

Введение в Mininet

Лабораторная работа № 1

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Основной целью работы является развёртывание в системе виртуализации (например, в VirtualBox) mininet, знакомство с основными командами для работы с Mininet через командную строку и через графический интерфейс.

Выполнение лабораторной работы

Выполнение лабораторной работы

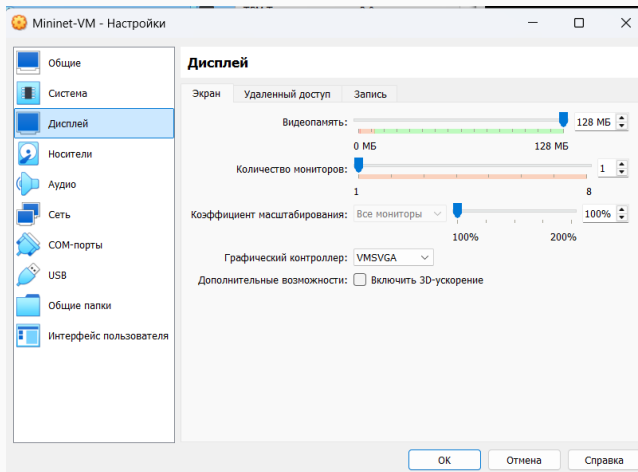


Рис. 1: настройка виртуальной машины

Выполнение лабораторной работы

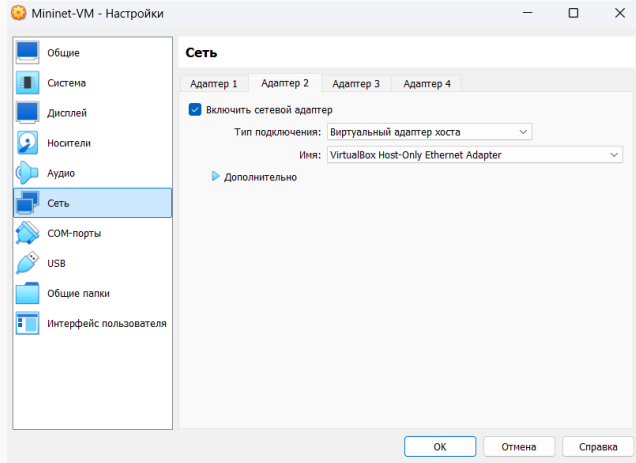


Рис. 2: настройка сетевого адаптера

Выполнение лабораторной работы

```
Mininet-VM-avshuluuzhuk [Работает] - Oracle VM VirtualBox
Файл  Машина  Вид  Ввод  Устройства  Справка
mininet-vm login: mininet
Password:
Welcome to Ubuntu 20.04.1 LTS (GNU/Linux 5.4.0-42-generic x86_64)

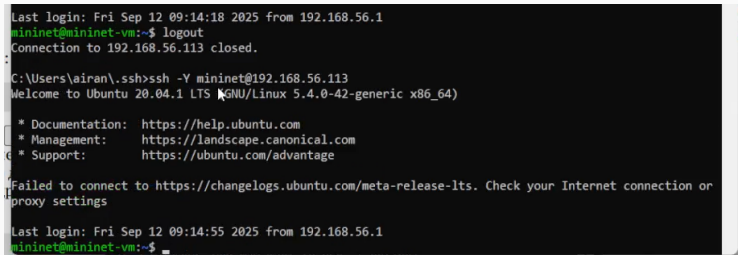
 * Documentation:  https://help.ubuntu.com
 * Management:    https://landscape.canonical.com
 * Support:       https://ubuntu.com/advantage

Last login: Fri Sep 12 11:30:42 PDT 2025 from 192.168.56.1 on pts/1
mininet@mininet-vm:~$ ifconfig
ifconfig: command not found
mininet@mininet-vm:~$ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
    inet 192.168.56.113  netmask 255.255.255.0  broadcast 192.168.56.255
    ether 08:00:27:1e:4c:7d  txqueuelen 1000  (Ethernet)
    RX packets 11  bytes 2389 (2.3 KB)
    RX errors 0  dropped 0  overruns 0  frame 0
    TX packets 2  bytes 684 (684.0 B)
    TX errors 0  dropped 0  overruns 0  carrier 0  collisions 0

eth1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
    inet 10.0.2.15  netmask 255.255.255.0  broadcast 10.0.2.255
    ether 08:00:27:e1:f7:c5  txqueuelen 1000  (Ethernet)
    RX packets 205  bytes 32565 (32.5 KB)
    RX errors 0  dropped 0  overruns 0  frame 0
    TX packets 207  bytes 19471 (19.4 KB)
    TX errors 0  dropped 0  overruns 0  carrier 0  collisions 0
```

Рис. 3: запуск виртуальной машины и логин

Выполнение лабораторной работы



```
Last login: Fri Sep 12 09:14:18 2025 from 192.168.56.1
mininet@mininet-vm:~$ logout
Connection to 192.168.56.113 closed.

C:\Users\airan\.ssh>ssh -Y mininet@192.168.56.113
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: Fri Sep 12 09:14:55 2025 from 192.168.56.1
mininet@mininet-vm:~$
```

Рис. 4: подключение к виртуальной машине из хостовой машины

```
mininet@mininet-vm:~$ sudo dhclient eth1
mininet@mininet-vm:~$ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.56.113 netmask 255.255.255.0 broadcast 192.168.56.255
    ether 08:00:27:1e:4c:7d txqueuelen 1000 (Ethernet)
    RX packets 567 bytes 107470 (107.4 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 531 bytes 101562 (101.5 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

eth1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.0.2.15 netmask 255.255.255.0 broadcast 10.0.2.255
    ether 08:00:27:e1:f7:c5 txqueuelen 1000 (Ethernet)
    RX packets 2 bytes 1180 (1.1 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 2 bytes 684 (684.0 B)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

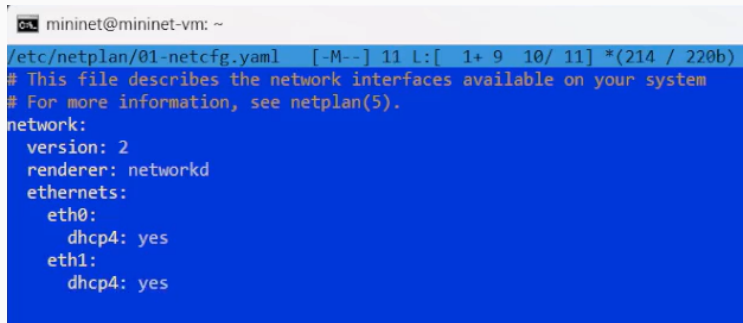
lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
    loop txqueuelen 1000 (Local Loopback)
    RX packets 2000 bytes 153200 (153.2 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 2000 bytes 153200 (153.2 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

mininet@mininet-vm:~$
```

Рис. 5: активирование NAT адреса


```
mininet@mininet-vm:~$ sudo apt install mc
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
  libssh2-1 mc-data unzip
Suggested packages:
  arj catdvi | texlive-binaries dbview djvulibre-bin epub-utils genisoimage gv imagemagick
  libaspell-dev links | w3m | lynx odt2txt poppler-utils python python-boto python-tz xpdf
  | pdf-viewer zip
The following NEW packages will be installed:
  libssh2-1 mc mc-data unzip
0 upgraded, 4 newly installed, 0 to remove and 84 not upgraded.
Need to get 1,986 kB of archives.
After this operation, 8,587 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/universe amd64 libssh2-1 amd64 1.8.0-2.1build1 [75.4 kB]
Get:2 http://us.archive.ubuntu.com/ubuntu focal/universe amd64 mc-data all 3:4.8.24-2ubuntu1 [1,265 kB]
Get:3 http://us.archive.ubuntu.com/ubuntu focal/universe amd64 mc amd64 3:4.8.24-2ubuntu1 [477 kB]
Get:4 http://us.archive.ubuntu.com/ubuntu focal/main amd64 unzip amd64 6.0-25ubuntu1 [169 kB]
Fetched 1,986 kB in 3s (601 kB/s)
Selecting previously unselected package libssh2-1:amd64.
(Reading database ... 55%
```

Рис. 6: установка mc



```
mininet@mininet-vm: ~  
/etc/netplan/01-netcfg.yaml [-M--] 11 L:[ 1+ 9 10/ 11] *(214 / 220b)  
# This file describes the network interfaces available on your system  
# For more information, see netplan(5).  
network:  
  version: 2  
  renderer: networkd  
  ethernet:  
    eth0:  
      dhcp4: yes  
    eth1:  
      dhcp4: yes
```

Рис. 7: редактирование файла

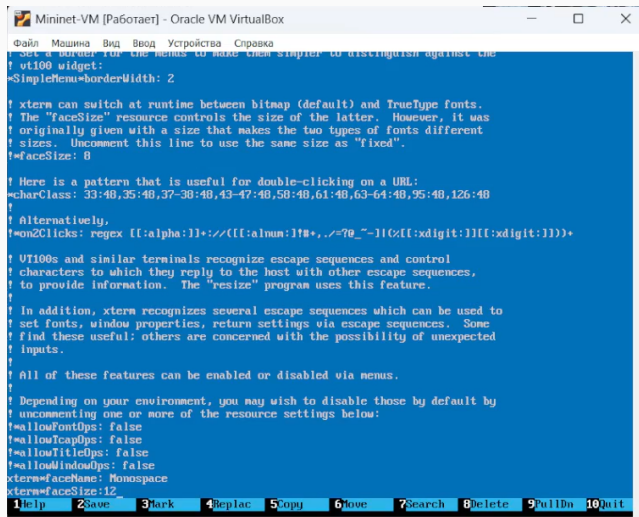
```
mininet@mininet-vm:~$ mv ~/mininet ~/mininet.orig
mininet@mininet-vm:~$ cd ~
mininet@mininet-vm:~$ git clone https://github.com/mininet/mininet.git
Cloning into 'mininet'...
remote: Enumerating objects: 10388, done.
remote: Counting objects: 100% (128/128), done.
remote: Compressing objects: 100% (60/60), done.
remote: Total 10388 (delta 102), reused 68 (delta 68), pack-reused 10260 (from 3)
Receiving objects: 100% (10388/10388), 3.36 MiB | 885.00 KiB/s, done.
Resolving deltas: 100% (6905/6905), done.
mininet@mininet-vm:~$ cd ~/mininet
mininet@mininet-vm:~/mininet$ sudo male install
sudo: male: command not found
mininet@mininet-vm:~/mininet$ sudo make install
cc -Wall -Wextra \
-DVERSION=\"PYTHONPATH=. python -B bin/mn --version 2>&1\" mnexec.c -o mnexec
install -D mnexec /usr/bin/mnexec
PYTHONPATH=. help2man -N -n "create a Mininet network." \
--no-discard-stderr "python -B bin/mn" -o mn.1
help2man -N -n "execution utility for Mininet." \
-h "-h" -v "-v" --no-discard-stderr ./mnexec -o mnexec.1
install -D -t /usr/share/man/man1 mn.1 mnexec.1
python -m pip uninstall -y mininet || true
Found existing installation: mininet 2.3.0
Uninstalling mininet-2.3.0:
  Successfully uninstalled mininet-2.3.0
python -m pip install .
```

Рис. 8: обновлении версии

```
Building wheels for collected packages: mininet
  Building wheel for mininet (setup.py) ... done
  Created wheel for mininet: filename=mininet-2.3.1b4-py3-none-any.whl size=160942 sha256=bd99372
9688706e4185f2222a292b8c6402080be8d7164783af602cd36153
  Stored in directory: /tmp/pip-ephem-wheel-cache-zaq47vll/wheels/cd/7d/a7/aafc1b3eaff31efd6ba4e2
c9690a717bdf739db6cfe8d45
Successfully built mininet
Installing collected packages: mininet
Successfully installed mininet-2.3.1b4
mininet@mininet-vm:~/mininet$ mn --version
2.3.1b4
mininet@mininet-vm:~/mininet$
```

Рис. 9: проверка обновления

Настройка параметров XTerm



```
Mininet-VM [Работает] - Oracle VM VirtualBox
Файл  Машина  Вид  Ввод  Устройства  Справка
! Set a border for the menus to make them simpler to distinguish against the
! vt100 widget:
*SimpleMenu*borderWidth: 2

! xterm can switch at runtime between bitmap (default) and TrueType fonts.
! The "faceSize" resource controls the size of the latter.  However, it was
! originally given with a size that makes the two types of fonts different
! sizes.  Uncomment this line to use the same size as "fixed".
!*faceSize: 8

! Here is a pattern that is useful for double-clicking on a URL:
*charClass: 33:48,35:48,37-38:48,43-47:48,58:48,61:48,63-64:48,95:48,126:48
!
! Alternatively,
!*on2Clicks: regex [[[:alpha:]]+://([[:alnum:]]?#+,./=?@_~-'|)(%[[[:xdigit:]]|[:xdigit:]]))+

! VT100s and similar terminals recognize escape sequences and control
! characters to which they reply to the host with other escape sequences,
! to provide information.  The "resize" program uses this feature.
!
! In addition, xterm recognizes several escape sequences which can be used to
! set fonts, window properties, return settings via escape sequences.  Some
! find these useful; others are concerned with the possibility of unexpected
! inputs.
!
! All of these features can be enabled or disabled via menus.
!
! Depending on your environment, you may wish to disable those by default by
! uncommenting one or more of the resource settings below:
!*allowFontOps: false
!*allowIcapOps: false
!*allowTitleOps: false
!*allowWindowOps: false
xterm*faceName: Monospace
xterm*faceSize: 12
1 Help    2 Save    3 Mark    4 Replac  5 Copy    6 Move    7 Search  8 Delete  9 PullDn  10 Quit
```

Рис. 10: установка шрифта

Настройка соединения X11 для суперпользователя

```
mininet@mininet-vm:~$ xauth list $DISPLAY
mininet-vm/unix:11 MIT-MAGIC-C00KIE-1 583de15a3dd36497221f5d500990037f
mininet@mininet-vm:~$ sudo -i
root@mininet-vm:~# xauth list
mininet-vm/unix:10 MIT-MAGIC-C00KIE-1 01f7e6007504688ee72ac8d165dd613e
root@mininet-vm:~# xauth add mininet-vm/unix:11 ^C
root@mininet-vm:~# xauth add mininet-vm/unix:11 MIT-MAGIC-C00KIE-1 583de15a3dd3
6497221f5d500990037f
root@mininet-vm:~# xauth list $DISPLAY
mininet-vm/unix:11 MIT-MAGIC-C00KIE-1 583de15a3dd36497221f5d500990037f
root@mininet-vm:~# xterm
```

Рис. 11: настройка соединения для графических приложений

Работа с Mininet из-под Windows

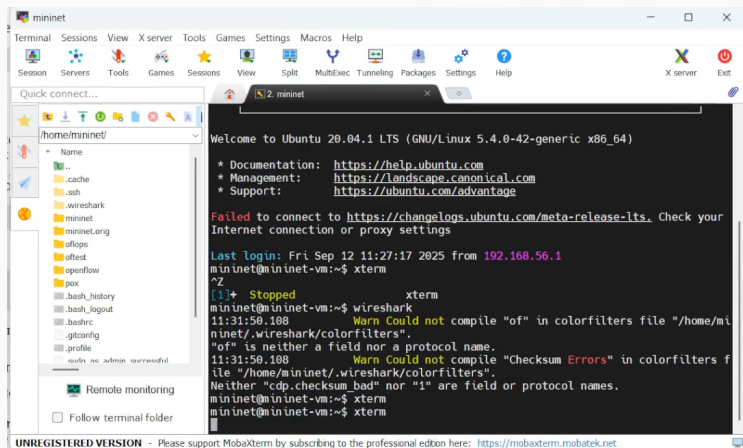


Рис. 12: работа с Mininet из-под Windows

```
mininet@mininet-vm:~/mininet$ cd
mininet@mininet-vm:~$ sudo mn
*** Creating network
*** Adding controller
*** Adding hosts:
h1 h2
*** Adding switches:
s1
*** Adding links:
(h1, s1) (h2, s1)
*** Configuring hosts
h1 h2
*** Starting controller
c0
*** Starting 1 switches
s1 ...
*** Starting CLI:
mininet>
```

Рис. 13: запуск минимальной топологии


```
mininet@mininet-vm: ~  
*** Starting CLI:  
mininet> help  
  
Documented commands (type help <topic>):  
=====
```

EOF	gterm	iperfudp	nodes	pingpair	py	switch	xterm
dpctl	help	link	noecho	pingpairfull	quit	time	
dump	intfs	links	pingall	ports	sh	wait	
exit	iperf	net	pingallfull	px	source	x	

```
  
You may also send a command to a node using:  
  <node> command {args}  
For example:  
  mininet> h1 ifconfig  
  
The interpreter automatically substitutes IP addresses  
for node names when a node is the first arg, so commands  
like  
  mininet> h2 ping h3  
should work.  
  
Some character-oriented interactive commands require  
noecho:  
  mininet> noecho h2 vi foo.py  
However, starting up an xterm/gterm is generally better:  
  mininet> xterm h2  
  
mininet> nodes  
available nodes are:  
c0 h1 h2 s1  
mininet> █ I
```

Рис. 14: отображение доступных узлов

```
mininet> net
h1 h1-eth0:s1-eth1
h2 h2-eth0:s1-eth2
s1 lo: s1-eth1:h1-eth0 s1-eth2:h2-eth0
c0
mininet> h1 ifconfig
h1-eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.0.0.1 netmask 255.0.0.0 broadcast 10.255.255.255
    ether ea:bc:b4:a8:99:46 txqueuelen 1000 (Ethernet)
    RX packets 0 bytes 0 (0.0 B)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 0 bytes 0 (0.0 B)
    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 0 bytes 0 (0.0 B)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 0 bytes 0 (0.0 B)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

mininet> █ I
```

Рис. 15: просмотр конфигурации узлов

```
mininet> h1 ping 10.0.0.2
PING 10.0.0.2 (10.0.0.2) 56(84) bytes of data.
64 bytes from 10.0.0.2: icmp_seq=1 ttl=64 time=1.11 ms
64 bytes from 10.0.0.2: icmp_seq=2 ttl=64 time=0.204 ms
64 bytes from 10.0.0.2: icmp_seq=3 ttl=64 time=0.056 ms
64 bytes from 10.0.0.2: icmp_seq=4 ttl=64 time=0.070 ms
64 bytes from 10.0.0.2: icmp_seq=5 ttl=64 time=0.062 ms
64 bytes from 10.0.0.2: icmp_seq=6 ttl=64 time=0.092 ms
^C
--- 10.0.0.2 ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 5079ms
rtt min/avg/max/mdev = 0.056/0.265/1.109/0.380 ms
mininet> exit
*** Stopping 1 controllers
c0
*** Stopping 2 links
..
*** Stopping 1 switches
s1
*** Stopping 2 hosts
h1 h2
*** Done
completed in 140.728 seconds
mininet@mininet-vm:~$
```

Рис. 16: проверка связности

Построение и эмуляция сети в Mininet с использованием графического интерфейса

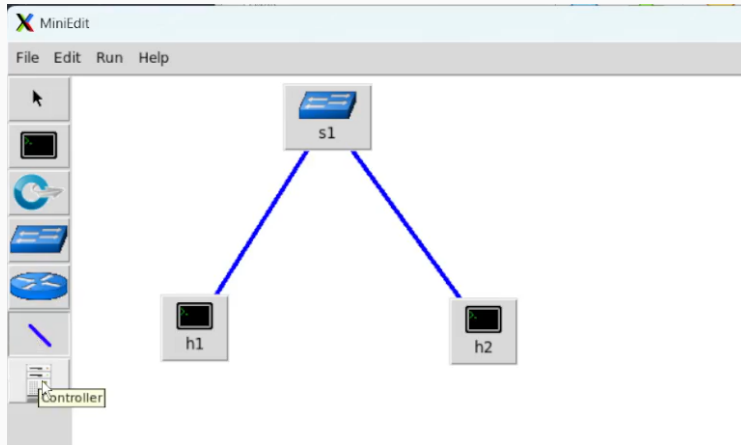


Рис. 17: запуск редактора MiniEdit и добавление топологии сети

Построение и эмуляция сети в Mininet с использованием графического интерфейса

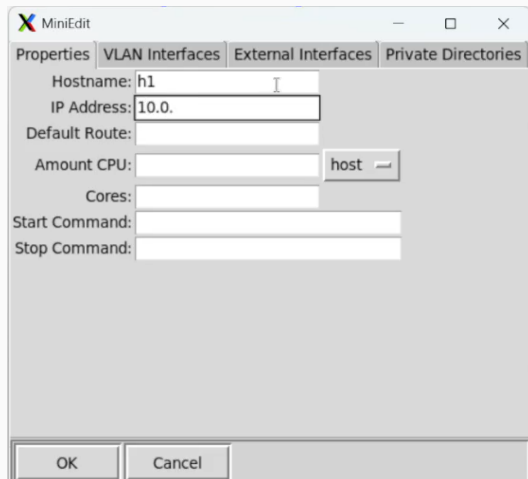


Рис. 18: настройка IP адресации вручную

```
"Host: h2"@mininet-vm
root@mininet-vm:/home/mininet# ping 10.0.0.1
PING 10.0.0.1 (10.0.0.1) 56(84) bytes of data.
64 bytes from 10.0.0.1: icmp_seq=1 ttl=64 time=0.192 ms
64 bytes from 10.0.0.1: icmp_seq=2 ttl=64 time=0.049 ms
64 bytes from 10.0.0.1: icmp_seq=3 ttl=64 time=0.059 ms
64 bytes from 10.0.0.1: icmp_seq=4 ttl=64 time=0.048 ms
64 bytes from 10.0.0.1: icmp_seq=5 ttl=64 time=0.049 ms
^C
--- 10.0.0.1 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4100ms
rtt min/avg/max/mdev = 0.048/0.079/0.192/0.056 ms
root@mininet-vm:/home/mininet#
```

Рис. 19: проверка связности

Построение и эмуляция сети в Mininet с использованием графического интерфейса

```
Host: h2" @mininet-vm
Command 'ifconfog' not found, did you mean:
    command 'ifconfig' from deb net-tools (1.60+git20180626.aebd88e-1ubuntu1)
Try: apt install <deb name>

root@mininet-vm:/home/mininet# ifconfig
h2-eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 15.0.0.2 netmask 255.0.0.0 broadcast 15.255.255.255
    ether 32:a2:50:dd:42:f4 txqueuelen 1000 (Ethernet)
    RX packets 0 bytes 0 (0.0 B)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 0 bytes 0 (0.0 B)
    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 955 bytes 247284 (247.2 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 955 bytes 247284 (247.2 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

root@mininet-vm:/home/mininet#
```

Рис. 20: автоматическое назначение IP-адресов

```
PS C:\> cd Users
PS C:\Users> cd airan
PS C:\Users\airan> scp mininet@192.168.56.113:~/work/lab01.mn .
lab01.mn                                     100% 1654   807.6KB/s   00:00
PS C:\Users\airan> scp mininet@192.168.56.113:~/work/lab01.mn .
```

Рис. 21: сохранение файла на хостовую машину

Выводы

В результате выполнения лабораторной работы было проведено развёртывание в системе виртуализации mininet, знакомство с основными командами для работы с Mininet через командную строку и через графический интерфейс.