



RIPE NCC
RIPE NETWORK COORDINATION CENTER

How RIPE Atlas Hosts Help Build Resilience and Monitor Performance

Internet event analysis with **RIPE Atlas**

Comparing the Impact of Submarine Cable outages

Comparing two classes of submarine cable outage

Baltic Sea outage:

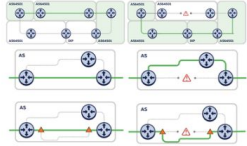
- Resilient network, low impact
- Redundancy + many vantage points = clear visibility

Côte d'Ivoire & Red Sea outage:

- Resilience not guaranteed, higher impact
- Latency & packet loss increased
- Limited vantage points = harder to see what happened

Lessons for Africa: performance, resilience, and visibility all depend on infrastructure & measurements

Baltic Sea cable damage as seen on RIPE Labs



A Deep Dive Into the Baltic Sea Cable Cuts

Emile Aben • 19 Dec 2024 • 25 min read

With last month's cuts in two major Baltic Sea Internet cables now successfully repaired, and another cut having occurred in the meantime, we analyse these events and delve deeper into the question of how exactly the Internet has remained resilient.

atlas outages research +2

65 0



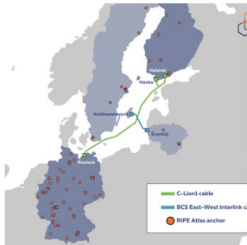
Emile Aben: How the Internet Routed Around Damage in the Baltic Sea

Alun Davies • 31 Mar 2025 • 2 min read

When two Internet cables in the Baltic Sea were reported as broken last November, we turned to RIPE Atlas to examine the damage. In this episode, Emile Aben discusses what his analysis uncovered about the impact of these and similar incidents, and how the Internet remained resilient.

atlas outages podcast measurements

35 0



Does the Internet Route Around Damage? - Baltic Sea Cable Cuts

Emile Aben • 20 Nov 2024 • 10 min read

This week's Internet cable cuts in the Baltic Sea have been widely reported, even as attempts to understand their cause and impact continue. We turn to RIPE Atlas to provide a preliminary analysis of these events and ask to what extent the Internet in the region has been resilient to them.

atlas outages research +3

220 2

Read more on
RIPE Labs:





About the author

Manage Profile

Based in [Amsterdam, NL](#)

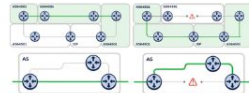
I'm a data scientist at the RIPE NCC. I'm a chemist by training, but have been working since 1998 on Internet related things, as a sysadmin, security consultant, web developer and researcher. I am interested in technology changes (like IPv6 deployment), Internet measurement, data analysis, data visualisation, sustainability and security. I'd like to bring research and operations closer together, ie. do research that is operationally relevant. When I'm not working I like to make music (electric guitar, bass and drums), do sports (swimming, (inline) skating, bouldering, soccer), and try to be a good parent.

Links & Social



Articles 105 Contributions 64 Comments 18

Newest



A Deep Dive Into the Baltic Sea Cable Cuts

 Emile Aben • 19 Dec 2024 • 25 min read

With last month's cuts in two major Baltic Sea Internet cables now successfully repaired, and another cut having occurred in the meantime, we analyse these events and delve deeper into the question of how

Baltic Sea cable damage



Media coverage

Two Baltic Sea cables disrupted – is this ‘hybrid warfare’?

By Annie Turner - 19 November 2024

European governments point finger at Russia over Baltic cable cuts

Investigations are underway into two subsea cable breaches in the Baltic and European governments are starting to suggest that Russia is behind

Mary Lennighan
November 20, 2024

3 Min Read



Sweden opens inquiry into damaged undersea cable as Nato deploys ships

A vessel has been seized at optic line, probably due to

December 31, 2024

Christmas Day Cable Cuts in the Baltic Sea

Written by Alexander Lott

Damaged cables appear to be accident, Finland says

3 December 2024
George Wright
BBC News

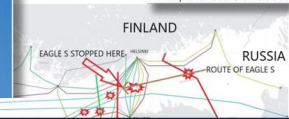
Share Save



marine telecommunication cables in Lithuania, Russia, and... In addition, an undersea cable was cut by a ship anchor. The incident involving a foreign cable ship over a hundred kilometers

incident occurred in October 2024, and the location is indicated on the map by the infrastructure located in the NewNew f... electricity cable and the ship's decisive intervention

ical offshore infrastructure and the Eagle S incident



Sweden Investigates New Cable Break Under Baltic Sea

Authorities are looking into possible damage to an undersea cable east of Gotland island. NATO has stepped up its surveillance in the region.

Baltic subsea cable damage was accidental, not sabotage - US and European officials

Refutes all claims of Russian sabotage

January 20, 2025 By: Niva Yadav Have your say



Subsea cable damage in the Baltic Sea in recent months was likely the result of maritime accidents, not Russian sabotage, according to several US and European intelligence officials.

As reported by [The Washington Post](#), US and European officials have gathered evidence - including intercepted communications - which have concluded that anchors were dragged across the seabed accidentally because of inexperienced crews aboard poorly maintained



Swedish Coast Guard vessel in the Baltic Sea. Sweden also investigated the severing



Baltic Sea cable damage



Fri 27 Dec 2024 13:48
0 knots

It then carried on across four undersea fibreoptic cables, three of which registered failures around the time the ship crossed them. The ship was suspected by Finnish authorities of having dragged its anchor to damage the cables and was escorted into custody.

- Fibre-optic cables
- Estlink 2 power cab
- Infrastructure dam



The Guardian

Sources: OpenStreetMap, Esri, Telegeography, Marin

Baltic Sea cable damage



Partial timeline (focus on initial events we analysed)

- 17 Nov 2024: **BCS East-West** outage
- 18 Nov 2024: **C-LION1** outage
- 27 Nov 2024: **BCS East-West** restored
- 28 Nov 2024: **C-LION1** restored
- 25 Dec 2024: **C-LION1** outage
- 06 Jan 2025: **C-LION1** restored
- 26 Jan 2025: **LVRTC** outage
- 28 Feb 2025: **LVRTC** restored

Measuring damage with RIPE Atlas



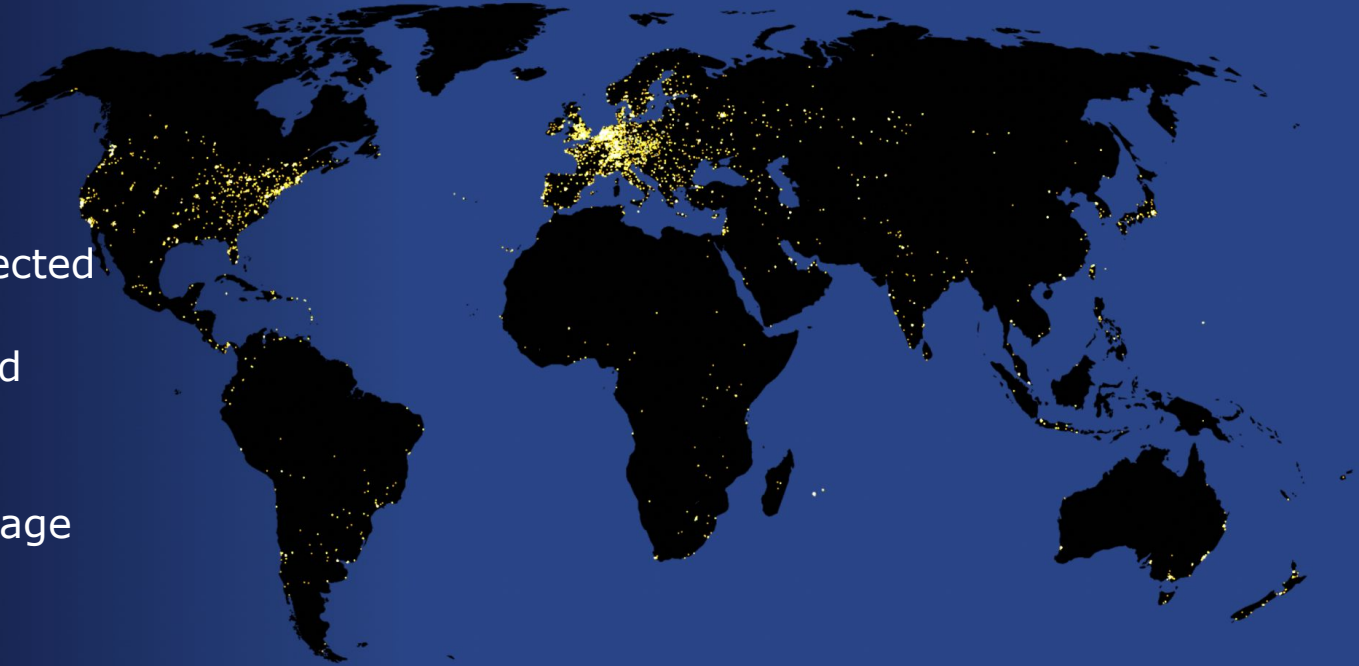
RIPE Atlas

A global network of probes measuring the Internet in real time

13,400+ probes connected

800+ anchors deployed

35,000+ daily measurements on average (both user-defined and built-in)



Measuring damage with RIPE Atlas

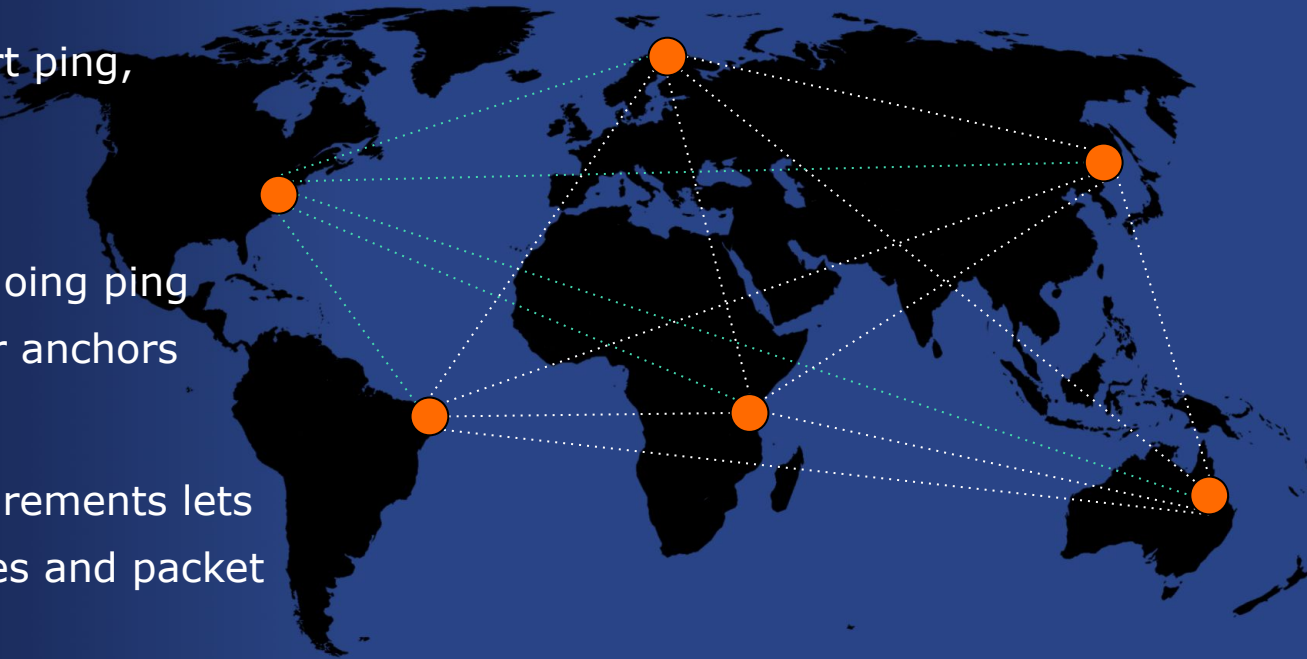


Anchor mesh

RIPE Atlas anchors support ping, traceroute, DNS, HTTP/S measurements

Each anchor performs ongoing ping measurements to all other anchors at four-minute intervals

Resulting 'mesh' of measurements lets us observe latency changes and packet loss between anchors



First look



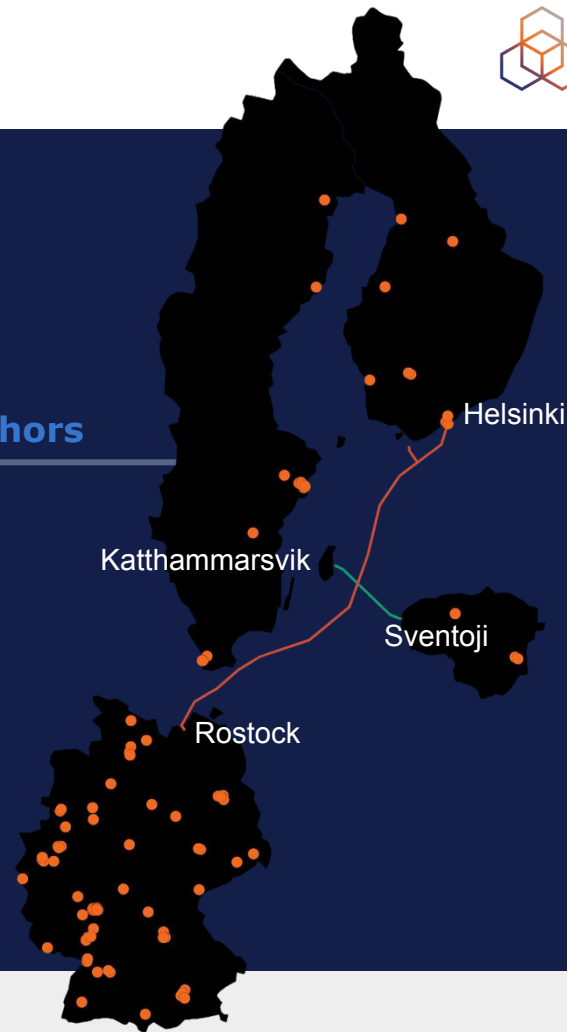
17-18 November

BCS East-West: Sweden-Lithuania

C-LION1: Germany-Finland

We looked at results in the RIPE Atlas anchor mesh between these countries around reported time of the event

Country	# anchors
Germany:	100
Sweden:	15
Finland:	12
Lithuania:	5



BCS East West (SE-LT)



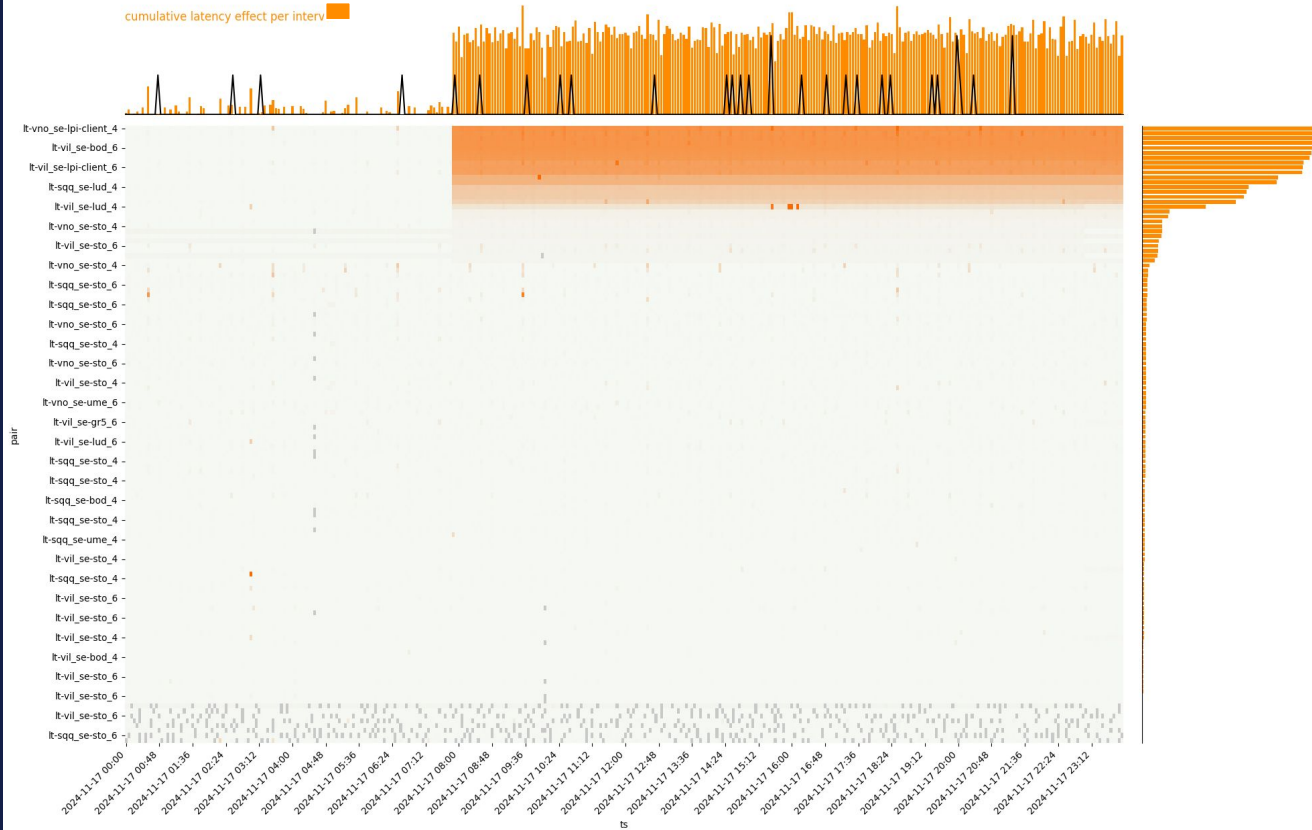
Packet loss
Latency effects

Latency shift

12 hour before/after
time of event

Latency increase of
approx 10-20 ms
shortly before
08:00 UTC on
17 November

*We subtract the minimum
latency for a path during our
observation period to make the
latency jumps comparable*



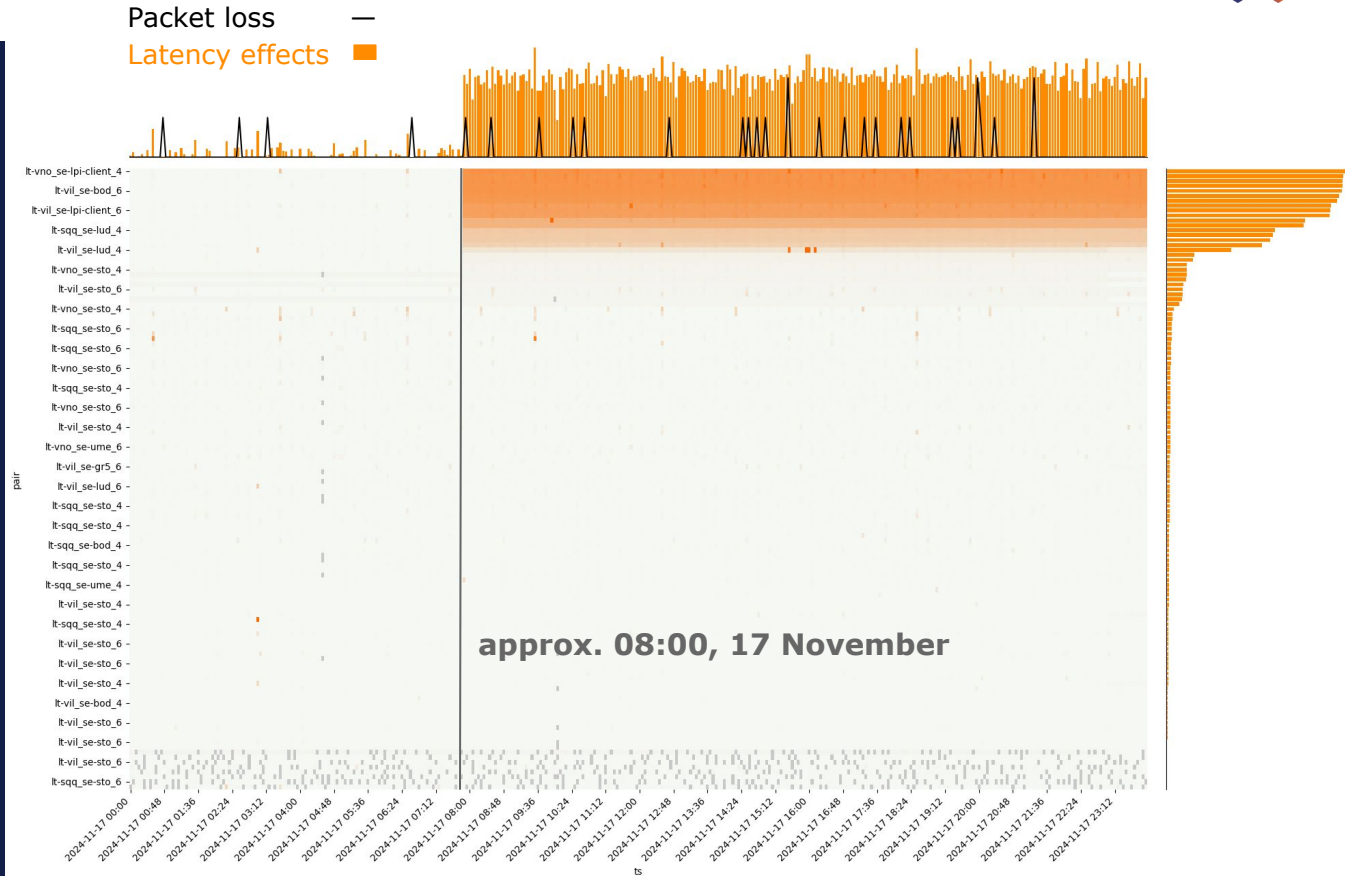


Latency shift

12 hour before/after
time of event

Latency increase of
approx 10-20 ms
shortly before
08:00 UTC on
17 November

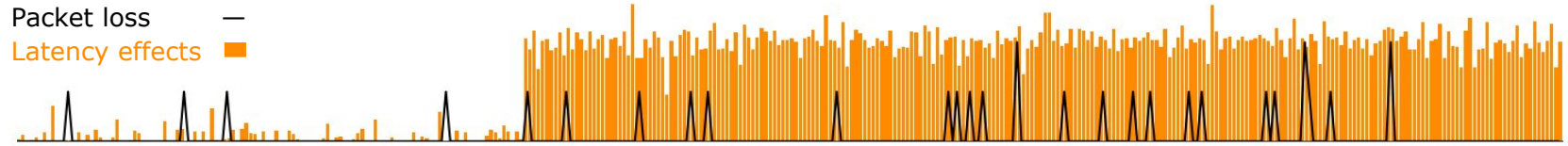
*We subtract the minimum
latency for a path during our
observation period to make the
latency jumps comparable*





Packet loss

Baseline of 0% packet loss
(with occasional spikes)



No significant increase in packet loss at
time of the cable outage (shortly before
08:00 UTC)

C-LION1 (DE-FI)

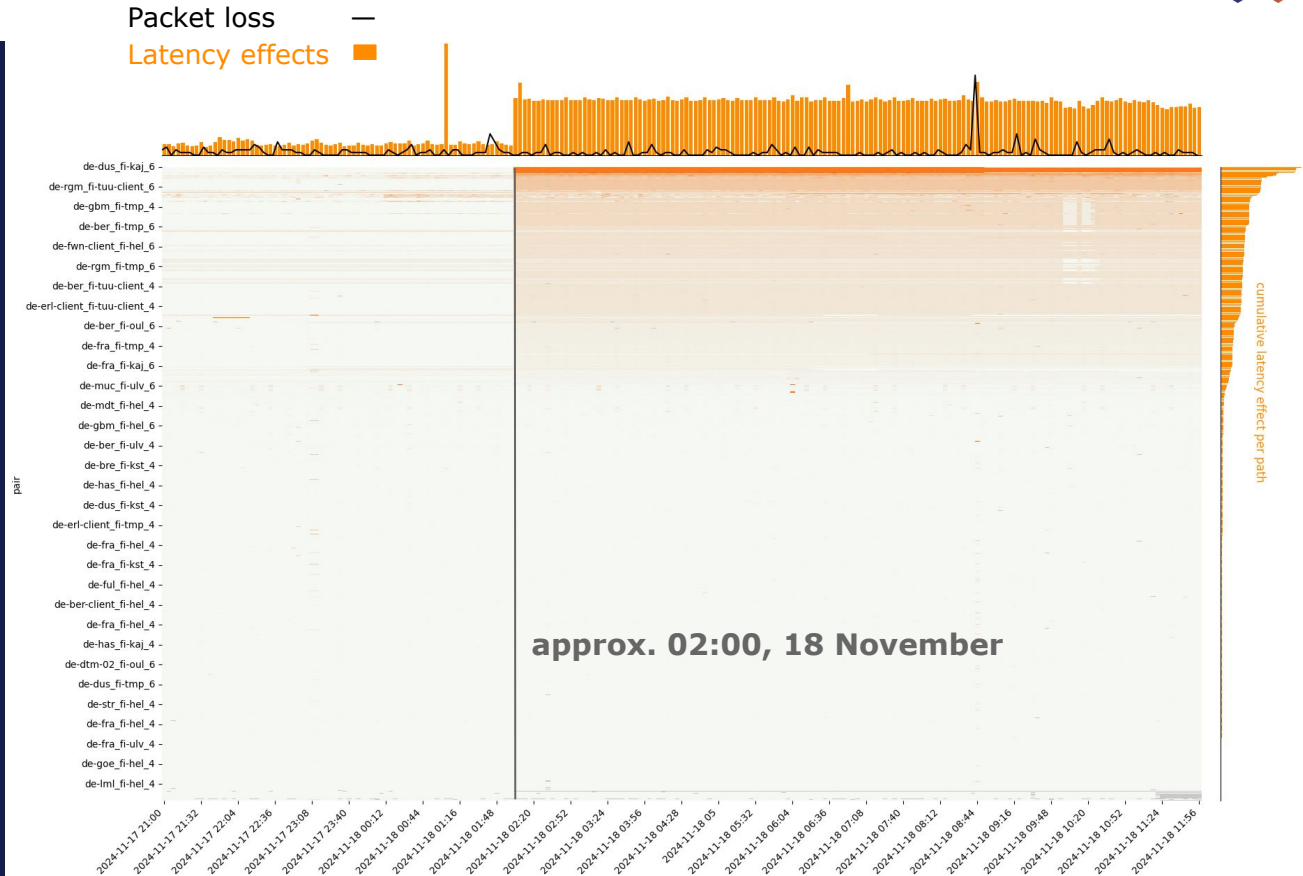


Latency shift

Latency increase of approx 5ms a little after 02:00 UTC on 18 November

Packet loss

Again, no significant increase in packet loss at time of outage

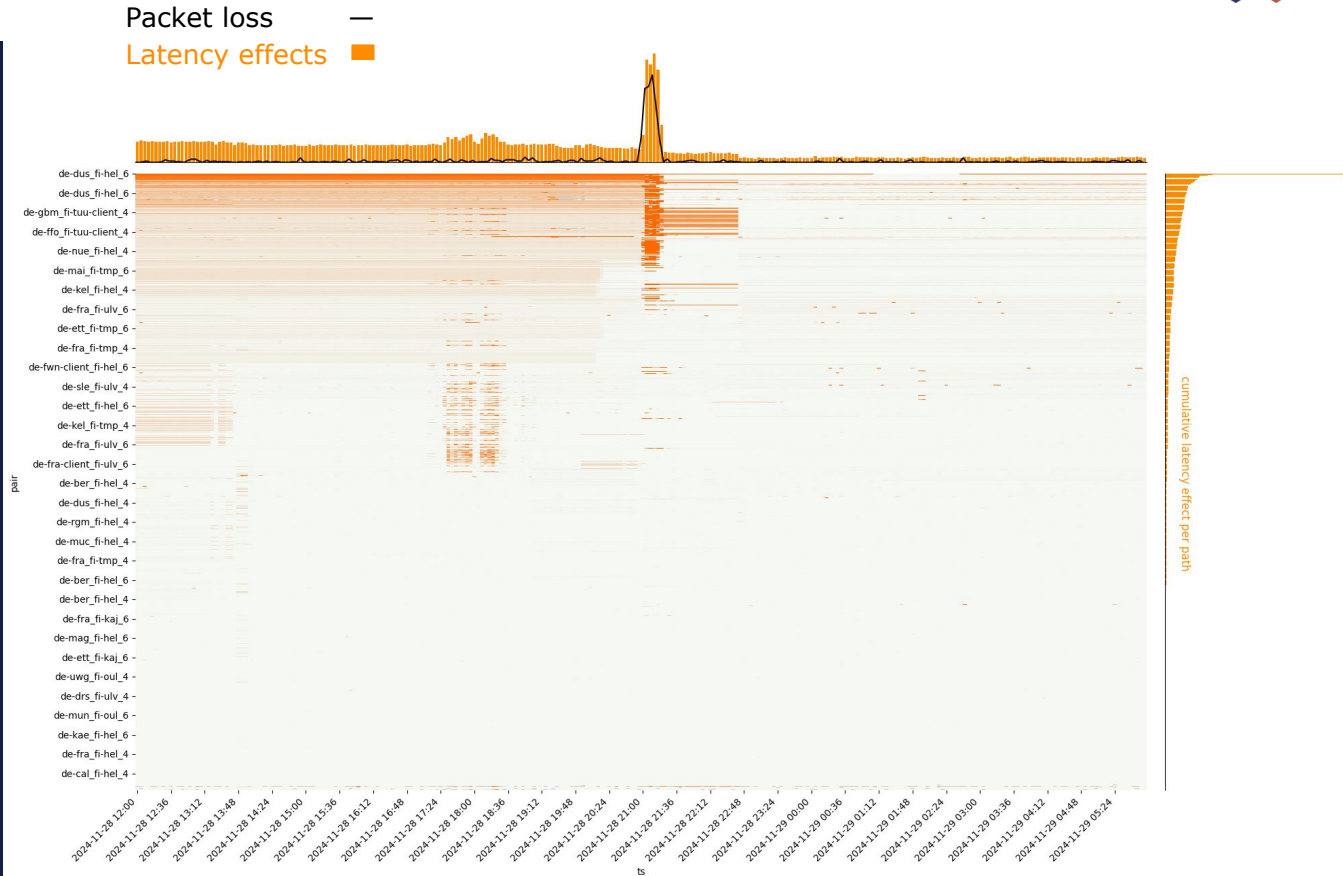


C-LION1 repair



28 November (17:30 UTC): C-Lion1 cable repair ship reported leaving the area after successful repair

Unclear what exactly causes these latency effects and the temporary increase in packet loss...



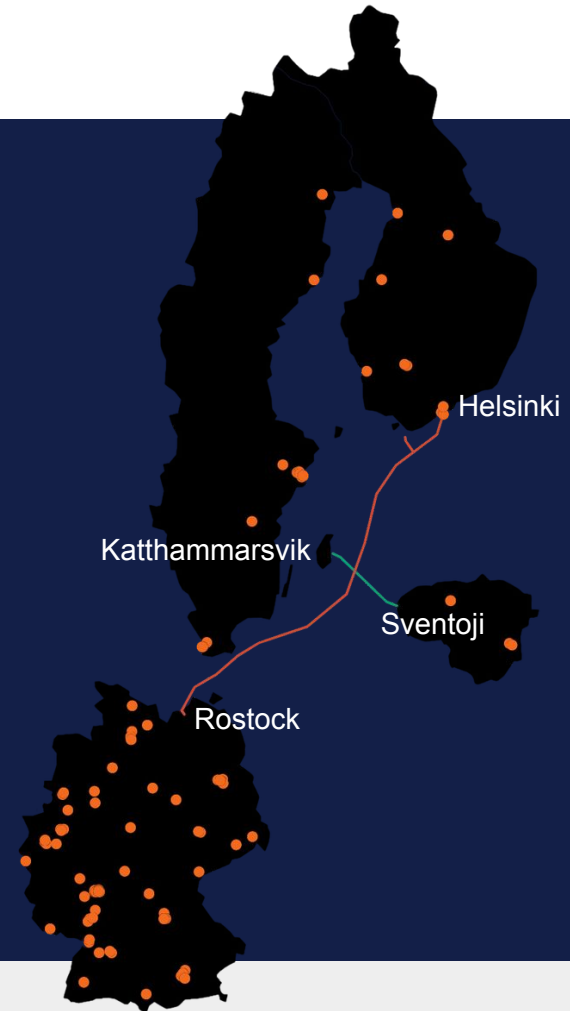
Summing up



There was a relatively minor but visible shift in latency for around 20-30% of paths between observed anchors

But there was no concurrent increase in packet loss

The Internet routed around damage!

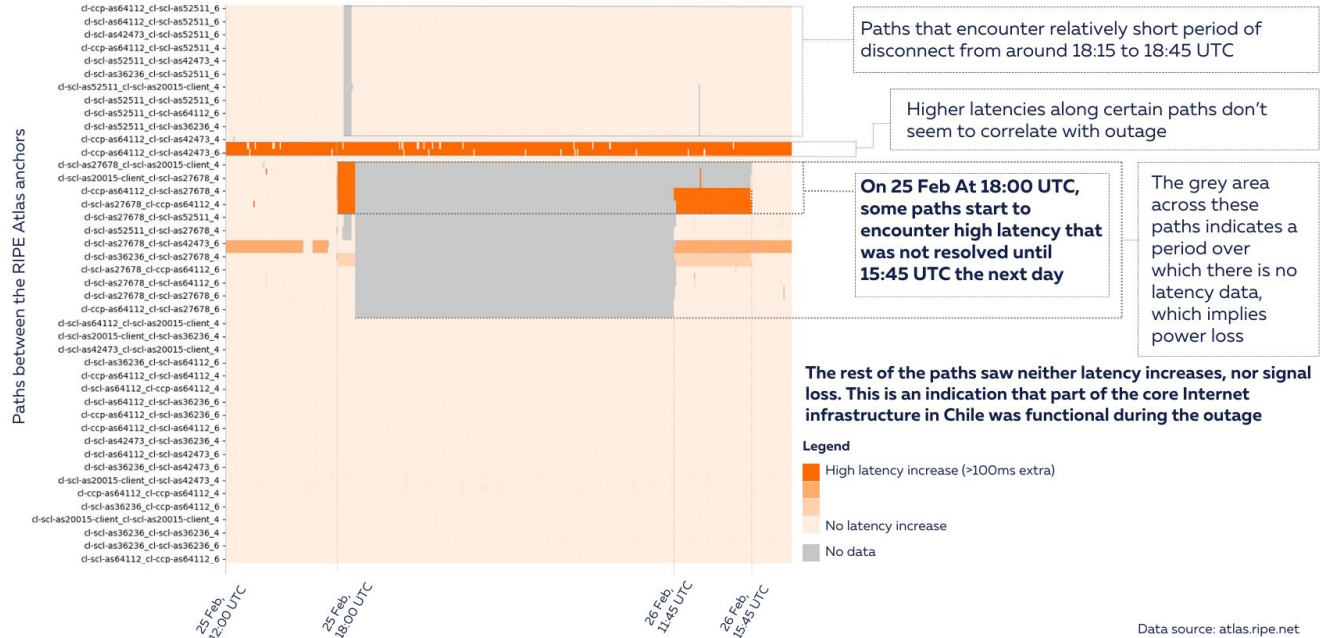




Chile Power Outage

On 25 February, at around 18:00 UTC, a nationwide power outage affected Chile. The RIPE Atlas anchors (Internet measurement devices) in Chile give us a glimpse of how the Internet infrastructure coped with the power outage. Here's a breakdown of the effects we saw on the paths between the anchors.

Anchor mesh measurements have broad potential for getting insights into outages



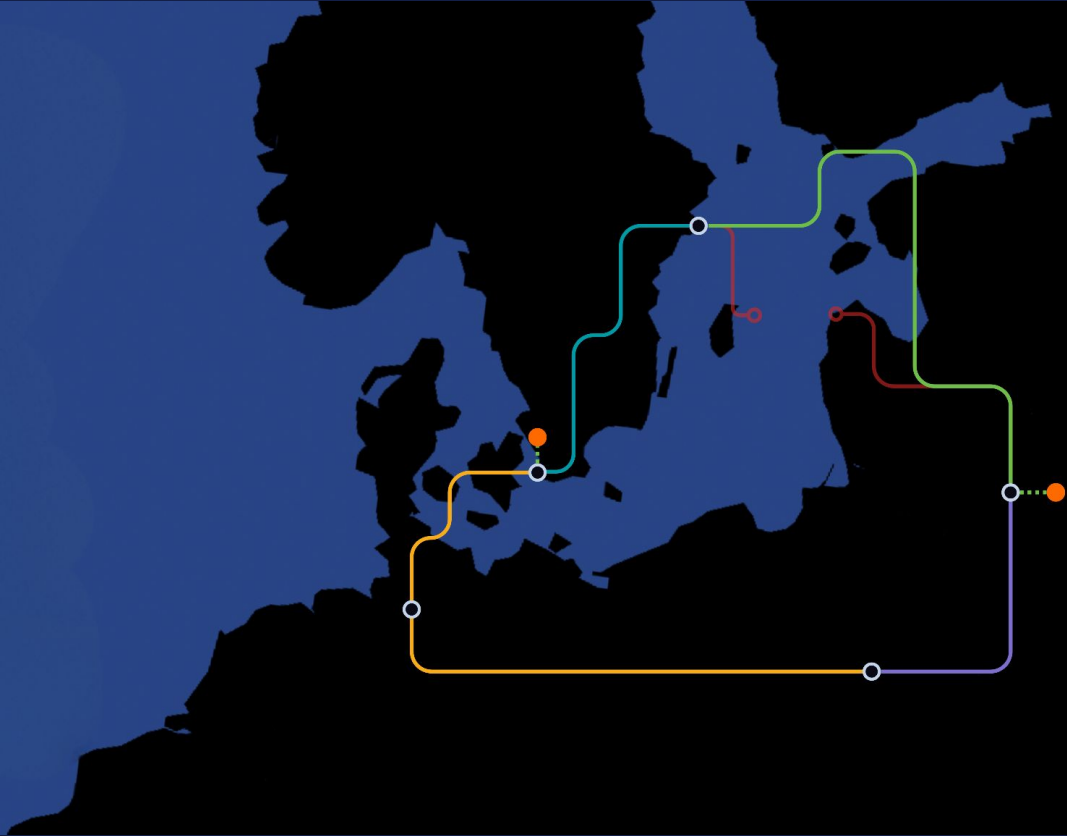
Deeper dive



Initial analysis was based on ping
(end-to-end latency) data

We followed this up with in depth
analysis using traceroute data

Aim: to examine how the paths
actually changed while end-to-end
connectivity was maintained

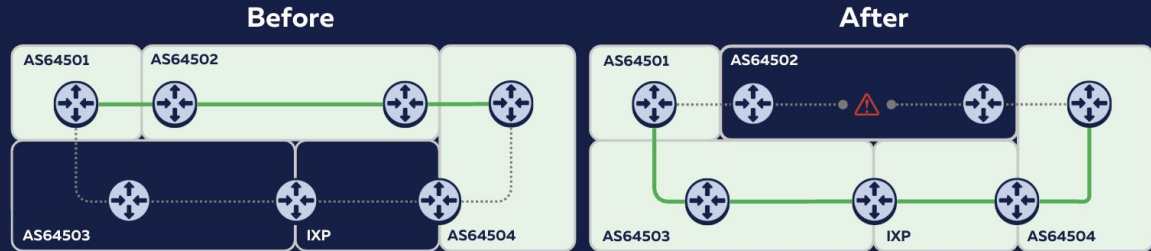


Levels of resilience



Inter-domain rerouting:

Traffic rerouted through alternative ASes/IXPs (eBGP routing protocol)



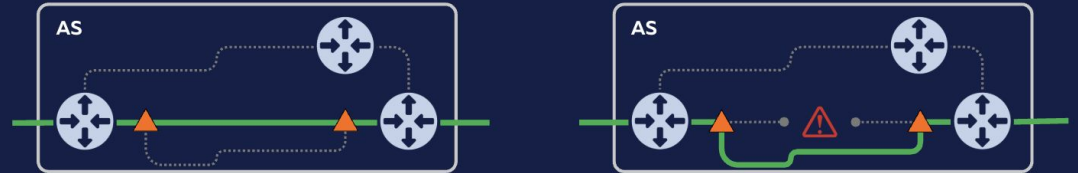
Intra-domain rerouting:

Rerouting *within* networks over alternative paths (IGP: OSPF, IS-IS)



Circuit-level rerouting:

Rerouting along alternative circuit-level connections between routers (same IP address!)



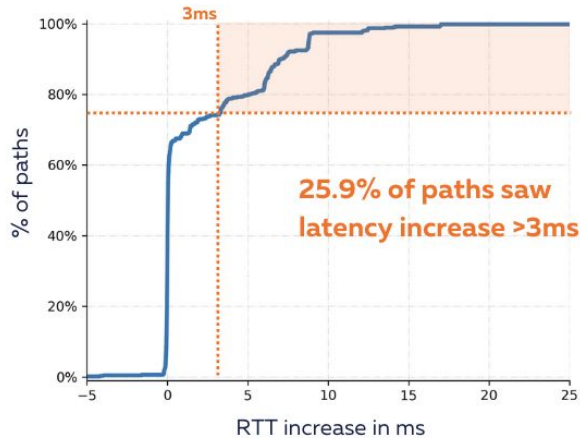
Levels of resilience



Of the 2,141 paths between anchors in Germany and Finland used for this analysis:

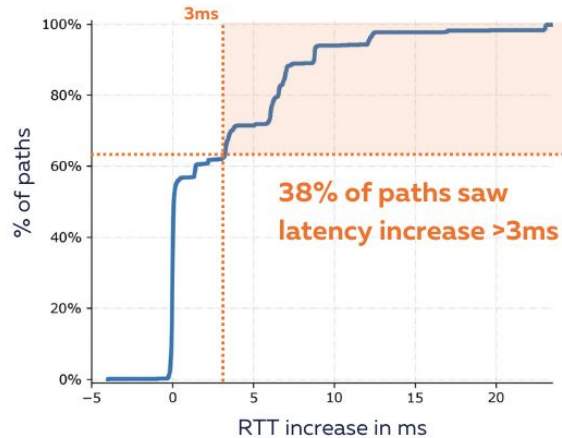
Inter-domain rerouting

RTT profile for **637** paths where inter-domain routing changed.



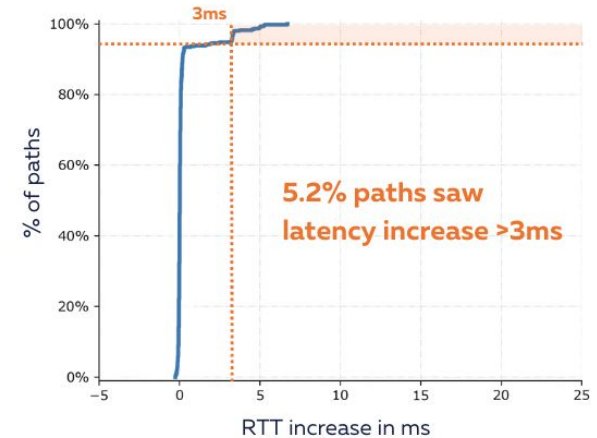
Intra-domain rerouting

RTT profile for **1,044** paths with IP-level changes, but no inter-domain changes.



Circuit-level rerouting

RTT profile for **460** paths with no inter-domain or intra-domain changes.



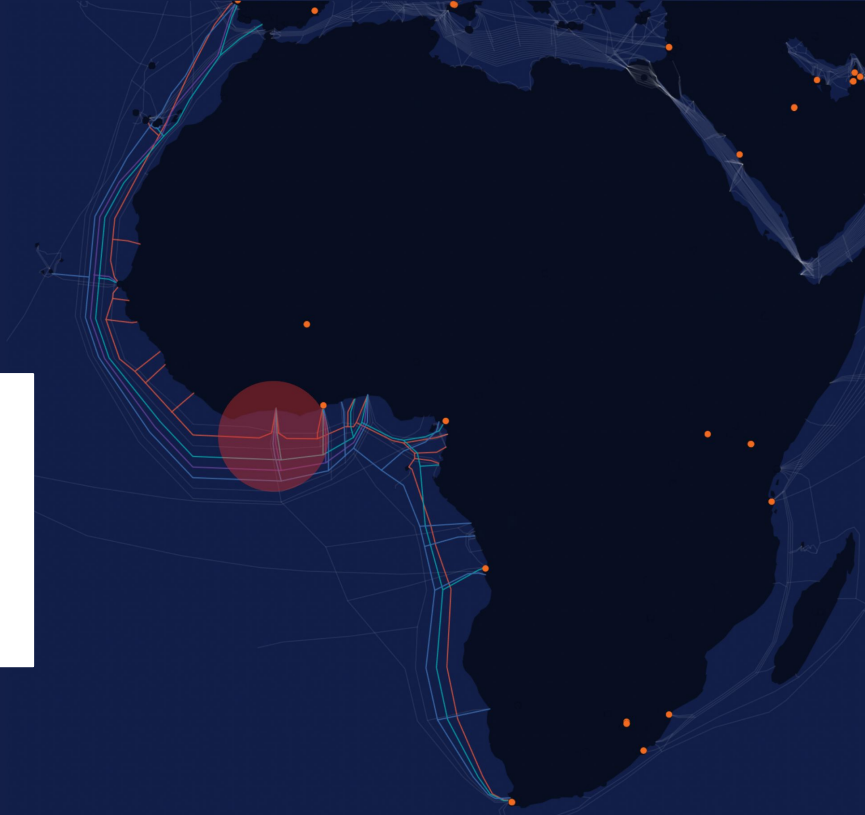
Resilience is not guaranteed: Côte d'Ivoire, 2024



Cable damage in Africa

14 March 2024: Submarine landslide off coast of Cote d'Ivoire resulted in damage across multiple cables:

- **ACE: Africa Coast to Europe**
- **MainOne**
- **SAT-3: Submarine Atlantic 3/West Africa Submarine Cable**
- **WACS: West Africa Cable System**



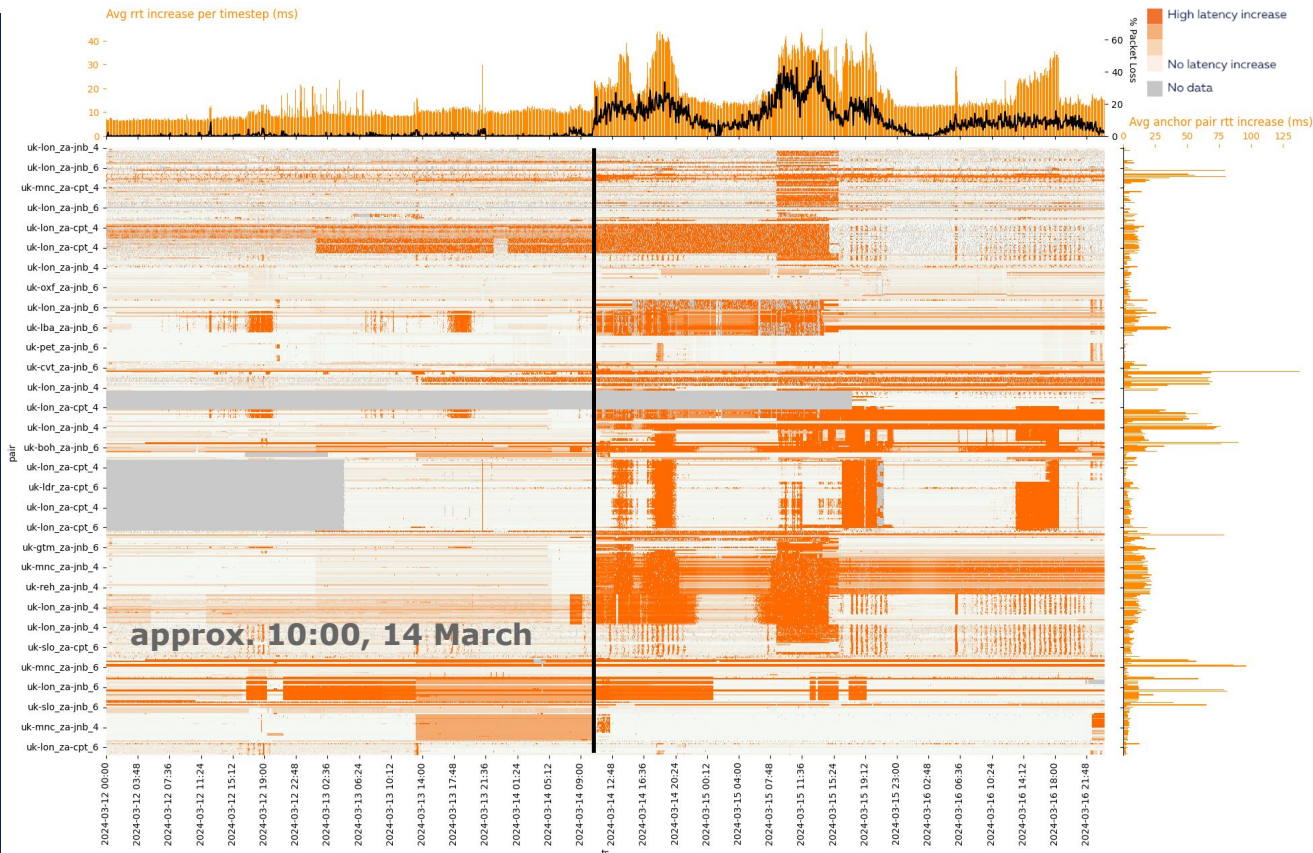
Resilience is not guaranteed: Côte d'Ivoire, 2024



Latency shift with packet loss

View of paths between anchors in UK and South Africa.

Latency increases of approx 20-30 ms accompanied by concurrent increase in packet loss



Resilience is not guaranteed: Red Sea, 2025



Cable damage in the Red Sea

5 September 2025:
Reports emerge of
cable outages in the
Red Sea affecting:

- **FALCON**
- **SeaMeWe-4**
- **IMEWE**
- **Europe India Gateway (EIG)**



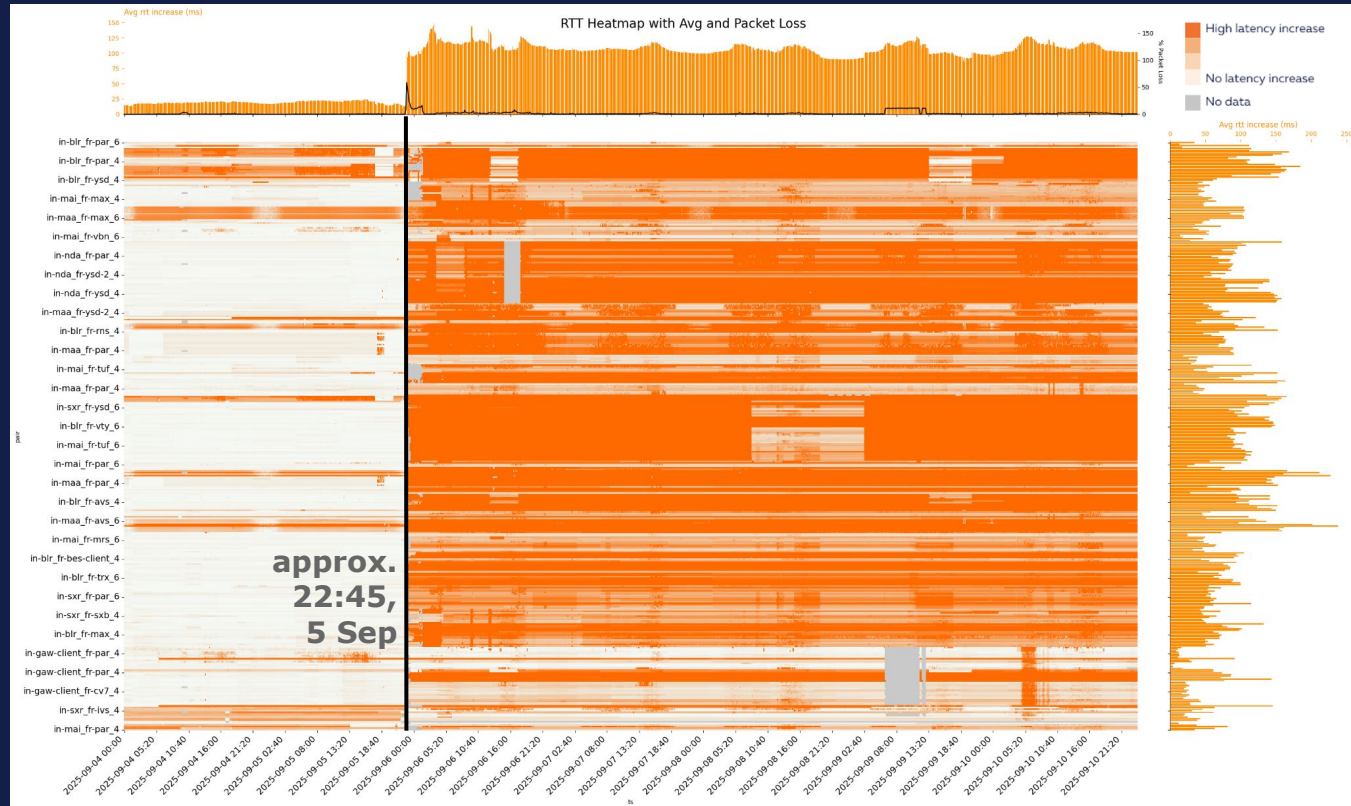
Resilience is not guaranteed: Red Sea, 2025



Latency shift with packet loss

View of paths between anchors in France and India.

Latency increases of approx 100 ms accompanied by concurrent increase in packet loss

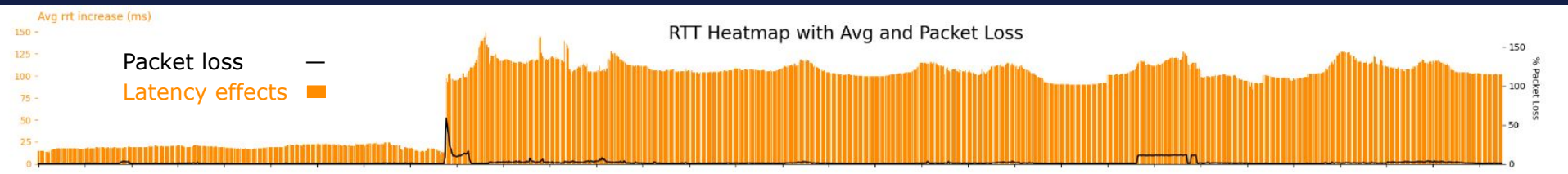


Resilience is not guaranteed: Red Sea, 2025



Packet loss

Up to 50% increase in packet loss



Significant increase (up to 50%) in packet loss at time of the initial cable outage followed by ongoing loss over next 24 hours.

Note: the right hand y-axis (associated with the black line indicating packet loss) is of a higher scale here compared to previous plots: 0-150 ms



In the Baltic Sea:

- “The Internet routed around damage”
- Internet resilience depends on multiple levels of redundancy
 - Redundancy between networks
 - Redundancy within networks (circuit and routing)

But resilience is not guaranteed

We have to keep monitoring, measuring, understanding

RIPE Atlas coverage - how far can we see?



RIPE NCC is a neutral source
of Internet measurement
data

To gain visibility into Internet
events, we need vantage
points

Coverage is key!

*We are actively seeking hosts who can help us get RIPE Atlas probes
and anchors set up in locations where they can shed light on the state of
the Internet. Learn more!*



RIPE Atlas coverage - how far can we see?



Country code	Nr of anchor	Nr of cities w a...	Nr of ASNs w a...	landings
LY	0	0	0	14
CV	0	0	0	10
EG	0	0	0	8
DZ	0	0	0	6
ZA	16	4	15	6
MA	0	0	0	5
MU	2	2	2	4
KM	0	0	0	4
MG	0	0	0	4
KE	2	1	2	3
SO	0	0	0	3
TN	0	0	0	2
RE	0	0	0	2
YT	0	0	0	2
SC	0	0	0	2
DJ	2	1	1	2
UG	1	1	1	2
NG	0	0	0	2
BJ	0	0	0	1
CI	0	0	0	1
GM	0	0	0	1
GH	1	1	1	1

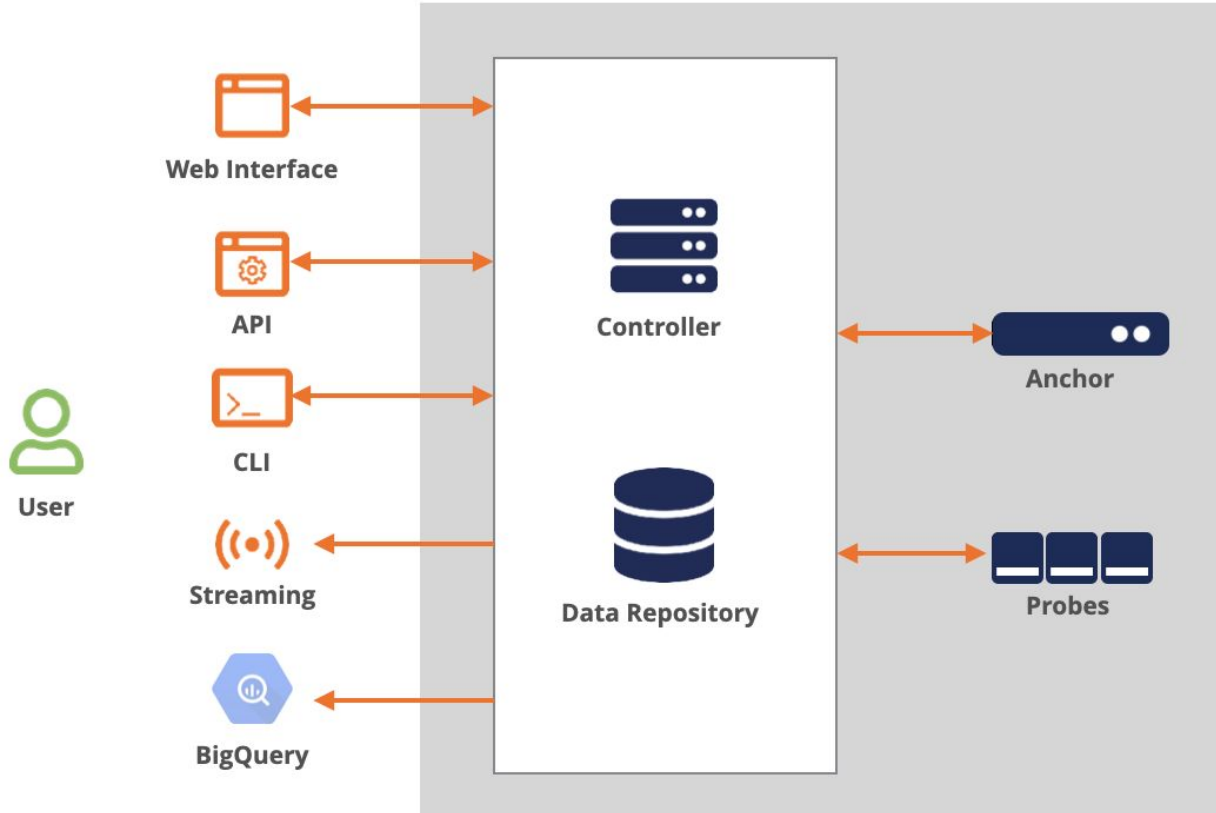
What makes RIPE Atlas stand out



- **Global Reach** – Not just cloud servers, but *real users' networks*
- **Real-World Insight** – See how your network looks from homes, schools, and ISPs
- **Custom Measurements** – Run your own tests, your way, anytime
- **Open & Trusted** – Community-driven, vendor-neutral, fully transparent
- **Cost-Effective** – Free to use, fair credits model
- **Network Level** - observation on Level 3 only, RIPE Atlas do not measure on Layer 2 level

RIPE Atlas is the only platform built on thousands of live probes around the world — giving you unmatched visibility from the ground up.

RIPE Atlas Interfaces



RIPE Atlas Probes vs Anchors



Feature	RIPE Atlas Probe	RIPE Atlas Anchor
Purpose	Lightweight, broad coverage	High-capacity, stable vantage point
Hardware	Small device or software	Dedicated VM or hardware
Measurements	Standard (ping, traceroute, DNS, NTP, SSL/TLS)	Standard + built-in anchoring measurements
Stability	Various: residential/office networks/data centre	Hosted in data centers, highly stable
Network Role	Acts as a probe only	Acts as both probe and measurement target (http)
Visibility	Public Map (probe list)	Public map + used in anchoring infrastructure
Credits Earned	Yes, 21600/24 hours	Yes, 10X more
Hosting Requirements	Basic internet access, dynamic IP ok	Public static IPv4/IPv6, no firewall, stable VM



Network Requirements

- Public **IPv4 and IPv6** addresses (native, not tunneled)
- **Gateways** must be in the same subnet as the IPs (IPv6 link-local also allowed)
- **Static IPs**, unfiltered (no firewall blocking Atlas traffic)
- Up to **10 Mbit/s bandwidth** (actual usage is lower)

RIPE Atlas Anchors generate many built-in measurements (pings, traceroutes, DNS) that help in outage analysis

Application Process

Application Approved

Complete Anchor Details

Download ISO Image

Prepare Your VM

Install Software

Post-Install Steps

Internal Tests (RIPE NCC)

Anchor Goes Live!



Questions & Comments



eaben@ripe.net

lhestina@ripe.net



RIPE NCC
RIPE NETWORK COORDINATION CENTER

THANK YOU!