



**RIPE NCC**  
RIPE NETWORK COORDINATION CENTER

# How the Internet routed around **Cable Damage** in the **Baltic Sea**

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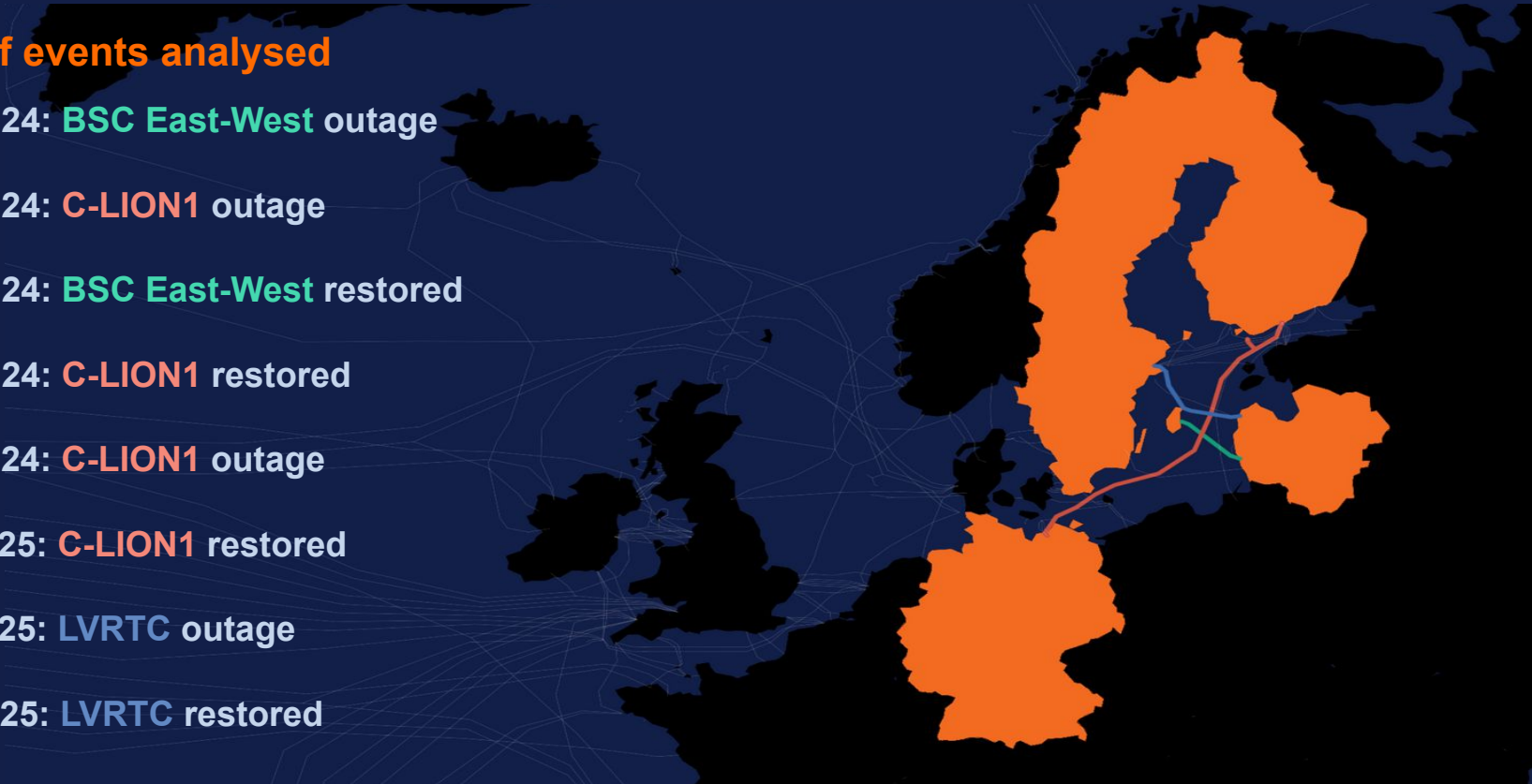
Internet event analysis with **RIPE Atlas**

# Baltic Sea cable incidents



## Timeline of events analysed

- 17 Nov 2024: **BSC East-West** outage
- 18 Nov 2024: **C-LION1** outage
- 27 Nov 2024: **BSC 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



# Baltic Sea cable incidents



## Media reaction

### 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 and European governments are starting to suggest that Russia is responsible.

Mary Lennighan  
November 20, 2024

3 Min Read



### Sweden opens inquiry into damaged undersea cable as Nato deploys ships

A vessel has been seized after suspected sabotage on an optical line, probably due to external influence.

December 31, 2024



### Christmas Day Cable Cuts in the Baltic Sea

Written by Alexander Lott

In less than 14 months, submarine telecommunications cables connecting Estonia, Finland, Germany, Lithuania, Russia, and Sweden have been cut

in the Baltic Sea. In addition, an undersea cable was cut by a ship anchor in the Baltic Sea. In addition, an undersea cable was cut by a ship anchor in the Baltic Sea. In addition, an undersea cable was cut by a ship anchor in the Baltic Sea.

### Damaged cables appear to be accident, Finland says

3 December 2024

George Wright  
BBC News



### 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

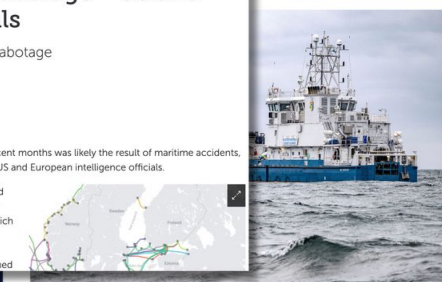
Subsea cable damage in the Baltic Sea in recent months was likely the result of maritime accidents, not Russian sabotage, according to several US and European intelligence officials.

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

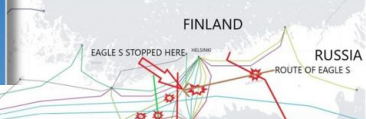
### Sweden Investigates New Cable Break Under Baltic Sea

The authorities are looking into possible damage to an undersea line east of Gotland island. NATO has stepped up its surveillance of the region.

Share full article



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



# Measuring incidents 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 incidents 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



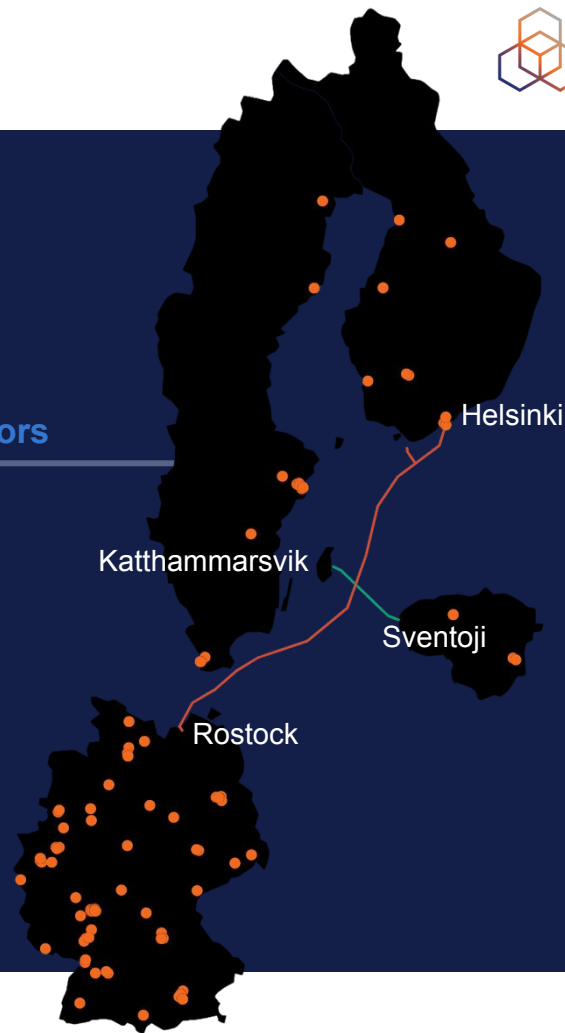
17-18 November

BSC 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



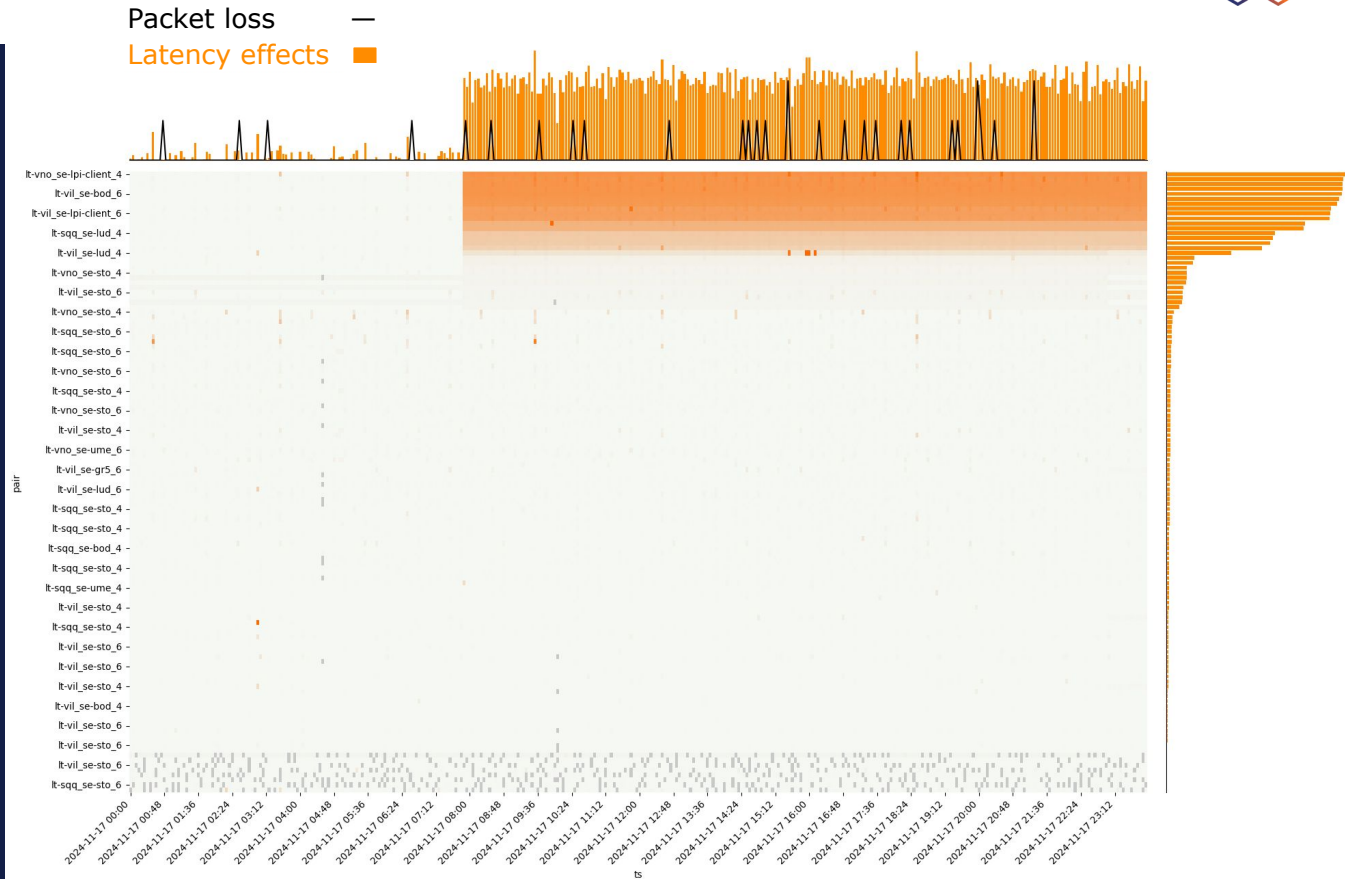


## Latency shift

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*



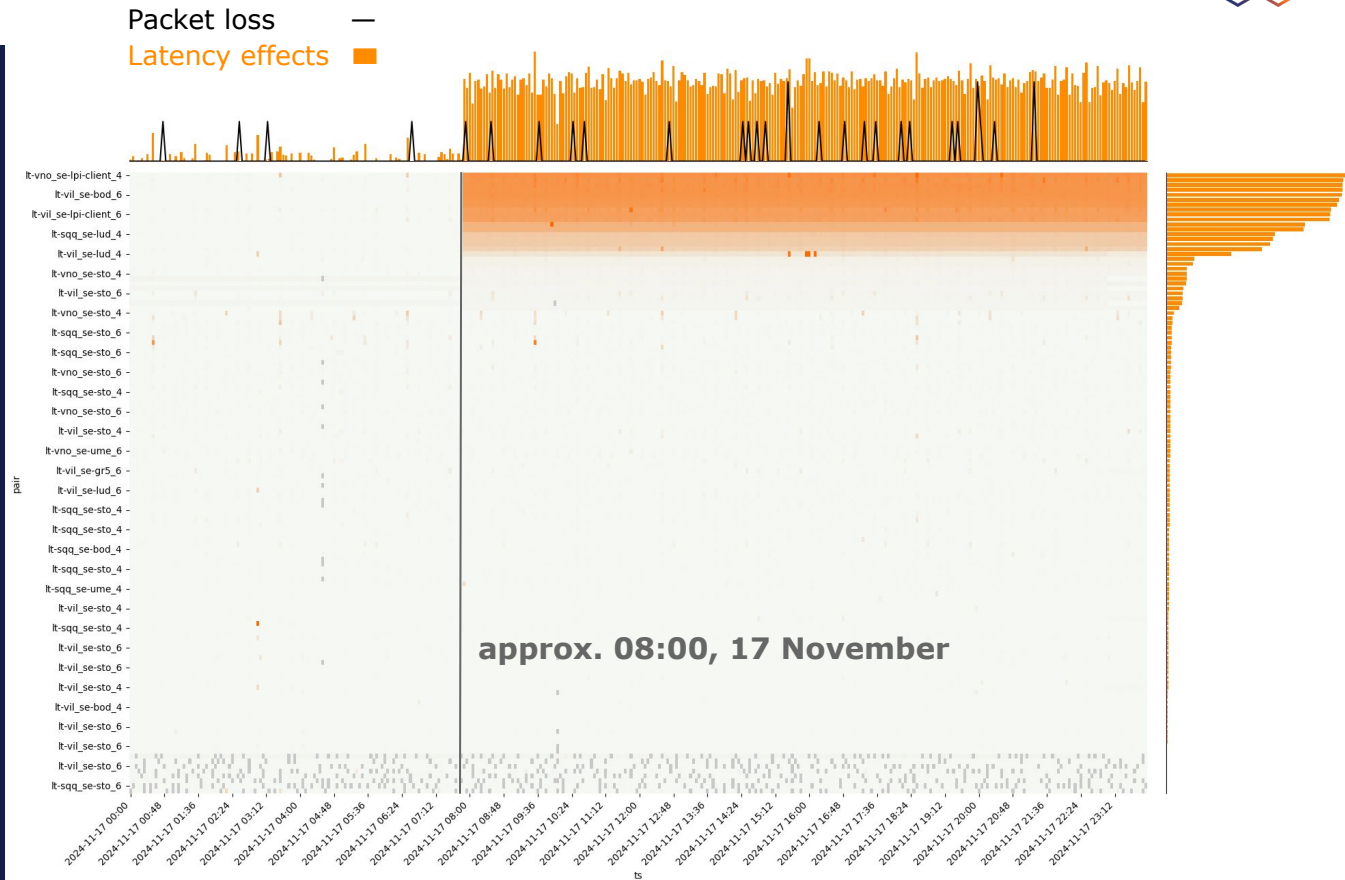


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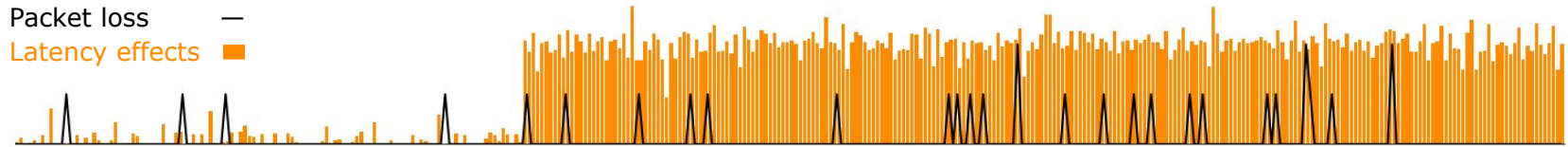






## Packet loss

Baseline of 0% packet loss with occasional spikes



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

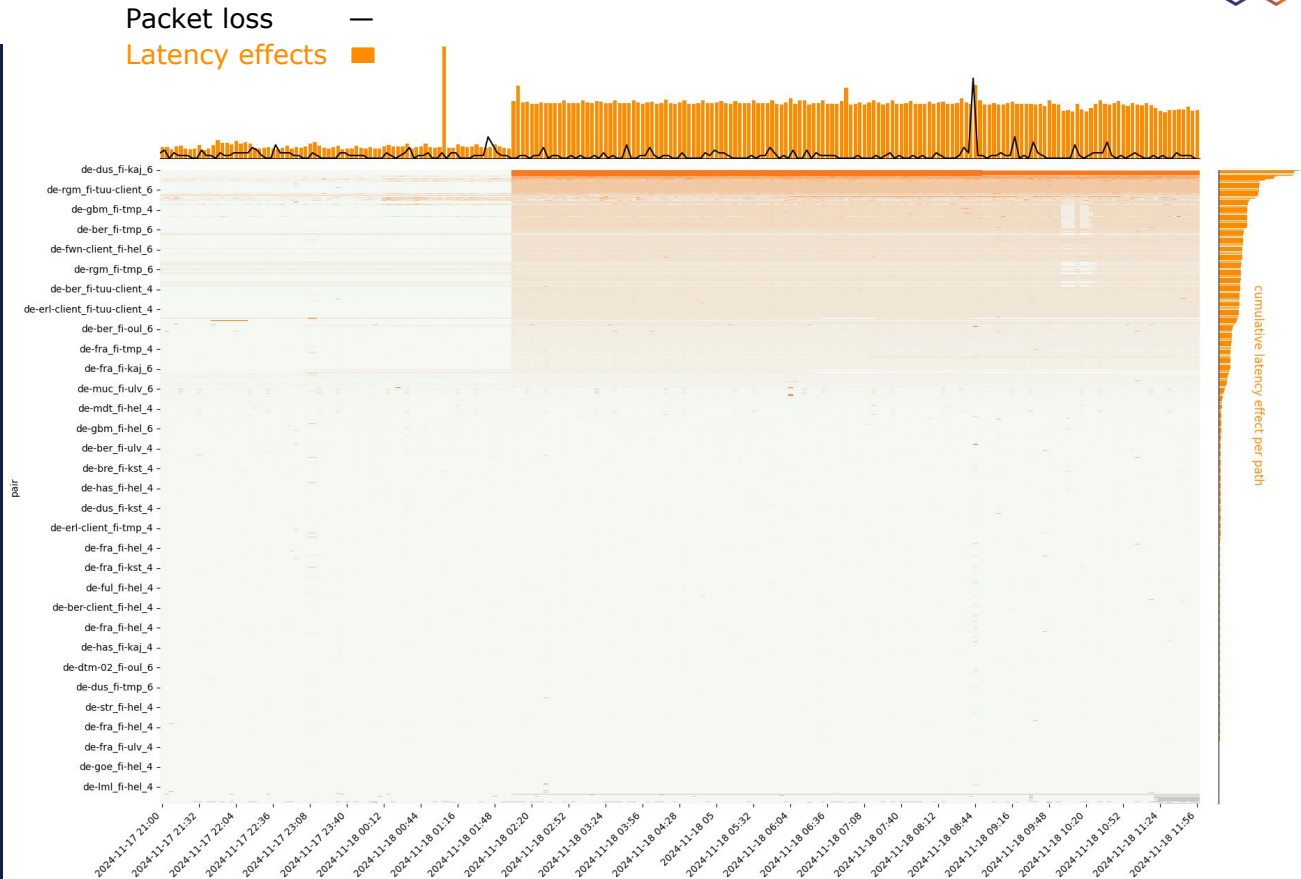


## Latency shift

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 break



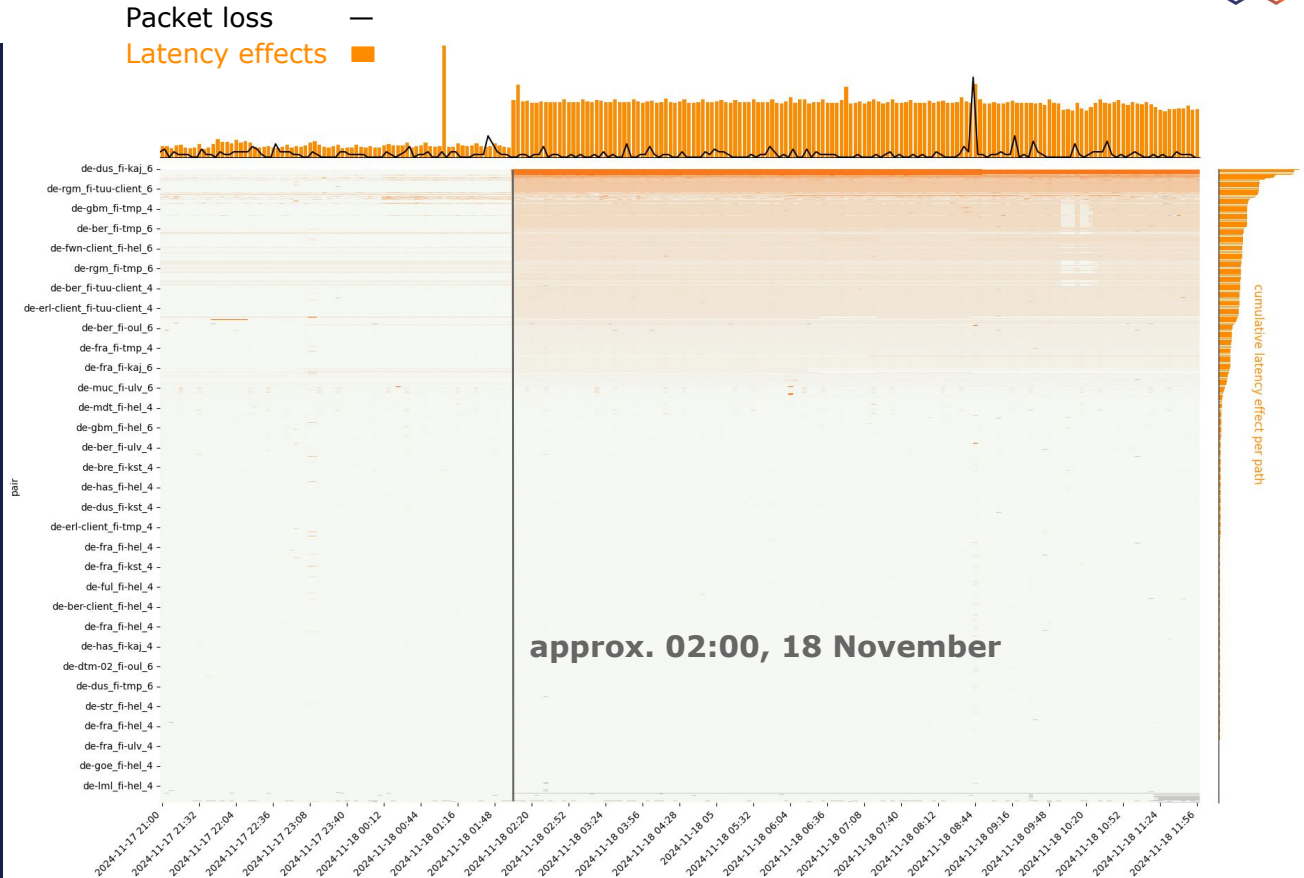


## Latency shift

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 break



# C-LION1 repair



On 28 November at 17:30 UTC, the 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...



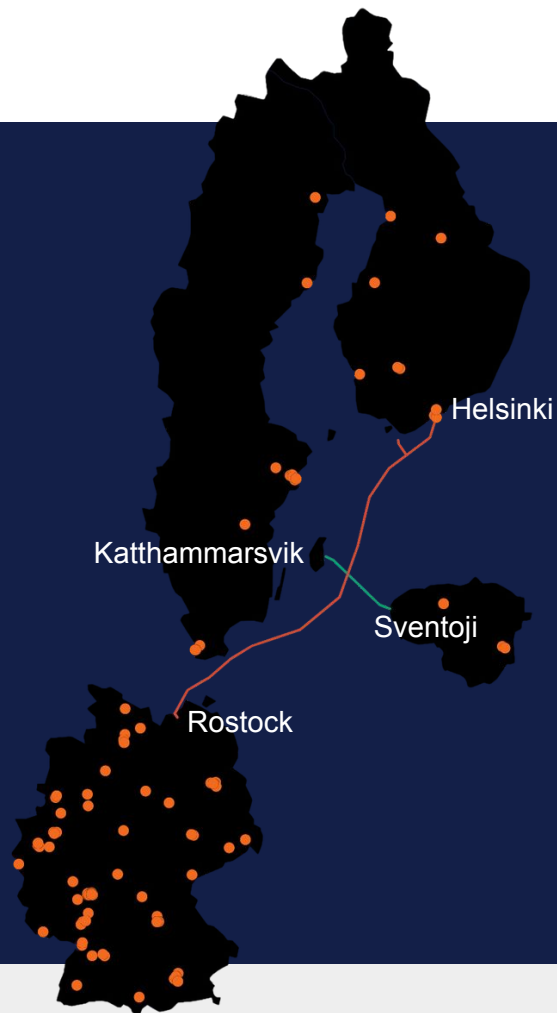
# Summing up



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!**



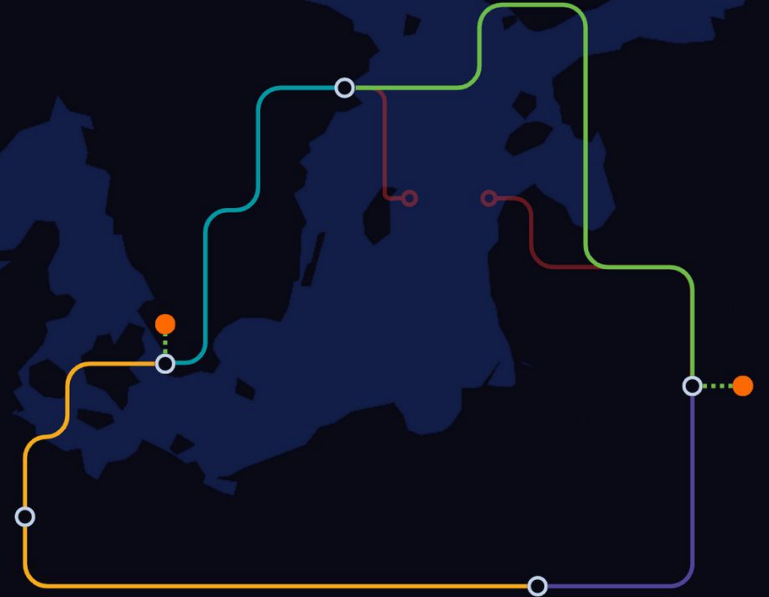
# Deeper dive



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)

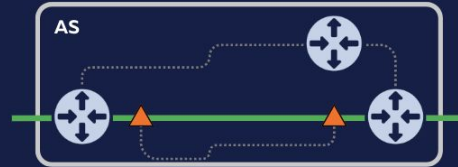
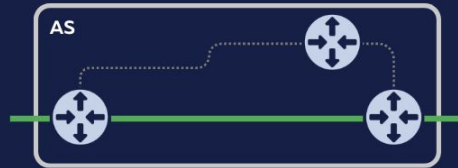
## Circuit-level rerouting:

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

Before



After



# Levels of resilience



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

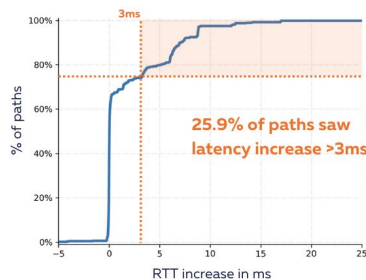
**Inter-domain changes: 637 (29.8%)**

**Intra-domain changes: 1,044 (48.8%)**

**Other changes: 460 (21.5%)**

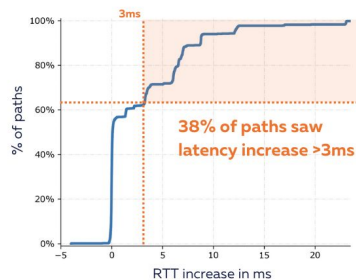
## Inter-domain rerouting

RTT profile for paths where inter-domain routing changed.



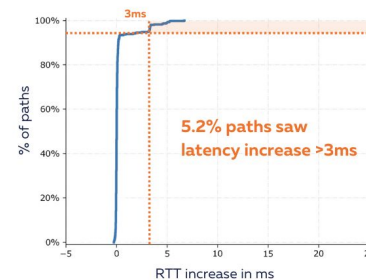
## Intra-domain rerouting

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



## Circuit-level rerouting

RTT profile for paths without IP-level changes.







## What can we learn from this?

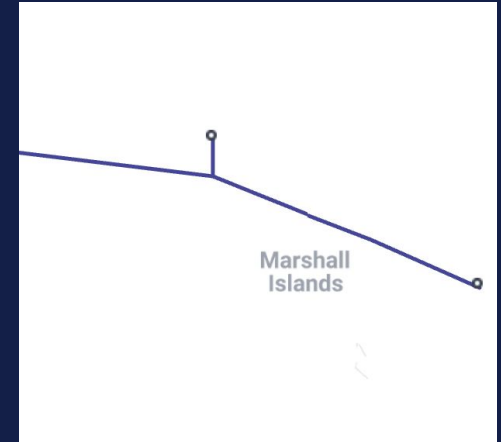
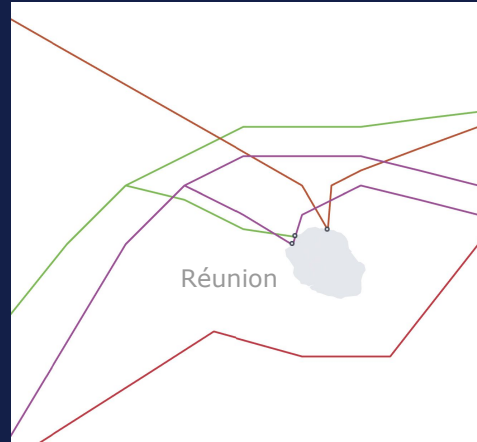
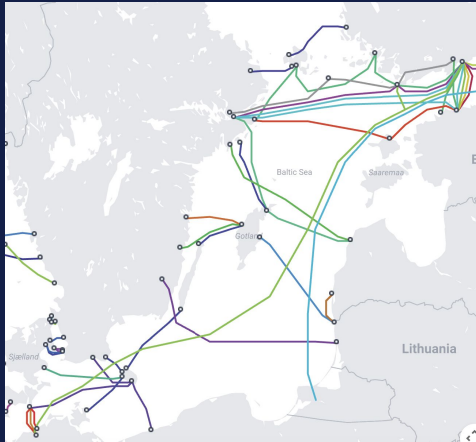
In the Baltic Sea:

- “The Internet routed around damage”
- Internet resilience due to defence in depth against local damage
  - Redundancy within networks (circuit and routing)
  - Redundancy between networks

## What can we learn from this?

What do we need to model a-priori information about resilience, redundancy and capacity?

- It is complex! 1 cable = multiple fibres = multiple lambdas with upgradable capacity
- Monitoring is a vital part of the puzzle



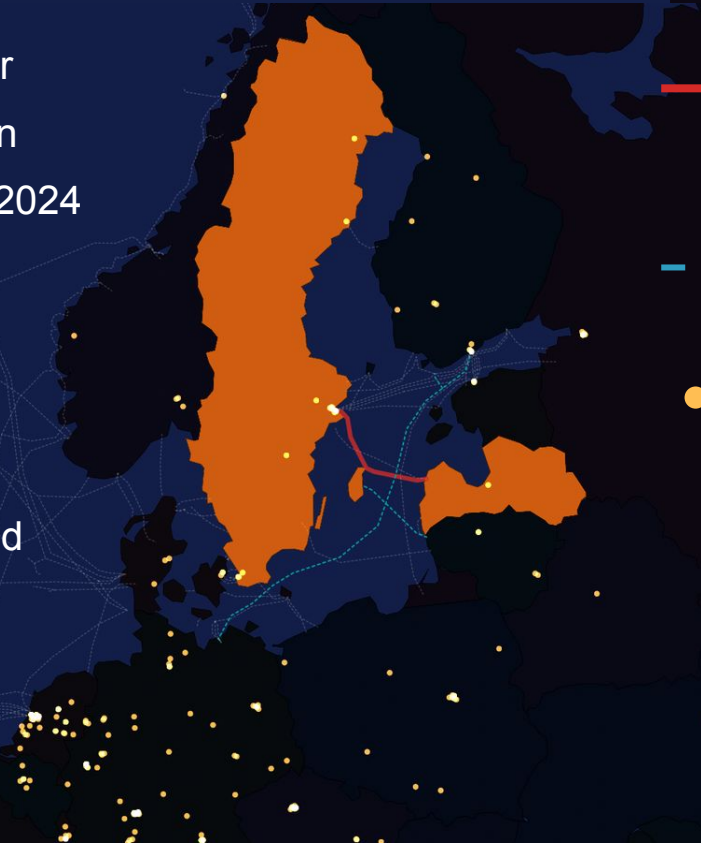
# Ongoing incidents



There have been multiple further instances of damage to cables in the Baltic Sea since November 2024

Last known reported incident occurred on: XXXX

We are continuing to monitor and analyse events!



- Sweden-Latvia Internet cable belonging to Latvia State Radio and Television Center (LVRTC) was reportedly cut on 26 Jan 2025.
- This is another in a series of cuts on submarine cables in the region in recent months.

- Packet delays between selected RIPE Atlas anchors increased by 5-20ms at around 00:45 UTC – *but absence of packet loss indicates that the Internet successfully routed around the damage*

Read further analyses of cable cuts and Internet outages on [RIPE Labs](https://labs.ripe.net/search/tag/outages/):  
<https://labs.ripe.net/search/tag/outages/>



# Beyond the Baltic Sea



We have a relatively high number of RIPE Atlas anchors in **some** countries around the Baltic Sea

Damage to cables is not so easy to analyse: e.g., much less visibility into recent damage to Taiwan cables



*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!**