

# Защита по лабораторной работе №3

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## Информация

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## Цель

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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 воспроизводимого эксперимента по измерению пропускной способности моделируемой сети в среде Mininet.

Создаем необходимые папки и копируем emptynet.py .

```
mininet@mininet-vm: ~/work/lab_iperf3/lab_iperf3_topo
mininet@mininet-vm:~$ cd ~/work/lab_iperf3
-bash: cd: /home/mininet/work/lab_iperf3: No such file or directory
mininet@mininet-vm:~$ mkdir -r work/lab_iperf3
mkdir: invalid option -- 'r'
Try 'mkdir --help' for more information.
mininet@mininet-vm:~$ mkdir work
mininet@mininet-vm:~$ cd work/
mininet@mininet-vm:~/work$ cd lab_iperf3
-bash: cd: lab_iperf3: No such file or directory
mininet@mininet-vm:~/work$ mkdir lab_iperf3
mininet@mininet-vm:~/work$ cd lab_iperf3
mininet@mininet-vm:~/work/lab_iperf3$ pwd
/home/mininet/work/lab_iperf3
mininet@mininet-vm:~/work/lab_iperf3$ mkdir lab_iperf3_topo
mininet@mininet-vm:~/work/lab_iperf3$ cd lab_iperf3_topo/
mininet@mininet-vm:~/work/lab_iperf3/lab_iperf3_topo$ cp ~/mininet/examples/empty
net.py ~/work/lab_iperf3/lab_iperf3_topo
mininet@mininet-vm:~/work/lab_iperf3/lab_iperf3_topo$ ls
emptynet.py
mininet@mininet-vm:~/work/lab_iperf3/lab_iperf3_topo$ mv emptynet.py lab_iperf3_t
opo.py
mininet@mininet-vm:~/work/lab_iperf3/lab_iperf3_topo$
```

Запускаем файл .

```
mininet@mininet-vm: ~/work/lab_iperf3/lab_iperf3_topo
opo.py
mininet@mininet-vm:~/work/lab_iperf3/lab_iperf3_topo$ sudo python lab_iperf3_topo
.py
*** Adding controller
*** Adding hosts
*** Adding switch
*** Creating links
*** Starting network
*** Configuring hosts
h1 h2
*** Starting controller
c0
*** Starting 1 switches
s3 ...
*** Waiting for switches to connect
s3
*** Running CLI
*** Starting CLI:
mininet> net
h1 h1-eth0:s3-eth1
h2 h2-eth0:s3-eth2
s3 lo: s3-eth1:h1-eth0 s3-eth2:h2-eth0
c0
mininet>
```

## Смотрим все элементы топологии .

```
mininet@mininet-vm: ~/work/lab_iperf3/lab_iperf3_topo
mininet> net
h1 h1-eth0:s3-eth1
h2 h2-eth0:s3-eth2
s3 lo: s3-eth1:h1-eth0 s3-eth2:h2-eth0
c0
mininet> links
h1-eth0<->s3-eth1 (OK OK)
h2-eth0<->s3-eth2 (OK OK)
mininet> dump
<Host h1: h1-eth0:10.0.0.1 pid=20690>
<Host h2: h2-eth0:10.0.0.2 pid=20694>
<OVSSwitch s3: lo:127.0.0.1,s3-eth1:None,s3-eth2:None pid=20699>
<Controller c0: 127.0.0.1:6653 pid=20683>
mininet> exit
*** Stopping network*** Stopping 1 controllers
c0
*** Stopping 2 links
..
*** Stopping 1 switches
s3
*** Stopping 2 hosts
h1 h2
*** Done
mininet@mininet-vm:~/work/lab_iperf3/lab_iperf3_topo$ nano
```

В коде выводим IP&MAC адрес .

```
mininet@mininet-vm: ~/work/lab_iperf3/lab_iperf3_topo
/home/mininet-topo.py [----] 80 L:[ 26* 9 35/ 48] *(896 /1067b) 10 0x00A [*][X]
info( '*** Adding switch\n' )
s3 = net.addSwitch( 's3' )

info( '*** Creating links\n' )
net.addLink( h1, s3 )
net.addLink( h2, s3 )

info( '*** Starting network\n' )
net.start()
print( "Host ", h1.name, " has IP address ", h1.IP(), " and MAC ", h1.MAC() )

info( '*** Running CLI\n' )
CLI( net )

info( '*** Stopping network' )
net.stop()

if __name__ == '__main__':
    setLogLevel( 'info' )
    emptyNet()
```

Запускаем отредактированную программу .

```
mininet@mininet-vm:~/work/lab_iperf3/lab_iperf3_topo
h1 h2
*** Done
mininet@mininet-vm:~/work/lab_iperf3/lab_iperf3_topo$ nano lab_iperf3_topo.py
mininet@mininet-vm:~/work/lab_iperf3/lab_iperf3_topo$ mcedit lab_iperf3_topo.py

mininet@mininet-vm:~/work/lab_iperf3/lab_iperf3_topo$ sudo python lab_iperf3_topo
.py
*** Adding controller
*** Adding hosts
*** Adding switch
*** Creating links
*** Starting network
*** Configuring hosts
h1 h2
*** Starting controller
c0
*** Starting 1 switches
s3 ...
*** Waiting for switches to connect
s3
Host h1 has IP address 10.0.0.1 and MAC ea:1f:b8:8a:bc:d1
*** Running CLI
*** Starting CLI:
mininet>
```

Добавляем такое же отображение для 2 хоста .

```
mininet@mininet-vm: ~/work/lab_iperf3/lab_iperf3_topo
/home/mininet/topo.py [-M--] 66 L:[ 27+ 9 36/ 48] *(963 /1133b) 10 0x00A [*][X]
s3 = net.addSwitch( 's3' )

info( '*** Creating links\n' )
net.addLink( h1, s3 )
net.addLink( h2, s3 )

info( '*** Starting network\n' )
net.start()
print( "Host ", h1.name, " has IP address ", h1.IP(), " and MAC ", h1.MAC() )
print( "Also for h2: 1) IP: ", h2.IP(), " 2)MAC: ", h2.MAC() )
info( '*** Running CLI\n' )
CLI( net )

info( '*** Stopping network' )
net.stop()

if __name__ == '__main__':
    setLogLevel( 'info' )
    emptyNet()
```

Запускаем отредактированную программу .

```
mininet@mininet-vm: ~/work/lab_iperf3/lab_iperf3_topo
*** Starting network
*** Configuring hosts
h1 h2
*** Starting controller
c0
*** Starting 1 switches
s3 ...
*** Waiting for switches to connect
s3
Host h1 has IP address 10.0.0.1 and MAC da:15:b4:a3:3b:2f
Also for h2: 1) IP: 10.0.0.2 2)MAC: b2:7f:b0:bc:a2:a9
*** Running CLI
*** Starting CLI:
mininet> exit
*** Stopping network*** Stopping 1 controllers
c0
*** Stopping 2 links
..
*** Stopping 1 switches
s3
*** Stopping 2 hosts
h1 h2
*** Done
mininet@mininet-vm:~/work/lab_iperf3/lab_iperf3_topo$
```

Добавляем импорты CPULimitHost & TCLink .

```
mininet@mininet-vm: ~/work/lab_iperf3/lab_iperf3_topo
/home/mininet-topo2.py [-M--] 61 L:[ 1+18 19/ 50] *(488 /1206b) 32 0x020 [*][X]
#!/usr/bin/env python

"""
This example shows how to create an empty Mininet object
(without a topology object) and add nodes to it manually.
"""

from mininet.net import Mininet
from mininet.node import Controller
from mininet.node import CPULimitedHost
from mininet.node import TCLink
from mininet.cli import CLI
from mininet.log import setLogLevel, info

def emptyNet():
    """
    Create an empty network and add nodes to it.

    net = Mininet( controller=Controller, waitConnected=True, )
    info( '*** Adding controller\n' )
    net.addController( 'c0' )

    1Help 2Save 3Mark 4Replace 5Copy 6Move 7Search 8Delete 9Pull/Dn 10Quit
```

## Расширяем net импортированными модулями .

```
mininet@mininet-vm: ~/work/lab_iperf3/lab_iperf3_topo
/home/mininet-topo2.py [-M--] 40 L: [ 6*20 26/ 51] *(672 /1244b) 39 0x027 [*][X]
***

from mininet.net import Mininet
from mininet.node import Controller
from mininet.node import CPULimitedHost
from mininet.node import TCLink
from mininet.cli import CLI
from mininet.log import setLogLevel, info

def emptyNet():

    "Create an empty network and add nodes to it."

    net = Mininet( controller=Controller, waitConnected=True,
<----->host = CPULimitedHost, link = TCLink )

    info( '*** Adding controller\n' )
    net.addController( 'c0' )

    info( '*** Adding hosts\n' )
    h1 = net.addHost( 'h1', ip='10.0.0.1' )
    h2 = net.addHost( 'h2', ip='10.0.0.2' )

1Help 2Save 3Mark 4Replace 5Copy 6Move 7Search 8Delete 9PullDown 10Quit
```

Добавляем ограничение CPU на хосты .

```
mininet@mininet-vm: ~/work/lab_iperf3/lab_iperf3_topo
/home/mininet-topo2.py [-M--] 8 L: [ 14*20 34/ 52] *(888 /1330b) 32 0x020 [*][X]

def emptyNet():
    "Create an empty network and add nodes to it."
    net = Mininet( controller=Controller, waitConnected=True,
<----->host = CPULimitedHost, link = TCLink )

    info( '*** Adding controller\n' )
    net.addController( 'c0' )

    info( '*** Adding hosts\n' )
    h1 = net.addHost( 'h1', ip='10.0.0.1', cpu = 50 )
    h2 = net.addHost( 'h2', ip='10.0.0.2', cpu = 45 )

    info( '*** Adding switch\n' )
    s3 = net.addSwitch( 's3' )

    info( '*** Creating links\n' )
    net.addLink( h1, s3, bw=10, delay="5ms",
<-----> max_queue_size=1000, loss=10, use_htb=True )
    net.addLink( h2, s3 )
```

Запускаем код .

```
mininet@mininet-vm: ~/work/lab_iperf3/lab_iperf3_topo
ImportError: cannot import name 'TCLink' from 'mininet.node' (/usr/local/lib/python3.8/dist-packages/mininet/node.py)
mininet@mininet-vm:~/work/lab_iperf3/lab_iperf3_topo$ mcedit lab_iperf3_topo2.py

mininet@mininet-vm:~/work/lab_iperf3/lab_iperf3_topo$ sudo ./lab_iperf3_topo2.py
*** Adding controller
*** Adding hosts
*** Adding switch
*** Creating links
(10.00Mbit 5ms delay 10.00000% loss) (10.00Mbit 5ms delay 10.00000% loss) *** Starting network
*** Configuring hosts
h1 (cfs 10000000/100000us) h2 (cfs 9000000/100000us)
*** Starting controller
c0
*** Starting 1 switches
s3 (10.00Mbit 5ms delay 10.00000% loss) ... (10.00Mbit 5ms delay 10.00000% loss)
*** Waiting for switches to connect
s3
Host h1 has IP address 10.0.0.1 and MAC 76:4e:8c:13:7a:d2
Also for h2: 1) IP: 10.0.0.2 2)MAC: c2:22:78:09:9b:0a
*** Running CLI
*** Starting CLI:
mininet>
```

Изменяем структуру .

```
mininet@mininet-vm: ~/work/lab_iperf3/iperf3
mininet> exit
*** Stopping network*** Stopping 1 controllers
c0
*** Stopping 2 links
..
*** Stopping 1 switches
s3
*** Stopping 2 hosts
h1 h2
*** Done
mininet@mininet-vm:~/work/lab_iperf3/lab_iperf3_topo$ cp lab_iperf3_topo2.py lab_iperf3.py
mininet@mininet-vm:~/work/lab_iperf3/lab_iperf3_topo$ mkdir -p ~/work/lab_iperf3/iperf3
mininet@mininet-vm:~/work/lab_iperf3/lab_iperf3_topo$ mv ~/work/lab_iperf3/lab_iperf3_topo/lab_iperf3.py ~/work/lab_iperf3/iperf3
mininet@mininet-vm:~/work/lab_iperf3/lab_iperf3_topo$ cd ~/work/lab_iperf3/iperf3
mininet@mininet-vm:~/work/lab_iperf3/iperf3$ ls
mininet@mininet-vm:~/work/lab_iperf3/iperf3$ ls -al
total 12
drwxrwxr-x 2 mininet mininet 4096 Oct 11 11:13 .
drwxrwxr-x 4 mininet mininet 4096 Oct 11 11:13 ..
-rwxrwxr-x 1 mininet mininet 1330 Oct 11 11:13 lab_iperf3.py
mininet@mininet-vm:~/work/lab_iperf3/iperf3$
```

Выполняем iperf команды прямо в коде .

```
mininet@mininet-vm: ~/work/lab_iperf3/iperf3
/home/miniperf3.py [-M--] 6 L:[ 27+10 45/ 55] *(1143/1276b) 67 0x043 [*][X]
h1 = net.addHost( 'h1', ip='10.0.0.1' )
h2 = net.addHost( 'h2', ip='10.0.0.2' )

info( '*** Adding switch\n' )
s3 = net.addSwitch( 's3' )

info( '*** Creating links\n' )
net.addLink( h1, s3, bw=100, delay="75ms" )
net.addLink( h2, s3, bw=100, delay="75ms" )

info( '*** Starting network\n' )
net.start()

h2.cmdPrint("iperf3 -s -D -1")
time.sleep(10)
h1.cmdPrint("iperf3 -c", h2.IP(), "-J > iperf_result.json")

# info( '*** Running CLI\n' )
# CLI( net )

info( '*** Stopping network' )
net.stop()

1Help 2Save 3Mark 4Replace 5Copy 6Move 7Search 8Delete 9PullDown 10Quit
```

Запускаем измененный код .

```
mininet@mininet-vm: ~/work/lab_iperf3/iperf3
*** Creating links
(100.00Mbit 75ms delay) (100.00Mbit 75ms delay) (100.00Mbit 75ms delay) (100.00Mbit 75ms delay)
*** Starting network
*** Configuring hosts
h1 (cfs -1/1000000us) h2 (cfs -1/1000000us)
*** Starting controller
c0
*** Starting 1 switches
s3 (100.00Mbit 75ms delay) (100.00Mbit 75ms delay) ... (100.00Mbit 75ms delay) (100.00Mbit 75ms delay)
*** Waiting for switches to connect
s3
*** h2 : ('iperf3 -s -D -1',)
*** h1 : ('iperf3 -c', '10.0.0.2', '-J > iperf_result.json')
*** Stopping network*** Stopping 1 controllers
c0
*** Stopping 2 links
..
*** Stopping 1 switches
s3
*** Stopping 2 hosts
h1 h2
*** Done
mininet@mininet-vm:~/work/lab_iperf3/iperf3$
```

Создаем Мэйкфайл и настраиваем его .

```
mininet@mininet-vm: ~/work/lab_iperf3/iperf3
*** h2 : ('iperf3 -s -D -l',)
*** h1 : ('iperf3 -c', '10.0.0.2', '-J > iperf_result.json')
*** Stopping network*** Stopping 1 controllers
c0
*** Stopping 2 links
..
*** Stopping 1 switches
s3
*** Stopping 2 hosts
h1 h2
*** Done
mininet@mininet-vm:~/work/lab_iperf3/iperf3$ ls
iperf_result.json  lab_iperf3.py
mininet@mininet-vm:~/work/lab_iperf3/iperf3$ plot_iperf.sh iperf_result.json
mininet@mininet-vm:~/work/lab_iperf3/iperf3$ ls
iperf.csv  iperf_result.json  lab_iperf3.py  results
mininet@mininet-vm:~/work/lab_iperf3/iperf3$ touch Makefile
mininet@mininet-vm:~/work/lab_iperf3/iperf3$ nano Makefile
mininet@mininet-vm:~/work/lab_iperf3/iperf3$ make clean
rm -f *.json *.csv
rm -rf results
mininet@mininet-vm:~/work/lab_iperf3/iperf3$ ls
lab_iperf3.py  Makefile
mininet@mininet-vm:~/work/lab_iperf3/iperf3$
```

Пробуем наш Мэйкфайл .

```
mininet@mininet-vm: ~/work/lab_iperf3/iperf3
*** Configuring hosts
h1 (cfs -1/100000us) h2 (cfs -1/100000us)
*** Starting controller
c0
*** Starting 1 switches
s3 (100.00Mbit 75ms delay) (100.00Mbit 75ms delay) ... (100.00Mbit 75ms delay) (100.00Mbit 75ms delay)
*** Waiting for switches to connect
s3
*** h2 : ('iperf3 -s -D -1',)
*** h1 : ('iperf3 -c', '10.0.0.2', '-J > iperf_result.json')
*** Stopping network*** Stopping 1 controllers
c0
*** Stopping 2 links
..
*** Stopping 1 switches
s3
*** Stopping 2 hosts
h1 h2
*** Done
plot_iperf.sh iperf_result.json
mininet@mininet-vm:~/work/lab_iperf3/iperf3$ ls
iperf.csv iperf_result.json lab_iperf3.py Makefile results
mininet@mininet-vm:~/work/lab_iperf3/iperf3$
```

Спасибо за внимание.

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