WHEREIS

IP Address Registration Geo-Consistency

Robert Beverly
Amreesh Phokeer
Oliver Gasser

IMC 2026
Karlsruhe, DE

SDSU

Internet Society

IPinfo

Regional Internet Registries

*"The primary role of RIRs is to manage and distribute public Internet address space within their respective regions." [**ARIN NRPM, RIPE-738, NRO**]*

Internet numbers registry goals [**RFC 7020**]:

- Allocation pool management (finite resource, uniqueness)
- Hierarchical allocation (efficiency)
- Registration accuracy (to meet operational needs)

Contributions

- **Where are IP prefixes physically used after allocation?**
  - Define a taxonomy of registration “geo-consistency”
  - Large-scale distributed active IPv4 and IPv6 measurements to perform a “geo-audit”
- **Analysis of prefix geo-audit:**
  - Confounding / explaining factors
  - Influence on IP geolocation databases
- **Validation and dissemination:**
  - Coordinated with 3 RIRs and 1 IP leasing broker
  - AFRINIC case study

Motivation

- IP addresses are a *valuable commodity*
- What are the *technical* implications of out-of-region use?
- What are the *policy* implications of out-of-region use?

KrebsonSecurity
In-depth security news and investigation

HOME ABOUT THE AUTHOR ADVERTISING/SPEAKING

The Great $50M African IP Address

December 11, 2019

A top executive at the nonprofit entity responsible for doling out c
businesses and other organizations in Africa has resigned his pos

Your email addre Subscribe

NEWS PRESS OFFICE FEATUR

Internet addresses worth R1.8 billion seized

Jan Vermeulen 11 July 2021

AFRINIC
The Internet Numbers Registry for Africa

ABOUT US OUR WORK PART

About Us

- About Us
  - History
  - Service Region

AFRINIC Litigation related Frequently

1. What is the origin of the litigation between AFRINIC
2. What does it mean to be a good Registry (steward)

Wait! Out-of-region use allowed?

- Not looking at intra/inter-RIR transfers
  - Instead OOR use that can *only* be uncovered via *measurement*
- Significant policy differences between RIRs

	Out-of-region			Out-of-region usage
	Owner	Infrastructure	Routing	
AFRINIC	✗	✗	✗	✗[1]
APNIC	✓	✓	✓	✓
ARIN	✗	✗	✗	✗[2]
LACNIC	✗	✗	✓	✗[3]
RIPE	✓	✗	✓	✓

[1] Only allowed for connectivity back to Africa.
[2] Must prove real and substantial connection with the ARIN region.
[3] Allowed for Anycast prefixes

Methodology Overview

```
inetnum:        79.174.20.0 - 79.174.20.255
netname:        Yunnan-Logame-Technology-Co-Ltd
country:        HK
org:            ORG-YLTC1-RIPE
admin-c:        KY603-RIPE
organisation:   ORG-YLTC1-RIPE
org-type:       OTHER
address:        37k yen chow street sham shui po
address:        unit 708 level 7 dragon center
address:        Hong Kong
```

- Probe targets in WHOIS registered prefix using RIPE Atlas
- Constraint-based geo finds RIRs in feasible geo-region
- Apply best measurement practices
- Consider correlating factors: e.g., BGP, leasing, legacy addresses, age
- Goal: precision over recall

Methodology Overview

```
inetnum:        79.174.20.0 - 79.174.20.255
netname:        Yunnan-Logame-Technology-Co-Ltd
country:        HK
org:            ORG-YLTC1-RIPE
admin-c:        KY603-RIPE
organisation:   ORG-YLTC1-RIPE
org-type:       OTHER
address:        37k yen chow street sham shui po
address:        unit 708 level 7 dragon center
address:        Hong Kong
```

- Probe targets in WHOIS registered prefix using RIPE Atlas
- Constraint-based geo finds RIRs in feasible geo-region
- Apply best measurement practices
- Consider correlating factors: e.g., BGP, leasing, legacy addresses, age

- /24 in a /8 allocated to RIPE
- Registered owner in Hong Kong (outside RIPE NCC's region)

Methodology Overview

```
inetnum:        79.174.20.0 - 7
netname:        Yunnan-Logame-T
country:        HK
org:            ORG-YLTC1-RIPE
admin-c:        KY603-RIPE
organisation:   ORG-YLTC1-RIPE
org-type:       OTHER
address:        37k yen chow street sham shui po
address:        unit 708 level 7 dragon center
address:        Hong Kong
```

- Registration versus Inferred:
  - In RIPE NCC's region?
  - In APNIC's region?
  - In neither RIPE nor APNIC?
- (See paper for detailed taxonomy of geo consistency)

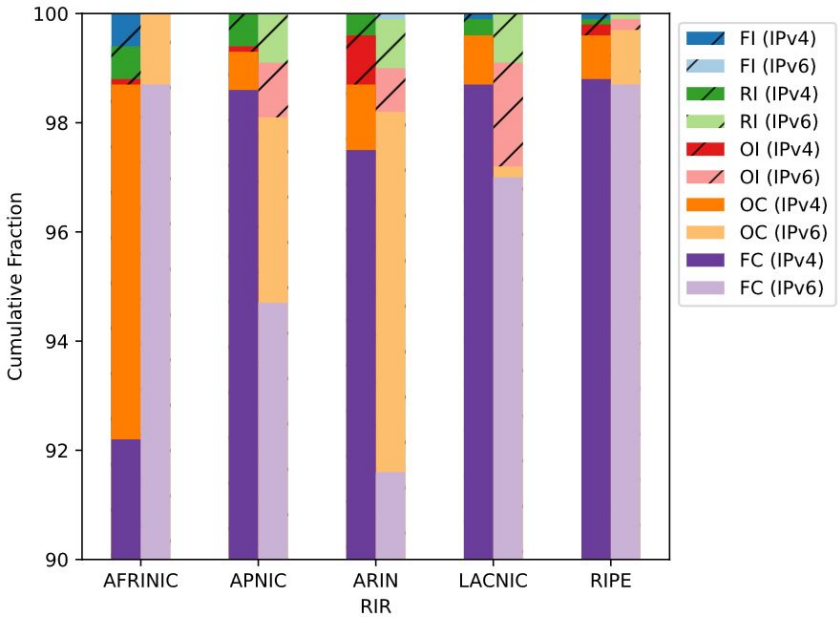
ds

on

- Consider correlating factors: e.g., BGP, leasing, legacy addresses, age
- Goal: precision over recall

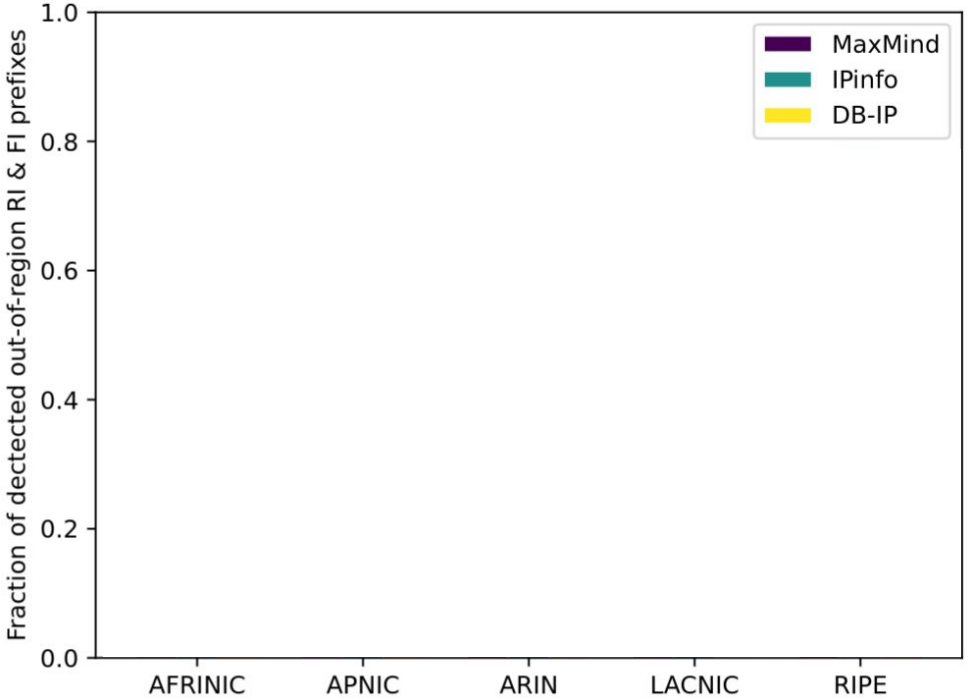
Geo-consistency results

Result	IPv4 Prefixes	IPv6 Prefixes
Fully Geo-consistent	60,972 (98.2%)	42,019 (97.7%)
Org Geo-consistent	653 (1.1%)	739 (1.7%)
Org Geo-inconsistent	255 (0.4%)	128 (0.3%)
Registry Geo-inconsistent	166 (0.6%)	106 (0.2%)
Fully Geo-inconsistent	38 (0.1%)	8 (0.0%)



→ **More than 99% are geo-consistent, significant differences between RIRs and IP versions**

Effect on IP geolocation DBs



➜ **IPinfo detects many more OOR prefixes, MaxMind & DB-IP seem to rely on incorrect WHOIS information**

Dashboard using IPinfo’s ProbeNet measurements

IPinfo | Type / to search | Products | Enterprise | Why IPinfo? | Pricing | Resources | Docs

OUT-OF-REGION IP ADDRESS SPACE

Registered in one region, used in another

Live data · updated regularly

In a research paper collaboration we developed the tool "WHEREIS", which geolocates every delegated IPv4 and IPv6 prefix and compares the result against the WHOIS registry that delegated it. These are the prefixes whose measured location falls outside their registry's service region, updated regularly.

Check a prefix | Read the paper

OUT-OF-REGION PREFIXES

23,428

22,133 IPv4 prefixes

1,295 IPv6 prefixes

Oct 10, 2026 Latest snapshot

WHEREIS Summary

Internet-wide IP geo-location consistency audit

- 0.7% IPv4 & 0.2% IPv6 prefixes in WHOIS are used out-of-region
- Significant differences between RIR regions

RIR Validation & Coordination

Validated and coordinated with three RIRs

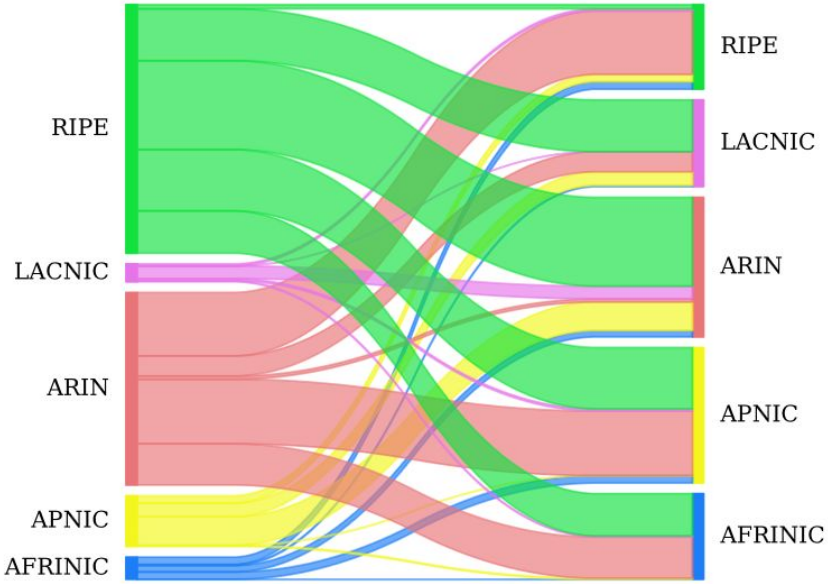
Production Transition

Transitioned to production deployment at IPinfo with public dashboard

Thanks! Questions?

Backup

Where are inconsistent prefixes used?



IPv4

→ **AFRINIC IPv4 prefixes are mostly used in APNIC, RIPE NCC, and ARIN regions**