ImpROVement

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Can we determine which ASes really should start doing ROV?

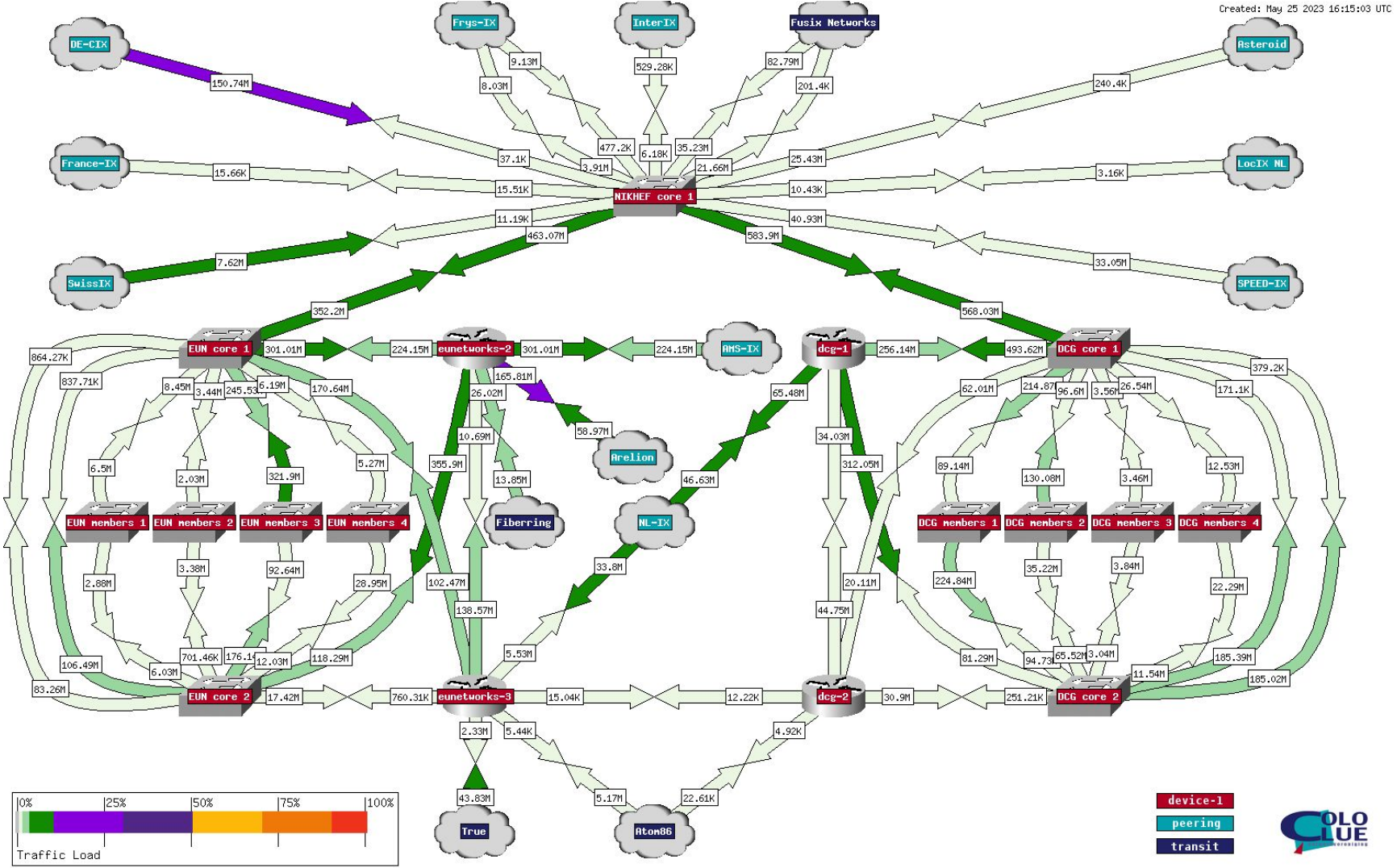
185.49.142.0/**23**

[VALID]

London	Amsterdam	Frankfurt	Madrid	Paris	Stoc
Warsaw	Miami	Atlanta	Chicago	Dallas	Hon
Los Angeles	Mexico City	Seattle	Silicon Valley	Toronto	Tokyo
Bangalore	Delhi NCR	Mumbai	Osaka	Seoul	Singapore
Tel Aviv	Sydney	Melbourne	Johannesburg	São Paulo	Santiago

185.49.142.0/**24**

[INVALID]


Created: May 25 2023 16:15:03 UTC
DE-CIX
Frys-IX
InterIX
Fusix Networks
Asteroid
France-IX
LocIX NL
SwissIX
SPEED-IX
NIKHEF core 1
EUN core 1
eunetworks-2
AMS-IX
dcg-1
DCG core 1
Arelion
Fiberring
NL-IX
EUN members 1
EUN members 2
EUN members 3
EUN members 4
DCG members 1
DCG members 2
DCG members 3
DCG members 4
EUN core 2
eunetworks-3
dcg-2
DCG core 2
True
Atom86
0%
25%
50%
75%
100%
Traffic Load
device-1
peering
transit

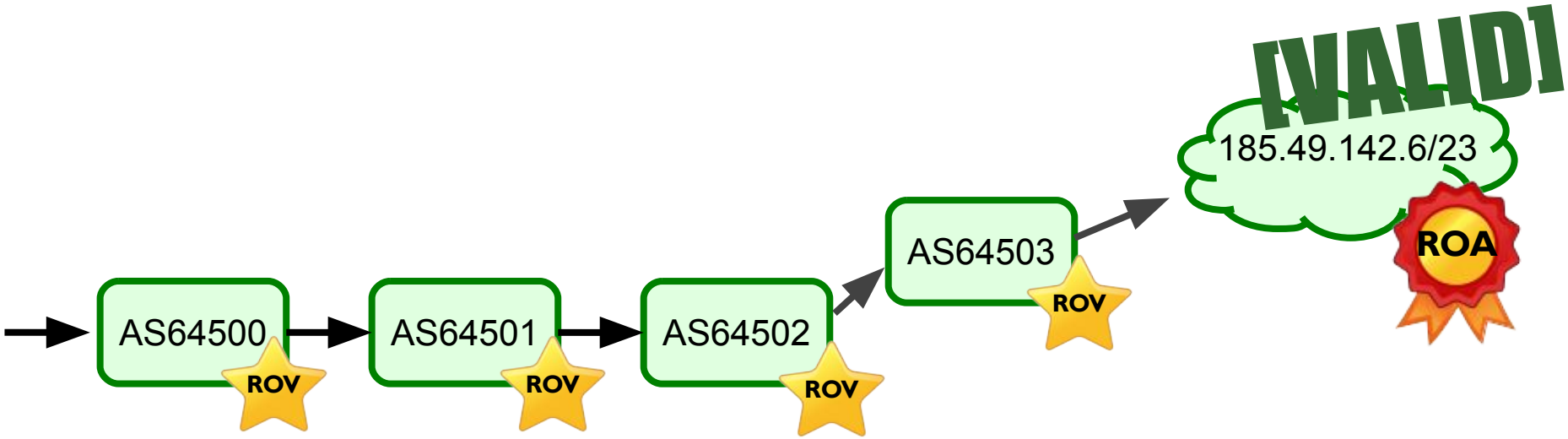
185.49.142.6/**23**

185.49.143.6/**23**

```
$ dig @185.49.142.6 rpkitest.nlnetlabs.nl TXT +short
"HOORAY - Your resolver reached the RPKI Valid announcement :)!"
```

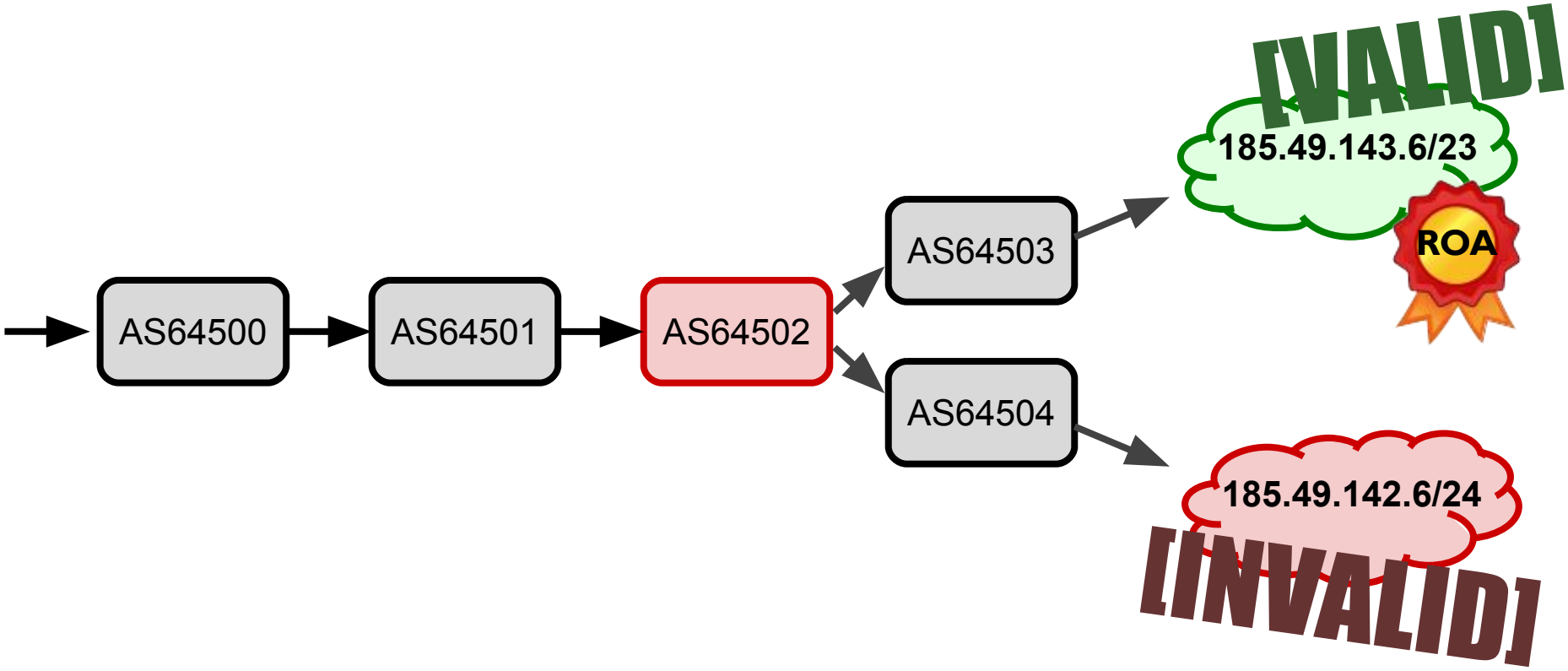
185.49.142.6/**24**

```
$ dig @185.49.142.6 rpkitest.nlnetlabs.nl TXT +short
"NO - Your resolver reached the RPKI Invalid announcement :("
```




```
$ traceroute 185.49.142.6   ← to valid
$ traceroute 185.49.143.6   ← same
```

$ traceroute 185.49.143.6 ← to the valid



$ traceroute 185.49.142.6 ← to the invalid

Measurements on 2023-03-10 on RIPE Atlas with 12115 probes

	msm id	IPv6 equivalent
`dig @185.49.142.6 rpkitest.nlnetlabs.nl TXT +nsid`	50791569	50791565
`traceroute 185.49.142.6`	50791571	50791567
`traceroute 185.49.143.6`	50791572	50791568
`dig @185.49.143.6 rpkitest.nlnetlabs.nl TXT +nsid`	*50791570*	*50791566*

Thank you Emile💖

43%

… of IPv6 probes ended up at the invalid

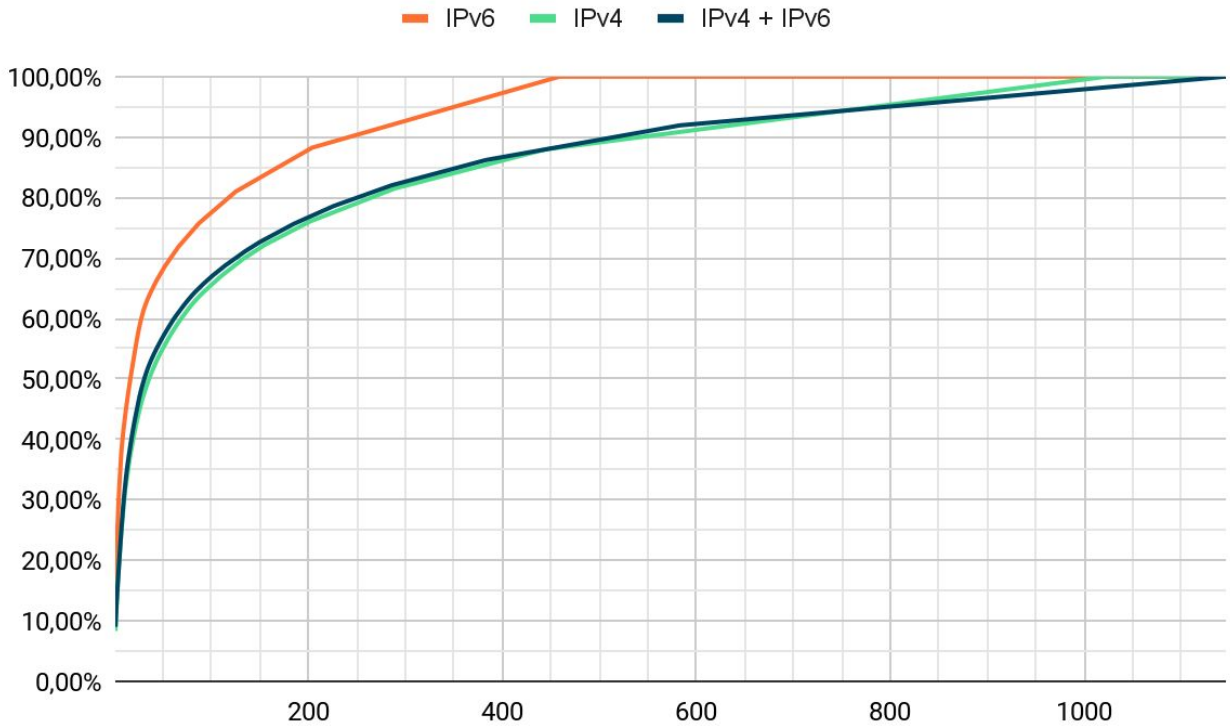
(2288 out of 5285)

48%

… of IPv4 probes ended up at the invalid

(5539 out of 11442)

The impact if the top N ASes that currently do not do ROV would do ROV



And the winner is...

🥇	**Telecom Italia (AS 6762)**	9%
🥈	**Free SAS (AS 12322)**	3.5%
🥉	**Vodafone (AS 3209)**	2.7%

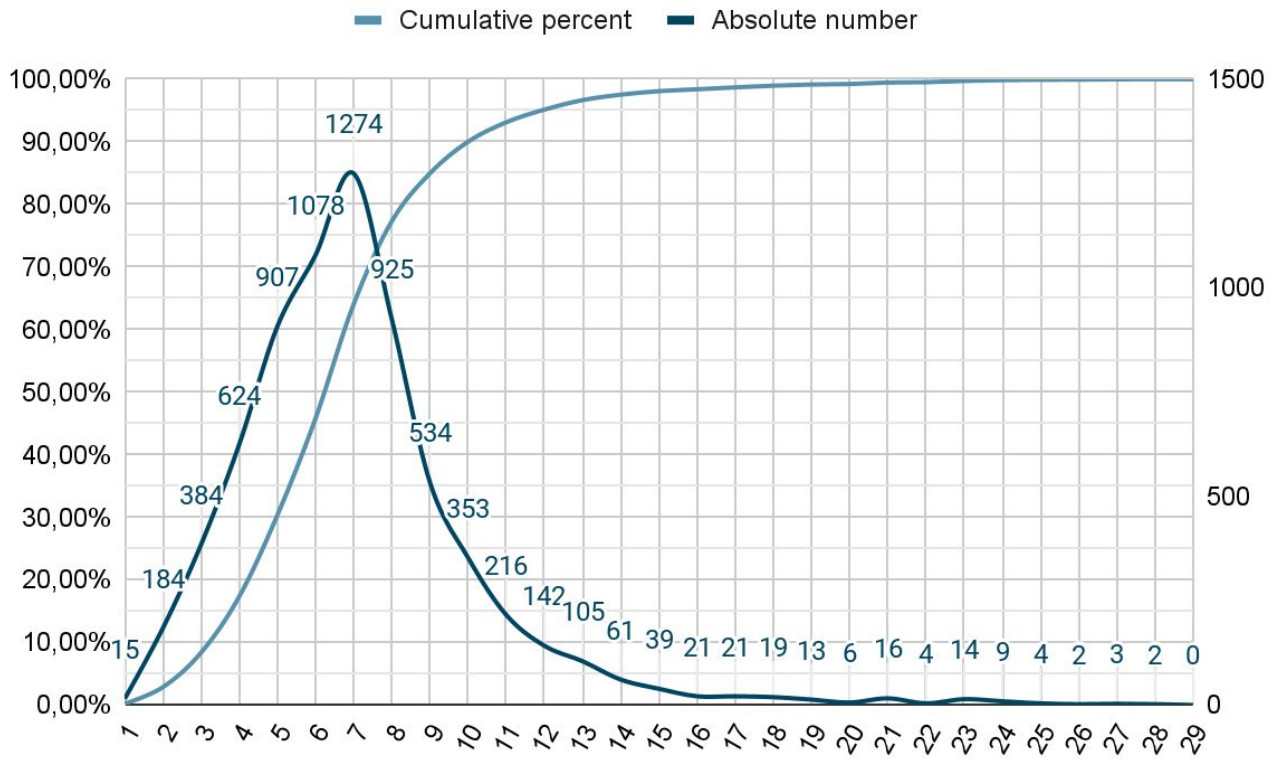
IPv6

🥇	**Telecom Italia (AS 6762)**	10.5%
🥈	**Free SAS (AS 12322)**	9.3%
🥉	**NOS COMUNICACOES (AS 2860)**	4.8%

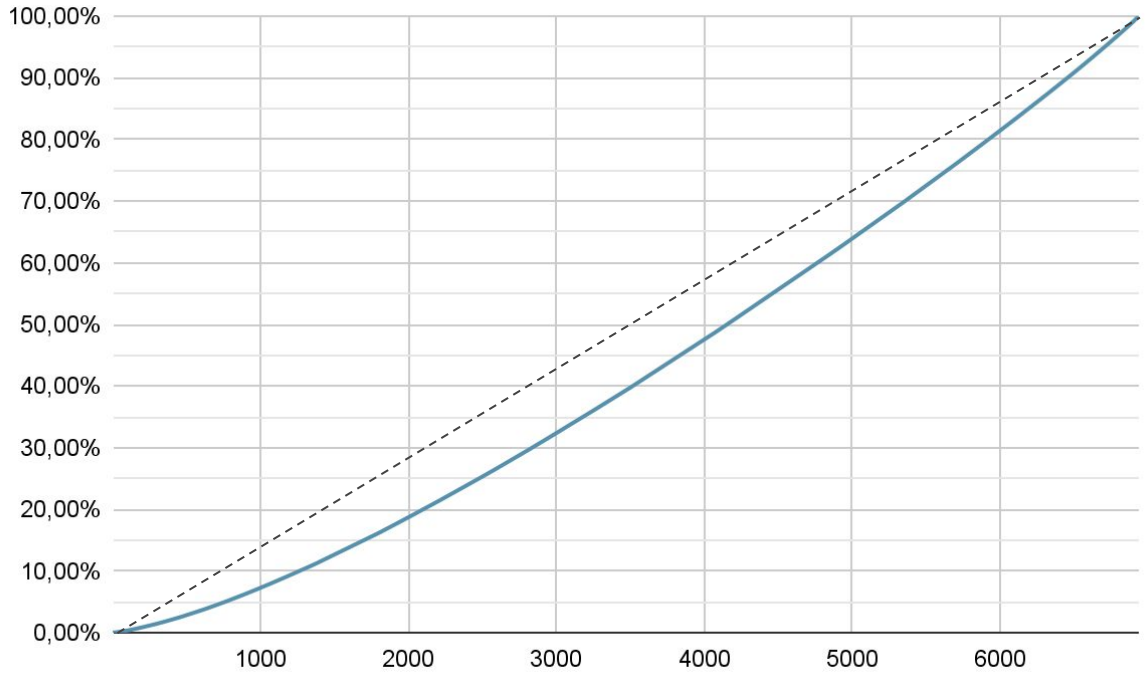
IPv4

🥇	**Telecom Italia (AS 6762)**	8.3%
🥈	**Superonline A.S. (AS 34984)**	3.3%
🥉	**PCCW Global, Inc. (AS 3491)**	3.1%

Traffic divergence per hop

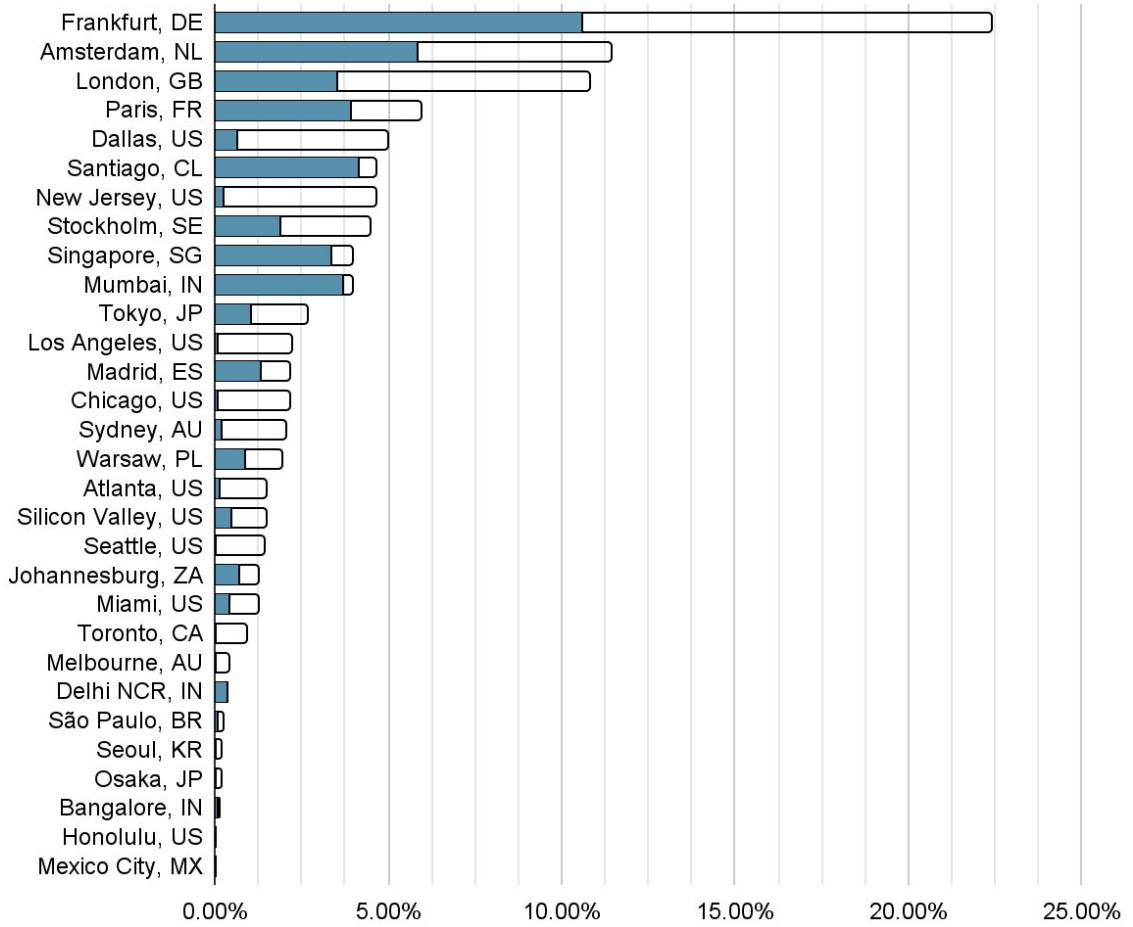


Cumulative diverging hop relative to valid path length



Percentage of total number of resolvers having affinity with a certain POP

Coloured area reaching the invalid



Conclusions

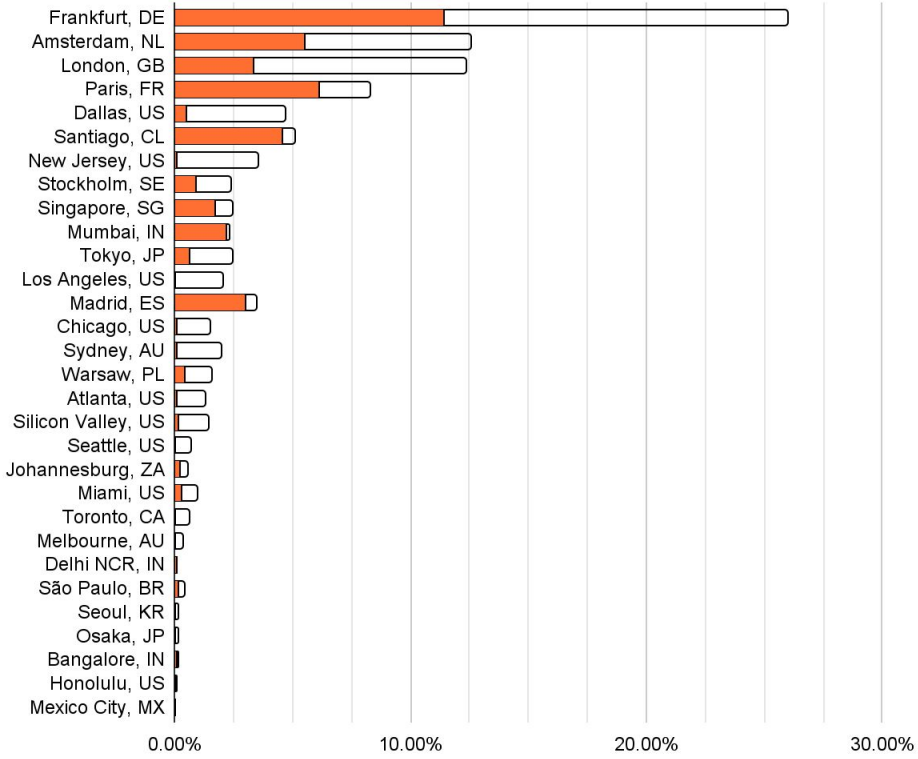
- A small group of organisations can have a big impact on routing security
- This can happen anywhere on the path
- Some POPs fare better than others

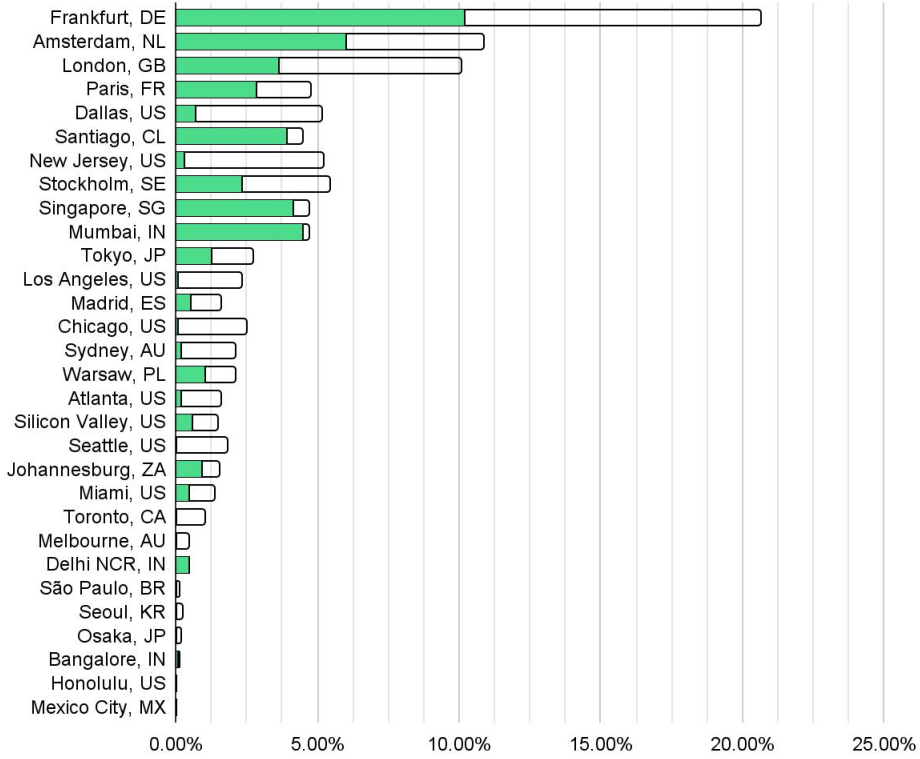
More room for ImpROVment?

- **Observation**
  - Validating can see if a peer does not do Route Origin Validation
- **Suggestion**
  - Avoid paths to peers that don’t ROV

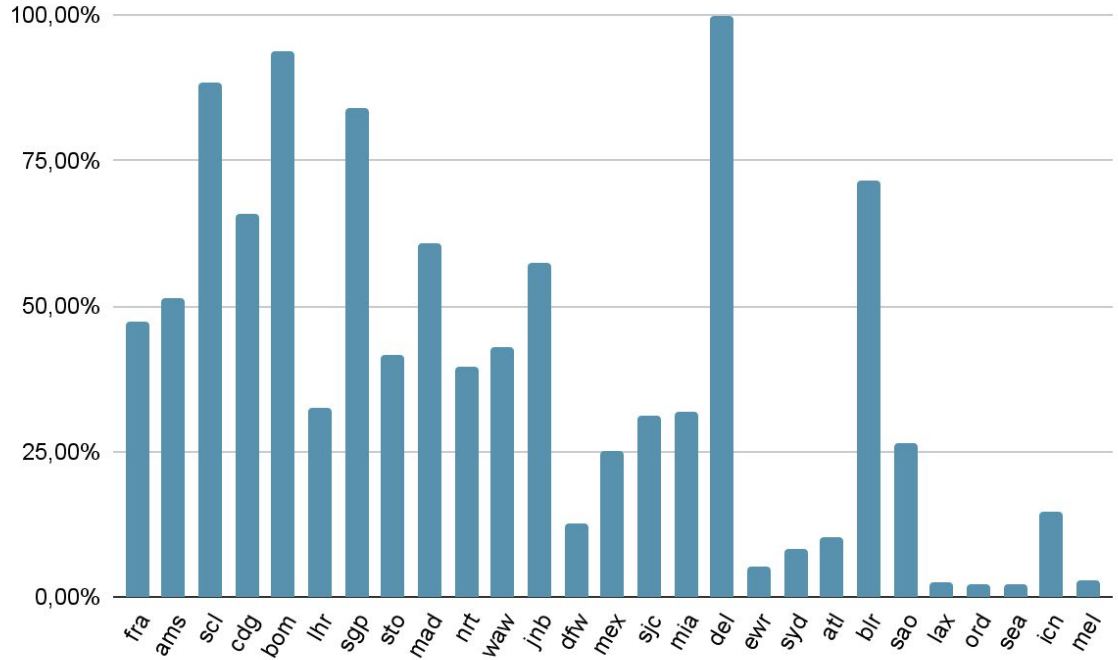
Percentage of total number of resolvers having affinity with a certain POP (IPv6 vs IPv4)

Coloured area reaching the invalid





Percentage of traffic for a specific POP ending up at the invalid (sorted by most common POP)



fra: Frankfurt, DE
ams: Amsterdam, NL
scl: Santiago, CL
cdg: Paris, FR
bom: Mumbai, IN
lhr: London, GB
sgp: Singapore, SG
sto: Stockholm, SE
mad: Madrid, ES
nrt: Tokyo, JP
waw: Warsaw, PL
jnb: Johannesburg, ZA
dfw: Dallas, US
sjc: Silicon Valley, US
mia: Miami, US
del: Delhi NCR, IN
ewr: New Jersey, US
syd: Sydney, AU
atl: Atlanta, US
blr: Bangalore, IN
sao: São Paulo, BR
lax: Los Angeles, US
ord: Chicago, US
sea: Seattle, US
icn: Seoul, KR
mel: Melbourne, AU
mex: Mexico City, MX