A first look at Starlink performance

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fnrs
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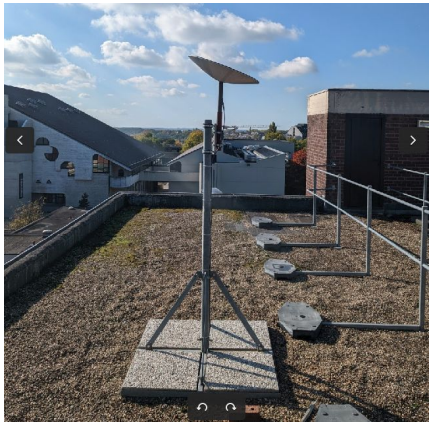
POLITECNICO DI TORINO

Starlink setup

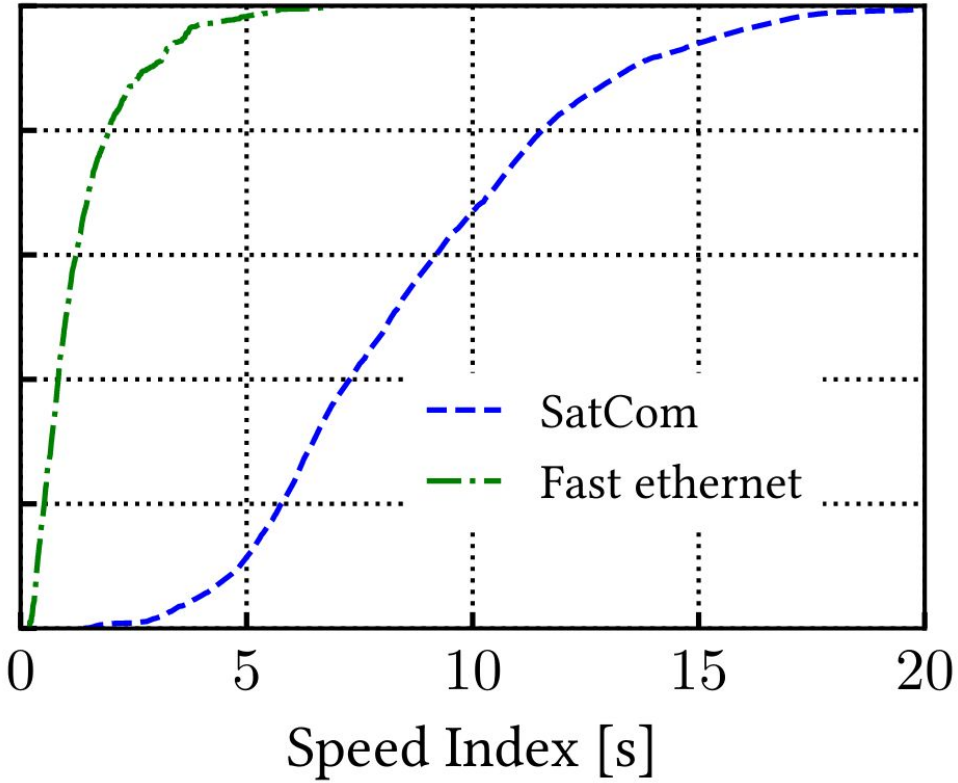
Starlink proposes several formulas with different guarantees.

We ordered the **standard** offer (80$/month).

Placed in Louvain-la-Neuve, Belgium



Web browsing using BrowserTime [3] on top-120 websites



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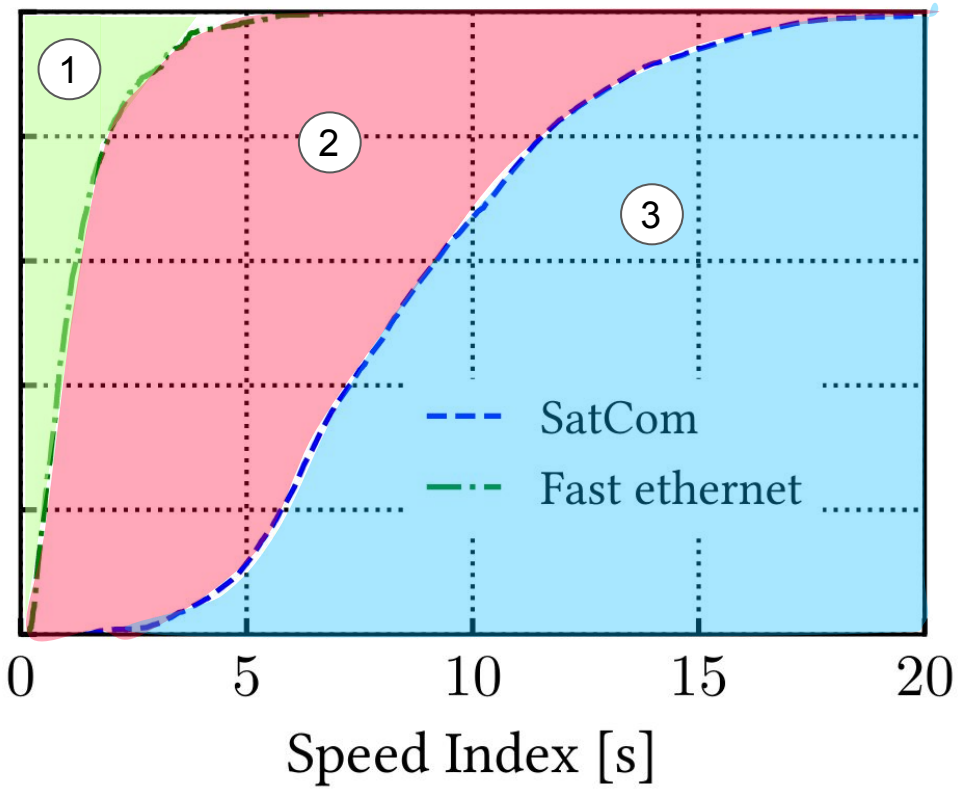
Where to place Starlink ?



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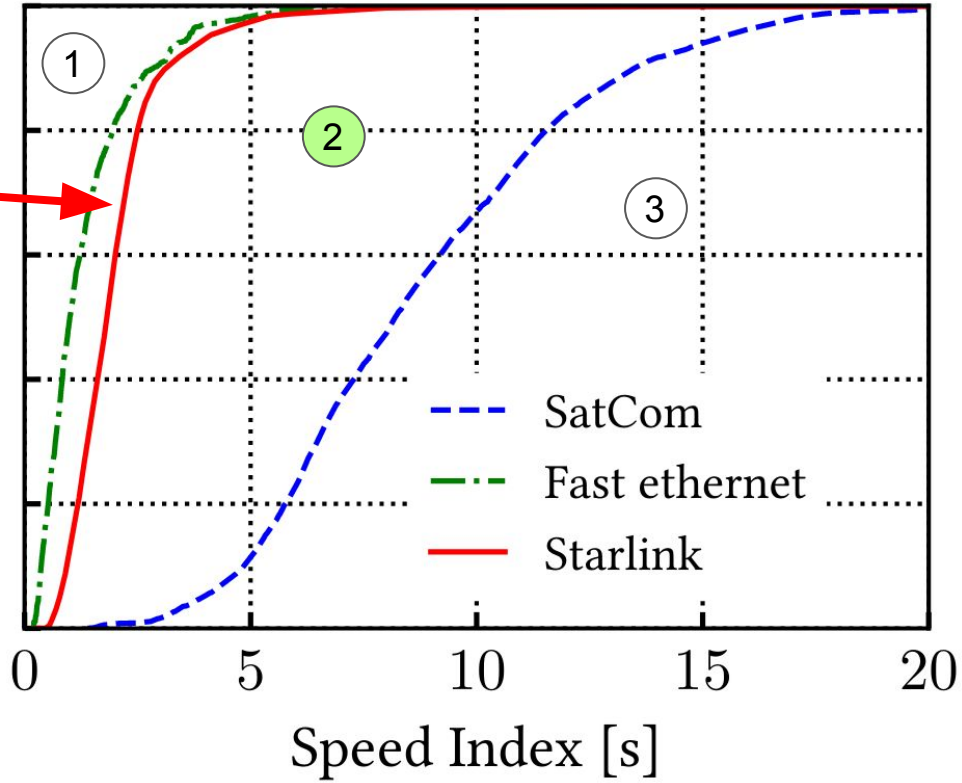
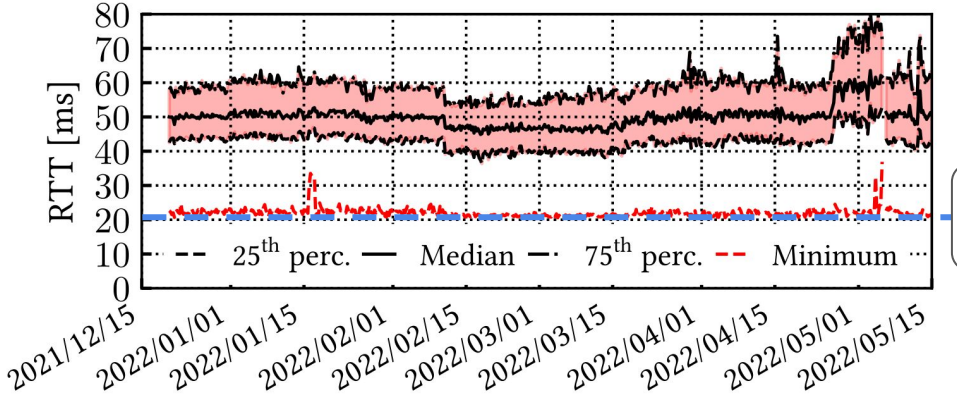


Outline: measures of our access point

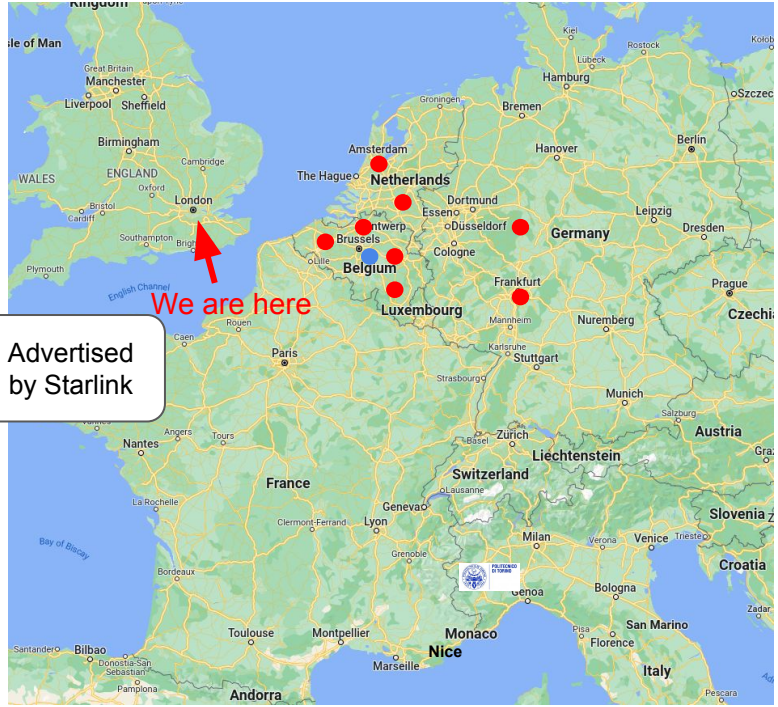
1. Idle latency
2. Latency under load
3. Packet drop rates
4. Packet loss bursts

Latency: pings

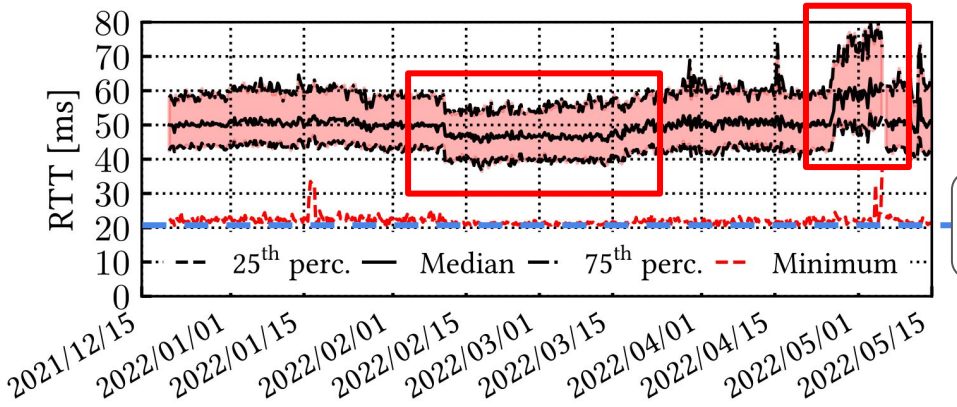


Ping towards european anchors over time

Advertised by Starlink



Latency: pings



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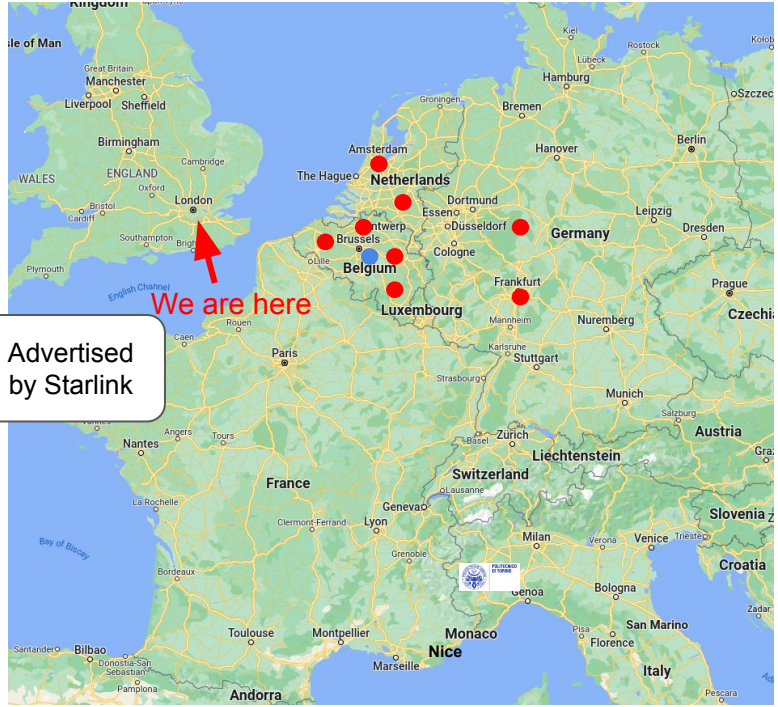

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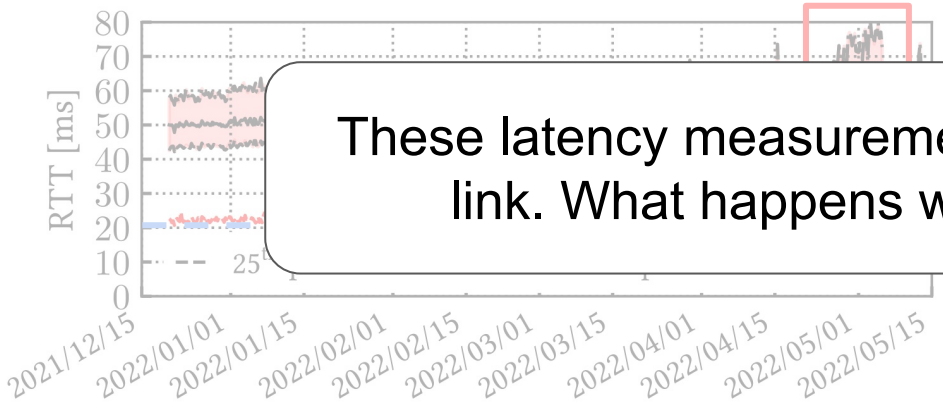

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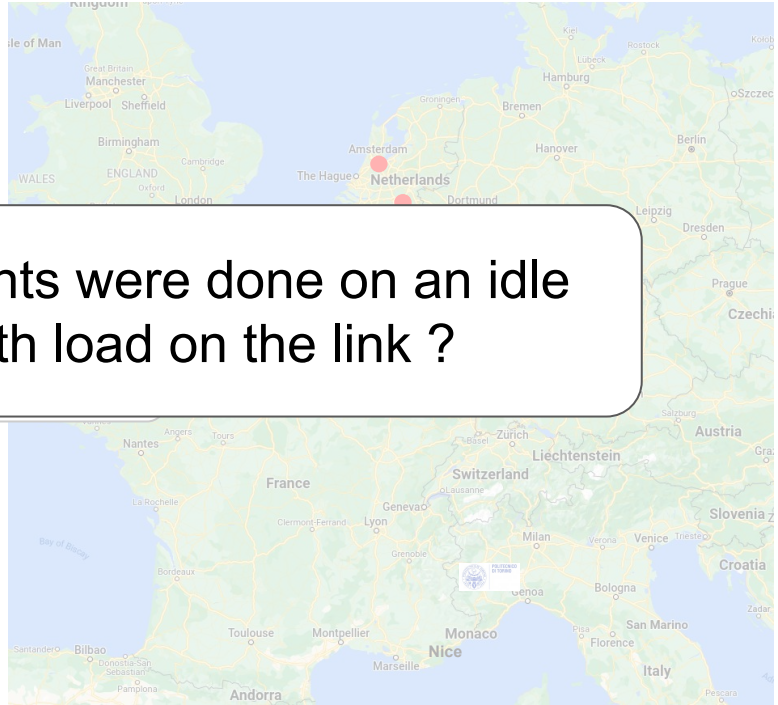
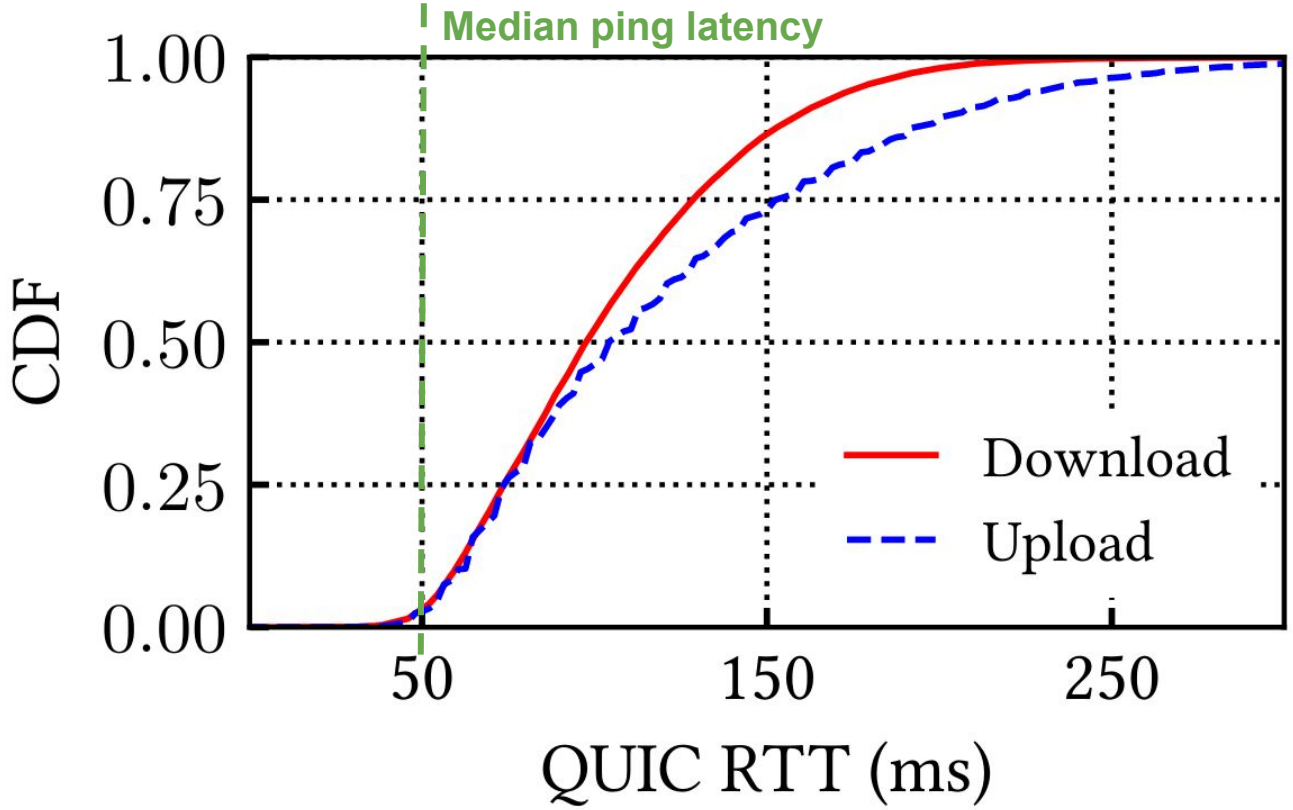
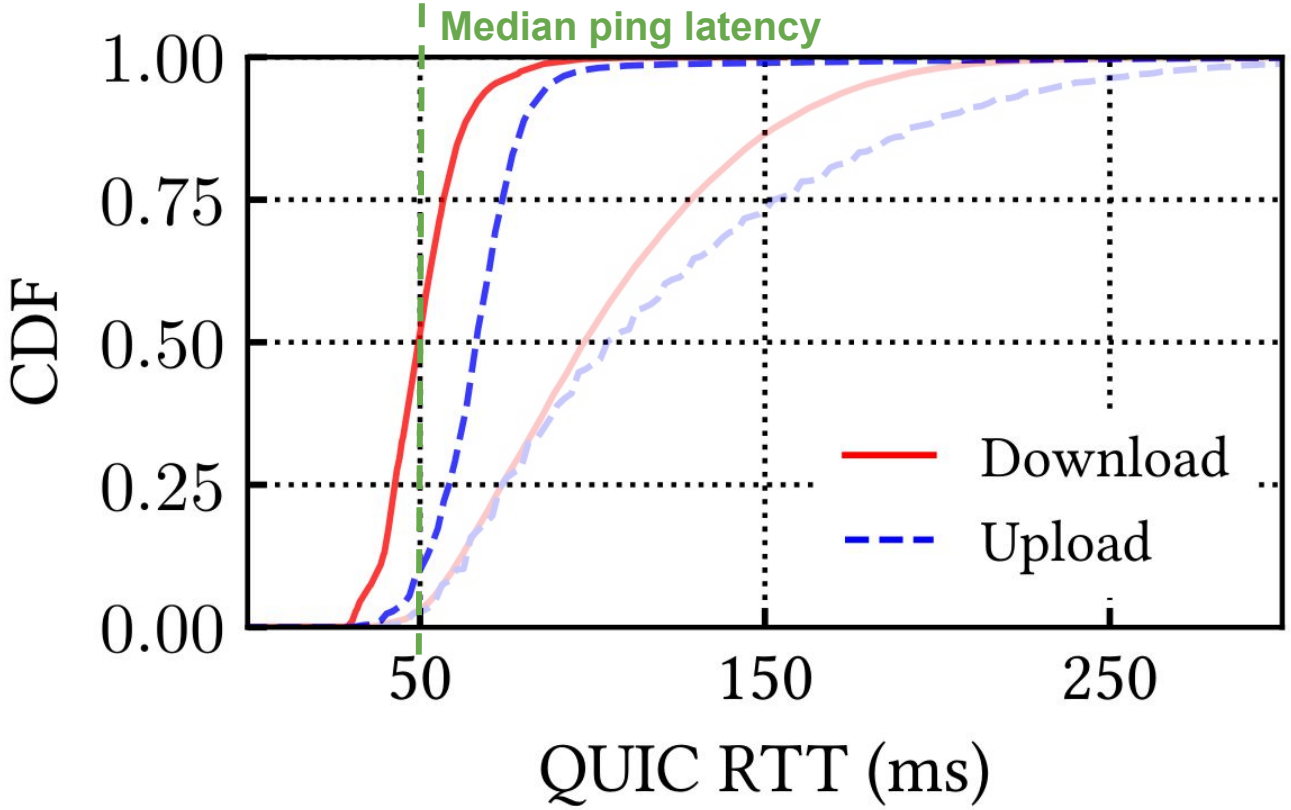


These latency measurements were done on an idle link. What happens with load on the link ?

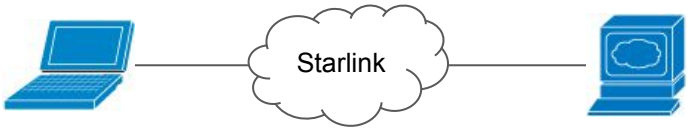
Latency under heavy load with bulk HTTP/3 transfers



Latency under light load: 25 messages per second at 3Mbps



Packet loss rates

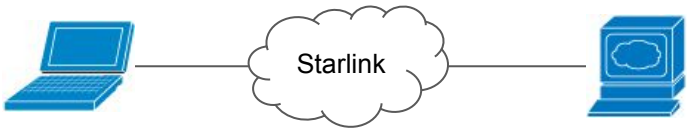


laptop @ UCLouvain

H3 server @ UCLouvain

Heavy load		Light load	
H3 ↓	H3 ↑	Messages ↓	Messages ↑
1.56%	1.96%	0.40%	0.45%

Packet loss rates



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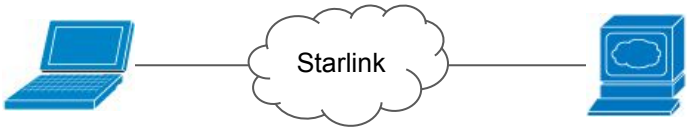

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- Apparently congestion-induced losses for bulk download.
- The network is not loss free without load.

Loss bursts: heavy and light load

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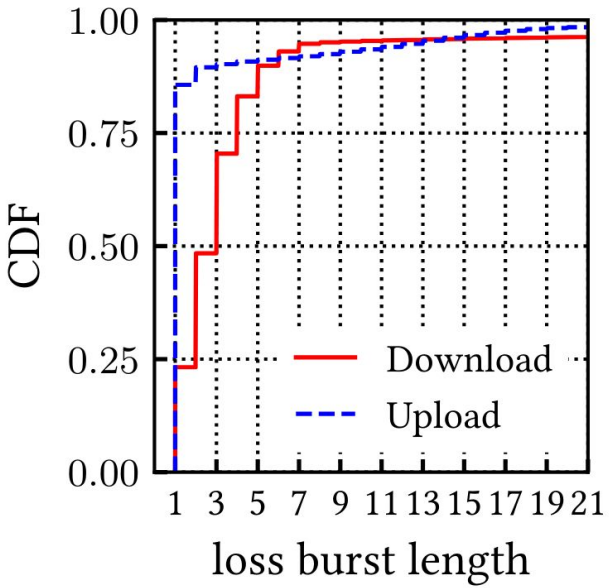
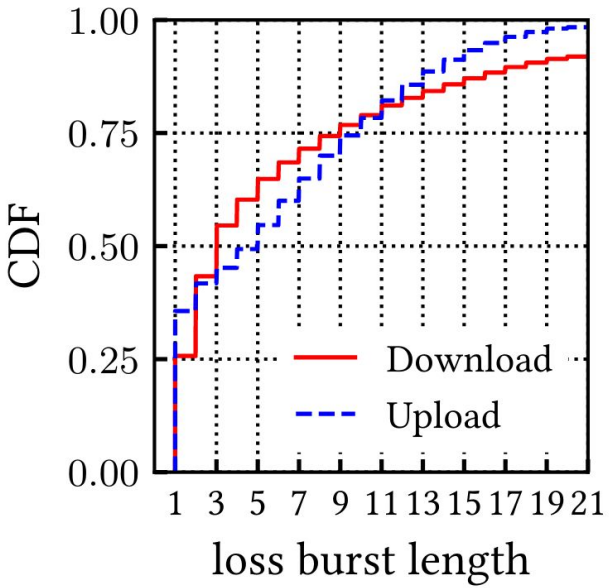
Heavy load (H3)



Light load (Messages)



The **loss rate is high (1.5~2%)** but the loss bursts are small on average

The **loss rate is low (0.4%)** but the loss bursts are longer on average

Many more results in the article !

Throughput, search for PEPs & middleboxes with tracebox [1], and more !

A First Look at Starlink Performance

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ABSTRACT

With new Low Earth Orbit satellite constellations such as Starlink, satellite-based Internet access is becoming an alternative to traditional fixed and wireless technologies with comparable throughputs and latencies. In this paper, we investigate the user-perceived performance of Starlink. Our measurements show that latency remains low and does not vary significantly under idle or lightly loaded links. Compared to another commercial Internet access using a geostationary satellite, Starlink achieves higher TCP throughput and provides faster web browsing. To avoid interference from performance enhancing proxies commonly used in satellite networks, we also use QUIC to assess performance under load and packet loss. Our results indicate that delay and packet loss increase slightly under load for both upload and download.

CCS CONCEPTS

• **Networks** → **Network measurement**; *Wireless access networks.*

combine cellular and xDSL [22, 28]. Given the opportunities offered by these rural areas, several companies nowadays offer satellite-based Internet access solutions.

Classical Satellite Communications (SatCom) use geostationary satellites with at an orbit of 22 236 miles. A single satellite can cover a large portion of the Earth at the price of a latency of several hundreds of milliseconds due to their high elevation [18, 30]. Such communication technology may provide connectivity to thousands customers with connections easily reaching a speed up to 100 MB, with the drawback of a minimum latency of about 600 ms [37].

A new approach is to use a constellation of Low Earth Orbit (LEO) satellites to dramatically reduce communications latency. The first large-scale deployment of this kind is the Starlink constellation, currently operating more than two thousand satellites. The commercial service started in beta version in October 2020 in the United States and from 2021 in European countries. It promises Internet access with latency on the order of 20 ms and bandwidth speeds between 100 and 200 Mbps [12]. Being this a newborn ser-

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Limitation: We studied a single vantage point in Belgium. Future work is multi-vantage points and ISLs study.

Thank you !

Want to collaborate on the next steps ? Send us an e-mail !

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Our dataset (>500GB of pcaps & keys) is publicly available :

https://smartdata.polito.it/a-first-look-at-starlink-performance-open-data/

References

[1] Detal Gregory *et al.* Revealing middlebox interference with tracebox. In : IMC 2013.

[2] Fangfan Li et al. 2019. *A large-scale analysis of deployed traffic differentiation practices.* SIGCOMM 2019.

[3] 2022-05-13. *Browsertime*. https://www.sitespeed.io/documentation/browsertime/

[4] 2022-05-13. *Website Traffic Analysis & Competitive Intelligence, SimilarWeb*. https://www.similarweb.com/