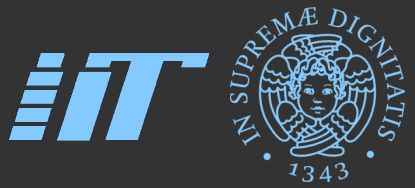


STUDYING FORWARDING DIFFERENCES IN EUROPEAN MOBILE BROADBAND WITH A NET NEUTRALITY PERSPECTIVE

ENRICO GREGORI, VALERIO LUCONI, ALESSIO VECCHIO

NET NEUTRALITY

Washington Governor Signs First State Net Neutrality Bill

Net neutrality, abrogata la legge che proteggeva la libertà della Rete

La neutralité du Net dans la Constitution ? « Ce serait une sage décision » 5

Washington DC braces for net neutrality protests later this month

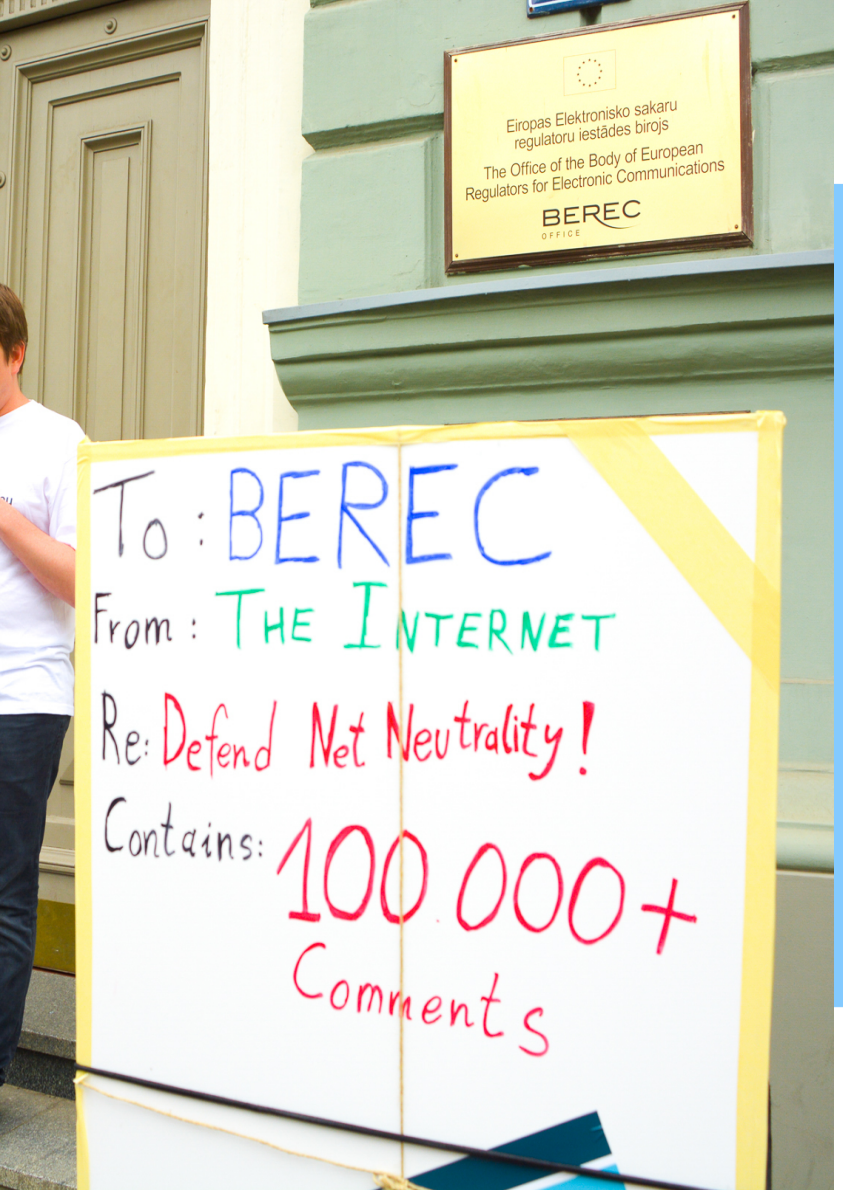
Verizon's always-on throttling is an affront to customers and net neutrality

Anyone who uses Verizon is now going to have a worse experience streaming video.

Why the net neutrality protest matters

Companies such as Facebook, Google and Amazon will band together for a day of action against a threat to the open internet. So what's the big deal?

Net neutrality: What is it, and why it might affect you

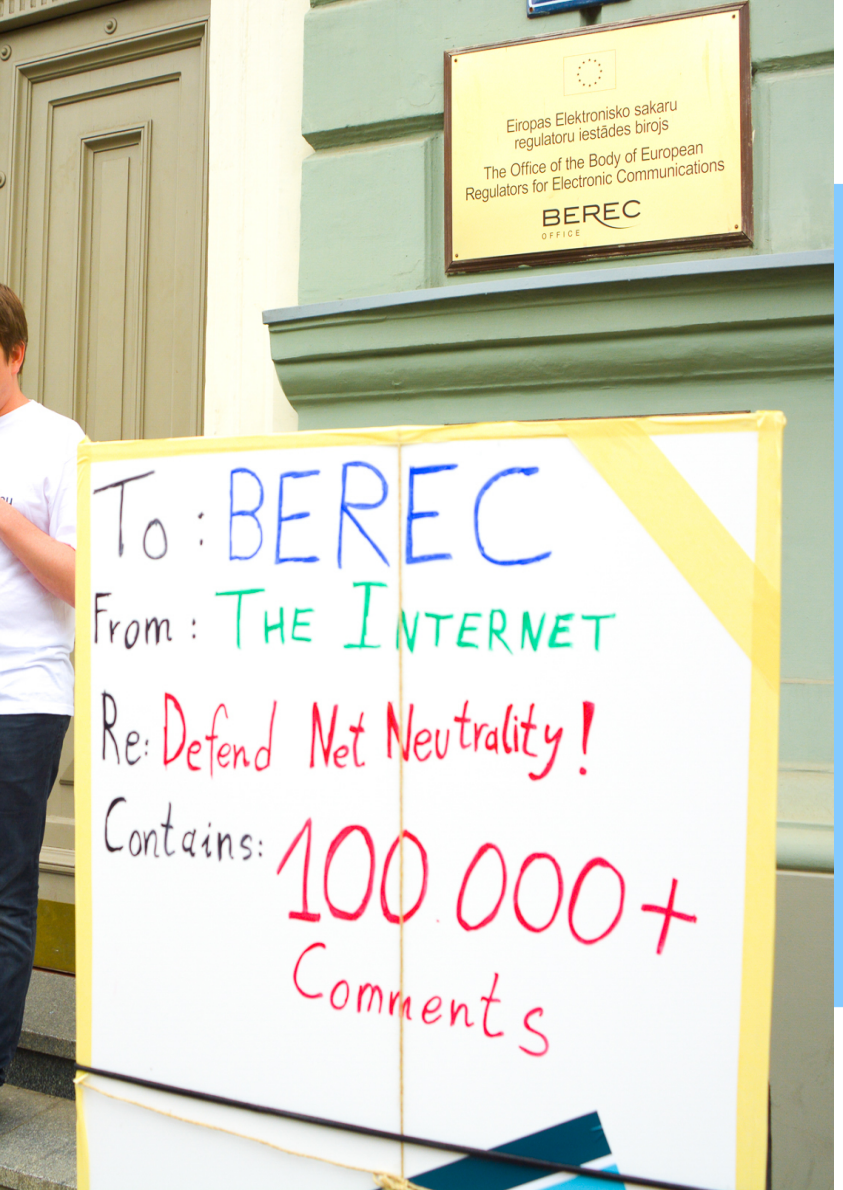


NET NEUTRALITY

(in Europe)

Every European must have access to the open Internet.
All Internet traffic must be treated equally.
No form of traffic prioritization can be enforced.

(BEREC guidelines, 2016)



NET NEUTRALITY

(in Europe)

IS IT REALLY LIKE THAT?

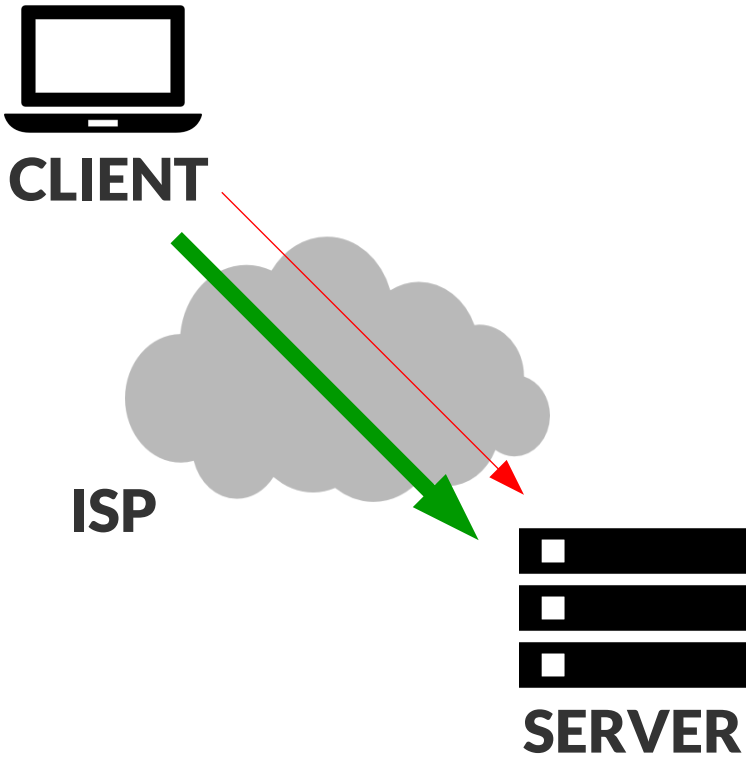
Every European must have access to the open Internet.
All Internet traffic must be treated equally.
No form of traffic prioritization can be enforced.

(BEREC guidelines, 2016)

NEUTMON

Measures the neutrality of an ISP's network basing on the throughput and the path experienced by two classes of traffic:

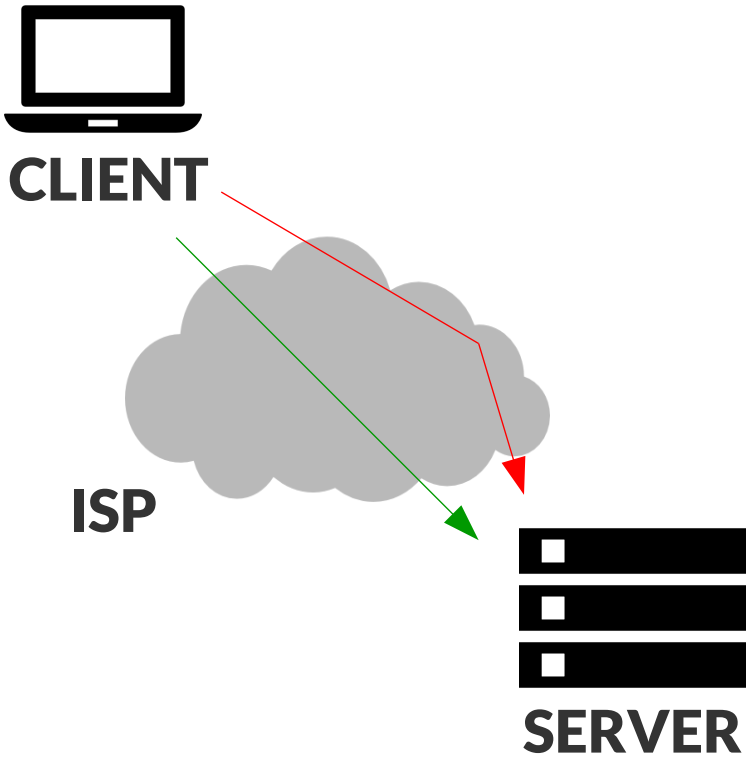
BitTorrent Traffic (BT)
Random Control Traffic (CT)



NEUTMON

Measures the neutrality of an ISP's network basing on the throughput and the path experienced by two classes of traffic:

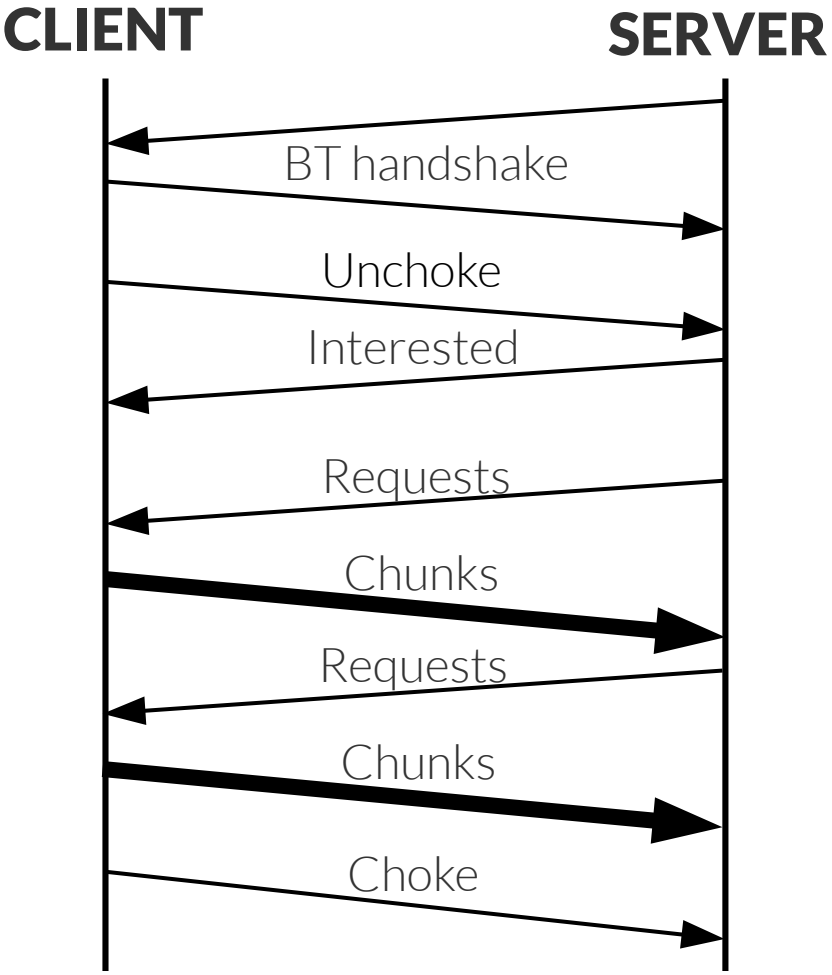
BitTorrent Traffic (BT)
Random Control Traffic (CT)



METHOD

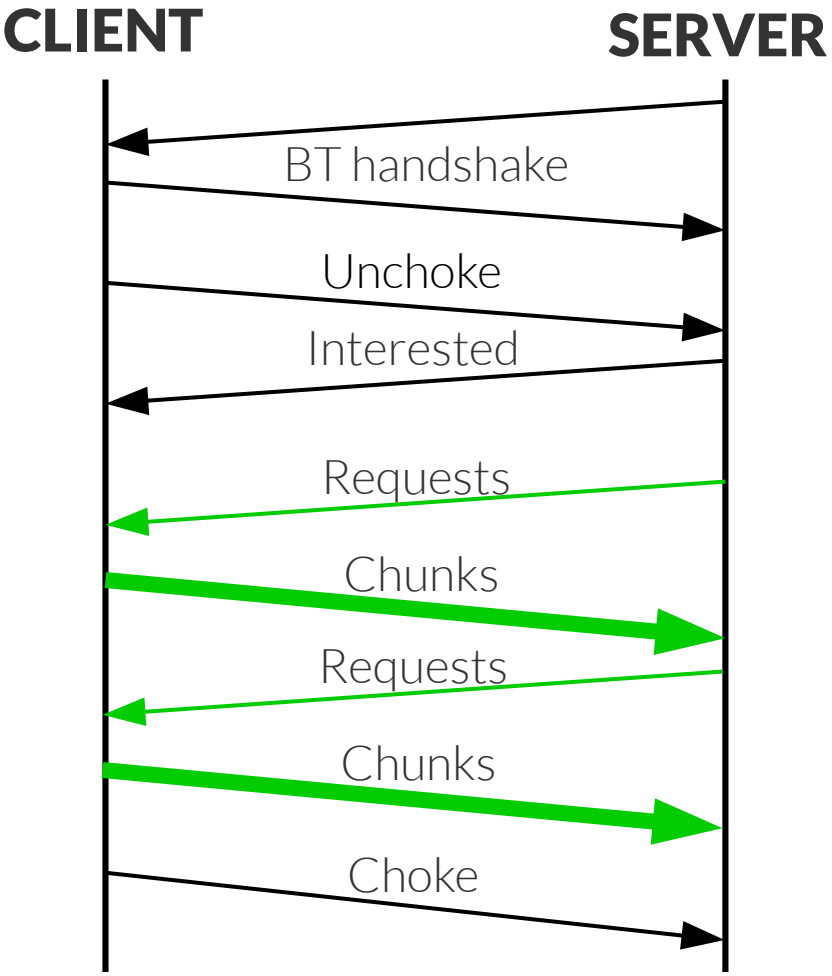
BT data exchange follows the BitTorrent Protocol Specification, in order to be detected by possible shapers.

CT follows the same pattern with random payload.



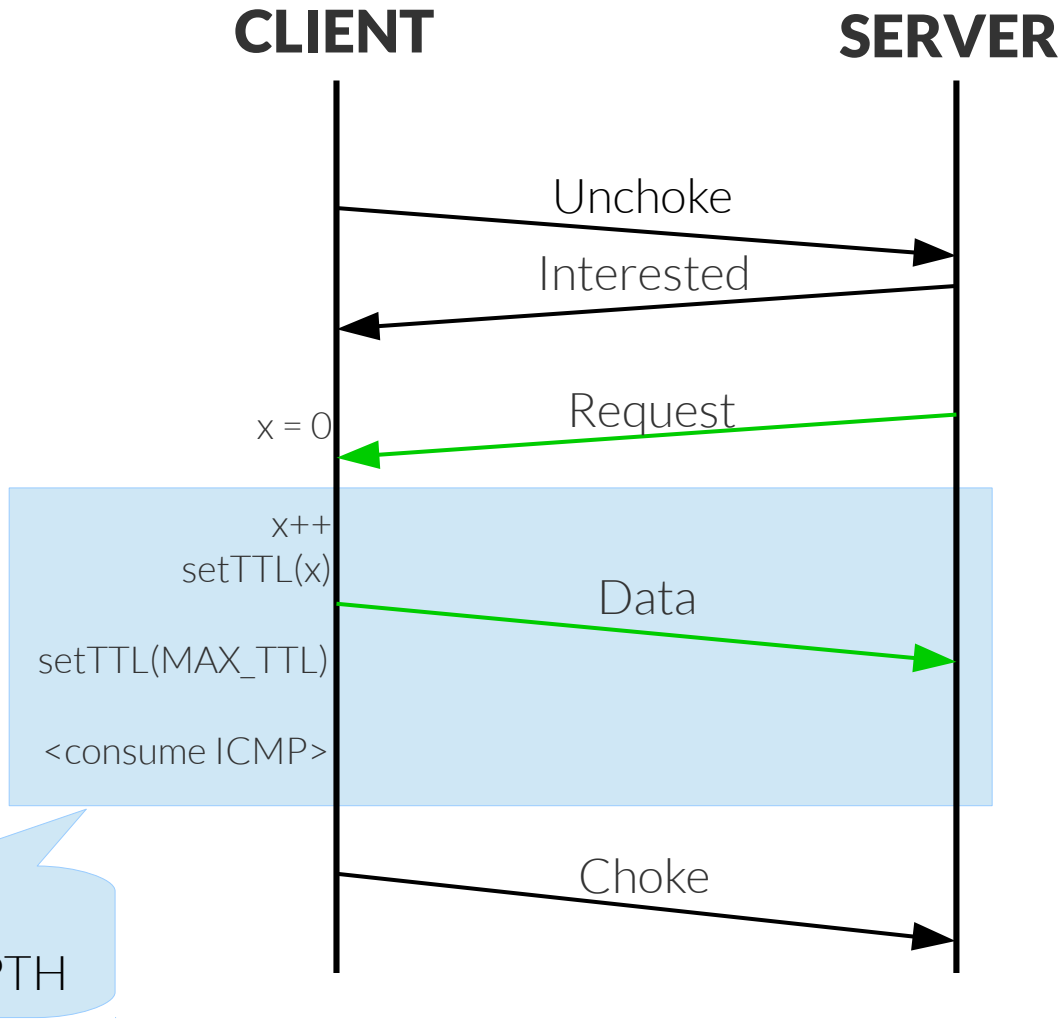
SPEED TEST

Measures the throughput obtained by the different classes of traffic.



TRACEROUTE TEST

Uses the same connection of Speed test.
Traceroute-like behaviour with application-level traffic.



MONROE TESTBED

Distributed testbed for experimentations in mobile broadband networks.

Four European countries: Italy, Norway, Spain, Sweden.

Approximately 15 network operators

COMPARING TRACES

	BT	CT
Hop 1	{IP1}	{IP1}
Hop 2	{IP2, IP3}	{IP2}
Hop 3	{IP4, IP5, IP6}	{IP5, IP7}
Hop 4	{IP8}	{IP9}

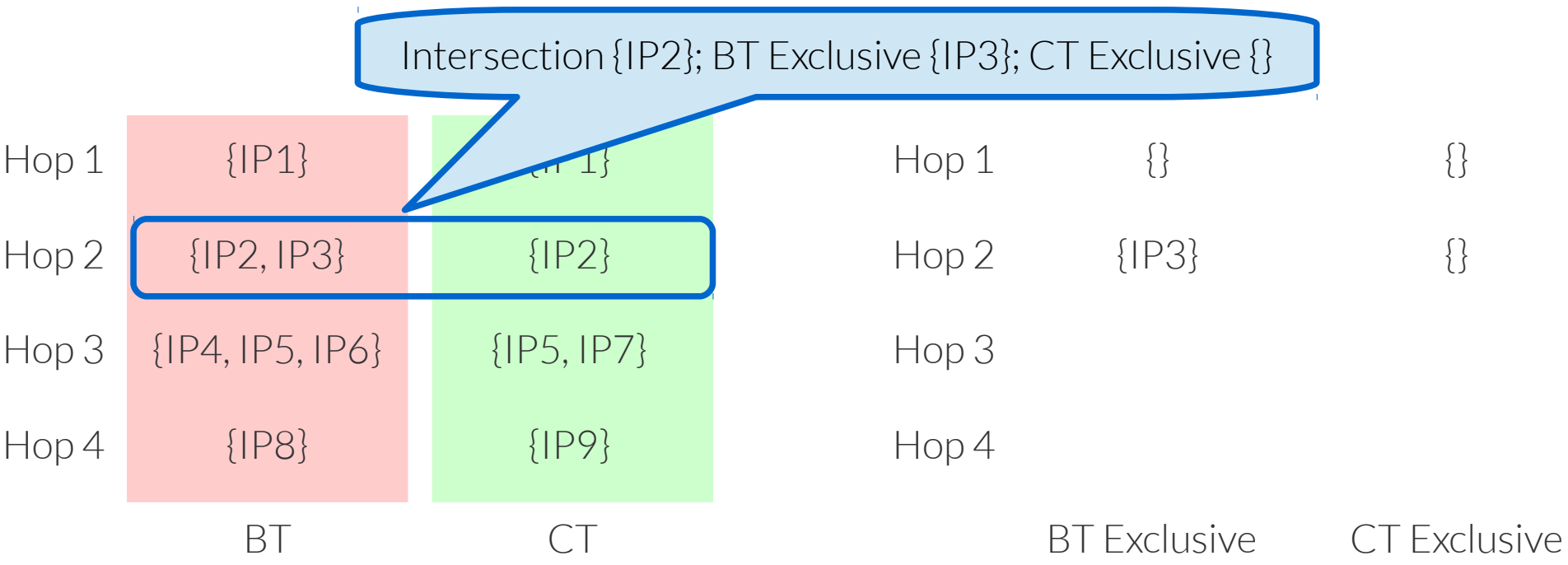
	BT Exclusive	CT Exclusive
Hop 1		
Hop 2		
Hop 3		
Hop 4		

COMPARING TRACES

Intersection {IP1}; BT Exclusive {}; CT Exclusive {}

	BT	CT		BT Exclusive	CT Exclusive
Hop 1	{IP1}	{IP1}	Hop 1	{}	{}
Hop 2	{IP2, IP3}	{IP2}	Hop 2		
Hop 3	{IP4, IP5, IP6}	{IP5, IP7}	Hop 3		
Hop 4	{IP8}	{IP9}	Hop 4		

COMPARING TRACES



COMPARING TRACES

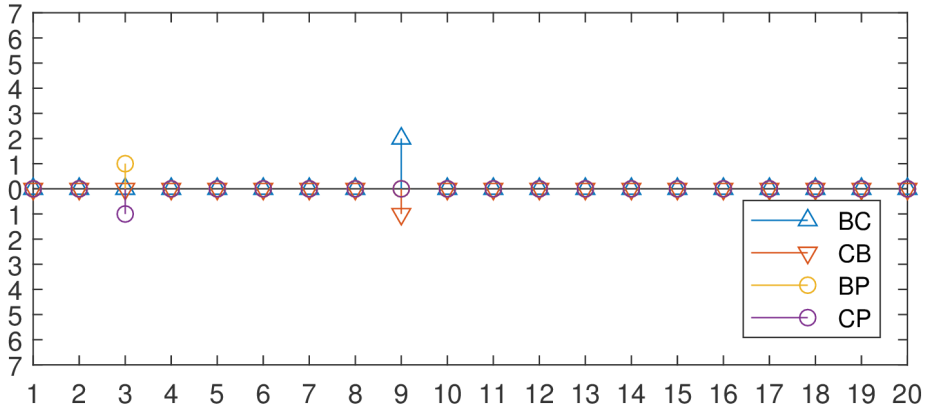
	BT	CT
Hop 1	{IP1}	{IP1}
Hop 2	{IP2, IP3}	{IP2}
Hop 3	{IP4, IP5, IP6}	{IP5, IP7}
Hop 4	{IP8}	{IP9}

	BT Exclusive	CT Exclusive
Hop 1	{}	{}
Hop 2	{IP3}	{}
Hop 3	{IP4}	{IP7}
Hop 4	{IP8}	{IP9}

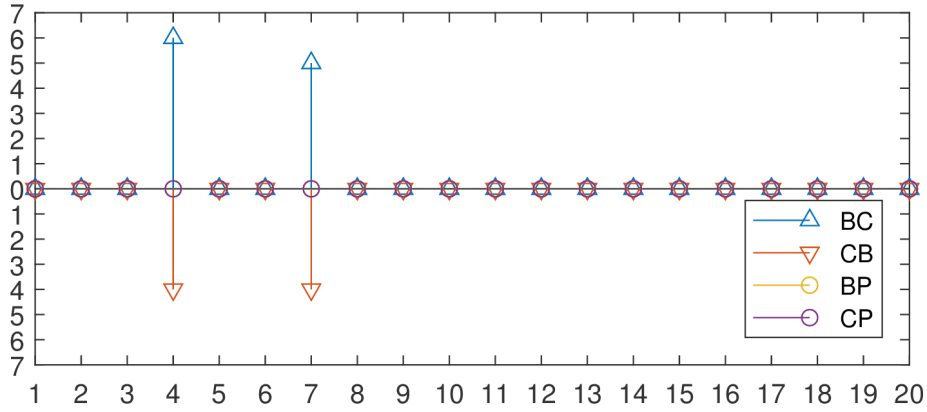
RESULTS

ITALY	NORWAY	SPAIN	SWEDEN
TIM	ICE	Orange	H3G
Vodafone	Telenor	Vodafone (R)	Telenor
Wind	Telia Mobile (R)	Yoigo	Telia Mobile
	Telia Norge		

RESULTS (ITALY)

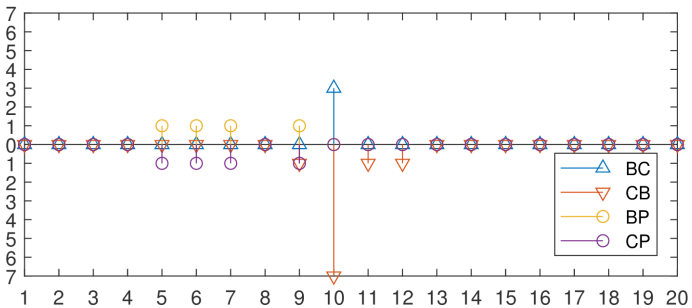


TIM

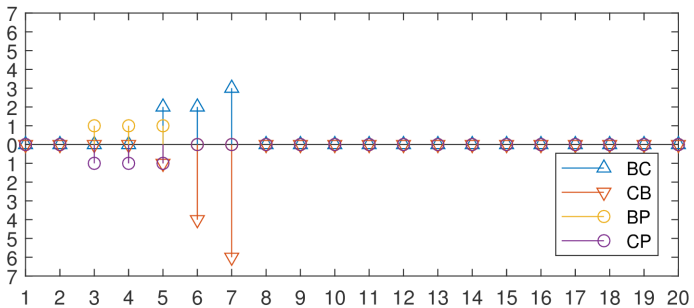


Wind

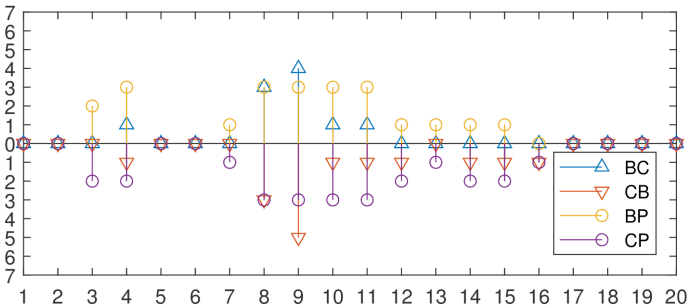
RESULTS (NORWAY)



Telenor

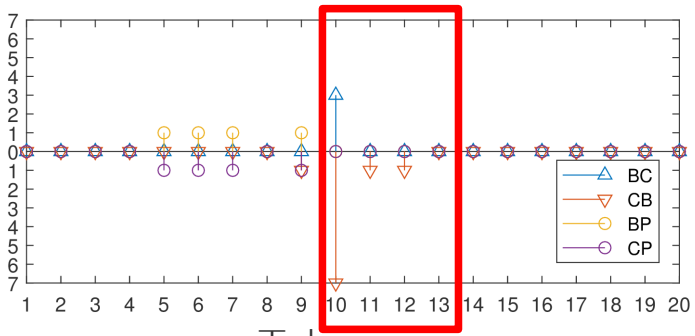


Telia Mobile

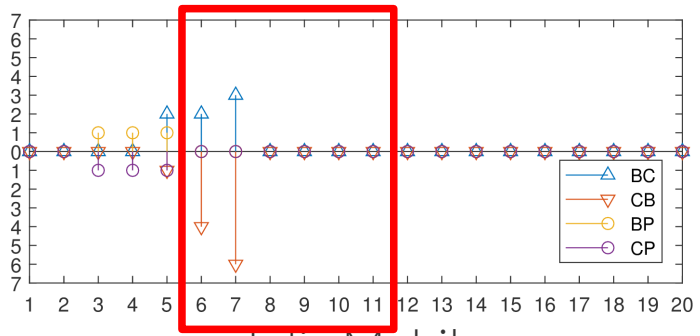


Telia Norge

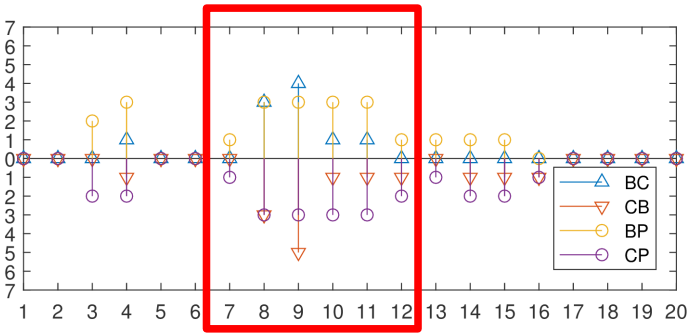
RESULTS (NORWAY)



Telenor



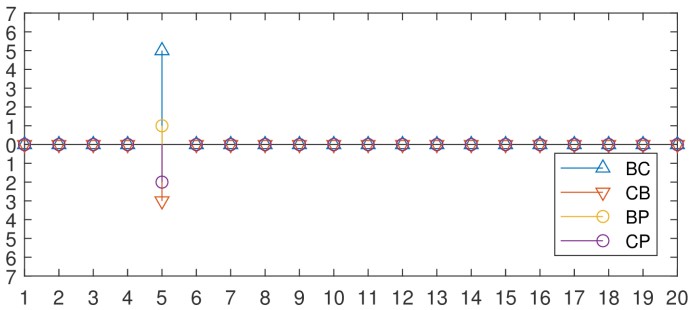
Telia Mobile



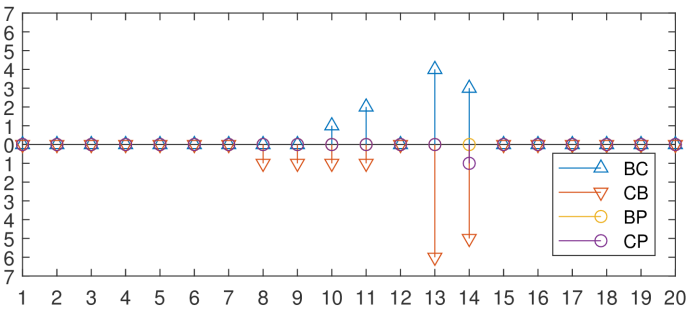
Telia Norge

Telianet (AS1299)

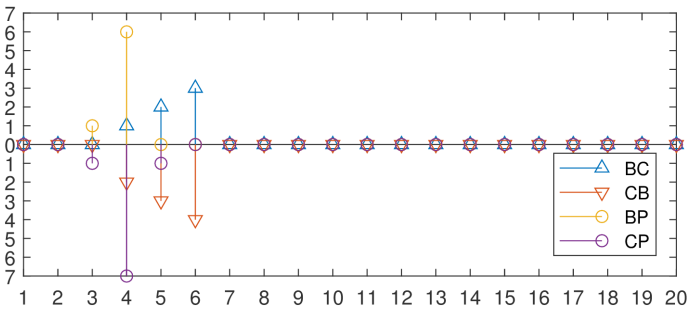
RESULTS (SWEDEN)



H3G

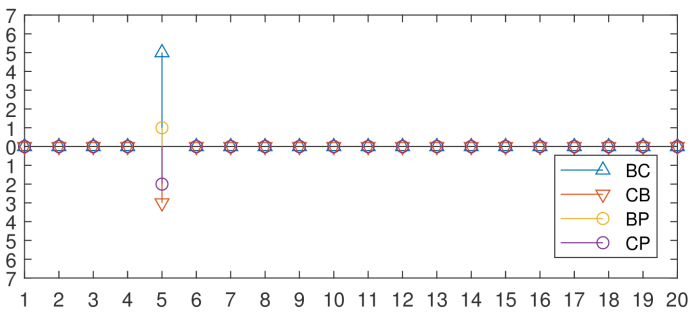


Telenor

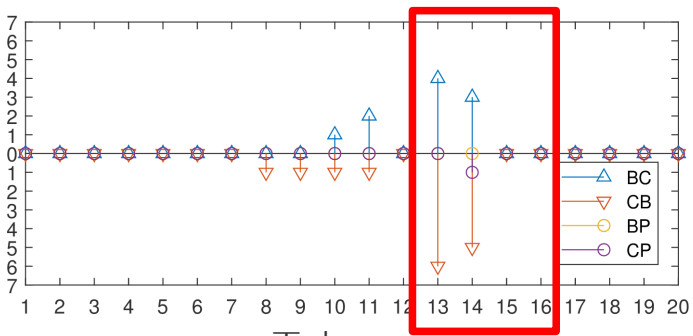


Telia Mobile

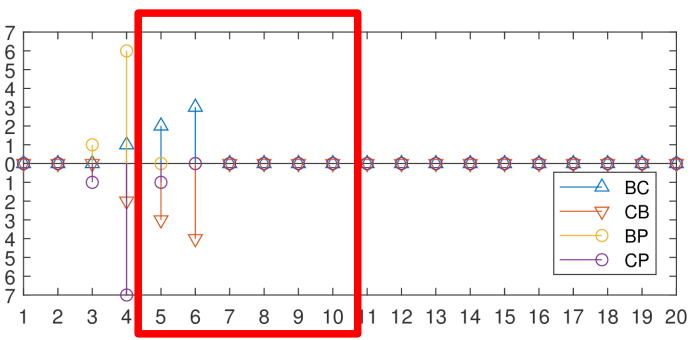
RESULTS (SWEDEN)



H3G



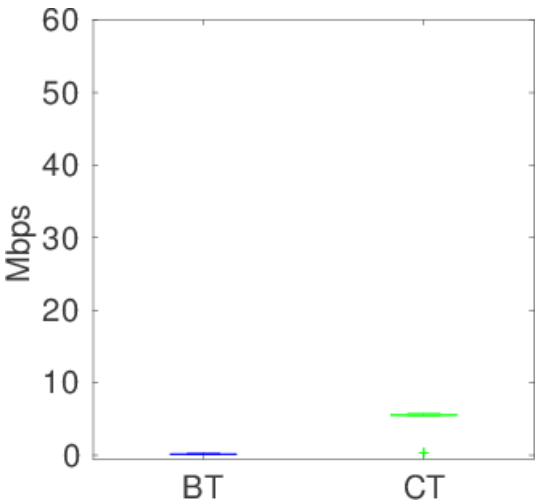
Telenor



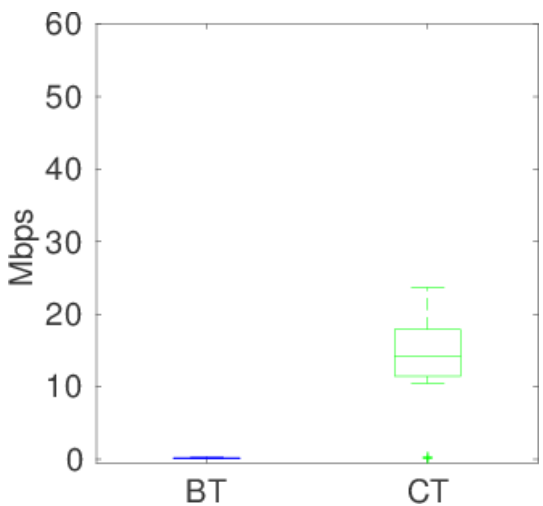
Telia Mobile

Telianet (AS1299)

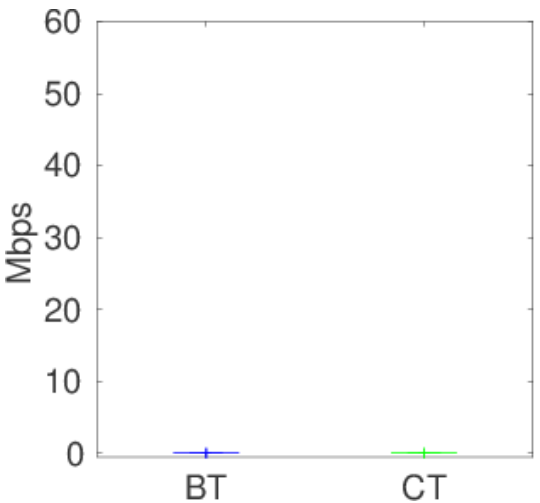
COMPARISON WITH SPEED TEST



Vodafone (Italy)



Vodafone (Spain)



Yoigo (Spain)

CONCLUSION

01

Presented a traceroute-like mechanism to detect forwarding differences applied to different classes of traffic.

02

Even if some differences were detected it does not seem that operators are applying them to degrade performance.

03

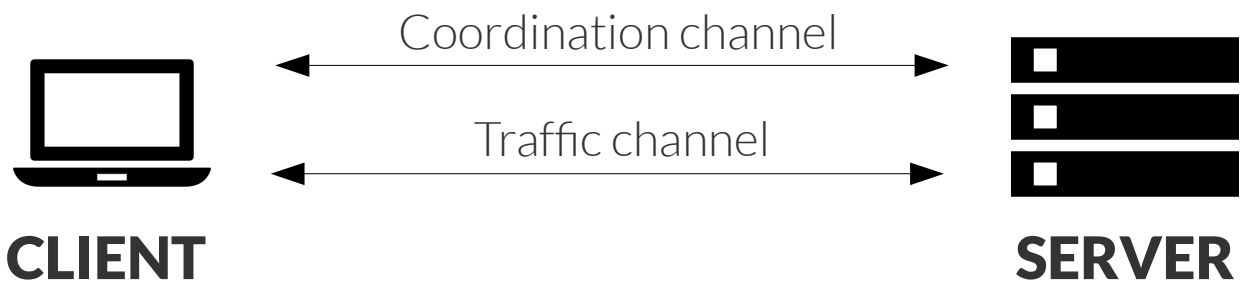
Future works will focus on conducting a more extensive measurement campaign to deepen the analysis.

THANK YOU

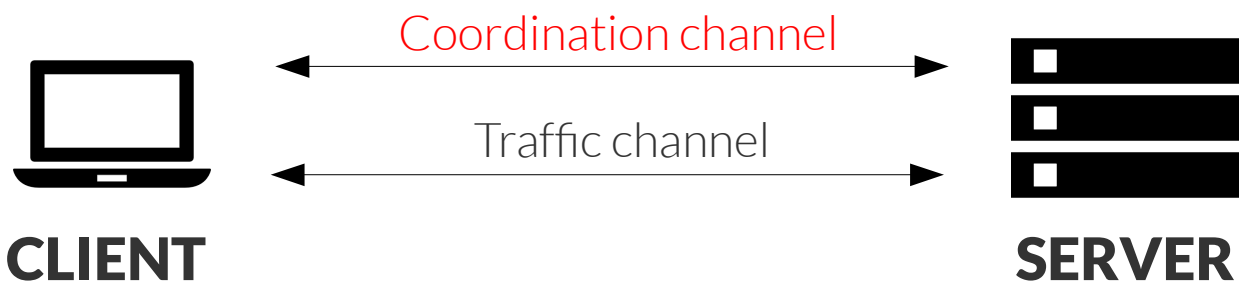
Questions?

valerio.luconi@iit.cnr.it

ARCHITECTURE

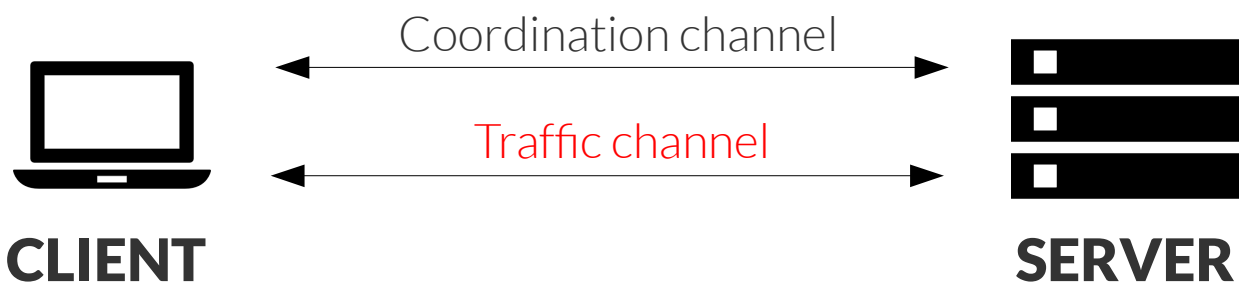


ARCHITECTURE



To exchange commands and transfer results

ARCHITECTURE

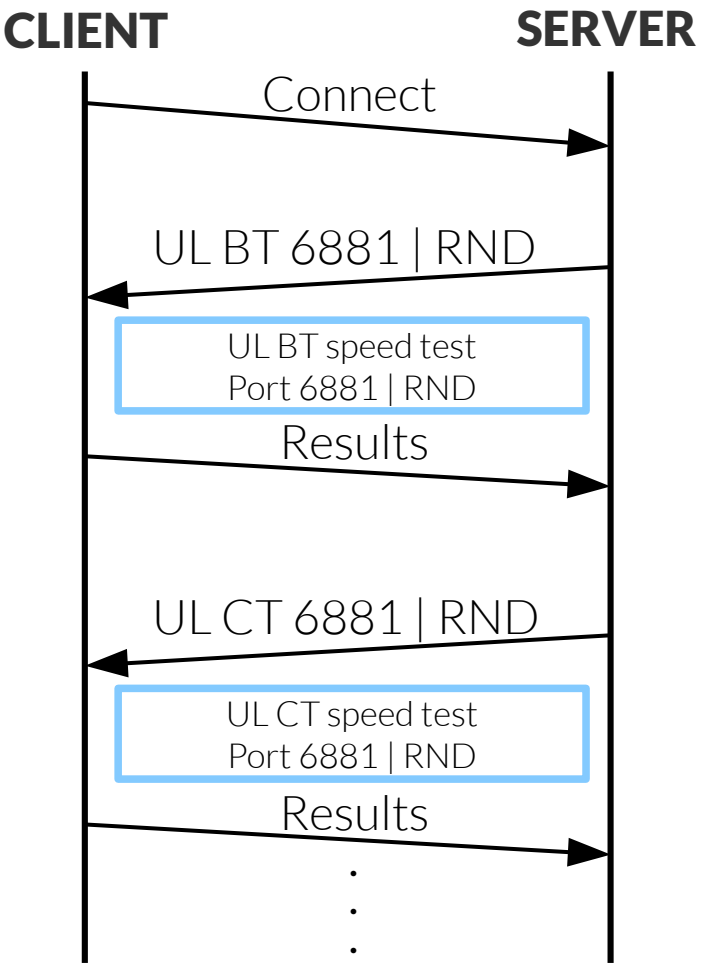


To execute tests

INTERACTION

If uplink BT test fails on port 6881, the test is repeated on a random high port (>50000).

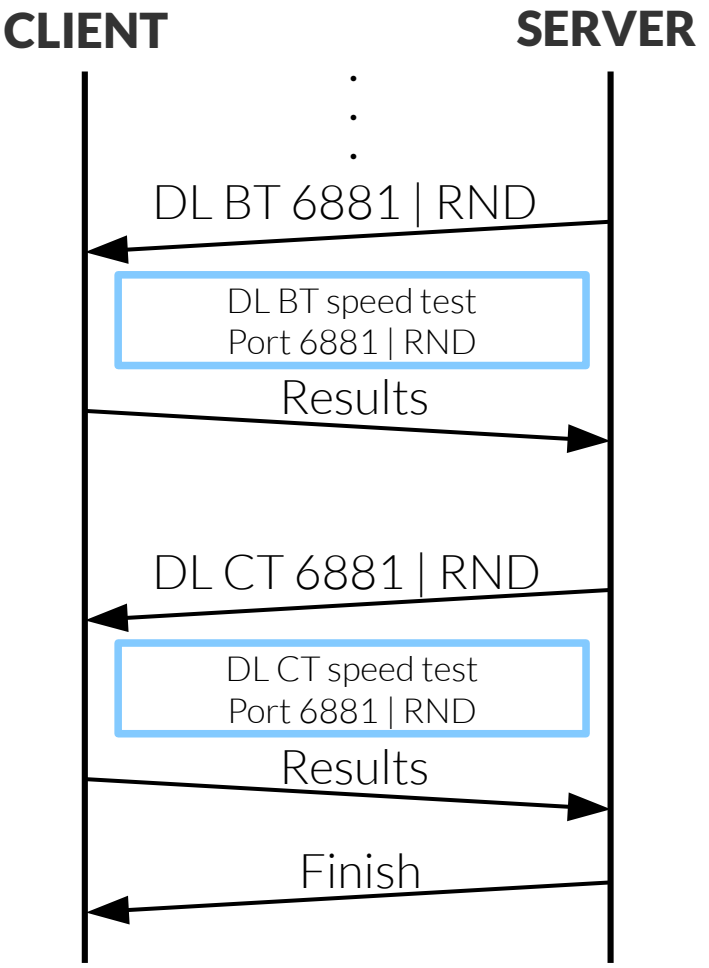
All other tests are then executed on the same port.



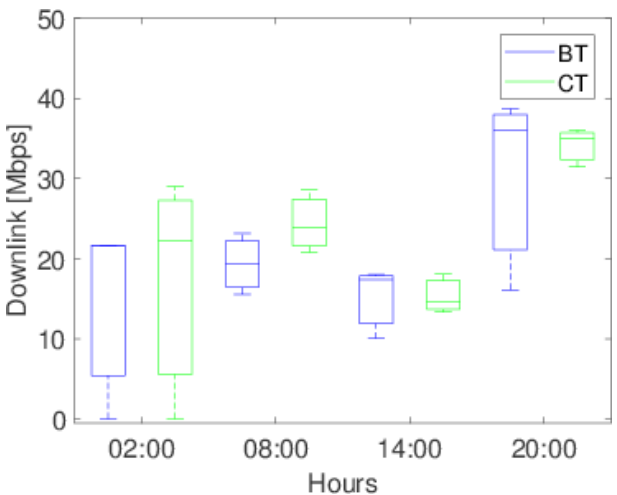
INTERACTION

If uplink BT test fails on port 6881, the test is repeated on a random high port (>50000).

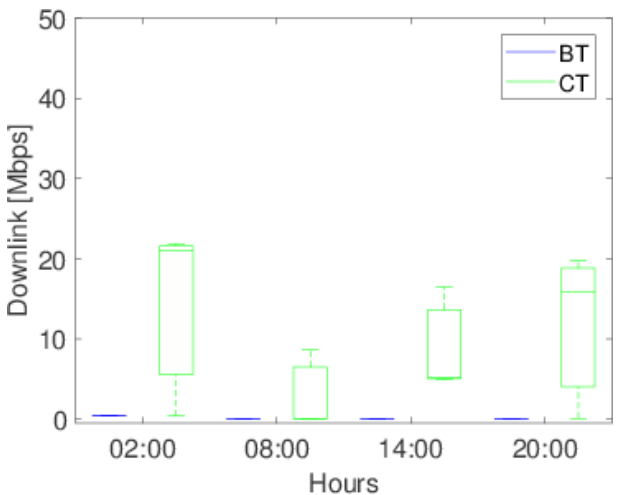
All other tests are then executed on the same port.



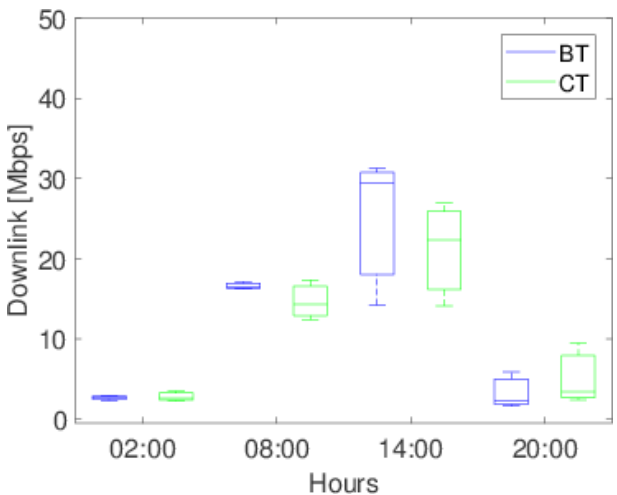
WIDE-RANGE ITALY



TIM
0%

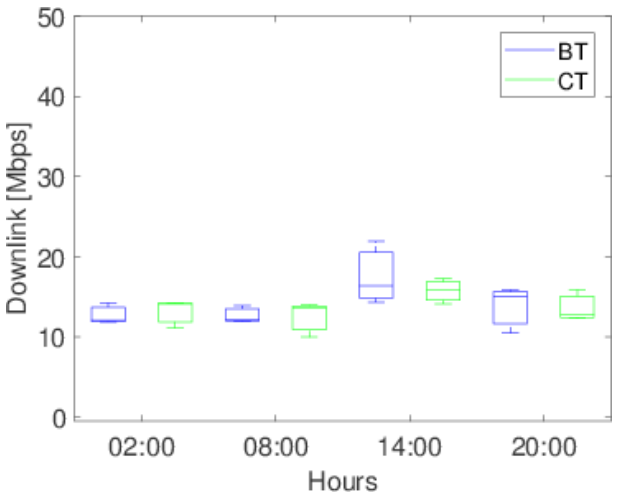


Vodafone
86.4%

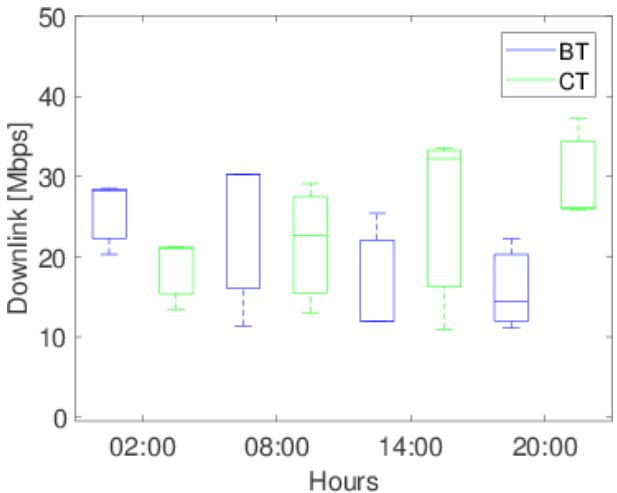


Wind
41.2%

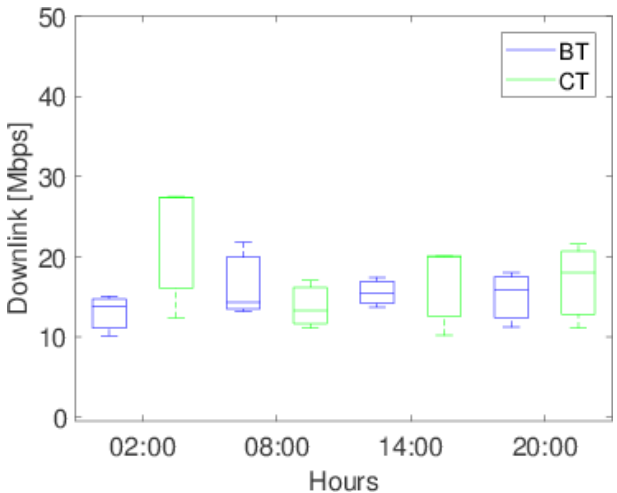
WIDE-RANGE NORWAY



ICE
0%

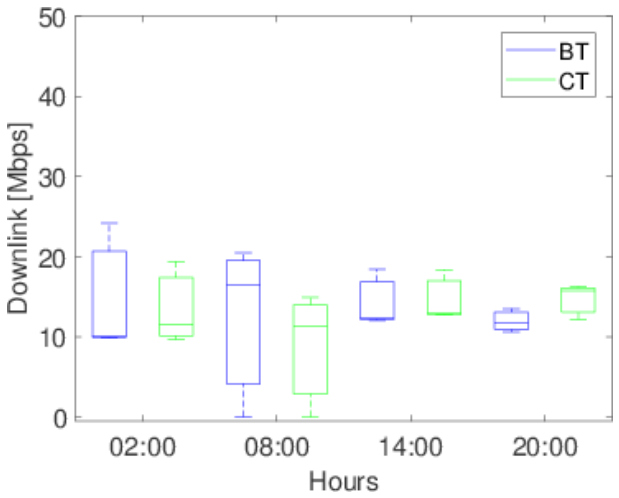


Telenor
0%



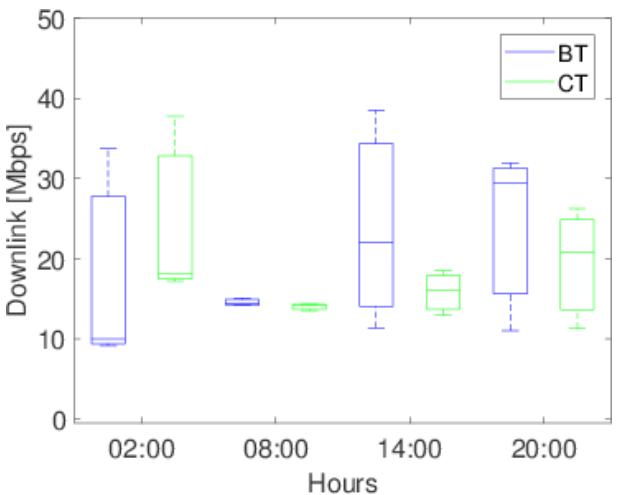
Telia Mobile
0%

WIDE-RANGE NORWAY

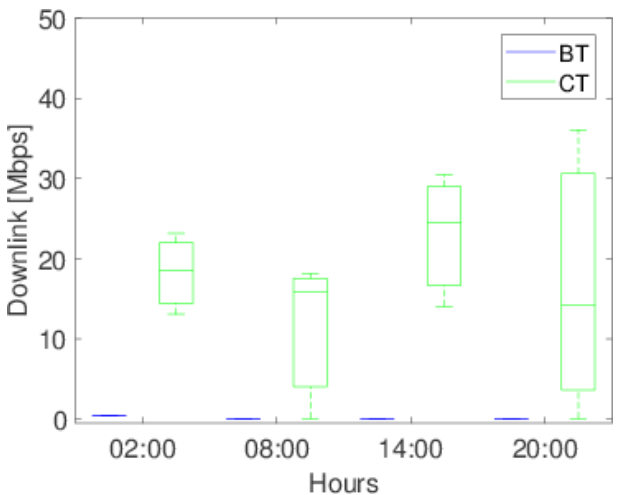


Telia Norge
0%

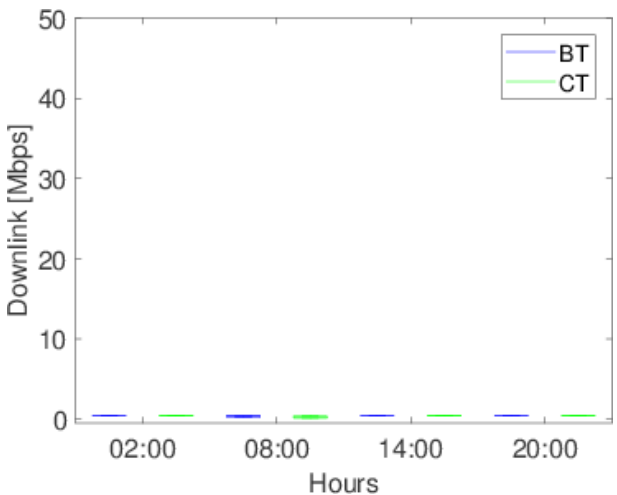
WIDE-RANGE SPAIN



Orange
0%

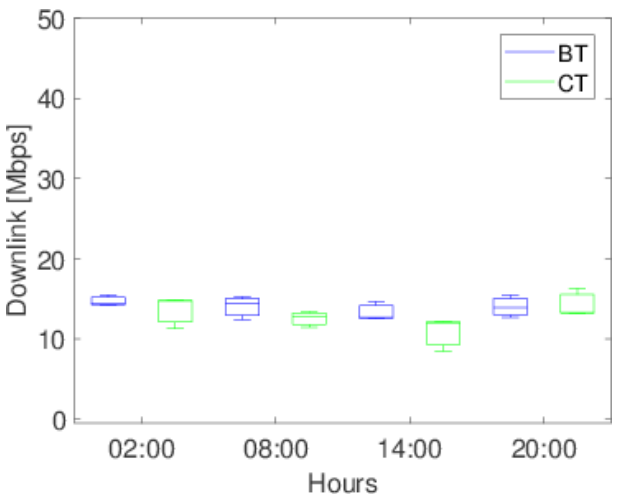


Vodafone
73.9%

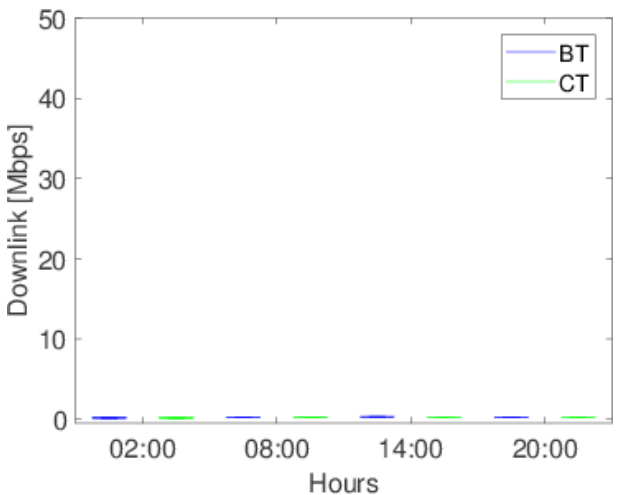


Yoigo
100%

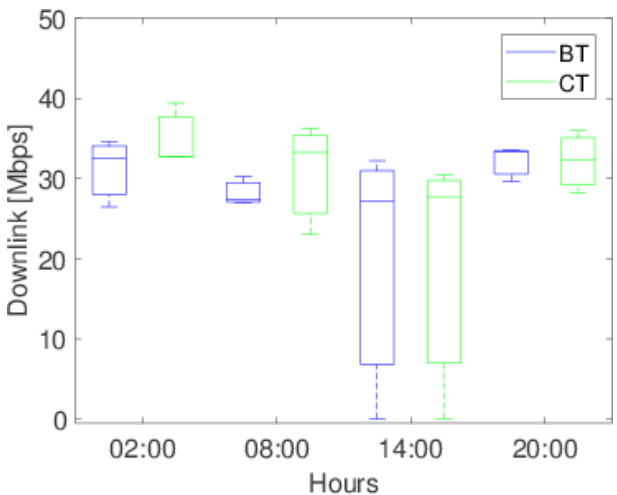
WIDE-RANGE SWEDEN



H3G
0%



Telenor
58.3%



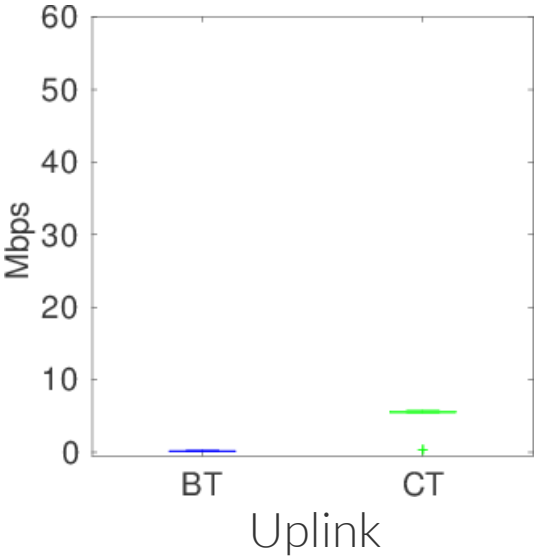
Telia Mobile
0%

FOCUSED
ITALY VODAFONE

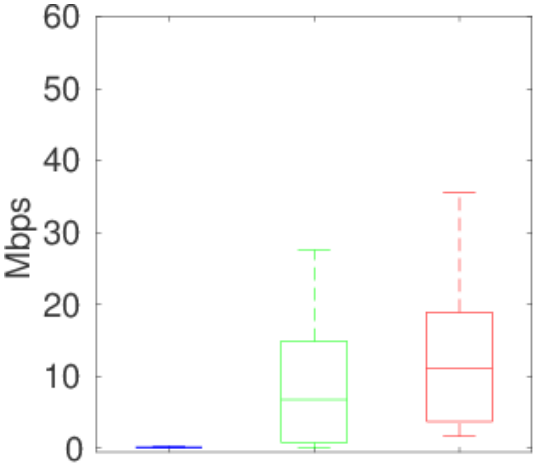
Port 6881 is always blocked
except for night hours.

In night hours BT tpt is 0.3 Mbps.
In day hours 0.05 Mpbs.

Vodafone seems to perform DPI to throttle traffic.



Uplink



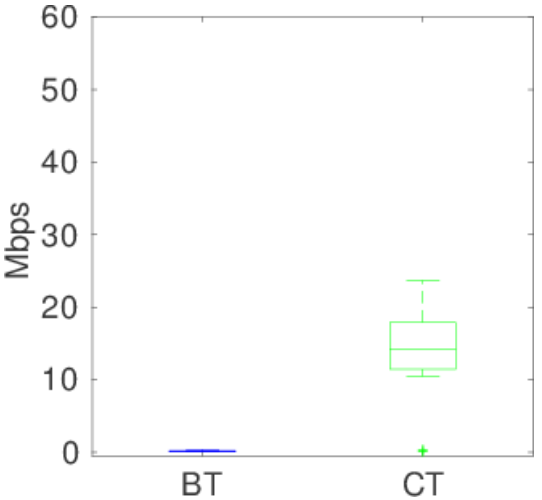
Downlink

FOCUSED
SPAIN VODAFONE

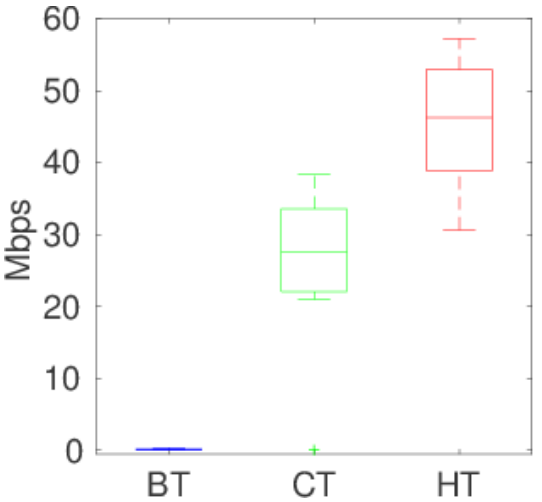
Port 6881 is always blocked
except for night hours.

In night hours BT tpt is 0.3 Mbps.
In day hours 0.05 Mpbs.

Vodafone seems to perform DPI to throttle traffic.



Uplink

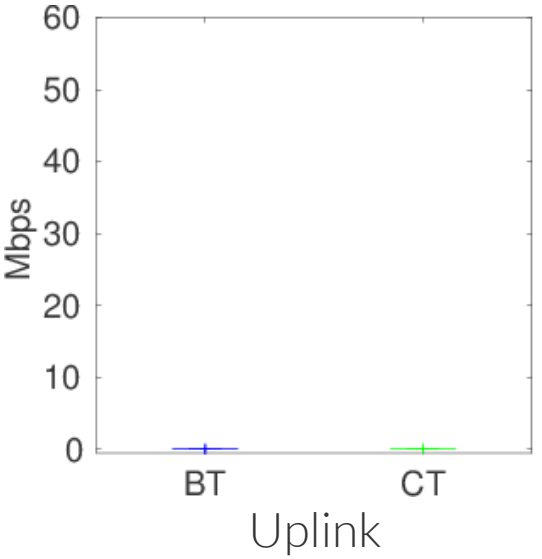


Downlink

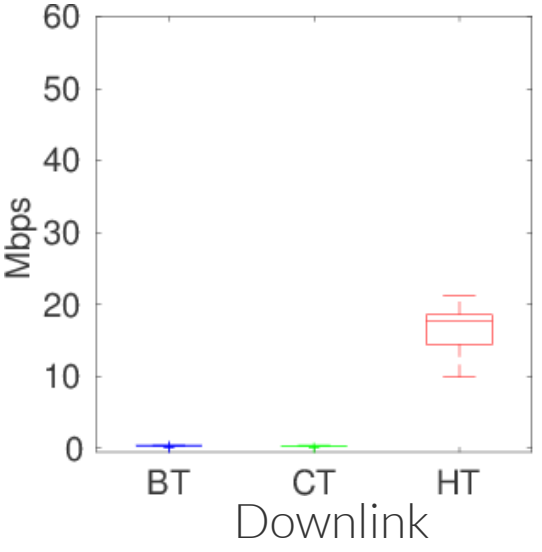
FOCUSED SPAIN YOIGO

Port 6881 is always blocked.

Yoigo seems to perform differentiation basing on port number.



Uplink

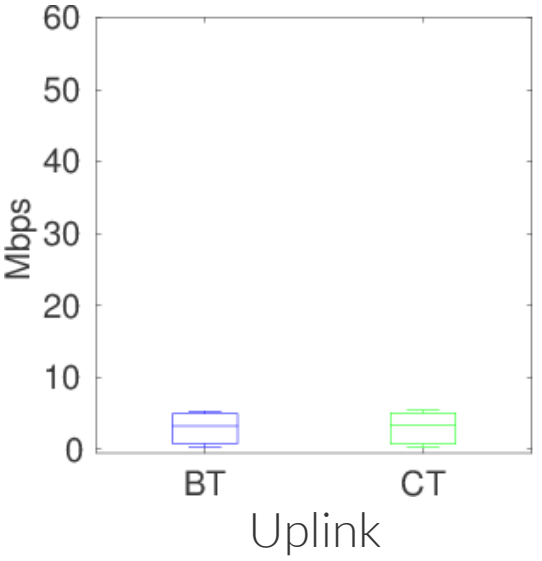


Downlink

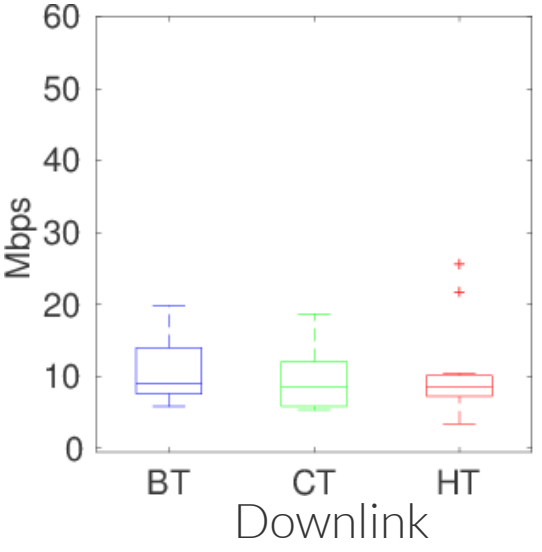
FOCUSED SWEDEN TELENOR

Port 6881 is blocked in 50% of runs.

Throttling is not confirmed.



Uplink



Downlink