

IPv6 deployment: trends and tidbits of 4,800 dual-stack ASes

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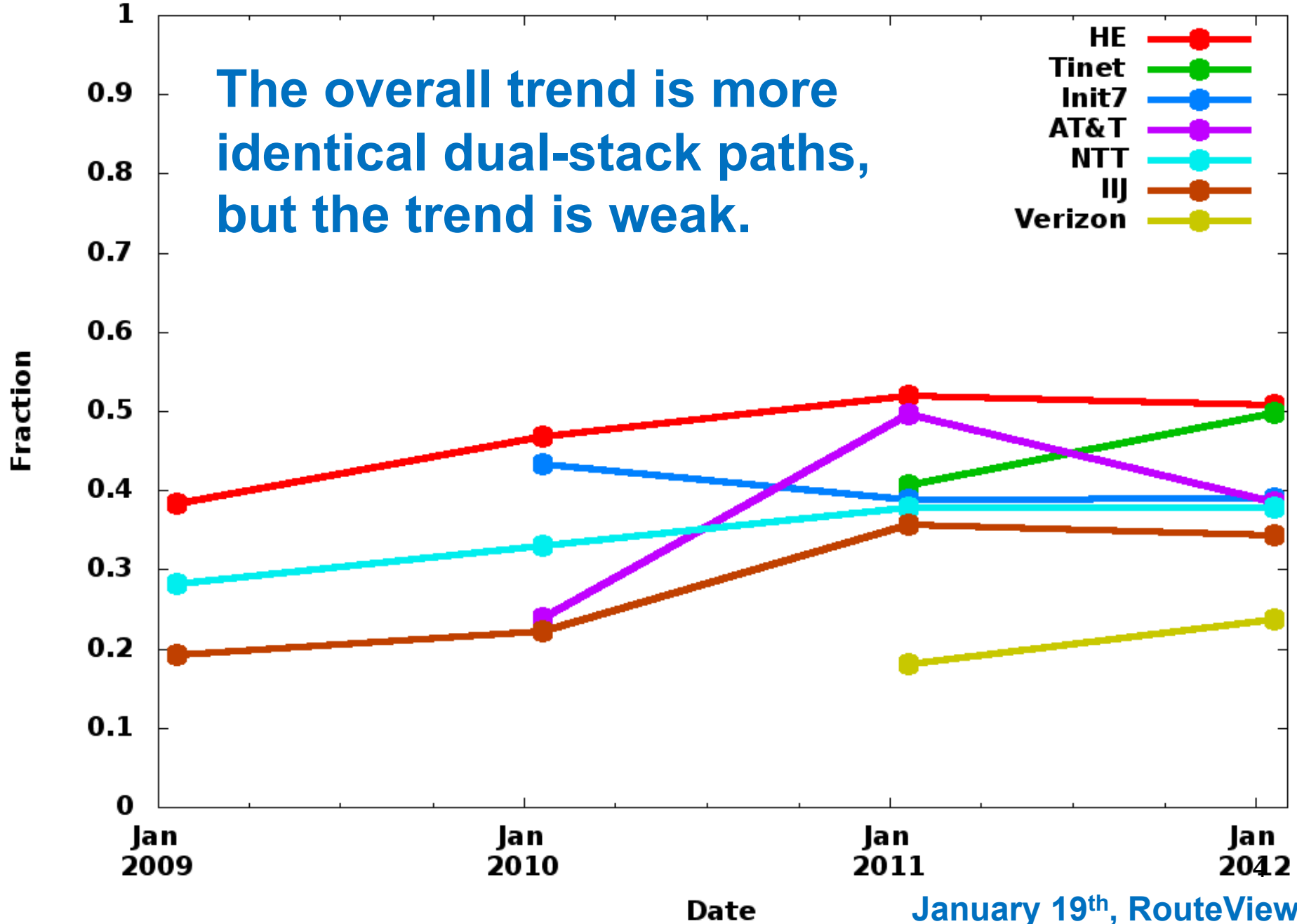
CAIDA

Hypothesis 1

- **In nearly all cases, IPv4 and IPv6 AS-level paths should be the same if the network is 'mature'.**
- **Edit distance:** how many additions, subtractions, and substitutions are required to transform one string into another?
- IPv6 is 'maturing' if fraction of zero edit distance dual-stack paths increases over time

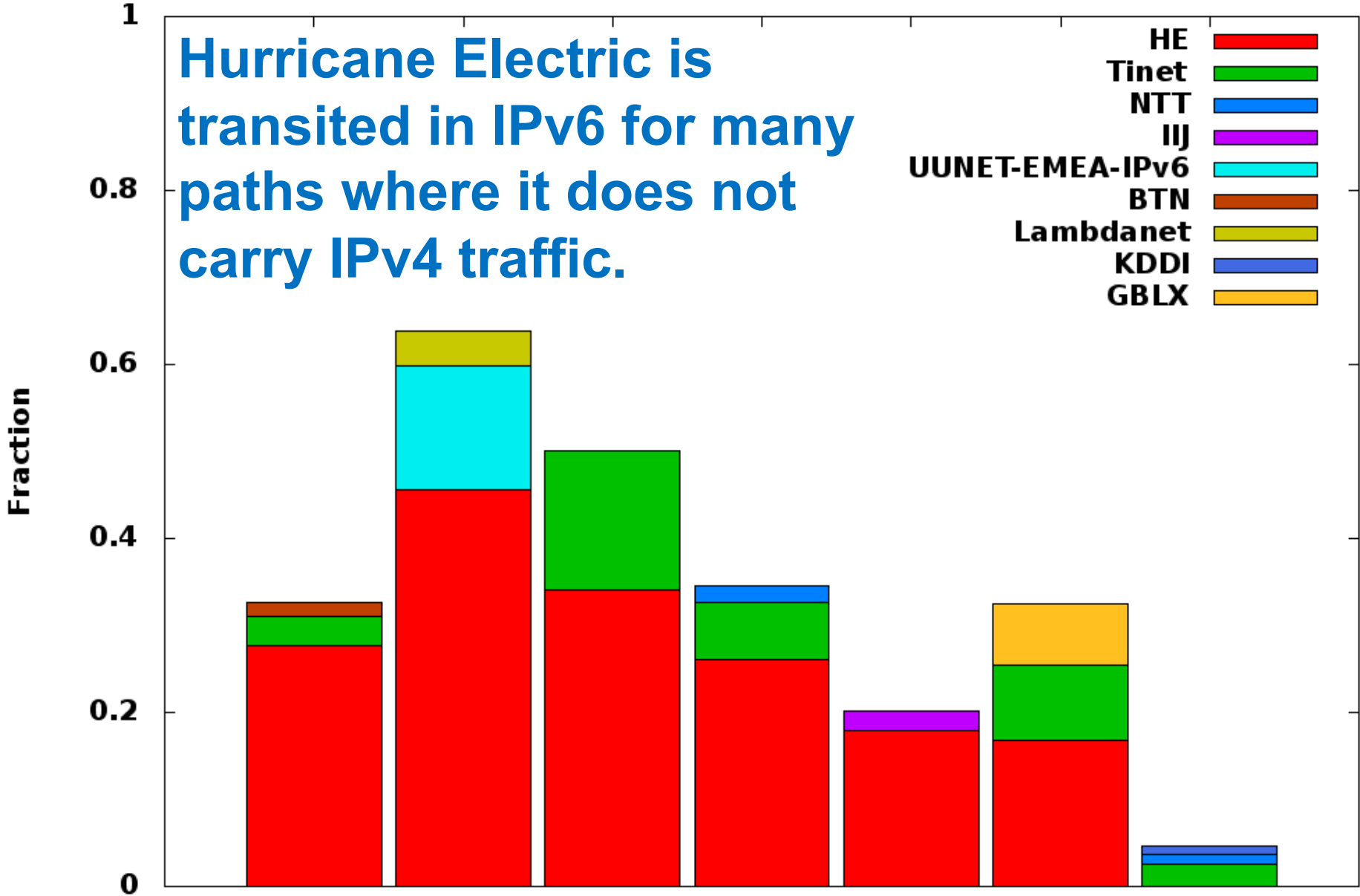
Fraction of dual-stack paths with zero edit distance over time

BGP



Top three new ASes in different IPv6 paths

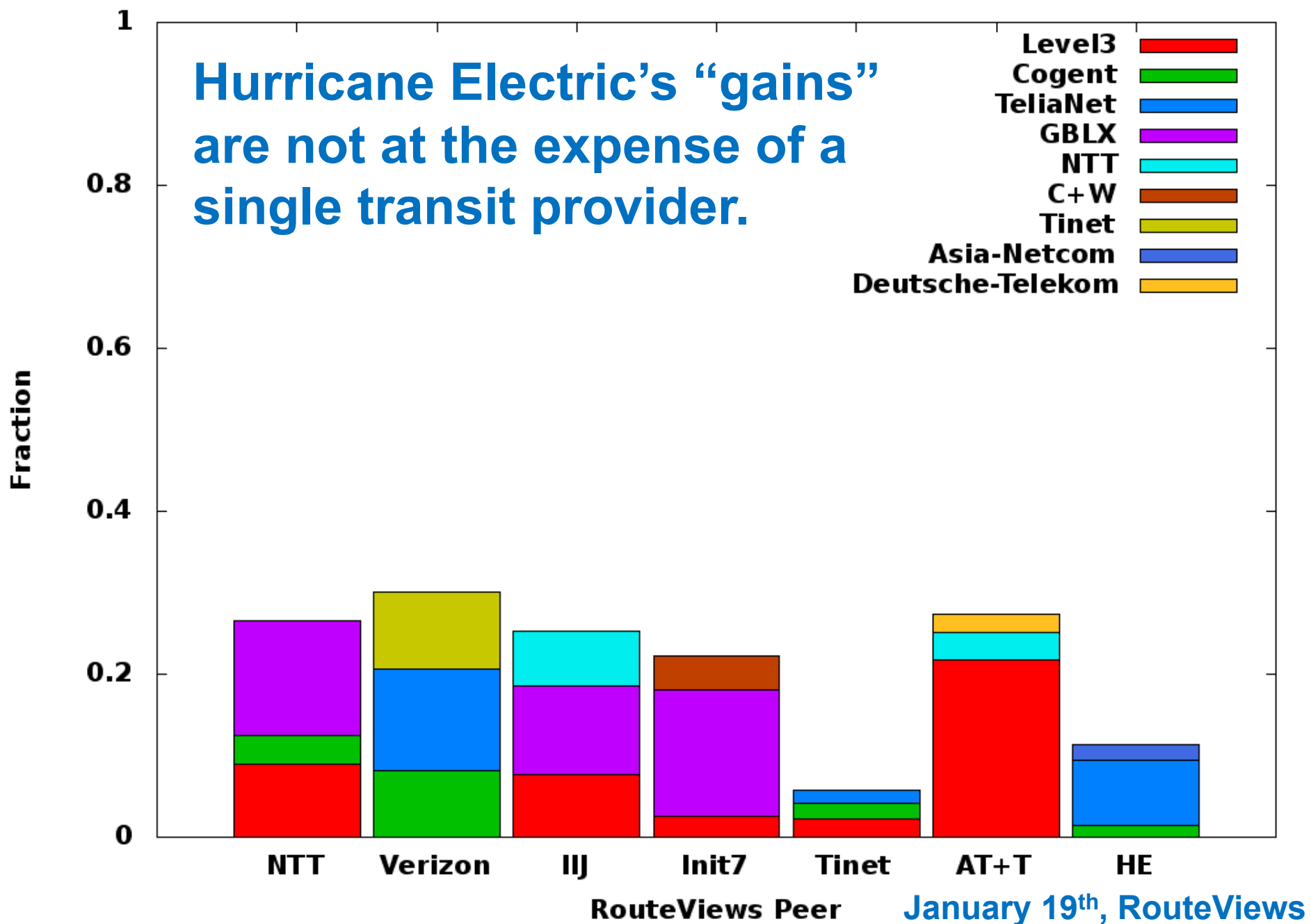
Hurricane Electric is transited in IPv6 for many paths where it does not carry IPv4 traffic.



RouteViews Peer

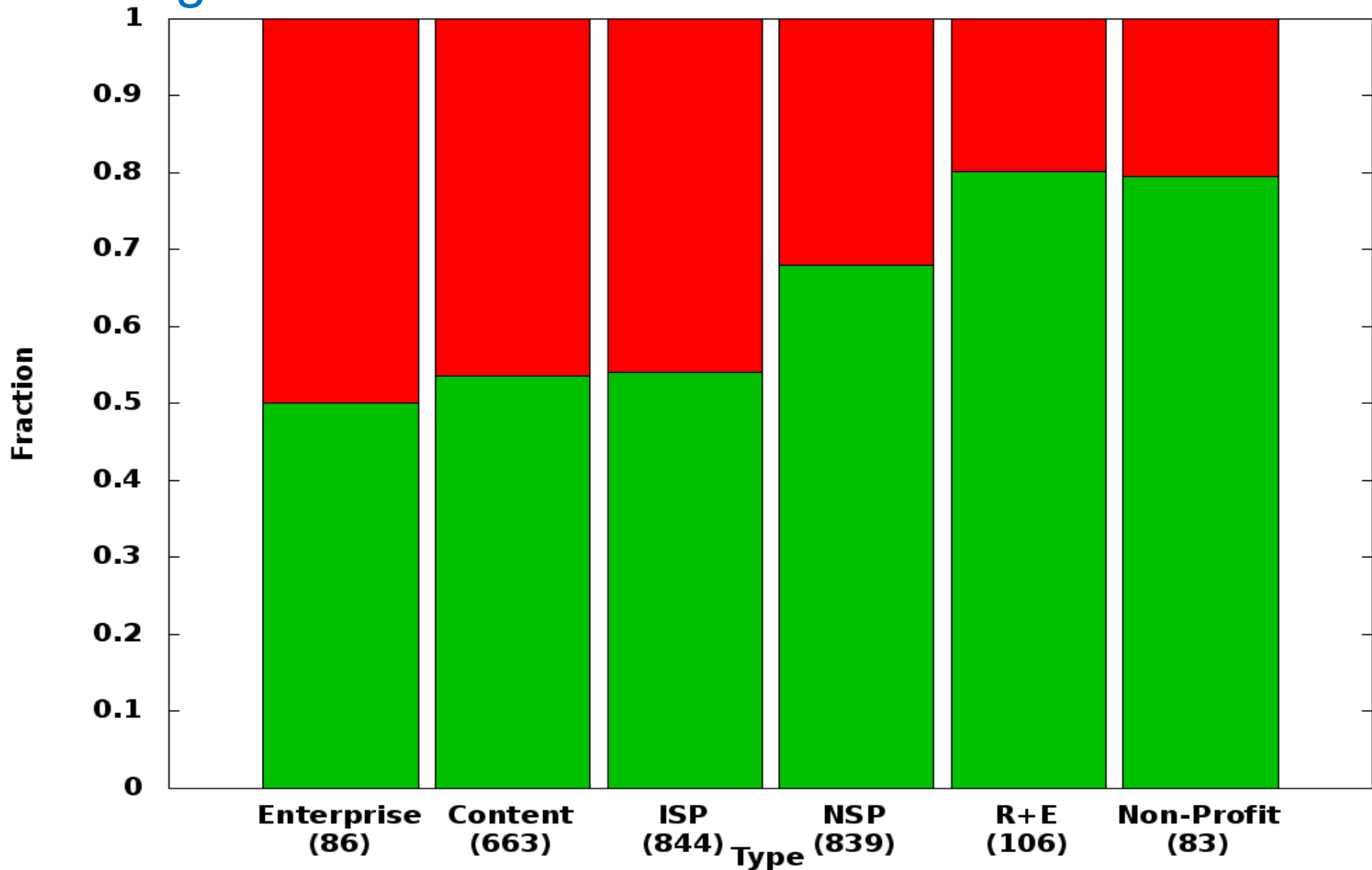
January 19th, RouteViews

Top three missing ASes in different IPv6 paths

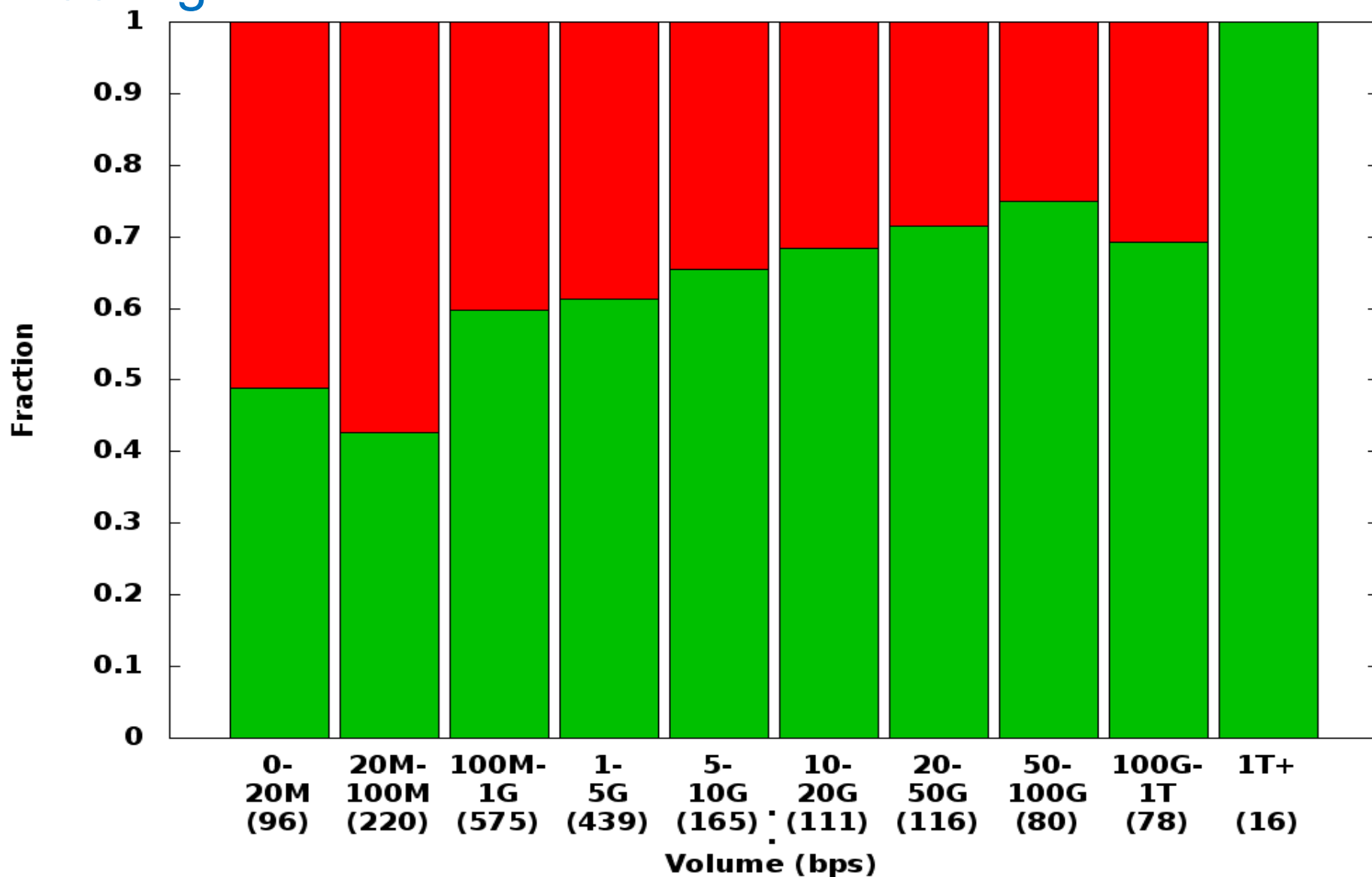


Hypothesis 2

- **Does IPv6 capability correlate with network business type, bandwidth, geographic region, or RIR exhaustion?**
- **PeeringDB**: Self-selected set of ASes, large enough to want to peer and use it.
- Analyse 30th January 2012 snapshot
 - 2,622 ASes
 - 60% of networks in PeeringDB advertise themselves as “IPv6 capable”.

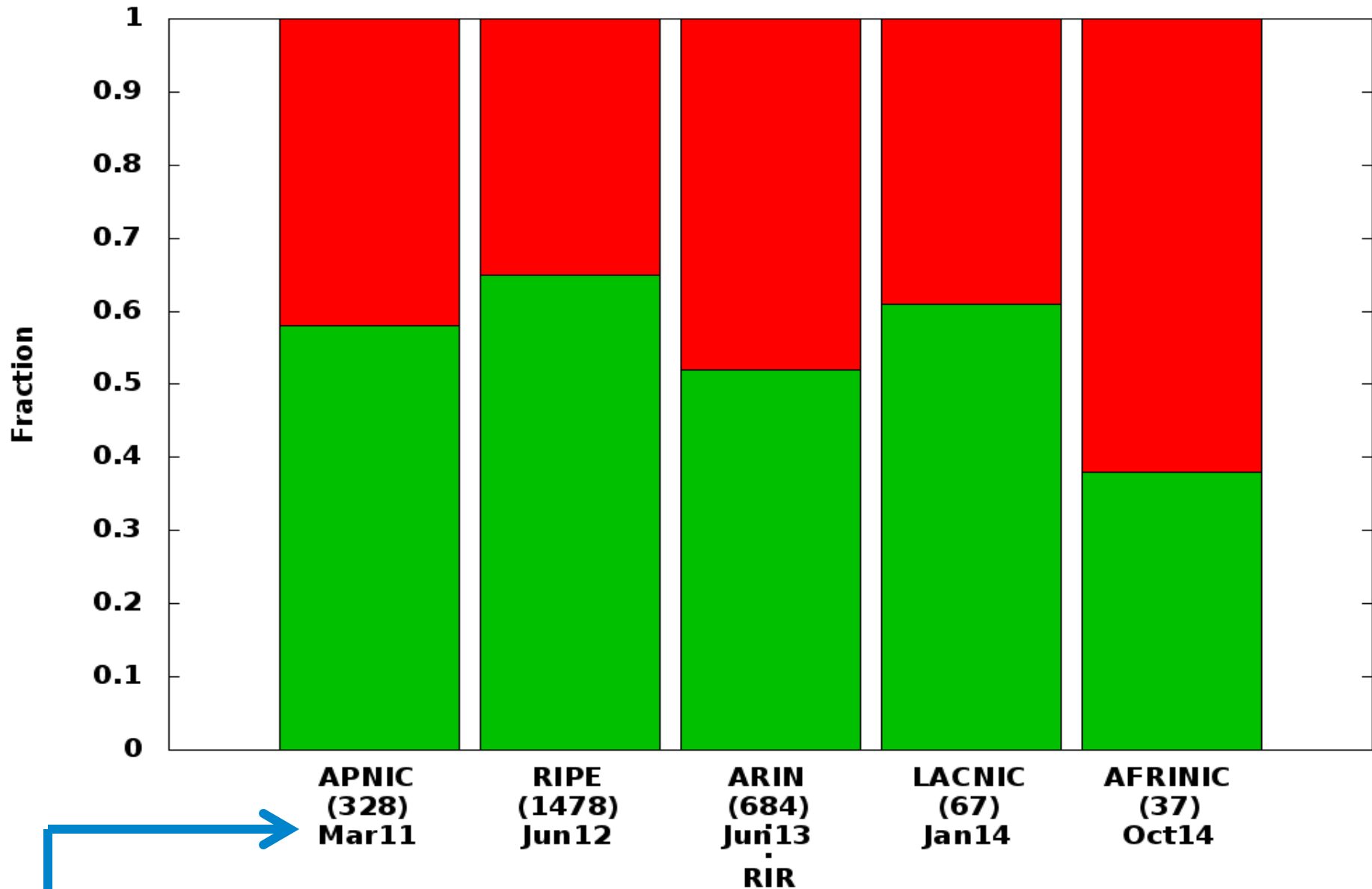


More NSPs than access ISPs are IPv6-capable.
 Comparatively less capability in Content networks.⁸



The higher the reported traffic volume, the more likely the network is to report IPv6 capability.⁹

IPv6 penetration of PeeringDB ASes per their WHOIS registered RIR region



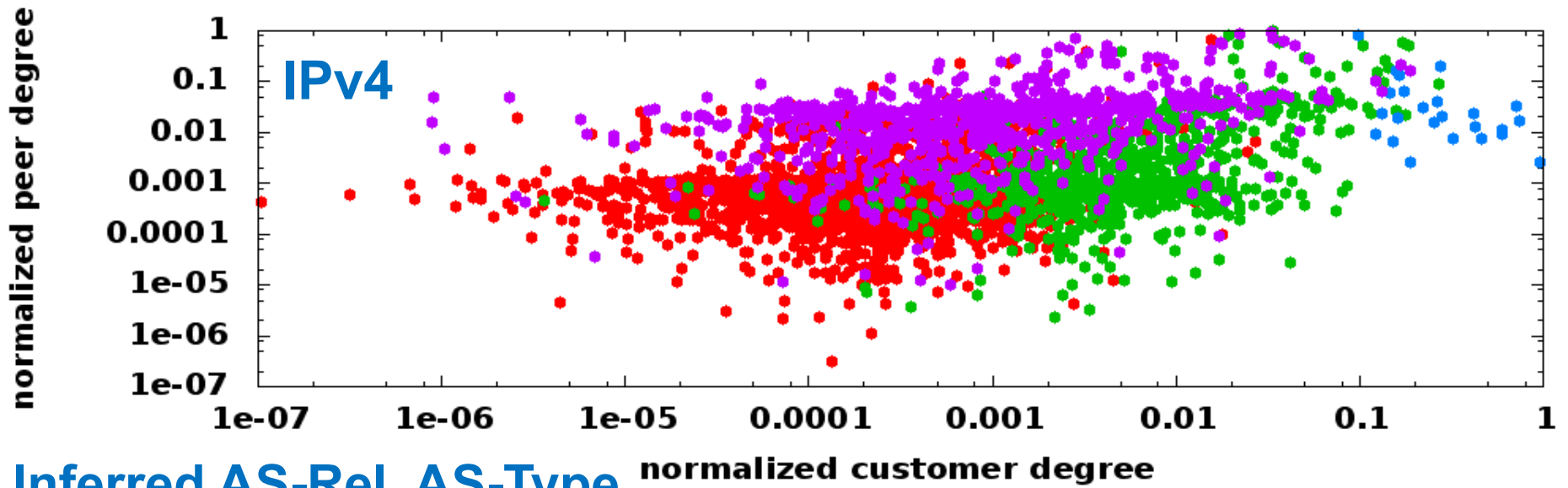
Limited correlation w/ est. date of IPv4 exhaustion at RIR.

Hypothesis 3

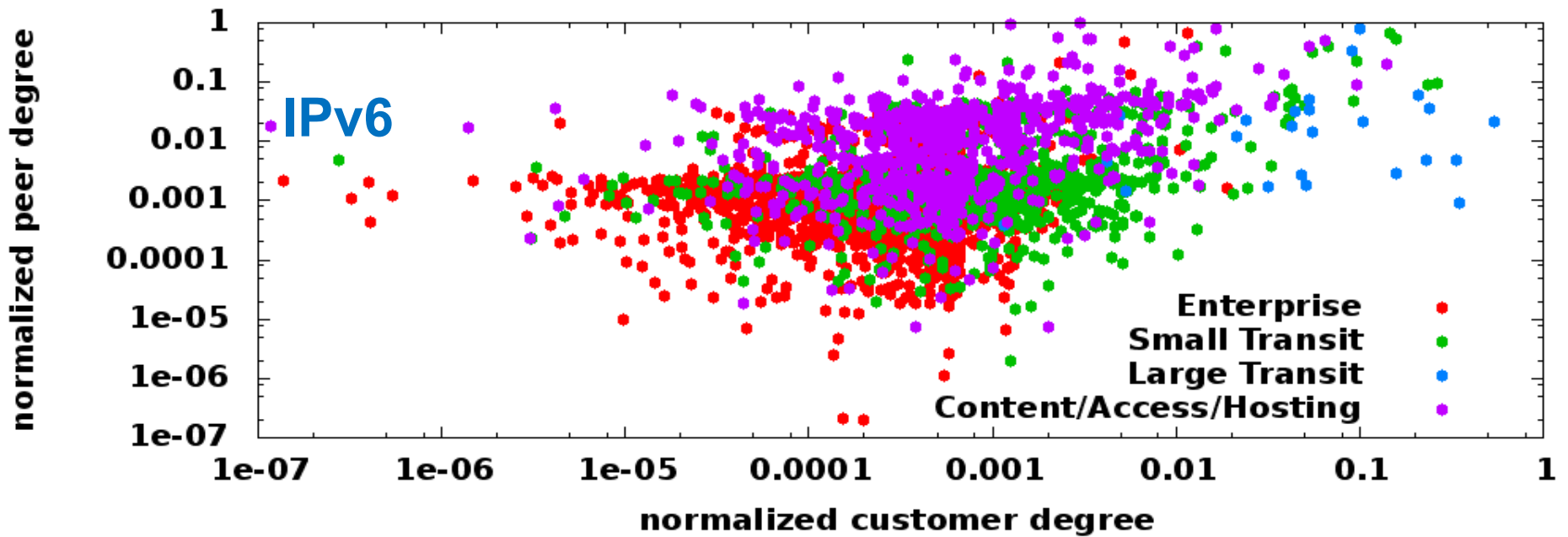
- **The profile of business relationships of dual-stacked ASes should be similar in IPv4 and IPv6.**
- **Infer relationships (p2p, p2c)** for IPv4 graph, apply those relationships to IPv6 graph -- use Gao's algorithm
- For each dual-stacked AS
 - **Infer type of AS (Enterprise, Content, Transit)**
 - Plot customer degree against peer degree in IPv4 and IPv6

Customer and peer degrees, by inferred type

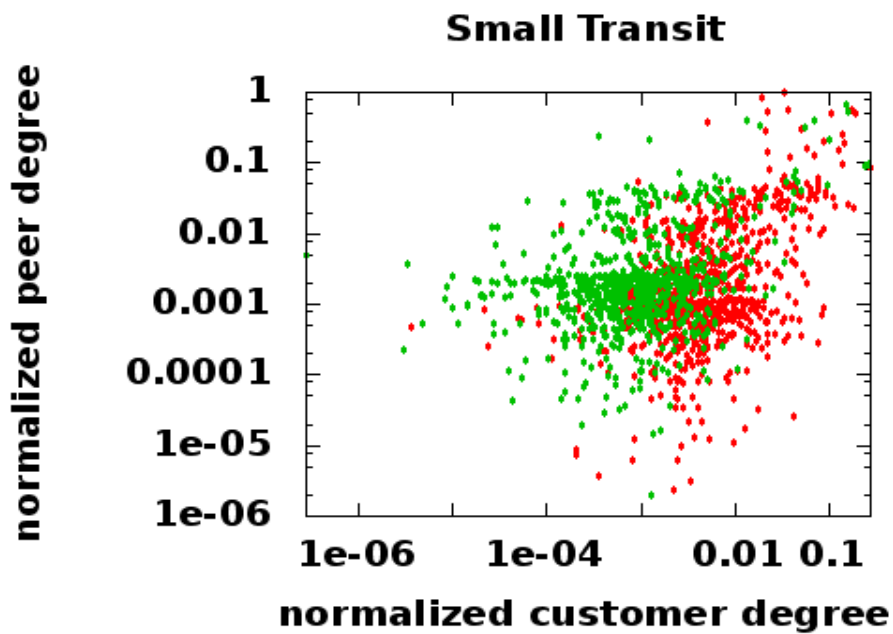
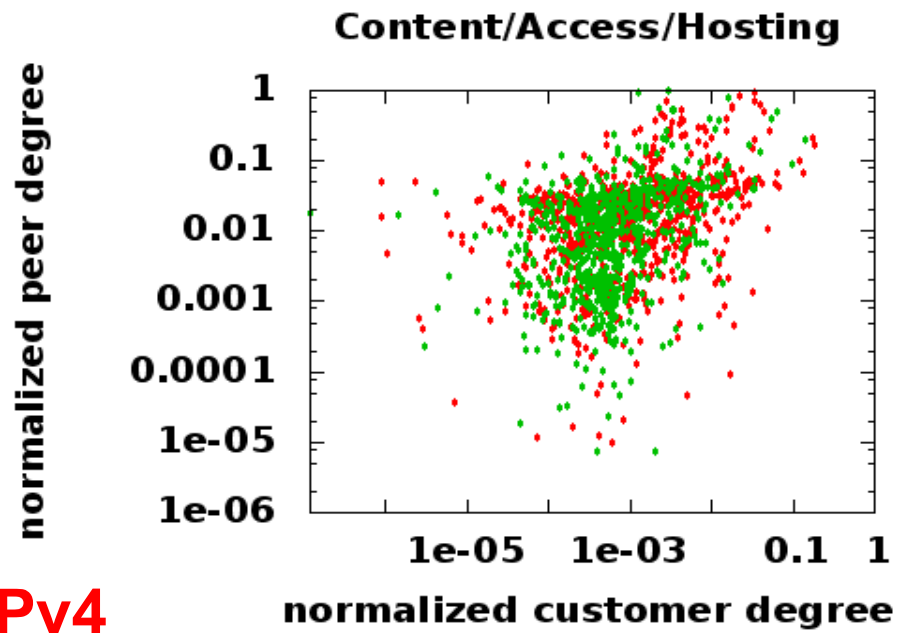
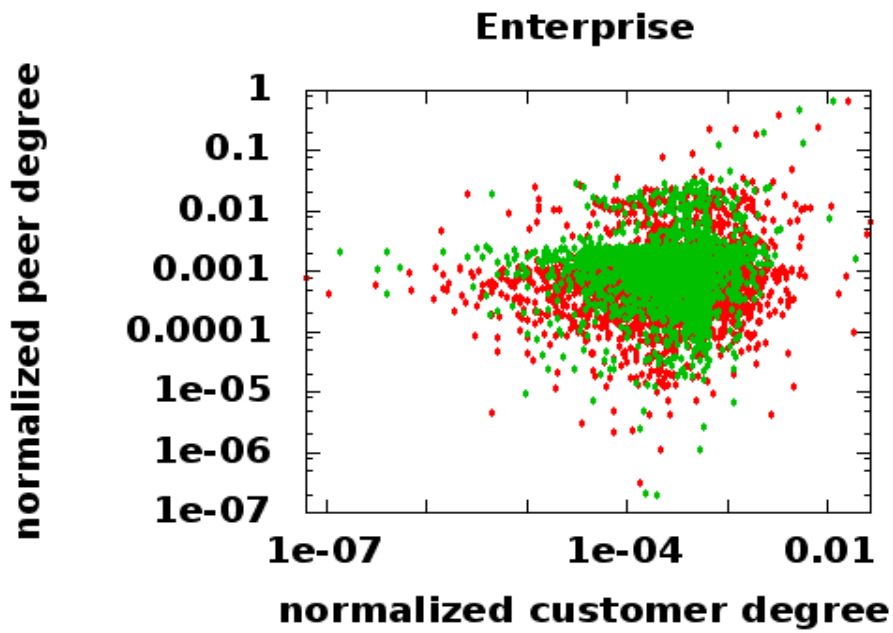
Jan 2012



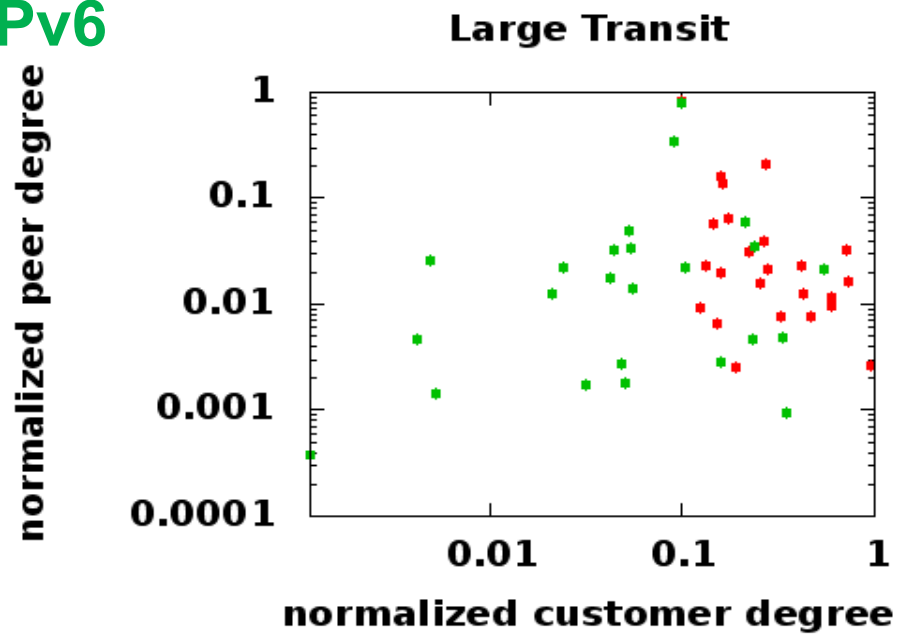
Inferred AS-Rel, AS-Type



Dual-stack ASes have about the same profile for each protocol 12



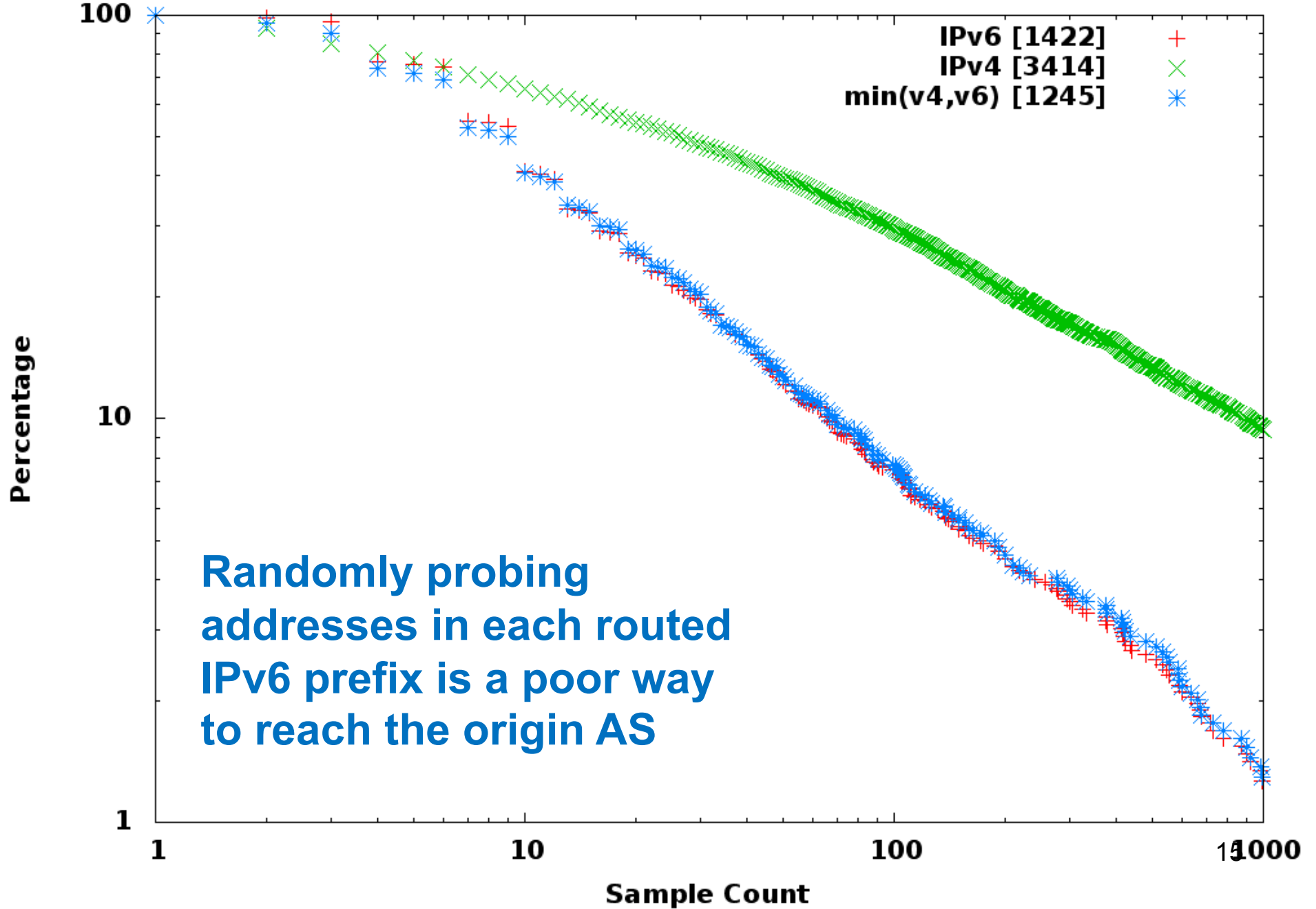
IPv4
IPv6

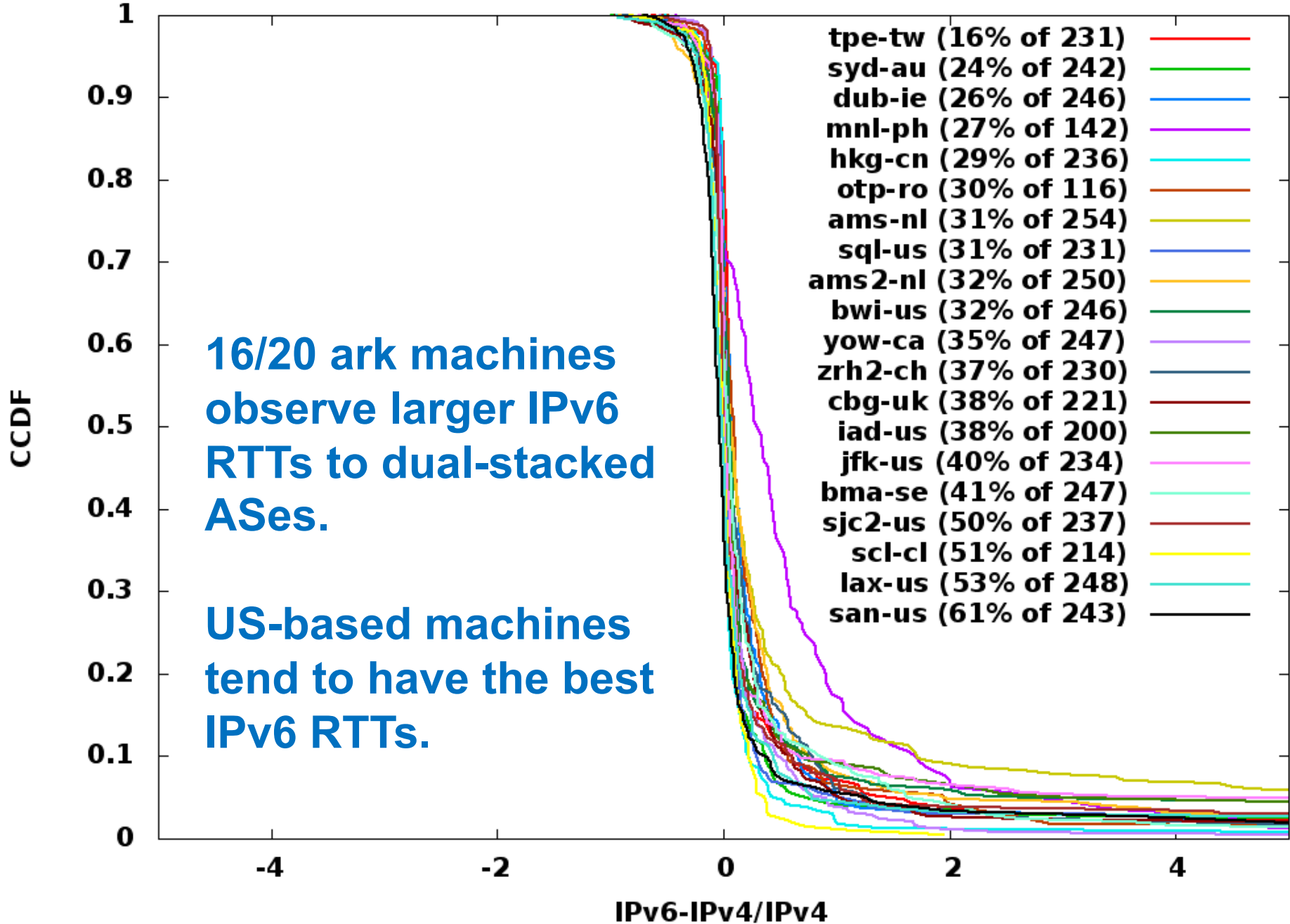


Dual-stack Transit ASes have smaller customer degree in IPv6

Hypothesis 4

- **IPv6 is maturing if the IPv4 and IPv6 RTTs for each AS are similar**
- **CAIDA Ark**: Use 20 dual-stacked boxes (used primarily for traceroute mapping)
- For each AS
 - determine median RTT values in IPv4 and IPv6 from traceroute responses
 - how different are the median RTT values for each AS?





Comments, Questions?

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Spare Slides

Maximum edit distance of AS paths, v6

