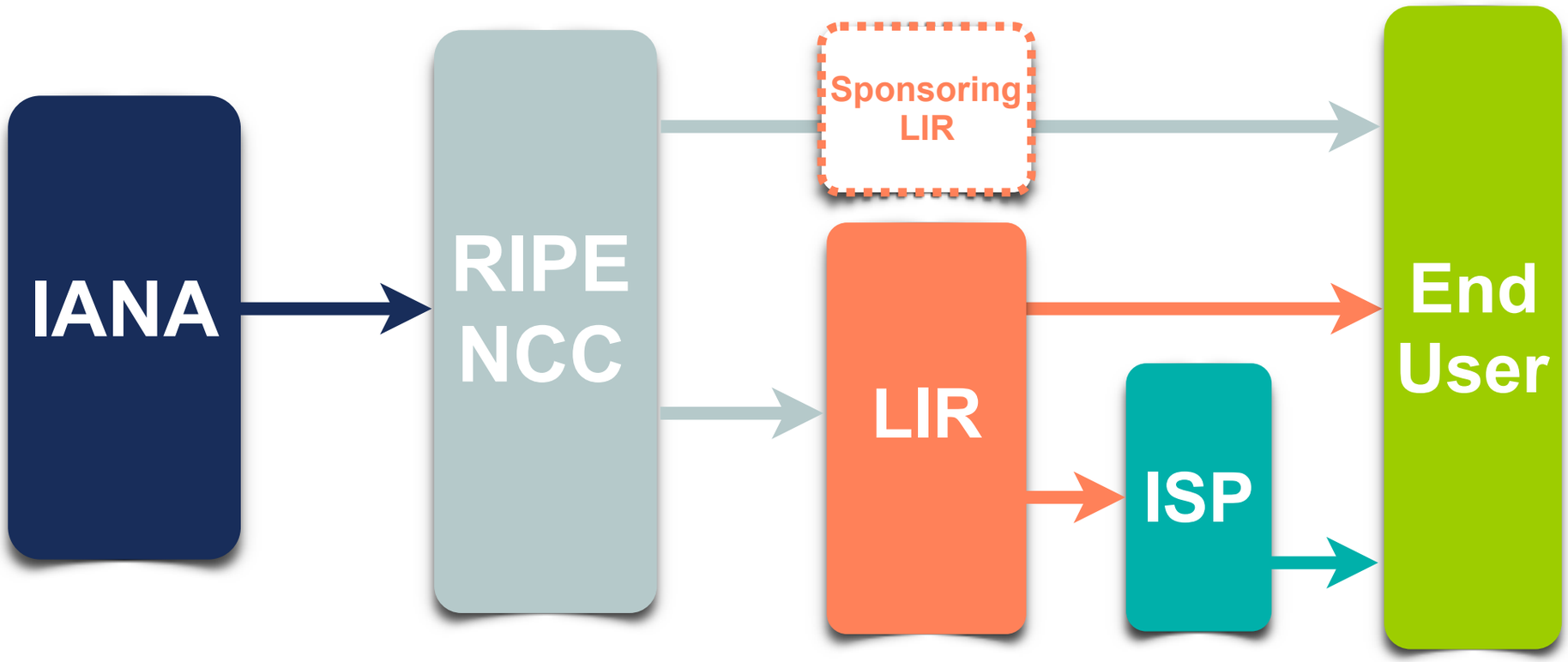
RIPE NCC
RIPE NETWORK COORDINATION CENTRE

The dynamics of IPv4 runout and IPv6 deployments

Jad El Cham | December 2019 | Government Roundtable - UAE

RIPE NCC Region



IPv4 Allocation: Before the Waiting List

- Submit the IPv4 Allocation Request form
  - LIR Portal
- Each LIR can get **one /22** block
  - = 1024 IPv4 addresses
- Cannot be transferred for 24 months after receiving it

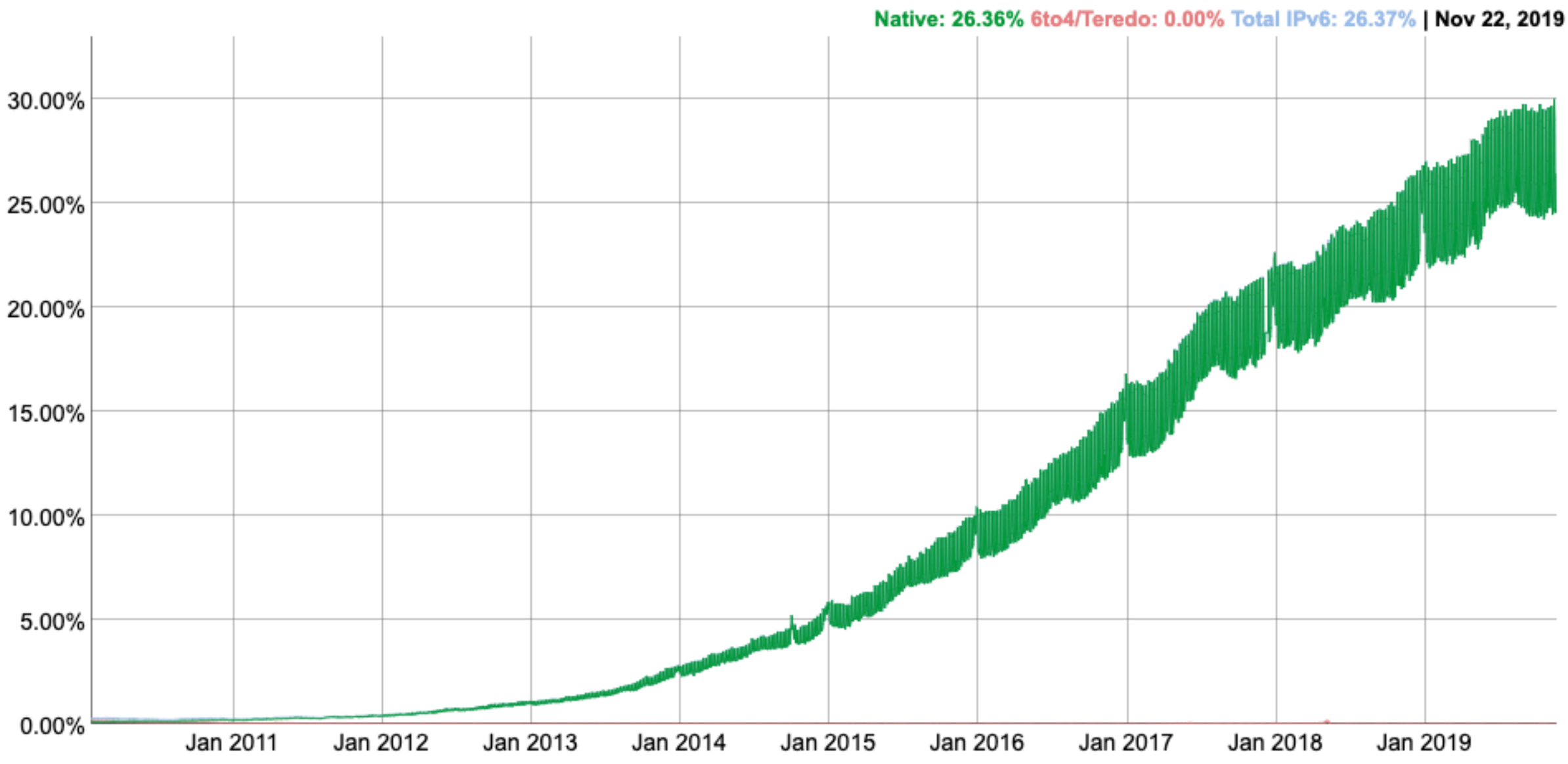
IPv4 Allocation: The Waiting List

- Submit the IPv4 Allocation Request form
  - LIR Portal
- Each LIR is put on the first-come-first-served waiting list to get **one /24** block
  - = 256 IPv4 addresses
- Cannot be transferred for 24 months after receiving it

IPv6 Allocation

- Minimum allocation for LIRs size /32
  - 65,536 /48s
  - 16,777,216 /56s
  - 4,294,967,296 /64s
- Every LIR can ask for /29 no questions asked
  - 8 /32s
- Customer assignments (sites) between:
  - /64 (1 subnet)
  - /48 (65,536 subnets)
- Every subnet should be a /64
  - 18,446,744,073,709,551,616 IP addresses in 1 subnet

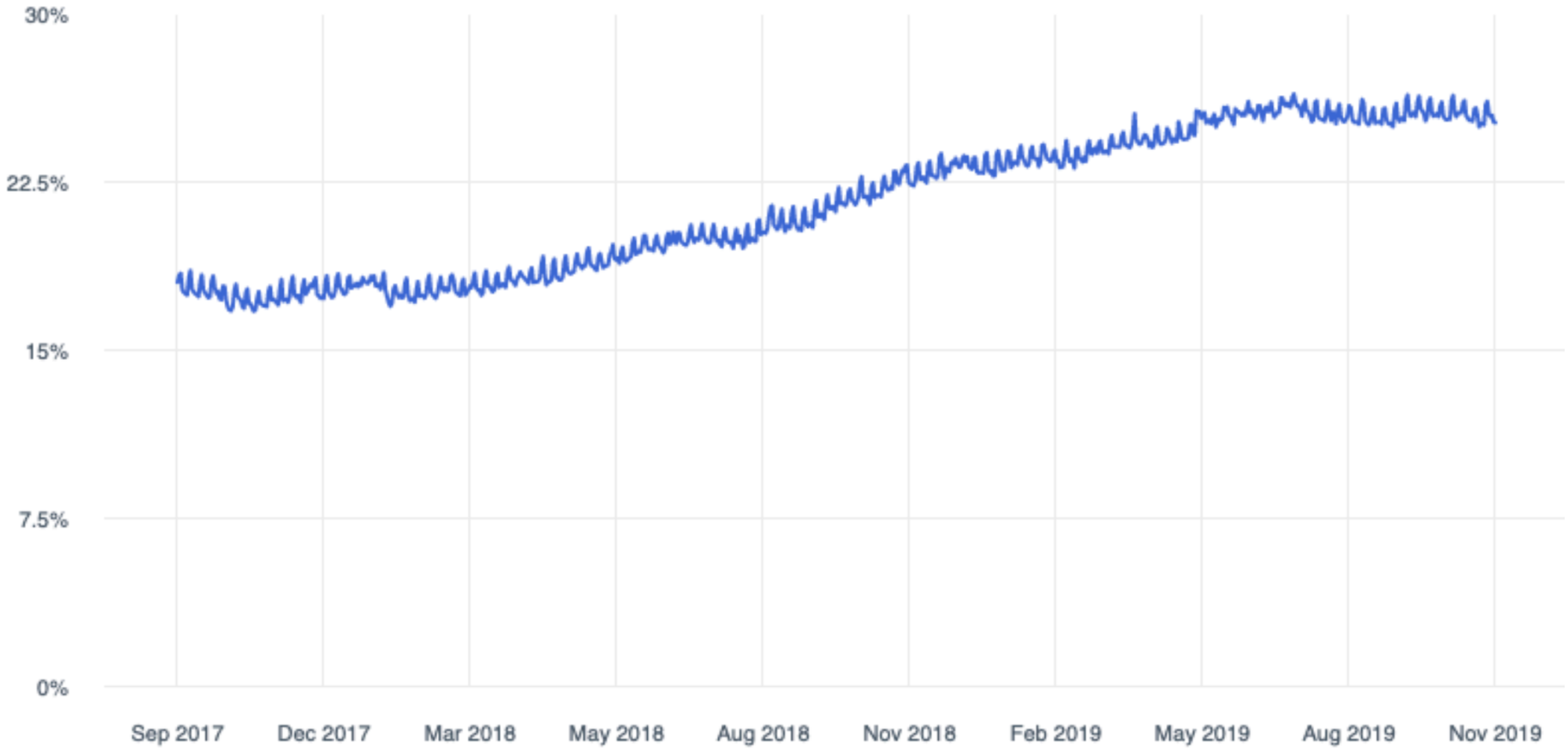
IPv6 Statistics - Google



Percentage of IPv6 users that access Google over IPv6

Source: https://www.google.com/intl/en/ipv6/statistics.html

IPv6 Statistics - Facebook



Percentage of IPv6 users that access Facebook over IPv6

Source: https://www.facebook.com/ipv6/?tab=ipv6

There is still time to move…

- In the run up to the year 2000, the global IT industry mobilised to combat the potential threat posed by the so-called millennium bug. In 2019, those responsible for the health and smooth operation of their organisation's data networks are facing a new, creeping threat from the depletion of IPv4 addresses.

- Unlike the millennium bug, however, this threat has no defined deadline, no 'high noon', to encourage action. Many large, international organisations are failing to plan for the potential impacts of the inevitable IPv4 shortage or their switch over to its successor IPv6 and, as a result, are sitting on their own personal timebomb that could blow up at any time.

https://www.idgconnect.com/ (March 2019)

IPv6 Statistics - Facebook - AE

Percentage of IPv6 users that access Facebook over IPv6

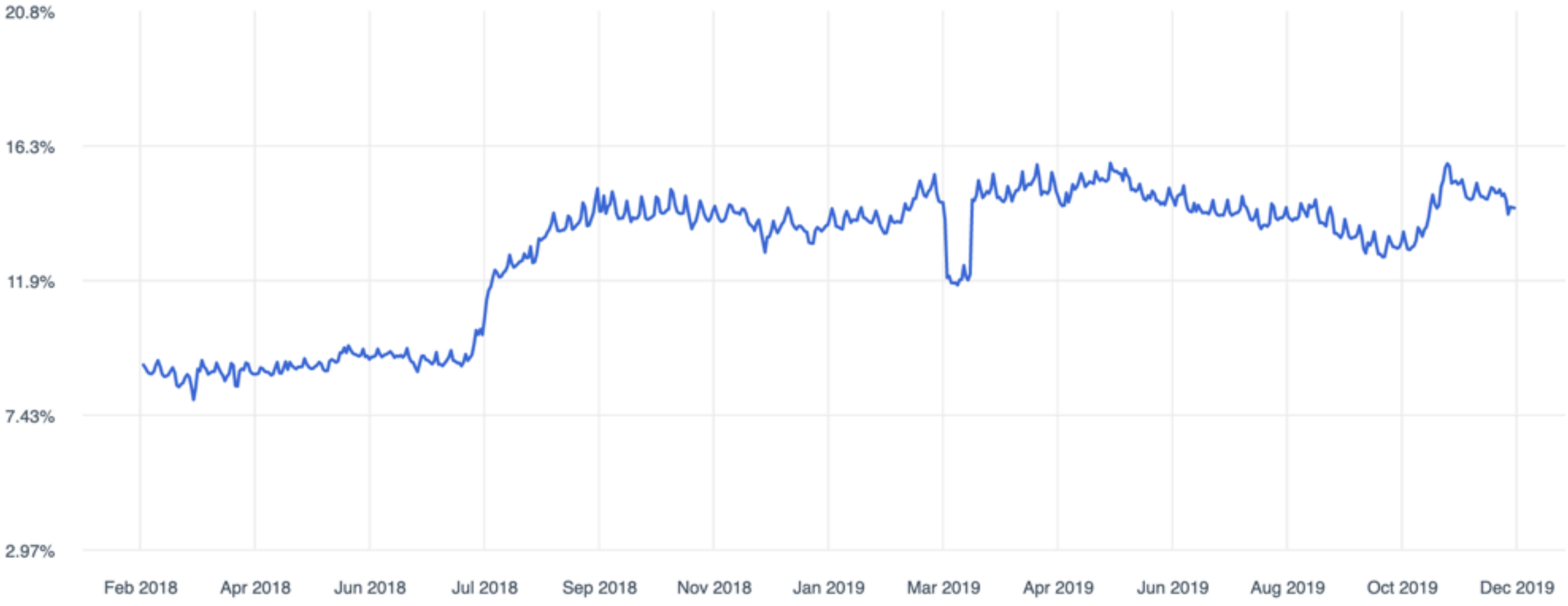
Source: https://www.facebook.com/ipv6/?tab=ipv6

IPv6 Statistics - Akamai - AE

Percentage of IPv6 adoption from Akamai's perspective

Source: https://www.akamai.com/us/en/resources/our-thinking/state-of-the-internet-report/

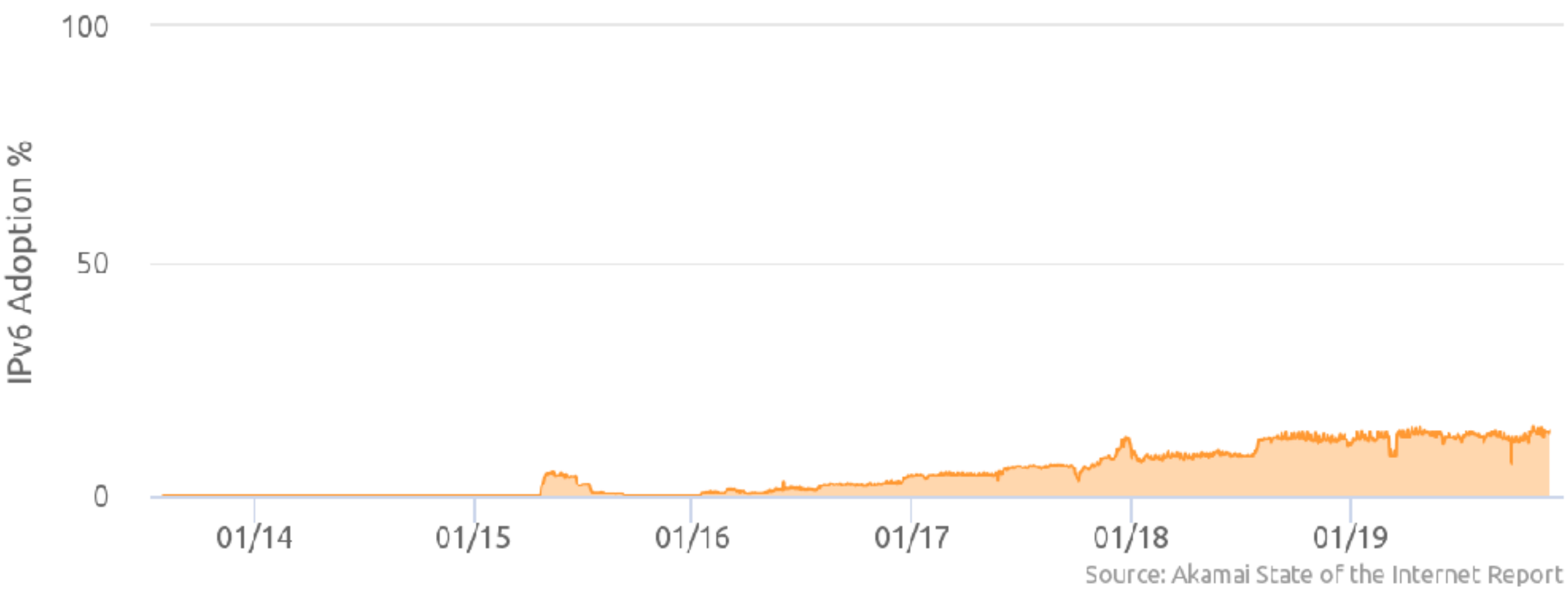
IPv6 Statistics - Facebook - SA



Percentage of IPv6 users that access Facebook over IPv6

Source: https://www.facebook.com/ipv6/?tab=ipv6

IPv6 Statistics - Akamai - SA



Percentage of IPv6 adoption from Akamai's perspective

Source: https://www.akamai.com/us/en/resources/our-thinking/state-of-the-internet-report/

IPv6 Statistics - Facebook - OM

Percentage of IPv6 users that access Facebook over IPv6

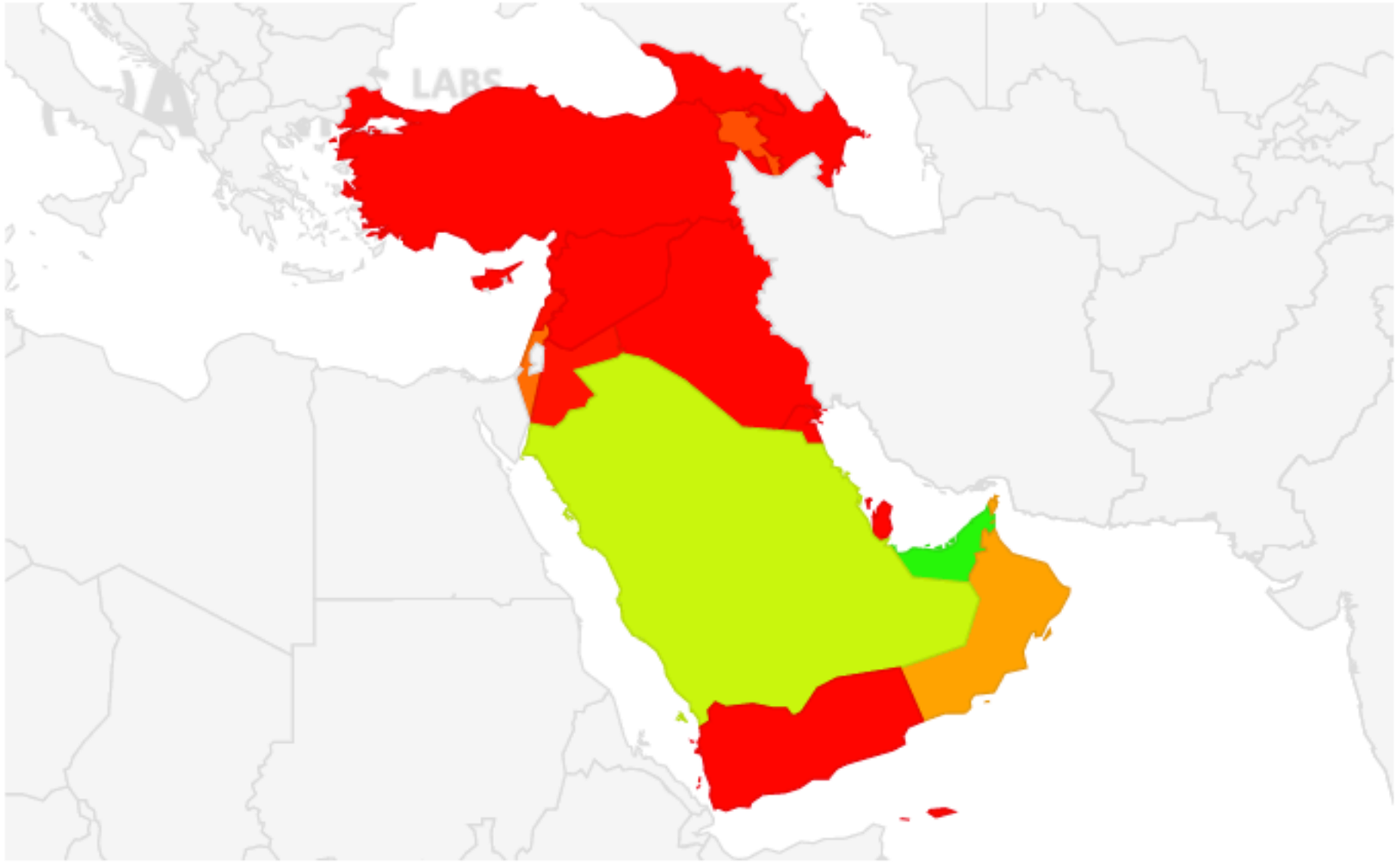
Source: https://www.facebook.com/ipv6/?tab=ipv6

IPv6 Statistics - Akamai - OM

Percentage of IPv6 adoption from Akamai's perspective

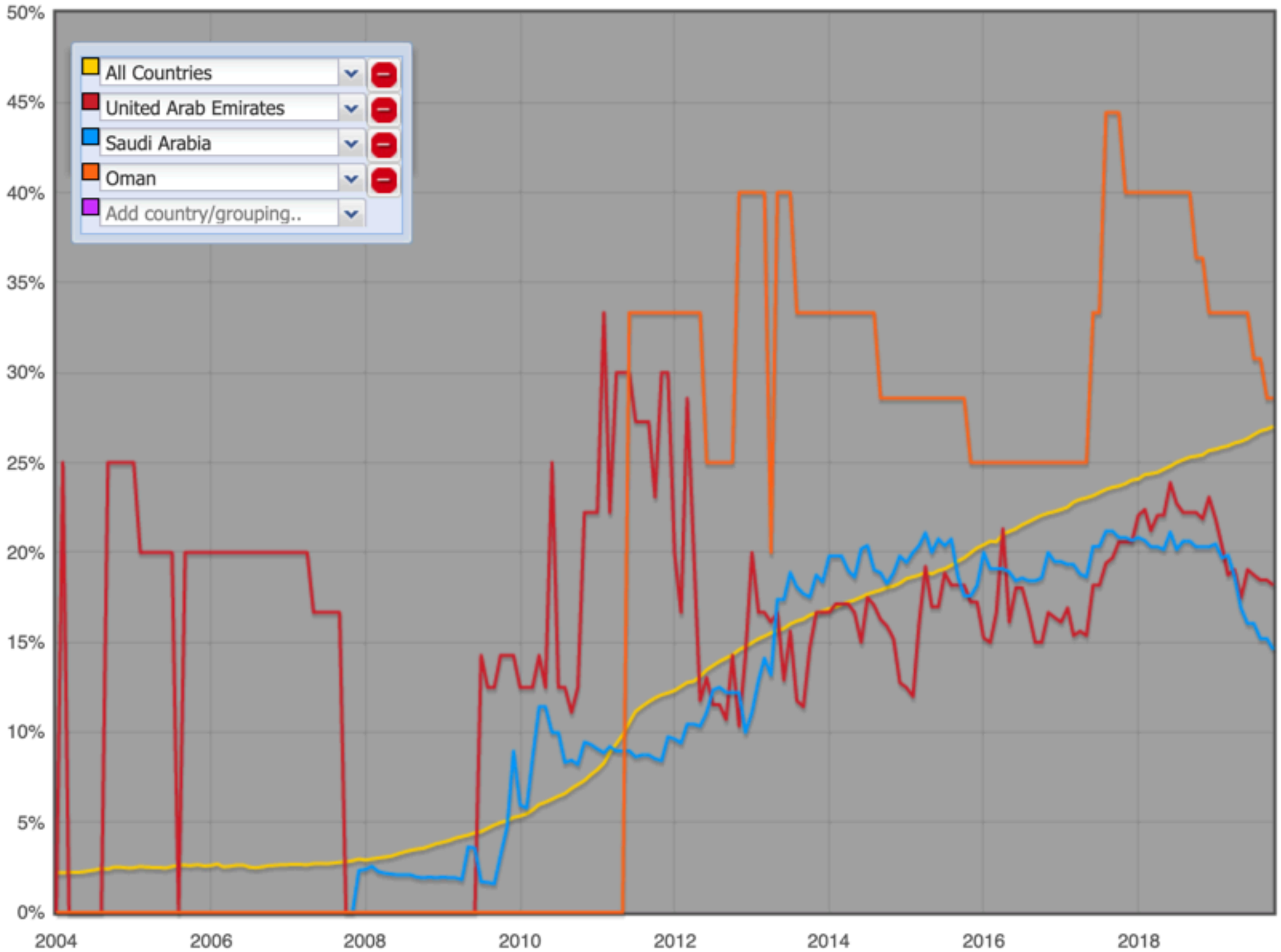
Source: https://www.akamai.com/us/en/resources/our-thinking/state-of-the-internet-report/

IPv6 Statistics - APNIC



Source: https://stats.labs.apnic.net/ipv6/AE

IPv6 Statistics - RIPEness



Percentage AS announcing IPv6 prefix in UAE

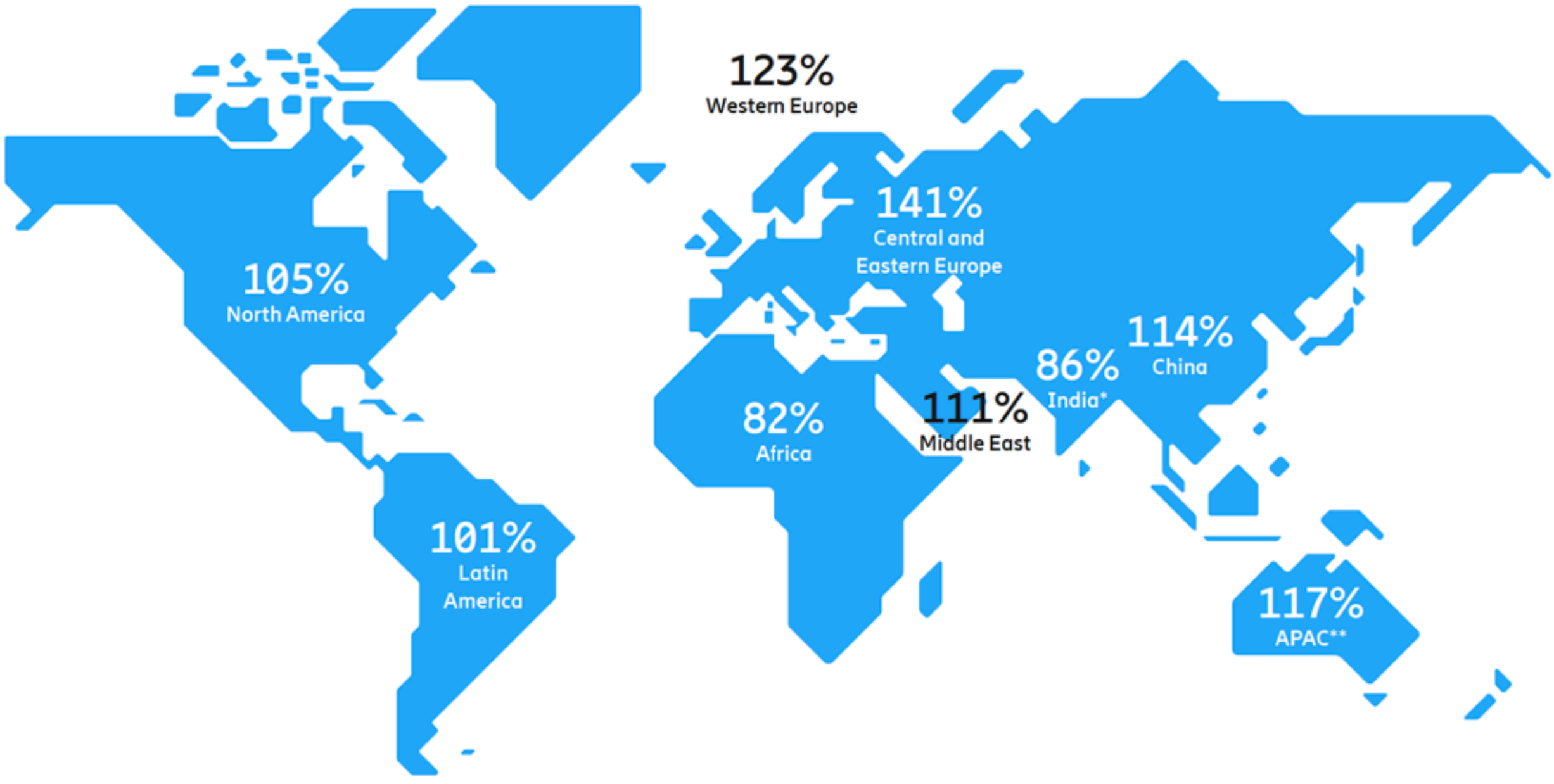
Source: http://v6asns.ripe.net/v/6?s=_ALL;s=AE

Standards migration / Competition

- The demand for public IPv4 addresses is essentially the same under different IPv6 transition approaches.
- It is the interaction between an operator's subscriber size/growth rate and its gateway IPv4/IPv6 traffic ratio that determines the number of public IPv4 addresses required.
- The more quickly an operator's traffic ratio shifts towards IPv6, the more quickly they can reduce demand for public IPv4 addresses.
- The higher the growth rate in subscribers or users, the longer it will take for a network's IPv4 addresses requirements to begin to decline If they are not growing rapidly, they do not have to wait as long - but the lower the growth rate, the lower the incentive to invest heavily in IPv6.

https://www.internetgovernance.org (Feb 2019)

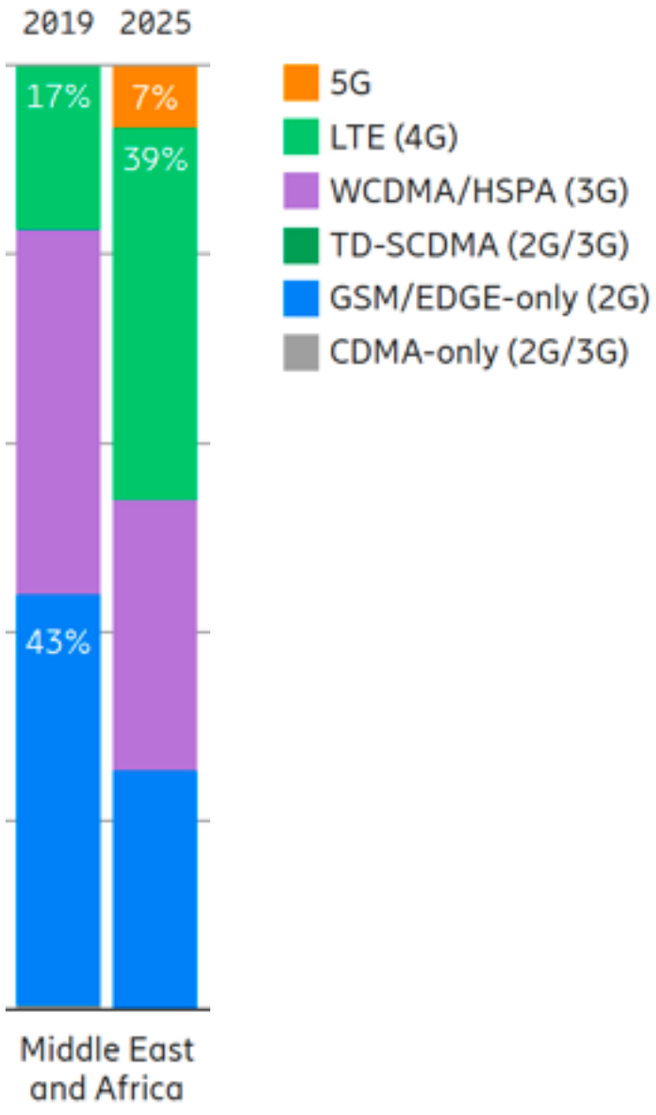
Expectations of Growth



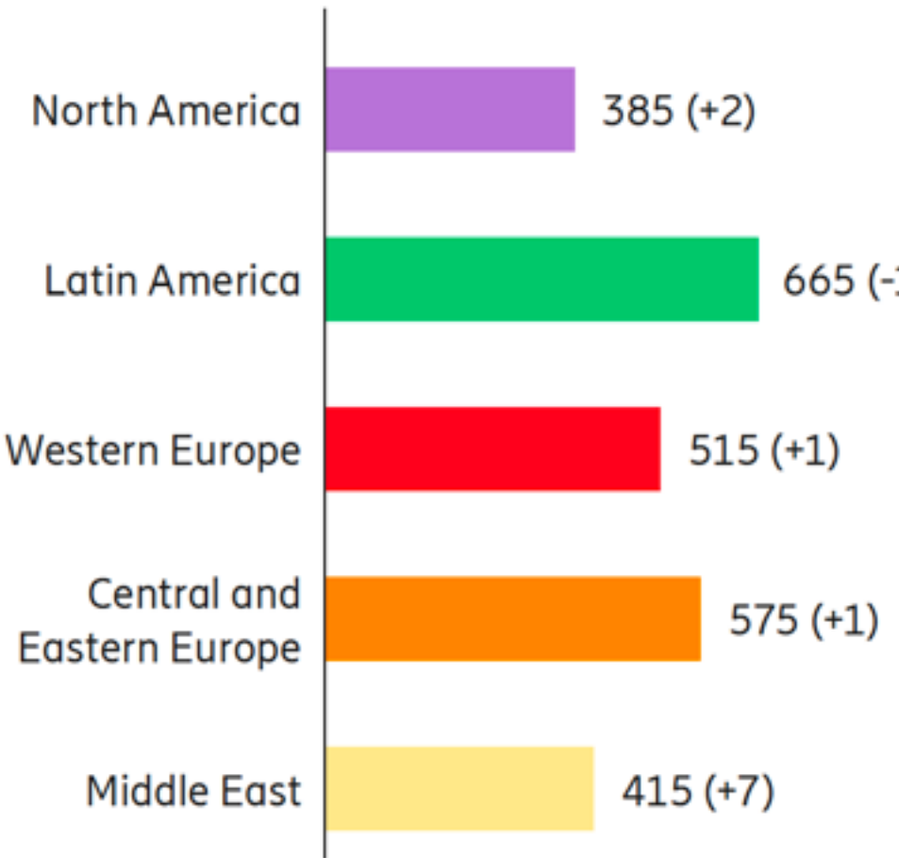
Subscription penetration Q3 2019

Source: Ericsson Mobility Report (Nov 2019)

Expectations of Growth



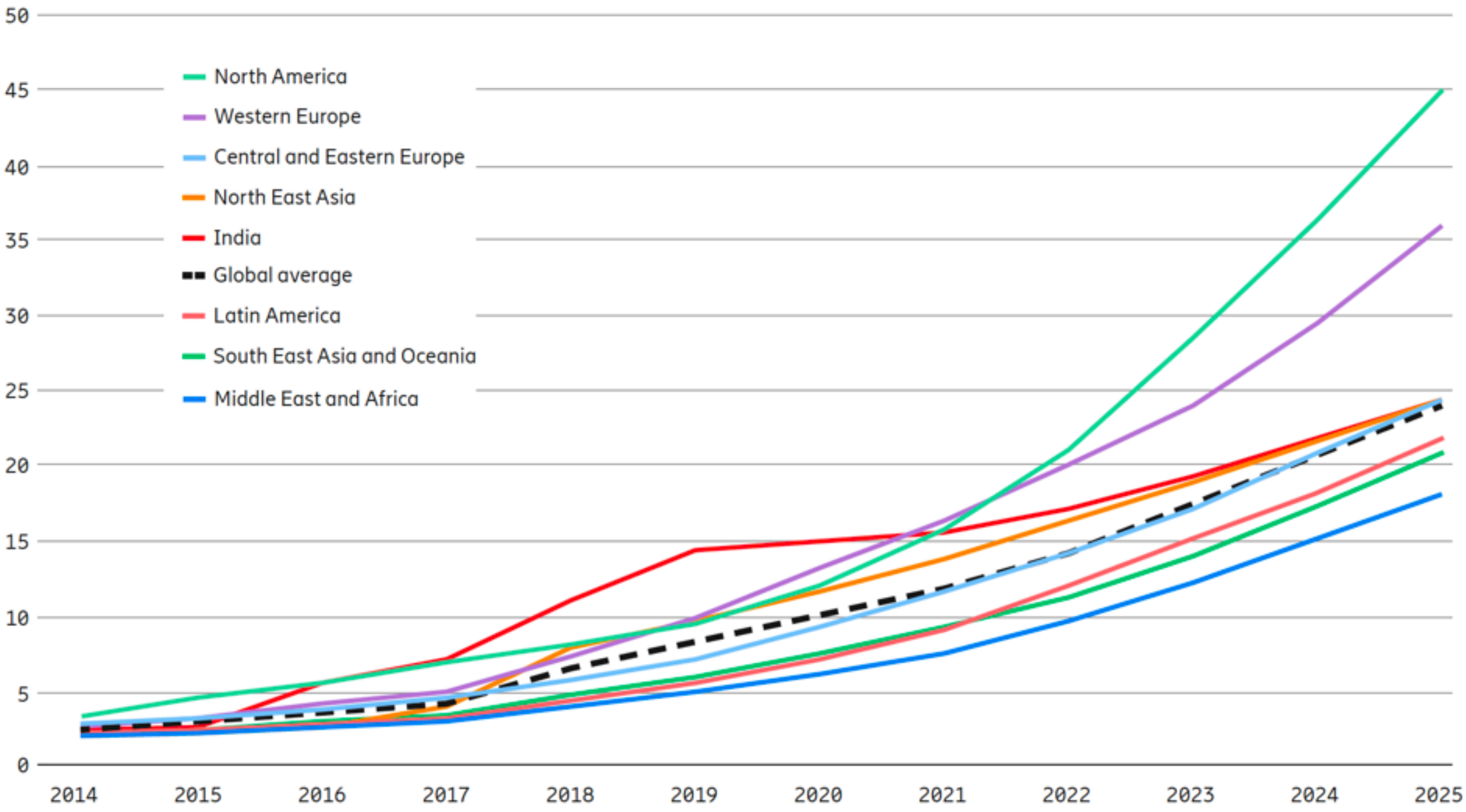
Type of Mobile subscriptions



Total and net additions for mobile Subscriptions Q3 2019 (millions)

Source: Ericsson Mobility Report (Nov 2019)

Expectations of Growth



Mobile Data Traffic per smartphone (GB/month)

Source: Ericsson Mobility Report (Nov 2019)

Expectations of Growth

Downstream

EMEA ⬇ APPLICATION TRAFFIC SHARE **TOP 10**

1	YOUTUBE	16.10% ⬇
2	NETFLIX	12.99% ⬇
3	HTTP MEDIA STREAM	10.30% ⬇
4	AMAZON PRIME	6.06% ⬇
5	QUIC	5.41% ⬇
6	PLAYSTATION DOWNLOAD	3.75% ⬇
7	TWITCH	3.11% ⬇
8	HTTP (TLS)	2.93% ⬇
9	STEAM DOWNLOAD	2.84% ⬇
10	HTTP DOWNLOAD	2.44% ⬇

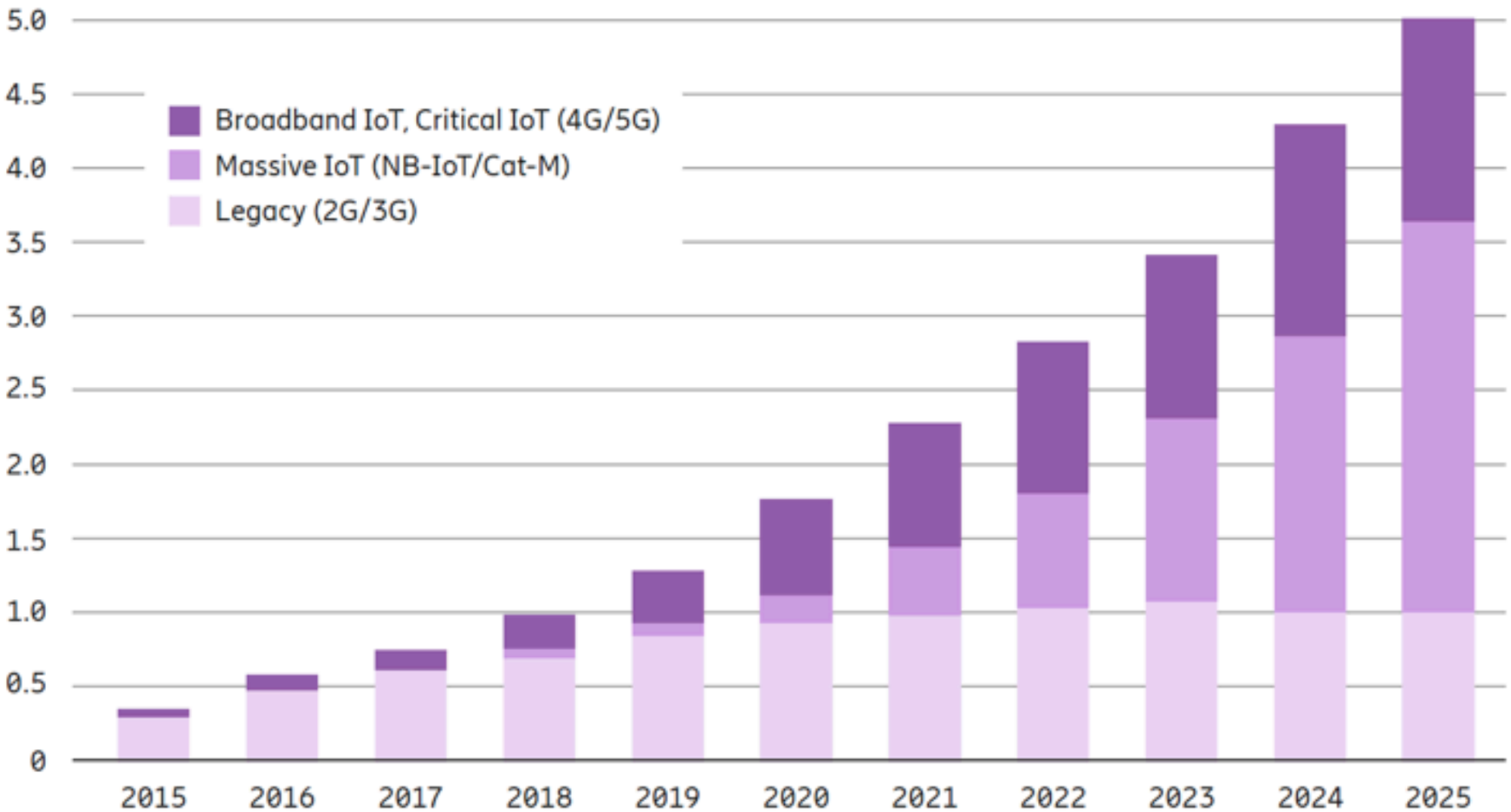
Source: Sandvine - Internet Report 2018

Upstream

EMEA ⬆ APPLICATION TRAFFIC SHARE **TOP 10**

1	BITTORRENT TRANSFER	31.73% ⬆
2	GOOGLE	9.42% ⬆
3	HTTP MEDIA STREAM	6.44% ⬆
4	YOUTUBE	4.09% ⬆
5	RTP	2.31% ⬆
6	WHATSAPP	2.16% ⬆
7	WEBRTC	1.88% ⬆
8	HTTP	1.83% ⬆
9	FACEBOOK	1.80% ⬆
10	NETFLIX	1.69% ⬆

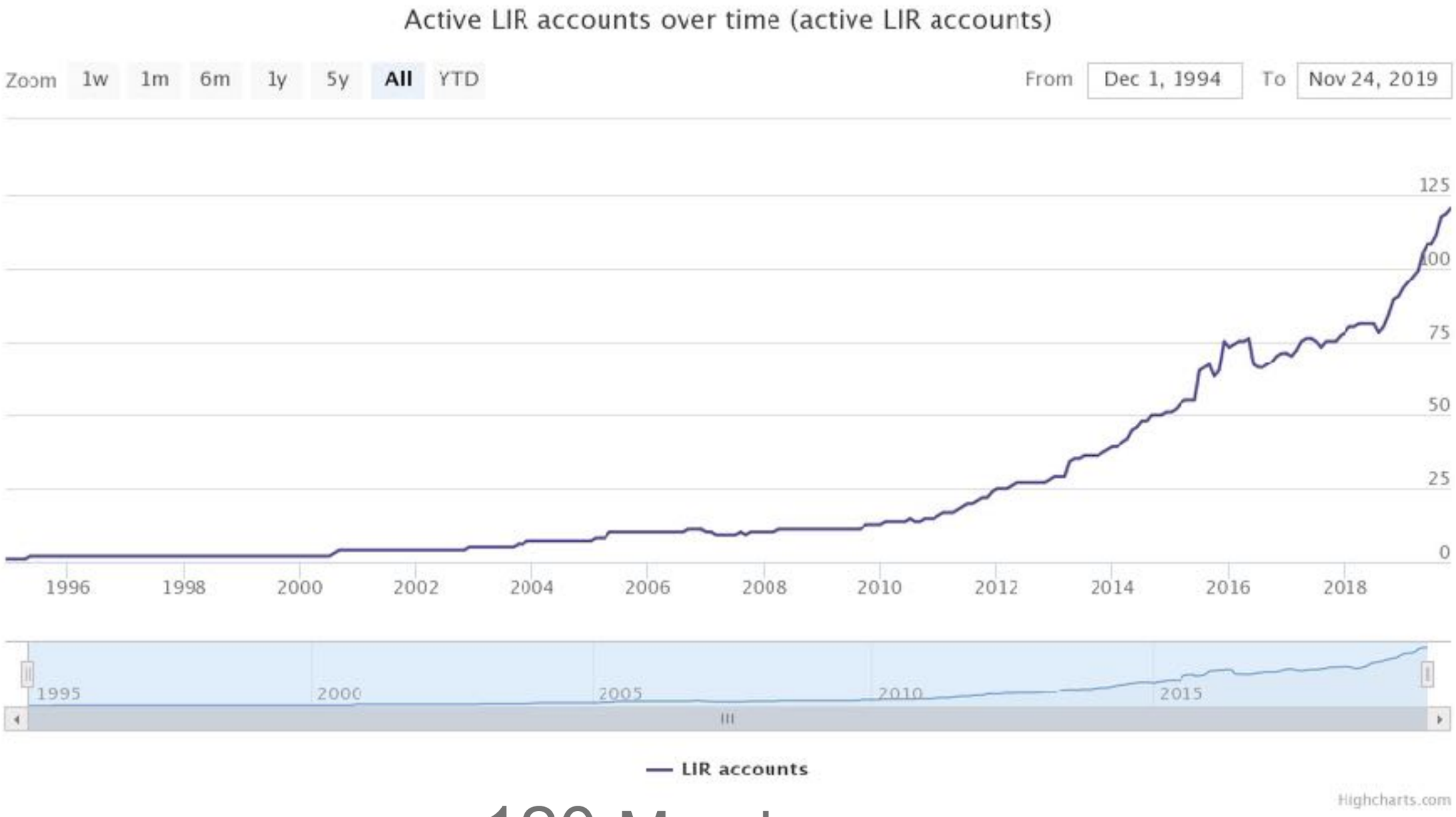
Expectations of Growth



Cellular IoT connections

Source: Ericsson Mobility Report (Nov 2019)

AE Membership Growth



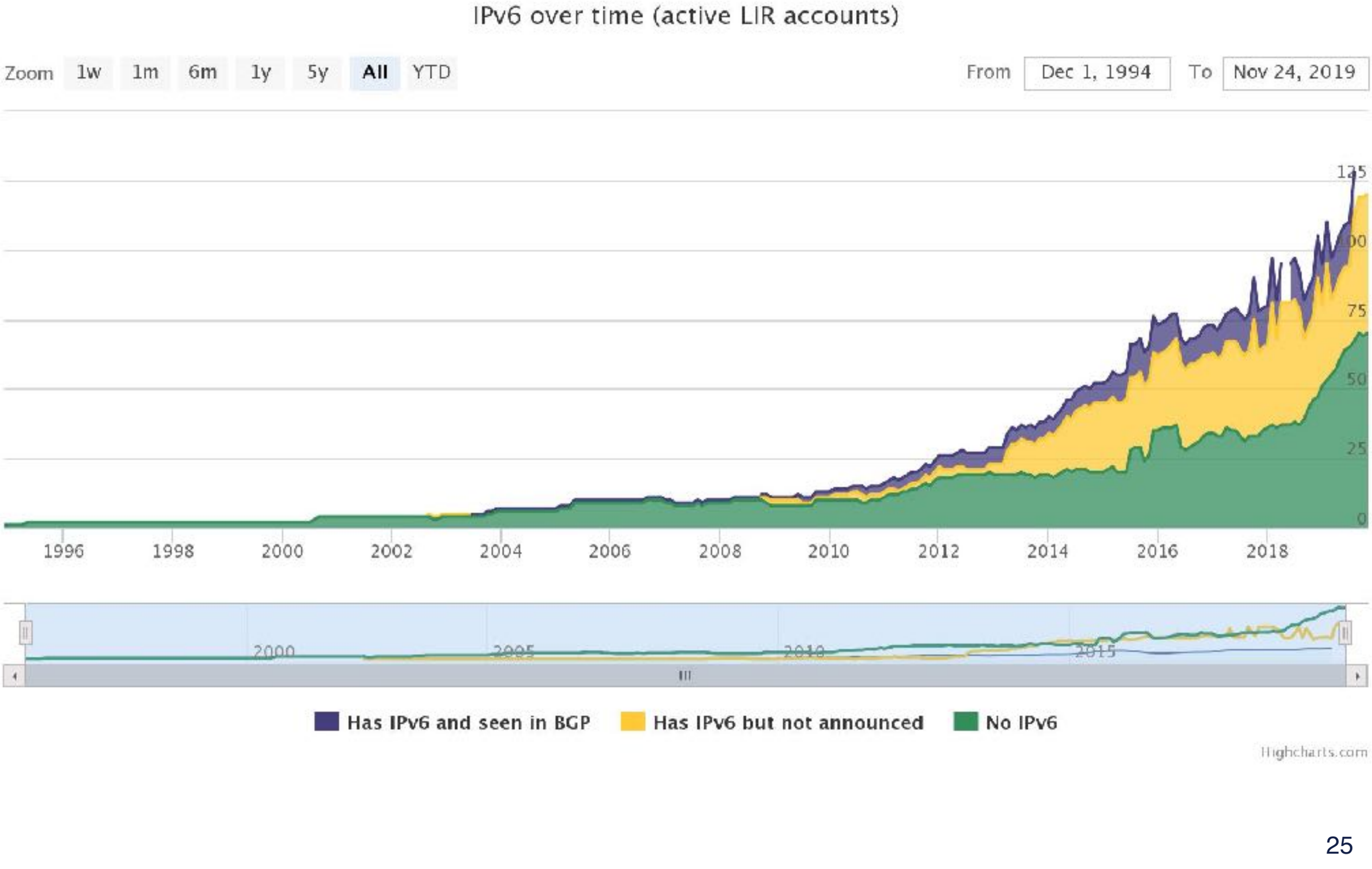
120 Members

Allocated IPv4: ~ 3.74M

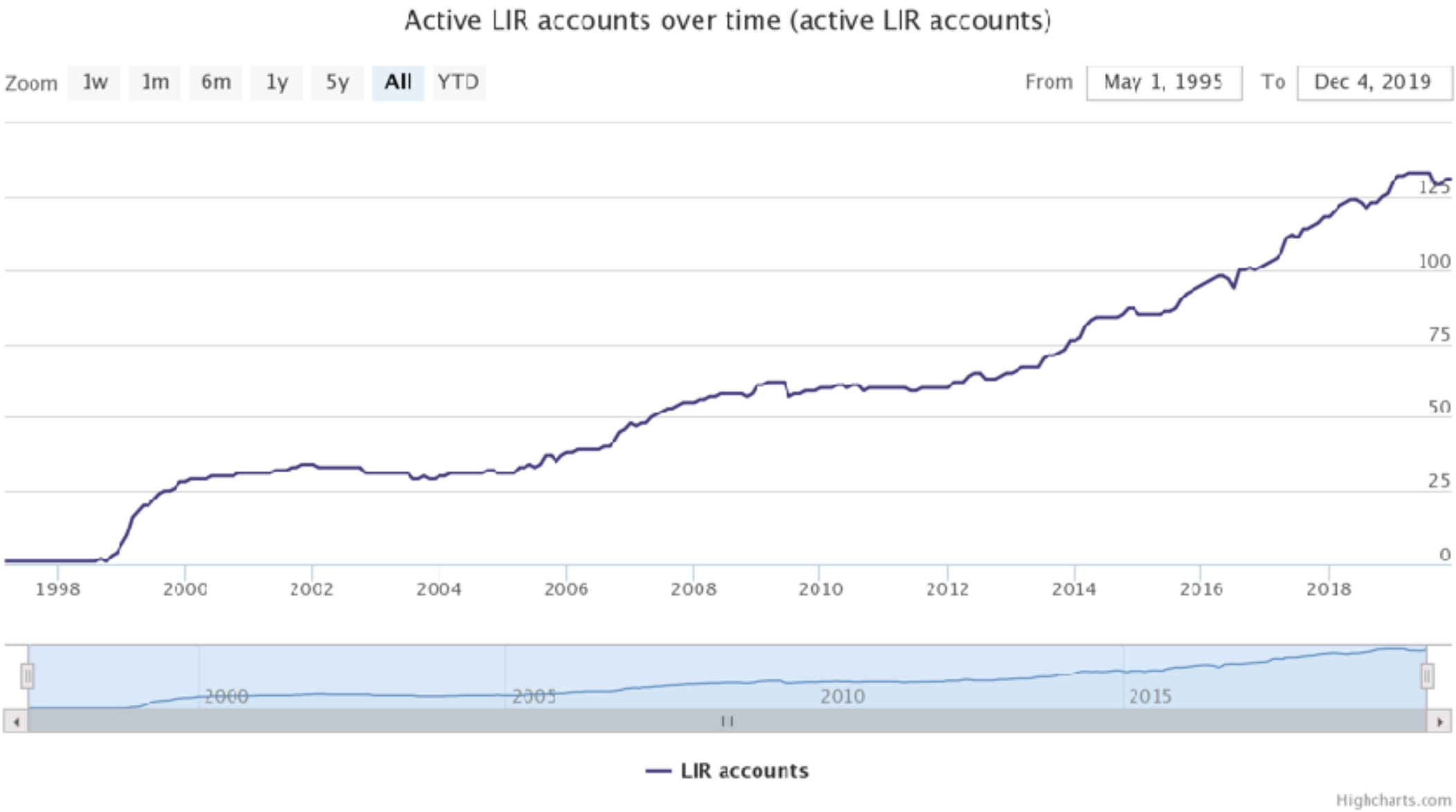
Advertised IPv4: ~ 3.64M

AE Membership Growth

AE Membership Growth

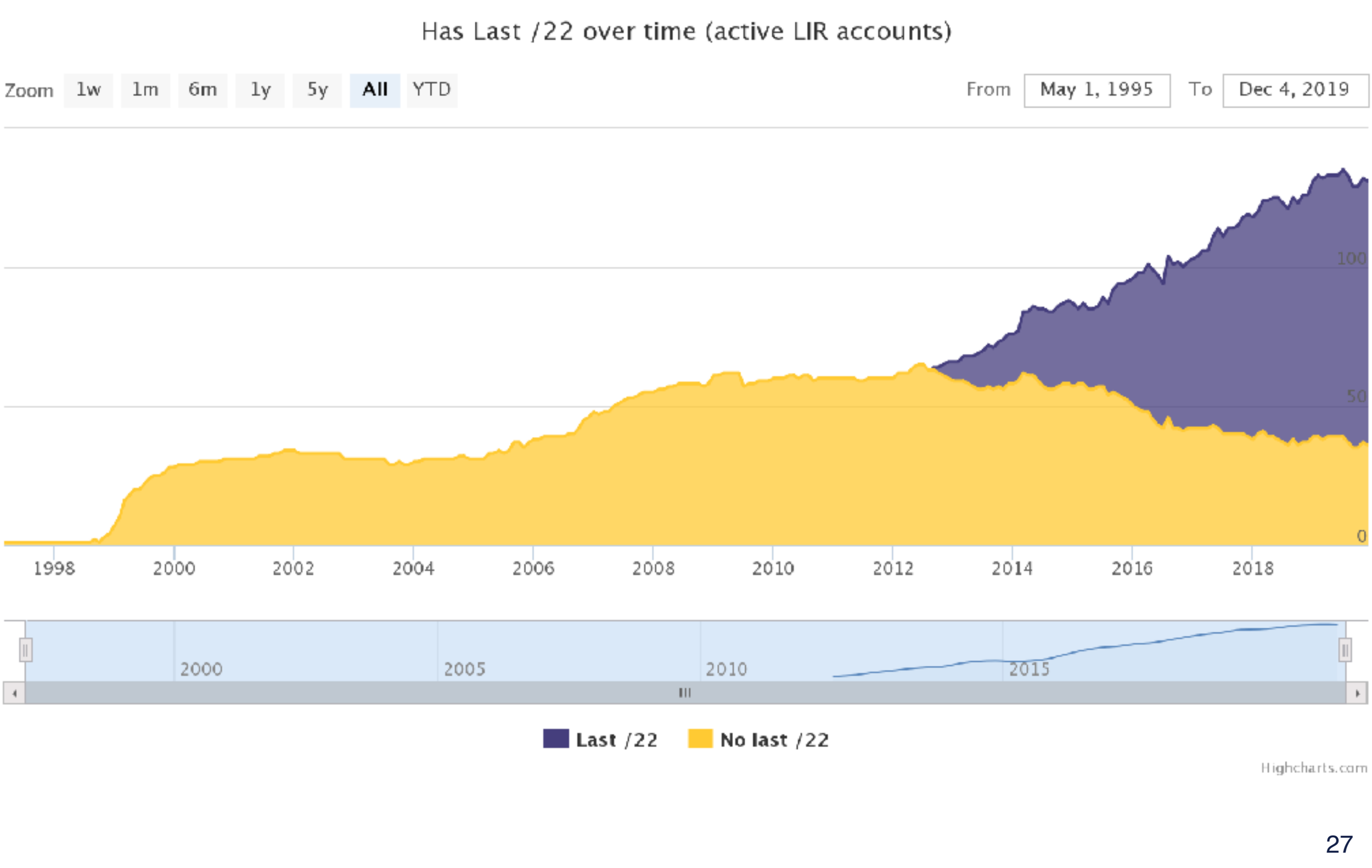


SA Membership Growth

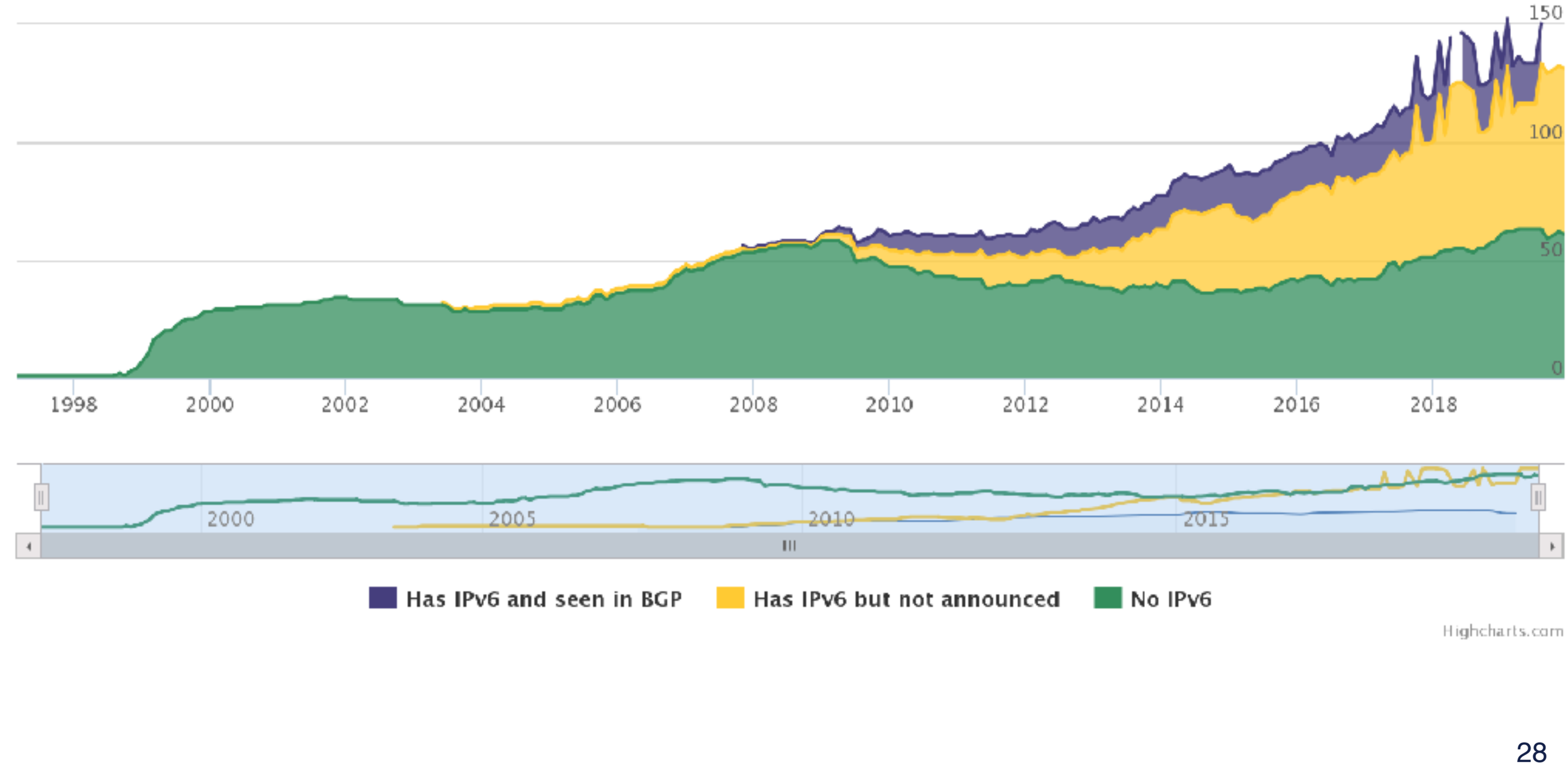


131 Members
Allocated IPv4: ~ 10.4M
Advertised IPv4: ~ 9.7M

SA Membership Growth



SA Membership Growth



There are workarounds…

- Because broadband Internet access has become essential to the United States and the rest of the world, the exhaustion of IPv4 addresses and the transition to IPv6 could result in significant, but not insurmountable, problems for broadband Internet services. In the short term, to permit the network to continue to grow, engineers have developed a series of kludges. These kludges include more efficient use of the IPv4 address resource, conservation, and the sharing of IPv4 addresses through the use of Network Address Translation (NAT).

- While these work-arounds provide partial mitigation for IPv4 exhaustion, they are not a long-term solution because they increase network costs and merely postpone some of the consequences of address exhaustion without solving the underlying problem. Some of these fixes break end-to-end connectivity, impairing innovation and hampering applications, degrading network performance, and resulting in an inferior version of the Internet. Moreover, these kludges require capital investment and ongoing operational costs by network service providers, diverting investment from other business objectives. Network operators will be confronted with increased costs to offer potentially inferior service.

https://www.fcc.gov/ (Dec 2010)

Carrier Grade Nat (CGN)

- Carrier Grade NAT (CGN/CGNAT), also known as Large Scale NAT (LSN)
- CGN enables organisations to deliver IPv4 connectivity while oversubscribing their limited global IPv4 addresses.
- Carriers can assign local (private) IPv4 addresses in their access network, and use a centralised device to manage the address translation to the global (public) Internet.
- Some operators in the region NAT up to 4K users behind a single public IPv4 address.

Carrier Grade Nat (CGN)

Council of the European Union

Brussels, 16 January 2017
(OR. en)

5127/17

LIMITE

CYBER 7
COPEN 9
JAI 33
COSI 8
ENFOPOL 33

NOTE

From:	EUROPOL/EC3
To:	Delegations
Subject:	Carrier-Grade Network Address Translation (CGN) and the Going Dark Problem - initial debate

Source: http://www.statewatch.org/news/2017/jan/eu-europol-cgn-tech-going-dark-data-retention-note-5127-17.pdf

IPv4 Transfers & Brokers

- Some members may decide to use a broker to find an organisation offering or seeking address space and to help facilitate the process by advising on the processes and policies that need to be followed.
- It is up to members to find and organise a transfer of IPv4 address space.
- The RIPE NCC will not be involved in the process of reaching an agreement between the parties involved in the transfer of IPv4 address space.

https://www.ripe.net/manage-ips-and-asns/resource-transfers-and-mergers/transfers/brokers/brokers

Cost of running an IP Network

- Cost of running IPv4 network {Cv4}
  - Cost of acquiring new IPv4 addresses {A}
  - Cost of extending the usage cycle of IPv4 addresses (NAT, CGNAT, etc) {B}
- Cost of running IPv6 network {Cv6}
  - Initial investment in infrastructure (one-off) {X}
  - Interoperability Cost (NAT64/DNS64, etc) {Y}
  - Cost of acquiring new IPv6 addresses {Z}
- {A} will keep on increasing due to rise in IPv4 prices
- {B} and {Y} are comparable in nature today.

Cost of running an IP Network

- How do we compare {Cv4} and {Cv6}
  - Depends on the size of the network
  - Depends on the traffic ratio between v4 and v6
  - Depends on the technology adopted for IPv6 deployments

- Network growth is key driver to adopt IPv6

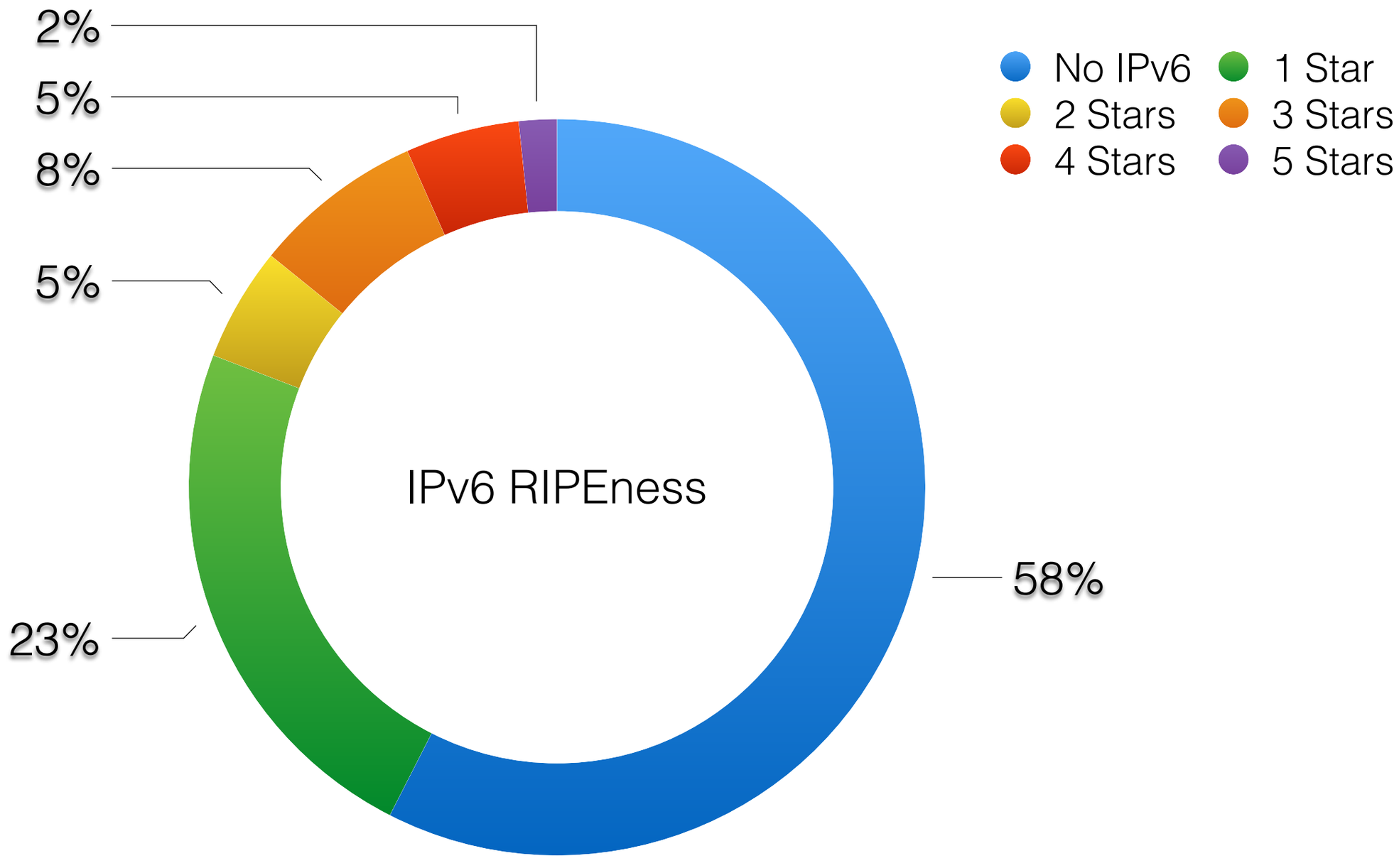
- Any initiative to lower Initial investment cost of deployment or lowers interoperability costs will be an incentive to IPv6

- Traffic pattern of the eyeballs will affect the total need of IPv4 addresses and transition mechanisms

Cost of running an IP Network

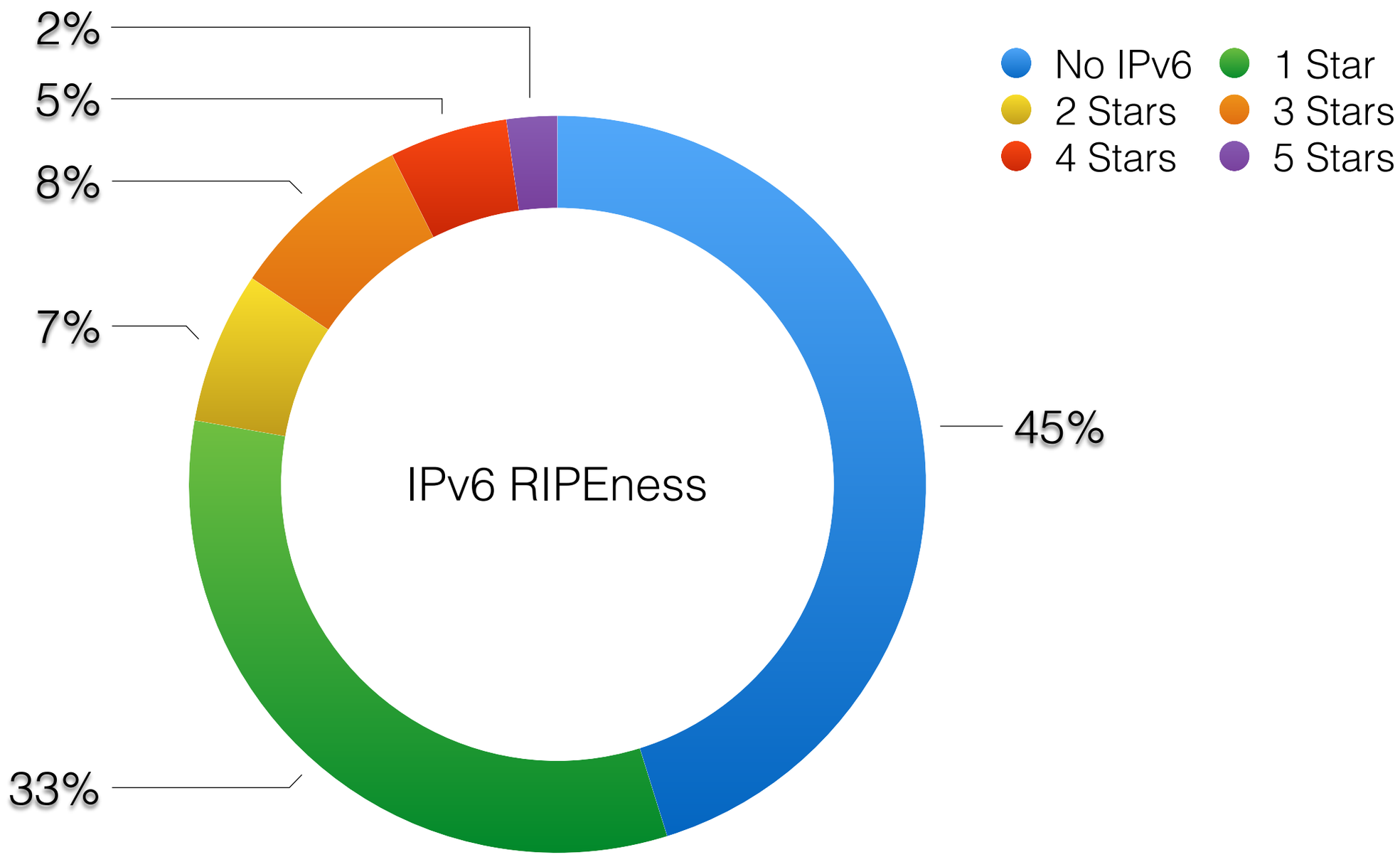
- The more network traffic flows over IPv6, the more the deployment becomes efficient
- In that sense, a network operator cost of deployment will depend on the adoption of IPv6 by others
  - Content ↑ IPv6 ↑ Interoperability ↓ Cost ↓

IPv6 Statistics - RIPEness - UAE



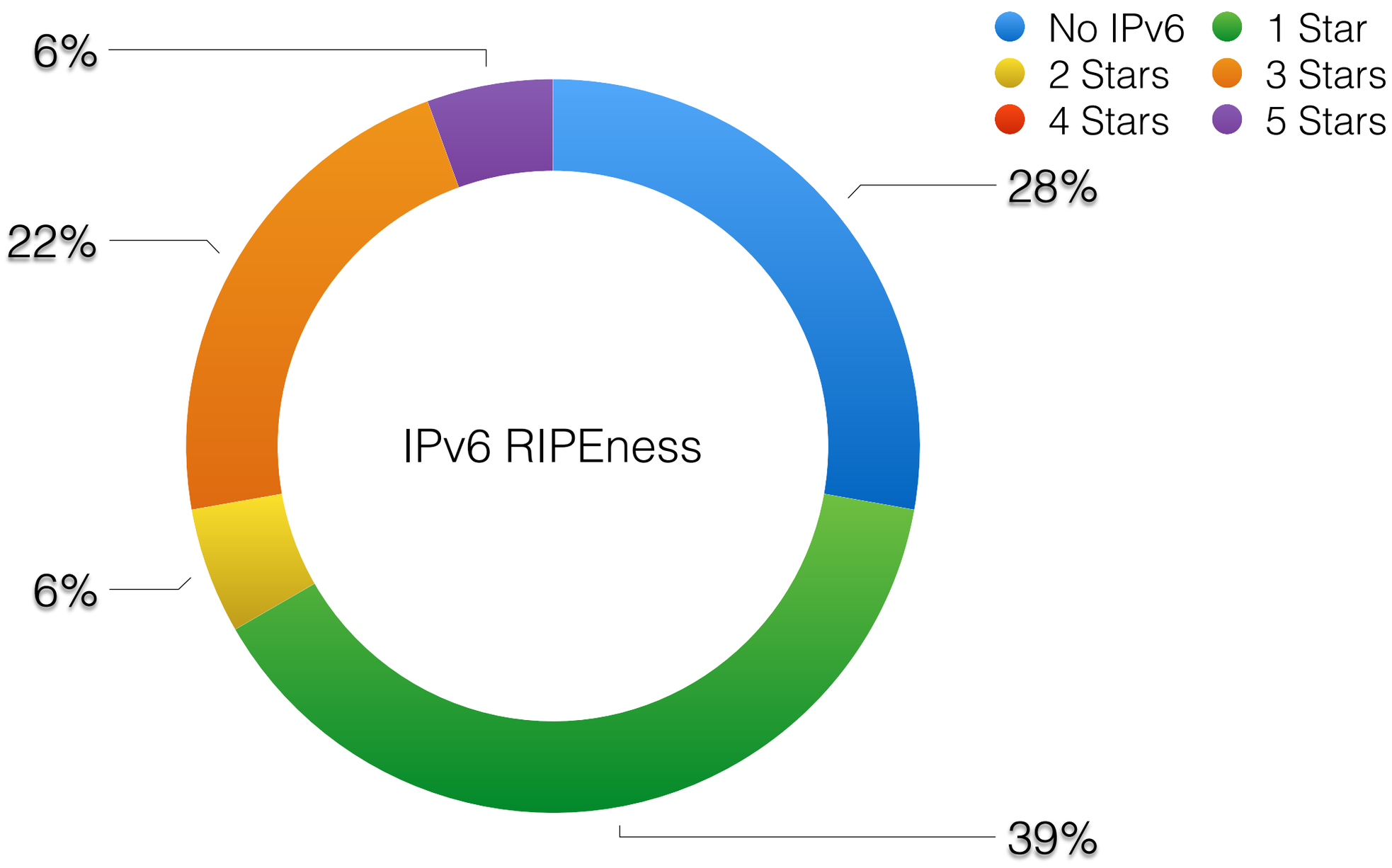
Source: http://ripeness.ripe.net/pies.html

IPv6 Statistics - RIPEness - KSA



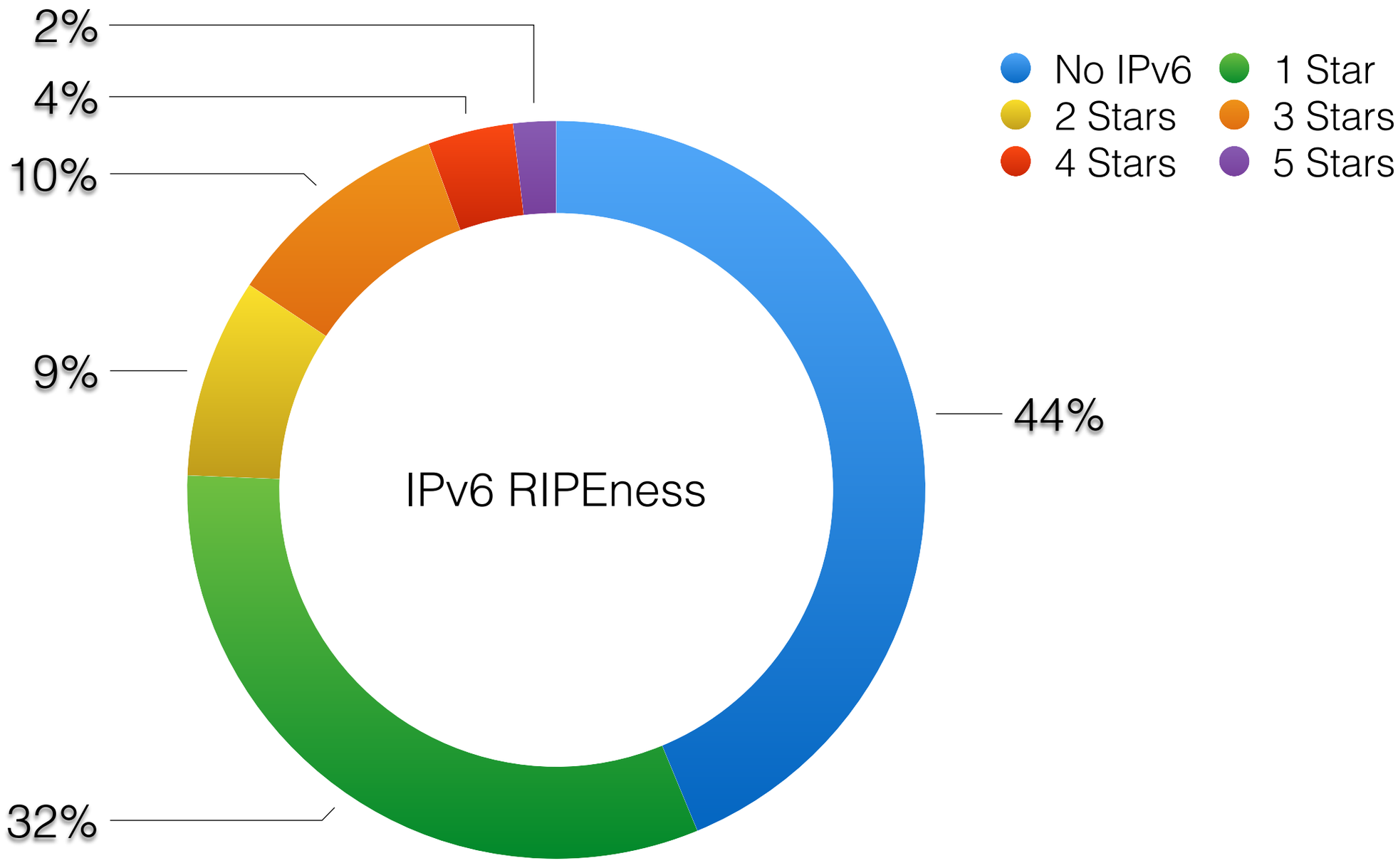
Source: http://ripeness.ripe.net/pies.html

IPv6 Statistics - RIPEness - Oman



Source: http://ripeness.ripe.net/pies.html

IPv6 Statistics - RIPEness - LB



Source: http://ripeness.ripe.net/pies.html

IF IPv6 adoption is slow

- IPv6 ↓ IPv4 ↑ Cost ↑ Transfers ↑ Security ↓

- Need for IPv4 ↑ Growth ↓ Sustainability ↓

- Need for IPv4 ↑ NAT ↑ Operations ↑ Security ↓

- IPv4 Cost ↑ BGP Hijacks ↑ Security ↓

Government's role(s)

- User
- Regulator
- Growth Enabler
- Financial Enabler
- Innovation Enabler
- Infrastructure build out for private sector
- First-mover advantage?

Business Risks of not migrating

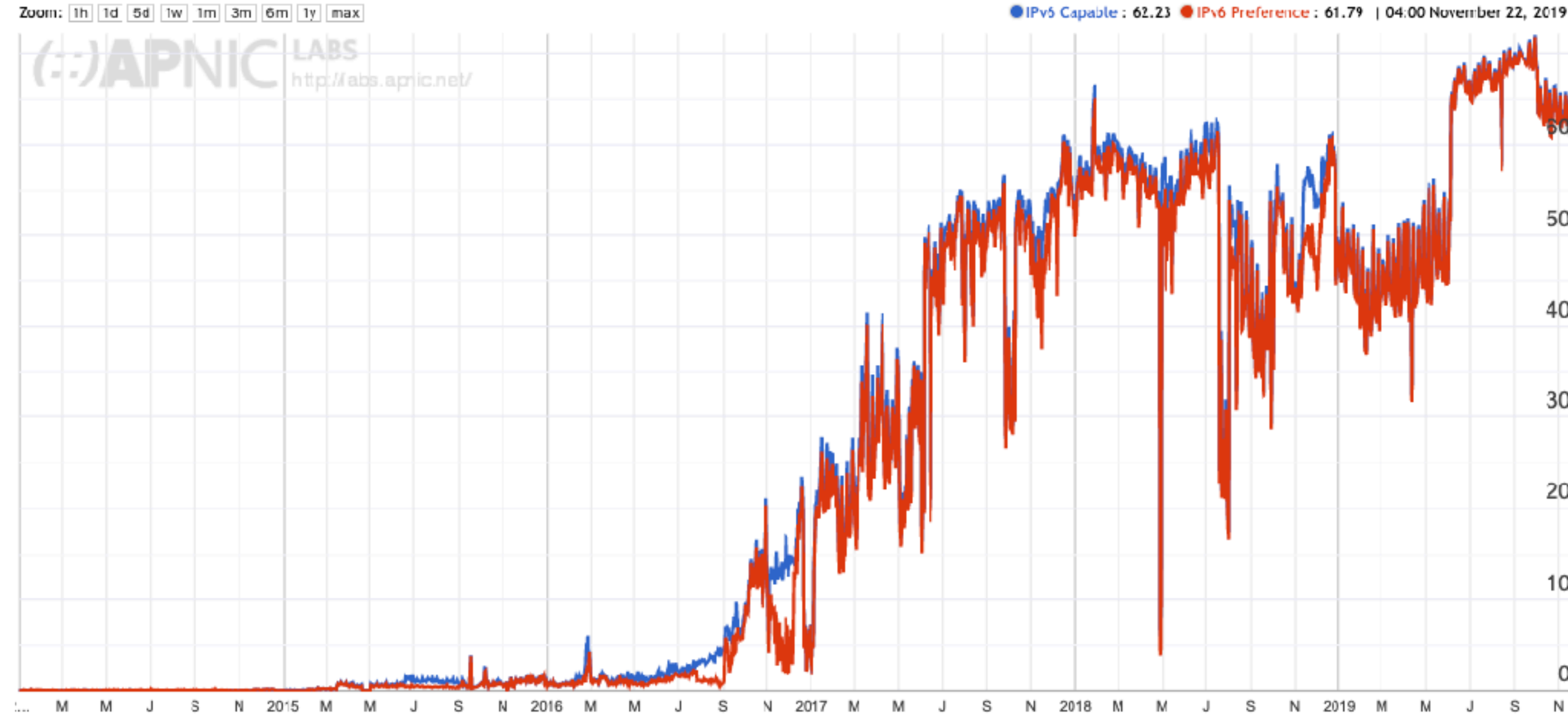
- The risk of being left out of a growing mobile market demographic because you can't communicate with them over IPv6 (lost opportunity)
- The inability to test and validate how services are performing because you can't test and monitor the IPv6 services due to lack of deployment internally (lack of assurance)
- The speed and performance improvements from IPv6 provide users with a better experience from a competitor (who does have IPv6) and away from you due to lack of deployment (lost business)
- The lack of IPv6 reduces the addressable market opportunity for the company (lost business)
- Failure to have your iOS mobile app accepted in the Apple store due to lack of IPv6 testing and support (interruption of existing revenue)
- No logging or business data correlation information for those coming from IPv6 (lost marketing and business analytics opportunity)

https://blogs.infoblox.com/ (Feb 2019)

Relationships with Trade Partners

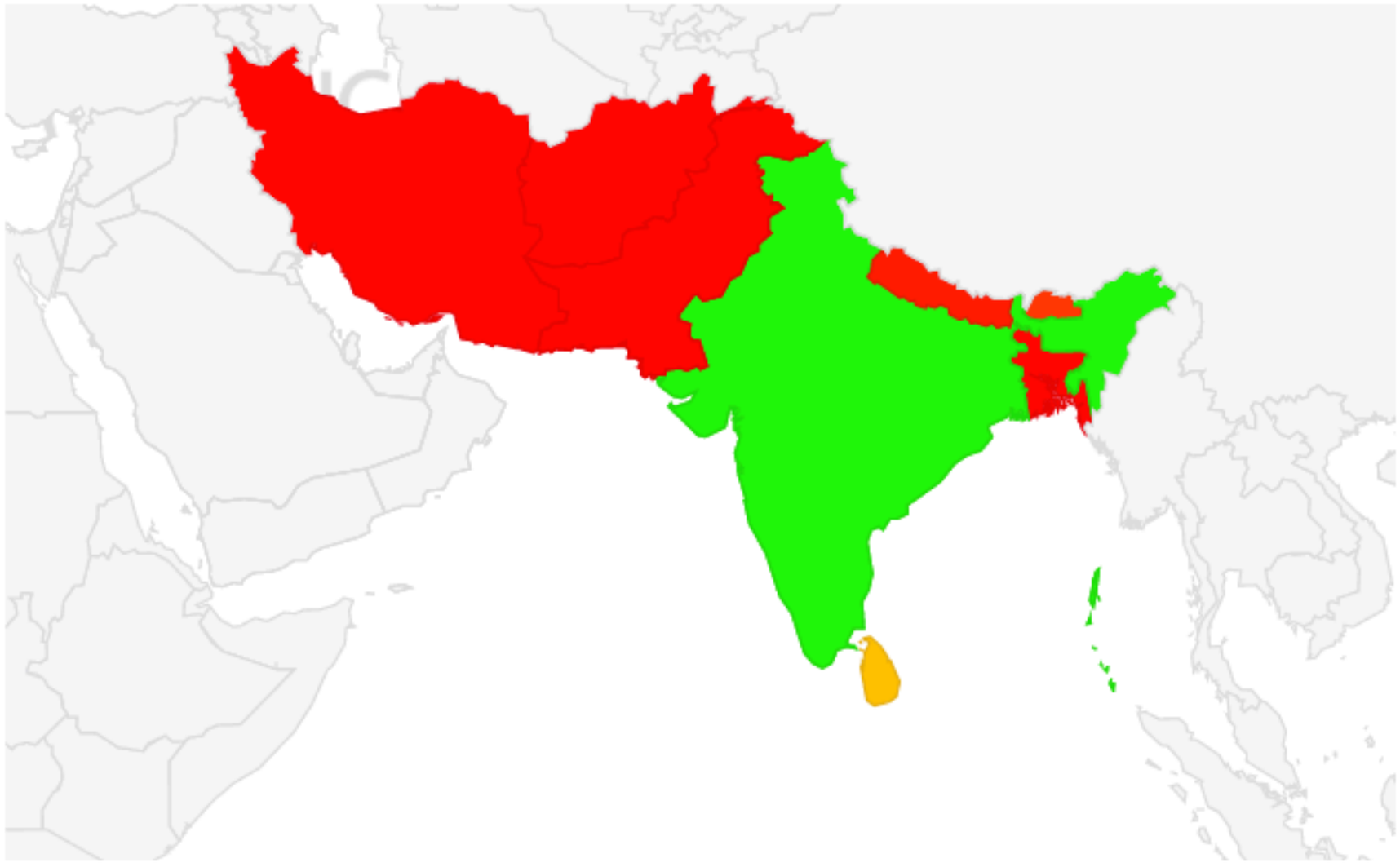
- IPv6 is becoming the default standard in many of the new SW/HW
- Being IP6-ready will help mitigate interoperability issues
- Better user experience across networks / across countries (i.e Roaming)
- Access to latest developments in the tech world
- IPv6 is being developed as a core part of the next generation's backbones (i.e SRv6)
- IoT efforts to develop solutions on top of IPv6
- Improved e-services/e-payments
- Access to IPv6-Only technology

IPv6 Statistics - APNIC - India



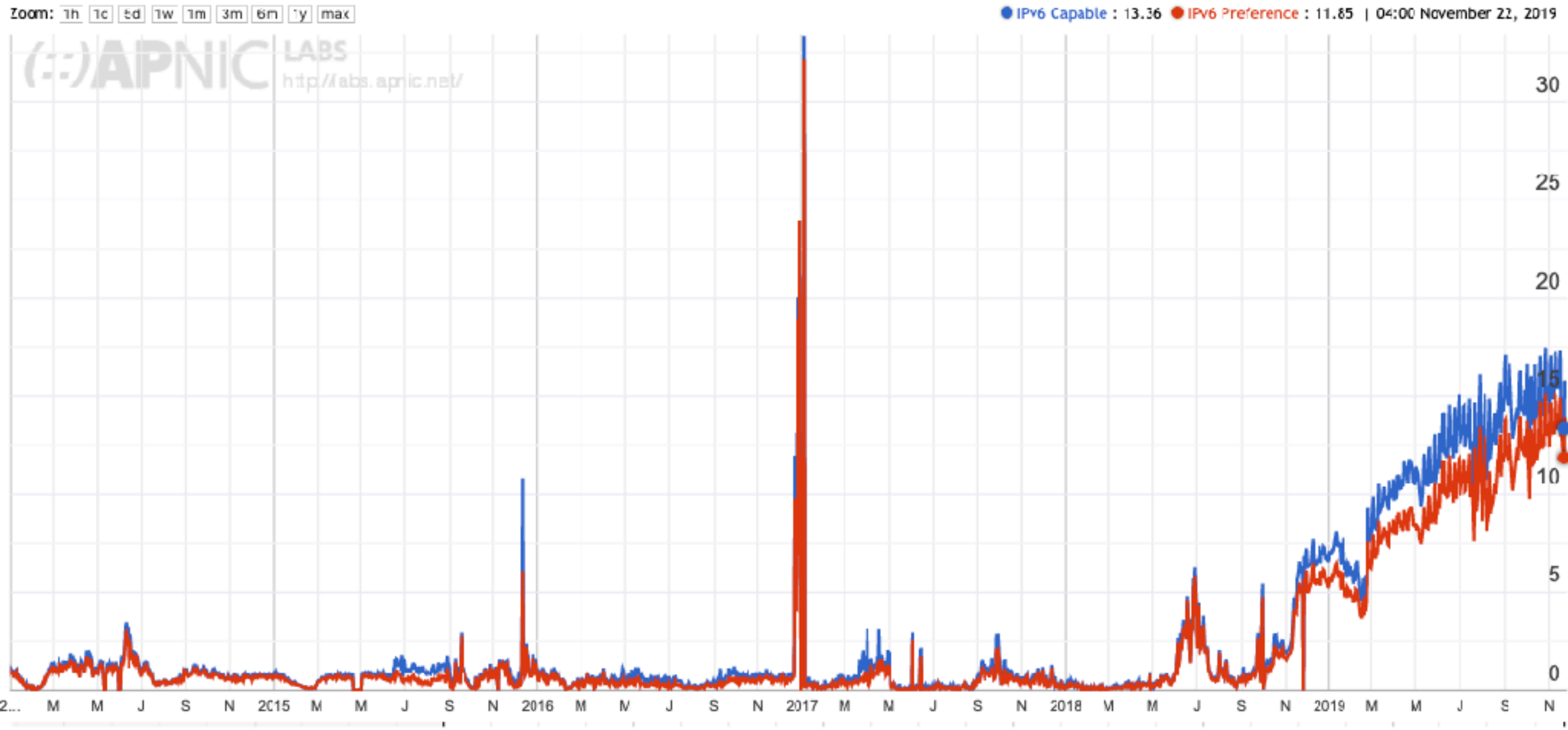
Source: https://stats.labs.apnic.net/ipv6/IN

IPv6 Statistics - APNIC - India



Source: https://stats.labs.apnic.net/ipv6/IN

IPv6 Statistics - APNIC - China

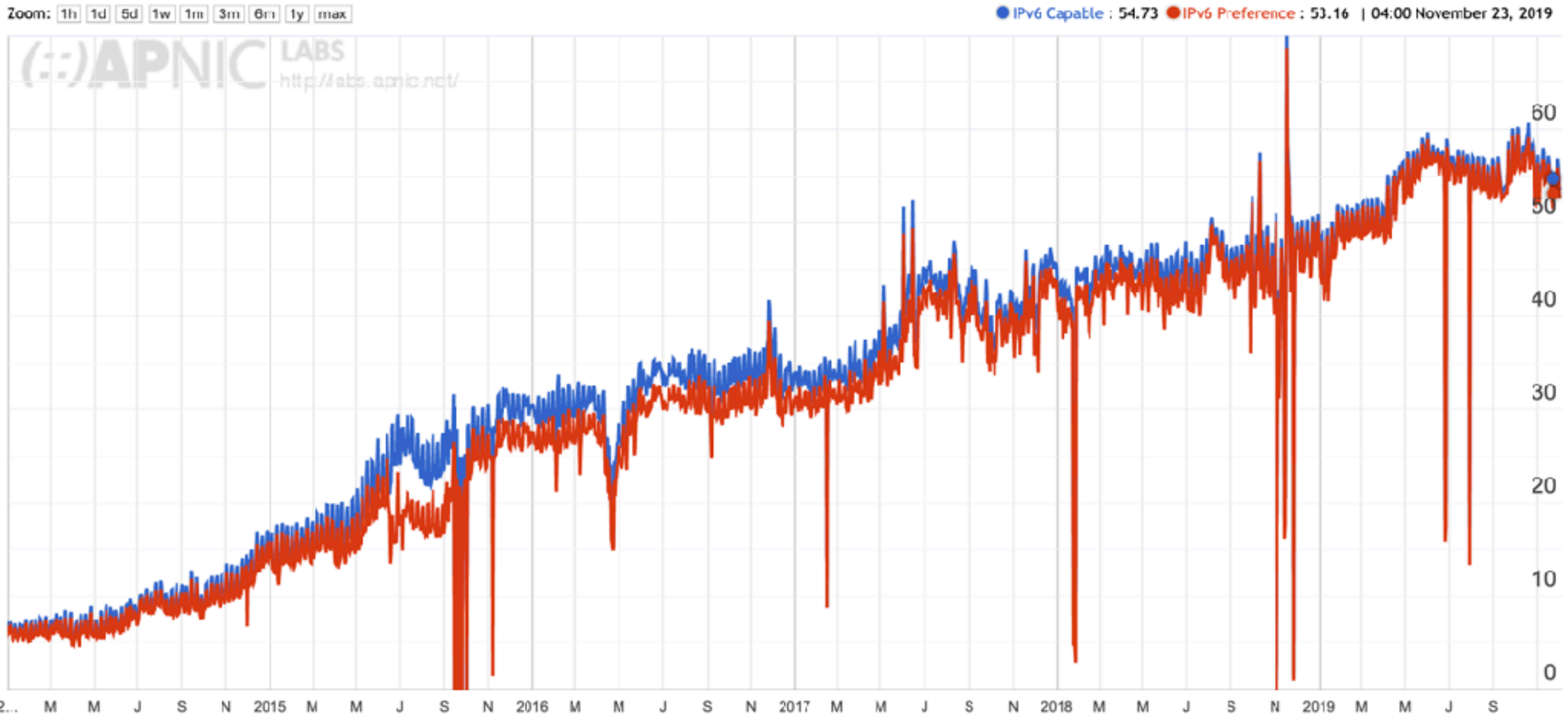


Source: https://stats.labs.apnic.net/ipv6/CN

IPv6 Statistics - APNIC - China

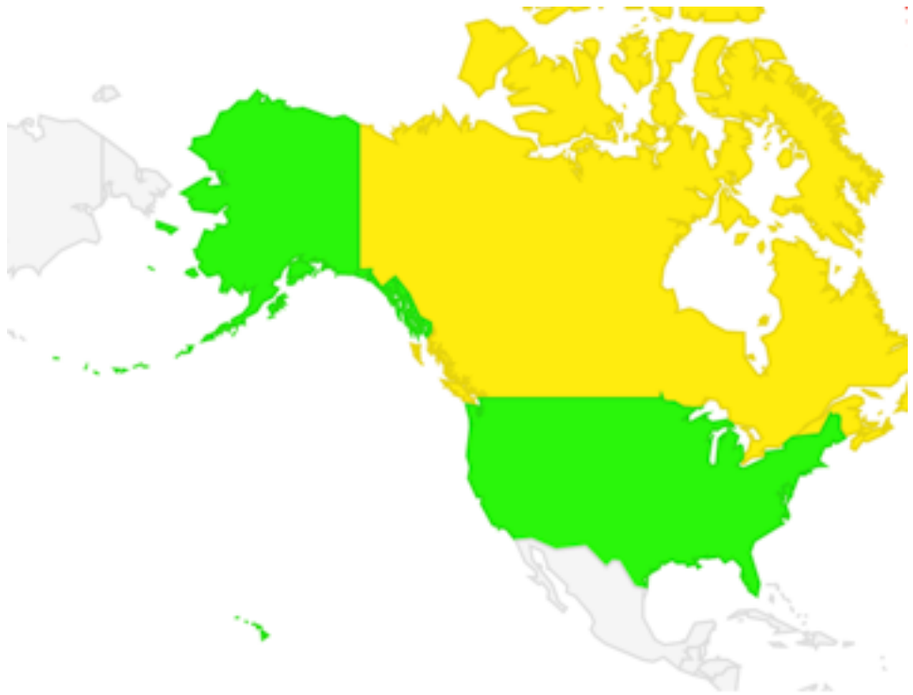
Source: https://stats.labs.apnic.net/ipv6/CN

IPv6 Statistics - APNIC - USA



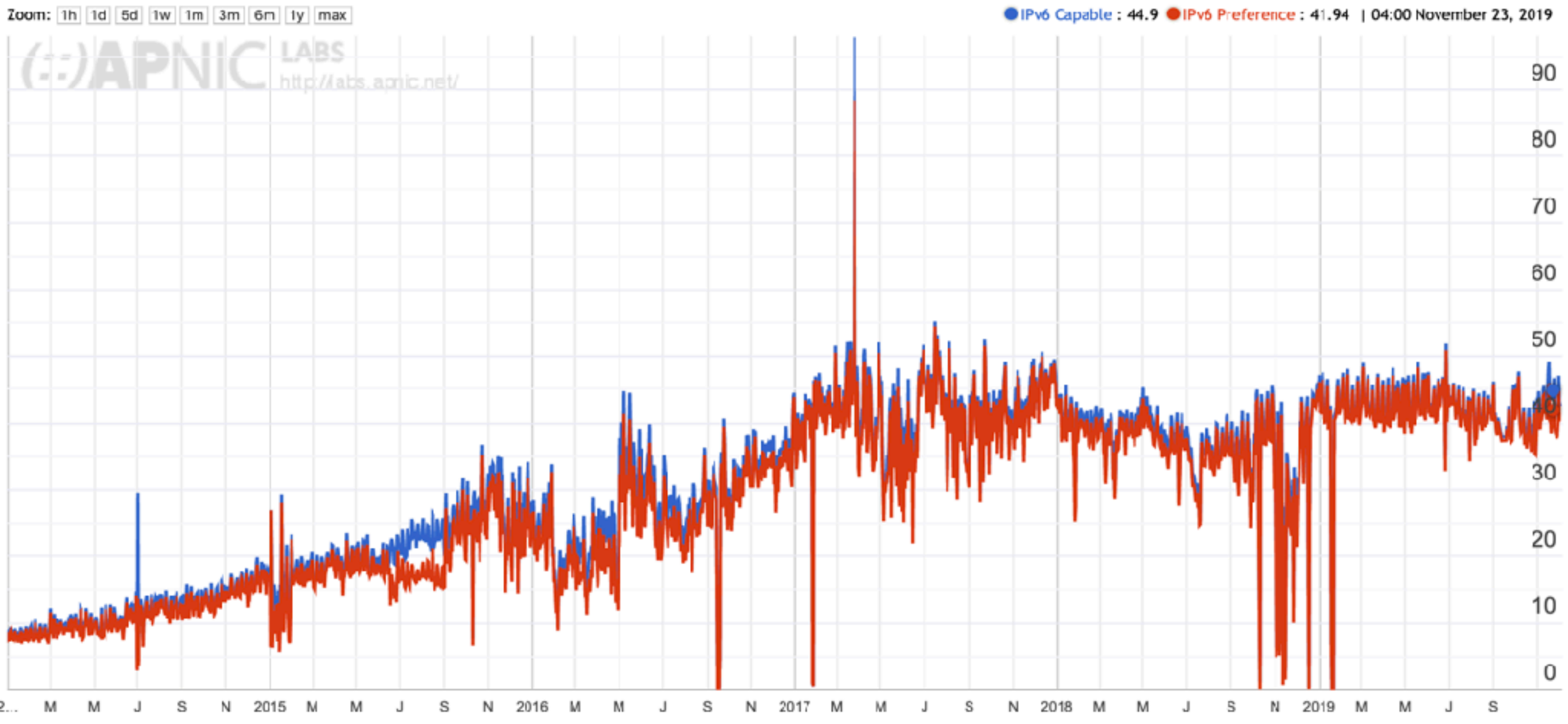
Source: https://stats.labs.apnic.net/ipv6/US

IPv6 Statistics - APNIC - USA



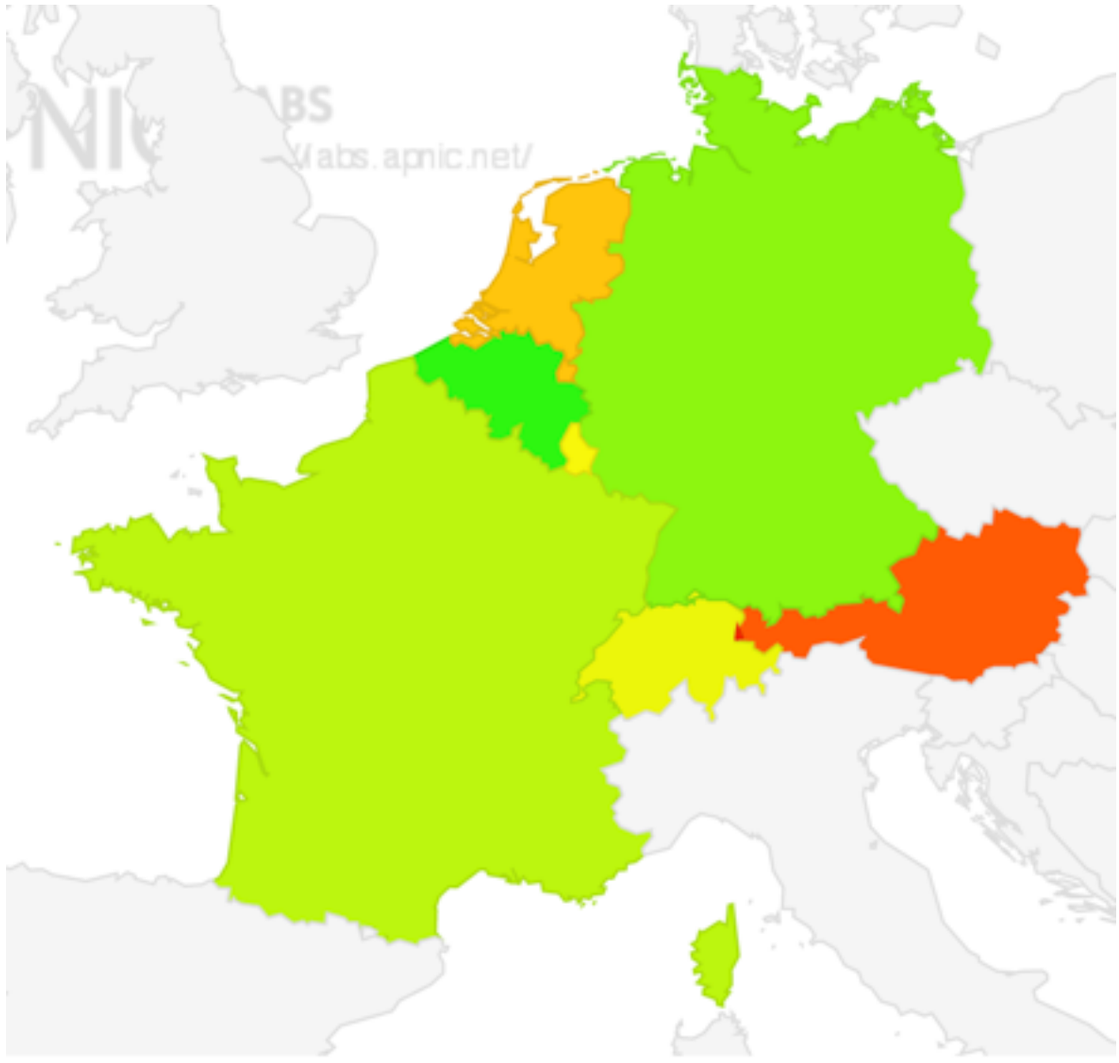
Source: https://stats.labs.apnic.net/ipv6/US

IPv6 Statistics - APNIC - Germany



Source: https://stats.labs.apnic.net/ipv6/DE

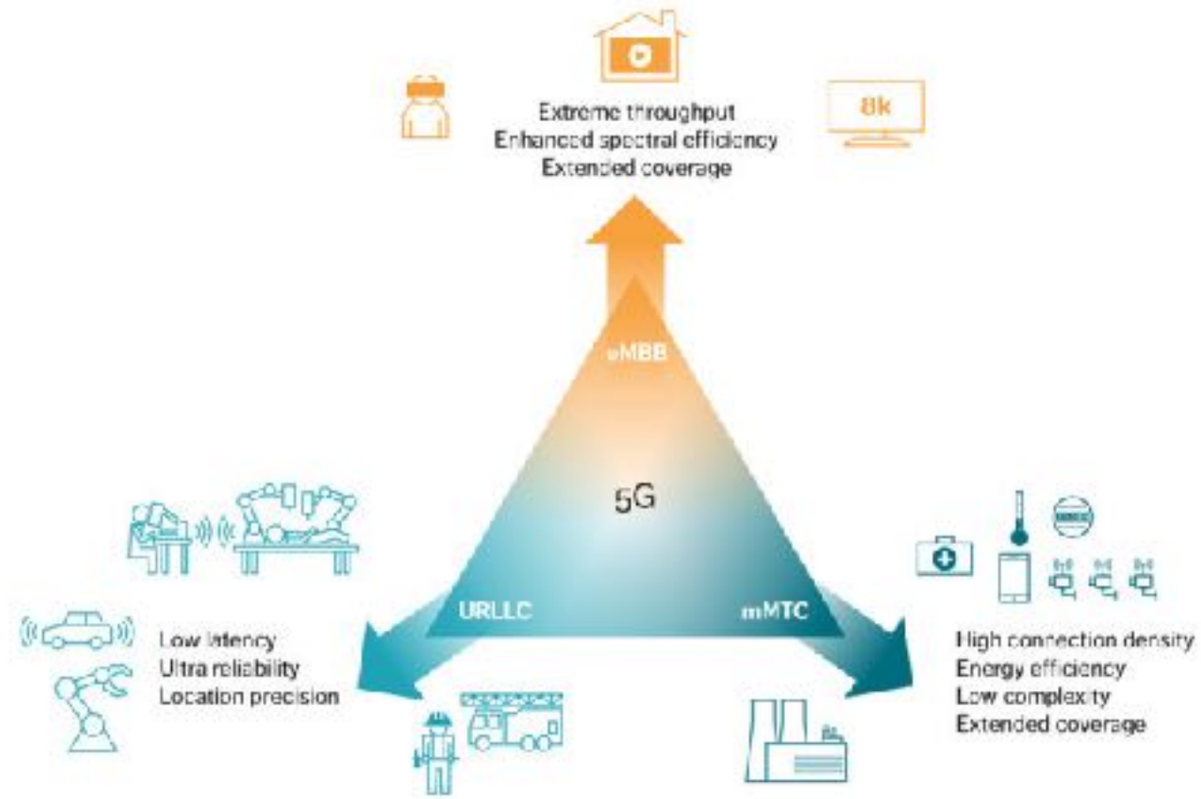
IPv6 Statistics - APNIC - Europe



Source: https://stats.labs.apnic.net/ipv6/US

The impact of 5G

5G Use Cases



Source: Ericsson

5G - eMBB

Coverage ↑ Users ↑ Need for IPs ↑

5G - mMTC

Density ↑ Growth ↑ Need for IPs ↑

5G - URLLC

NAT ↑ Latency ↑ Location ↓

Questions