

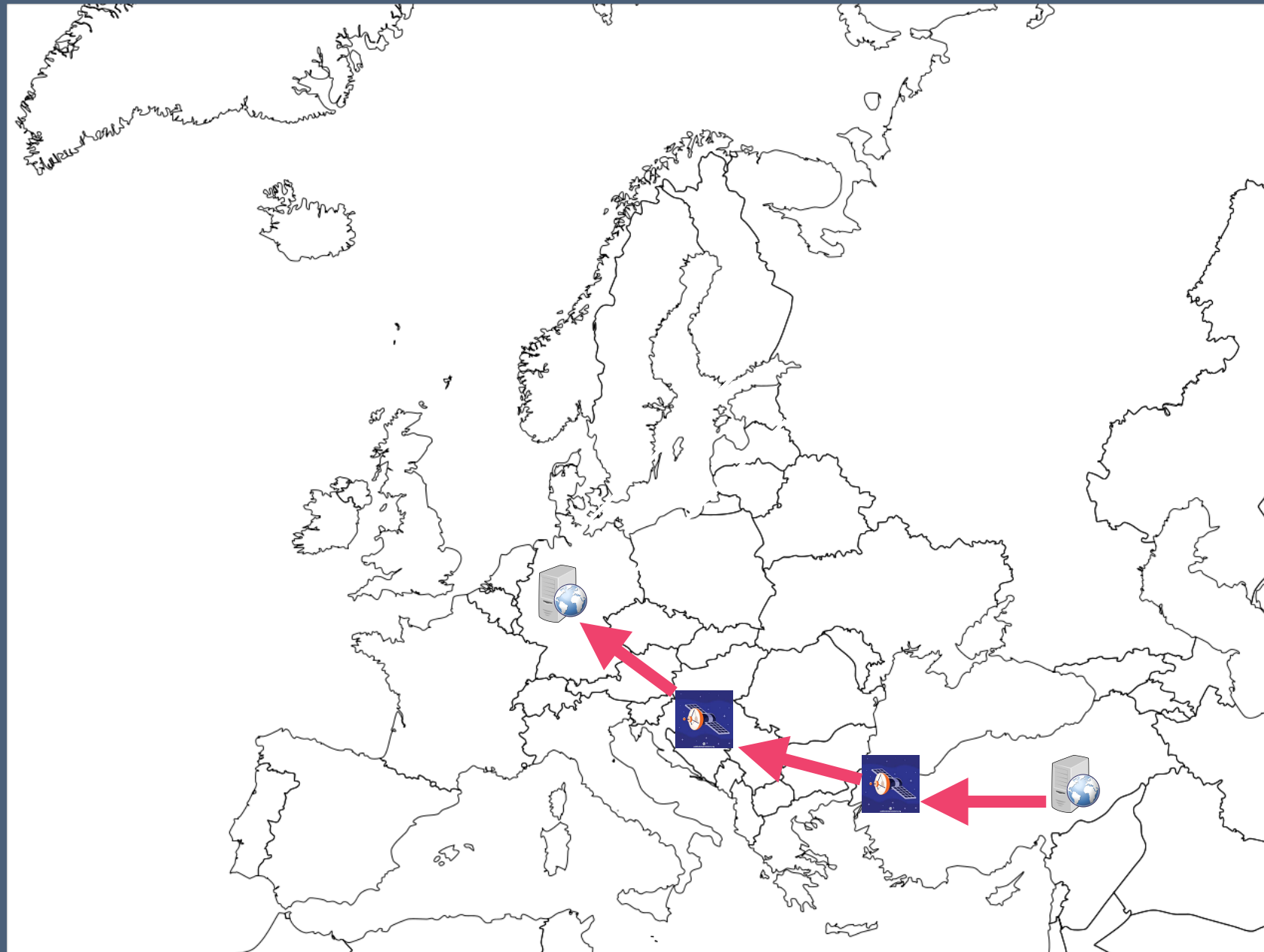
Are there Inter-Satellite Links in Starlink?

Part of „Evaluating Resiliency and Performance of Networked Satellite Systems“

How do networked satellite systems route?

... using ISLs

This image WILL become more beautiful.

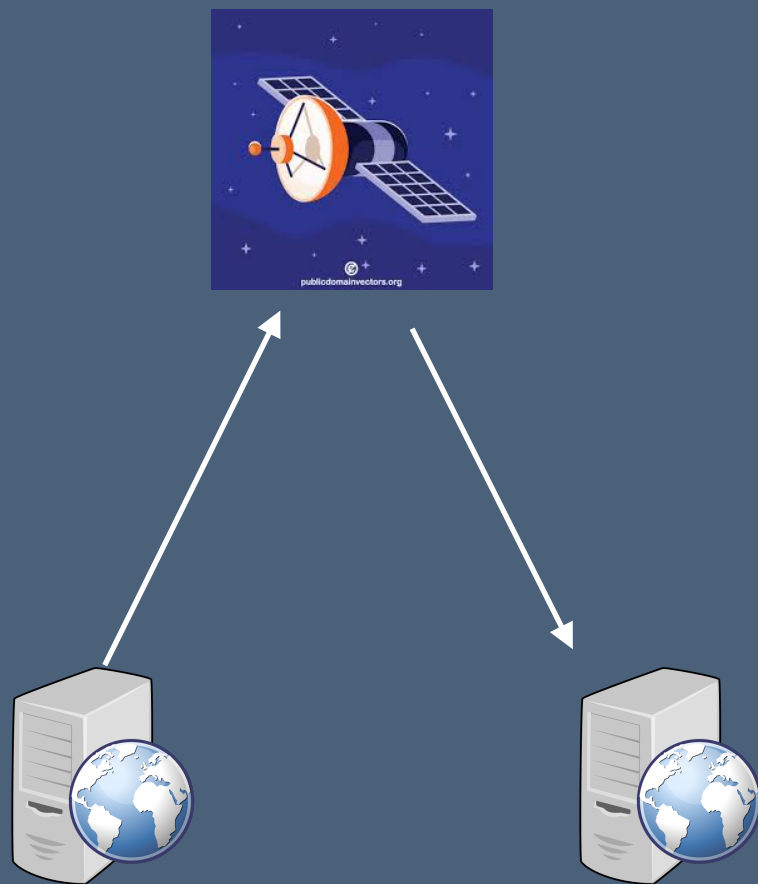


The Bent-Pipe

The mechanism behind ISLs

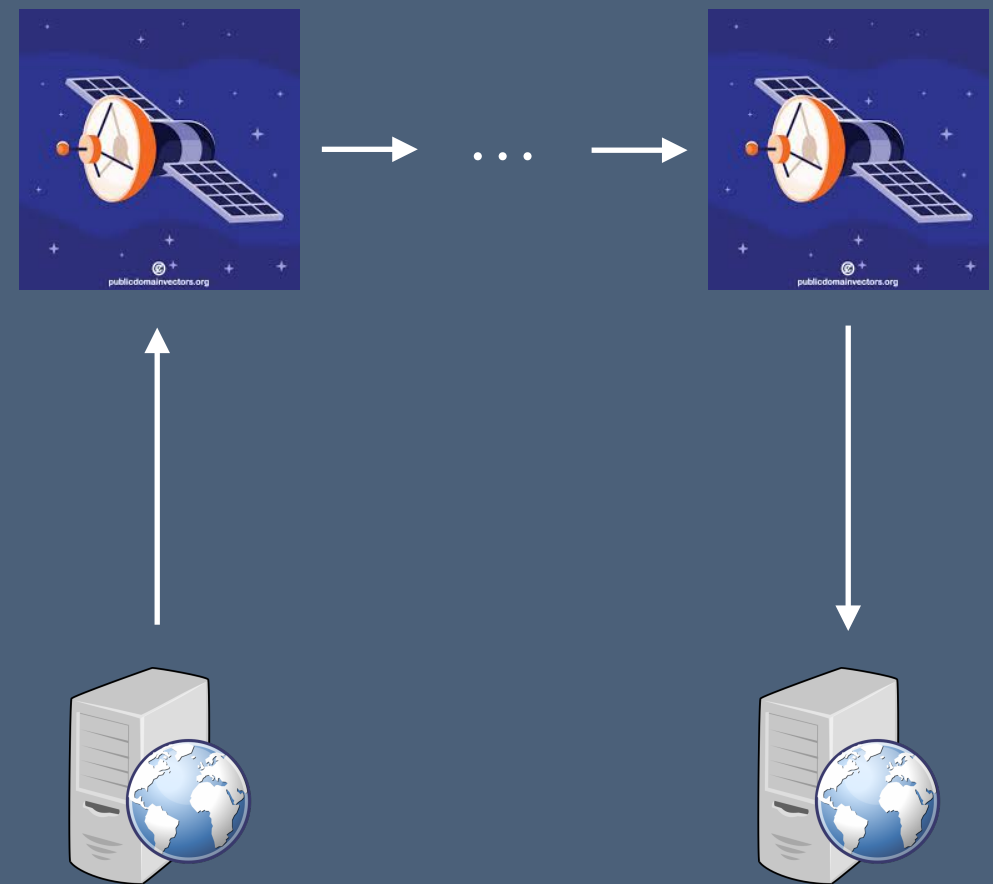
Probably switch to
diagram from Mohan2024.
Might be easier to understand

- 1-hop-Bent-Pipe



(No usage of ISLs)

- n-hop-Bent-Pipe



(Usage of ISLs with $n > 1$)

What we don't know (yet) ...









Research Questions

- **Are they used in current networked satellite systems?**
 - Only Starlink is considered here due to data availability.
- **Do ISLs have a positive impact on performance?**
 - Arguments pro: [Hauri2020, Mohan2024]
 - Arguments contra: [Li2023, Tanveer2023]
 - More added later ...

Methodology

Where do I get my data from?

- I create a dataset containing 50GB of traceroute data from RIPE Atlas Starlink probes
- Data collection will be published at the end of my master's thesis

>  disconnect_event_data	32M
>  http_data	399M
>  http_result_data	228M
>  ping_data	90G
>  ripe_atlas_probe_data	128K
>  satellite_data	6,1M
>  tls_data	43M
>  traceroute_data	50G

There is more data, but I did not have the whole data set right now at my hand

Are ISLs used in Starlink?

(1) Built-in? (2) Activated?

- (1) Built-In
 - Starlink has deployed ISL-equipped satellites since 2021 (as Starlink claimed on Twitter in 2023)

Are ISLs used in Starlink?

(1) Built-in? (2) Activated?

Image of Routing from Philippines to root server using routes with distances longer than a single Satellite can provide

- (2) Activated? -> Yes, as first visible hop is far away from probe's location => Without ISL, that would not be possible as Starlink beams are quite small (matches with previous literature observations)

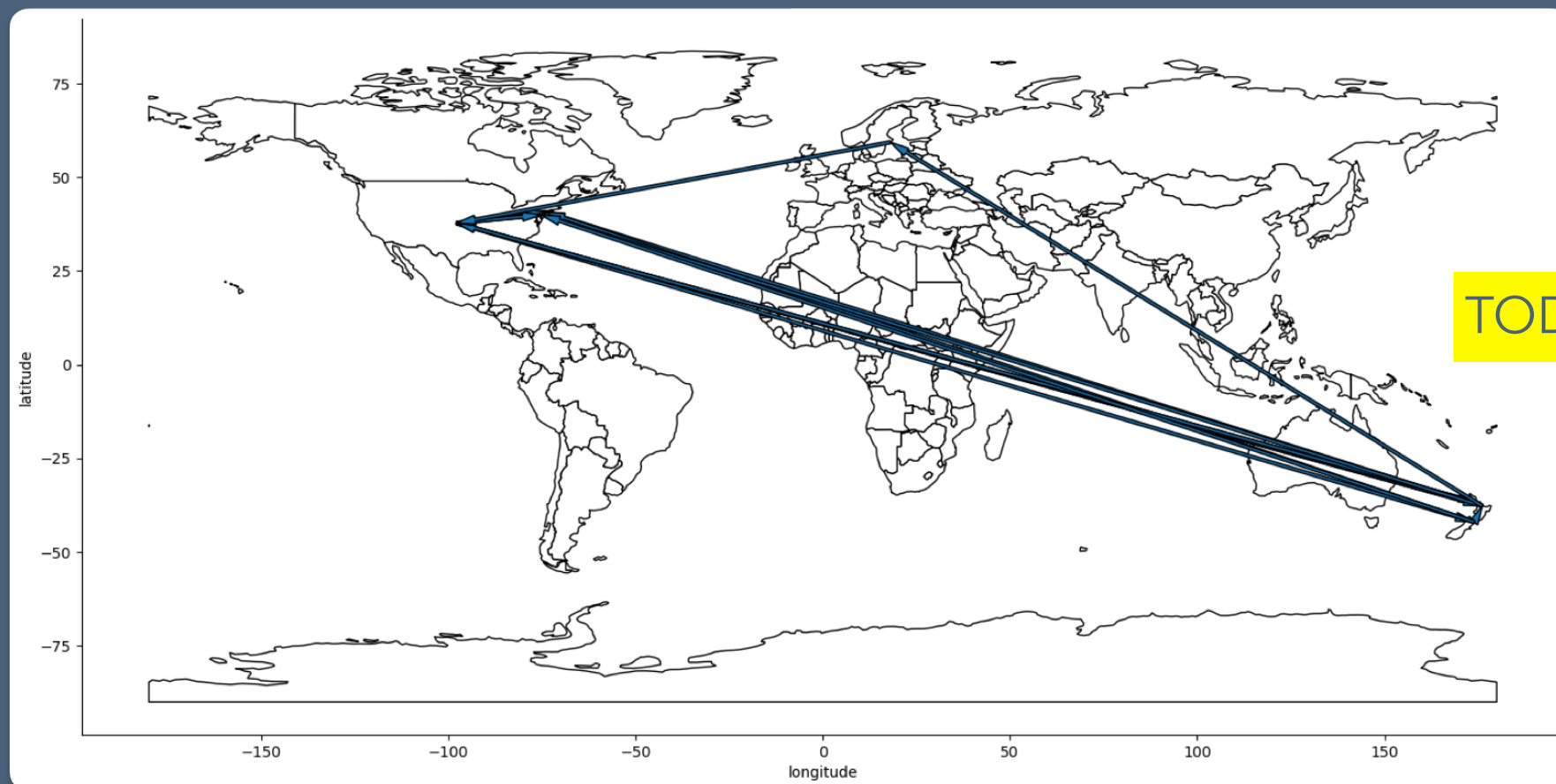


I'll pick a more beautiful
And elaborate picture from my collection
For finalizing the slides

Are ISLs improving performance?

Enter terrestrial networks as soon as possible or stay in satellite constellation as long as possible?

- Observation: Starlink enters terrestrial networks as soon as possible
- Assumption: There is something wrong with ISLs
- (Hops over Bent-Pipe are not visible in traceroute)



TODO: Better illustration

Throughput Comparison

Latency-per-Distance comparison

- TODO: Comparison of First-Hop latency to distance, also compare with terrestrial performance
- TODO: How does throughput change if longer ISL routes are used?

Questions?