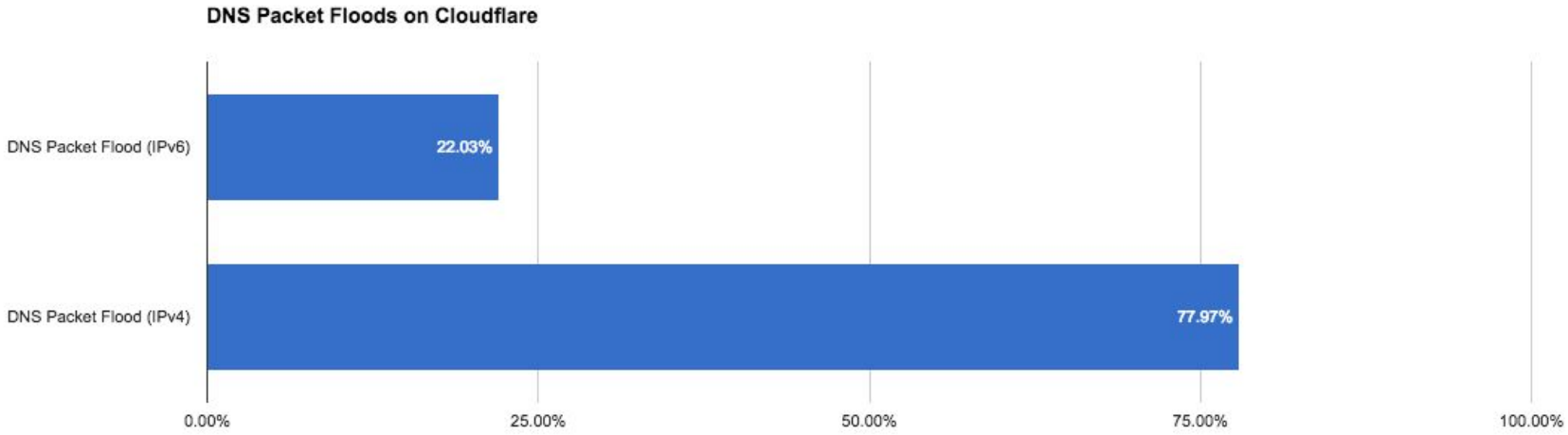
A View From The Edge

2017 North American IPv6 Summit
April 25-26, 2017
LinkedIn Headquarters
Sunnyvale, CA

Are there DDoS attacks over IPv6?



*Note that every DNS packet floods we see over IPv6 we also see over IPv4. We do not see any IPv6-only DNS packet floods.

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AS1335 / Cloudflare

- 6 M customers
- 4.8 M HTTP rps
- 1.2 M DNS qps
- 110 data centers

CLOUDFLARE

What are we even going to talk about

1. Backstory

What are we even going to talk about

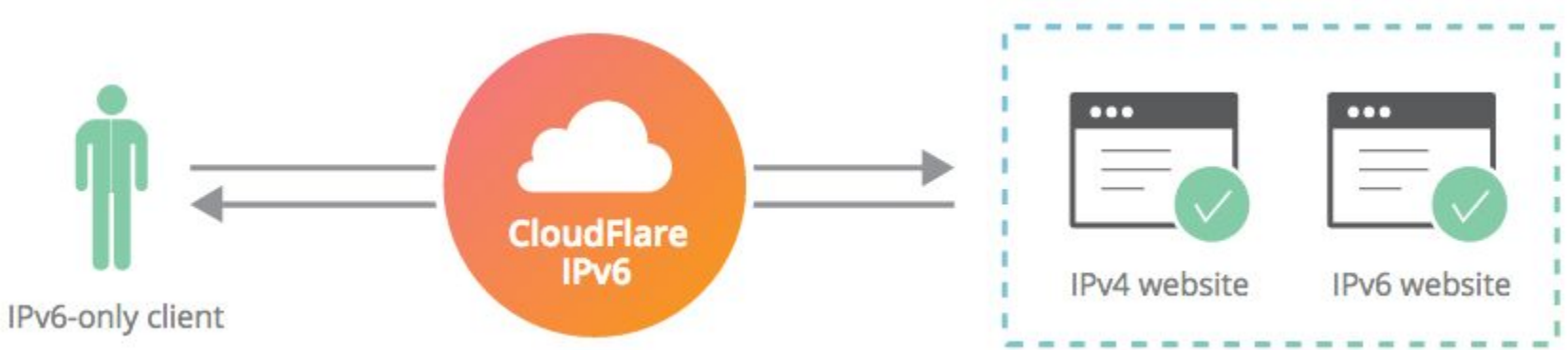
1. Backstory
2. Data

What are we even going to talk about

1. Backstory
2. Data
3. A very serious discussion about DNS

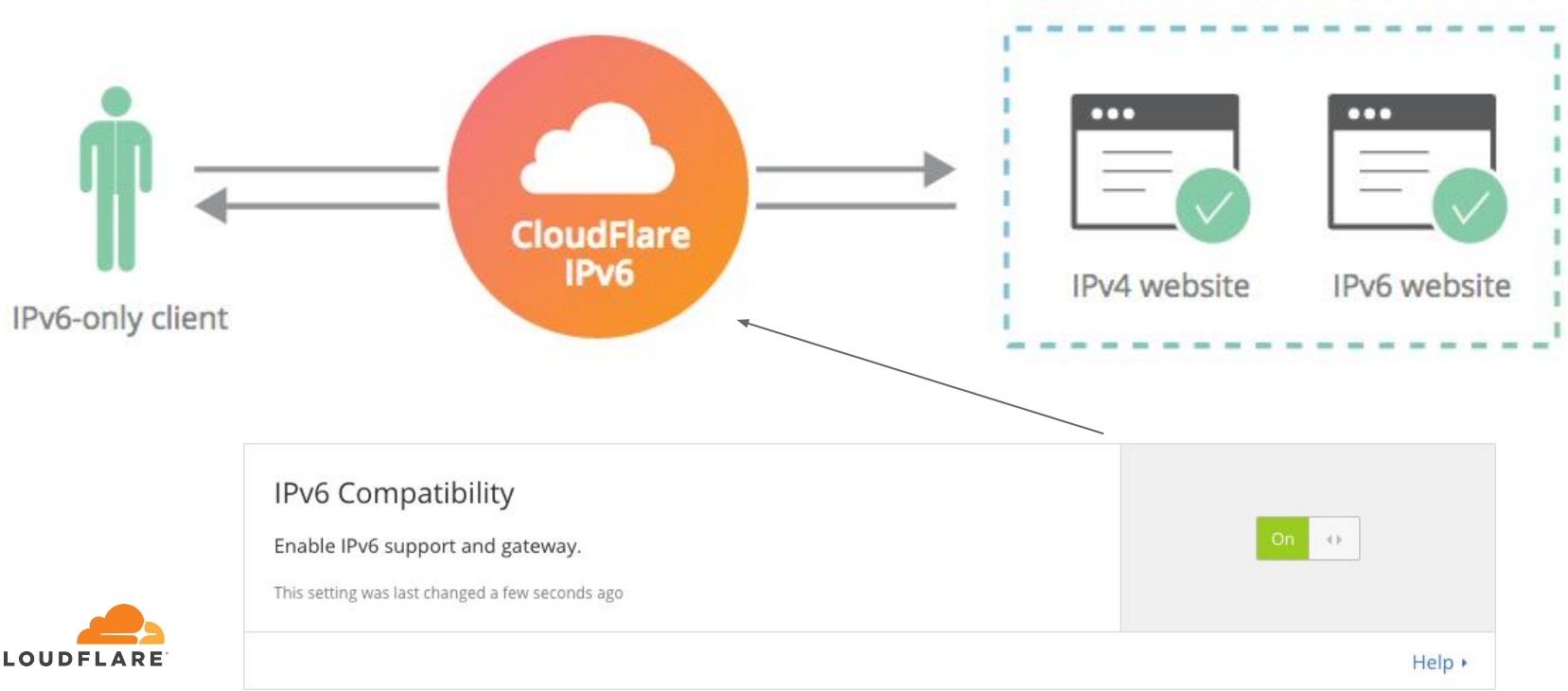
IPv6 @ Cloudflare is so
2606:4700::5ca1:ab1e:6810:4737

Cloudflare can be an IPv6 bridge



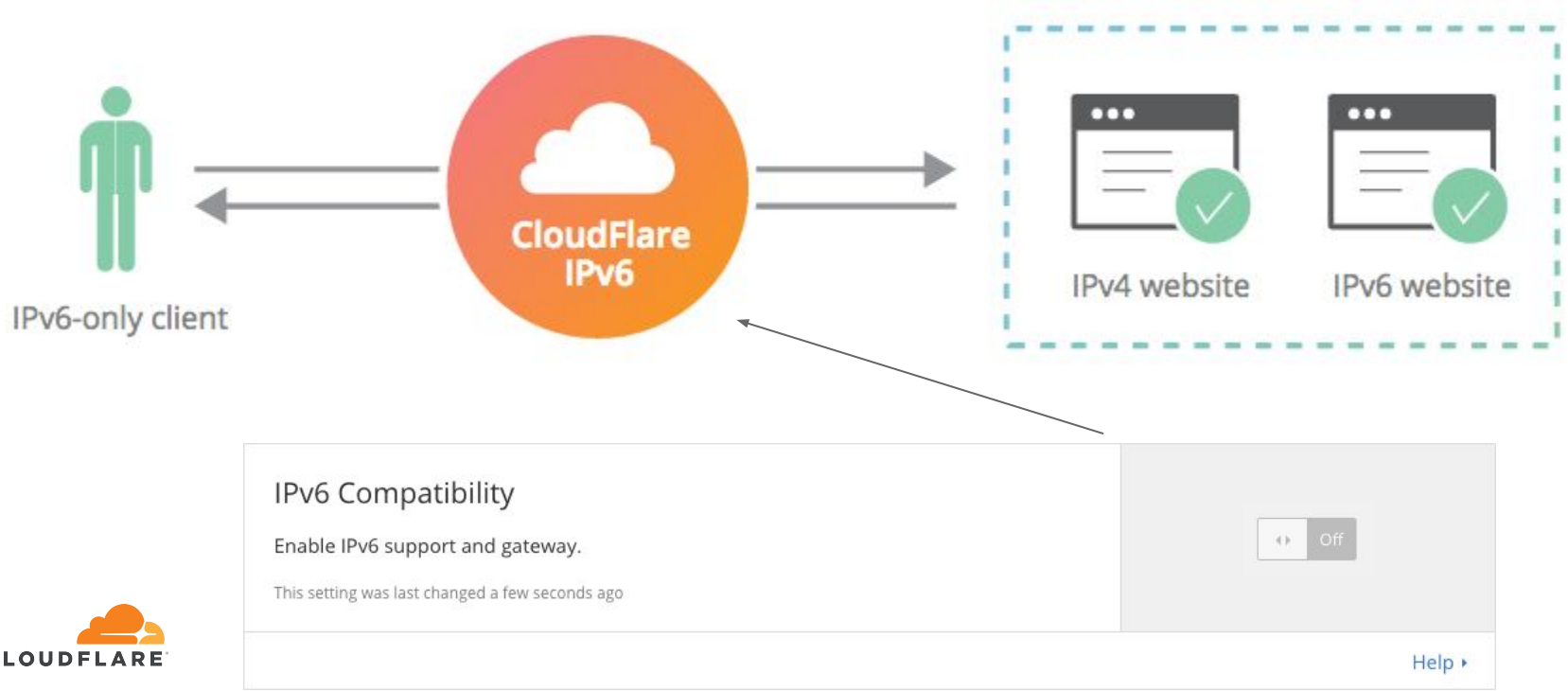
CLOUDFLARE

Cloudflare can be an IPv6 bridge



CLOUDFLARE

Cloudflare can be an IPv6 bridge



CLOUDFLARE

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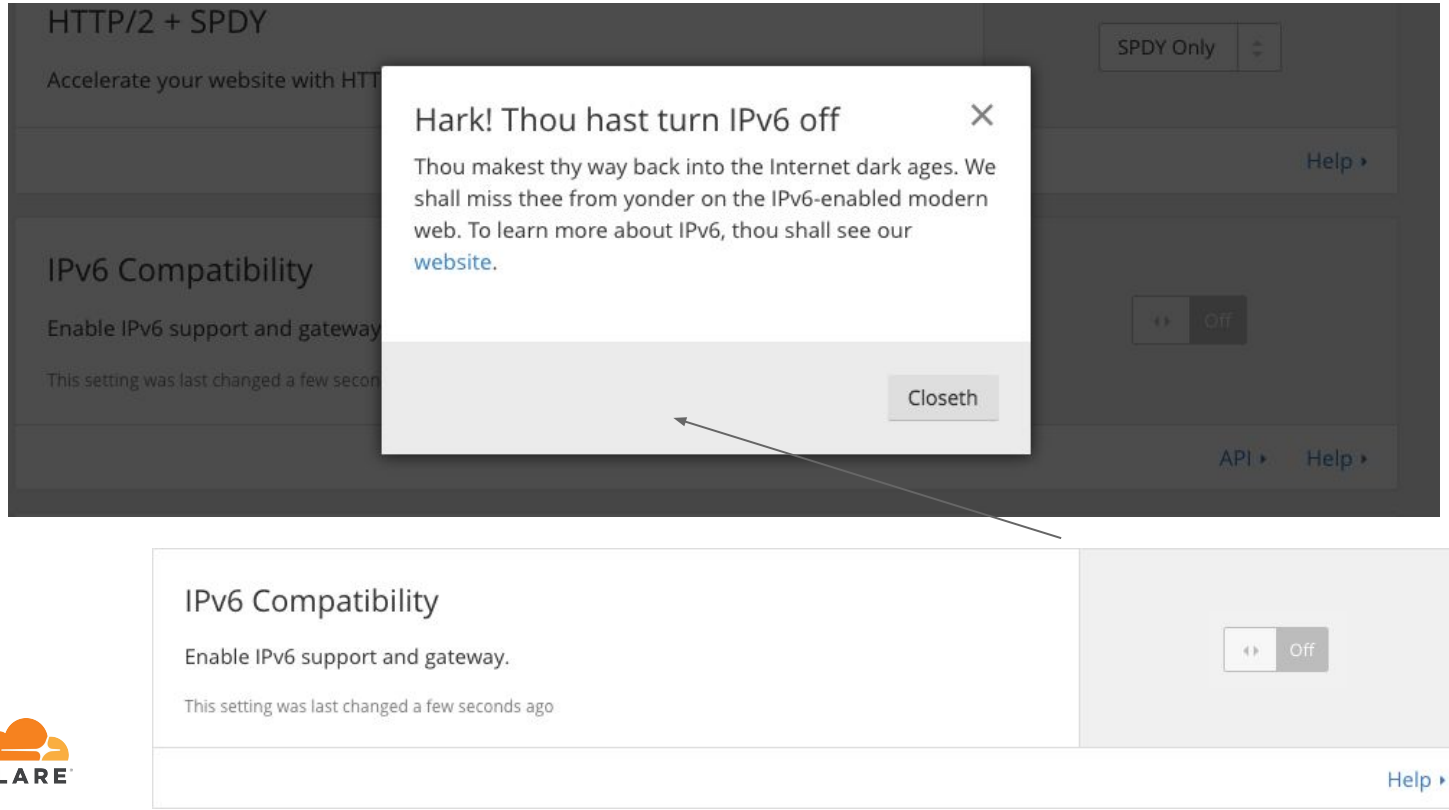
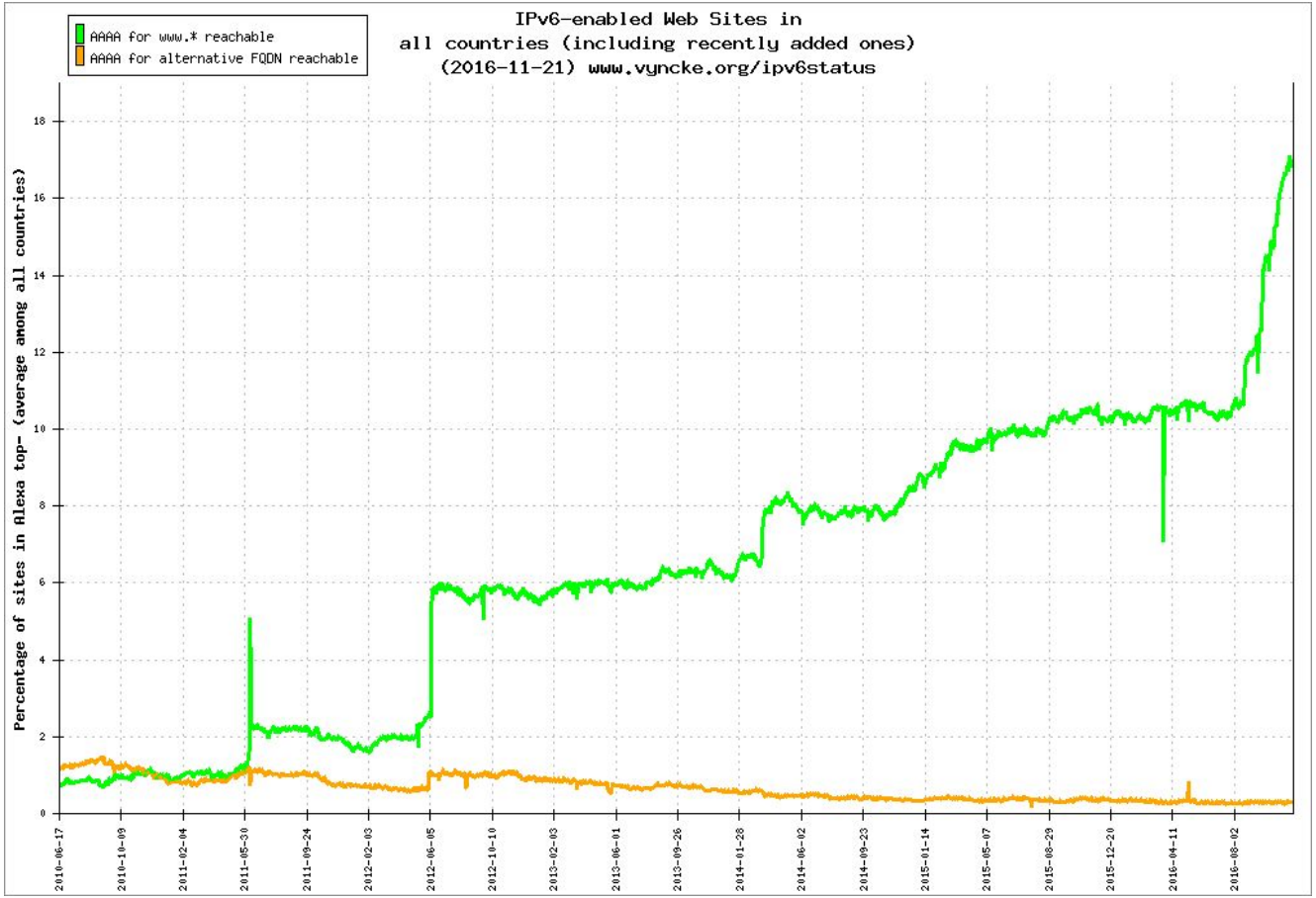


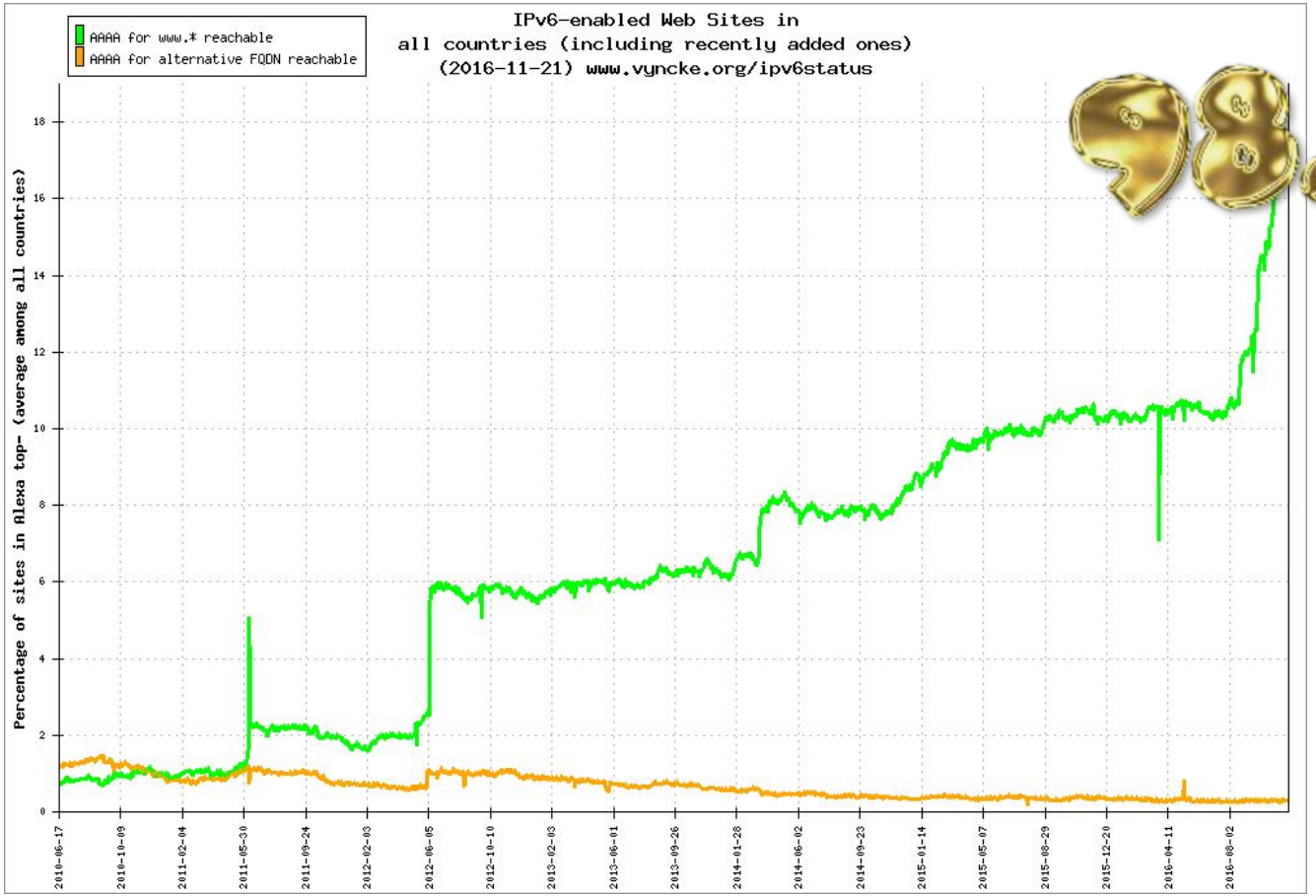
CLOUDFLARE

CLOUDFLARE



CLOUDFLARE

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



CLOUDFLARE

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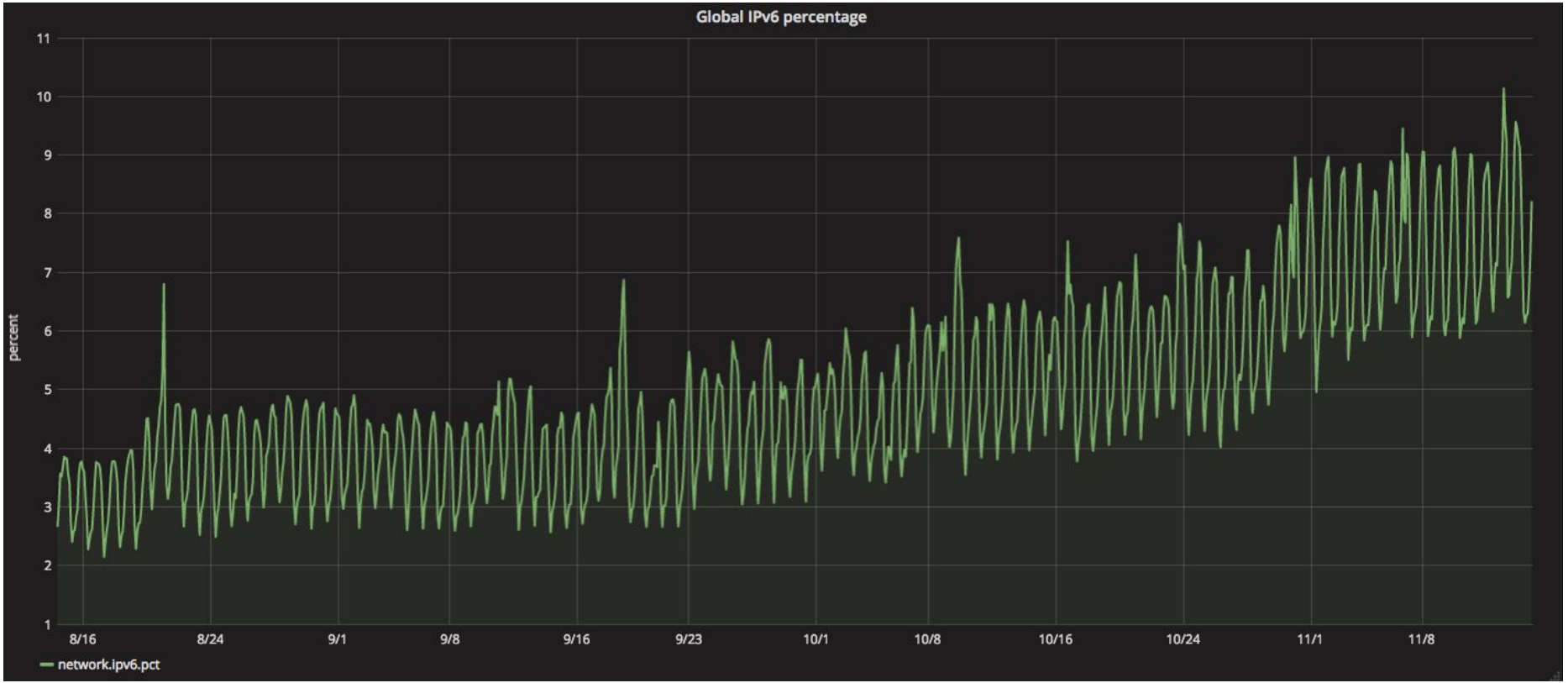
Global IPv6 percentage
percent
11
10
9
8
7
6
5
4
3
2
1
8/16
8/24
9/1
9/8
9/16
9/23
10/1
10/8
10/16
10/24
11/1
11/8
network.ipv6.pct

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Who and what is driving IPv6?

Top IPv6 Countries

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%

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Percent Traffic IPv6 - Belgium
70
60
50
40
30
20
10
0
1/1
1/8
1/16
1/24
2/1
2/8
2/15
2/22
3/1
3/8
3/16
3/24
4/1
4/8
4/16

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2a03:2880:ffff::/48	Facebook Ireland Ltd
2a03:2880:fffe::/48	Facebook Ireland Ltd
2a03:2880:f22b::/48	Facebook Ireland Ltd
2a03:2880:f22a::/48	Facebook Ireland Ltd
2a03:2880:f229::/48	Facebook Ireland Ltd
2a03:2880:f228::/48	Facebook Ireland Ltd
2a03:2880:f227::/48	Facebook Ireland Ltd
2a03:2880:f226::/48	Facebook Ireland Ltd
2a03:2880:f224::/48	Facebook Ireland Ltd
2a03:2880:f222::/48	Facebook Ireland Ltd
2a03:2880:f221::/48	Facebook Ireland Ltd
2a03:2880:f21f::/48	Facebook Ireland Ltd
2a03:2880:f21c::/48	Facebook Ireland Ltd
2a03:2880:f21b::/48	Facebook Ireland Ltd
2a03:2880:f21a::/48	Facebook Ireland Ltd
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% FB thru CF = IPv6
- FB = 6.9% CF's outbound IPv6

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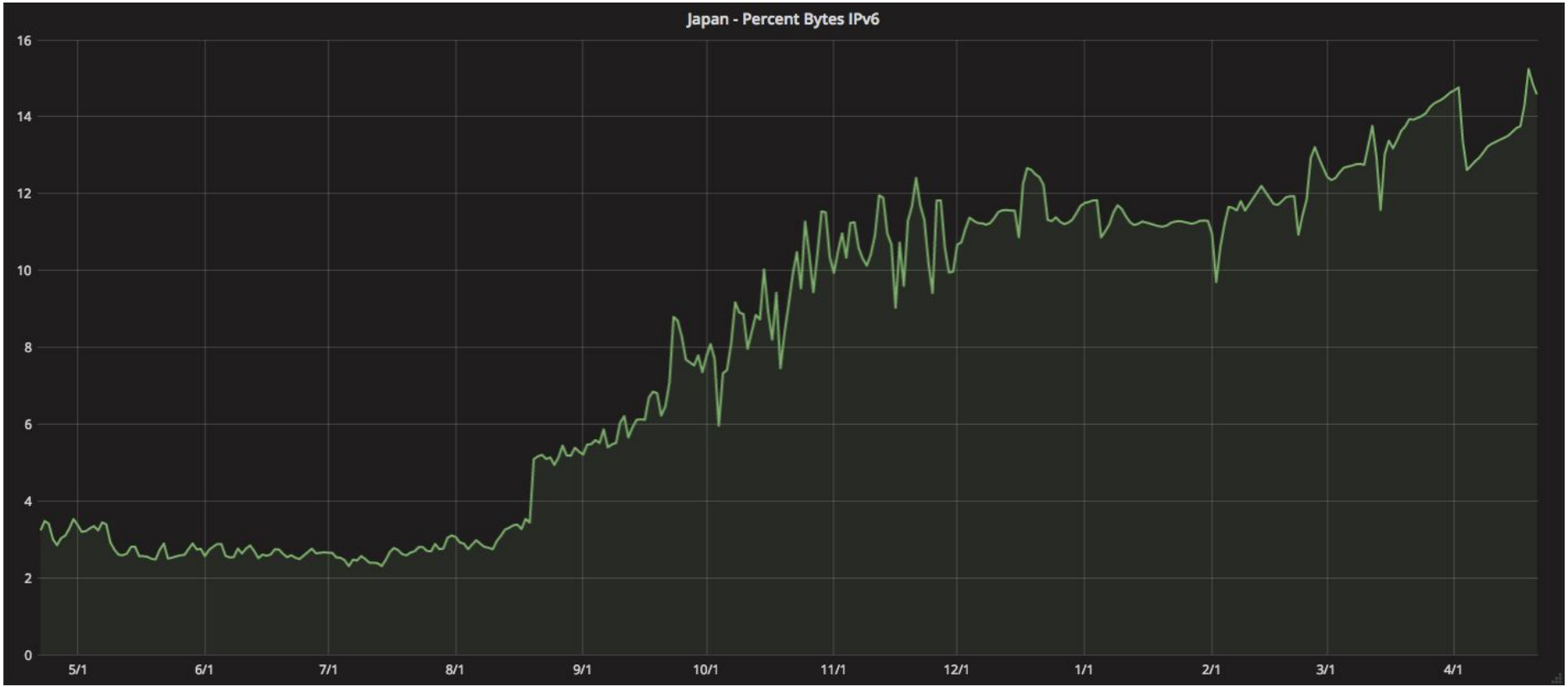
Japan - Percent Bytes IPv6
16
14
12
10
8
6
4
2
0
5/1
6/1
7/1
8/1
9/1
10/1
11/1
12/1
1/1
2/1
3/1
4/1

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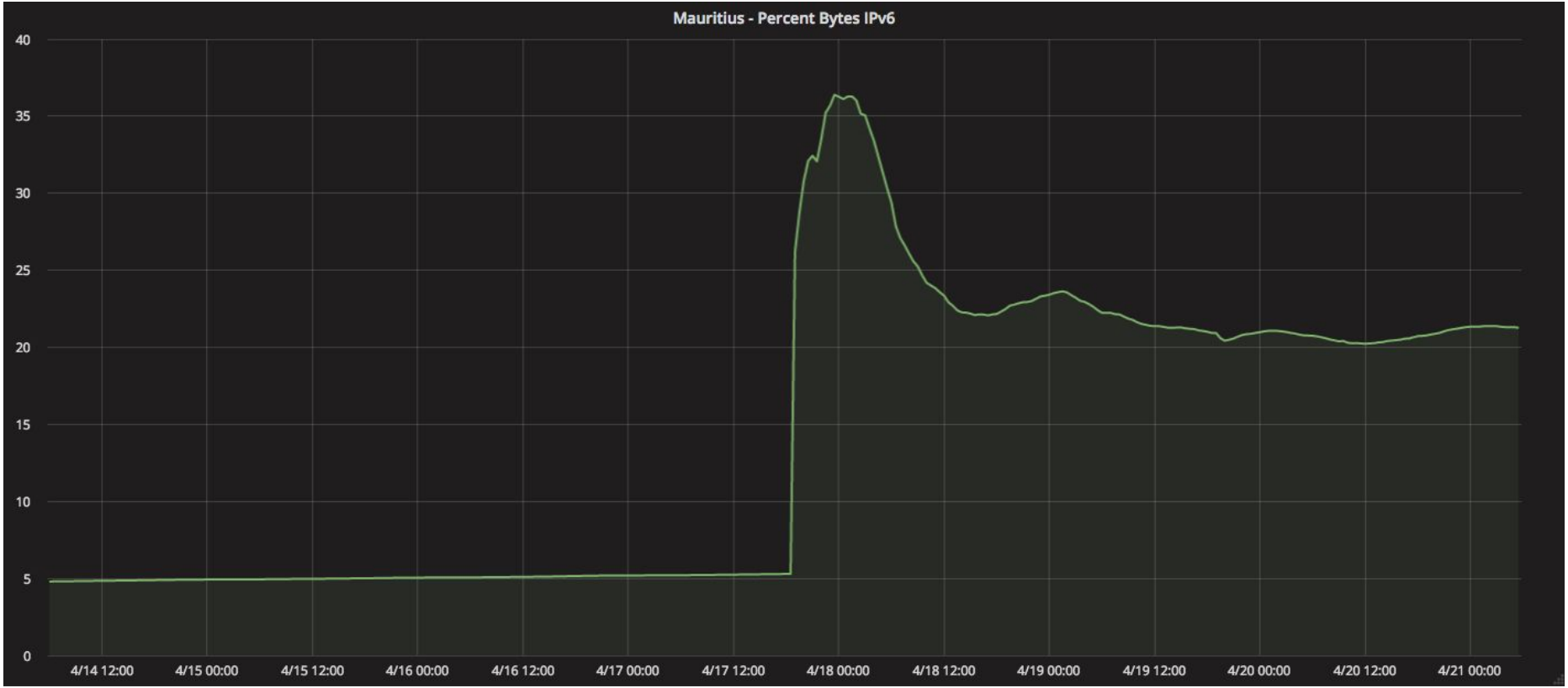
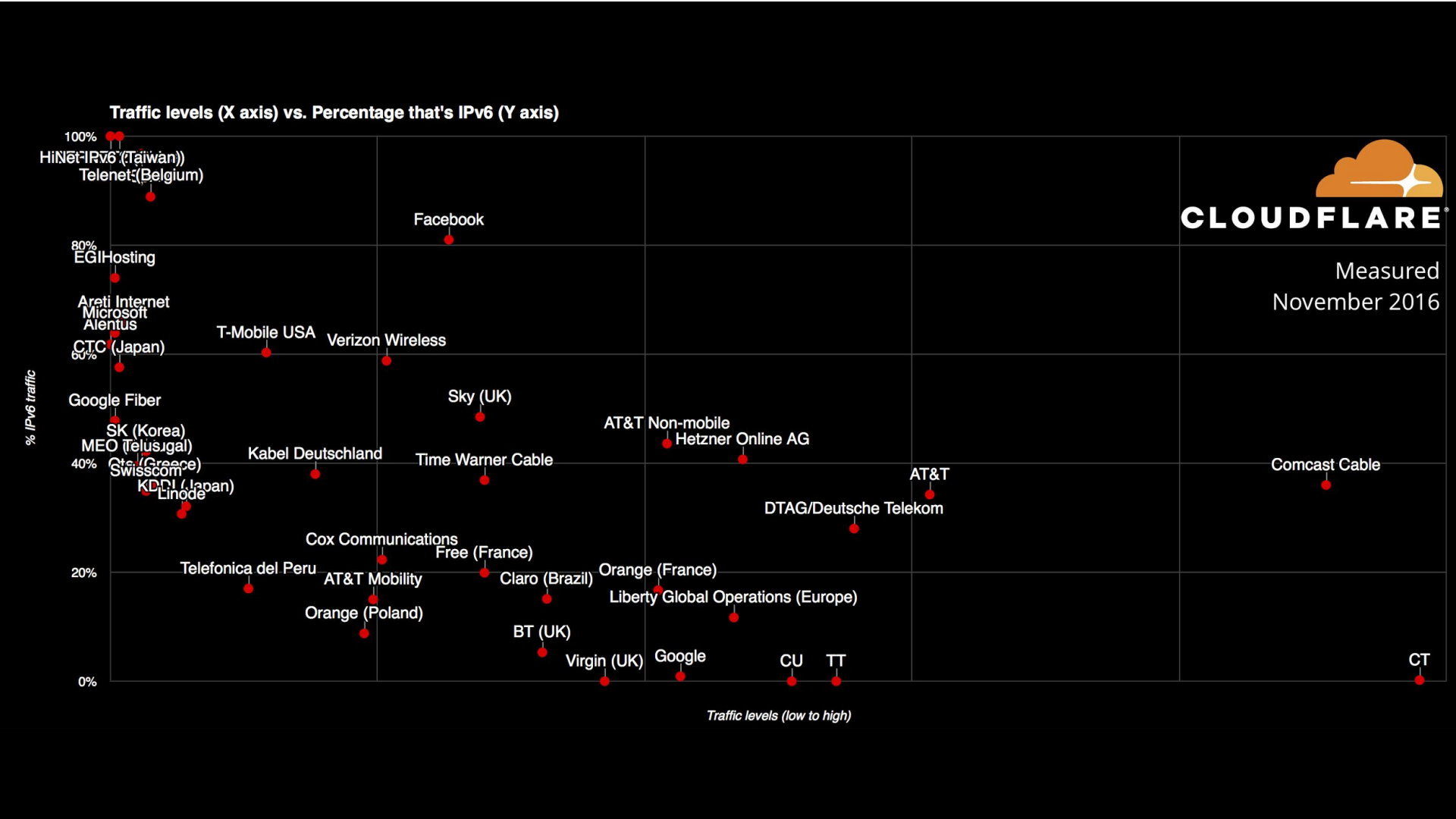
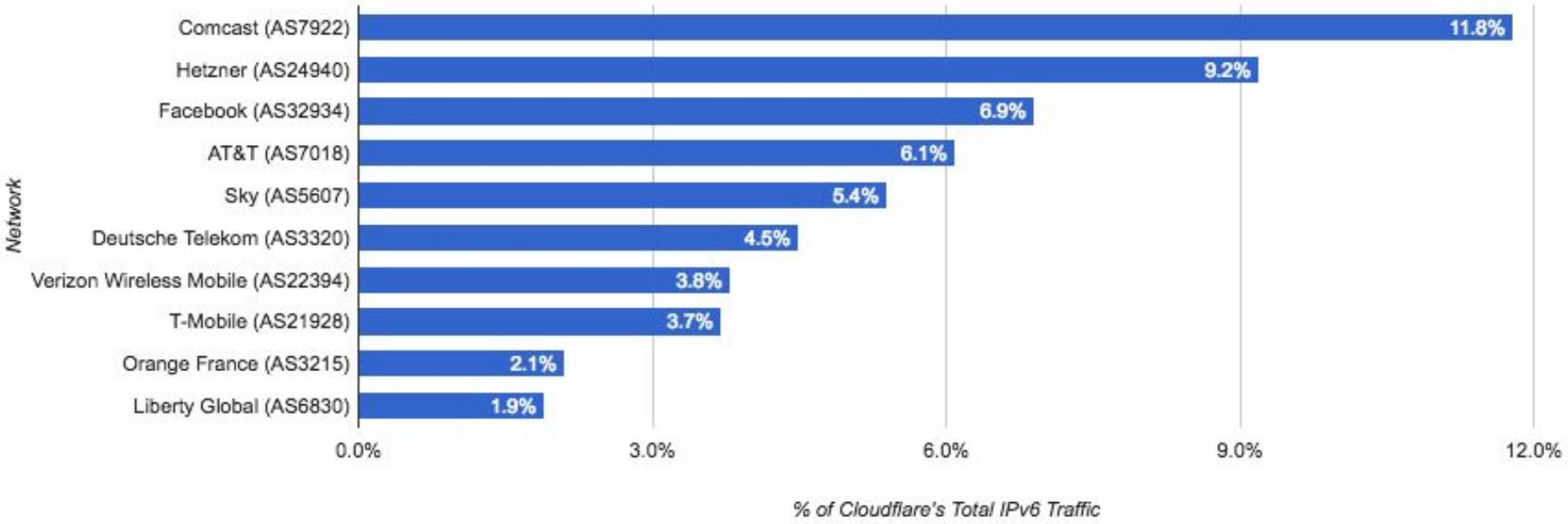

Mauritius - Percent Bytes IPv6
40
35
30
25
20
15
10
5
0
4/14 12:00
4/15 00:00
4/15 12:00
4/16 00:00
4/16 12:00
4/17 00:00
4/17 12:00
4/18 00:00
4/18 12:00
4/19 00:00
4/19 12:00
4/20 00:00
4/20 12:00
4/21 00:00

CLOUDFLARE


Traffic levels (X axis) vs. Percentage that's IPv6 (Y axis)
100%
80%
60%
40%
20%
0%
% IPv6 traffic
Traffic levels (low to high)
HiNet IRv6 (Taiwan)
Telenet (Belgium)
Facebook
EGIHosting
Areti Internet
Microsoft
Alentus
CTC (Japan)
T-Mobile USA
Verizon Wireless
Google Fiber
Sky (UK)
SK (Korea)
MEO (Telusgal)
Swisscom
KDDI (Japan)
Linode
Kabel Deutschland
Time Warner Cable
AT&T Non-mobile
Hetzner Online AG
AT&T
DTAG/Deutsche Telekom
Comcast Cable
Cox Communications
Free (France)
Telefonica del Peru
AT&T Mobility
Claro (Brazil)
Orange (France)
Liberty Global Operations (Europe)
Orange (Poland)
BT (UK)
Virgin (UK)
Google
CU
TT
CT
CLOUDFLARE
Measured
November 2016

Top 10 by bytes IPv6 (55.4% of CF IPv6 Traffic)



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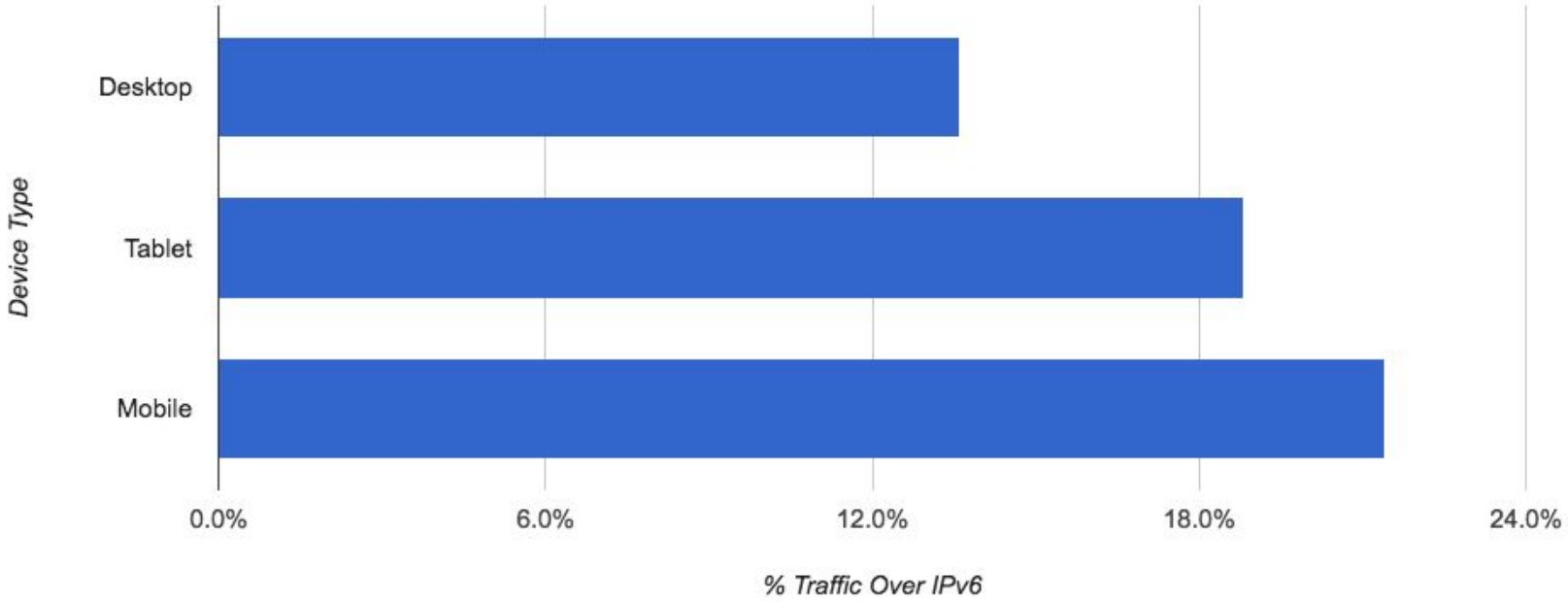
Top 10 by IPv6 ratio

#	IPv6 %	ASN	NAME
1	100.0%	AS43447	Orange Polska
2	100.0%	AS23910	China Next Generation Internet CERNET2
3	100.0%	AS17419	HiNet IPv6 (Taiwan)
4	96.8%	AS6848	Telenet (Belgium)
5	91.5%	AS12271	Time Warner Cable
6	88.9%	AS3651	Sprint
7	81.0%	AS32934	Facebook
8	74.0%	AS54500	EGIHosting
9	65.9%	AS21321	Areti Internet
10	63.9%	AS3598	Microsoft

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



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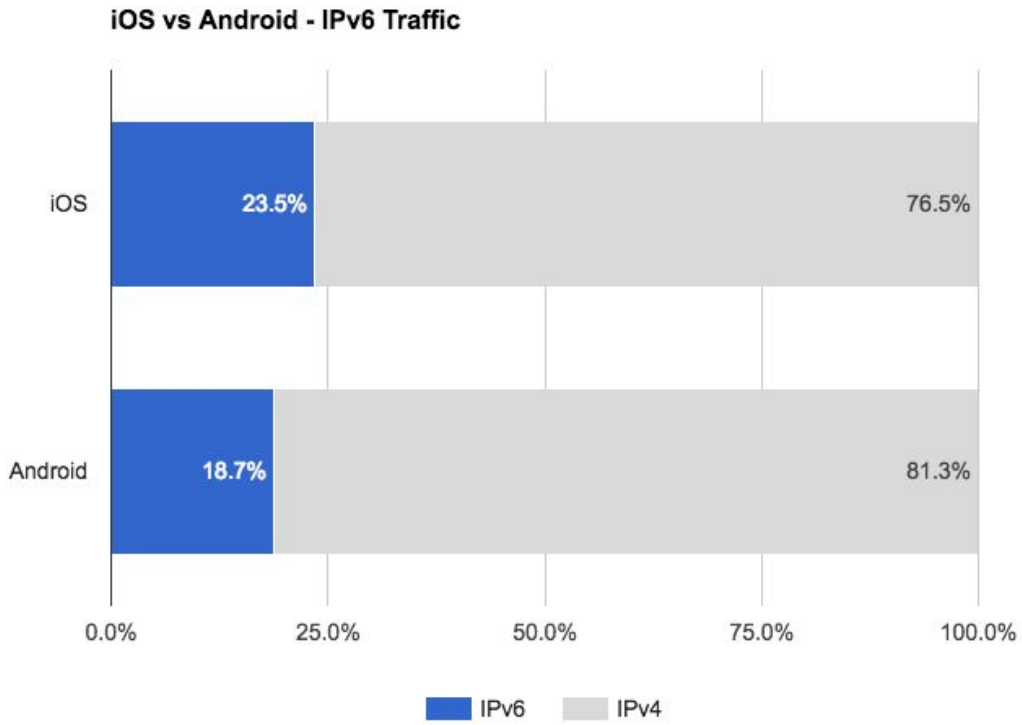
iOS vs Android



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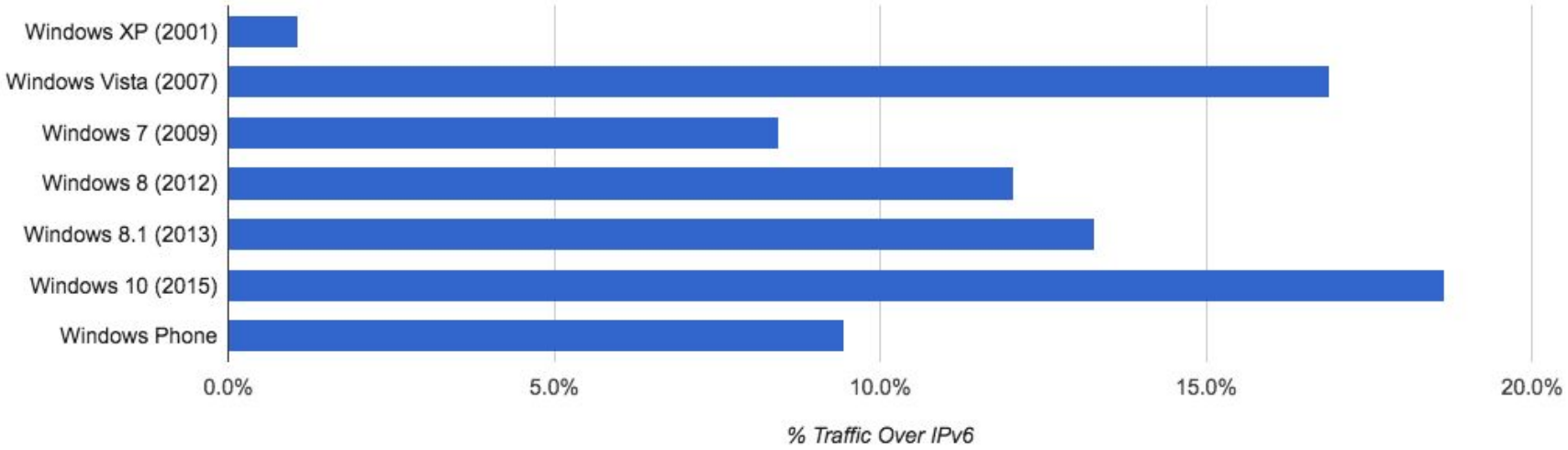
Windows and IPv6



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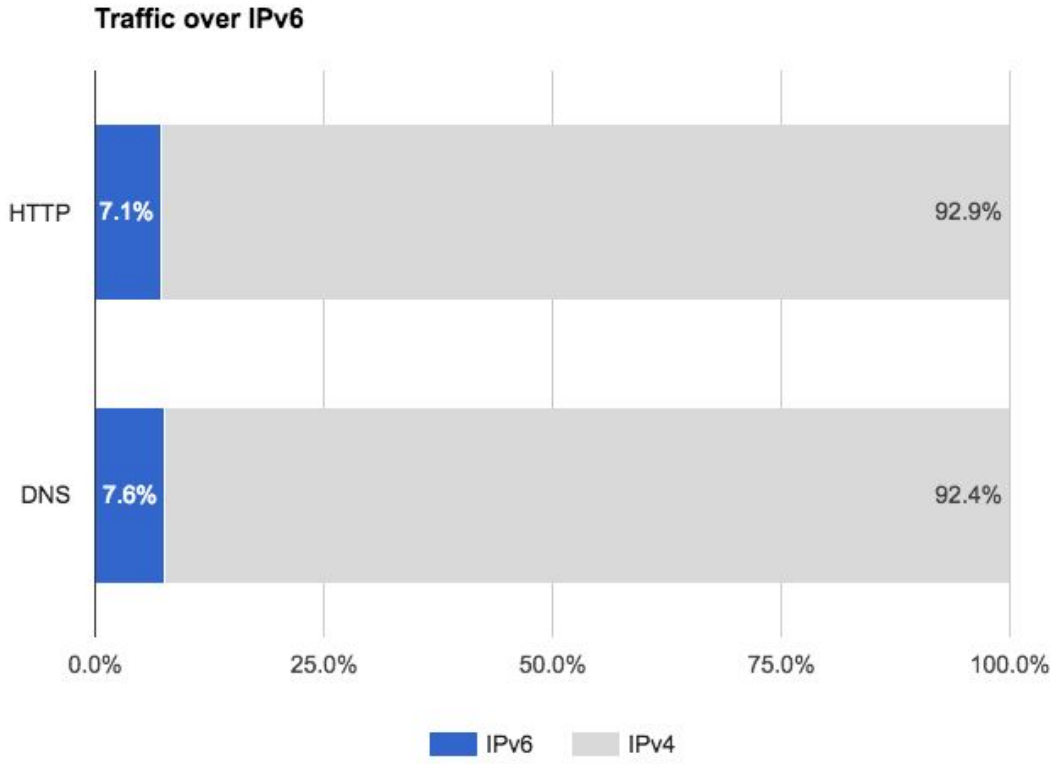
IPv6 and DNS



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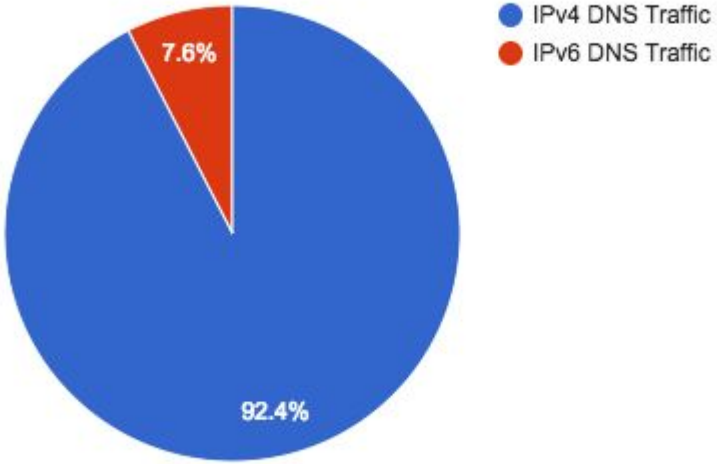
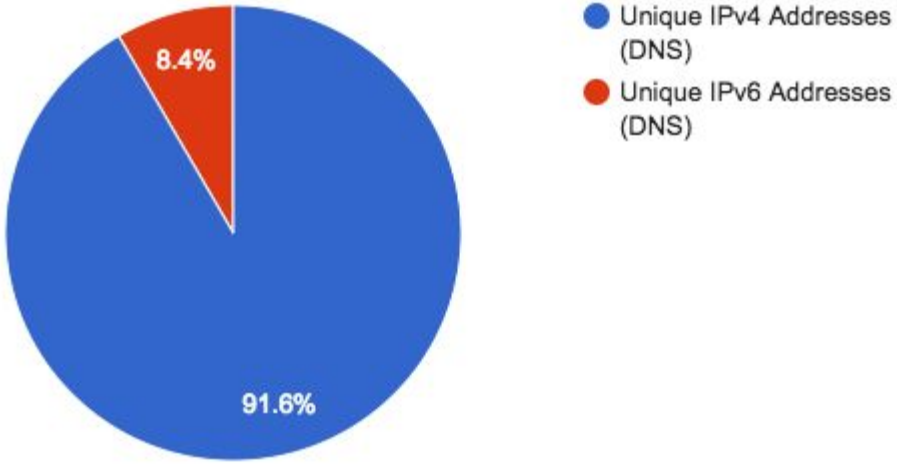
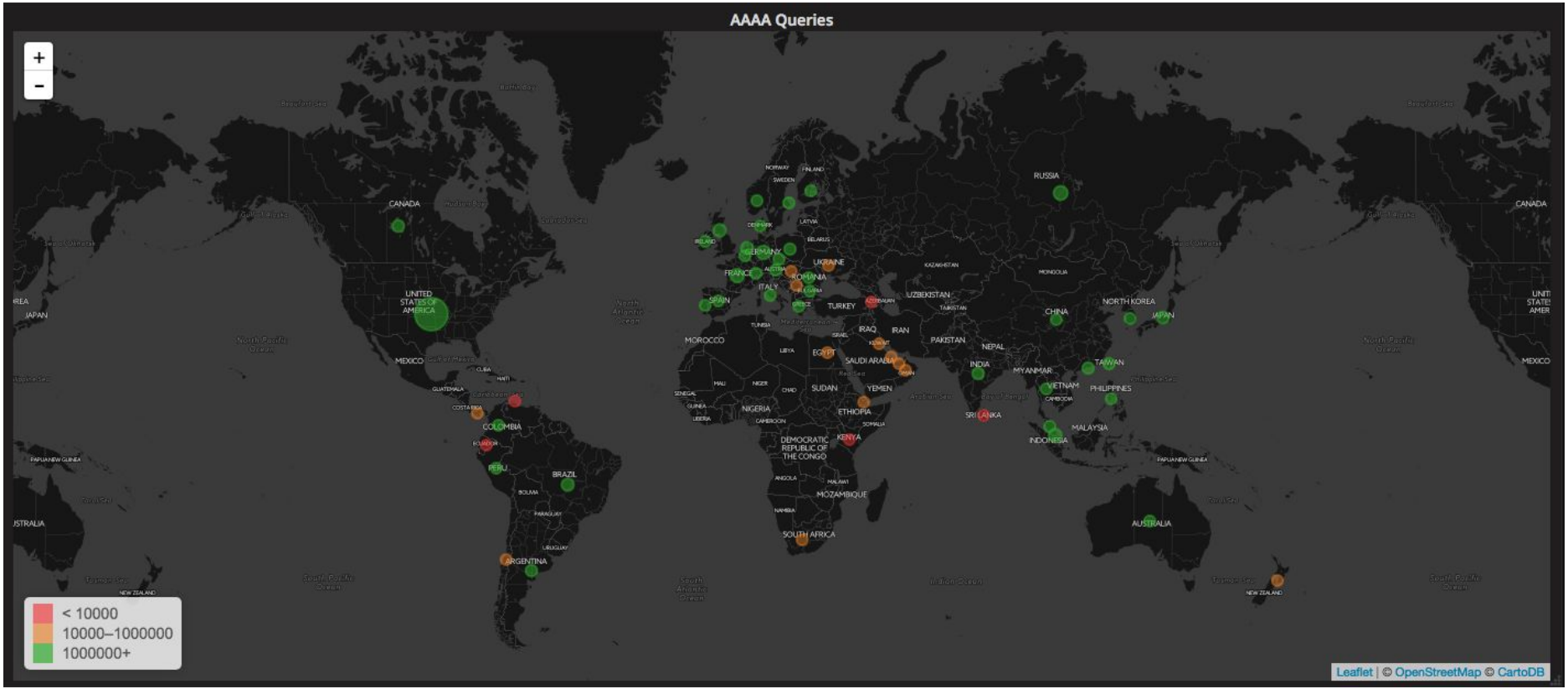
More v6 addresses != more v6 uniques in DNS

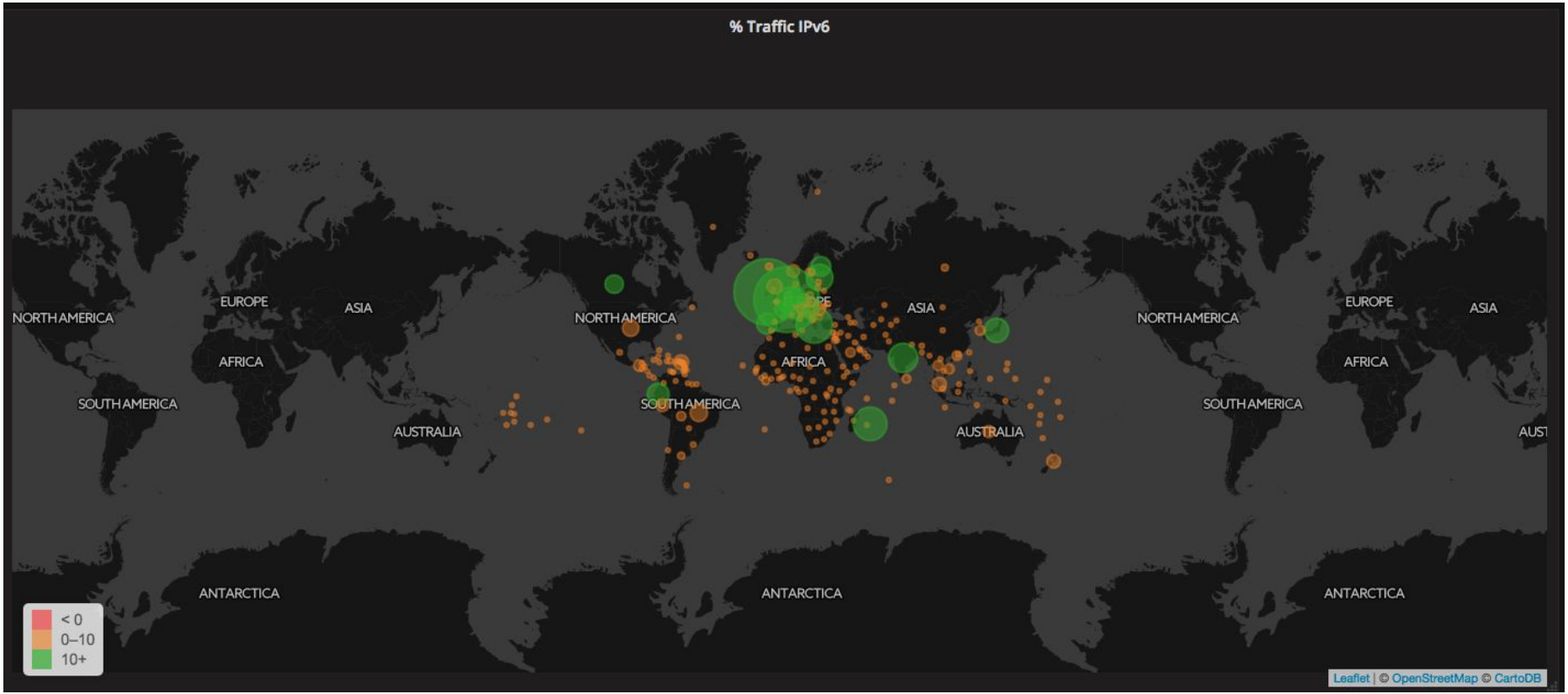




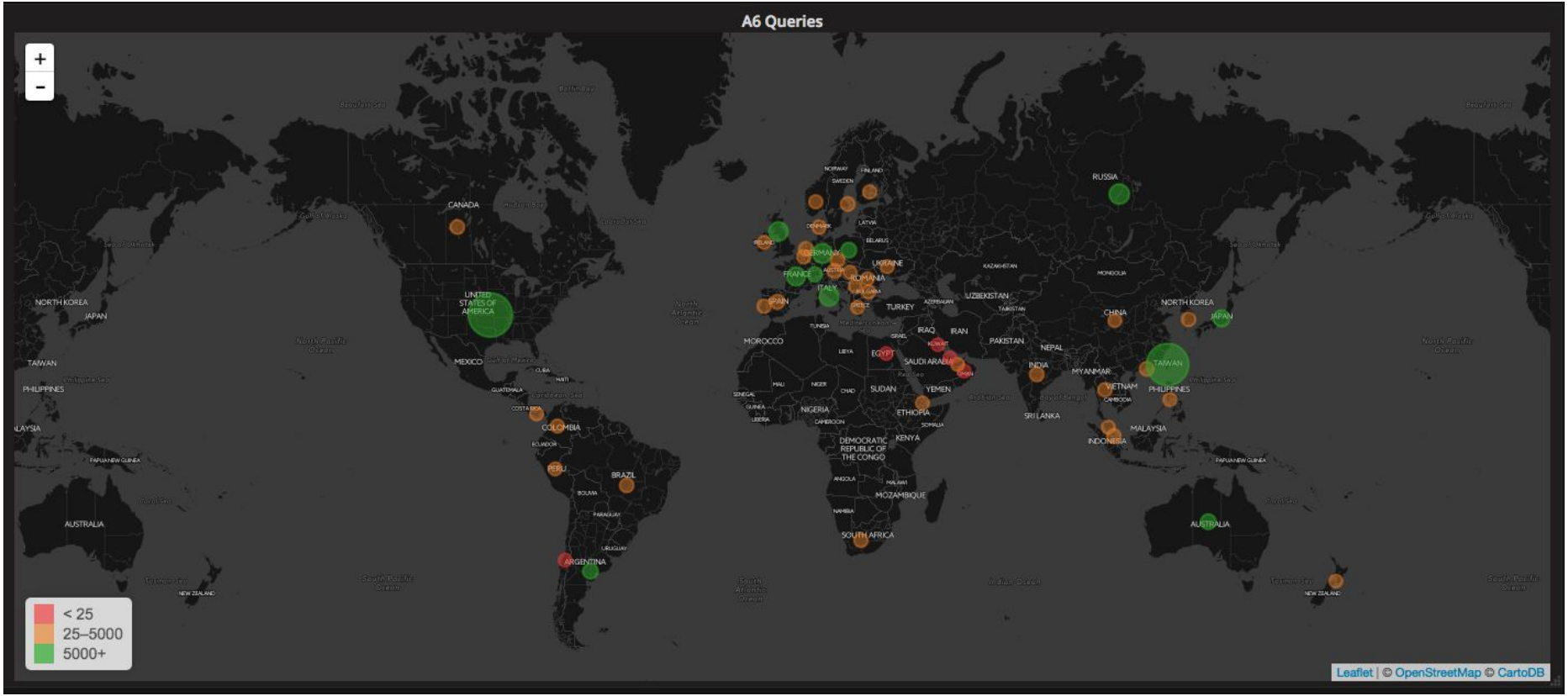
CLOUDFLARE


AAAA Queries
+
-
< 10000
10000–1000000
1000000+
Leaflet | © OpenStreetMap © CartoDB
CANADA
UNITED STATES OF AMERICA
MEXICO
BRAZIL
PERU
COLOMBIA
ARGENTINA
RUSSIA
CHINA
INDIA
AUSTRALIA
JAPAN
NORTH KOREA
SOUTH AFRICA
NIGERIA
ETHIOPIA
KENYA
SUDAN
EGYPT
SAUDI ARABIA
IRAN
IRAQ
TURKEY
FRANCE
GERMANY
UKRAINE
SPAIN
ITALY
POLAND
SWEDEN
NORWAY
FINLAND
MOROCCO
PAKISTAN
INDONESIA
MALAYSIA
PHILIPPINES
VIETNAM
MYANMAR
TAIWAN
NEPAL
SRI LANKA
MONGOLIA
KAZAKHSTAN
UZBEKISTAN

CLOUDFLARE


% Traffic IPv6
NORTH AMERICA
EUROPE
ASIA
AFRICA
SOUTH AMERICA
AUSTRALIA
ANTARCTICA
< 0
0–10
10+
Leaflet | © OpenStreetMap © CartoDB

CLOUDFLARE


A6 Queries
+
-
< 25
25–5000
5000+
Leaflet | © OpenStreetMap © CartoDB
CANADA
UNITED STATES OF AMERICA
MEXICO
COLOMBIA
PERU
BRAZIL
ARGENTINA
AUSTRALIA
NEW ZEALAND
PAPUA NEW GUINEA
PHILIPPINES
TAIWAN
NORTH KOREA
JAPAN
RUSSIA
NORWAY
SWEDEN
FINLAND
DENMARK
LATVIA
BELARUS
POLAND
GERMANY
UKRAINE
FRANCE
AUSTRIA
ROMANIA
ITALY
SPAIN
GREECE
TURKEY
KAZAKHSTAN
MONGOLIA
UZBEKISTAN
AZERBAIJAN
TAJIKISTAN
CHINA
MOROCCO
TUNISIA
LIBYA
EGYPT
ISRAEL
IRAQ
IRAN
KUWAIT
SAUDI ARABIA
PAKISTAN
NEPAL
INDIA
MYANMAR
VIETNAM
CAMBODIA
SRI LANKA
INDONESIA
MALAYSIA
SUDAN
YEMEN
ETHIOPIA
NIGERIA
KENYA
SOMALIA
DEMOCRATIC REPUBLIC OF THE CONGO
ANGOLA
MALAWI
MOZAMBIQUE
NAMIBIA
SOUTH AFRICA

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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

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If you want these stats for your CF zone...

```
curl -H 'X-Auth-Email: you@email.com' -H 'X-Auth-Key: 000000'
'https://api.cloudflare.com/client/v4/zones/{zone_id}/dns_analytics/re
port?dimensions=ipVersion'
```

docs @ api.cloudflare.com

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What’s next? Fix DNS!

How silly is this in 2017

- Separate A & AAAA records
- In a happy-eyeball environment we still need two DNS queries

AAAAA!

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.

CLOUDFLARE

[Docs] [txt|pdf|xml|html] [Tracker] [Email] [Nits]

Versions: 00

Network Working Group — M. Vavrusa
Internet-Draft — O. Gudmundsson
Intended status: Standards Track — CloudFlare Inc.
Expires: September 22, 2016 — March 21, 2016

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.

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Next steps

- Cloudflare to submit draft to IETF
- We’re looking for resolvers who want to test this out with us - dani@cloudflare.com if interested

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Thank you!
{dani@cloudflare.com}