

Лабораторная работа 2

Измерение и тестирование пропускной способности сети

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Информация

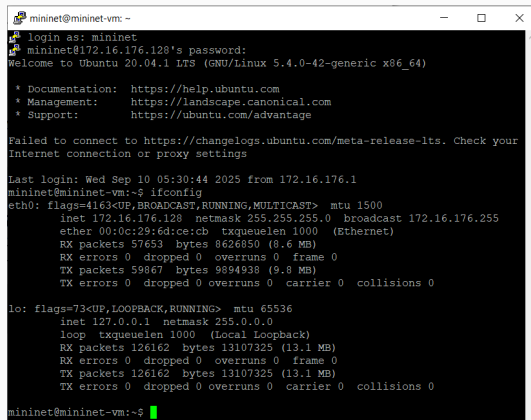
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Основной целью работы является знакомство с инструментом для измерения пропускной способности сети в режиме реального времени – iPerf3, а также получение навыков проведения интерактивного эксперимента по измерению пропускной способности моделируемой сети в среде Mininet.

1. Установить на виртуальную машину mininet iPerf3 и дополнительное программное обеспечения для визуализации и обработки данных.
2. Провести ряд интерактивных экспериментов по измерению пропускной способности с помощью iPerf3 с построением графиков.

Выполнение лабораторной работы

Выполнение лабораторной работы

A terminal window titled 'mininet@mininet-vm: ~' with standard window controls. The terminal shows a login sequence for 'mininet' on '172.16.176.128' with password 'mininet'. It displays the Ubuntu 20.04.1 LTS welcome message and system information. After a failed connection to the Ubuntu changelogs, it shows the last login time. The user then runs 'ifconfig', displaying details for the 'eth0' interface (IP: 172.16.176.128) and the 'lo' interface (IP: 127.0.0.1).

```
mininet@mininet-vm: ~  
login as: mininet  
mininet@172.16.176.128's password:  
Welcome to Ubuntu 20.04.1 LTS (GNU/Linux 5.4.0-42-generic x86_64)  
  
 * Documentation:  https://help.ubuntu.com  
 * Management:    https://landscape.canonical.com  
 * Support:       https://ubuntu.com/advantage  
  
Failed to connect to https://changelogs.ubuntu.com/meta-release-lts. Check your  
Internet connection or proxy settings  
  
Last login: Wed Sep 10 05:30:44 2025 from 172.16.176.1  
mininet@mininet-vm:~$ ifconfig  
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500  
        inet 172.16.176.128  netmask 255.255.255.0  broadcast 172.16.176.255  
        ether 00:0c:29:6d:ce:cb  txqueuelen 1000  (Ethernet)  
        RX packets 57653  bytes 8626850 (8.6 MB)  
        RX errors 0  dropped 0  overruns 0  frame 0  
        TX packets 59867  bytes 9894938 (9.8 MB)  
        TX errors 0  dropped 0  overruns 0  carrier 0  collisions 0  
  
lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536  
        inet 127.0.0.1  netmask 255.0.0.0  
        loop txqueuelen 1000  (Local Loopback)  
        RX packets 126162  bytes 13107325 (13.1 MB)  
        RX errors 0  dropped 0  overruns 0  frame 0  
        TX packets 126162  bytes 13107325 (13.1 MB)  
        TX errors 0  dropped 0  overruns 0  carrier 0  collisions 0  
  
mininet@mininet-vm:~$
```

Рис. 1: Просмотр адреса машины

```
Last login: Sat Sep 20 09:43:37 2025
mininet@mininet-vml:~$ sudo dhclient eth1
mininet@mininet-vml:~$ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 172.16.176.128 netmask 255.255.255.0 broadcast 172.16.176.255
    ether 00:0c:29:6d:ce:cd txqueuelen 1000 (Ethernet)
    RX packets 227 bytes 19557 (19.5 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 294 bytes 28176 (28.1 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

eth1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 172.16.18.128 netmask 255.255.255.0 broadcast 172.16.18.255
    ether 00:0c:29:6d:ce:d5 txqueuelen 1000 (Ethernet)
    RX packets 15 bytes 1863 (1.8 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 9 bytes 1260 (1.2 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
    loop txqueuelen 1000 (Local Loopback)
    RX packets 87 bytes 7830 (7.8 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 87 bytes 7830 (7.8 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

mininet@mininet-vml:~$ sudo apt-get update
Hit:1 http://us.archive.ubuntu.com/ubuntu focal InRelease
Get:2 http://us.archive.ubuntu.com/ubuntu focal-updates InRelease [128 kB]
```

Рис. 2: Активация интерфейса


```
mininet@mininet-vm:~$ sudo apt-get install iperf3
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
  libiperf0 libsctp1
Suggested packages:
  libsctp-tools
The following NEW packages will be installed:
  iperf3 libiperf0 libsctp1
0 upgraded, 3 newly installed, 0 to remove and 393 not upgraded.
Need to get 94.1 kB of archives.
After this operation, 331 kB of additional disk space will be used.
Do you want to continue? [Y/n] y
Get:1 http://us.archive.ubuntu.com/ubuntu focal/main amd64 libsctp1 amd64 1.0.18+dfsg-1 [7,876 B]
Get:2 http://us.archive.ubuntu.com/ubuntu focal/universe amd64 libiperf0 amd64 3.7-3 [72.0 kB]
Get:3 http://us.archive.ubuntu.com/ubuntu focal/universe amd64 iperf3 amd64 3.7-3 [14.2 kB]
Fetched 94.1 kB in 1s (135 kB/s)
Selecting previously unselected package libsctp1:amd64.
(Reading database ... 101729 files and directories currently installed.)
```

Рис. 3: Установка ПО

```
mininet@mininet-vm:~$ cd /tmp
mininet@mininet-vm:/tmp$ git clone https://github.com/ekfoury/iperf3_plotter.git
Cloning into 'iperf3_plotter'...
remote: Enumerating objects: 74, done.
remote: Total 74 (delta 0), reused 0 (delta 0), pack-reused 74 (from 1)
Unpacking objects: 100% (74/74), 100.09 KiB | 923.00 KiB/s, done.
mininet@mininet-vm:/tmp$ cd /tmp/iperf3_plotter
mininet@mininet-vm:/tmp/iperf3_plotter$ sudo cp plot_* /usr/bin
mininet@mininet-vm:/tmp/iperf3_plotter$ sudo cp *.sh /usr/bin
```

Рис. 4: Развертывание iperf3_plotter

```
mininet@mininet-vm:~$ sudo mn --topo=single,2 -x
*** Creating network
*** Adding controller
*** Adding hosts:
h1 h2
*** Adding switches:
s1
*** Adding links:
(h1, s1) (h2, s1)
*** Configuring hosts
h1 h2
*** Running terms on localhost:10.0
*** Starting controller
c0
*** Starting 1 switches
s1 ...
*** Starting CLI:
mininet> net
h1 h1-eth0:s1-eth1
h2 h2-eth0:s1-eth2
s1 lo: s1-eth1:h1-eth0 s1-eth2:h2-eth0
c0
mininet> links
h1-eth0<->s1-eth1 (OK OK)
h2-eth0<->s1-eth2 (OK OK)
mininet> dump
<Host h1: h1-eth0:10.0.0.1 pid=8095>
<Host h2: h2-eth0:10.0.0.2 pid=8097>
<OVSSwitch s1: lo:127.0.0.1,s1-eth1:None,s1-eth2:None pid=8102>
<Controller c0: 127.0.0.1:6653 pid=8088>
```

Рис. 5: Запуск простейшей топологии

Выполнение лабораторной работы

```
root@mininet-vn:/home/mininet# iperf3 -c 10.0.0.2
Connecting to host 10.0.0.2, port 5201
[ 7] local 10.0.0.1 port 56300 connected to 10.0.0.2 port 5201
[ ID] Interval      Transfer      Bitrate      Retr  Cwnd
[ 7] 0.00-1.00 sec  287 Mbytes  2.40 Gbits/sec  0  1.55 Mbytes
[ 7] 1.00-2.00 sec  409 Mbytes  3.43 Gbits/sec  0  1.71 Mbytes
[ 7] 2.00-3.00 sec  362 Mbytes  3.04 Gbits/sec  0  1.71 Mbytes
[ 7] 3.00-4.00 sec  411 Mbytes  3.46 Gbits/sec  0  1.71 Mbytes
[ 7] 4.00-5.00 sec  394 Mbytes  3.38 Gbits/sec  0  1.71 Mbytes
[ 7] 5.00-6.00 sec  394 Mbytes  3.31 Gbits/sec  0  1.71 Mbytes
[ 7] 6.00-7.00 sec  352 Mbytes  2.95 Gbits/sec  0  1.71 Mbytes
[ 7] 7.00-8.00 sec  404 Mbytes  3.39 Gbits/sec  0  1.80 Mbytes
[ 7] 8.00-9.00 sec  401 Mbytes  3.37 Gbits/sec  0  1.80 Mbytes
[ 7] 9.00-10.00 sec 444 Mbytes  3.72 Gbits/sec  0  1.80 Mbytes
- - - - -
[ ID] Interval      Transfer      Bitrate      Retr      sender    receiver
[ 7] 0.00-10.00 sec  3.77 Gbytes  3.24 Gbits/sec  0
[ 7] 0.00-10.00 sec  3.75 Gbytes  3.22 Gbits/sec  0

iperf Done.
root@mininet-vn:/home/mininet#
```

```
root@mininet-vn:/home/mininet# iperf3 -s
warning: this system does not seem to support IPv6 - trying IPv4
Server listening on 5201
Accepted connection from 10.0.0.1, port 56298
[ 7] local 10.0.0.2 port 5201 connected to 10.0.0.1 port 56300
[ ID] Interval      Transfer      Bitrate
[ 7] 0.00-1.00 sec  265 Mbytes  2.23 Gbits/sec
[ 7] 1.00-2.00 sec  409 Mbytes  3.42 Gbits/sec
[ 7] 2.00-3.00 sec  362 Mbytes  3.03 Gbits/sec
[ 7] 3.00-4.00 sec  412 Mbytes  3.46 Gbits/sec
[ 7] 4.00-5.00 sec  394 Mbytes  3.31 Gbits/sec
[ 7] 5.00-6.00 sec  393 Mbytes  3.29 Gbits/sec
[ 7] 6.00-7.00 sec  352 Mbytes  2.96 Gbits/sec
[ 7] 7.00-8.00 sec  404 Mbytes  3.39 Gbits/sec
[ 7] 8.00-9.00 sec  402 Mbytes  3.37 Gbits/sec
[ 7] 9.00-10.00 sec 444 Mbytes  3.72 Gbits/sec
- - - - -
[ ID] Interval      Transfer      Bitrate
[ 7] 0.00-10.00 sec  3.75 Gbytes  3.22 Gbits/sec
Server listening on 5201
```

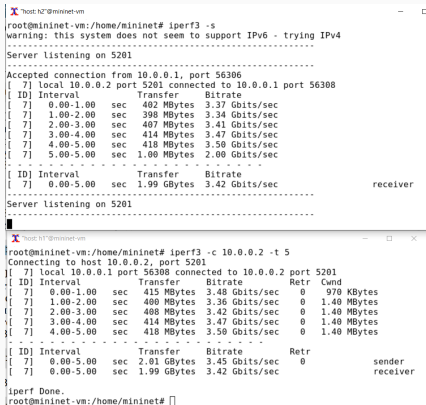
Рис. 6: Тестирование соединения

```
mininet> h2 iperf3 -s &
mininet> h1 iperf3 -c h2
Connecting to host 10.0.0.2, port 5201
[ S] local 10.0.0.1 port 56304 connected to 10.0.0.2 port 5201
[ ID] Interval      Transfer    Bitrate    Retr  Cwnd
[ S]  0.00-1.00    sec  245 MBytes  2.04 Gbits/sec  0    3.76 MBytes
[ S]  1.00-2.00    sec  189 MBytes  1.59 Gbits/sec  0    3.95 MBytes
[ S]  2.00-3.00    sec  200 MBytes  1.68 Gbits/sec  0    4.15 MBytes
[ S]  3.00-4.01    sec  179 MBytes  1.49 Gbits/sec  0    4.36 MBytes
[ S]  4.01-5.01    sec  176 MBytes  1.48 Gbits/sec  0    4.36 MBytes
[ S]  5.01-6.00    sec  175 MBytes  1.47 Gbits/sec  0    4.36 MBytes
[ S]  6.00-7.02    sec  181 MBytes  1.50 Gbits/sec  0    4.57 MBytes
[ S]  7.02-8.01    sec  166 MBytes  1.42 Gbits/sec  0    4.57 MBytes
[ S]  8.01-9.01    sec  206 MBytes  1.72 Gbits/sec  0    4.57 MBytes
[ S]  9.01-10.00   sec  198 MBytes  1.67 Gbits/sec  0    4.57 MBytes
-----
[ ID] Interval      Transfer    Bitrate    Retr
[ S]  0.00-10.00   sec  1.87 GBytes  1.61 Gbits/sec  0          sender
[ S]  0.00-10.00   sec  1.87 GBytes  1.61 Gbits/sec                  receiver

iperf Done.
mininet> h2 killall iperf3
warning: this system does not seem to support IPv6 - trying IPv4
iperf3: error - unable to start listener for connections: Address already in use
iperf3: exiting
mininet> h2 killall iperf3
iperf3: no process found
mininet>
```

Рис. 7: Тестирование соединения в интерфейсе mininet

Выполнение лабораторной работы



The image shows two terminal windows from a host named 'h2' and 'h1' on a 'mininet' VM. The top window shows the server output for iperf3, and the bottom window shows the client output for iperf3 -c 10.0.0.2 -t 5.

```
host: h2@mininet-vm
root@mininet-vm:/home/mininet# iperf3 -s
warning: this system does not seem to support IPv6 - trying IPv4
Server listening on 5201
Accepted connection from 10.0.0.1, port 56306
[ 7] local 10.0.0.2 port 5201 connected to 10.0.0.1 port 56308
[ ID] Interval      Transfer    Bitrate
[ 7] 0.00-1.00 sec   402 MBytes  3.37 Gbits/sec
[ 7] 1.00-2.00 sec   398 MBytes  3.34 Gbits/sec
[ 7] 2.00-3.00 sec   407 MBytes  3.41 Gbits/sec
[ 7] 3.00-4.00 sec   414 MBytes  3.47 Gbits/sec
[ 7] 4.00-5.00 sec   418 MBytes  3.50 Gbits/sec
[ 7] 5.00-5.00 sec   1.00 MBytes  2.00 Gbits/sec
[ ID] Interval      Transfer    Bitrate
[ 7] 0.00-5.00 sec   1.99 GBytes  3.42 Gbits/sec
Server listening on 5201

host: h1@mininet-vm
root@mininet-vm:/home/mininet# iperf3 -c 10.0.0.2 -t 5
Connecting to host 10.0.0.2, port 5201
[ 7] local 10.0.0.1 port 56308 connected to 10.0.0.2 port 5201
[ ID] Interval      Transfer    Bitrate   Retr  Cwnd
[ 7] 0.00-1.00 sec   415 MBytes  3.48 Gbits/sec    0   970 KBytes
[ 7] 1.00-2.00 sec   400 MBytes  3.36 Gbits/sec    0   1.40 MBytes
[ 7] 2.00-3.00 sec   408 MBytes  3.42 Gbits/sec    0   1.40 MBytes
[ 7] 3.00-4.00 sec   414 MBytes  3.47 Gbits/sec    0   1.40 MBytes
[ 7] 4.00-5.00 sec   418 MBytes  3.50 Gbits/sec    0   1.40 MBytes
[ ID] Interval      Transfer    Bitrate   Retr
[ 7] 0.00-5.00 sec   2.01 GBytes  3.45 Gbits/sec    0
[ 7] 0.00-5.00 sec   1.99 GBytes  3.42 Gbits/sec    0
iperf Done.
root@mininet-vm:/home/mininet#
```

Рис. 8: Указание периода времени передачи

Выполнение лабораторной работы

```
root@mininet-vm:/home/mininet#
root@mininet-vm:/home/mininet# iperf3 -s -i 2
warning: this system does not seem to support IPv6 - trying IPv4
.....
Server listening on 5201
.....
Accepted connection from 10.0.0.1, port 56310
[ 7] local 10.0.0.2 port 5201 connected to 10.0.0.1 port 56312
[ ID] Interval      Transfer    Bitrate
[ 7]  0.00-2.00 sec    739 MBytes  3.10 Gbits/sec
[ 7]  2.00-4.00 sec    805 MBytes  3.38 Gbits/sec
[ 7]  4.00-6.00 sec    790 MBytes  3.32 Gbits/sec
[ 7]  6.00-8.00 sec    855 MBytes  3.58 Gbits/sec
[ 7]  8.00-10.00 sec   717 MBytes  3.01 Gbits/sec
.....
[ ID] Interval      Transfer    Bitrate
[ 7]  0.00-10.00 sec   3.82 GBytes  3.28 Gbits/sec
receiver
X host:hl1@mininet-vm
dash: [: missing `]'
root@mininet-vm:/home/mininet# [ 7]  0.00-5.00 sec  2.01 GBytes  3.45 Gbits
/sec 0 sender
dash: [: missing `]'
root@mininet-vm:/home/mininet# [ 7]  0.00-5.00 sec  1.99 GBytes  3.42 Gbits
/sec receiver
dash: [: missing `]'
root@mininet-vm:/home/mininet#
root@mininet-vm:/home/mininet# iperf3 -c 10.0.0.2 -i 2
connecting to host 10.0.0.2, port 5201
[ 7] local 10.0.0.1 port 56312 connected to 10.0.0.2 port 5201
[ ID] Interval      Transfer    Bitrate  Retr  Cwnd
[ 7]  0.00-2.00 sec    759 MBytes  3.18 Gbits/sec  0  1.53 MBytes
[ 7]  2.00-4.00 sec    806 MBytes  3.38 Gbits/sec  0  1.69 MBytes
[ 7]  4.00-6.00 sec    791 MBytes  3.32 Gbits/sec  0  1.69 MBytes
[ 7]  6.00-8.00 sec    854 MBytes  3.58 Gbits/sec  0  1.69 MBytes
[ 7]  8.00-10.00 sec   719 MBytes  3.01 Gbits/sec  0  2.15 MBytes
.....
[ ID] Interval      Transfer    Bitrate  Retr
[ 7]  0.00-10.00 sec   3.84 GBytes  3.30 Gbits/sec  0
[ 7]  0.00-10.00 sec   3.82 GBytes  3.28 Gbits/sec
sender
receiver
```

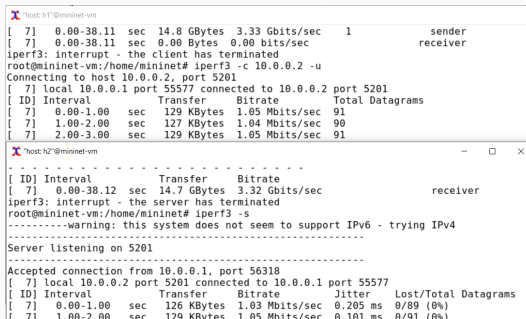
Рис. 9: Настройка двухсекундного времени отсчета

Выполнение лабораторной работы

```
host: h1" @mininet-vm
root@mininet-vm:/home/mininet# iperf3 -c 10.0.0.2 -n 16G
Connecting to host 10.0.0.2, port 5201
[ 7] local 10.0.0.1 port 56316 connected to 10.0.0.2 port 5201
[ ID] Interval           Transfer     Bitrate      Retr    Cwnd
[ 7]  0.00-1.00 sec      401 MBytes  3.36 Gbits/sec    0   1.10 MBytes
[ 7]  1.00-2.00 sec      390 MBytes  3.27 Gbits/sec    0   1.27 MBytes
[ 7]  2.00-3.00 sec      389 MBytes  3.26 Gbits/sec    0   1.47 MBytes
[ 7]  3.00-4.00 sec      358 MBytes  3.00 Gbits/sec    0   1.47 MBytes
[ 7]  4.00-5.00 sec      352 MBytes  2.96 Gbits/sec    0   1.47 MBytes
[ 7]  5.00-6.00 sec      418 MBytes  3.50 Gbits/sec    0   1.47 MBytes
[ 7]  6.00-7.00 sec      426 MBytes  3.58 Gbits/sec    0   1.47 MBytes
host: h2" @mininet-vm
-----
Server listening on 5201
-----
iperf3: interrupt - the server has terminated
root@mininet-vm:/home/mininet# iperf3 -s
warning: this system does not seem to support IPv6 - trying IPv4
-----
Server listening on 5201
-----
Accepted connection from 10.0.0.1, port 56314
[ 7] local 10.0.0.2 port 5201 connected to 10.0.0.1 port 56316
[ ID] Interval           Transfer     Bitrate
[ 7]  0.00-1.00 sec      387 MBytes  3.24 Gbits/sec
[ 7]  1.00-2.00 sec      389 MBytes  3.26 Gbits/sec
[ 7]  2.00-3.00 sec      389 MBytes  3.26 Gbits/sec
```

Рис. 10: Установки количества байт для передачи

Выполнение лабораторной работы



```
host: h1@mininet-vm
[ 7]  0.00-38.11 sec  14.8 GBytes  3.33 Gbits/sec  1          sender
[ 7]  0.00-38.11 sec  0.00 Bytes  0.00 bits/sec                                     receiver
iperf3: interrupt - the client has terminated
root@mininet-vm:/home/mininet# iperf3 -c 10.0.0.2 -u
Connecting to host 10.0.0.2, port 5201
[ 7] local 10.0.0.1 port 55577 connected to 10.0.0.2 port 5201
[ ID] Interval      Transfer      Bitrate      Total Datagrams
[ 7]  0.00-1.00 sec  129 KBytes  1.05 Mbits/sec  91
[ 7]  1.00-2.00 sec  127 KBytes  1.04 Mbits/sec  90
[ 7]  2.00-3.00 sec  129 KBytes  1.05 Mbits/sec  91

host: h2@mininet-vm
-----
[ ID] Interval      Transfer      Bitrate
[ 7]  0.00-38.12 sec  14.7 GBytes  3.32 Gbits/sec                                     receiver
iperf3: interrupt - the server has terminated
root@mininet-vm:/home/mininet# iperf3 -s
-----warning: this system does not seem to support IPv6 - trying IPv4
-----
Server listening on 5201
-----
Accepted connection from 10.0.0.1, port 56318
[ 7] local 10.0.0.2 port 5201 connected to 10.0.0.1 port 55577
[ ID] Interval      Transfer      Bitrate      Jitter      Lost/Total Datagrams
[ 7]  0.00-1.00 sec  126 KBytes  1.03 Mbits/sec  0.205 ms  0/89 (0%)
[ 7]  1.00-2.00 sec  129 KBytes  1.05 Mbits/sec  0.101 ms  0/91 (0%)
```

Рис. 11: Изменение протокола передачи

Выполнение лабораторной работы

```
root@mininet-vm:/home/mininet# iperf3 -c 10.0.0.2 -p 3250
Connecting to host 10.0.0.2, port 3250
[ 7] local 10.0.0.1 port 52164 connected to 10.0.0.2 port 3250
[ ID] Interval      Transfer    Bitrate      Retr  Cwnd
[ 7]  0.00-1.00 sec   425 MBytes  3.56 Gbits/sec  0    1.35 MBytes
[ 7]  1.00-2.00 sec   380 MBytes  3.19 Gbits/sec  0    1.35 MBytes
[ 7]  2.00-3.00 sec   390 MBytes  3.27 Gbits/sec  0    2.08 MBytes
[ 7]  3.00-4.00 sec   396 MBytes  3.32 Gbits/sec  0    2.40 MBytes
[ 7]  4.00-5.00 sec   379 MBytes  3.17 Gbits/sec  0    2.40 MBytes
[ 7]  5.00-6.00 sec   402 MBytes  3.38 Gbits/sec  0    2.40 MBytes
[ 7]  6.00-7.00 sec   290 MBytes  2.43 Gbits/sec  0    2.40 MBytes
-----
Node: h2@mininet-vm
-----
Server listening on 3250
-----
Accepted connection from 10.0.0.1, port 52162
[ 7] local 10.0.0.2 port 3250 connected to 10.0.0.1 port 52164
[ ID] Interval      Transfer    Bitrate
[ 7]  0.00-1.00 sec   404 MBytes  3.38 Gbits/sec
[ 7]  1.00-2.00 sec   381 MBytes  3.20 Gbits/sec
[ 7]  2.00-3.00 sec   386 MBytes  3.24 Gbits/sec
[ 7]  3.00-4.00 sec   395 MBytes  3.32 Gbits/sec
[ 7]  4.00-5.00 sec   378 MBytes  3.18 Gbits/sec
[ 7]  5.00-6.00 sec   403 MBytes  3.38 Gbits/sec
[ 7]  6.00-7.00 sec   289 MBytes  2.42 Gbits/sec
[ 7]  7.00-8.00 sec   387 MBytes  3.26 Gbits/sec
[ 7]  8.00-9.00 sec   396 MBytes  3.32 Gbits/sec
[ 7]  9.00-10.00 sec  362 MBytes  3.04 Gbits/sec
[ 7] 10.00-10.01 sec   896 KBytes  1.15 Gbits/sec
-----
[ ID] Interval      Transfer    Bitrate
[ 7]  0.00-10.01 sec  3.69 GBytes  3.17 Gbits/sec
-----
receiver
Server listening on 3250
```

Рис. 12: Изменение номера порта для отправки/получения пакетов или датаграмм

Выполнение лабораторной работы

```
root@mininet-vm:/home/mininet# iperf3 -c 10.0.0.2
Connecting to host 10.0.0.2, port 5201
[ 7] local 10.0.0.1 port 56330 connected to 10.0.0.2 port 5201
[ ID] Interval      Transfer    Bitrate      Retr    Cwnd
[ 7] 0.00-1.00 sec    440 MBytes  3.68 Gbits/sec  9      2.29 MBytes
[ 7] 1.00-2.00 sec    410 MBytes  3.44 Gbits/sec  0      2.29 MBytes
[ 7] 2.00-3.00 sec    438 MBytes  3.67 Gbits/sec  0      2.29 MBytes
[ 7] 3.00-4.00 sec    396 MBytes  3.32 Gbits/sec  0      2.29 MBytes
[ 7] 4.00-5.00 sec    408 MBytes  3.42 Gbits/sec  0      2.29 MBytes
[ 7] 5.00-6.00 sec    420 MBytes  3.58 Gbits/sec  0      2.29 MBytes
[ 7] 6.00-7.00 sec    444 MBytes  3.72 Gbits/sec  0      2.29 MBytes
[ 7] 7.00-8.00 sec    440 MBytes  3.69 Gbits/sec  0      2.29 MBytes
[ 7] 8.00-9.00 sec    432 MBytes  3.63 Gbits/sec  0      2.29 MBytes
[ 7] 9.00-10.00 sec   409 MBytes  3.43 Gbits/sec  0      2.29 MBytes
-----
[ ID] Interval      Transfer    Bitrate      Retr
[ 7] 0.00-10.00 sec  4.14 GBytes  3.56 Gbits/sec  9
[ 7] 0.00-10.00 sec  4.12 GBytes  3.54 Gbits/sec
sender
receiver

iperf Done.
X "Node h2" @ mininet-vm
-----
iperf3: interrupt - the server has terminated
root@mininet-vm:/home/mininet# iperf3 -s -l
warning: this system does not seem to support IPv6 - trying IPv4
-----
Server listening on 5201
-----
Accepted connection from 10.0.0.1, port 56328
[ 7] local 10.0.0.2 port 5201 connected to 10.0.0.1 port 56330
[ ID] Interval      Transfer    Bitrate
[ 7] 0.00-1.00 sec    414 MBytes  3.48 Gbits/sec
[ 7] 1.00-2.00 sec    411 MBytes  3.45 Gbits/sec
[ 7] 2.00-3.00 sec    437 MBytes  3.67 Gbits/sec
[ 7] 3.00-4.00 sec    396 MBytes  3.32 Gbits/sec
[ 7] 4.00-5.00 sec    408 MBytes  3.43 Gbits/sec
[ 7] 5.00-6.00 sec    426 MBytes  3.57 Gbits/sec
```

Рис. 13: Параметр обработки данных только от одного клиента с остановкой сервера по завершении теста

Выполнение лабораторной работы

```
root@mininet-vms:/home/mininet# iperf3 -c 10.0.0.2 -j
{
  "start": {
    "connected": {
      "socket": 7,
      "local_host": "10.0.0.1",
      "local_port": 56334,
      "remote_host": "10.0.0.2",
      "remote_port": 5201
    },
    "version": "iperf 3.7",
    "system_info": "Linux mininet-vms 5.4.0-42-generic #46-Ubuntu SMP Fri Jul 10 00:24:02 UTC 2020 x86_64",
    "timestamp": {
      "time": "Sat, 20 Sep 2025 15:16:00 GMT",
      "timesecs": 1758381360
    },
    "connecting_to": {
      "host": "10.0.0.2",
      "port": 5201
    },
    "cookie": "ak64jhva3zg3tseocpx3l55ryjtw4guqssty"
  }
}

-----
Server listening on 5201
-----
Accepted connection from 10.0.0.1, port 56332
[ 7] local 10.0.0.2 port 5201 connected to 10.0.0.1 port 56334
[ ID] Interval      Transfer    Bitrate
[ 7] 0.00-1.00 sec  416 MBytes  3.49 Gbits/sec
[ 7] 1.00-2.00 sec  406 MBytes  3.41 Gbits/sec
[ 7] 2.00-3.00 sec  402 MBytes  3.37 Gbits/sec
[ 7] 3.00-4.00 sec  367 MBytes  3.08 Gbits/sec
[ 7] 4.00-5.00 sec  382 MBytes  3.28 Gbits/sec
[ 7] 5.00-6.00 sec  280 MBytes  2.35 Gbits/sec
[ 7] 6.00-7.00 sec  336 MBytes  2.82 Gbits/sec
[ 7] 7.00-8.00 sec  327 MBytes  2.75 Gbits/sec
[ 7] 8.00-9.00 sec  388 MBytes  3.25 Gbits/sec
[ 7] 9.00-10.00 sec 369 MBytes  3.10 Gbits/sec
[ 7] 10.00-10.00 sec 128 KBytes   306 Mbits/sec
.....
```

Рис. 14: Экспорт результатов в файл JSON

Выполнение лабораторной работы

```
root@mininet-virtual-machine: /home/mininet# iperf3 -c 10.0.0.2 -J > /home/mininet/work/lab_iperf3/iperf3_results.json
mininet - VMware Workstation
File Edit View VM Jobs Help
Library
Type here to search
My Computer
mininet
mininet@mininet:~$ sudo -i
root@mininet:~# ls
mininet@mininet:~$ cd /home/mininet/work/lab_iperf3
mininet@mininet:~/work/lab_iperf3$ ls -l
total 0
-rw-r--r-- 1 root root 7968 Sep 28 08:17 iperf3_results.json
mininet@mininet:~/work/lab_iperf3$
```

Рис. 15: Просмотр файла iperf_results.json

```
mininet@mininet-vm:~/work/lab_iperf3$ plot_iperf.sh iperf_results.json
mininet@mininet-vm:~/work/lab_iperf3$ cd results/
mininet@mininet-vm:~/work/lab_iperf3/results$ ls -l
total 88
-rw-rw-r-- 1 mininet mininet 461 Sep 20 08:24 1.dat
-rw-rw-r-- 1 mininet mininet 9839 Sep 20 08:24 bytes.pdf
-rw-rw-r-- 1 mininet mininet 9655 Sep 20 08:24 cwnd.pdf
-rw-rw-r-- 1 mininet mininet 9836 Sep 20 08:24 MTU.pdf
-rw-rw-r-- 1 mininet mininet 8987 Sep 20 08:24 retransmits.pdf
-rw-rw-r-- 1 mininet mininet 3073 Sep 20 08:24 RTT.pdf
-rw-rw-r-- 1 mininet mininet 3224 Sep 20 08:24 RTT_Var.pdf
-rw-rw-r-- 1 mininet mininet 9561 Sep 20 08:24 throughput.pdf
mininet@mininet-vm:~/work/lab_iperf3/results$
```

Рис. 16: Визуализация результатов эксперимента

Выводы

В результате выполнения работы познакомились с инструментом для измерения пропускной способности сети в режиме реального времени – iPerf3, а также получение навыков проведения интерактивного эксперимента по измерению пропускной способности моделируемой сети в среде Mininet.