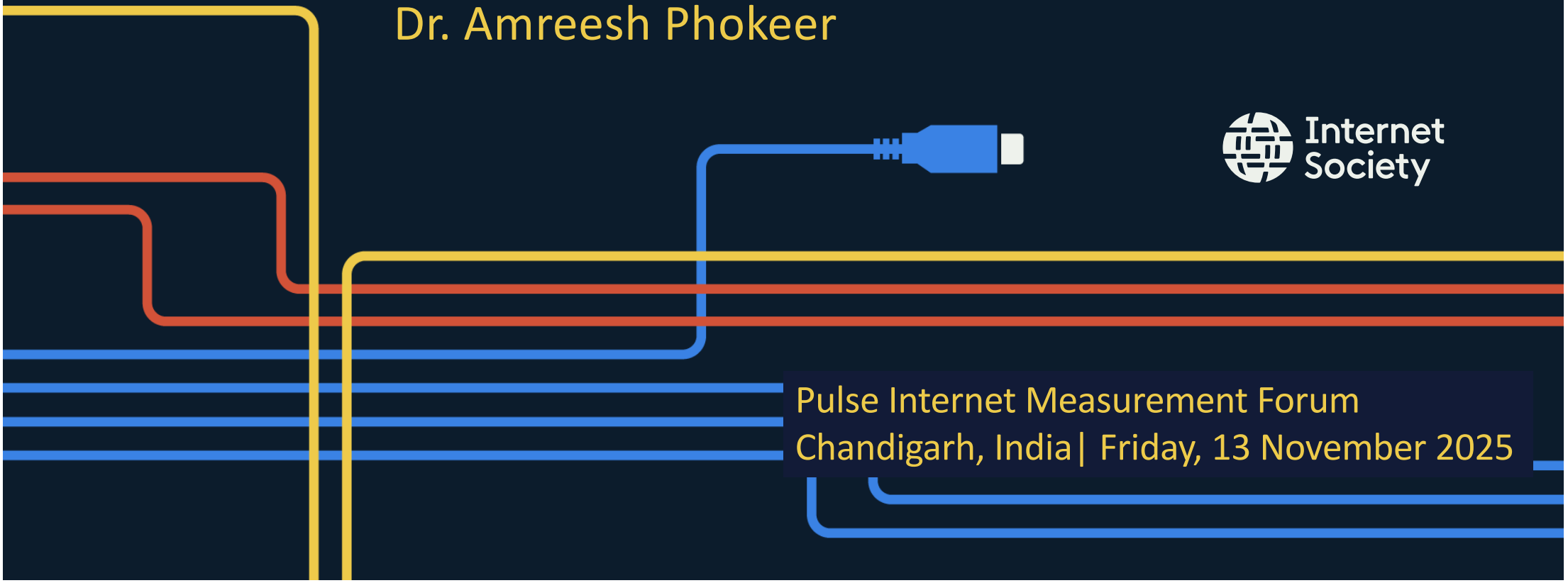
Why Measure the Internet?

Dr. Amreesh Phokeer



Internet Society

Pulse Internet Measurement Forum
Chandigarh, India| Friday, 13 November 2025

~ % whoami

- From Mauritius 🇲🇺
- Internet Measurement Expert at the Internet Society
- Previously Research Manager at AFRINIC
- ACM IMC, USENIX SEC, Sigcomm, IEEE Comsnets
- PhD in Computer Science

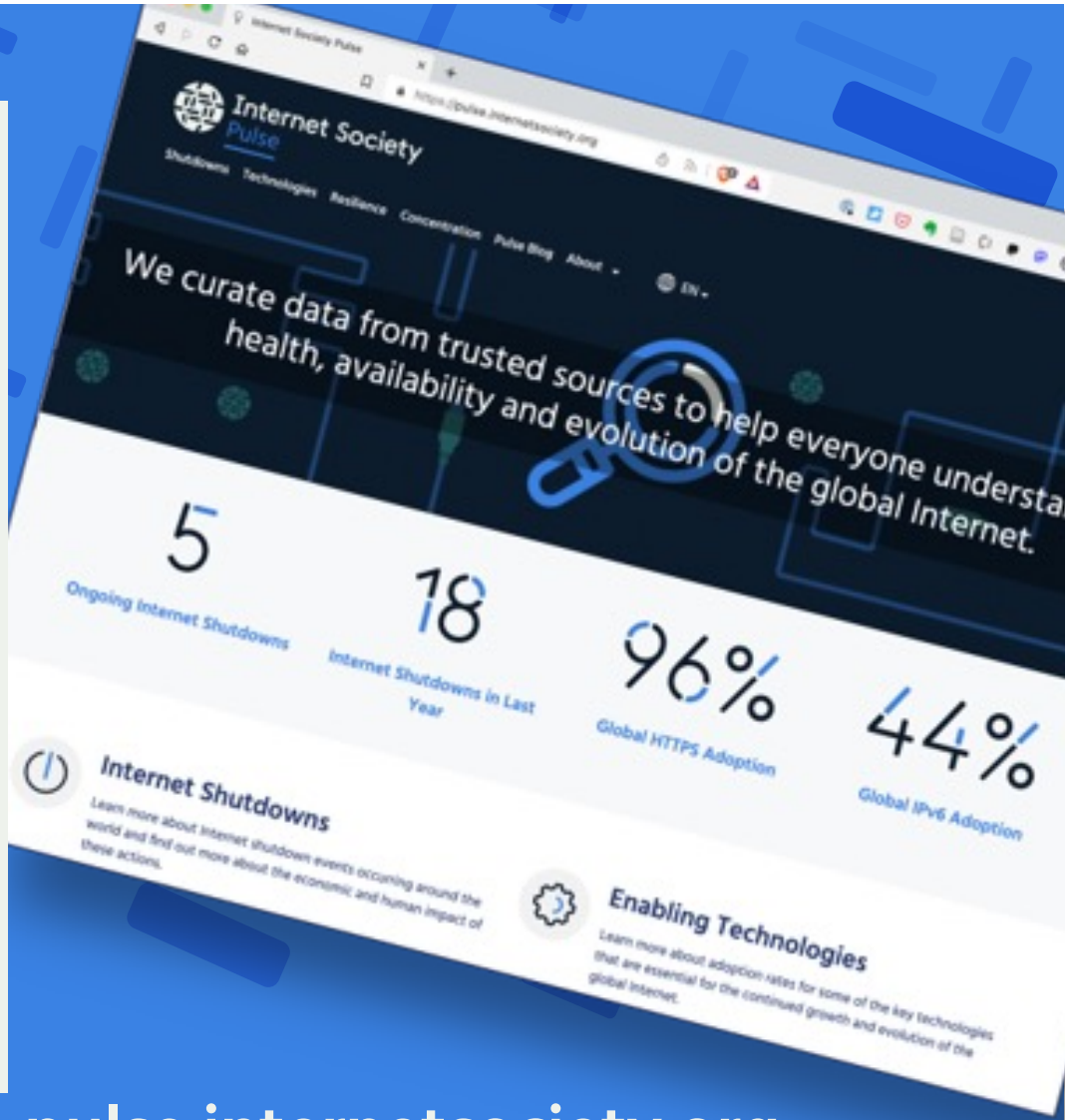
https://amreesh.github.io/

Internet Society Pulse

- Launched in December 2020.
- We curate Internet measurement data from trusted sources to help everyone gain deeper, data-driven insight into the Internet.

Trusted data from multiple sources:

- **Benefit**: Helps to assess whether efforts to ensure that the Internet remains open, globally connected, secure, and trustworthy are working.
- **Benefit:** Allows policymakers, researchers, journalists, network operators, civil society groups, and others to better understand the health, availability, and evolution of the Internet.



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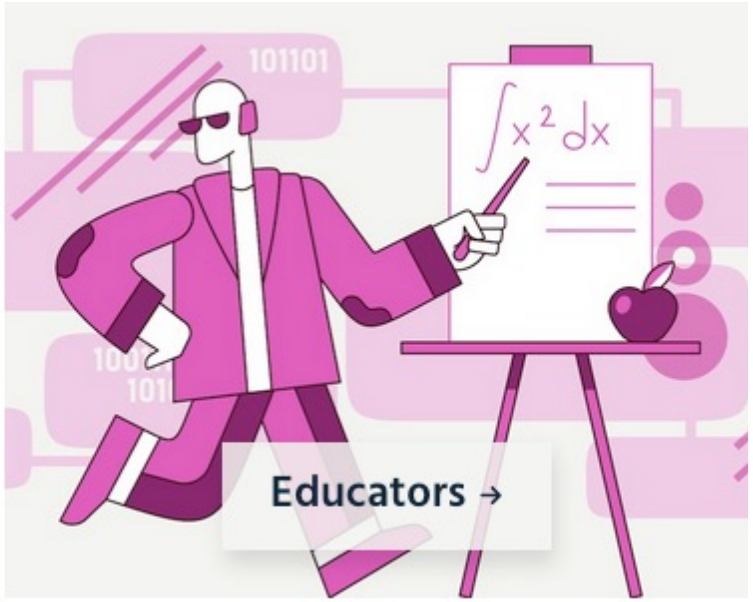
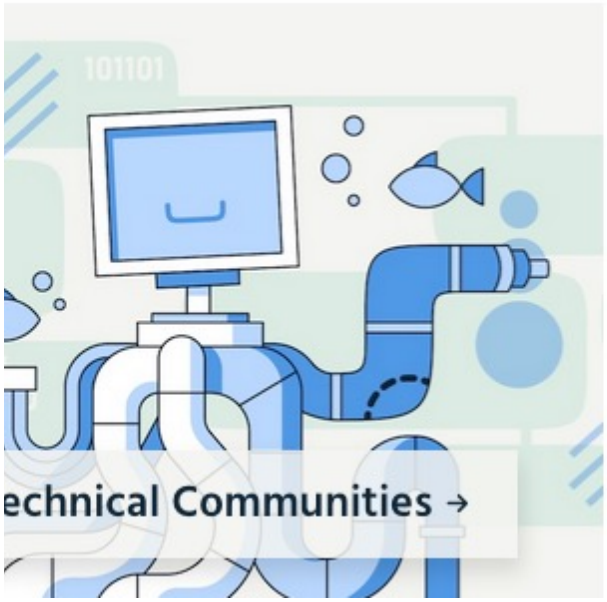


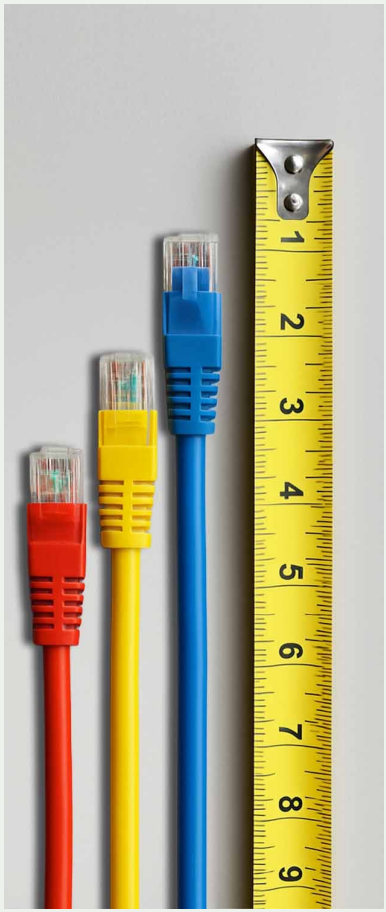


https://www.internetsociety.org/issues/internet-governance/who-runs-the-internet/

“When you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind”

Lord Kelvin

Why measure?



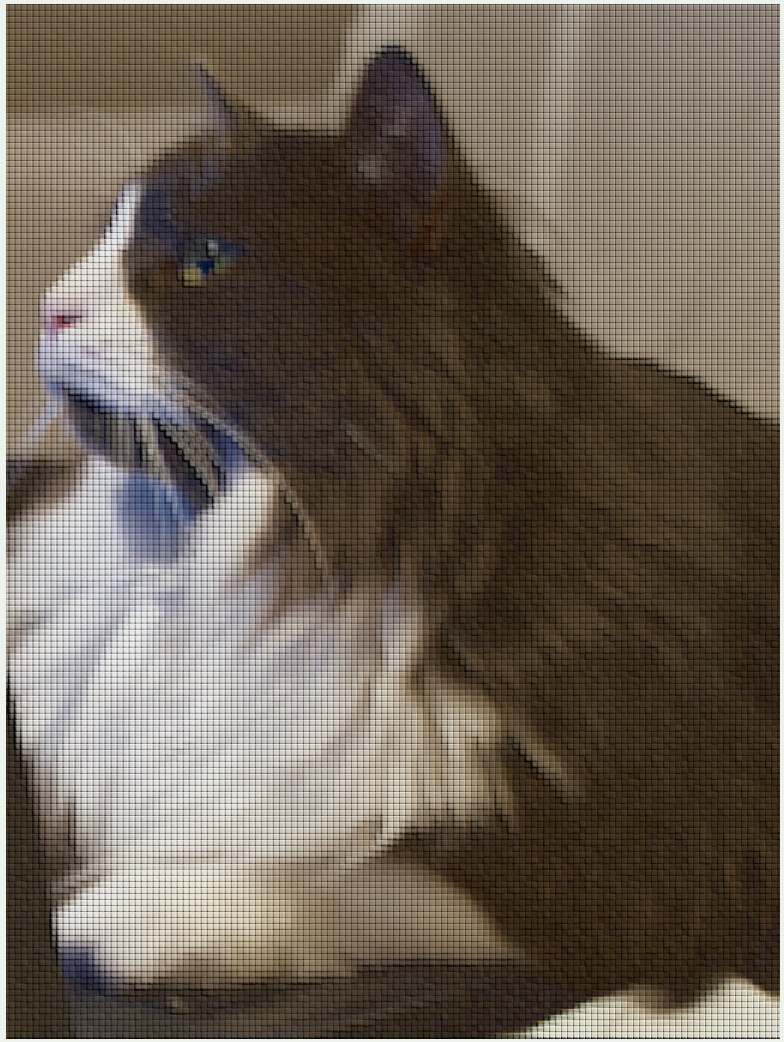
- Effective digital policy requires a clear view of the network. Without data, we are making decisions based on anecdotes, not evidence.
- Without data, we are forced to be **reactive** to problems (like outages or congestion) rather than **proactive** in building resilience.
- We cannot measure the true impact and Return on Investment (ROI) of major national projects like **BharatNet** or digital literacy initiatives.

What is Internet Measurement?

• "Internet measurements are like health check-ups for the Internet. They help us understand how data flows, where bottlenecks are, and how fast your cat pictures load.”

• Active Measurements: Sending probes (e.g., ping, traceroute) to measure performance. "Think of it as knocking on your neighbor’s door to see if they’re home.”

•Passive Measurements: Observing traffic without interfering. "Like eavesdropping on a conversation (but legally!)."



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Understanding the Onion

Physical Layer (Outer Peel): The cables, fiber, and radio waves. (e.g., Cable cuts, infrastructure mapping).

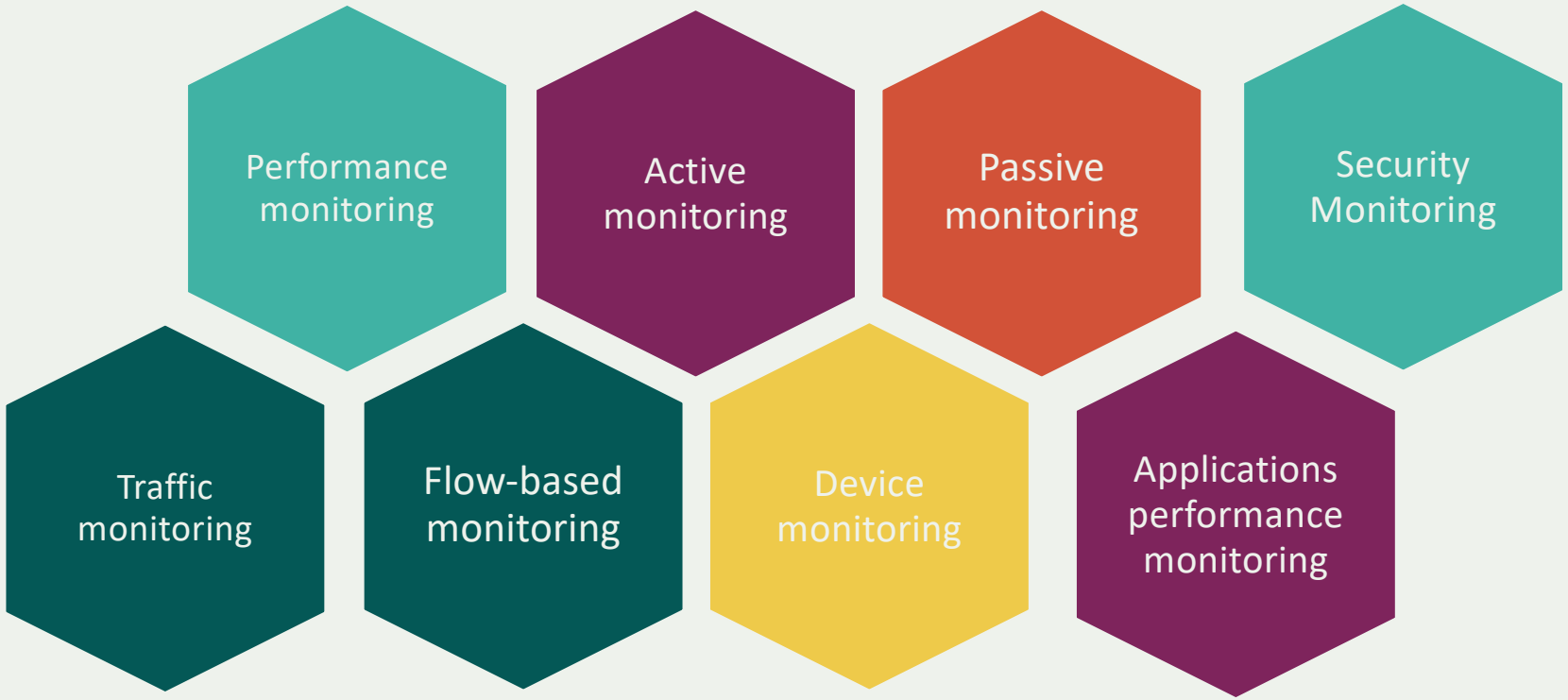
Data Link Layer: How devices on a local network communicate. (e.g., Ethernet, Wi-Fi performance).

Network Layer: IP addresses and routing. How data finds its way across the globe. (e.g., BGP routing integrity, latency).

Transport Layer: Ensuring reliable data delivery between applications. (e.g., TCP/UDP performance, packet loss).

Application Layer (Core): What users directly interact with. (e.g., Website loading times, streaming quality, DNS resolution).

Types of Network monitoring



What Can We Discover by Measuring the Internet?

Key Insights:

- **Latency**: How long it takes for your cat picture to load.
- **Packet Loss**: Why your video call freezes mid-meow.
- **Routing Paths**: The secret highways your data takes to reach you.
- **Congestion Points**: Where the internet gets clogged (like traffic jams for data).

Source: NDTV

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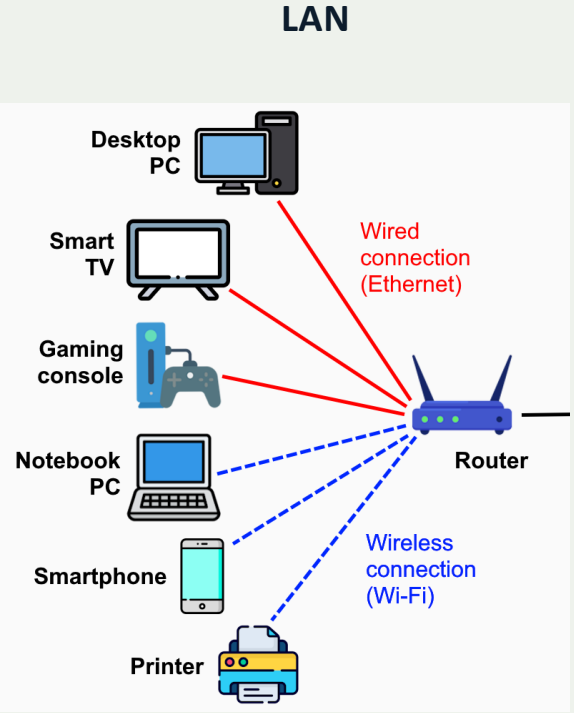
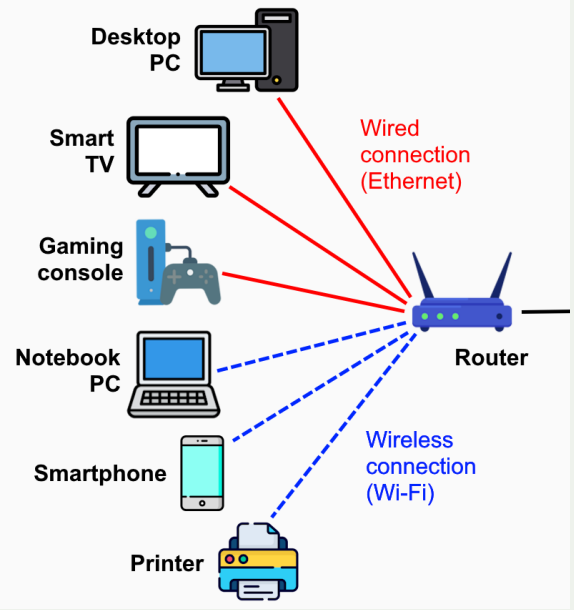
Where do we do measure? DATA PLANE

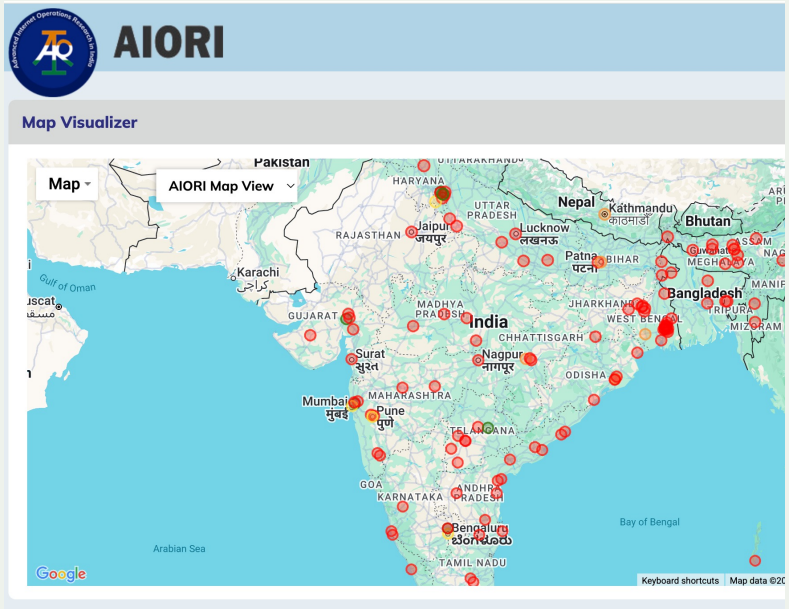


Where do we do measure?

LAN



WAN



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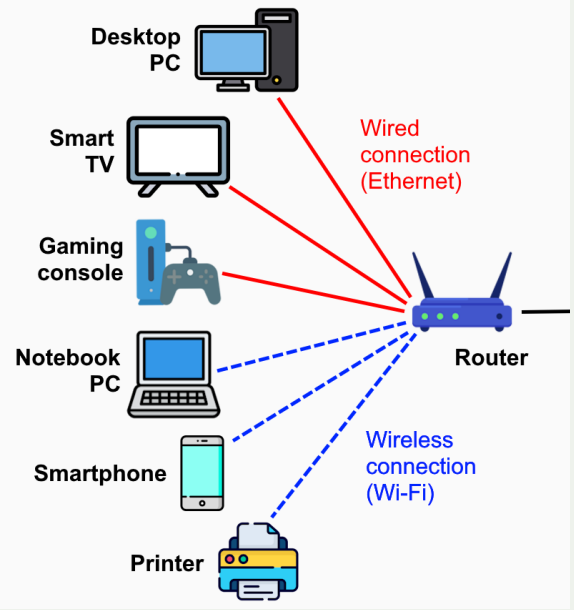

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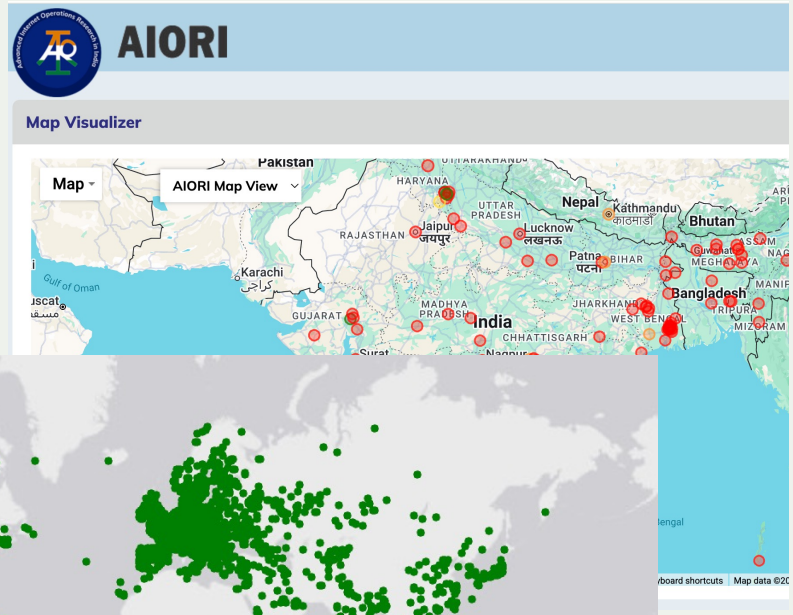
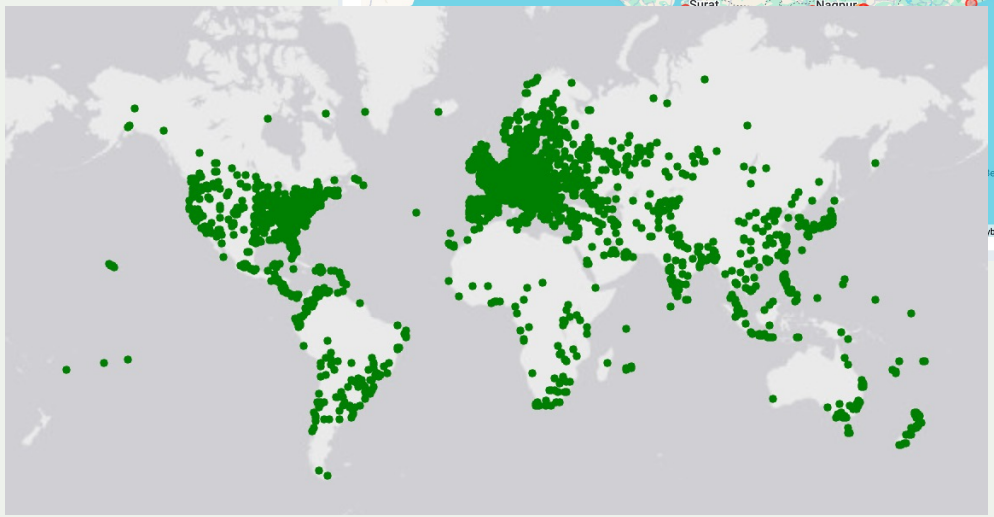
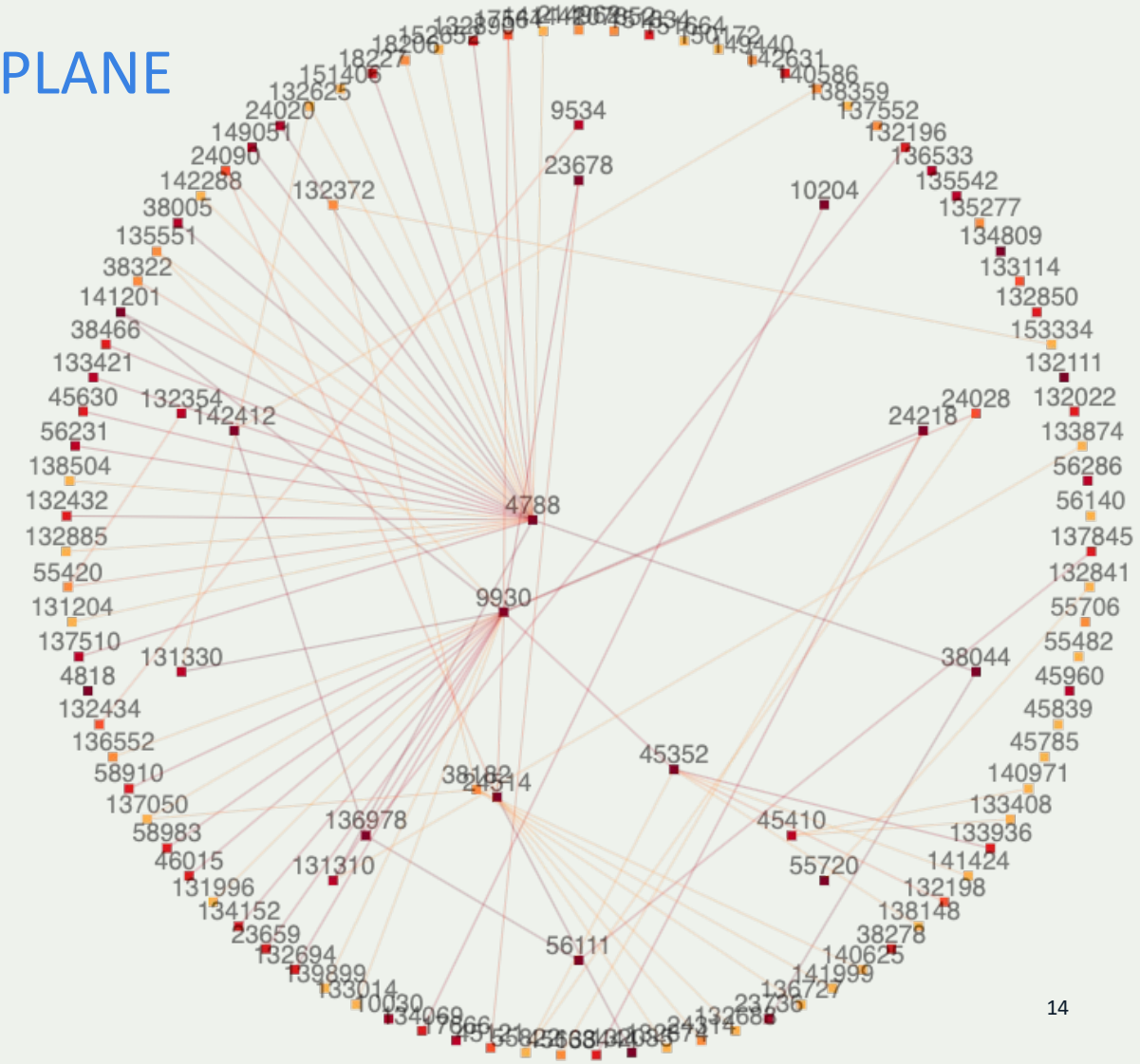




RIPE Atlas

Network topology – CONTROL PLANE

- Routeviews
- RIS (RIPE NCC)
- PCH (Packet Clearing House)
- Looking Glasses



Peering and interconnection

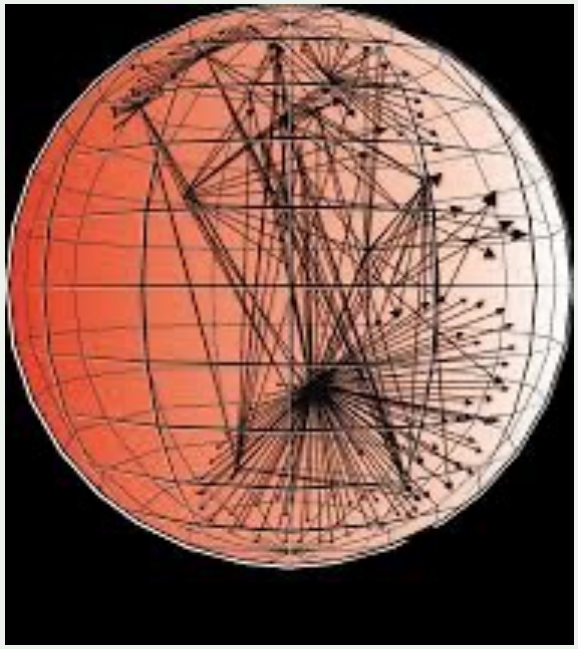
- IXPs play a huge role in improving Internet performance & resilience.
- Measurements help identify **where new peering opportunities exist**.
- Data gaps and biases mean we must **interpret results carefully**.
- Better measurement = **better interconnection decisions**!

APNIC Blog

Internet Background Radiation

IBR is unsolicited network traffic that is sent to non-existent or unused IP addresses on the Internet caused by:

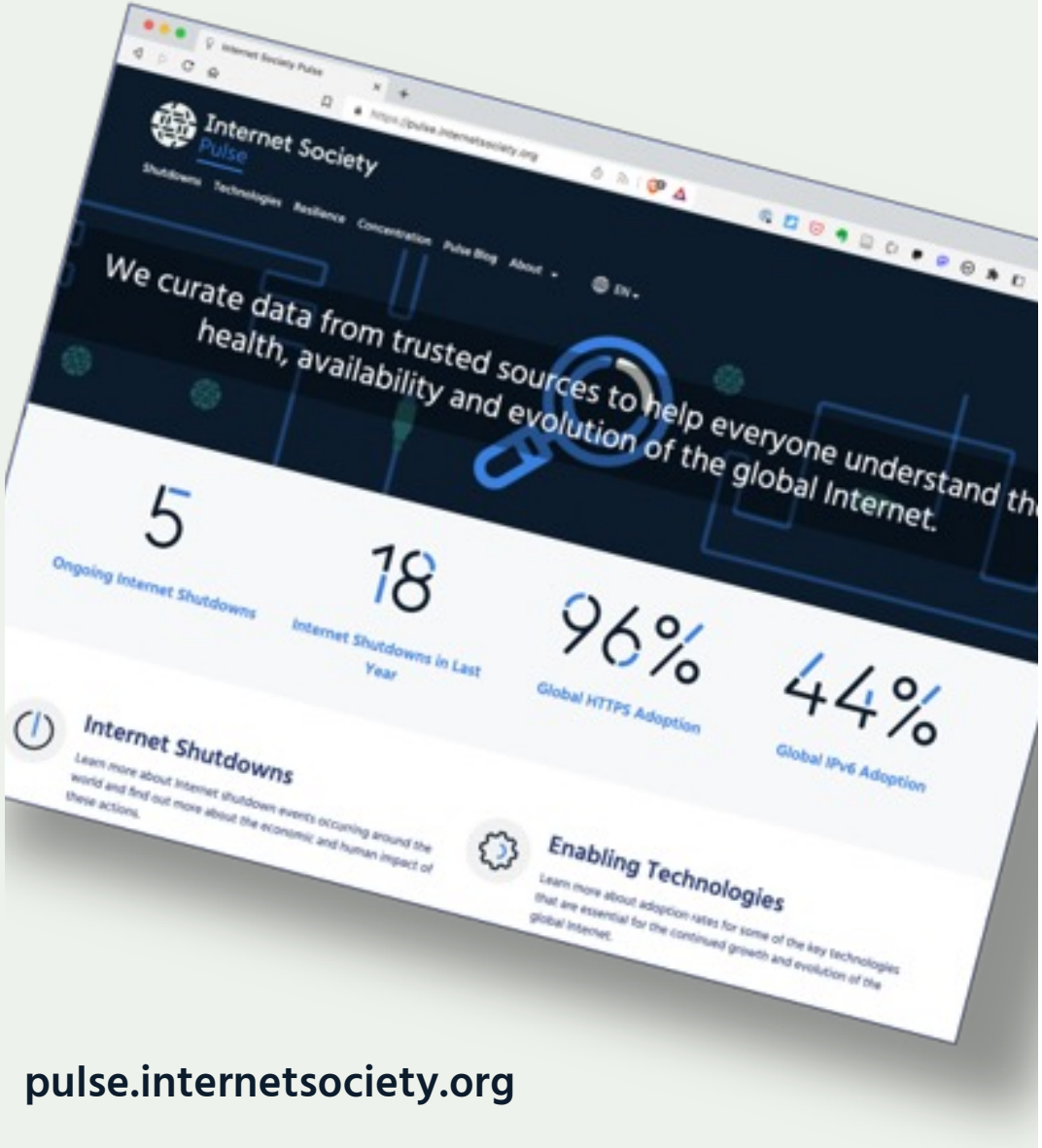
- **Malicious activities**: Scans for vulnerable hosts, worms, and the "backscatter" from Distributed Denial of Service (DDoS) attacks.
- **Misconfigurations**: Incorrectly configured devices or commands can send packets to the wrong destination.
- **Network errors**: Traces of network activity or errors can get sent out inadvertently.



CAIDA

What Pulse offers?

- Provides Relevant Data: Pulse gives you statistics and context to support your positions and influence policy development.
- Tracks National Resilience: Using the 4 pillars (Infrastructure, Performance, Security, Market), you can track Internet resilience score over time.
- Monitors Disruptions: Get real, objective data on shutdowns and outages, helping you understand their technical implementation and impact.
- Identifies Opportunities: By showing where peering is low or routing security is weak, Pulse highlights where policy can make the biggest difference.



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A Data-Driven Policy Lifecycle

1. Measure

Use tools like RIPE Atlas, and AIORI stats to get a baseline of your network's health.

2. Identify

Pinpoint the problems: bottlenecks, single points of failure, "digital deserts," or security gaps.

3. Act

Formulate targeted, evidence-based policy. (e.g., Invest in IXPs, liberalize ISP licenses, fund BharatNet).

4. Verify

Continue measuring to prove the policy's effectiveness, demonstrate ROI, and hold stakeholders accountable.

Case studies: COMCAST 2008

The Measurement

Network researchers and users employed various **traffic analysis and measurement tools** to detect and document how the ISP **Comcast** was managing its network traffic. The measurements revealed that Comcast was using "deep packet inspection" to send false "reset packets" to its customers, **selectively blocking or delaying** their use of peer-to-peer file-sharing applications like BitTorrent. This was happening regardless of the level of network congestion.

Regulatory Impact

This concrete, measurable evidence was central to the U.S. Federal Communications Commission's (FCC) finding in 2008 that Comcast's practice was "unreasonably discriminatory" and interfered with consumers' rights. This case and others fueled the debate and helped lead to the formal adoption of **Open Internet Rules** (Net Neutrality rules), which included prohibitions on blocking and throttling, subject to reasonable network management.

Case studies: Measuring Broadband America program

The Measurement

The FCC in the U.S., for instance, has conducted broadband speed and performance testing programs (like the **Measuring Broadband America program**) that collect data from thousands of volunteers across the country. These measurements gather data on speeds, latency, and packet loss for various ISPs.

Regulatory Impact

This data provides a clear, objective assessment of real-world internet performance versus advertised speeds. Regulators use this to:

- Hold ISPs accountable for their marketing claims.
- Inform policy decisions on where subsidies are needed for underserved areas.
- Establish minimum quality of service requirements for companies receiving public funding to deploy broadband infrastructure.

India: TRAI Spectrum Auctions & Quality of Service Regulations

The Measurement

TRAI heavily uses data from:

Drive tests

Call drop measurements

Broadband speed measurements

Crowdsourced apps like MySpeed

Regulatory Impact

Penalties for call drops introduced using measured call failure rates.

Minimum QoS requirements for broadband were updated based on speed-test data.

Spectrum reserve prices were tied to measurement-based network usage.

Bad example: Social Media Tax in Uganda (2018)

Policy:

Uganda introduced a daily tax on social media usage (200 UGX/day) after political leaders *claimed*, without evidence, that social media was being used for "gossip" and undermining social stability.

Impact:

- A **30% drop** in total Ugandan Internet users within months.
- Surge in VPN use, breaking the policy's purpose and further taxing networks.
- Significant loss of digital revenue for local businesses.
- Widened the digital divide between rural and urban communities.
- International criticism for being regressive and anti-innovation.

“Measurements provide objective, verifiable data, moving the conversation from assertion to evidence.”

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