# IPv6 Address Assignment Practices in Domestic ISPs

Stephen Strowes <sds@fastly.com>, 2021-10-13, GAIA Workshop

# DynamIPs: Analyzing address assignment practices in IPv4 and IPv6

Ramakrishna Padmanabhan, John P. Rula,
Philipp Richter, **Stephen Strowes**, Alberto Dainotti

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# Motivation: why care about address assignments?

(ranges of) IP addresses are assigned to ISP subscribers

we infer a lot about users from these addresses

the addresses are not permanent, in time or space

# Assignment *size* has impact

**Reputation**: what has an address range been used for in the past?

**Geolocation**: how much space in the same location?

**Measurement targets**: scoping

**Logging**: what is a suitable netmask to meaningfully obfuscate IP addresses in logs?

# Assignment *duration* has impact

**Reputation**: when can the slate be wiped clean?

**Geolocation**: has this space potentially moved?

**Measurement targets**: will the target still exist, or be elsewhere?

# We study IPv4 addresses and IPv6 /64 prefixes using RIPE Atlas's IP Echo dataset


https://beta-docs.atlas.ripe.net/built-in/
measurements 12027, 13027

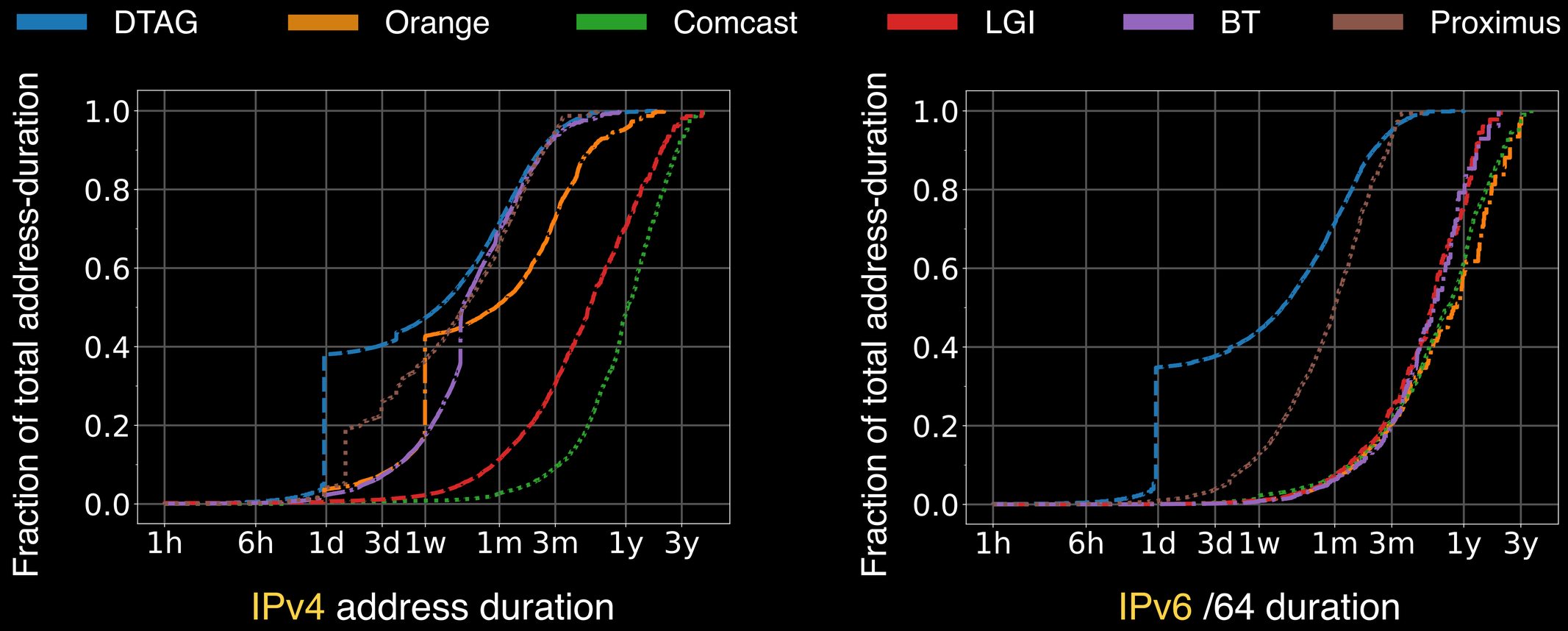
RIPE Atlas platform consists of ~11K active probes

We use the built-in HTTP "IP Echo" dataset (2014 to 2020)

In the paper: we corroborate RIPE Atlas measurements against Akamai's (much larger) dataset

# Temporal dynamics

# IPv6 assignments have longer durations than IPv4 assignments




The CDN dataset corroborates our observations of long assignment durations

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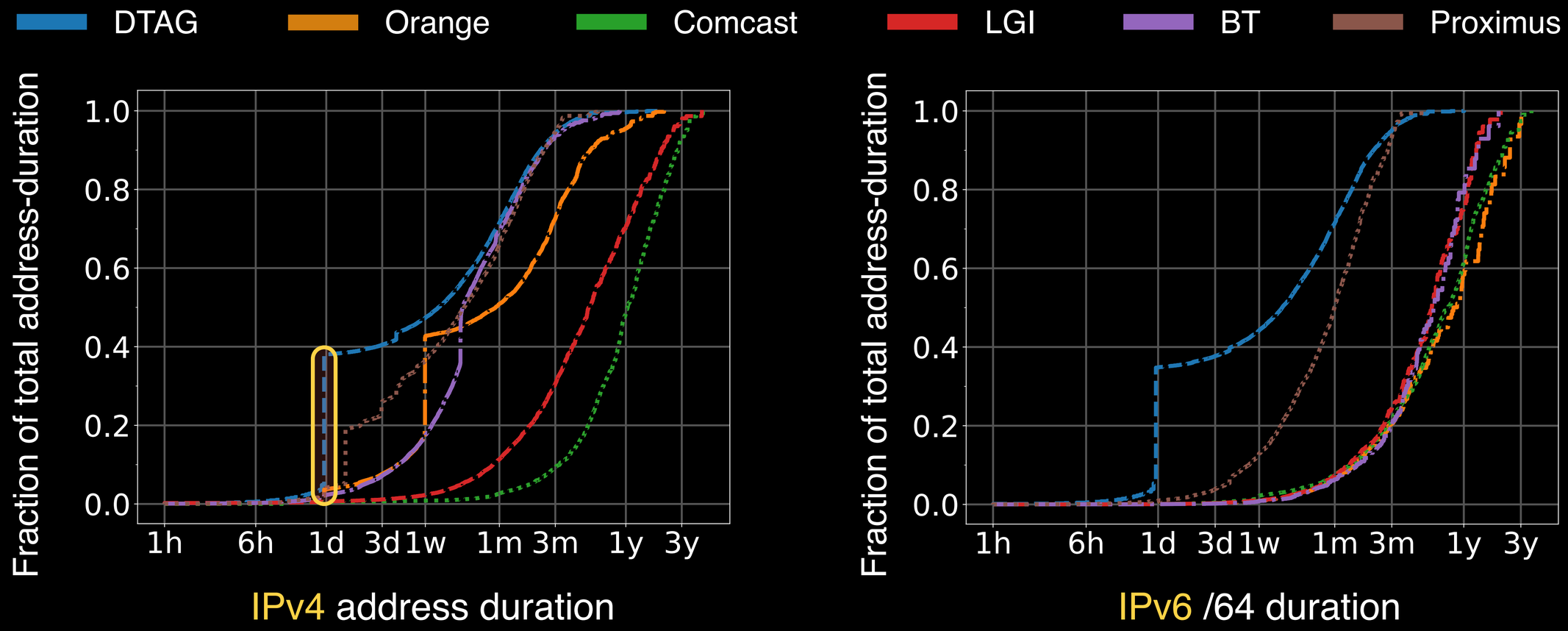


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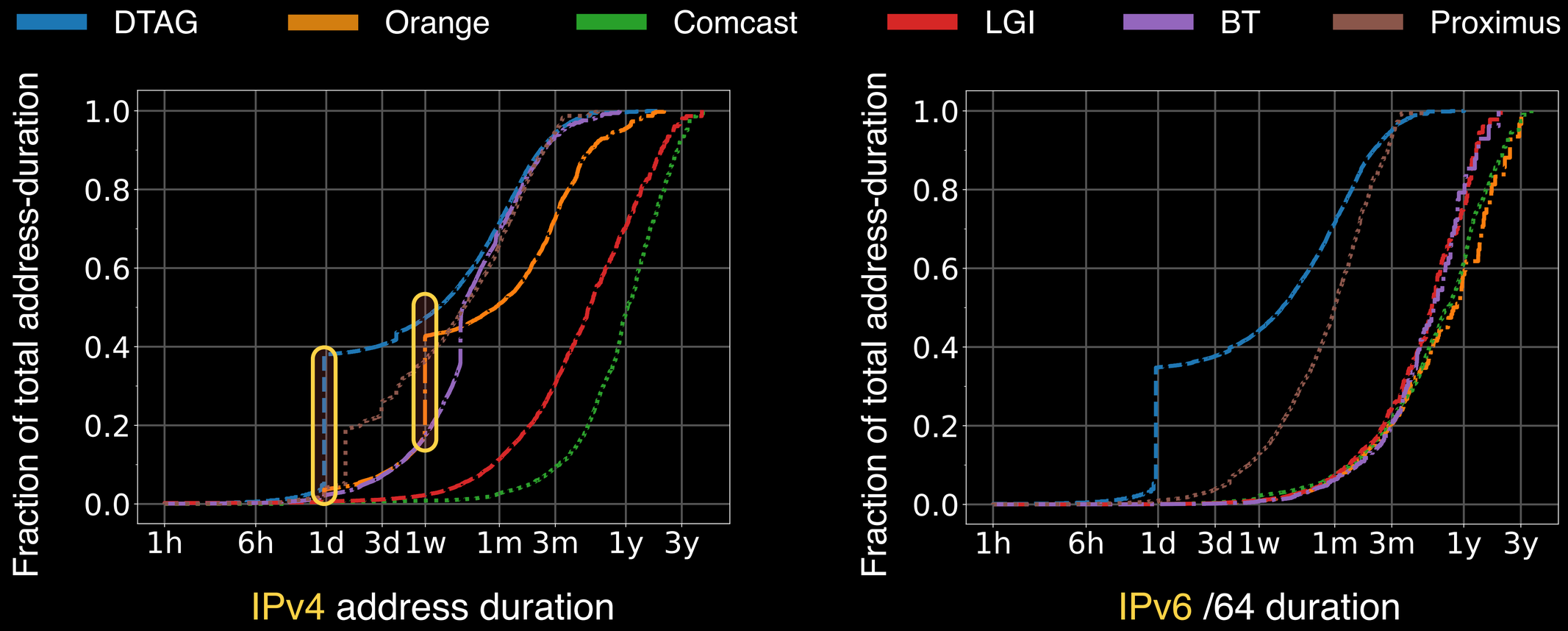


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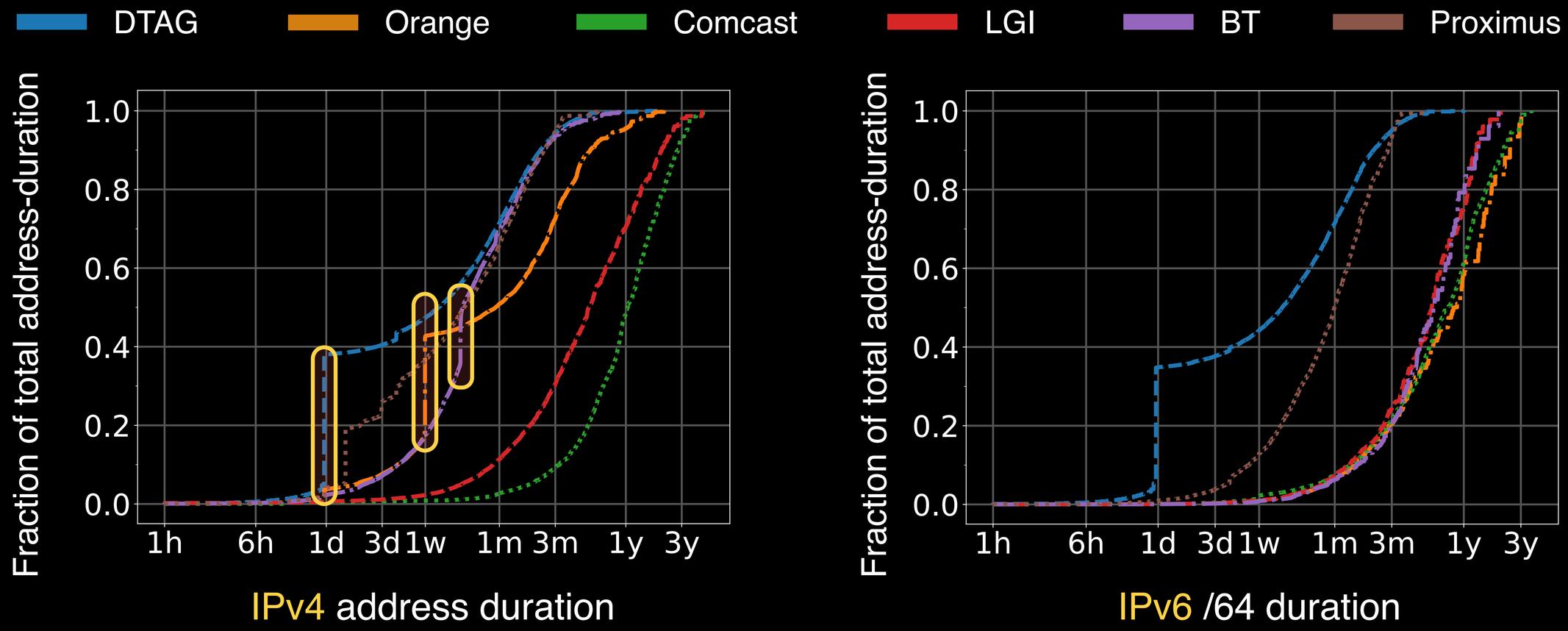


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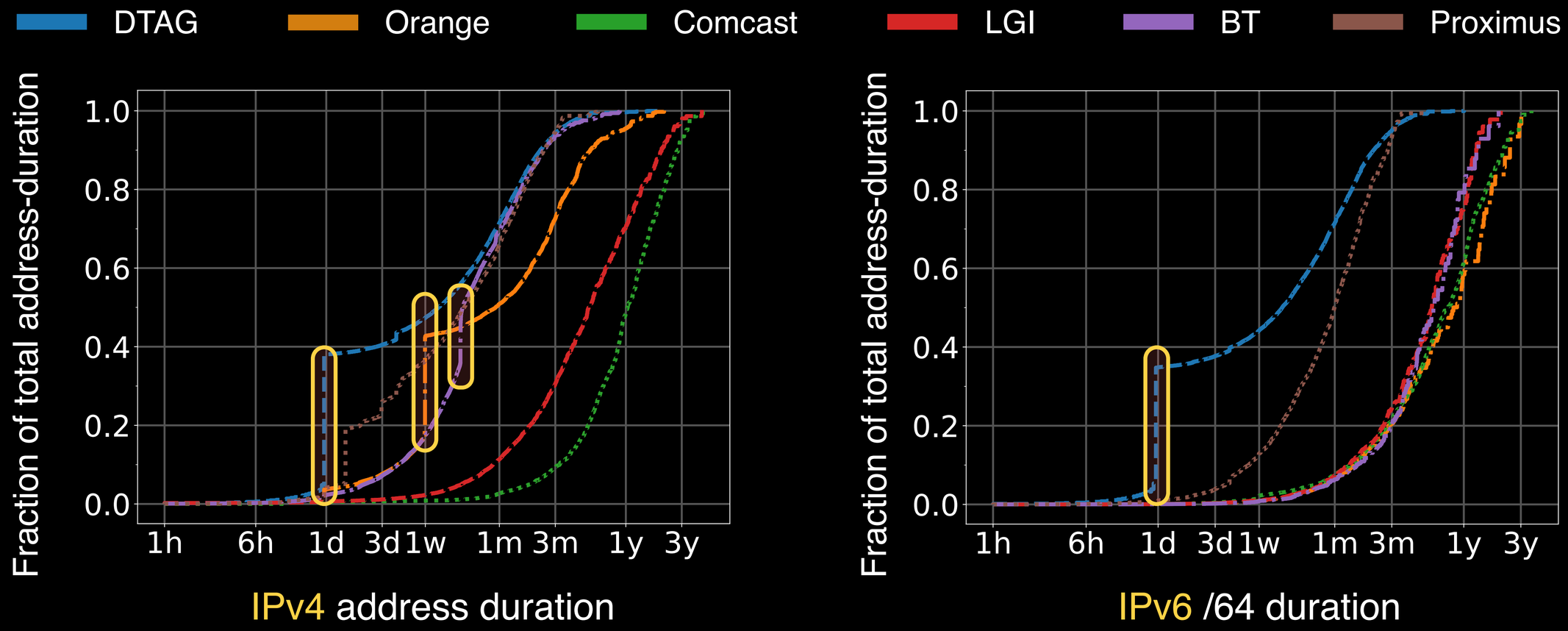


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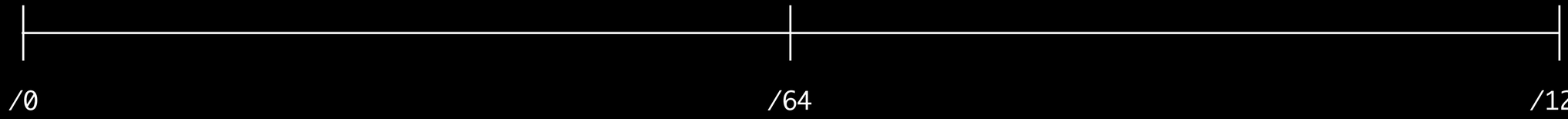
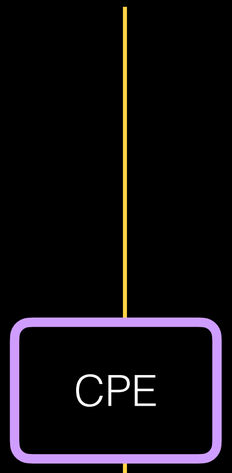
# Spatial dynamics

# IPv6 assignment practices




BCOP: https://www.ripe.net/publications/docs/ripe-690

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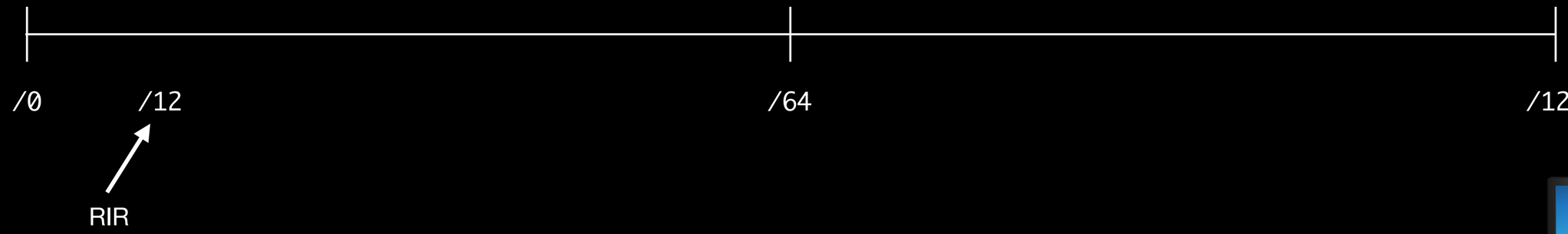


CPE

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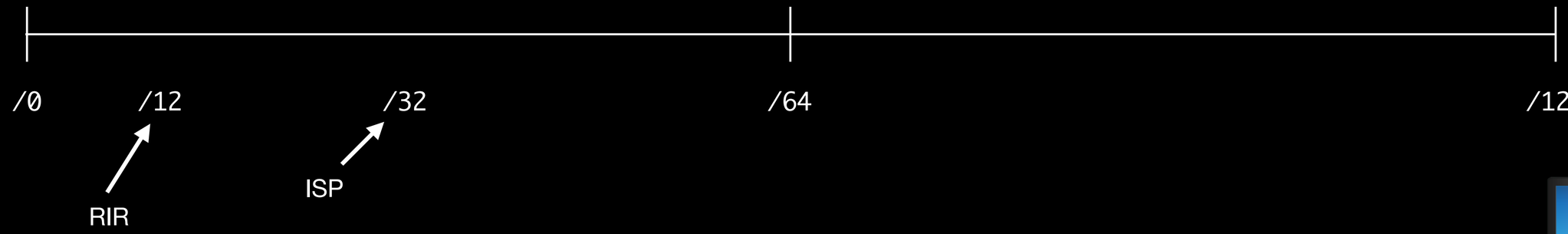


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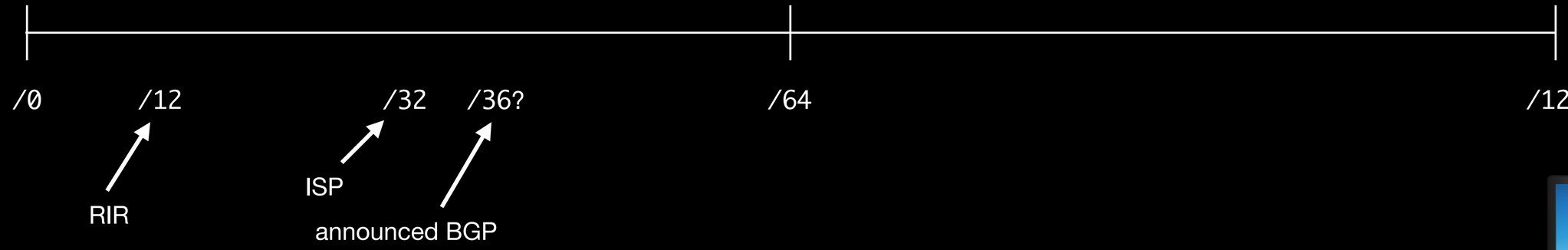


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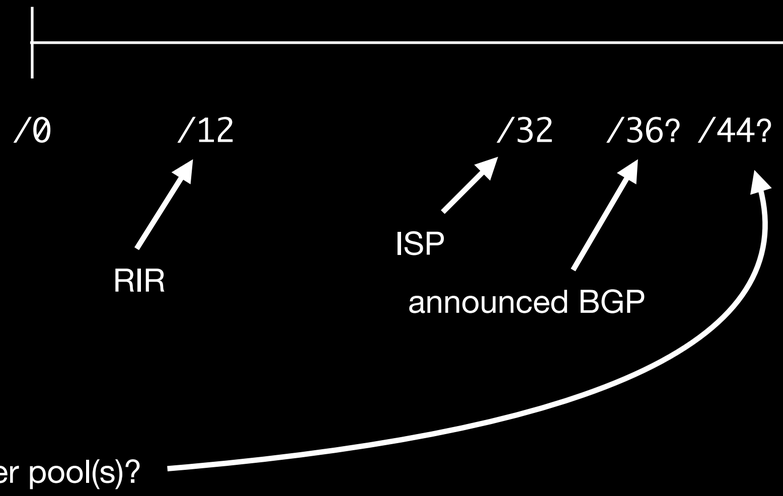


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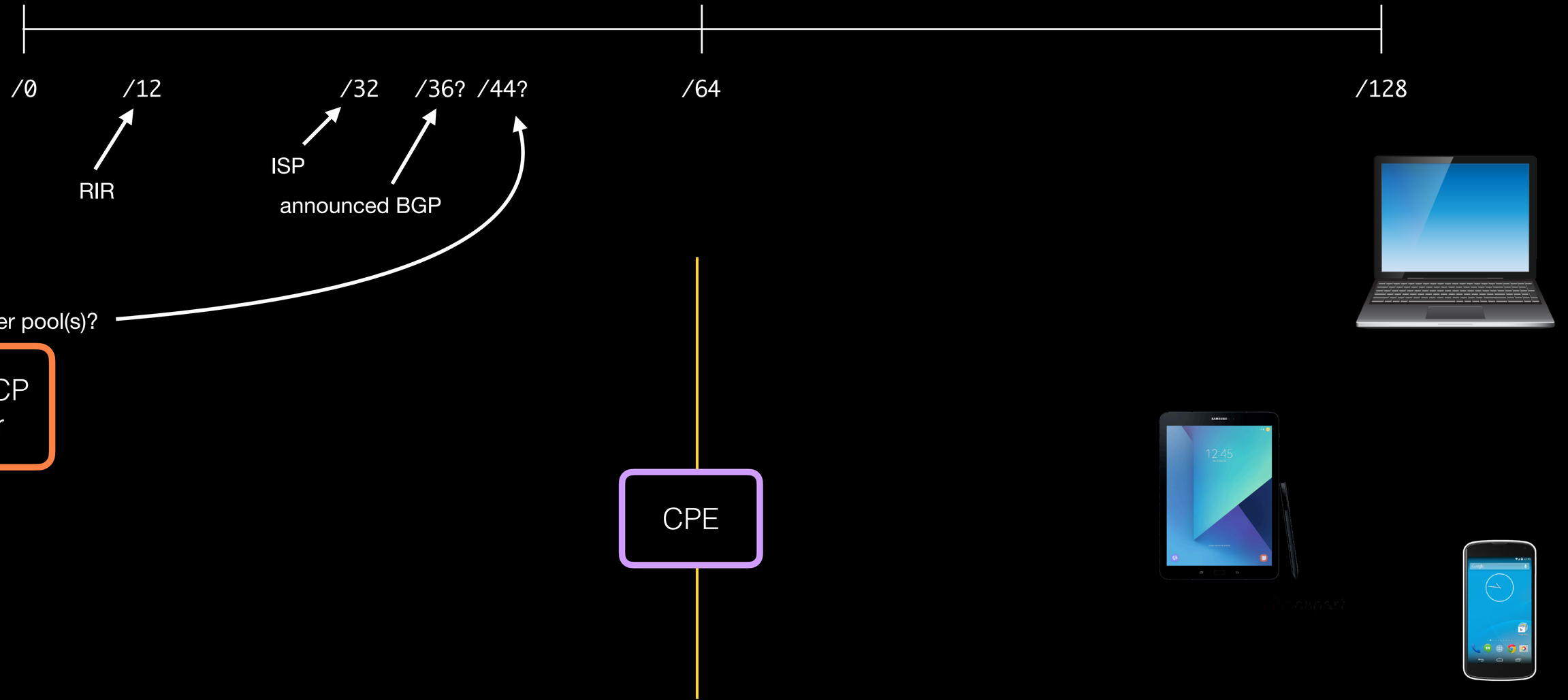


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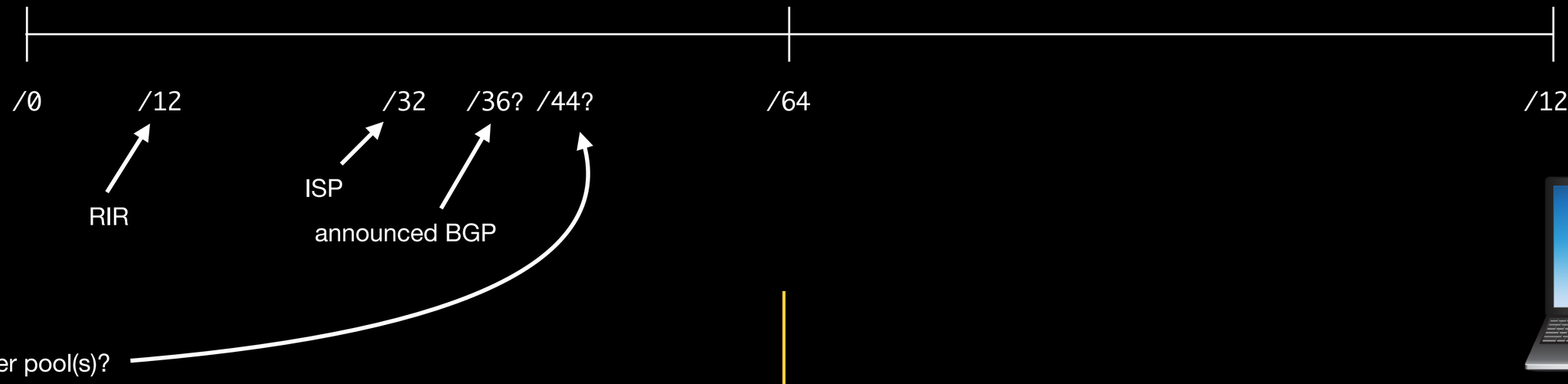


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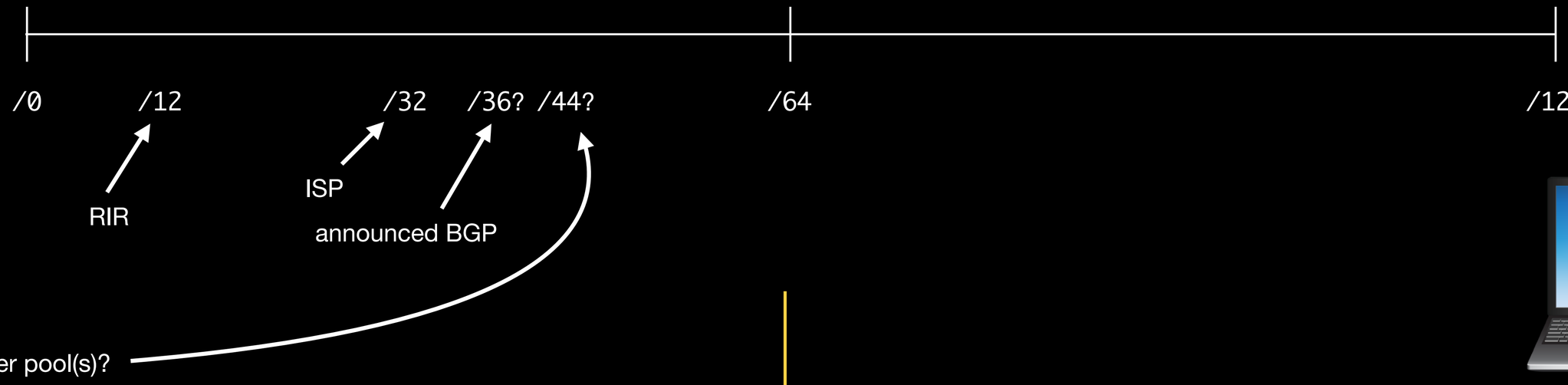


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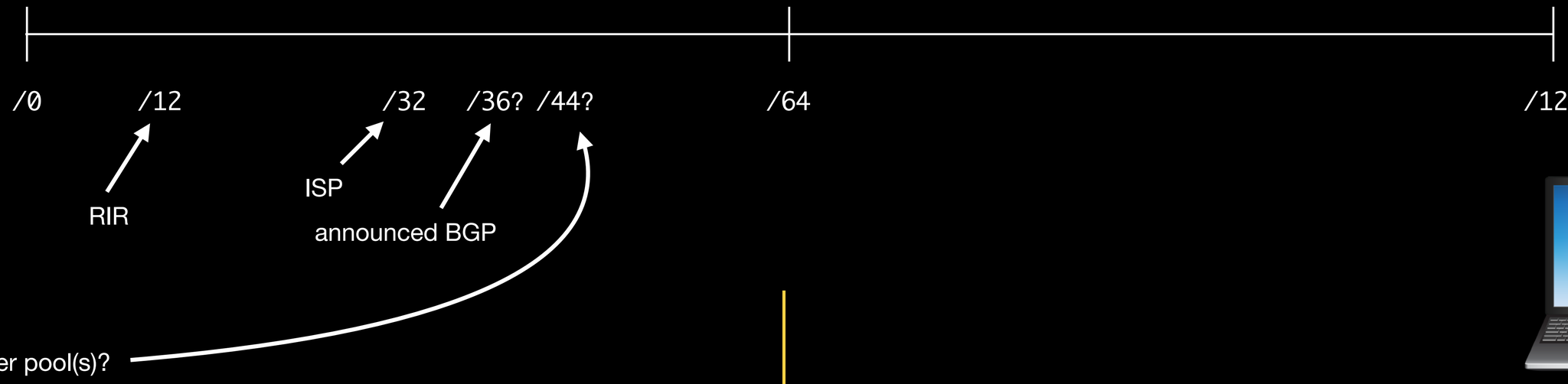


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/0 /12 /32 /36? /44? /56? /64 /128

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ISP

announced BGP

subscriber pool(s)?

size of assignment to customer site

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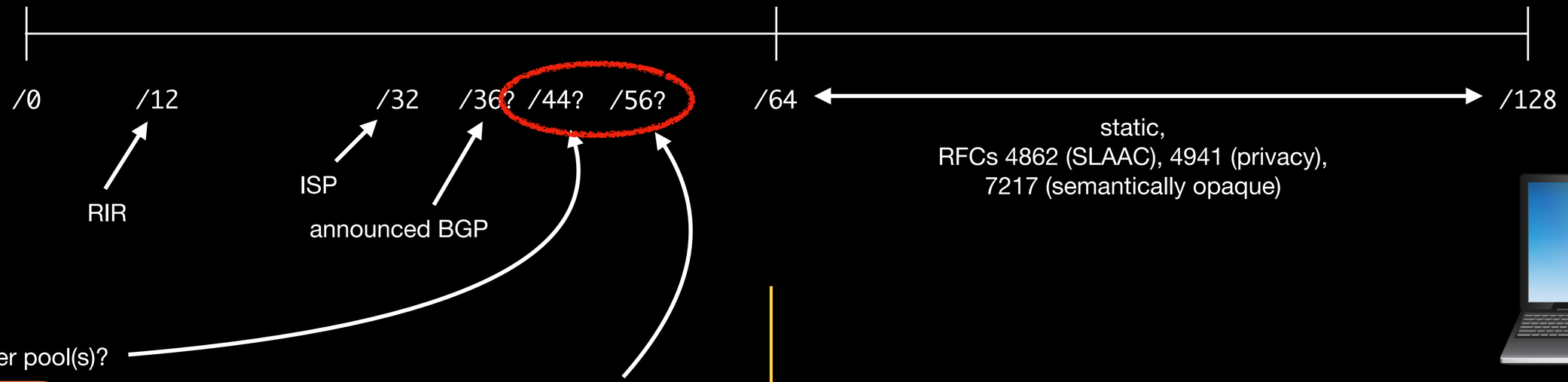


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# Finding a subscriber's pool and delegated prefix by observing assignments over time

IPv6 /64s assigned over time to probe 17511 in Sky U.K. (AS 5607)

2a02:0c7f:c610:0f00::/64
2a02:0c7f:c616:1300::/64
2a02:0c7f:c61b:e700::/64
2a02:0c7f:c622:2400::/64
2a02:0c7f:c60f:3300::/64
2a02:0c7f:c623:a500::/64
2a02:0c7f:c627:9d00::/64
2a02:0c7f:c617:6d00::/64
2a02:0c7f:c66a:bf00::/64
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2a02:0c7f:c622:2400::/64
2a02:0c7f:c60f:3300::/64
2a02:0c7f:c623:a500::/64
2a02:0c7f:c627:9d00::/64
2a02:0c7f:c617:6d00::/64
2a02:0c7f:c66a:bf00::/64
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2a02:0c7f:c623:a500::/64
2a02:0c7f:c627:9d00::/64
2a02:0c7f:c617:6d00::/64
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**Suggests this subscriber pool roughly a /40**

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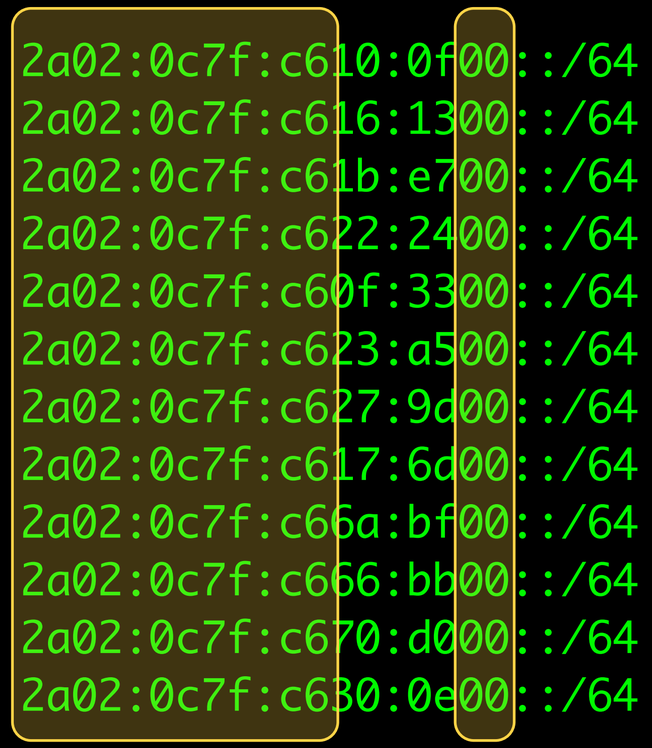


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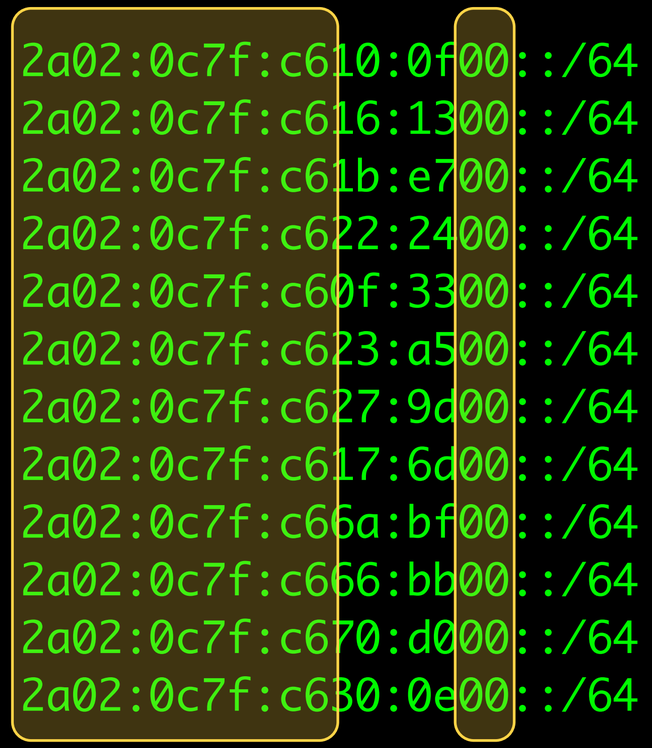
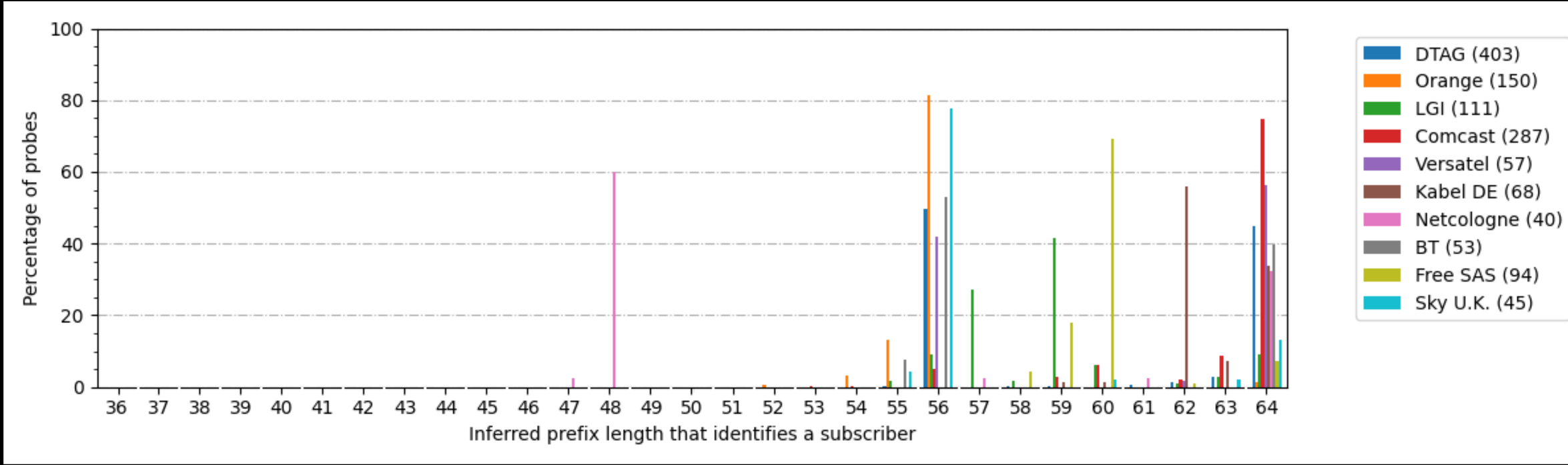



**Suggests this subscriber pool roughly a /40**

**Rightmost 8 bits in the network part are always set to 0**

**Inferred delegated prefix: /56**

# Finding a subscriber's delegated prefix by observing multiple /64 assignments over time



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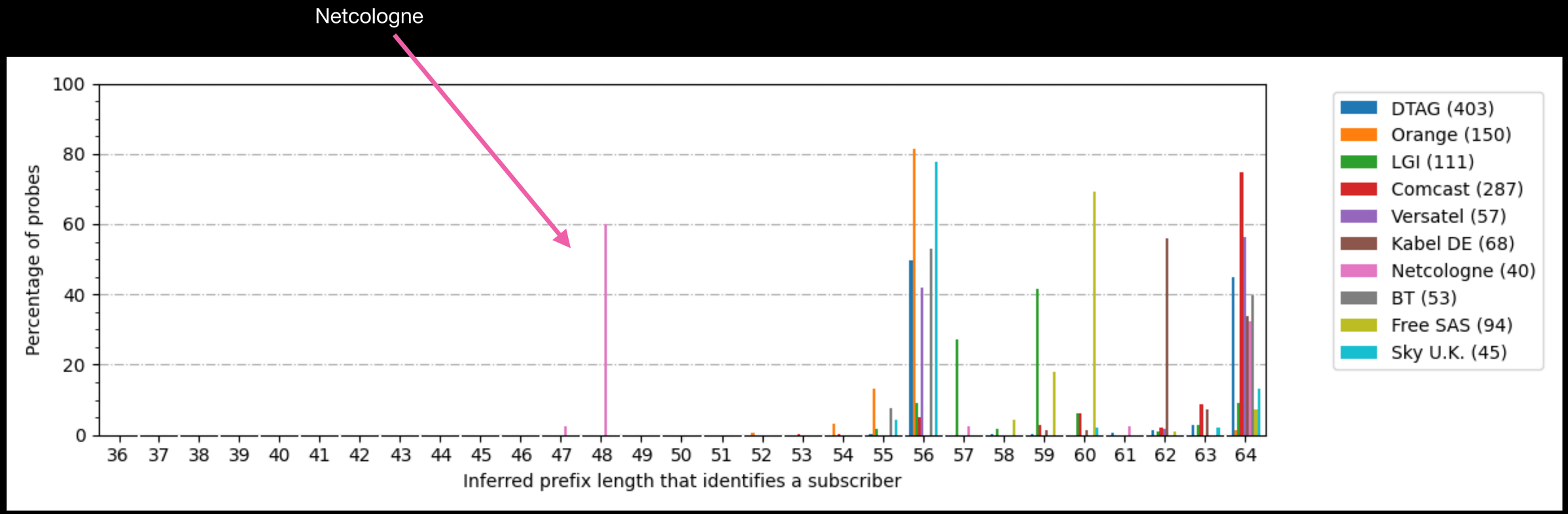

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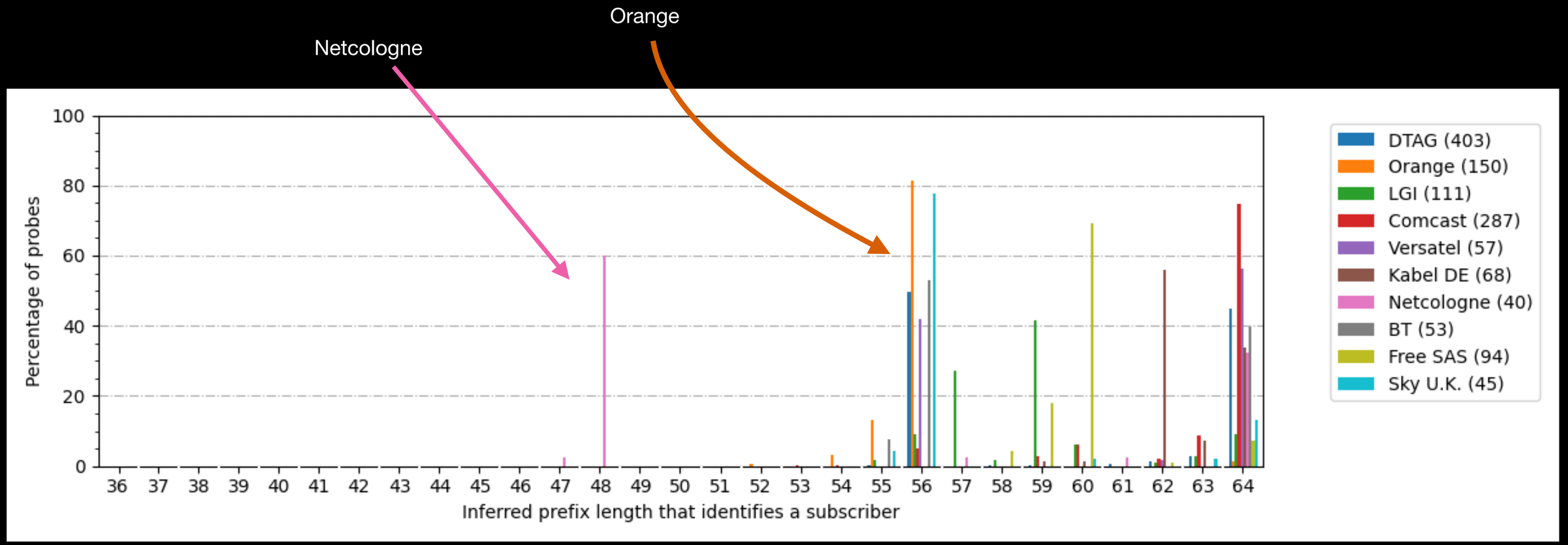

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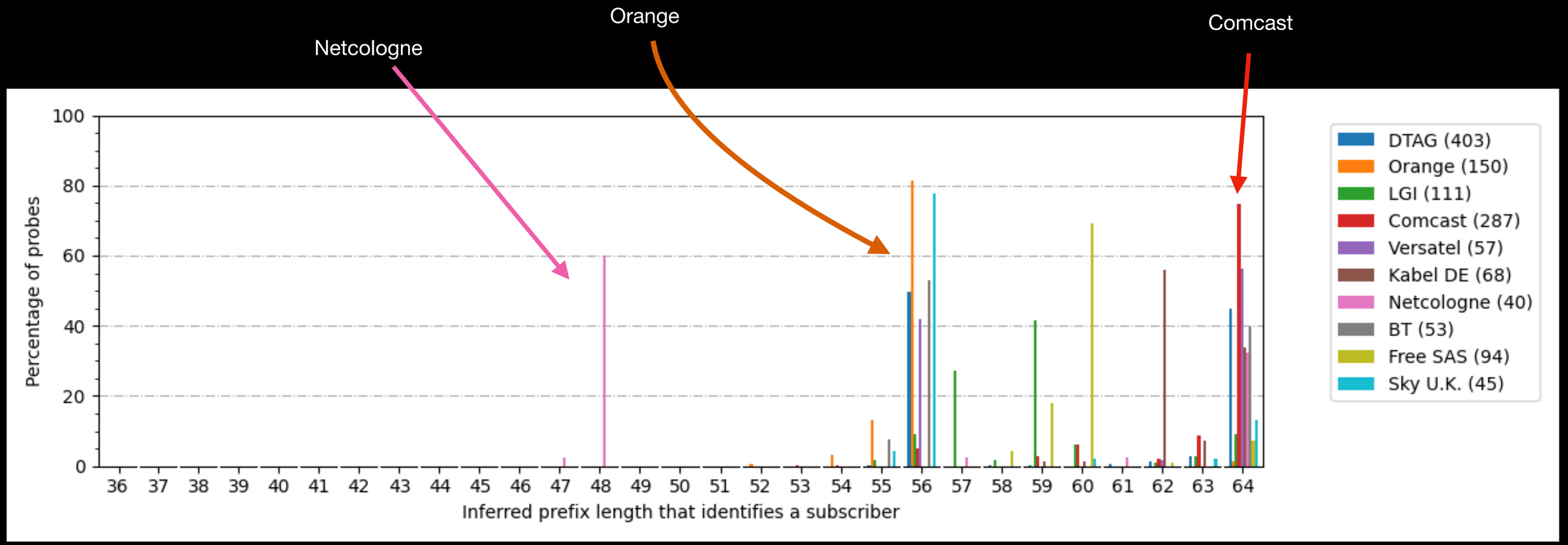

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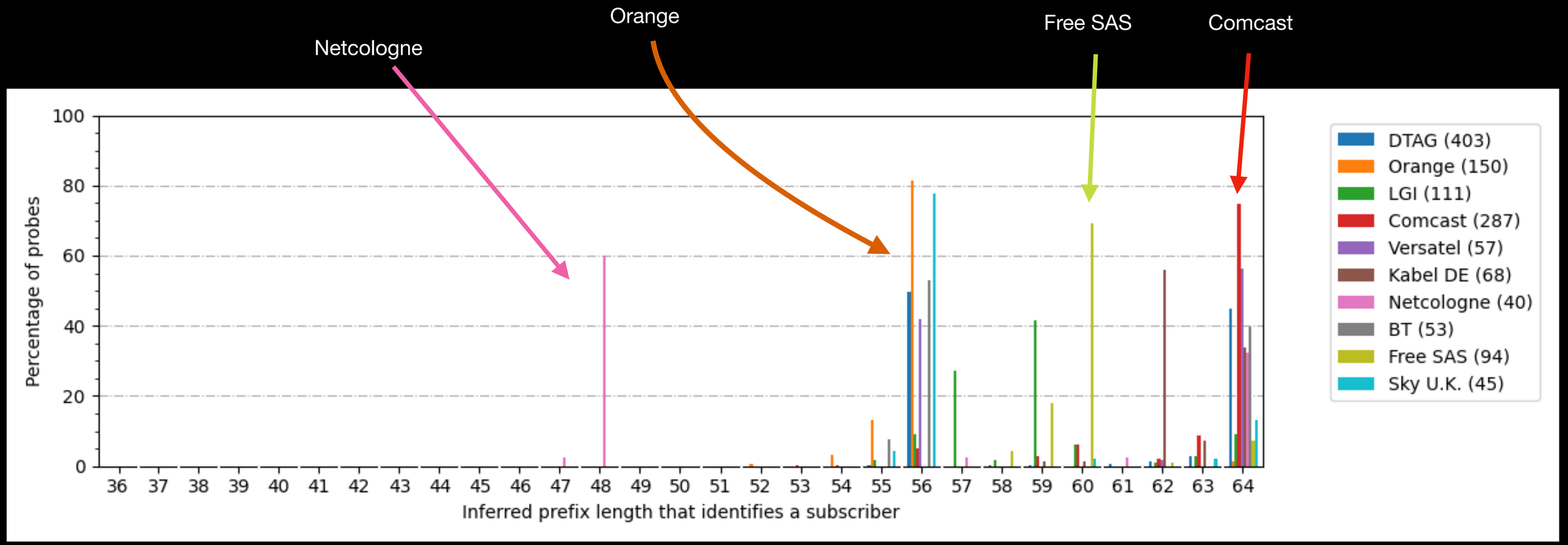

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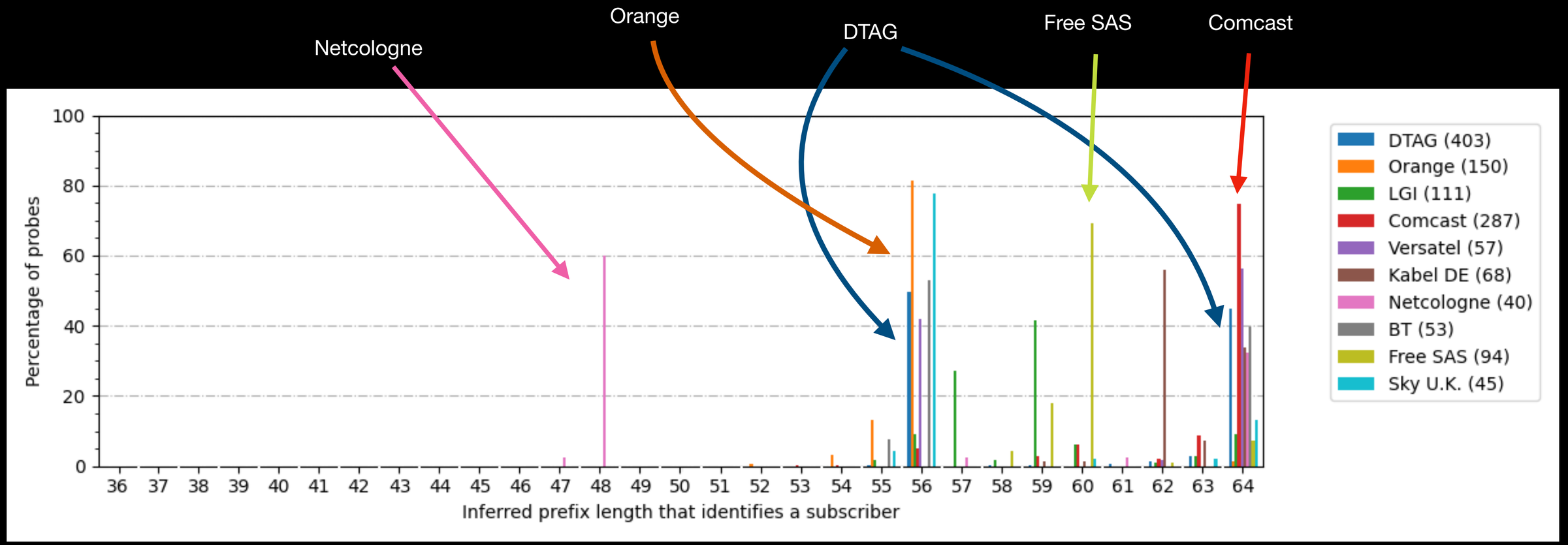

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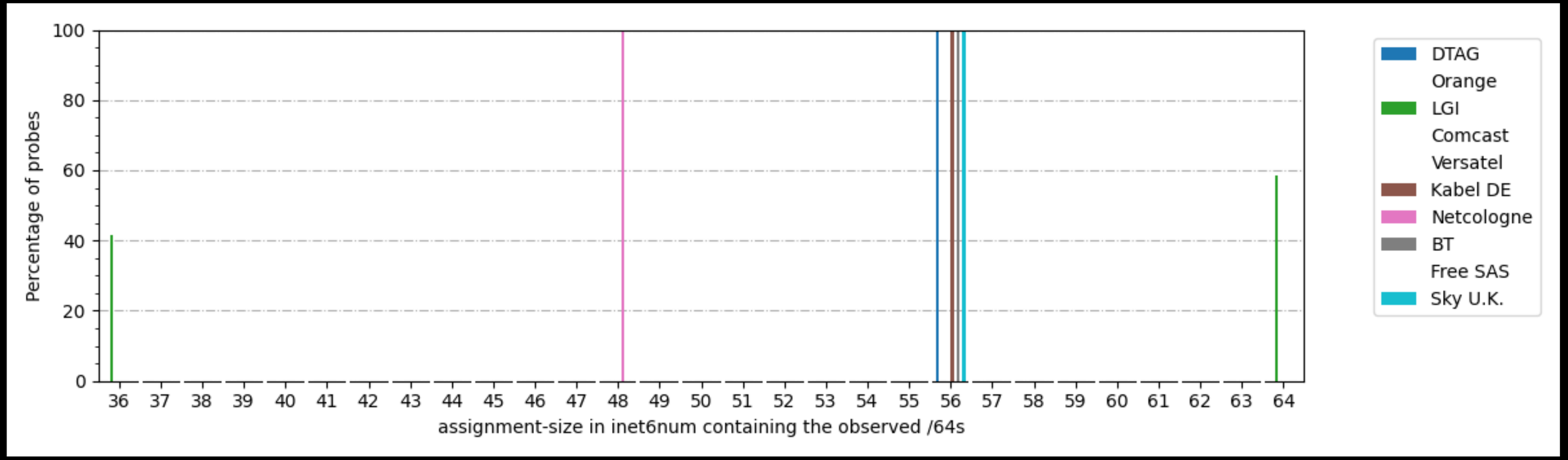


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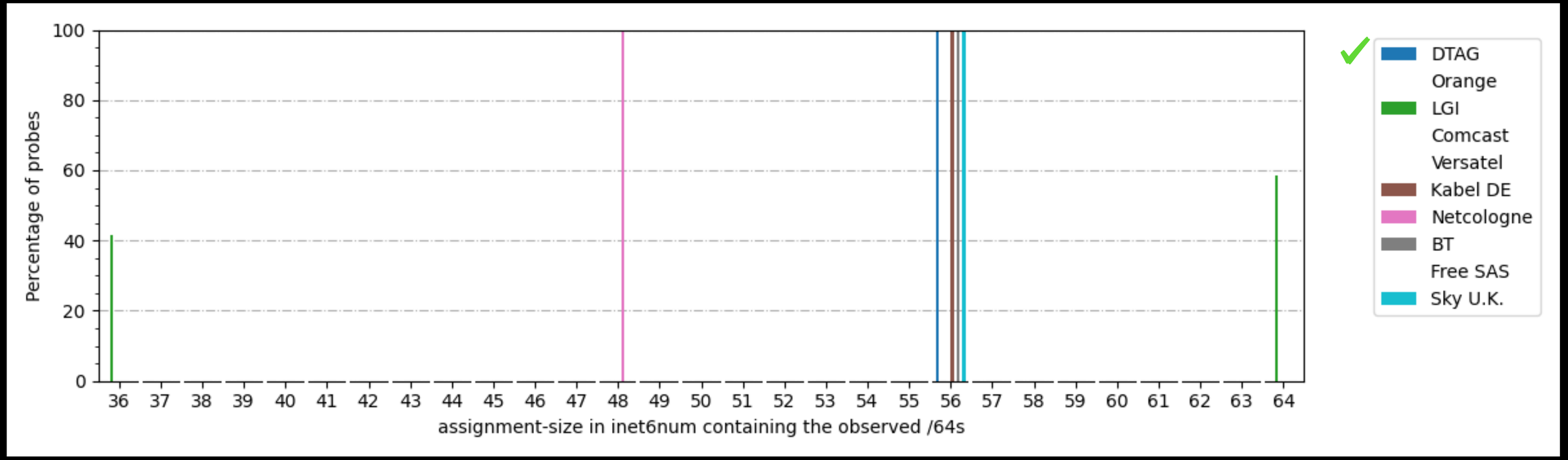


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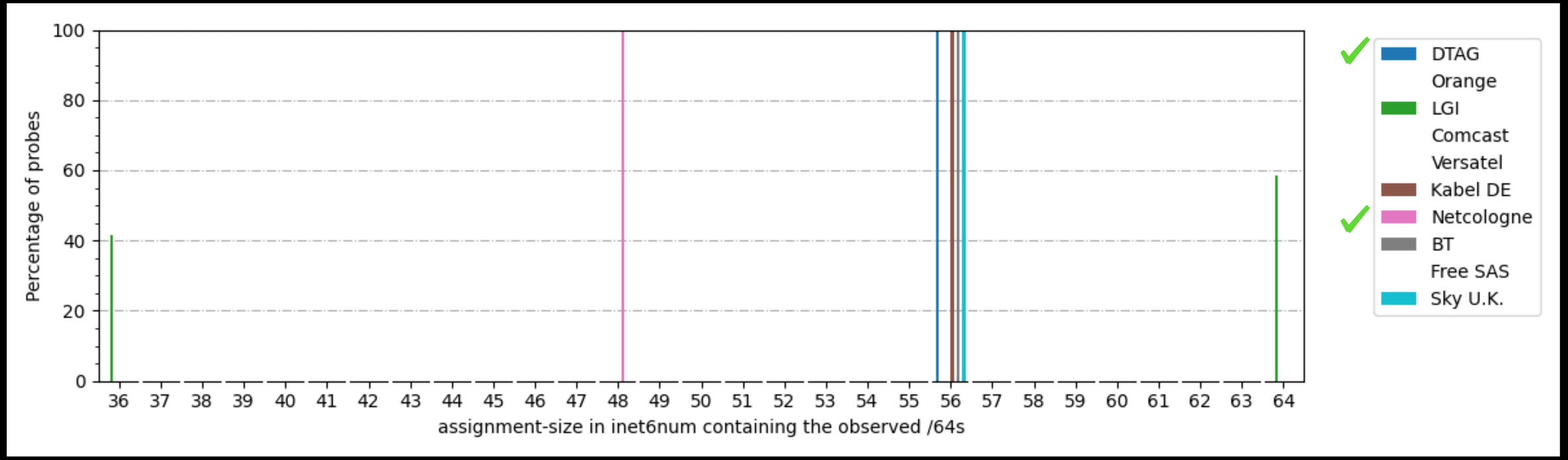


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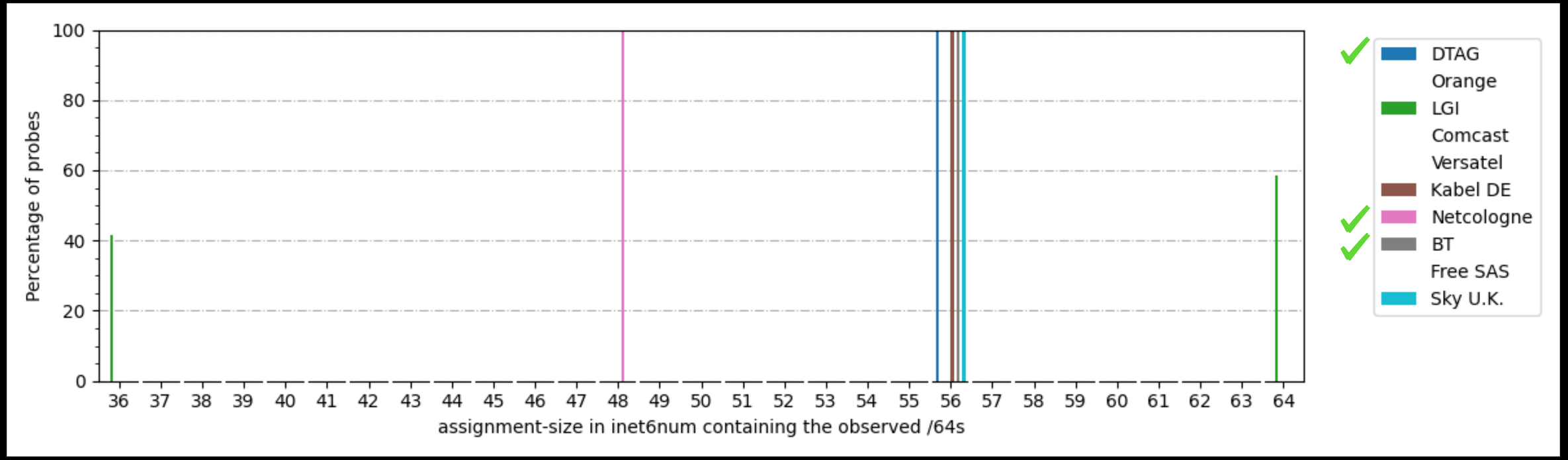


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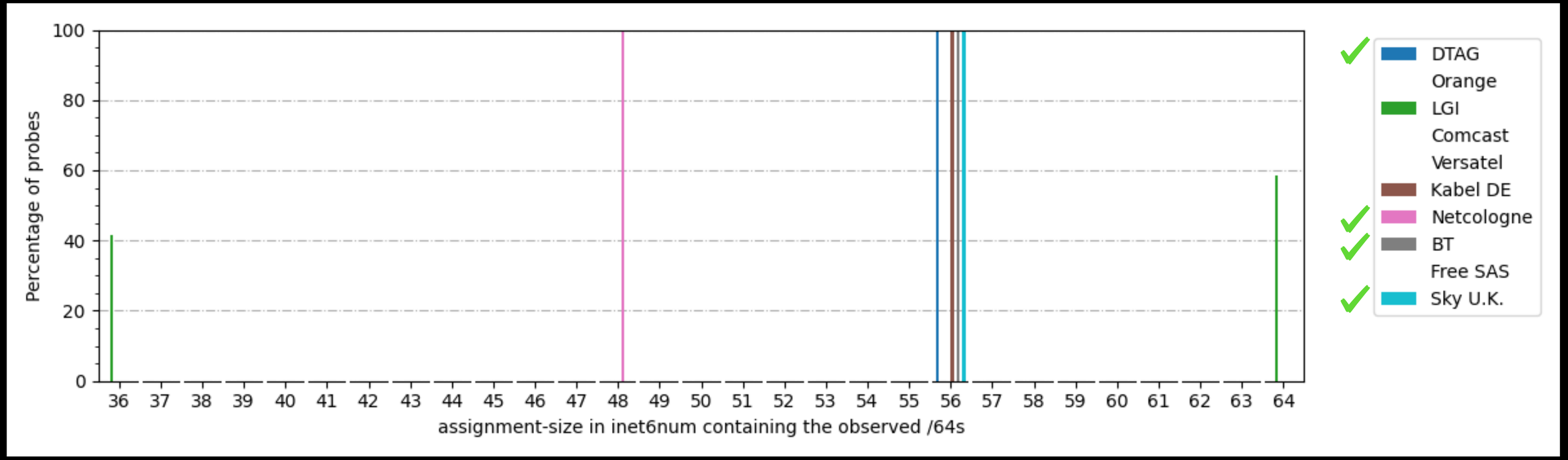


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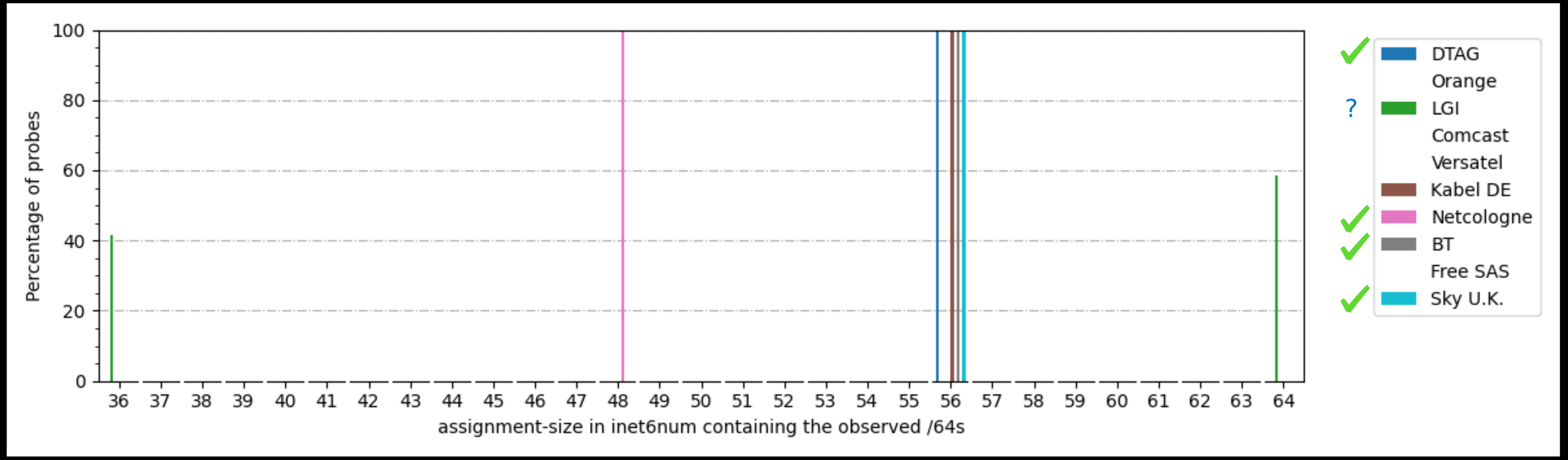
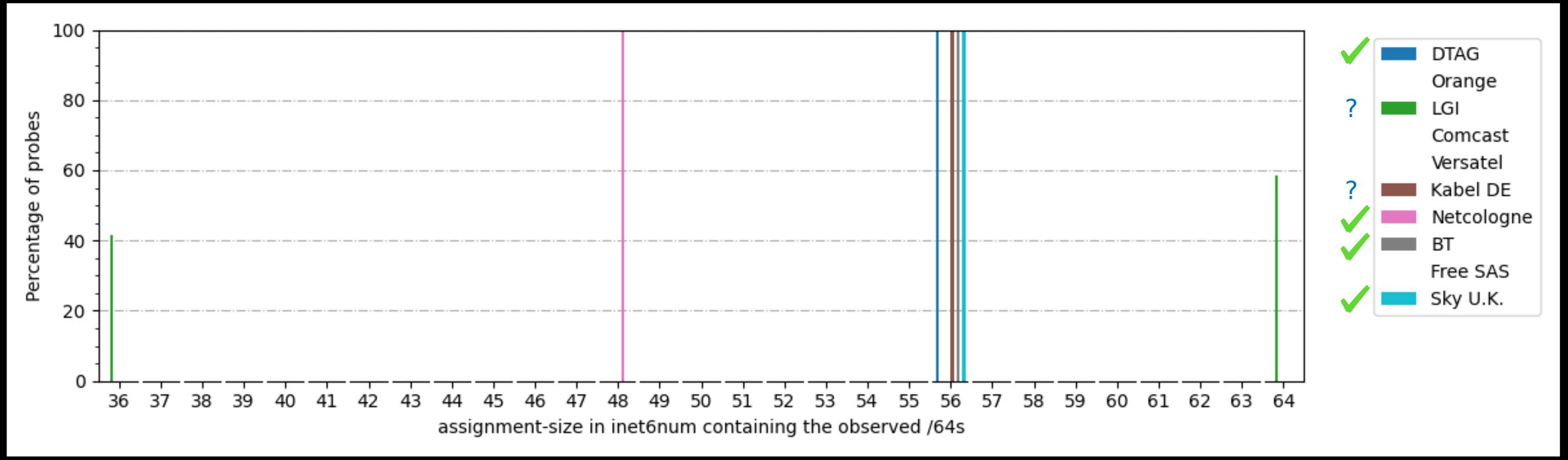



https://www.ripe.net/manage-ips-and-asns/db/support/documentation/documenting-ipv6-assignments-in-the-ripe-database

# Declaring assignment size in the RIPE DB

Operators can declare an *assignment-size* for blocks assigned to subscribers, in an AGGREGATED-BY-LIR object
(RIPE DB only; not implemented in other RIRs)




https://www.ripe.net/manage-ips-and-asns/db/support/documentation/documenting-ipv6-assignments-in-the-ripe-database

# Findings

**Temporal:**

- **IPv6 assignments to residential subscribers may remain unchanged for months**

**Spatial:**

- **subscriber pools often ~/40**
- **delegated prefix lengths vary widely across ISPs**

# Questions?

more:

Akamai dataset in paper corroborates public RIPE Atlas data
https://catalog.caida.org/details/paper/2020_dynamips
https://labs.ripe.net/author/stephen_strowes/address-assignment-practices-in-ipv4-and-ipv6/

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