

# Лабораторная работа № 1

Введение в Mininet

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# Информация

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## Цель работы

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.

1. Настройка стенда виртуальной машины Mininet
2. Основы работы с Mininet

# Настройка образа VirtualBox

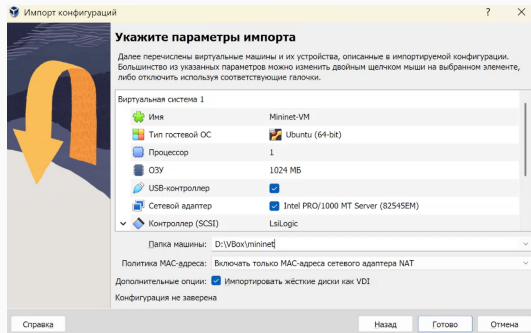


Рис. 1: Импорт файла .ovf.

# Подключение к виртуальной машине

```
asdoershteyj@fedora:~$ ssh -Y mininet@192.168.48.5
The authenticity of host '192.168.48.5 (192.168.48.5)' can't be established.
ED25519 key fingerprint is SHA256:HEs+eh2sR30LnQWey51x2RVDabE/07QikvlyUapRJ.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '192.168.48.5' (ED25519) to the list of known hosts.
mininet@192.168.48.5'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 07:52:08 2025 from 192.168.48.1
/usr/bin/sauth: file /home/mininet/.Xauthority does not exist
mininet@mininet-vm:~$ logout
Connection to 192.168.48.5 closed.
asdoershteyj@fedora:~$ ssh-copy-id mininet@192.168.48.5
/usr/bin/ssh-copy-id: INFO: attempting to log in with the new key(s), to filter out any that are already installed
/usr/bin/ssh-copy-id: INFO: 1 key(s) remain to be installed -- if you are prompted now it is to install the new keys
mininet@192.168.48.5's password:

Number of key(s) added: 1

Now try logging into the machine, with:  "ssh 'mininet@192.168.48.5'"
and check to make sure that only the key(s) you wanted were added.

asdoershteyj@fedora:~$ ssh -Y mininet@192.168.48.5
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 07:55:16 2025 from 192.168.48.1
mininet@mininet-vm:~$
```

Заккрыть

Рис. 2: Подключение по ssh

# Настройка доступа к Интернет

Посмотрела IP-адреса машины.

```
mininet@mininet-vm:~$ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
    inet 192.168.48.5  netmask 255.255.255.0  broadcast 192.168.48.255
    ether 08:00:27:eb:bd:44  txqueuelen 1000  (Ethernet)
    RX packets 181  bytes 29224 (29.2 KB)
    RX errors 0  dropped 0  overruns 0  frame 0
    TX packets 173  bytes 31298 (31.2 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 368  bytes 28200 (28.2 KB)
    RX errors 0  dropped 0  overruns 0  frame 0
    TX packets 368  bytes 28200 (28.2 KB)
    TX errors 0  dropped 0  overruns 0  carrier 0  collisions 0

mininet@mininet-vm:~$
```

Рис. 3: IP-адреса машины



# Настройка доступа к Интернет

Активировала второй интерфейс командой `sudo dhclient eth1`.

```
mininet@mininet-vm:~$ sudo dhclient eth1
mininet@mininet-vm:~$ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.48.5 netmask 255.255.255.0 broadcast 192.168.48.255
    ether 08:00:27:eb:bd:44 txqueuelen 1000 (Ethernet)
    RX packets 201 bytes 31194 (31.1 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 186 bytes 33582 (33.5 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

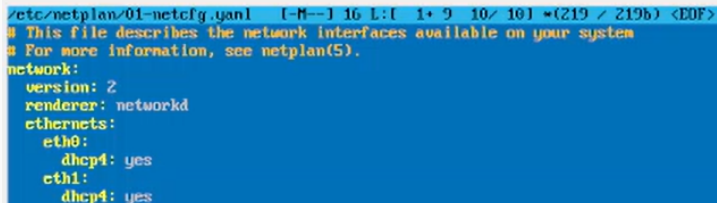
eth1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.0.2.15 netmask 255.255.255.0 broadcast 10.0.2.255
    ether 08:00:27:1a:a8:cb txqueuelen 1000 (Ethernet)
    RX packets 3 bytes 1770 (1.7 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 3 bytes 1026 (1.0 KB)
    TX 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 448 bytes 34328 (34.3 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 448 bytes 34328 (34.3 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

mininet@mininet-vm:~$ _
```

# Настройка доступа к Интернет

Добавила для mininet указание на использование двух адаптеров при запуске.



```
/etc/netplan/01-netcfg.yaml [-M--] 16 L:[ 1+ 9 10/ 10] *(219 / 219b) <EOF>
# 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
```

Рис. 5: 01-netcfg.yaml

## Обновление версии 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'...
fatal: unable to access 'https://github.com/mininet/mininet.git/': Failed to connect to github.com
port 443: Connection timed out
mininet@mininet-vm:~$ git clone https://github.com/mininet/mininet.git
Cloning into 'mininet'...
fatal: unable to access 'https://github.com/mininet/mininet.git/': Failed to connect to github.com
port 443: Connection timed out
mininet@mininet-vm:~$ git clone https://github.com/mininet/mininet.git
fatal: destination path 'mininet' already exists and is not an empty directory.
mininet@mininet-vm:~$ git clone https://github.com/mininet/mininet.git
Cloning into 'mininet'...
fatal: unable to access 'https://github.com/mininet/mininet.git/': Failed to connect to github.com
port 443: Connection timed out
mininet@mininet-vm:~$ git clone https://github.com/mininet/mininet.git
Cloning into 'mininet'...
fatal: unable to access 'https://github.com/mininet/mininet.git/': Could not resolve host: github.co
mininet@mininet-vm:~$ git clone https://github.com/mininet/mininet.git
Cloning into 'mininet'...
fatal: unable to access 'https://github.com/mininet/mininet.git/': Could not resolve host: github.co
mininet@mininet-vm:~$ mv ~/mininet.orig ~/mininet
mininet@mininet-vm:~$ mv --version
2.3.0
```

Рис. 6: Обновление версии mininet

# Обновление версии Minninet

```
mininet@mininet-vm:~$ ping -c 3 google.com
PING google.com (142.251.1.139) 56(84) bytes of data.
64 bytes from lb-in-f139.1e100.net (142.251.1.139): icmp_seq=1 ttl=107 time=22.3 ms
64 bytes from lb-in-f139.1e100.net (142.251.1.139): icmp_seq=2 ttl=107 time=22.1 ms
64 bytes from lb-in-f139.1e100.net (142.251.1.139): icmp_seq=3 ttl=107 time=24.9 ms

--- google.com ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2005ms
rtt min/avg/max/ndev = 22.135/23.100/24.907/1.278 ms
mininet@mininet-vm:~$ curl -I https://linux-console.net/

Command 'curl' not found, but can be installed with:

sudo apt install curl

mininet@mininet-vm:~$ ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 08:00:27:eb:bd:44 brd ff:ff:ff:ff:ff:ff
    inet 192.168.48.5/24 brd 192.168.48.255 scope global dynamic eth0
        valid_lft 509sec preferred_lft 509sec
3: eth1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 08:00:27:1a:a8:cb brd ff:ff:ff:ff:ff:ff
    inet 10.0.2.15/24 brd 10.0.2.255 scope global dynamic eth1
        valid_lft 84571sec preferred_lft 84571sec
mininet@mininet-vm:~$ ip r
default via 10.0.2.2 dev eth1
10.0.2.0/24 dev eth1 proto kernel scope link src 10.0.2.15
192.168.48.0/24 dev eth0 proto kernel scope link src 192.168.48.5
mininet@mininet-vm:~$ ping -c 2 192.168.48.5
PING 192.168.48.5 (192.168.48.5) 56(84) bytes of data.
64 bytes from 192.168.48.5: icmp_seq=1 ttl=64 time=0.020 ms
64 bytes from 192.168.48.5: icmp_seq=2 ttl=64 time=0.042 ms

--- 192.168.48.5 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1015ms
rtt min/avg/max/ndev = 0.020/0.031/0.042/0.011 ms
mininet@mininet-vm:~$ ping -c 2 10.0.2.15
PING 10.0.2.15 (10.0.2.15) 56(84) bytes of data.
64 bytes from 10.0.2.15: icmp_seq=1 ttl=64 time=0.024 ms
64 bytes from 10.0.2.15: icmp_seq=2 ttl=64 time=0.045 ms

--- 10.0.2.15 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1030ms
rtt min/avg/max/ndev = 0.024/0.034/0.045/0.010 ms
mininet@mininet-vm:~$ ping -c 3 github.com
PING github.com (140.82.121.3) 56(84) bytes of data.

--- github.com ping statistics ---
3 packets transmitted, 0 received, 100% packet loss, time 2035ms

mininet@mininet-vm:~$ git clone https://github.com/mininet/mininet.git
Cloning into 'mininet'...
fatal: unable to access 'https://github.com/mininet/mininet.git/': Failed to connect to github.com port 443: Connection timed out
mininet@mininet-vm:~$ ping -c 3 github.com
PING github.com (140.82.121.3) 56(84) bytes of data.

--- github.com ping statistics ---
```

Закреть

# Настройка параметров XTerm

Для увеличения размера шрифта и применения векторных шрифтов внесла изменения в файл

```
/etc/X11/app-defaults/XTerm  [-M--] 10 L:[233+34 267/267] *(10377/10377b) <EOF>  [*]IXI
! 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
!*allowUnderOps: false
```

# Настройка соединения X11 для суперпользователя

```
mininet@mininet-vm:~$ xauth list $DISPLAY
mininet-vm/unix:10 MIT-MAGIC-COOKIE-1 509d240f2d4cac829374815fb96c9ca4
mininet@mininet-vm:~$ sudo -i
root@mininet-vm:~# xauth list
xauth: file /root/.Xauthority does not exist
root@mininet-vm:~# xauth add mininet-vm/unix:10 mininet-vm/unix:10 MIT-MAGIC-COOKIE-1 509d240f2d4cac829374815fb96c9ca4
xauth: file /root/.Xauthority does not exist
xauth: (argv):1: bad "add" command line
root@mininet-vm:~# xauth add mininet-vm/unix:10 MIT-MAGIC-COOKIE-1 509d240f2d4cac829374815fb96c9ca4
xauth: file /root/.Xauthority does not exist
root@mininet-vm:~# xauth list $DISPLAY mininet-vm/unix:10 MIT-MAGIC-COOKIE-1 509d240f2d4cac829374815fb96c9ca4
mininet-vm/unix:10 MIT-MAGIC-COOKIE-1 509d240f2d4cac829374815fb96c9ca4
mininet-vm/unix:10 MIT-MAGIC-COOKIE-1 509d240f2d4cac829374815fb96c9ca4
xauth: (argv):1: bad display name "MIT-MAGIC-COOKIE-1" in "list" command
xauth: (argv):1: bad display name "509d240f2d4cac829374815fb96c9ca4" in "list" command
root@mininet-vm:~# xauth list
mininet-vm/unix:10 MIT-MAGIC-COOKIE-1 509d240f2d4cac829374815fb96c9ca4
root@mininet-vm:~# logout
```

Рис. 9: Редактирование xauth list

## Работа с Mininet с помощью командной строки

```
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. 10: Запуск минимальной топологии

## Работа с Mininet с помощью командной строки

Отобразили доступные узлы, посмотрели доступные линки и интерфейсы хоста h1.

```
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> 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 12:78:9e:db:43:9f 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
```

Рис. 11: Команды net, links, h1 ifconfig



## Работа с Mininet с помощью командной строки

И интерфейсы хоста h2. Затем проверила связь между хостами командой ping.

```
mininet> h2 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 3a:36:67:9a:17:93 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=1.42 ms
64 bytes from 10.0.0.2: icmp_seq=2 ttl=64 time=0.191 ms
64 bytes from 10.0.0.2: icmp_seq=3 ttl=64 time=0.058 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=0.057 ms
64 bytes from 10.0.0.2: icmp_seq=6 ttl=64 time=0.060 ms
```

# Построение и эмуляция сети в Mininet с использованием графического интерфейса

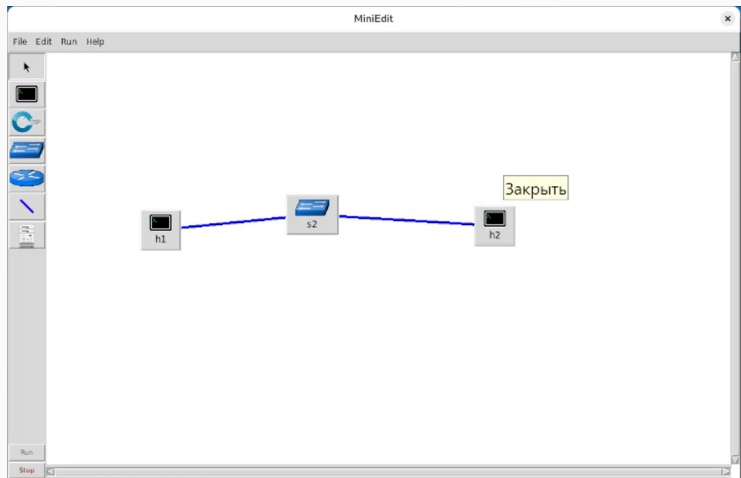
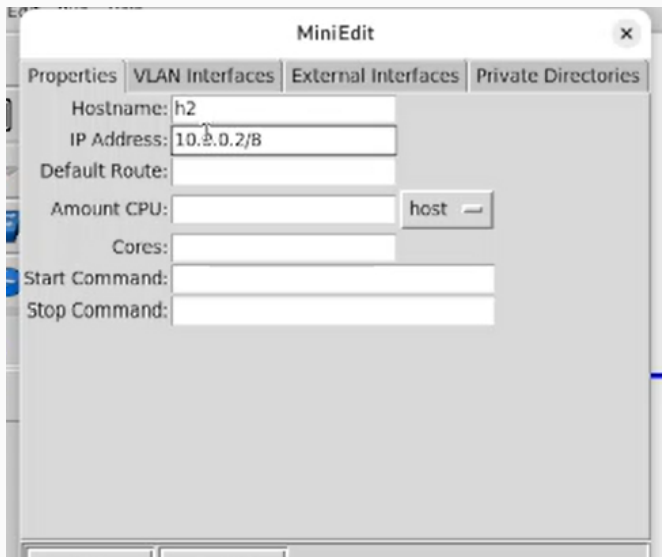


Рис. 13: Топология в MiniEdit

# Построение и эмуляция сети в Mininet с использованием графического интерфейса



# Построение и эмуляция сети в Mininet с использованием графического интерфейса

```
Host: h1"

ether 82:2c:6d:cf:31:6c 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

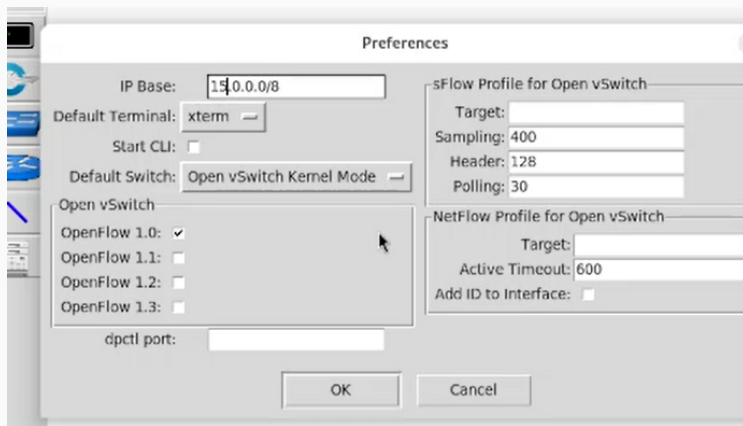
lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
inet 127.0.0.1  netmask 255.0.0.0
loop txqueuelen 1000 (Local Loopback)
RX packets 905  bytes 253572 (253.5 KB)
RX errors 0  dropped 0  overruns 0  frame 0
TX packets 905  bytes 253572 (253.5 KB)
TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

root@mininet-vm:/home/mininet# ping -c 3 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=0.229 ms
64 bytes from 10.0.0.2: icmp_seq=2 ttl=64 time=0.066 ms
64 bytes from 10.0.0.2: icmp_seq=3 ttl=64 time=0.068 ms

--- 10.0.0.2 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2021ms
rtt min/avg/max/mdev = 0.066/0.121/0.229/0.076 ms
```

Рис. 15: Связь между хостами

# Построение и эмуляция сети в Mininet с использованием графического интерфейса



**Рис. 16:** Автоматическое назначение IP-адресов

# Построение и эмуляция сети в Mininet с использованием графического интерфейса

```

"Host: h1"

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 4a:7e:74:12:30:2c 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 951 bytes 263540 (263.5 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 951 bytes 263540 (263.5 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

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

Рис. 17: Связь между хостами

# Построение и эмуляция сети в Mininet с использованием графического интерфейса

Создала каталог для работы с проектами mininet, после сохранения проекта поменяла права доступа к файлам в каталоге проекта.

```
mininet@mininet-vm:~$ mkdir ~/work
mininet@mininet-vm:~$ cd work
mininet@mininet-vm:~/work$ cd ..
mininet@mininet-vm:~$ ls
mininet  oflops  oftest  opendflow  pax  work
mininet@mininet-vm:~$ cd work
mininet@mininet-vm:~/work$ ls
lab1.mn
mininet@mininet-vm:~/work$ cd ..
mininet@mininet-vm:~$ sudo chown -R mininet:mininet ~/work
mininet@mininet-vm:~$
```

Рис. 18: Сохранение проекта

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