

# **Лабораторная работа №1**

Моделирование сетей передачи данных

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# Докладчик

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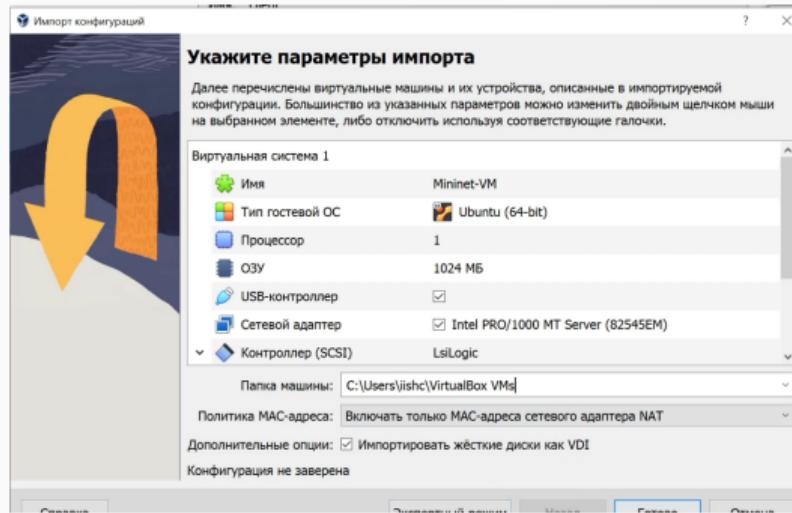
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## Цель работы

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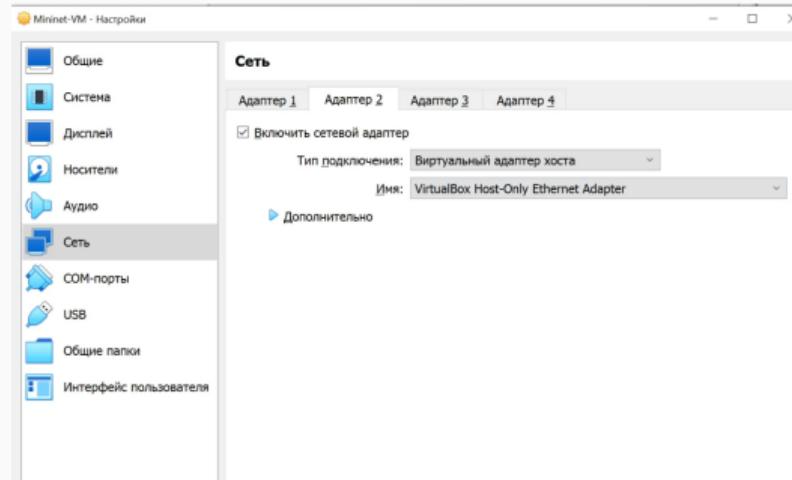
Основной целью работы является развертывание в системе виртуализации VirtualBox mininet, знакомство с основными командами для работы с Mininet через командную строку и через графический интерфейс.

# Создание ВМ



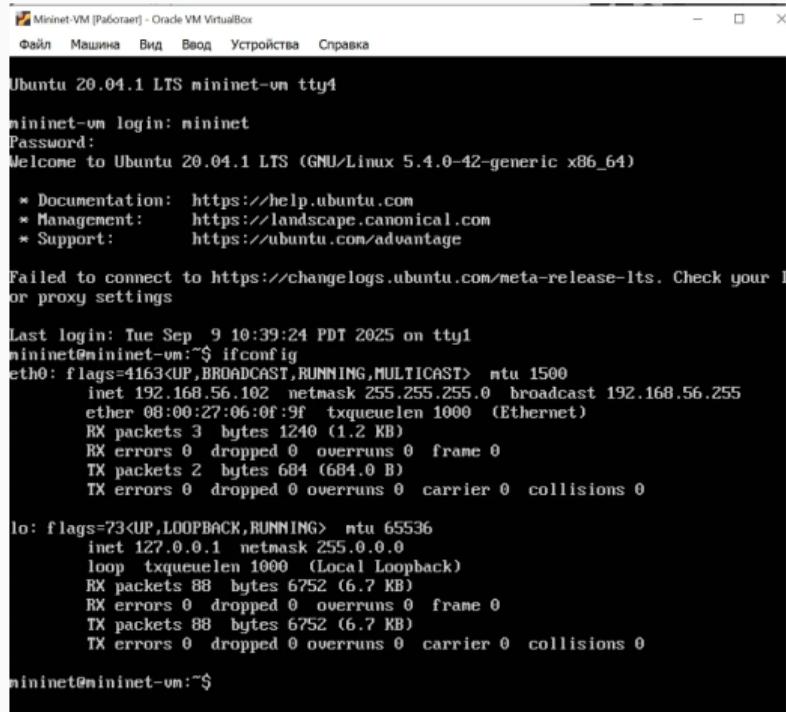
**Рисунок 1:** Создание ВМ

# Настройка сети



**Рисунок 2:** Настройка сети

# Запуск mininet



```
Ubuntu 20.04.1 LTS mininet-vm tty4

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

Failed to connect to https://changelogs.ubuntu.com/meta-release-lts. Check your Internet connection or proxy settings

Last login: Tue Sep  9 10:39:24 PDT 2025 on tty1
mininet@mininet-vm:~$ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
      inet 192.168.56.102 netmask 255.255.255.0 broadcast 192.168.56.255
        ether 08:00:27:06:0f:9f txqueuelen 1000 (Ethernet)
          RX packets 3 bytes 1240 (1.2 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 88 bytes 6752 (6.7 KB)
          RX errors 0 dropped 0 overruns 0 frame 0
          TX packets 88 bytes 6752 (6.7 KB)
          TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

mininet@mininet-vm:~$
```

Рисунок 3: Запуск mininet

# Подключение к ВМ с mininet через SSH

```
C:\Users\lilish>ssh -V mininet@192.168.56.102
The authenticity of host '192.168.56.102 (192.168.56.102)' can't be established.
ED25519 key fingerprint is SHA256:6Q72Qr1sYANBK95Ew4LQZIUzgvbI3d9i28Zl8VxsNiM.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '192.168.56.102' (ED25519) to the list of known hosts.
mininet@192.168.56.102'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: Tue Sep  9 10:40:09 2025
mininet@mininet-vm:~$
```

**Рисунок 4:** Подключение к ВМ с mininet через SSH

# Просмотр IP-адресов машины

```
C:\Users\iishc>ssh -Y mininet@192.168.56.102
mininet@192.168.56.102's password:
Permission denied, please try again.
mininet@192.168.56.102's password:
Permission denied, please try again.
mininet@192.168.56.102'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
tion or proxy settings

Last login: Tue Sep  9 10:42:47 2025 from 192.168.56.1
mininet@mininet-vm:~$ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
      inet 192.168.56.102  netmask 255.255.255.0  broadcast 192.168.56.255
        ether 08:00:27:06:0f:9f  txqueuelen 1000  (Ethernet)
          RX packets 74  bytes 13481 (13.4 KB)
          RX errors 0  dropped 0  overruns 0  frame 0
          TX packets 70  bytes 12784 (12.7 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 528  bytes 40456 (40.4 KB)
          RX errors 0  dropped 0  overruns 0  frame 0
          TX packets 528  bytes 40456 (40.4 KB)
          TX errors 0  dropped 0  overruns 0  carrier 0  collisions 0

mininet@mininet-vm:~$
```

Рисунок 5: Просмотр IP-адресов машины

# Активация второго интерфейса

```
mininet@mininet-vm:~$ sudo dhclient eth1
mininet@mininet-vm:~$ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
      inet 192.168.56.102  netmask 255.255.255.0  broadcast 192.168.56.255
          ether 08:00:27:06:0f:9f  txqueuelen 1000  (Ethernet)
            RX packets 137  bytes 18223 (18.2 KB)
            RX errors 0  dropped 0  overruns 0  frame 0
            TX packets 103  bytes 16762 (16.7 KB)
            TX errors 0  dropped 0  overruns 0  carrier 0  collisions 0

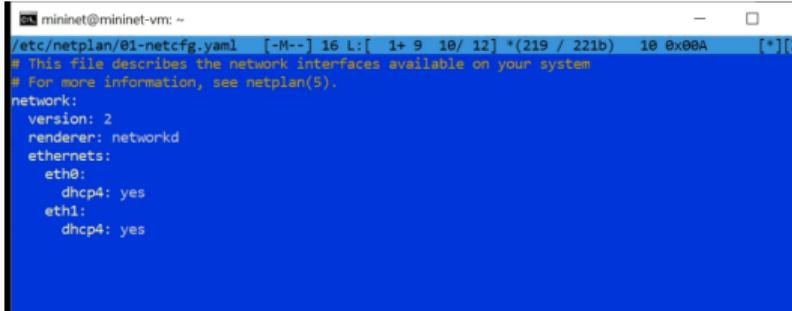
eth1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
      inet 10.0.2.15  netmask 255.255.255.0  broadcast 10.0.2.255
          ether 08:00:27:76:68:42  txqueuelen 1000  (Ethernet)
            RX packets 3  bytes 1770 (1.7 KB)
            RX errors 0  dropped 0  overruns 0  frame 0
            TX packets 3  bytes 1026 (1.0 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 568  bytes 43520 (43.5 KB)
            RX errors 0  dropped 0  overruns 0  frame 0
            TX packets 568  bytes 43520 (43.5 KB)
            TX errors 0  dropped 0  overruns 0  carrier 0  collisions 0

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 djvu libre-bin epub-utils genisoimage gv imagemagick
  libaspell-dev links | w3m | lynx cdt2txt 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] v
```

Рисунок 6: Активация второго интерфейса

## Файл /etc/netplan/01-netcfg.yaml



```
mininet@mininet-vm: ~
/etc/netplan/01-netcfg.yaml  [-M--] 16 L:[ 1+ 9 10/ 12] *(219 / 221b)  18 0x00A  [*][X]
# This file describes the network interfaces available on your system
# For more information, see netplan(5).
network:
  version: 2
  renderer: networkd
  ethernets:
    eth0:
      dhcp4: yes
    eth1:
      dhcp4: yes
```

Рисунок 7: Файл /etc/netplan/01-netcfg.yaml

# Обновление Mininet

```
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% (59/59), done.
remote: Total 10388 (delta 102), reused 69 (delta 69), pack-reused 10260 (from 3)
Receiving objects: 100% (10388/10388), 3.36 MiB | 219.00 KiB/s, done.
Resolving deltas: 100% (6906/6906), done.
mininet@mininet-vm:~$ cd ~/mininet
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 .
Processing /home/mininet/mininet
Requirement already satisfied: setuptools in /usr/lib/python3/dist-packages (from mininet==2.3.0b4) (45.2.0)
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=71e9132b8f58d6a855426587b9c8f556b3cb998719982048ad25fd63aa2603a
    Stored in directory: /tmp/pip-ephem-wheel-cache-sdsvksef/wheels/cd/7d/a7/aafe1b3eaff31efd6ba45e2ea6c9690a717bdf739db6cfe8d45
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$ _
```

Рисунок 8: Обновление Mininet

# Настройка шрифтов XTerm

```
! Depending on your environment, you may wish to disable those by default by
! uncommenting one or more of the resource settings below:
!*allowFontOps: false
!*allowTcapOps: false
!*allowTitleOps: false
!*allowWindowOps: false
xterm*faceName: Monospace
xterm*faceSize: 12
```

Рисунок 9: Настройка шрифтов XTerm

# XLaunch

---

Установим putty и VcXsrv Windows X Server. Запустим XLaunch.

Выберем опции:

- Multiple windows;
- Display number: -1;
- Start no client.

# Опция перенаправления X11

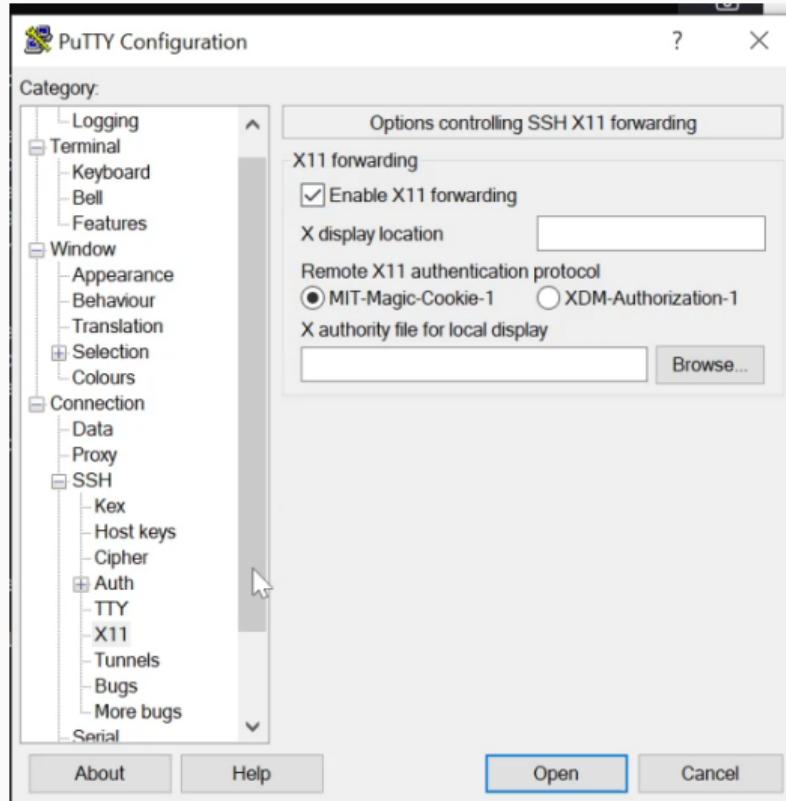


Рисунок 10: Опция перенаправления X11

# Настройка соединения X11 для суперпользователя

```
mininet@mininet-vm:~$ xauth list $DISPLAY
mininet-vm/unix:10  MIT-MAGIC-COOKIE-1  f011e2d40ce0blef190090ecd3327810
mininet@mininet-vm:~$ "C
mininet@mininet-vm:~$ sudo -i
root@mininet-vm:~# xauth add mininet-vm/unix:10 MIT-MAGIC-COOKIE-1 f011e2d40ce0blef1900
90ecd3327810
xauth:  file /root/.Xauthority does not exist
root@mininet-vm:~# xauth list
mininet-vm/unix:10  MIT-MAGIC-COOKIE-1  f011e2d40ce0blef190090ecd3327810
root@mininet-vm:~# logout
```

**Рисунок 11:** Настройка соединения X11 для суперпользователя

# Работа с Mininet с помощью командной строки

```
mininet@mininet-vm: ~
mininet@192.168.56.102'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: Tue Sep  9 10:52:28 2025 from 192.168.56.1
/usr/bin/xauth: file /home/mininet/.Xauthority does not exist
mininet@mininet-vm:~$ sudo mn
*** Creating network
*** Adding controller
*** Adding hosts
*** 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> help

Documented commands (type help <topic>):
-----
EOF qterm 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> net
h1 h1-eth0:s1-eth1
h2 h2-eth0:s1-eth2
s1 lo: s1-eth1:h1-eth0 s1-eth2:h2-eth0
c0
mininet>
```

# Проверка связности хостов

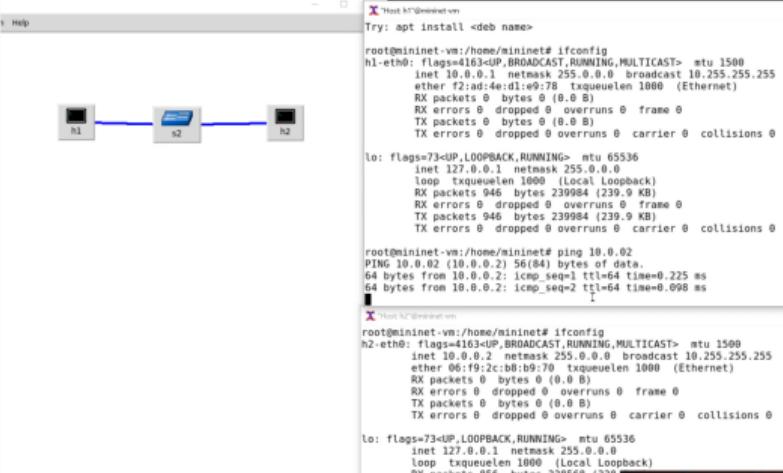
```
mininet> h1 ifconfig
h1-eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
      inet 10.0.0.1 netmask 255.0.0.0 broadcast 10.255.255.255
        ether 86:47:f7:7b:bb:48 txqueuelen 1000  (Ethernet)
          RX packets 0 bytes 0 (0.0 B)
          RX errors 0 dropped 0 overruns 0 frame 0
          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> 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=2.14 ms
64 bytes from 10.0.0.2: icmp_seq=2 ttl=64 time=0.324 ms
64 bytes from 10.0.0.2: icmp_seq=3 ttl=64 time=0.062 ms
64 bytes from 10.0.0.2: icmp_seq=4 ttl=64 time=0.066 ms
64 bytes from 10.0.0.2: icmp_seq=5 ttl=64 time=0.065 ms
^C
--- 10.0.0.2 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4082ms
rtt min/avg/max/mdev = 0.062/0.531/2.138/0.809 ms
mininet> exit
*** Stopping 1 controllers
c0
*** Stopping 2 links
..
*** Stopping 1 switches
s1
*** Stopping 2 hosts
h1 h2
*** Done
completed in 103.109 seconds
```

Рисунок 13: Проверка связности хостов

# Проверка IP-адресов. Пинг



The screenshot shows a terminal window with three tabs. The first tab displays a network diagram with three nodes: h1, s2, and h2 connected in a line. The second tab shows the output of the command `root@mininet-vm:/home/mininet# ifconfig`, listing interfaces h1-eth0, lo, and h2-eth0 with their respective configurations. The third tab shows the output of the command `root@mininet-vm:/home/mininet# ping 10.0.0.2`, which pings host h2 at address 10.0.0.2. The terminal window has a light gray background and black text.

```
Try: apt install <deb name>

root@mininet-vm:/home/mininet# 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 f2:0:ad:4e:d1:e9 brd 10.255.255.255
                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 946 bytes 239984 (239.9 KB)
                RX errors 0 dropped 0 overruns 0 frame 0
                TX packets 946 bytes 239984 (239.9 KB)
                TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

root@mininet-vm:/home/mininet# 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=0.225 ms
64 bytes from 10.0.0.2: icmp_seq=2 ttl=64 time=0.098 ms

root@mininet-vm:/home/mininet# ifconfig
h2-eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
        inet 10.0.0.2 netmask 255.0.0.0 broadcast 10.255.255.255
                ether 06:f9:2c:b8:b9:70 brd 10.255.255.255
                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)
                TX packets 0 bytes 0 (0.0 B)
```

Рисунок 14: Проверка IP-адресов. Пинг

# Смена базового IP-адреса

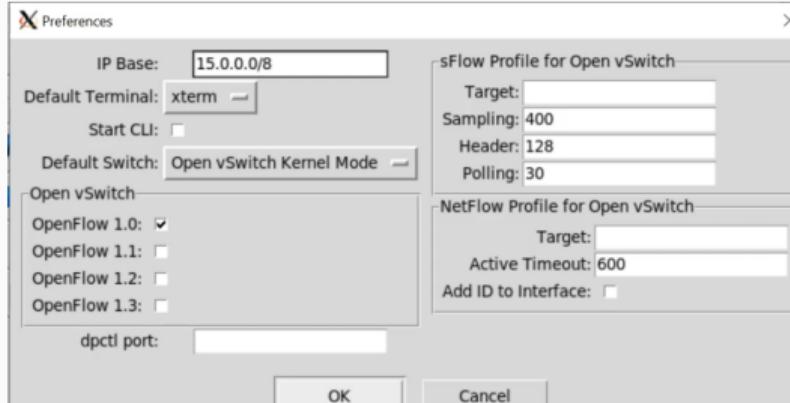


Рисунок 15: Смена базового IP-адреса

# Просмотр IP-адреса на h1

```
Host: h1"@mininet-vm
root@mininet-vm:/home/mininet# ifconfig
h1-eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 15.0.0.1 netmask 255.0.0.0 broadcast 15.255.255.255
        ether c6:02:03:05:53:9e 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 854 bytes 228672 (228.6 KB)
        RX errors 0 dropped 0 overruns 0 frame 0
        TX packets 854 bytes 228672 (228.6 KB)
        TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

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

```
Host: h2"@mininet-vm
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 22:39:cd:55:10:26 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 853 bytes 228412 (228.4 KB)
        RX errors 0 dropped 0 overruns 0 frame 0
        TX packets 853 bytes 228412 (228.4 KB)
        TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

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

# Сохранение топологии

---

```
bone
mininet@mininet-vm:~$ mkdir ~/work
mininet@mininet-vm:~$ sudo ~/mininet/mininet/examples/miniedit.py
topo=none
mininet@mininet-vm:~$ sudo chown -R mininet:mininet ~/work
```

**Рисунок 17:** Сохранение топологии

## Выводы

В ходе выполнения лабораторной работы я развёрнула mininet в системе виртуализации VirtualBox и ознакомилась с основными командами для работы с Mininet через командную строку и через графический интерфейс.