



RIPE NCC
RIPE NETWORK COORDINATION CENTER

A Look at a Root Cause for DNS Latency

What frustrates Internet users most? Slow DNS



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!**

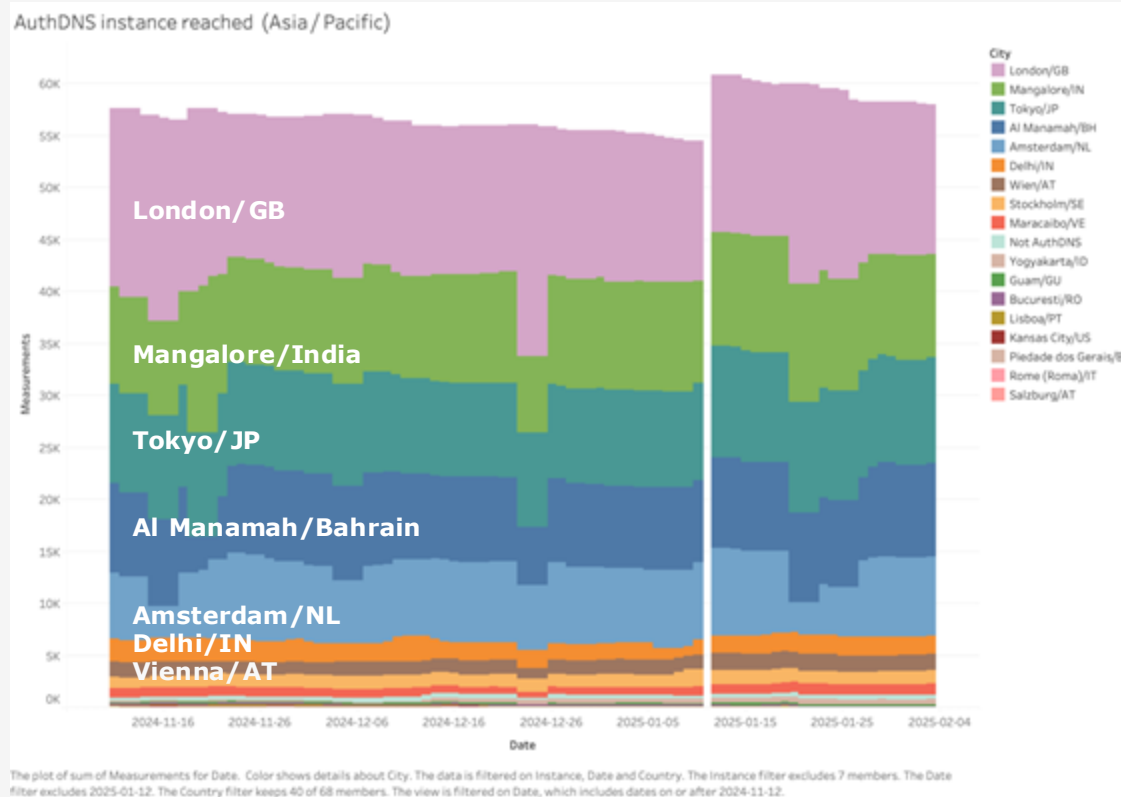
msm-id	Region	Measurement period
81884795	PacificAndOceania	2024-11-11 14:01:21 2025-01-10 00:00:00
81884639	SouthEastAsia	2024-11-11 13:59:19 2025-01-10 00:00:00
81884620	SouthAsia	2024-11-11 13:59:06 2025-01-10 00:00:00
81884592	EastAsia	2024-11-11 13:58:46 2025-01-10 00:00:00
86051460	SouthEastAsia+Oceania	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?



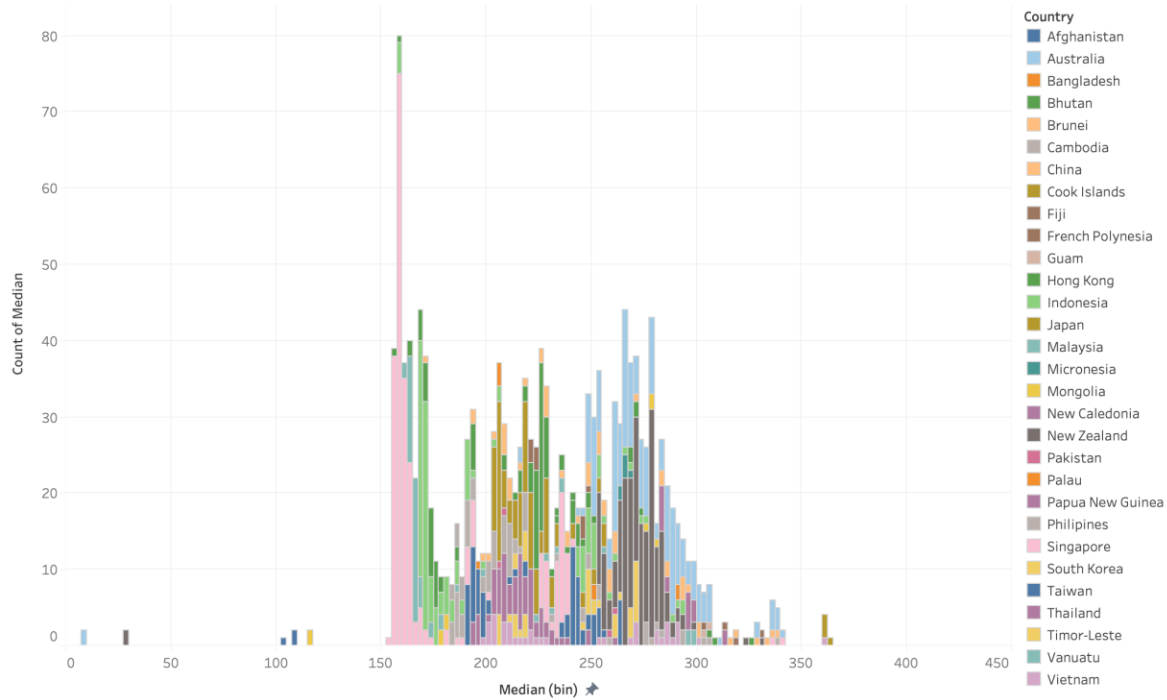
Most queries got answers from outside the region like **Europe** and **Middle East**

Let's Analyse:

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



Distribution of median RTTs - Asia Pacific - Amsterdam/NL, London/GB, Wien/AT 2025-01-31



The trend of count of Median for Median (bin). Color shows details about Country. The data is filtered on Date and City. The Date filter keeps 2025-01-31. The City filter keeps Amsterdam/NL, London/GB and Wien/AT. The view is filtered on Country, which keeps 68 of 68 members.

Asia Pacific to Europe

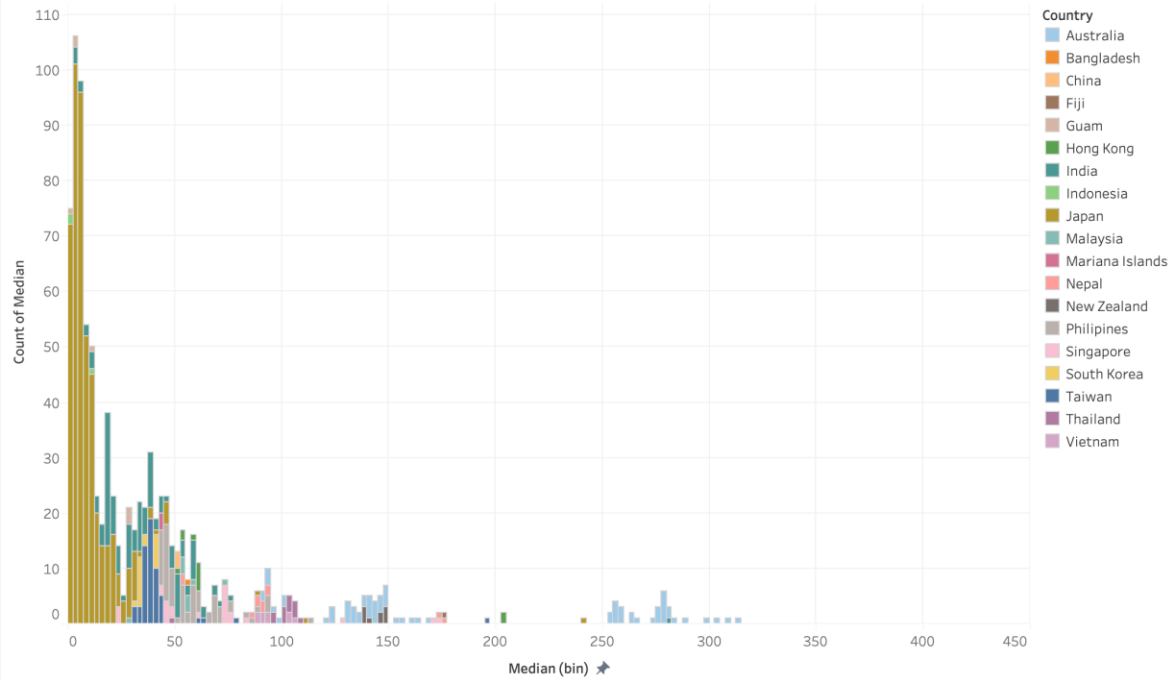
- RTTs to Europe generally are in the 150ms-300ms range
- The three Afghan probes are closer to 100ms
- Two probes which we thought be in AU / NZ have RTTs to London/Amsterdam that are far too low for the distance; those likely have wrong (user supplied) coordinates



Let's Analyse:

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

Distribution of median RTTs - Asia Pacific - Delhi/IN, Guam/GU, Mangalore/IN and 2 more
2025-01-31



The trend of count of Median for Median (bin). Color shows details about Country. The data is filtered on Date and City. The Date filter keeps 2025-01-31. The City filter keeps Delhi/IN, Guam/GU, Mangalore/IN, Tokyo/JP and Yogyakarta/ID. The view is filtered on Country, which keeps 68 of 68 members.

Within Asia Pacific

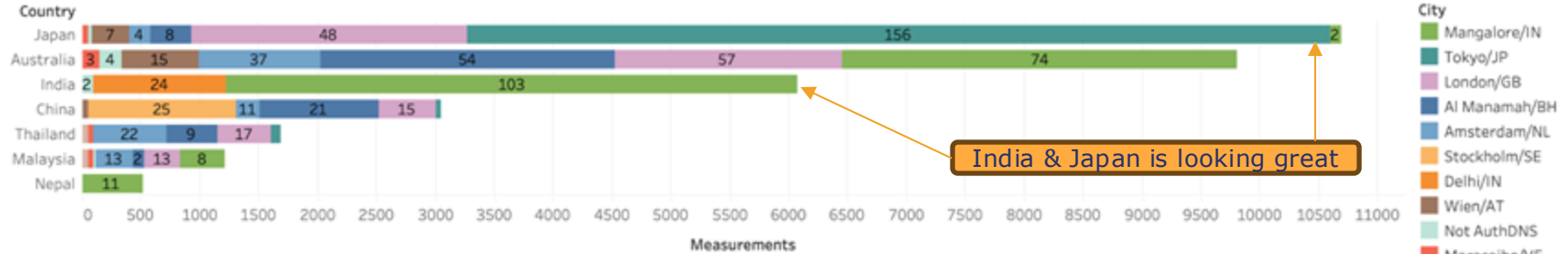
- RTTs from Asia probes to Asian AuthDNS are mostly below 80ms, but for some countries they are higher; **Thailand, Vietnam, Nepal** and especially **Australia / New Zealand**



Let's Analyse:

Which node answered DNS queries from certain economies?

AuthDns by Country - Asia Pacific - 2025-01-31

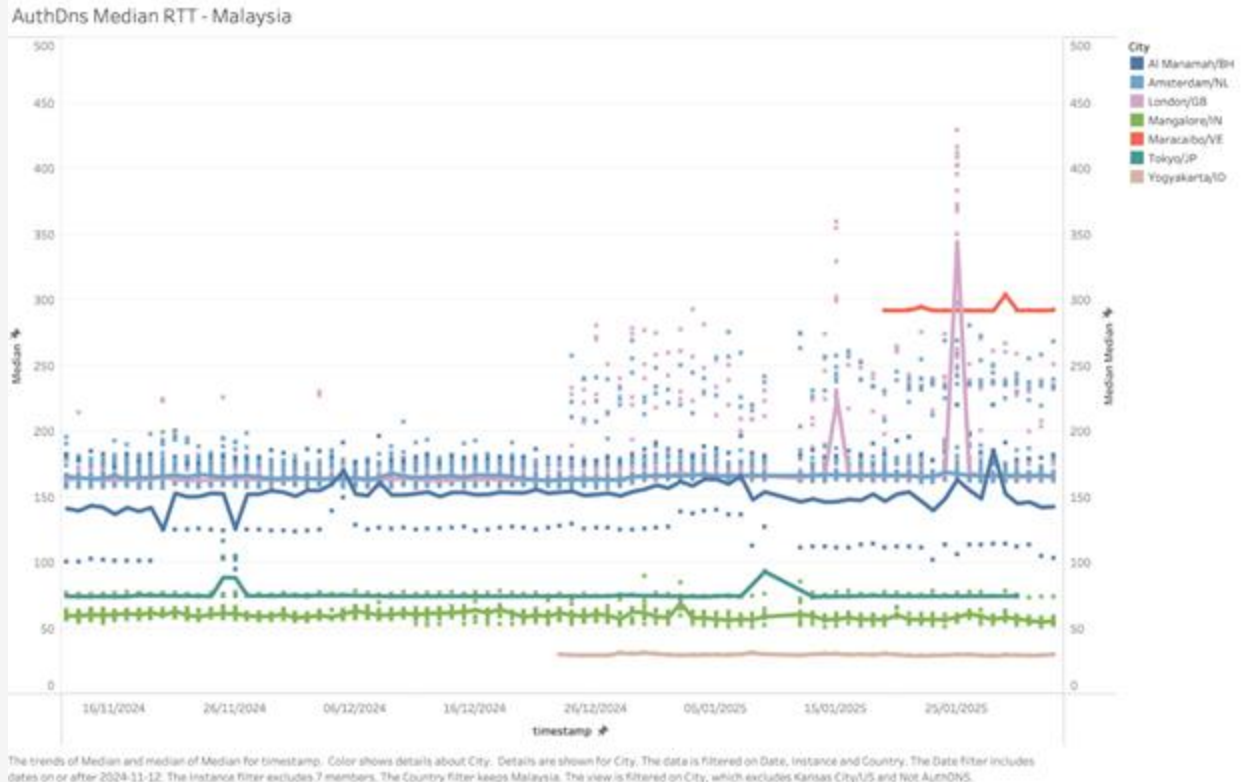


Sum of Measurements for each Country. Color shows details about City. The marks are labeled by distinct count of Id. The data is filtered on Date and Instance. The Date filter keeps 2025-01-31. The Instance filter excludes 7 members. The view is filtered on Country, which keeps 7 of 68 members.

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:



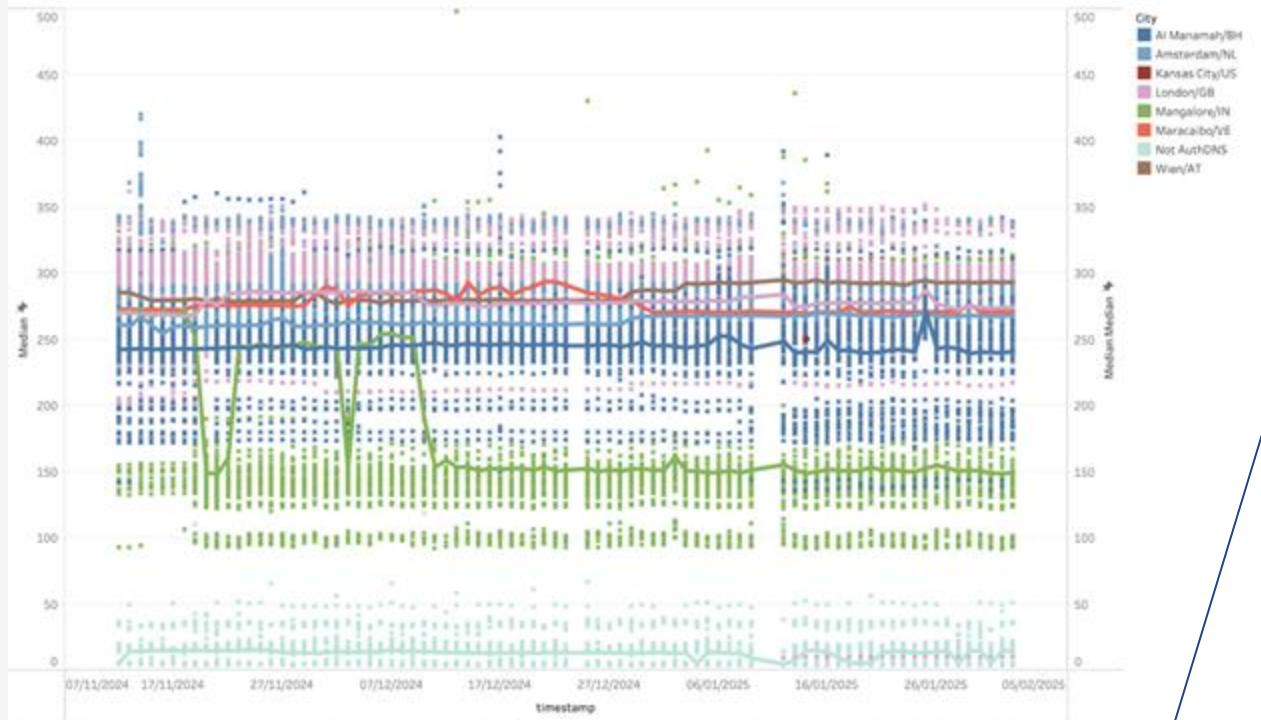
Minimum RTT

- **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:



AuthDns Median RTT - Australia



The trends of Median and median of Median for timestamp. Color shows details about City. Details are shown for City. The data is filtered on Data, Instance and Country. The Date filter includes dates on or after 2024-11-12. The Instance filter excludes 7 members. The Country filter keeps Australia. The view is filtered on City, which excludes Tokyo/JP.

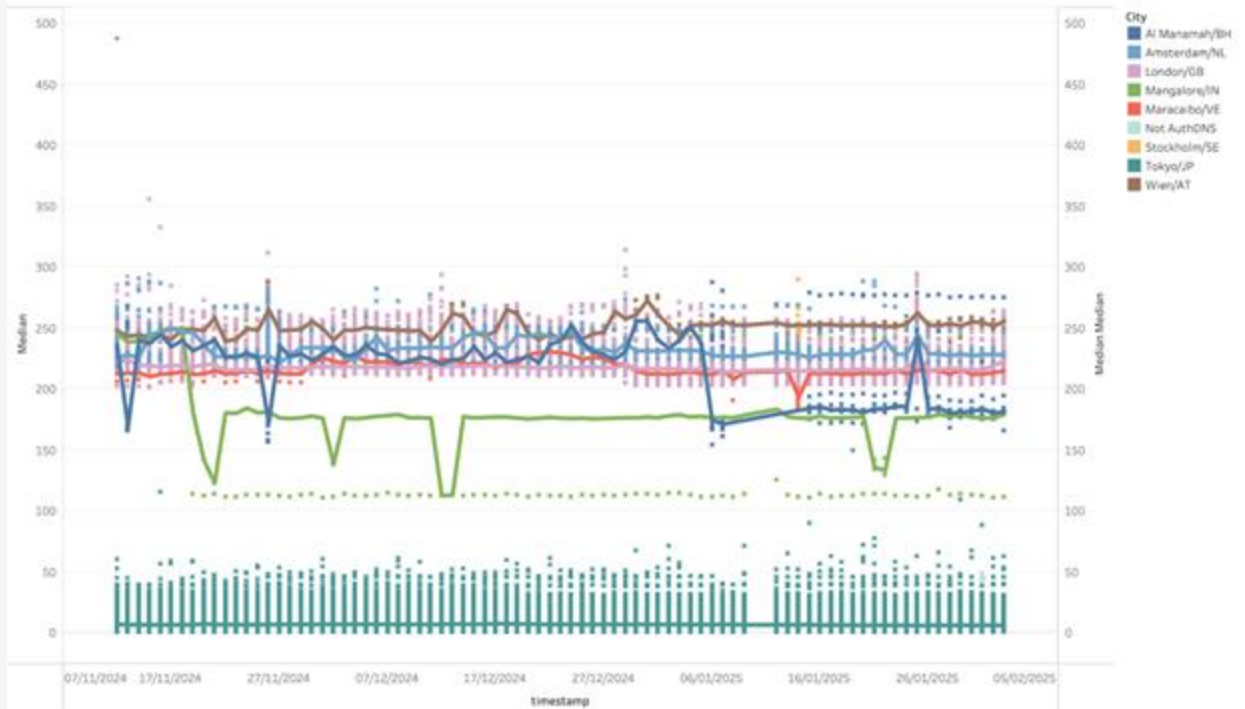
Minimum RTT

- 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

Let's Zoom in Japan:



AuthDns Median RTT - Japan

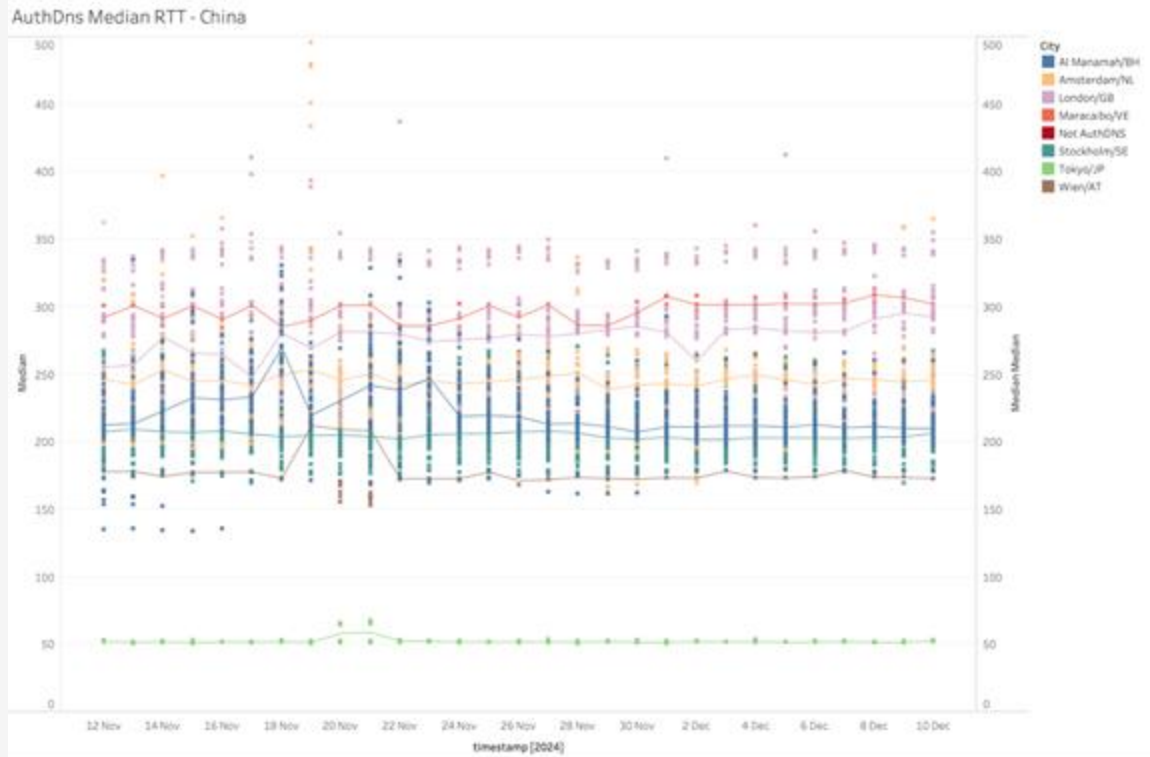


The trends of Median and median of Median for timestamp. Color shows details about City. Details are shown for City. The data is filtered on Data, Instance and Country. The Data filter includes dates on or after 2024-11-12. The Instance filter excludes 7 members. The Country filter keeps Japan. The view is filtered on City, which excludes Guam/GU, Kansas City/US and Rome (Roma)/IT.

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



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

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!





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>

Demo

Subscriptions to the stream are sent as a JSON object containing various filter parameters. You can adjust the parameters below and see the messages that are streamed on the right.

```
{
  "prefix": null,
  "path": 4788,
  "type": null,
  "require": null,
  "moreSpecific": true,
  "peer": null,
  "next": null,
  "sackOrder": {
    "include": true,
    "acknowledge": true
  }
}
```

Live RIS BGP messages

Connected 812 matching messages - 0 filters

```
// Received at 1211146.11.97 second delay
{
  "timestamp": 1720055042.16,
  "peer": "2001:db8::13:1218:1",
  "peer_asn": "133218",
  "ip": "2001:db8::13:1218:1-4100000000000",
  "next": "2001:db8::13:1218:1",
  "type": "UPDATE",
  "path": [110018, 6039, 4788, 24281, 24183, 24283, 24083, 139851],
  "community": [10433, 4090, [2433, 24133, 12413, 408211, "origin"], "IGP", "announcements"],
  "next_hop": "2001:db8::1:800:1",
  "prefixes": [
    {
      "next_hop": "2001:db8::1:800:1",
      "prefixes": [
        {
          "next_hop": "2001:db8::1:800:1"
        }
      ]
    }
  ],
  "withdrawals": []
}
```

Code examples

Below are simple examples of using the RIS Live Websocket interface. For a full guide, see the [RIS Live manual](#).



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



RIPE Atlas

Measurement Form

Use this form to create (and optionally schedule) a new measurement, or to configure an API call to do the same.

Step 1: Definitions

Please select the type of measurement you want to create (you can add multiple).

PING TRACEROUTE DNS TLS HTTP NTP

Step 2: Probe Selection

SEARCH ON MAP RANDOM BY... IDS LIST REUSE FROM EXISTING MEASUREMENT

Probe Selection

50 Random Probes AREA: Worldwide

Step 3: Timing

Please select if this is a one-off (vs. periodic) measurement and start and end times (if needed). All times are displayed in your local time (but submitted in UTC).

This is a One-off:

Start Time:

ASAP

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

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



Step 4: Costs

Who should be billed for this?
lhestina@ripe.net

Current Balance: **116,784,422**

This measurement would have a daily cost of: **N/A**

Daily Income: **285,242**

Days until balance exhausted: **N/A**

Total cost for this measurement (if stop date known or is One-off): **0**

API Spec

CREATE THIS MEASUREMENT

Analysing Results



Measurement 81884620

RIPE authdns rtt + nsid - SouthAsia

LATEST

GO

PERIODIC DNS measurement to 193.0.9.7 via IPv4.

OVERVIEW

RESULTS

DETAILS

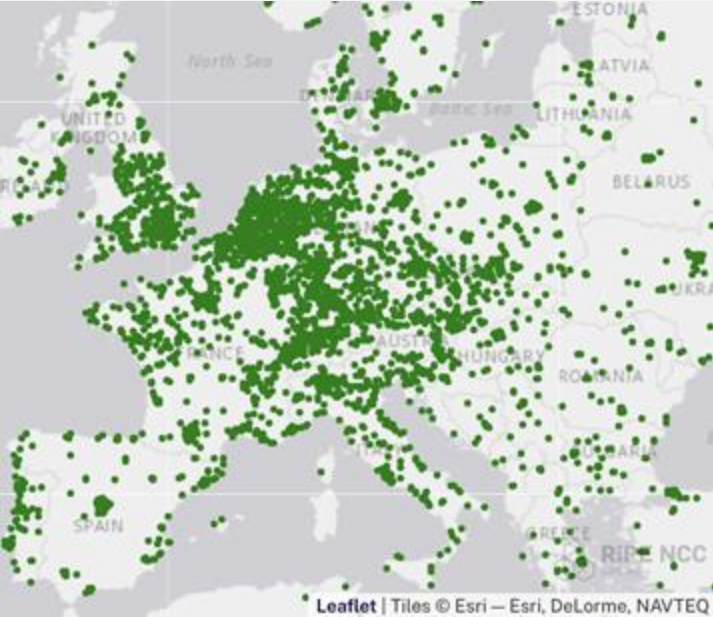
Search Results

DOWNLOAD OPTIONS

Hide no reply Hide no report

Probe ↑	ASN (v4)	ASN (v6)	Country	Time (UTC)	Response Time ↑	RCODE	NSID
↓ 6575	45170	45170	IN	2024-12-10 11:47	218,705 ms	NOERROR	ns1.bh-amh.authdns.ripe.net
↓ 6785	58717	58717	IN	2024-12-11 06:17	170,069 ms	NOERROR	ns1.bh-amh.authdns.ripe.net
↓ 6953	12008	12008	IN	2024-12-11 06:17	35,138 ms	NOERROR	ns1.in-mal.authdns.ripe.net
↓ 6954	12008	12008	IN	2024-12-11 06:17	17,767 ms	NOERROR	ns1.in-mal.authdns.ripe.net
↓ 6968	14061	14061	IN	2024-12-11 06:17	33,642 ms	NOERROR	ns1.in-mal.authdns.ripe.net
↓ 7077	132420		IN	2024-12-11 06:17	50,536 ms	NOERROR	ns1.in-mal.authdns.ripe.net
↓ 7115	7642	7642	IN	2024-12-11 06:17	183,938 ms	NOERROR	ns1.bh-amh.authdns.ripe.net
↓ 7269	45117	45117	IN	2024-12-11 06:33	35,735 ms	NOERROR	ns1.in-del.authdns.ripe.net
↓ 7276	138322	138322	IN	2024-12-11 06:33	156,511 ms	NOERROR	ns1.bh-amh.authdns.ripe.net
↓ 7375	136800	136800	IN	2024-12-11 06:17	77,437 ms	NOERROR	ns1.in-mal.authdns.ripe.net
↓ 7405	152533	152533	IN	2024-12-11 06:33	10,622 ms	NOERROR	ns1.in-mal.authdns.ripe.net
↓ 7407	149021	149021	IN	2024-12-11 06:17	156,038 ms	NOERROR	ns1.bh-amh.authdns.ripe.net
11976	24560	24560	IN	2024-12-11 06:33	19,794 ms	NOERROR	ns1.in-mal.authdns.ripe.net
13785	135817	135817	IN	2024-12-11 06:35	9,459 ms	NOERROR	ns1.in-del.authdns.ripe.net

RIPE Atlas Coverage Density



Europe



Asia Pacific



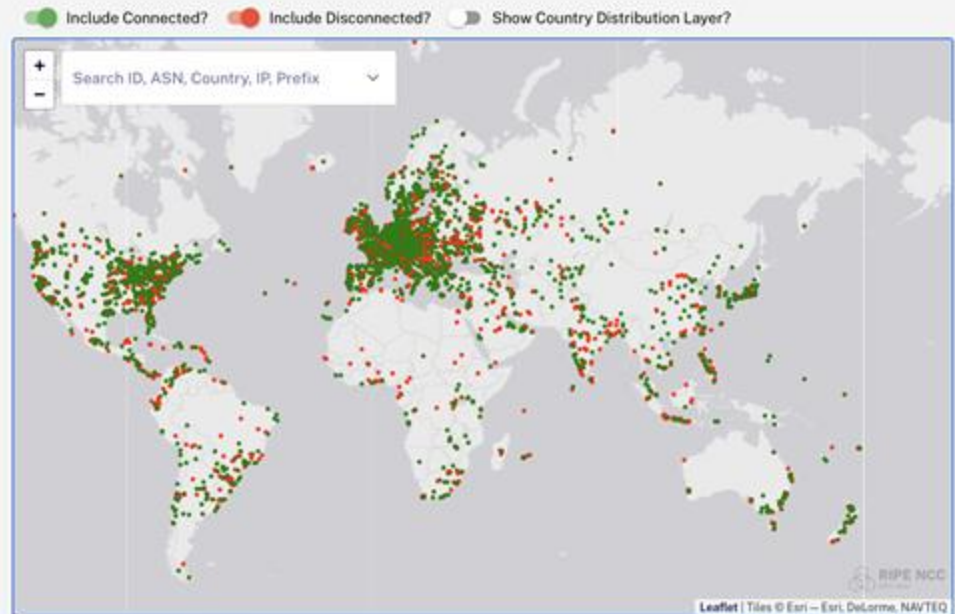
How you can help

- **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

Coverage and Statistics

This page contains the RIPE Atlas probe coverage map and various statistics on [Global Indicators](#), [measurements](#), [ASN / IP Prefix / Country Coverage](#), [Top ASNs / Prefixes / Countries](#), [probes, users and anchors](#).

Global RIPE Atlas Network Coverage



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**





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	



- **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



- 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

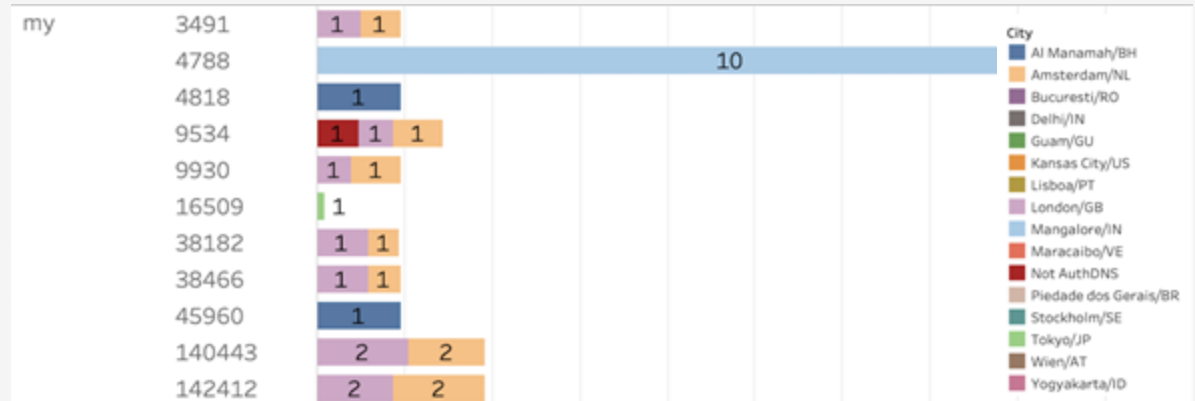


RIPE Atlas

- 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

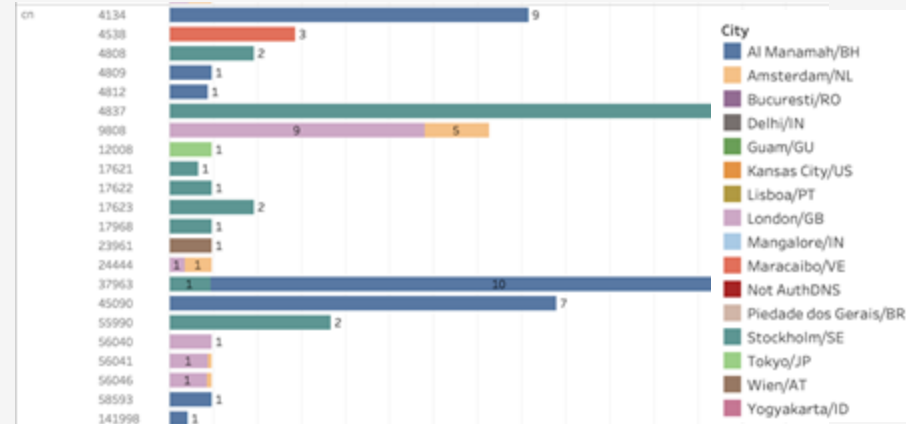
- We want to distribute probes to:
 - 24400 CMNET-V4Shanghai
 - 56048 CMNET - BEIJING
 - 24445 CMNET-V4Henan
- Where?
 - End user network
 - Core network
 - (close to) IXPs

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

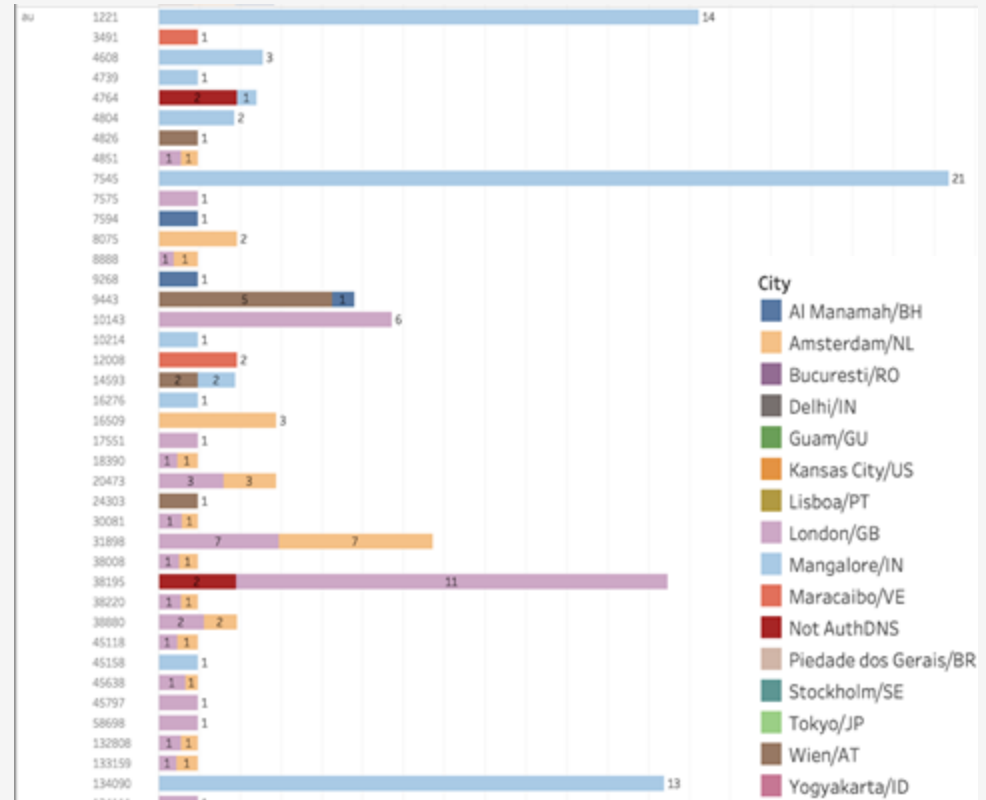


RIS & AuthDNS

- Host AuthDNS in:
 - IXP
 - AS1221

Network Operator

Evaluate the paths from your network to key infrastructure





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



Lia Hestina <lhestina@ripe.net>



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
```