RIPE NCC
RIPE NETWORK COORDINATION CENTER

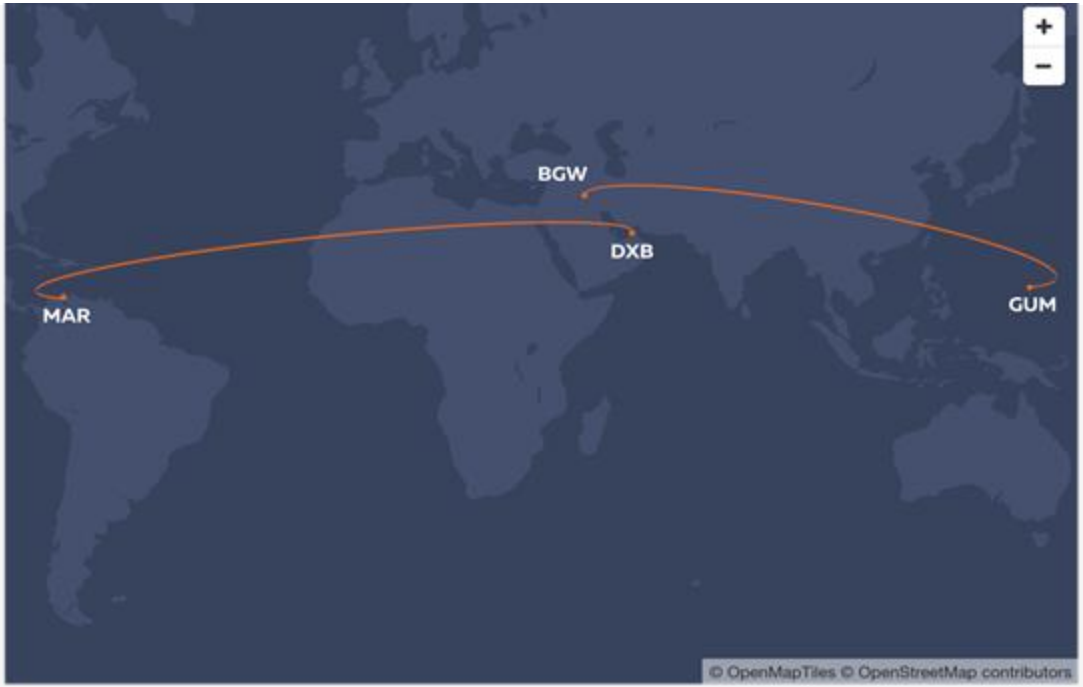
# A Look at a Root Cause for DNS Latency

What frustrates Internet users most? Slow DNS

**Lia Hestina** | **APRICOT 2025** | FEBRUARY 2025

# The Problem

# What Frustrates Internet Users Most?




**High DNS latency**
Due to routing, slowing down experiences

**Traffic is not local**
Slow response due to detour around the world

# How Is RIPE NCC's AuthDNS Reached from Asia Pacific?

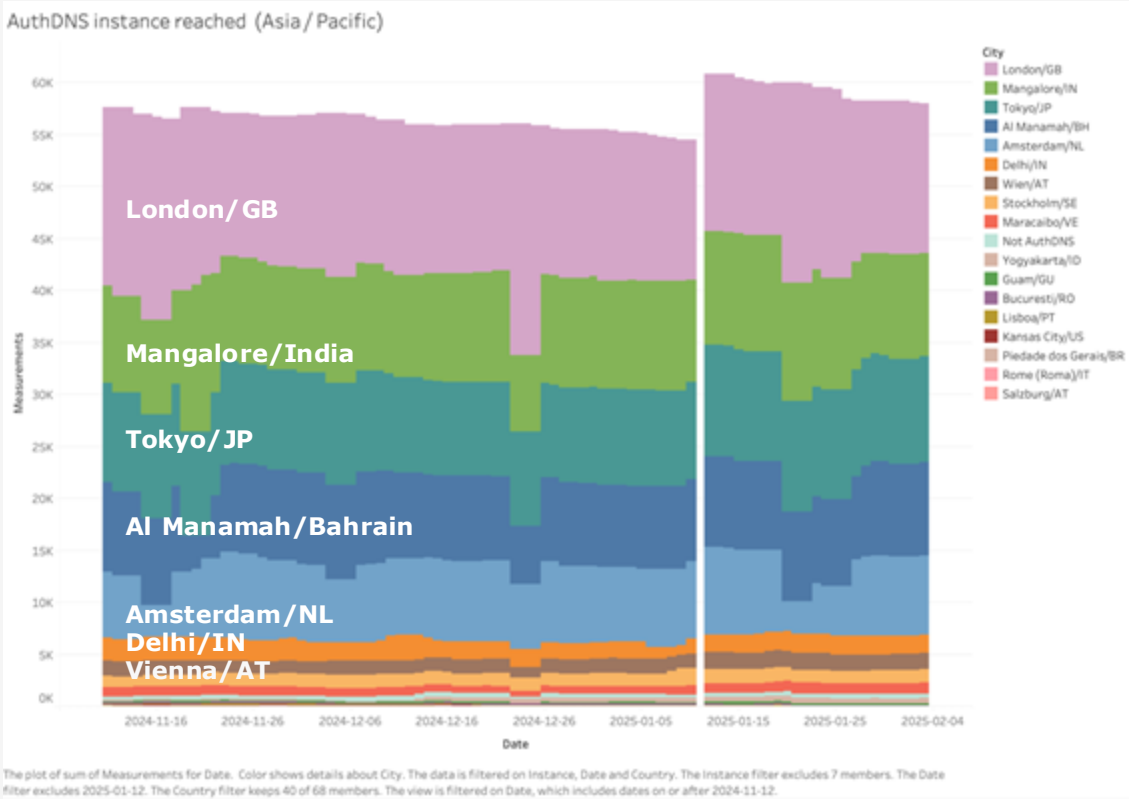
| | |
|---|---|
| 1. | Target: RIPE NCC AuthDNS service |
| 2. | From 1481 probes in Asia Pacific |
| 3. | DNS and NSID measurements |
| 4. | We got replies from 1263 probes |
| 5. | You can do this too! |

| msm-id | Region | Measurement period |
|---|---|---|
| 81884795 | PacificAndOceania | 2024-11-11 14:01:21 2025-01-10 00:00:00 |
| 81884639 | SouthEastAsia | 2024-11-11 13:59:19 2025-01-10 00:00:00 |
| 81884620 | SouthAsia | 2024-11-11 13:59:06 2025-01-10 00:00:00 |
| 81884592 | EastAsia | 2024-11-11 13:58:46 2025-01-10 00:00:00 |
| 86051460 | SouthEastAsia+Oceania | 2025-01-12 23:01:41 2025-03-04 00:00:00 |
| 86051450 | East-and-South-Asia | 2025-01-12 22:58:42 2025-03-04 00:00:00 |

https://atlas.ripe.net/measurements/

# Let's Take a Closer Look

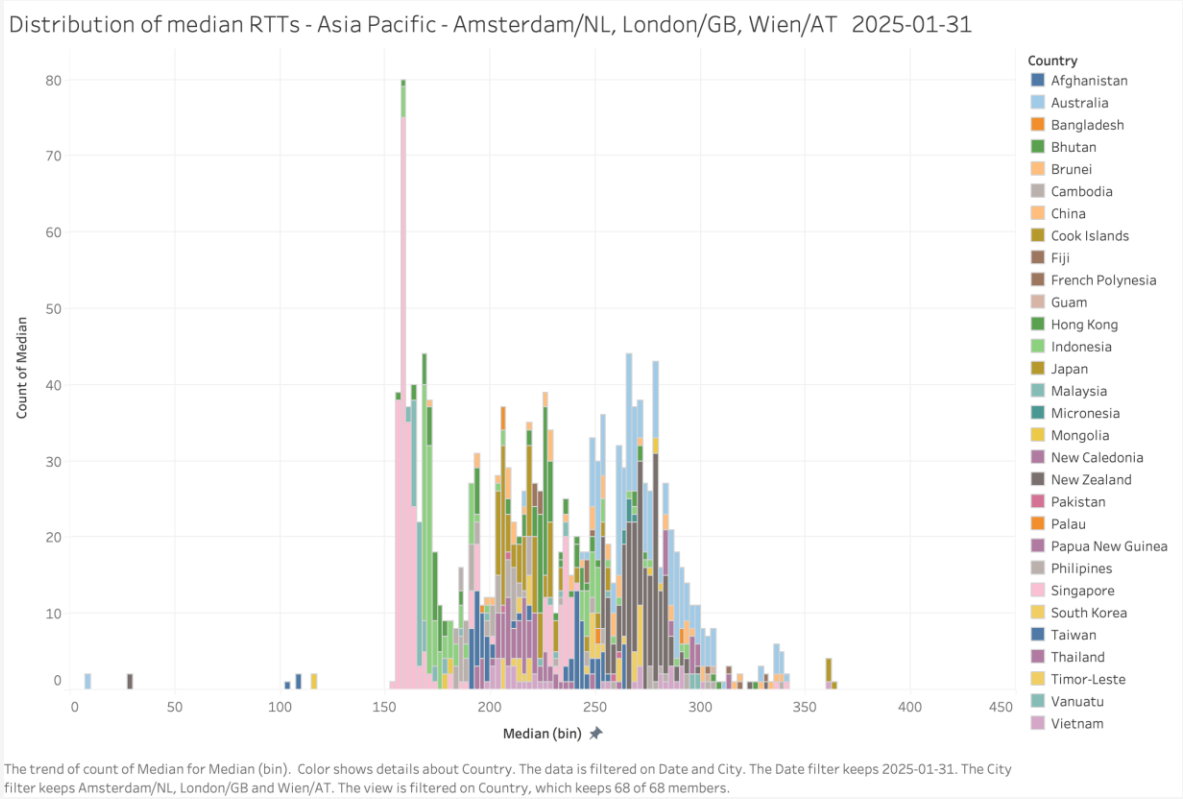
## Which node gives the most answers?




**Most queries got answers from outside the region like Europe and Middle East**

# Let's Analyse:

## RTT answer from AuthDNS nodes in Europe on 31/01/25

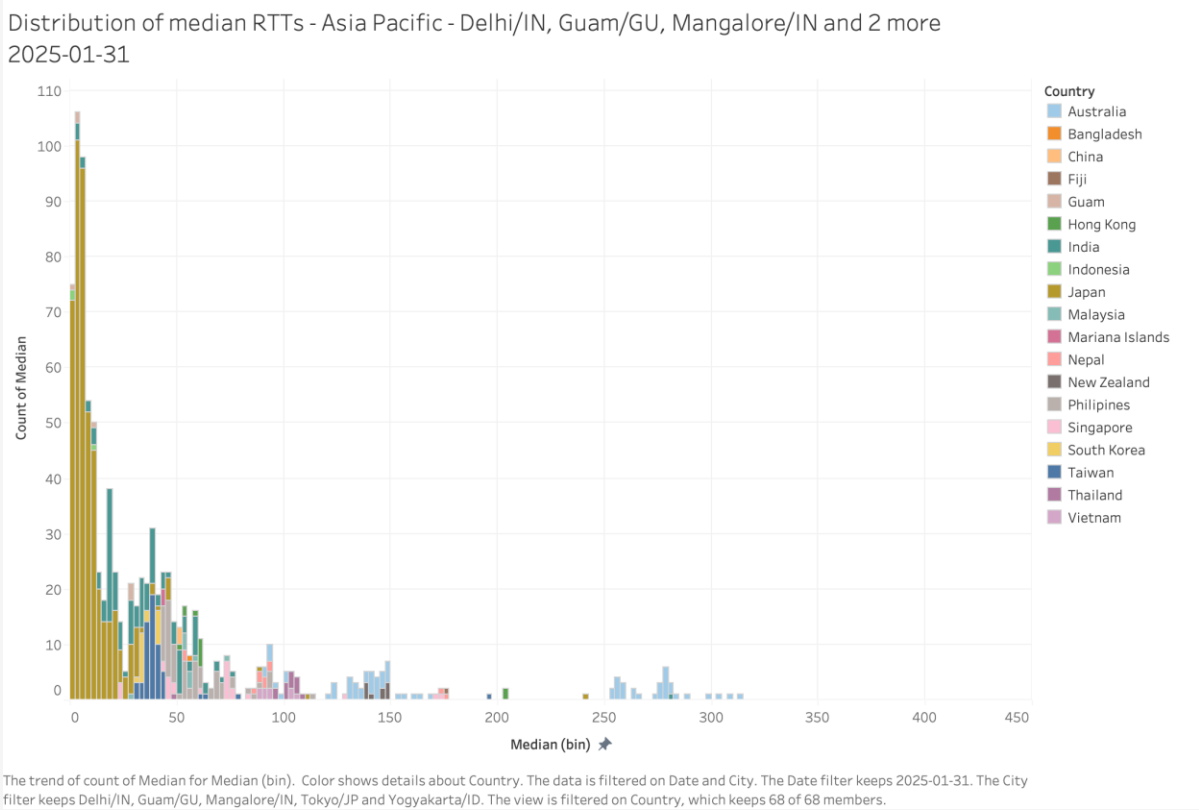



## Asia Pacific to Europe

- RTTs to Europe generally are in the 150ms-300ms range
- The three Afghan probes are closer to 100ms
- Two probes which we thought be in AU / NZ have RTTs to London/Amsterdam that are far too low for the distance; those likely have wrong (user supplied) coordinates

# Let's Analyse:

## RTT answer from AuthDNS nodes in Asia Pacific on 31/01/25

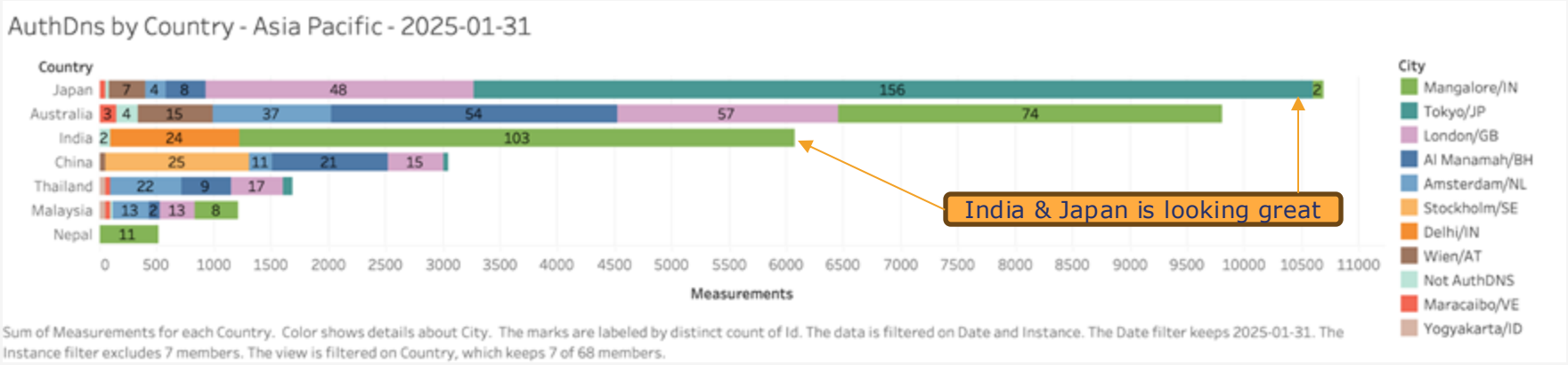



## Within Asia Pacific

- RTTs from Asia probes to Asian AuthDNS are mostly below 80ms, but for some countries they are higher; **Thailand, Vietnam, Nepal** and especially **Australia / New Zealand**

# Let's Analyse:

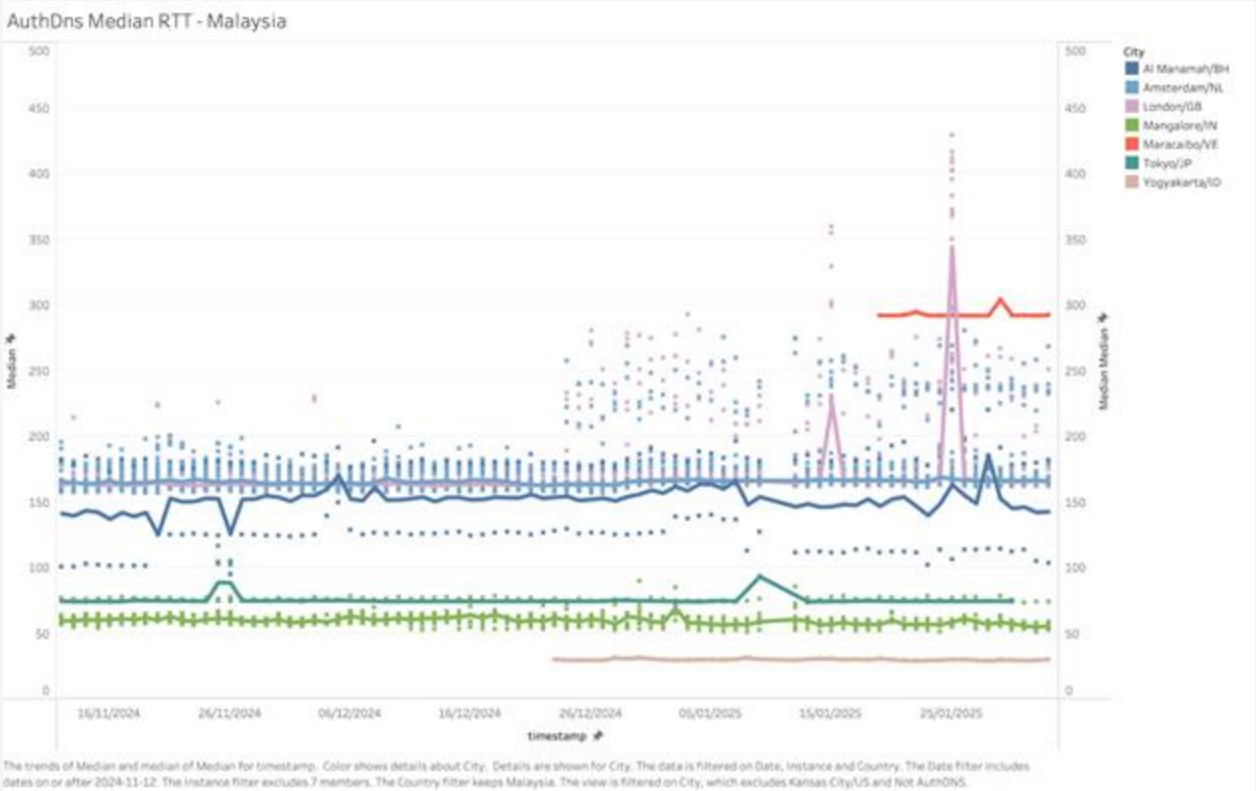
Which node answered DNS queries from certain economies?




## World tour

- We have 2 nodes in Japan, some of the probes still prefer to go to London and Amsterdam and 1 to Venezuela
- Australia: No AuthDNS node - some got answer from Bahrain, GB, India, or Venezuela
- Thailand and Malaysia: No AuthDNS node - some got answer from Bahrain, GB, India and Venezuela
- China: Most probes prefers to go to Europe or Bahrain
- India: 2 local nodes in Delhi and Mangalore - 95% of the probes go answer locally
- Nepal: All the probes got answer from India

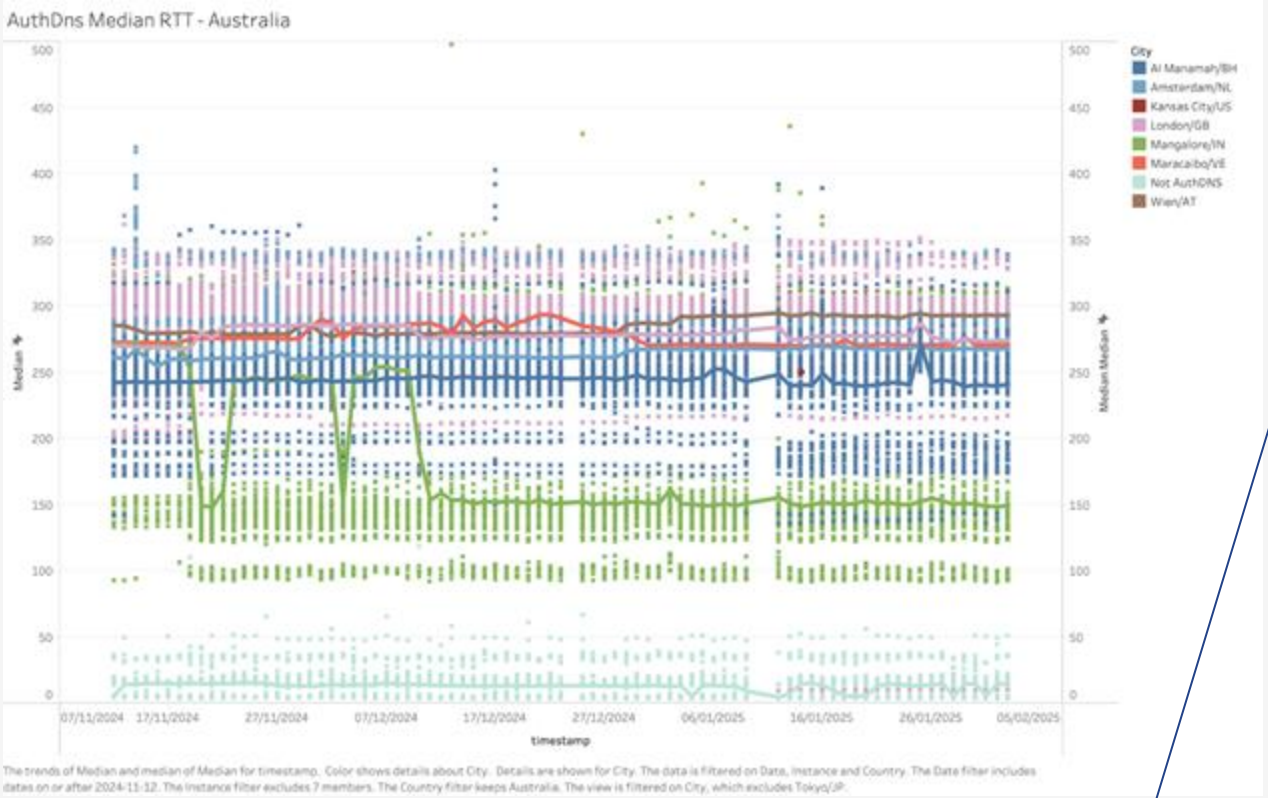
# Let’s Zoom in Malaysia:




## Minimum RTT

- **Best performance**: Answer from closest nodes in Yogyakarta at **CitraWeb** 25ms (1), followed by Tokyo, Japan(1), and Mangalore, India(8), **under 80ms**
- **Highest latency** coming from Amsterdam(13) and London(13) nodes 150-250ms
- **Recommendation**: Place a node in a strategic location in Malaysia.

# Let’s Zoom in Australia:



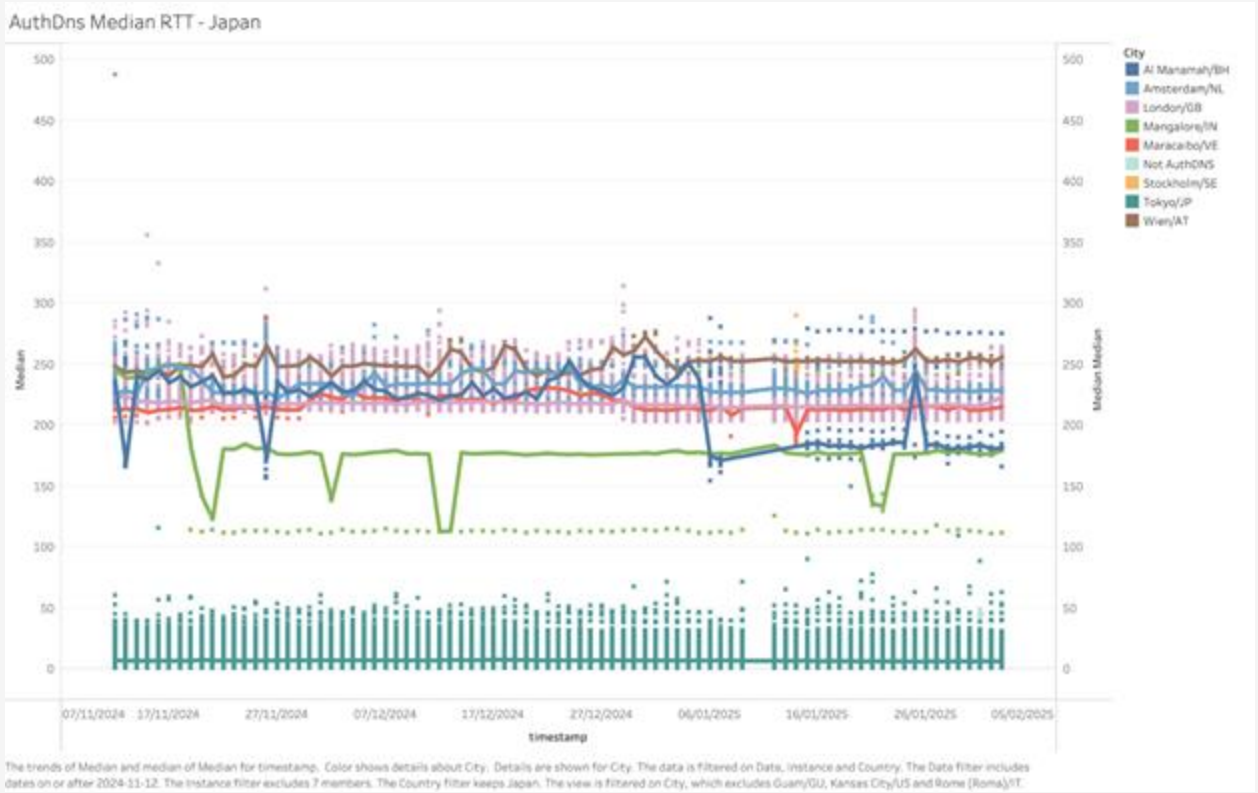

## Minimum RTT

- Most probes in Australia get answers from nodes in Europe
- **Best performance**: Answer from **not AuthDNS** (4) and node in **India** (74)
- **Highest latency** coming from Amsterdam and London (109) nodes 250-350ms
- **Recommendation**: Place a node in a strategic location in Australia



dnsadl04.island.aussiebb.io: 1 | 85m61: 1 | dnssyd05.island.aussiebb.io: 1 | 84m44: 1

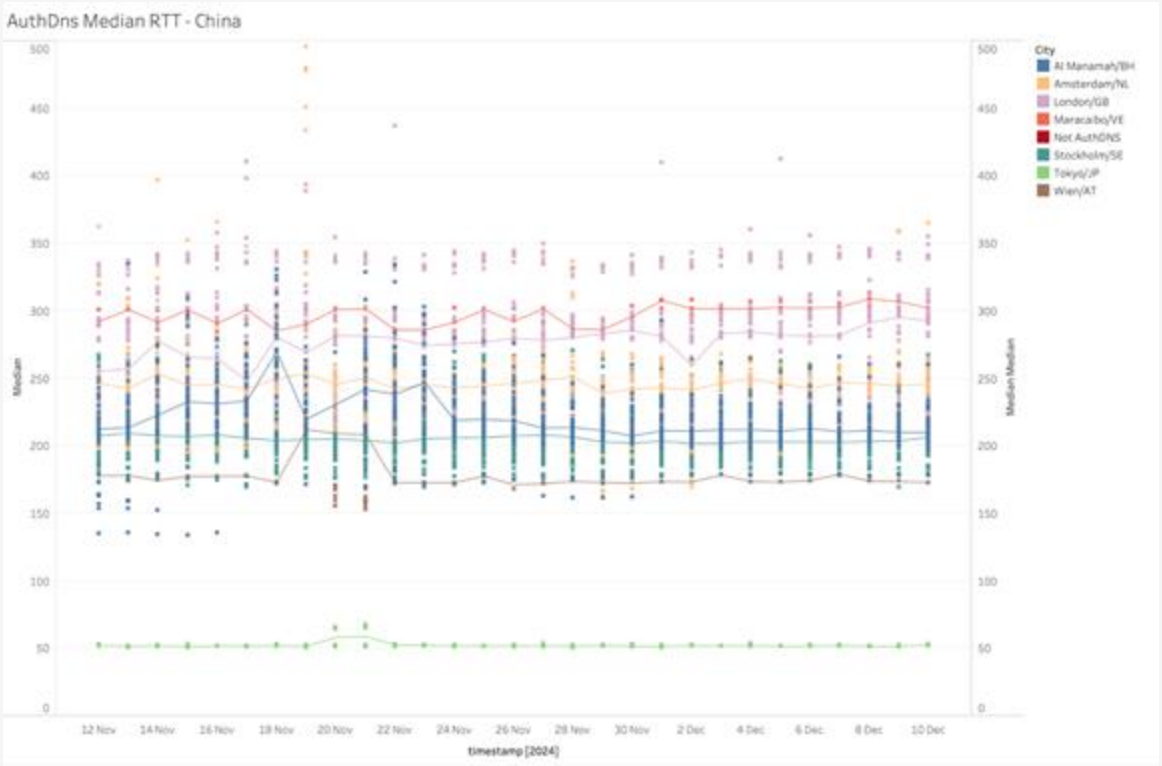
# Let’s Zoom in Japan:




## Minimum RTT

- Most probes (156) get answers from local nodes in Japan
- **Best performance**: Answer from **2 nodes in JPIX & JPNAP** under 50ms
- **Highest latency**: 48 probes get answer from London node 200-250ms and around 20 probes get answer from various nodes
- **Recommendation**: Place a node in a strategic location in Japan or improve peering policy

# Let’s Zoom in China:




## Minimum RTT

- Tokyo nodes have the lowest RTT 50ms (1)
- **Highest Latency**: In the range 150-350ms probes get answers from several Authdns nodes mostly in Europe(52) and some from Bahrain(21)
- **Recommendation**: Place a node in a strategic location in China.

# The Solution

# Keeping Traffic Local with AuthDNS

## Anycast

Local DNS server reduces latency. More deployment increases resilience.

## Contribution

Anycasted servers can be hosted in more networks.

## Security

- Local AuthDNS is a machine that announces the AuthDNS prefixes.
- It helps reduce path lengths for your network and peers.

# What is AuthDNS?

**AuthDNS is an authoritative DNS server responsible for serving various DNS zones**

- Zones served:
  - ripe.net,
  - in-addr.arpa,
  - ip6.arpa
  - RIR Zones: RIPE NCC + other RIR **reverse DNS** zones (*crucial service*)
  - ccTLDs for smaller TLDs: SY, JO, PS, etc (and others)
- Low Effort, High Impact: You provide the server, RIPE NCC handles the rest.
- **Risk**: AuthDNS is similar to *any* BGP peer you add
- Most benefit from adding an AuthDNS server in: **AU, SG, NZ, ID, CN, PH, HK, TW, TH, KR, MY, VN, NP**
- **For who**? Big ISPs or parties offering an IXP port

# RIS for Routing Issues/Anomaly Detection

## RIS

Allow Researchers to spot attacks using shared data across networks

## Transparency

Publicly available data supports mutual improvement

## Security

RIS receives the same data **any** BGP peer receives. You are already widely sharing this!

# RIS: Routing Information Service

## Hey RIS, is my Prefix announced in Malaysia on November 10?

- RIS allows Researchers to detect possible attacks. Find out using
  - RIPEstat: RIPEstat uses RIS routing data for network insights & diagnostic
  - RIS Live: Live BGP announcements
  - *Open source* that relies on our services: BGPalerter, …
- Action: Peer* with RIS and work together for better visibility and a more secure routing
- Which economies are far from our infrastructure:
  - **KI, NR, AF, NU, FM, TO, NF, VU, SB, PW, FJ, PG, BV, NZ, TK, NC,**
  - **TH, MM, TL**
  - **BD, PK, NP**
  - **TW, KR, IN, CN, MN**
- Which Networks:

https://observablehq.com/@emileaben/what-peers-would-decrease-as-distance-to-ris-most

# Hand-On Solution - Be Proactive with RIPE Atlas

## Global network of sensors monitoring Internet paths in real time

### Measurements

Run six types of measurements to **any** target, with **views** from **outside** your network

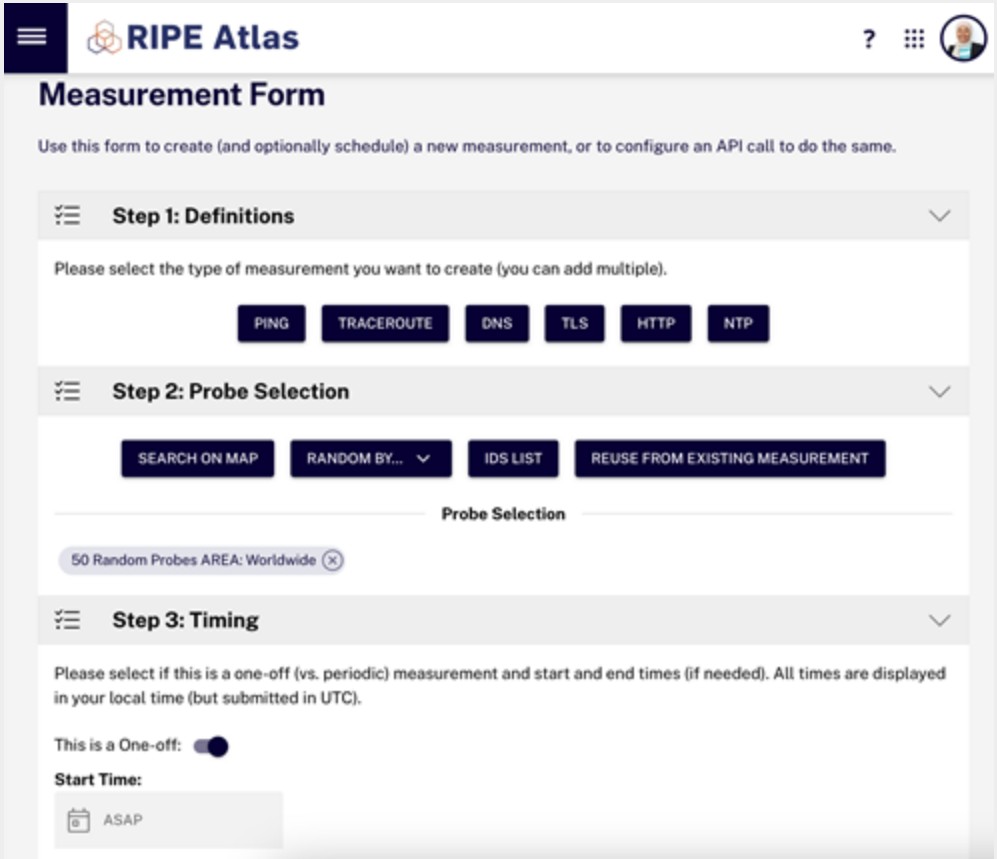
### Coverage

Over 12K global probes, credit system and **trusted source**

### Access

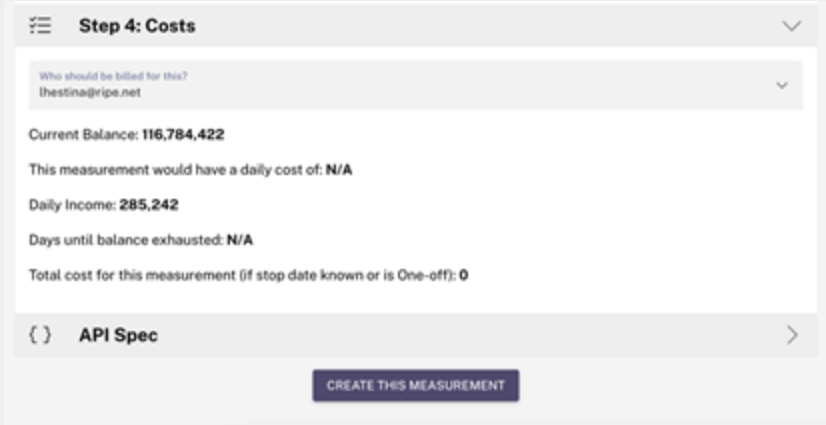
Accessible via WEB GUI, API, CLI tools. Can be the basis for your own tools

# Try It Yourself: Create a Measurement

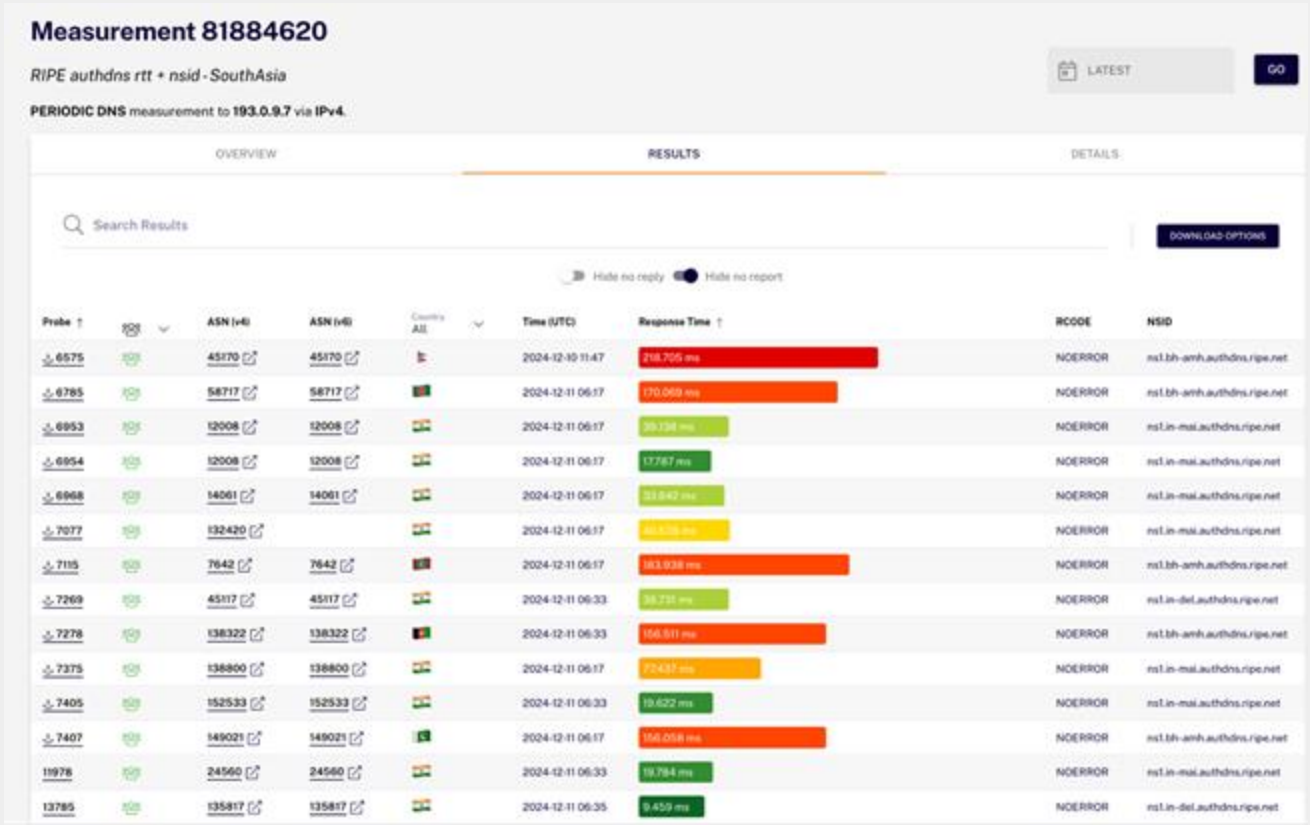



https://atlas.ripe.net/measurements/form/

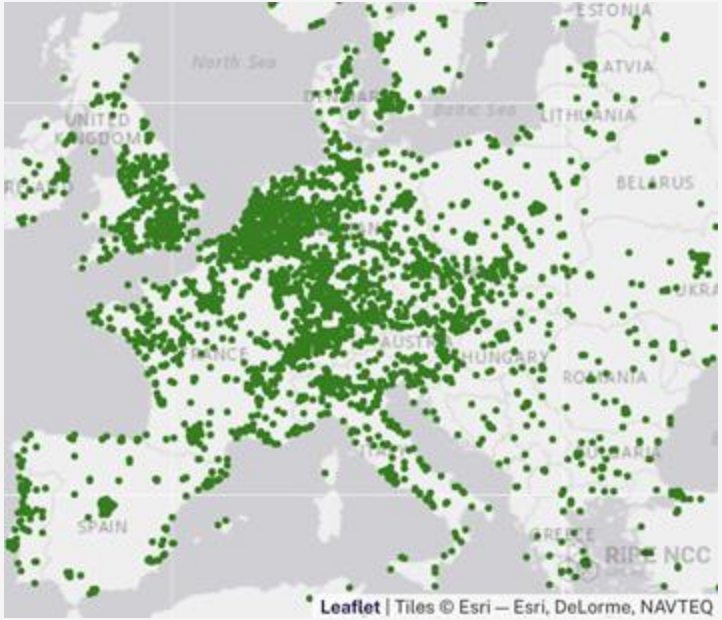
1. Create a RIPE NCC SSO account
2. Redeem 200K credits **APRICOT2025**
3. Get started:



# Analysing Results



# RIPE Atlas Coverage Density



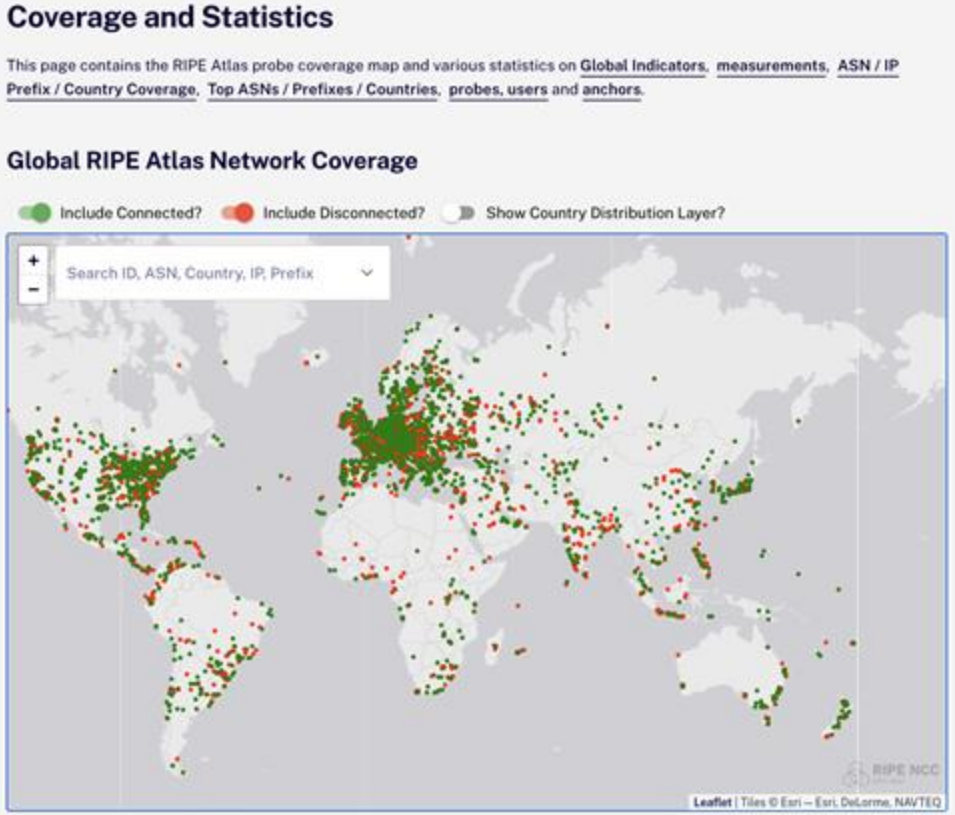

Europe


Asia Pacific

# RIPE Atlas in the Asia Pacific region

## How you can help

- **Extremely low coverage** in many economies, we need:
  - More topological diversity
  - Especially:
    - More diversity in network & type of location:
      - end user vs. core
      - More in eyeball networks
      - Paths via IXPs



# **Supporting RIPE NCC Research** Reports on Internet events

RIPE NCC research into outages, hijacks, and events that damage the Internet

Recent analysis of **Baltic Sea cable cuts at end of 2024** drawing on data from RIPE Atlas anchors

Read the full analysis on **RIPE Labs**

# RIPE Atlas Anchors Use Case: Submarine Cable Cuts

## Does the Internet route around damage?

- On 16 November a submarine cable got cut, on 17 November another one
- Did the Internet route around this damage?
- We used RIPE Atlas Anchors to investigate:
  - https://labs.ripe.net/author/emileaben/does-the-internet-route-around-damage-baltic-sea-cable-cuts/
- Findings:
  - No increased packet loss
  - 20-30% of paths had increased latency (0-20ms)

# RIPE Atlas Anchor Deployment

## Help us deploy RIPE Atlas Anchors!

The Baltic Sea Cable cuts analysis was possible because a sufficient number of RIPE Atlas Anchors was deployed in the region (on both sides of the cables).

We consider 5 RIPE Atlas Anchors with enough diversity to be the minimum on each side.

Check out this page to see if your country needs more anchors for this type of measurement:

https://sg-pub.ripe.net/emile/tmp/cc2anchor.csv

| East Asia | Southeast Asia | South Asia |
|---|---|---|
| Mongolia | Brunei | Bhutan |
| China | Cambodia | Sri Lanka |
| South Korea | Laos | Nepal |
| Taiwan | Myanmar | Pakistan |
| | Timor Leste | Afghanistan |
| | Malaysia | Bangladesh |
| | Philippines | Maldives |
| | Thailand | |
| | Vietnam | |

# Summary

- **Problem**: Slow DNS response times frustrate internet users
- **Cause**: High latency due to inefficient routing, with traffic often travel not locally
- **Solution**:
  - Keep DNS traffic local by hosting more AuthDNS (anycasted DNS servers)
  - Host more RIPE Atlas in diverse location to provide real time view on the field
  - Use RIS data (and peer with RIS*) to mutually help detects BGP hijacks or misconfiguration across networks
- **Benefit**: Local DNS reduces latency, improve user experience, and enhances security by reducing paths lengths and hijack risks
- **Tools**: Use RIPE Atlas for measuring DNS latency and assessing route inefficiencies.
- **Deployment**: Target economies to improve local DNS infrastructure include: AU, SG, NZ, CN, ID, PH, TW, HK, TH and more .
- **Call to action** per country recommendation

# Sources

- RIPE Atlas Measurement Result: https://atlas.ripe.net/measurements/81446294/
- RIS – How far is Internet from our infrastructure: https://observablehq.com/@emileaben/what-peers-would-decrease-as-distance-to-ris-most
- Baltic Cable Cut: https://labs.ripe.net/author/emileaben/does-the-internet-route-around-damage-baltic-sea-cable-cuts/
- AuthDNS analysis: https://labs.ripe.net/author/anandb/reaching-authdns-a-ripe-atlas-analysis-by-region/

# Recommendations: Malaysia

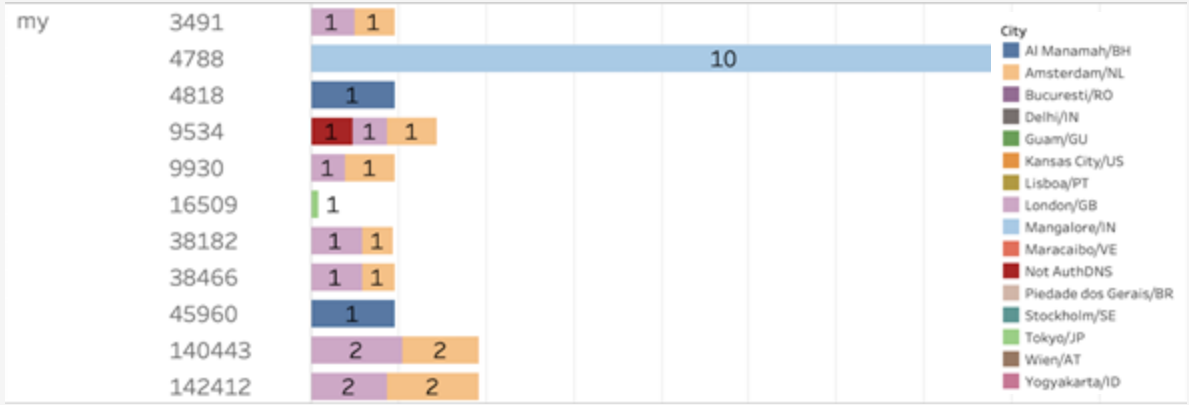
## RIPE Atlas

- We want to distribute probes to:
  - 10030 CELCOMNET-AP
  - 38466 UMOBILE-AS-AP
  - 45960 YTLCOMMS-AS-AP
  - 38322 TTSSB-MY
  - 56231 ASTRO-MY-AS-AP
  - 45410 ALLOTECH-AS-MY

- Where?
  - End user network
  - Core network
  - (close to) IXPs

## Network Operator

- Evaluate the paths from your network to key infrastructure




## AuthDNS

- Host AuthDNS in:
  - IXP
  - AS4788
  - AS9534

# Recommendations: China

## RIPE Atlas

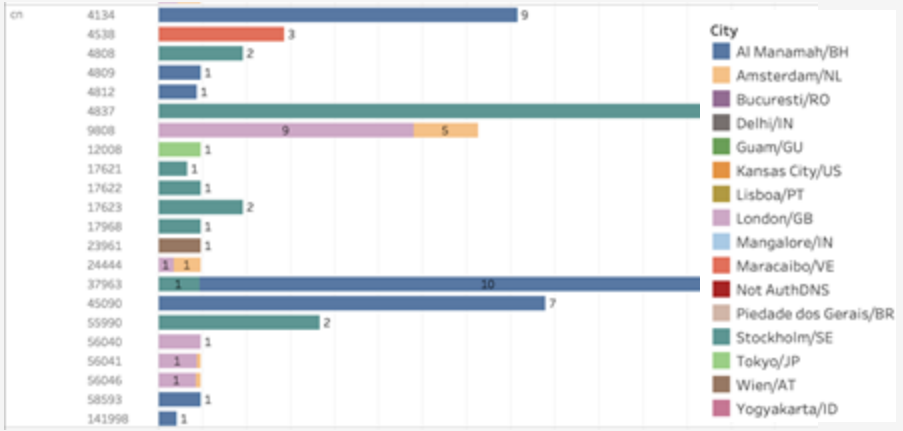
- We want to distribute probes to:
  - 24400 CMNET-V4Shanghai
  - 56048 CMNET - BEIJING
  - 24445 CMNET-V4Henan
- Where?
  - End user network
  - Core network
  - (close to) IXPs

## RIS & AuthDNS

- Networks that will improve hops to RIS infrastructure:
  - IXP route servers
  - 9808
  - 4837
  - 4134
  - 58453
  - 4538
  - 56047
- Host AuthDNS in:
  - China IX?
  - AS4134
  - AS4837
  - AS9808

## Network Operator

Evaluate the paths from your network to key infrastructure



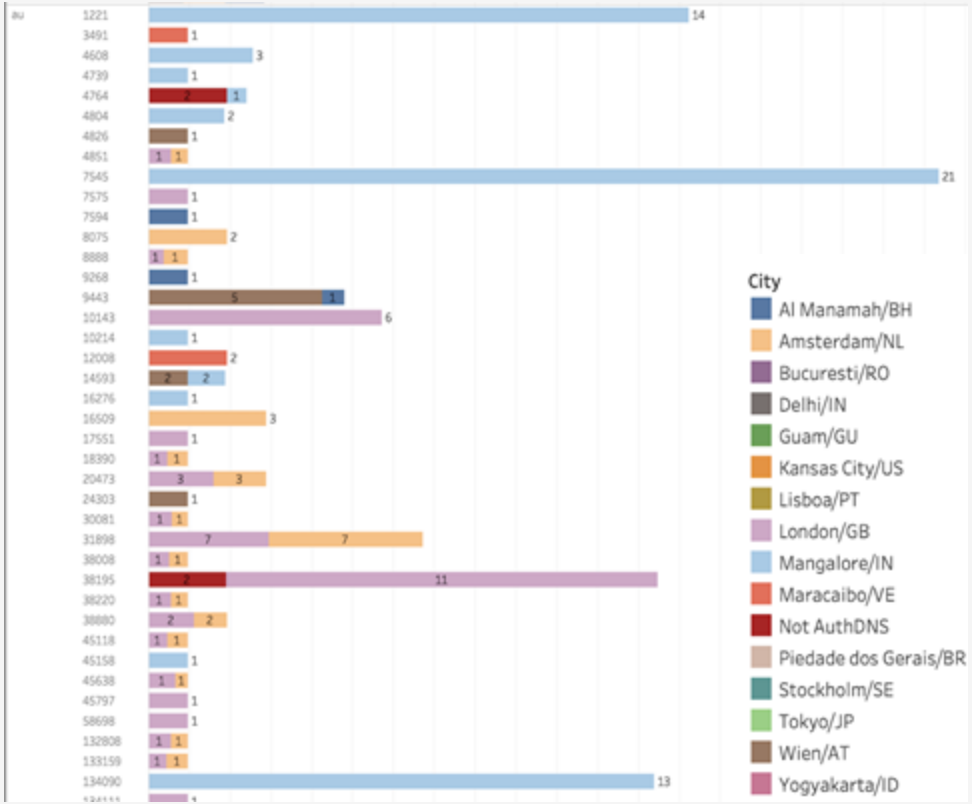
# Recommendations: Australia

## RIS & AuthDNS

- Host AuthDNS in:
  - IXP
  - AS1221

## Network Operator

Evaluate the paths from your network to key infrastructure



# Recommendations: Indonesia

## RIPE Atlas

- We want to distribute probes to:
  - 23693 TELKOMSEL-ASN-ID
  - 24203 NAPXLNET-AS-ID
  - 45727 THREE-AS-ID
  - 18004 WIRELESSNET-ID
  - 9341 ICONPLN-ID-AP
  - 63859 MYREPUBLIC-AS-ID
- Where?
  - End user network
  - Core network
  - (close to) IXPs

## RIS & AuthDNS

- Host one more AuthDNS in:
  - AS7713
  - AS23693
  - IIX or IXP

## Network Operator

- Evaluate the paths from your network to key infrastructure

# Questions & Comments

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RIPE NCC
RIPE NETWORK COORDINATION CENTER

# THANK YOU!

# AS path from AuthDNS side

**AS-path from Guam IX AuthDNS node to Atlas Anchor #7009**

```
ns1.gu-gum.authdns.ripe.net# show ip bgp 45.94.14.204
BGP routing table entry for 45.94.14.0/24, version 63919178
Paths: (1 available, best #1, table default)
  Not advertised to any peer
  152735 7131 701 3257 8895 8895 208520, (aggregated by 208520 45.94.12.1)
    103.142.153.1 from 103.142.153.1 (103.142.152.254)
      Origin IGP, valid, external, atomic-aggregate, best (First path received)
      Community: 65000:7131
      Last update: Wed Nov 20 13:47:46 2024
```