RIPE NCC
RIPE NETWORK COORDINATION CENTRE

Introduction to Internet Measurements

Using RIPE Atlas

Webinar

January 2025

RIPE NCC Learning & Development

This session is being recorded

Agenda

Internet Measurements

RIPE Atlas

Exploring RIPE Atlas

Demo: Polls and Demo

Viewing Measurements

Demo: Step-by-step and Demo

Creating a Measurement

Demo: In RIPE Atlas and Demo

Analysing the Results

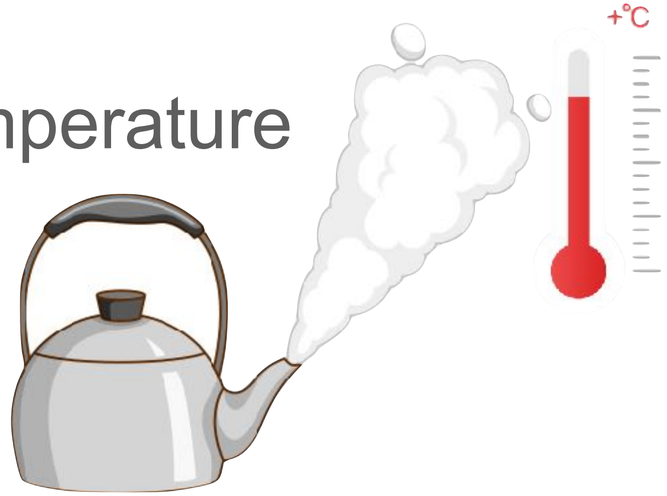
Getting Started!

Internet Measurements

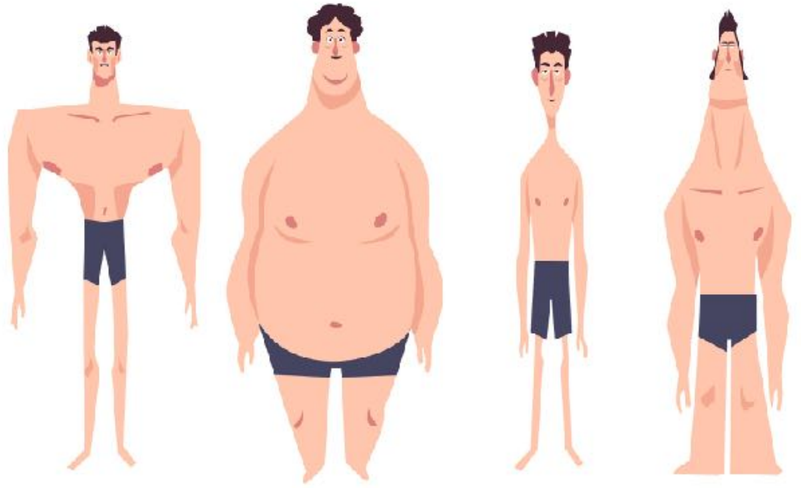
What do we measure?

What is a Measurement?

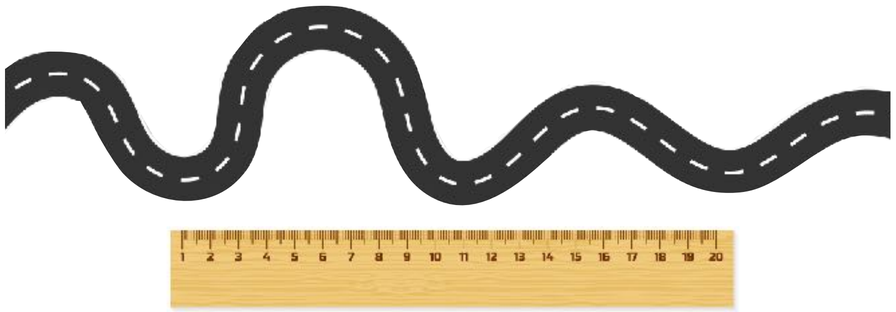
- Temperature



- Weight

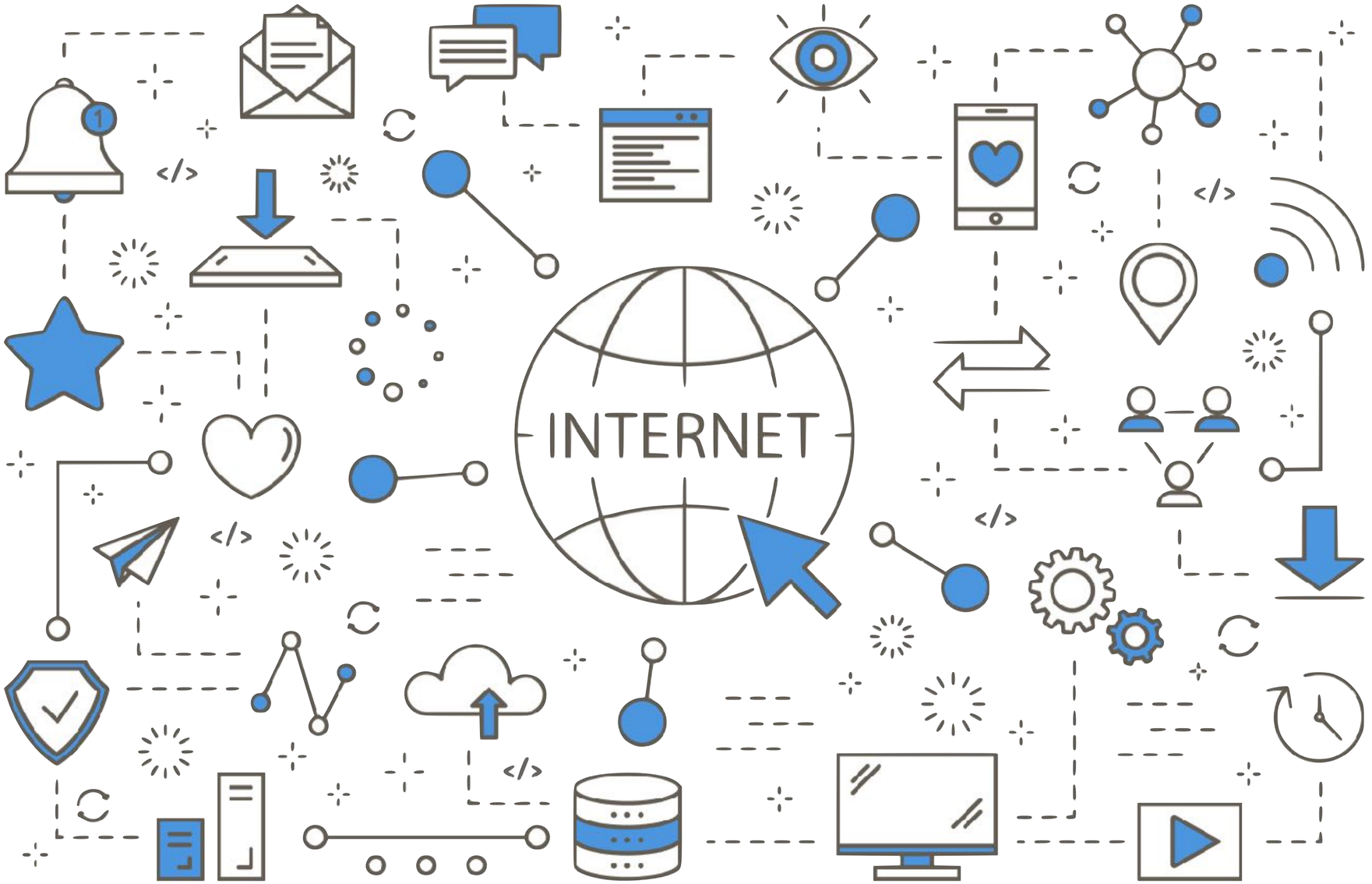


- Length



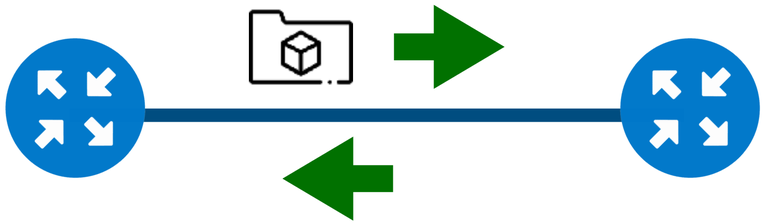
- Volume

Why Measure the Internet?

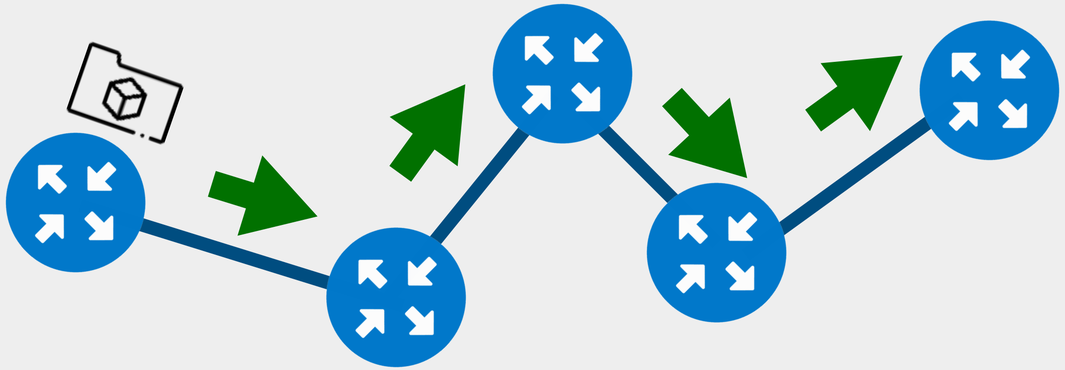


What Do We Measure?

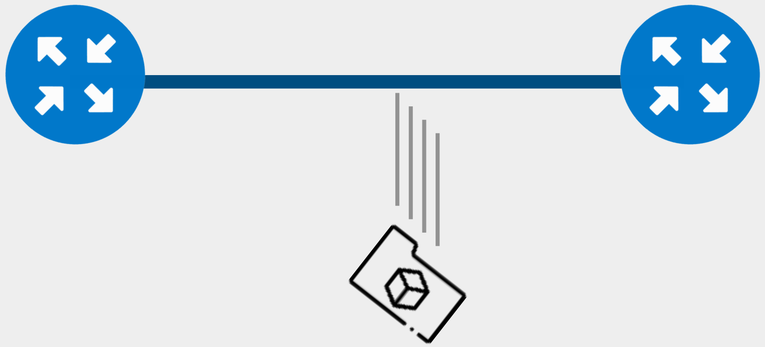
Latency / Delay / Jitter



Path / Hop count



Packet Loss



Availability / Uptime

Take the poll!

What would you like to **find out** about your Internet connections?

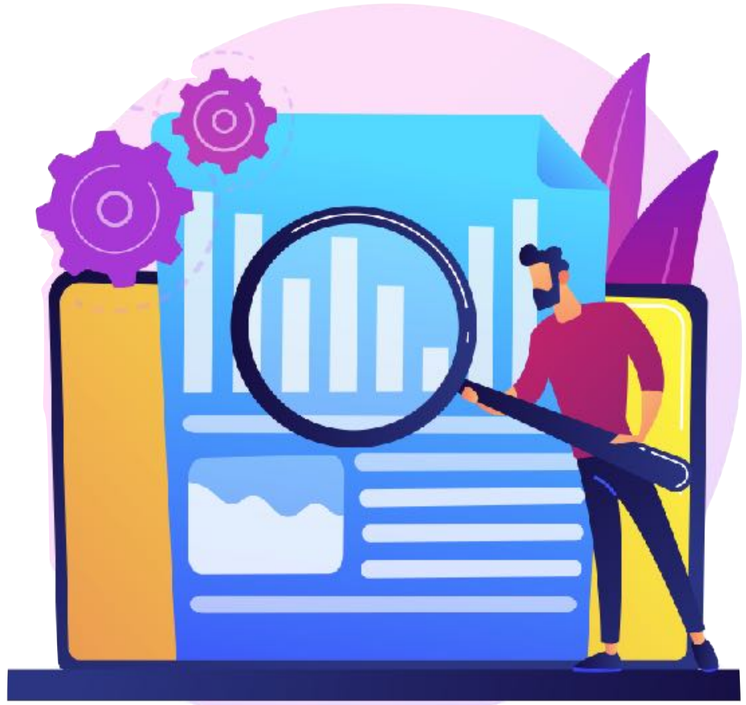
Write your answer.

1 min.

What Is Your goal?

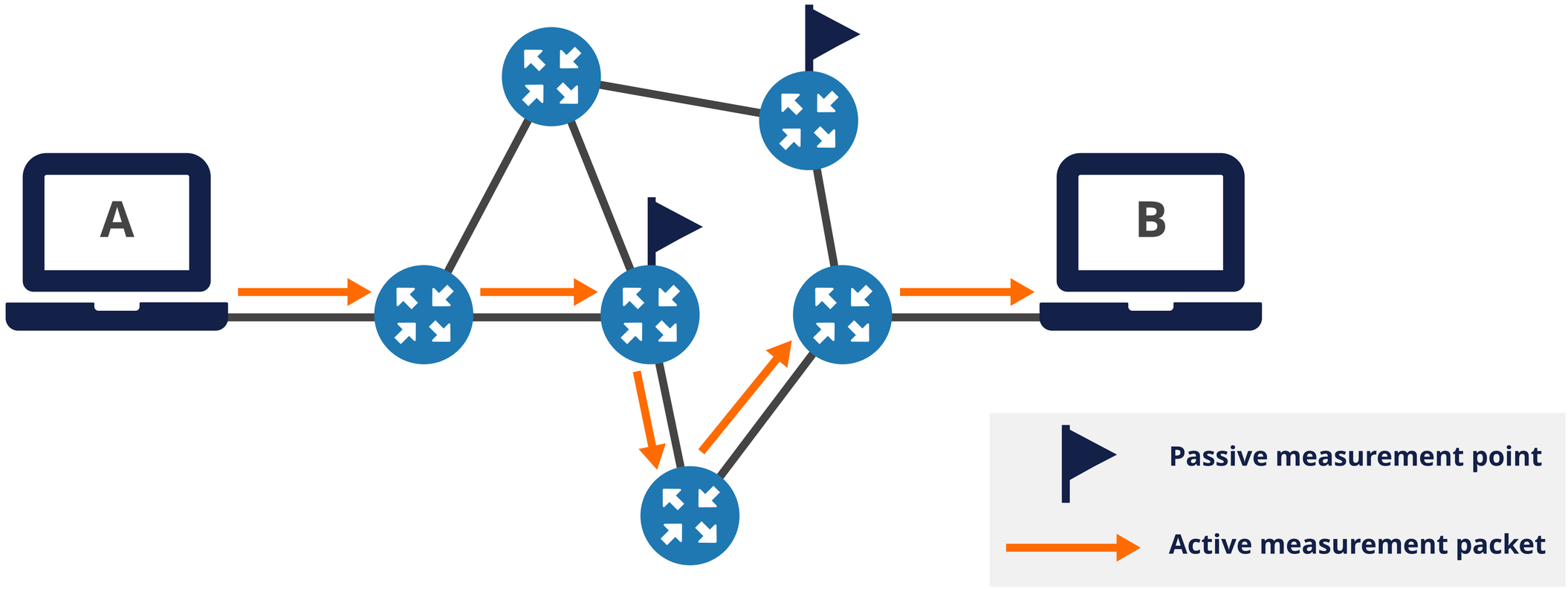
- Define a benchmark for your network
- Network performance monitoring
- Connectivity testing
- Troubleshooting network issues
- Geographic performance
- Discovering network topology
- Some other goals…?

Exploring Versus Confirming

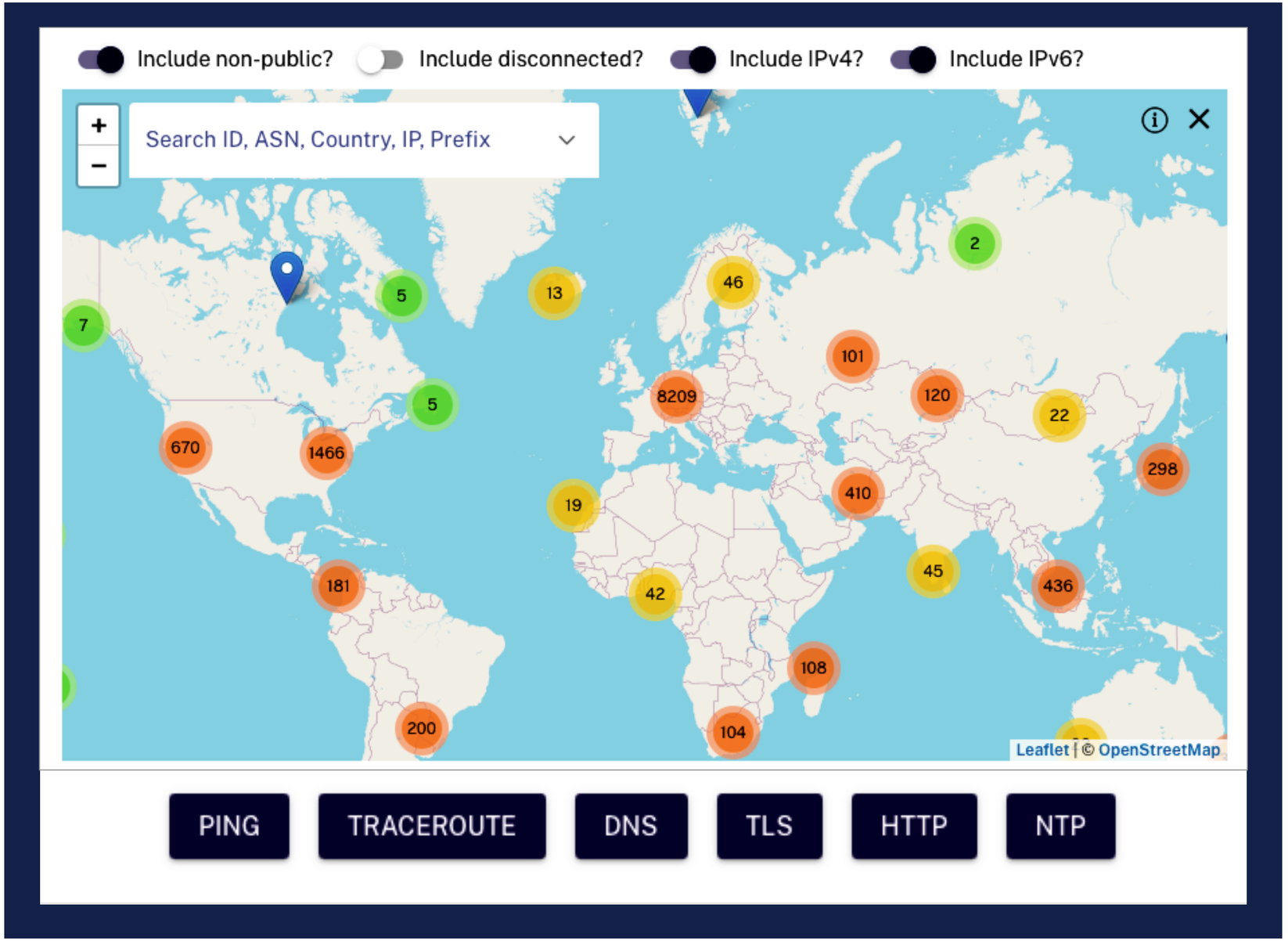


Active and Passive Measurements

- **Active**: Relies on active involvement in the data collection process
- **Passive**: Limited to capturing existing network traffic without interfering

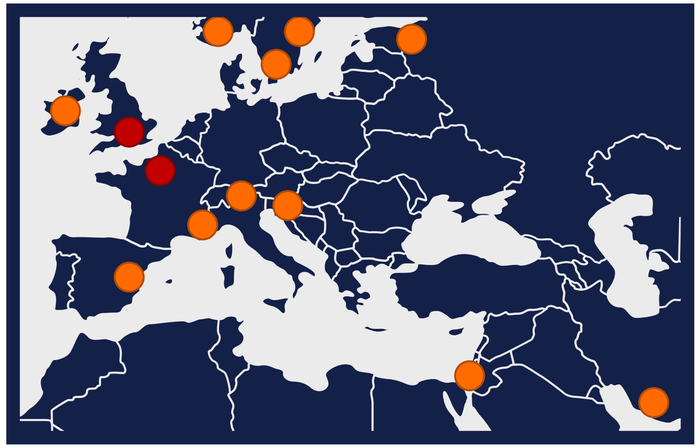


Location and Types



Consider the Context

- It is important to **understand the factors that surround a situation** to interpret results accurately
- Distinguishing between **problems** and **normal** variations in operations is crucial
- The **context in which the measurements are taken** adds credibility to the conclusions drawn



Concurrent outages
Regional events

Changing traffic patterns

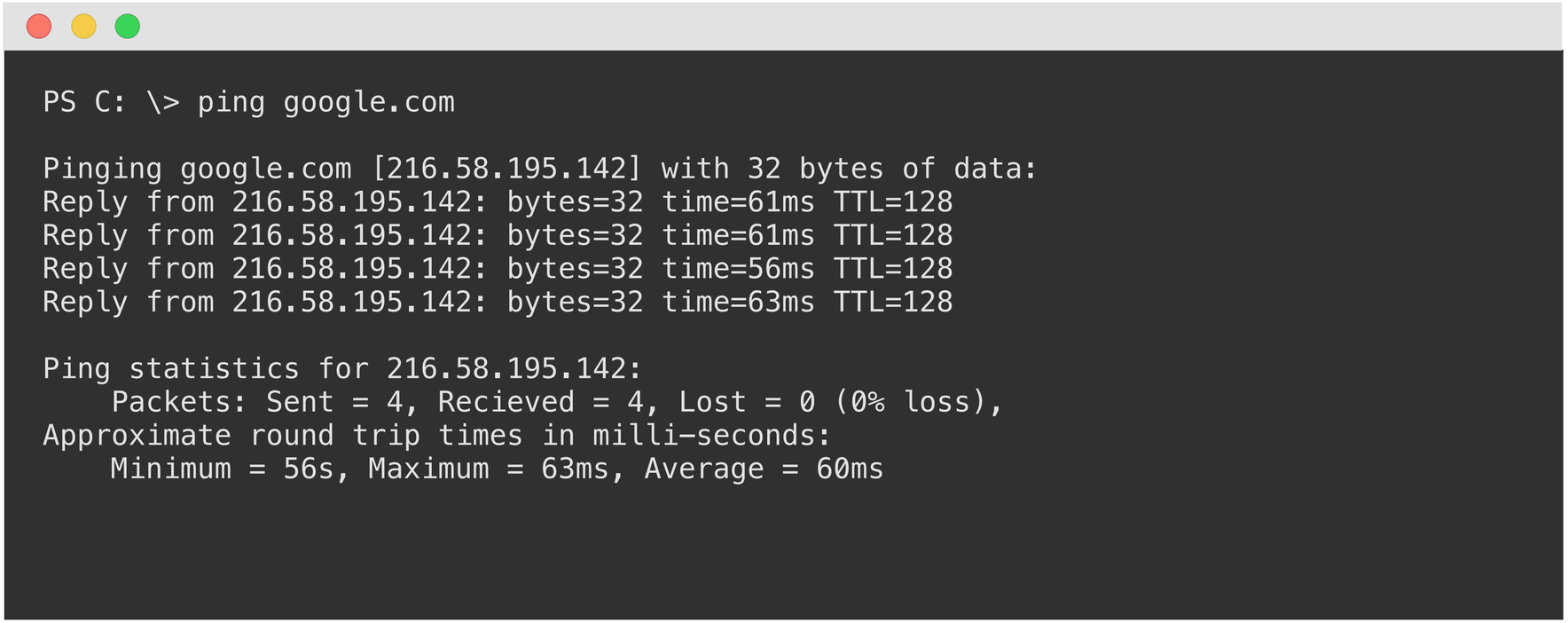
Weather/natural disasters

Types of Measurements

- ping
- traceroute
- dns
- tls
- http
- ntp
- Among others...

ping

- Sends packets to a target host
- Measures Round Trip Time (RTT)
- Also lets you know about packet loss



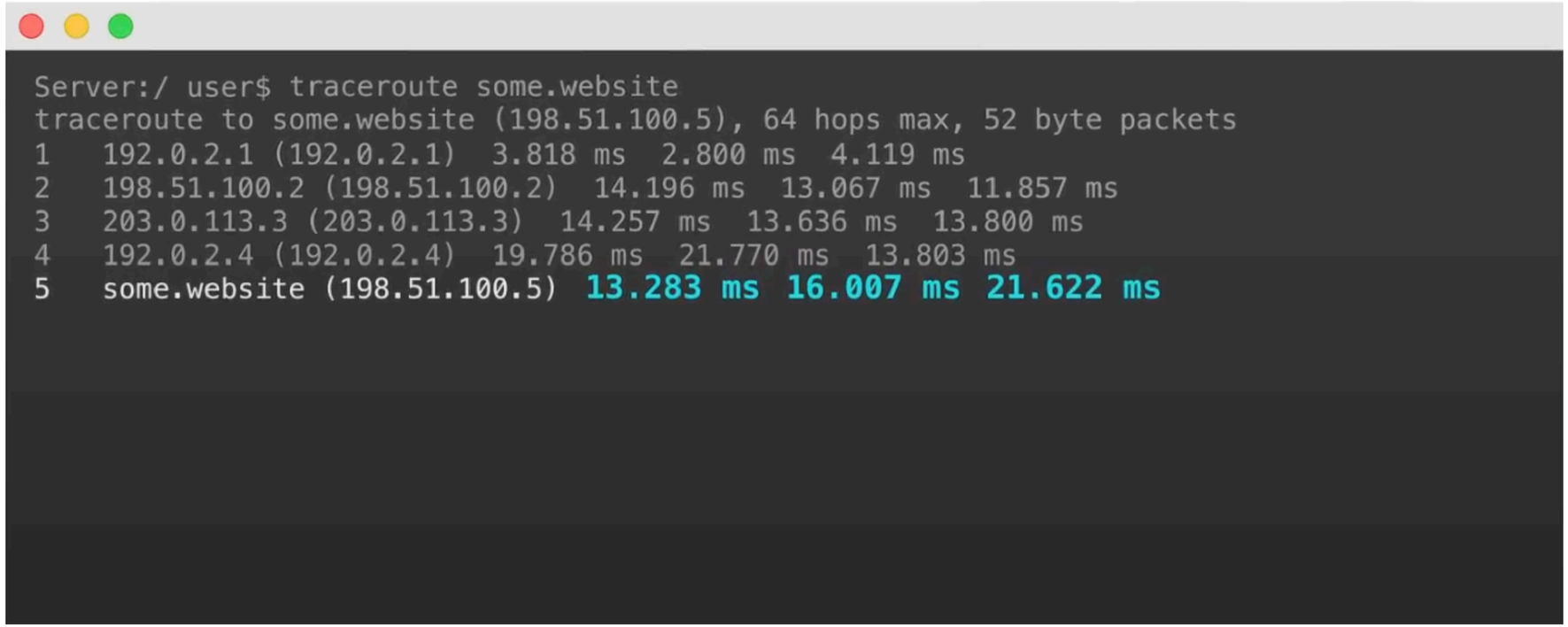
```
PS C: \> ping google.com

Pinging google.com [216.58.195.142] with 32 bytes of data:
Reply from 216.58.195.142: bytes=32 time=61ms TTL=128
Reply from 216.58.195.142: bytes=32 time=61ms TTL=128
Reply from 216.58.195.142: bytes=32 time=56ms TTL=128
Reply from 216.58.195.142: bytes=32 time=63ms TTL=128

Ping statistics for 216.58.195.142:
    Packets: Sent = 4, Recieved = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 56s, Maximum = 63ms, Average = 60ms
```

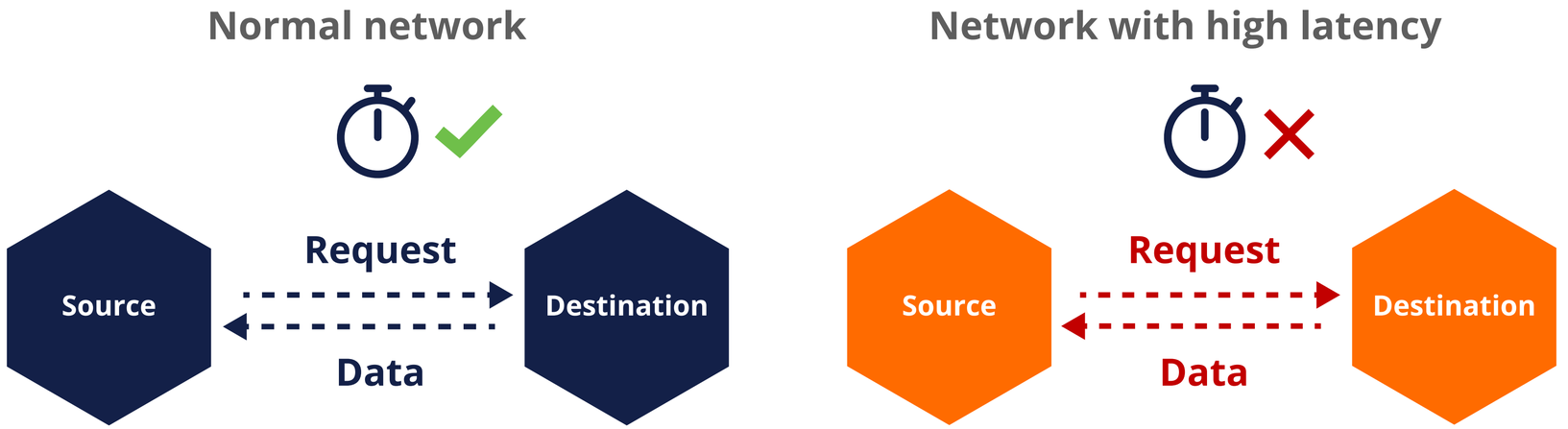
traceroute

- Tracks the path from the sender to the destination host
- Identifying each hop along the way

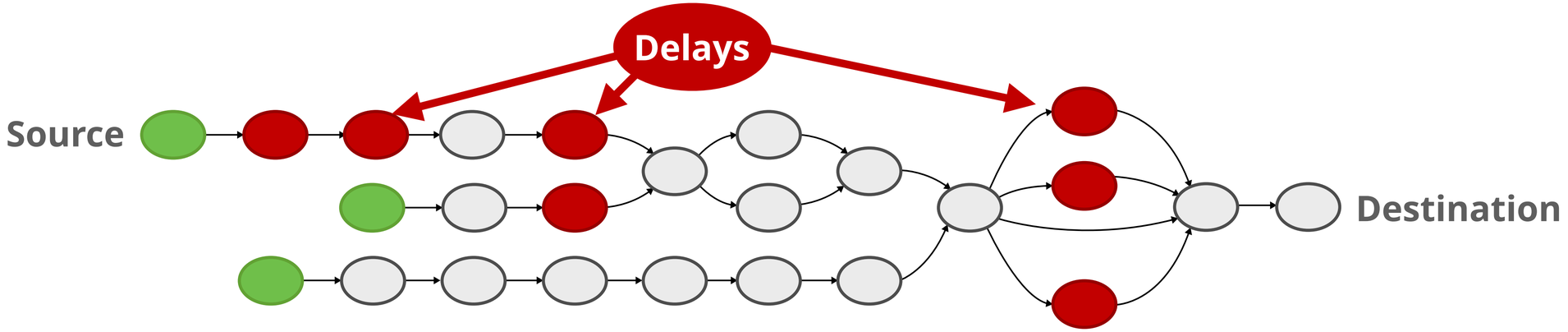


What Do Measurement Results Tell Us?

- **Ping RTTs** indicate end-to-end delay between nodes

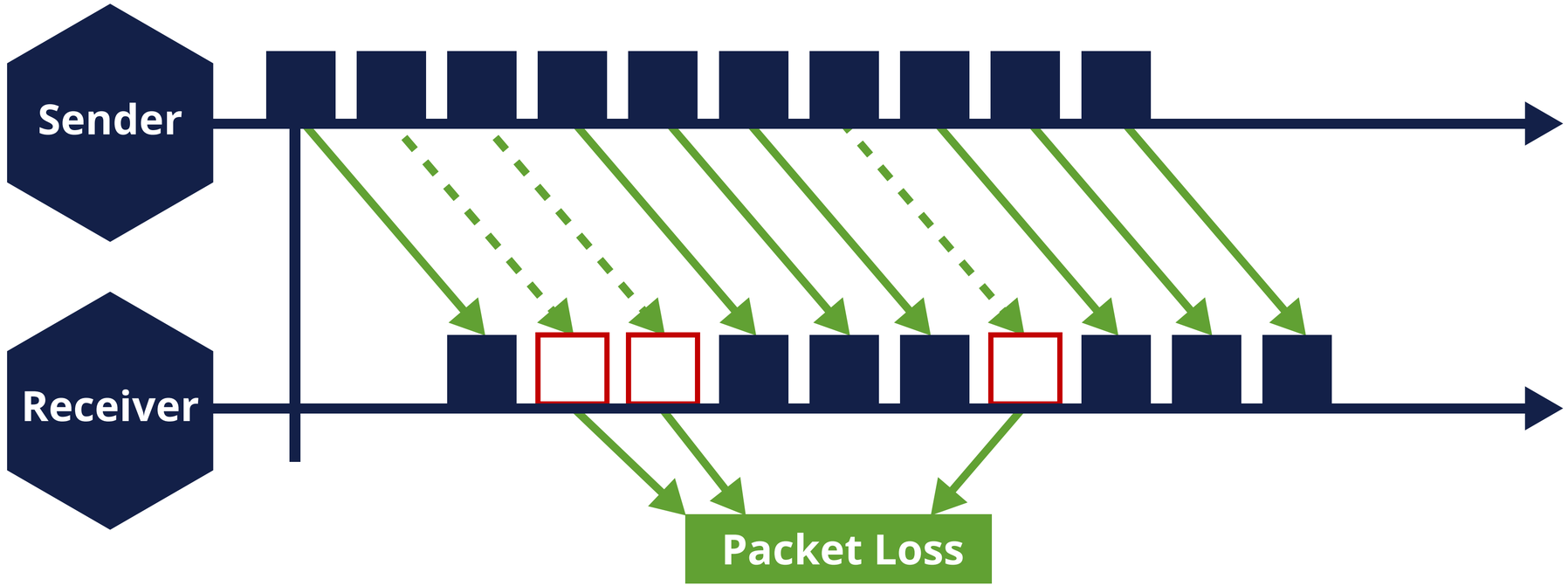


- **Traceroute hop performance** shows where delays occurs



What Do Measurement Results Tell Us?

- Packet Loss



Take the poll!

Can you think of **situations** that can affect your network performance?

Write your answer.

1 min.

Ethical Concerns

- **Invasion of Privacy**
  - Privacy concerns in Internet measurements: Monitoring individuals
  - Protect privacy: Consent, anonymisation, aggregation

- **Data Security and Protection**
  - Access, breaches, protection
  - Encryption, storage, access control: Data integrity

Ethical Concerns

- **Transparency and Informed Consent**
  - Clear communication: Purpose, scope, risks
  - Informed consent: Participant's informed decision

- **Responsible Data Handling**
  - Protect identities: Anonymise, aggregate data
  - Follow data protection laws for responsible handling
  - Measurements may expose the network topology

RIPE Atlas

An Internet Measurement Tool

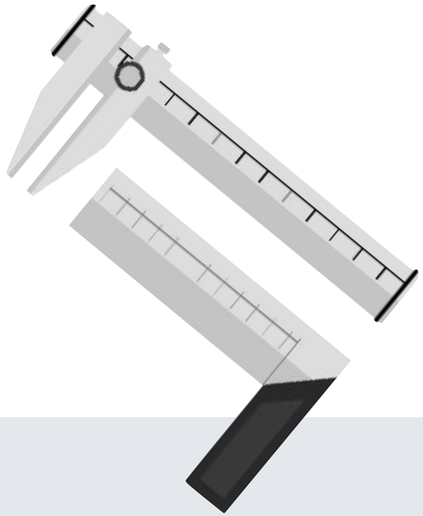
An Introduction

- RIPE Atlas is a **global active measurements platform**
- **Goal**: Measure the performance, connectivity, and stability of the Internet
- Probes (our vantage points) are hosted by **volunteers**
- Data **publicly available**
- **Users**: Network operators, researchers, etc.
- **Applications**: Route monitoring, DNS performance analysis, Latency mapping, Outage detection, Peering analysis, IPv6 deployment monitoring, DDoS attack analysis and more!

https://atlas.ripe.net

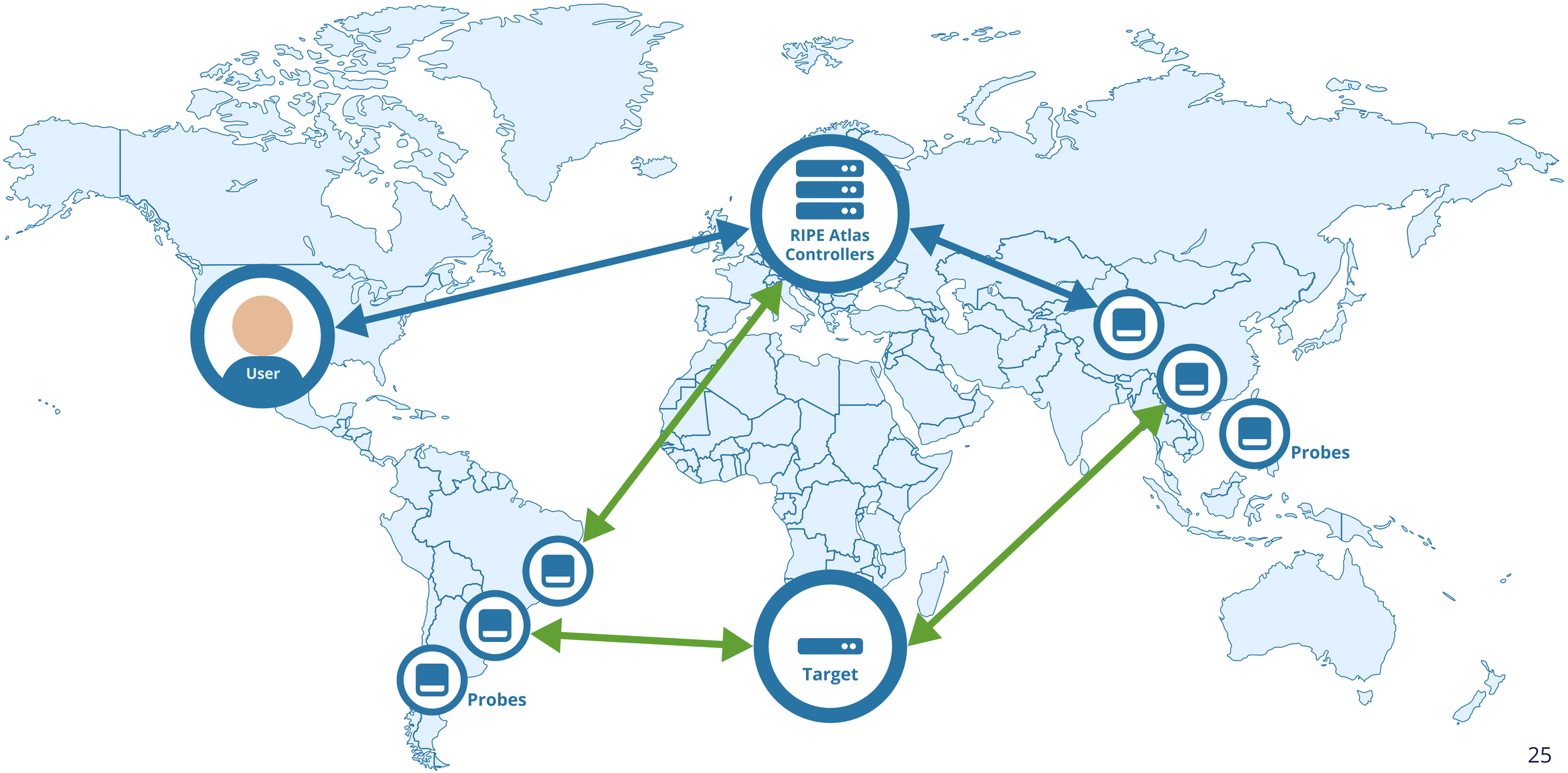
Measurements

- **RIPE Atlas** performs **built-in** and **user-defined** measurements
- **Built-in measurements**: ping, traceroute, DNS, SSL/TLS, HTTP
- **User-defined measurements**: Six types available (ping, traceroute, DNS, SSL/TLS, NTP, HTTP*)
- **Targets**: Root DNS servers, RIPE Atlas anchors, user-defined targets



https://atlas.ripe.net/docs/built-in-measurements/

RIPE Atlas Concept



Probes and Anchors

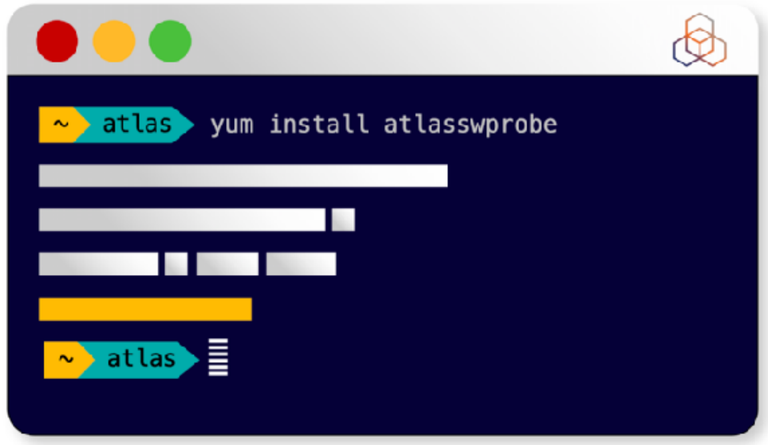
- **12,000+** probes connected (**600+** RIPE Atlas Anchors)
- **10,000+** results collected per second
- **23,000+** measurements currently running

RIPE Atlas probe V5

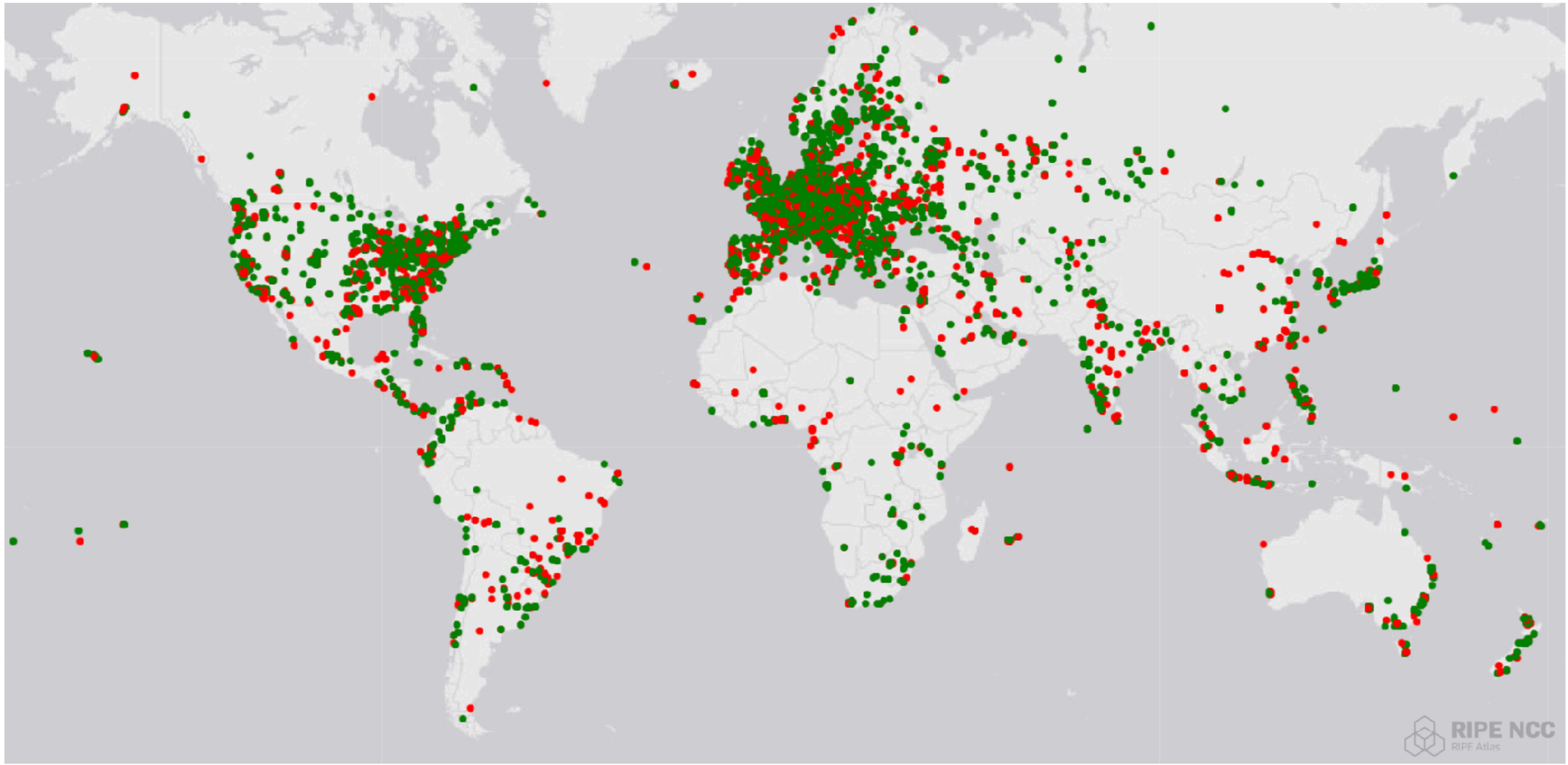
RIPE Atlas anchor V3

RIPE Atlas Software Probes

- Software packages that work like regular probes
- Install and run on a virtual machine (VM), container or router
- Supported on several platforms
- Further information: **https://atlas.ripe.net/docs/software-probe/**

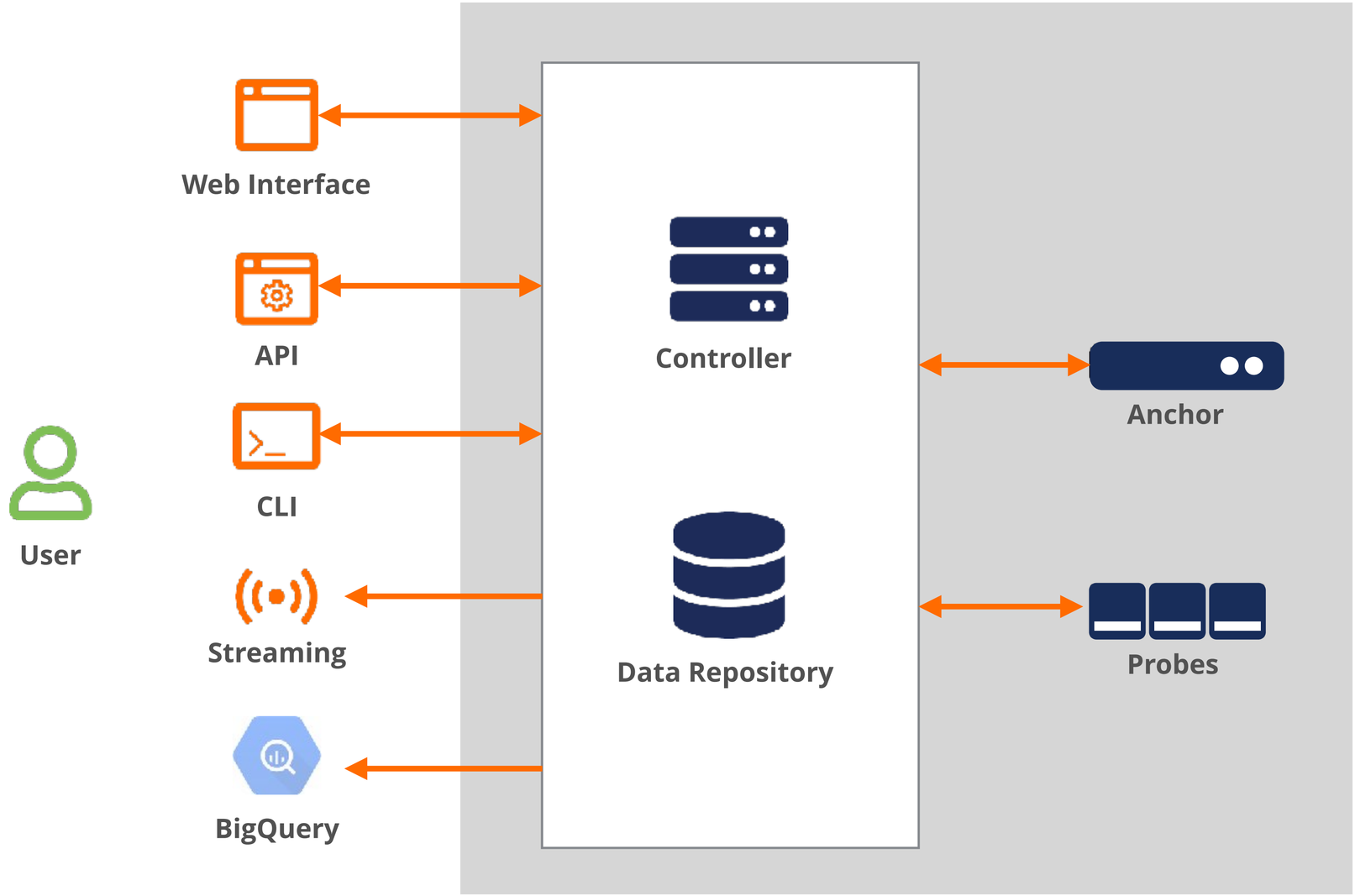


RIPE Atlas Coverage



https://atlas.ripe.net/coverage/

RIPE Atlas Interfaces



Credits System

- Why? **Fairness** and to **avoid overload**
- Measurements cost credits
  - ping = **10 credits**, traceroute = **20**, etc.
- Spending limit
- Max number of measurements

How to Earn Credits?

Earn credits by...

- Hosting a RIPE Atlas probe or anchor
- Being a RIPE Atlas sponsor
- Being a RIPE NCC member
- Through a transfer of credits

Probes and Credits

- You receive **15 credits for each minute** a probe is connected
  - Roughly **21.600 credits every 24 hours**
- **Host more than one probe, only if in different ASNs**: earn double, triple, etc

More Credits

- **Anchors** earn 10 times as many credits as regular probes
- **Sponsors** earn credits for the probes they sponsor
- **Anyone who creates measurement results** also receives additional credits
  - At the rate of **one credit per measurement result**
- Users can **transfer and receive** credits from other users

Take the poll!

So how is it that you can **earn credits**

for RIPE Atlas again?

Choose the answers.

1 min.

Questions

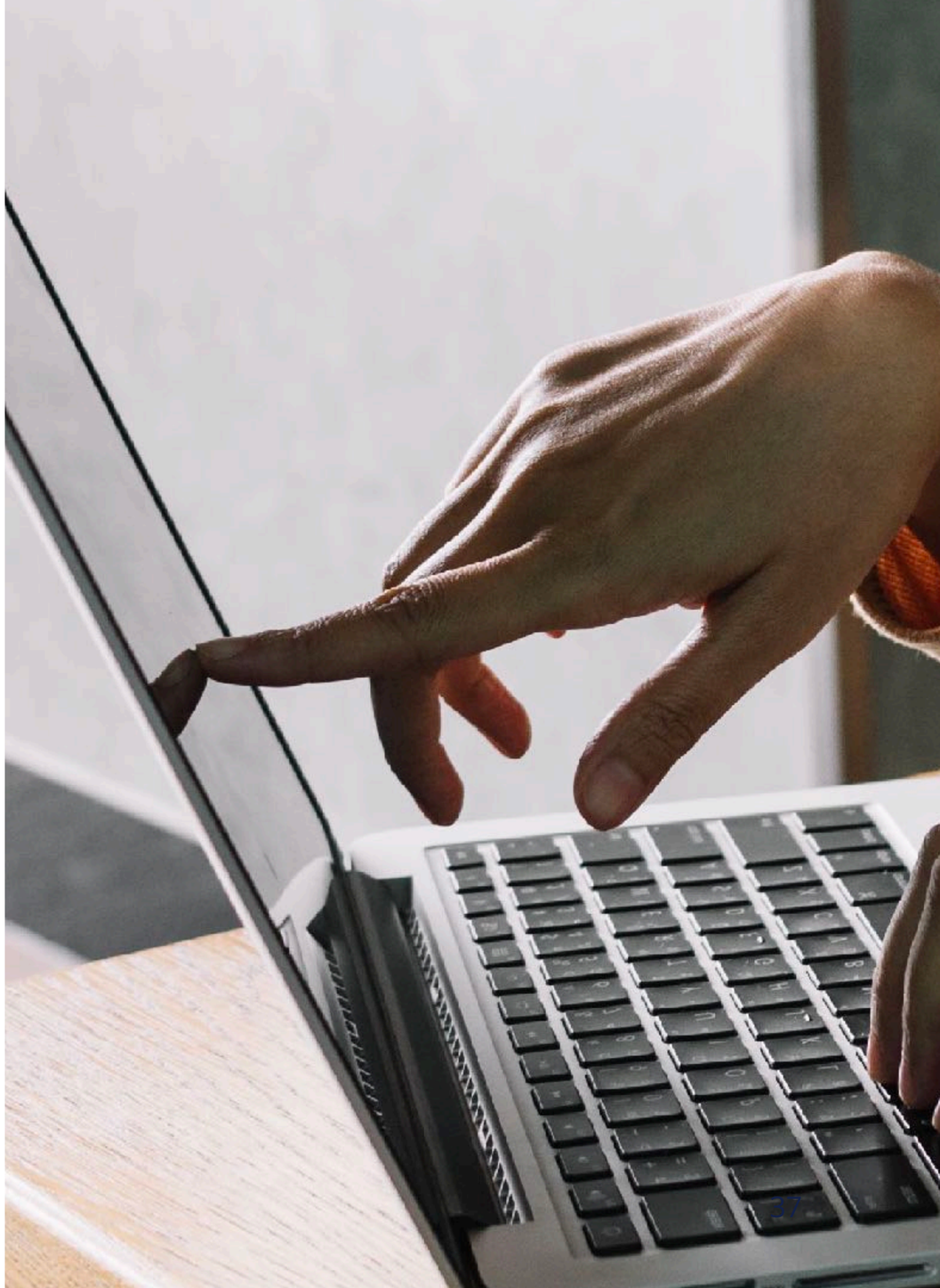
Exploring RIPE Atlas

Demo

Demo time!

We will demo the activity on the screen.

Watch what we do.



Viewing Measurements

In RIPE Atlas

Measurements Page

PUBLIC | MINE

Search Measurements

All | Built-In | Anchoring

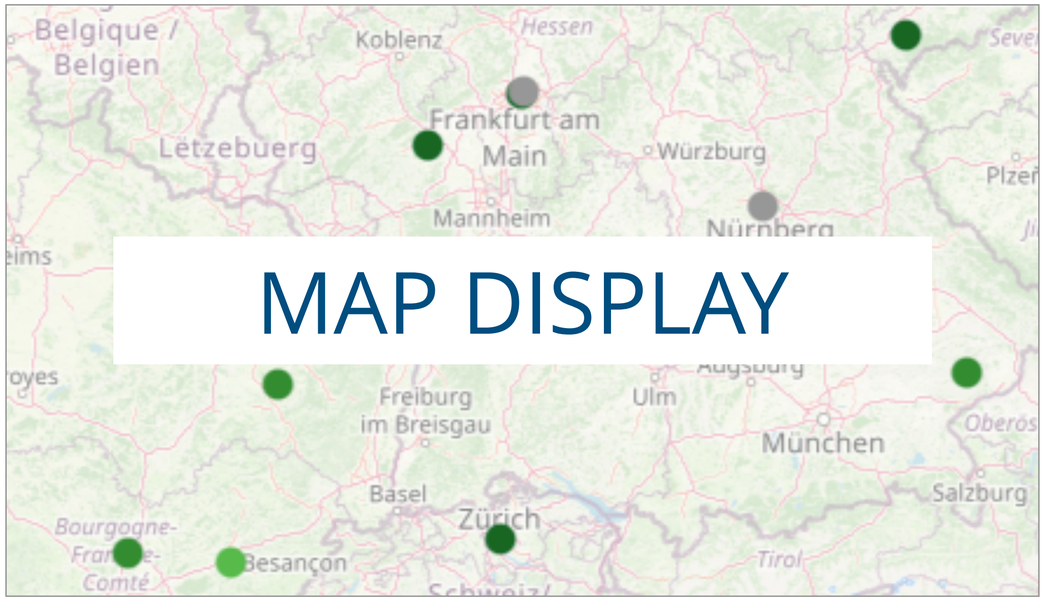
ID	Type All	IPv4/v6 All	Target	Description	Probes	Interval All	Time (UTC)
######	Which type	Protocol	IP or hostname	Some text to make it unique	###	one-off or ms	▷When it started
978321	ping	6	www.ripe.net	Ping test to RIPE web server	75	one-off	▷2023-07-01 10:05
978321	trace	4	203.0.113.0	Some host with reachability issues	250	900	▷2023-02-18 12:30

Measurement Overview

Measurement

Description of the measurement

OVERVIEW | RESULTS | DETAILS



Result summary (latest, as of 2024-05-22 11:50 UTC):

43 probes reached their target.

7 prob

RESULT SUMMARY

Min RTT: 0.666

Mean RTT: 9.167

Measurement Results

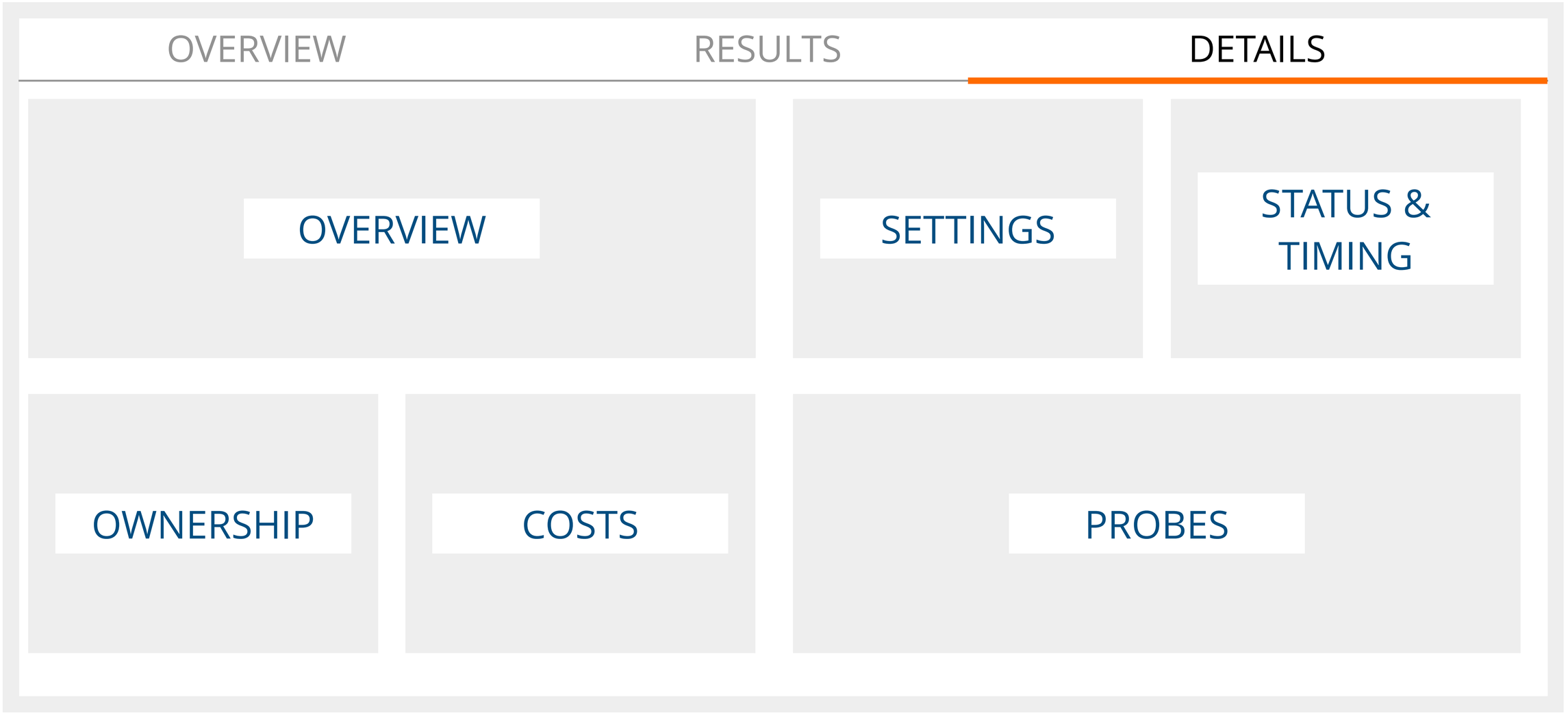
OVERVIEW | RESULTS | DETAILS

🔍 Search Results

DOWNLOAD RESULTS

Probe	ASN	Country All ∨	Time (UTC)	Min RTT	Packet Loss
#####	#####	**Where probe is located**	**When probe did it**	**RTT in milliseconds**	**Percent of packets lost**
6025	8839	🇫🇷	2024-05-28 09:42:13	13.309 ms	0.00%
6352	13041	🇪🇸	2024-05-28 09:42:13	39.749 ms	0.00%

Measurement Details



Measurement Management

OVERVIEW RESULTS DETAILS MANAGE

STOP MEASUREMENT REMOVE PROBES ADD PROBES

Participation Requests

ID	Created	Action	Type	Value

CHANGES TO THE PROBES

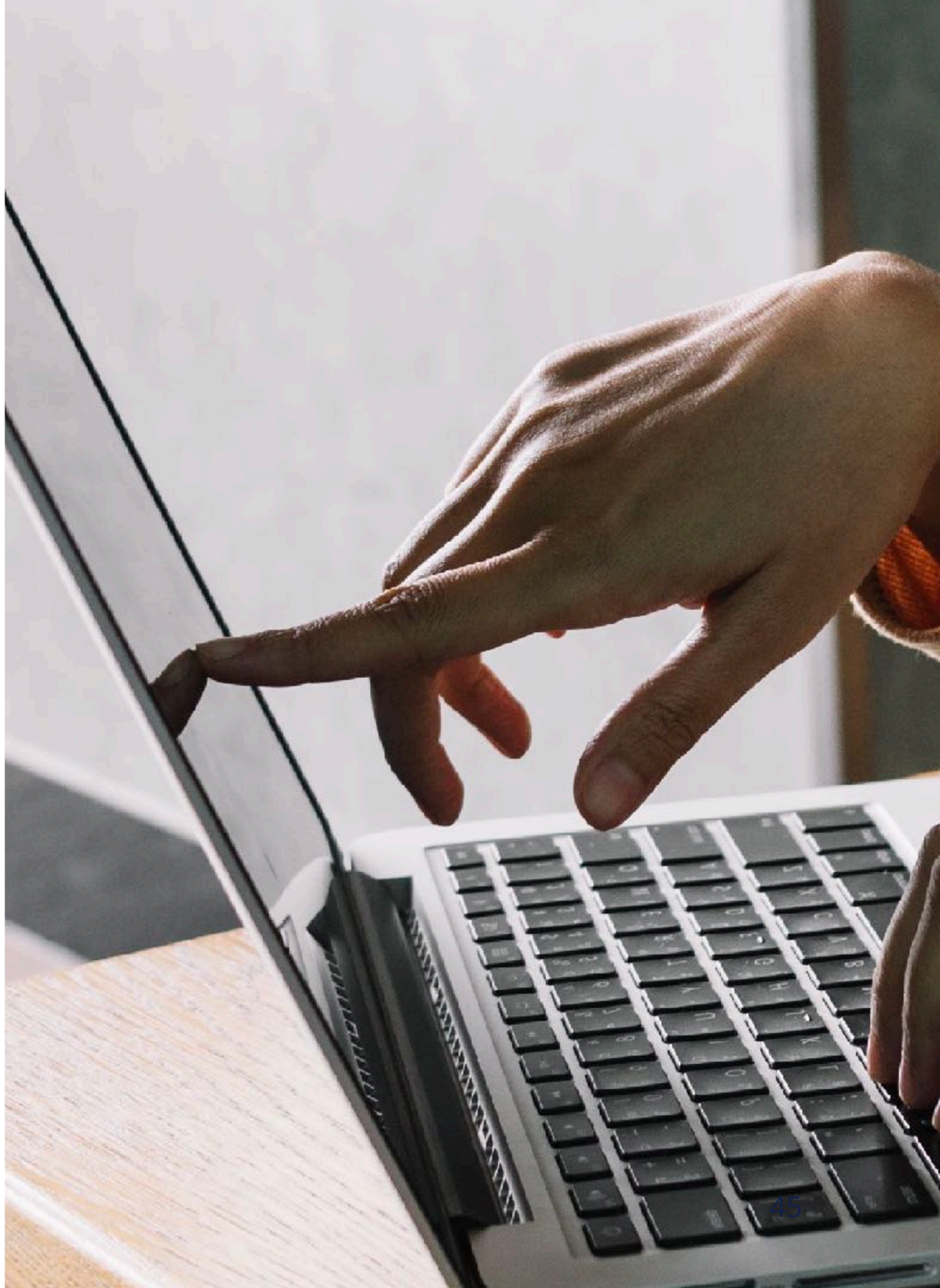
Viewing Measurements

Demo

Demo time!

Let’s look at a measurement and see if we can find any issues…

We will analyse the results of measurement **64393469**



Questions

Let’s take a
5 minutes
break!


WELCOME
WE ARE
OPEN
PLEASE COME IN

Creating a Measurement

Step-by-Step

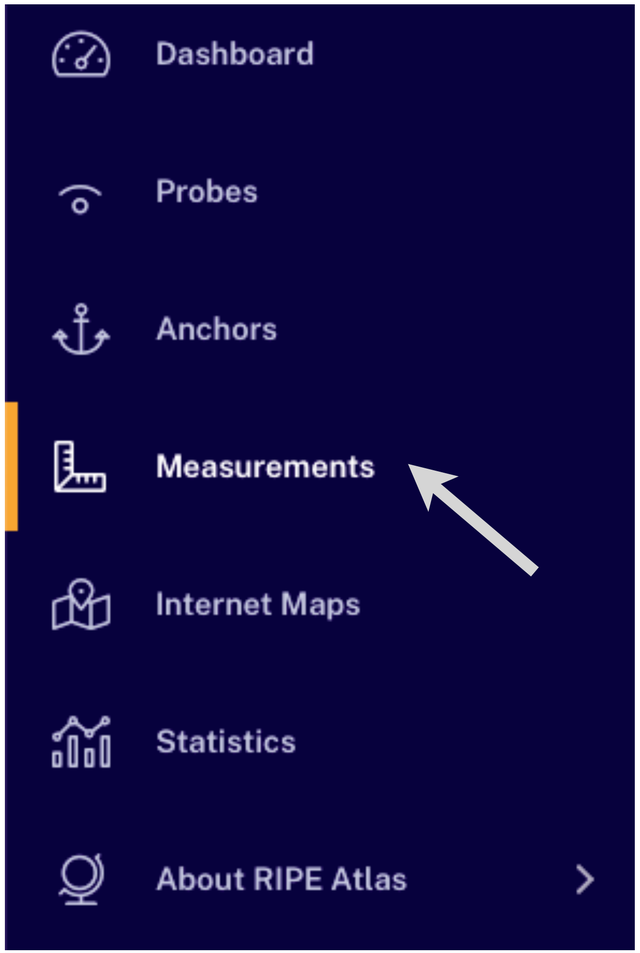
Before you create anything...

Ask yourself these things:

- What is the goal of the measurement?
- Which measurement type helps me achieve this goal?
- Where do I want/need the probes to be located?
- How long should the measurement run? Enough credits?
- How will I analyse the data in the results?
- Is there an existing measurement I can use?

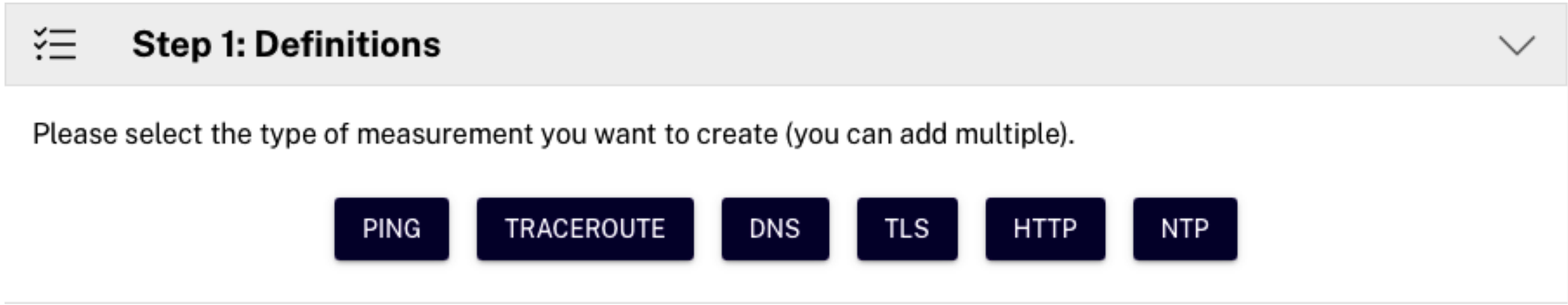
Create a Measurement

- Sign in to **https://atlas.ripe.net/**
  - Use your RIPE NCC Access account
- Go to “**Measurements**” —> “**Create Measurement**”



1. Which measurement type?

- Choose the type you need based on your goals

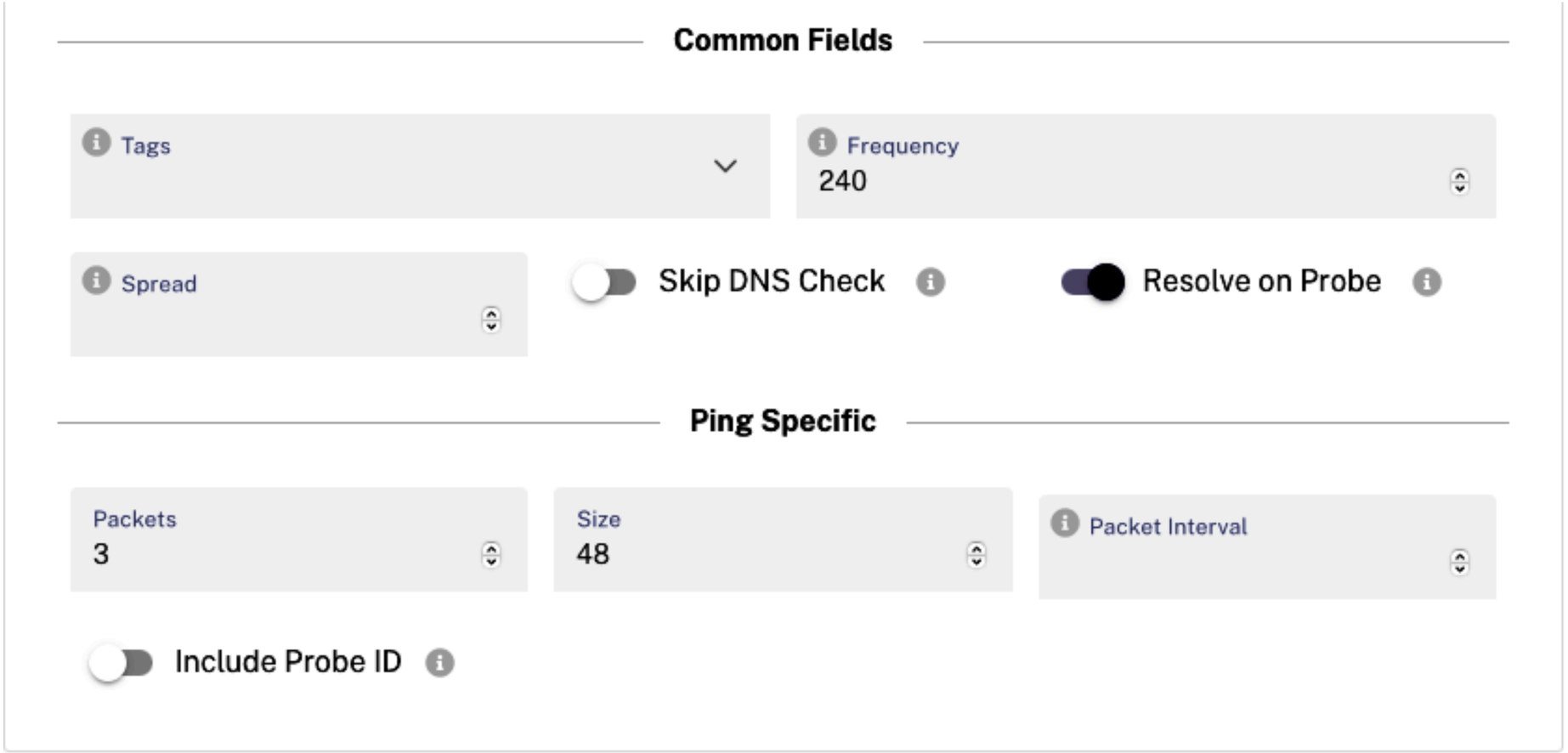


1. Which measurement type?

- Provide the required parameters for that type of measurement

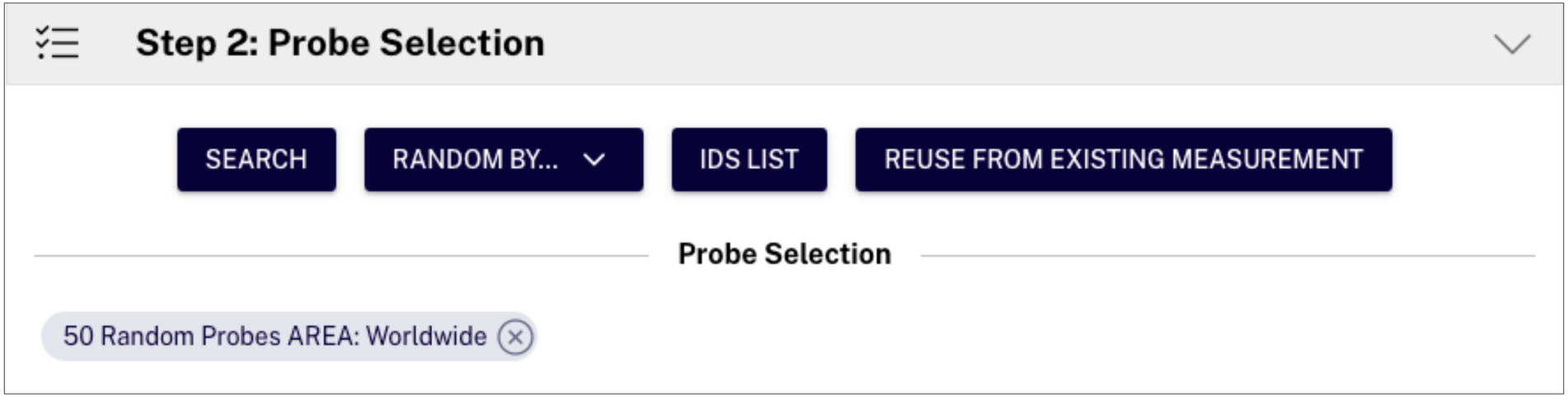
1. Which measurement type?

- **More Options** give you more settings to use



2. Which probes do you want?

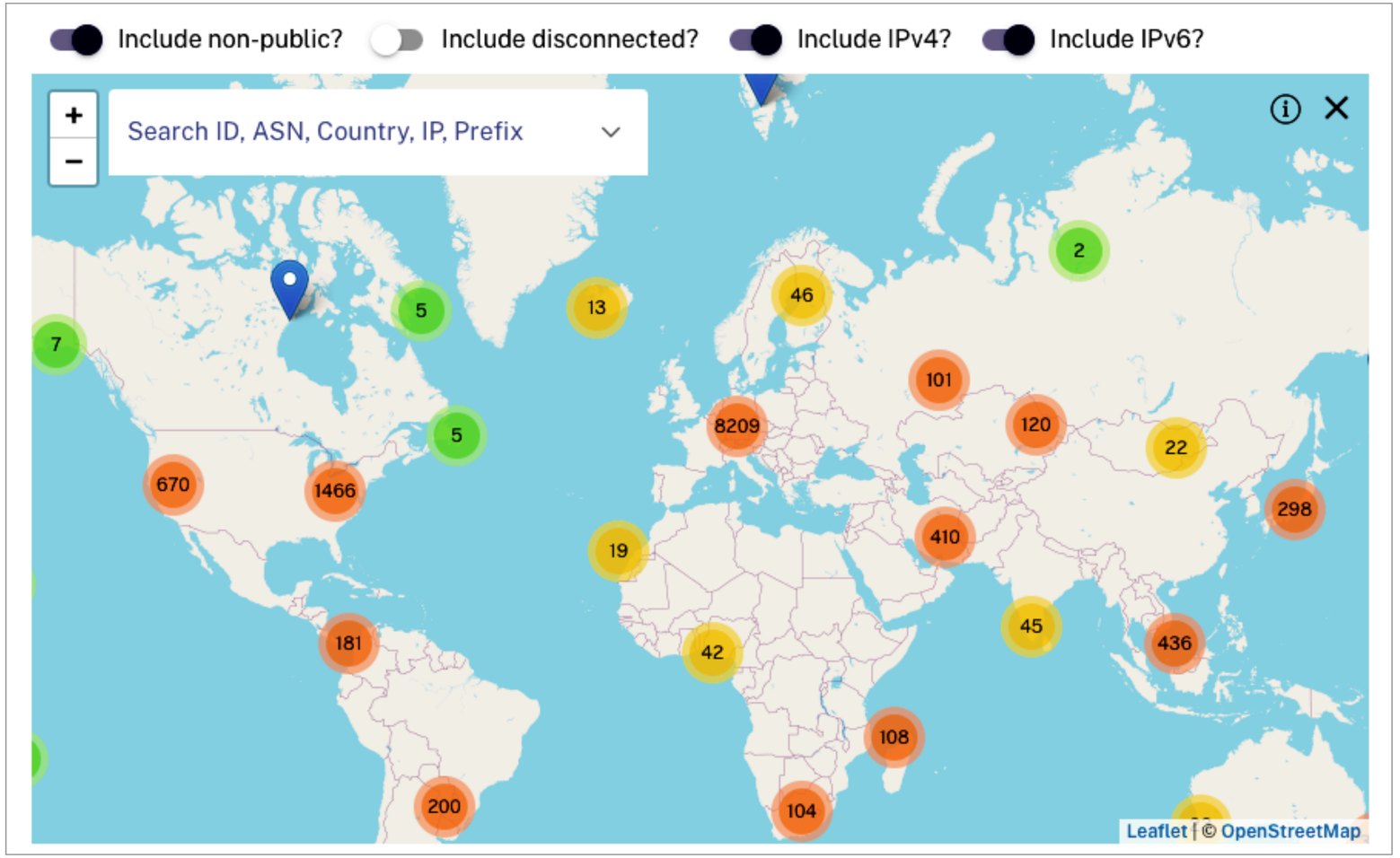
- Now you can **choose** which probes you want to use
- **Default** is 50 random probes worldwide



- There are **multiple ways** to select probes!

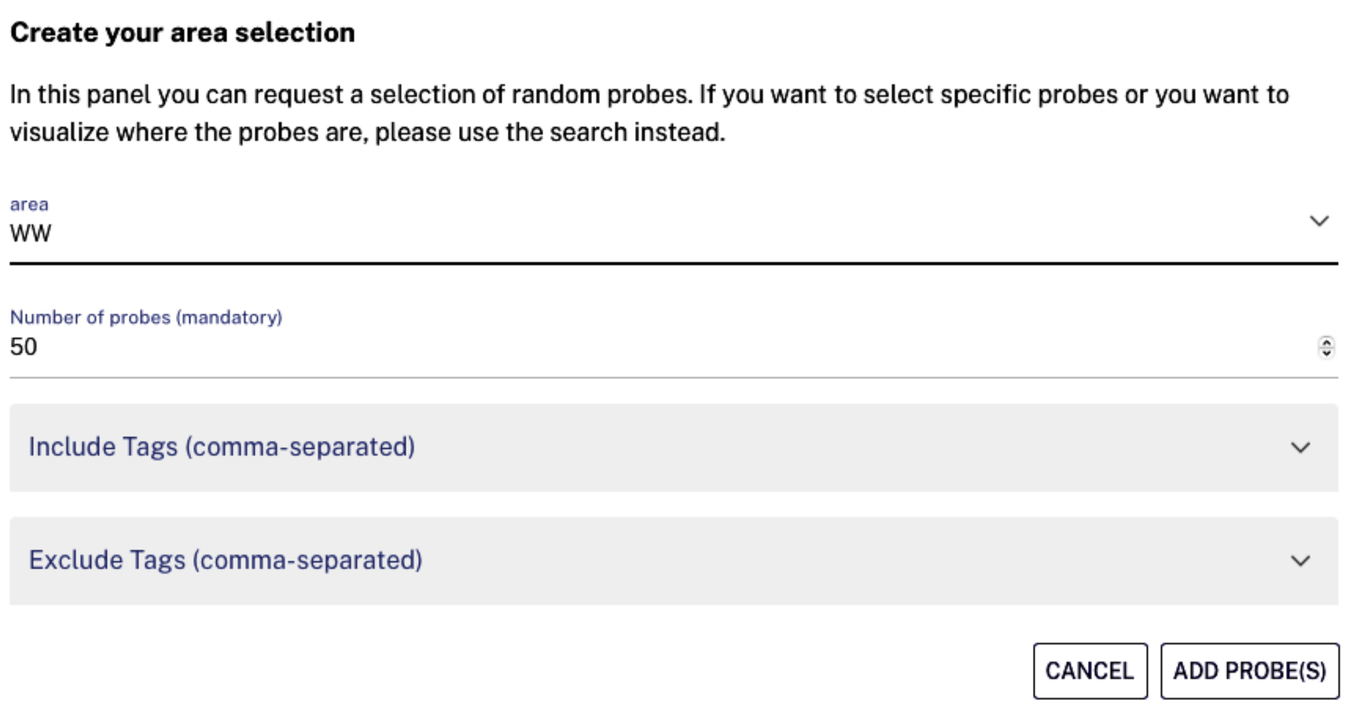
Search

- Choose the probes from a world map
- You can search by:
  - **Country**
  - **IP address**
  - **Prefix**
  - **Probe IDs**
  - **AS number**



Random Probes

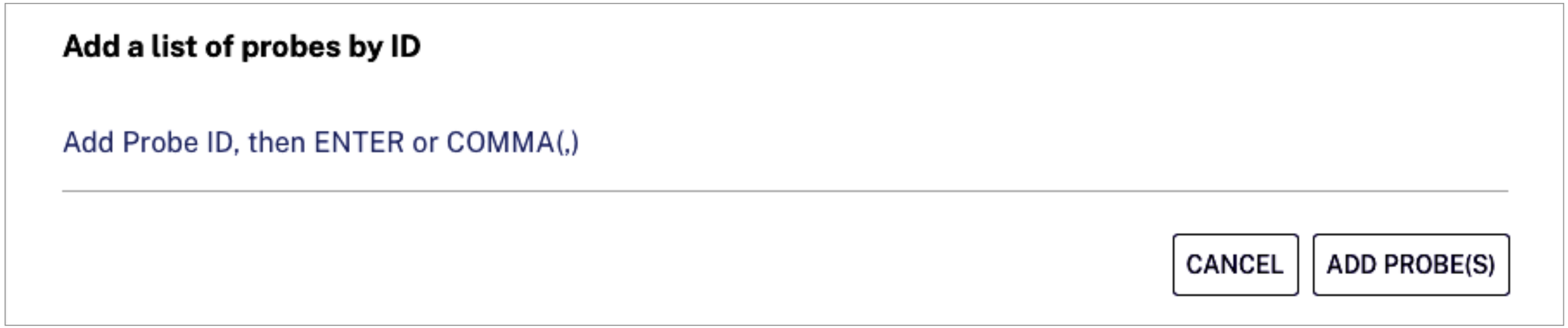
- “**Random by…”** lets you create a list of random probes
- Based on:
  - **Area**
  - **Country**
  - **Prefix**
  - **ASN**
- Use **tags** to refine the selection
  - i.e. system-ipv6-works



IDs List

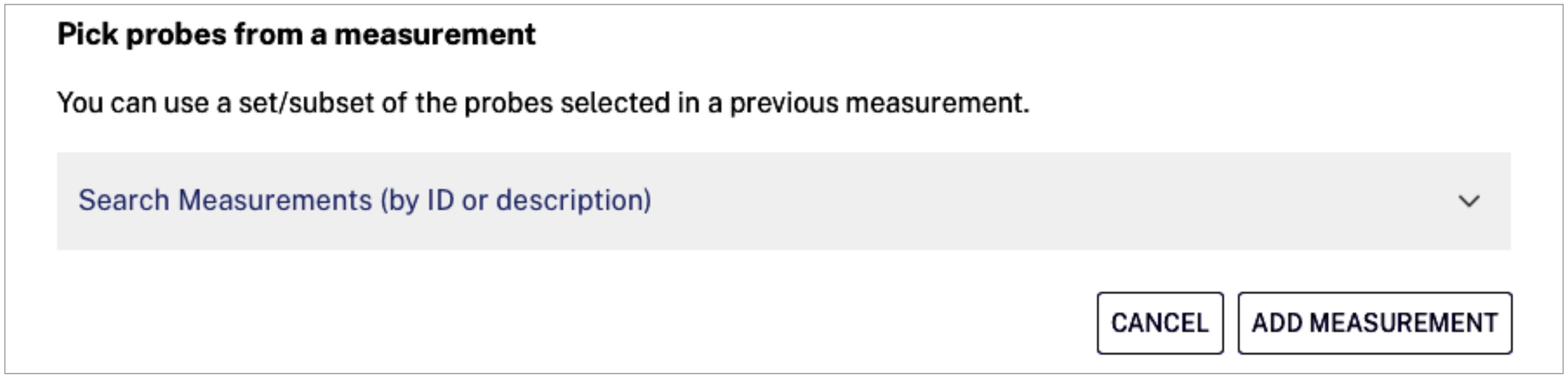
- Provide the IDs of the probes you want to use
  - Requires to know the probe IDs before you create the measurement
- See the whole list of probes:

  https://atlas.ripe.net/probes/



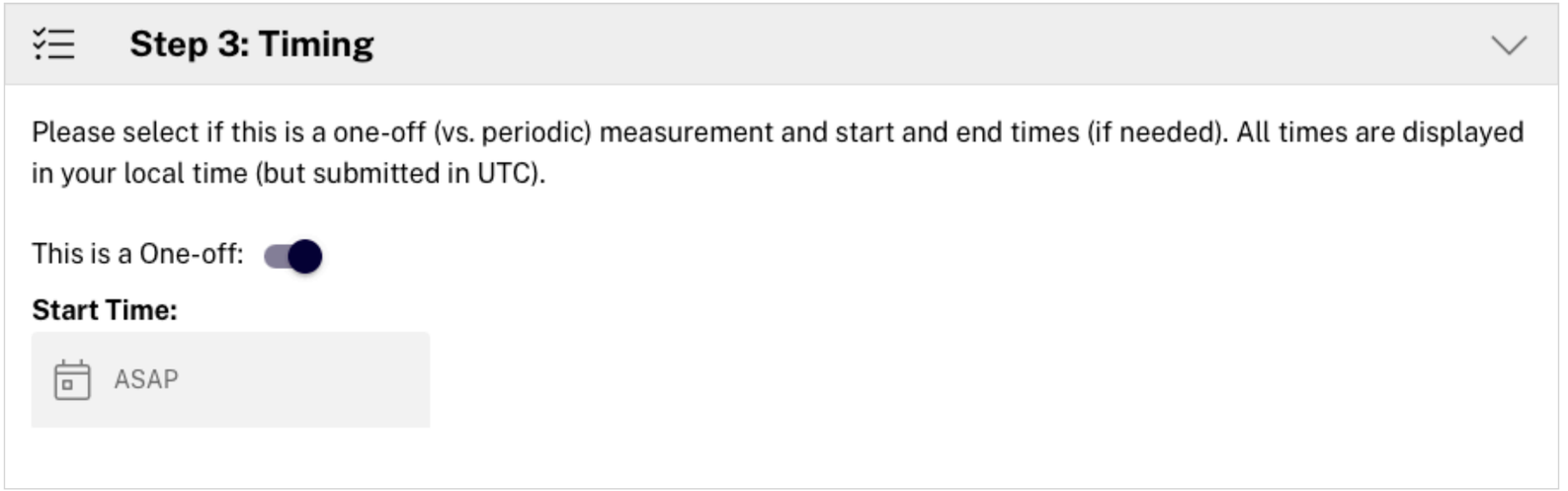
Reuse a Set From a Measurement

- Use the same probes as in a previous measurement
  - *It must be one of your own!*
- Provide the **measurement ID**



3. When Should it Run?

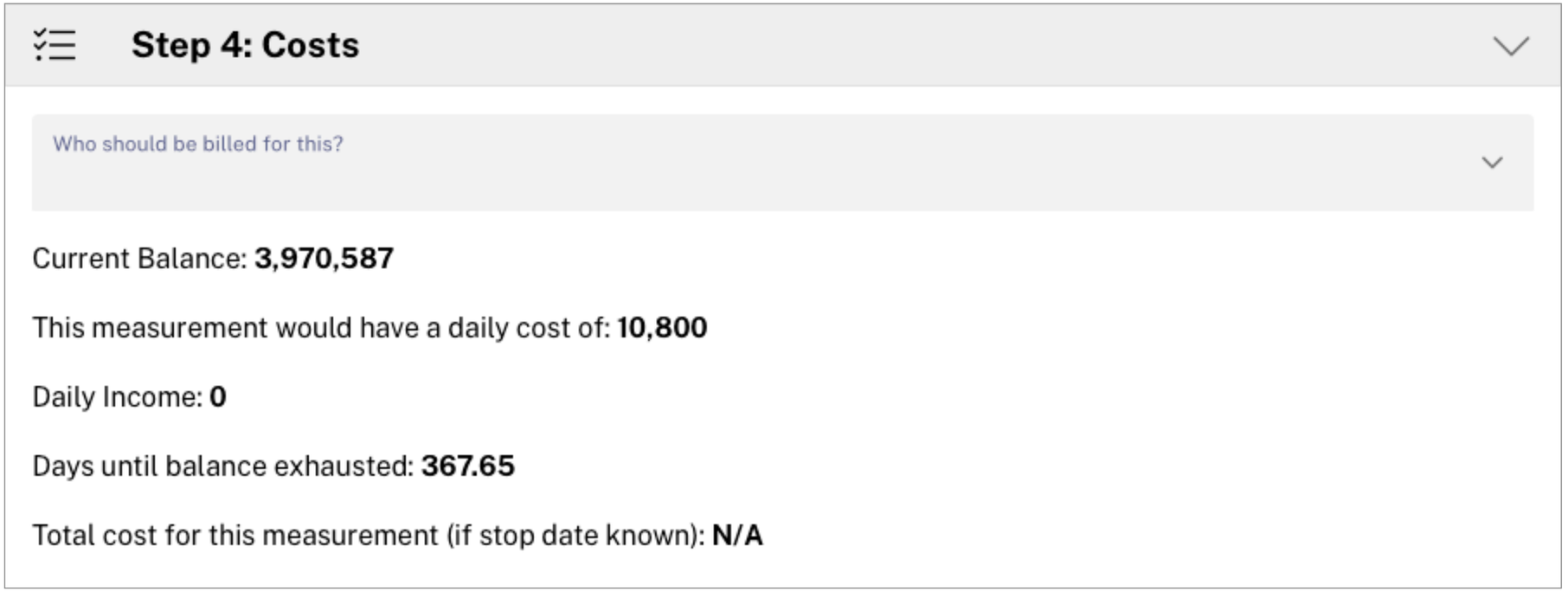
- **Set the time** when the measurement should run



- Leave the default to do a **One-off** measurement
- You can also program a start and end time
  - Just turn off the “One-off” option

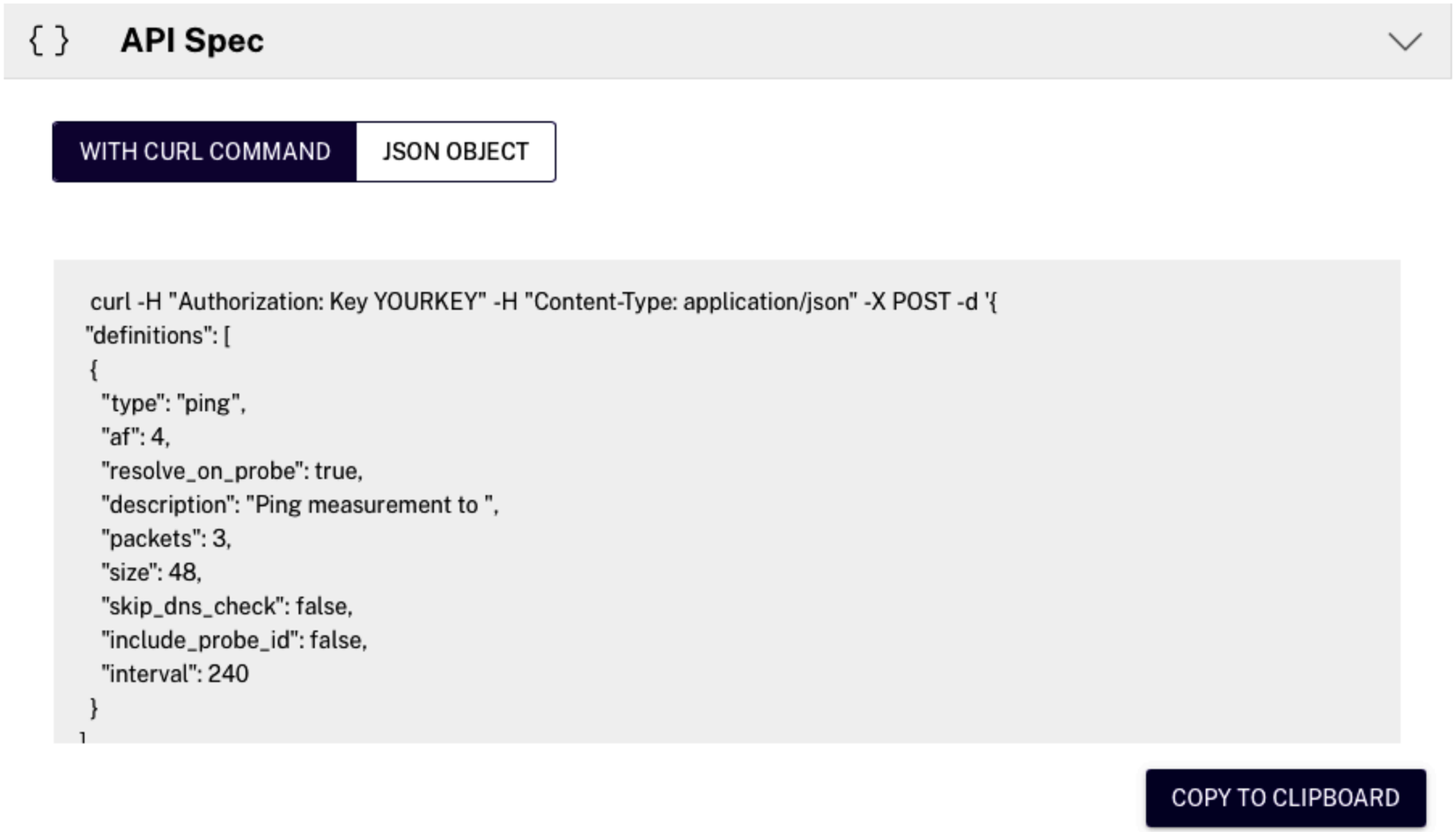
4. Costs

- The Costs tab lets you see an estimate of the amount of credits needed



Additional API Spec

- Can be used to learn how to create measurements directly through the API



5. Create the measurement(s)

- Click on the button when you're ready: 

- You get an ID you can click on to view the measurement settings and results

Limits

- <= **100** simultaneous measurements
- <= **1000** probes per measurement
- <= **100,000** results can be generated per day
- <= **50** measurement results per second per measurement
- <= **1,000,000** credits may be used each day
- <= **25** ongoing and **25** one-off measurements
  - Of the **same type** running against the **same target** at any time

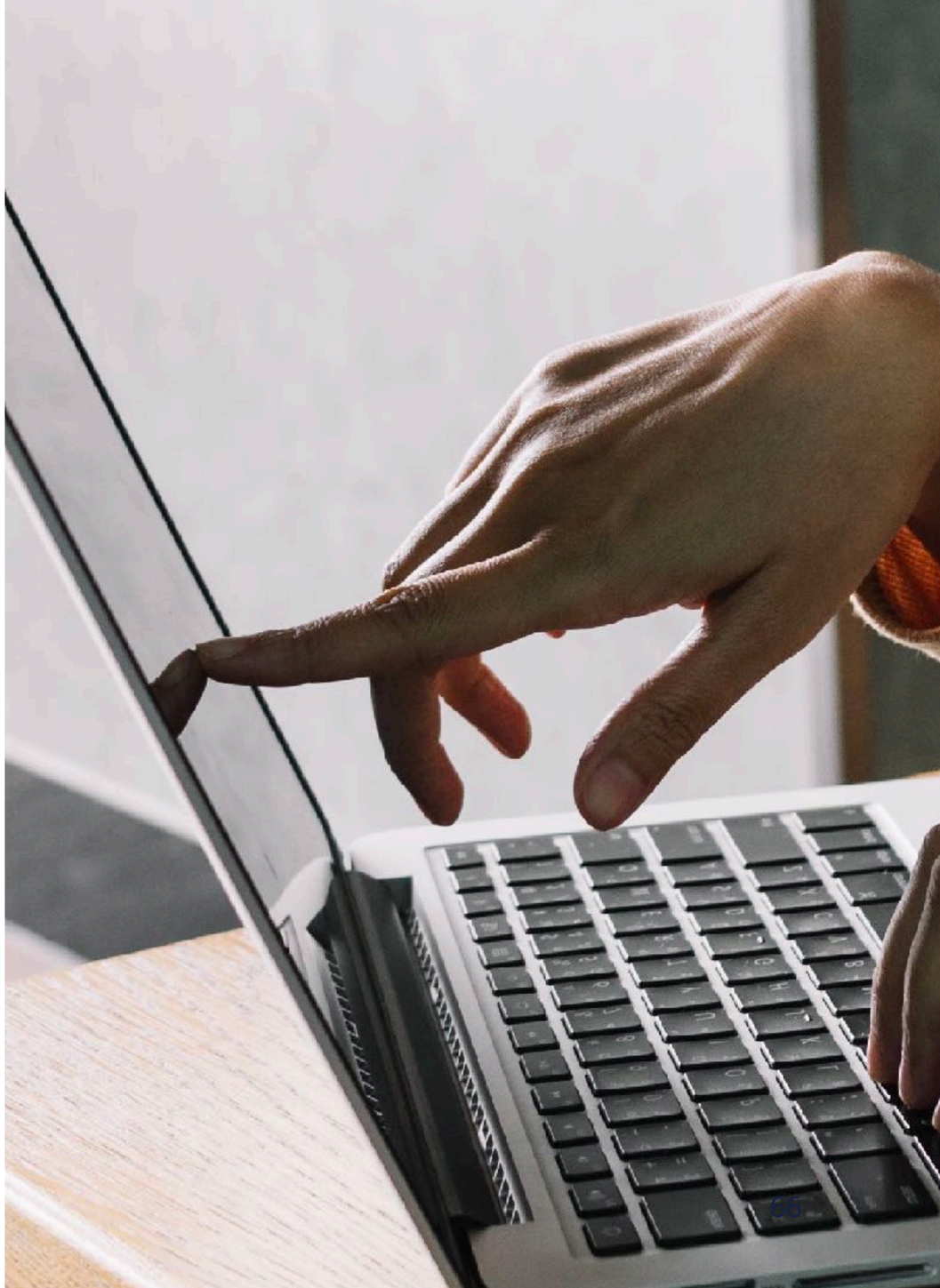
Creating a Measurement

Demo

Demo time!

Let’s create a measurement for this scenario:

- How is the server performing where **www.ripe.net** is hosted?
- How reachable is it from **ten** major networks in Europe?
- How is the connectivity from these networks over a period of **24 hours**?



Analysing the Results

Just a guide...

Take the poll!

What **kinds of issues** are we looking for

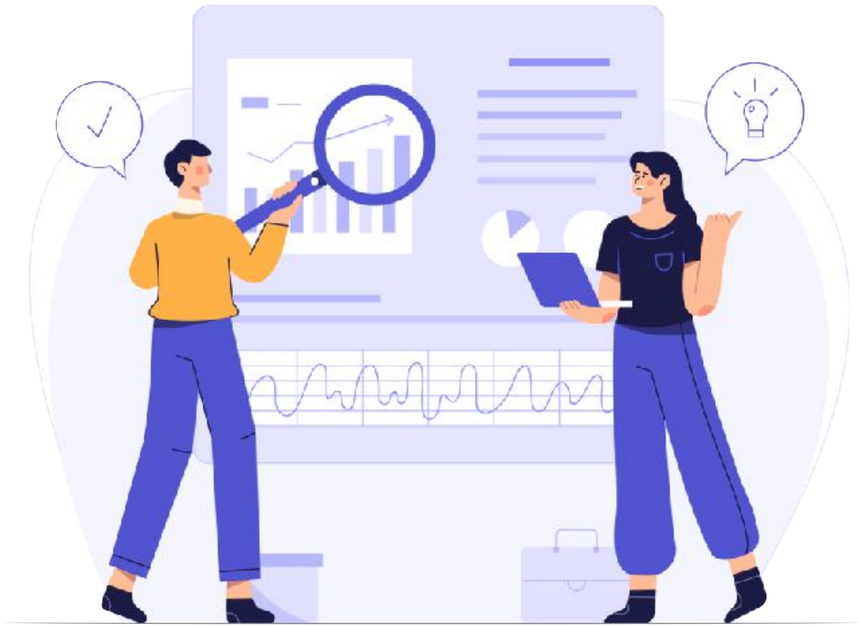
in the measurement results?

Write your answers.

1 min.

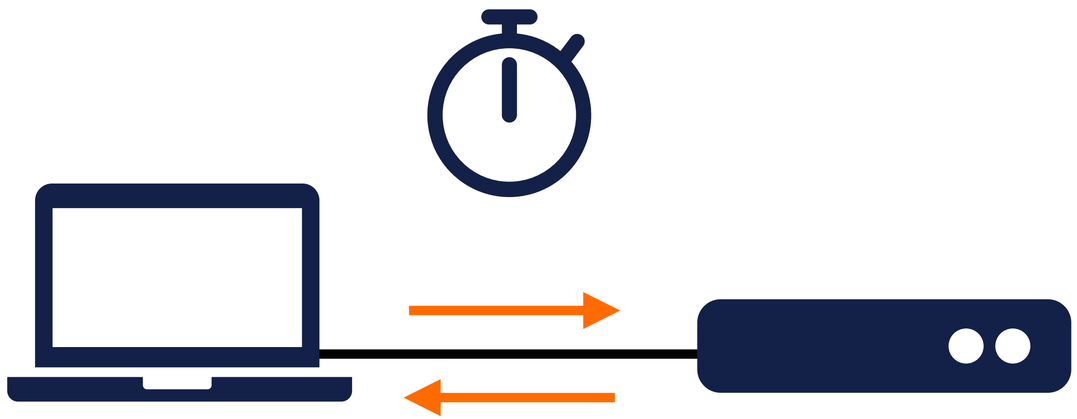
What Are We Looking For?

- In the measurement results, we will look for issues like:
  - **Latency problems**
  - Routing issues
  - Network reachability
  - Packet loss
  - Network congestion

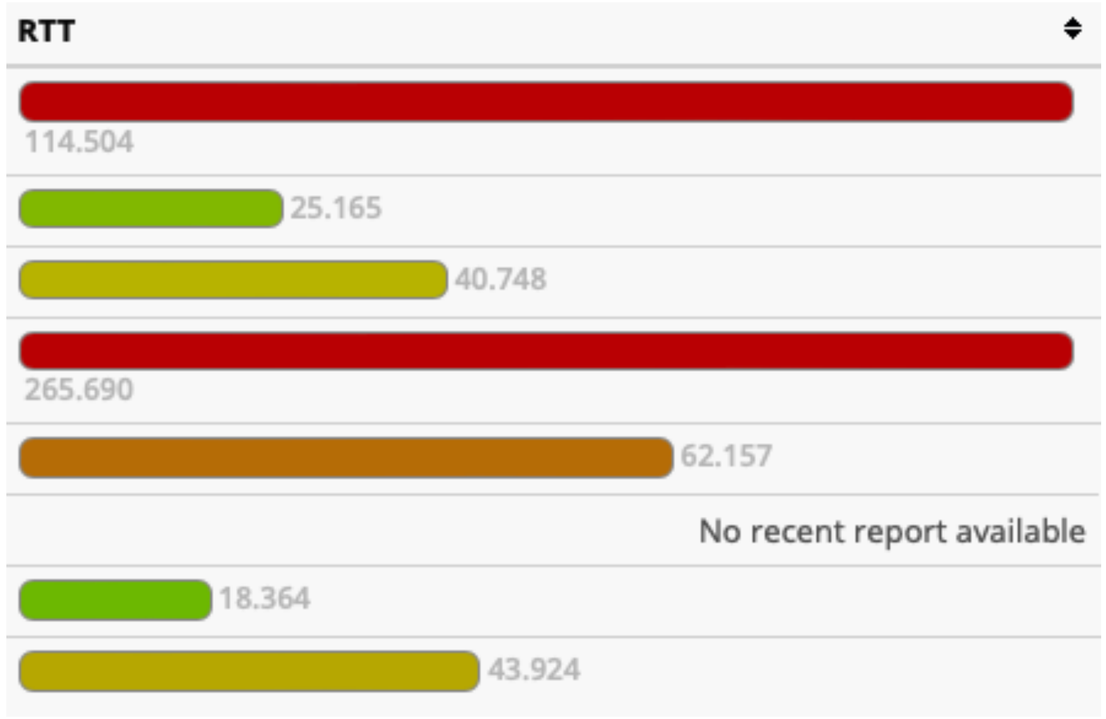


Latency Problems

1. The measurement results will display round-trip response time for each packet in milliseconds. Look for noticeably high or inconsistent times.

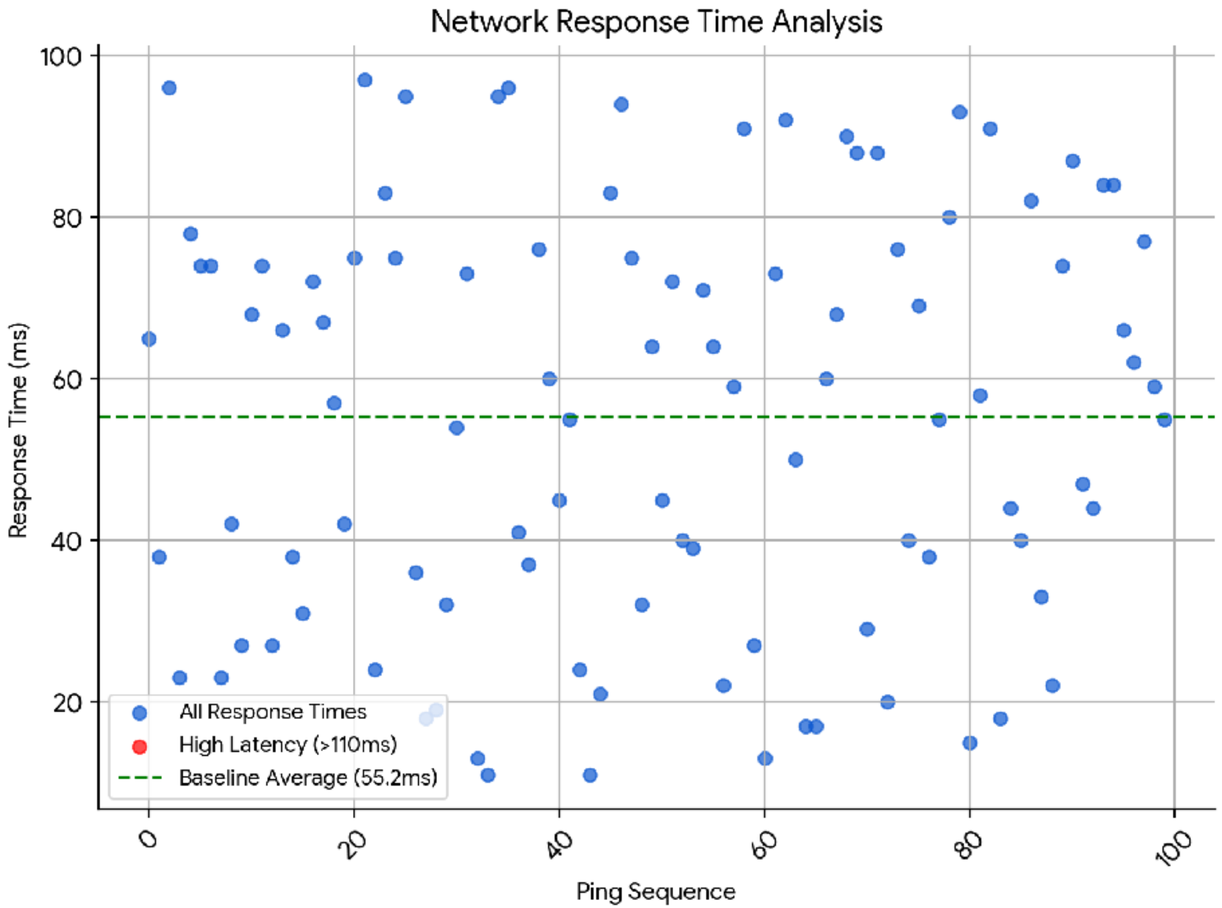


Latency = 550 ms



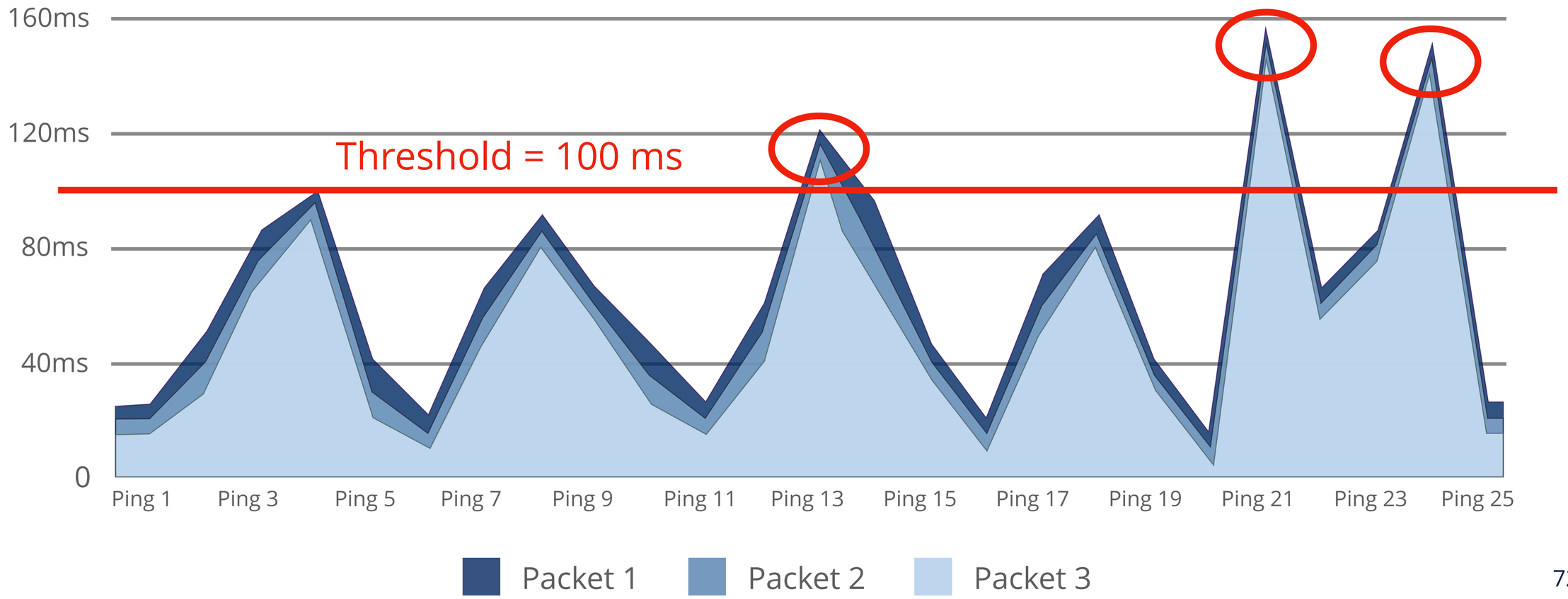
Latency Problems

2. Determine a **baseline average** response time for the network under normal conditions. Anything significantly above this could indicate latency issues.



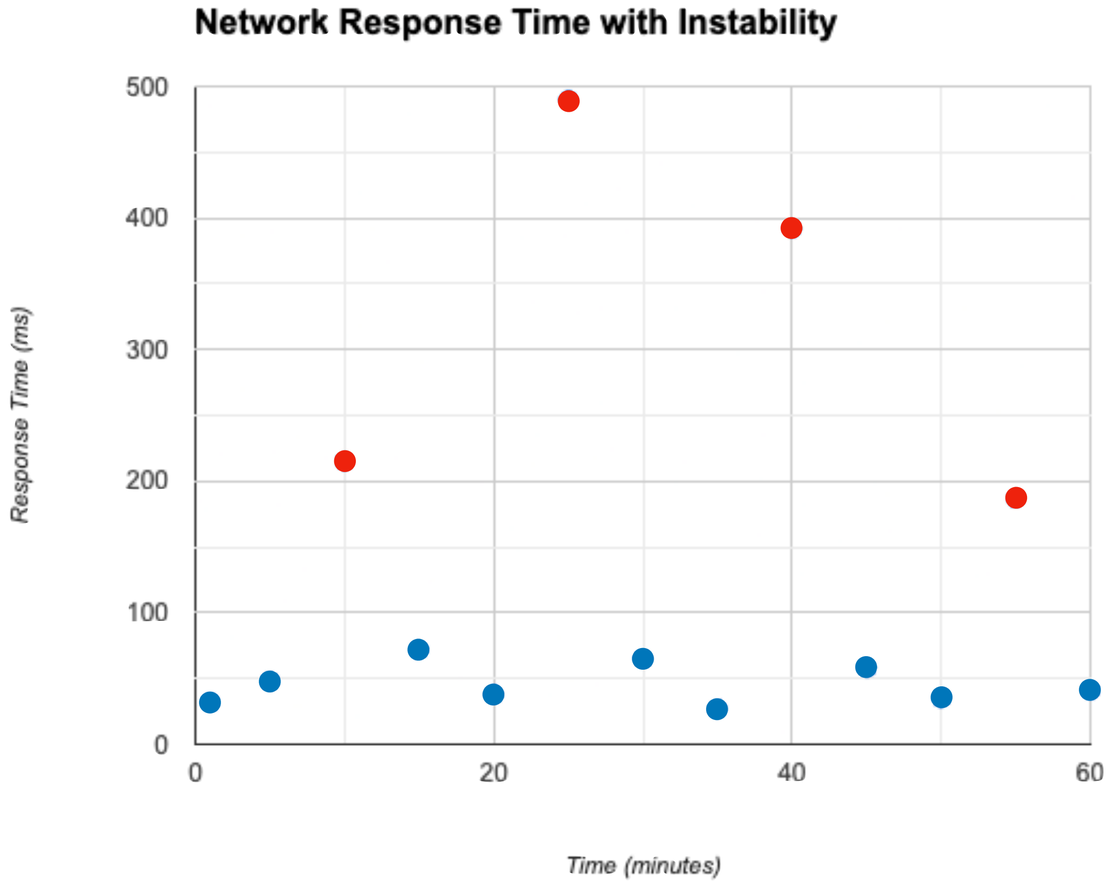
Latency Problems

3. Check for results above 100ms, which is generally unacceptable for user experience. Consistently high pings are a red flag.



Latency Problems

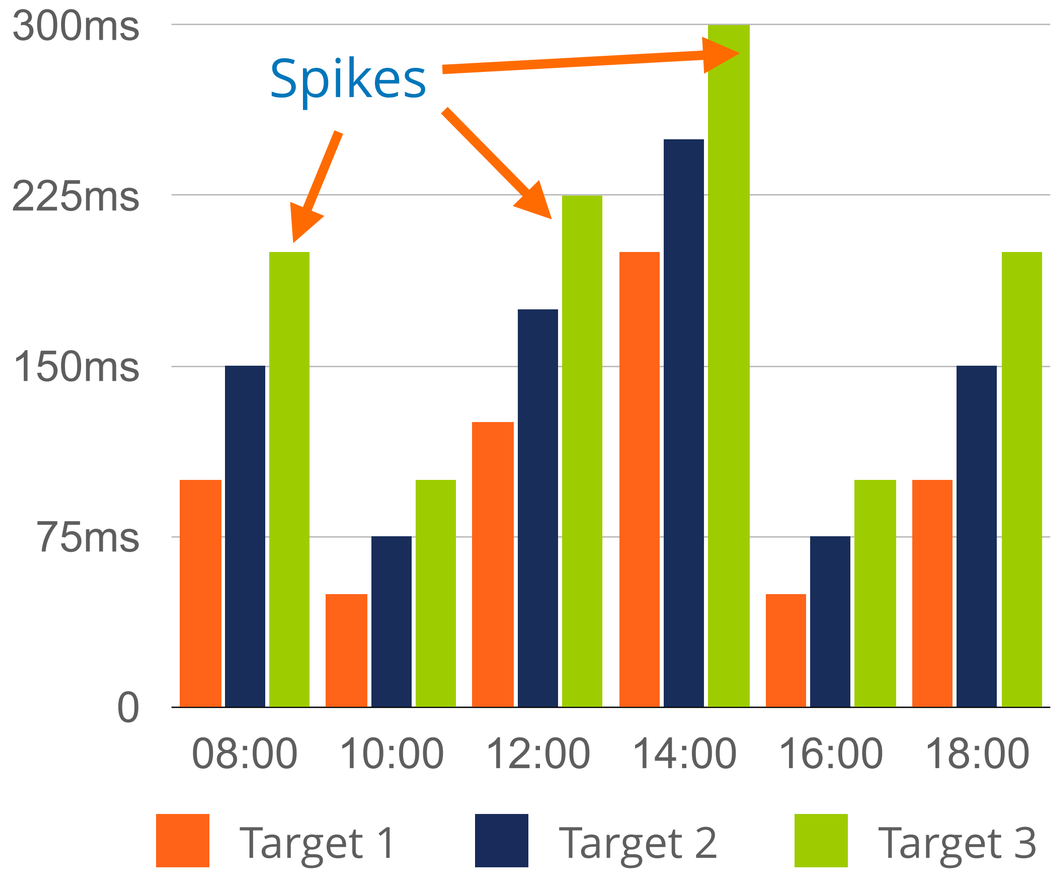
4. Look for instability, like responses fluctuating wildly between 20-500ms. This suggests intermittent problems along the route.



Latency Problems

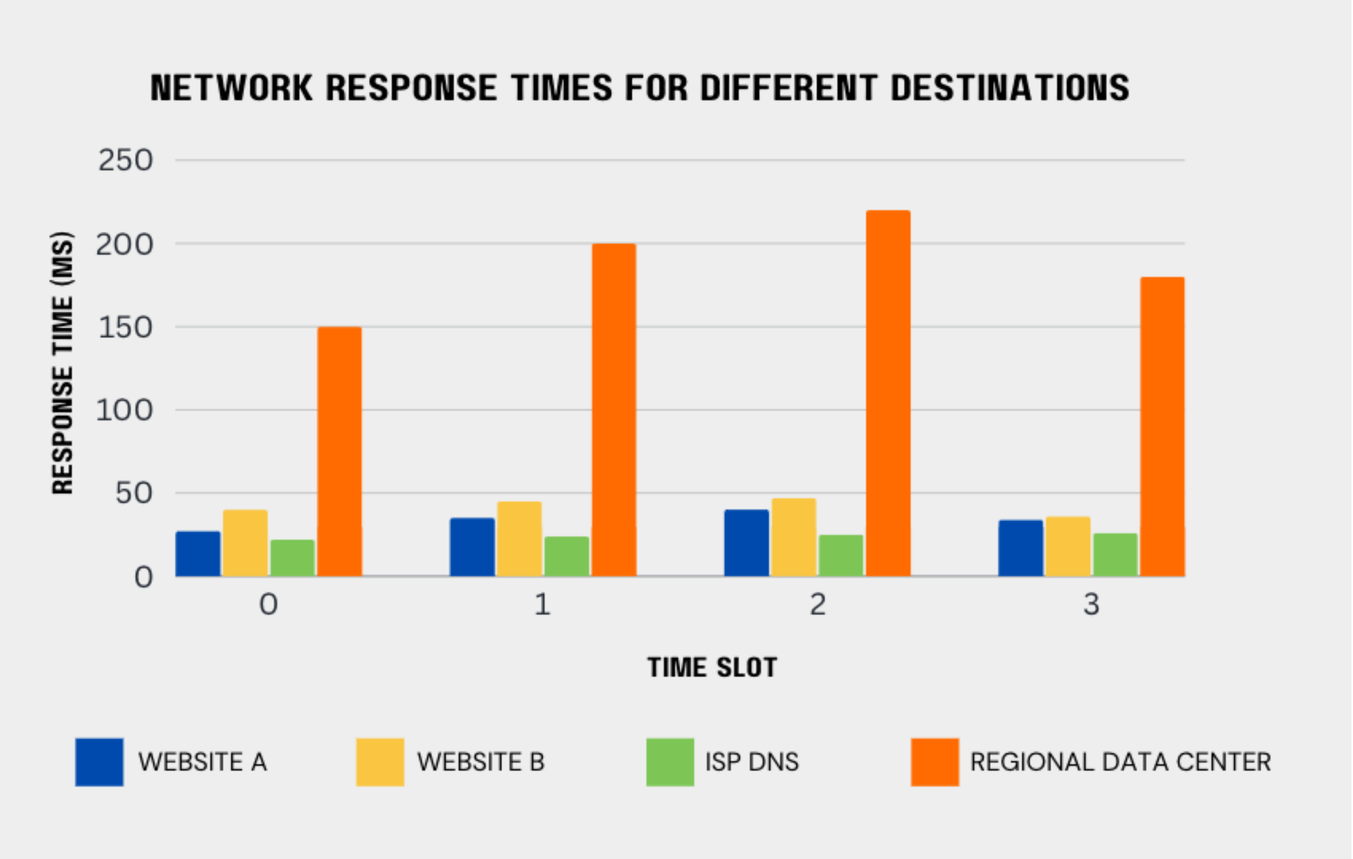
5. Try pinging the same targets multiple times over an extended period. Graph results to identify latency spikes at certain times of day.

Time of day	Target 1	Target 2	Target 3
08:00	100 ms	150 ms	200 ms
10:00	50 ms	75 ms	100 ms
12:00	125 ms	175 ms	225 ms
14:00	200 ms	250 ms	300 ms
16:00	50 ms	75 ms	100 ms
18:00	100 ms	150 ms	200 ms



Latency Problems

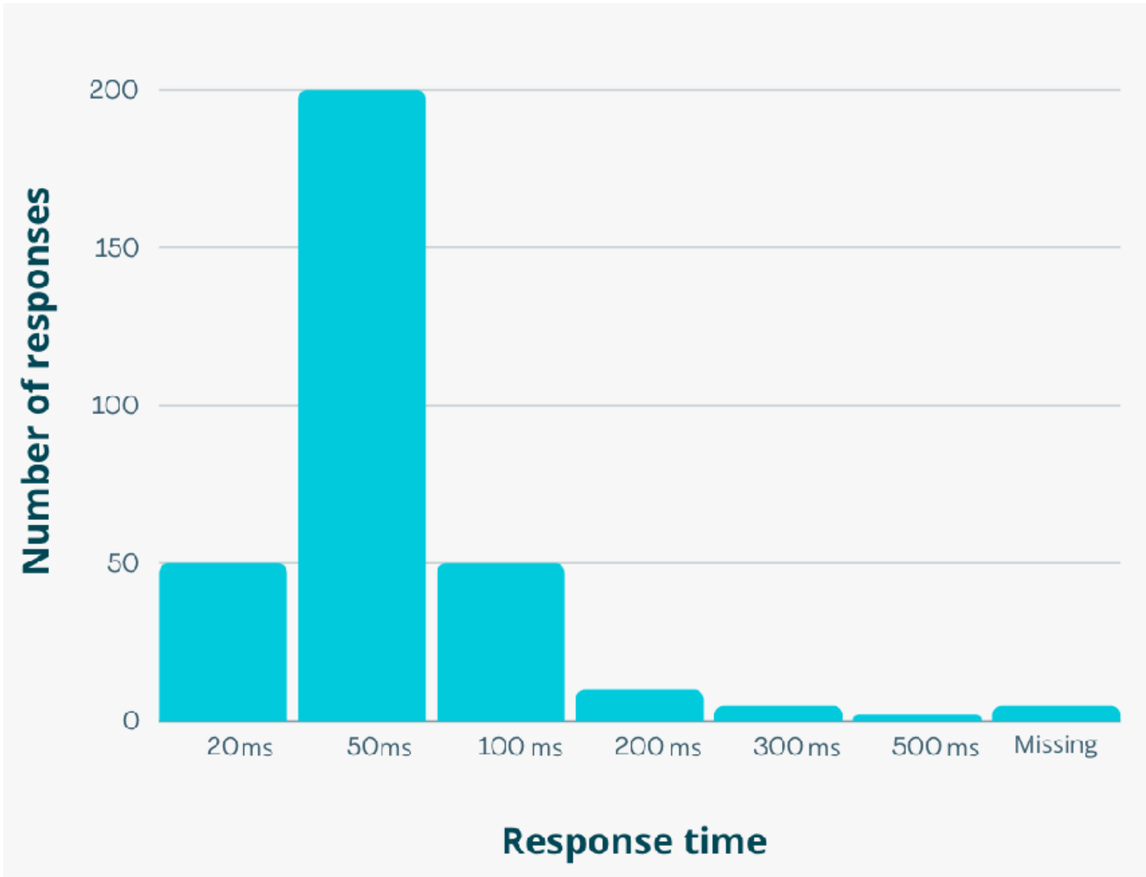
6. Compare response times for different destinations. Similar values mean local network congestion, divergent ones point to problems farther out.



Latency Problems

7. Check for missing replies or very high outliers, which point to transient connectivity failures or packet loss worsening latency.

Response time	Number of responses
20 ms	50
50 ms	200
100 ms	50
200 ms	10
300 ms	5
500 ms	2
Missing	5



Getting started!

Activities for you
to do in your own time

1) Search for a Measurement

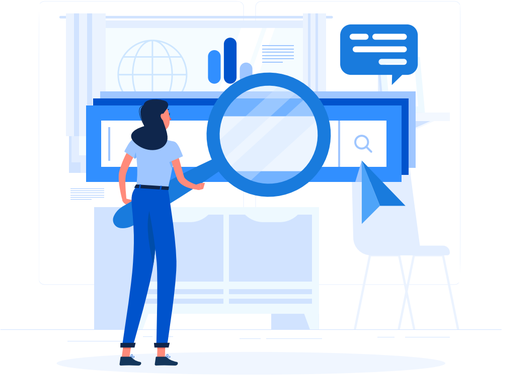
Before you create a measurement of your own, search an existing one!

Go to the RIPE Atlas Measurements page and search for a measurement to an IP or prefix you know.

Once you have found the measurement, click on it to view more information.

Here are some things you can do:

- Analyse the results of the measurement to identify trends or patterns
- Compare the results of the measurement to other measurements
- Troubleshoot network problems
- Track the performance of a network over time

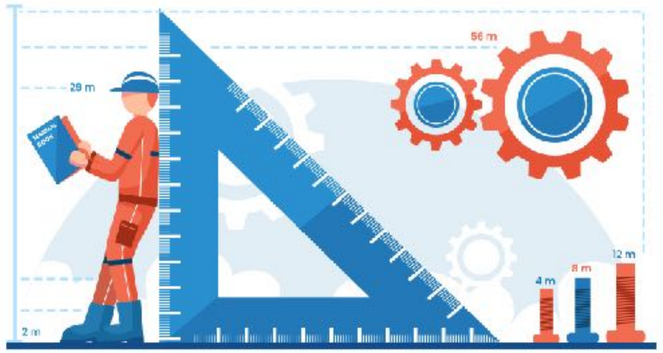


2) Create a Measurement

You now know enough to create your own measurement!

Get started by doing the following:

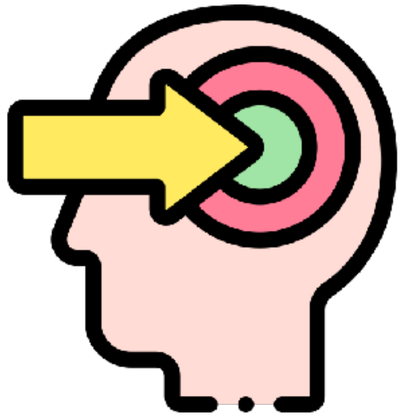
- Choose a target and define your goal: what do you want to find out?
- Choose the probes from locations of interest to you
- Create the measurement and wait for the results
- Analyse the results and see what you discover!



Remember...

Here are some questions to help you analyse the results:

- Are the results what you expected?
- Do any patterns or anomalies appear in the data?
- How do the results compare over time or from different vantage points?
- What conclusions can you draw and how might this data be useful?



Other Resources

- **RIPE NCC Internet Measurements**
  https://www.ripe.net/analyse/internet-measurements/
- **APNIC Labs**
  https://labs.apnic.net/measurements/
- **Internet Society**
  https://www.internetsociety.org/action-plan/measuring-the-internet/
- **Center for Applied Internet Data Analysis (CAIDA)**
  https://www.caida.org/
- **M-LAB**
  https://www.measurementlab.net/
- **The ZMap Project**
  https://zmap.io/

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