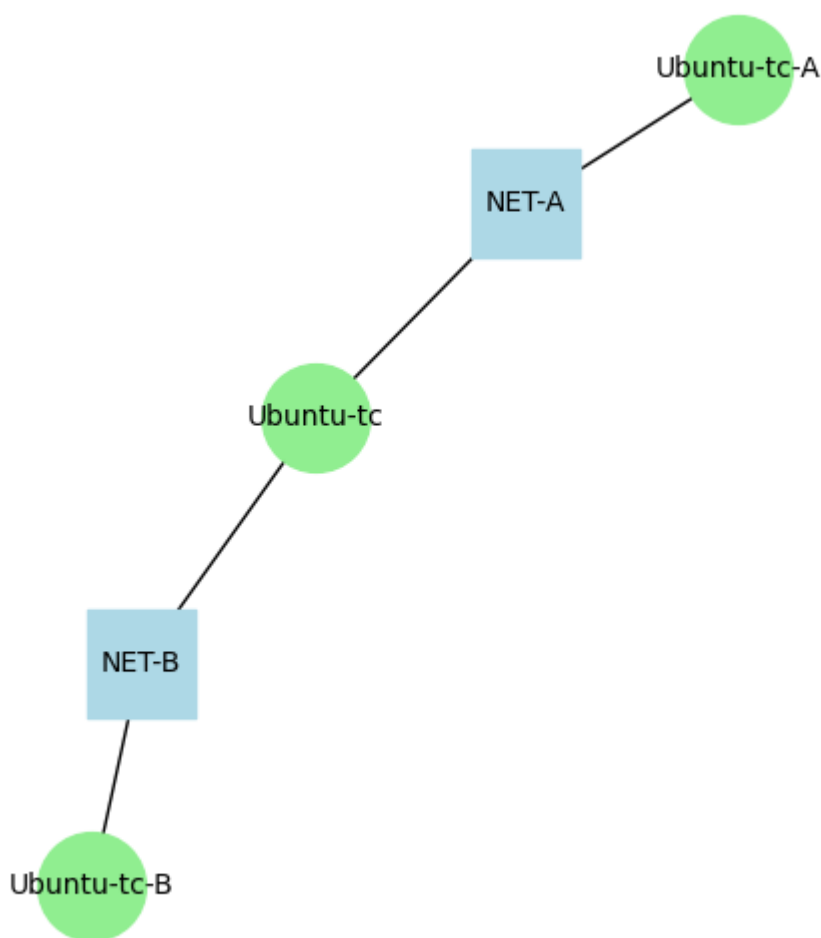


Linux: TC - ograniczanie pasma, indukowanie błędów w transmisji i opóźnienia

programy wykorzystane do zrobienia pomiarów:

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

Schemat Połączeniowy



Schemat wygenerowany za pomocą [mojego skryptu](#)

Nazwa maszyny	Karta sieciowa	Adres ip	brama	Switch wirtualny
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

Ustawienia na maszynie "Ubuntu-tc"

- włączenie forwardingu dla ipv4

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

- zrestartuj interfejsy sieciowe
- skopiowanie tc-gui na maszynę oraz uruchomienie

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

- Otwieramy w przeglądarce firefox adres 127.0.0.1:5000

TCGUI - 4 Available Interfaces

eth0 (192.168.1.1)
eth1 (192.168.2.1)
eth2 (172.30.16.210)
lo (127.0.0.1)

eth0 (192.168.1.1)

Name	Current Value	New Value	Variance / Correlation	New Value
Rate	None	<input type="text"/> mbit		
Delay	None	<input type="text"/> ms	±None	± <input type="text"/> ms
Loss	None	<input type="text"/> %	None	<input type="text"/> %
Duplicate	None	<input type="text"/> %		
Reorder	None	<input type="text"/> %	None	<input type="text"/> %
Corrupt	None	<input type="text"/> %		
Limit	None	<input type="text"/>		

[Apply eth0 \(192.168.1.1\) Rules](#)

[Remove eth0 \(192.168.1.1\) Rules](#)

Ustawienia na reszcie maszyn

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

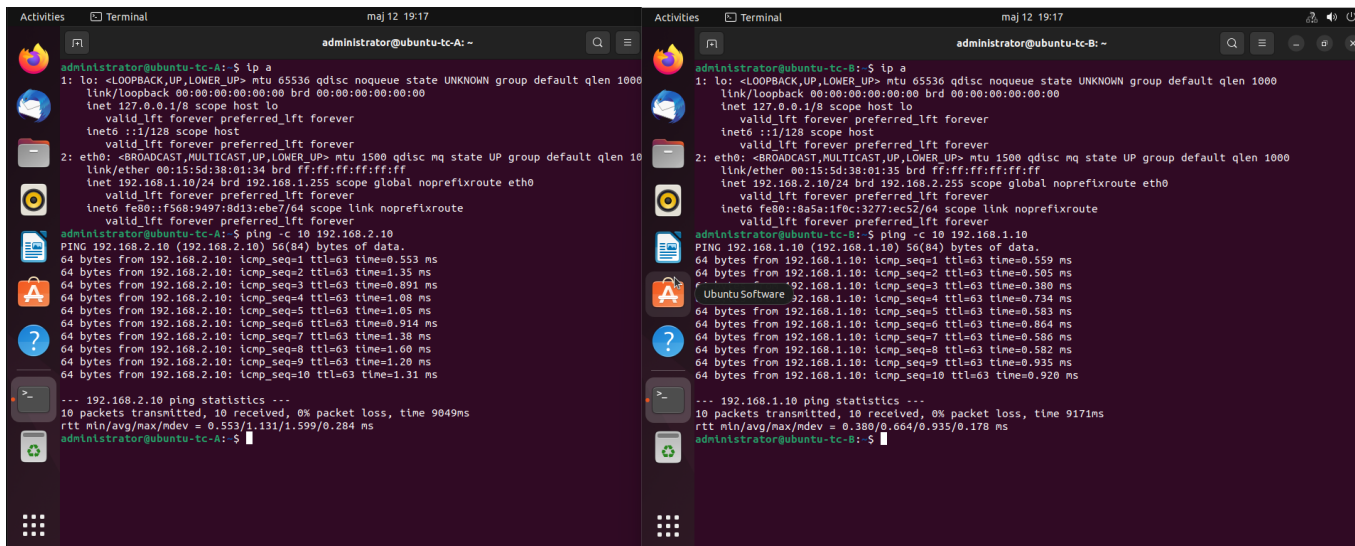
Musimy je jeszcze zaadresować statycznie za pomocą GUI albo za pomocą netplan

Tabela wyników testów

Opis Testu	protokół	straty	pasmo	opóźnienie [ms]
Testy opóźnień				
Test bez dodanego opóźnienia	icmp	0%	—	1,131
Test z dodanym opóźnieniem 10ms wynik z 100 pomiarów	icmp	0%	—	11,020
test z dodanym opóźnieniem 100ms wynik z 100 pomiarów	icmp	0%	—	101,071
test z dodanym opóźnieniem 1000ms wynik z 100 pomiarów	icmp	0%	—	1000,911
Testy pasma UDP				
Opis Testu	protokół	Utracone/Wysłane	pasmo	opóźnienie [ms]
Test bez ograniczenia 30s (UDP 1Gbps iperf)	UDP	—	998 Mbps	—
Ograniczenie pasma do 300Mbps 30s (UDP iperf)	UDP	72%	282 Mbps	—
Ograniczenie pasma do 100Mbps 30s (UDP iperf)	UDP	91%	94,3 Mbps	—
Ograniczenie pasma do 10Mbps 30s (UDP iperf)	UDP	99%	9,72 Mbps	—
Ograniczenie pasma do 1Mbps 30s (UDP iperf)	UDP	1e+02%	972 kbps	—
Testy pasma TCP				
Opis Testu	protokół	retransmisje	pasmo	opóźnienie [ms]
Test bez ograniczenia 30s (TCP iperf)	TCP	2	10,3 Gbps	—
Ograniczenie pasma do 300Mbps 30s (TCP iperf)	TCP	0	282 Mbps	—
Ograniczenie pasma do 100Mbps 30s (TCP iperf)	TCP	0	94,3 Mbps	—
Ograniczenie pasma do 10Mbps 30s (TCP iperf)	TCP	152	9,72 Mbps	—
Ograniczenie pasma do 1Mbps 30s (TCP iperf)	TCP	0	972 kbps	—
Inne Testy				
Test łącza w obie strony 10Mbps, opóźnienie 2000ms, urata 3%, uszkodzone 10% (ping 100 pomiarów)	ICMP	24%	—	4001,69
Test łącza w obie strony 10Mbps, opóźnienie 600ms, utrata 3%, uszkodzone 10% (TCP iperf)	TCP	23	82 kbps	—
Test łącza w obie strony 10Mbps, opóźnienie 600ms, utrata 3%, uszkodzone 10% (UDP iperf)	UDP	99%	7,79 kbps	—
Test łącza w obie strony 60Mbps, opóźnienie 600ms, utrata 5% (UDP iperf)	UDP	98%	14,7 Mbps	—

Testy opóźnień

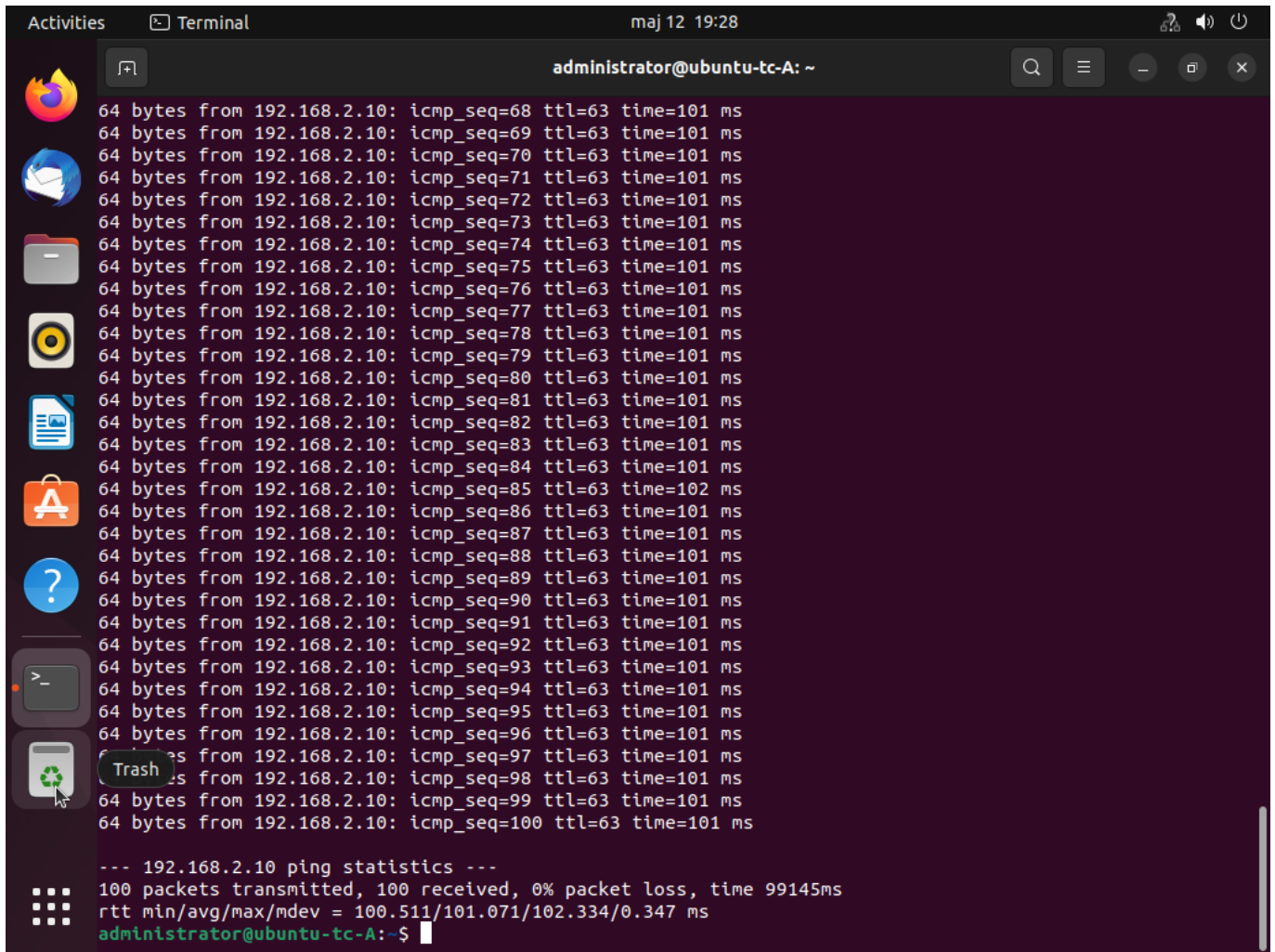
Test bez dodanego opóźnienia



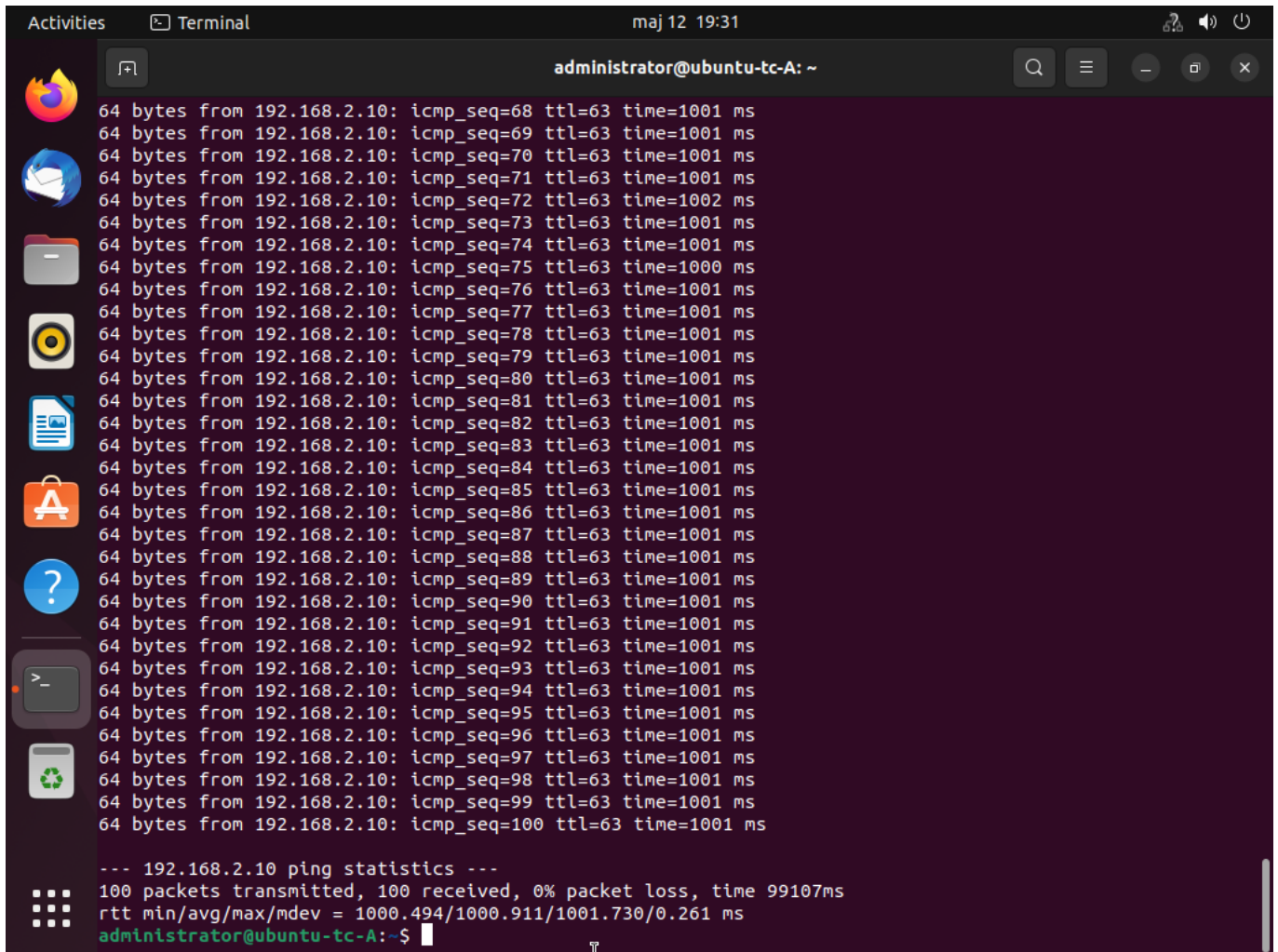
Test z dodanym opóźnieniem 10ms wynik z 100 pomiarów

```
Activities Terminal maj 12 19:26 administrator@ubuntu-tc-A: ~  
64 bytes from 192.168.2.10: icmp_seq=68 ttl=63 time=11.3 ms  
64 bytes from 192.168.2.10: icmp_seq=69 ttl=63 time=10.9 ms  
64 bytes from 192.168.2.10: icmp_seq=70 ttl=63 time=10.9 ms  
64 bytes from 192.168.2.10: icmp_seq=71 ttl=63 time=11.9 ms  
64 bytes from 192.168.2.10: icmp_seq=72 ttl=63 time=11.5 ms  
64 bytes from 192.168.2.10: icmp_seq=73 ttl=63 time=11.0 ms  
64 bytes from 192.168.2.10: icmp_seq=74 ttl=63 time=11.4 ms  
64 bytes from 192.168.2.10: icmp_seq=75 ttl=63 time=10.7 ms  
64 bytes from 192.168.2.10: icmp_seq=76 ttl=63 time=10.7 ms  
64 bytes from 192.168.2.10: icmp_seq=77 ttl=63 time=11.4 ms  
64 bytes from 192.168.2.10: icmp_seq=78 ttl=63 time=10.6 ms  
64 bytes from 192.168.2.10: icmp_seq=79 ttl=63 time=10.8 ms  
64 bytes from 192.168.2.10: icmp_seq=80 ttl=63 time=10.8 ms  
64 bytes from 192.168.2.10: icmp_seq=81 ttl=63 time=10.8 ms  
64 bytes from 192.168.2.10: icmp_seq=82 ttl=63 time=10.9 ms  
64 bytes from 192.168.2.10: icmp_seq=83 ttl=63 time=11.8 ms  
64 bytes from 192.168.2.10: icmp_seq=84 ttl=63 time=10.9 ms  
64 bytes from 192.168.2.10: icmp_seq=85 ttl=63 time=11.3 ms  
64 bytes from 192.168.2.10: icmp_seq=86 ttl=63 time=10.7 ms  
64 bytes from 192.168.2.10: icmp_seq=87 ttl=63 time=10.9 ms  
64 bytes from 192.168.2.10: icmp_seq=88 ttl=63 time=10.8 ms  
64 bytes from 192.168.2.10: icmp_seq=89 ttl=63 time=10.9 ms  
64 bytes from 192.168.2.10: icmp_seq=90 ttl=63 time=10.8 ms  
64 bytes from 192.168.2.10: icmp_seq=91 ttl=63 time=11.0 ms  
64 bytes from 192.168.2.10: icmp_seq=92 ttl=63 time=10.7 ms  
64 bytes from 192.168.2.10: icmp_seq=93 ttl=63 time=11.1 ms  
64 bytes from 192.168.2.10: icmp_seq=94 ttl=63 time=10.6 ms  
64 bytes from 192.168.2.10: icmp_seq=95 ttl=63 time=10.9 ms  
64 bytes from 192.168.2.10: icmp_seq=96 ttl=63 time=10.9 ms  
64 bytes from 192.168.2.10: icmp_seq=97 ttl=63 time=11.4 ms  
64 bytes from 192.168.2.10: icmp_seq=98 ttl=63 time=10.6 ms  
64 bytes from 192.168.2.10: icmp_seq=99 ttl=63 time=11.6 ms  
64 bytes from 192.168.2.10: icmp_seq=100 ttl=63 time=10.5 ms  
--- 192.168.2.10 ping statistics ---  
100 packets transmitted, 100 received, 0% packet loss, time 99159ms  
rtt min/avg/max/mdev = 10.523/11.020/12.214/0.333 ms  
administrator@ubuntu-tc-A:~$
```

test z dodanym opóźnieniem 100ms wynik z 100 pomiarów



test z dodanym opóźnieniem 1000ms wynik z 100 pomiarów



```
Activities Terminal maj 12 19:31 administrator@ubuntu-tc-A: ~
64 bytes from 192.168.2.10: icmp_seq=68 ttl=63 time=1001 ms
64 bytes from 192.168.2.10: icmp_seq=69 ttl=63 time=1001 ms
64 bytes from 192.168.2.10: icmp_seq=70 ttl=63 time=1001 ms
64 bytes from 192.168.2.10: icmp_seq=71 ttl=63 time=1001 ms
64 bytes from 192.168.2.10: icmp_seq=72 ttl=63 time=1002 ms
64 bytes from 192.168.2.10: icmp_seq=73 ttl=63 time=1001 ms
64 bytes from 192.168.2.10: icmp_seq=74 ttl=63 time=1001 ms
64 bytes from 192.168.2.10: icmp_seq=75 ttl=63 time=1000 ms
64 bytes from 192.168.2.10: icmp_seq=76 ttl=63 time=1001 ms
64 bytes from 192.168.2.10: icmp_seq=77 ttl=63 time=1001 ms
64 bytes from 192.168.2.10: icmp_seq=78 ttl=63 time=1001 ms
64 bytes from 192.168.2.10: icmp_seq=79 ttl=63 time=1001 ms
64 bytes from 192.168.2.10: icmp_seq=80 ttl=63 time=1001 ms
64 bytes from 192.168.2.10: icmp_seq=81 ttl=63 time=1001 ms
64 bytes from 192.168.2.10: icmp_seq=82 ttl=63 time=1001 ms
64 bytes from 192.168.2.10: icmp_seq=83 ttl=63 time=1001 ms
64 bytes from 192.168.2.10: icmp_seq=84 ttl=63 time=1001 ms
64 bytes from 192.168.2.10: icmp_seq=85 ttl=63 time=1001 ms
64 bytes from 192.168.2.10: icmp_seq=86 ttl=63 time=1001 ms
64 bytes from 192.168.2.10: icmp_seq=87 ttl=63 time=1001 ms
64 bytes from 192.168.2.10: icmp_seq=88 ttl=63 time=1001 ms
64 bytes from 192.168.2.10: icmp_seq=89 ttl=63 time=1001 ms
64 bytes from 192.168.2.10: icmp_seq=90 ttl=63 time=1001 ms
64 bytes from 192.168.2.10: icmp_seq=91 ttl=63 time=1001 ms
64 bytes from 192.168.2.10: icmp_seq=92 ttl=63 time=1001 ms
64 bytes from 192.168.2.10: icmp_seq=93 ttl=63 time=1001 ms
64 bytes from 192.168.2.10: icmp_seq=94 ttl=63 time=1001 ms
64 bytes from 192.168.2.10: icmp_seq=95 ttl=63 time=1001 ms
64 bytes from 192.168.2.10: icmp_seq=96 ttl=63 time=1001 ms
64 bytes from 192.168.2.10: icmp_seq=97 ttl=63 time=1001 ms
64 bytes from 192.168.2.10: icmp_seq=98 ttl=63 time=1001 ms
64 bytes from 192.168.2.10: icmp_seq=99 ttl=63 time=1001 ms
64 bytes from 192.168.2.10: icmp_seq=100 ttl=63 time=1001 ms

--- 192.168.2.10 ping statistics ---
100 packets transmitted, 100 received, 0% packet loss, time 99107ms
rtt min/avg/max/mdev = 1000.494/1000.911/1001.730/0.261 ms
administrator@ubuntu-tc-A:~$
```

test z dodanym opóźnieniem 5000ms wynik z 100 pomiarów

Test ograniczeń pasma

Test bez ograniczenia 30s (UDP 1Gbps iperf)

```

[ ID] Interval      Transfer      Btrate      Total Datagrams
[ 5] 0.00-1.00 sec  119 MBytes  999 Mbits/sec  86279
[ 5] 1.00-2.00 sec  119 MBytes  1000 Mbits/sec  86325
[ 5] 2.00-3.00 sec  119 MBytes  1000 Mbits/sec  86322
[ 5] 3.00-4.00 sec  119 MBytes  1000 Mbits/sec  86323
[ 5] 4.00-5.00 sec  119 MBytes  1.00 Gbits/sec  86327
[ 5] 5.00-6.00 sec  119 MBytes  1.00 Gbits/sec  86327
[ 5] 6.00-7.00 sec  119 MBytes  1000 Mbits/sec  86329
[ 5] 7.00-8.00 sec  119 MBytes  1000 Mbits/sec  86323
[ 5] 8.00-9.00 sec  119 MBytes  1.00 Gbits/sec  86328
[ 5] 9.00-10.00 sec 119 MBytes  1000 Mbits/sec  86326
[ 5] 10.00-11.00 sec 119 MBytes  1000 Mbits/sec  86324
[ 5] 11.00-12.00 sec 119 MBytes  1.00 Gbits/sec  86333
[ 5] 12.00-13.00 sec 119 MBytes  1.00 Gbits/sec  86331
[ 5] 13.00-14.00 sec 119 MBytes  1000 Mbits/sec  86319
[ 5] 14.00-15.00 sec 119 MBytes  1000 Mbits/sec  86324
[ 5] 15.00-16.00 sec 119 MBytes  1.00 Gbits/sec  86330
[ 5] 16.00-17.00 sec 119 MBytes  1000 Mbits/sec  86321
[ 5] 17.00-18.00 sec 119 MBytes  1000 Mbits/sec  86313
[ 5] 18.00-19.00 sec 119 MBytes  1.00 Gbits/sec  86339
[ 5] 19.00-20.00 sec 119 MBytes  1.00 Gbits/sec  86327
[ 5] 20.00-21.00 sec 119 MBytes  1000 Mbits/sec  86321
[ 5] 21.00-22.00 sec 119 MBytes  1.00 Gbits/sec  86329
[ 5] 22.00-23.00 sec 119 MBytes  1.00 Gbits/sec  86331
[ 5] 23.00-24.00 sec 119 MBytes  1000 Mbits/sec  86328
[ 5] 24.00-25.00 sec 119 MBytes  1000 Mbits/sec  86326
[ 5] 25.00-26.00 sec 119 MBytes  1.00 Gbits/sec  86328
[ 5] 26.00-27.00 sec 119 MBytes  1.00 Gbits/sec  86326
[ 5] 27.00-28.00 sec 119 MBytes  1000 Mbits/sec  86325
[ 5] 28.00-29.00 sec 119 MBytes  1.00 Gbits/sec  86327
[ 5] 29.00-30.00 sec 119 MBytes  1000 Mbits/sec  86325

[ ID] Interval      Transfer      Btrate      Jitter      Lost/Total Datagrams
[ 5] 0.00-30.00 sec  3.49 GBytes  998 Mbits/sec  0.002 ms  0/2589728 (0%) sender
[ 5] 0.00-30.00 sec  3.49 GBytes  998 Mbits/sec  0.002 ms  4048/2589728 (0.16%) receiver
server listening on 5201
  
```

Ograniczenie pasma do 300Mbps 30s (UDP iperf)

```

[ ID] Interval      Transfer      Btrate      Total Datagrams
[ 5] 0.00-1.00 sec  119 MBytes  999 Mbits/sec  86200
[ 5] 1.00-2.00 sec  119 MBytes  1.00 Gbits/sec  86327
[ 5] 2.00-3.00 sec  119 MBytes  1000 Mbits/sec  86324
[ 5] 3.00-4.00 sec  119 MBytes  1.00 Gbits/sec  86328
[ 5] 4.00-5.00 sec  119 MBytes  1000 Mbits/sec  86324
[ 5] 5.00-6.00 sec  119 MBytes  1000 Mbits/sec  86325
[ 5] 6.00-7.00 sec  119 MBytes  1.00 Gbits/sec  86341
[ 5] 7.00-8.00 sec  119 MBytes  1000 Mbits/sec  86316
[ 5] 8.00-9.00 sec  119 MBytes  1.00 Gbits/sec  86328
[ 5] 9.00-10.00 sec 119 MBytes  1000 Mbits/sec  86321
[ 5] 10.00-11.00 sec 119 MBytes  1.00 Gbits/sec  86332
[ 5] 11.00-12.00 sec 119 MBytes  1000 Mbits/sec  86320
[ 5] 12.00-13.00 sec 119 MBytes  1.00 Gbits/sec  86331
[ 5] 13.00-14.00 sec 119 MBytes  1000 Mbits/sec  86322
[ 5] 14.00-15.00 sec 119 MBytes  1000 Mbits/sec  86327
[ 5] 15.00-16.00 sec 119 MBytes  1000 Mbits/sec  86325
[ 5] 16.00-17.00 sec 119 MBytes  1.00 Gbits/sec  86330
[ 5] 17.00-18.00 sec 119 MBytes  1000 Mbits/sec  86321
[ 5] 18.00-19.00 sec 119 MBytes  1.00 Gbits/sec  86327
[ 5] 19.00-20.00 sec 119 MBytes  1.00 Gbits/sec  86327
[ 5] 20.00-21.00 sec 119 MBytes  1.00 Gbits/sec  86327
[ 5] 21.00-22.00 sec 119 MBytes  1.00 Gbits/sec  86327
[ 5] 22.00-23.00 sec 119 MBytes  1000 Mbits/sec  86322
[ 5] 23.00-24.00 sec 119 MBytes  1.00 Gbits/sec  86332
[ 5] 24.00-25.00 sec 119 MBytes  1.00 Gbits/sec  86330
[ 5] 25.00-26.00 sec 119 MBytes  1000 Mbits/sec  86304
[ 5] 26.00-27.00 sec 119 MBytes  1000 Mbits/sec  86321
[ 5] 27.00-28.00 sec 119 MBytes  1.00 Gbits/sec  86337
[ 5] 28.00-29.00 sec 119 MBytes  1000 Mbits/sec  86312
[ 5] 29.00-30.00 sec 119 MBytes  1.00 Gbits/sec  86331

[ ID] Interval      Transfer      Btrate      Jitter      Lost/Total Datagrams
[ 5] 0.00-30.00 sec  3.49 GBytes  1000 Mbits/sec  0.000 ms  0/2589717 (0%) sender
[ 5] 0.00-30.04 sec  1010 MBytes  282 Mbits/sec  0.048 ms  1858455/2589708 (72%) receiver
server listening on 5201
  
```

Ograniczenie pasma do 100Mbps 30s (UDP iperf)

```

[ ID] Interval      Transfer      Btrate        Total Datagrams
[ 5] 0.00-1.00 sec  119 MBytes   1000 Mbits/sec  86324
[ 5] 1.00-2.00 sec  119 MBytes   999 Mbits/sec   86271
[ 5] 2.00-3.00 sec  119 MBytes   1000 Mbits/sec  86321
[ 5] 3.00-4.00 sec  119 MBytes   1.00 Gbts/sec   86326
[ 5] 4.00-5.00 sec  119 MBytes   1000 Mbits/sec  86322
[ 5] 5.00-6.00 sec  119 MBytes   1.00 Gbts/sec   86330
[ 5] 6.00-7.00 sec  119 MBytes   1.00 Gbts/sec   86333
[ 5] 7.00-8.00 sec  119 MBytes   1000 Mbits/sec  86316
[ 5] 8.00-9.00 sec  119 MBytes   1.00 Gbts/sec   86351
[ 5] 9.00-10.00 sec 119 MBytes   1000 Mbits/sec  86321
[ 5] 10.00-11.00 sec 119 MBytes   1000 Mbits/sec  86309
[ 5] 11.00-12.00 sec 119 MBytes   1.00 Gbts/sec   86338
[ 5] 12.00-13.00 sec 119 MBytes   1000 Mbits/sec  86322
[ 5] 13.00-14.00 sec 119 MBytes   1.00 Gbts/sec   86333
[ 5] 14.00-15.00 sec 119 MBytes   1000 Mbits/sec  86312
[ 5] 15.00-16.00 sec 119 MBytes   1.00 Gbts/sec   86334
[ 5] 16.00-17.00 sec 119 MBytes   1000 Mbits/sec  86322
[ 5] 17.00-18.00 sec 119 MBytes   1.00 Gbts/sec   86328
[ 5] 18.00-19.00 sec 119 MBytes   1000 Mbits/sec  86324
[ 5] 19.00-20.00 sec 119 MBytes   1000 Mbits/sec  86325
[ 5] 20.00-21.00 sec 119 MBytes   1000 Mbits/sec  86323
[ 5] 21.00-22.00 sec 119 MBytes   1.00 Gbts/sec   86331
[ 5] 22.00-23.00 sec 119 MBytes   1000 Mbits/sec  86323
[ 5] 23.00-24.00 sec 119 MBytes   1.00 Gbts/sec   86330
[ 5] 24.00-25.00 sec 119 MBytes   1.00 Gbts/sec   86331
[ 5] 25.00-26.00 sec 119 MBytes   1.00 Gbts/sec   86330
[ 5] 26.00-27.00 sec 119 MBytes   1.00 Gbts/sec   86326
[ 5] 27.00-28.00 sec 119 MBytes   1000 Mbits/sec  86318
[ 5] 28.00-29.00 sec 119 MBytes   1.00 Gbts/sec   86342
[ 5] 29.00-30.00 sec 119 MBytes   1000 Mbits/sec  86308
[ 5] 30.00-30.12 sec 338 MBytes   94.3 Mbits/sec 0.171 ms 2344557/2589638 (91%) sender

[ ID] Interval      Transfer      Btrate        Jitter      Lost/Total Datagrams
[ 5] 0.00-30.12 sec  338 MBytes   94.3 Mbits/sec 0.000 ms 0/2589717 (0%) sender
[ 5] 0.00-30.12 sec  338 MBytes   94.3 Mbits/sec 0.171 ms 2344557/2589638 (91%) receiver

iperf Done.
administrator@ubuntu-tc-A: $
  
```

```

[ 5] 0.00-1.00 sec  11.6 MBytes   97.1 Mbits/sec 0.201 ms 67613/75998 (89%)
[ 5] 1.00-2.00 sec  11.6 MBytes   97.2 Mbits/sec 0.184 ms 77946/86335 (90%)
[ 5] 2.00-3.00 sec  11.6 MBytes   97.2 Mbits/sec 0.197 ms 77916/86306 (90%)
[ 5] 3.00-4.00 sec  11.6 MBytes   97.2 Mbits/sec 0.185 ms 77937/86326 (90%)
[ 5] 4.00-5.00 sec  11.6 MBytes   97.2 Mbits/sec 0.188 ms 77941/86331 (90%)
[ 5] 5.00-6.00 sec  11.6 MBytes   97.2 Mbits/sec 0.206 ms 77935/86324 (90%)
[ 5] 6.00-7.00 sec  11.6 MBytes   97.2 Mbits/sec 0.197 ms 77934/86324 (90%)
[ 5] 7.00-8.00 sec  11.6 MBytes   97.2 Mbits/sec 0.193 ms 77944/86333 (90%)
[ 5] 8.00-9.00 sec  2.74 MBytes   23.0 Mbits/sec 0.167 ms 18415/20401 (90%)
[ 5] 9.00-10.00 sec  9.94 MBytes   83.5 Mbits/sec 0.186 ms 145062/152261 (90%)
[ 5] 10.00-11.00 sec  11.6 MBytes   97.2 Mbits/sec 0.198 ms 77921/86311 (90%)
[ 5] 11.00-12.00 sec  11.6 MBytes   97.2 Mbits/sec 0.209 ms 77938/86327 (90%)
[ 5] 12.00-13.00 sec  11.6 MBytes   97.2 Mbits/sec 0.191 ms 77939/86329 (90%)
[ 5] 13.00-14.00 sec  11.6 MBytes   97.2 Mbits/sec 0.196 ms 77936/86325 (90%)
[ 5] 14.00-15.00 sec  11.6 MBytes   97.2 Mbits/sec 0.188 ms 77944/86334 (90%)
[ 5] 15.00-16.00 sec  11.6 MBytes   97.2 Mbits/sec 0.192 ms 77923/86312 (90%)
[ 5] 16.00-17.00 sec  11.6 MBytes   97.2 Mbits/sec 0.204 ms 77938/86328 (90%)
[ 5] 17.00-18.00 sec  11.6 MBytes   97.2 Mbits/sec 0.200 ms 77940/86335 (90%)
[ 5] 18.00-19.00 sec  11.6 MBytes   97.2 Mbits/sec 0.198 ms 77929/86318 (90%)
[ 5] 19.00-20.00 sec  11.6 MBytes   97.2 Mbits/sec 0.200 ms 77934/86324 (90%)
[ 5] 20.00-21.00 sec  11.6 MBytes   97.2 Mbits/sec 0.204 ms 77941/86330 (90%)
[ 5] 21.00-22.00 sec  11.6 MBytes   97.2 Mbits/sec 0.191 ms 77940/86330 (90%)
[ 5] 22.00-23.00 sec  11.6 MBytes   97.2 Mbits/sec 0.196 ms 77931/86320 (90%)
[ 5] 23.00-24.00 sec  11.6 MBytes   97.2 Mbits/sec 0.194 ms 77933/86323 (90%)
[ 5] 24.00-25.00 sec  11.6 MBytes   97.2 Mbits/sec 0.162 ms 77954/86343 (90%)
[ 5] 25.00-26.00 sec  11.6 MBytes   97.2 Mbits/sec 0.200 ms 77924/86314 (90%)
[ 5] 26.00-27.00 sec  11.6 MBytes   97.2 Mbits/sec 0.192 ms 77943/86332 (90%)
[ 5] 27.00-28.00 sec  11.6 MBytes   97.2 Mbits/sec 0.196 ms 77936/86326 (90%)
[ 5] 28.00-29.00 sec  11.6 MBytes   97.2 Mbits/sec 0.192 ms 77932/86321 (90%)
[ 5] 29.00-30.00 sec  11.6 MBytes   97.2 Mbits/sec 0.193 ms 77934/86324 (90%)
[ 5] 30.00-30.12 sec  1.37 MBytes   97.1 Mbits/sec 0.171 ms 9198/10193 (90%)

Server listening on 5201
Show Applications
  
```

Ograniczenie pasma do 10Mbps 30s (UDP iperf)

```

[ ID] Interval      Transfer      Btrate        Total Datagrams
[ 5] 0.00-1.00 sec  119 MBytes   1000 Mbits/sec  86273
[ 5] 1.00-2.00 sec  119 MBytes   1000 Mbits/sec  86319
[ 5] 2.00-3.00 sec  119 MBytes   1.00 Gbts/sec   86335
[ 5] 3.00-4.00 sec  119 MBytes   1.00 Gbts/sec   86333
[ 5] 4.00-5.00 sec  119 MBytes   1000 Mbits/sec  86307
[ 5] 5.00-6.00 sec  119 MBytes   1.00 Gbts/sec   86344
[ 5] 6.00-7.00 sec  119 MBytes   1000 Mbits/sec  86318
[ 5] 7.00-8.00 sec  119 MBytes   1.00 Gbts/sec   86337
[ 5] 8.00-9.00 sec  119 MBytes   1000 Mbits/sec  86314
[ 5] 9.00-10.00 sec 119 MBytes   1.00 Gbts/sec   86366
[ 5] 10.00-11.00 sec 119 MBytes   1000 Mbits/sec  86296
[ 5] 11.00-12.00 sec 119 MBytes   1.00 Gbts/sec   86329
[ 5] 12.00-13.00 sec 119 MBytes   1000 Mbits/sec  86310
[ 5] 13.00-14.00 sec 119 MBytes   1000 Mbits/sec  86323
[ 5] 14.00-15.00 sec 119 MBytes   1000 Mbits/sec  86322
[ 5] 15.00-16.00 sec 119 MBytes   1.00 Gbts/sec   86332
[ 5] 16.00-17.00 sec 119 MBytes   1.00 Gbts/sec   86334
[ 5] 17.00-18.00 sec 119 MBytes   1.00 Gbts/sec   86342
[ 5] 18.00-19.00 sec 119 MBytes   1000 Mbits/sec  86319
[ 5] 19.00-20.00 sec 119 MBytes   1.00 Gbts/sec   86336
[ 5] 20.00-21.00 sec 119 MBytes   1000 Mbits/sec  86323
[ 5] 21.00-22.00 sec 119 MBytes   1000 Mbits/sec  86324
[ 5] 22.00-23.00 sec 119 MBytes   1.00 Gbts/sec   86335
[ 5] 23.00-24.00 sec 119 MBytes   1.00 Gbts/sec   86330
[ 5] 24.00-25.00 sec 119 MBytes   1000 Mbits/sec  86330
[ 5] 25.00-26.00 sec 119 MBytes   1.00 Gbts/sec   86338
[ 5] 26.00-27.00 sec 119 MBytes   1000 Mbits/sec  86328
[ 5] 27.00-28.00 sec 119 MBytes   1.00 Gbts/sec   86341
[ 5] 28.00-29.00 sec 119 MBytes   1.00 Gbts/sec   86341
[ 5] 29.00-30.00 sec 119 MBytes   1000 Mbits/sec  86304

[ ID] Interval      Transfer      Btrate        Jitter      Lost/Total Datagrams
[ 5] 0.00-30.00 sec  3.49 GBytes   1000 Mbits/sec 0.000 ms 0/2589727 (0%) sender
[ 5] 0.00-31.19 sec  36.1 MBytes   9.72 Mbits/sec 0.289 ms 2563457/2589624 (99%) receiver

iperf Done.
administrator@ubuntu-tc-A: $
  
```

```

[ 5] 1.00-2.00 sec  1.16 MBytes   9.72 Mbits/sec 0.237 ms 67932/68771 (99%)
[ 5] 2.00-3.00 sec  1.16 MBytes   9.72 Mbits/sec 0.227 ms 85488/86327 (99%)
[ 5] 3.00-4.00 sec  1.16 MBytes   9.72 Mbits/sec 0.257 ms 85369/86408 (99%)
[ 5] 4.00-5.00 sec  1.16 MBytes   9.72 Mbits/sec 0.317 ms 85472/86311 (99%)
[ 5] 5.00-6.00 sec  1.16 MBytes   9.72 Mbits/sec 0.289 ms 85511/86352 (99%)
[ 5] 6.00-7.00 sec  1.16 MBytes   9.72 Mbits/sec 0.289 ms 85486/86325 (99%)
[ 5] 7.00-8.00 sec  1.16 MBytes   9.72 Mbits/sec 0.262 ms 85488/86327 (99%)
[ 5] 8.00-9.00 sec  1.16 MBytes   9.72 Mbits/sec 0.368 ms 85486/86319 (99%)
[ 5] 9.00-10.00 sec  1.16 MBytes   9.72 Mbits/sec 0.231 ms 140337/141175 (99%)
[ 5] 10.00-11.00 sec  1.16 MBytes   9.72 Mbits/sec 0.326 ms 30558/31397 (97%)
[ 5] 11.00-12.00 sec  1.16 MBytes   9.72 Mbits/sec 0.281 ms 85495/86334 (99%)
[ 5] 12.00-13.00 sec  1.16 MBytes   9.72 Mbits/sec 0.259 ms 85481/86320 (99%)
[ 5] 13.00-14.00 sec  1.16 MBytes   9.72 Mbits/sec 0.273 ms 85486/86325 (99%)
[ 5] 14.00-15.00 sec  1.16 MBytes   9.72 Mbits/sec 0.231 ms 85486/86325 (99%)
[ 5] 15.00-16.00 sec  1.16 MBytes   9.72 Mbits/sec 0.265 ms 85485/86324 (99%)
[ 5] 16.00-17.00 sec  1.16 MBytes   9.72 Mbits/sec 0.275 ms 85474/86313 (99%)
[ 5] 17.00-18.00 sec  1.16 MBytes   9.72 Mbits/sec 0.278 ms 85529/86308 (99%)
[ 5] 18.00-19.00 sec  1.16 MBytes   9.72 Mbits/sec 0.260 ms 85495/86334 (99%)
[ 5] 19.00-20.00 sec  1.16 MBytes   9.72 Mbits/sec 0.306 ms 85532/86371 (99%)
[ 5] 20.00-21.00 sec  1.16 MBytes   9.72 Mbits/sec 0.309 ms 85492/86331 (99%)
[ 5] 21.00-22.00 sec  1.16 MBytes   9.72 Mbits/sec 0.278 ms 85485/86324 (99%)
[ 5] 22.00-23.00 sec  1.16 MBytes   9.72 Mbits/sec 0.248 ms 85492/86331 (99%)
[ 5] 23.00-24.00 sec  1.16 MBytes   9.72 Mbits/sec 0.252 ms 85470/86309 (99%)
[ 5] 24.00-25.00 sec  1.16 MBytes   9.72 Mbits/sec 0.254 ms 85501/86340 (99%)
[ 5] 25.00-26.00 sec  1.16 MBytes   9.71 Mbits/sec 0.259 ms 85393/86231 (99%)
[ 5] 26.00-27.00 sec  1.16 MBytes   9.72 Mbits/sec 0.322 ms 85481/86320 (99%)
[ 5] 27.00-28.00 sec  1.16 MBytes   9.72 Mbits/sec 0.260 ms 85503/86342 (99%)
[ 5] 28.00-29.00 sec  1.16 MBytes   9.72 Mbits/sec 0.271 ms 85488/86327 (99%)
[ 5] 29.00-30.00 sec  1.16 MBytes   9.72 Mbits/sec 0.324 ms 85466/86305 (99%)
[ 5] 30.00-31.00 sec  1.16 MBytes   9.72 Mbits/sec 0.272 ms 85509/86348 (99%)
[ 5] 31.00-31.19 sec  228 KBytes   9.75 Mbits/sec 0.289 ms 16391/16552 (99%)

Server listening on 5201
  
```

Ograniczenie pasma do 1Mbps 30s (UDP iperf)

```

[ 5] Interval      Transfer      Bitrate      Total Datagrams
[ 5] 0.00-1.00 sec  119 MBytes   999 Mbts/sec  86272
[ 5] 1.00-2.00 sec  119 MBytes   1.00 gbts/sec  86345
[ 5] 2.00-3.00 sec  119 MBytes   1000 Mbts/sec  86309
[ 5] 3.00-4.00 sec  119 MBytes   1000 Mbts/sec  86314
[ 5] 4.00-5.00 sec  119 MBytes   1.00 gbts/sec  86338
[ 5] 5.00-6.00 sec  119 MBytes   1.00 gbts/sec  86346
[ 5] 6.00-7.00 sec  119 MBytes   1000 Mbts/sec  86305
[ 5] 7.00-8.00 sec  119 MBytes   1.00 gbts/sec  86336
[ 5] 8.00-9.00 sec  119 MBytes   1000 Mbts/sec  86322
[ 5] 9.00-10.00 sec 119 MBytes   1000 Mbts/sec  86321
[ 5] 10.00-11.00 sec 119 MBytes   1.00 gbts/sec  86335
[ 5] 11.00-12.00 sec 119 MBytes   1000 Mbts/sec  86316
[ 5] 12.00-13.00 sec 119 MBytes   1000 Mbts/sec  86326
[ 5] 13.00-14.00 sec 119 MBytes   1.00 gbts/sec  86326
[ 5] 14.00-15.00 sec 119 MBytes   1.00 gbts/sec  86327
[ 5] 15.00-16.00 sec 119 MBytes   1000 Mbts/sec  86326
[ 5] 16.00-17.00 sec 119 MBytes   1.00 gbts/sec  86361
[ 5] 17.00-18.00 sec 119 MBytes   1.00 gbts/sec  86336
[ 5] 18.00-19.00 sec 119 MBytes   1000 Mbts/sec  86289
[ 5] 19.00-20.00 sec 119 MBytes   1000 Mbts/sec  86325
[ 5] 20.00-21.00 sec 119 MBytes   1.00 gbts/sec  86317
[ 5] 21.00-22.00 sec 119 MBytes   1.00 gbts/sec  86328
[ 5] 22.00-23.00 sec 119 MBytes   1000 Mbts/sec  86323
[ 5] 23.00-24.00 sec 119 MBytes   1.00 gbts/sec  86328
[ 5] 24.00-25.00 sec 119 MBytes   1.00 gbts/sec  86336
[ 5] 25.00-26.00 sec 119 MBytes   1000 Mbts/sec  86320
[ 5] 26.00-27.00 sec 119 MBytes   1000 Mbts/sec  86301
[ 5] 27.00-28.00 sec 119 MBytes   1.00 gbts/sec  86368
[ 5] 28.00-29.00 sec 119 MBytes   1000 Mbts/sec  86302
[ 5] 29.00-30.00 sec 119 MBytes   1.00 gbts/sec  86340

[ 5] Interval      Transfer      Bitrate      Jitter      Lost/Total Datagrams
[ 5] 0.00-30.00 sec  3.49 GBytes  1000 Mbts/sec  0.000 ms    0/2589738 (0%) sender
[ 5] 0.00-41.92 sec  4.86 MBytes  972 kbts/sec  0.147 ms    2585788/2589304 (1e+02%) receiver

iperf Done.
administrator@ubuntu-tc-A: $
  
```

Test bez ograniczenia 30s (TCP iperf)

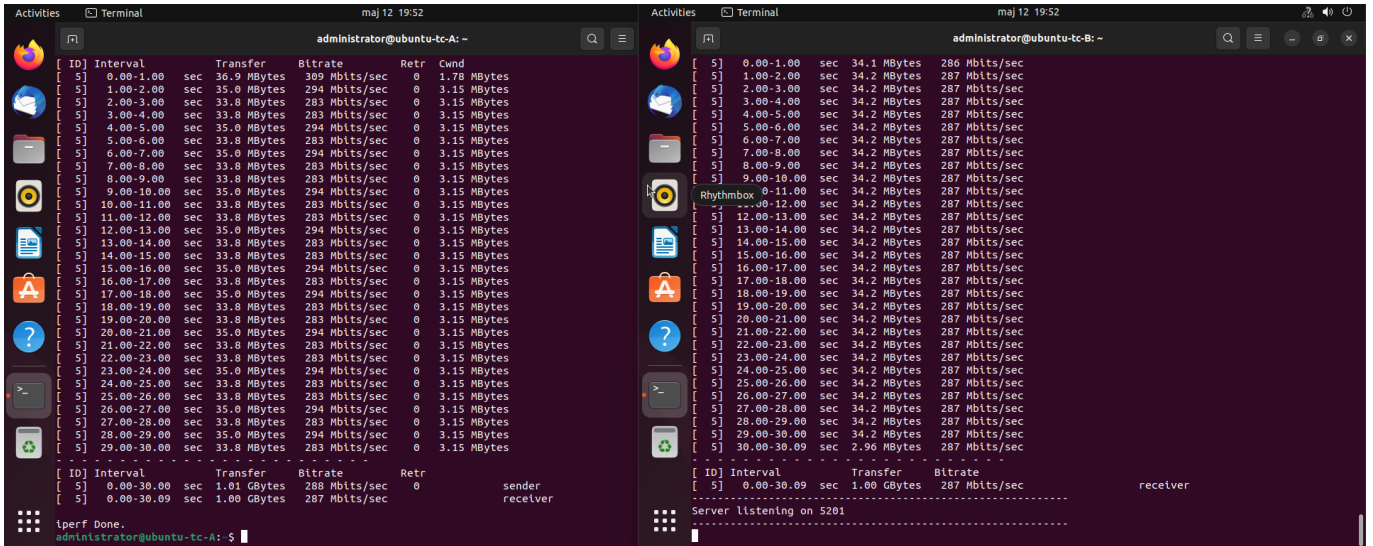
```

[ 5] Interval      Transfer      Bitrate      Retr      Cwnd
[ 5] 0.00-1.00 sec  1.17 GBytes  10.8 gbts/sec  0 3.16 MBytes
[ 5] 1.00-2.00 sec  1.25 GBytes  10.8 gbts/sec  0 3.16 MBytes
[ 5] 2.00-3.00 sec  1.29 GBytes  11.1 gbts/sec  0 3.16 MBytes
[ 5] 3.00-4.00 sec  1.27 GBytes  10.9 gbts/sec  0 3.16 MBytes
[ 5] 4.00-5.00 sec  1.26 GBytes  10.9 gbts/sec  0 3.16 MBytes
[ 5] 5.00-6.00 sec  1.26 GBytes  10.8 gbts/sec  0 3.16 MBytes
[ 5] 6.00-7.00 sec  1.27 GBytes  10.9 gbts/sec  0 3.16 MBytes
[ 5] 7.00-8.00 sec  1.25 GBytes  10.7 gbts/sec  0 3.16 MBytes
[ 5] 8.00-9.00 sec  1.24 GBytes  10.7 gbts/sec  0 3.16 MBytes
[ 5] 9.00-10.00 sec 1.26 GBytes  10.8 gbts/sec  0 3.16 MBytes
[ 5] 10.00-11.00 sec 1.23 GBytes  10.5 gbts/sec  0 3.16 MBytes
[ 5] 11.00-12.00 sec 1.22 GBytes  10.4 gbts/sec  0 3.16 MBytes
[ 5] 12.00-13.00 sec 1.25 GBytes  10.7 gbts/sec  0 3.16 MBytes
[ 5] 13.00-14.00 sec 1.20 GBytes  10.3 gbts/sec  0 3.16 MBytes
[ 5] 14.00-15.00 sec 1.05 GBytes  9.01 gbts/sec  0 3.16 MBytes
[ 5] 15.00-16.00 sec 1.17 GBytes  10.0 gbts/sec  0 3.16 MBytes
[ 5] 16.00-17.00 sec 1.19 GBytes  10.2 gbts/sec  0 3.16 MBytes
[ 5] 17.00-18.00 sec 1.18 GBytes  10.1 gbts/sec  0 3.16 MBytes
[ 5] 18.00-19.00 sec 1.18 GBytes  10.1 gbts/sec  0 3.16 MBytes
[ 5] 19.00-20.00 sec 1.18 GBytes  10.1 gbts/sec  0 3.16 MBytes
[ 5] 20.00-21.00 sec 1.18 GBytes  10.1 gbts/sec  0 3.16 MBytes
[ 5] 21.00-22.00 sec 1.21 GBytes  10.4 gbts/sec  0 3.16 MBytes
[ 5] 22.00-23.00 sec 1.13 GBytes  9.73 gbts/sec  1 3.16 MBytes
[ 5] 23.00-24.00 sec 1.13 GBytes  9.68 gbts/sec  0 3.16 MBytes
[ 5] 24.00-25.00 sec 1.06 GBytes  9.08 gbts/sec  1 3.16 MBytes
[ 5] 25.00-26.00 sec 1.25 GBytes  10.7 gbts/sec  0 3.16 MBytes
[ 5] 26.00-27.00 sec 1.19 GBytes  10.2 gbts/sec  0 3.16 MBytes
[ 5] 27.00-28.00 sec 1.17 GBytes  10.1 gbts/sec  0 3.16 MBytes
[ 5] 28.00-29.00 sec 1.21 GBytes  10.4 gbts/sec  0 3.16 MBytes
[ 5] 29.00-30.00 sec 1.24 GBytes  10.6 gbts/sec  0 3.16 MBytes

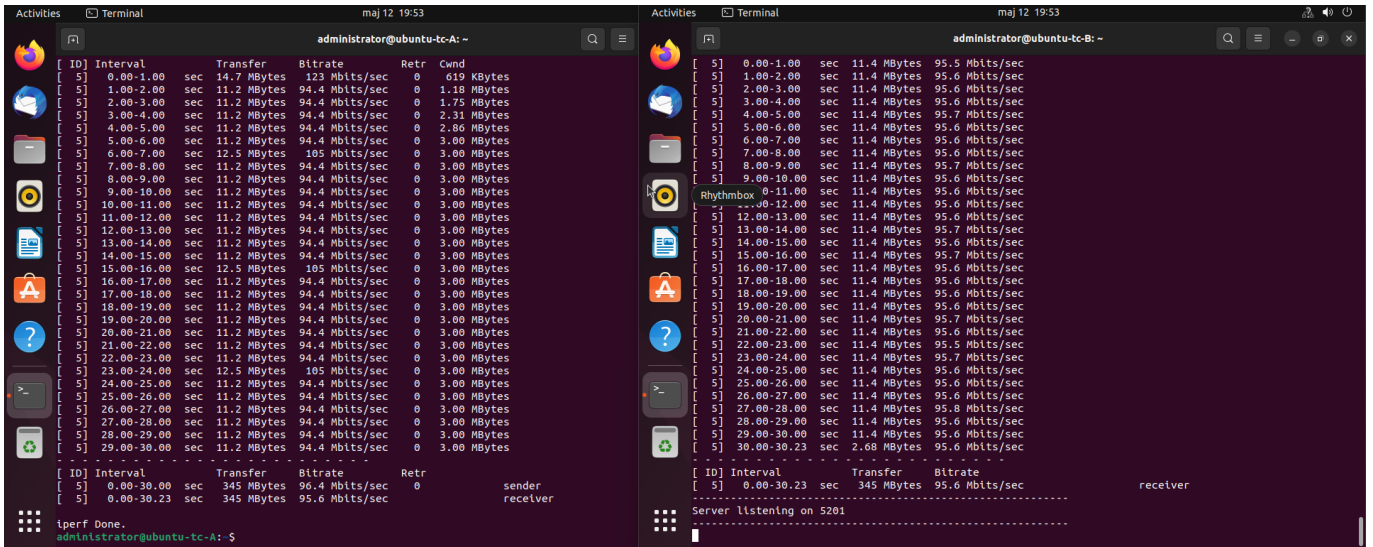
[ 5] Interval      Transfer      Bitrate      Retr
[ 5] 0.00-30.00 sec  36.1 GBytes  10.3 gbts/sec  2
[ 5] 0.00-30.00 sec  36.1 GBytes  10.3 gbts/sec

iperf Done.
administrator@ubuntu-tc-A: $
  
```

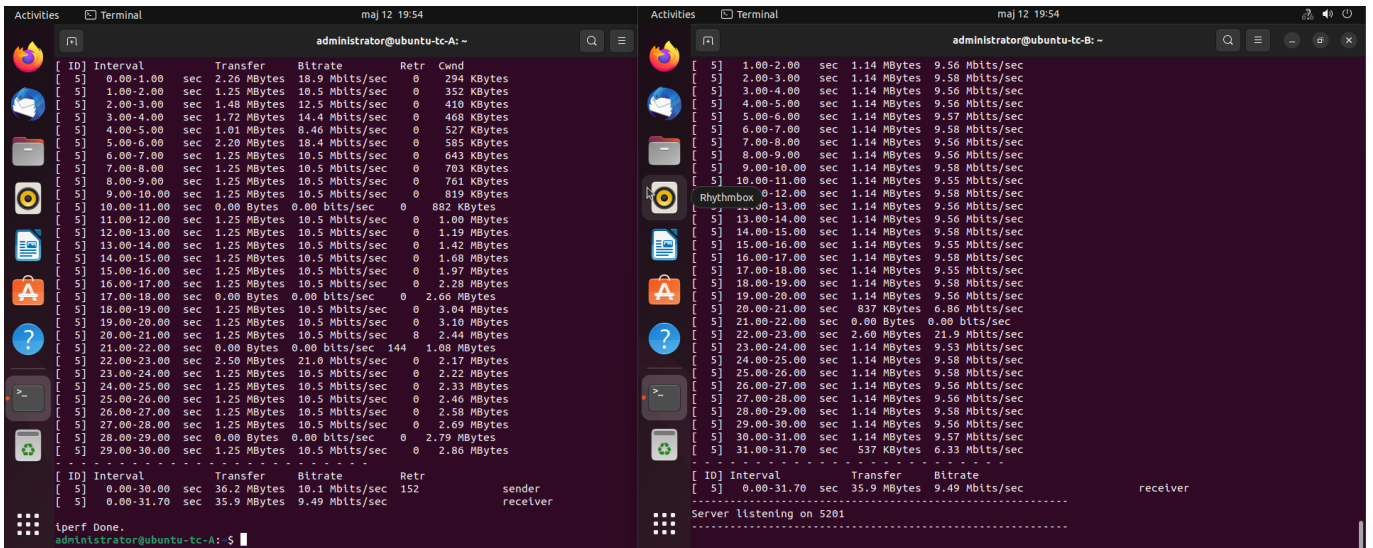
Ograniczenie pasma do 300Mbps 30s (TCP iperf)



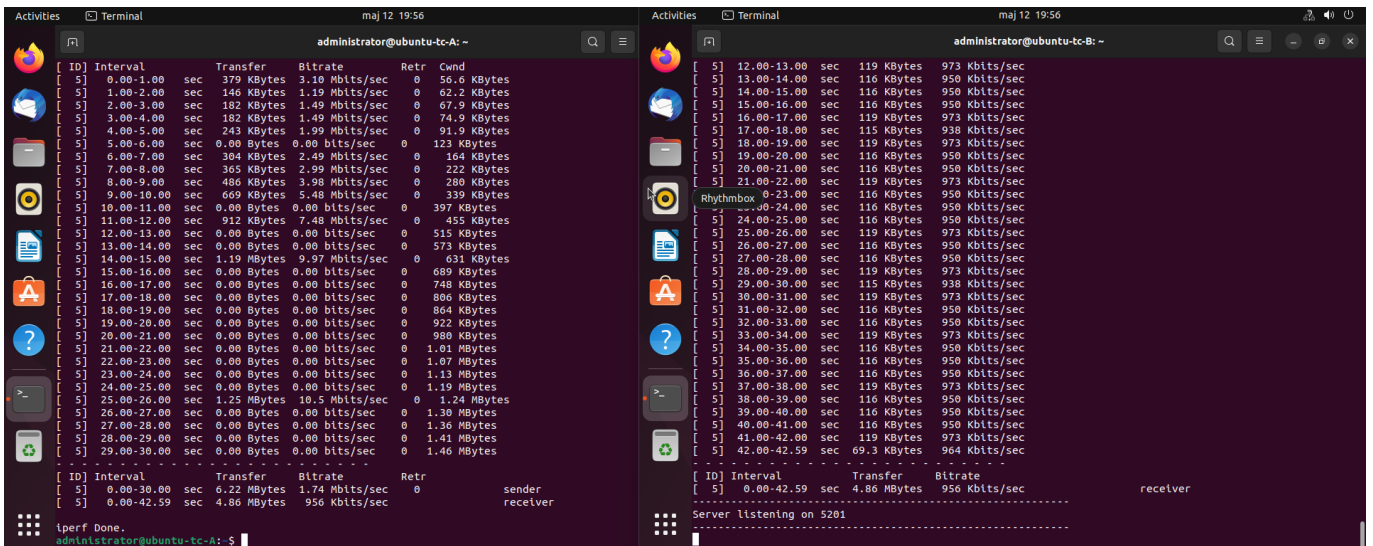
Ograniczenie pasma do 100Mbps 30s (TCP iperf)



Ograniczenie pasma do 10Mbps 30s (TCP iperf)



Ograniczenie pasma do 1Mbps 30s (TCP iperf)



Test łączy w obie strony 10Mbps, opóźnienie 2000ms, urata 3%, uszkodzone 10% (ping 100 pomiarów)

```

Activities Terminal maj 12 20:04 administrator@ubuntu-tc-A: ~
64 bytes from 192.168.2.10: icmp_seq=57 ttl=63 time=4002 ms
64 bytes from 192.168.2.10: icmp_seq=58 ttl=63 time=4002 ms
64 bytes from 192.168.2.10: icmp_seq=59 ttl=63 time=4003 ms
64 bytes from 192.168.2.10: icmp_seq=60 ttl=63 time=4001 ms
64 bytes from 192.168.2.10: icmp_seq=61 ttl=63 time=4001 ms
64 bytes from 192.168.2.10: icmp_seq=62 ttl=63 time=4001 ms
64 bytes from 192.168.2.10: icmp_seq=64 ttl=63 time=4001 ms
64 bytes from 192.168.2.10: icmp_seq=65 ttl=63 time=4001 ms
64 bytes from 192.168.2.10: icmp_seq=66 ttl=63 time=4001 ms
64 bytes from 192.168.2.10: icmp_seq=67 ttl=63 time=4001 ms
64 bytes from 192.168.2.10: icmp_seq=68 ttl=63 time=4001 ms
64 bytes from 192.168.2.10: icmp_seq=70 ttl=63 time=4001 ms
64 bytes from 192.168.2.10: icmp_seq=71 ttl=63 time=4001 ms
64 bytes from 192.168.2.10: icmp_seq=72 ttl=63 time=4001 ms
64 bytes from 192.168.2.10: icmp_seq=73 ttl=63 time=4001 ms
64 bytes from 192.168.2.10: icmp_seq=74 ttl=63 time=4001 ms
64 bytes from 192.168.2.10: icmp_seq=76 ttl=63 time=4001 ms
64 bytes from 192.168.2.10: icmp_seq=78 ttl=63 time=4001 ms
64 bytes from 192.168.2.10: icmp_seq=82 ttl=63 time=4001 ms
64 bytes from 192.168.2.10: icmp_seq=84 ttl=63 time=4001 ms
64 bytes from 192.168.2.10: icmp_seq=85 ttl=63 time=4002 ms
64 bytes from 192.168.2.10: icmp_seq=86 ttl=63 time=4001 ms
64 bytes from 192.168.2.10: icmp_seq=87 ttl=63 time=4001 ms
64 bytes from 192.168.2.10: icmp_seq=88 ttl=63 time=4001 ms
64 bytes from 192.168.2.10: icmp_seq=89 ttl=63 time=4001 ms
64 bytes from 192.168.2.10: icmp_seq=90 ttl=63 time=4002 ms
64 bytes from 192.168.2.10: icmp_seq=91 ttl=63 time=4001 ms
64 bytes from 192.168.2.10: icmp_seq=93 ttl=63 time=4001 ms
64 bytes from 192.168.2.10: icmp_seq=94 ttl=63 time=4001 ms
64 bytes from 192.168.2.10: icmp_seq=97 ttl=63 time=4001 ms
64 bytes from 192.168.2.10: icmp_seq=98 ttl=63 time=4001 ms
64 bytes from 192.168.2.10: icmp_seq=99 ttl=63 time=4001 ms
64 bytes from 192.168.2.10: icmp_seq=100 ttl=63 time=4001 ms

--- 192.168.2.10 ping statistics ---
100 packets transmitted, 76 received, 24% packet loss, time 99542ms
rtt min/avg/max/mdev = 4000.690/4001.120/4002.574/0.383 ms, pipe 5
administrator@ubuntu-tc-A:~$

```

Test łącza w obie strony 10Mbps, opóźnienie 600ms, utrata 3%, uszkodzone 10% (TCP iperf)

```

Activities Terminal maj 12 20:06 administrator@ubuntu-tc-A: ~
[ ID] Interval      Transfer      Bitrate      Retr  Cwnd
[ 5] 0.00-1.20    sec  102 KBytes   695 Kbits/sec  0  14.1 KBytes
[ 5] 1.20-2.00    sec  0.00 Bytes   0.00 bbits/sec  0  14.1 KBytes
[ 5] 2.00-3.00    sec  93.3 KBytes  765 Kbits/sec  0  28.3 KBytes
[ 5] 3.00-4.00    sec  0.00 Bytes   0.00 bbits/sec  3  32.5 KBytes
[ 5] 4.00-5.00    sec  0.00 Bytes   0.00 bbits/sec  1  22.6 KBytes
[ 5] 5.00-6.00    sec  0.00 Bytes   0.00 bbits/sec  0  22.6 KBytes
[ 5] 6.00-7.00    sec  0.00 Bytes   0.00 bbits/sec  1  28.3 KBytes
[ 5] 7.00-8.00    sec  0.00 Bytes   0.00 bbits/sec  2  21.2 KBytes
[ 5] 8.00-9.00    sec  90.5 KBytes  742 Kbits/sec  1  17.0 KBytes
[ 5] 9.00-10.00   sec  0.00 Bytes   0.00 bbits/sec  0  15.6 KBytes
[ 5] 10.00-11.00  sec  0.00 Bytes   0.00 bbits/sec  1  12.7 KBytes
[ 5] 11.00-12.00  sec  0.00 Bytes   0.00 bbits/sec  0  12.7 KBytes
[ 5] 12.00-13.00  sec  0.00 Bytes   0.00 bbits/sec  3  9.90 KBytes
[ 5] 13.00-14.00  sec  122 KBytes  997 Kbits/sec  1  8.48 KBytes
[ 5] 14.00-15.00  sec  0.00 Bytes   0.00 bbits/sec  0  5.66 KBytes
[ 5] 15.00-16.00  sec  0.00 Bytes   0.00 bbits/sec  0  7.07 KBytes
[ 5] 16.00-17.00  sec  0.00 Bytes   0.00 bbits/sec  0  11.3 KBytes
[ 5] 17.00-18.00  sec  0.00 Bytes   0.00 bbits/sec  0  11.3 KBytes
[ 5] 18.00-19.00  sec  0.00 Bytes   0.00 bbits/sec  0  17.0 KBytes
[ 5] 19.00-20.00  sec  0.00 Bytes   0.00 bbits/sec  2  12.7 KBytes
[ 5] 20.00-21.00  sec  0.00 Bytes   0.00 bbits/sec  0  14.1 KBytes
[ 5] 21.00-22.00  sec  0.00 Bytes   0.00 bbits/sec  0  18.4 KBytes
[ 5] 22.00-23.00  sec  0.00 Bytes   0.00 bbits/sec  1  12.7 KBytes
[ 5] 23.00-24.00  sec  0.00 Bytes   0.00 bbits/sec  0  12.7 KBytes
[ 5] 24.00-25.00  sec  0.00 Bytes   0.00 bbits/sec  1  7.07 KBytes
[ 5] 25.00-26.00  sec  0.00 Bytes   0.00 bbits/sec  3  7.07 KBytes
[ 5] 26.00-27.00  sec  0.00 Bytes   0.00 bbits/sec  1  5.66 KBytes
[ 5] 27.00-28.00  sec  122 KBytes  996 Kbits/sec  0  12.7 KBytes
[ 5] 28.00-29.00  sec  0.00 Bytes   0.00 bbits/sec  1  8.48 KBytes
[ 5] 29.00-30.00  sec  0.00 Bytes   0.00 bbits/sec  0  8.48 KBytes

iperf Done.
administrator@ubuntu-tc-A:~$

Activities Terminal maj 12 20:06 administrator@ubuntu-tc-B: ~
[ 5] 1.00-2.00    sec  0.00 Bytes   0.00 bbits/sec
[ 5] 2.00-3.00    sec  14.1 KBytes  116 Kbits/sec
[ 5] 3.00-4.00    sec  11.3 KBytes  92.7 Kbits/sec
[ 5] 4.00-5.00    sec  2.83 KBytes  23.2 Kbits/sec
[ 5] 5.00-6.00    sec  0.00 Bytes   0.00 bbits/sec
[ 5] 6.00-7.00    sec  56.0 KBytes  463 Kbits/sec
[ 5] 7.00-8.00    sec  1.41 KBytes  11.6 Kbits/sec
[ 5] 8.00-9.00    sec  33.9 KBytes  278 Kbits/sec
[ 5] 9.00-10.00   sec  32.5 KBytes  267 Kbits/sec
[ 5] 10.00-11.00  sec  7.07 KBytes  57.9 Kbits/sec
[ 5] 11.00-12.00  sec  0.00 Bytes   0.00 bbits/sec
[ 5] 12.00-13.00  sec  4.24 KBytes  34.8 Kbits/sec
[ 5] 13.00-14.00  sec  14.1 KBytes  116 Kbits/sec
[ 5] 14.00-15.00  sec  12.7 KBytes  104 Kbits/sec
[ 5] 15.00-16.00  sec  5.66 KBytes  46.4 Kbits/sec
[ 5] 16.00-17.00  sec  7.07 KBytes  57.9 Kbits/sec
[ 5] 17.00-18.00  sec  0.00 Bytes   0.00 bbits/sec
[ 5] 18.00-19.00  sec  11.3 KBytes  92.7 Kbits/sec
[ 5] 19.00-20.00  sec  2.83 KBytes  23.2 Kbits/sec
[ 5] 20.00-21.00  sec  24.0 KBytes  197 Kbits/sec
[ 5] 21.00-22.00  sec  14.1 KBytes  116 Kbits/sec
[ 5] 22.00-23.00  sec  0.00 Bytes   0.00 bbits/sec
[ 5] 23.00-24.00  sec  0.00 Bytes   0.00 bbits/sec
[ 5] 24.00-25.00  sec  18.4 KBytes  151 Kbits/sec
[ 5] 25.00-26.00  sec  0.00 Bytes   0.00 bbits/sec
[ 5] 26.00-27.00  sec  0.00 Bytes   0.00 bbits/sec
[ 5] 27.00-28.00  sec  19.4 KBytes  151 Kbits/sec
[ 5] 28.00-29.00  sec  0.00 Bytes   0.00 bbits/sec
[ 5] 29.00-30.00  sec  0.00 Bytes   0.00 bbits/sec
[ 5] 30.00-31.00  sec  19.8 KBytes  162 Kbits/sec
[ 5] 31.00-31.20  sec  0.00 Bytes   0.00 bbits/sec

iperf Done.
Server listening on 5201

```

Test łącza w obie strony 10Mbps, opóźnienie 600ms, utrata 3%, uszkodzone 10% (UDP iperf)

```

[ 5] Interval      Transfer      Bitrate      Total Datagrams
[ 5] 0.00-1.20    sec 1.41 Kbytes  9.65 Kbits/sec 1
[ 5] 1.20-2.00    sec 238 Mbytes  2.50 Gbits/sec 172598
[ 5] 2.00-3.00    sec 119 Mbytes  1.00 Gbits/sec 86329
[ 5] 3.00-4.00    sec 119 Mbytes  1000 Mbits/sec 86319
[ 5] 4.00-5.00    sec 119 Mbytes  1.00 Gbits/sec 86351
[ 5] 5.00-6.00    sec 119 Mbytes  1000 Mbits/sec 86297
[ 5] 6.00-7.00    sec 119 Mbytes  1000 Mbits/sec 86321
[ 5] 7.00-8.00    sec 119 Mbytes  1.00 Gbits/sec 86328
[ 5] 8.00-9.00    sec 119 Mbytes  1.00 Gbits/sec 86337
[ 5] 9.00-10.00   sec 119 Mbytes  1000 Mbits/sec 86324
[ 5] 10.00-11.00  sec 119 Mbytes  1000 Mbits/sec 86321
[ 5] 11.00-12.00  sec 119 Mbytes  1.00 Gbits/sec 86343
[ 5] 12.00-13.00  sec 119 Mbytes  1000 Mbits/sec 86310
[ 5] 13.00-14.00  sec 119 Mbytes  1.00 Gbits/sec 86328
[ 5] 14.00-15.00  sec 119 Mbytes  1.00 Gbits/sec 86328
[ 5] 15.00-16.00  sec 119 Mbytes  1000 Mbits/sec 86321
[ 5] 16.00-17.00  sec 119 Mbytes  1.00 Gbits/sec 86343
[ 5] 17.00-18.00  sec 119 Mbytes  1.00 Gbits/sec 86331
[ 5] 18.00-19.00  sec 119 Mbytes  1000 Mbits/sec 86324
[ 5] 19.00-20.00  sec 119 Mbytes  1000 Mbits/sec 86321
[ 5] 20.00-21.00  sec 119 Mbytes  1.00 Gbits/sec 86322
[ 5] 21.00-22.00  sec 119 Mbytes  1.00 Gbits/sec 86329
[ 5] 22.00-23.00  sec 119 Mbytes  1.00 Gbits/sec 86326
[ 5] 23.00-24.00  sec 119 Mbytes  1.00 Gbits/sec 86334
[ 5] 24.00-25.00  sec 119 Mbytes  1000 Mbits/sec 86324
[ 5] 25.00-26.00  sec 119 Mbytes  1.00 Gbits/sec 86333
[ 5] 26.00-27.00  sec 119 Mbytes  1000 Mbits/sec 86306
[ 5] 27.00-28.00  sec 119 Mbytes  1.00 Gbits/sec 86342
[ 5] 28.00-29.00  sec 119 Mbytes  1000 Mbits/sec 86321
[ 5] 29.00-30.00  sec 119 Mbytes  1000 Mbits/sec 86325

iperf Done.
administrator@ubuntu-tc-A:~$

[ 5] Interval      Transfer      Bitrate      Jitter      Lost/Total Datagrams
[ 5] 1.00-2.00    sec 0.00 Bytes  0.00 bits/sec 0.000 ms  0/0 (0%)
[ 5] 2.00-3.00    sec 635 Kbytes  5.21 Mbits/sec 1.320 ms  69/518 (13%)
[ 5] 3.00-4.00    sec 1.04 Mbytes  8.73 Mbits/sec 1.260 ms  189195/189949 (1e+02%)
[ 5] 4.00-5.00    sec 1.05 Mbytes  8.80 Mbits/sec 0.243 ms  85629/86380 (99%)
[ 5] 5.00-6.00    sec 1.04 Mbytes  8.72 Mbits/sec 0.249 ms  85598/86351 (99%)
[ 5] 6.00-7.00    sec 1.06 Mbytes  8.87 Mbits/sec 0.301 ms  85578/86341 (99%)
[ 5] 7.00-8.00    sec 1.05 Mbytes  8.82 Mbits/sec 0.271 ms  85428/86189 (99%)
[ 5] 8.00-9.00    sec 1.05 Mbytes  8.78 Mbits/sec 0.247 ms  85583/86341 (99%)
[ 5] 9.00-10.00   sec 1.02 Mbytes  8.56 Mbits/sec 0.314 ms  85617/86356 (99%)
[ 5] 10.00-11.00  sec 1.04 Mbytes  8.74 Mbits/sec 0.248 ms  85572/86326 (99%)
[ 5] 11.00-12.00  sec 1.04 Mbytes  8.70 Mbits/sec 0.330 ms  85380/86331 (99%)
[ 5] 12.00-13.00  sec 1.03 Mbytes  8.68 Mbits/sec 0.300 ms  85370/86327 (99%)
[ 5] 13.00-14.00  sec 1.04 Mbytes  8.70 Mbits/sec 0.272 ms  85571/86322 (99%)
[ 5] 14.00-15.00  sec 1.04 Mbytes  8.71 Mbits/sec 0.301 ms  85579/86331 (99%)
[ 5] 15.00-16.00  sec 1.05 Mbytes  8.82 Mbits/sec 0.294 ms  85558/86319 (99%)
[ 5] 16.00-17.00  sec 1.03 Mbytes  8.64 Mbits/sec 0.287 ms  85591/86337 (99%)
[ 5] 17.00-18.00  sec 1.04 Mbytes  8.70 Mbits/sec 0.291 ms  85545/86286 (99%)
[ 5] 18.00-19.00  sec 1.04 Mbytes  8.76 Mbits/sec 0.266 ms  85577/86333 (99%)
[ 5] 19.00-20.00  sec 1.06 Mbytes  8.86 Mbits/sec 0.243 ms  85577/86342 (99%)
[ 5] 20.00-21.00  sec 1.01 Mbytes  8.44 Mbits/sec 0.277 ms  85578/86307 (99%)
[ 5] 21.00-22.00  sec 1.05 Mbytes  8.77 Mbits/sec 0.265 ms  85598/86355 (99%)
[ 5] 22.00-23.00  sec 1.05 Mbytes  8.70 Mbits/sec 0.275 ms  85548/86380 (99%)
[ 5] 23.00-24.00  sec 1.04 Mbytes  8.70 Mbits/sec 0.267 ms  85640/86391 (99%)
[ 5] 24.00-25.00  sec 1.07 Mbytes  8.94 Mbits/sec 0.265 ms  85581/86353 (99%)
[ 5] 25.00-26.00  sec 332 Kbytes  2.72 Mbits/sec 0.246 ms  25828/26063 (99%)
[ 5] 26.00-27.00  sec 693 Kbytes  5.68 Mbits/sec 1.250 ms  148269/148758 (1e+02%)
[ 5] 27.00-28.00  sec 1.02 Mbytes  8.55 Mbits/sec 0.265 ms  91330/92074 (99%)
[ 5] 28.00-29.00  sec 1.05 Mbytes  8.77 Mbits/sec 0.265 ms  85565/86322 (99%)
[ 5] 29.00-30.00  sec 1.05 Mbytes  8.84 Mbits/sec 0.280 ms  85565/86328 (99%)
[ 5] 30.00-31.00  sec 1.05 Mbytes  8.78 Mbits/sec 0.279 ms  85573/86331 (99%)
[ 5] 31.00-31.79  sec 853 Kbytes  6.83 Mbits/sec 0.240 ms  67330/68333 (99%)

iperf Done.
Server listening on 5201
administrator@ubuntu-tc-B:~$
  
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Test łącza w obie strony 60Mbps, opóźnienie 600ms, utrata 5% (UDP iperf)

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[ 5] Interval      Transfer      Bitrate      Total Datagrams
[ 5] 0.00-1.00    sec 119 Mbytes  999 Mbits/sec 86263
[ 5] 1.00-2.00    sec 119 Mbytes  1.00 Gbits/sec 86329
[ 5] 2.00-3.00    sec 119 Mbytes  1000 Mbits/sec 86321
[ 5] 3.00-4.00    sec 119 Mbytes  1.00 Gbits/sec 86338
[ 5] 4.00-5.00    sec 119 Mbytes  1000 Mbits/sec 86314
[ 5] 5.00-6.00    sec 119 Mbytes  1.00 Gbits/sec 86334
[ 5] 6.00-7.00    sec 119 Mbytes  1000 Mbits/sec 86326
[ 5] 7.00-8.00    sec 119 Mbytes  1000 Mbits/sec 86318
[ 5] 8.00-9.00    sec 119 Mbytes  1.00 Gbits/sec 86337
[ 5] 9.00-10.00   sec 119 Mbytes  1.00 Gbits/sec 86328
[ 5] 10.00-11.00  sec 119 Mbytes  1000 Mbits/sec 86310
[ 5] 11.00-12.00  sec 119 Mbytes  1.00 Gbits/sec 86342
[ 5] 12.00-13.00  sec 119 Mbytes  1.00 Gbits/sec 86332
[ 5] 13.00-14.00  sec 119 Mbytes  1000 Mbits/sec 86313
[ 5] 14.00-15.00  sec 119 Mbytes  1.00 Gbits/sec 86327
[ 5] 15.00-16.00  sec 119 Mbytes  1.00 Gbits/sec 86334
[ 5] 16.00-17.00  sec 119 Mbytes  1000 Mbits/sec 86314
[ 5] 17.00-18.00  sec 119 Mbytes  1.00 Gbits/sec 86337
[ 5] 18.00-19.00  sec 119 Mbytes  1000 Mbits/sec 86323
[ 5] 19.00-20.00  sec 119 Mbytes  1000 Mbits/sec 86312
[ 5] 20.00-21.00  sec 119 Mbytes  1.00 Gbits/sec 86341
[ 5] 21.00-22.00  sec 119 Mbytes  1.00 Gbits/sec 86326
[ 5] 22.00-23.00  sec 119 Mbytes  1000 Mbits/sec 86319
[ 5] 23.00-24.00  sec 119 Mbytes  1.00 Gbits/sec 86331
[ 5] 24.00-25.00  sec 119 Mbytes  1.00 Gbits/sec 86326
[ 5] 25.00-26.00  sec 119 Mbytes  1000 Mbits/sec 86316
[ 5] 26.00-27.00  sec 119 Mbytes  1.00 Gbits/sec 86377
[ 5] 27.00-28.00  sec 119 Mbytes  1000 Mbits/sec 86304
[ 5] 28.00-29.00  sec 119 Mbytes  1000 Mbits/sec 86294
[ 5] 29.00-30.00  sec 119 Mbytes  1.00 Gbits/sec 86334

iperf Done.
administrator@ubuntu-tc-A:~$

[ 6] Interval      Transfer      Bitrate      Jitter      Lost/Total Datagrams
[ 6] 7.00-8.00    sec 1.68 Mbytes  14.1 Mbits/sec 0.281 ms  54372/55591 (98%)
[ 6] 8.00-9.00    sec 1.38 Mbytes  11.6 Mbits/sec 0.232 ms  50950/51550 (98%)
[ 6] 9.00-10.00   sec 785 Kbytes  6.43 Mbits/sec 0.188 ms  141905/142520 (1e+02%)
[ 6] 10.00-11.00  sec 2.08 Mbytes  16.7 Mbits/sec 0.256 ms  66953/68398 (98%)
[ 6] 11.00-12.00  sec 2.76 Mbytes  23.2 Mbits/sec 0.290 ms  101843/103842 (98%)
[ 6] 12.00-13.00  sec 2.11 Mbytes  17.7 Mbits/sec 0.273 ms  94130/95658 (98%)
[ 6] 13.00-14.00  sec 2.03 Mbytes  17.0 Mbits/sec 0.278 ms  58569/60041 (98%)
[ 6] 14.00-15.00  sec 2.76 Mbytes  23.2 Mbits/sec 0.252 ms  181795/183795 (98%)
[ 6] 15.00-16.00  sec 2.07 Mbytes  17.4 Mbits/sec 0.292 ms  93689/95140 (98%)
[ 6] 16.00-17.00  sec 2.07 Mbytes  17.4 Mbits/sec 0.294 ms  59015/60514 (98%)
[ 6] 17.00-18.00  sec 2.76 Mbytes  23.2 Mbits/sec 0.285 ms  101766/103766 (98%)
[ 6] 18.00-19.00  sec 2.76 Mbytes  23.2 Mbits/sec 0.307 ms  93224/94699 (98%)
[ 6] 19.00-20.00  sec 2.11 Mbytes  17.7 Mbits/sec 0.309 ms  59587/61032 (98%)
[ 6] 20.00-21.00  sec 2.76 Mbytes  23.2 Mbits/sec 0.270 ms  181764/183764 (98%)
[ 6] 21.00-22.00  sec 2.00 Mbytes  16.8 Mbits/sec 0.270 ms  92737/94186 (98%)
[ 6] 22.00-23.00  sec 2.14 Mbytes  18.0 Mbits/sec 0.260 ms  59964/61515 (97%)
[ 6] 23.00-24.00  sec 2.70 Mbytes  23.2 Mbits/sec 0.272 ms  101792/103792 (98%)
[ 6] 24.00-25.00  sec 1.97 Mbytes  16.5 Mbits/sec 0.292 ms  92249/93665 (98%)
[ 6] 25.00-26.00  sec 2.15 Mbytes  18.3 Mbits/sec 0.284 ms  66489/61986 (97%)
[ 6] 26.00-27.00  sec 2.76 Mbytes  23.2 Mbits/sec 0.290 ms  101755/103755 (98%)
[ 6] 27.00-28.00  sec 1.93 Mbytes  16.2 Mbits/sec 0.265 ms  91839/93236 (99%)
[ 6] 28.00-29.00  sec 2.21 Mbytes  18.6 Mbits/sec 0.301 ms  60817/62420 (97%)
[ 6] 29.00-30.00  sec 2.76 Mbytes  23.2 Mbits/sec 0.285 ms  181754/183754 (98%)
[ 6] 30.00-31.00  sec 1.98 Mbytes  15.9 Mbits/sec 0.283 ms  91431/92804 (99%)
[ 6] 31.00-32.00  sec 2.25 Mbytes  18.8 Mbits/sec 0.268 ms  61223/62850 (97%)
[ 6] 32.00-33.00  sec 2.76 Mbytes  23.2 Mbits/sec 0.282 ms  101762/103762 (98%)
[ 6] 33.00-34.00  sec 1.88 Mbytes  15.6 Mbits/sec 0.294 ms  91027/92373 (99%)
[ 6] 34.00-35.00  sec 2.28 Mbytes  19.2 Mbits/sec 0.266 ms  61620/63274 (99%)
[ 6] 35.00-36.00  sec 0.00 Bytes  0.00 bits/sec 0.260 ms  0/0 (0%)
[ 6] 36.00-37.00  sec 0.00 Bytes  0.00 bits/sec 0.260 ms  0/0 (0%)
[ 6] 37.00-37.81  sec 0.00 Bytes  0.00 bits/sec 0.260 ms  0/0 (0%)

iperf Done.
Server listening on 5201
administrator@ubuntu-tc-B:~$
  
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