

# 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

We will look at how European Internet Exchanges have progressed in adoption of IPv6.

My assumptions are:

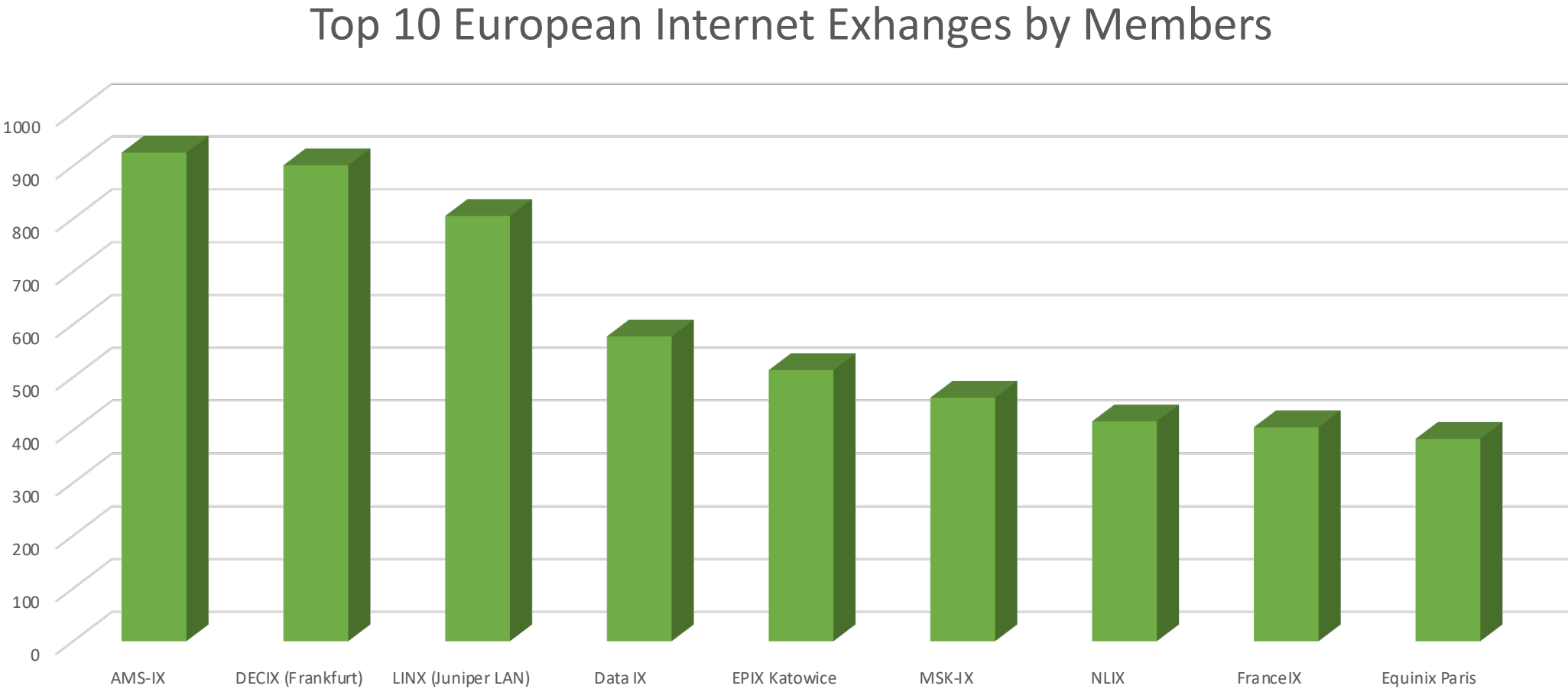
- Internet Exchanges historically are where we grow the Internet.
- Increasing IPv6 traffic across exchanges starts with increasing IPv6 peering.

# IPv6 Adoption at the top European IXs

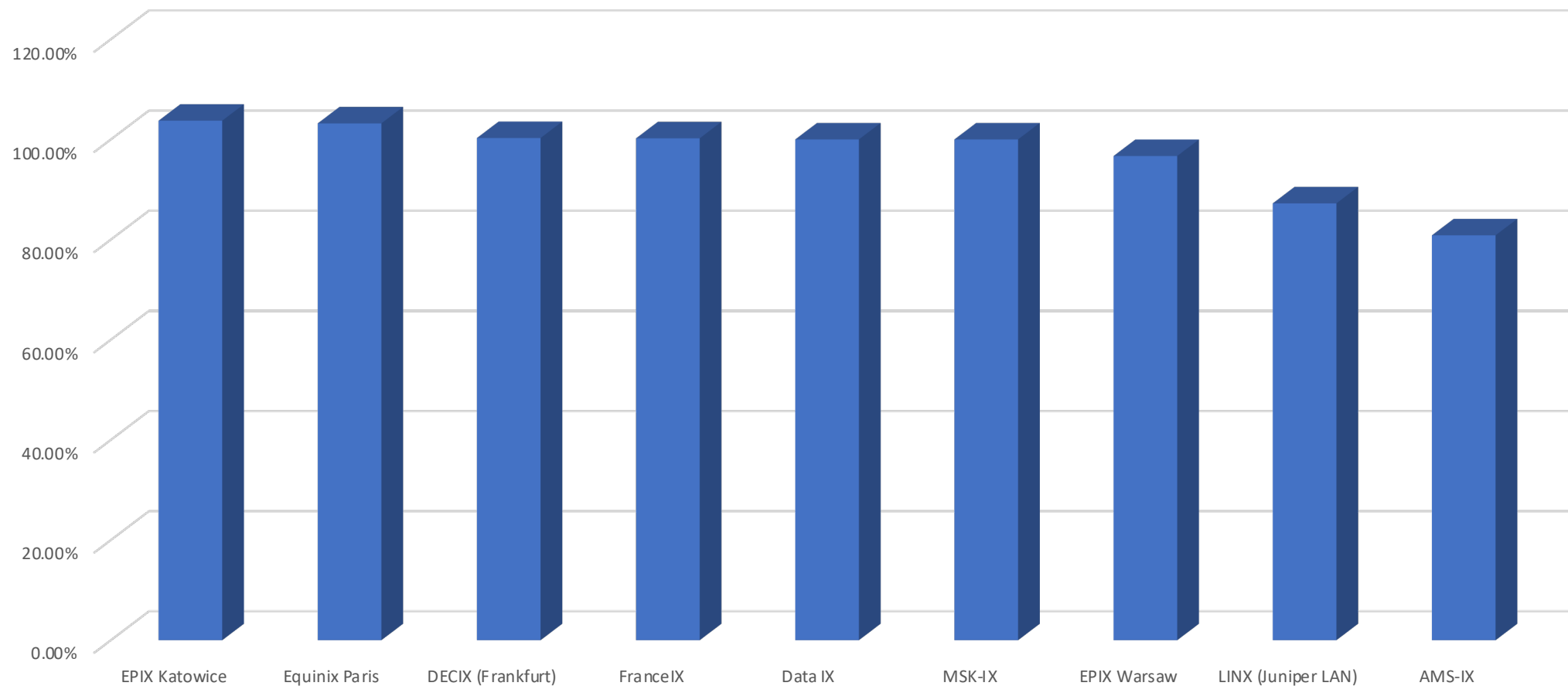
Behavior at European exchanges shapes the industry. Here are a few IPv6 and IX facts to keep in mind:

- 27.3 percent of all existing networks advertise IPv6 prefixes.
- 622 Internet Exchanges world wide, 242 of which are in Europe, including the 7 new exchanges that formed this year.
- Europe hosts 11 of the top 20 Internet Exchanges by participants in the world.
- Peers are more likely to have both an IPv4 and IPv6 peering session on a European exchange.

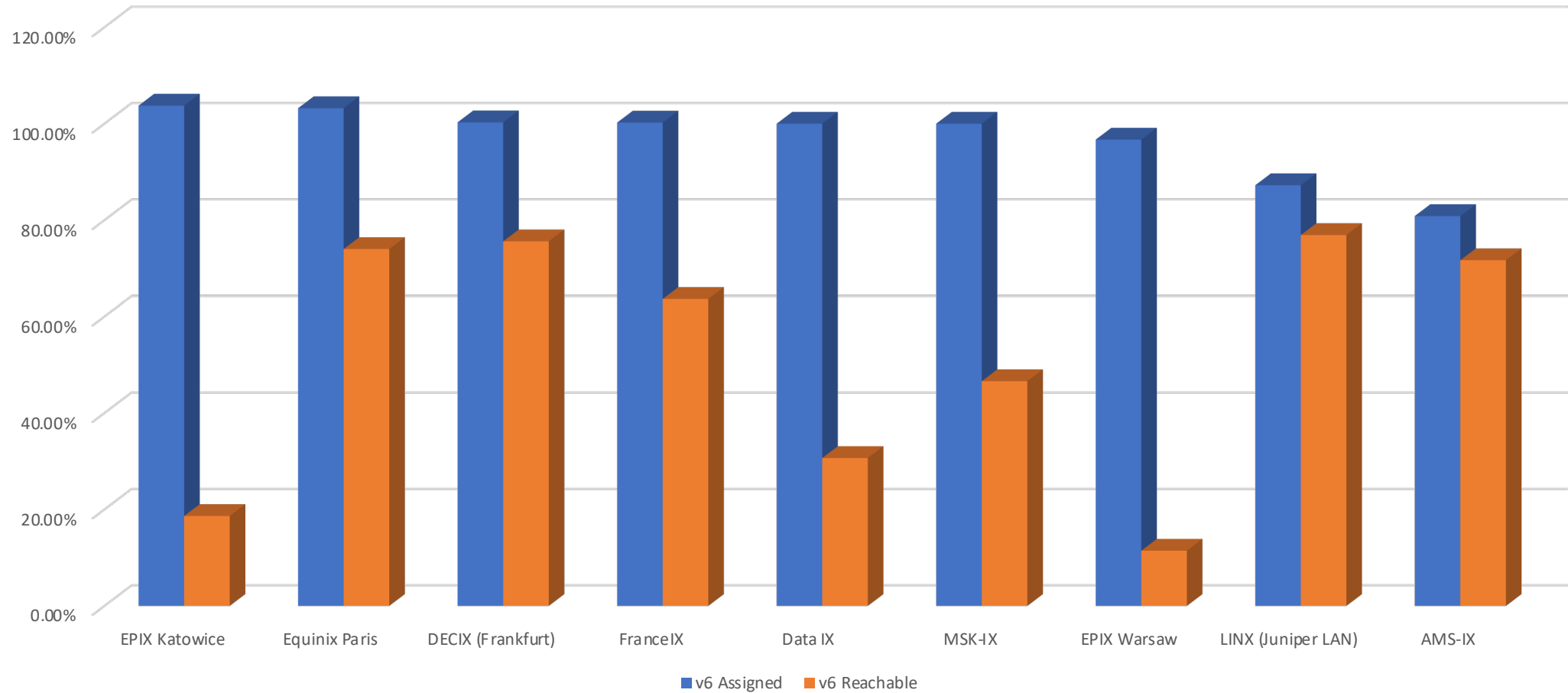
# Top 10 European Exchanges by Members



# Assigned IPv6 per IPv4 at Top European IXs



# Reachable IPv6 at the Top European IXs



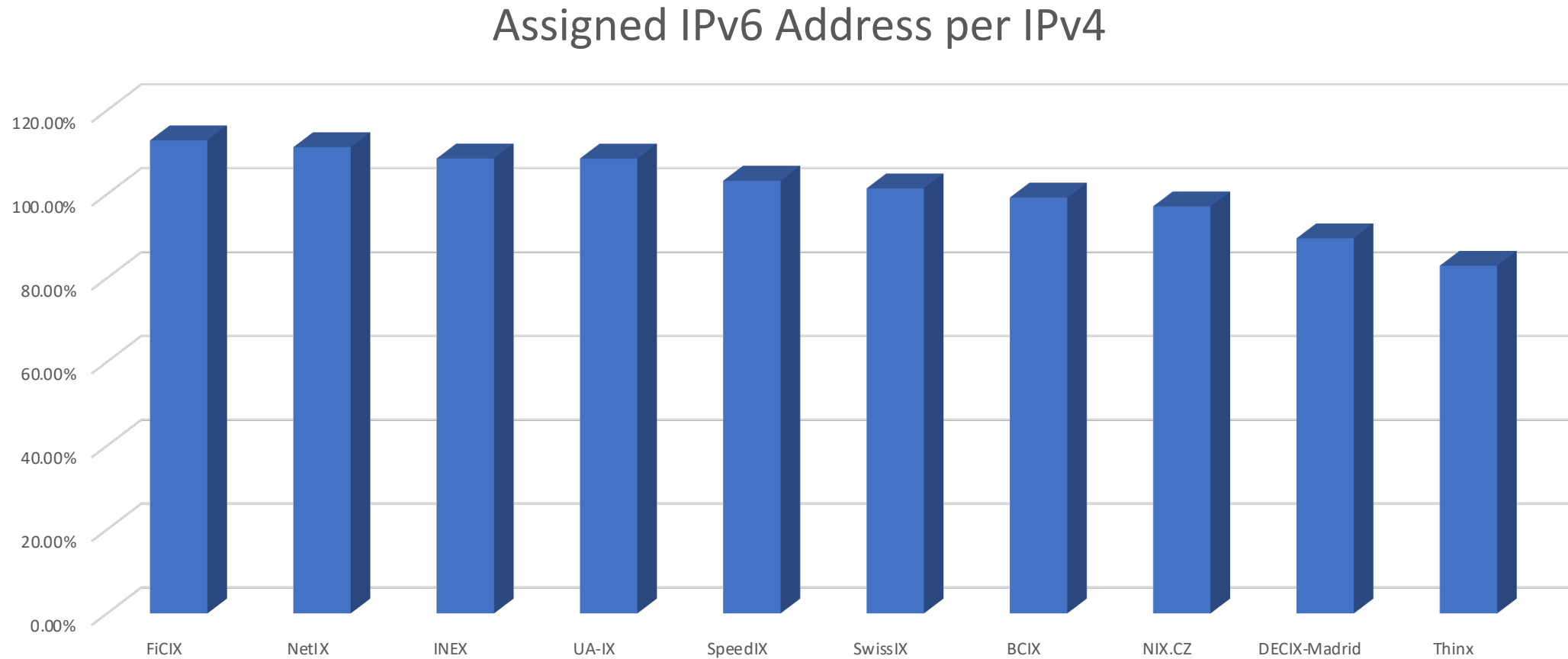
# IPv6 Adoption over Internet Exchanges

This seemed like IPv6 might have some room for improvement.

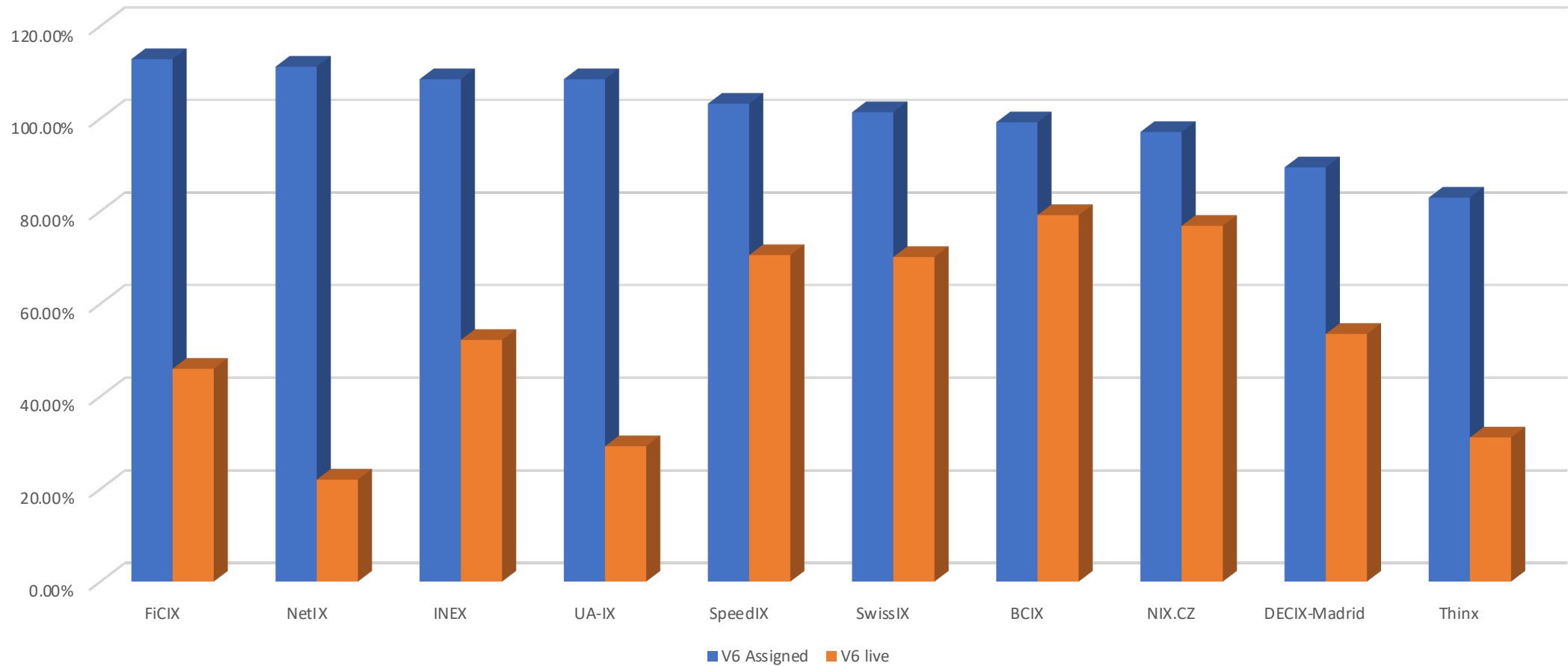
Perhaps more data is needed.



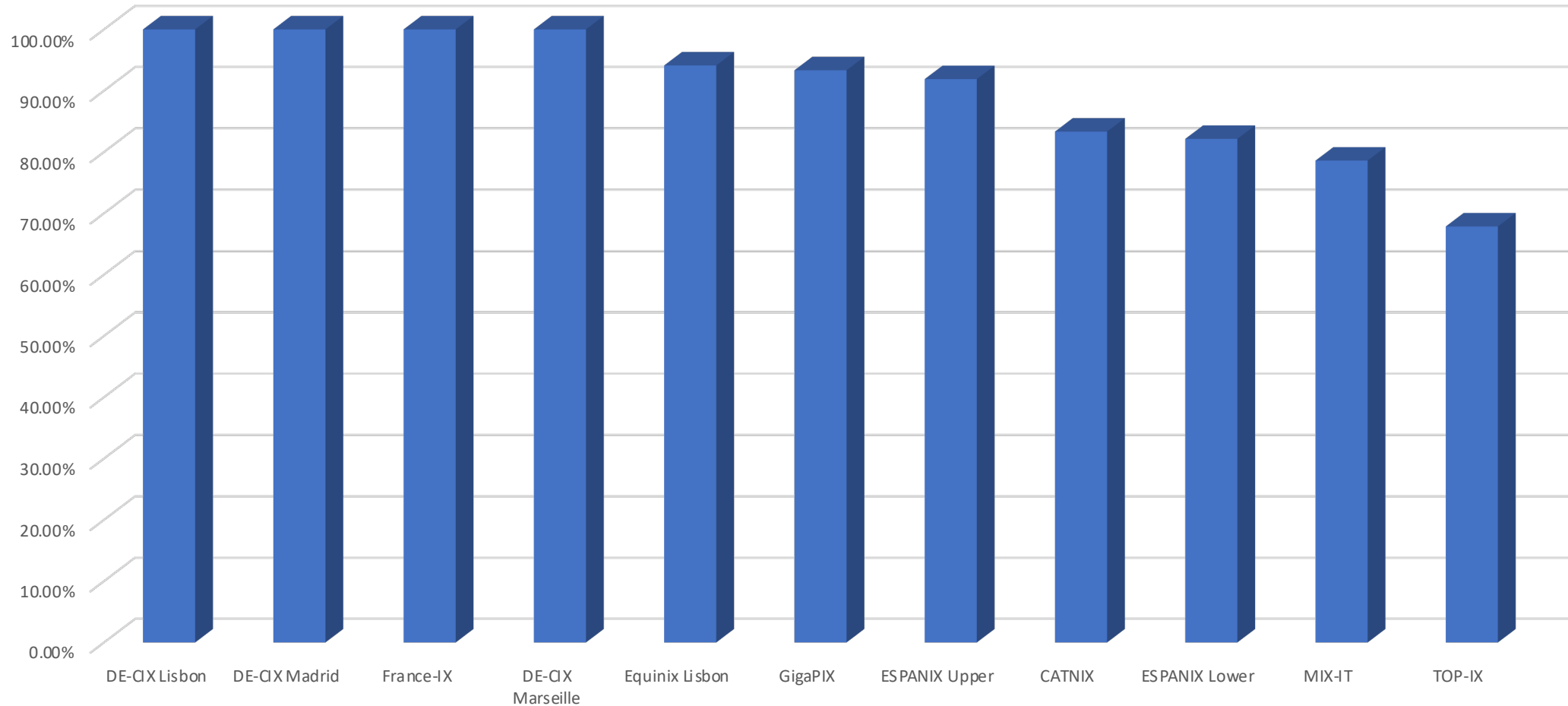
# Assigned IPv6 per IPv4 at Smaller IXs



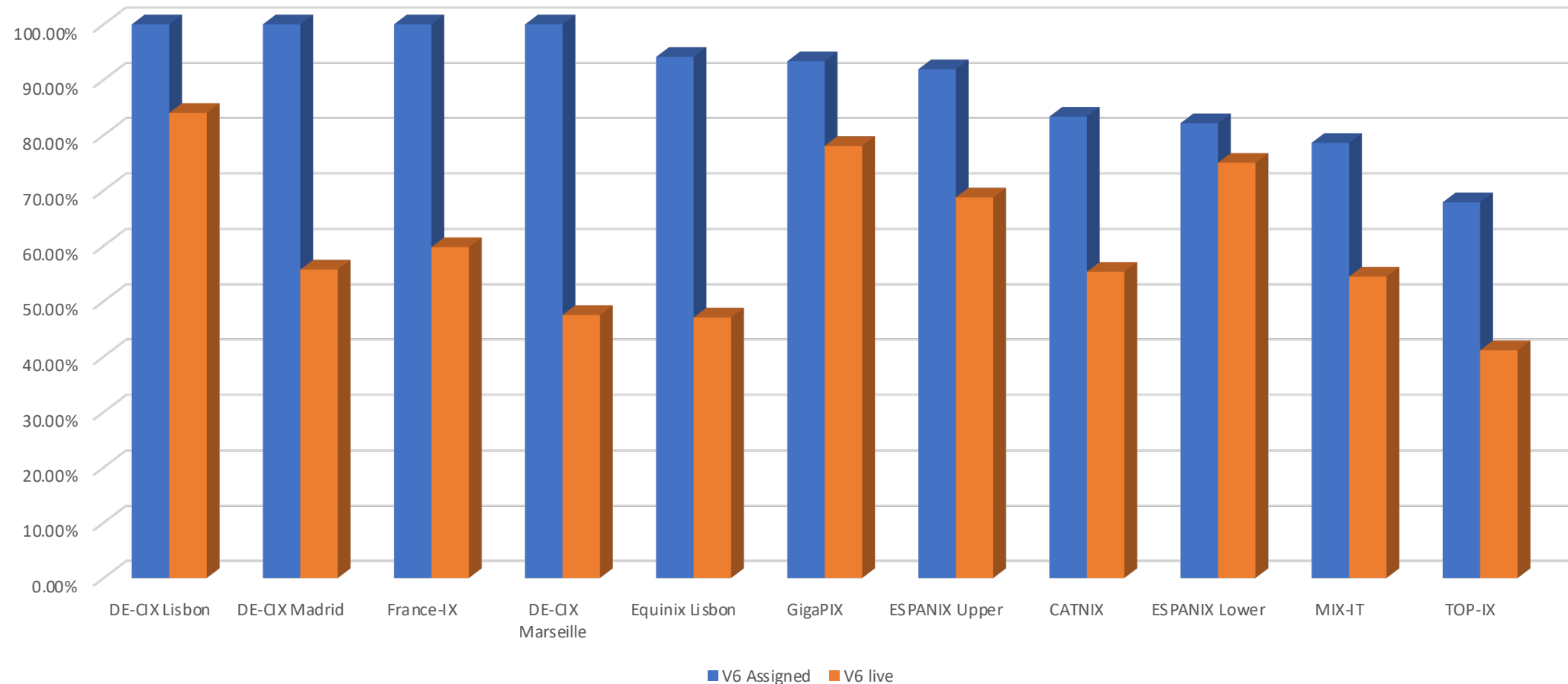
# Reachable IPv6 addresses at the Smaller IXs



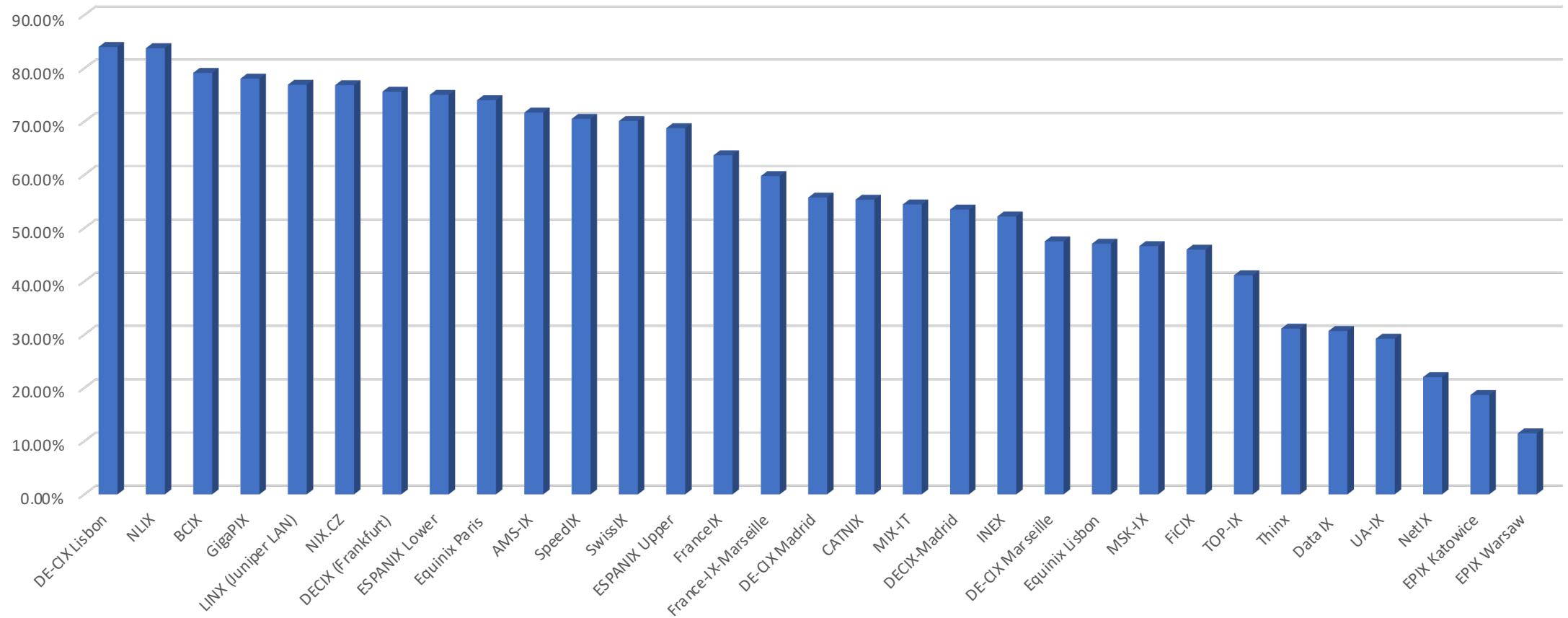
# Assigned IPv4 to IPv6 in Southern Europe



# Reachable IPv6 Addresses in Southern Europe

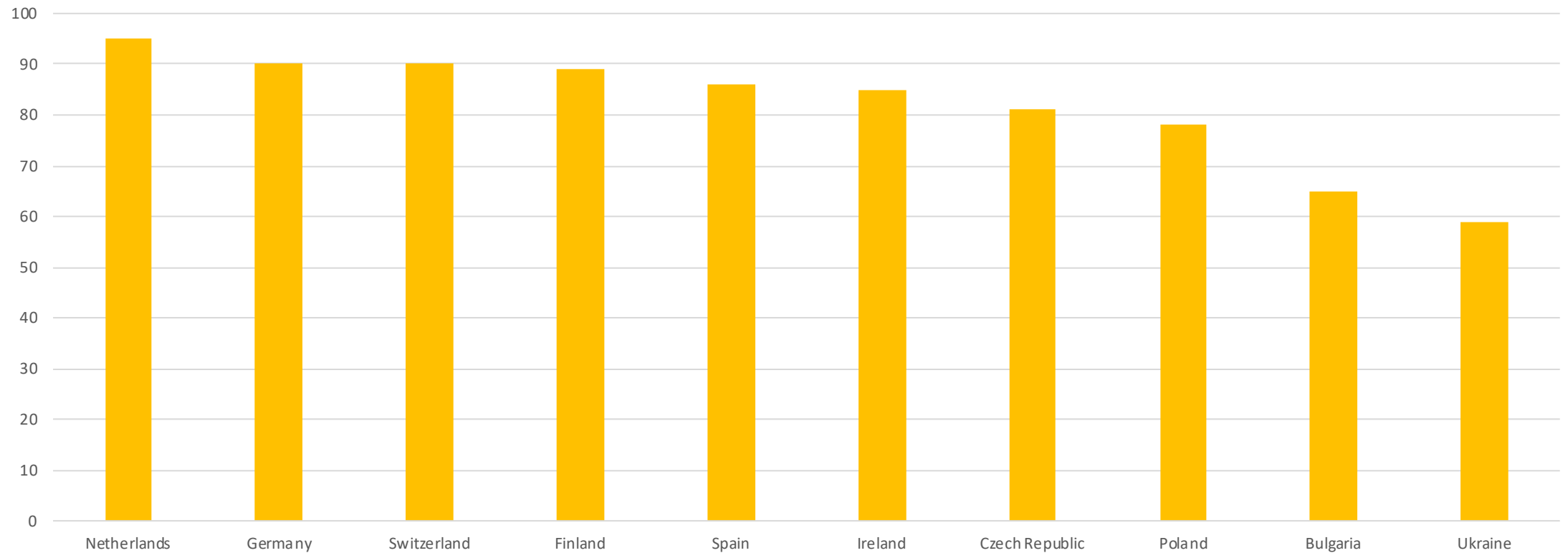


# Reachable IPv6 Addresses For All IXs



# IPv6 Adoption over Internet Exchanges

Percentage of Population that are Internet Users



# IPv6 Adoption over Internet Exchanges

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 European exchanges.
- A large percentage of Western European 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.

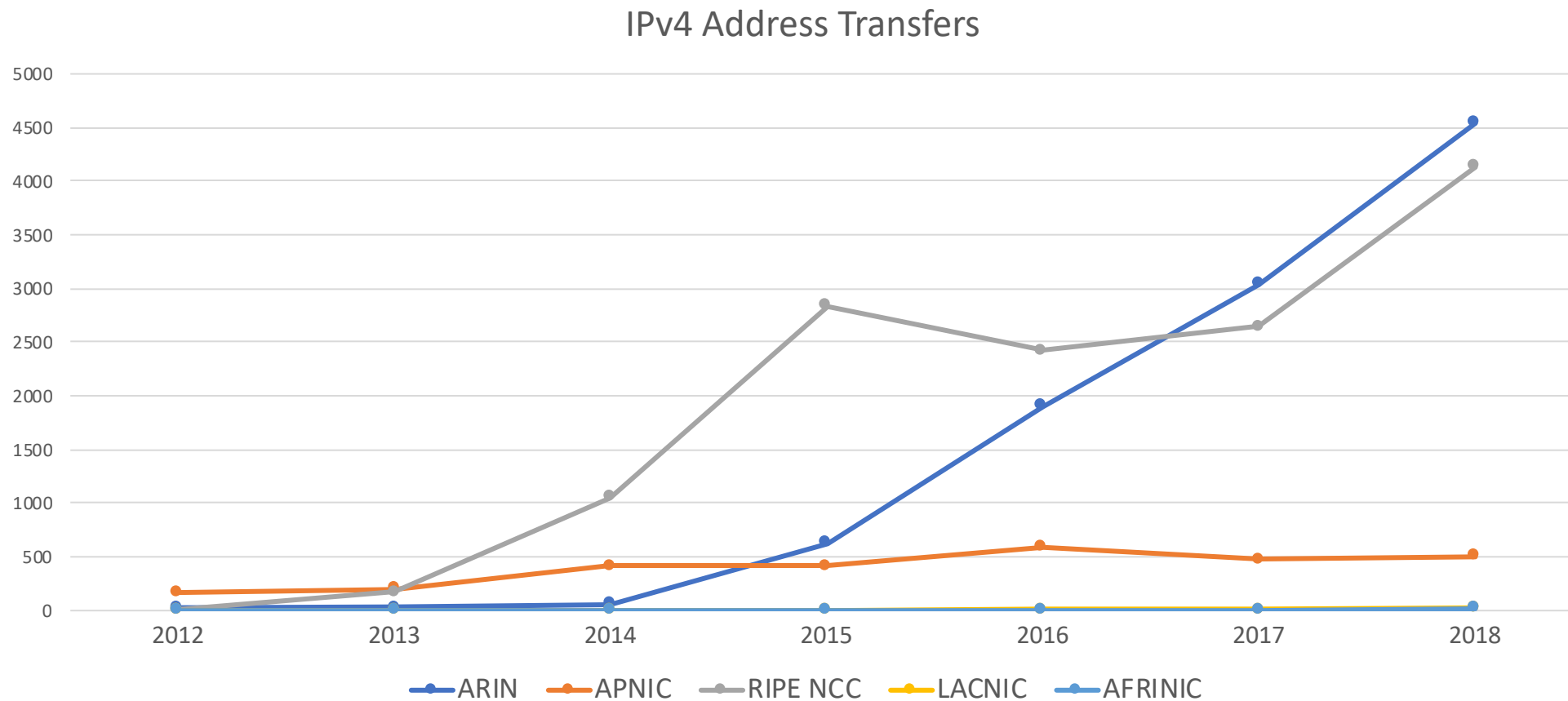
# Why Internet Exchanges need more IPv6 peers

RIPE distributed its final contiguous /22 on 2 October 2019 and distributed its final non-contiguous allocation on 25 November.

- You can NAT, but CGN solutions still required additional IP space.
- Yes, you still can buy IPv4 addresses. Current pricing averages €21 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, and the demand is increasing the price of IPv4 space.

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 most networks will be able to get IP space, but demand and speculation will put pressure on the price.

# Why Internet Exchanges need more IPv6 peers

It's obvious that more peering on Internet exchanges will drive more IPv6 deployment.

What might not be as 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 Europe's 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>
- “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>