AIORI

Advanced Internet Operations Research in India

DINR 2023

HTTPS://AIORI.IN

1. ABOUT THE PROJECT

- Large scale measurement of performance matrices is important to understand the performance of the network and quality of Internet experience by end-users.

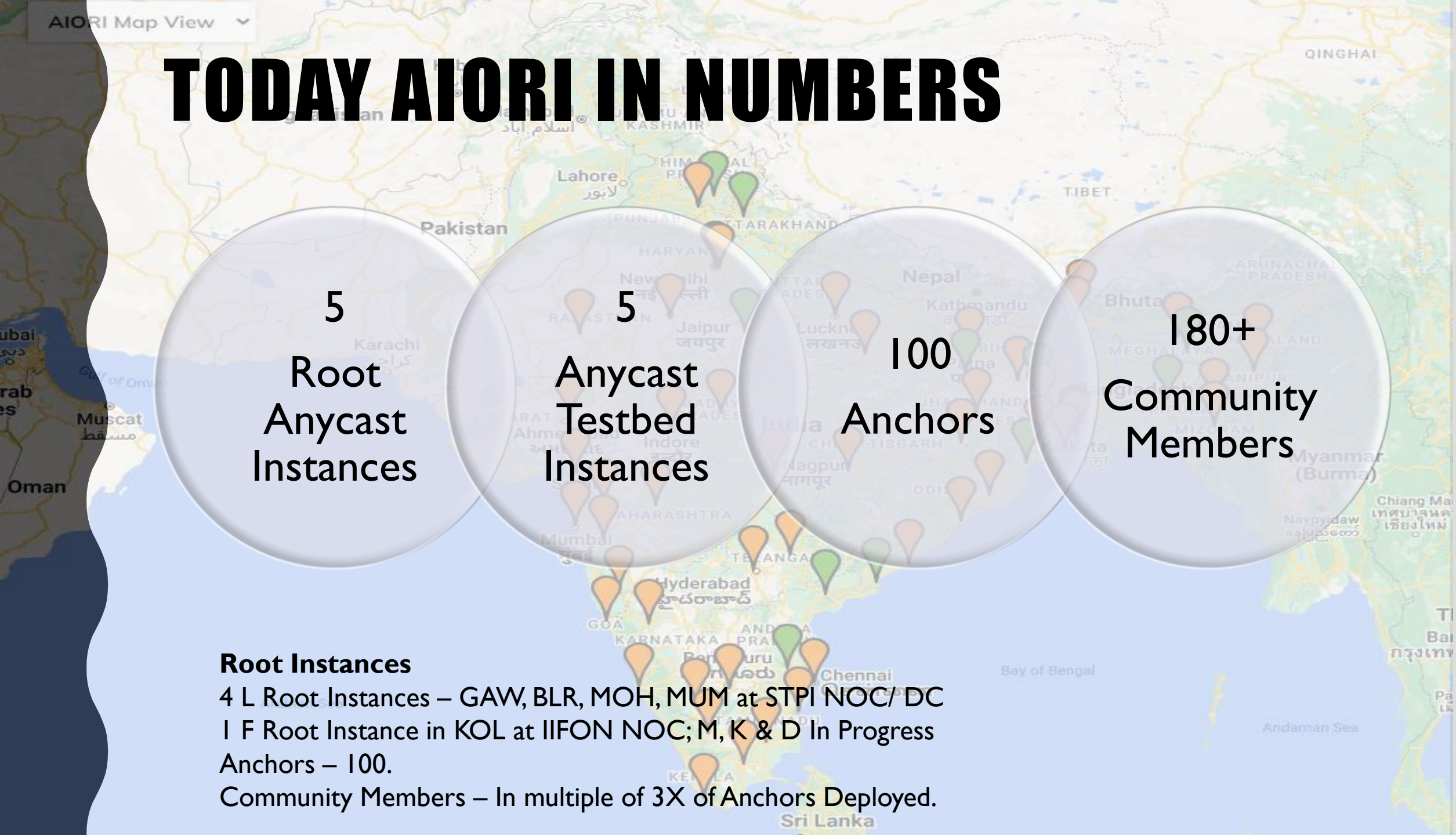
- AIORI (Advanced Internet Operations Research in India) program has created a network of devices (anchors) deployed across India and Internet measurement platform that actively measures Internet connectivity and reachability, providing an unprecedented understanding of the state of the Internet in real time.

- Starting in 2023, 100 anchors have been deployed across India till now which is helping in improving our understanding of the Internet as a whole and intends to benefit end-users, researchers, network owners and policy makers.

WHY NOT USING EXISTING MEASUREMENT PLATFORMS – RIPE ATLAS?

- Large Scale Deployment not in India
- Tried to get in large numbers but failed.
- Dependent on the measurement available in the platform and experimenting with news ones takes time, whereas in AIORI we can provision a new measurement within two weeks of time.
- What AIORI is having
  - Edge and Core performance and measurement using Pub/Sub architecture of distributed computing paradigm
  - Integrating new measurements is easy with the new architecture
  - API availability to ingrate with use cases and other measurement initiatives
  - Anycast/CDN measurement and Infrastructure to build and research

TODAY AIORI IN NUMBERS



5
Root Anycast Instances

5
Anycast Testbed Instances

100
Anchors

180+
Community Members

Root Instances

4 L Root Instances – GAW, BLR, MOH, MUM at STPI NOC/ DC

1 F Root Instance in KOL at IIFON NOC; M, K & D In Progress

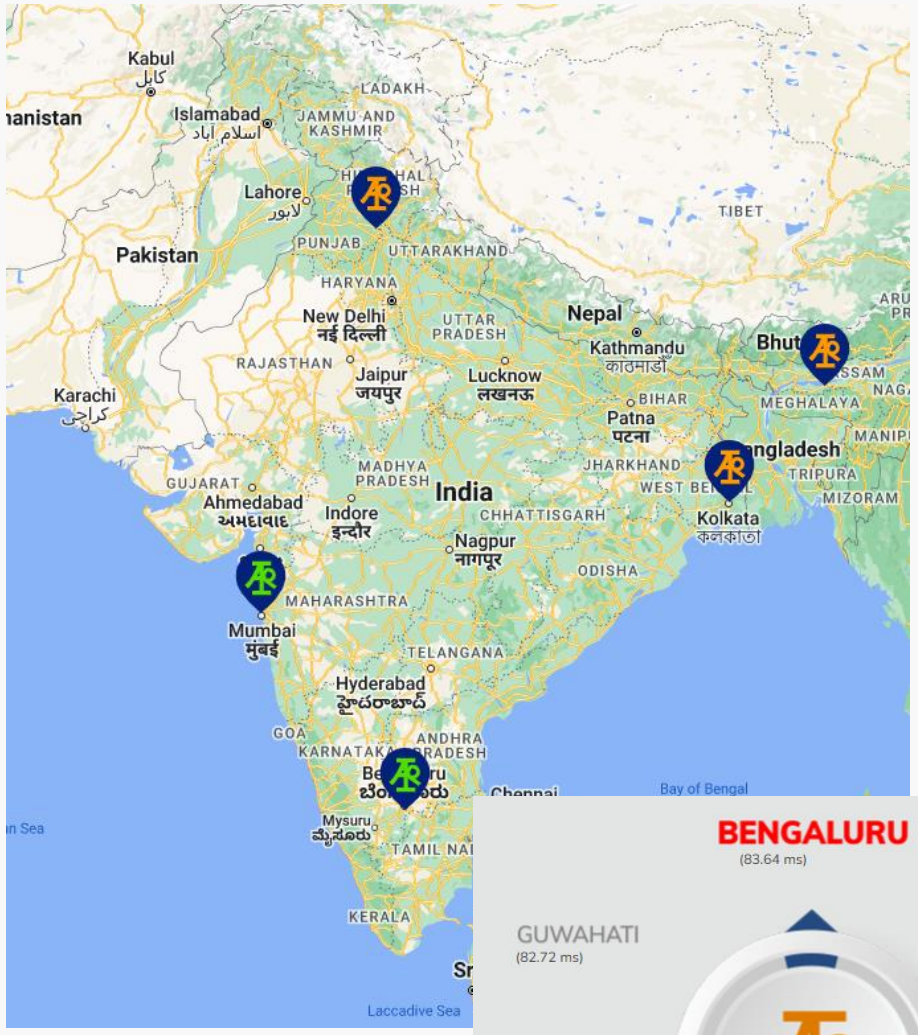
Anchors – 100.

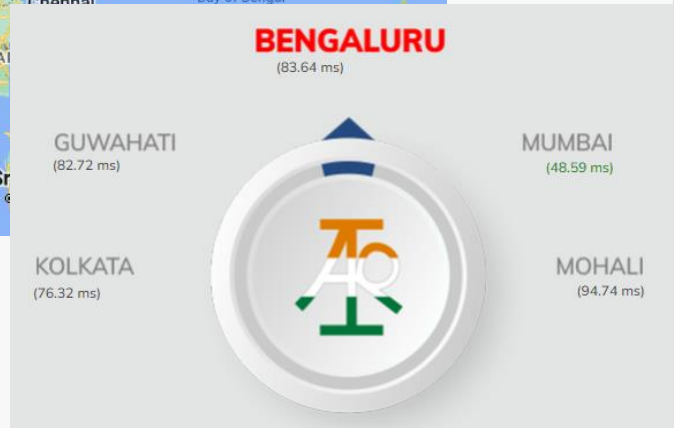
Community Members – In multiple of 3X of Anchors Deployed.

ANYCAST TESTBED

ANYCAST PRIVATE CLOUD INFRASTRUCTURE

- In Five Locations across INDIA
- This is helping us measure the local interconnection availabilities and uncover the issues related to resilient functioning of Internet.
- We are adding more academic institutions to host the testbed for more research initiatives to be taken up from academia.
- This testbed is giving us insights of building resilient services and researching on fututistic models of deployment.

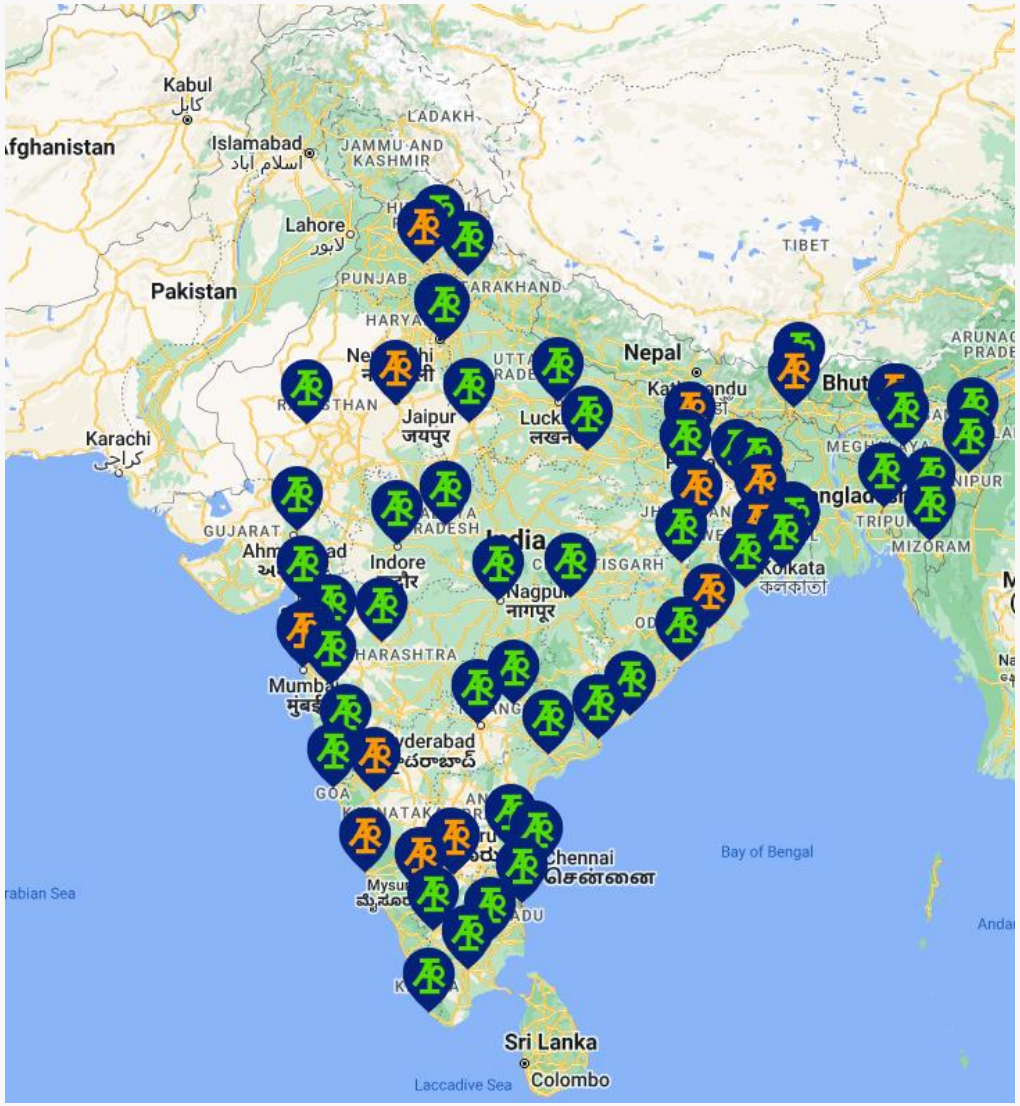


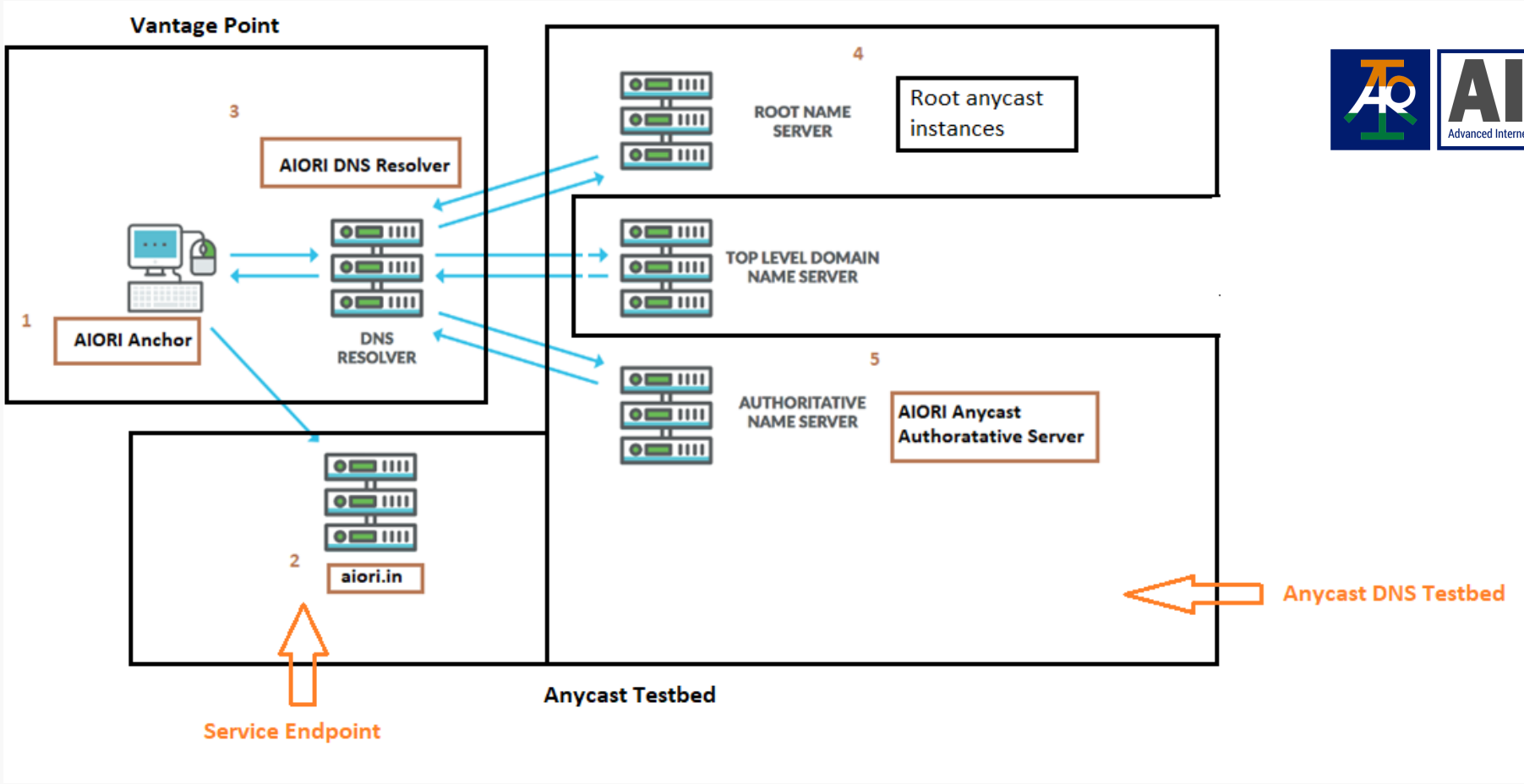


ANCHOR NETWORK

REMOTE MEASUREMENT ANCHORS

- Complete Indigenous development
- In 85+ locations across India, Next 430 locations in progress
- This is helping us measure the user level services availability and routing

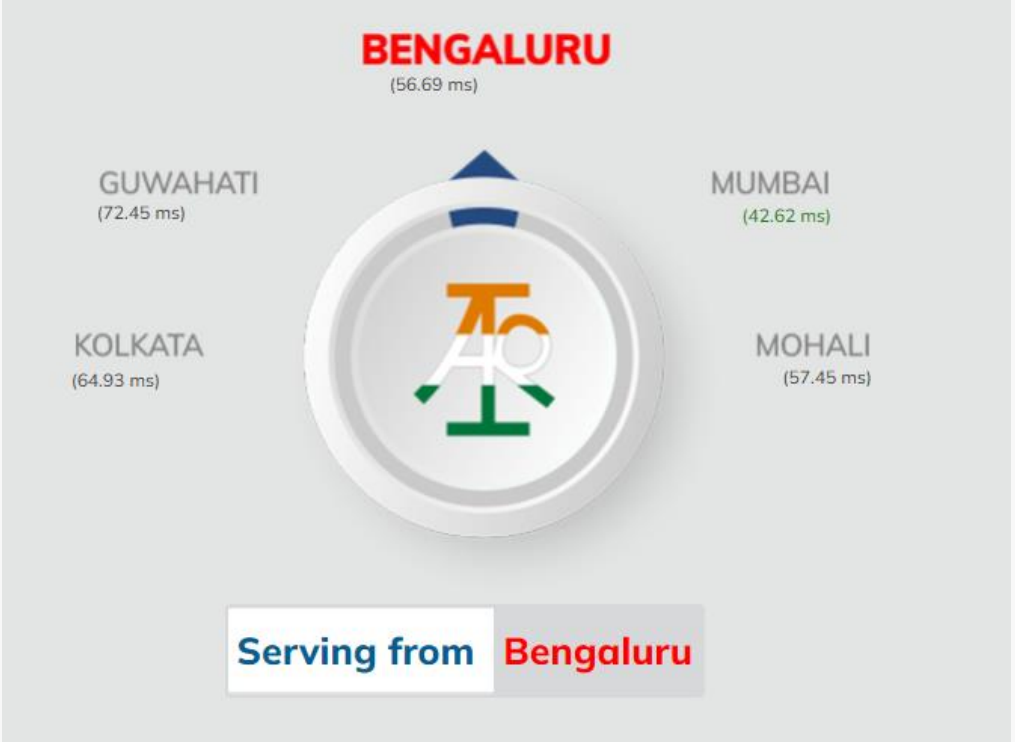




1. AIORI Anchors is used to measure the performance and availability from last mile, user location.
2. https://aiori in is a researcher portal, anycast testbed and Internet measurement portal for the research community in India
3. AIORI DNS Resolver (Anycast, IPv6) opens avenues of DNS resolver, authoritative and resilient service deployment model research for academia and start-ups.
4. The root anycast instances
5. AIORI Anycast authoritative server to host nameservers of businesses and CII within India in a secured and resilient manner

USE CASE 1 :
ANYCAST MEASUREMENT

- The AIORI portal is hosted using the same Anycast IP for WWW and DNS in multiple locations and when users are visiting the site, they are contributing to mining the routing latency measurements data to help understand the routing and peering state of the region. This will help us in studying and proposing routing and peering fixes for more resilient and responsive Internet experience.

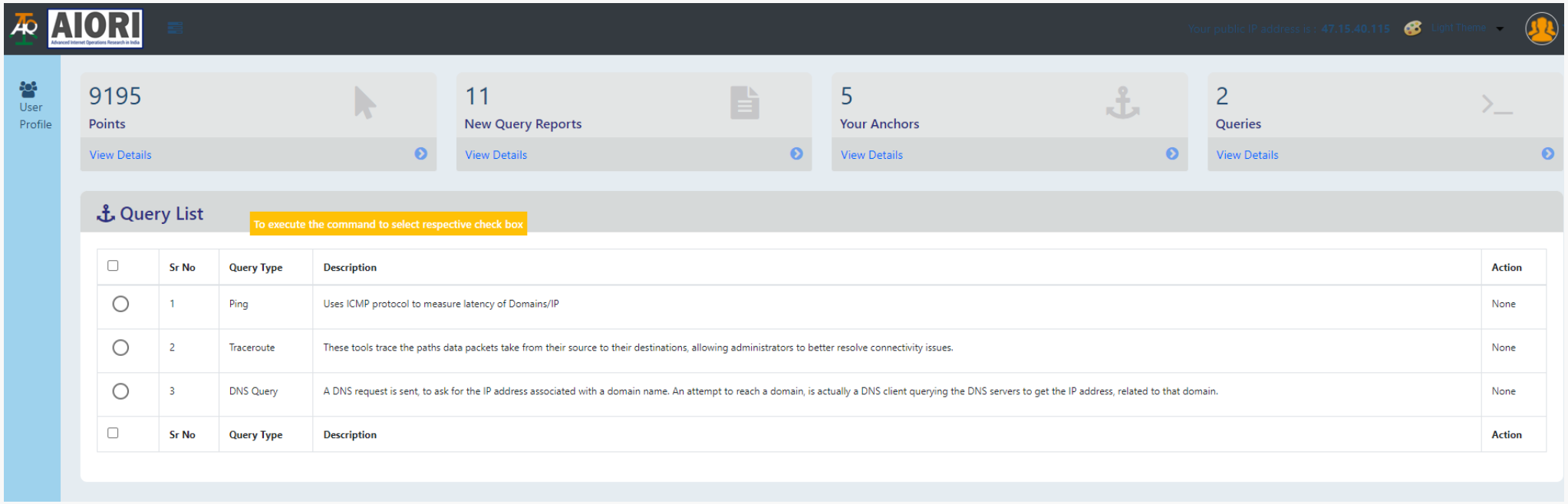


I am accessing https://aiori.in from Kolkata. The best latency is Mumbai but serving from Bengaluru. The latency should be less than ~30 ms from Kolkata.

USE CASE 1 :
COMMUNITY DRIVEN RESEARCH

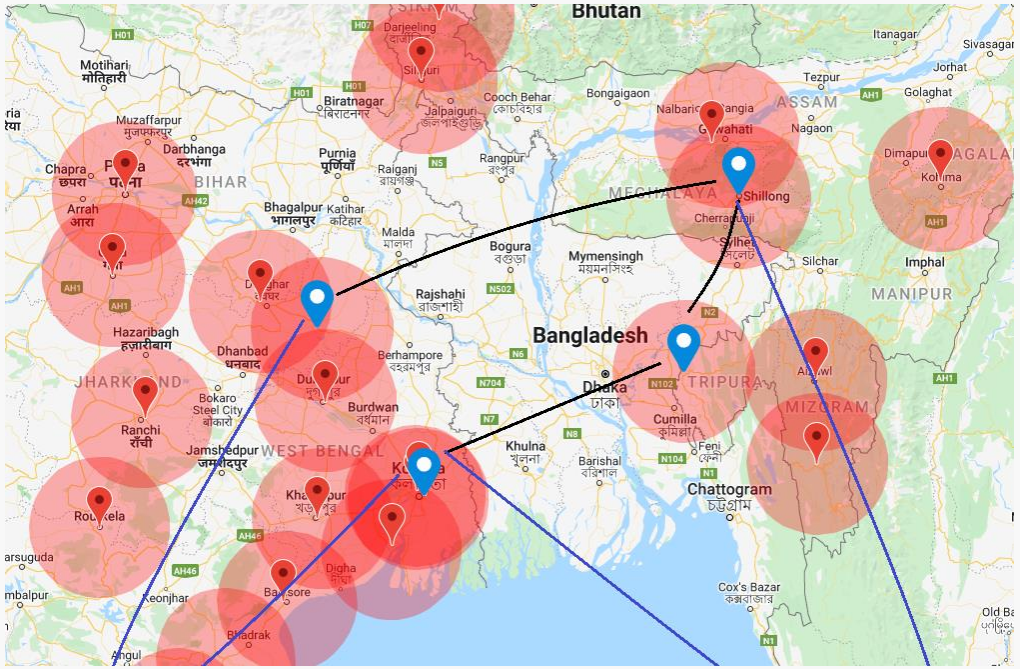
The AIORI portal (https://aiori.in), anycast nodes and anchor management network is an indigenously developed first of its kind took for different stakeholders for Internet measurement.

Anyone can login into the portal and use the network measurement tools to troubleshoot network issues and measure the health.



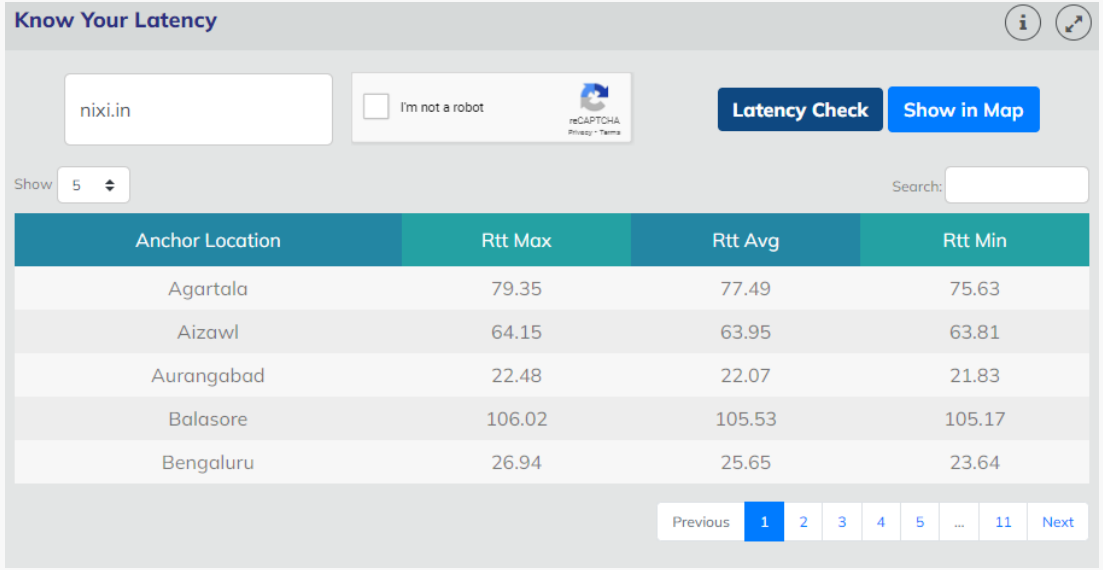
USE CASE 2 :
ROUTING DETOURS

- The AIORI Interment Measurement infrastructure will help to analyze the data in transit paths taken when user connects for services from one ASN to another inside the country. This will uncover ASN-to-ASN peering routes as well as help us uncover international routing detours.

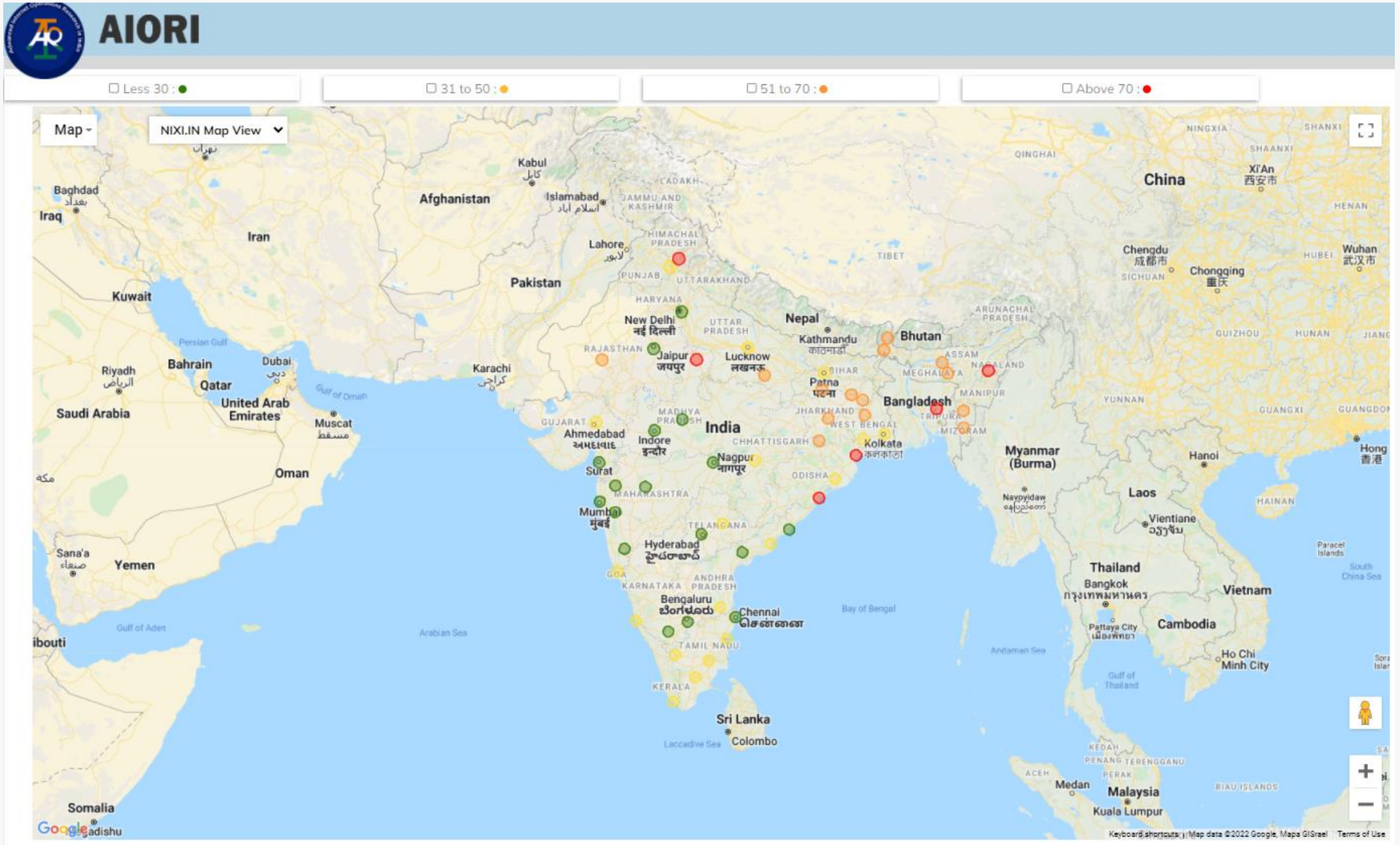


USE CASE 3 :
MEASURING SERVICES LATENCY

- The AIORI Interment Measurement infrastructure will help to analyze the latency of services in different parts of country. This will be useful for government, business to understand the reachability issues of their domains.
- We have given color codes to understand the latency better. In our study we are plotting nixi.in latency across the country.
- The slides proceeding will show the latency health



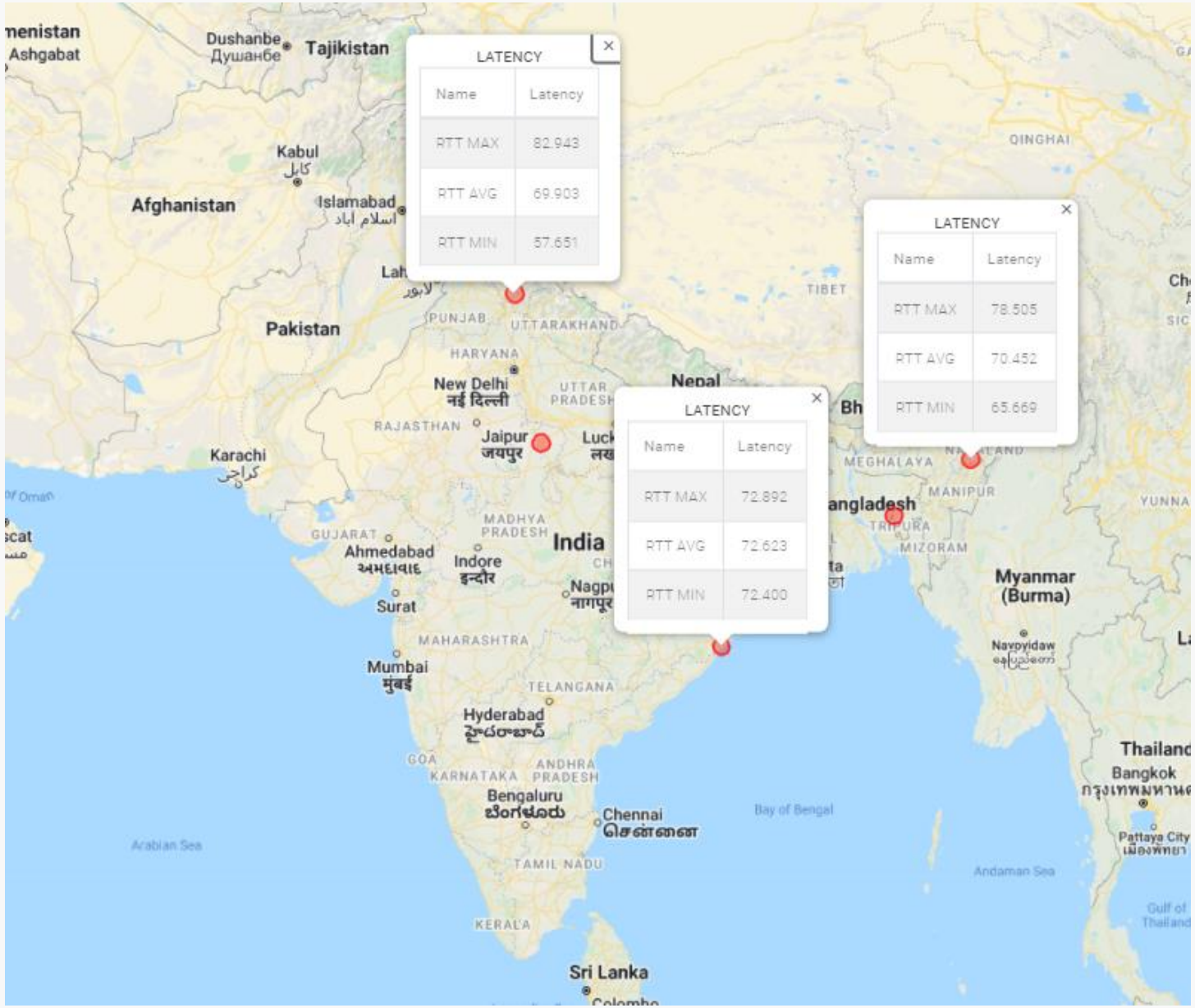
Use Case 3 : Illustration



Use Case 3 : Illustration

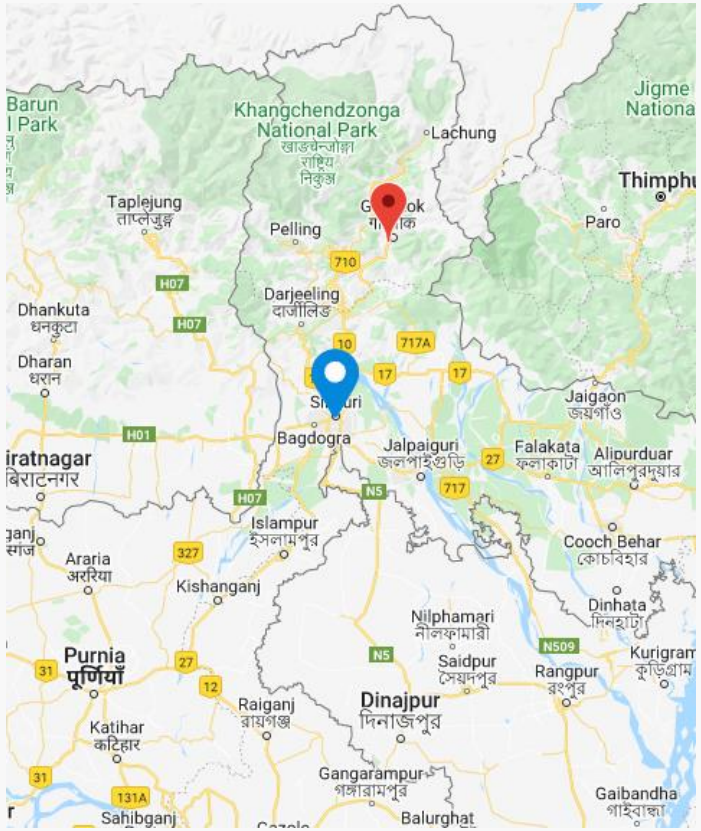
Based on the results the AIORI portal provides further tools and measurements to analyze:

1. Which networks are responsible for slow performance.
2. What is the status of peering where the content is hosted.
3. More tools….



USE CASE 4 :
DNS RESILIENCY FROM USER ENDPOINT

- The AIORI Interment Measurement infrastructure will help to analyze the DNS resiliency from use end point in terms of availability and latency of the hierarchy. This will be great tool for resiliency enforcement by different zone maintainers.
- Measurement : meity.gov.in A record
- Location : Guwahati Anchor



Use Case 4 : Root zone availability/Resiliency

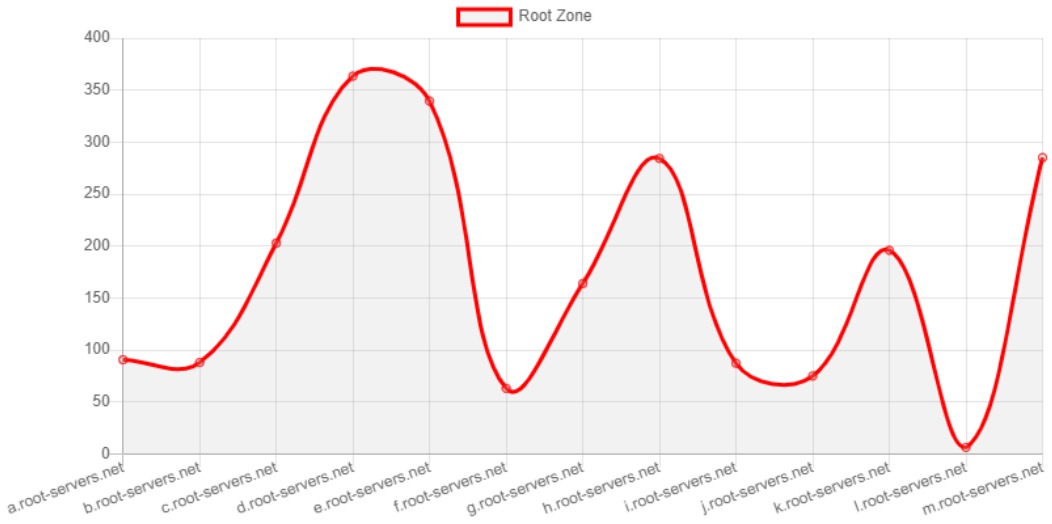
Because of L root deployment in Guwahati the latency in [6.21 ms], wherein the maximum is for E [339.43]

Measurement : meity.gov.in A record
Location : Guwahati Anchor
Zone: Root [.]

Root Zone

Resource Record	Value	Time(ms)
a.root-servers.net	198.41.0.4	90.59
b.root-servers.net	199.9.14.201	87.93
c.root-servers.net	192.33.4.12	202.78
d.root-servers.net	199.7.91.13	363.43
e.root-servers.net	192.203.230.10	339.43
f.root-servers.net	192.5.5.241	63.11
g.root-servers.net	192.112.36.4	163.91
h.root-servers.net	198.97.190.53	284.22
i.root-servers.net	192.36.148.17	87.26
j.root-servers.net	192.58.128.30	74.93
k.root-servers.net	193.0.14.129	195.89
l.root-servers.net	199.7.83.42	6.21
m.root-servers.net	202.12.27.33	285.08

Root Zone Graphical View



Use Case 4 : cctld zone availability/Resiliency

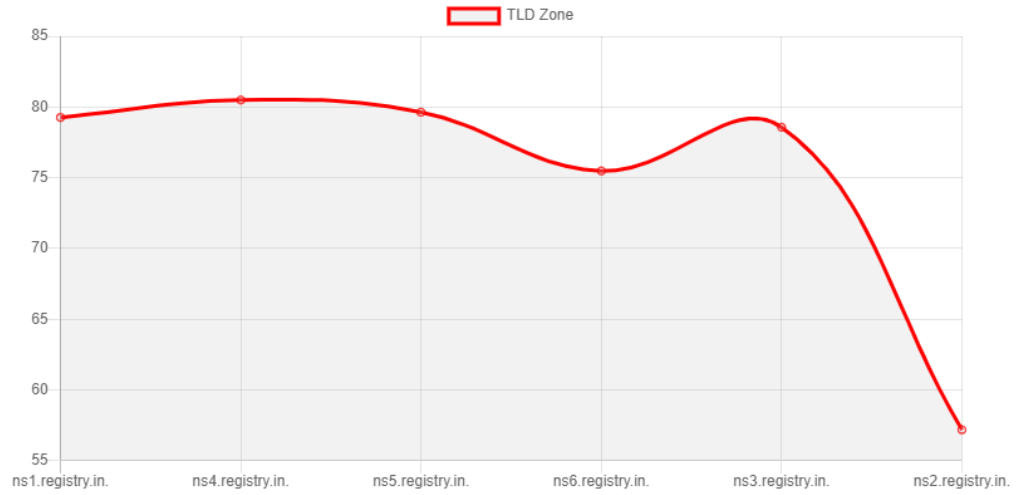
Because of L root deployment in Guwahati the latency in [6.21 ms], wherein the maximum is for E [339.43]

Measurement : meity.gov.in A record
Location : Guwahati Anchor
Zone : [gov.in.]

TLD Zone

Resource Record	Value	Time(ms)
ns1.registry.in.	37.209.192.12	79.26
ns4.registry.in.	37.209.198.12	80.49
ns5.registry.in.	156.154.100.20	79.63
ns6.registry.in.	156.154.101.20	75.48
ns3.registry.in.	37.209.196.12	78.57
ns2.registry.in.	37.209.194.12	57.19

TLD Zone Graphical View



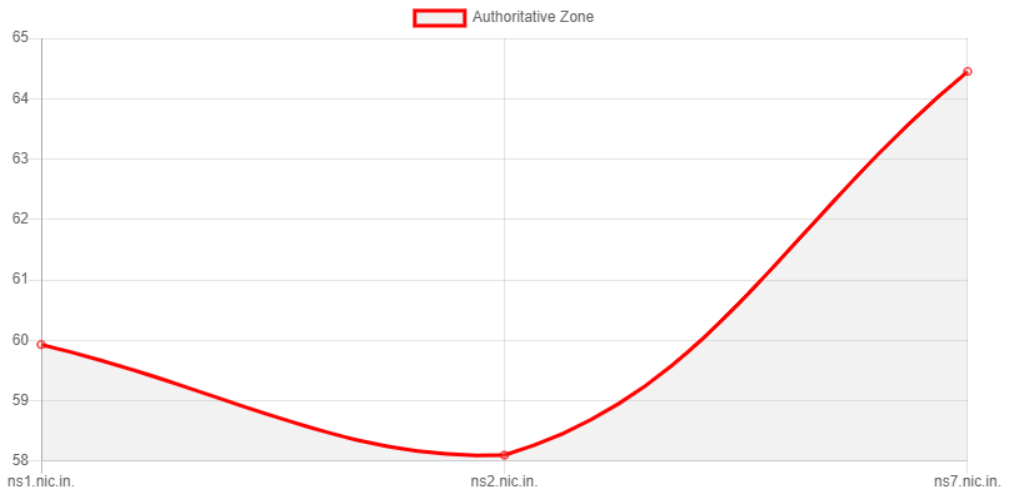
Use Case 4 :Autorotative zone availability/Resiliency

Measurement : meity.gov.in A record
Location : Guwahati Anchor
Zone : [meity.gov.in.]

Authoritative Zone

Resource Record	Value	Answered	Time(ms)
ns1.nic.in.	164.100.14.3	true	59.93
ns2.nic.in.	164.100.10.18	true	58.10
ns7.nic.in.	164.100.2.11	true	64.45

Authoritative Zone Graphical View



USE CASE 5 :
TOOLS: DNSSEC VISUALIZER

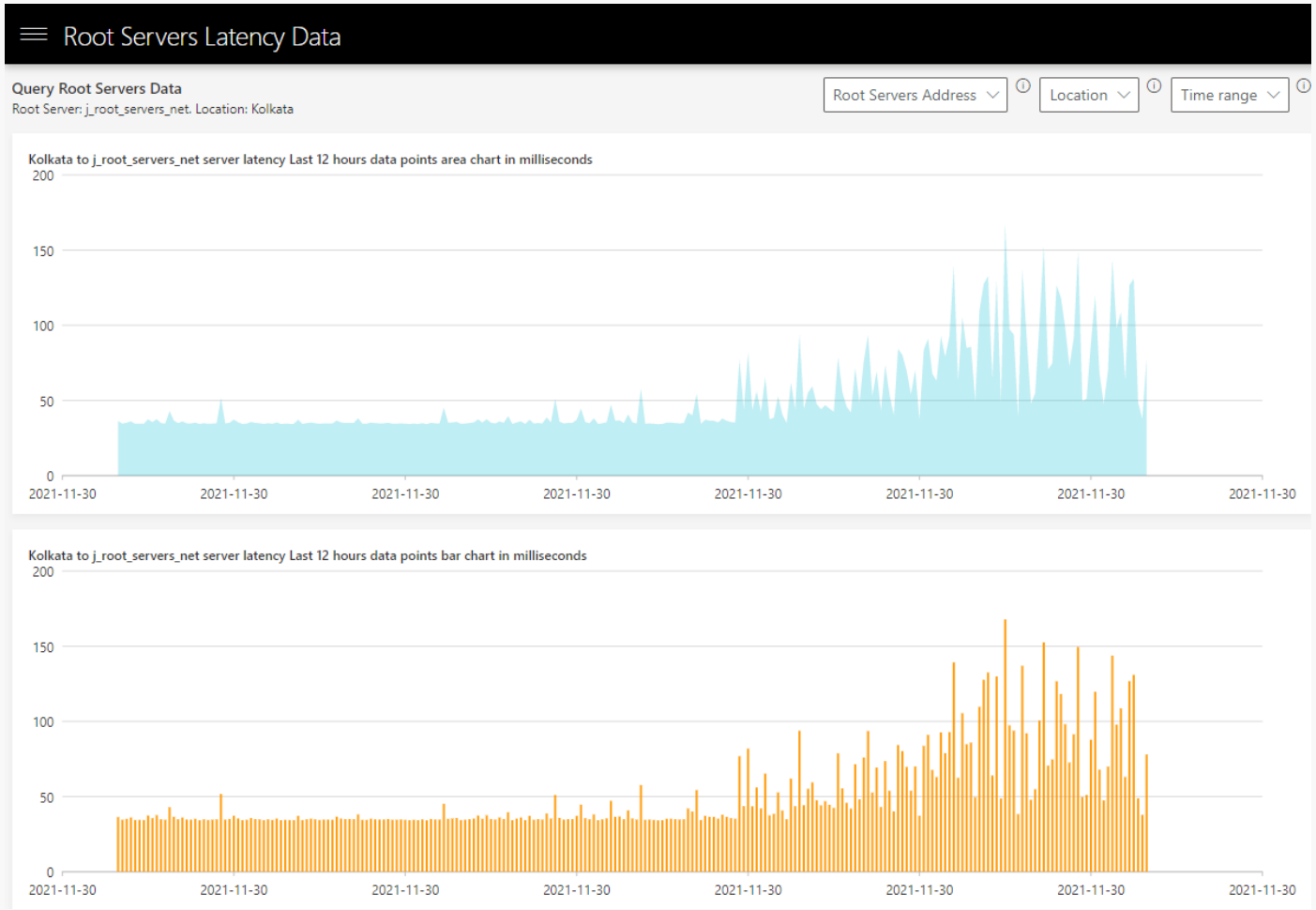
USE CASE 6 :
DNS SERVER HEALTH MEASUREMENT IN A GEOGRAPHIC REGION

Measurement : 13 root server latency from anchors

The historic data will provide us inputs in the event of DDoS attacks or other failures, and it will act as alarm system from users' perspective.

Best suited for edge deployment measurements

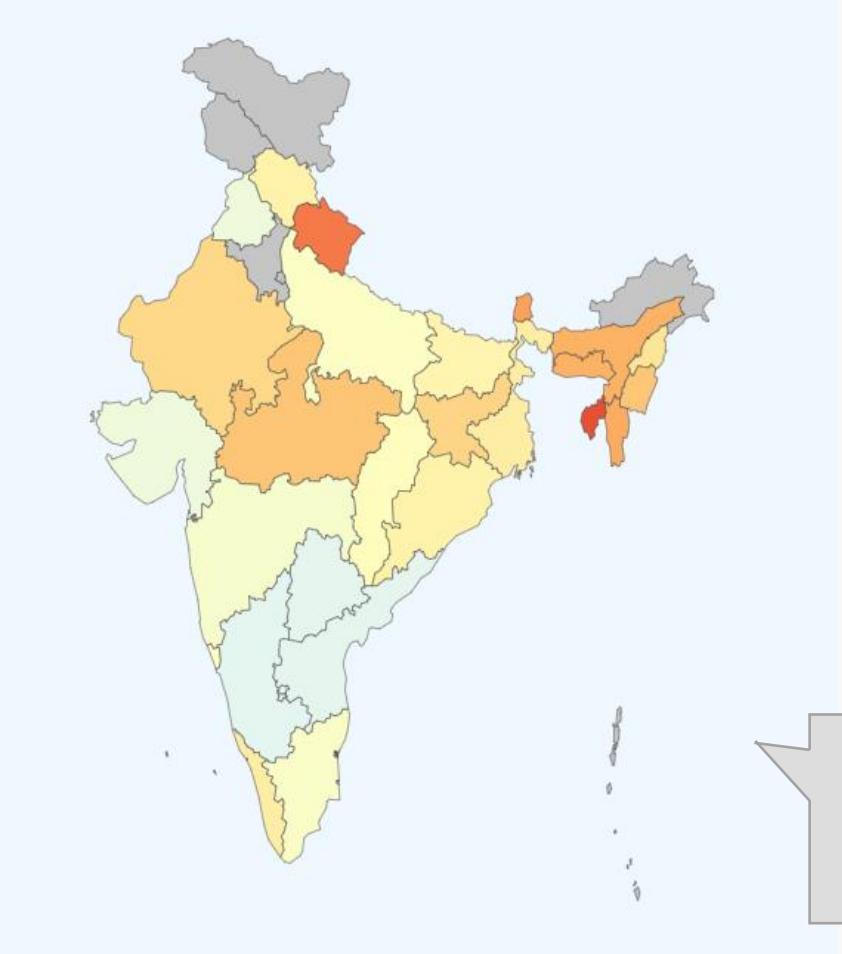
Sample data available in https://tools.aiori.in



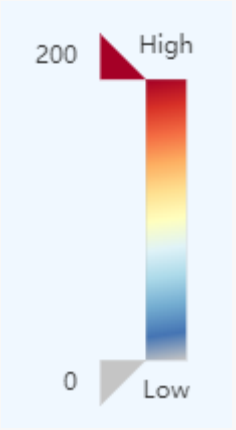
AIORI
Advanced Internet Operations Research in India

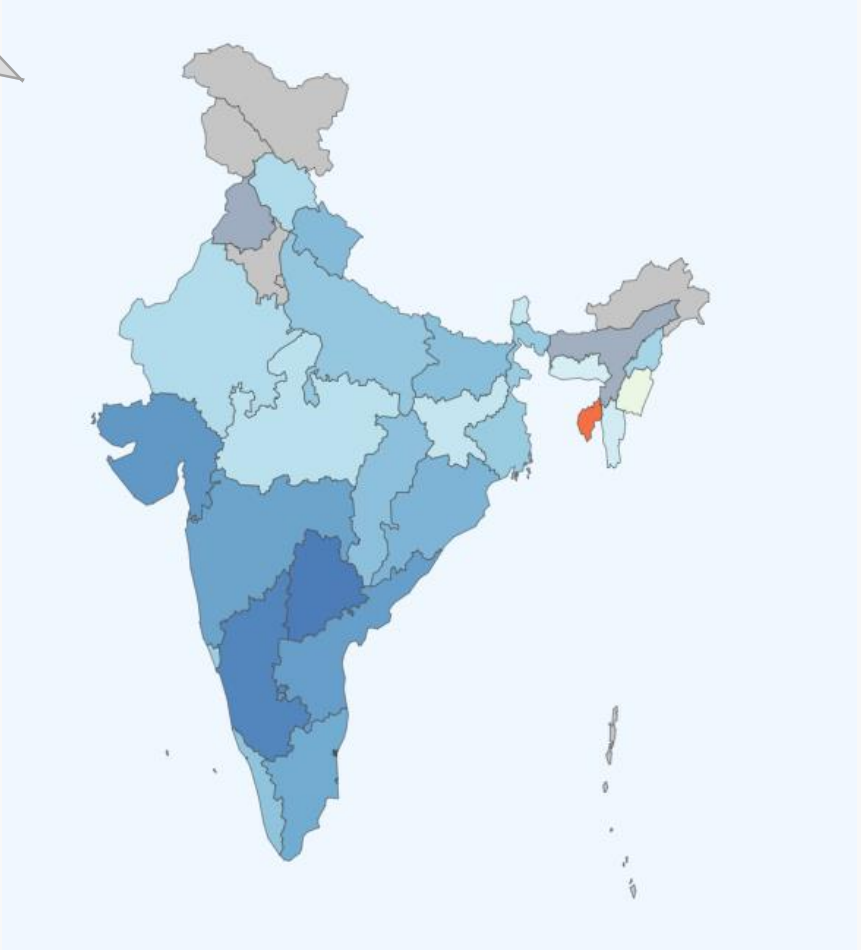
https://aiori.in

Continuous monitoring and measurement for availability and quality of Critical Internet and Information Infrastructure within the country



L Root





All Root Instances

THANKS

TEAM AIORI

HTTPS://AIORI.IN