When Routes Speak Politics: Measuring the Impact of Geopolitical Tensions on the Internet

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Motivation

The Internet is often seen as **borderless**, but in reality, it reflects **geopolitical boundaries and tensions**.

Conflicts and sanctions affect:

- **How countries interconnect**
- **Who controls routing paths**
- **What users can access online**

Goal: understand **how politics leaves technical fingerprints** on the global Internet.

Motivation

Geopolitical tensions are relational, not just national.

They change how two countries connect to each other.

Example: Ukraine’s reduced reliance on Russian networks in 2022.

We need pairwise metrics — to track how relationships between countries evolve technically and politically.

This work aims to make “inter-country connectivity” a measurable concept.

Research Goal

Develop a framework to:

- Quantify how geopolitical events reshape Internet structure.
- Correlate technical changes (routing, peering, security and reachability) with economic and political shifts.
- Inform policymakers and infrastructure operators about emerging fragmentation risks.
- Bridge data-driven Internet measurement with international policy discussions.

From Concept to Measurement

To connect high-level geopolitical behavior with measurable Internet evidence,

we translate each dimension into a quantitative index.

Each index captures a different facet of how politics shapes connectivity,

from physical presence to routing, security, and accessibility.

Peering Index 1/2

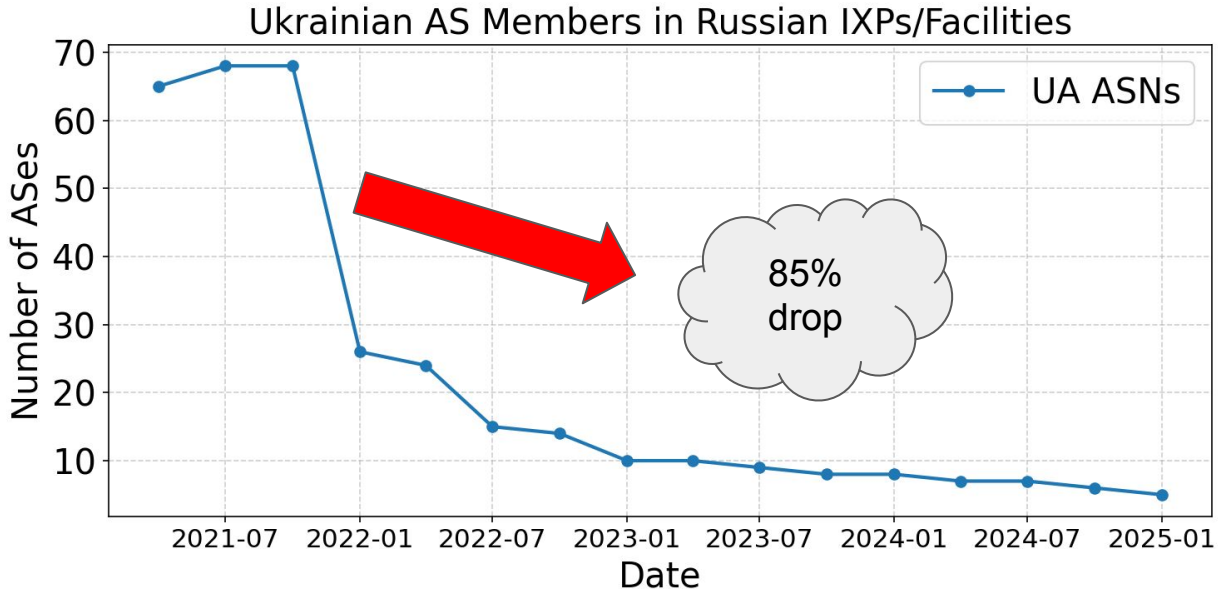
The physical presence of foreign Autonomous Systems (ASes) at Internet Exchange Points (IXPs) and other facilities in a target country.

Countries in conflict reduce physical exchange of traffic

Source: 

Peering Index 2/2

Cross-border peering collapsed following the 2022 invasion.



Country Dependency Index 1/2

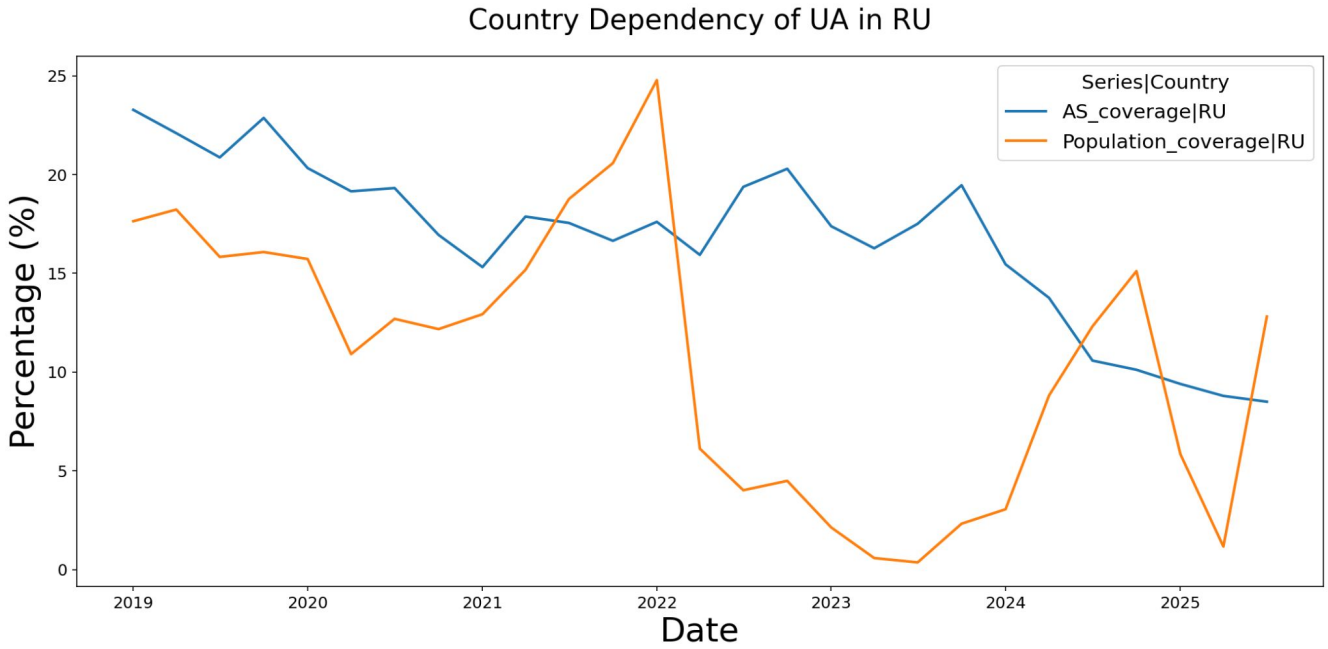
The degree to which one country's network (ASes) relies on the routing infrastructure of another country.

A decline indicates that a country is **diversifying its routing paths** to reduce reliance on networks that belong to another country.

Source: Internet Health Report & Caida

Country Dependency Index 2/2

Ukraine’s routing dependence on Russian networks declined sharply after 2022.



Routing Security Index 1/2

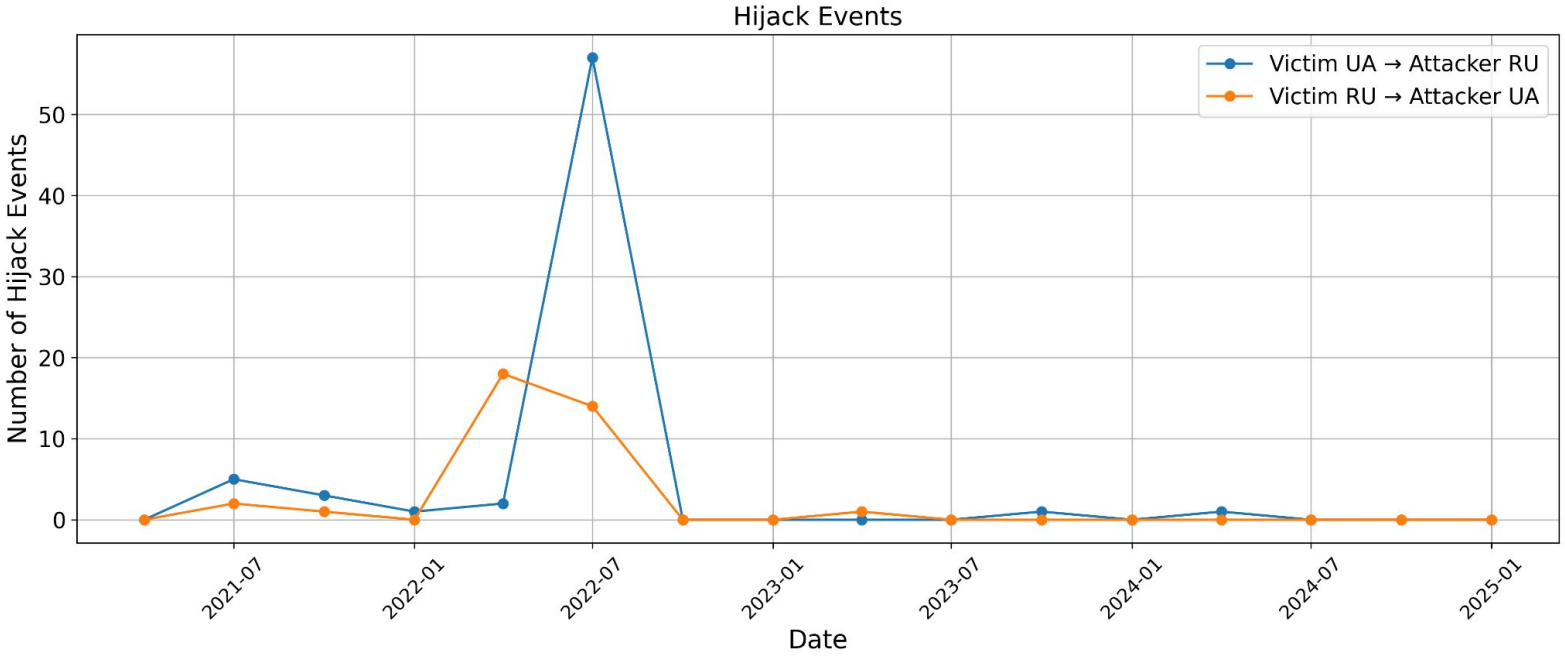
The number of detected BGP hijack events originating from one country and targeting the IP space of another.

Spikes in cross-border BGP hijacks serve as technical fingerprints of geopolitical strain and instability.

Source: GRIP

GRIP computes BGP hijacks by monitoring global routing data (BGP updates) and identifying prefix origin changes that are inconsistent with known, legitimate network ownership. (Suspicion score >= 80)

Routing Security Index 1/2



Trading Volume Data 1/2

The value of Imports and Exports (Trade Volume in Million USD) exchanged between the two countries over time.

Source: UN Comtrade statistics

https://comtradeplus.un.org/

Trading Volume 2/2

Trade flows between the two countries dropped to near zero following 2022.

Overview of Indices

Insight	Index	Data Source	Implemented
Cross-border interconnection: countries in conflict reduce physical exchange of traffic	Peering Index: Presence of foreign ASes at IXPs	PeeringDB	✓
Routing dependence: countries diversify away from adversarial networks	AS Dependency Index: Routing reliance on foreign ASes	CAIDA + IHR	✓
Trust and security: instability or attacks reflect political strain	Routing Security Index: BGP hijacks across borders	GRIP	✓
User experience & access: reachability losses mirror censorship or isolation	Website Accessibility Index: Cross-border web reachability	OONI	✗

Case Study: Russia–Ukraine

Parallel declines in technical and economic interconnection:

- Ukrainian ASes at Russian IXPs ↓ **85%**
- Russia-Ukraine Trade volume ↓ **≈100%**
- Ukraine's dependency on Russian ASes decreased significantly
- We observe a spike in BGP hijack events

- Accessibility metrics under development.

  Shows that **political conflict leaves measurable traces** in Internet topology.

Future Work

- The Internet **speaks geopolitics** — routing, peering, and accessibility all reflect tensions.
- Future work:
  - Add the Website Accessibility Index (Cross border web reachability)
  - Integrate all indices into a **unified geopolitical monitoring framework**.
  - Apply globally to detect **early signs of digital fragmentation**.


Danke
Merci
Gracias
Thank you
Grazie
謝謝
Спасибо