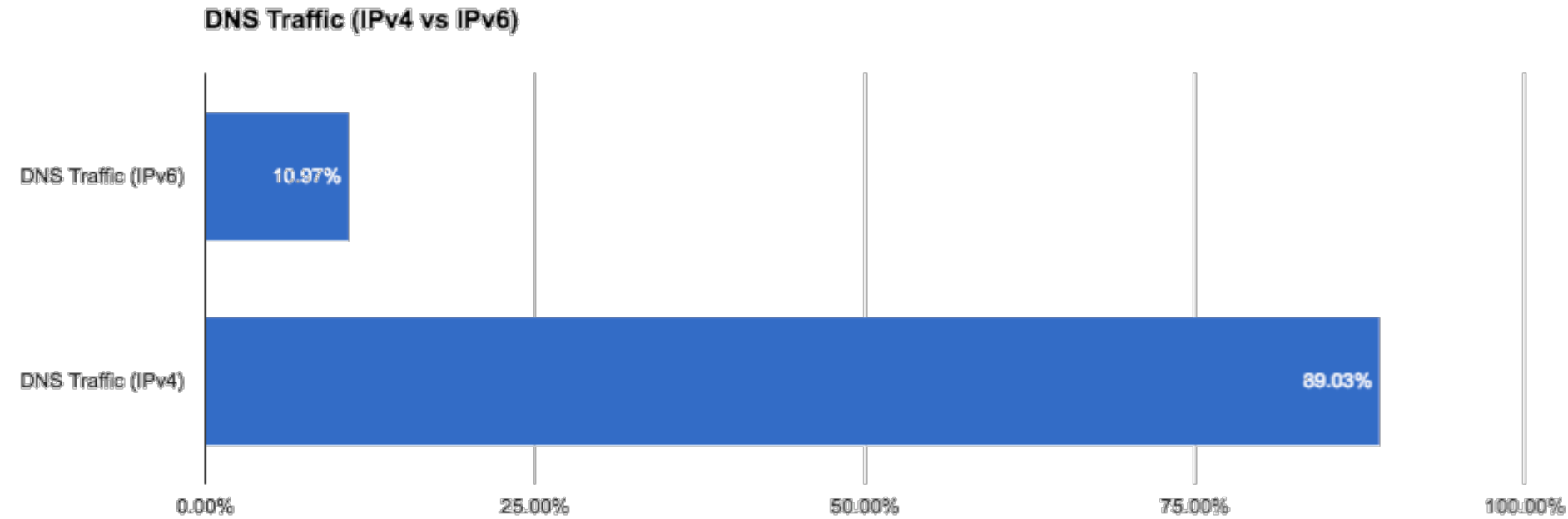
iOS vs Android - IPv6 Traffic



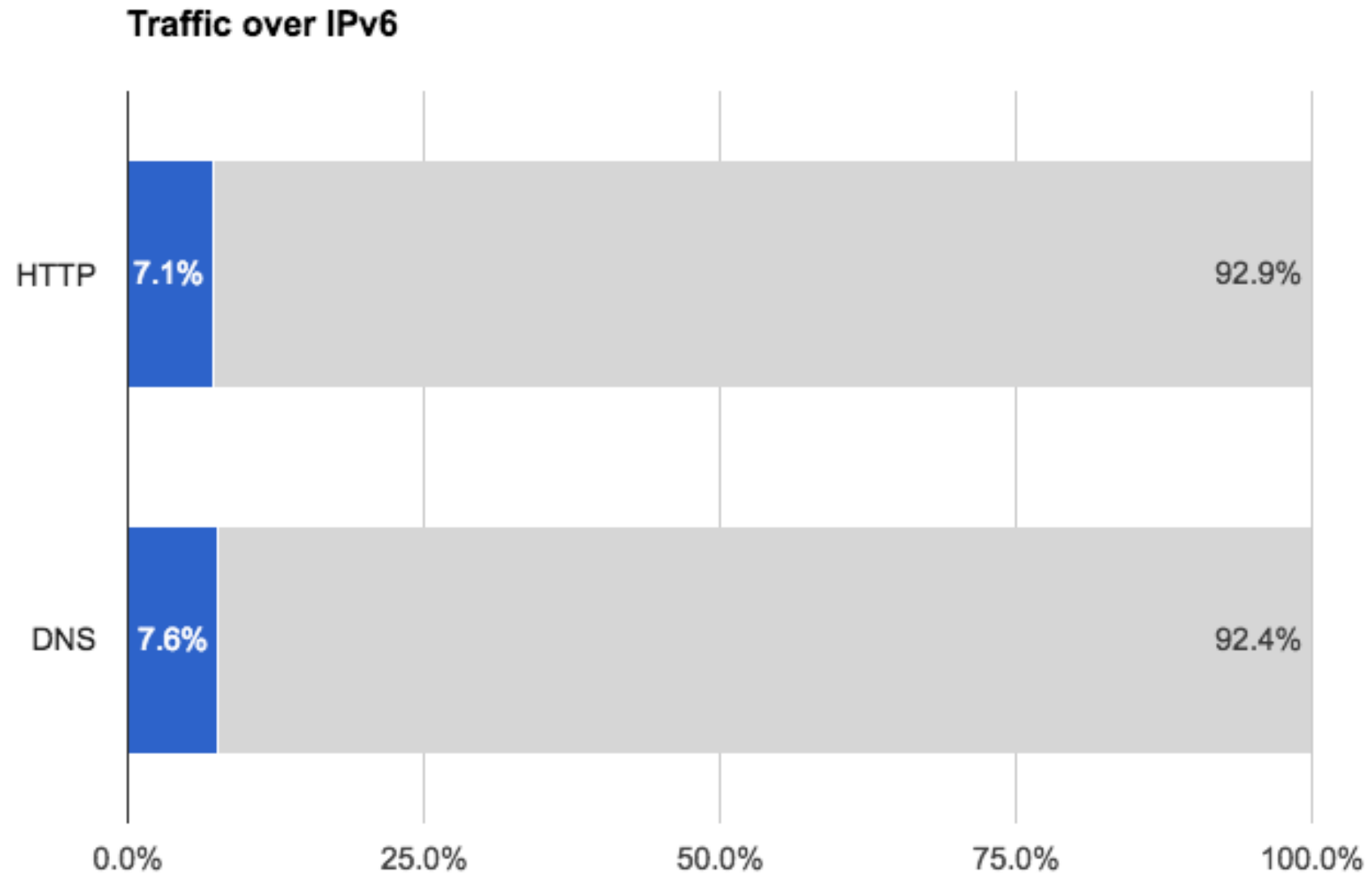
Windows and IPv6



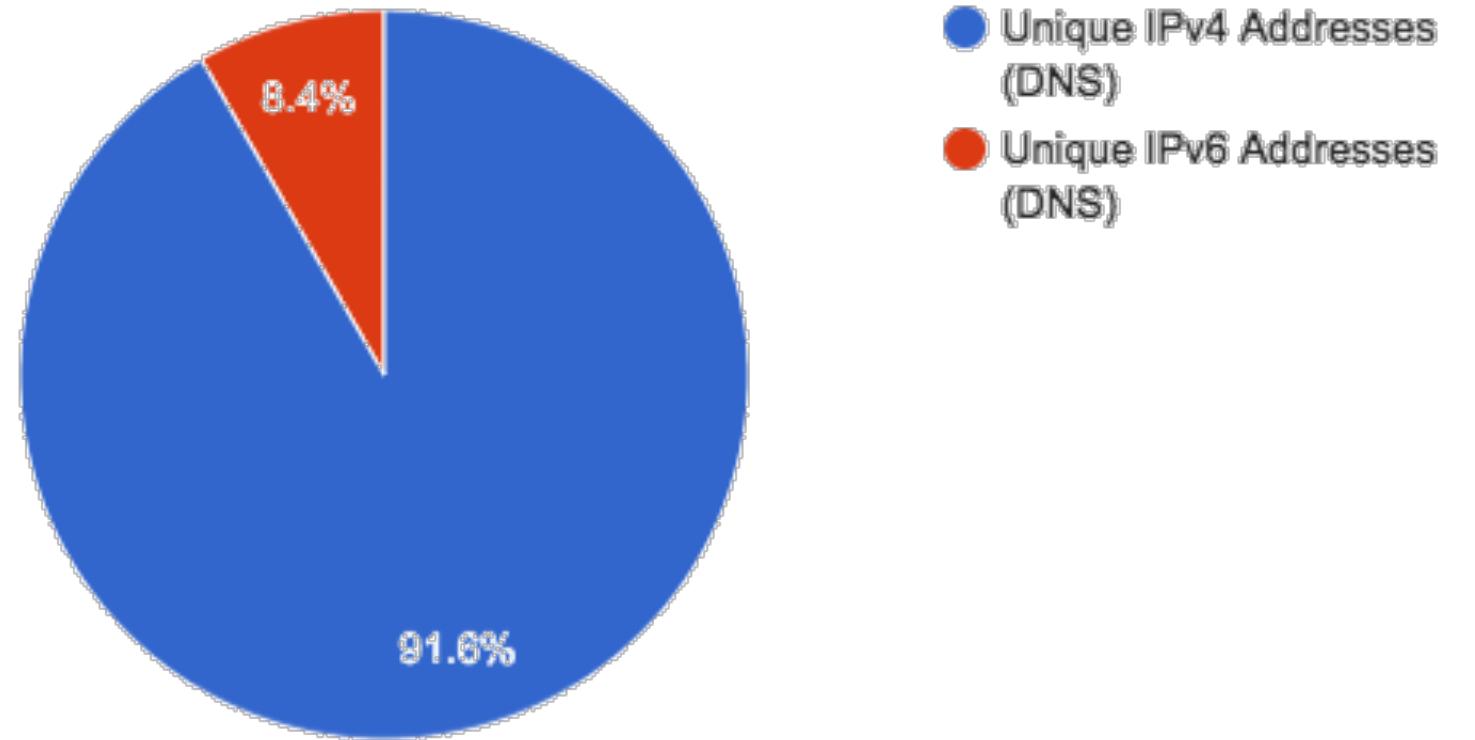
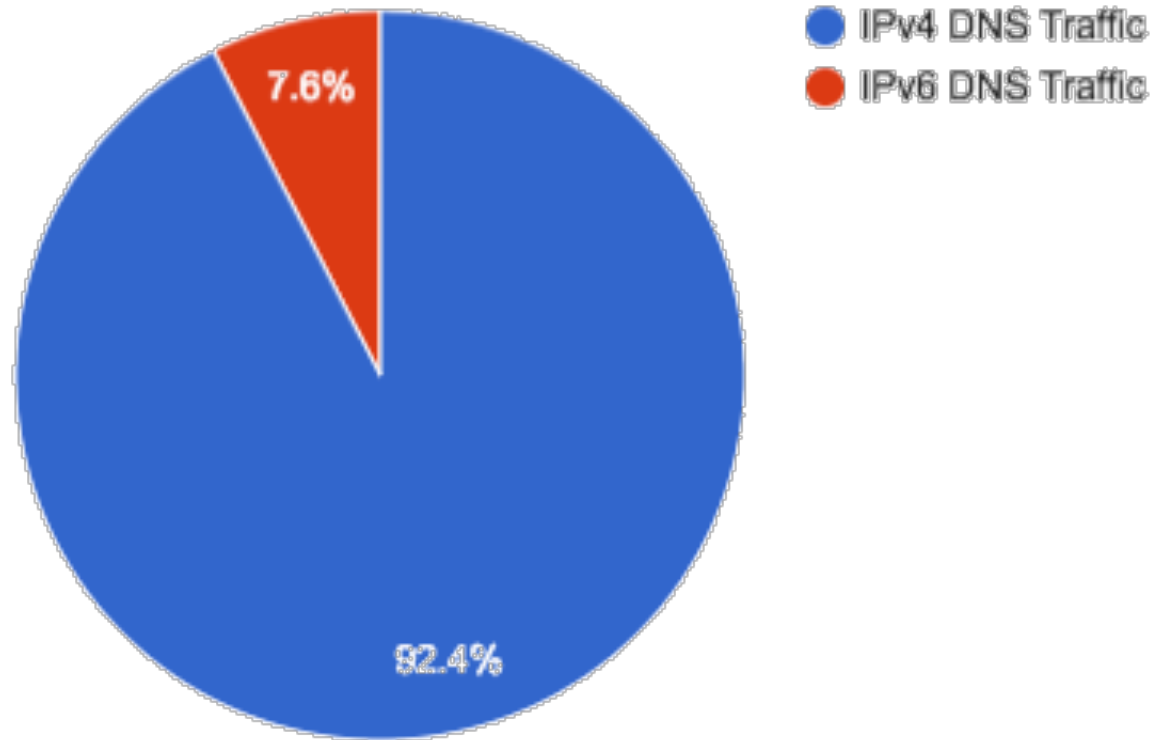
DNS traffic and floods (IPv4 vs IPv6)



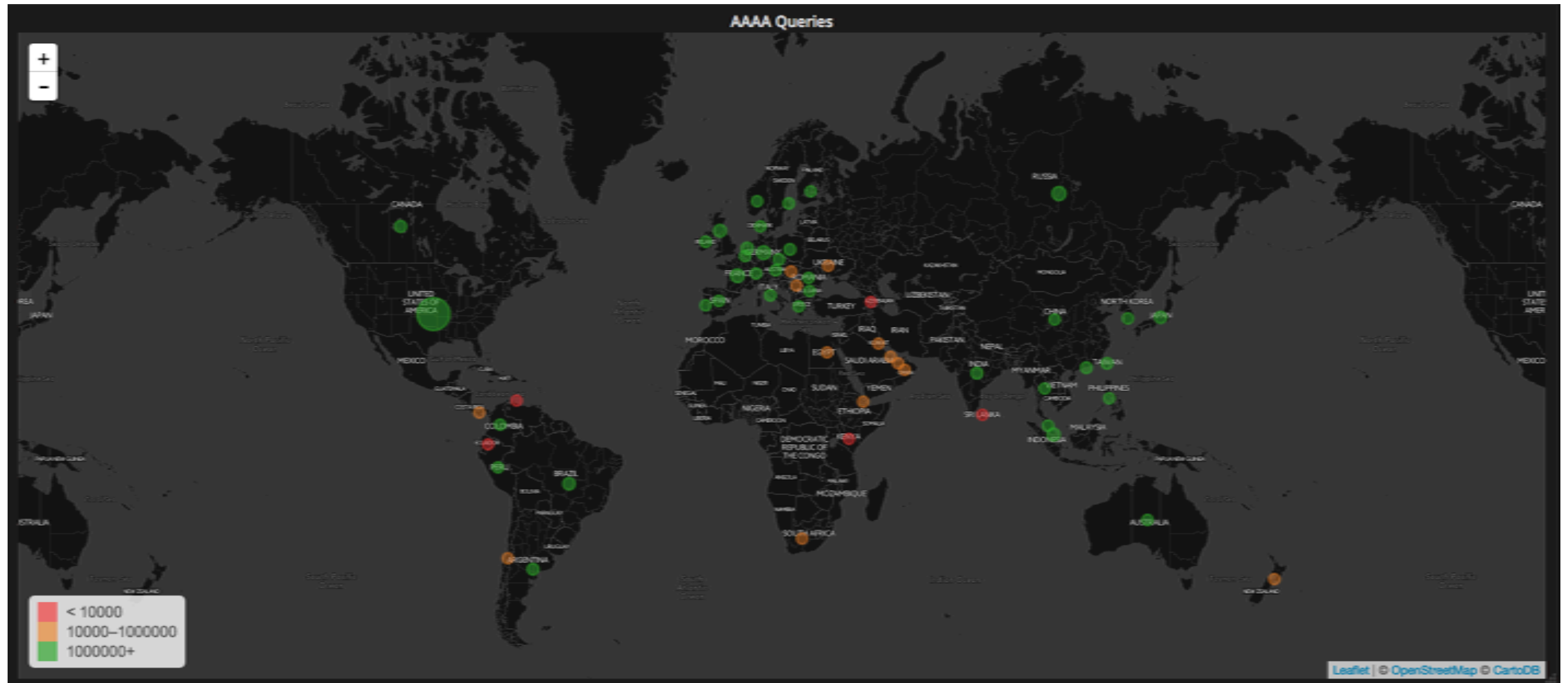
IPv6 and DNS



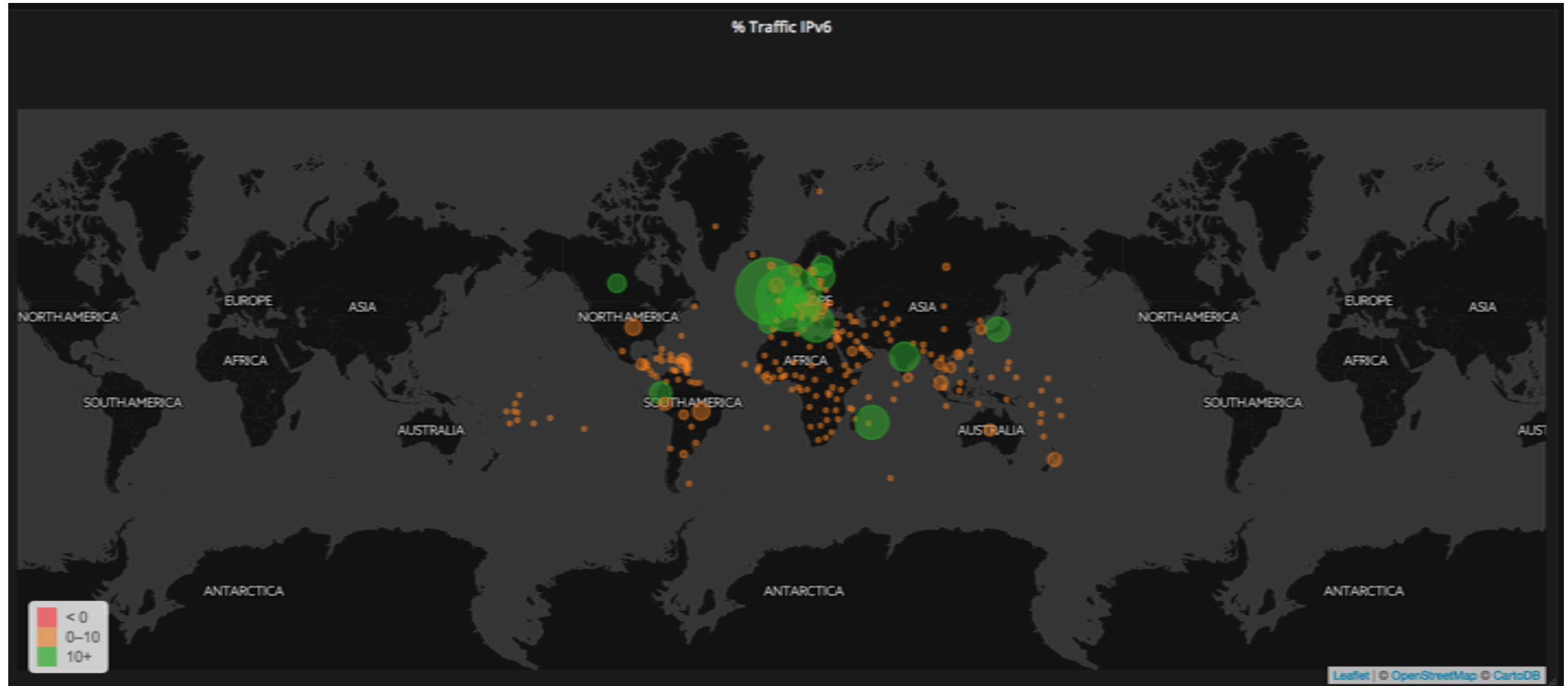
More v6 addresses != more v6 uniques in DNS



IPv6 global map (AAAA queries)

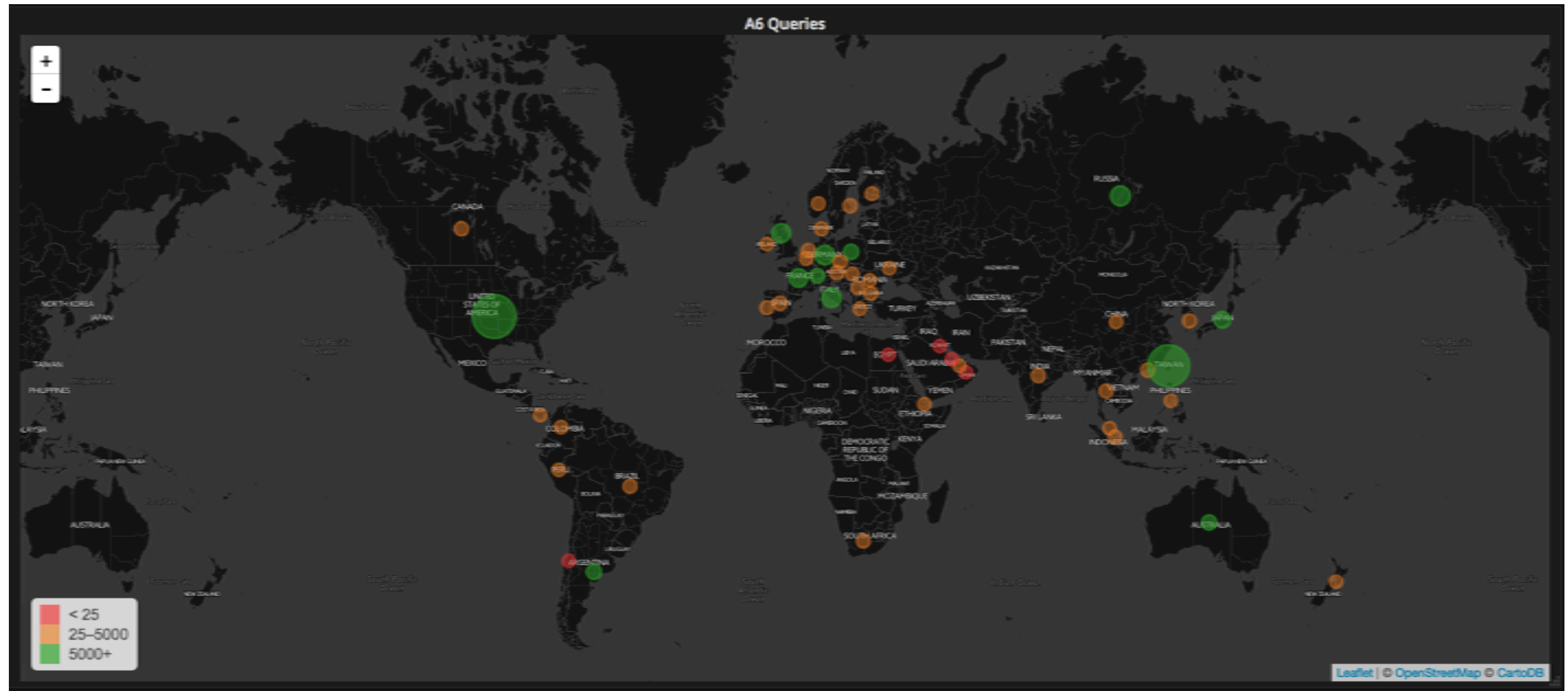


IPv6 global map (% Traffic IPv6)

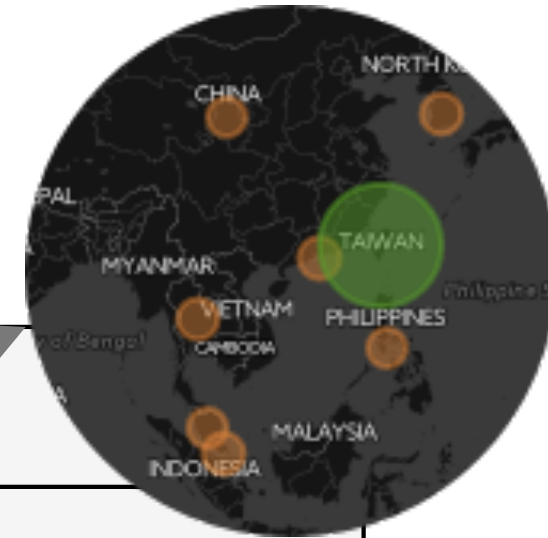


Deprecated IPv6 DNS – remember A6?

IPv6 global map (A6 queries – yeah not a typo)



Who is sending A6?



1	AS3462	Data Communication Business Group
2	AS6181	CAR-PART.COM
3	AS24683	Orenburg State University
4	AS1221	Telstra Internet
5	AS2510	FUJITSU LIMITED
6	AS24945	Telecommunication Company Vinteleport Ltd.
7	AS7127	Southern California Edison
8	AS701	MCI Communications Services, Inc. d/b/a Verizon Business
9	AS12962	First Investment Bank AD
10	AS1659	Ministry of Education Computer Center

What's next for IPv6? Fix DNS!

A & AAAA records - how silly is this in 2017?

- Separate A & AAAA records
- In a happy-eyeball environment we still need two DNS queries (before any TCP connection can be instigated)

Query for A record

Header	QR AA RCODE=NOERROR
Question	www.example.com IN A
Answer	www.example.com. IN A 192.0.2.1
Authority	<empty>
Additional	<empty>

Query for AAAA record

Header	QR AA RCODE=NOERROR
Question	www.example.com IN AAAA
Answer	www.example.com. IN AAAA 2001:db8::1
Authority	<empty>
Additional	<empty>

AAAA for free (when doing an A query)!

Cloudflare proposed solution:

1. A + AAAA in new meta-query
2. Resolver asks for A or AAAA
3. If positive answer, the resolver then checks AAAA + A meta-query
4. Resolver remembers whether authoritative server supports meta-query for future queries
5. Resolver adds both A and AAAA to cache

Want to try it?

```
$ dig cloudflare.com @ns1.cloudflare.com -t TYPE65535 +short
198.41.215.162
198.41.214.162
2400:cb00:2048:1::c629:d6a2
2400:cb00:2048:1::c629:d7a2
$
```

This is live - try it with any domain on Cloudflare.

```
$ dig taylorswift.com @ashley.ns.cloudflare.com -t TYPE65535 +short
104.16.193.61
104.16.194.61
104.16.191.61
104.16.192.61
104.16.195.61
2400:cb00:2048:1::6810:c33d
2400:cb00:2048:1::6810:c13d
2400:cb00:2048:1::6810:bf3d
2400:cb00:2048:1::6810:c23d
2400:cb00:2048:1::6810:c03d
$
```



```
$ dig vidaxl.hu @june.ns.cloudflare.com -t TYPE65535 +short
104.16.60.29
104.16.61.29
2400:cb00:2048:1::6810:3d1d
2400:cb00:2048:1::6810:3c1d
$
```

IETF draft – pick one, any one (maybe ours?)

<https://tools.ietf.org/html/draft-vavrusa-dnsop-aaaa-for-free-00>

<https://tools.ietf.org/html/draft-yao-dnsop-accompanying-questions-02>

<https://tools.ietf.org/html/draft-bellis-dnsexp-multi-qtypes-03>

Network Working Group Internet-Draft Intended status: Standards Track Expires: September 22, 2016	M. Vavrusa O. Gudmundsson CloudFlare Inc. March 21, 2016
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**Providing AAAA records for free with QTYPE=A
draft-vavrusa-dnsop-aaaa-for-free-00**

Abstract

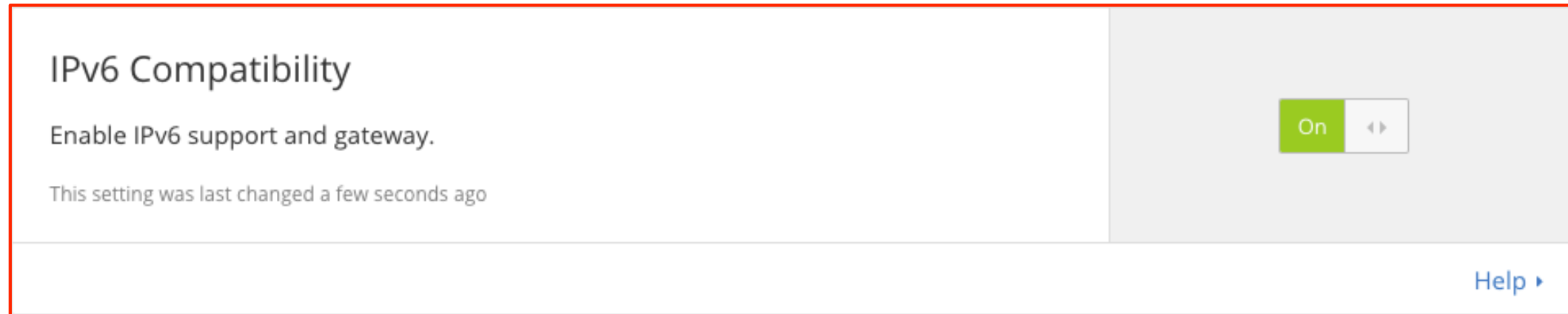
This document enables DNS servers to include AAAA addresses in the answer section for DNS queries with QTYPE=A in order to reduce the number of resolver round-trips during address lookups, and also provides guidance for recursive DNS servers in accepting such records.

<https://tools.ietf.org/html/draft-vavrusa-dnsop-aaaa-for-free-00>

Removing the switch

The disable IPv6 switch goes away!

Before:



IPv6 Compatibility

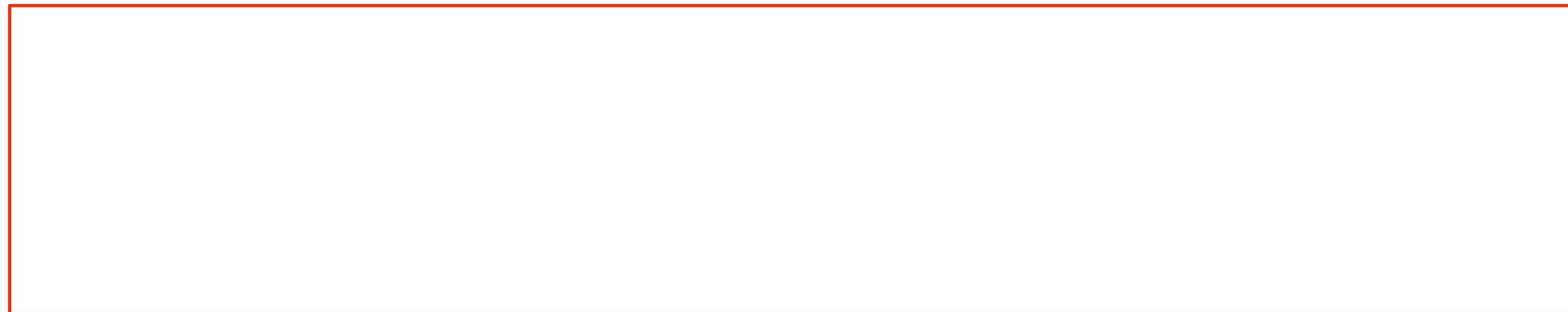
Enable IPv6 support and gateway.

This setting was last changed a few seconds ago

On

Help ▶

After:



... IPv6 is on by default (and unchangeable) for the vast majority** of accounts!

