UNIVERSITÄT DES SAARLANDES

Live Long and Prosper:Analyzing Long-Lived MOAS Prefixes in BGP

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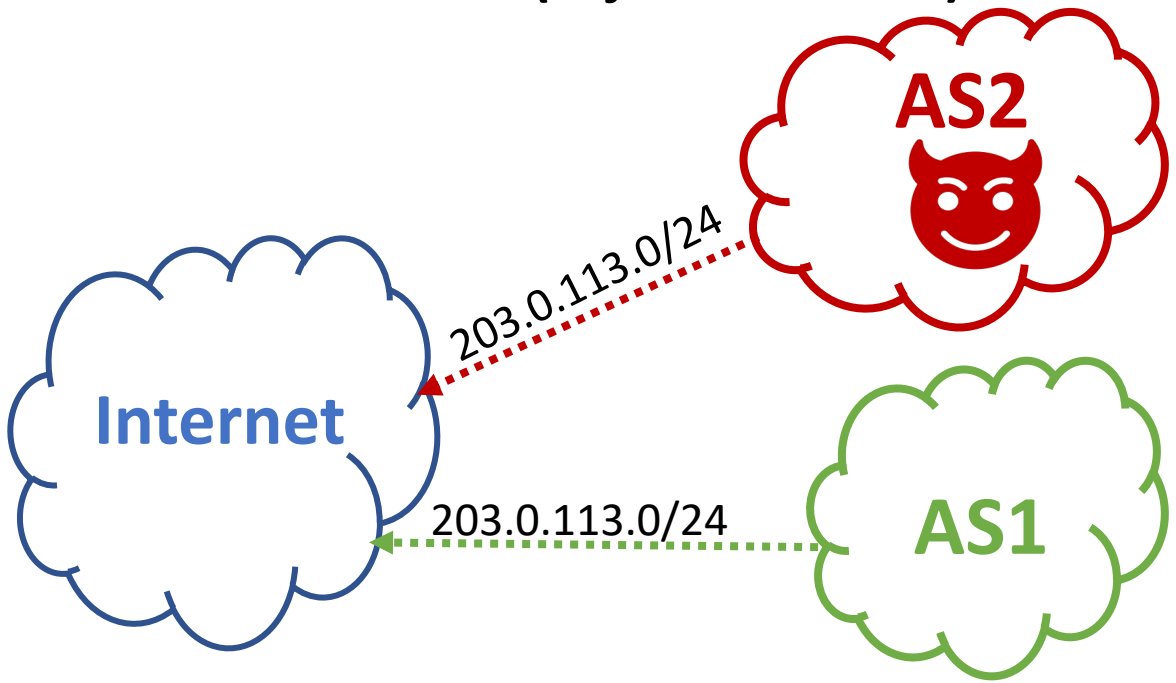
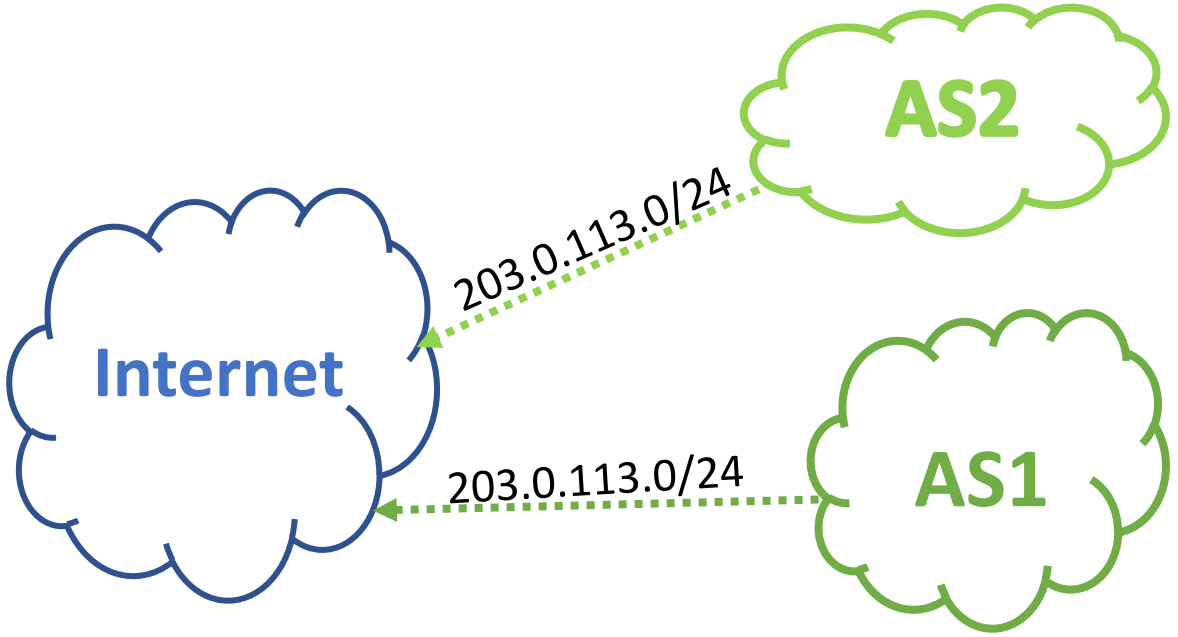
Introduction

1. MOAS Prefix (Hijacked Prefix)



2. MOAS Prefix (Long-lived)



We are intersted in Long-lived MOAS prefixes

Problem: How to differentiate between both cases?

Motivation

IP to AS mapping - > Geolocating problem

MOAS prefix usage for anycast services

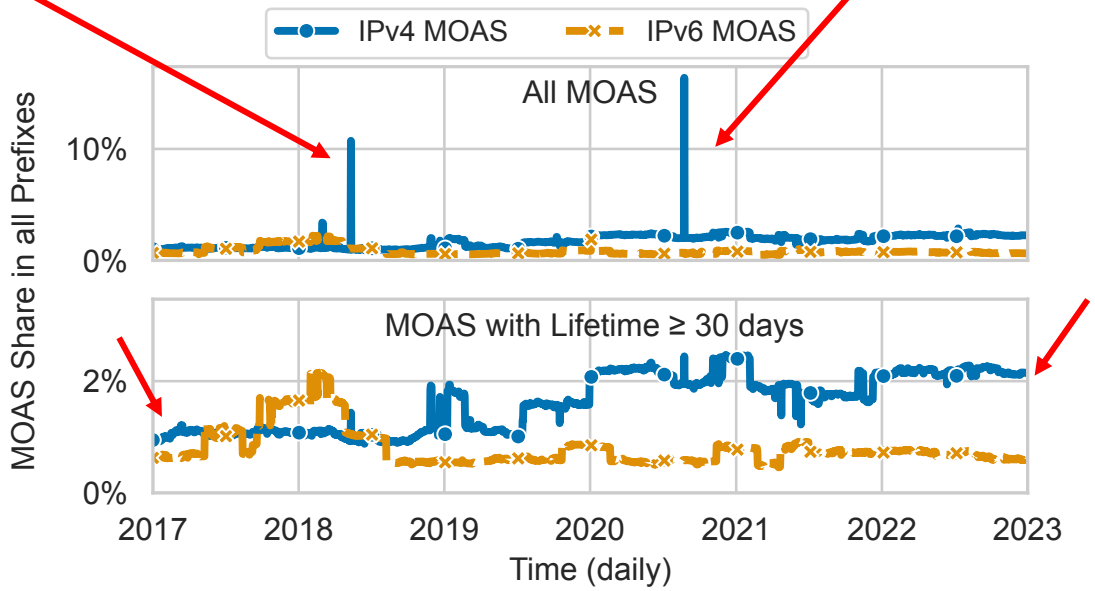
Characteristics and users of MOAS prefixes

All MOAS and Long-live MOAS

Huge Networks - DDoS Mitigation (AS264409) **143k prefixes**

Angola Cables (AS37468) **90k prefixes**

IPv4 MOAS increased from **1% to 2%**



RPKI Status of MOAS Prefixes

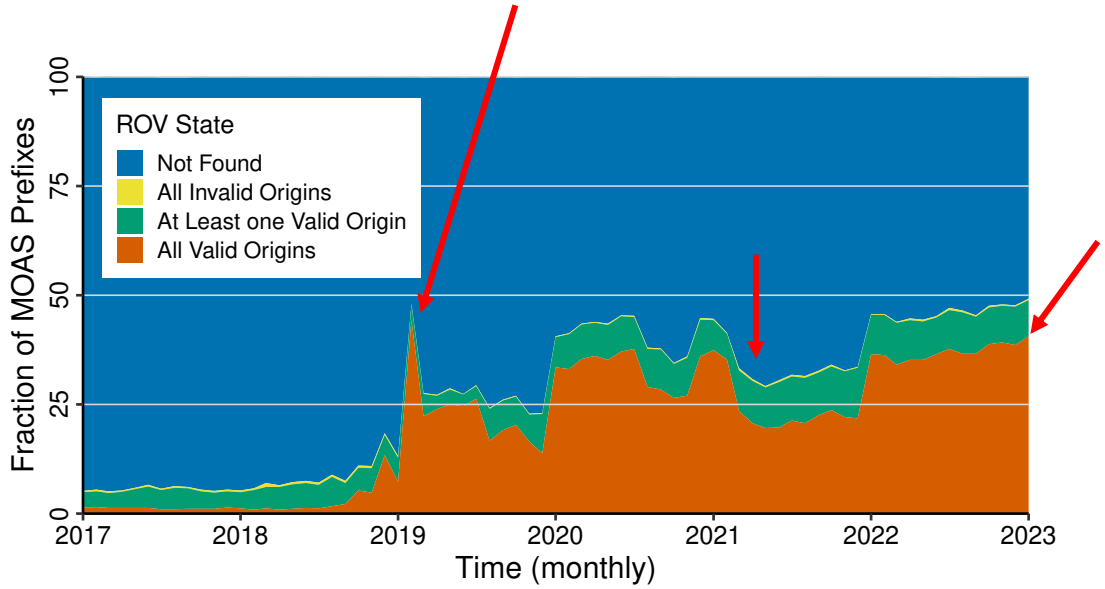
All Valid Origins increased **5% - 40%**

- **MOAS -> not prefix hijacks**

Not all origin ASes entered information in the RPKI database -> **Partial Valid**

Less than **1% All Invalid Origins**

Merger of TTNet and Turk Telekomunikasyon

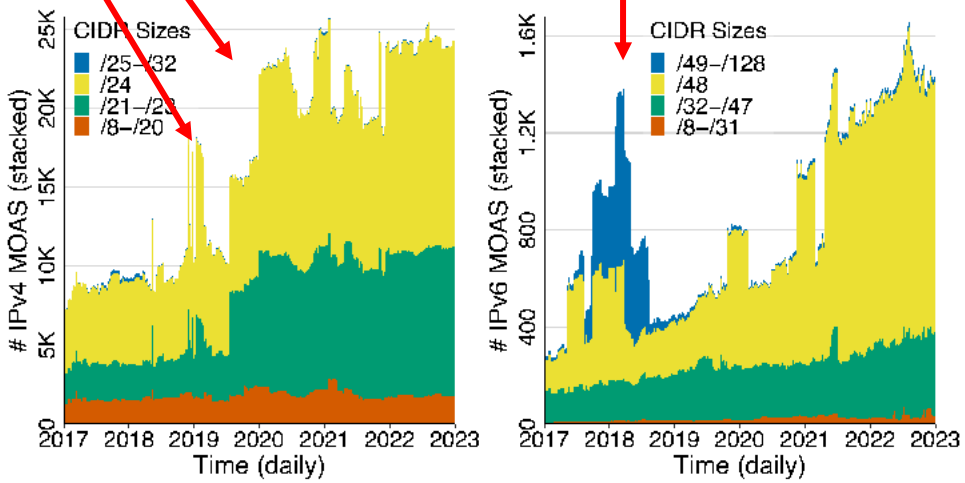


CIDR Sizes

Jazztel acquired by Orange (Orange Spain)

acquisition of KPN International by GTT

TTNet and Turk Telekomunikasyon



ASes use fine-granular CIDR sizes MOAS

Merger and **acquisition** lead to MOAS prefixes

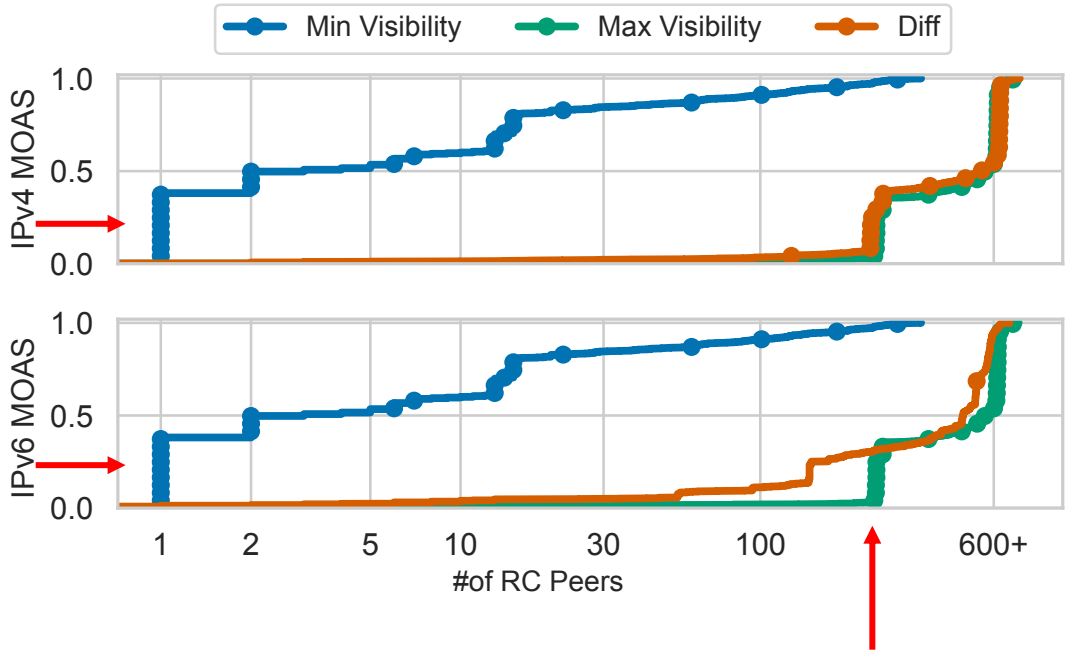
Minimum and Maximum Visibility

For 99% of MOAS one Prefix Origin pair is visible by 100+ RC peers

For 40% MOAS at least one PO pair is visible only at one RC peer

One PO visible at 100 another barely visible

Hint: MOAS not mainly used for anycast



Anycast in MOAS Prefixes

Using bgp.tools anycast dataset

0.9% of IPv4 and 6.3% of IPv6 MOAS prefixes are **anycast** prefixes

Most of anycasted MOAS use **more than ten origin Ases**

A and **J root DNS servers, use MOAS prefixes** with a /24 CIDR size

Conclusion

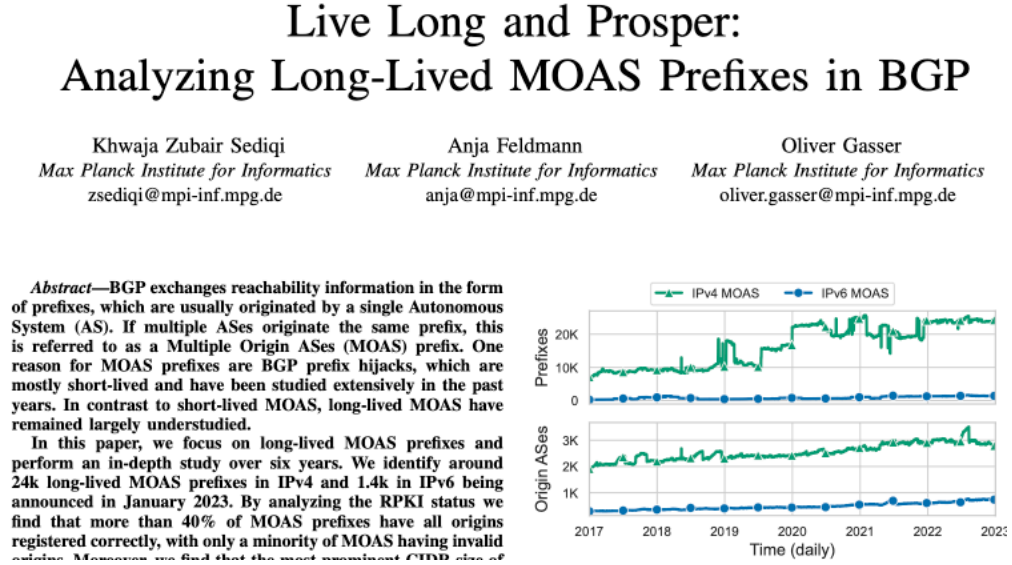
Analyzed long-lived MOAS prefixes for a period of six years

Majority of MOAS prefixes

- valid ROV state in the RPKI
- mergers and acquisitions of companies
- customer-provider relationship
- users are IT companies

Rarely used for anycast purposes

We recommend network operators clean up the extra MOAS prefixes



Live Long and Prosper:
Analyzing Long-Lived MOAS Prefixes in BGP

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***Abstract*—BGP exchanges reachability information in the form of prefixes, which are usually originated by a single Autonomous System (AS). If multiple ASes originate the same prefix, this is referred to as a Multiple Origin ASes (MOAS) prefix. One reason for MOAS prefixes are BGP prefix hijacks, which are mostly short-lived and have been studied extensively in the past years. In contrast to short-lived MOAS, long-lived MOAS have remained largely understudied.**

In this paper, we focus on long-lived MOAS prefixes and perform an in-depth study over six years. We identify around 24k long-lived MOAS prefixes in IPv4 and 1.4k in IPv6 being announced in January 2023. By analyzing the RPKI status we find that more than 40% of MOAS prefixes have all origins registered correctly, with only a minority of MOAS having invalid

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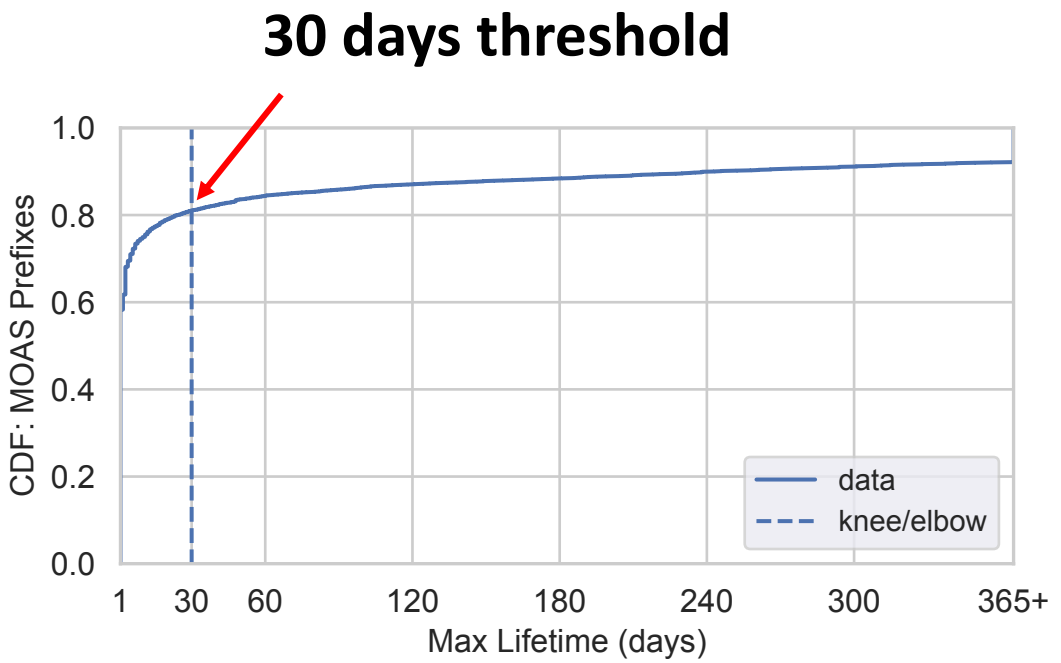
Thank you!

Identifying Long-Lived MOAS Prefixes

Daily RIBs from RIPE-RIS and Routeviews RCs

Measure the maximum lifetime of MOAS prefixes for **six years** (2017 – 2023)

Kneedle algorithm[1] to determine the "elbow", **maximum curvature value**, within the lifetime of all MOAS prefixes



1. Satopaa, J. Albrecht, D. Irwin, and B. Raghavan, "Finding a "Kneedle" in a Haystack: Detecting Knee Points in System Behavior," in *IEEE ICDCS*, 2011.

Big players in the Internet

11 out of 16 **Hypergiants**[1] use MOAS prefixes

1. Verizon
2. Netflix
3. Google

to improve their network's resilience, performance, and quality of experience

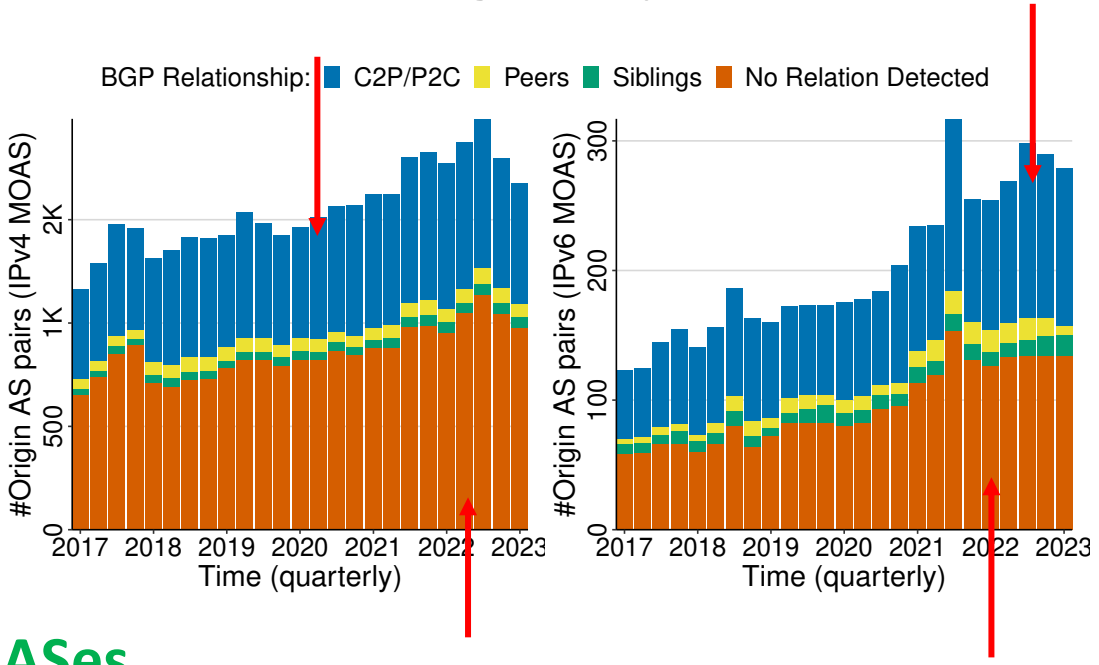
1. P. Gigis, M. Calder, L. Manassakis, G. Nomikos, V. Kotronis, X. Dimitropoulos, E. Katz-Bassett, and G. Smaragdakis, "Seven years in the life of Hypergiants' off-nets," in *ACM SIGCOMM*, 2021.

BGP Relationship of MOAS Prefix Origin ASes

Using CAIDA datasets

No relationship for 50% of origin AS pairs

Half of all origin AS pairs are C2P/P2C



Many MOAS prefixes are not related to sibling ASes

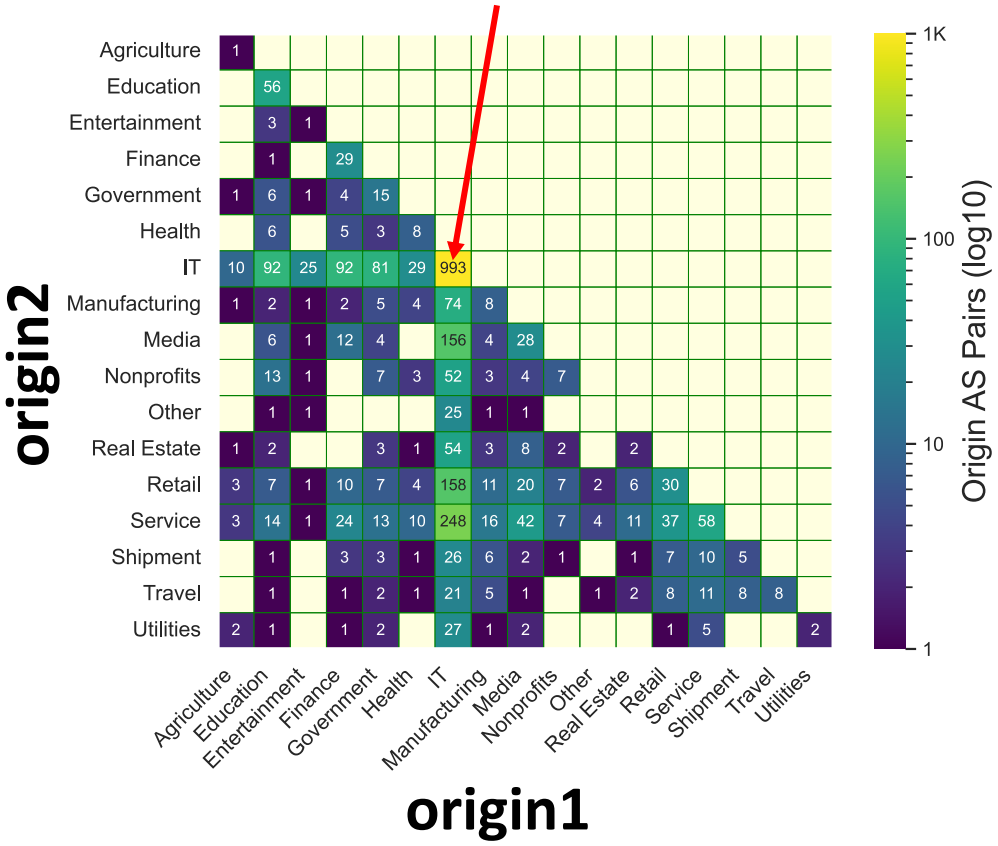
Business Type of MOAS Users

Using ASdb dataset

IT company pairs with other business types

Same company type for both origins being most common

40% of the cases, both MOAS origins fall into the **“IT”** category

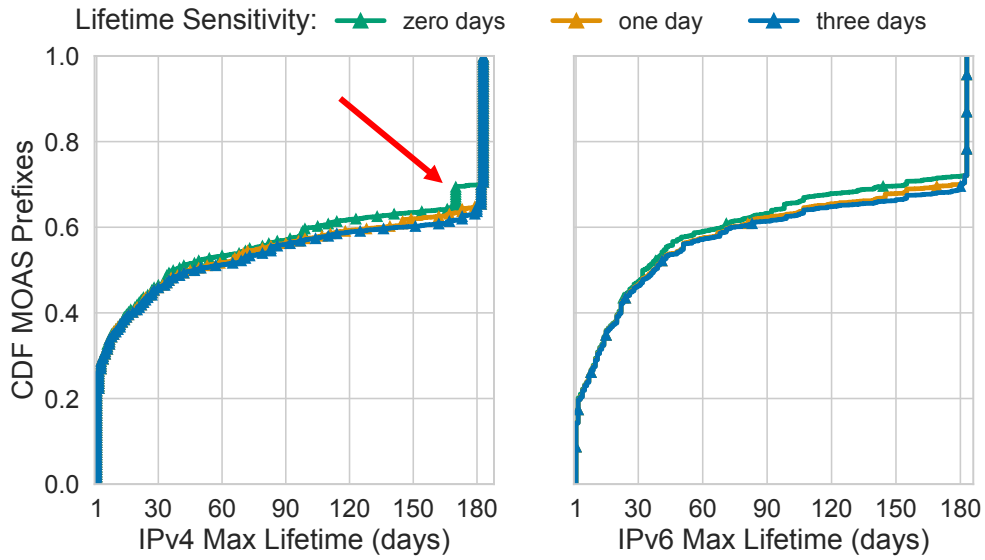


Lifetime Analysis

Six months data from RC projects

Lifetime = duration a prefix is seen as a MOAS continuously

We use the **one day** sensitivity threshold



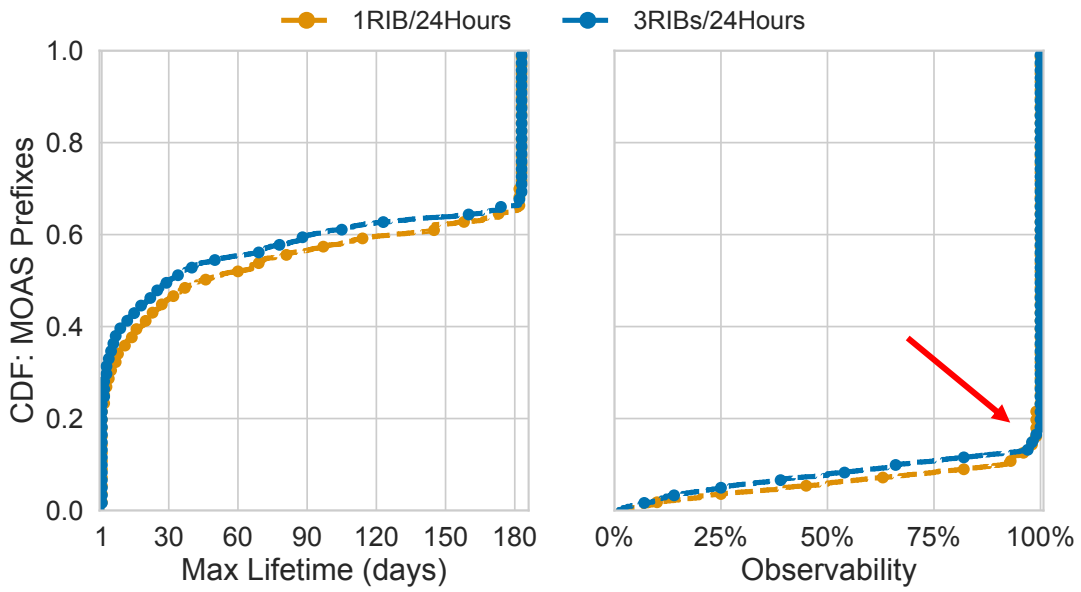
Using More Than One RIB per Day

Three RIBS per day **does not increase the Max Lifetime** of MOAS prefixes

~ 80% of MOAS have > 95% observability

How consistently prefixes are visible as MOAS?

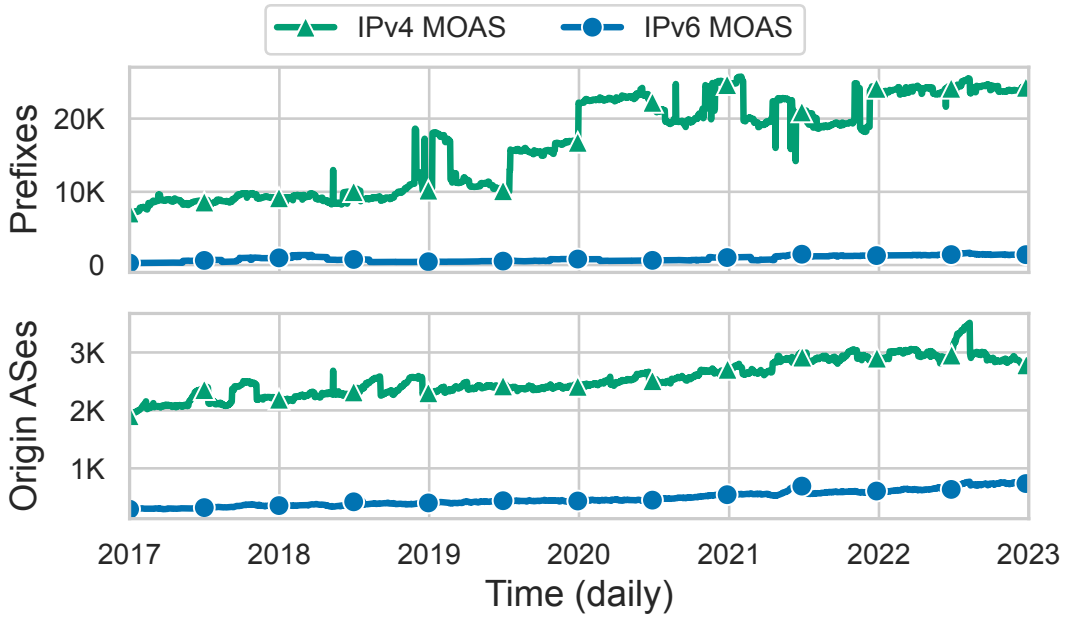
- **Observatbility** = number of days out of the total days, when a prefix is observed as a MOAS



MOAS Growth

IPv4 long-lived MOAS prefixes increase from **10k** in 2017 to over **24k** prefixes at 2023

Number of origin ASes growing by about **50%** in the same time period.

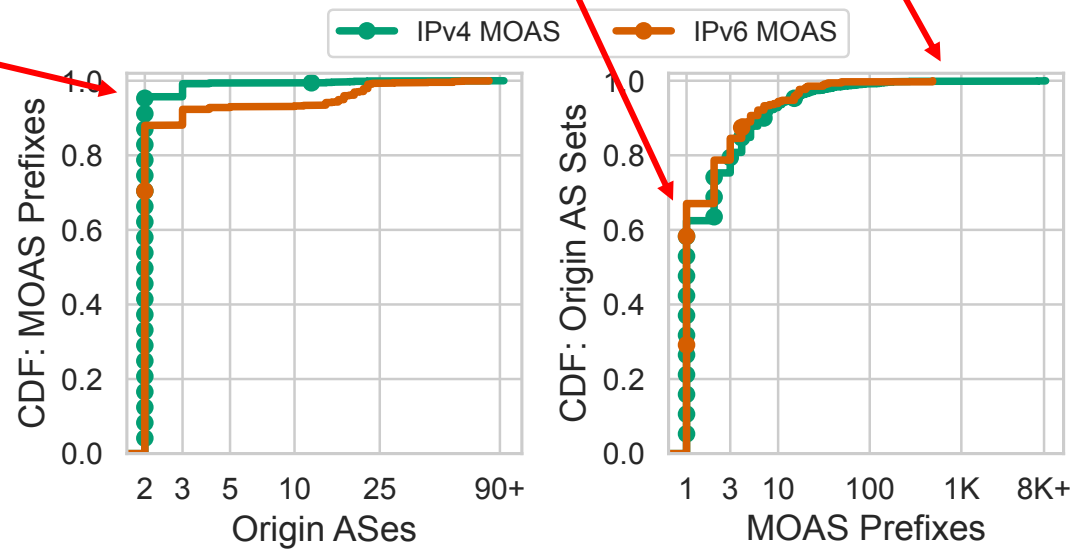


Origin ASes

Few ASes announce large numbers of MOAS

60% of origin AS sets
announce single MOAS

95% IPv4 and 88% IPv6 MOAS
have 2 origins ASes



Visibility Across Route Collector Peers

MOAS PO pairs around **50% visible in 100+ peers**

Followed by visibility of 3 or fewer peers