Keep your Friends close, but your Routeservers closer

Insights into RPKI Validation in the Internet

Thomas Hlavacek, Haya Shulman, Niklas Vogel, and Michael Weidner

German National Research Center for Applied Cybersecurity ATHENE
Fraunhofer Institute for Secure Information Technology SIT
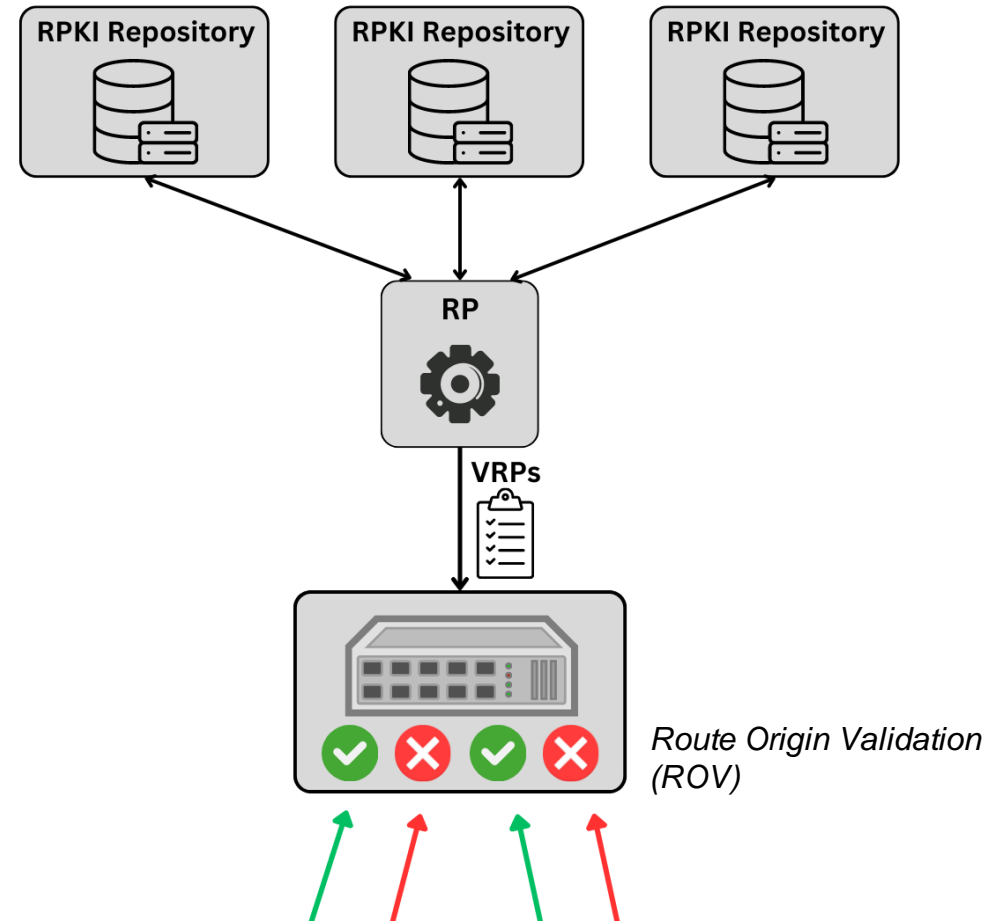Goethe University Frankfurt

Fundamentals on BGP and RPKI

The inherent Hijack-Problem in BGP

AS 3

I own
10.0.0.0/16

I own
10.0.0.0/24

AS 1

AS 2
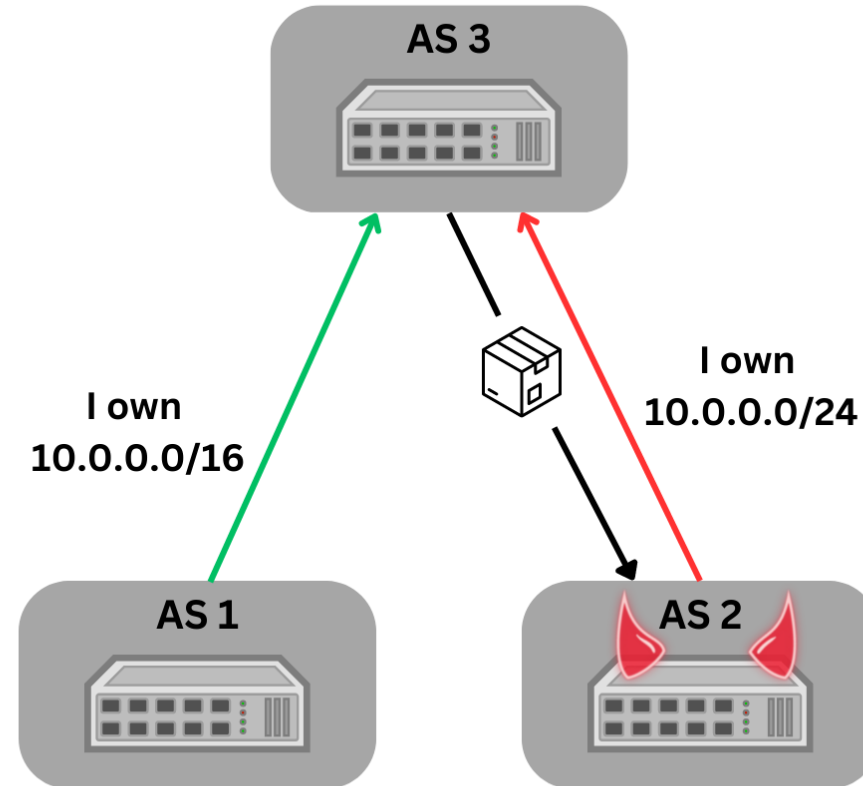
Attackers can hijack IP traffic

Preventing Hijacks with the RPKI

Routers drop malicious BGP origins

How many Systems enforce ROV?

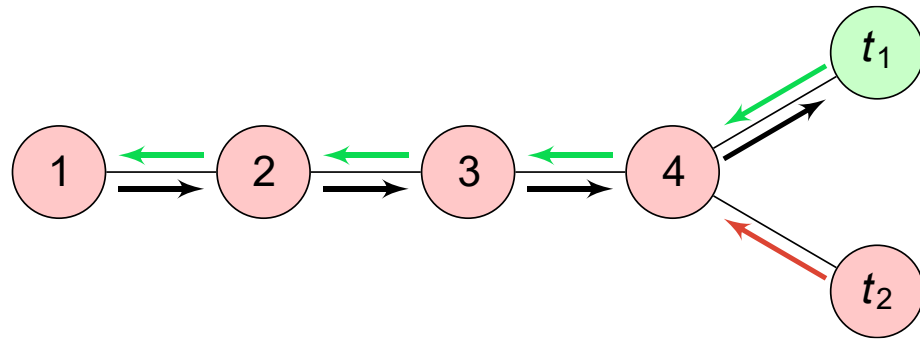| Project Name	Year	ROV
Cloudflare [1]	2023	30%
APNIC [2]	2023	28%
Rodday et al. [3]	2021	0.6%

Measuring ROV reliably is an open research question

[1]: https://isbgpsafeyet.com/ (Accessed 04.08.2023)
[2]: https://stats.labs.apnic.net/rpki   (Accessed 04.08.2023)
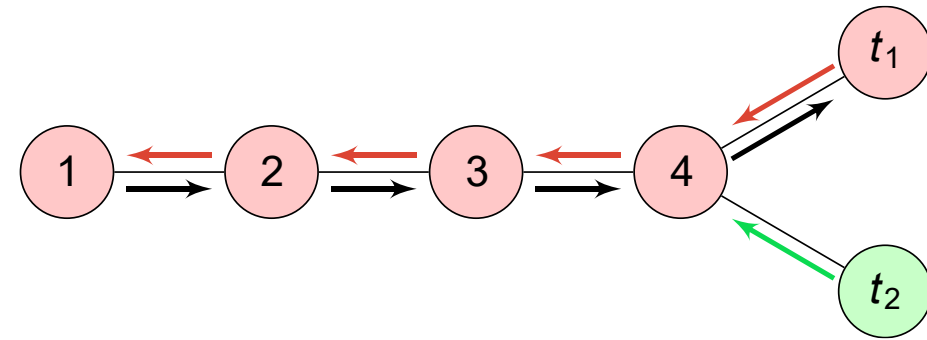[3]: https://par.nsf.gov/servlets/purl/10317492 (Accessed 04.08.2023)

Efficient Measurements of ROV

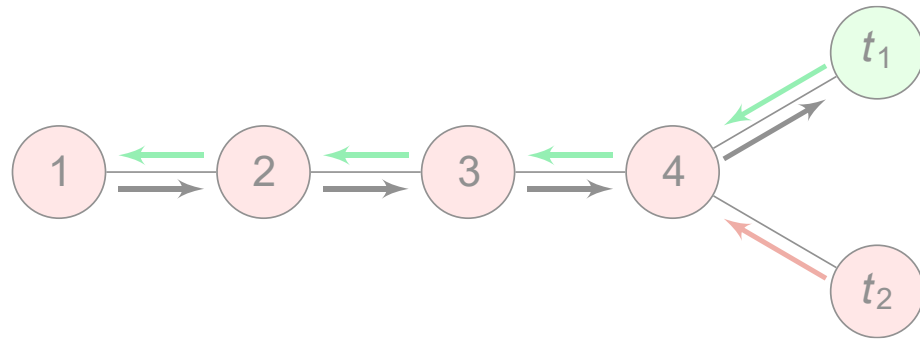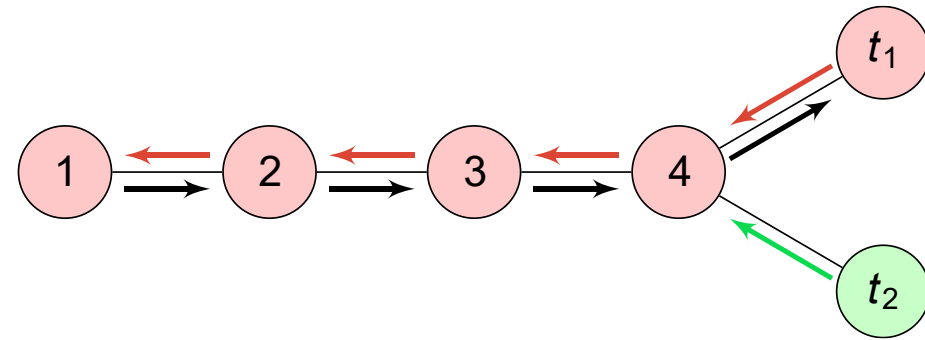# How to measure ROV Enforcement?

- **Network without ROV**

Prefix 1

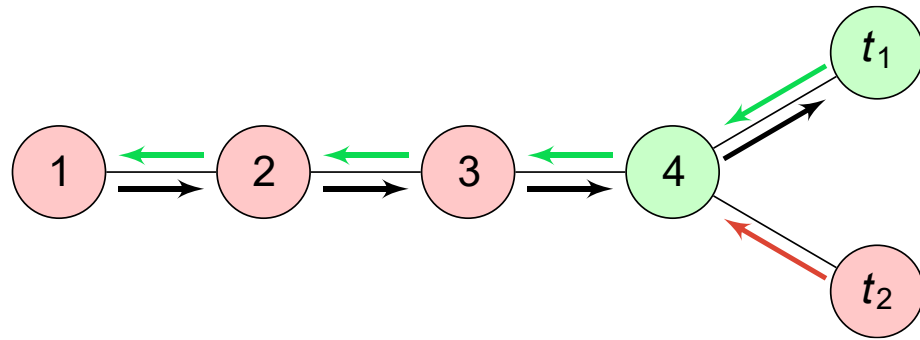*Prefix 2*

How to measure ROV Enforcement?

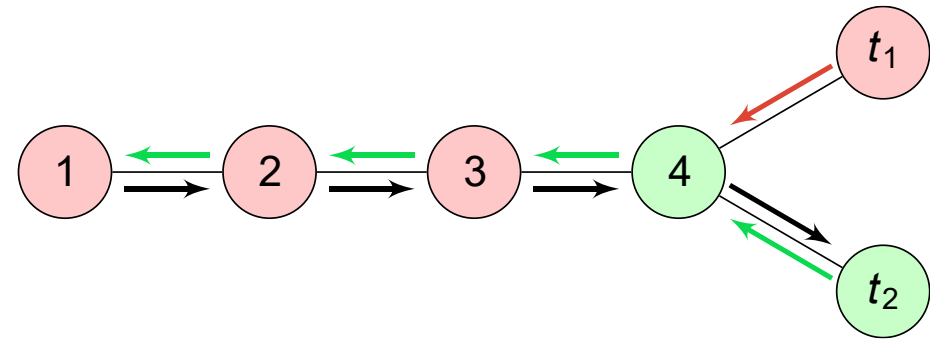- **Network without ROV**

Prefix 1

Prefix 2

How to measure ROV Enforcement?

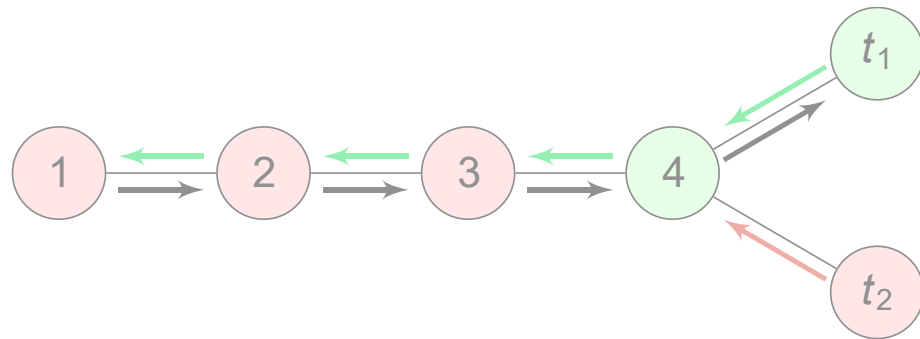- **Network with ROV**
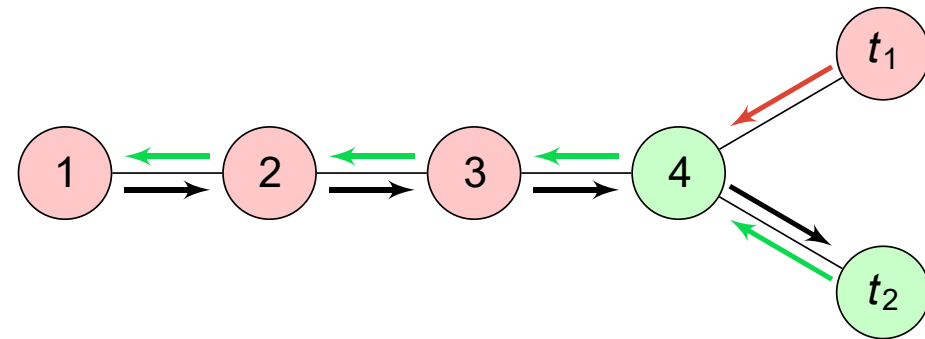

Prefix 1

Prefix 2

How to measure ROV Enforcement?
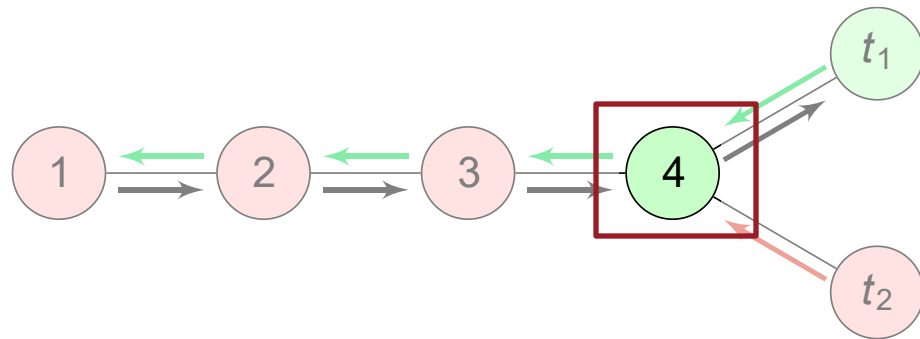
- **Network with ROV**

Prefix 1

Prefix 2
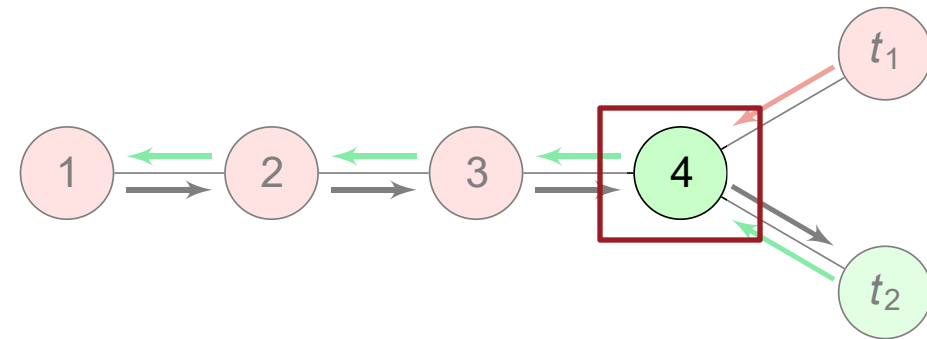
How to measure ROV Enforcement?

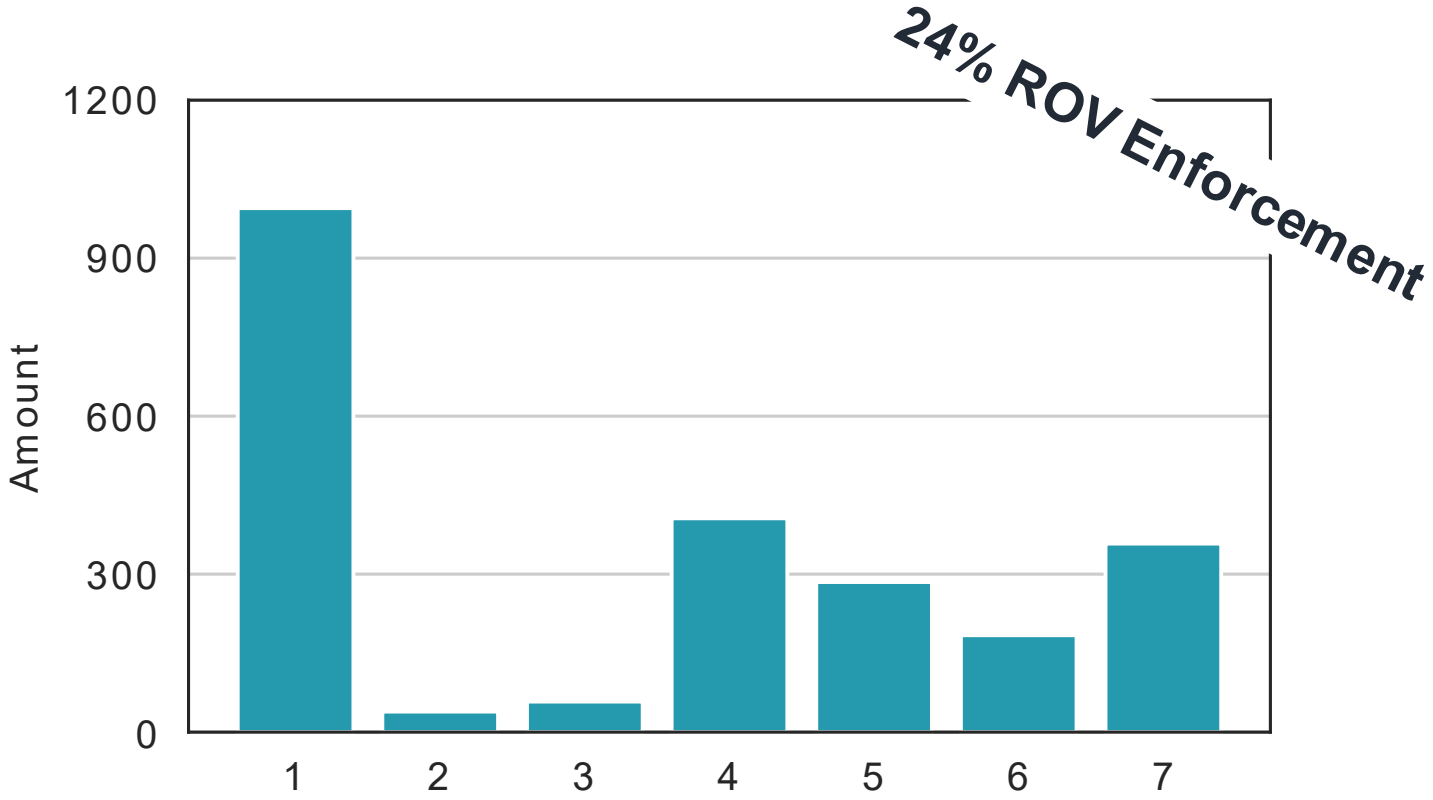- **Metric: Divergence Point**

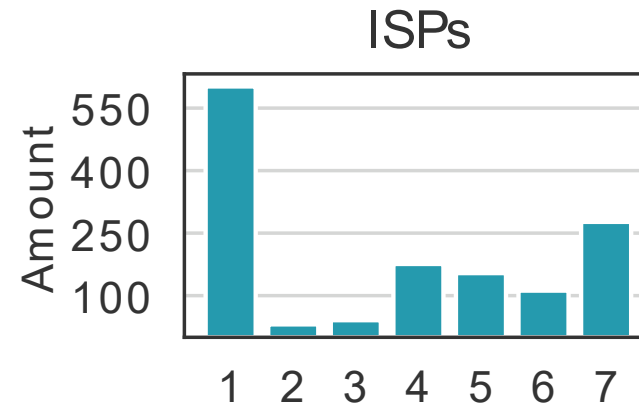

Prefix 1

Prefix 2

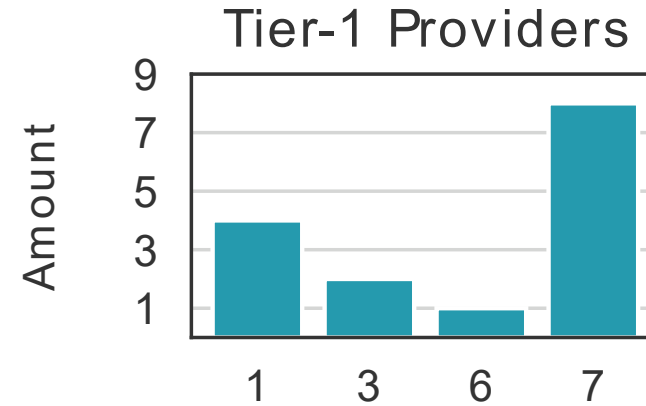## Divergence Points indicate ROV Enforcement

Measurement Results

Results ROV Enforcement

Results ROV Enforcement
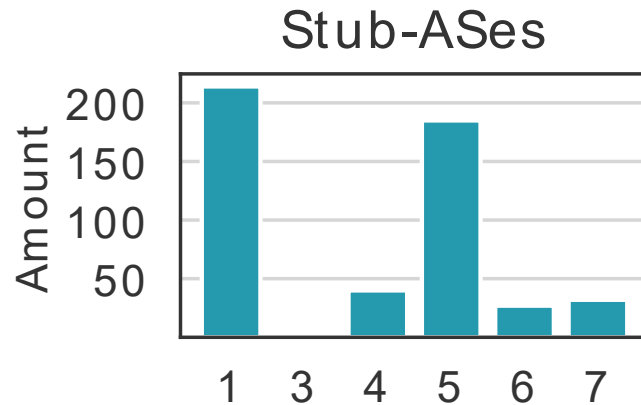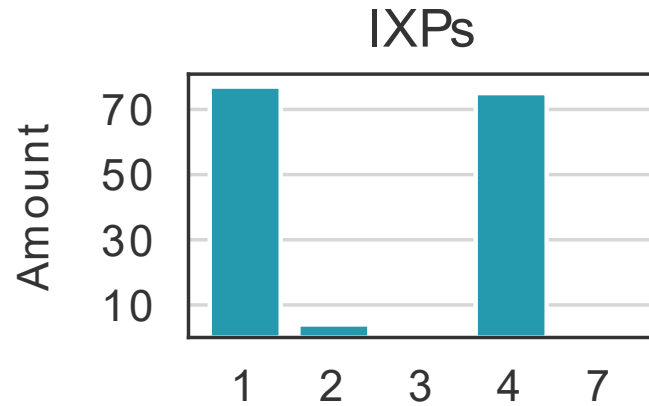
ROV enforcement differs by AS type

IXP Routeservers
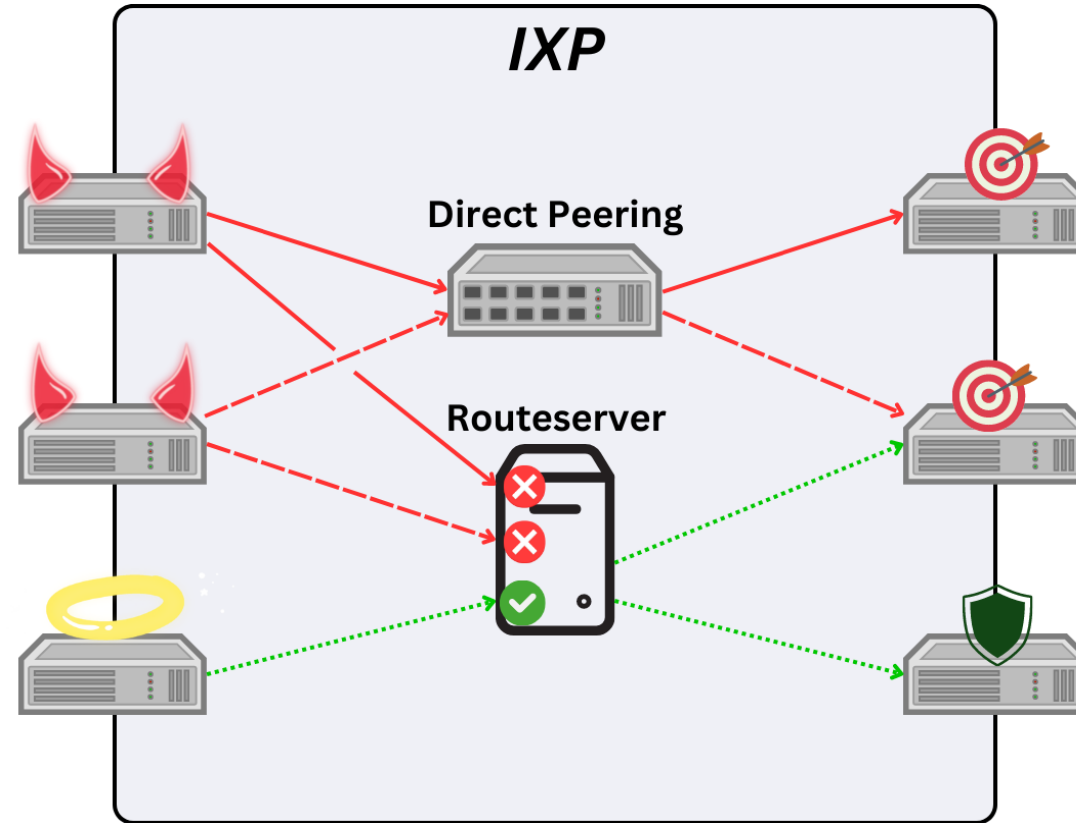
Routeservers can only protect connected systems with ROV

Low Enforcement in IXPs?
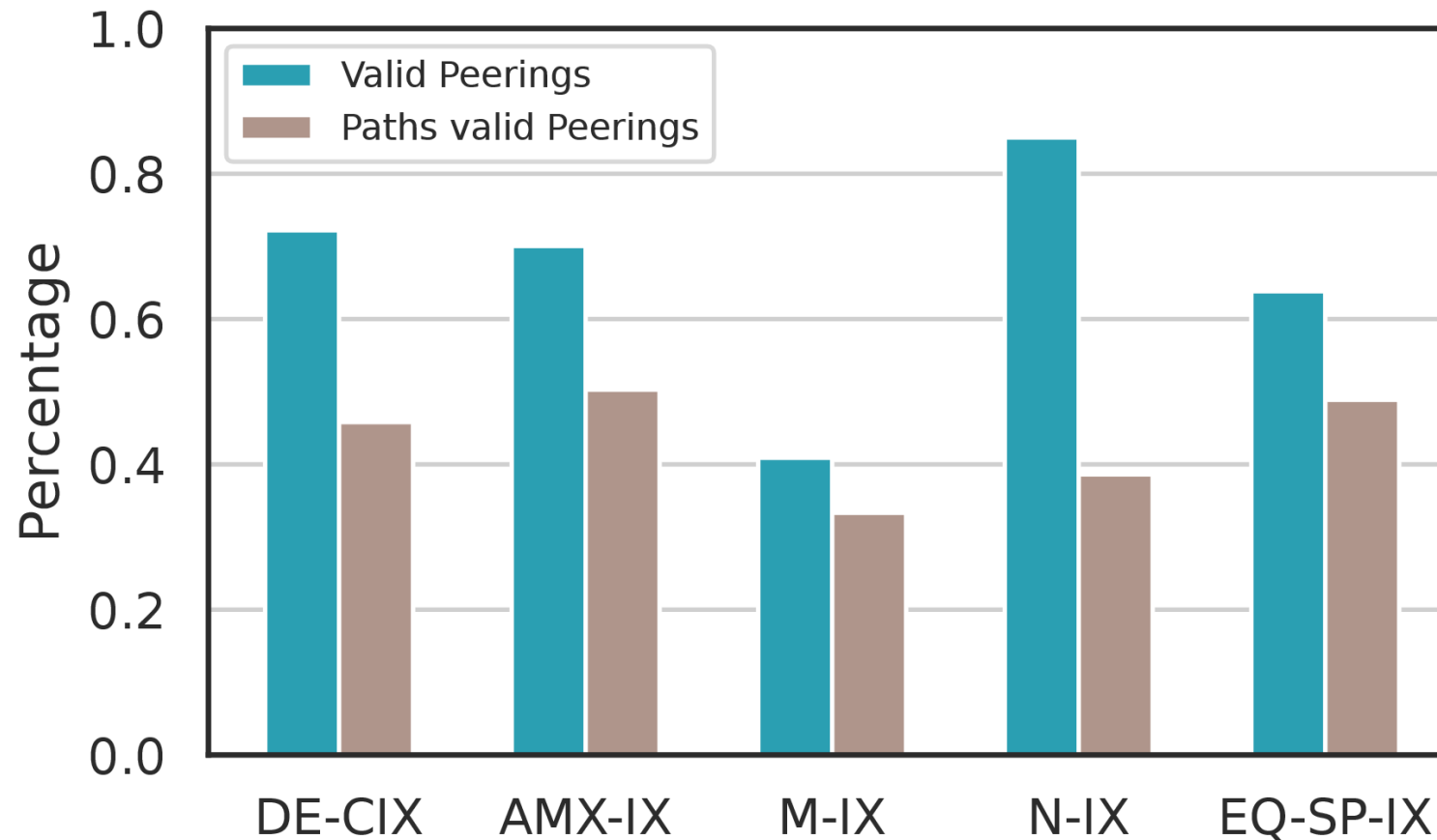
Many Paths over direct peerings

Impact of ROV on Spread of Hijacks

What is the Impact of ROV?

Graph Parameters	G_1	G_2	G_3
Vertices	2156	2156	2156
Edges	3810	1974	3173
Components	1	808	35
Largest Component	2156	1315	2110
Avg. Node-Degree	1.77	0.90	1.47
Avg. Algebraic-Connectivity	187.97	6.29	21.68
Avg. Shortest-Path Length	4.55	2.97	5.00
Avg. Longest-Path Length	9.52	5.78	9.34

G1	G2	G3
No ROV	All ROV	IXP ROV

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<u>IXP ROV reduces connectivity of graph</u>

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IXP ROV barely limits the reach of hijacks

Conclusion

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- The rate of ROV enforcement differs by AS type

- ROV provides measurable protection against hijacks in today's Internet

- Direct peering sessions limit the impact of IXP routeservers

Thank you for your attention!

If you have any other questions, contact me at
niklas.vogel@sit.fraunhofer.de

!תודה רבה

çok
teşekkürler

谢谢

Merci
beaucoup!

Thank you
very much!

Dank je
wel!

Vielen
Dank!

Muchas gracias

ありがとうございました

Dziękuję!

zor spas

Grazie mille!

اشكرك