IPinfo | THE INTERNET DATA COMPANY

# WHEREIS

IP Address Registration Geo-Consistency

# Regional Internet Registries

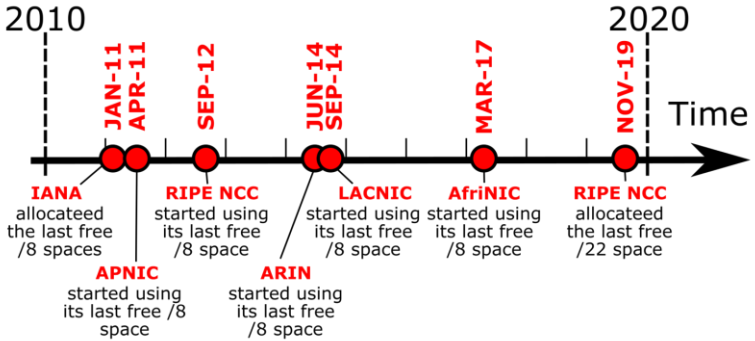
*“The primary role of RIRs is to manage and distribute public Internet address space within their respective regions.” [ARIN NRPM, RIPE-738, NRO]*


Internet numbers registry goals [RFC 7020]:

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

# IPv4 address exhaustion

# IPv4 address exhaustion

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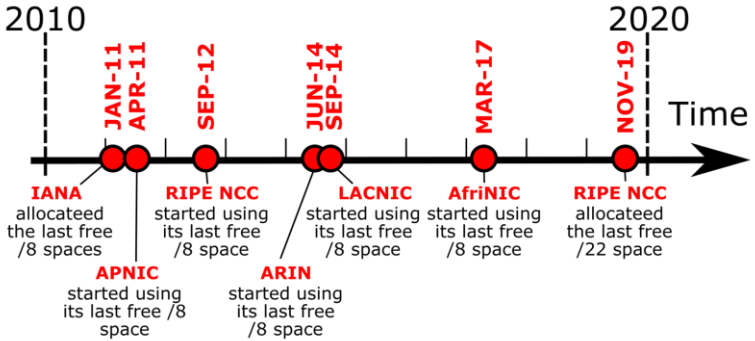
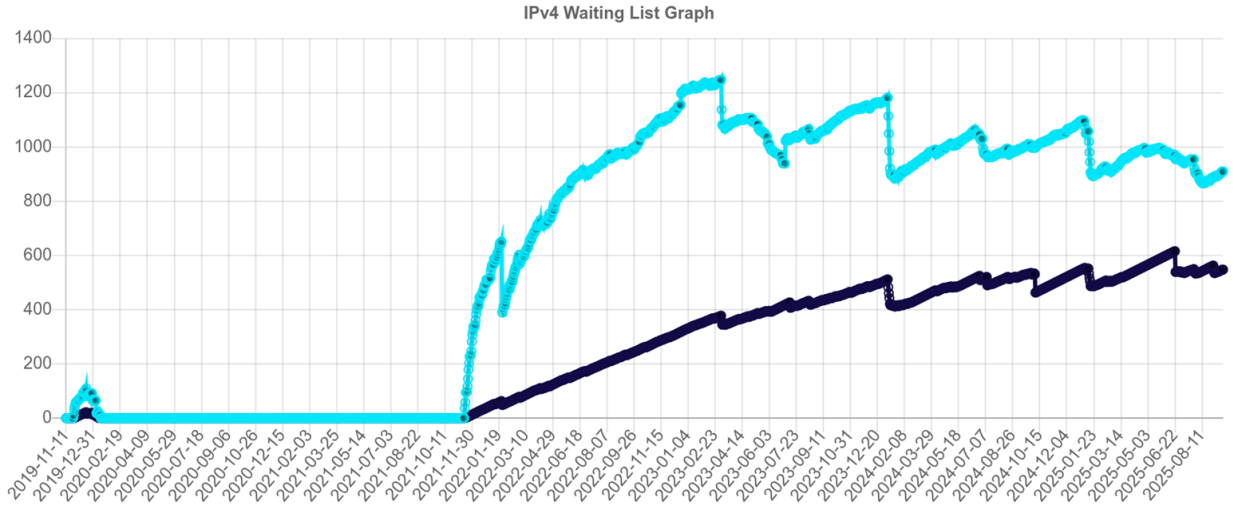
# IPv4 address exhaustion




- 910 LIRs on waiting list
- **548 days** that the first LIR in queue has been waiting

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# Stealing IPv4 addresses

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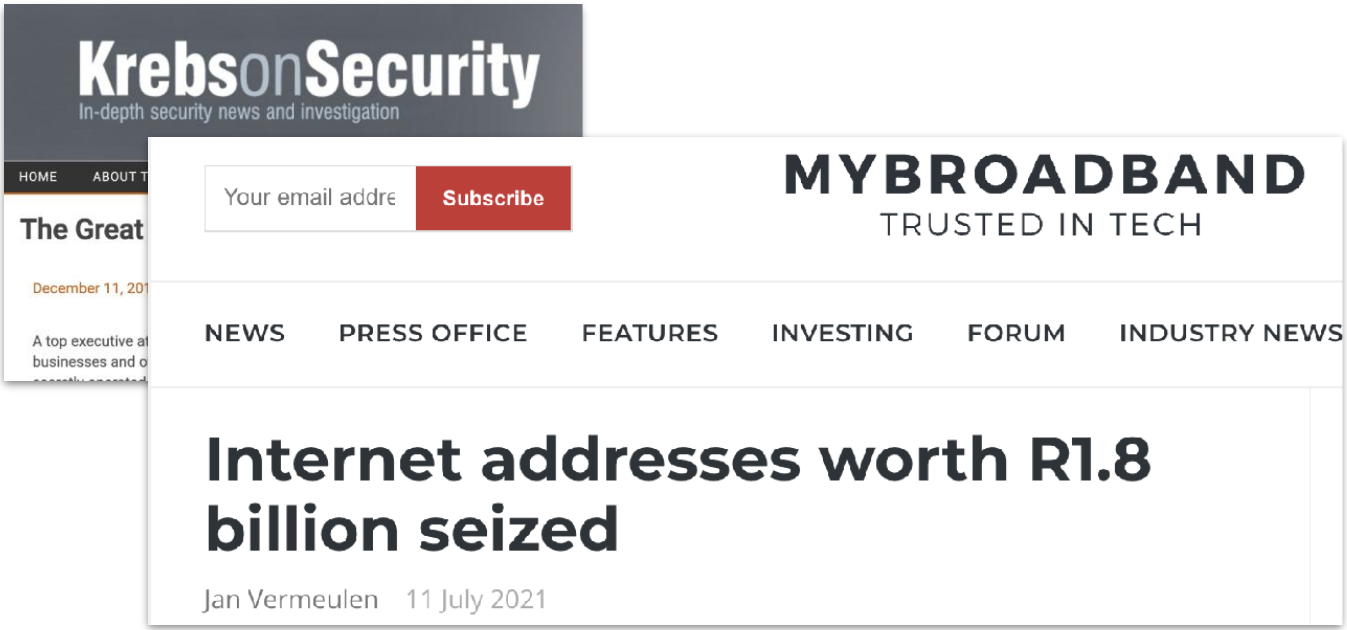


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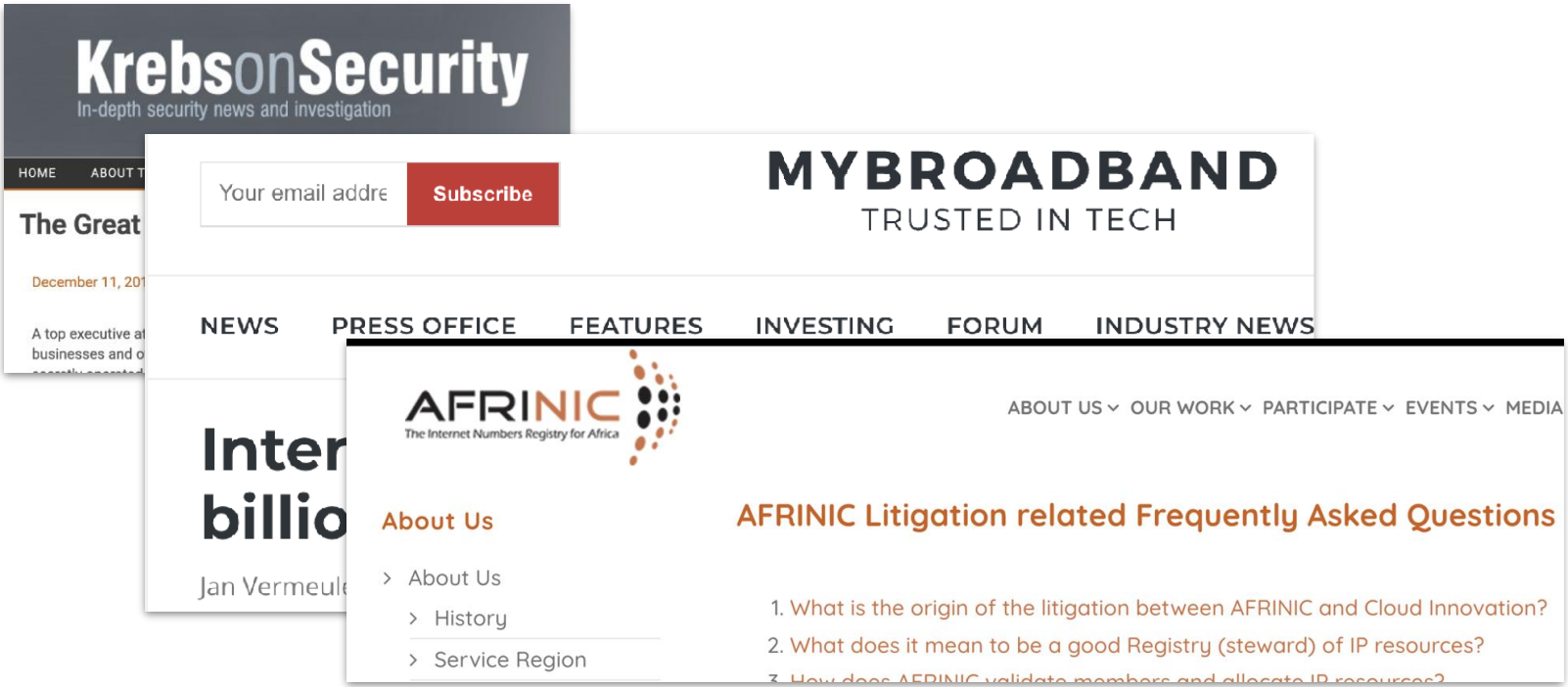


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# Stealing IPv4 addresses


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# Where are prefixes used after allocation?


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# Is out-of-region use allowed?

| | 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

# WHOIS to the rescue

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# WHOIS to the rescue

```
NetHandle:      NET-104-148-63-0-1
OrgID:          C05266659
Parent:         NET-104-148-0-0-1
NetName:        WEB-OMEGA-DO-BRASIL
NetRange:       104.148.63.0 - 104.148.63.255
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- **WHOIS RIR:** ARIN

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OrgID:          C05266659
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Street:         Rua do Xareu, qd 13, lote 20
City:           Goiania
State/Prov:     GO
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- **WHOIS RIR:** ARIN
- **WHOIS Organization RIR:** LACNIC (Brazil)

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- **WHOIS RIR:** ARIN
- **WHOIS Organization RIR:** LACNIC (Brazil)
- **Actual location RIR:** ?

# RIPE Atlas

- Globally distributed network of measurement probes
- Managed by the RIPE NCC
- 7.8k hardware probes
- 5.3k software probes
- 889 anchors (more powerful probes)
- Credit-based system to schedule measurements


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➜ **Find geo-inconsistent prefixes using RTT measurements and speed-of-light inference**

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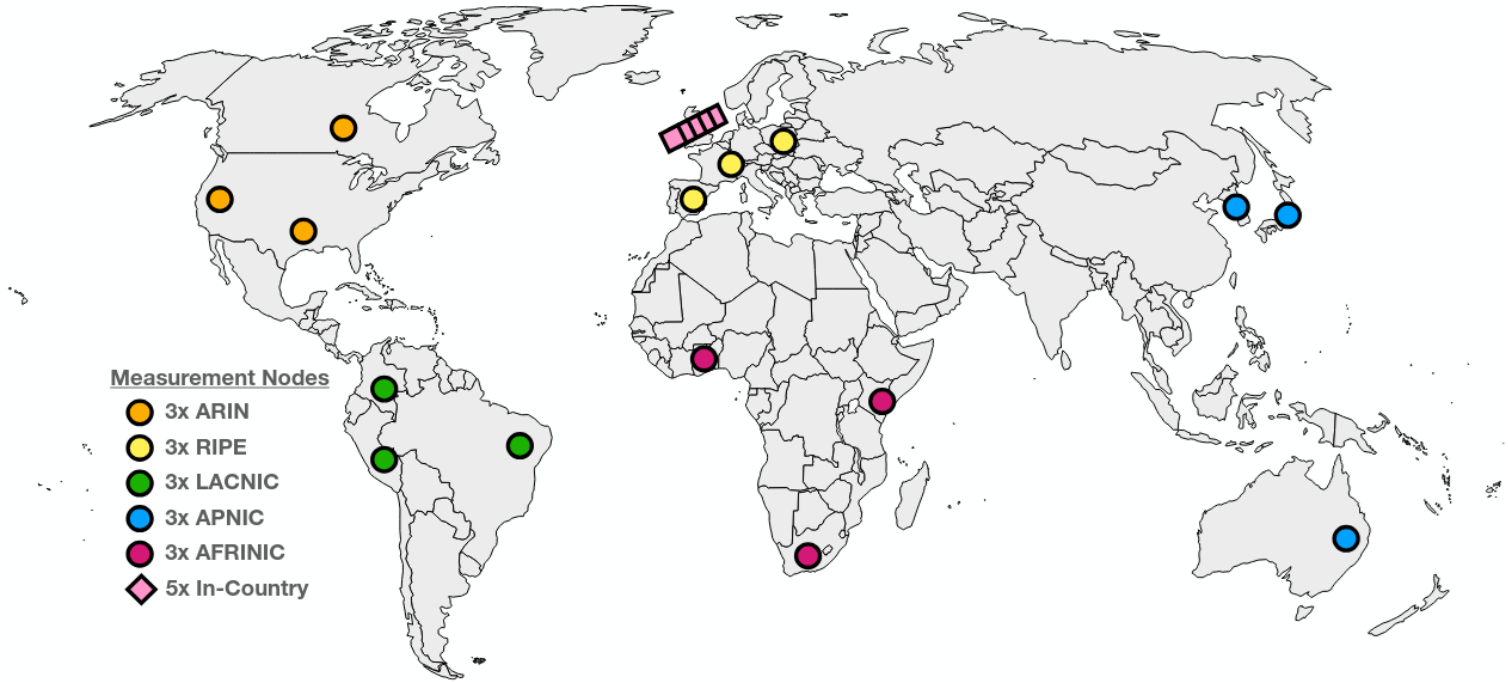
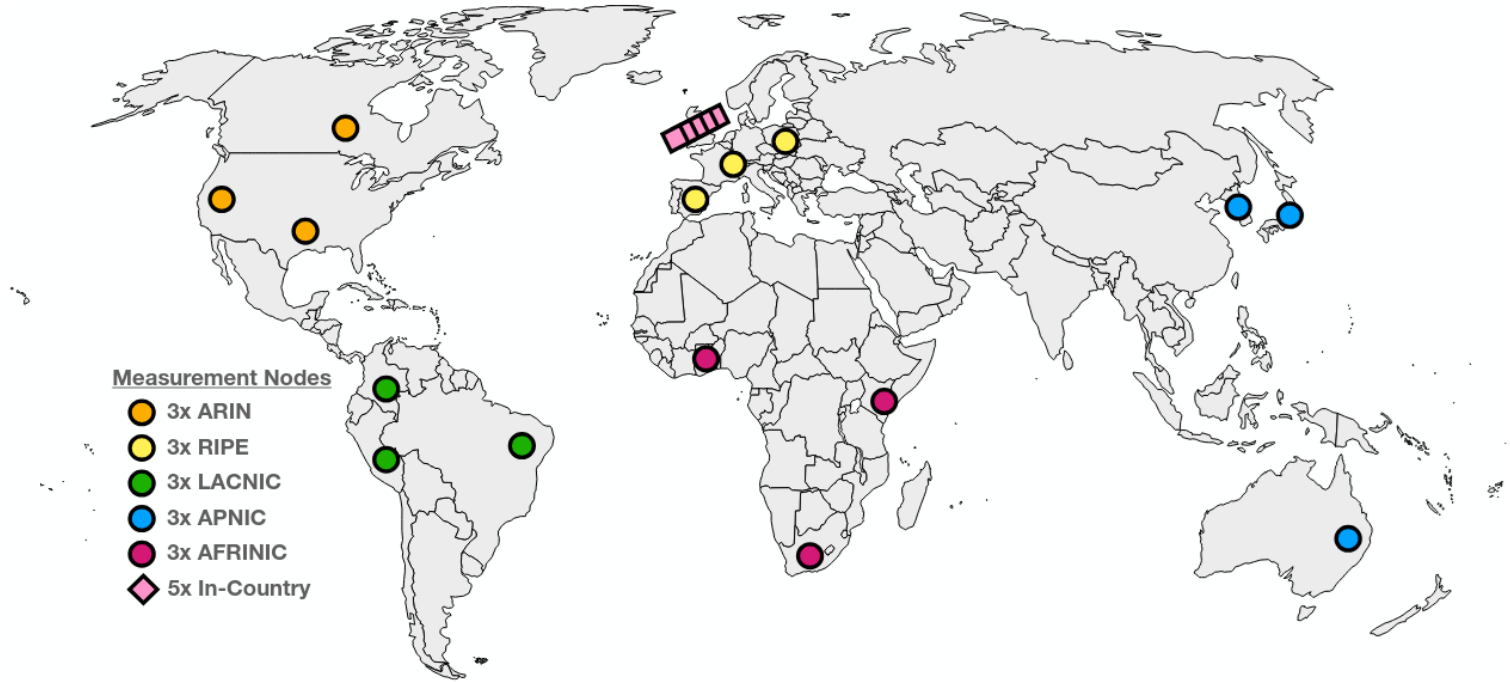
# RIPE Atlas measurements



# RIPE Atlas measurements




→ Measure from 20 probes in different country and RIR locations

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# Terminology: Classifying different inconsistencies

| Example | | |
|---|---|---|
| $RIR_{Reg}$ | $RIR_{Org}$ | $RIR_{Geo}$ |

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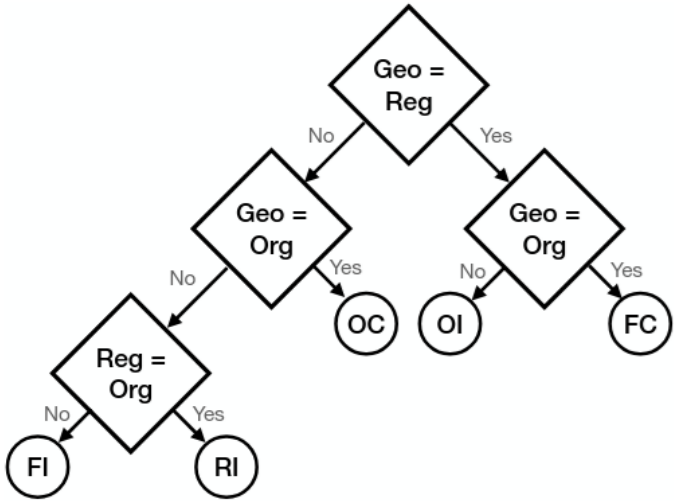


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| Result | Description | Example $RIR_{Reg}$ | Example $RIR_{Org}$ | Example $RIR_{Geo}$ |
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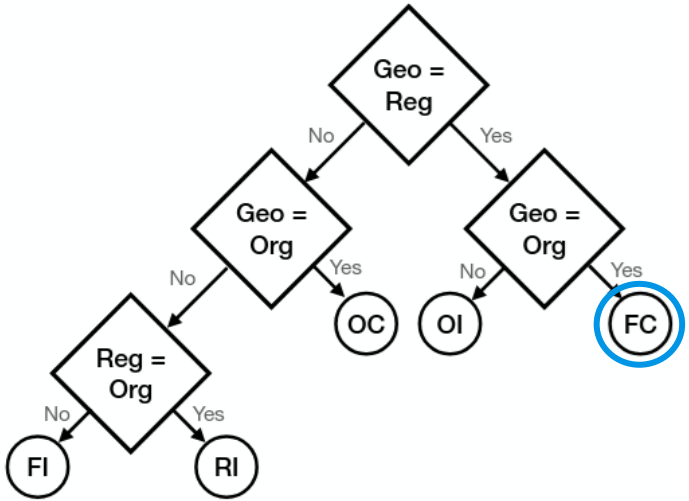


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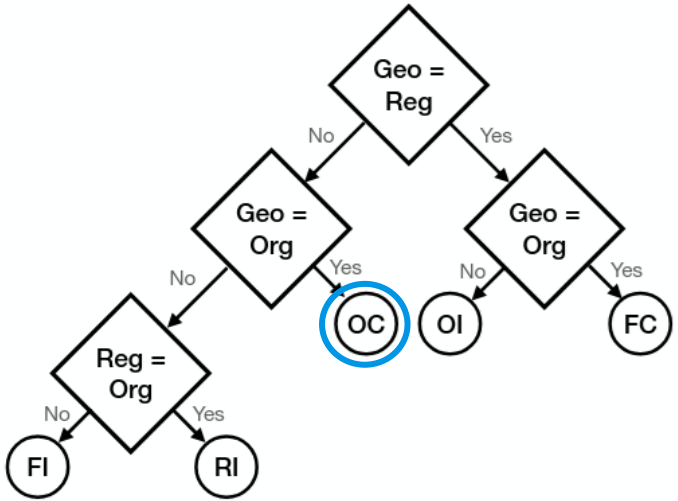


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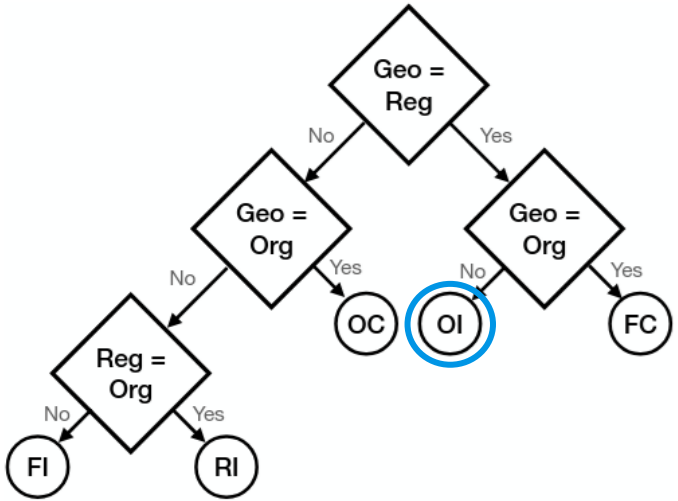


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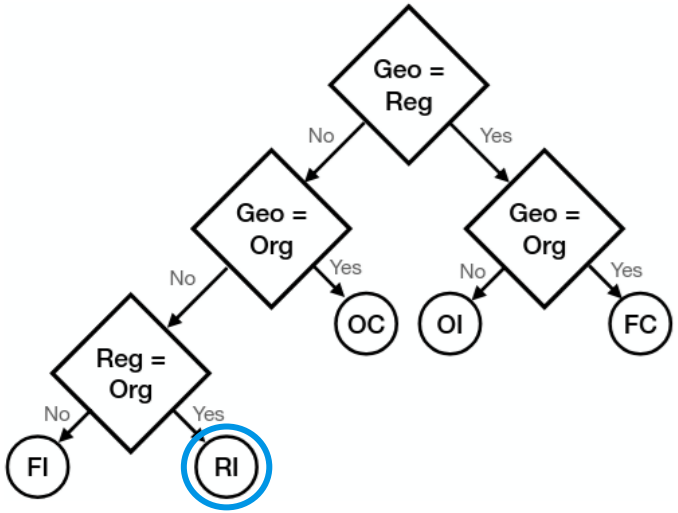


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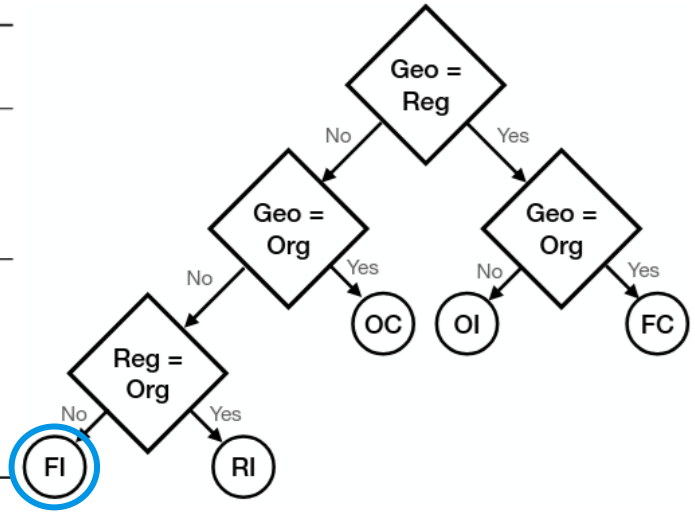


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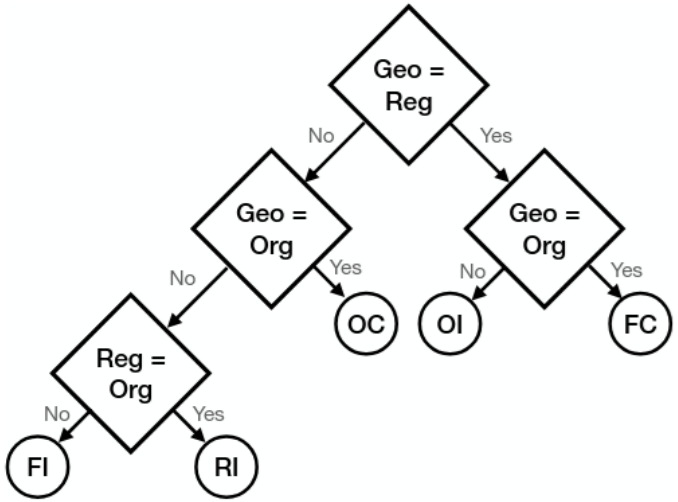


➜ **Different types of inconsistencies depending on Reg, Org, and Geo regions**

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# Geo-consistency results

| Result | IPv4 Prefixes | IPv6 Prefixes |
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| Fully Geo-consistent | 67,080 (97.9%) | 54,327 (97.0%) |
| Org Geo-consistent | 718 (1.0%) | 817 (1.5%) |
| Org Geo-inconsistent | 282 (0.4%) | 222 (0.4%) |
| Registry Geo-inconsistent | 422 (0.6%) | 630 (1.1%) |
| Fully Geo-inconsistent | 44 (0.1%) | 27 (0.0%) |
| Anycast | 46 | 16 |

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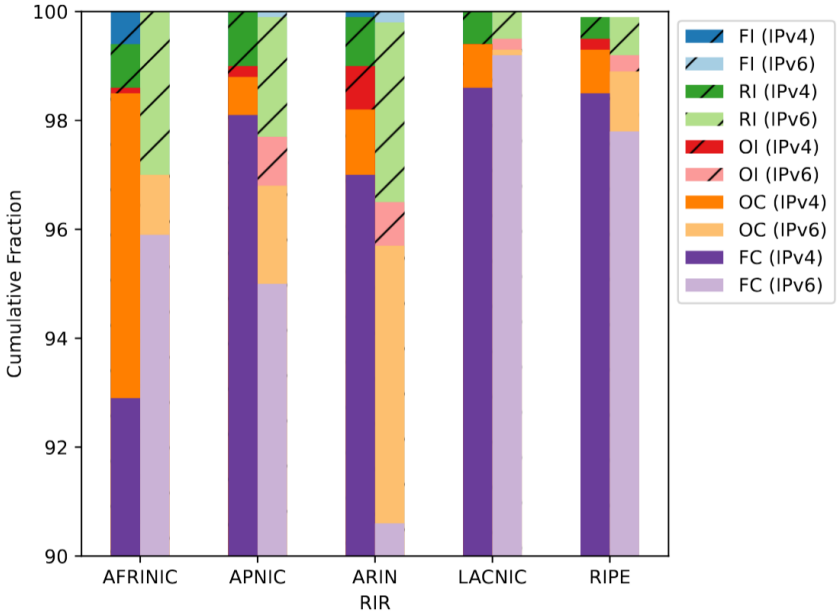


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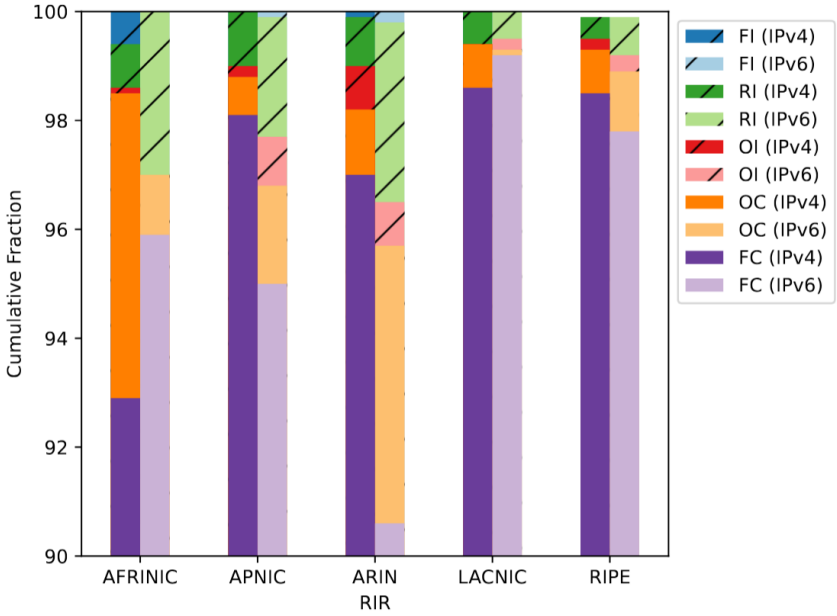
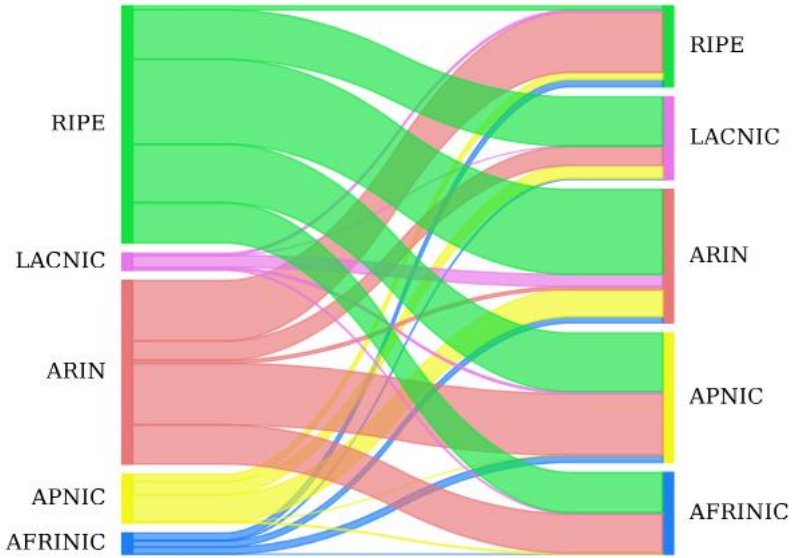



➜ **More than 98% are geo-consistent, some variation between RIRs**

IPinfo

# Where are inconsistent prefixes used?




IPv4

IPinfo

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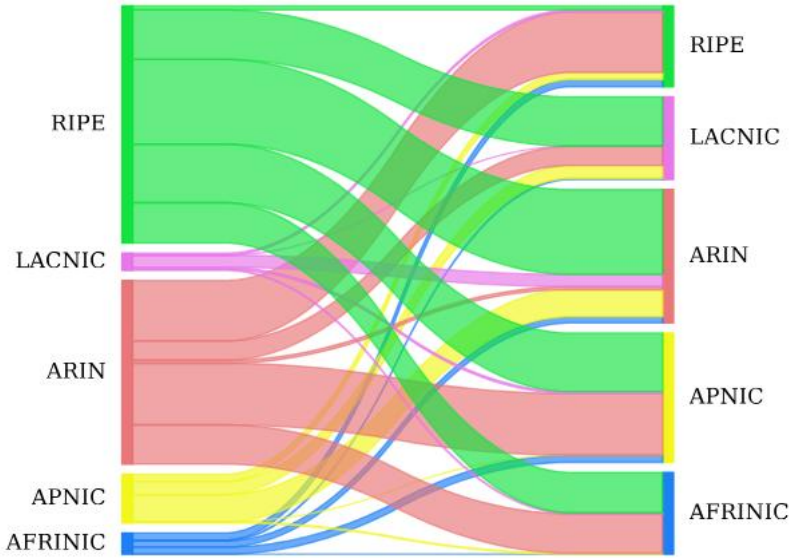
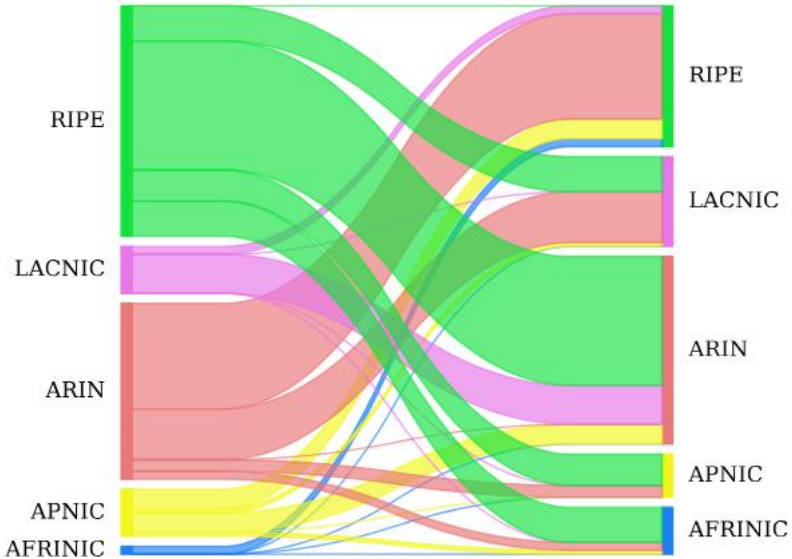


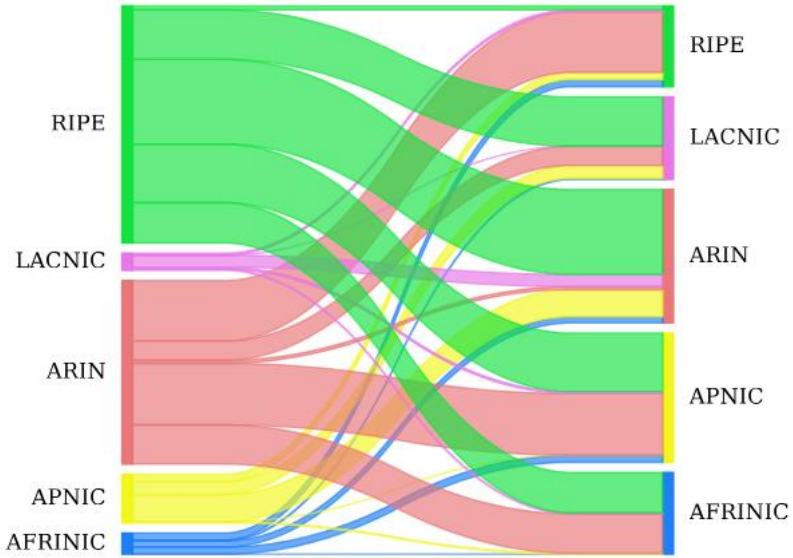

IPv4



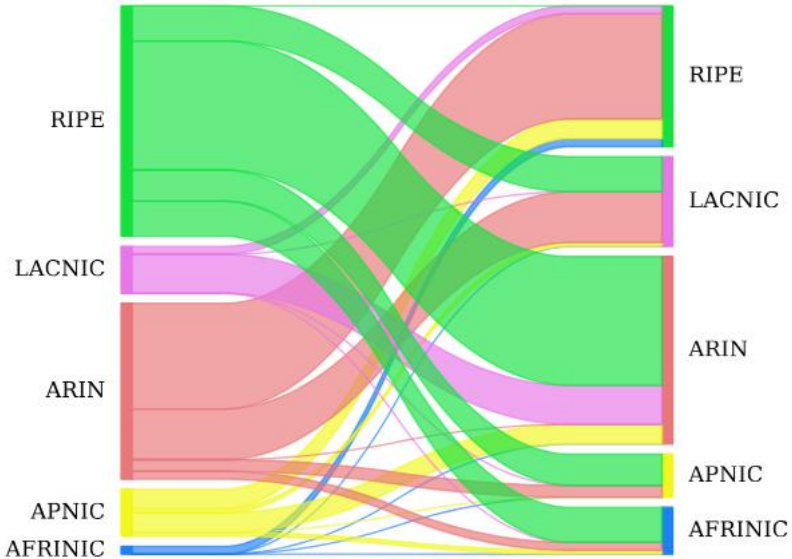

IPv6

IPinfo

# Where are inconsistent prefixes used?




IPv4




IPv6

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

IPinfo

# Effect on IP geolocation DBs

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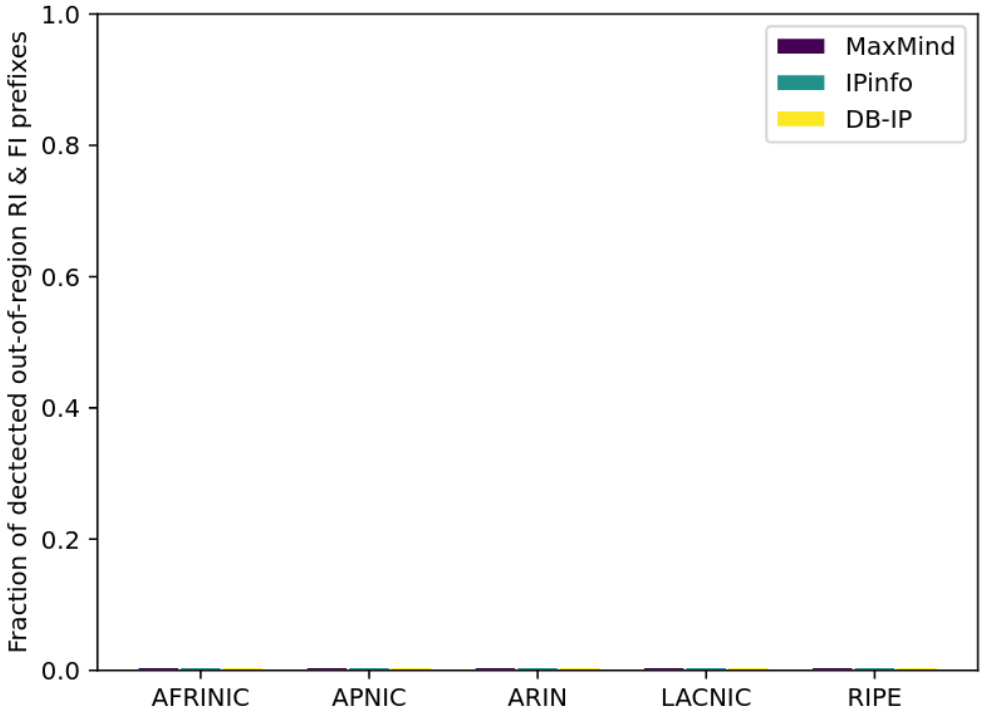


IPinfo

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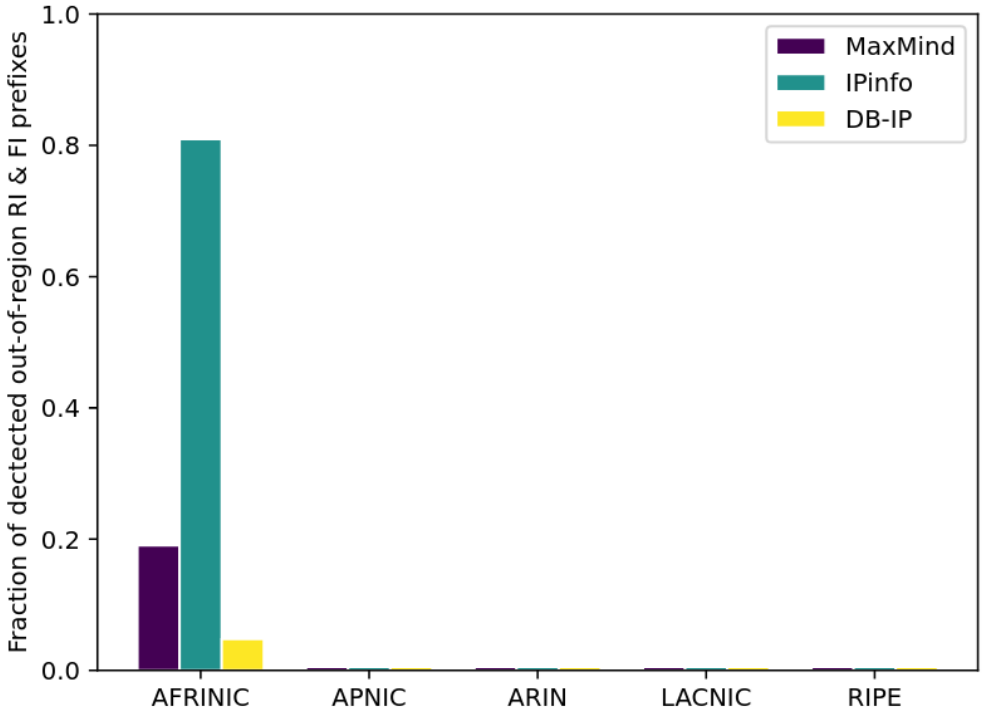


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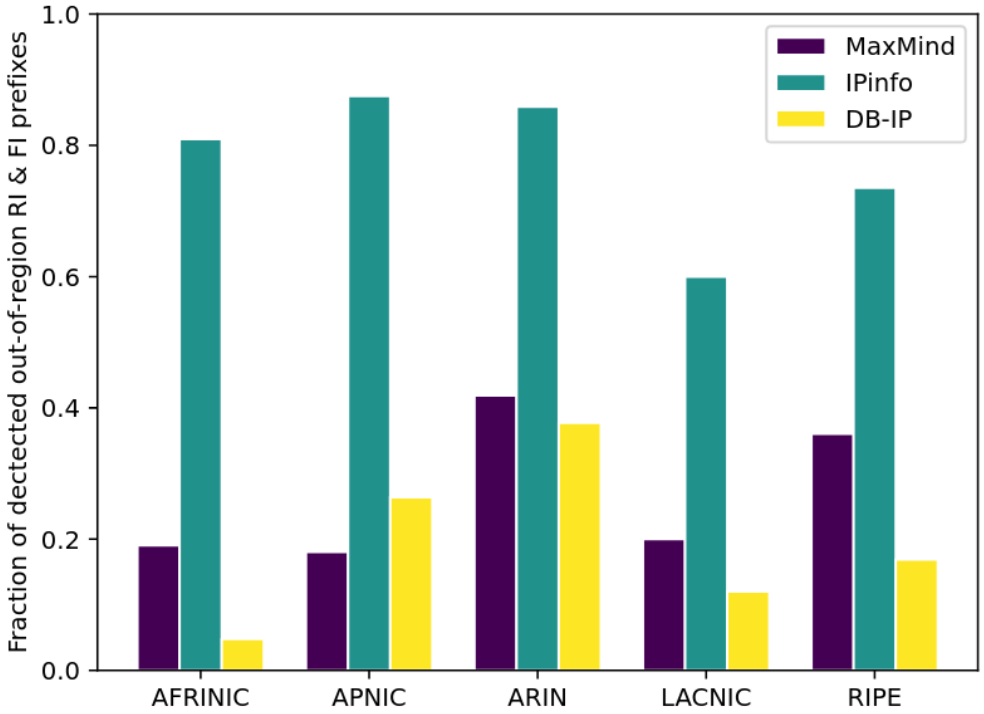


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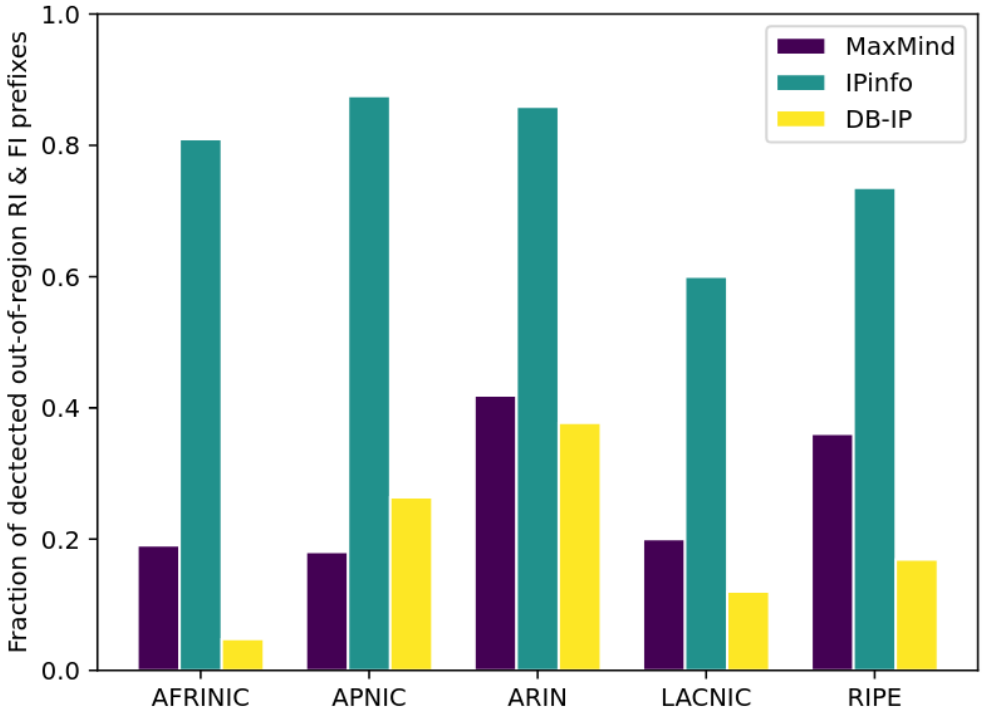


➜ **IPinfo detects many more OOR prefixes, MaxMind & DB-IP seem to rely on incorrect WHOIS information**

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# IPinfo’s probe network

- 1100+ globally distributed probes
- 440+ ASes
- 135+ countries
- 460+ cities
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**➜ IPinfo leverages probe network to validate geolocation information**

IPinfo

# Leveraging IPinfo’s probe network

- Approach
  - Use RTT measurements from IPinfo’s probe network
  - Target all pingable IP addresses
  - Same detection algorithm as with RIPE Atlas

IPinfo

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**➜ IPinfo's probe network detects 60x more inconsistent IPv4 prefixes compared to RIPE Atlas**

IPinfo

# Closing thoughts

## IPinfo probe network

Detects 60x more geo-inconsistent prefixes compared to RIPE Atlas

## Community coordination

Reached out and validated results with ARIN, RIPE, and AFRINIC

## Industry coordination

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oliver@ipinfo.io

IPinfo