

Санкт-Петербургский национальный исследовательский университет
информационных технологий, механики и оптики

Факультет инфокоммуникационных технологий

Направление подготовки 11.03.02

Лабораторная работа №4

Элементы безопасности в Linux

Выполнил:

Доценников Никита Андреевич

Группа: К3221

Проверил:

Береснев Артем Дмитриевич

Санкт-Петербург

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Цель работы:

Получить практические навыки работы с сетевой подсистемой в Linux, научиться управлять пользователями, правами на файлы и каталоги, научиться настраивать сетевые интерфейсы, NAT и настраивать ssh.

Часть 1. Подготовка конфигурации.

У себя на машине я создал новую виртуальную сеть:

```
virsh net-define /tmp/intnet.xml
virsh net-autostart intnet
virsh net-start intnet
```

Содержание файла `/tmp/intnet.xml`:

```
<network>
  <name>intnet</name>
  <forward mode='none' />
</network>
```

К первой машине я добавил дополнительный интерфейс, подключенный к сети intnet:

```
virsh attach-interface --domain ubuntu24.04 --type network --
source intnet --model virtio --config --live
```

Вторую машину я полностью перевел во внутреннюю сеть:

```
virsh detach-interface --domain ubuntu24.04-clone --type
network --mac 52:54:00:76:1f:db --config --live
virsh attach-interface --domain ubuntu24.04-clone --type
network --source intnet --model virtio --config --live
```

^ ~ >

ssh nik@192.168.122.33

Ⓢ 10:57

nik@192.168.122.33's password:

Welcome to Ubuntu 24.04.3 LTS (GNU/Linux 6.8.0-85-generic x86_64)

* Documentation: <https://help.ubuntu.com>
* Management: <https://landscape.canonical.com>
* Support: <https://ubuntu.com/pro>

System information as of Tue Oct 7 07:57:15 AM UTC 2025

System load:	0.11	Processes:	157
Usage of /:	43.9% of 11.21GB	Users logged in:	0
Memory usage:	6%	IPv4 address for enp1s0:	192.168.122.33
Swap usage:	0%		

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See <https://ubuntu.com/esm> or run: `sudo pro status`

Last login: Tue Oct 7 07:47:53 2025 from 192.168.122.1

nik@c7-1:~\$

```

nik@c7-1:~$ ssh nik@10.0.0.2
nik@10.0.0.2's password:
Welcome to Ubuntu 24.04.3 LTS (GNU/Linux 6.8.0-85-generic x86_64)

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

System information as of Tue Oct  7 07:58:07 AM UTC 2025

System load: 0.0           Memory usage: 6%    Processes:      162
Usage of /:  44.4% of 11.21GB Swap usage:   0%    Users logged in: 1

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

Last login: Tue Oct  7 07:48:02 2025 from 10.0.0.1
nik@c7-2:~$ █

```

Ha c7-1:

```

nik@c7-1:~$ sudo nvim /etc/netplan/60-intnet.yaml
nik@c7-1:~$ sudo netplan apply

** (generate:2292): WARNING **: 08:07:57.285: Permissions for /etc/netplan/60-intnet.yaml are too open. Netplan configuration should NOT be accessible by others.

** (process:2290): WARNING **: 08:07:57.598: Permissions for /etc/netplan/60-intnet.yaml are too open. Netplan configuration should NOT be accessible by others.

** (process:2290): WARNING **: 08:07:57.682: Permissions for /etc/netplan/60-intnet.yaml are too open. Netplan configuration should NOT be accessible by others.
nik@c7-1:~$ cat /etc/netplan/60-intnet.yaml
network:
  version: 2
  ethernets:
    enp8s0:
      addresses: [10.0.0.1/24]
nik@c7-1:~$ █

```

```
nik@c7-1:~$ 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=0.401 ms
64 bytes from 10.0.0.2: icmp_seq=2 ttl=64 time=0.403 ms
64 bytes from 10.0.0.2: icmp_seq=3 ttl=64 time=0.388 ms
64 bytes from 10.0.0.2: icmp_seq=4 ttl=64 time=0.513 ms
64 bytes from 10.0.0.2: icmp_seq=5 ttl=64 time=0.567 ms
^C
--- 10.0.0.2 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4122ms
rtt min/avg/max/mdev = 0.388/0.454/0.567/0.072 ms
nik@c7-1:~$
```

```
nik@c7-1:~$ ping 8.8.8.8
PING 8.8.8.8 (8.8.8.8) 56(84) bytes of data.
64 bytes from 8.8.8.8: icmp_seq=3 ttl=117 time=704 ms
64 bytes from 8.8.8.8: icmp_seq=4 ttl=117 time=830 ms
64 bytes from 8.8.8.8: icmp_seq=8 ttl=117 time=1033 ms
64 bytes from 8.8.8.8: icmp_seq=10 ttl=117 time=893 ms
64 bytes from 8.8.8.8: icmp_seq=11 ttl=117 time=1023 ms
^C
--- 8.8.8.8 ping statistics ---
12 packets transmitted, 5 received, 58.3333% packet loss, time 11172ms
rtt min/avg/max/mdev = 703.785/896.690/1033.467/123.649 ms, pipe 2
nik@c7-1:~$
```

```
nik@c7-1:~$ sudo nvim /etc/sysctl.conf
nik@c7-1:~$ cat /etc/sysctl.conf | grep net.ipv4.ip_forward=1
net.ipv4.ip_forward=1
nik@c7-1:~$ sudo sysctl -p
net.ipv4.ip_forward = 1
nik@c7-1:~$ sudo iptables -t nat -A POSTROUTING -o enp1s0 -j MASQUERADE
nik@c7-1:~$
```

Ha c7-2:

```

nik@c7-2:~$ sudo netplan apply

** (generate:1921): WARNING **: 08:13:36.606: Permissions for /etc/netplan/60-intnet.yaml are too open. Netplan configuration should NOT be accessible by others.

** (process:1919): WARNING **: 08:13:36.991: Permissions for /etc/netplan/60-intnet.yaml are too open. Netplan configuration should NOT be accessible by others.

** (process:1919): WARNING **: 08:13:37.055: Permissions for /etc/netplan/60-intnet.yaml are too open. Netplan configuration should NOT be accessible by others.
nik@c7-2:~$ cat /etc/netplan/60-intnet.yaml
network:
  version: 2
  ethernet:
    enp1s0:
      addresses: [10.0.0.2/24]
      routes:
        - to: default
          via: 10.0.0.1
      nameservers:
        addresses: [8.8.8.8, 77.88.8.1]
nik@c7-2:~$

```

```

nik@c7-2:~$ 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=0.391 ms
64 bytes from 10.0.0.1: icmp_seq=2 ttl=64 time=0.595 ms
64 bytes from 10.0.0.1: icmp_seq=3 ttl=64 time=0.480 ms
64 bytes from 10.0.0.1: icmp_seq=4 ttl=64 time=0.518 ms
^C
--- 10.0.0.1 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3078ms
rtt min/avg/max/mdev = 0.391/0.496/0.595/0.073 ms
nik@c7-2:~$

```

```

nik@c7-2:~$ ping 8.8.8.8
PING 8.8.8.8 (8.8.8.8) 56(84) bytes of data.
64 bytes from 8.8.8.8: icmp_seq=1 ttl=116 time=996 ms
64 bytes from 8.8.8.8: icmp_seq=2 ttl=116 time=1086 ms
64 bytes from 8.8.8.8: icmp_seq=3 ttl=116 time=1183 ms
64 bytes from 8.8.8.8: icmp_seq=6 ttl=116 time=959 ms
^C
--- 8.8.8.8 ping statistics ---
7 packets transmitted, 4 received, 42.8571% packet loss, time 6056ms
rtt min/avg/max/mdev = 958.750/1056.080/1182.953/86.657 ms, pipe 2
nik@c7-2:~$

```

Часть 2. Создание пользователей и настройка OpenSSH Server (sshd).

Я создал пользователя на каждой машине:

```

nik@c7-1:~$ sudo adduser nik-c7-1
info: Adding user `nik-c7-1' ...
info: Selecting UID/GID from range 1000 to 59999 ...
info: Adding new group `nik-c7-1' (1001) ...
info: Adding new user `nik-c7-1' (1001) with group `nik-c7-1 (1001)' ...
info: Creating home directory `/home/nik-c7-1' ...
info: Copying files from `/etc/skel' ...
New password:
Retype new password:
passwd: password updated successfully
Changing the user information for nik-c7-1
Enter the new value, or press ENTER for the default
    Full Name []:
    Room Number []:
    Work Phone []:
    Home Phone []:
    Other []:
Is the information correct? [Y/n] Y
info: Adding new user `nik-c7-1' to supplemental / extra groups `users' ...
info: Adding user `nik-c7-1' to group `users' ...
nik@c7-1:~$ id nik-c7-1
uid=1001(nik-c7-1) gid=1001(nik-c7-1) groups=1001(nik-c7-1),100(users)
nik@c7-1:~$ █

```

```

nik@c7-2:~$ sudo adduser nik-c7-2
[sudo] password for nik:
info: Adding user `nik-c7-2' ...
info: Selecting UID/GID from range 1000 to 59999 ...
info: Adding new group `nik-c7-2' (1001) ...
info: Adding new user `nik-c7-2' (1001) with group `nik-c7-2 (1001)' ...
info: Creating home directory `/home/nik-c7-2' ...
info: Copying files from `/etc/skel' ...
New password:
Retype new password:
passwd: password updated successfully
Changing the user information for nik-c7-2
Enter the new value, or press ENTER for the default
    Full Name []:
    Room Number []:
    Work Phone []:
    Home Phone []:
    Other []:
Is the information correct? [Y/n]
info: Adding new user `nik-c7-2' to supplemental / extra groups `users' ...
info: Adding user `nik-c7-2' to group `users' ...
nik@c7-2:~$ id nik-c7-2
uid=1001(nik-c7-2) gid=1001(nik-c7-2) groups=1001(nik-c7-2),100(users)
nik@c7-2:~$ █

```

Затем я настроил `ssh` на обеих машинах:

```
# override default of no subsystems
Subsystem      sftp      /usr/lib/openssh/sftp-server

# Example of overriding settings on a per-user basis
#Match User anoncvs
#      X11Forwarding no
#      AllowTcpForwarding no
#      PermitTTY no
#      ForceCommand cvs server

PermitRootLogin yes
MaxAuthTries 2
UseDNS no
/etc/ssh/sshd_config [+] 135,1 99%
-- VISUAL LINE -- 3
```

И перезапустил daemon:

```
nik@c7-1:~$ sudo nvim /etc/ssh/sshd_config
nik@c7-1:~$ sudo systemctl restart ssh
nik@c7-1:~$ sudo systemctl status ssh
WARNING: terminal is not fully functional
Press RETURN to continue
● ssh.service - OpenBSD Secure Shell server
   Loaded: loaded (/usr/lib/systemd/system/ssh.service; enabled;>
   Active: active (running) since Tue 2025-10-07 08:43:45 UTC; 8>
  TriggeredBy: ● ssh.socket
     Docs: man:sshd(8)
           man:sshd_config(5)
   Process: 2552 ExecStartPre=/usr/sbin/sshd -t (code=exited, sta>
   Main PID: 2554 (sshd)
     Tasks: 1 (limit: 4605)
    Memory: 1.2M (peak: 1.4M)
       CPU: 20ms
    CGroup: /system.slice/ssh.service
           └─2554 "sshd: /usr/sbin/sshd -D [listener] 0 of 10-10>

Oct 07 08:43:45 c7-1 systemd[1]: Starting ssh.service - OpenBSD Se>
Oct 07 08:43:45 c7-1 sshd[2554]: Server listening on 0.0.0.0 port >
Oct 07 08:43:45 c7-1 sshd[2554]: Server listening on :: port 22.
Oct 07 08:43:45 c7-1 systemd[1]: Started ssh.service - OpenBSD Sec>
nik@c7-1:~$
```

Все те же действия я проделал на второй машине.

Попробовал подключиться с c7-1 на c7-2:

```
nik@c7-1:~$ ssh nik-c7-2@10.0.0.2
nik-c7-2@10.0.0.2's password:
Welcome to Ubuntu 24.04.3 LTS (GNU/Linux 6.8.0-85-generic x86_64)

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

System information as of Tue Oct  7 08:46:58 AM UTC 2025

System load:  0.0               Processes:    173
Usage of /:   44.5% of 11.21GB   Users logged in: 1
Memory usage: 6%               IPv4 address for enp1s0: 10.0.0.2
Swap usage:  0%

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

nik-c7-2@c7-2:~$
```

Часть 3. Подключение к виртуальной машине c7-1 по ssh через NAT VirtualBox.

У себя на машине:

```
sudo iptables -t nat -A PREROUTING -p tcp -d 127.0.0.10 --dport 2221 -j DNAT
--to-destination 192.168.122.33:22
[sudo] password for nik:
A labs/lab4/assets 1 main 11:50
sudo iptables -A FORWARD -p tcp -d 192.168.122.33 --dport 22 -j ACCEPT
A labs/lab4/assets 1 main 11:50
sudo iptables -t nat -L PREROUTING -n
Chain PREROUTING (policy ACCEPT)
target     prot opt source                destination
DNAT       tcp  --  0.0.0.0/0             127.0.0.10            tcp dpt:2221
to:192.168.122.33:22
A labs/lab4/assets 1 main 11:50
```

```
ssh nik@192.168.122.33
nik@192.168.122.33's password:
Welcome to Ubuntu 24.04.3 LTS (GNU/Linux 6.8.0-85-generic x86_64)

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

System information as of Tue Oct  7 09:58:13 AM UTC 2025

System load:  1.72          Processes:           166
Usage of /:   44.0% of 11.21GB Users logged in:       0
Memory usage: 5%          IPv4 address for enp1s0: 192.168.122.33
Swap usage:   0%

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

Last login: Tue Oct  7 07:57:15 2025 from 192.168.122.1
nik@c7-1:~$ ls
nik@c7-1:~$
```

```
ssh nik-c7-1@192.168.122.33
nik-c7-1@192.168.122.33's password:
Welcome to Ubuntu 24.04.3 LTS (GNU/Linux 6.8.0-85-generic x86_64)

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

System information as of Tue Oct  7 09:59:53 AM UTC 2025

System load:  0.32          Processes:           165
Usage of /:   44.1% of 11.21GB Users logged in:       0
Memory usage: 6%          IPv4 address for enp1s0: 192.168.122.33
Swap usage:   0%

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

nik-c7-1@c7-1:~$
```

Копирование файла с c7-2 на c7-1:

```
Last login: Tue Oct 7 08:45:05 2025 from 10.0.0.1
nik@c7-2:~$ ls
info.sh  part.sh  test.txt
nik@c7-2:~$ cat test.txt
hello world!
nik@c7-2:~$ scp test.txt nik@10.0.0.1:/home/nik/
The authenticity of host '10.0.0.1 (10.0.0.1)' can't be established.
ED25519 key fingerprint is SHA256:adw6Jrv304d+4mZuYSksMR3sl0tBoe90ja3VyYRX9PY.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '10.0.0.1' (ED25519) to the list of known hosts.
nik@10.0.0.1's password:
test.txt
nik@c7-2:~$ logout
Connection to 10.0.0.2 closed.
nik@c7-1:~$ ls
test.txt
nik@c7-1:~$ cat test.txt
hello world!
nik@c7-1:~$
```

100% 13 15.7KB/s 00:00

Копирование с c7-2 на c7-1:

```

nik@c7-1:~$ scp nik@10.0.0.2:/home/nik/part.sh /home/nik/
nik@10.0.0.2's password:
part.sh
nik@c7-1:~$ cat part.sh
#!/bin/bash

for disk in /dev/sd{a,b,c,d,e}; do
    sudo parted -s $disk mklabel gpt
    sudo parted -s $disk mkpart primary 0% 100%
done

nik@c7-1:~$ ssh nik@10.0.0.2
nik@10.0.0.2's password:
Welcome to Ubuntu 24.04.3 LTS (GNU/Linux 6.8.0-85-generic x86_64)

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

System information as of Tue Oct  7 10:12:11 AM UTC 2025

System load:  0.1               Processes:            165
Usage of /:   44.5% of 11.21GB   Users logged in:     1
Memory usage: 6%               IPv4 address for enp1s0: 10.0.0.2
Swap usage:   0%

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

Last login: Tue Oct  7 10:09:10 2025 from 10.0.0.1
nik@c7-2:~$ ls
info.sh  part.sh  test.txt
nik@c7-2:~$ cat part.sh
#!/bin/bash

for disk in /dev/sd{a,b,c,d,e}; do
    sudo parted -s $disk mklabel gpt
    sudo parted -s $disk mkpart primary 0% 100%
done

nik@c7-2:~$

```

Часть 4. Установка и настройка NAT в iptables.

Я установил `iptables`:

```

nik@c7-1:~$ sudo apt install -y iptables
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
iptables is already the newest version (1.8.10-3ubuntu2).
iptables set to manually installed.
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
nik@c7-1:~$ █

```

Настроил клиентский NAT, то есть настроил связь между 10.0.0.0/24 и enpls0 через роутер c7-1.

```

nik@c7-1:~$ sudo sysctl -w net.ipv4.ip_forward=1
net.ipv4.ip_forward = 1
nik@c7-1:~$ sudo iptables -t nat -A POSTROUTING -o enpls0 -s 10.0.0.0/24 -j MASQUERADE
nik@c7-1:~$ █

```

Затем я разрешил форвардинг трафика на c7-1:

```

nik@c7-1:~$ █
nik@c7-1:~$ sudo iptables -A FORWARD -d 10.0.0.0/24 -j ACCEPT
nik@c7-1:~$ sudo iptables -A FORWARD -s 10.0.0.0/24 -j ACCEPT
nik@c7-1:~$ █

```

После этого я проверил работу интернета с c7-2:

```

nik@c7-2:~$ ping 8.8.8.8
PING 8.8.8.8 (8.8.8.8) 56(84) bytes of data.
64 bytes from 8.8.8.8: icmp_seq=9 ttl=116 time=870 ms
64 bytes from 8.8.8.8: icmp_seq=12 ttl=116 time=867 ms
64 bytes from 8.8.8.8: icmp_seq=13 ttl=116 time=688 ms
64 bytes from 8.8.8.8: icmp_seq=15 ttl=116 time=500 ms
^C
--- 8.8.8.8 ping statistics ---
15 packets transmitted, 4 received, 73.3333% packet loss, time 14288ms
rtt min/avg/max/mdev = 499.626/731.227/869.839/152.669 ms
nik@c7-2:~$ █

```

Я настроил проброс порта:

```

nik@c7-1:~$ sudo iptables -t nat -A PREROUTING -i enpls0 -p tcp --dport 55022 -j DNAT --to-destination 10.0.0.2:22
nik@c7-1:~$ █

```

На c7-1:

```
nik@c7-1:~$ sudo iptables -t nat -A PREROUTING -i enp1s0 -p tcp --dport 55022 -j DNAT --to-destination 10.0.0.2:22
[sudo] password for nik:
nik@c7-1:~$
```

Локально:

```
^ ~ >
ssh -p 55022 nik@192.168.122.33
nik@192.168.122.33's password:
Welcome to Ubuntu 24.04.3 LTS (GNU/Linux 6.8.0-85-generic x86_64)

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

System information as of Tue Oct  7 10:55:42 AM UTC 2025

System load:  0.0               Processes:            166
Usage of /:   44.5% of 11.21GB   Users logged in:     1
Memory usage: 6%               IPv4 address for enp1s0: 10.0.0.2
Swap usage:   0%

 * Strictly confined Kubernetes makes edge and IoT secure. Learn how MicroK8s
   just raised the bar for easy, resilient and secure K8s cluster deployment.

   https://ubuntu.com/engage/secure-kubernetes-at-the-edge

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

Last login: Tue Oct  7 10:51:01 2025 from 192.168.122.1
nik@c7-2:~$
```

Текущие правила:

```

nik@c7-1:~$
nik@c7-1:~$ sudo iptables -L -v -n
[sudo] password for nik:
Chain INPUT (policy ACCEPT 0 packets, 0 bytes)
  pkts bytes target     prot opt in     out     source                   destination

Chain FORWARD (policy ACCEPT 0 packets, 0 bytes)
  pkts bytes target     prot opt in     out     source                   destination
   96 28473 ACCEPT     0    -- *     *       0.0.0.0/0                10.0.0.0/24
  137 20835 ACCEPT     0    -- *     *       10.0.0.0/24              0.0.0.0/0
    0    0 ACCEPT     0    -- enp8s0 enp1s0 10.0.0.0/24              0.0.0.0/0
    0    0 ACCEPT     0    -- enp1s0 enp8s0 0.0.0.0/0                10.0.0.0/24                                state RELATED,ESTABLISHED

Chain OUTPUT (policy ACCEPT 0 packets, 0 bytes)
  pkts bytes target     prot opt in     out     source                   destination

nik@c7-1:~$ sudo iptables -t nat -L -v -n
Chain PREROUTING (policy ACCEPT 43 packets, 10193 bytes)
  pkts bytes target     prot opt in     out     source                   destination
    2   120 DNAT       6    -- enp1s0 *       0.0.0.0/0                0.0.0.0/0                tcp dpt:55022 to:10.0.0.2:22
    0    0 DNAT       6    -- enp1s0 *       0.0.0.0/0                0.0.0.0/0                tcp dpt:55022 to:10.0.0.2:22
    0    0 DNAT       6    -- enp1s0 *       0.0.0.0/0                0.0.0.0/0                tcp dpt:55022 to:10.0.0.2:22

Chain INPUT (policy ACCEPT 0 packets, 0 bytes)
  pkts bytes target     prot opt in     out     source                   destination

Chain OUTPUT (policy ACCEPT 0 packets, 0 bytes)
  pkts bytes target     prot opt in     out     source                   destination

Chain POSTROUTING (policy ACCEPT 34 packets, 2764 bytes)
  pkts bytes target     prot opt in     out     source                   destination
   15  1074 MASQUERADE 0    -- *     enp1s0 10.0.0.0/24              0.0.0.0/0
nik@c7-1:~$

```

Настройки не сбрасываются после перезагрузки:

```

nik@c7-1:~$ sudo iptables-save | sudo tee /etc/iptables/rules.v4
# Generated by iptables-save v1.8.10 (nf_tables) on Tue Oct  7 10:59:54 2025
*filter
:INPUT ACCEPT [0:0]
:FORWARD ACCEPT [0:0]
:OUTPUT ACCEPT [0:0]
-A FORWARD -d 10.0.0.0/24 -j ACCEPT
-A FORWARD -s 10.0.0.0/24 -j ACCEPT
-A FORWARD -s 10.0.0.0/24 -i enp8s0 -o enp1s0 -j ACCEPT
-A FORWARD -d 10.0.0.0/24 -i enp1s0 -o enp8s0 -m state --state RELATED,ESTABLISHED -j ACCEPT
COMMIT
# Completed on Tue Oct  7 10:59:54 2025
# Generated by iptables-save v1.8.10 (nf_tables) on Tue Oct  7 10:59:54 2025
*nat
:PREROUTING ACCEPT [45:10572]
:INPUT ACCEPT [0:0]
:OUTPUT ACCEPT [0:0]
:POSTROUTING ACCEPT [43:3419]
-A PREROUTING -i enp1s0 -p tcp -m tcp --dport 55022 -j DNAT --to-destination 10.0.0.2:22
-A PREROUTING -i enp1s0 -p tcp -m tcp --dport 55022 -j DNAT --to-destination 10.0.0.2:22
-A PREROUTING -i enp1s0 -p tcp -m tcp --dport 55022 -j DNAT --to-destination 10.0.0.2:22
-A POSTROUTING -s 10.0.0.0/24 -o enp1s0 -j MASQUERADE
COMMIT
# Completed on Tue Oct  7 10:59:54 2025
nik@c7-1:~$

```

Часть 5. Настройка прав на файлы и каталоги.

Я создал скрипт `mkuser.sh`:

```

#!/usr/bin/env bash
set -euo pipefail

```

```

count="${1:?}"
start="${2:?}"
for ((i=0;i<count;i++)); do
    n=$((start+i))
    u="u${n}"
    p="DerParol${n}"
    id -u "$u" >/dev/null 2>&1 || adduser --disabled-password --
gecos "" "$u"
    echo "${u}:${p}" | chpasswd
done

```

```

nik@c7-2:~$ sudo ./mkuser.sh 5 1
[sudo] password for nik:
info: Adding user `u1' ...
info: Selecting UID/GID from range 1000 to 59999 ...
info: Adding new group `u1' (1002) ...
info: Adding new user `u1' (1002) with group `u1 (1002)' ...
info: Creating home directory `/home/u1' ...
info: Copying files from `/etc/skel' ...
info: Adding new user `u1' to supplemental / extra groups `users' ...
info: Adding user `u1' to group `users' ...
info: Adding user `u2' ...
info: Selecting UID/GID from range 1000 to 59999 ...
info: Adding new group `u2' (1003) ...
info: Adding new user `u2' (1003) with group `u2 (1003)' ...
info: Creating home directory `/home/u2' ...
info: Copying files from `/etc/skel' ...
info: Adding new user `u2' to supplemental / extra groups `users' ...
info: Adding user `u2' to group `users' ...
info: Adding user `u3' ...
info: Selecting UID/GID from range 1000 to 59999 ...
info: Adding new group `u3' (1004) ...
info: Adding new user `u3' (1004) with group `u3 (1004)' ...
info: Creating home directory `/home/u3' ...
info: Copying files from `/etc/skel' ...
info: Adding new user `u3' to supplemental / extra groups `users' ...
info: Adding user `u3' to group `users' ...
info: Adding user `u4' ...
info: Selecting UID/GID from range 1000 to 59999 ...
info: Adding new group `u4' (1005) ...
info: Adding new user `u4' (1005) with group `u4 (1005)' ...
info: Creating home directory `/home/u4' ...
info: Copying files from `/etc/skel' ...
info: Adding new user `u4' to supplemental / extra groups `users' ...
info: Adding user `u4' to group `users' ...
info: Adding user `u5' ...
info: Selecting UID/GID from range 1000 to 59999 ...
info: Adding new group `u5' (1006) ...
info: Adding new user `u5' (1006) with group `u5 (1006)' ...
info: Creating home directory `/home/u5' ...
info: Copying files from `/etc/skel' ...
info: Adding new user `u5' to supplemental / extra groups `users' ...
info: Adding user `u5' to group `users' ...
nik@c7-2:~$

```

```
nik@c7-2:~$ getent passwd | grep '^u[1-5]:'  
u1:x:1002:1002:,,,:/home/u1:/bin/bash  
u2:x:1003:1003:,,,:/home/u2:/bin/bash  
u3:x:1004:1004:,,,:/home/u3:/bin/bash  
u4:x:1005:1005:,,,:/home/u4:/bin/bash  
u5:x:1006:1006:,,,:/home/u5:/bin/bash  
nik@c7-2:~$
```

Затем я создал группу:

```
nik@c7-2:~$  
nik@c7-2:~$ sudo groupadd labgrp  
nik@c7-2:~$ getent group labgrp  
labgrp:x:1007:  
nik@c7-2:~$
```

Членам группы я выдал полный доступ, а остальным только чтение:

```
nik@c7-2:~$ sudo mkdir -p /DATA  
nik@c7-2:~$ sudo chown root:labgrp /DATA  
nik@c7-2:~$ sudo chmod 2775 /DATA
```

```
nik@c7-2:~$ sudo setfacl -m g:labgrp:rwX,o:rx /DATA  
[sudo] password for nik:  
nik@c7-2:~$ sudo setfacl -d -m g:labgrp:rwX,o:rx /DATA  
nik@c7-2:~$ sudo usermod -aG labgrp u1
```

Проверим:

```
nik@c7-2:~$ sudo -u u1 touch /DATA/test_by_u1.txt
nik@c7-2:~$ sudo -u u2 ls -l /DATA
total 0
-rw-rw-r--+ 1 u1 labgrp 0 Oct  7 11:57 test_by_u1.txt
nik@c7-2:~$ sudo -u u2 cat /DATA/test_by_u1.txt
nik@c7-2:~$ ls -ld /DATA
drwxrwsr-x+ 2 root labgrp 4096 Oct  7 11:57 /DATA
nik@c7-2:~$ getfacl /DATA
getfacl: Removing leading '/' from absolute path names
# file: DATA
# owner: root
# group: labgrp
# flags: -s-
user::rwx
group::rwx
group:labgrp:rwx
mask::rwx
other::r-x
default:user::rwx
default:group::rwx
default:group:labgrp:rwx
```

Я сделал так, чтобы в `/DATA/sec1` любой мог писать, но удалять - только свои файлы:

```
nik@c7-2:~$ sudo mkdir -p /DATA/sec1
nik@c7-2:~$ sudo chmod 1777 /DATA/sec1
```

Проверим:

```
nik@c7-2:~$ sudo -u u1 touch /DATA/sec1/a
nik@c7-2:~$ sudo -u u2 rm /DATA/sec1/a || echo "expected: cannot remove others' file"
rm: remove write-protected regular empty file '/DATA/sec1/a'?
nik@c7-2:~$
nik@c7-2:~$ ls -ld /DATA/sec1
drwxrwsrwt+ 2 root labgrp 4096 Oct  7 12:01 /DATA/sec1
nik@c7-2:~$
```

`/DATA/sec2` настроен на полный доступ для спец. пользователя, для пользователей `uN` только чтение, для прочих нельзя.

```

nik@c7-2:~$ id nik-c7-2
uid=1001(nik-c7-2) gid=1001(nik-c7-2) groups=1001(nik-c7-2),100(users)
nik@c7-2:~$ SPEC_USER="nik-c7-2"
nik@c7-2:~$ sudo mkdir -p /DATA/sec2
nik@c7-2:~$ sudo groupadd -f sec2readers
nik@c7-2:~$ sudo chgrp sec2readers /DATA/sec2
nik@c7-2:~$ sudo usermod -aG sec2readers u1
nik@c7-2:~$ sudo usermod -aG sec2readers u2
nik@c7-2:~$ sudo usermod -aG sec2readers u3
nik@c7-2:~$ sudo usermod -aG sec2readers u4
nik@c7-2:~$ sudo usermod -aG sec2readers u5
nik@c7-2:~$ sudo chown "${SPEC_USER}":sec2readers /DATA/sec2
nik@c7-2:~$ sudo chmod 2750 /DATA/sec2
nik@c7-2:~$ sudo setfacl -m u:"${SPEC_USER}":rwx,g:sec2readers:rx,o:--- /DATA/sec2
nik@c7-2:~$ sudo setfacl -d -m u:"${SPEC_USER}":rwx,g:sec2readers:r--,o:--- /DATA/sec2
nik@c7-2:~$

```

Проверим:

```

nik@c7-2:~$ sudo -u "${SPEC_USER}" bash -lc 'echo ok > /DATA/sec2/owned.txt'
nik@c7-2:~$ sudo -u u1 cat /DATA/sec2/owned.txt
ok
<ATA/sec2/owned.txt' || echo "expected: read-only for group"
nik@c7-2:~$ sudo -u u1 ls /DATA/sec2 >/dev/null || echo "should list: group has x"
nik@c7-2:~$ sudo -u nobody ls /DATA/sec2 || echo "expected: permission denied for others"
ls: cannot open directory '/DATA/sec2': Permission denied
expected: permission denied for others
nik@c7-2:~$

```

В `/DATA/sec3` скопировал `nano` и любой пользователь смог изменять с помощью его файлы в нем.

```

nik@c7-2:~$ sudo mkdir -p /DATA/sec3
nik@c7-2:~$ sudo cp /bin/nano /DATA/sec3/nano
nik@c7-2:~$ sudo chown root:root /DATA/sec3/nano
nik@c7-2:~$ sudo chmod 4755 /DATA/sec3/nano

```

Проверим:

```

nik@c7-2:~$ sudo -u u1 /DATA/sec3/nano /DATA/sec2/owned.txt
[sudo] password for nik:

```

A screenshot of a GNU nano 7.2 terminal window. The title bar shows the file path /DATA/sec2/owned.txt and an asterisk indicating it is modified. The main editing area contains two lines of text: 'ok' on the first line and 'fail' on the second line. The bottom status bar displays various keyboard shortcuts: ^G Help, ^X Exit, ^O Write Out, ^R Read File, ^W Where Is, ^\ Replace, ^K Cut, ^U Paste, ^T Execute, and ^J Justify. The window is running on a desktop environment, with a taskbar at the top showing the time as 03:18 PM and various system icons.

Права:

```

nik@c7-2:~$
nik@c7-2:~$ ls -ld /DATA /DATA/sec1 /DATA/sec2 /DATA/sec3
drwxrwsr-x+ 5 root      labgrp      4096 Oct  7 12:15 /DATA
drwxrwsrwt+ 2 root      labgrp      4096 Oct  7 12:01 /DATA/sec1
drwxrws---+ 2 nik-c7-2  sec2readers 4096 Oct  7 12:18 /DATA/sec2
drwxrwsr-x+ 2 root      labgrp      4096 Oct  7 12:15 /DATA/sec3
nik@c7-2:~$ getfacl -p /DATA /DATA/sec2 | sed 's/# file: .*//'

# owner: root
# group: labgrp
# flags: -s-
user::rwx
group::rwx
group:labgrp:rwx
mask::rwx
other::r-x
default:user::rwx
default:group::rwx
default:group:labgrp:rwx
default:mask::rwx
default:other::r-x

# owner: nik-c7-2
# group: sec2readers
# flags: -s-
user::rwx
user:nik-c7-2:rwx
group::rwx
group:labgrp:rwx
group:sec2readers:r-x
mask::rwx
other::---
default:user::rwx
default:user:nik-c7-2:rwx
default:group::rwx
default:group:labgrp:rwx
default:group:sec2readers:r--
default:mask::rwx
default:other::---

```

Часть 6. Настройка аутентификации по ключу.

Локально я создал пару ssh ключей:

```
ssh-keygen -t ed25519 -C "nik@lab"
Generating public/private ed25519 key pair.
Enter file in which to save the key (/home/nik/.ssh/id_ed25519): /home/nik/.ssh/id_ed25519_lab
Enter passphrase for "/home/nik/.ssh/id_ed25519_lab" (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /home/nik/.ssh/id_ed25519_lab
Your public key has been saved in /home/nik/.ssh/id_ed25519_lab.pub
The key fingerprint is:
SHA256:fzxjPhKxt3RWxMhDxGY+Zcj73DdEyOppKmDFNer3Xv0 nik@lab
The key's randomart image is:
+--[ED25519 256]--+
|      .*++      |
|      o  oX*=|   |
|      . o . .+.* |
```

Я передал его на c7-2:

```
ssh-copy-id -i ~/.ssh/id_ed25519_lab.pub -p 55022 nik@192.168.122.33
/usr/bin/ssh-copy-id: INFO: Source of key(s) to be installed: "/home/nik/.ssh/id_ed25519_lab.pub"
/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
nik@192.168.122.33's password:

Number of key(s) added: 1

Now try logging into the machine, with: "ssh -i /home/nik/.ssh/id_ed25519_lab -p 55022 'nik@192.168.122.33'"
and check to make sure that only the key(s) you wanted were added.
```

И теперь могу заходить без пароля:

```
ssh -i ~/.ssh/id_ed25519_lab -p 55022 nik@192.168.122.33 22:25
Welcome to Ubuntu 24.04.3 LTS (GNU/Linux 6.8.0-85-generic x86_64)

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

System information as of Tue Oct 7 07:26:27 PM UTC 2025

System load: 0.0          Processes:              165
Usage of /:  44.6% of 11.21GB Users logged in:           0
Memory usage: 6%          IPv4 address for enp1s0: 10.0.0.2
Swap usage:  0%

 * Strictly confined Kubernetes makes edge and IoT secure. Learn how MicroK
8s
```

И скопировал файл к себе на компьютер:

```
^ ~ >
scp -i ~/.ssh/id_ed25519_lab -P 55022 nik@192.168.122.33:/home/nik/mkuser.s
h ~/Downloads/
mkuser.sh                               100% 255    58.0KB/s   00:00
^ ~ >
|                                         22:29
```

Часть 7. Sudo.

Я установил `sudo` на `c7-1`:

```
omponents [11.0 kB]
Get:27 http://ru.archive.ubuntu.com/ubuntu noble-backports/multiverse amd64
Components [212 B]
Fetched 10.7 MB in 14s (752 kB/s)
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
1 package can be upgraded. Run 'apt list --upgradable' to see it.
nik@c7-1:~$ sudo apt install -y sudo
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
sudo is already the newest version (1.9.15p5-3ubuntu5.24.04.1).
sudo set to manually installed.
0 upgraded, 0 newly installed, 0 to remove and 1 not upgraded.
nik@c7-1:~$
```

Разрешил пользователю из части 2 п.1 повышать привелегии до root.

```
nik@c7-1:~$ sudo usermod -aG sudo nik-c7-1
nik@c7-1:~$ groups nik-c7-1
nik-c7-1 : nik-c7-1 sudo users
nik@c7-1:~$
```

Ограничил права первого из созданных в части 5 пользователей:

```
nik@c7-1:~$ sudo visudo
```

```
GNU nano 7.2 /etc/sudoers.tmp *
%admin ALL=(ALL) ALL

# Allow members of group sudo to execute any command
%sudo ALL=(ALL:ALL) ALL

# See sudoers(5) for more information on "@include" directives:

@include /etc/sudoers.d

nik-c7-1 ALL=(ALL:ALL) ALL
u1 ALL=(ALL) /usr/bin/passwd

^G Help      ^O Write Out  ^W Where Is   ^K Cut        ^T Execute
^X Exit      ^R Read File  ^\ Replace    ^U Paste      ^J Justify
```

Проверил работу прав:

```
nik@c7-1:~$ su - nik-c7-1
Password:
To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

nik-c7-1@c7-1:~$ sudo ls /root
[sudo] password for nik-c7-1:
nik-c7-1@c7-1:~$ sudo ls /root
nik-c7-1@c7-1:~$
```

```
nik@c7-1:~$ su - u1
Password:
u1@c7-1:~$ sudo passwd u1
[sudo] password for u1:
New password:
Retype new password:
Sorry, passwords do not match.
passwd: Authentication token manipulation error
passwd: password unchanged
```

```
u1@c7-1:~$ sudo ls /root
Sorry, user u1 is not allowed to execute '/usr/bin/ls /root' as root on c7-1.
u1@c7-1:~$
```

Часть 8. Получение информации о пользователях.

Я вывел входы пользователей в систему за текущий месяц:

```
nik@c7-2:~$ last -F | head -n 20
nik pts/0 10.0.0.1 Tue Oct 7 19:45:35 2025 still logged in
nik pts/0 192.168.122.1 Tue Oct 7 19:28:51 2025 - Tue Oct 7 19:28:56 2025 (00:00)
nik pts/0 192.168.122.1 Tue Oct 7 19:26:27 2025 - Tue Oct 7 19:28:29 2025 (00:02)
nik pts/0 192.168.122.1 Tue Oct 7 19:21:54 2025 - Tue Oct 7 19:21:56 2025 (00:00)
nik pts/0 10.0.0.1 Tue Oct 7 19:12:39 2025 - Tue Oct 7 19:14:19 2025 (00:01)
reboot system boot 6.8.0-85-generic Tue Oct 7 19:11:47 2025 still running
nik pts/0 10.0.0.1 Tue Oct 7 12:17:40 2025 - Tue Oct 7 12:20:48 2025 (00:03)
nik pts/0 10.0.0.1 Tue Oct 7 11:04:05 2025 - Tue Oct 7 12:17:13 2025 (01:13)
nik pts/0 192.168.122.1 Tue Oct 7 10:55:42 2025 - Tue Oct 7 10:57:34 2025 (00:01)
nik pts/0 192.168.122.1 Tue Oct 7 10:51:01 2025 - Tue Oct 7 10:55:38 2025 (00:04)
nik pts/0 10.0.0.1 Tue Oct 7 10:46:41 2025 - Tue Oct 7 10:46:56 2025 (00:00)
nik pts/0 10.0.0.1 Tue Oct 7 10:25:49 2025 - Tue Oct 7 10:27:26 2025 (00:01)
nik pts/0 10.0.0.1 Tue Oct 7 10:23:40 2025 - Tue Oct 7 10:24:59 2025 (00:01)
nik pts/0 10.0.0.1 Tue Oct 7 10:12:26 2025 - Tue Oct 7 10:16:34 2025 (00:04)
nik pts/0 10.0.0.1 Tue Oct 7 10:09:10 2025 - Tue Oct 7 10:10:39 2025 (00:01)
nik-c7-2 pts/0 10.0.0.1 Tue Oct 7 08:46:59 2025 - Tue Oct 7 08:52:19 2025 (00:05)
nik pts/0 10.0.0.1 Tue Oct 7 08:45:05 2025 - Tue Oct 7 08:46:53 2025 (00:01)
nik pts/0 10.0.0.1 Tue Oct 7 08:35:09 2025 - Tue Oct 7 08:38:48 2025 (00:03)
nik pts/0 10.0.0.1 Tue Oct 7 08:22:20 2025 - Tue Oct 7 08:33:59 2025 (00:11)
nik pts/0 10.0.0.1 Tue Oct 7 08:17:07 2025 - Tue Oct 7 08:19:49 2025 (00:02)
nik@c7-2:~$
```

Вывел информацию о пользователе из части 2 п. 1:

```
nik@c7-2:~$ id nik-c7-2
uid=1001(nik-c7-2) gid=1001(nik-c7-2) groups=1001(nik-c7-2),100(users)
nik@c7-2:~$
```

Ответы на вопросы.

В части 4 вы использовали готовые команды для настройки NAT. Поясните какие параметры передаются в ключах команды `iptables`.

```
iptables -t nat -A POSTROUTING -o enp1s0 -s 10.0.0.0/24 -j MASQUERADE
```

`-t nat` — выбрать таблицу NAT, `-A POSTROUTING` — добавить правило в цепочку POSTROUTING, `-o enp1s0` — указывает выходной интерфейс, `-s 10.0.0.0/24` — диапазон внутренних адресов, для которых применяется правило, `-j MASQUERADE` — действие: подменить IP-адрес источника на внешний адрес интерфейса. Аналогично, при `-j SNAT --to-source <ip>` адрес подменяется на указанный вручную.

При создании ключей ssh программа-генератор предлагает ввести пароль. Зачем он нужен и для чего используется?

Пароль защищает приватный ключ. Даже если файл ключа попадёт в чужие руки, без пароля им нельзя воспользоваться.

При первом подключении по ssh к новому серверу вам выводится хэш и программа предлагает принять его или отклонить. Зачем это нужно?

Это fingerprint публичного ключа сервера. Он нужен, чтобы убедиться, что мы подключаемся к правильному серверу, а не к подменённому. После подтверждения отпечаток сохраняется в `~/.ssh/known_hosts`. Если при следующем подключении хэш изменился — SSH предупредит о возможной подмене.

Как на сервере ssh определить сколько подключений по ssh есть и от каких пользователей?

```
ss -tuna | grep ':22'
```

или

```
who
```

или

```
ps aux | grep sshd
```

`sshd` показывает каждое активное соединение, `who` — кто вошёл в систему, с каких ip, и сколько пользователей сейчас в системе.

Если у двух пользователей в Linux будут одинаковые пароли, то сможем ли мы понять это по данным в файле `/etc/shadow`?

Почему?

Нет. Файл `/etc/shadow` хранит хэши паролей с солью, то есть у каждого пароля добавляется случайное значение перед хэшированием. Даже если два пользователя используют одинаковый пароль, их хэши будут разными.

Заполните таблицу, описывающую действие различных атрибутов прав (r, w, x) и атрибутов безопасности (suid, sgid, sticky bit) при назначении их файлу или каталогу. В таблице должны быть следующие столбцы:

атрибут	сокращенное название	значение действия для файла	значение действия для каталога
read	r	разрешает чтение файла	разрешает просматривать содержимое каталога <code>ls</code>
write	w	разрешает изменять или удалять файл	разрешает создавать и удалять файлы внутри каталога
execute	x	разрешает выполнять файл как программу	разрешает входить в каталог <code>cd</code>
setuid	s (u+s)	файл выполняется с правами владельца	не применяется
setgid	s (g+s)	файл выполняется с правами группы	новые файлы внутри каталога наследуют группу каталога
sticky	t	не применяется	удалять файлы может только владелец или root (пример: /tmp)

В Linux существует расширенные права на файлы или каталоги. Работать с ними можно с помощью утилит `setfacl` и `getfacl`. Приведите пример команды, с помощью которой мы можем дать конкретному пользователю все права на файл, не делая его владельцем и не добавляя его в группы.

Чтобы дать пользователю `vlad` все права на файл `/DATA/info.txt`, не меняя владельца и групп:

```
sudo setfacl -m u:vlad:rwx /DATA/info.txt
```

Проверить можно при помощи:

```
getfacl /DATA/info.txt
```

Вывод.

В ходе лабораторной работы я изучил основы администрирования linux-систем: настройка nat, управление пользователями и правами доступа, работа с acl, организация аутентификации по ssh-ключам и настройка sudo. На практике реализовано взаимодействие двух виртуальных машин, проброс портов и защита доступа.