HURRICANE ELECTRIC
INTERNET SERVICES

IPv6 Adoption over Internet Exchanges

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Pro IPv6 Disclaimer

Hurricane Electric has worked to advance IPv6 deployments globally.

- HE received its first IPv6 allocation in 2001.
- Our network completed a native IPv6 conversion in 2007.
- HE peers with more ASNs over IPv6 than any other network.

IPv6 Adoption over Internet Exchanges

With IPv4 now depleted from two of the six RIRs, it is time to take a look at how the top Internet Exchanges have progressed in adoption of IPv6.

My assumptions are:

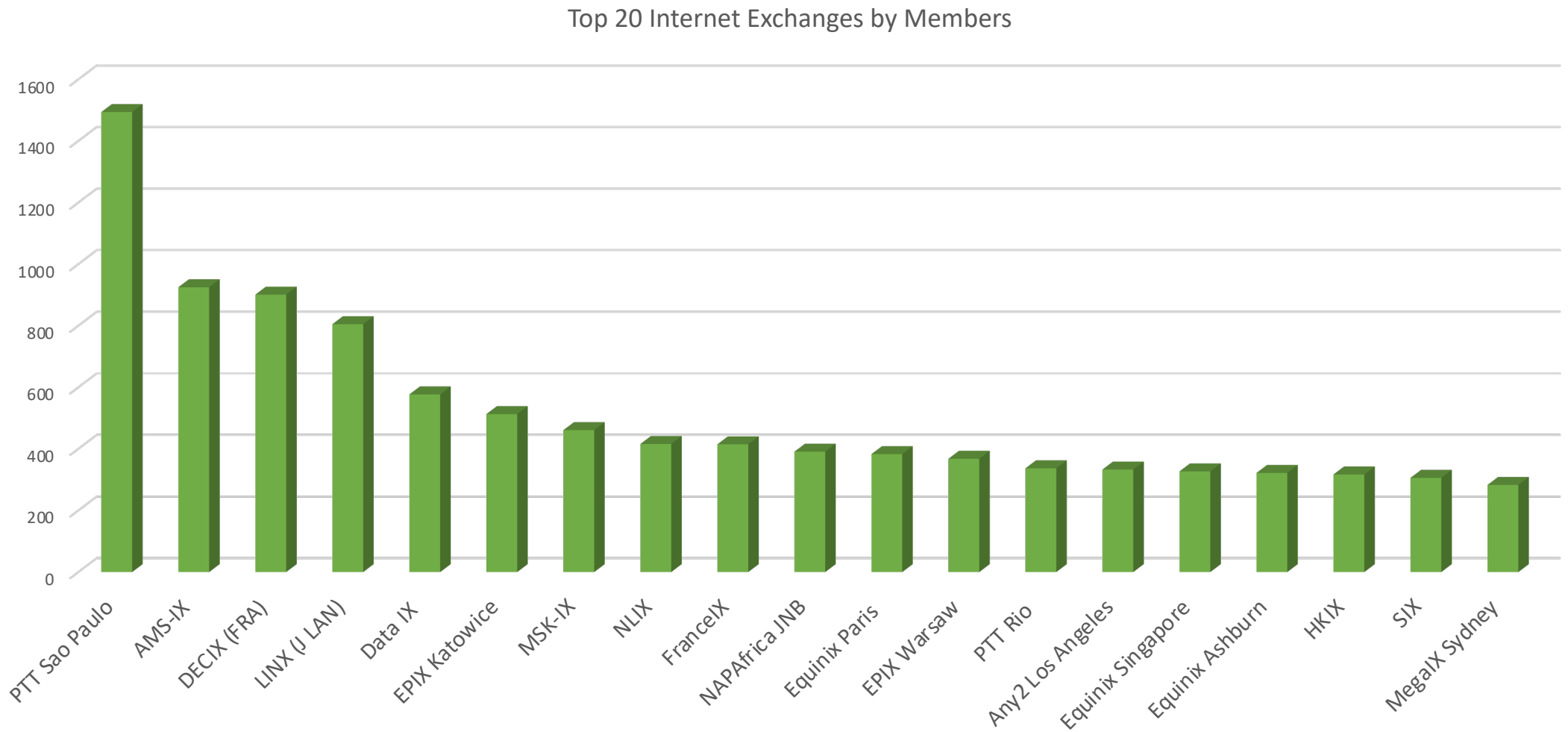
- Internet Exchanges historically are where we grow the Internet.
- Increasing IPv6 traffic across exchanges starts with increasing IPv6 peering.

IPv6 Adoption over Internet Exchanges

The development of Internet exchanges shaped the industry. Here are a few IPv6 and IX facts to keep in mind:

- 24.5 percent of all existing networks advertise IPv6 prefixes.
- Although we currently have 661 Internet Exchanges worldwide, 14 new exchanges formed in 2019.
- Peers are more likely to route IPv6 if they participate in an exchange.

Top 20 Internet Exchanges IPv6 Adoption



Regional IPv6 Adoption at Internet Exchanges

Global trends are a lot to take in.

So let's take a look at Internet exchanges by region and see how we are doing in the Asia Pacific by comparison.

How I measured the progress:

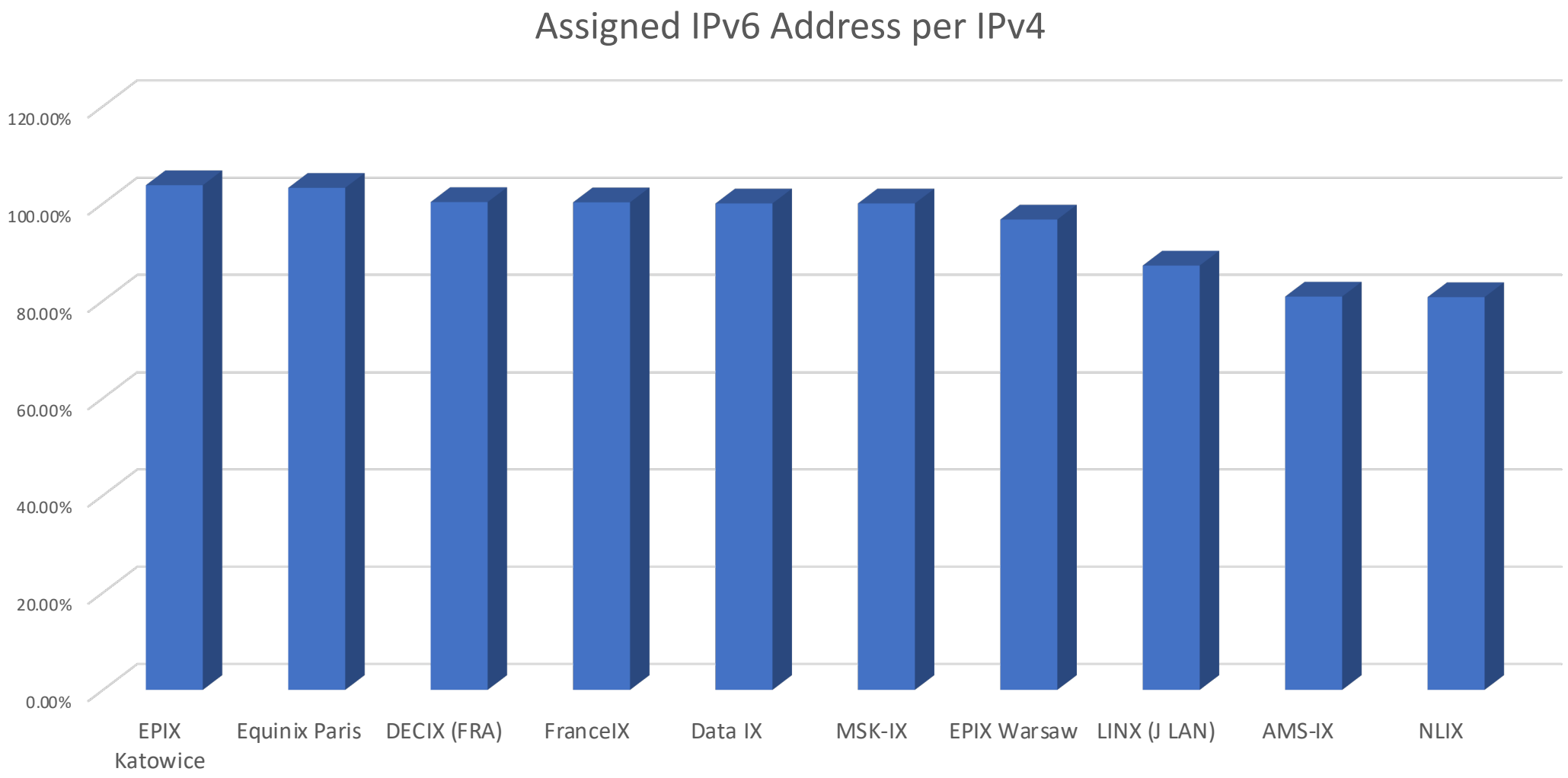
- Assessed how many listed addresses were on the exchange.
- Looked at how many of those IP addresses were reachable.
- Then compared how many reachable IPv6 addresses against how many reachable IPv4 addresses on the exchange to determine who is available to peer over IPv6 on the exchange.

IPv6 Adoption in European Exchanges

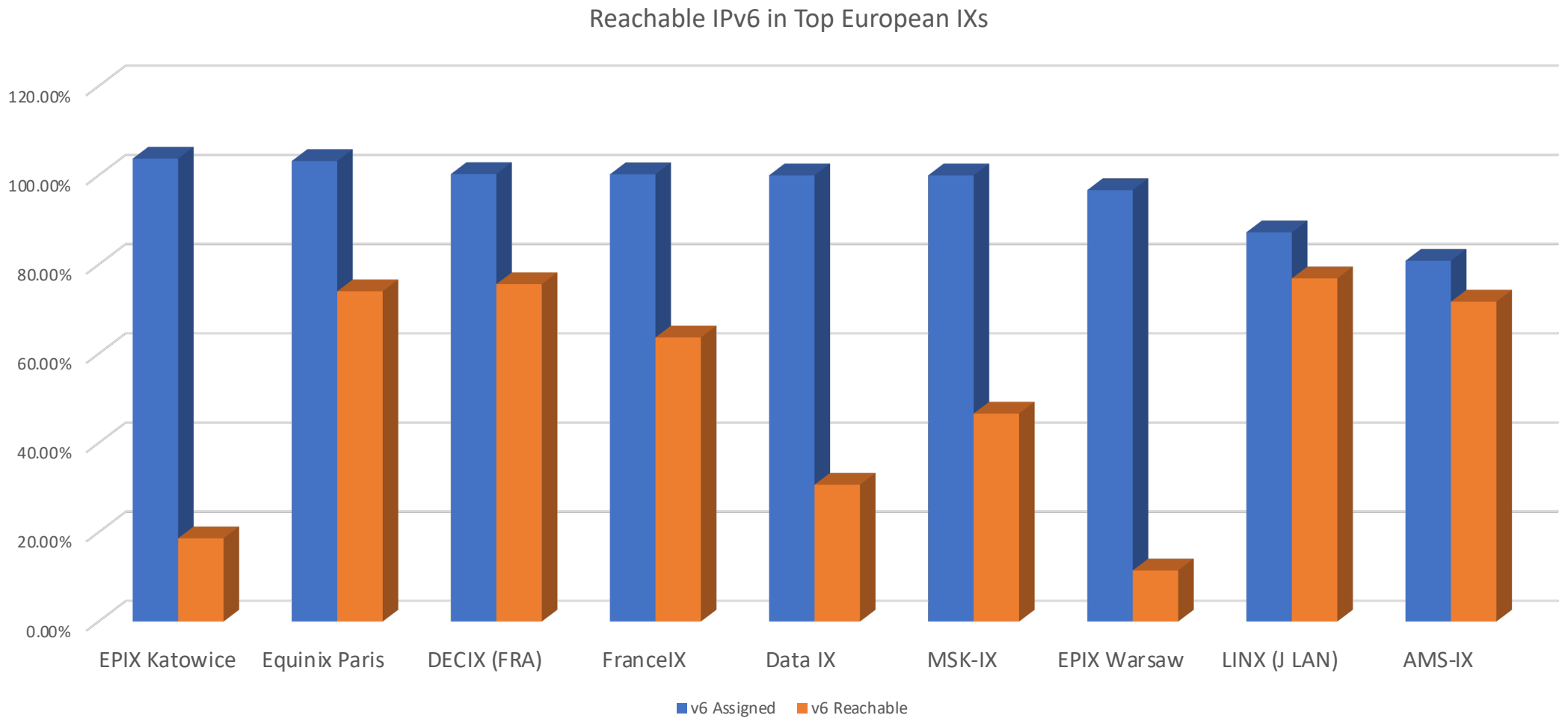
Europe literally has led the way in forming Internet exchanges. Some European IX trivia includes:

- Of the 661 Internet Exchanges worldwide, 241 of these exchanges are in Europe.
- The first Internet Exchanges in the world were established in Europe.
- Peers are more likely to have both an IPv4 and IPv6 peering session on a European exchange.

IPv6 Adoption at the top European IXs



IPv6 Adoption at European Exchanges

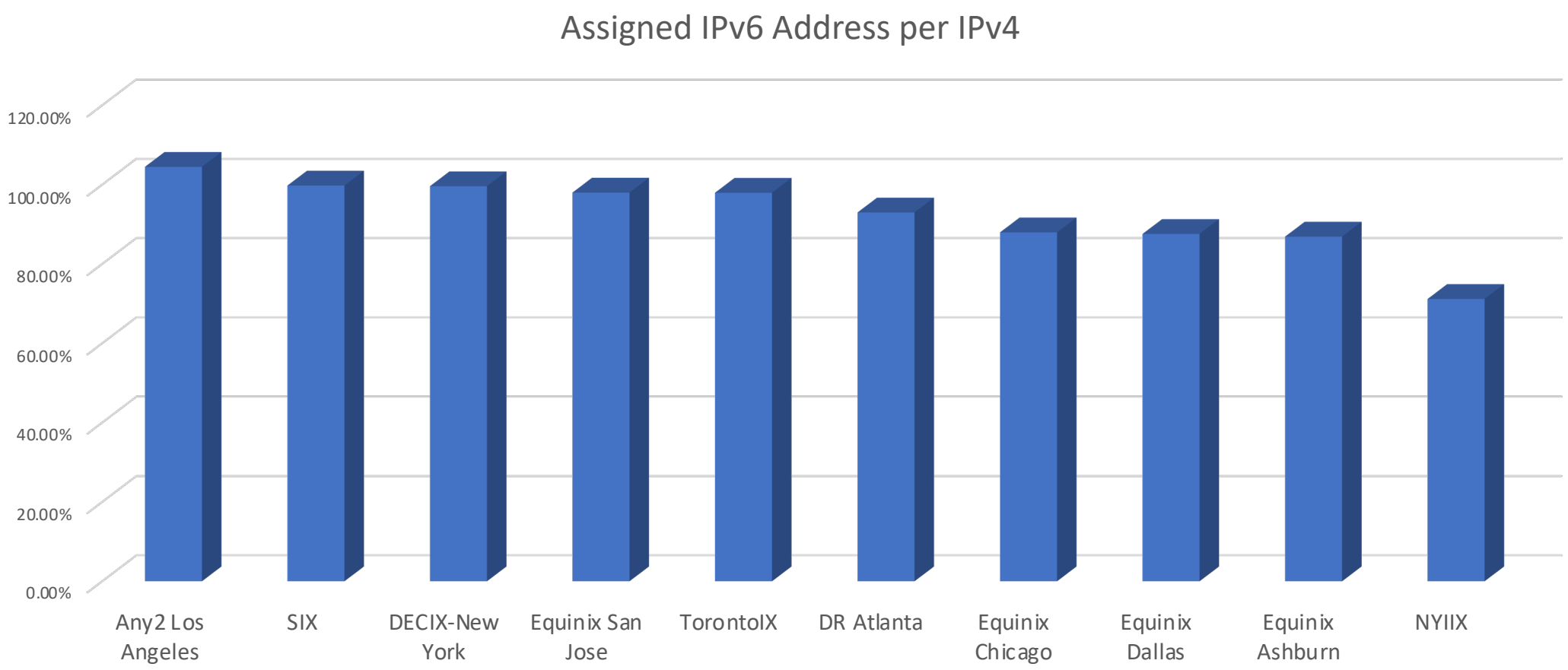


IPv6 Adoption at Exchanges in North America

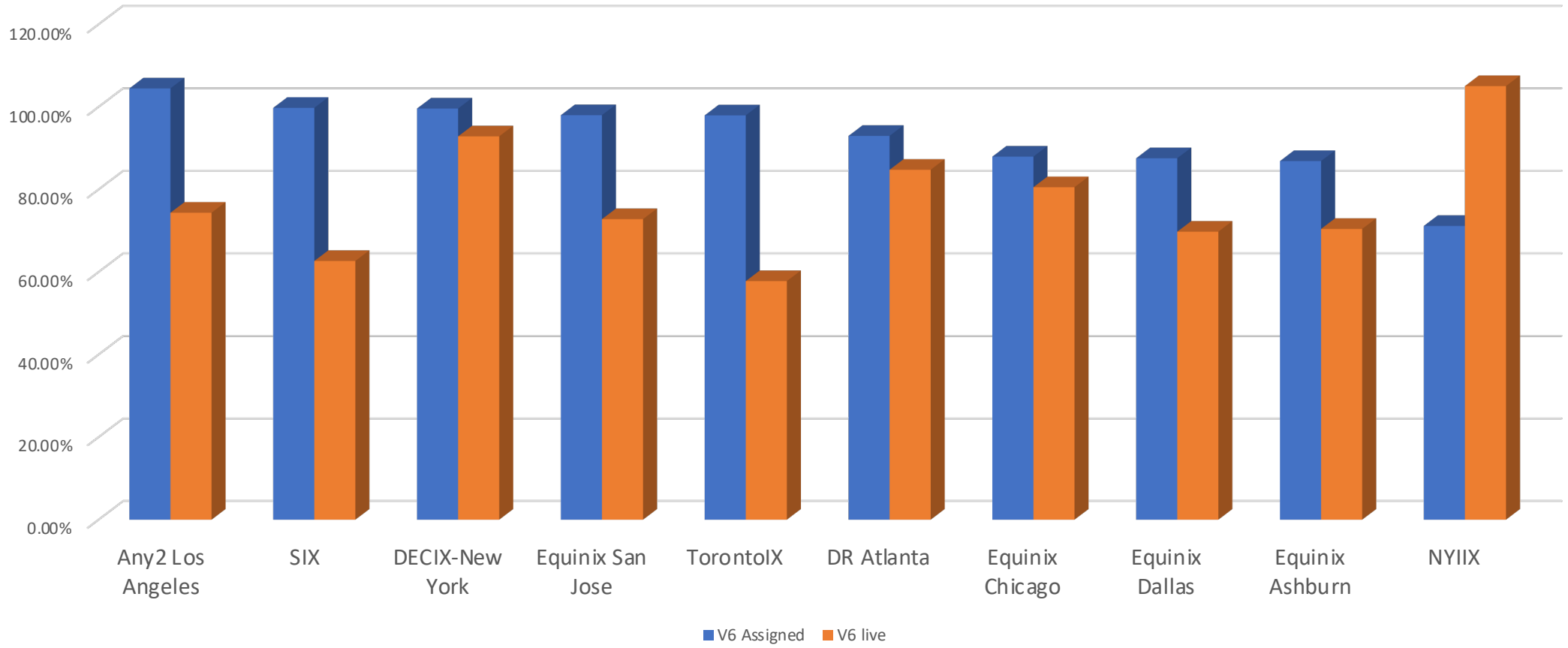
Next, I assessed the North American Internet Exchanges.

ARIN was the first RIR to exhaust its allocation, so let's look at the North American exchanges and see if that created a sense of urgency.

IPv6 Adoption in North America



Reachable IPv6 Addresses in North America

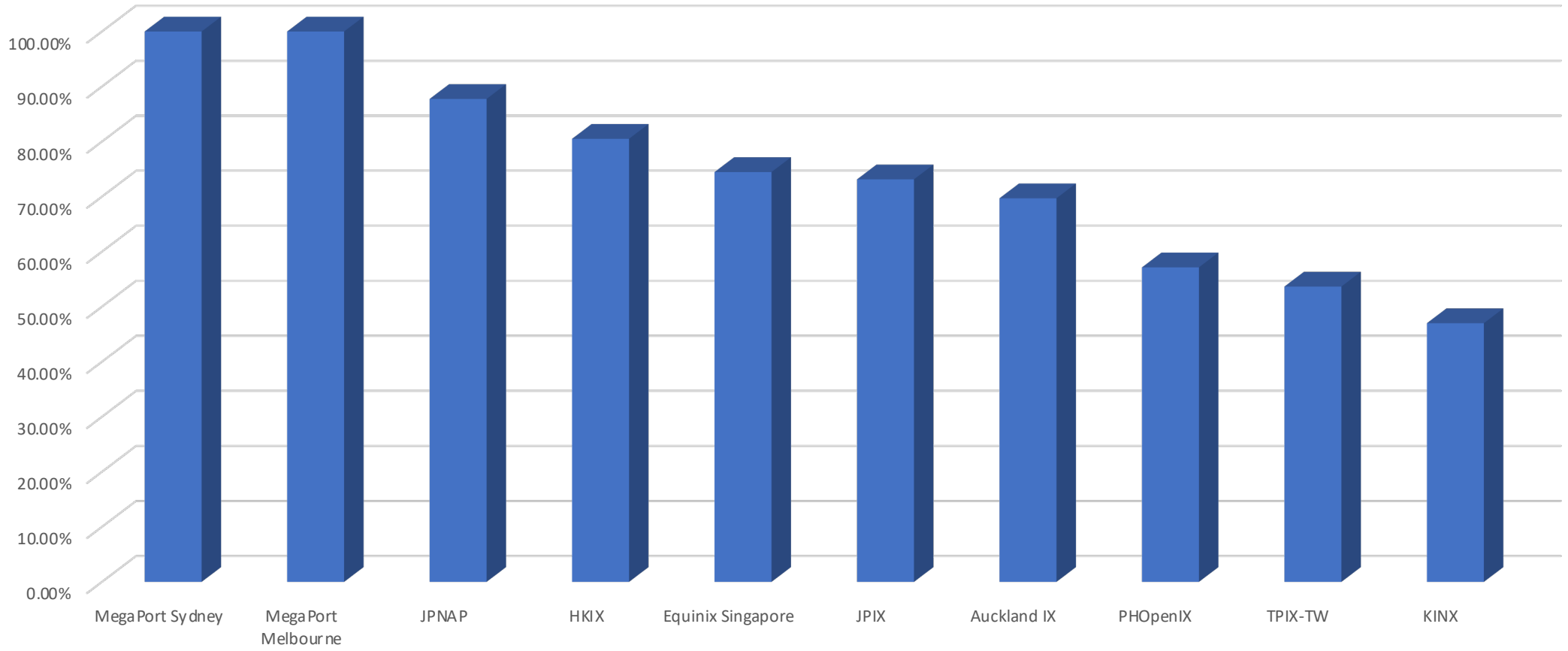


IPv6 in Asia-Pacific Internet Exchanges

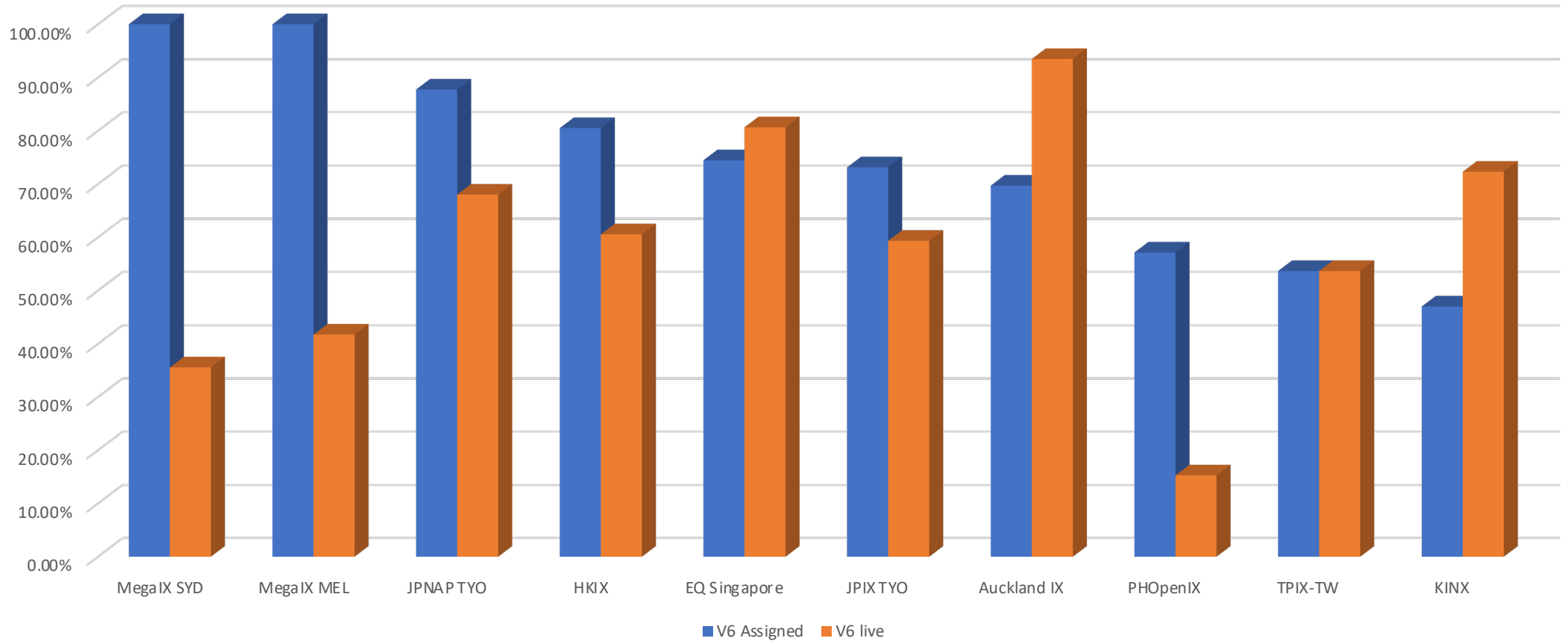
What about the Internet Exchanges in the Asia-Pacific region?

APNIC is projected to the last RIR standing, so let’s look to see if people on the exchanges in this region are exhibiting different behavior.

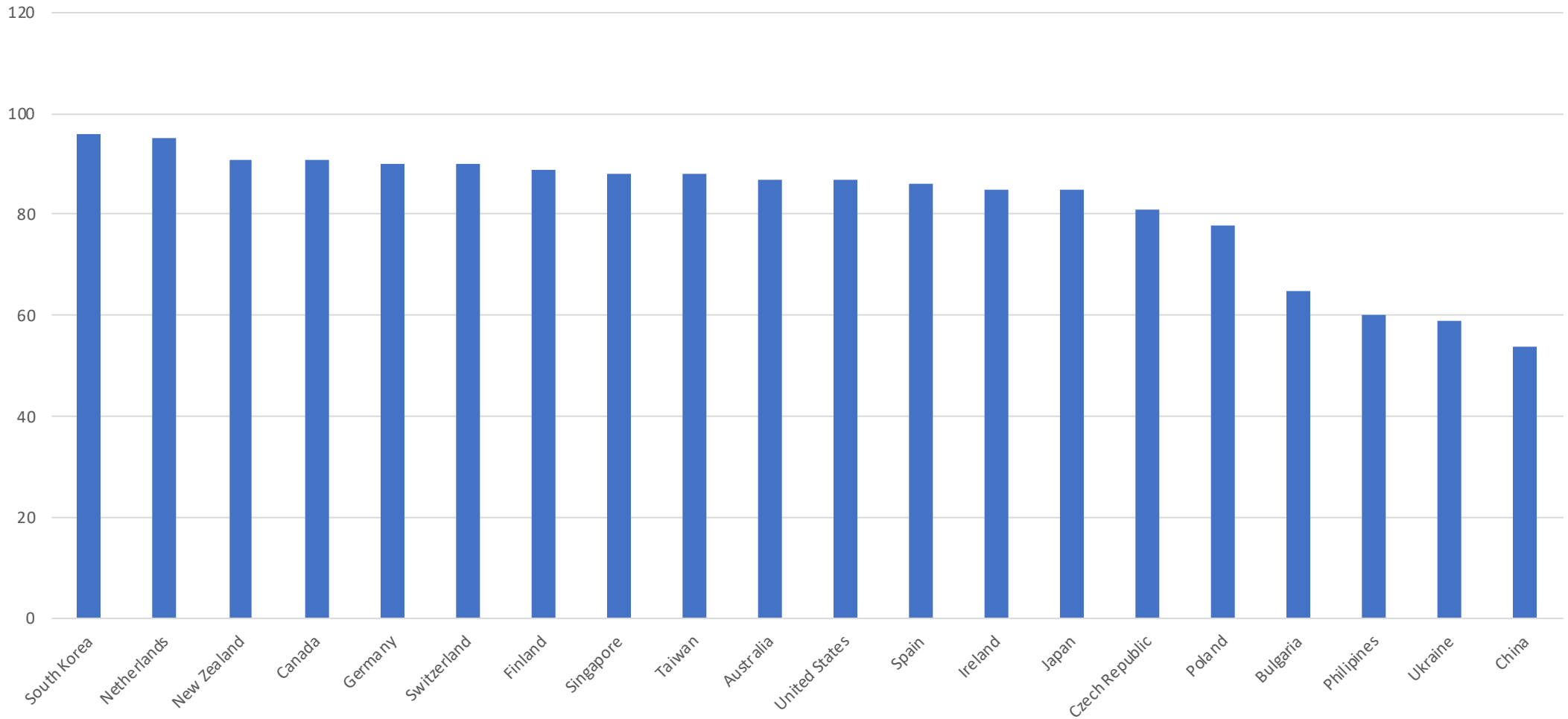
IPv6 Adoption in Asia-Pacific Internet Exchanges



Reachable IPv6 addresses in Asia-Pacific IXs



Internet Users by Population by Country



IPv6 Adoption over Internet Exchanges

Overall, these figures show that you can assign a network an IPv6 address, but you can't make them peer.

Based on what we just saw, a few assumptions seem reasonable:

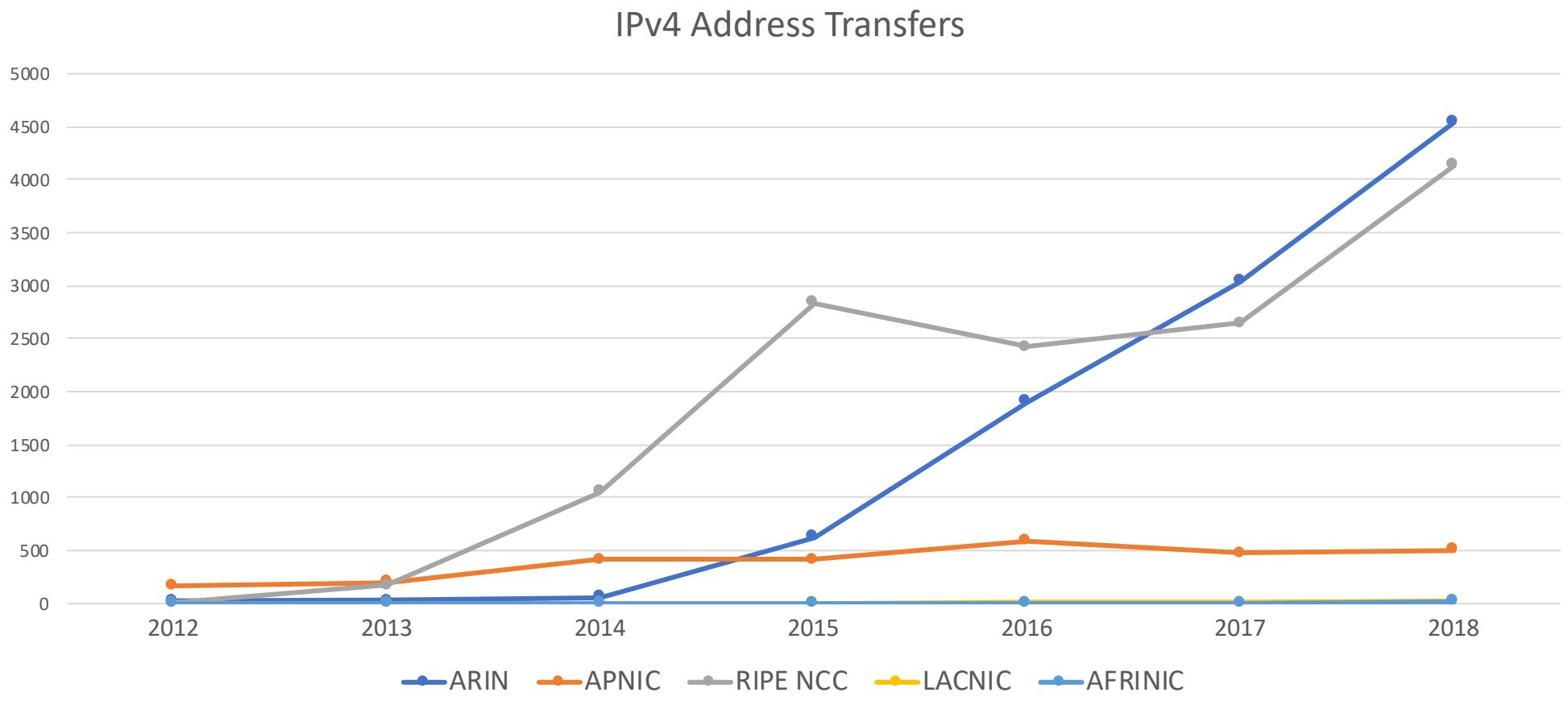
- IPv6 routing is actively encouraged on Internet exchanges.
- A large percentage of peering networks are routing IPv6, and on most exchanges, the number of networks is higher than the global average of 27.3 percent of all ASNs.
- If a network isn't peering over IPv6, it's probably because it has not deployed IPv6.

Why Internet Exchanges need more IPv6 peers

ARIN exhausted its IPv4 allocation in September 2015. RIPE just distributed its final /22 on November 25, 2019. The clock is ticking at the remaining RIRs.

- You can NAT, but CGN solutions still required additional IP space.
- Yes, you still can buy IPv4 addresses. Current pricing averages $25 per IP for a /24, /23, or /22. Depending on who you believe, prices could double over the next two years.
- IPv4 transactions are increasing year over year as RIRs exhaust their allocations and networks .

Maximizing IPv6 Traffic Across Exchanges



Why Internet Exchanges need more IPv6 peers

- The increasing number of transactions is a reflection of demand.
- The availability of IPv4 addresses soon will be through address brokers entirely.
- As more users are added to the Internet, demand will rise.
- The marketing and transfer of legacy IPv4 blocks means IPv4 space still is available, but demand and speculation will put pressure on the price.
- Price will drive IPv6 adoption.

Why Internet Exchanges need more IPv6 peers

So why does IPv6 deployment on Internet Exchanges matter?

- More peering on Internet exchanges will drive more IPv6 deployment.
- Less obvious is encouraging the growth of IPv6 networks works in favor of those who want to stay on IPv4.
- When more traffic moves to IPv6, it lessens the demand for IPv4 resources.
- When networks don’t deploy IPv6, they put pressure on the IPv4 supply, which increases prices and the cost of operating networks.

Why Internet Exchanges need more IPv6 peers

If you think more networks need to route traffic over IPv6, you can do something about it.

- Whenever you peer, ask to turn up IPv6 sessions with the IPv4 sessions.
- Advertise your IPv6 prefixes and ask other networks to advertise theirs.
- Check back with your IPv4-only neighbors from time to time to see if they have added IPv6 peering.

Increasing IPv6 Traffic Across Exchanges

Summary

- IPv6 participation on Internet exchanges is better than the global rate of 27.32 percent.
- While IPv6 adoption continues to increase, IPv4 here to stay for the foreseeable future.
- No matter what your protocol politics, increasing peering over IPv6 will help you meet your objectives.

Thank you!

Questions?

Resources

- Internet Exchanges data
  https://bgp.he.net/report/exchanges

  And network data from the Hurricane Electric network

- "Addressing 2018" by Geoff Huston, 30 Jan 2019
  https://www.potaroo.net/ispcol/2019-01/addr2018.html
- Individuals using the Internet (% of population)
  https://data.worldbank.org/indicator/IT.NET.USER.ZS