Following the Data Trail: An Analysis of IXP Dependencies

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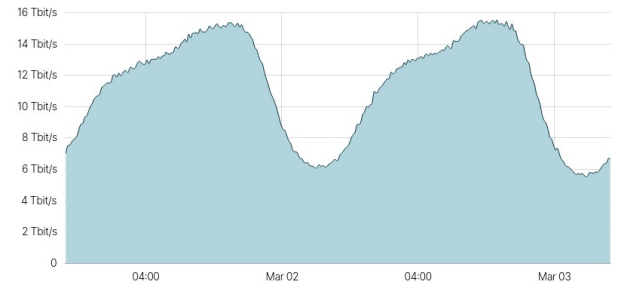
Motivation

- Internet eXchange Points (IXPs) are important for the internet topology
- Connect many networks
- Increasing size and usage

DE-CIX Frankfurt: 15.56 Tbps

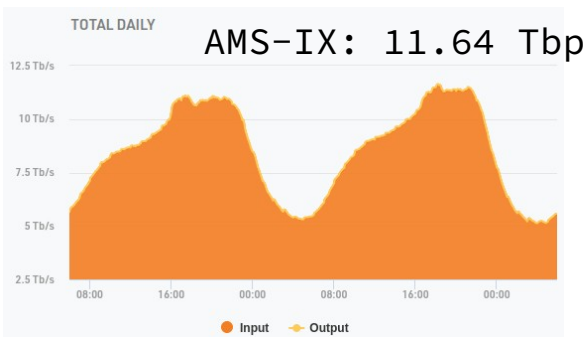


https://www.de-cix.net/en/locations/frankfurt/statistics

LINX LON1: 6.83 Tbps

https://portal.linx.net/services/lans-snmp

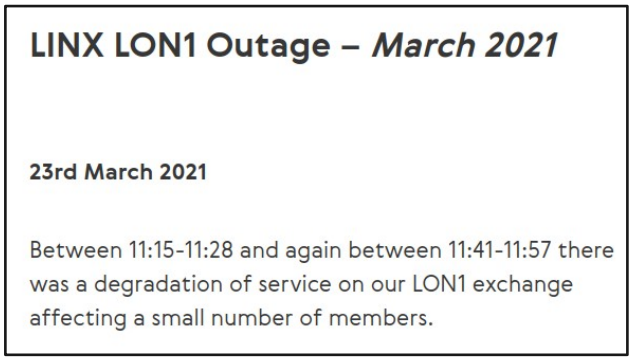
AMS-IX: 11.64 Tbps



https://www.ams-ix.net/ams/documentation/total-stats

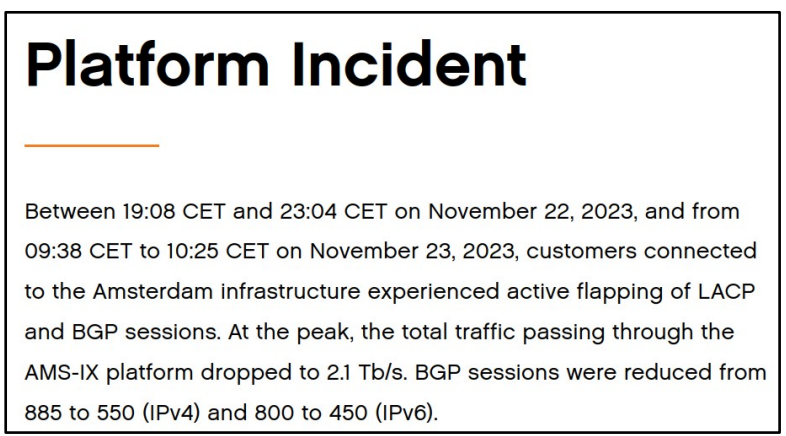
Motivation

- IXPs are not perfect
- Understand inter-dependencies of IXPs and networks
- New input for risk assessment of operators



https://www.linx.net/incidents-log/

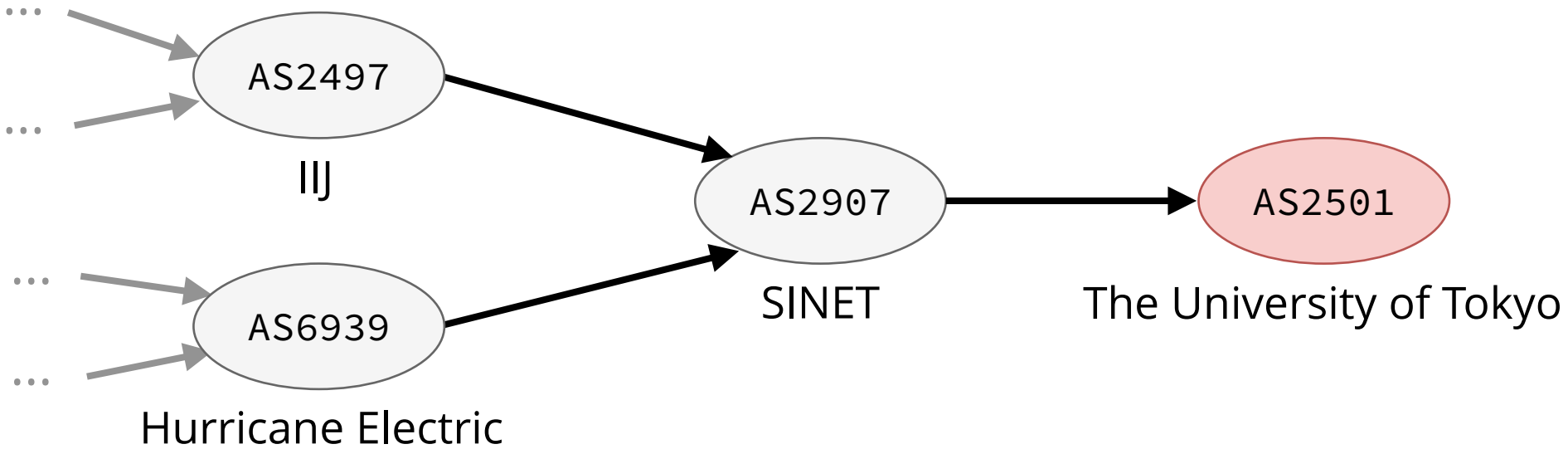
https://www.thousandeyes.com/blog/network-monitoring-de-cix-outage



https://www.ams-ix.net/ams/outage-on-amsterdam-peering-platform

How to infer AS dependencies?

Previous work built topology from BGP to infer AS dependencies



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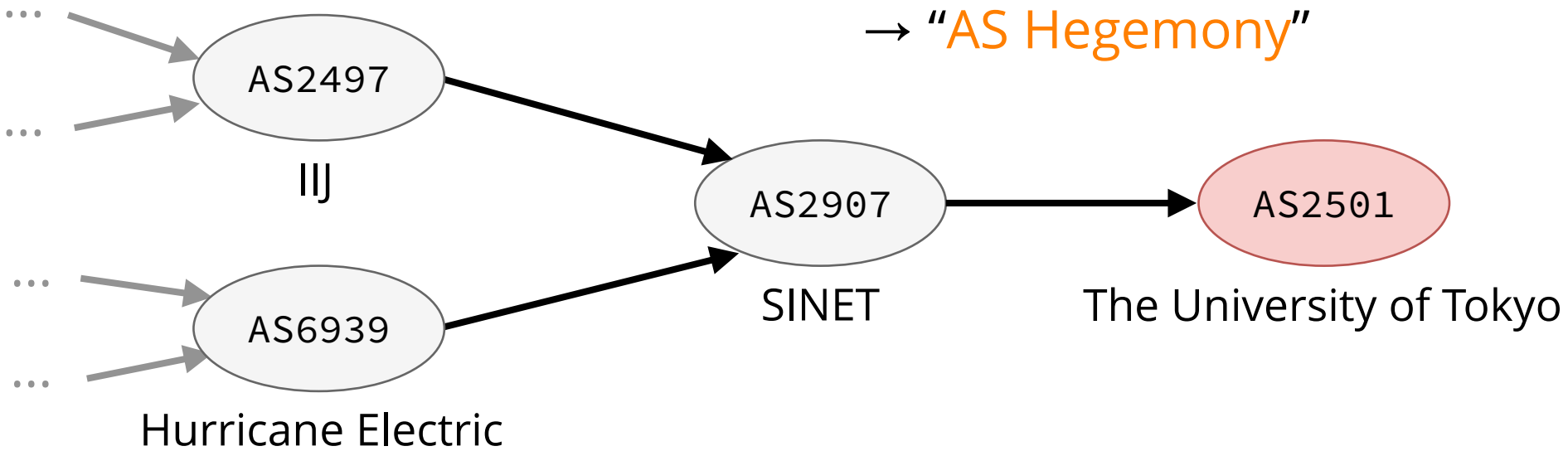

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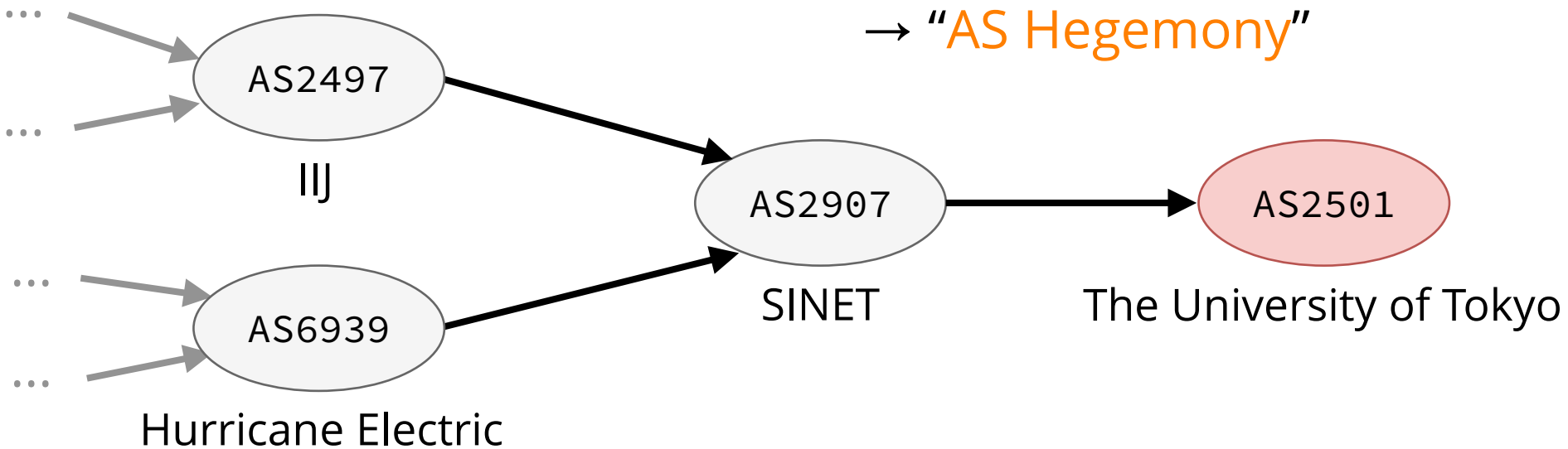

Problem: IXPs are (generally) not visible in BGP

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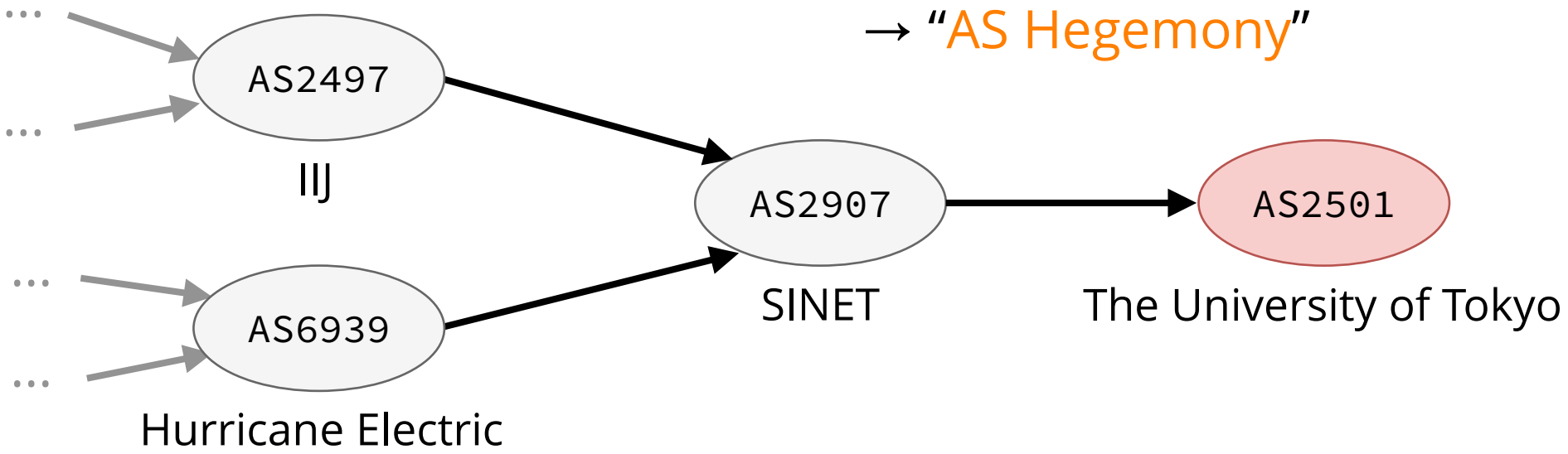

Problem: IXPs are (generally) not visible in BGP

Solution: Built topology from traceroutes → IXP peering LAN visible

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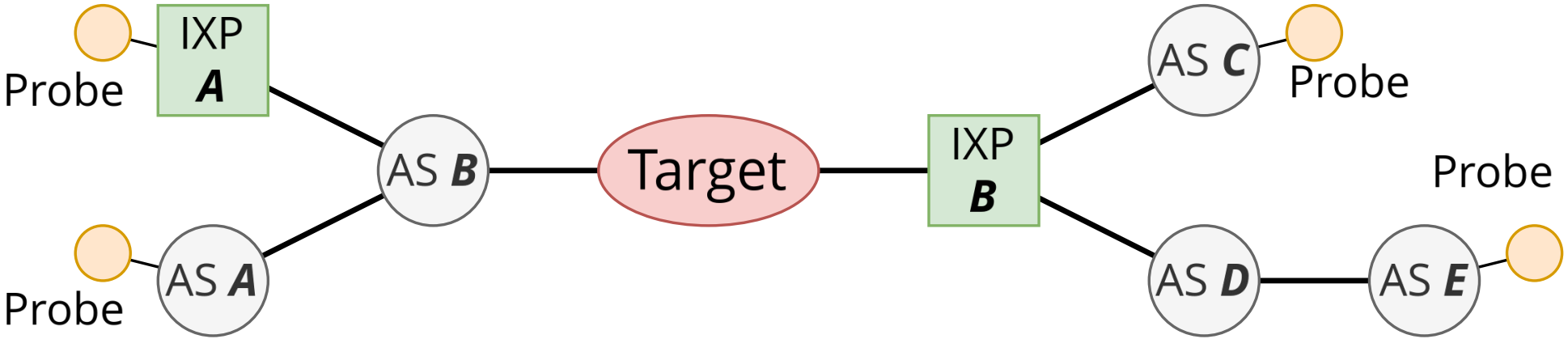

(Simplified)

1. Run traceroutes from probes to the target AS
2. Map the hops to an ASN and/or IXP
3. Build a topology and calculate AS Hegemony

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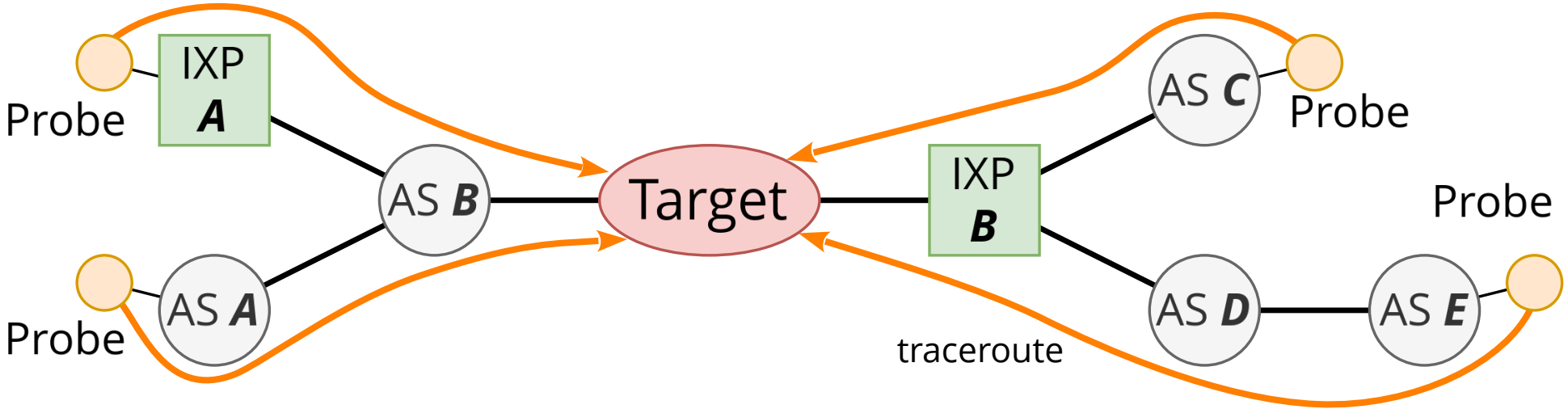

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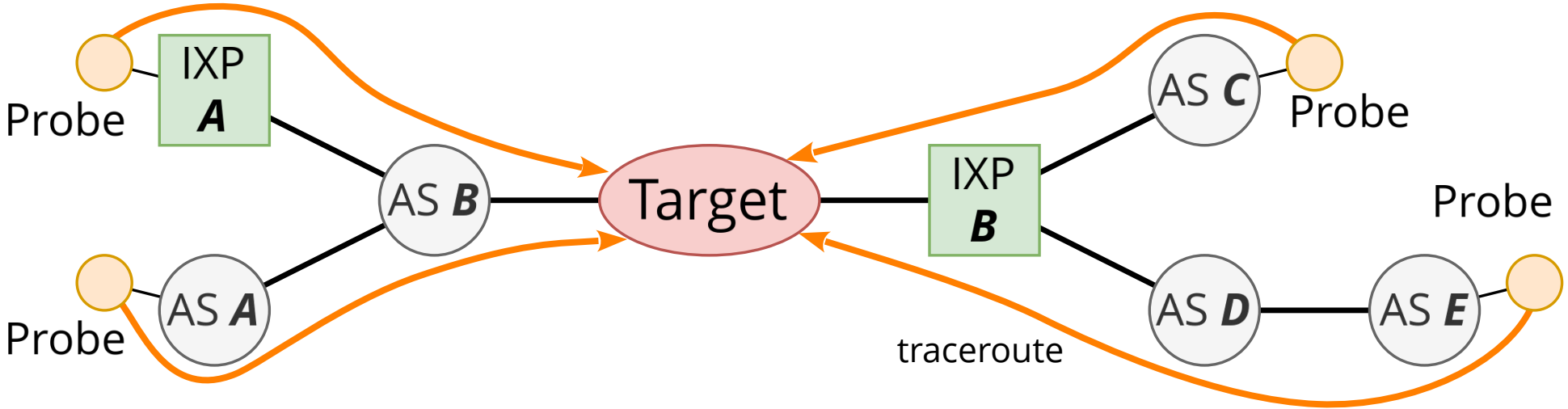

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AS Hegemony score is based on the share of paths going through each AS/IXP.

(plus some mechanisms to account for sampling bias)

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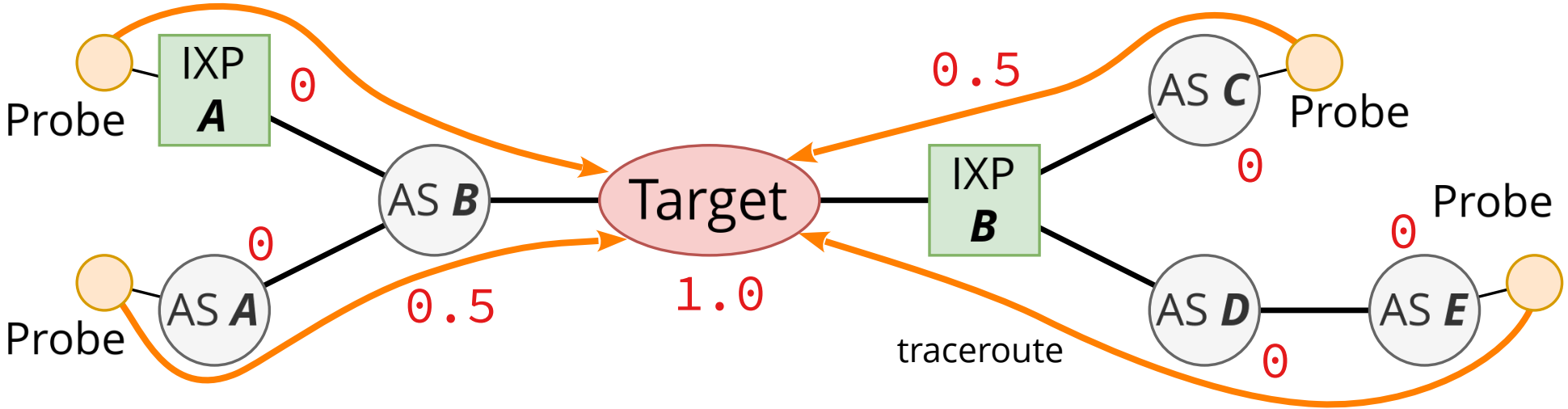

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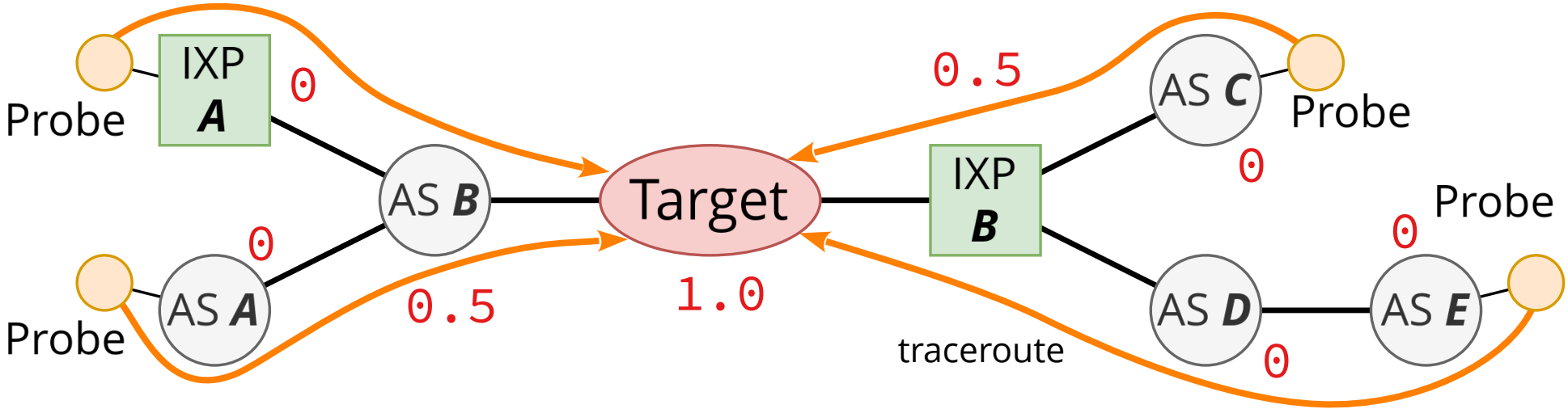

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Dependency: AS or IXP with a Hegemony score of ≥ 0.1

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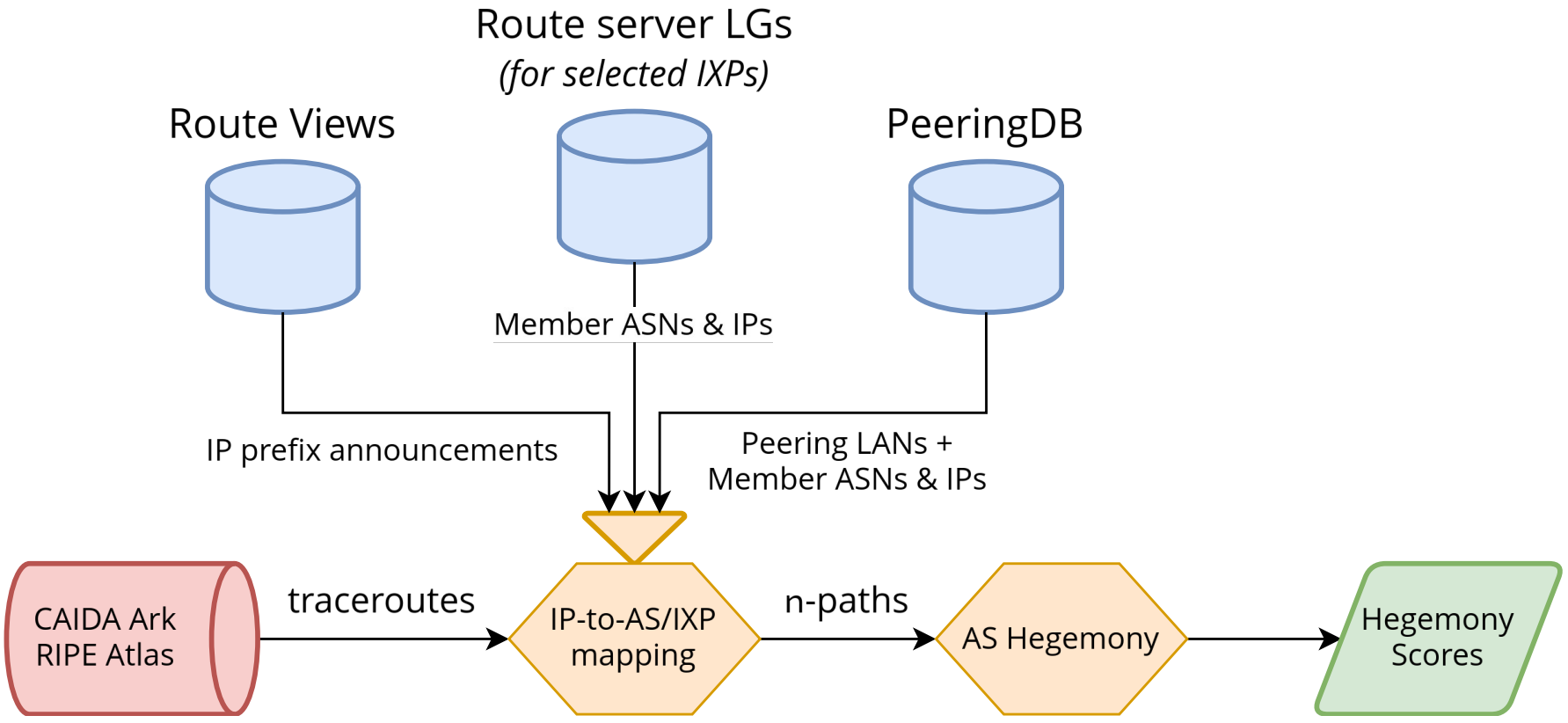
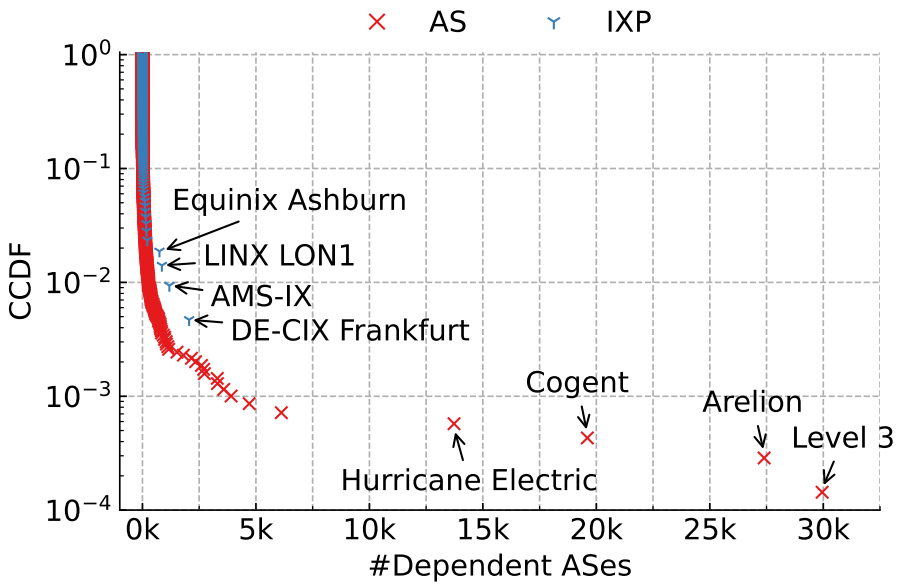
(plus some mechanisms to account for sampling bias)

Data sources / pipeline



Results — Overview

Number of dependents per AS/IXP



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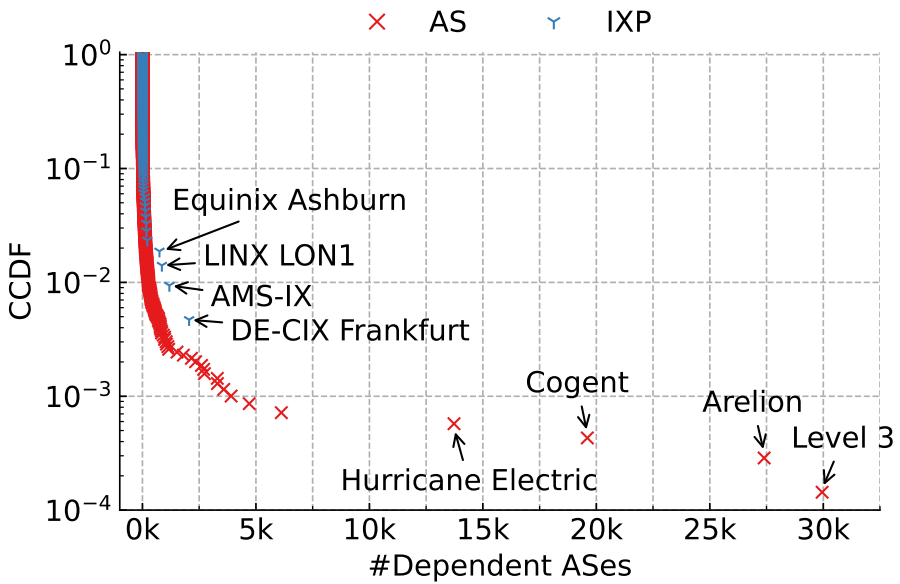

- IXPs have less dependents than ASes
- A few IXPs stand out

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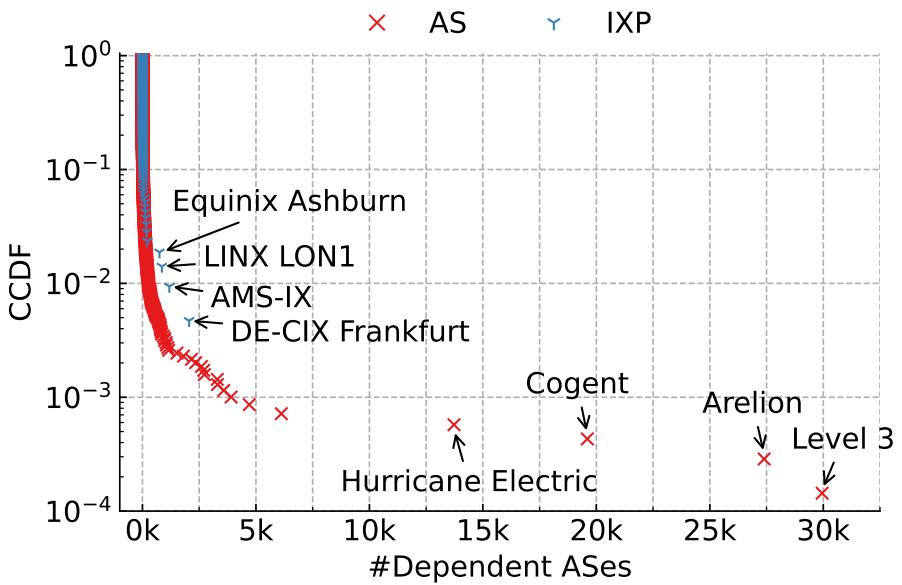
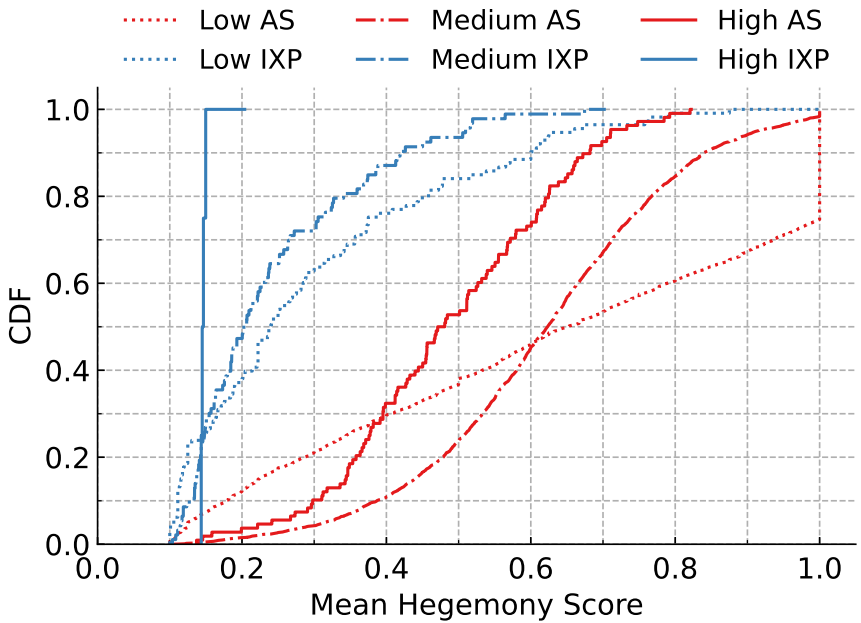


Distribution of Hegemony Scores



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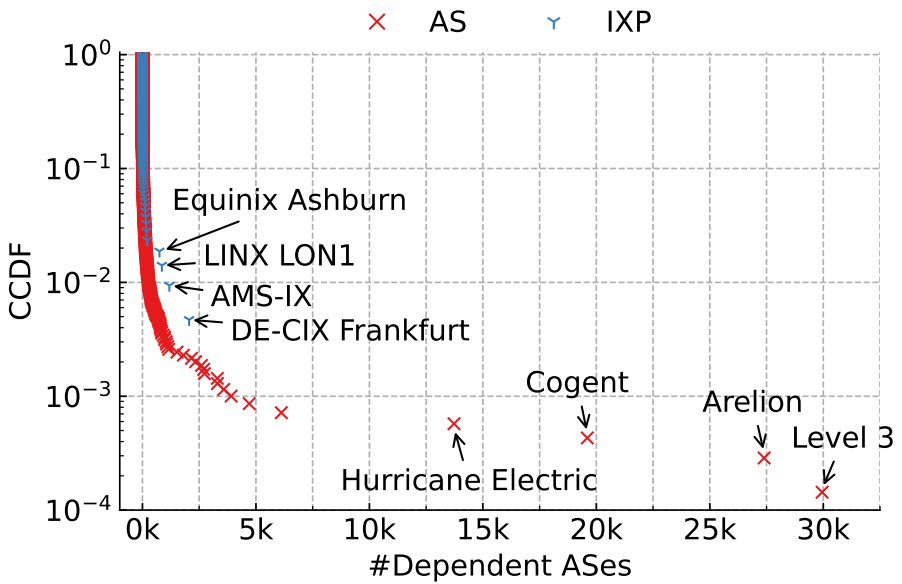

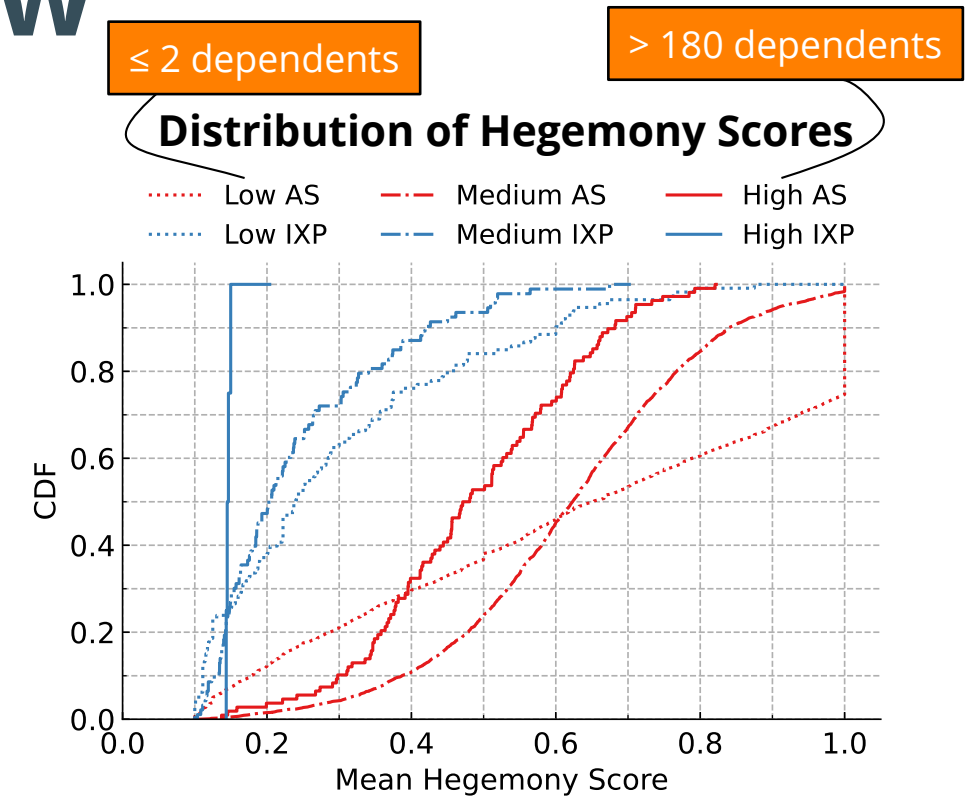

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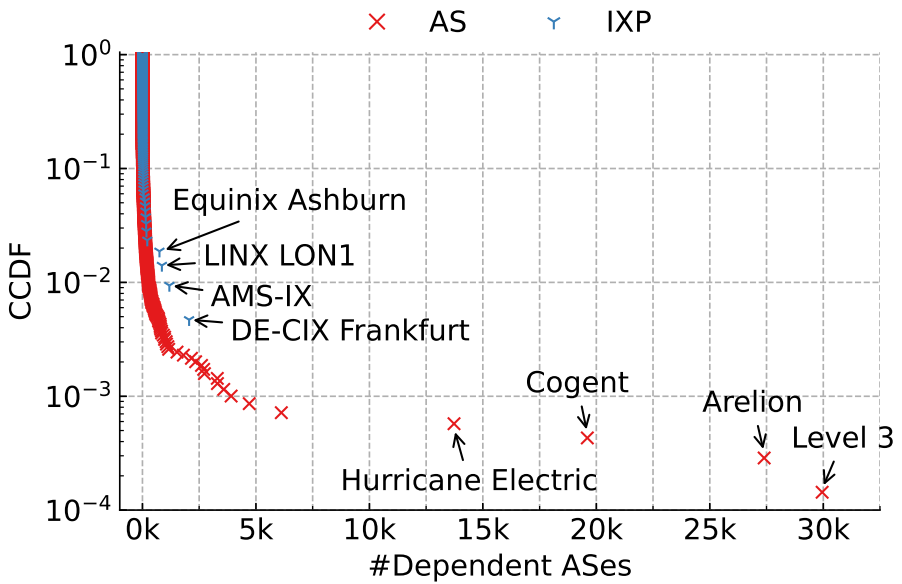

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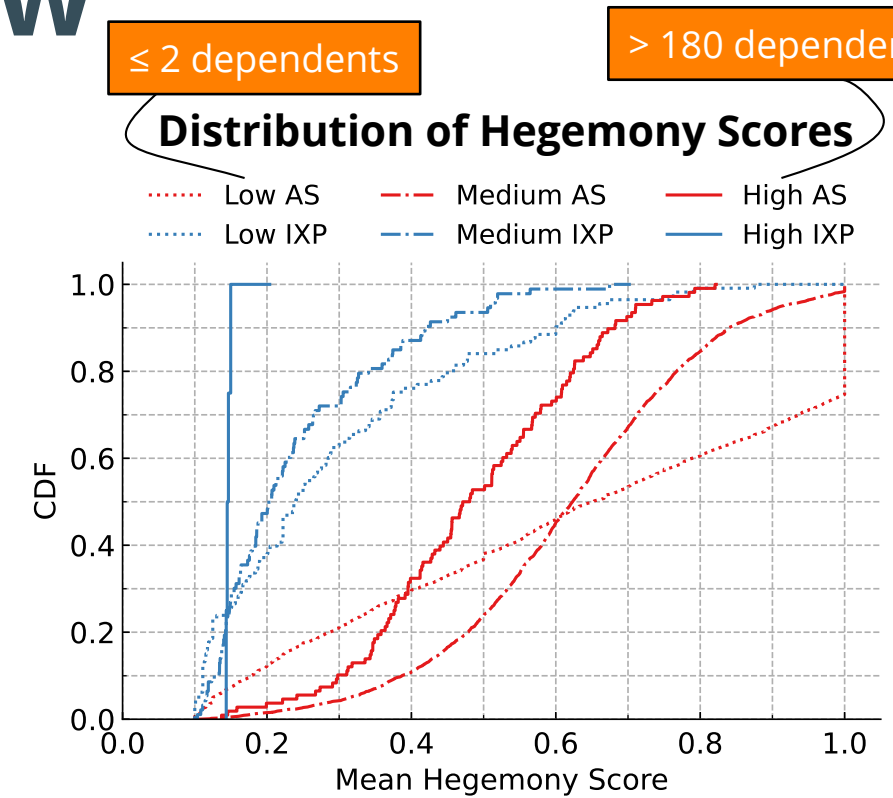

- IXPs have weaker dependencies than ASes
- IXPs/ASes with many dependents have weaker dependencies

Results — Regionality

Regionality: “The fraction of dependents that are located in the same country as the IXP.”

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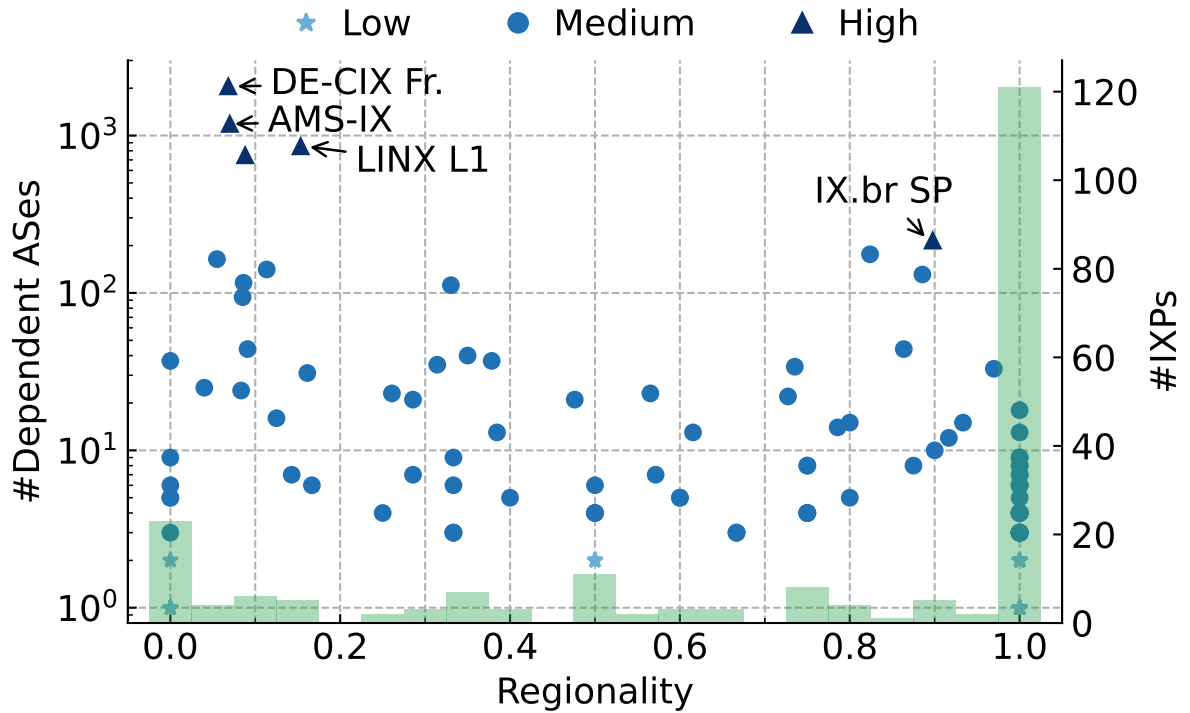

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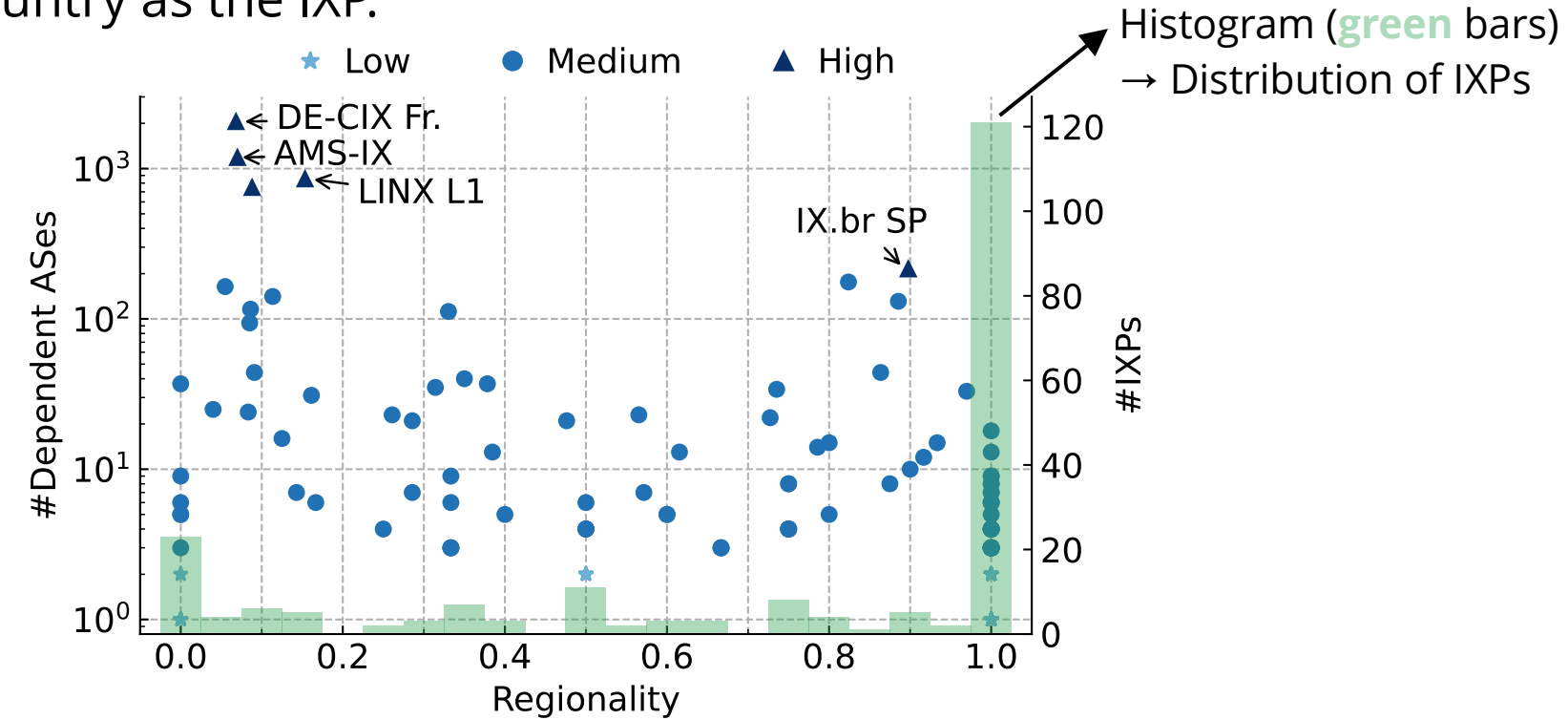

Results — Case Study

(Top 10) Countries with most dependents

DE-CIX Frankfurt
1050 members | 2055 dependents

IX.br São Paulo
2246 members | 215 dependents

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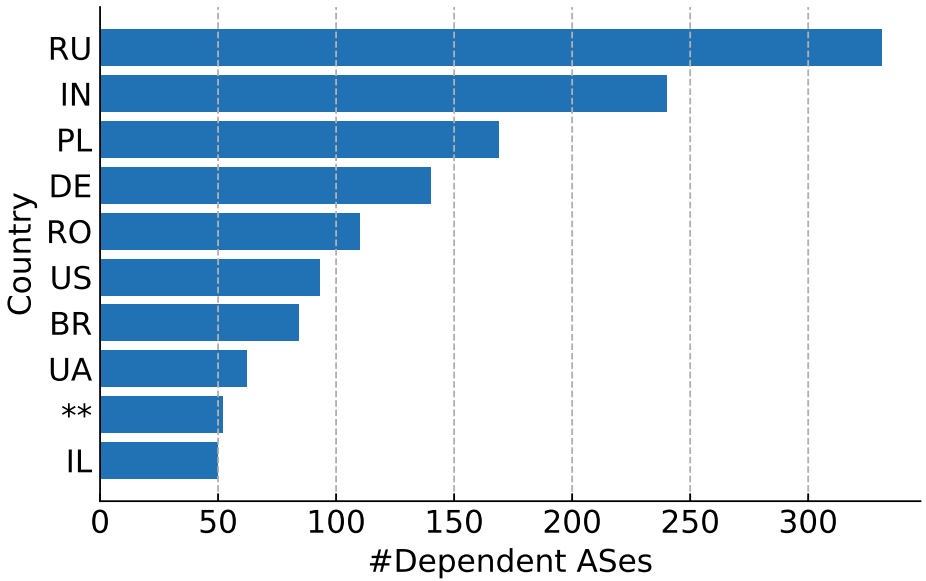

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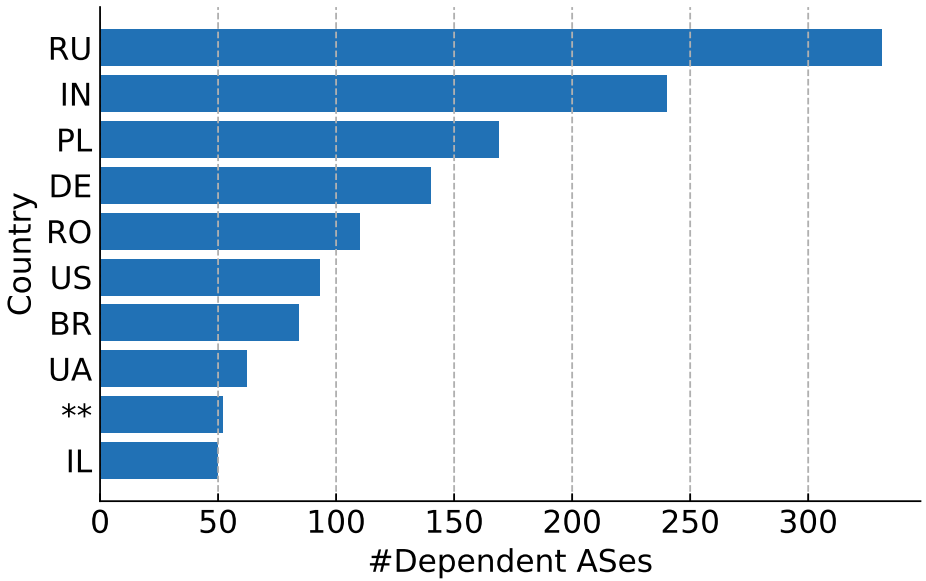

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- Dependents in 94 countries
- International

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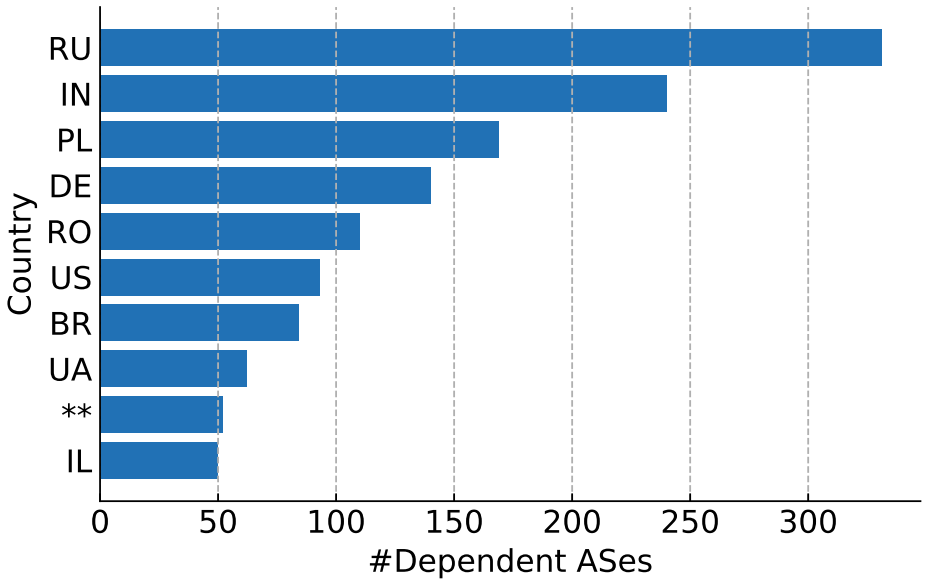

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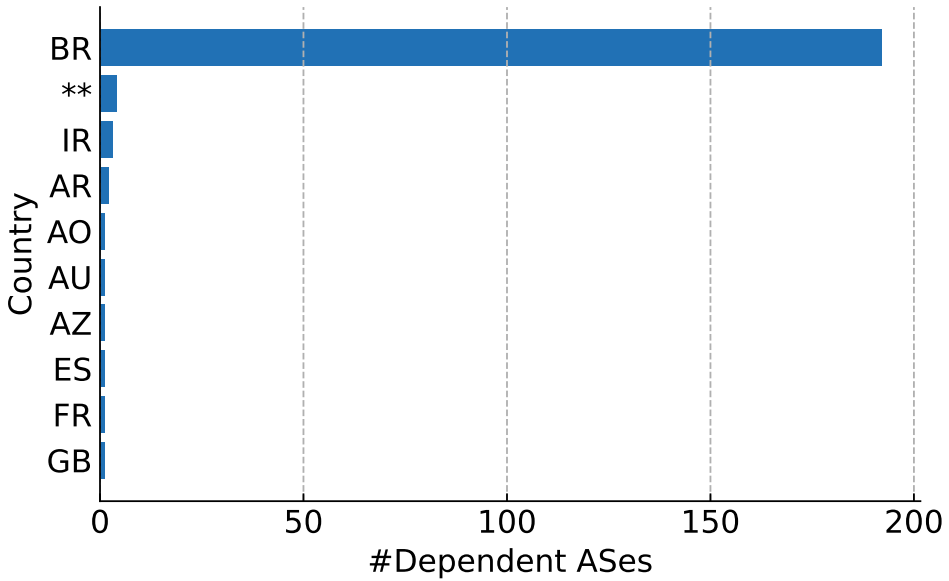

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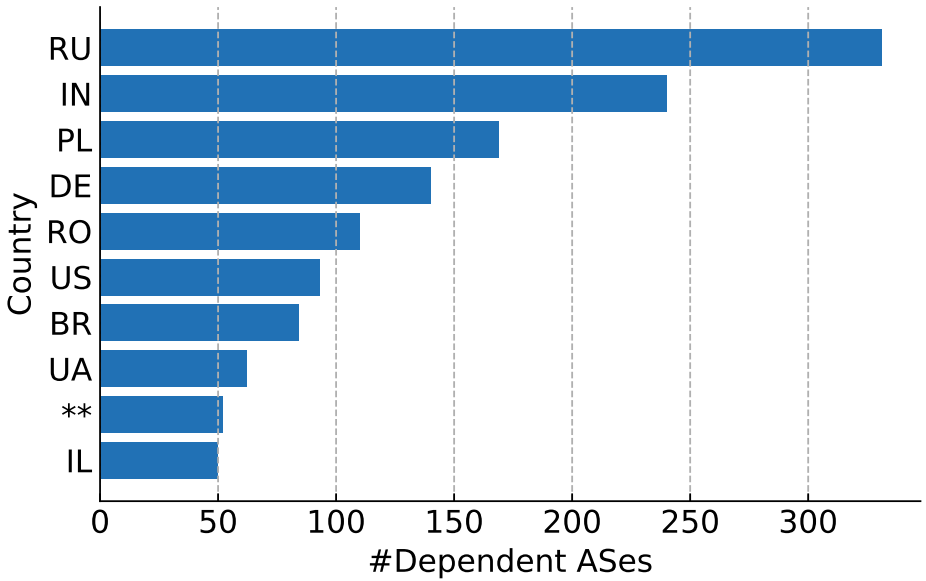

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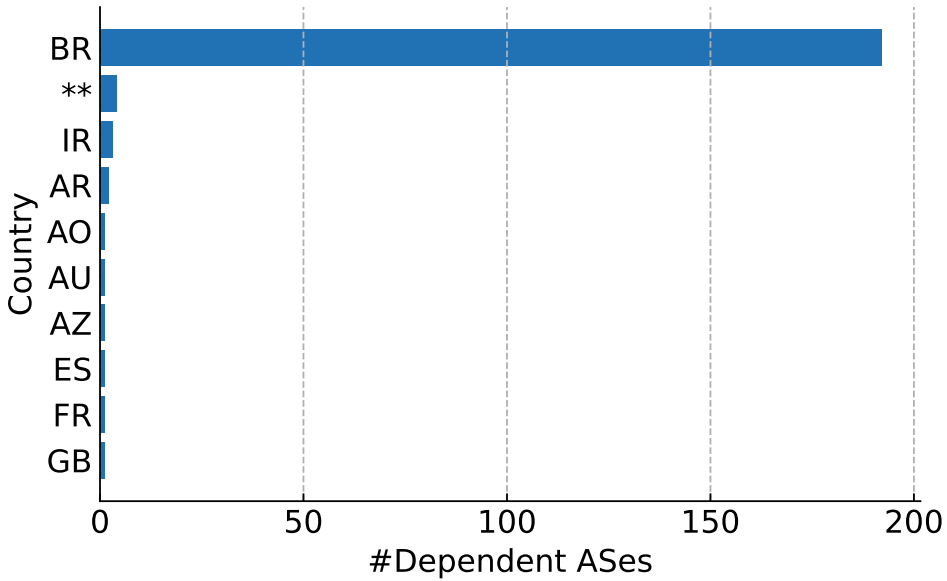
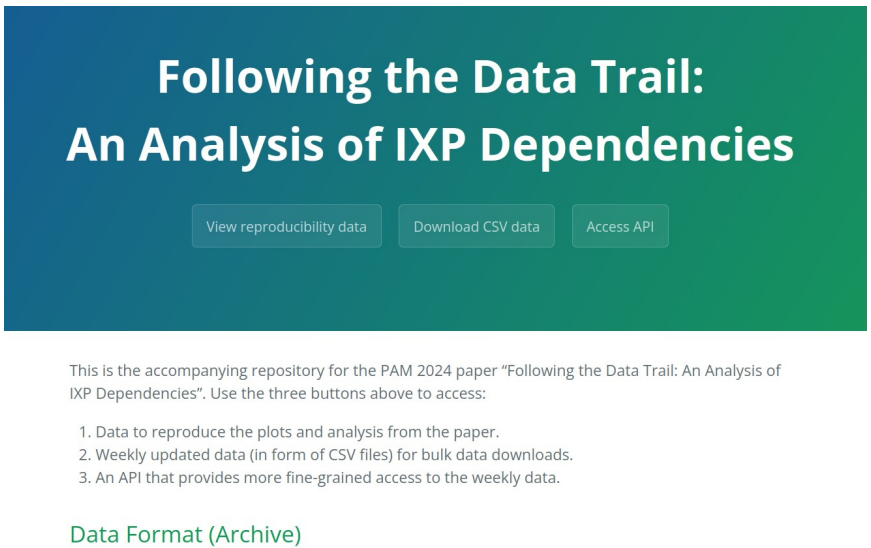


- Dependents in 16 countries
- Regional

Open Data

- Scripts & data to reproduce paper
- Weekly updates of dependency data via API or bulk download



https://internethealthreport.github.io/ixp-dependency/

Conclusion

- Study of IXP dependencies gives insights into the internet topology
- More results in the paper:
  - High-level comparison with BGP
  - Visibility of IXPs in traceroute
  - Member regionality
  - Case study
    - Which members connect dependent networks?
    - Do members share dependents?

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