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How the Internet routes around Cable Damage

Internet event analysis with **RIPE Atlas**

Alun Davies | **TLDCON 2025** | 15 September 2025

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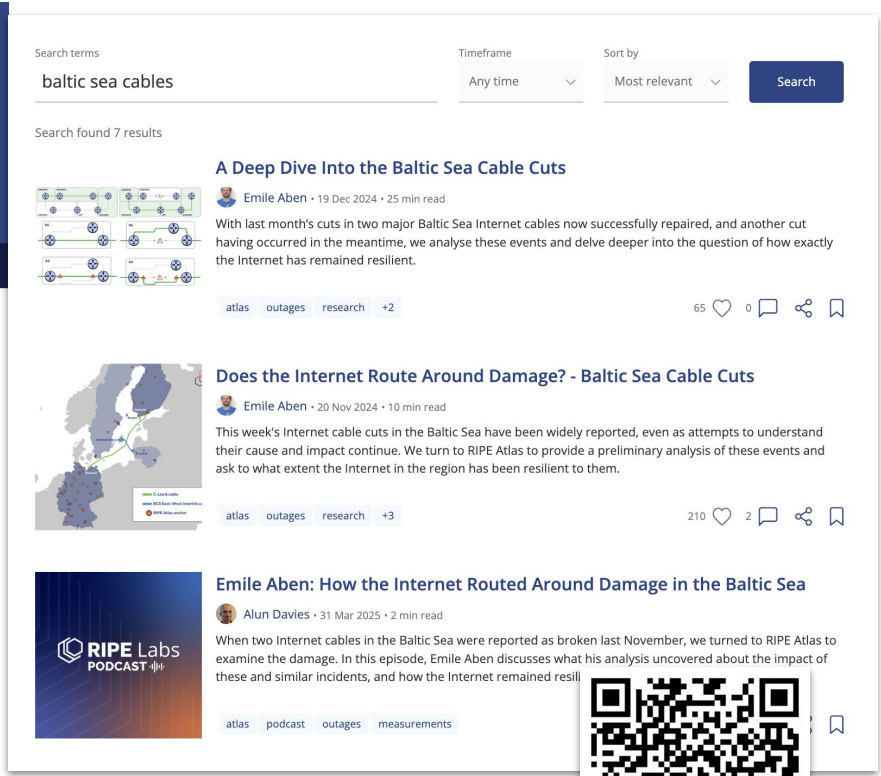

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Emile Aben

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About the author

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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.

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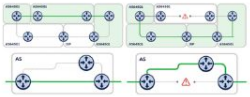


A Deep Dive Into the Baltic Sea Cable Cuts

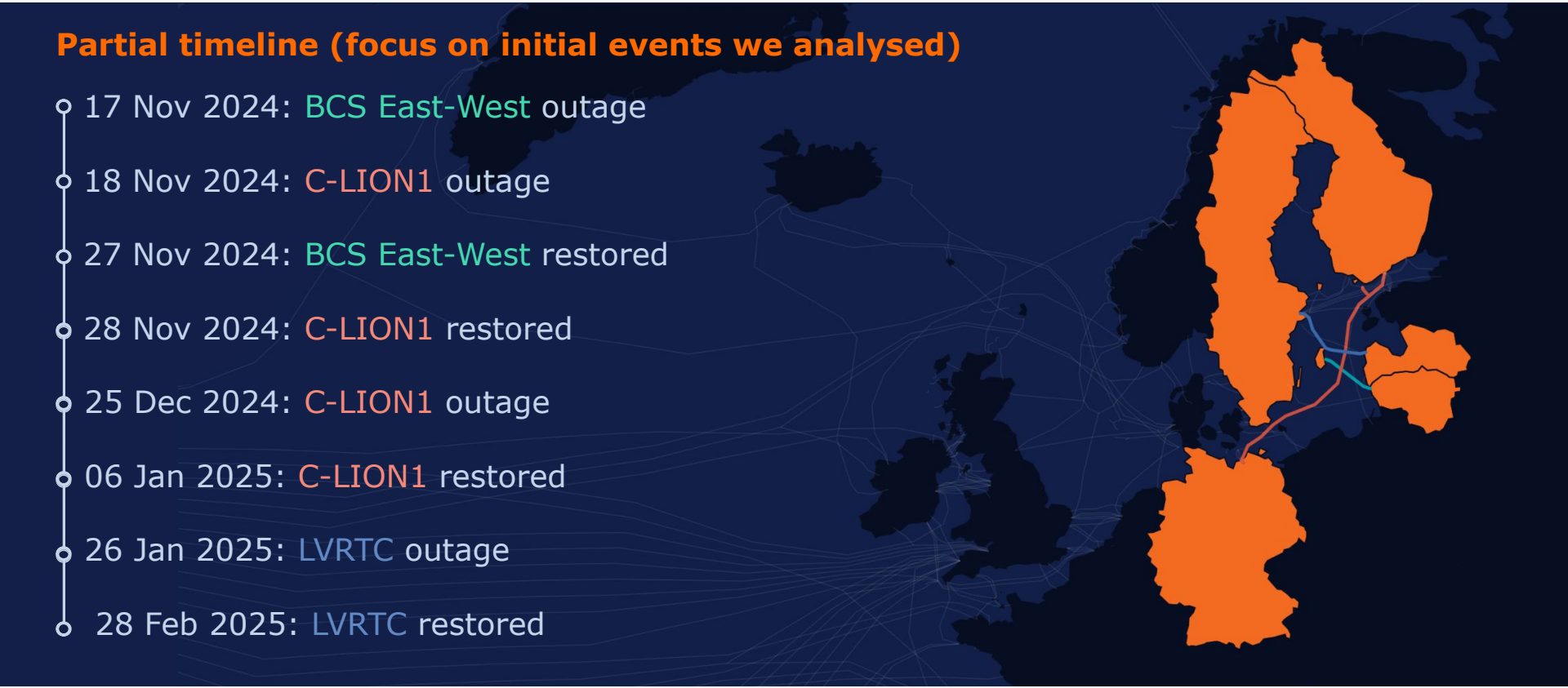
Emile Aben • 19 Dec 2024 • 25 min read

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

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

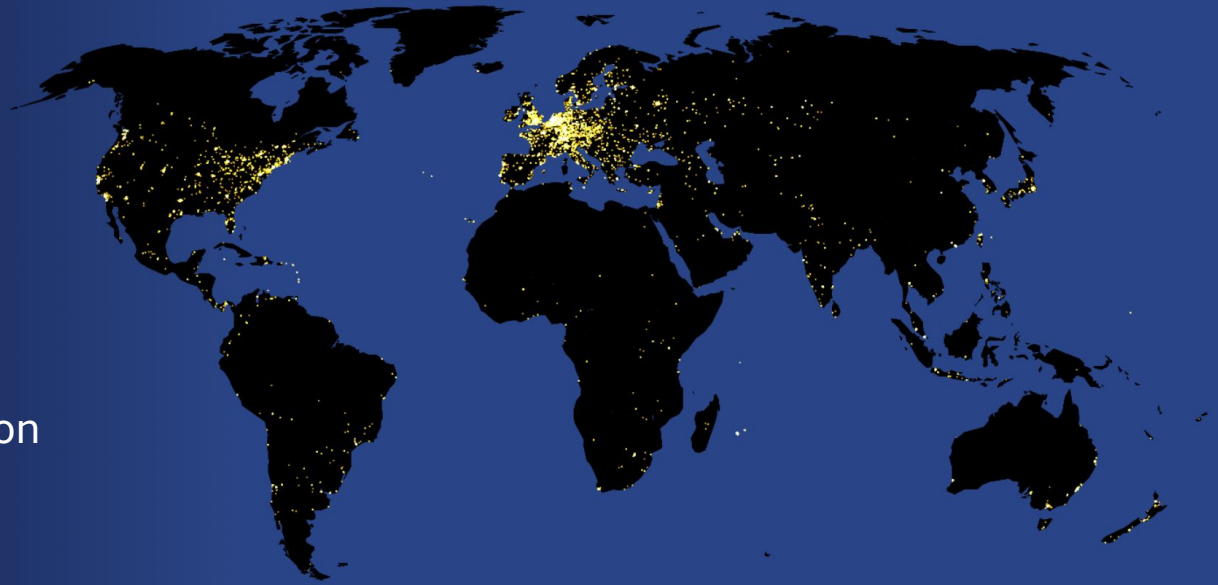
RIPE Atlas

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)



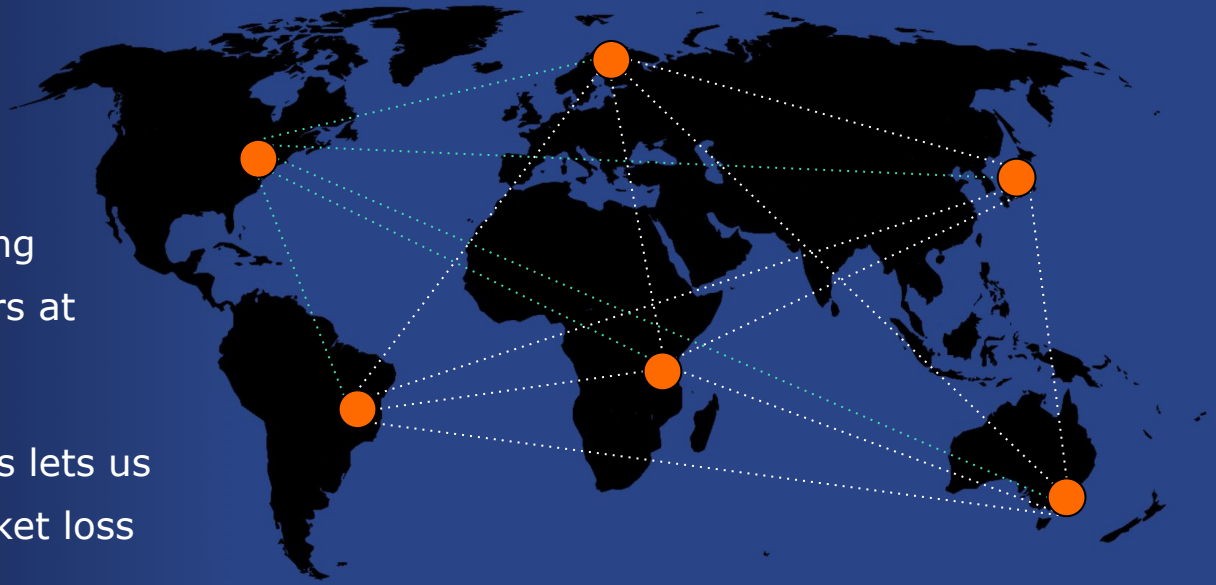
Measuring damage with RIPE Atlas

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

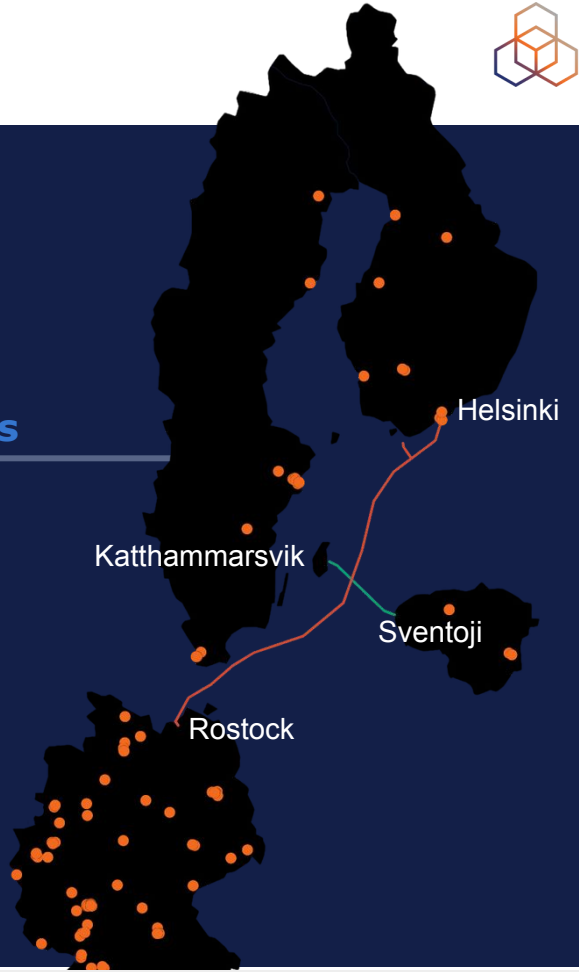
17-18 November

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



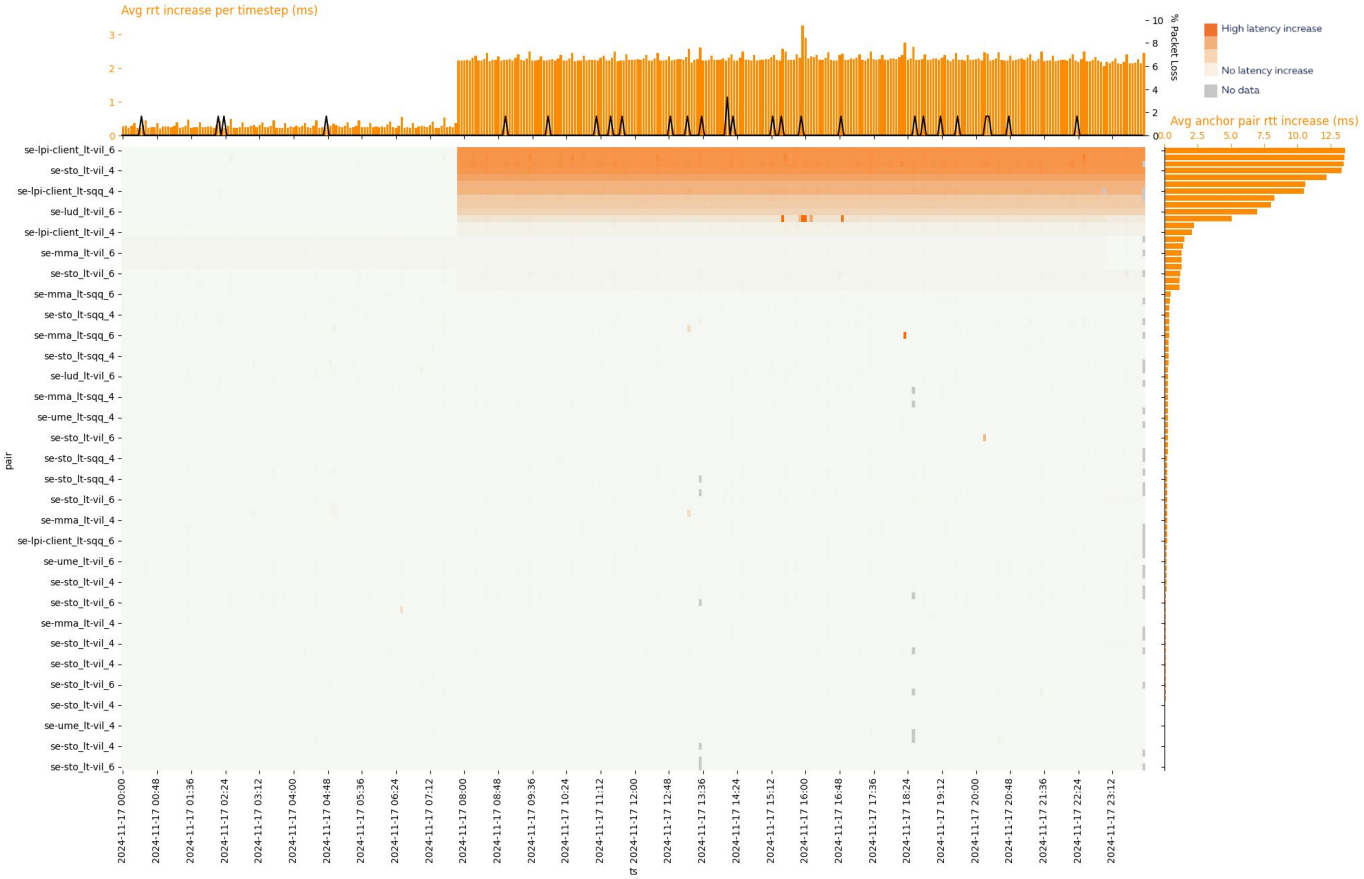
BCS East West

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



BCS East West

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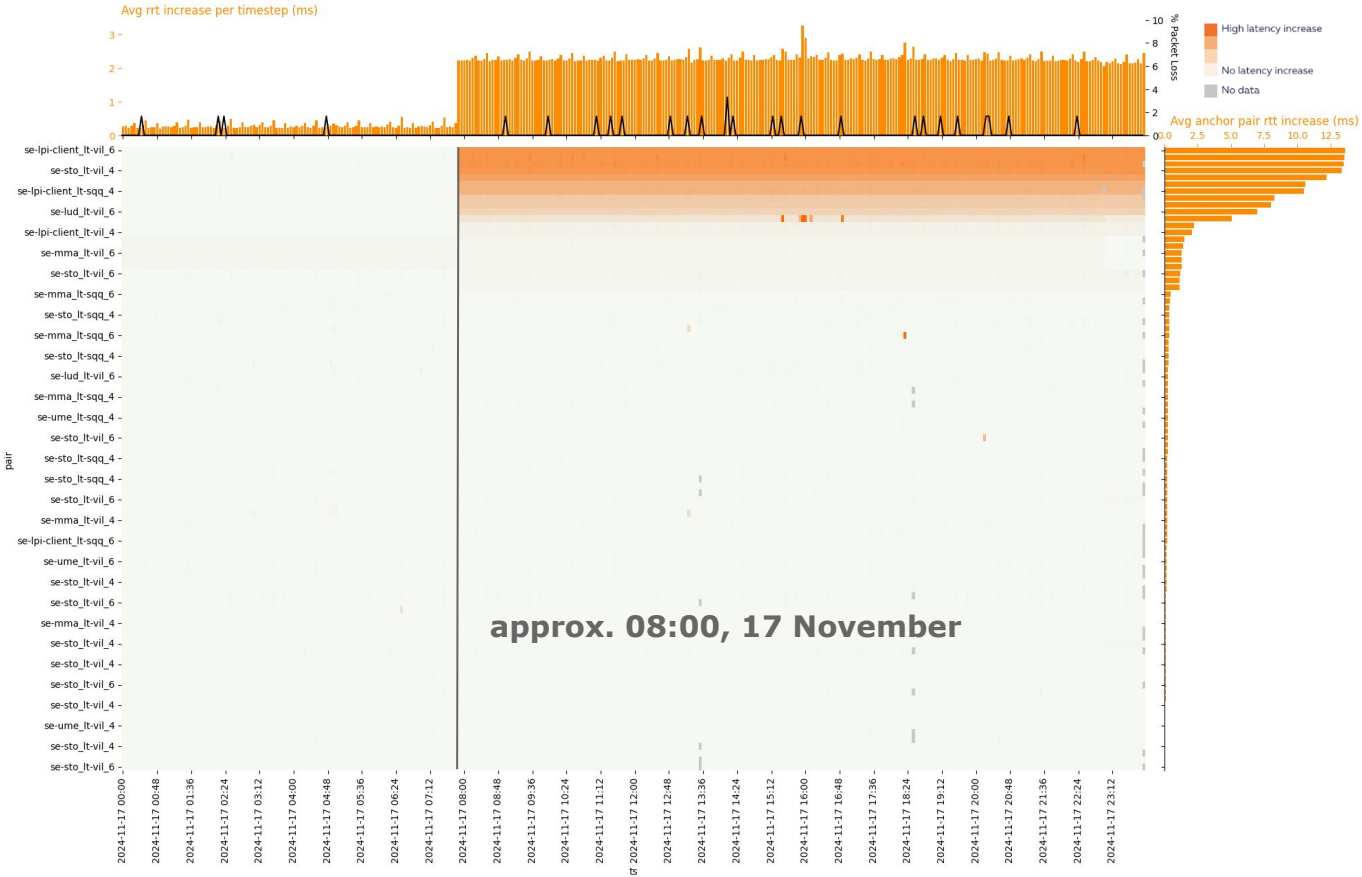
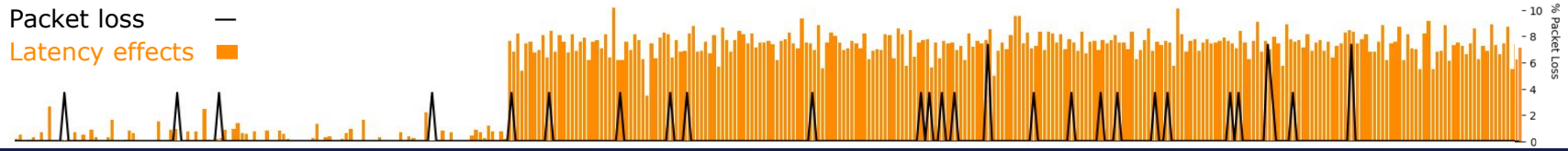


BCS East West

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

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

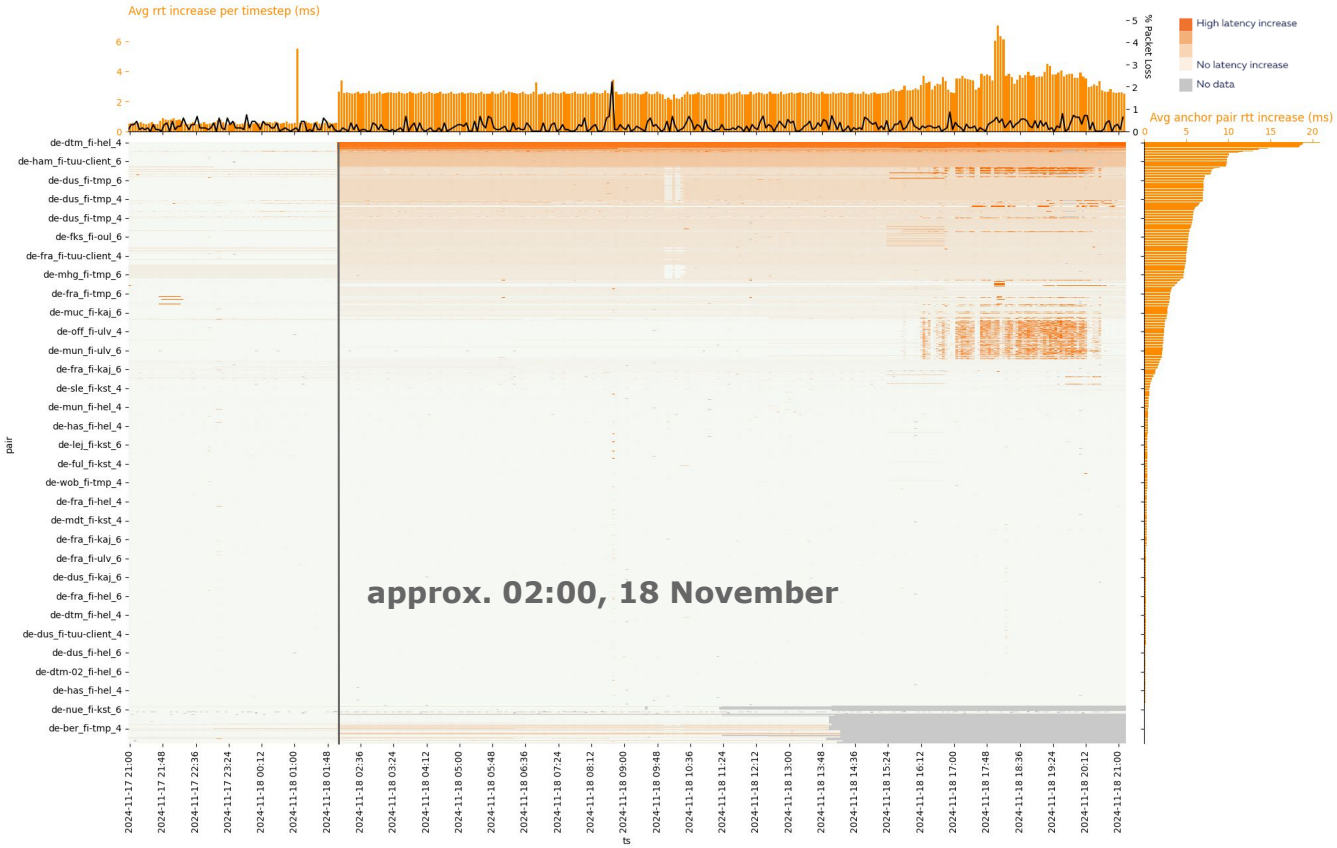
C-LION1

Latency shift

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

Packet loss

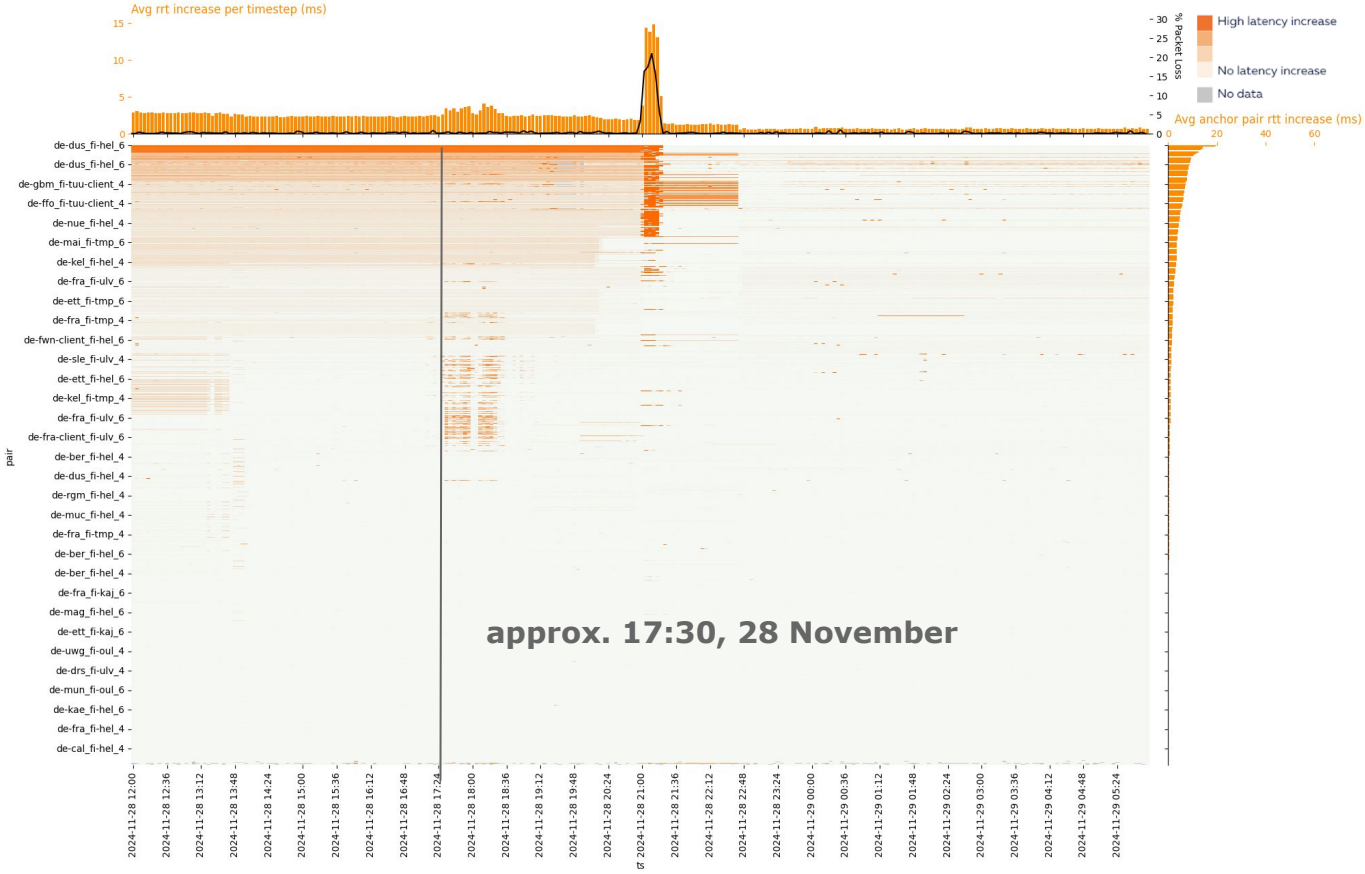
Again, no significant increase in packet loss at time of outage



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…

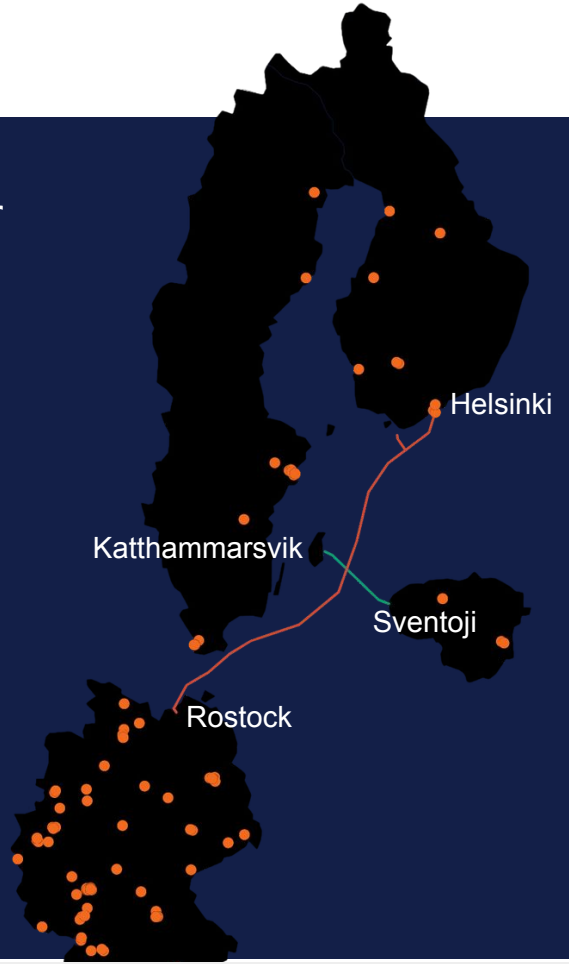


Summing up

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!

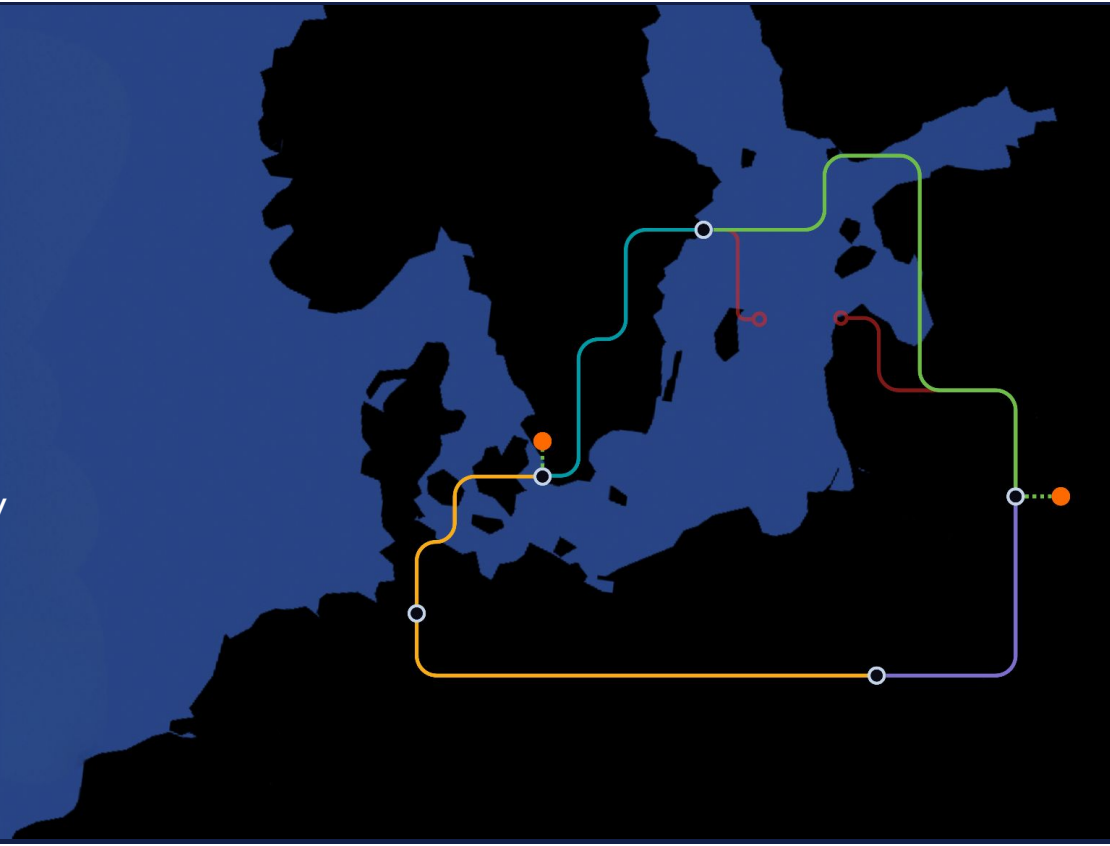


Deeper dive

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:

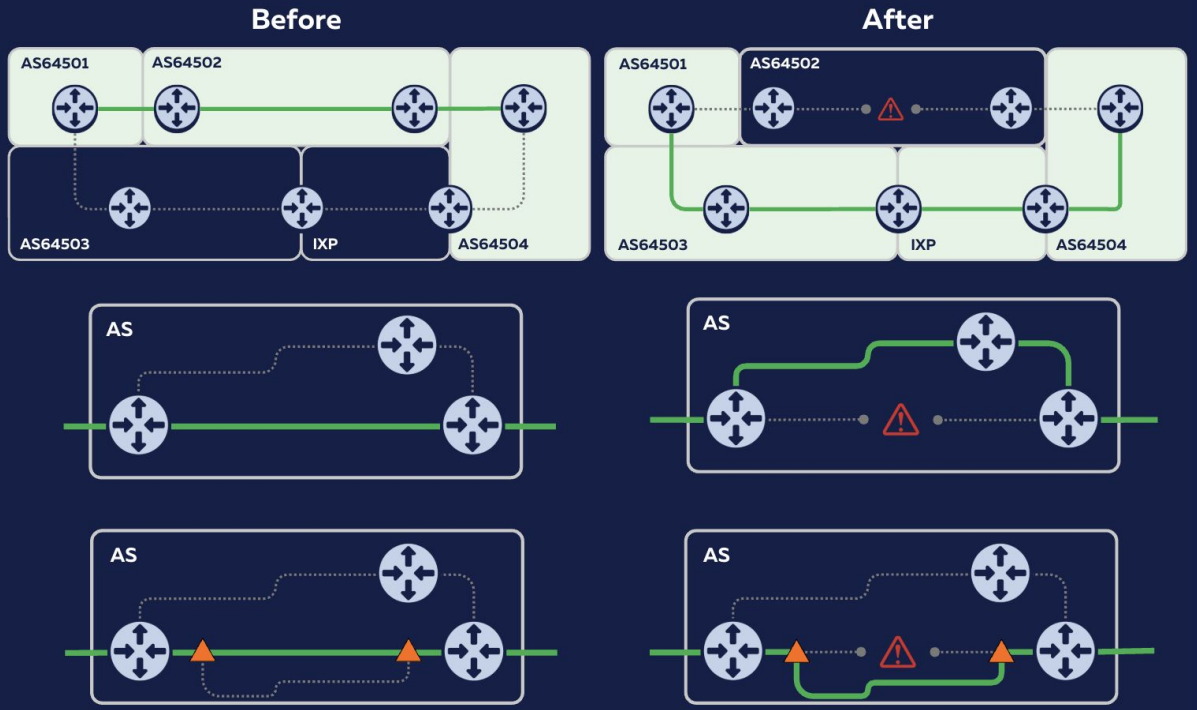
Traffic rerouted through alternative ASes/IXPs (eBGP routing protocol)

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!)



Resilience is not guaranteed

Cable damage in Africa

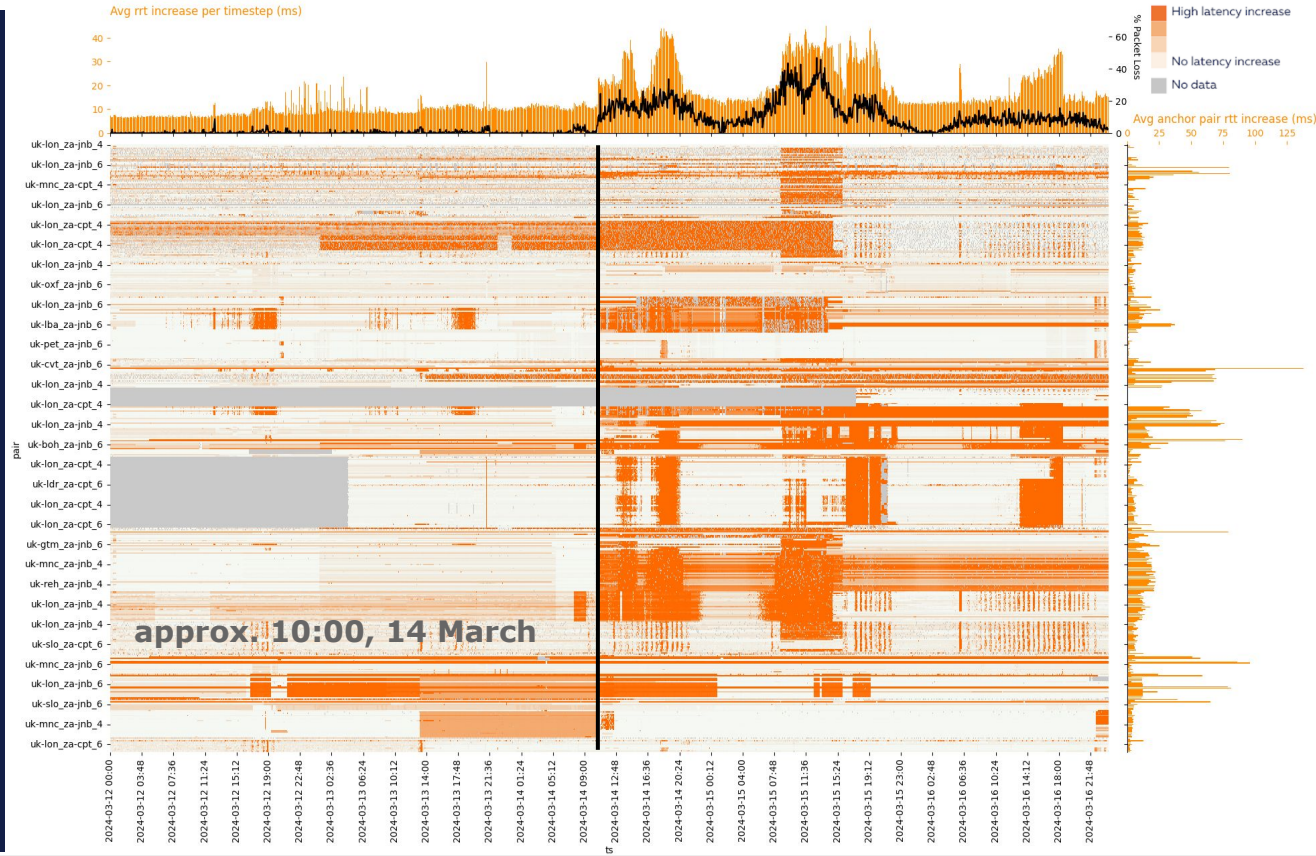
14 March 2024: Submarine landslide off coast of Cote d'Ivoire resulted in damage across multiple cables:

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

Resilience is not guaranteed

Latency shift *with* packet loss

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

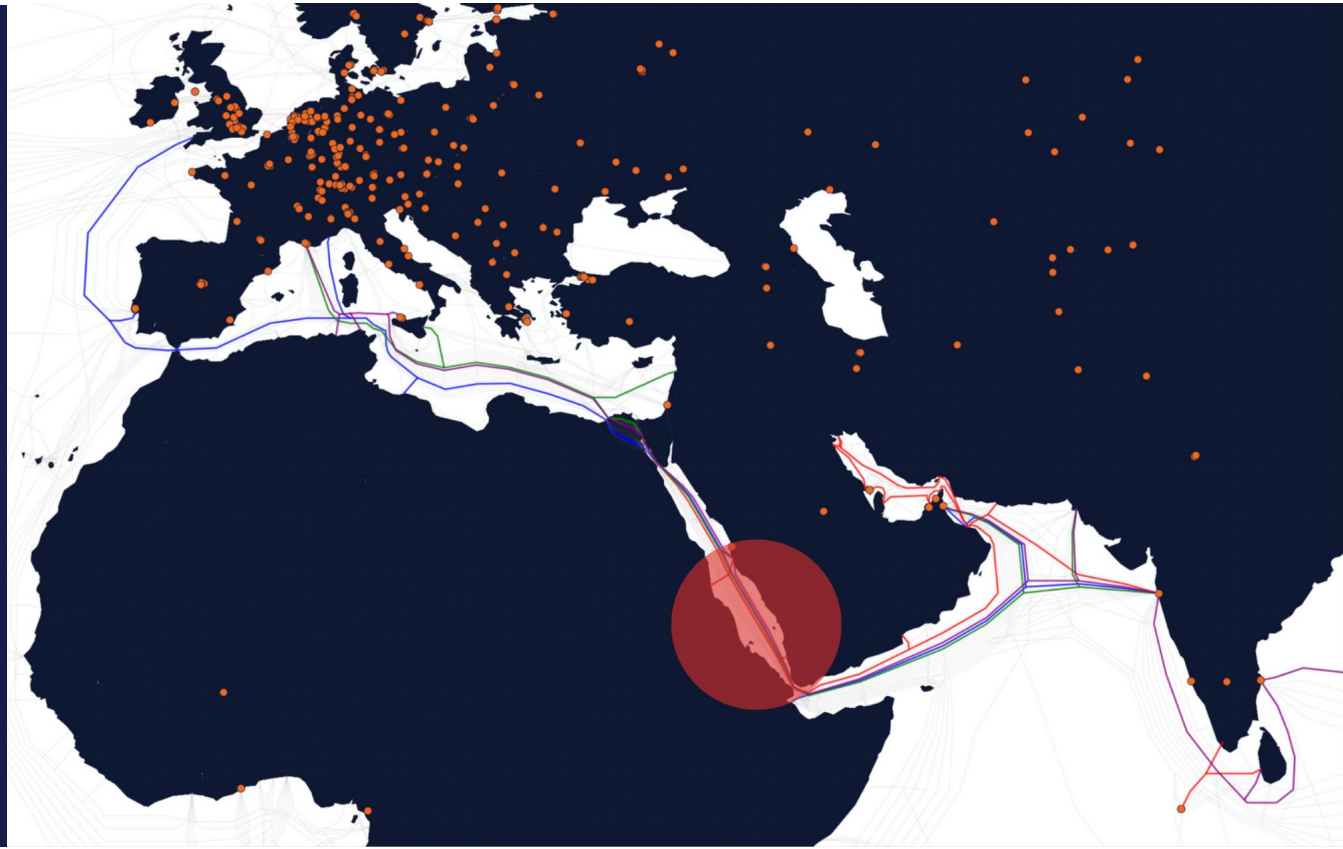


Resilience is not guaranteed

Cable damage in the Red Sea

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

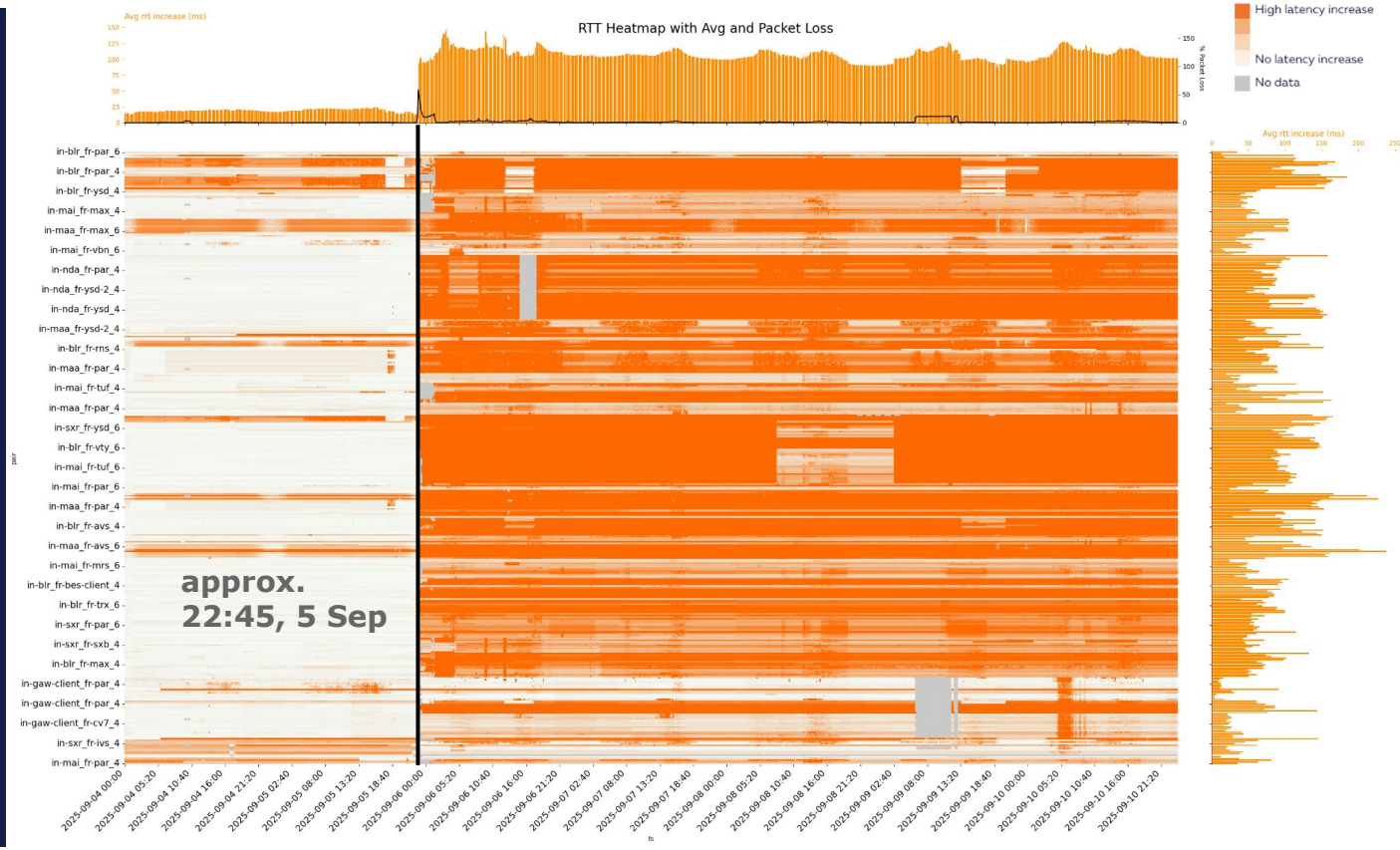
- **FALCON**
- **SeaMeWe-4**
- **IMEWE**
- **Europe India Gateway (EIG)**



Resilience is not guaranteed

Latency shift *with* packet loss

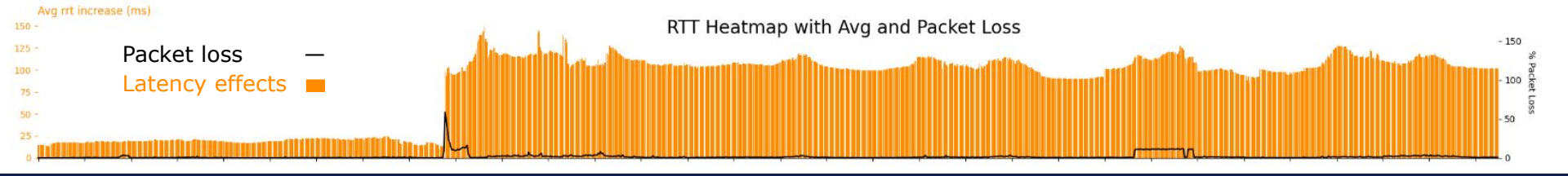
Latency increases of approx 100 ms accompanied by concurrent increase in packet loss



BCS East West

Packet loss

Up to 50% increase in packet loss



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

Conclusions

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:

Questions & Comments

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THANK YOU!