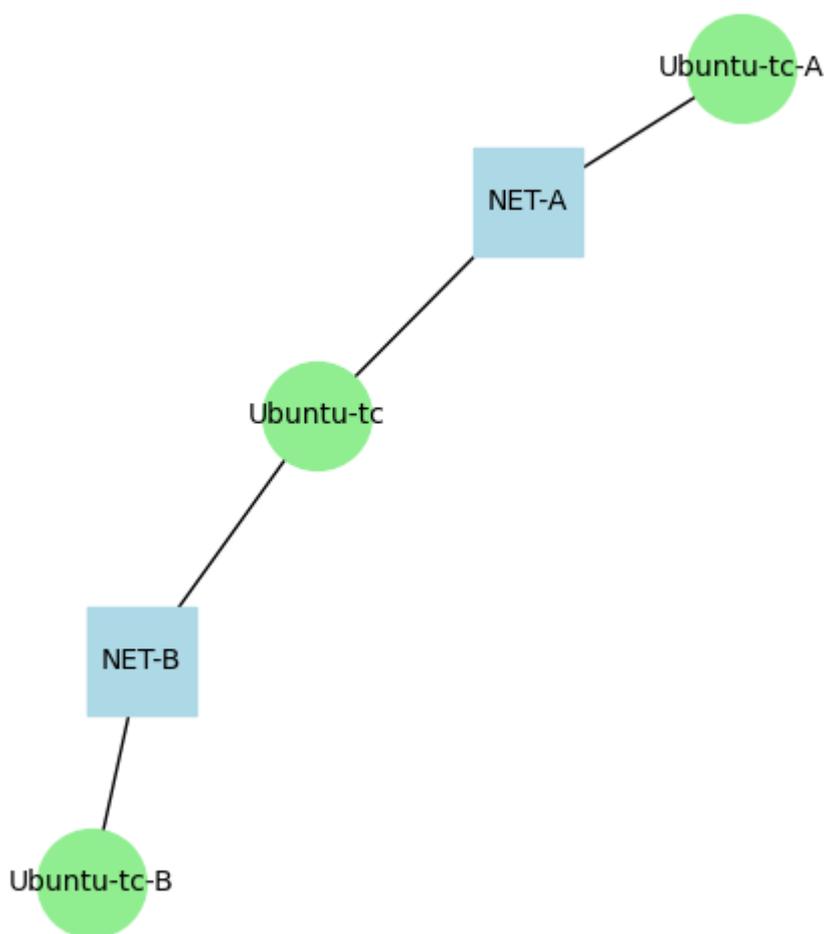


# Linux: TC - ograniczanie pasma, indukowanie błędów w transmisji i opóźnienia

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
```

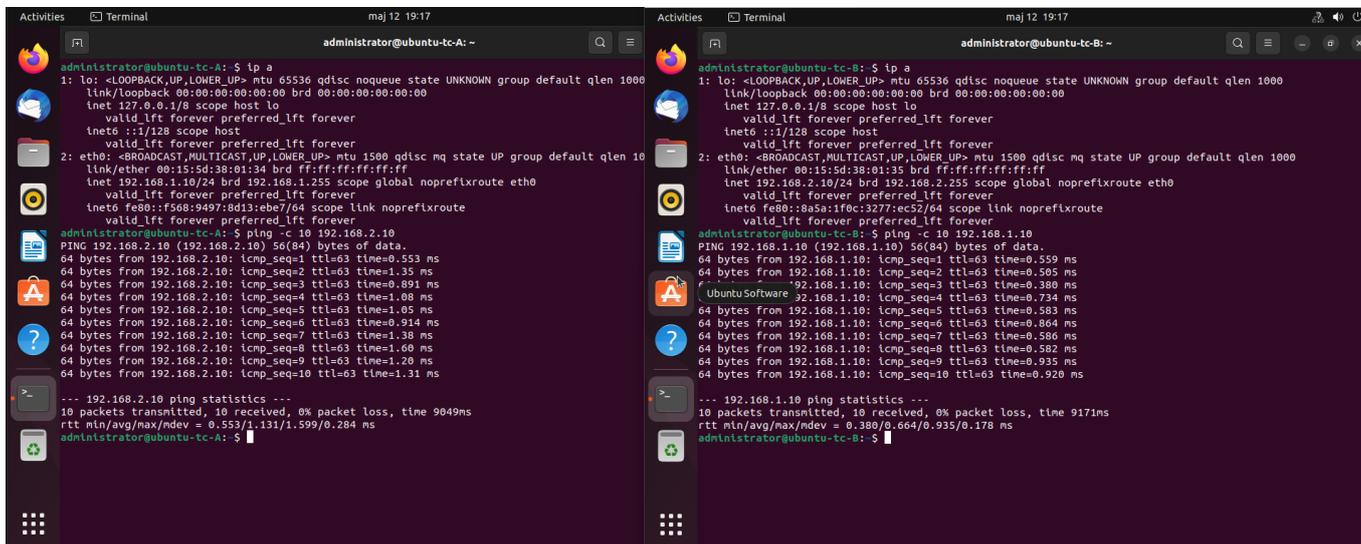
Musimy je jeszcze zaadresować statycznie za pomocą GUI albo za pomocą netplan

# Tabela wyników testów

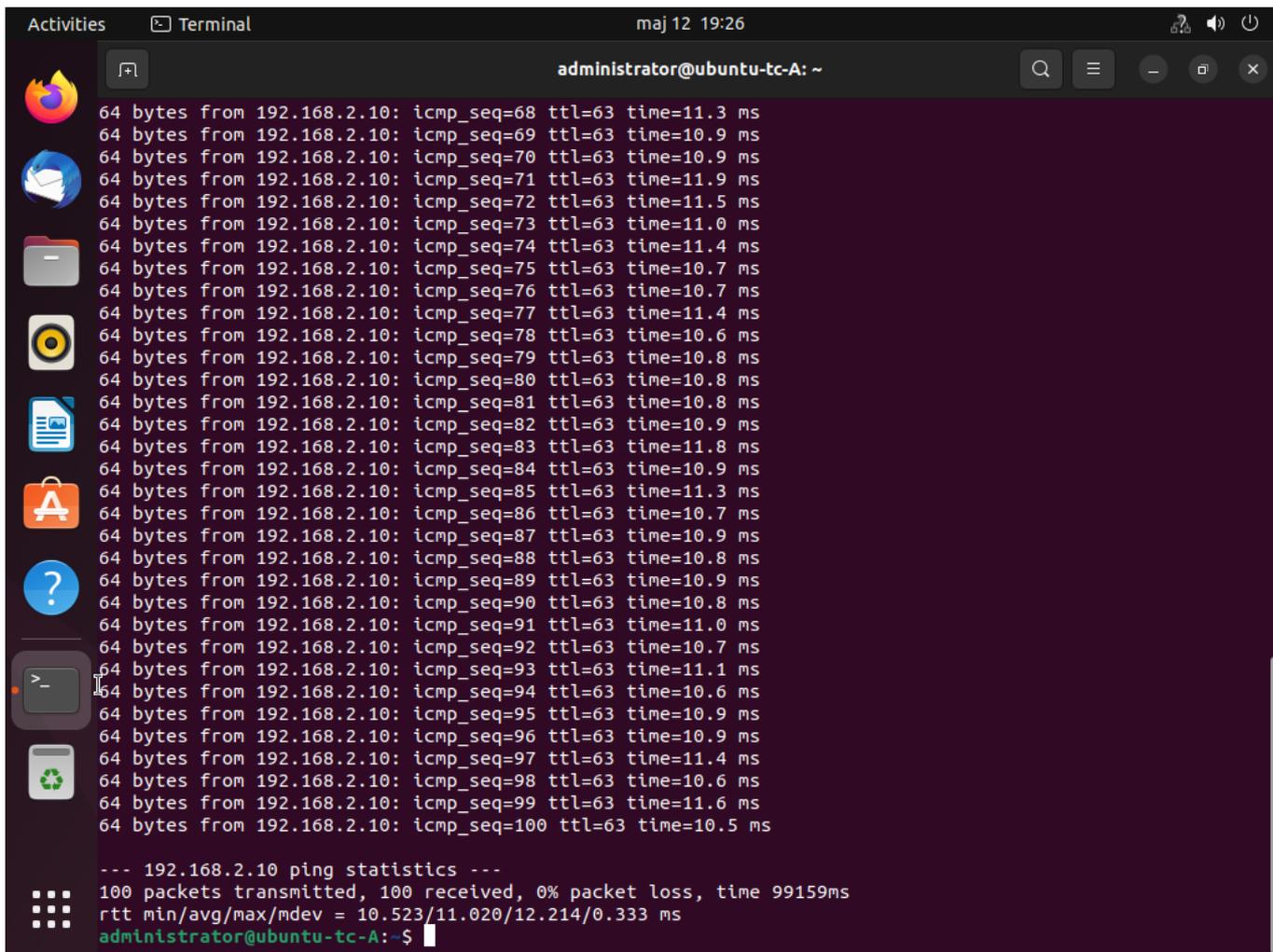
Opis Testu	protokół	straty	pasmo	opóźnienie [ms]
<b>Testy opóźnień</b>				
Test bez dodanego opóźnienia	icmp	0%	—	1,131
Test z dodanym opóźnieniem 10ms wynik z 100 pomiarów	icmp	0%	—	11,020
test z dodanym opóźnieniem 100ms wynik z 100 pomiarów	icmp	0%	—	101,071
test z dodanym opóźnieniem 1000ms wynik z 100 pomiarów	icmp	0%	—	1000,911
<b>Testy pasma UDP</b>				
Opis Testu	protokół	Utracone/Wysłane	pasmo	opóźnienie [ms]
Test bez ograniczenia 30s (UDP 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	—
<b>Testy pasma TCP</b>				
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	—
<b>Inne Testy</b>				
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

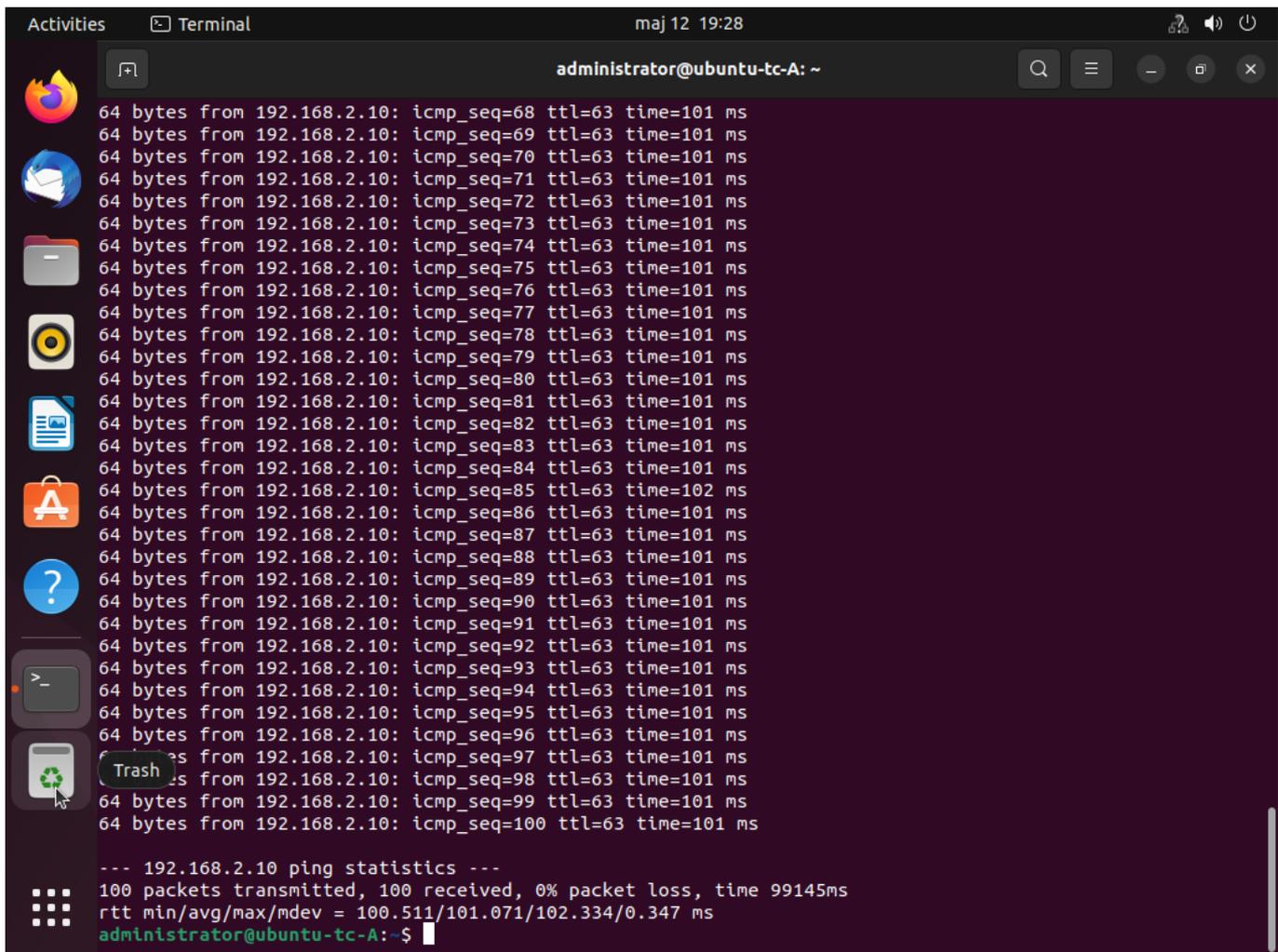


## Test z dodanym opóźnieniem 10ms wynik z 100 pomiarów

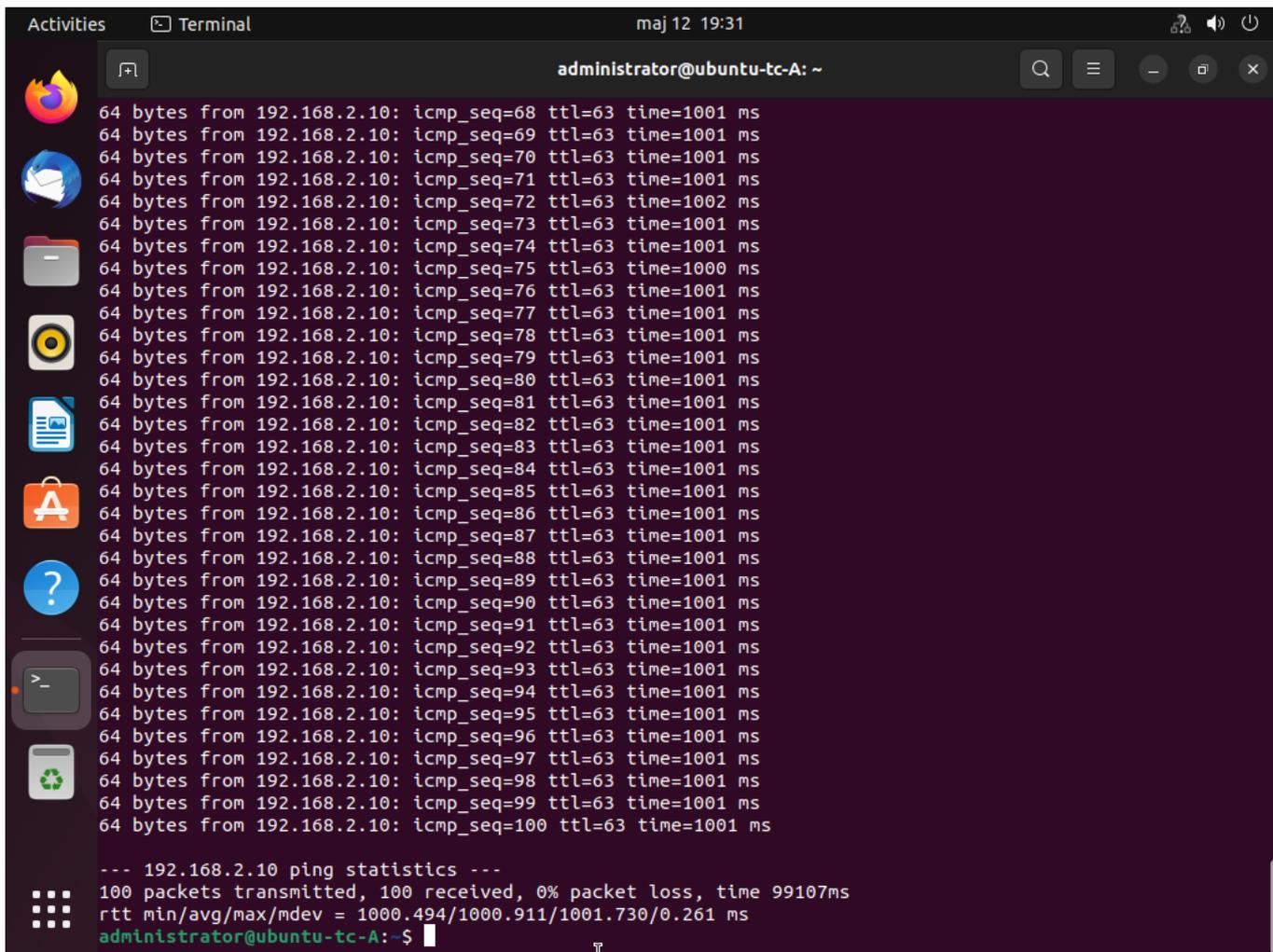


```
Activities Terminal maj 12 19:26 administrator@ubuntu-tc-A: ~  
64 bytes from 192.168.2.10: icmp_seq=68 ttl=63 time=11.3 ms  
64 bytes from 192.168.2.10: icmp_seq=69 ttl=63 time=10.9 ms  
64 bytes from 192.168.2.10: icmp_seq=70 ttl=63 time=10.9 ms  
64 bytes from 192.168.2.10: icmp_seq=71 ttl=63 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**



```
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)**

```
administrator@ubuntu-tc-A:~$ iperf3
[ ID ] Interval           Transfer             Bitrate             Total Datagrams
[ 5 ] 0.00-1.00 sec          119 MBytes          999 Mb/s            86279
[ 5 ] 1.00-2.00 sec          119 MBytes          1000 Mb/s           86325
[ 5 ] 2.00-3.00 sec          119 MBytes          1000 Mb/s           86322
[ 5 ] 3.00-4.00 sec          119 MBytes          1000 Mb/s           86323
[ 5 ] 4.00-5.00 sec          119 MBytes          1.00 Gb/s           86327
[ 5 ] 5.00-6.00 sec          119 MBytes          1.00 Gb/s           86327
[ 5 ] 6.00-7.00 sec          119 MBytes          1000 Mb/s           86329
[ 5 ] 7.00-8.00 sec          119 MBytes          1000 Mb/s           86323
[ 5 ] 8.00-9.00 sec          119 MBytes          1.00 Gb/s           86328
[ 5 ] 9.00-10.00 sec         119 MBytes          1000 Mb/s           86326
[ 5 ] 10.00-11.00 sec        119 MBytes          1000 Mb/s           86324
[ 5 ] 11.00-12.00 sec        119 MBytes          1.00 Gb/s           86333
[ 5 ] 12.00-13.00 sec        119 MBytes          1.00 Gb/s           86331
[ 5 ] 13.00-14.00 sec        119 MBytes          1000 Mb/s           86319
[ 5 ] 14.00-15.00 sec        119 MBytes          1000 Mb/s           86324
[ 5 ] 15.00-16.00 sec        119 MBytes          1.00 Gb/s           86330
[ 5 ] 16.00-17.00 sec        119 MBytes          1000 Mb/s           86321
[ 5 ] 17.00-18.00 sec        119 MBytes          1000 Mb/s           86313
[ 5 ] 18.00-19.00 sec        119 MBytes          1.00 Gb/s           86339
[ 5 ] 19.00-20.00 sec        119 MBytes          1.00 Gb/s           86327
[ 5 ] 20.00-21.00 sec        119 MBytes          1000 Mb/s           86321
[ 5 ] 21.00-22.00 sec        119 MBytes          1.00 Gb/s           86329
[ 5 ] 22.00-23.00 sec        119 MBytes          1.00 Gb/s           86331
[ 5 ] 23.00-24.00 sec        119 MBytes          1000 Mb/s           86328
[ 5 ] 24.00-25.00 sec        119 MBytes          1000 Mb/s           86326
[ 5 ] 25.00-26.00 sec        119 MBytes          1.00 Gb/s           86328
[ 5 ] 26.00-27.00 sec        119 MBytes          1.00 Gb/s           86326
[ 5 ] 27.00-28.00 sec        119 MBytes          1000 Mb/s           86325
[ 5 ] 28.00-29.00 sec        119 MBytes          1.00 Gb/s           86327
[ 5 ] 29.00-30.00 sec        119 MBytes          1000 Mb/s           86325

[ ID ] Interval           Transfer             Bitrate             Jitter              Lost/Total Datagrams
[ 5 ] 0.00-30.00 sec        3.49 GBytes         1000 Mb/s           0.000 ms            0/2589728 (0%) sender
[ 5 ] 0.00-30.00 sec        3.49 GBytes         998 Mb/s           0.002 ms            4048/2589728 (0.16%) receiver

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

## Ograniczenie pasma do 300Mbps 30s (UDP iperf)

```
administrator@ubuntu-tc-A:~$ iperf3
[ ID ] Interval           Transfer             Bitrate             Total Datagrams
[ 5 ] 0.00-1.00 sec          119 MBytes          999 Mb/s            86200
[ 5 ] 1.00-2.00 sec          119 MBytes          1.00 Gb/s           86327
[ 5 ] 2.00-3.00 sec          119 MBytes          1000 Mb/s           86324
[ 5 ] 3.00-4.00 sec          119 MBytes          1.00 Gb/s           86328
[ 5 ] 4.00-5.00 sec          119 MBytes          1000 Mb/s           86324
[ 5 ] 5.00-6.00 sec          119 MBytes          1000 Mb/s           86325
[ 5 ] 6.00-7.00 sec          119 MBytes          1.00 Gb/s           86341
[ 5 ] 7.00-8.00 sec          119 MBytes          1000 Mb/s           86316
[ 5 ] 8.00-9.00 sec          119 MBytes          1.00 Gb/s           86328
[ 5 ] 9.00-10.00 sec        119 MBytes          1000 Mb/s           86321
[ 5 ] 10.00-11.00 sec        119 MBytes          1.00 Gb/s           86332
[ 5 ] 11.00-12.00 sec        119 MBytes          1000 Mb/s           86320
[ 5 ] 12.00-13.00 sec        119 MBytes          1.00 Gb/s           86331
[ 5 ] 13.00-14.00 sec        119 MBytes          1.00 Gb/s           86322
[ 5 ] 14.00-15.00 sec        119 MBytes          1000 Mb/s           86327
[ 5 ] 15.00-16.00 sec        119 MBytes          1000 Mb/s           86325
[ 5 ] 16.00-17.00 sec        119 MBytes          1.00 Gb/s           86330
[ 5 ] 17.00-18.00 sec        119 MBytes          1000 Mb/s           86321
[ 5 ] 18.00-19.00 sec        119 MBytes          1.00 Gb/s           86327
[ 5 ] 19.00-20.00 sec        119 MBytes          1.00 Gb/s           86327
[ 5 ] 20.00-21.00 sec        119 MBytes          1.00 Gb/s           86327
[ 5 ] 21.00-22.00 sec        119 MBytes          1.00 Gb/s           86327
[ 5 ] 22.00-23.00 sec        119 MBytes          1000 Mb/s           86322
[ 5 ] 23.00-24.00 sec        119 MBytes          1.00 Gb/s           86332
[ 5 ] 24.00-25.00 sec        119 MBytes          1.00 Gb/s           86330
[ 5 ] 25.00-26.00 sec        119 MBytes          1000 Mb/s           86304
[ 5 ] 26.00-27.00 sec        119 MBytes          1000 Mb/s           86321
[ 5 ] 27.00-28.00 sec        119 MBytes          1.00 Gb/s           86337
[ 5 ] 28.00-29.00 sec        119 MBytes          1000 Mb/s           86312
[ 5 ] 29.00-30.00 sec        119 MBytes          1.00 Gb/s           86331

[ ID ] Interval           Transfer             Bitrate             Jitter              Lost/Total Datagrams
[ 5 ] 0.00-30.00 sec        3.49 GBytes         1000 Mb/s           0.000 ms            0/2589717 (0%) sender
[ 5 ] 0.00-30.04 sec        1010 MBytes         282 Mb/s           0.048 ms            1858455/2589708 (72%) receiver

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

## 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 GbIts/sec  86326
[ 5] 4.00-5.00 sec  119 MBytes  1000 Mbits/sec  86322
[ 5] 5.00-6.00 sec  119 MBytes  1.00 GbIts/sec  86330
[ 5] 6.00-7.00 sec  119 MBytes  1.00 GbIts/sec  86333
[ 5] 7.00-8.00 sec  119 MBytes  1000 Mbits/sec  86316
[ 5] 8.00-9.00 sec  119 MBytes  1.00 GbIts/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 GbIts/sec  86338
[ 5] 12.00-13.00 sec 119 MBytes  1000 Mbits/sec  86322
[ 5] 13.00-14.00 sec 119 MBytes  1.00 GbIts/sec  86333
[ 5] 14.00-15.00 sec 119 MBytes  1000 Mbits/sec  86312
[ 5] 15.00-16.00 sec 119 MBytes  1.00 GbIts/sec  86334
[ 5] 16.00-17.00 sec 119 MBytes  1000 Mbits/sec  86322
[ 5] 17.00-18.00 sec 119 MBytes  1.00 GbIts/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 GbIts/sec  86331
[ 5] 22.00-23.00 sec 119 MBytes  1000 Mbits/sec  86323
[ 5] 23.00-24.00 sec 119 MBytes  1.00 GbIts/sec  86330
[ 5] 24.00-25.00 sec 119 MBytes  1.00 GbIts/sec  86331
[ 5] 25.00-26.00 sec 119 MBytes  1.00 GbIts/sec  86326
[ 5] 26.00-27.00 sec 119 MBytes  1000 Mbits/sec  86318
[ 5] 27.00-28.00 sec 119 MBytes  1.00 GbIts/sec  86342
[ 5] 28.00-29.00 sec 119 MBytes  1000 Mbits/sec  86308
[ 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  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%)

iperf Done.
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  999 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 GbIts/sec  86335
[ 5] 3.00-4.00 sec  119 MBytes  1.00 GbIts/sec  86333
[ 5] 4.00-5.00 sec  119 MBytes  1000 Mbits/sec  86307
[ 5] 5.00-6.00 sec  119 MBytes  1.00 GbIts/sec  86344
[ 5] 6.00-7.00 sec  119 MBytes  1000 Mbits/sec  86318
[ 5] 7.00-8.00 sec  119 MBytes  1.00 GbIts/sec  86337
[ 5] 8.00-9.00 sec  119 MBytes  1000 Mbits/sec  86314
[ 5] 9.00-10.00 sec  119 MBytes  1.00 GbIts/sec  86366
[ 5] 10.00-11.00 sec  119 MBytes  1000 Mbits/sec  86296
[ 5] 11.00-12.00 sec  119 MBytes  1.00 GbIts/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 GbIts/sec  86332
[ 5] 16.00-17.00 sec  119 MBytes  1.00 GbIts/sec  86334
[ 5] 17.00-18.00 sec  119 MBytes  1.00 GbIts/sec  86342
[ 5] 18.00-19.00 sec  119 MBytes  1000 Mbits/sec  86319
[ 5] 19.00-20.00 sec  119 MBytes  1.00 GbIts/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 GbIts/sec  86335
[ 5] 23.00-24.00 sec  119 MBytes  1.00 GbIts/sec  86330
[ 5] 24.00-25.00 sec  119 MBytes  1000 Mbits/sec  86319
[ 5] 25.00-26.00 sec  119 MBytes  1.00 GbIts/sec  86338
[ 5] 26.00-27.00 sec  119 MBytes  1000 Mbits/sec  86328
[ 5] 27.00-28.00 sec  119 MBytes  1.00 GbIts/sec  86341
[ 5] 28.00-29.00 sec  119 MBytes  1.00 GbIts/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  85488/86319 (99%)
[ 5] 9.00-10.00 sec  1.16 MBytes  9.72 Mbits/sec  1.184 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  85529/86368 (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%)

iperf Done.
Server listening on 5201
  
```

## Ograniczenie pasma do 1Mbps 30s (UDP iperf)

```

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

[ ID] Interval Transfer Bitrate Total Datagrams
[ 5] 0.00-30.00 sec 3.49 GBytes 1000 Mb/s/sec 0.000 ms 0/2589738 (0%) sender
[ 5] 0.00-41.92 sec 4.86 MBytes 972 kb/s/sec 0.147 ms 2585788/2589304 (1e+02%) r

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

[ 5] 11.00-12.00 sec 119 KBytes 973 kb/s/sec 8.644 ms 5244/5328 (98%)
[ 5] 12.00-13.00 sec 119 KBytes 973 kb/s/sec 0.180 ms 86341/86425 (1e+02%)
[ 5] 13.00-14.00 sec 119 KBytes 973 kb/s/sec 0.327 ms 86323/86407 (1e+02%)
[ 5] 14.00-15.00 sec 119 KBytes 973 kb/s/sec 0.225 ms 86370/86454 (1e+02%)
[ 5] 15.00-16.00 sec 119 KBytes 973 kb/s/sec 0.225 ms 86361/86445 (1e+02%)
[ 5] 16.00-17.00 sec 119 KBytes 973 kb/s/sec 0.255 ms 86323/86407 (1e+02%)
[ 5] 17.00-18.00 sec 117 KBytes 961 kb/s/sec 0.257 ms 85299/85382 (1e+02%)
[ 5] 18.00-19.00 sec 119 KBytes 973 kb/s/sec 0.201 ms 86371/86455 (1e+02%)
[ 5] 19.00-20.00 sec 119 KBytes 973 kb/s/sec 0.197 ms 86380/86464 (1e+02%)
[ 5] 20.00-21.00 sec 119 KBytes 973 kb/s/sec 15.365 ms 102895/102899 (1e+02%)
[ 5] 21.00-22.00 sec 119 KBytes 973 kb/s/sec 11.929 ms 0/84 (0%)
[ 5] 22.00-23.00 sec 119 KBytes 973 kb/s/sec 11.918 ms 0/84 (0%)
[ 5] 23.00-24.00 sec 119 KBytes 973 kb/s/sec 11.923 ms 0/84 (0%)
[ 5] 24.00-25.00 sec 117 KBytes 961 kb/s/sec 11.922 ms 0/83 (0%)
[ 5] 25.00-26.00 sec 119 KBytes 973 kb/s/sec 11.911 ms 0/84 (0%)
[ 5] 26.00-27.00 sec 119 KBytes 973 kb/s/sec 11.995 ms 0/84 (0%)
[ 5] 27.00-28.00 sec 119 KBytes 973 kb/s/sec 11.911 ms 0/84 (0%)
[ 5] 28.00-29.00 sec 119 KBytes 973 kb/s/sec 11.910 ms 0/84 (0%)
[ 5] 29.00-30.00 sec 119 KBytes 973 kb/s/sec 11.907 ms 0/84 (0%)
[ 5] 30.00-31.00 sec 119 KBytes 973 kb/s/sec 11.898 ms 0/84 (0%)
[ 5] 31.00-32.00 sec 119 KBytes 973 kb/s/sec 7.989 ms 6599/6683 (99%)
[ 5] 32.00-33.00 sec 119 KBytes 973 kb/s/sec 0.267 ms 86331/86415 (1e+02%)
[ 5] 33.00-34.00 sec 117 KBytes 961 kb/s/sec 0.183 ms 85295/85378 (1e+02%)
[ 5] 34.00-35.00 sec 119 KBytes 973 kb/s/sec 0.140 ms 86411/86495 (1e+02%)
[ 5] 35.00-36.00 sec 119 KBytes 973 kb/s/sec 0.175 ms 86330/86414 (1e+02%)
[ 5] 36.00-37.00 sec 119 KBytes 973 kb/s/sec 0.312 ms 86322/86406 (1e+02%)
[ 5] 37.00-38.00 sec 119 KBytes 973 kb/s/sec 0.353 ms 86351/86435 (1e+02%)
[ 5] 38.00-39.00 sec 119 KBytes 973 kb/s/sec 0.159 ms 86388/86472 (1e+02%)
[ 5] 39.00-40.00 sec 119 KBytes 973 kb/s/sec 0.164 ms 86338/86422 (1e+02%)
[ 5] 40.00-41.00 sec 119 KBytes 973 kb/s/sec 0.214 ms 86307/86391 (1e+02%)
[ 5] 41.00-41.92 sec 109 KBytes 974 kb/s/sec 0.147 ms 79199/79276 (1e+02%)

[ ID] Interval Transfer Bitrate Jitter Lost/Total Datagrams
[ 5] 0.00-41.92 sec 4.86 MBytes 972 kb/s/sec 0.147 ms 2585788/2589304 (1e+02%) receiver

Server Listening on 5201
  
```

## Test bez ograniczenia 30s (TCP iperf)

```

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

[ ID] Interval Transfer Bitrate Retr Cwnd
[ 5] 0.00-30.00 sec 36.1 GBytes 10.3 Gb/s/sec 2 3.16 MBytes
[ 5] 0.00-30.00 sec 36.1 GBytes 10.3 Gb/s/sec 2 3.16 MBytes

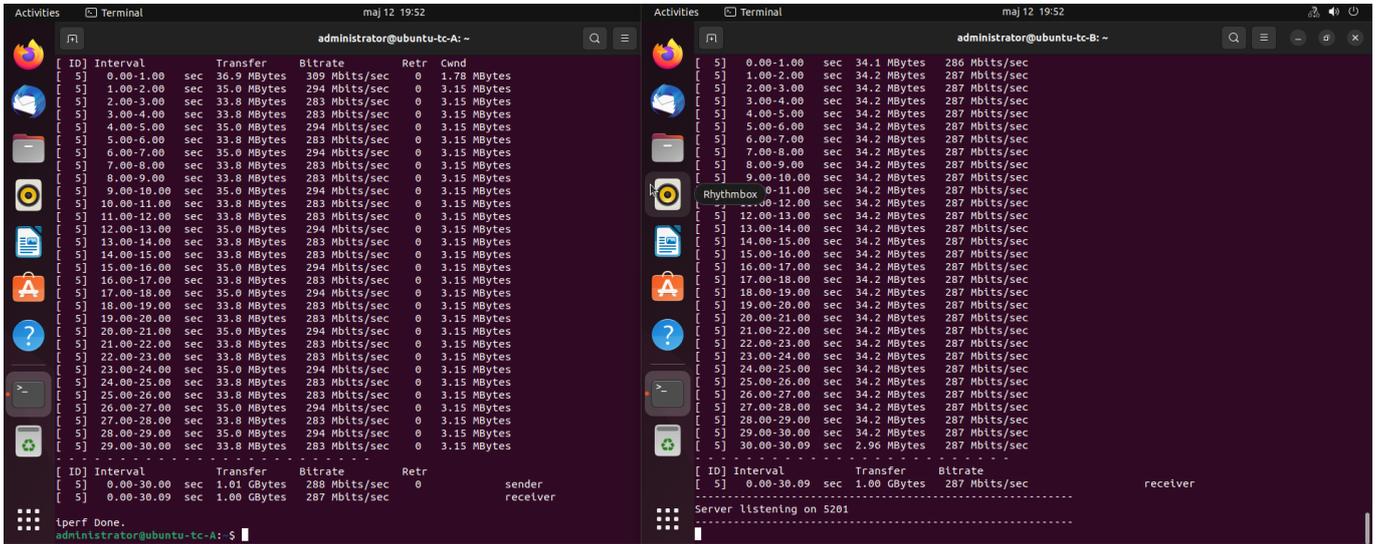
iperf Done.
administrator@ubuntu-tc-A:~$

[ 5] 0.00-1.00 sec 1.17 GBytes 10.0 Gb/s/sec
[ 5] 1.00-2.00 sec 1.25 GBytes 10.8 Gb/s/sec
[ 5] 2.00-3.00 sec 1.29 GBytes 11.1 Gb/s/sec
[ 5] 3.00-4.00 sec 1.27 GBytes 10.9 Gb/s/sec
[ 5] 4.00-5.00 sec 1.26 GBytes 10.9 Gb/s/sec
[ 5] 5.00-6.00 sec 1.26 GBytes 10.8 Gb/s/sec
[ 5] 6.00-7.00 sec 1.27 GBytes 10.9 Gb/s/sec
[ 5] 7.00-8.00 sec 1.25 GBytes 10.7 Gb/s/sec
[ 5] 8.00-9.00 sec 1.24 GBytes 10.7 Gb/s/sec
[ 5] 9.00-10.00 sec 1.26 GBytes 10.8 Gb/s/sec
[ 5] 10.00-11.00 sec 1.23 GBytes 10.5 Gb/s/sec
[ 5] 11.00-12.00 sec 1.22 GBytes 10.4 Gb/s/sec
[ 5] 12.00-13.00 sec 1.25 GBytes 10.7 Gb/s/sec
[ 5] 13.00-14.00 sec 1.20 GBytes 10.3 Gb/s/sec
[ 5] 14.00-15.00 sec 1.05 GBytes 9.01 Gb/s/sec
[ 5] 15.00-16.00 sec 1.17 GBytes 10.0 Gb/s/sec
[ 5] 16.00-17.00 sec 1.19 GBytes 10.2 Gb/s/sec
[ 5] 17.00-18.00 sec 1.17 GBytes 10.1 Gb/s/sec
[ 5] 18.00-19.00 sec 1.18 GBytes 10.1 Gb/s/sec
[ 5] 19.00-20.00 sec 1.18 GBytes 10.1 Gb/s/sec
[ 5] 20.00-21.00 sec 1.18 GBytes 10.1 Gb/s/sec
[ 5] 21.00-22.00 sec 1.21 GBytes 10.4 Gb/s/sec
[ 5] 22.00-23.00 sec 1.13 GBytes 9.73 Gb/s/sec
[ 5] 23.00-24.00 sec 1.13 GBytes 9.68 Gb/s/sec
[ 5] 24.00-25.00 sec 1.06 GBytes 9.08 Gb/s/sec
[ 5] 25.00-26.00 sec 1.25 GBytes 10.7 Gb/s/sec
[ 5] 26.00-27.00 sec 1.19 GBytes 10.2 Gb/s/sec
[ 5] 27.00-28.00 sec 1.17 GBytes 10.1 Gb/s/sec
[ 5] 28.00-29.00 sec 1.21 GBytes 10.4 Gb/s/sec
[ 5] 29.00-30.00 sec 1.24 GBytes 10.6 Gb/s/sec
[ 5] 30.00-30.00 sec 506 KBytes 8.62 Gb/s/sec

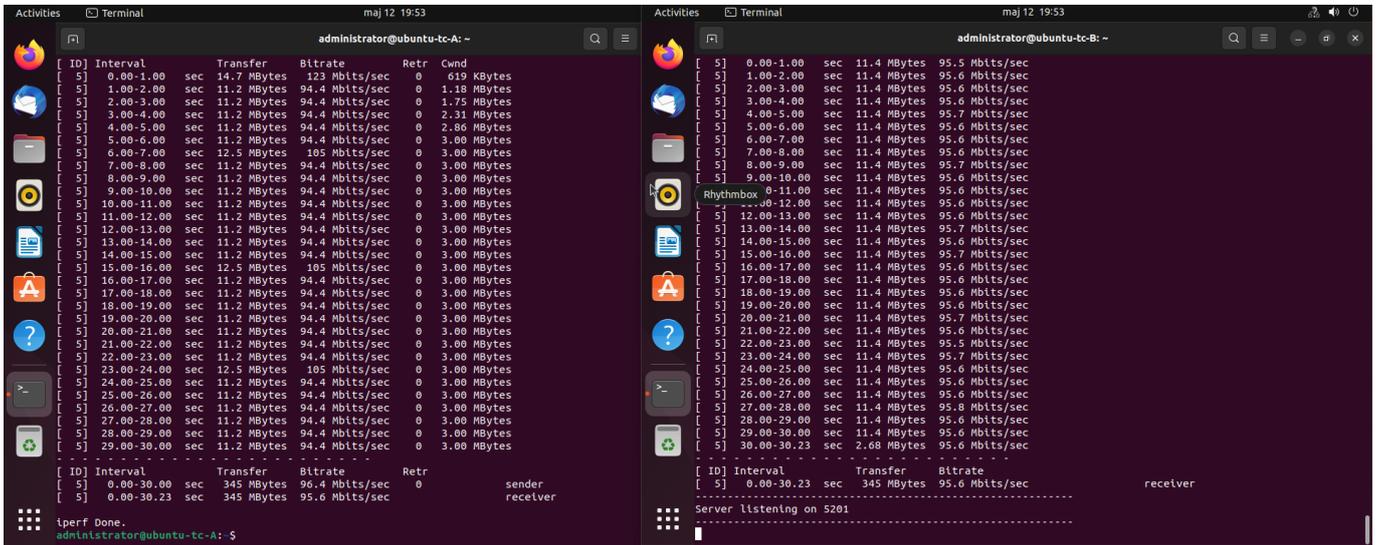
[ ID] Interval Transfer Bitrate
[ 5] 0.00-30.00 sec 36.1 GBytes 10.3 Gb/s/sec
[ 5] 0.00-30.00 sec 36.1 GBytes 10.3 Gb/s/sec

Server Listening on 5201
  
```

## Ograniczenie pasma do 300Mbps 30s (TCP iperf)



## Ograniczenie pasma do 100Mbps 30s (TCP iperf)



## Ograniczenie pasma do 10Mbps 30s (TCP iperf)

```
adminstrator@ubuntu-tc-A: ~  
[ ID] Interval      Transfer      Bitrate      Retr      Cwnd  
[ 5] 0.00-1.00    sec 2.26 MBytes  18.9 Mbits/sec  0      394 KBytes  
[ 5] 1.00-2.00    sec 1.25 MBytes  10.5 Mbits/sec  0      352 KBytes  
[ 5] 2.00-3.00    sec 1.48 MBytes  12.5 Mbits/sec  0      410 KBytes  
[ 5] 3.00-4.00    sec 1.72 MBytes  14.4 Mbits/sec  0      468 KBytes  
[ 5] 4.00-5.00    sec 1.01 MBytes  8.40 Mbits/sec  0      527 KBytes  
[ 5] 5.00-6.00    sec 2.20 MBytes  18.5 Mbits/sec  0      585 KBytes  
[ 5] 6.00-7.00    sec 1.25 MBytes  10.5 Mbits/sec  0      643 KBytes  
[ 5] 7.00-8.00    sec 1.25 MBytes  10.5 Mbits/sec  0      703 KBytes  
[ 5] 8.00-9.00    sec 1.25 MBytes  10.5 Mbits/sec  0      761 KBytes  
[ 5] 9.00-10.00   sec 1.25 MBytes  10.5 Mbits/sec  0      819 KBytes  
[ 5] 10.00-11.00  sec 0.00 Bytes   0.00 bits/sec  0      882 KBytes  
[ 5] 11.00-12.00  sec 1.25 MBytes  10.5 Mbits/sec  0      1.00 MBytes  
[ 5] 12.00-13.00  sec 1.25 MBytes  10.5 Mbits/sec  0      1.19 MBytes  
[ 5] 13.00-14.00  sec 1.25 MBytes  10.5 Mbits/sec  0      1.42 MBytes  
[ 5] 14.00-15.00  sec 1.25 MBytes  10.5 Mbits/sec  0      1.68 MBytes  
[ 5] 15.00-16.00  sec 1.25 MBytes  10.5 Mbits/sec  0      1.97 MBytes  
[ 5] 16.00-17.00  sec 1.25 MBytes  10.5 Mbits/sec  0      2.28 MBytes  
[ 5] 17.00-18.00  sec 0.00 Bytes   0.00 bits/sec  0      2.66 MBytes  
[ 5] 18.00-19.00  sec 1.25 MBytes  10.5 Mbits/sec  0      3.04 MBytes  
[ 5] 19.00-20.00  sec 1.25 MBytes  10.5 Mbits/sec  0      3.10 MBytes  
[ 5] 20.00-21.00  sec 1.25 MBytes  10.5 Mbits/sec  0      2.44 MBytes  
[ 5] 21.00-22.00  sec 0.00 Bytes   0.00 bits/sec  144    1.08 MBytes  
[ 5] 22.00-23.00  sec 2.50 MBytes  21.0 Mbits/sec  0      2.17 MBytes  
[ 5] 23.00-24.00  sec 1.25 MBytes  10.5 Mbits/sec  0      2.22 MBytes  
[ 5] 24.00-25.00  sec 1.25 MBytes  10.5 Mbits/sec  0      2.33 MBytes  
[ 5] 25.00-26.00  sec 1.25 MBytes  10.5 Mbits/sec  0      2.46 MBytes  
[ 5] 26.00-27.00  sec 1.25 MBytes  10.5 Mbits/sec  0      2.58 MBytes  
[ 5] 27.00-28.00  sec 1.25 MBytes  10.5 Mbits/sec  0      2.69 MBytes  
[ 5] 28.00-29.00  sec 0.00 Bytes   0.00 bits/sec  0      2.79 MBytes  
[ 5] 29.00-30.00  sec 1.25 MBytes  10.5 Mbits/sec  0      2.86 MBytes  
[ ID] Interval      Transfer      Bitrate      Retr      Cwnd  
[ 5] 0.00-30.00   sec 36.2 MBytes 10.1 Mbits/sec  152  
[ 5] 0.00-31.70   sec 35.9 MBytes  9.49 Mbits/sec  
iperf Done.  
adminstrator@ubuntu-tc-A: $
```

```
adminstrator@ubuntu-tc-B: ~  
[ 5] 1.00-2.00    sec 1.14 MBytes  9.56 Mbits/sec  
[ 5] 2.00-3.00    sec 1.14 MBytes  9.58 Mbits/sec  
[ 5] 3.00-4.00    sec 1.14 MBytes  9.56 Mbits/sec  
[ 5] 4.00-5.00    sec 1.14 MBytes  9.56 Mbits/sec  
[ 5] 5.00-6.00    sec 1.14 MBytes  9.57 Mbits/sec  
[ 5] 6.00-7.00    sec 1.14 MBytes  9.58 Mbits/sec  
[ 5] 7.00-8.00    sec 1.14 MBytes  9.58 Mbits/sec  
[ 5] 8.00-9.00    sec 1.14 MBytes  9.56 Mbits/sec  
[ 5] 9.00-10.00   sec 1.14 MBytes  9.58 Mbits/sec  
[ 5] 10.00-11.00  sec 1.14 MBytes  9.55 Mbits/sec  
[ 5] 11.00-12.00  sec 1.14 MBytes  9.58 Mbits/sec  
[ 5] 12.00-13.00  sec 1.14 MBytes  9.56 Mbits/sec  
[ 5] 13.00-14.00  sec 1.14 MBytes  9.56 Mbits/sec  
[ 5] 14.00-15.00  sec 1.14 MBytes  9.58 Mbits/sec  
[ 5] 15.00-16.00  sec 1.14 MBytes  9.55 Mbits/sec  
[ 5] 16.00-17.00  sec 1.14 MBytes  9.58 Mbits/sec  
[ 5] 17.00-18.00  sec 1.14 MBytes  9.58 Mbits/sec  
[ 5] 18.00-19.00  sec 1.14 MBytes  9.58 Mbits/sec  
[ 5] 19.00-20.00  sec 1.14 MBytes  9.56 Mbits/sec  
[ 5] 20.00-21.00  sec 837 KBytes  6.86 Mbits/sec  
[ 5] 21.00-22.00  sec 0.00 Bytes   0.00 bits/sec  
[ 5] 22.00-23.00  sec 2.60 MBytes  21.9 Mbits/sec  
[ 5] 23.00-24.00  sec 1.14 MBytes  9.53 Mbits/sec  
[ 5] 24.00-25.00  sec 1.14 MBytes  9.58 Mbits/sec  
[ 5] 25.00-26.00  sec 1.14 MBytes  9.58 Mbits/sec  
[ 5] 26.00-27.00  sec 1.14 MBytes  9.56 Mbits/sec  
[ 5] 27.00-28.00  sec 1.14 MBytes  9.56 Mbits/sec  
[ 5] 28.00-29.00  sec 1.14 MBytes  9.58 Mbits/sec  
[ 5] 29.00-30.00  sec 1.14 MBytes  9.56 Mbits/sec  
[ 5] 30.00-31.00  sec 1.14 MBytes  9.57 Mbits/sec  
[ 5] 31.00-31.70  sec 537 KBytes  6.33 Mbits/sec  
[ ID] Interval      Transfer      Bitrate  
[ 5] 0.00-31.70   sec 35.9 MBytes  9.49 Mbits/sec  
Server listening on 5201
```

## Ograniczenie pasma do 1Mbps 30s (TCP iperf)

```
adminstrator@ubuntu-tc-A: ~  
[ ID] Interval      Transfer      Bitrate      Retr      Cwnd  
[ 5] 0.00-1.00    sec 379 KBytes  3.10 Mbits/sec  0      56.6 KBytes  
[ 5] 1.00-2.00    sec 146 KBytes  1.19 Mbits/sec  0      62.2 KBytes  
[ 5] 2.00-3.00    sec 182 KBytes  1.49 Mbits/sec  0      67.9 KBytes  
[ 5] 3.00-4.00    sec 182 KBytes  1.49 Mbits/sec  0      74.9 KBytes  
[ 5] 4.00-5.00    sec 243 KBytes  1.99 Mbits/sec  0      91.9 KBytes  
[ 5] 5.00-6.00    sec 0.00 Bytes   0.00 bits/sec  0      123 KBytes  
[ 5] 6.00-7.00    sec 304 KBytes  2.49 Mbits/sec  0      164 KBytes  
[ 5] 7.00-8.00    sec 365 KBytes  2.99 Mbits/sec  0      222 KBytes  
[ 5] 8.00-9.00    sec 406 KBytes  3.39 Mbits/sec  0      280 KBytes  
[ 5] 9.00-10.00   sec 609 KBytes  5.40 Mbits/sec  0      339 KBytes  
[ 5] 10.00-11.00  sec 0.00 Bytes   0.00 bits/sec  0      397 KBytes  
[ 5] 11.00-12.00  sec 912 KBytes  7.48 Mbits/sec  0      455 KBytes  
[ 5] 12.00-13.00  sec 0.00 Bytes   0.00 bits/sec  0      515 KBytes  
[ 5] 13.00-14.00  sec 0.00 Bytes   0.00 bits/sec  0      573 KBytes  
[ 5] 14.00-15.00  sec 1.19 MBytes  9.97 Mbits/sec  0      631 KBytes  
[ 5] 15.00-16.00  sec 0.00 Bytes   0.00 bits/sec  0      689 KBytes  
[ 5] 16.00-17.00  sec 0.00 Bytes   0.00 bits/sec  0      748 KBytes  
[ 5] 17.00-18.00  sec 0.00 Bytes   0.00 bits/sec  0      806 KBytes  
[ 5] 18.00-19.00  sec 0.00 Bytes   0.00 bits/sec  0      864 KBytes  
[ 5] 19.00-20.00  sec 0.00 Bytes   0.00 bits/sec  0      922 KBytes  
[ 5] 20.00-21.00  sec 0.00 Bytes   0.00 bits/sec  0      980 KBytes  
[ 5] 21.00-22.00  sec 0.00 Bytes   0.00 bits/sec  0      1.01 MBytes  
[ 5] 22.00-23.00  sec 0.00 Bytes   0.00 bits/sec  0      1.07 MBytes  
[ 5] 23.00-24.00  sec 0.00 Bytes   0.00 bits/sec  0      1.13 MBytes  
[ 5] 24.00-25.00  sec 0.00 Bytes   0.00 bits/sec  0      1.19 MBytes  
[ 5] 25.00-26.00  sec 1.25 MBytes  10.5 Mbits/sec  0      1.24 MBytes  
[ 5] 26.00-27.00  sec 0.00 Bytes   0.00 bits/sec  0      1.30 MBytes  
[ 5] 27.00-28.00  sec 0.00 Bytes   0.00 bits/sec  0      1.36 MBytes  
[ 5] 28.00-29.00  sec 0.00 Bytes   0.00 bits/sec  0      1.41 MBytes  
[ 5] 29.00-30.00  sec 0.00 Bytes   0.00 bits/sec  0      1.46 MBytes  
[ ID] Interval      Transfer      Bitrate      Retr  
[ 5] 0.00-30.00   sec 6.22 MBytes 1.74 Mbits/sec  0  
[ 5] 0.00-42.59   sec 4.86 MBytes  956 Kbits/sec  
iperf Done.  
adminstrator@ubuntu-tc-A: $
```

```
adminstrator@ubuntu-tc-B: ~  
[ 5] 12.00-13.00  sec 119 KBytes  973 kbits/sec  
[ 5] 13.00-14.00  sec 116 KBytes  950 kbits/sec  
[ 5] 14.00-15.00  sec 116 KBytes  950 kbits/sec  
[ 5] 15.00-16.00  sec 116 KBytes  950 kbits/sec  
[ 5] 16.00-17.00  sec 119 KBytes  973 kbits/sec  
[ 5] 17.00-18.00  sec 115 KBytes  938 kbits/sec  
[ 5] 18.00-19.00  sec 119 KBytes  973 kbits/sec  
[ 5] 19.00-20.00  sec 116 KBytes  950 kbits/sec  
[ 5] 20.00-21.00  sec 116 KBytes  950 kbits/sec  
[ 5] 21.00-22.00  sec 119 KBytes  973 kbits/sec  
[ 5] 22.00-23.00  sec 116 KBytes  950 kbits/sec  
[ 5] 23.00-24.00  sec 116 KBytes  950 kbits/sec  
[ 5] 24.00-25.00  sec 116 KBytes  950 kbits/sec  
[ 5] 25.00-26.00  sec 119 KBytes  973 kbits/sec  
[ 5] 26.00-27.00  sec 116 KBytes  950 kbits/sec  
[ 5] 27.00-28.00  sec 116 KBytes  950 kbits/sec  
[ 5] 28.00-29.00  sec 119 KBytes  973 kbits/sec  
[ 5] 29.00-30.00  sec 115 KBytes  938 kbits/sec  
[ 5] 30.00-31.00  sec 119 KBytes  973 kbits/sec  
[ 5] 31.00-32.00  sec 116 KBytes  950 kbits/sec  
[ 5] 32.00-33.00  sec 116 KBytes  950 kbits/sec  
[ 5] 33.00-34.00  sec 119 KBytes  973 kbits/sec  
[ 5] 34.00-35.00  sec 116 KBytes  950 kbits/sec  
[ 5] 35.00-36.00  sec 116 KBytes  950 kbits/sec  
[ 5] 36.00-37.00  sec 116 KBytes  950 kbits/sec  
[ 5] 37.00-38.00  sec 119 KBytes  973 kbits/sec  
[ 5] 38.00-39.00  sec 116 KBytes  950 kbits/sec  
[ 5] 39.00-40.00  sec 116 KBytes  950 kbits/sec  
[ 5] 40.00-41.00  sec 116 KBytes  950 kbits/sec  
[ 5] 41.00-42.00  sec 119 KBytes  973 kbits/sec  
[ 5] 42.00-42.59  sec 69.3 KBytes 964 kbits/sec  
[ ID] Interval      Transfer      Bitrate  
[ 5] 0.00-42.59   sec 4.86 MBytes  956 Kbits/sec  
Server listening on 5201
```

Test łącza 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
[ ID] Interval      Transfer      Bitrate      Retr  Cwnd
[ 5] 0.00-30.00   sec  529 KBytes  144 Kbits/sec  23  sender
[ 5] 0.00-31.20   sec  313 KBytes  82.0 Kbits/sec  receiver

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
[ ID] Interval      Transfer      Bitrate
[ 5] 0.00-31.20   sec  313 KBytes  82.0 Kbits/sec

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 Gbts/sec 172598
[ 5 ] 2.00-3.00     sec 119 Mbytes 1.00 Gbts/sec 86329
[ 5 ] 3.00-4.00     sec 119 Mbytes 1000 Mbts/sec 86319
[ 5 ] 4.00-5.00     sec 119 Mbytes 1.00 Gbts/sec 86351
[ 5 ] 5.00-6.00     sec 119 Mbytes 1000 Mbts/sec 86297
[ 5 ] 6.00-7.00     sec 119 Mbytes 1000 Mbts/sec 86321
[ 5 ] 7.00-8.00     sec 119 Mbytes 1.00 Gbts/sec 86328
[ 5 ] 8.00-9.00     sec 119 Mbytes 1.00 Gbts/sec 86337
[ 5 ] 9.00-10.00    sec 119 Mbytes 1000 Mbts/sec 86324
[ 5 ] 10.00-11.00   sec 119 Mbytes 1000 Mbts/sec 86321
[ 5 ] 11.00-12.00   sec 119 Mbytes 1.00 Gbts/sec 86343
[ 5 ] 12.00-13.00   sec 119 Mbytes 1000 Mbts/sec 86310
[ 5 ] 13.00-14.00   sec 119 Mbytes 1.00 Gbts/sec 86328
[ 5 ] 14.00-15.00   sec 119 Mbytes 1.00 Gbts/sec 86328
[ 5 ] 15.00-16.00   sec 119 Mbytes 1000 Mbts/sec 86321
[ 5 ] 16.00-17.00   sec 119 Mbytes 1.00 Gbts/sec 86331
[ 5 ] 17.00-18.00   sec 119 Mbytes 1.00 Gbts/sec 86331
[ 5 ] 18.00-19.00   sec 119 Mbytes 1000 Mbts/sec 86324
[ 5 ] 19.00-20.00   sec 119 Mbytes 1000 Mbts/sec 86321
[ 5 ] 20.00-21.00   sec 119 Mbytes 1000 Mbts/sec 86322
[ 5 ] 21.00-22.00   sec 119 Mbytes 1.00 Gbts/sec 86329
[ 5 ] 22.00-23.00   sec 119 Mbytes 1.00 Gbts/sec 86326
[ 5 ] 23.00-24.00   sec 119 Mbytes 1.00 Gbts/sec 86334
[ 5 ] 24.00-25.00   sec 119 Mbytes 1000 Mbts/sec 86324
[ 5 ] 25.00-26.00   sec 119 Mbytes 1.00 Gbts/sec 86333
[ 5 ] 26.00-27.00   sec 119 Mbytes 1000 Mbts/sec 86306
[ 5 ] 27.00-28.00   sec 119 Mbytes 1.00 Gbts/sec 86342
[ 5 ] 28.00-29.00   sec 119 Mbytes 1000 Mbts/sec 86321
[ 5 ] 29.00-30.00   sec 119 Mbytes 1000 Mbts/sec 86325
[ 5 ] 0.00-30.00   sec 3.49 Gbytes 1000 Mbts/sec 0.000 ms 0/2589724 (0%) sender
[ 5 ] 0.00-31.79   sec 29.5 Mbytes 7.79 Mbts/sec 0.240 ms 2568223/2589610 (99%) receiver

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

```

```

[ 5 ] 1.00-2.00     sec 0.00 Bytes 0.00 bts/sec 0.000 ms 0/0 (0%)
[ 5 ] 2.00-3.00     sec 635 Kbytes 5.21 Mbts/sec 1.320 ms 69/518 (13%)
[ 5 ] 3.00-4.00     sec 1.04 Mbytes 8.73 Mbts/sec 1.260 ms 189195/189949 (1e+02%)
[ 5 ] 4.00-5.00     sec 1.05 Mbytes 8.80 Mbts/sec 0.243 ms 85629/86380 (99%)
[ 5 ] 5.00-6.00     sec 1.04 Mbytes 8.72 Mbts/sec 0.249 ms 85598/86351 (99%)
[ 5 ] 6.00-7.00     sec 1.06 Mbytes 8.87 Mbts/sec 0.301 ms 85578/86341 (99%)
[ 5 ] 7.00-8.00     sec 1.05 Mbytes 8.82 Mbts/sec 0.271 ms 85428/86189 (99%)
[ 5 ] 8.00-9.00     sec 1.05 Mbytes 8.78 Mbts/sec 0.247 ms 85583/86341 (99%)
[ 5 ] 9.00-10.00    sec 1.02 Mbytes 8.56 Mbts/sec 0.314 ms 85617/86356 (99%)
[ 5 ] 10.00-11.00   sec 1.04 Mbytes 8.74 Mbts/sec 0.248 ms 85572/86326 (99%)
[ 5 ] 11.00-12.00   sec 1.04 Mbytes 8.70 Mbts/sec 0.330 ms 85380/86331 (99%)
[ 5 ] 12.00-13.00   sec 1.03 Mbytes 8.68 Mbts/sec 0.300 ms 85370/86327 (99%)
[ 5 ] 13.00-14.00   sec 1.04 Mbytes 8.70 Mbts/sec 0.272 ms 85571/86322 (99%)
[ 5 ] 14.00-15.00   sec 1.04 Mbytes 8.71 Mbts/sec 0.301 ms 85579/86331 (99%)
[ 5 ] 15.00-16.00   sec 1.05 Mbytes 8.82 Mbts/sec 0.294 ms 85558/86319 (99%)
[ 5 ] 16.00-17.00   sec 1.03 Mbytes 8.64 Mbts/sec 0.287 ms 85591/86337 (99%)
[ 5 ] 17.00-18.00   sec 1.04 Mbytes 8.70 Mbts/sec 0.291 ms 85548/86286 (99%)
[ 5 ] 18.00-19.00   sec 1.04 Mbytes 8.76 Mbts/sec 0.266 ms 85577/86333 (99%)
[ 5 ] 19.00-20.00   sec 1.06 Mbytes 8.86 Mbts/sec 0.243 ms 85577/86342 (99%)
[ 5 ] 20.00-21.00   sec 1.01 Mbytes 8.44 Mbts/sec 0.277 ms 85578/86307 (99%)
[ 5 ] 21.00-22.00   sec 1.05 Mbytes 8.77 Mbts/sec 0.265 ms 85598/86355 (99%)
[ 5 ] 22.00-23.00   sec 1.05 Mbytes 8.70 Mbts/sec 0.276 ms 85548/86380 (99%)
[ 5 ] 23.00-24.00   sec 1.04 Mbytes 8.70 Mbts/sec 0.267 ms 85640/86391 (99%)
[ 5 ] 24.00-25.00   sec 1.07 Mbytes 8.94 Mbts/sec 0.265 ms 85581/86353 (99%)
[ 5 ] 25.00-26.00   sec 332 Kbytes 2.72 Mbts/sec 0.246 ms 25828/26063 (99%)
[ 5 ] 26.00-27.00   sec 693 Kbytes 5.68 Mbts/sec 1.250 ms 148269/148758 (1e+02%)
[ 5 ] 27.00-28.00   sec 1.02 Mbytes 8.55 Mbts/sec 0.265 ms 91330/92074 (99%)
[ 5 ] 28.00-29.00   sec 1.05 Mbytes 8.77 Mbts/sec 0.265 ms 85565/86322 (99%)
[ 5 ] 29.00-30.00   sec 1.05 Mbytes 8.84 Mbts/sec 0.280 ms 85565/86328 (99%)
[ 5 ] 30.00-31.00   sec 1.09 Mbytes 8.78 Mbts/sec 0.279 ms 85573/86331 (99%)
[ 5 ] 31.00-31.79   sec 853 Kbytes 6.83 Mbts/sec 0.240 ms 67730/68333 (99%)

Server listening on 5201

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# Test łącza w obie strony 60Mbps, opóźnienie 600ms, utrata 5% (UDP iperf)

```

[ 5 ] Interval      Transfer      Bitrate      Total Datagrams
[ 5 ] 0.00-1.00     sec 119 Mbytes 999 Mbts/sec 86263
[ 5 ] 1.00-2.00     sec 119 Mbytes 1.00 Gbts/sec 86329
[ 5 ] 2.00-3.00     sec 119 Mbytes 1000 Mbts/sec 86321
[ 5 ] 3.00-4.00     sec 119 Mbytes 1.00 Gbts/sec 86338
[ 5 ] 4.00-5.00     sec 119 Mbytes 1000 Mbts/sec 86314
[ 5 ] 5.00-6.00     sec 119 Mbytes 1.00 Gbts/sec 86334
[ 5 ] 6.00-7.00     sec 119 Mbytes 1000 Mbts/sec 86326
[ 5 ] 7.00-8.00     sec 119 Mbytes 1000 Mbts/sec 86318
[ 5 ] 8.00-9.00     sec 119 Mbytes 1.00 Gbts/sec 86337
[ 5 ] 9.00-10.00    sec 119 Mbytes 1.00 Gbts/sec 86328
[ 5 ] 10.00-11.00   sec 119 Mbytes 1000 Mbts/sec 86310
[ 5 ] 11.00-12.00   sec 119 Mbytes 1.00 Gbts/sec 86342
[ 5 ] 12.00-13.00   sec 119 Mbytes 1.00 Gbts/sec 86332
[ 5 ] 13.00-14.00   sec 119 Mbytes 1000 Mbts/sec 86313
[ 5 ] 14.00-15.00   sec 119 Mbytes 1.00 Gbts/sec 86327
[ 5 ] 15.00-16.00   sec 119 Mbytes 1.00 Gbts/sec 86334
[ 5 ] 16.00-17.00   sec 119 Mbytes 1000 Mbts/sec 86314
[ 5 ] 17.00-18.00   sec 119 Mbytes 1.00 Gbts/sec 86337
[ 5 ] 18.00-19.00   sec 119 Mbytes 1000 Mbts/sec 86323
[ 5 ] 19.00-20.00   sec 119 Mbytes 1000 Mbts/sec 86312
[ 5 ] 20.00-21.00   sec 119 Mbytes 1.00 Gbts/sec 86341
[ 5 ] 21.00-22.00   sec 119 Mbytes 1.00 Gbts/sec 86326
[ 5 ] 22.00-23.00   sec 119 Mbytes 1000 Mbts/sec 86319
[ 5 ] 23.00-24.00   sec 119 Mbytes 1.00 Gbts/sec 86331
[ 5 ] 24.00-25.00   sec 119 Mbytes 1.00 Gbts/sec 86326
[ 5 ] 25.00-26.00   sec 119 Mbytes 1000 Mbts/sec 86316
[ 5 ] 26.00-27.00   sec 119 Mbytes 1.00 Gbts/sec 86377
[ 5 ] 27.00-28.00   sec 119 Mbytes 1000 Mbts/sec 86304
[ 5 ] 28.00-29.00   sec 119 Mbytes 1000 Mbts/sec 86294
[ 5 ] 29.00-30.00   sec 119 Mbytes 1.00 Gbts/sec 86334
[ 5 ] 0.00-30.00   sec 3.49 Gbytes 1000 Mbts/sec 0.000 ms 0/2589720 (0%) sender
[ 5 ] 0.00-37.81   sec 66.3 Mbytes 14.7 Mbts/sec 0.266 ms 2515137/2563136 (98%) receiver

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

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[ 6 ] 7.00-8.00     sec 1.68 Mbytes 14.1 Mbts/sec 0.281 ms 54372/55591 (98%)
[ 6 ] 8.00-9.00     sec 1.38 Mbytes 11.6 Mbts/sec 0.232 ms 50950/51950 (98%)
[ 6 ] 9.00-10.00    sec 785 Kbytes 6.43 Mbts/sec 0.188 ms 141495/142520 (1e+02%)
[ 6 ] 10.00-11.00   sec 2.08 Mbytes 16.7 Mbts/sec 0.256 ms 66953/68398 (98%)
[ 6 ] 11.00-12.00   sec 2.76 Mbytes 23.2 Mbts/sec 0.290 ms 101843/103842 (98%)
[ 6 ] 12.00-13.00   sec 2.11 Mbytes 17.7 Mbts/sec 0.273 ms 94130/95658 (98%)
[ 6 ] 13.00-14.00   sec 2.03 Mbytes 17.0 Mbts/sec 0.278 ms 58569/60041 (98%)
[ 6 ] 14.00-15.00   sec 2.76 Mbytes 23.2 Mbts/sec 0.252 ms 181795/183795 (98%)
[ 6 ] 15.00-16.00   sec 2.07 Mbytes 17.4 Mbts/sec 0.292 ms 93689/95140 (98%)
[ 6 ] 16.00-17.00   sec 2.07 Mbytes 17.4 Mbts/sec 0.294 ms 59915/60514 (98%)
[ 6 ] 17.00-18.00   sec 2.76 Mbytes 23.2 Mbts/sec 0.285 ms 101766/103766 (98%)
[ 6 ] 18.00-19.00   sec 2.76 Mbytes 17.1 Mbts/sec 0.307 ms 93224/94699 (98%)
[ 6 ] 19.00-20.00   sec 2.11 Mbytes 17.7 Mbts/sec 0.309 ms 59587/61032 (98%)
[ 6 ] 20.00-21.00   sec 2.76 Mbytes 23.2 Mbts/sec 0.270 ms 181764/183764 (98%)
[ 6 ] 21.00-22.00   sec 2.00 Mbytes 16.8 Mbts/sec 0.270 ms 92737/94186 (98%)
[ 6 ] 22.00-23.00   sec 2.14 Mbytes 18.0 Mbts/sec 0.260 ms 59964/61515 (97%)
[ 6 ] 23.00-24.00   sec 2.70 Mbytes 23.2 Mbts/sec 0.272 ms 101792/103792 (98%)
[ 6 ] 24.00-25.00   sec 1.97 Mbytes 16.5 Mbts/sec 0.292 ms 92249/93665 (98%)
[ 6 ] 25.00-26.00   sec 2.15 Mbytes 18.3 Mbts/sec 0.284 ms 60489/61986 (97%)
[ 6 ] 26.00-27.00   sec 2.76 Mbytes 23.2 Mbts/sec 0.290 ms 101755/103755 (98%)
[ 6 ] 27.00-28.00   sec 1.93 Mbytes 16.2 Mbts/sec 0.265 ms 91839/93236 (99%)
[ 6 ] 28.00-29.00   sec 2.21 Mbytes 18.6 Mbts/sec 0.301 ms 60817/62420 (97%)
[ 6 ] 29.00-30.00   sec 2.76 Mbytes 23.2 Mbts/sec 0.285 ms 181754/183754 (98%)
[ 6 ] 30.00-31.00   sec 1.98 Mbytes 15.9 Mbts/sec 0.283 ms 91831/92804 (99%)
[ 6 ] 31.00-32.00   sec 2.25 Mbytes 18.8 Mbts/sec 0.268 ms 61223/62850 (97%)
[ 6 ] 32.00-33.00   sec 2.76 Mbytes 23.2 Mbts/sec 0.282 ms 101762/103762 (98%)
[ 6 ] 33.00-34.00   sec 1.88 Mbytes 15.6 Mbts/sec 0.294 ms 91027/92373 (99%)
[ 6 ] 34.00-35.00   sec 2.28 Mbytes 19.2 Mbts/sec 0.266 ms 61620/63274 (99%)
[ 6 ] 35.00-36.00   sec 0.00 Bytes 0.00 bts/sec 0.266 ms 0/0 (0%)
[ 6 ] 36.00-37.00   sec 0.00 Bytes 0.00 bts/sec 0.266 ms 0/0 (0%)
[ 6 ] 37.00-37.81   sec 0.00 Bytes 0.00 bts/sec 0.266 ms 0/0 (0%)

Server listening on 5201

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