

WHEREIS: IP Address Registration Geo-Consistency

CAIDA GMI AIMS 2025

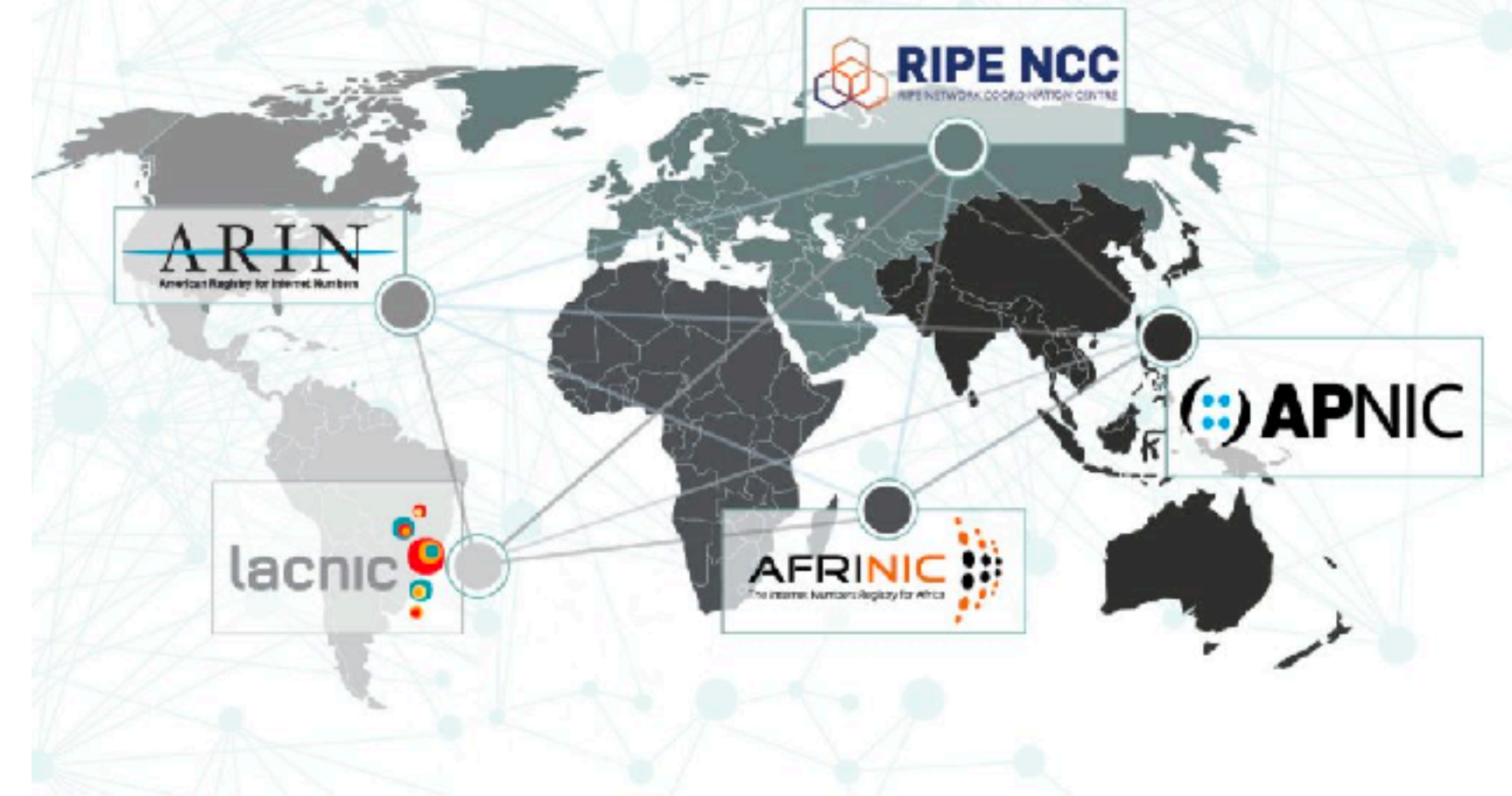
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Regional Internet Registry



- “*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)

Some (leading) questions about RIRs

- Where are prefixes used *post-allocation*?
- How, what, where: are prefixes used *outside* of their registered RIR region?
- What are the potential *technical* implications?
- What are the potential *policy* implications?

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The Great \$50M African IP Address Heist

December 11, 2019

A top executive at the nonprofit entity responsible for doling out chunks of Internet a businesses and other organizations in Africa has resigned his post following accusa



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AFRINIC Litigation related Frequently Asked Questions

1. What is the origin of the litigation between AFRINIC and Cloud Innovation?
2. What does it mean to be a good Registry (steward) of IP resources?
3. How does AFRINIC validate members and allocate IP resources?

Your email address

MYBROADBAND
TRUSTED IN TECH

NEWS PRESS OFFICE FEATURES INVESTING FORUM INDUSTRY NEWS

Internet addresses worth R1.8 billion seized

Jan Vermeulen 11 July 2021

WHEREIS: IP Address Registration Geo-Consistency

WHOIS

```
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
```

- RIPE Atlas active probe targets in a WHOIS registered prefix
- Constraint-based geo for RIRs responsible for feasible geo-region
- Best measurement practices, e.g., CBG, good vantages, etc
- Consider correlating factors: e.g., BGP, legacy addresses, age
- Goal: precision over recall

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address:          unit 708 level 7 dra
address:          Hong Kong
```

- RIPE Atlas active probe targets in a WHOIS registered prefix

- /24 in a /8 allocated to RIPE
- Registered owner in Hong Kong (outside of RIPE's region)
 - In RIPE's region? **OK**
 - In APNIC's region? **OK**
 - In neither RIPE nor APNIC region? **INCONSISTENT**

for RIRs
e geo-region
ctices, e.g.,
etc
ctors: e.g.,
s, age
call

Wait! Out-of-region use is allowed!

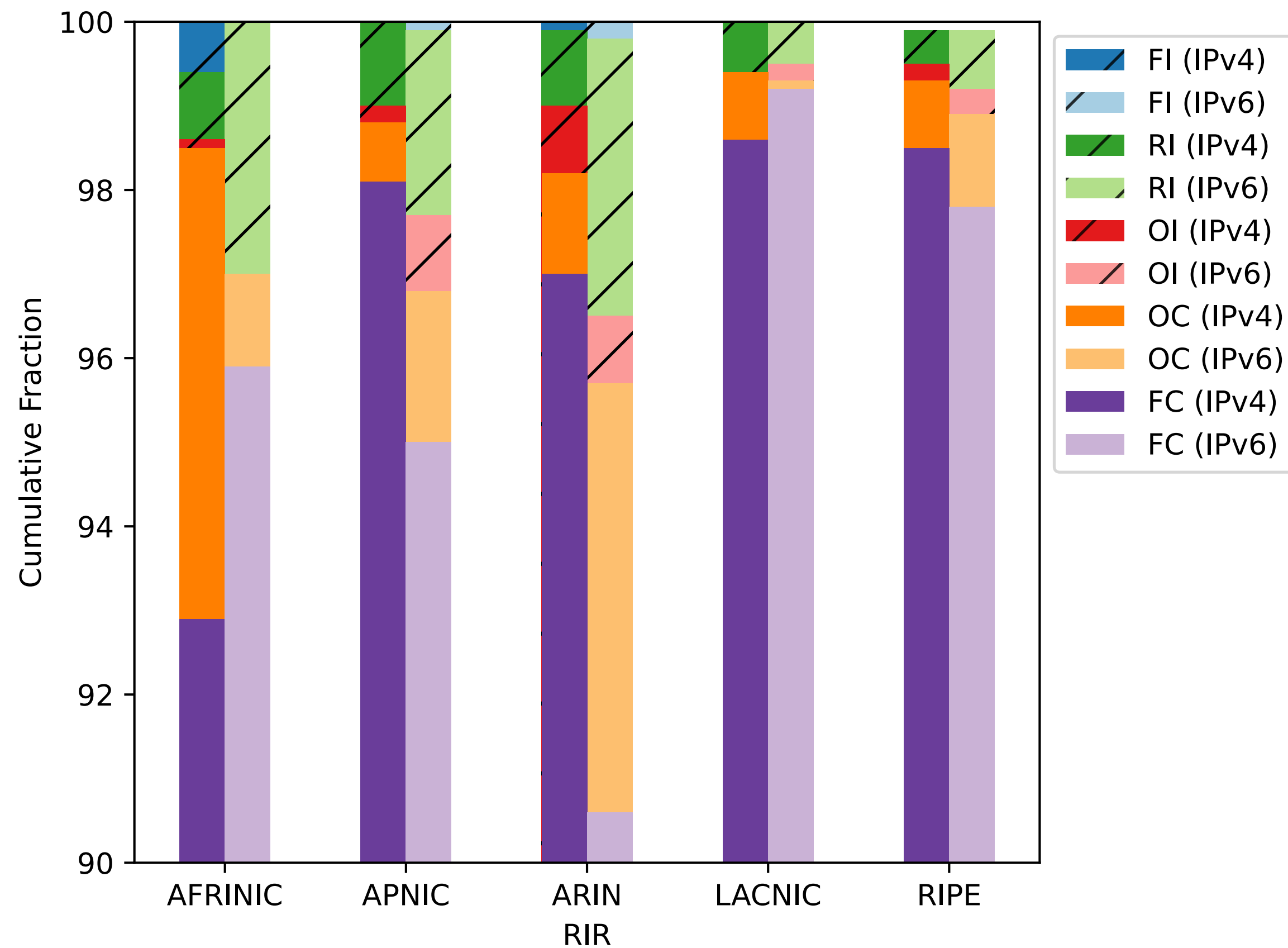
- Not looking at inter-RIR transfers (publicly logged and vetted by RIRs):
 - Instead, out-of-region use that can only be uncovered via measurement
- It's complicated: different RIRs have different policies

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

Taxonomy of Consistency

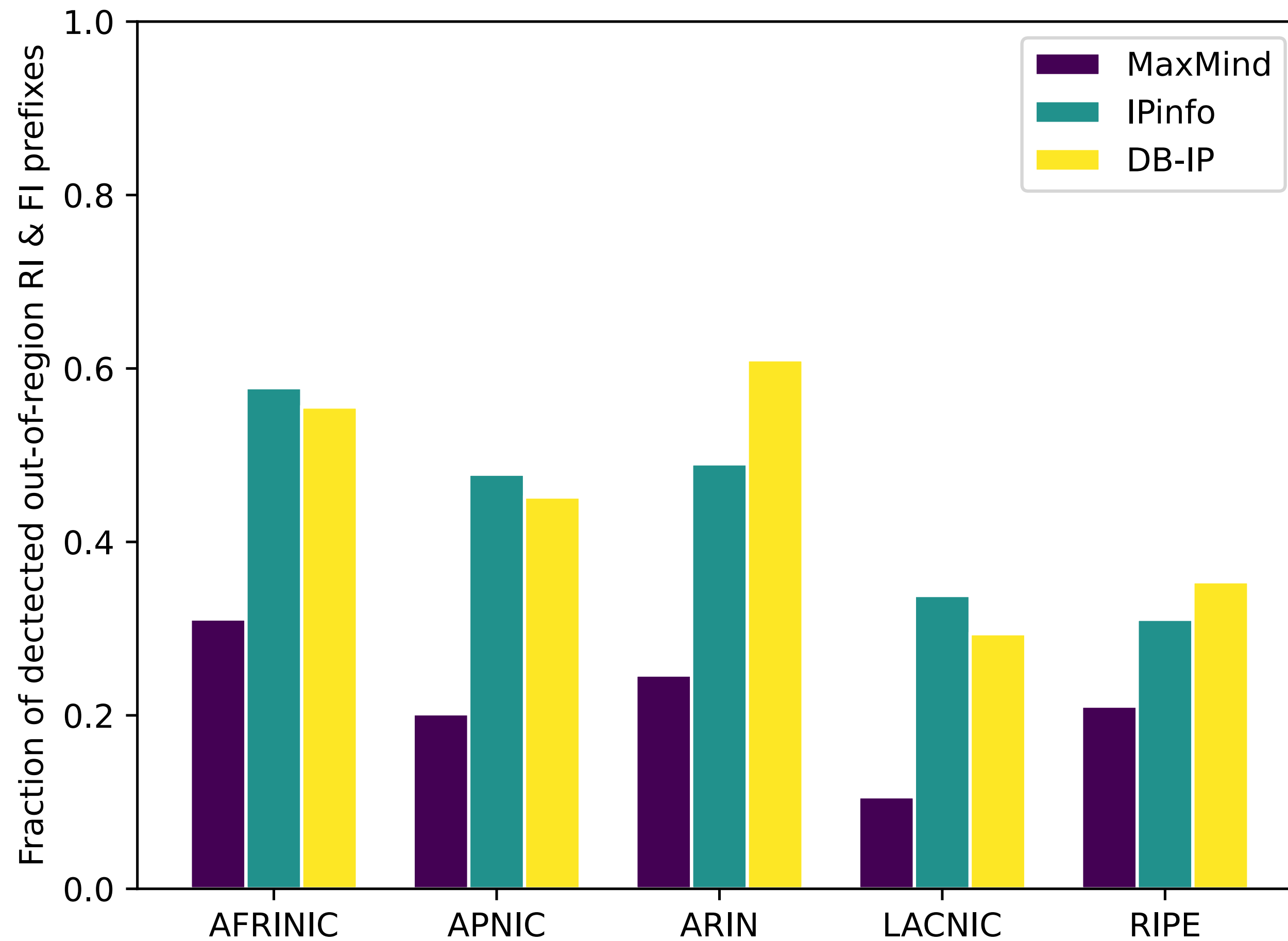
Result	Description	Example		
		RIR_{Reg}	RIR_{Org}	RIR_{Geo}
(FC) Fully Geo-consistent	Geolocates in RIR and org's region	ARIN	ARIN	ARIN
(OC) Org Geo-consistent	Geolocates outside RIR region, within org's region	RIPE	ARIN	ARIN
(OI) Org Geo-inconsistent	Geolocates in RIR's region, org is OOR	ARIN	RIPE	ARIN
(RI) Registry Geo-inconsistent	RIR and org's region consistent, geolocates OOR	ARIN	ARIN	RIPE
(FI) Fully Geo-inconsistent	RIR, org, and geolocation all in different regions	ARIN	RIPE	APNIC

Findings in One Slide



- ~70k IPv4, ~55k IPv6 prefixes
- 98% consistent -> relatively small number of (egregious) inconsistencies to manually investigate / fix
- (Conservative, lower bound)
- AFRINIC, ARIN most inconsistent
- IPv6 no more consistent

Why not geo databases?



- Self-delusion: geo databases use WHOIS data themselves
- Across three geo databases, at most 60% of our inferred inconsistencies are out-of-region

Community Engagement

Impact and Validation

- Shared data and obtained validation from ARIN, RIPE, and AFRINIC
- Shared data and obtained validation from leasing provider IPXO, resulted in corrections to the WHOIS records
- AFRINIC:
 - Exhaustive WHEREIS of all AFRINIC prefixes
 - Inconsistencies distributed across 51 BGP announcements and 23 ASN
 - Two ASN account for >53%

WHEREIS: take-aways

- Increase transparency and help community understand where scarce resources are used
- Quantify extent to which registry information is accurate and can serve operational needs
- Inform ongoing discussion over “in-region” address use and policy
- 98% consistent in most conservative view; 2% very inconsistent

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