Linux: TC - bandwidth limitation, transmission error induction and delays

programmes used to take measurements:

- https://man7.org/linux/man-pages/man8/tc.8.html
- https://github.com/tum-lkn/tcgui

Connection diagram

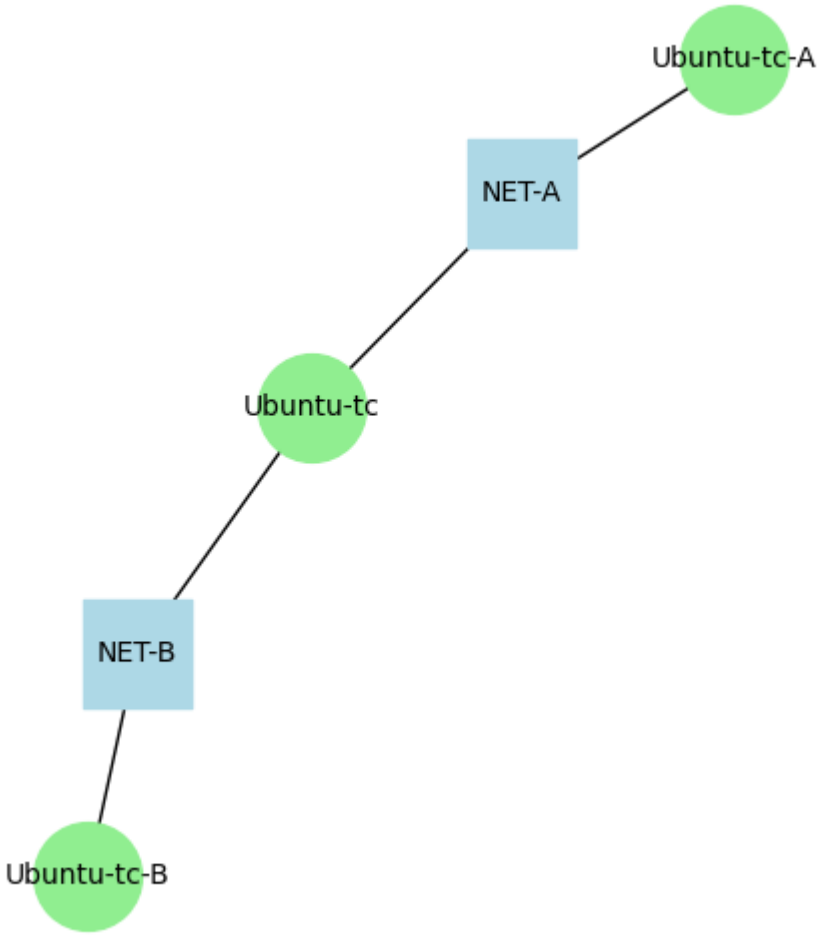


Diagram generated using my script

Machine name	Network card	ip address	gateway	Virtual switch
ubuntu-tc	eth0	192.168.1.1/24	X	NET-A
	eth1	192.168.2.1/24	X	NET-B
ubuntu-tc-A	eth0	192.168.1.10/24	192.168.1.1/24	NET-A
ubuntu-tc-B	eth0	192.168.2.10/24	192.168.2.1/24	NET-B

Settings on the "Ubuntu-tc" machine

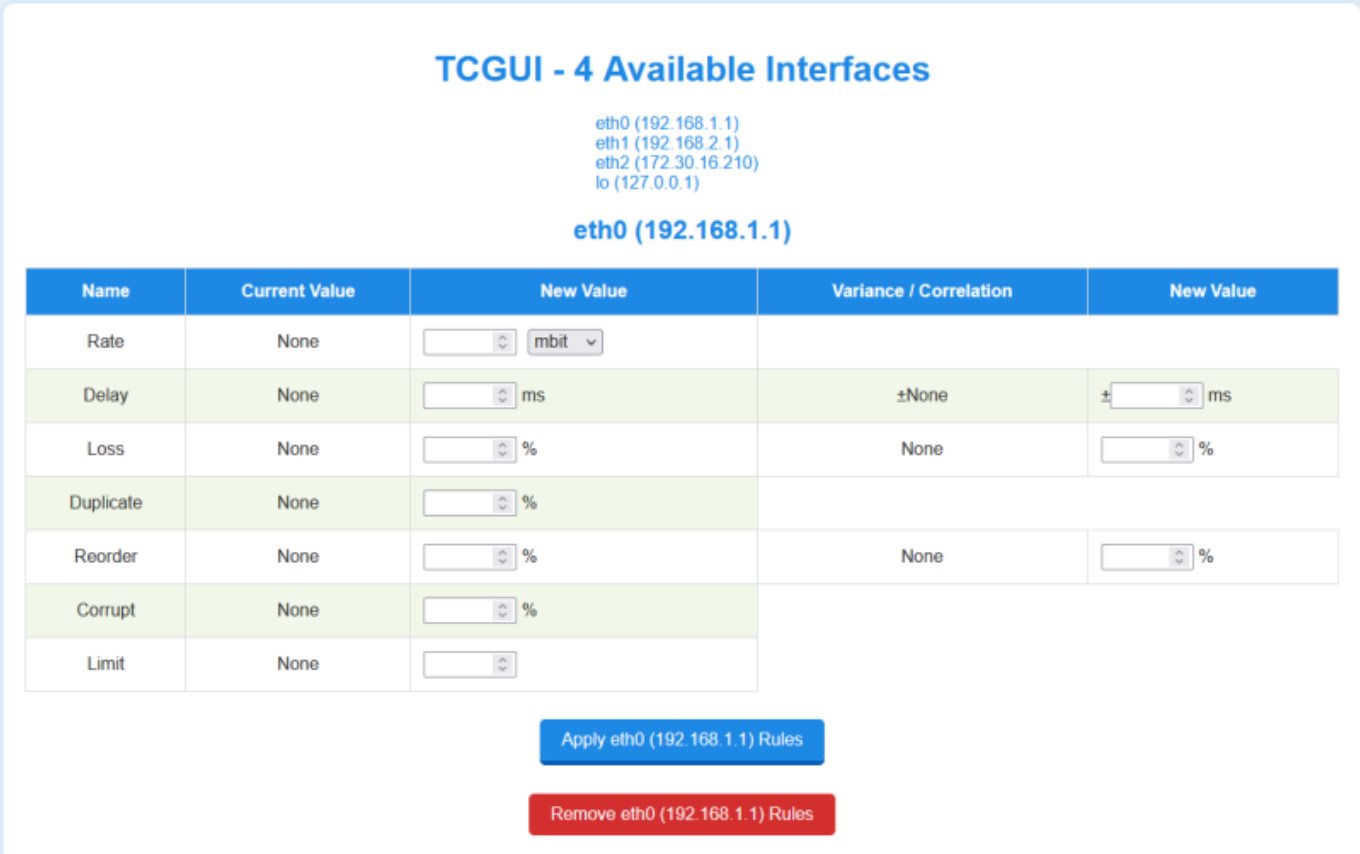
- enable forwarding for ipv4

```
echo "net.ipv4.ip_forward=1" | sudo tee -a /etc/sysctl.conf
```

- restart the network interfaces
- copy tc-gui to machine and run

```
sudo apt install git
git clone https://github.com/tum-lkn/tcgui
cd tcgui
sudo python3 main.py --ip 127.0.0.1
```

- open firefox browser to address `127.0.0.1:5000`



Settings on the rest of the machines

```
sudo apt-get update
sudo apt-get install iperf3
```

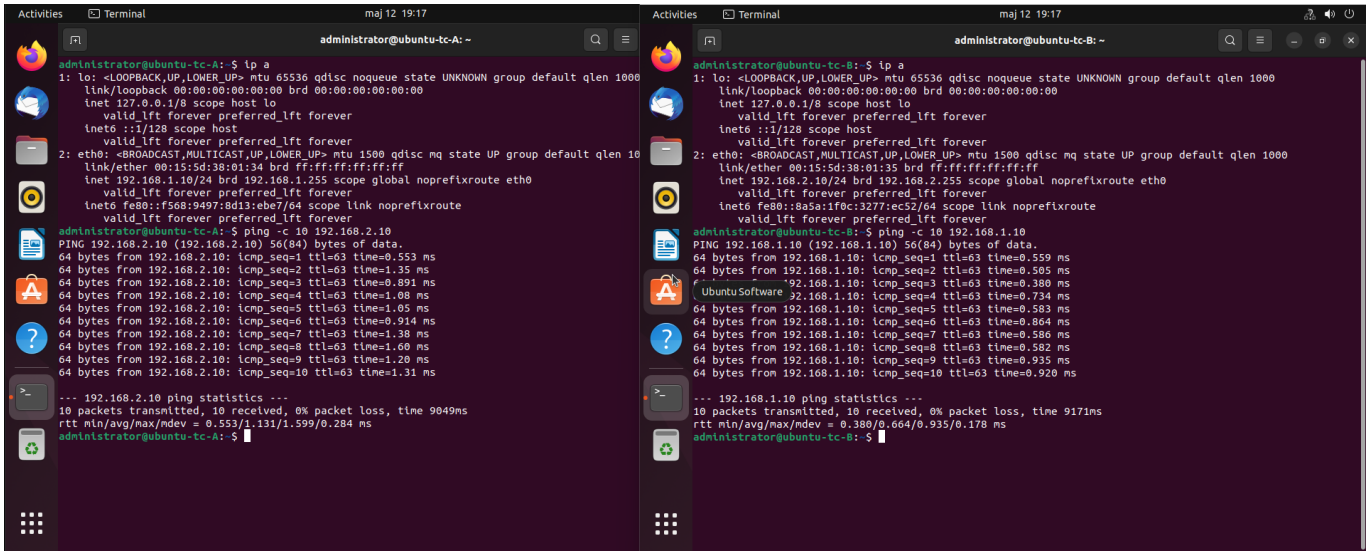
We still need to address them statically via the GUI or by using netplan

Test results table

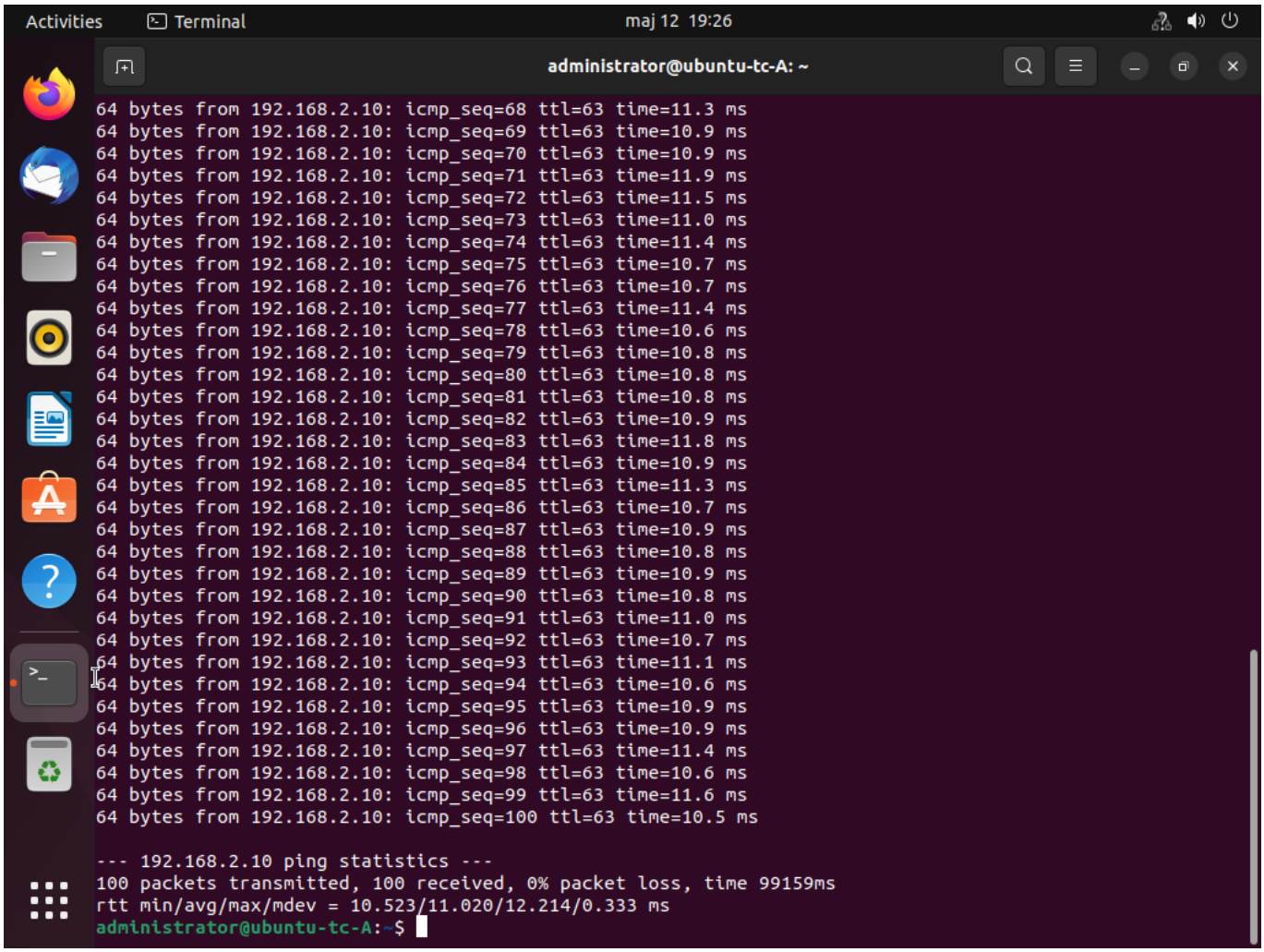
Test description	protocol	loss	bandwidth	delay [ms]
Delay tests				
Test without added delay	icmp	0%	—	1,131
Test with added 10ms delay result from 100 measurements	icmp	0%	—	11,020
test with added 100ms delay result from 100 measurements	icmp	0%	—	101,071
test with added 1000ms delay result from 100 measurements	icmp	0%	—	1000,911
UDP bandwidth tests	**protocol**	**Lost/Sent**	**bandwidth**	**delay [ms]**
Unlimited 30s test (UDP 1Gbps iperf)	UDP	—	998 Mbps	—
300Mbps 30s bandwidth limitation (UDP iperf)	UDP	72%	282 Mbps	—
Bandwidth limitation to 100Mbps 30s (UDP iperf)	UDP	91%	94.3 Mbps	—
10Mbps 30s bandwidth limitation (UDP iperf)	UDP	99%	9.72 Mbps	—
Bandwidth limitation to 1Mbps 30s (UDP iperf)	UDP	1e+02%	972 kbps	—
TCP bandwidth tests	**protocol**	**retransmissions**	**bandwidth**	**delay [ms]**
Unlimited 30s test (TCP iperf)	TCP	2	10.3 Gbps	—
Bandwidth limitation to 300Mbps 30s (TCP iperf)	TCP	0	282 Mbps	—
Bandwidth limitation to 100Mbps 30s (TCP iperf)	TCP	0	94.3 Mbps	—
Bandwidth limitation to 10Mbps 30s (TCP iperf)	TCP	152	9.72 Mbps	—
Bandwidth limitation to 1Mbps 30s (TCP iperf)	TCP	0	972 kbps	—
Other Tests				
Round trip link test 10Mbps, latency 2000ms, urata 3%, corrupted 10% (ping 100 measurements)	ICMP	24%	—	4001,69
10Mbps round trip link test, latency 600ms, loss 3%, corrupted 10% (TCP iperf)	TCP	23	82 kbps	—
10Mbps round trip link test, latency 600ms, loss 3%, faulty 10% (UDP iperf)	UDP	99%	7.79 kbps	—
60Mbps round trip link test, 600ms latency, 5% loss (UDP iperf)	UDP	98%	14.7 Mbps	—

Delay tests

Test without added delay

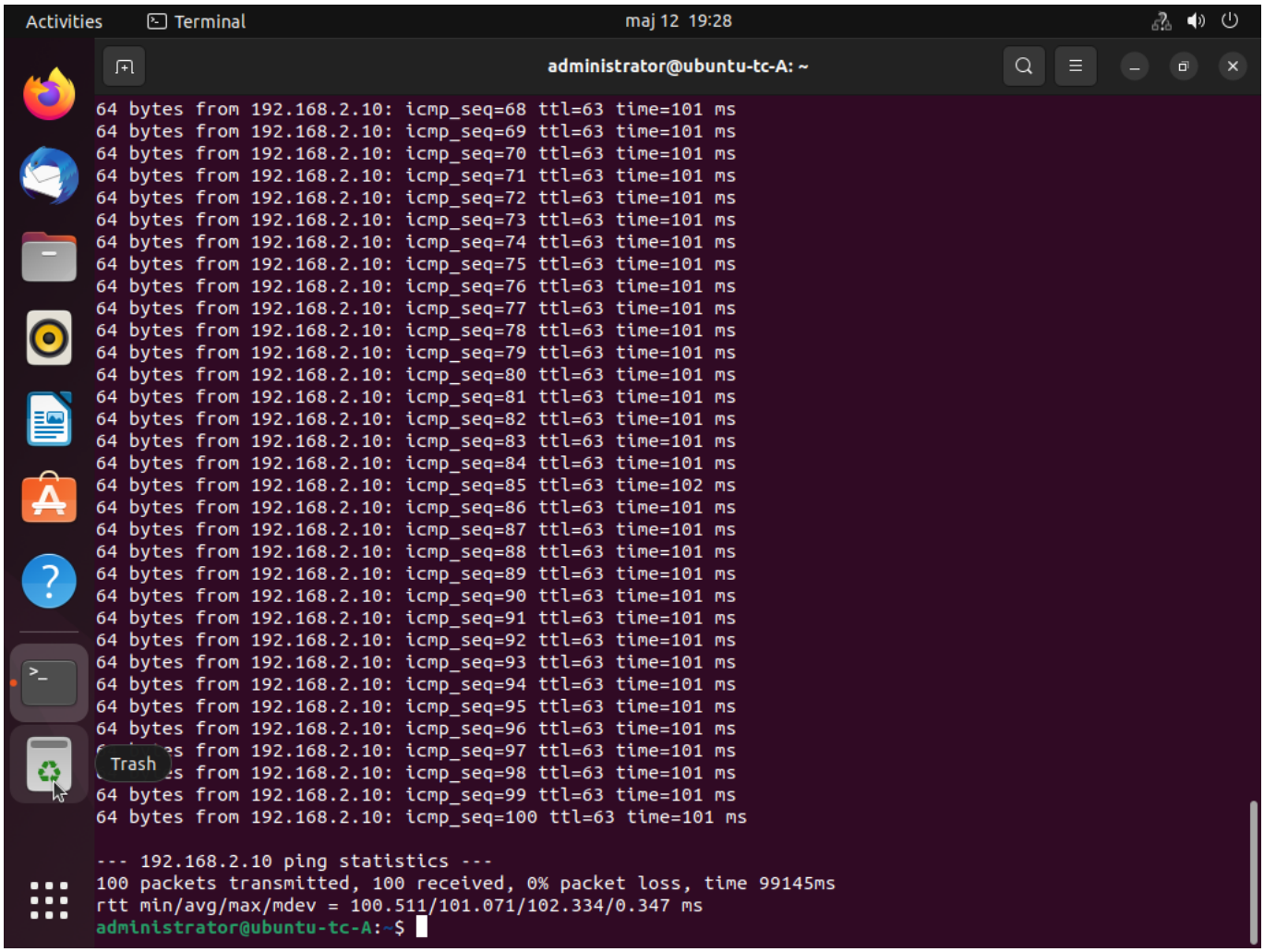


Test with added delay 10ms result from 100 measurements

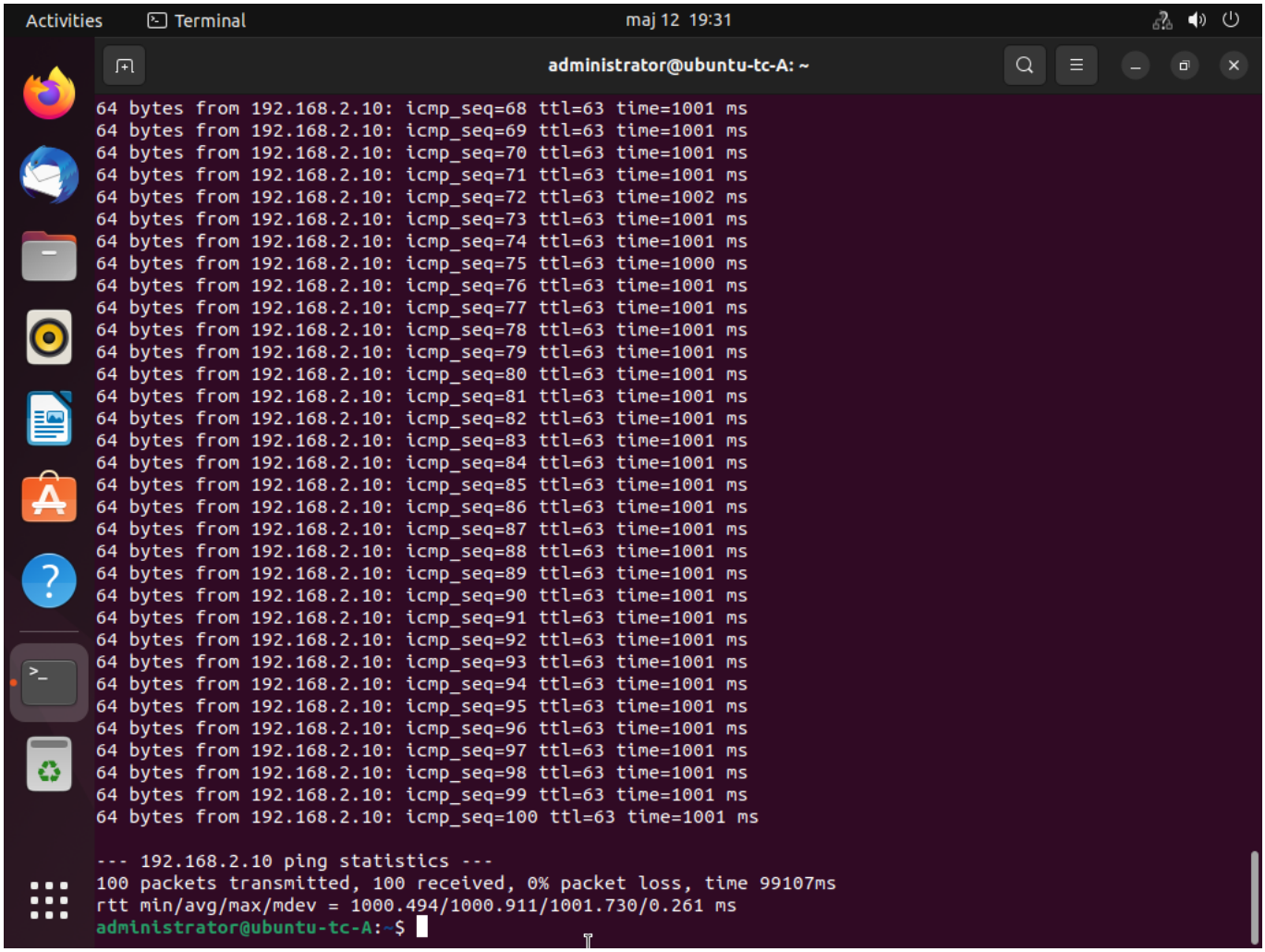


test with an added delay of 100ms result from 100

measurements



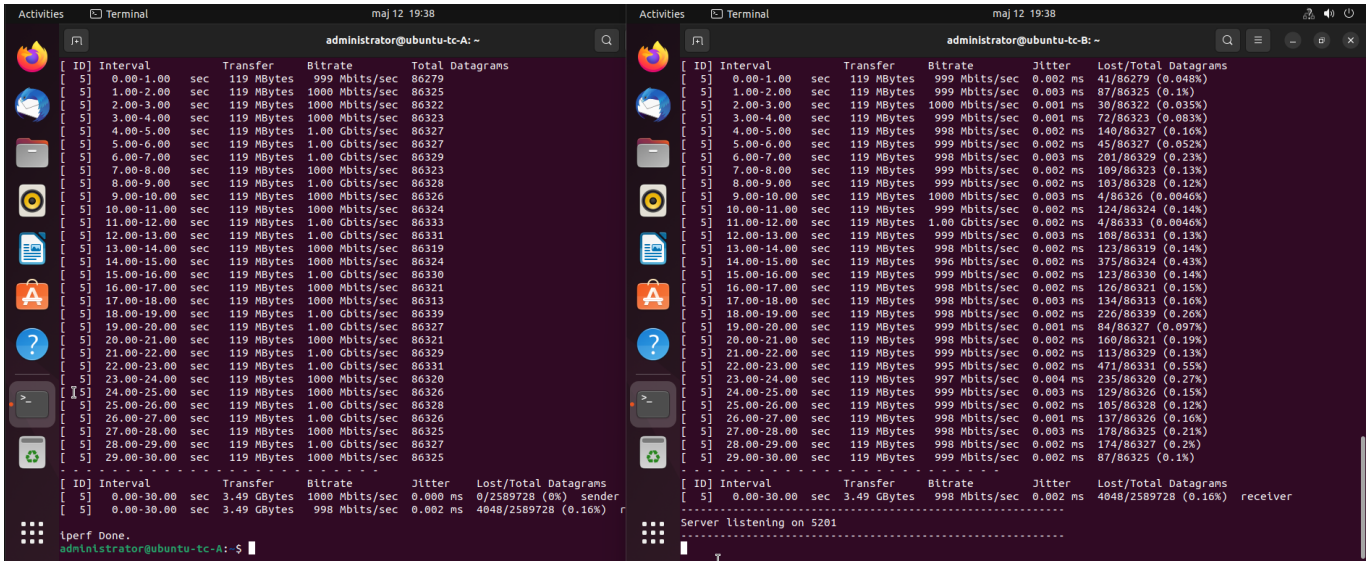
test with an added delay of 1000ms result from 100 measurements



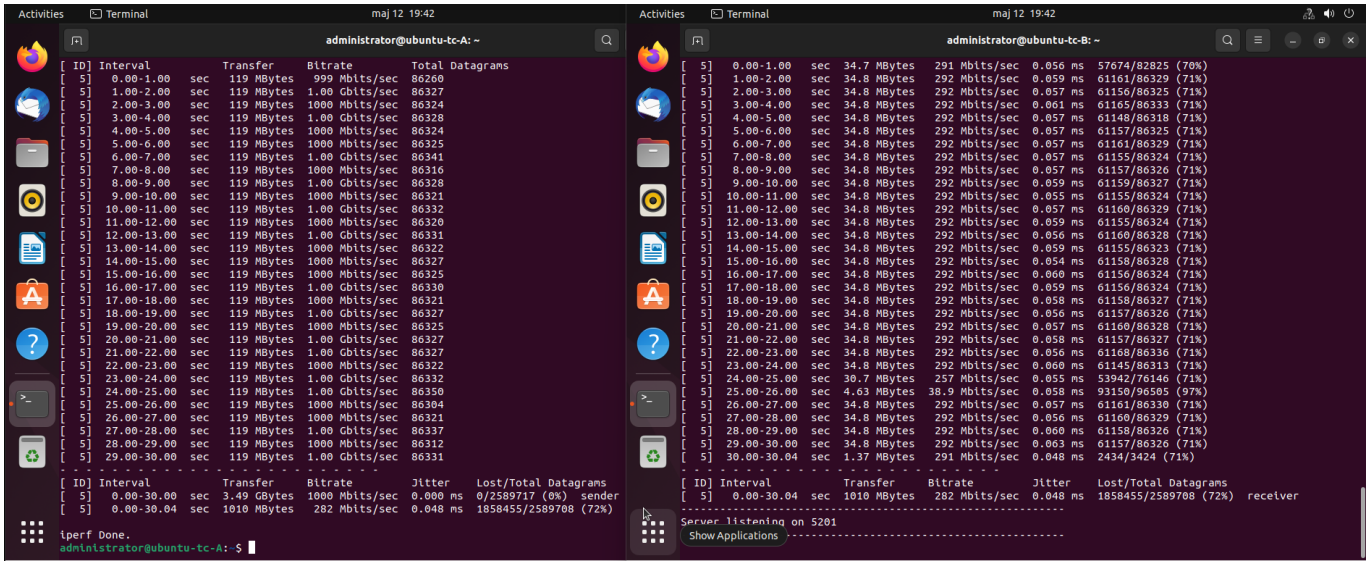
test with added delay of 5000ms result from 100 measurements

Bandwidth limitation test

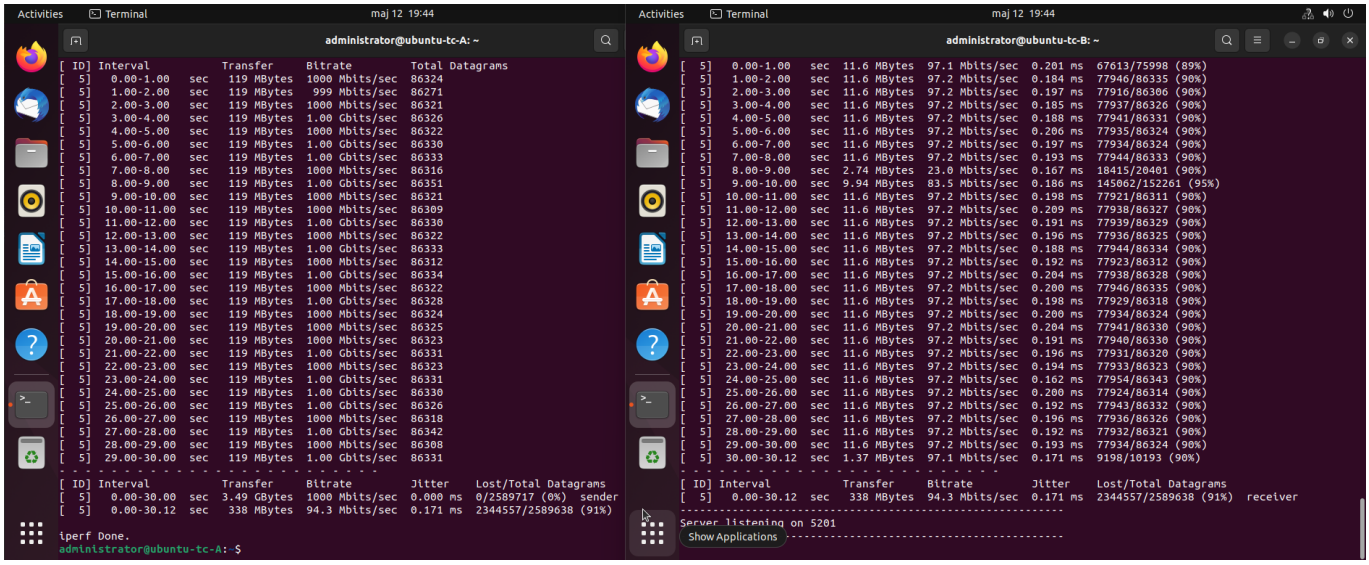
Unlimited 30s test (UDP 1Gbps iperf)



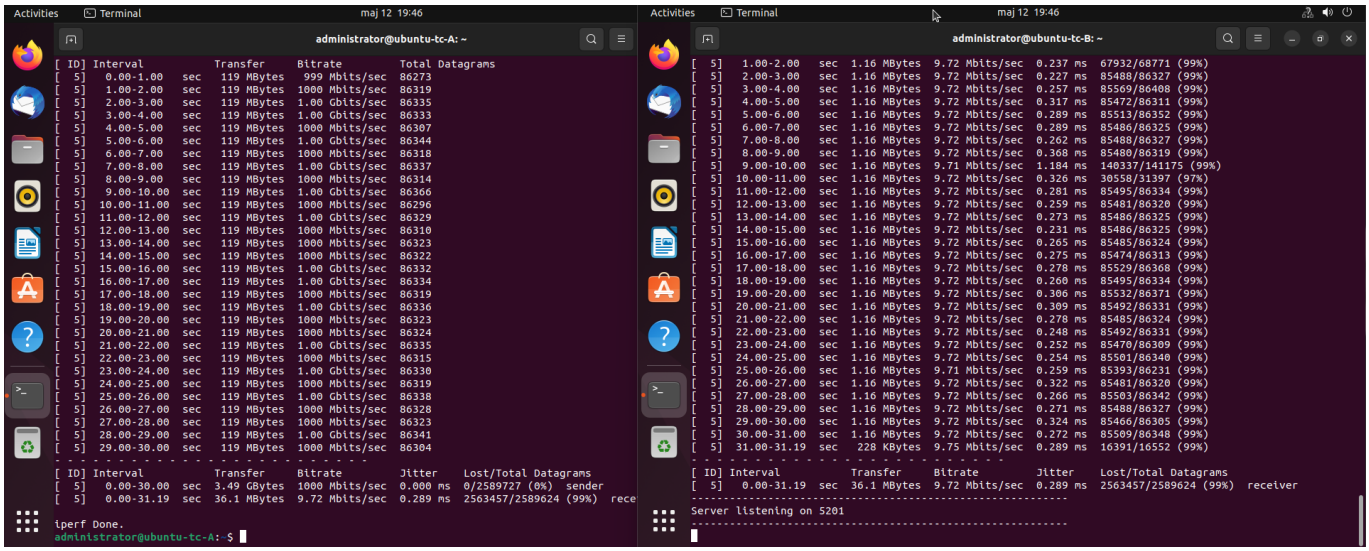
Bandwidth limited to 300Mbps 30s (UDP iperf)



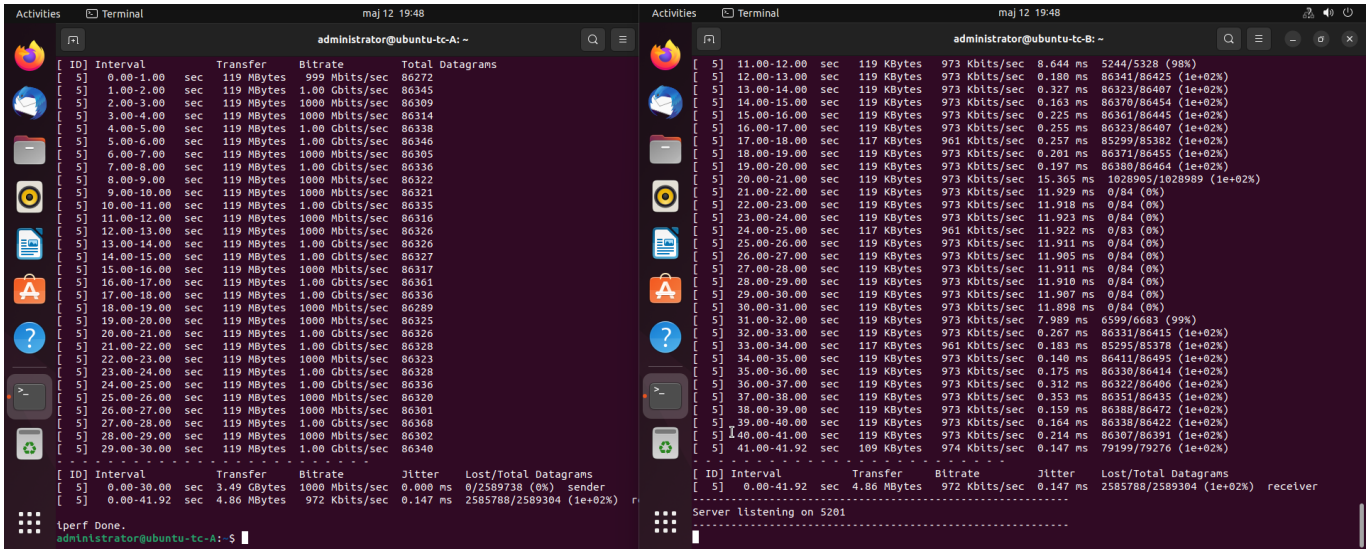
Bandwidth limitation to 100Mbps 30s (UDP iperf)



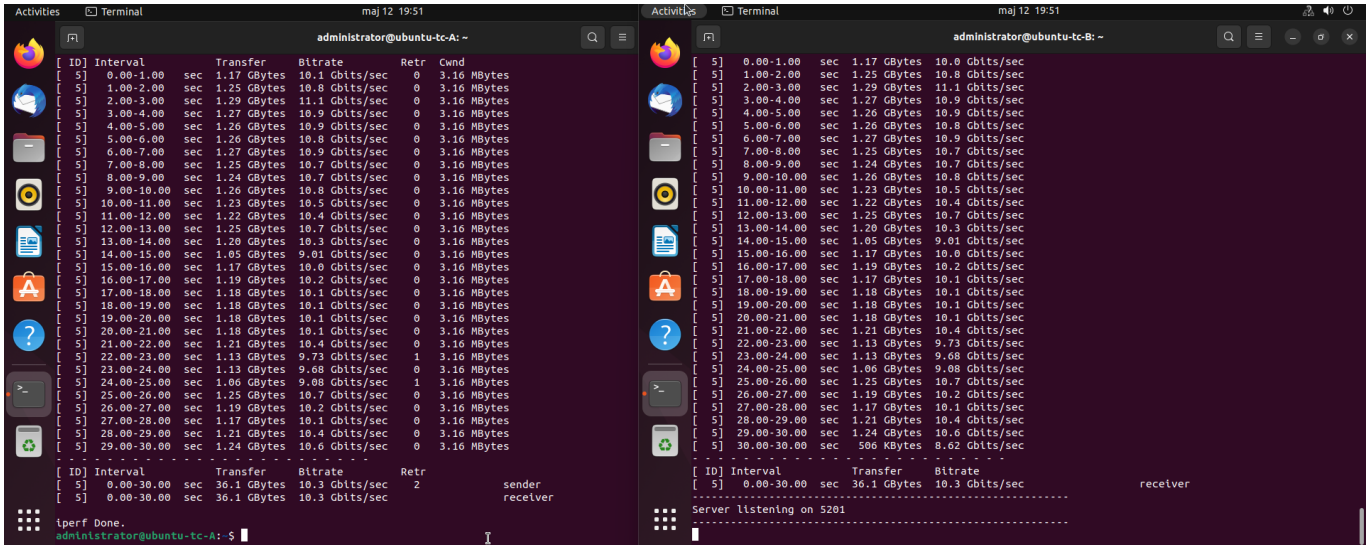
Bandwidth limitation to 10Mbps 30s (UDP iperf)



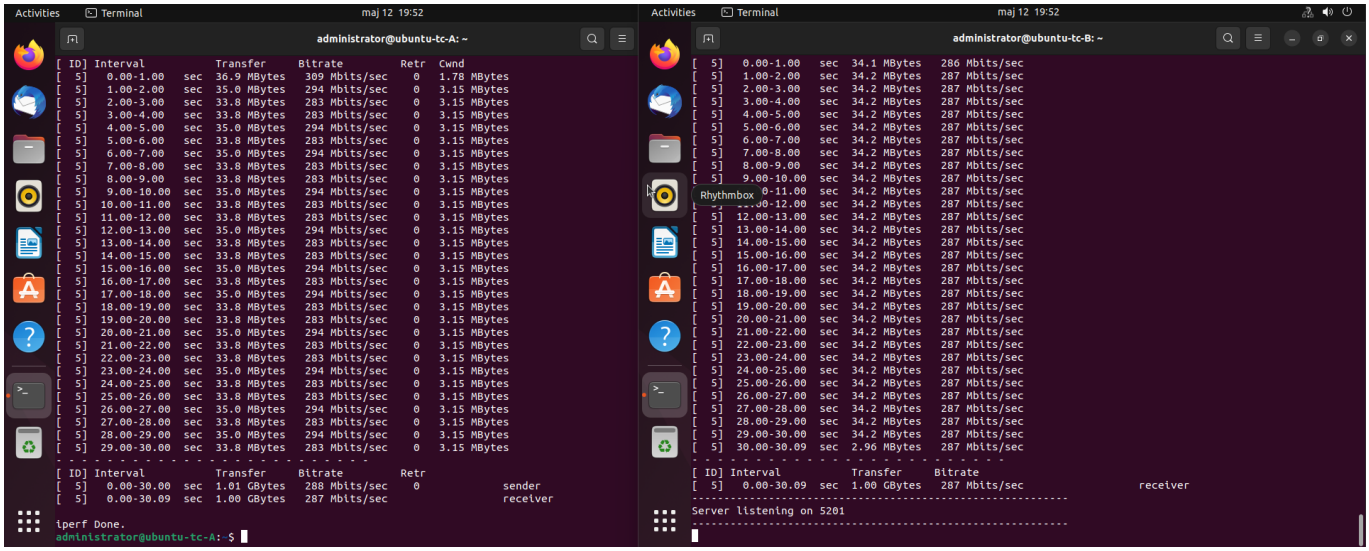
Bandwidth limitation to 1Mbps 30s (UDP iperf)



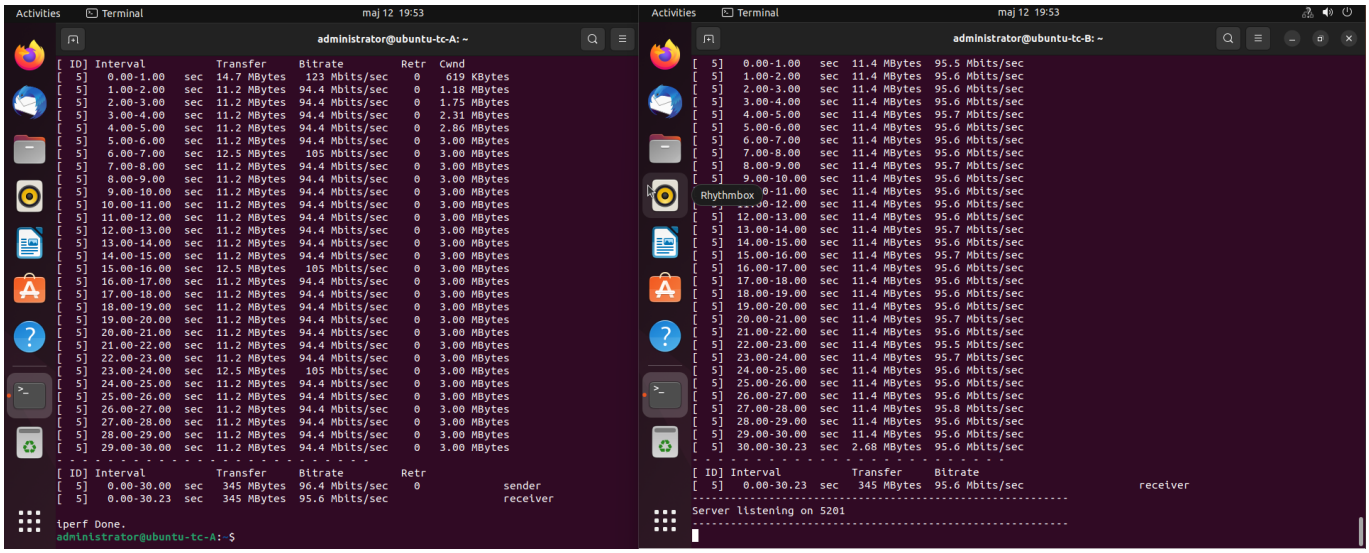
Unlimited test 30s (TCP iperf)



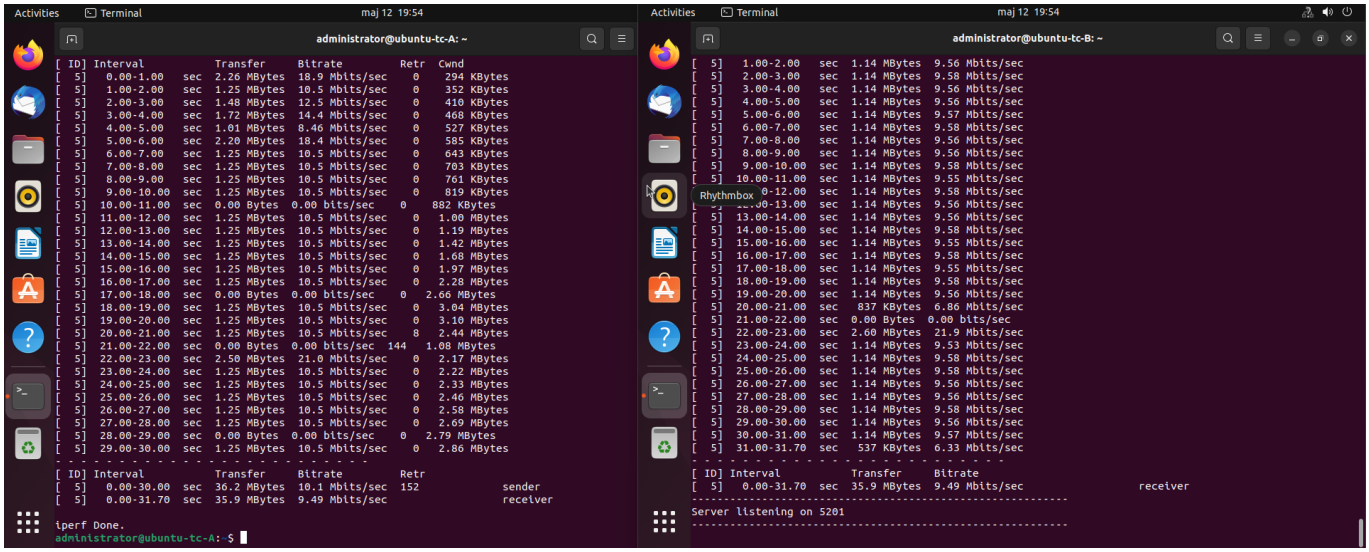
Bandwidth restriction up to 300Mbps 30s (TCP iperf)



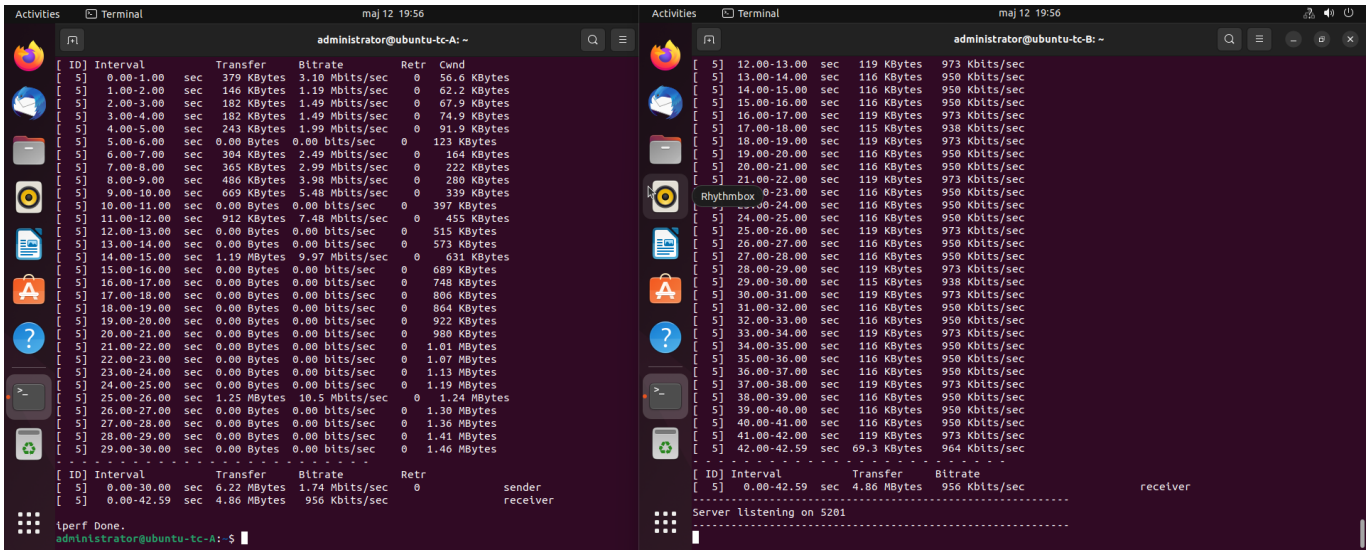
Bandwidth limitation to 100Mbps 30s (TCP iperf)



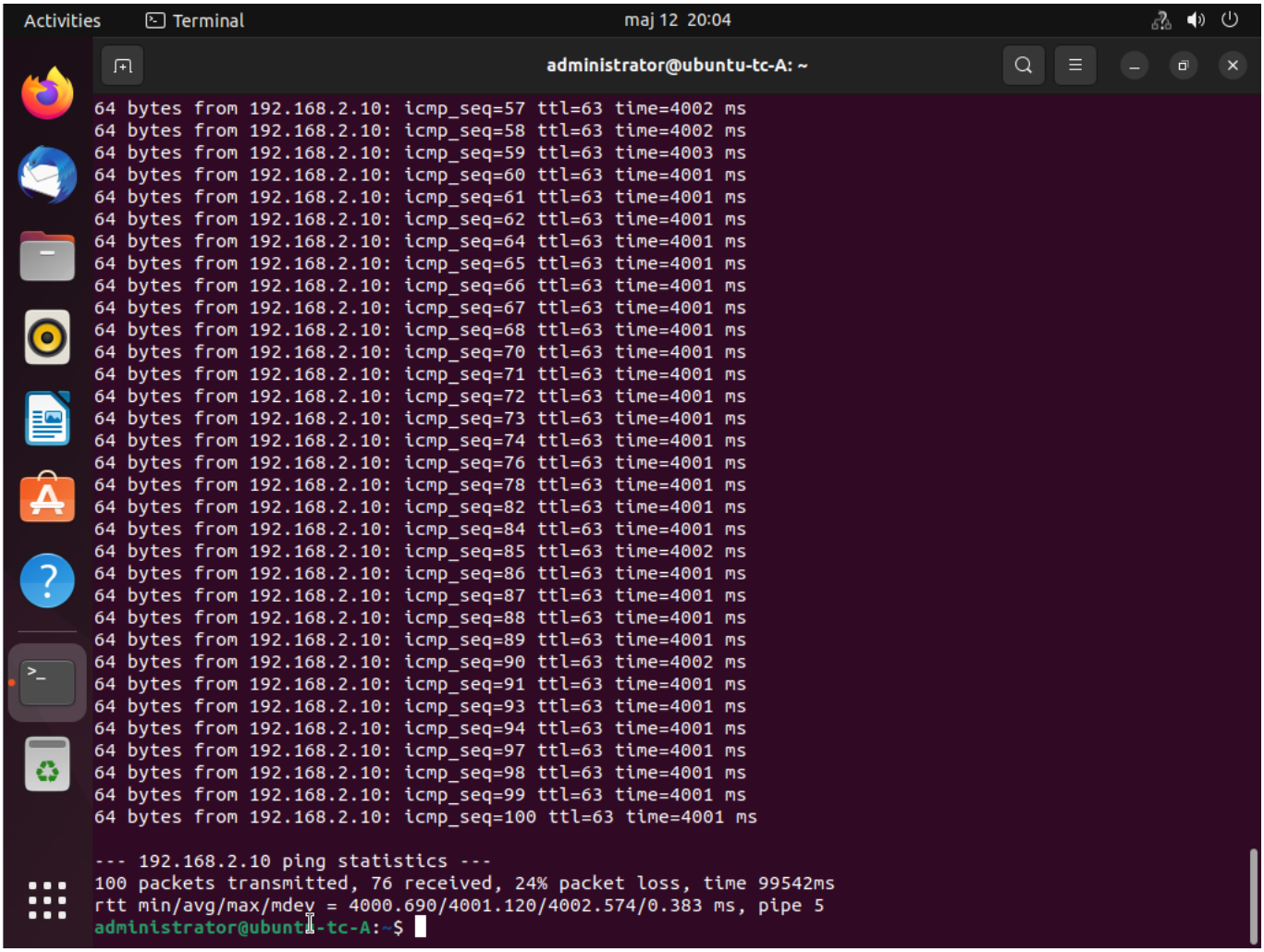
Bandwidth limitation to 10Mbps 30s (TCP iperf)



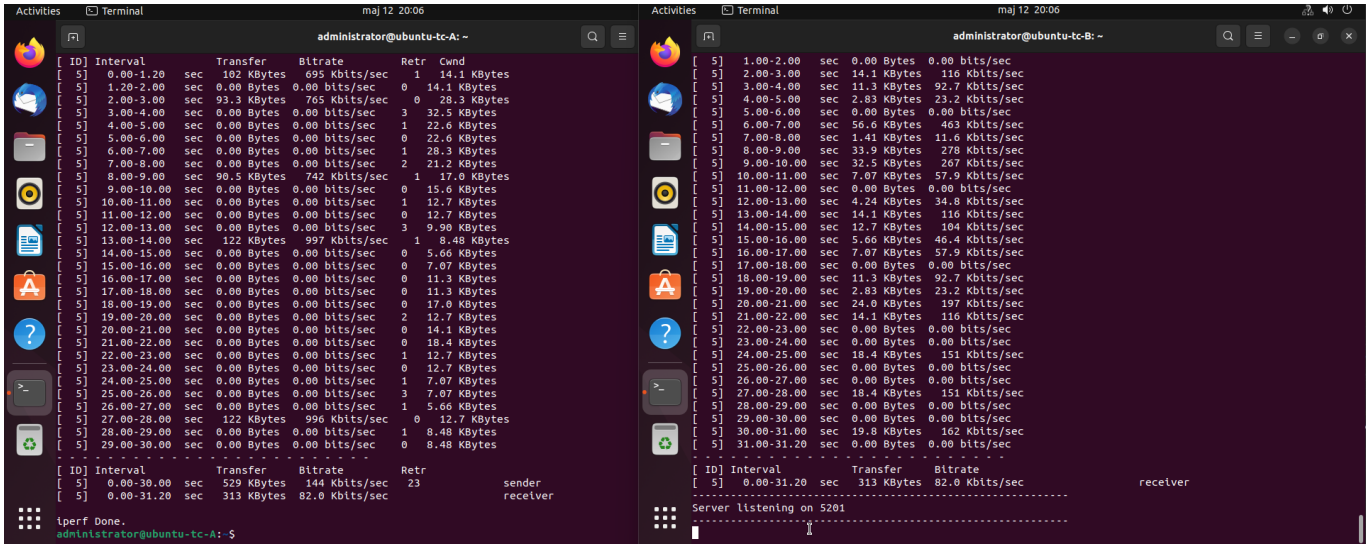
Bandwidth limitation to 1Mbps 30s (TCP iperf)



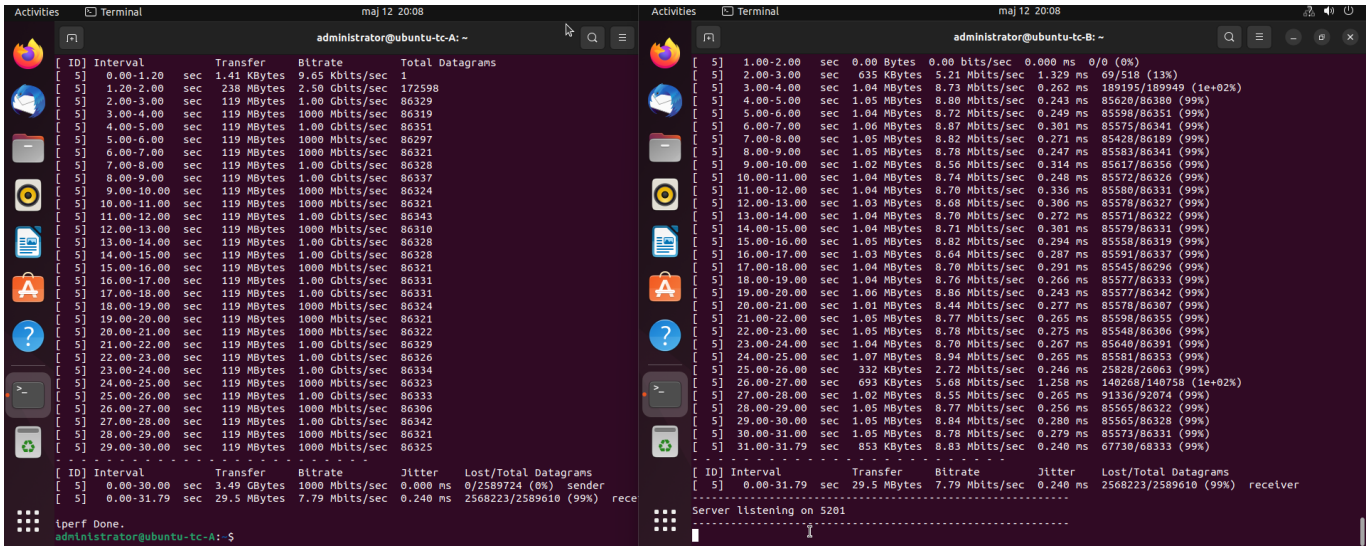
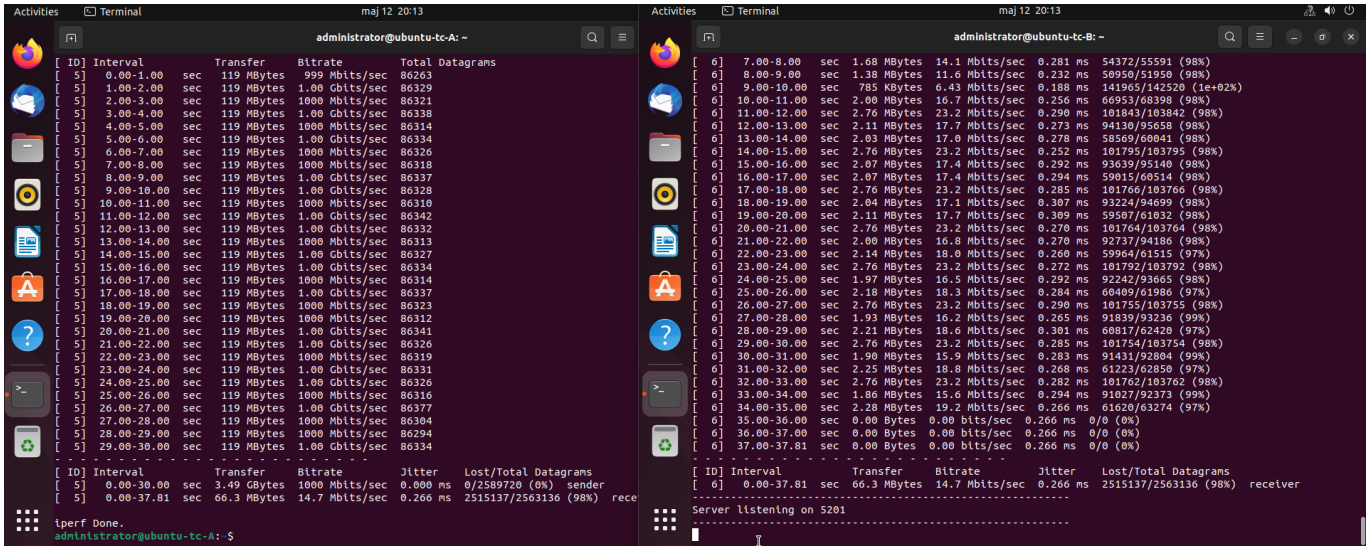
Round trip link test 10Mbps, latency 2000ms, urata 3%, faulty 10% (ping 100 measurements)



10Mbps round trip link test, latency 600ms, loss 3%, corrupted 10% (TCP iperf)



10Mbps round trip link test, 600ms latency, 3% loss, 10% corrupted (UDP iperf)



60Mbps round trip link test, 600ms latency, 5% loss (UDP iperf)