

Презентация по лабораторной работе №3

Дисциплина: Моделирование сетей передачи данных

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Цель

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.

Задание

1. Воспроизвести посредством API Mininet эксперименты по измерению пропускной способности с помощью iPerf3.
2. Построить графики по проведённому эксперименту.

Выполнение

```
mininet@mininet-vm:~$ cd ~/work/lab_iperf3
mininet@mininet-vm:~/work/lab_iperf3$ mkdir lab_iperf3_topo
mininet@mininet-vm:~/work/lab_iperf3$ cd ~/work/lab_iperf3/lab_iperf3_topo
mininet@mininet-vm:~/work/lab_iperf3/lab_iperf3_topo$ cp ~/mininet/examples/emphynet.py ~/work/lab_iperf3/lab_iperf3_topo
mininet@mininet-vm:~/work/lab_iperf3/lab_iperf3_topo$ ls
emphynet.py
mininet@mininet-vm:~/work/lab_iperf3/lab_iperf3_topo$ mv emphynet.py lab_iperf3_topo.py
mininet@mininet-vm:~/work/lab_iperf3/lab_iperf3_topo$ ls
lab_iperf3_topo.py
```

Рис. 1: Создание каталога и копирование файла

```
/home/mininet/work/lab_iperf3/lab_iperf3_topo/lab_iperf3_topo.py 985/985 100%
#!/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.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' )

    info( '*** Adding hosts\n' )
    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 )
    net.addLink( h2, s3 )

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

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

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

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

Рис. 2: Скриншот 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
█
```

Рис. 3: Запуск скрипта

```
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=892>
<Host h2: h2-eth0:10.0.0.2 pid=895>
<OVSSwitch s3: lo:127.0.0.1,s3-eth1:None,s3-eth2:None pid=900>
<Controller c0: 127.0.0.1:6653 pid=885>
mininet> exit
*** Stopping network*** Stopping 1 controllers
c0
*** Stopping 2 links
..
*** Stopping 1 switches
s3
*** Stopping 2 hosts
h1 h2
*** Done
```

Рис. 4: Элементы топологии

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

print("Host", h1.name, "has IP address", h1.IP(), "and MAC address", h1.MAC())

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

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

Рис. 5: Внесение изменений в скрипт

```
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 address 76:61:fb:6e:b7:67
*** Running CLI
*** Starting CLI:
mininet> 
```

Рис. 6: Запуск скрипта

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

print("Host", h1.name, "has IP address", h1.IP(), "and MAC address", h1.MAC())
print("Host", h2.name, "has IP address", h2.IP(), "and MAC address", h2.MAC())

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

Рис. 7: Внесение изменений в скрипт

```
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 address c2:d4:cf:16:d3:7f
Host h2 has IP address 10.0.0.2 and MAC address c2:1f:57:58:09:71
*** Running CLI
*** Starting CLI:
mininet>
```

Рис. 8: Запуск скрипта


```
mininet@mininet-vm:~/work/lab_iperf3/lab_iperf3_topo$ cp lab_iperf3_topo.py lab_iperf3_topo2.py
mininet@mininet-vm:~/work/lab_iperf3/lab_iperf3_topo$ ls
lab_iperf3_topo2.py  lab_iperf3_topo.py
mininet@mininet-vm:~/work/lab_iperf3/lab_iperf3_topo$
```

Рис. 9: Внесение изменений в скрипт

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

Рис. 10: Внесение изменений в скрипт

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

```
net = Mininet( controller=Controller, waitConnected=True, host=CPULimitedHost, link=TCLink )
```

Рис. 11: Внесение изменений в скрипт

```
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 )
```

Рис. 12: Внесение изменений в скрипт

```
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 )
```

Рис. 13: Внесение изменений в скрипт

```
mininet@mininet-vm:~/work/lab_iperf3/lab_iperf3_topo$ sudo python 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 5000000/100000us) h2 (cfs 4500000/100000us)
*** 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 address ba:71:c1:2d:32:aa
Host h2 has IP address 10.0.0.2 and MAC address 4a:6b:a3:f5:a7:fc
*** Running CLI
*** Starting CLI:
mininet>
```

Рис. 14: Внесение изменений в скрипт

```
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 address 42:de:a2:64:83:ac
Host h2 has IP address 10.0.0.2 and MAC address 02:14:ad:48:3b:4b
*** Running CLI
*** Starting CLI:
mininet>
```

Рис. 15: Запуск скрипта

```
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$ ls
lab_iperf3.py  lab_iperf3_topo2.py  lab_iperf3_topo.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
lab_iperf3.py
mininet@mininet-vm:~/work/lab_iperf3/iperf3$
```

Рис. 16: Создание подкаталога и копирование скрипта


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

Рис. 17: Внесение изменений в скрипт

```
info( '*** Adding hosts\n' )
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' )
```

Рис. 18: Внесение изменений в скрипт

```
info('*** Traffic generation\n')
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 )
```

Рис. 19: Внесение изменений в скрипт

```

mininet@mininet-vm:~/work/lab_iperf3/iperf3$ sudo python lab_iperf3.py
*** Adding controller
*** Adding hosts
*** Adding switch
*** 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 del
ay)
*** Waiting for switches to connect
s3
Host h1 has IP address 10.0.0.1 and MAC address 46:4c:cf:9c:2f:55
Host h2 has IP address 10.0.0.2 and MAC address 0e:55:9e:a4:f5:4c
*** Traffic generation
*** 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$ ls
iperf_result.json  lab_iperf3.py
mininet@mininet-vm:~/work/lab_iperf3/iperf3$

```

Рис. 20: Запуск скрипта

```
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$
```

Рис. 21: Построение графиков

```
GNU nano 4.8 /home/mininet/work/lab_iperf3/iperf3/Makefile Modified
all: iperf_result.json plot

iperf_result.json:
    sudo python lab_iperf3.py

plot: iperf_result.json
    plot_iperf.sh iperf_result.json

clean:
    -rm -f *.json *.csv
    -rm -rf results
```

Рис. 22: Написание скрипта Makefile

```

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$ 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$ make
sudo python lab_iperf3.py
*** Adding controller
*** Adding hosts
*** Adding switch
*** 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
Host h1 has IP address 10.0.0.1 and MAC address fe:8a:6a:64:9f:90
Host h2 has IP address 10.0.0.2 and MAC address 7e:c2:5c:57:f2:6f
*** Traffic generation
*** 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$

```

Рис. 23: Заныск скрупта Makefile

Вывод

Я ознакомилась с инструментом для измерения пропускной способности сети в режиме реального времени — iPerf3, а также получила навыки проведения воспроизводимого эксперимента по измерению пропускной способности моделируемой сети в среде Mininet.