The Central Asian Internet: Recursive Resolvers and Regional Latencies

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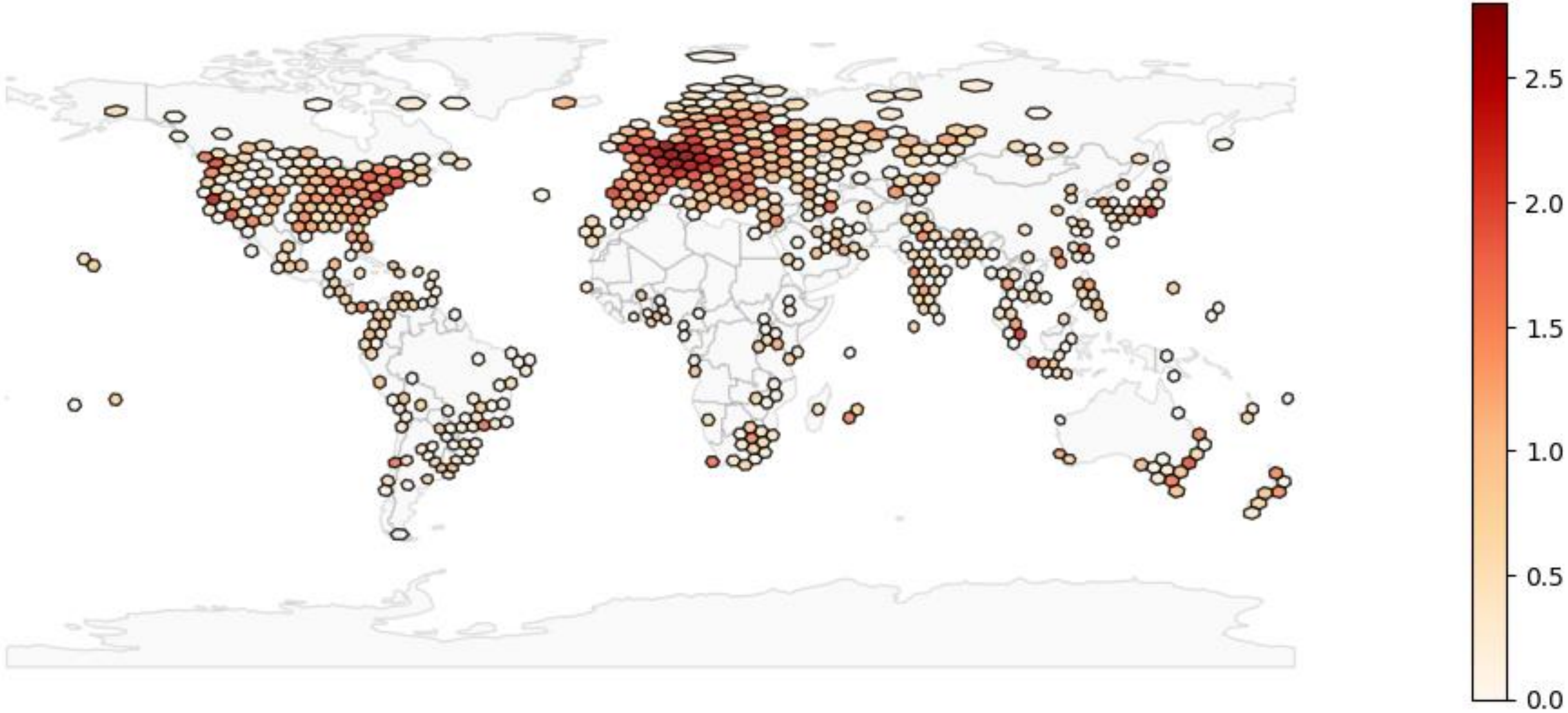
Internet History Initiative: Research Goals

- Collect and preserve the network operators' community legacy of Internet measurement datasets
- Extract time series data that reflect key aspects of regional Internet growth and diversification
- Study similarities and differences in Internet development across world regions
- Make these time series available to researchers studying different (potentially non-technical) aspects of international development

RIPE Atlas Global Probe Density (logscale)



Two Experiments, 2019-2024

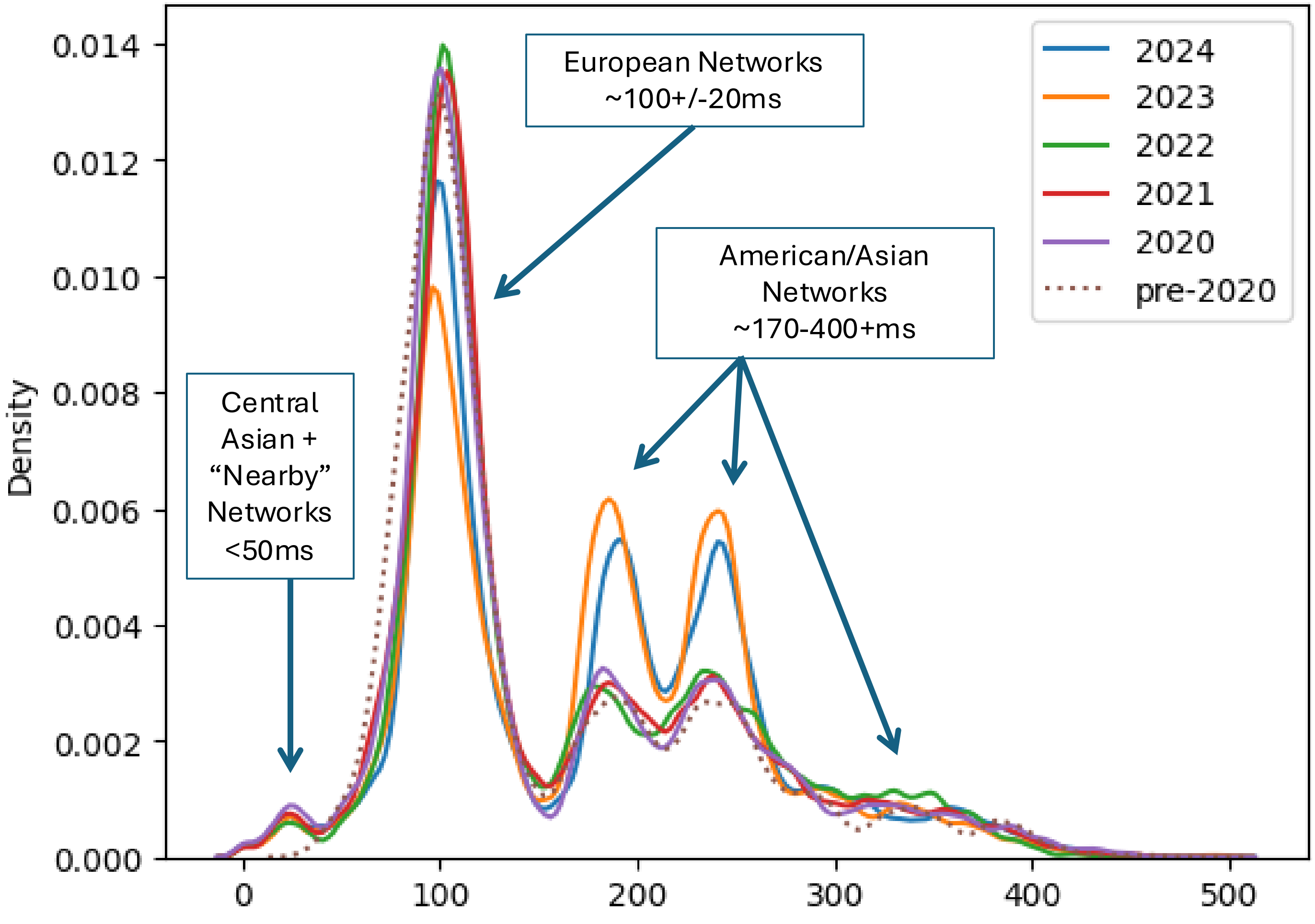
1. Regional Latency Trends into Central Asia

    - Use the ATLAS Anchor Mesh measurements to understand trends and disruptions in Central Asia's 'distance' from economically important world regions

2. DNS Recursive Resolver Preferences within Central Asia

    - Use ATLAS DNS measurements to reveal what regional probes are using for recursive DNS resolvers over time: 8.8.8.8? 9.9.9.9? 1.1.1.1? local?

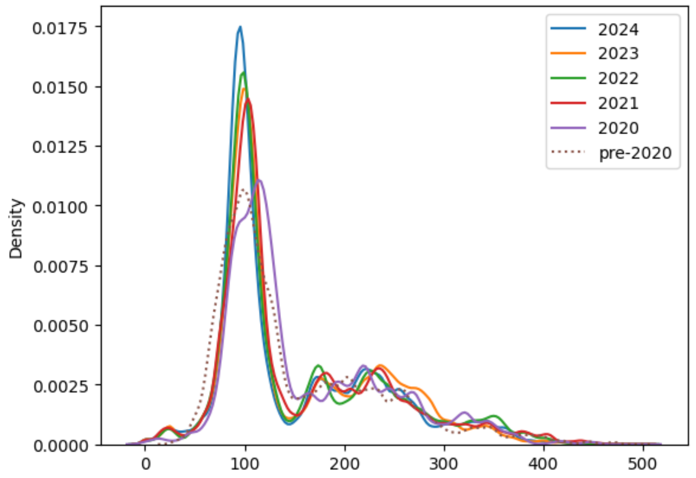
1. Regional Latency Trends into Central Asia



IPv4 to CA Anchors (ms)

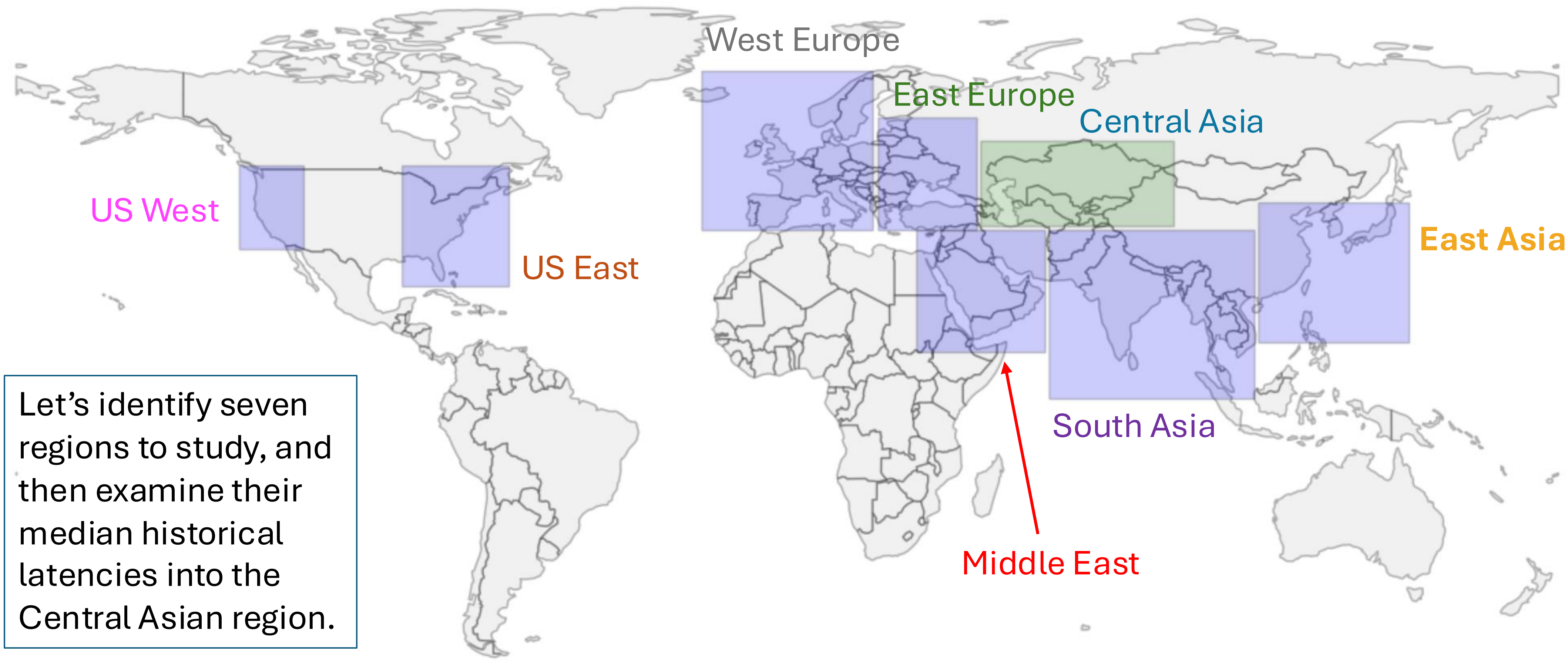
Start by sampling *all* mesh ICMP ping measurements on 1 Aug each year, from all probes, to all CA anchors.

Compute a kernel density estimate to reveal the most common latencies in IPv4 (left) and IPv6 (below)



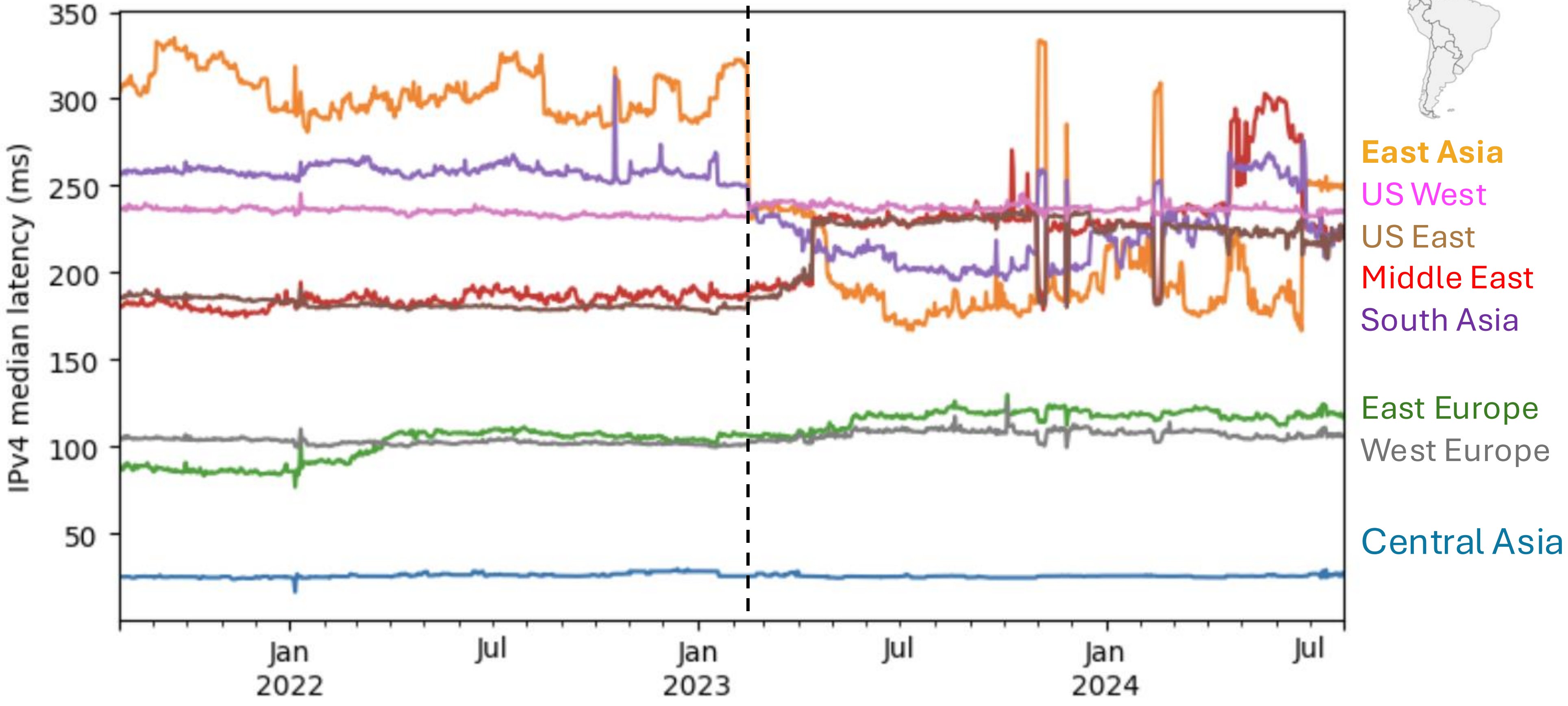
IPv6 to CA Anchors (ms)

How can we tell a story about regional trends?

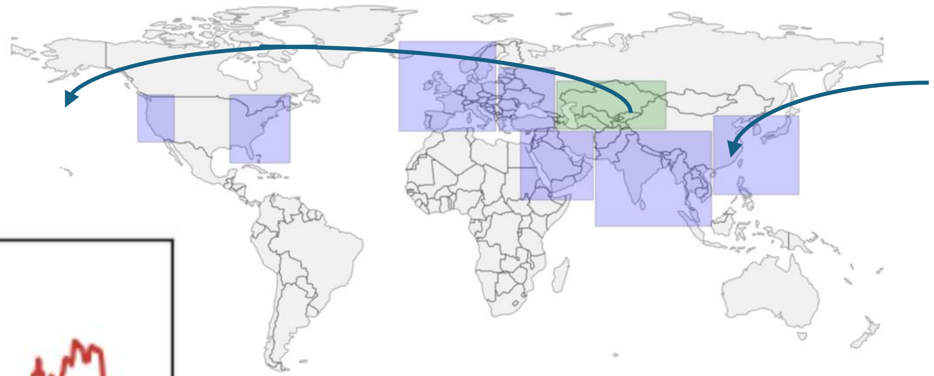


Let's identify seven regions to study, and then examine their median historical latencies into the Central Asian region.

IPv4 Latencies 2021-

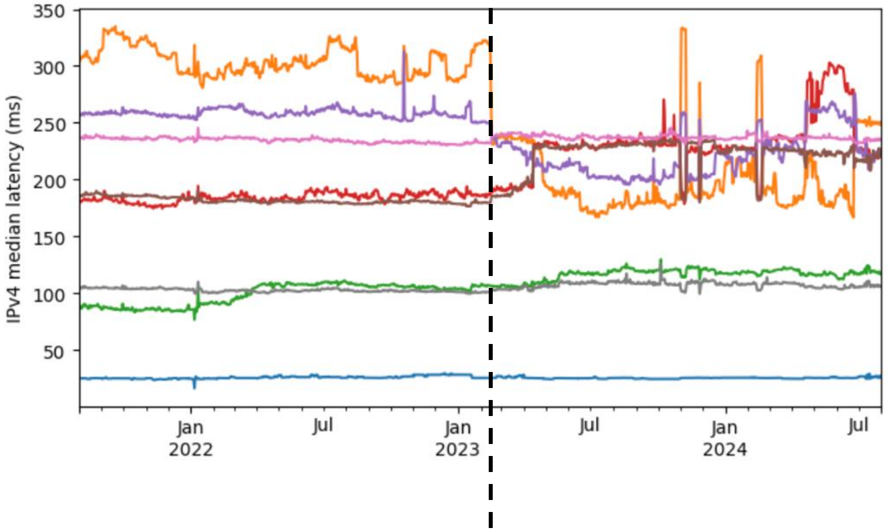


RIPE Atlas latency measurements to Central Asian probes, median IPv4 RTT, daily median, 1 August 2021 – 31 Jul 2024



15-16 Feb 2023: East Asian median latency shifts from "long way around" (320ms) to "short way around" (230ms), falling further in July (190ms)

Top final foreign routers: East Asia to KZ



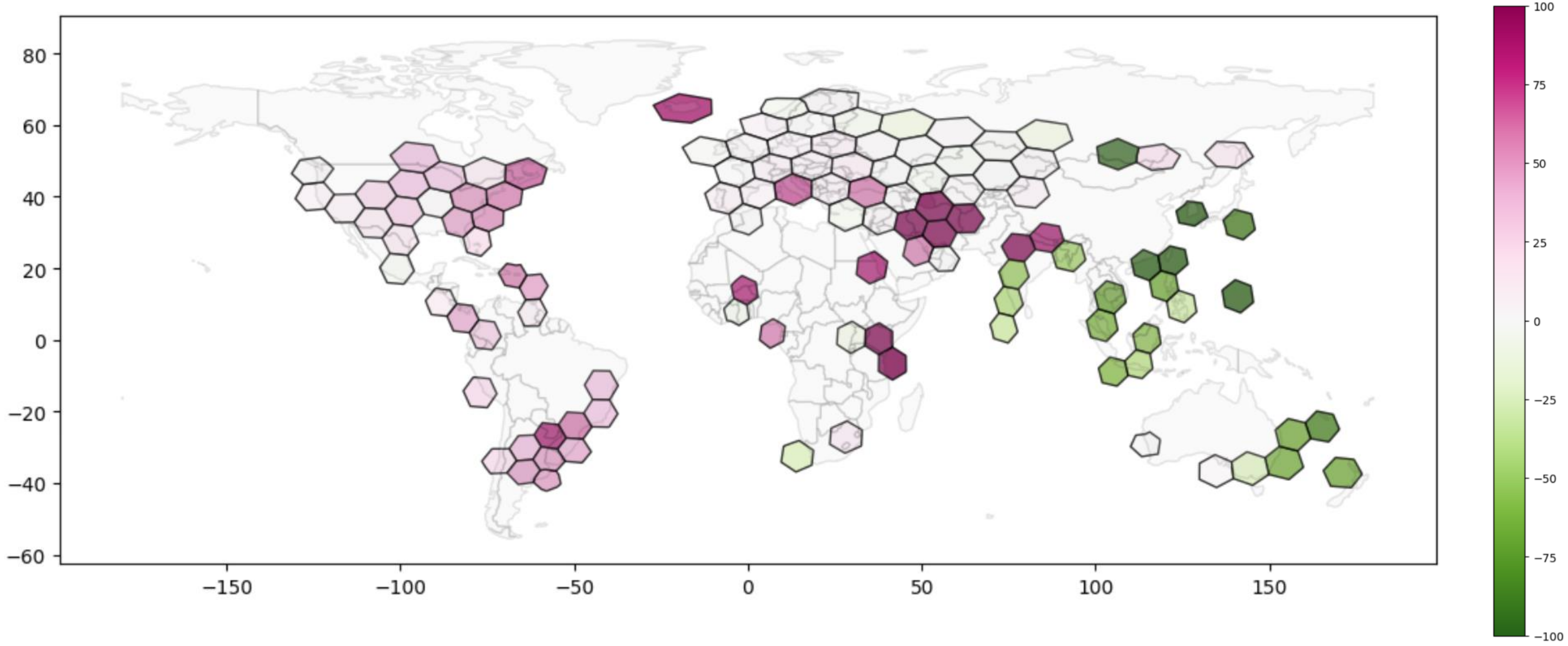
AFTER (17-24 Feb 2023, 230ms median)

178828 63.218.175.142 Kazakh.hu0-0-0-16.br06.hkg12.**as3491**.net PCCW
13593 87.245.238.15 gw-as41798.retn.net. (TTK)
6348 141.101.186.18 AS60299 MMTS (Russia)
2018 216.239.43.205 AS15169 Google
1350 52.79.0.175 [].ap-northeast-2.compute.amazonaws.com
1232 52.79.0.181 [].ap-northeast-2.compute.amazonaws.com
1011 52.79.0.167 [].ap-northeast-2.compute.amazonaws.com
982 52.79.0.179 [].ap-northeast-2.compute.amazonaws.com

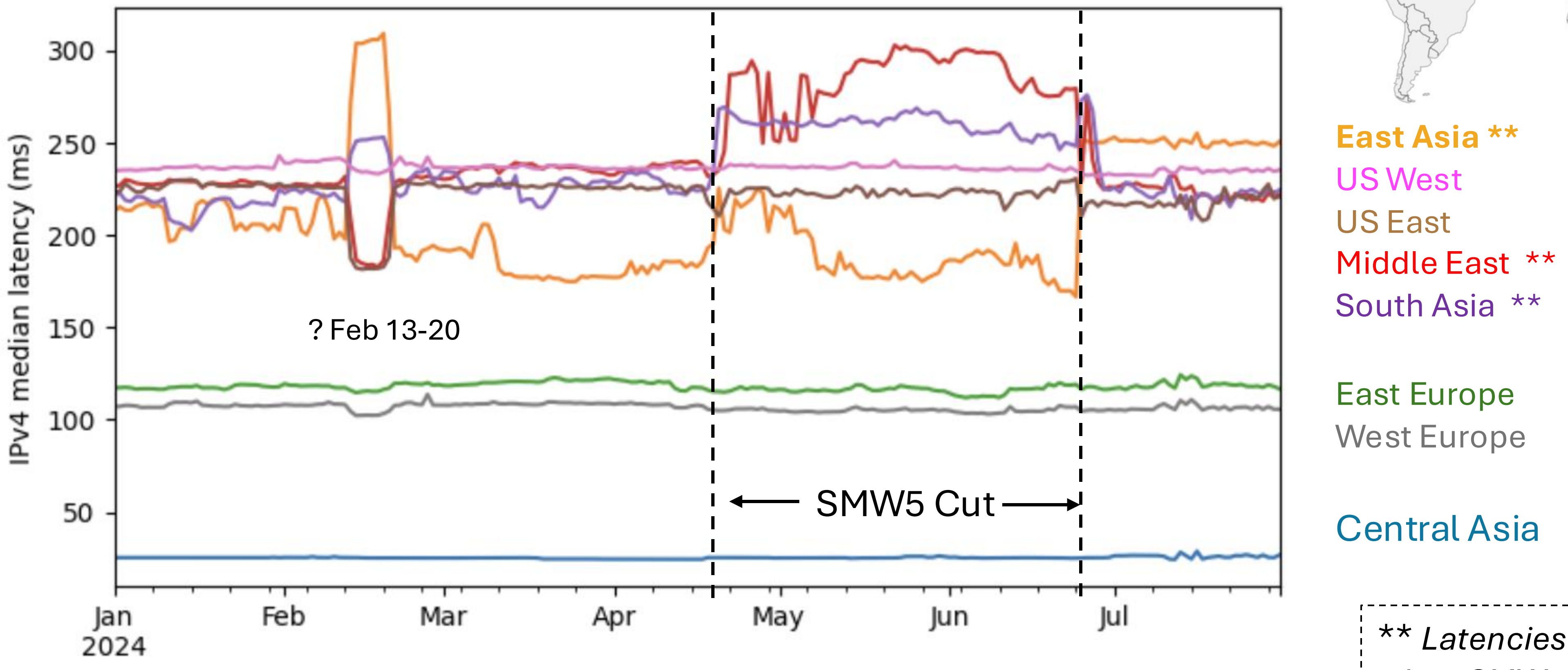
BEFORE (1-8 Feb 2023, 320ms median)

127656 81.211.81.125 AS3216 Vimpelcom
31033 188.43.31.221 DZV-gw.transtelecom.net
7451 5.180.92.38 AS209141 China Mobile Intl.(Russia)
5992 89.191.239.251 AS12389 Rostelecom
4924 188.254.34.50 AS12389 Rostelecom
4477 141.101.186.18 AS60299 MMTS (Russia)
4330 87.245.230.67 gw-as41798.retn.net. (TTK)
4192 178.210.33.81 AS43727 Kvant-Telekom

Latency shifts, 1 Aug 2023 vs 1 Aug 2022



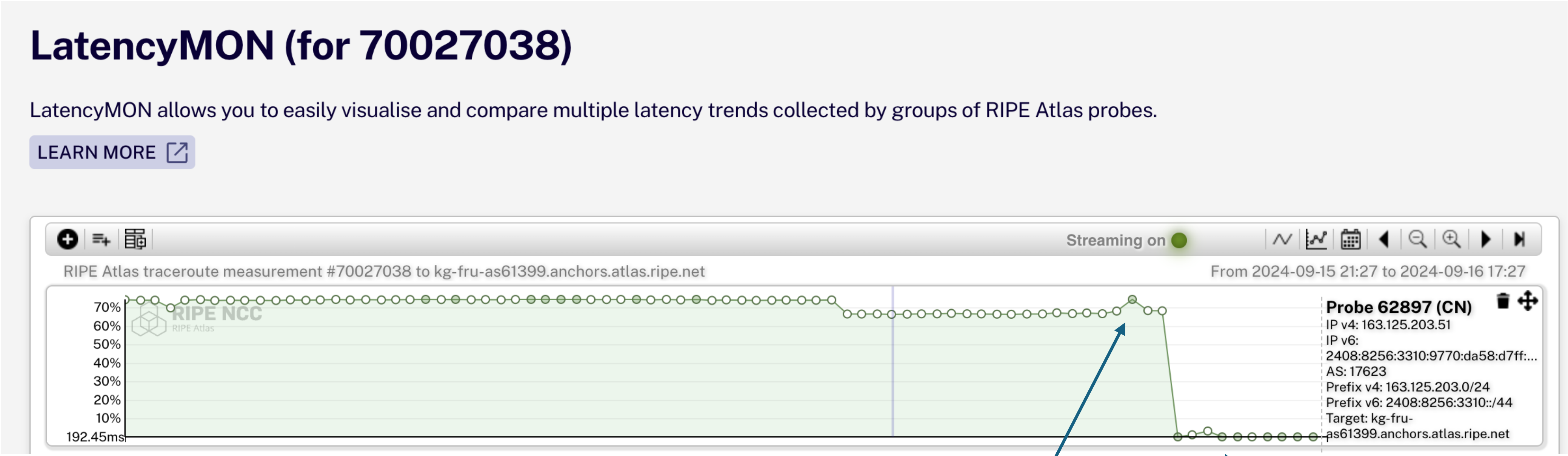
IPv4 Latencies (2024)



RIPE Atlas latency measurements to Central Asian anchor probes, median IPv4 RTT, daily median, 1 Jan 2024 – 31 Jul 2024

*** Latencies increase when SMW5 is cut in the Strait of Malacca*

160ms variance intraday Guangzhou – KG-IX



- Both “modes” of latency are present on a given day
- Long path east through New York
- Short path west through China Mobile

Date: 2024-09-16 14:12:25 UTC
Max: 360.78ms (>74.59%)
Med: 354.28ms (>74.59%)
Min: 353.92ms (>74.59%)
Packet loss: 0%
3 packet sent, 3 received

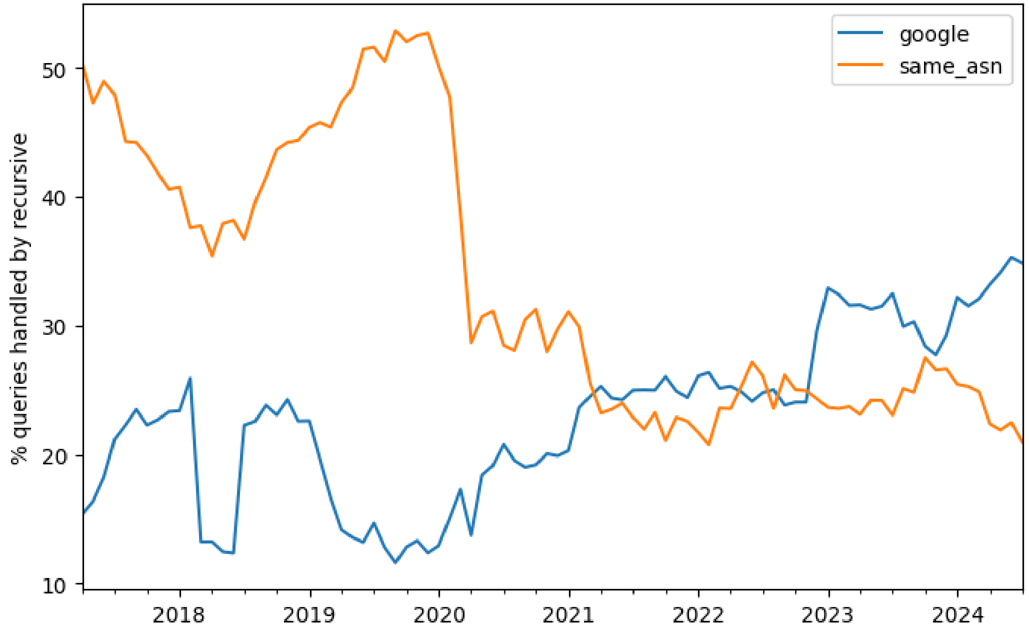
90 minutes later...

Date: 2024-09-16 15:42:24 UTC
Max: 193.49ms (0.54%)
Med: 192.97ms (0.27%)
Min: 192.71ms (<0.17%)
Packet loss: 0%
3 packet sent, 3 received

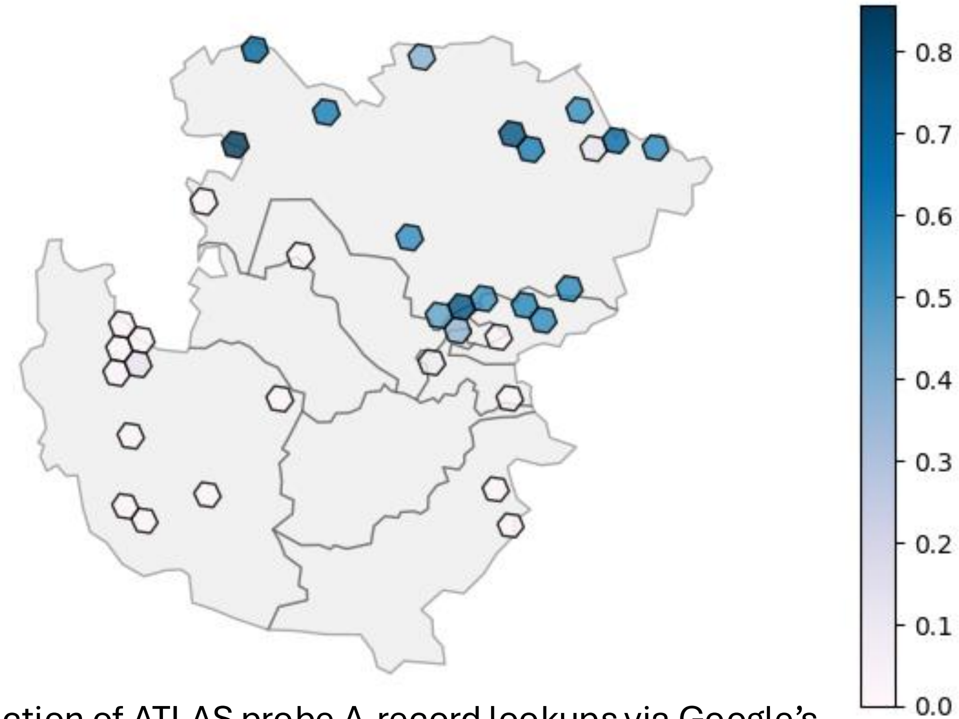
2. DNS Recursive Resolver Selection

- Two long-running daily ATLAS experiments allow us to see what recursive resolver makes queries to authoritative resolvers on behalf of an ATLAS probe
- This IP address can be classified as local (often same ASN) or anycast global (e.g., Google 8.8.8.8, Cloudflare 1.1.1.1, Quad9 9.9.9.9)
- In the case of Google, we can further determine which specific Google datacenter hosts the unicast address of the ultimate recursive resolver
- This may be different from the local anycast instance

Same-ASN recursives are declining, and Google's 8.8.8.8 is gaining market share, in Central Asia.



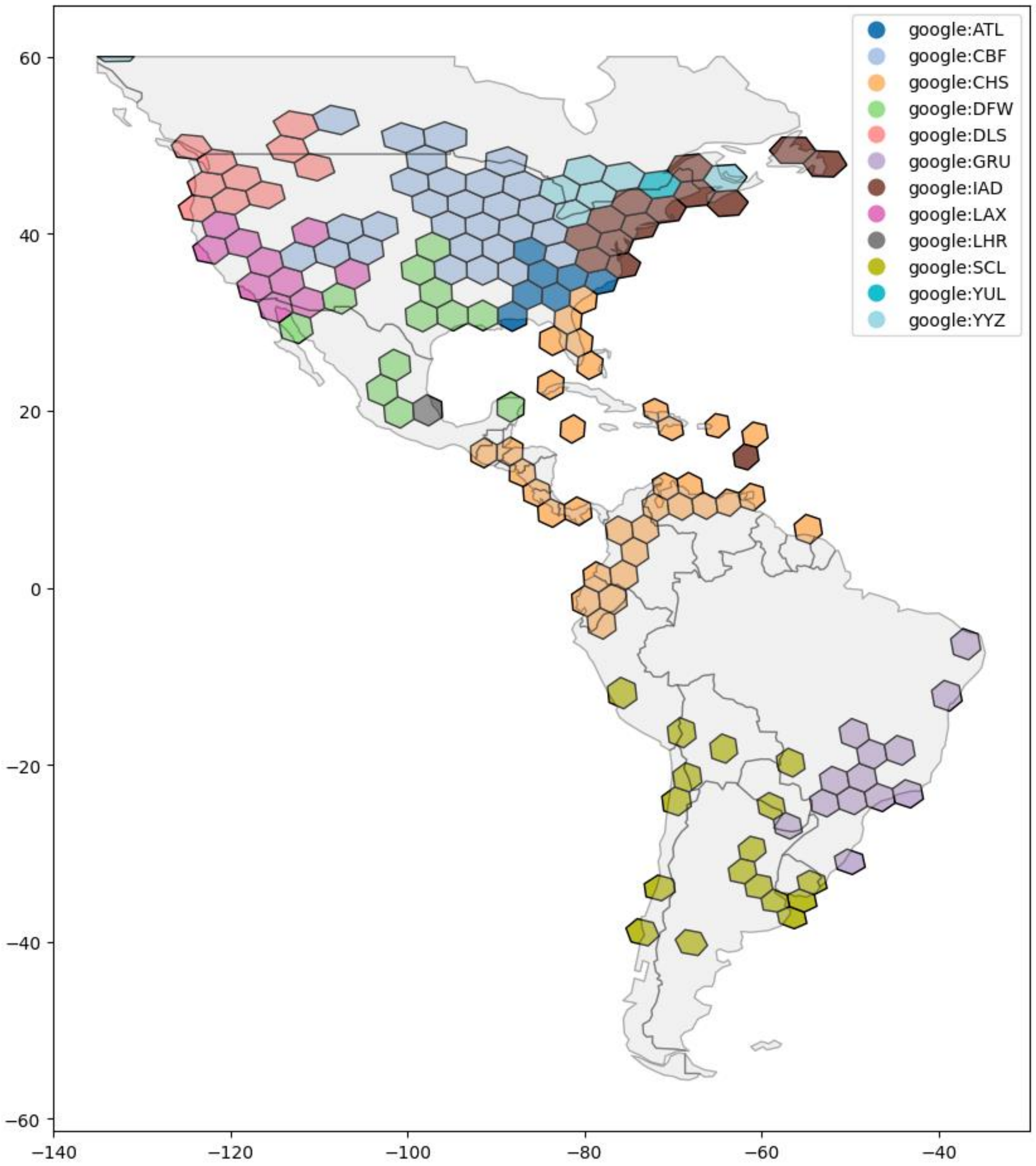
Fraction of ATLAS probe A-record lookups via anycast recursive resolver services at Google (8.8.8.8), or via resolvers in the same ASN as the ATLAS probe, Aug 2017 – Aug 2024



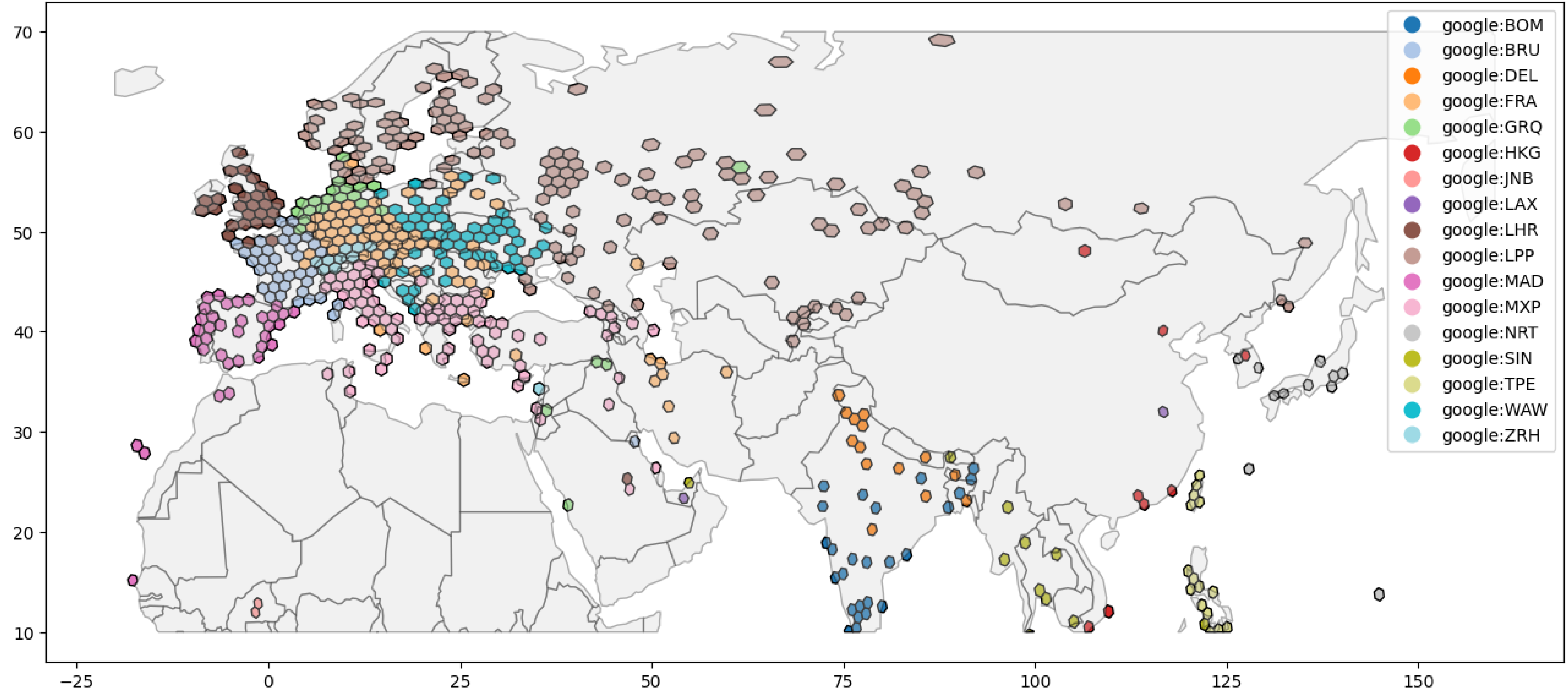
Fraction of ATLAS probe A-record lookups via Google's 8.8.8.8 recursive resolver service, Aug 2024 (extended region includes Iran, Pakistan)

Google creates 'watersheds' for 8.8.8.8 service

- Each hexagon is colored according to the most common Google datacenter hosting the ultimate unicast resolver address that queries authoritative servers when Atlas probes in that hex make a DNS query
- Most clients here are within 30ms of the ultimate resolver



Finland (LPP) provides 8.8.8.8 service to nearly all of the Russian-speaking world, at relatively high latencies.



Thanks!

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