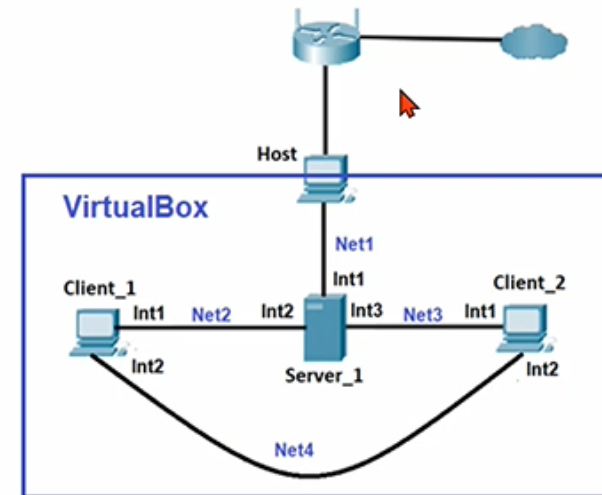


Practical task

- Server static IP-address configuration for Int1 and Int2
- Server DHCP client configuration for Int3
- DHCP Server config
- DHCP client config for Client_1 and Client_2
- SSH config
- Static routing config
- Traffic filtering config
- NAT config



Virtualbox: setting network adapters

<p>Имя: server-1 ОС: Ubuntu (64-bit)</p> <p>Система</p> <p>Дисплей</p> <p>Видеопамять: 16 МБ Графический контроллер: VMSVGA Сервер удалённого дисплея: Выключен Запись: Выключена</p> <p>Носители</p> <p>Аудио</p> <p>Сеть</p> <p>Адаптер 1: Intel PRO/1000 MT Desktop (Сетевой мост, 'Intel(R) Dual Band Wireless-AC 7265') Адаптер 2: Intel PRO/1000 MT Desktop (Внутренняя сеть, 'Net_2') Адаптер 3: Intel PRO/1000 MT Desktop (Внутренняя сеть, 'Net_3')</p>	<p>Имя: client-1 ОС: Ubuntu (64-bit)</p> <p>Система</p> <p>Дисплей</p> <p>Видеопамять: 16 МБ Графический контроллер: VMSVGA Сервер удалённого дисплея: Выключен Запись: Выключена</p> <p>Носители</p> <p>Аудио</p> <p>Сеть</p> <p>Адаптер 1: Intel PRO/1000 MT Desktop (Внутренняя сеть, 'Net_2') Адаптер 2: Intel PRO/1000 MT Desktop (Внутренняя сеть, 'Net_4')</p>	<p>Имя: client-2 ОС: Red Hat (64-bit)</p> <p>Система</p> <p>Дисплей</p> <p>Видеопамять: 48 МБ Графический контроллер: VMSVGA Сервер удалённого дисплея: Выключен Запись: Выключена</p> <p>Носители</p> <p>Аудио</p> <p>Сеть</p> <p>Адаптер 1: Intel PRO/1000 MT Desktop (Внутренняя сеть, 'Net_3') Адаптер 2: Intel PRO/1000 MT Desktop (Внутренняя сеть, 'Net_4')</p>
--	---	--

1. Configure static addresses on all interfaces on Server_1

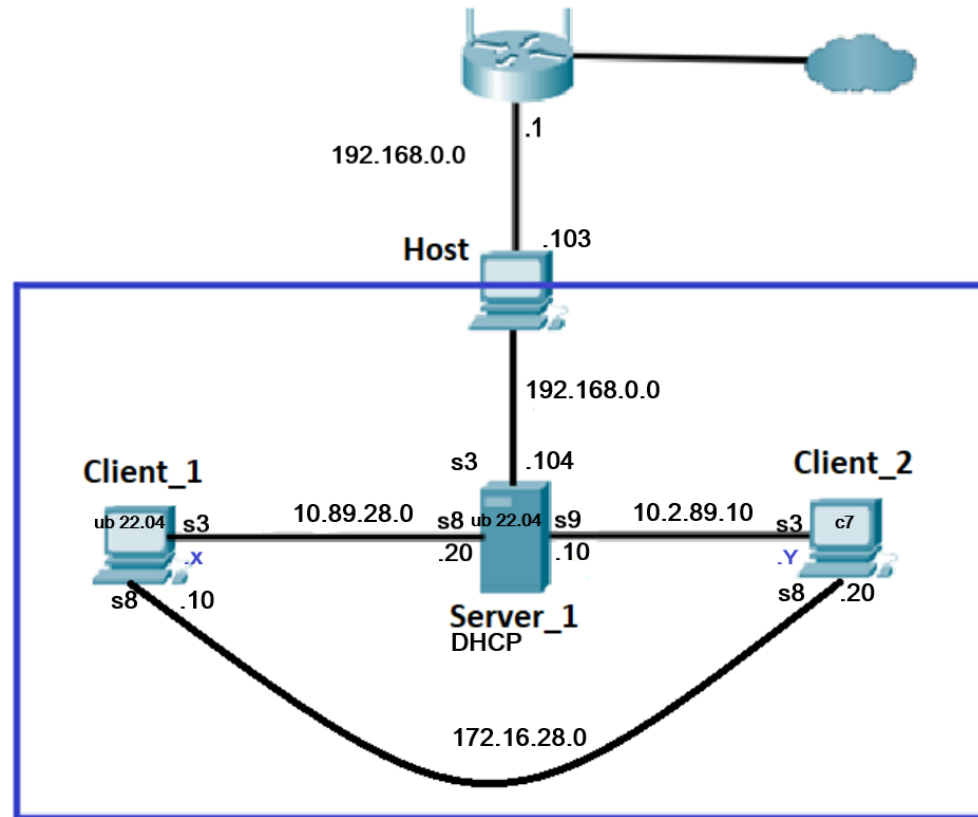


Fig 1. Network equivalent scheme

```
rita@server-1:~$ sudo ls /etc/netplan/
[sudo] password for rita:
01-network-manager-all.yaml
rita@server-1:~$ sudo cat /etc/netplan/01-network-manager-all.yaml
# Let NetworkManager manage all devices on this system
network:
  version: 2
  renderer: NetworkManager
rita@server-1:~$
```

Configure static addresses on all interfaces on Server_1

```

rita@server-1: ~
GNU nano 6.2 /etc/netplan/01-network-manager-
enp0s3:
  addresses: [192.168.0.104/24]
  routes:
    - to: default
      via: 192.168.0.1
  nameservers:
    addresses: [8.8.8.8, 192.168.0.100, 8.8.8.4]
  dhcp4: no
enp0s8:
  addresses: [10.89.28.20/24]
  routes:
    - to: 172.16.28.0/24
      via: 10.89.28.5
      metric: 50
  dhcp4: no
enp0s9:
  addresses: [10.2.89.10/24]
  routes:
    - to: 172.16.28.0/24
      via: 10.2.89.5
      metric: 10
  dhcp4: no

```

Check & and apply setting

```

rita@server-1:~$ sudo nano /etc/netplan/01-network-manager-all.yaml
rita@server-1:~$
rita@server-1:~$ sudo netplan try
Do you want to keep these settings?

Press ENTER before the timeout to accept the new configuration

Changes will revert in 119 seconds
Configuration accepted.
rita@server-1:~$ sudo netplan apply
rita@server-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=1 ttl=117 time=18.2 ms
64 bytes from 8.8.8.8: icmp_seq=2 ttl=117 time=17.8 ms
^C64 bytes from 8.8.8.8: icmp_seq=3 ttl=117 time=17.9 ms
64 bytes from 8.8.8.8: icmp_seq=4 ttl=117 time=18.0 ms
64 bytes from 8.8.8.8: icmp_seq=5 ttl=117 time=18.7 ms
^C
--- 8.8.8.8 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4051ms
rtt min/avg/max/mdev = 17.829/18.097/18.662/0.303 ms
rita@server-1:~$ ping google.com
PING google.com (142.250.186.206) 56(84) bytes of data.
64 bytes from waw07s05-in-f14.1e100.net (142.250.186.206): icmp_seq=1 ttl=117 t
ime=21.5 ms

rita@server-1:~$ ip route
default via 192.168.0.1 dev enp0s3 proto static metric 100
10.2.89.0/24 dev enp0s9 proto kernel scope link src 10.2.89.10 metric 102
10.89.28.0/24 dev enp0s8 proto kernel scope link src 10.89.28.20 metric 101
169.254.0.0/16 dev enp0s3 scope link metric 1000
172.16.28.0/24 via 10.2.89.5 dev enp0s9 proto static metric 10
172.16.28.0/24 via 10.89.28.5 dev enp0s8 proto static metric 40
192.168.0.0/24 dev enp0s3 proto kernel scope link src 192.168.0.104 metric 100

```

Device configuration client-1

```
rita@client-1:~$ nmcli con sh
NAME                UUID                                  TYPE      DEVICE
netplan-enp0s3      1eef7e45-3b9d-3043-bee3-fc5925c90273  ethernet  enp0s3
netplan-enp0s8      9a683faa-2cc7-384f-9230-8beaf91f9f29  ethernet  enp0s8
rita@client-1:~$ nmcli con add ifname enp0s9 type ethernet
Connection 'ethernet-enp0s9' (5a89a0f4-582a-4224-b6d1-ee67f05bcd7) successfully added.
rita@client-1:~$ nmcli con sh
NAME                UUID                                  TYPE      DEVICE
netplan-enp0s3      1eef7e45-3b9d-3043-bee3-fc5925c90273  ethernet  enp0s3
netplan-enp0s8      9a683faa-2cc7-384f-9230-8beaf91f9f29  ethernet  enp0s8
ethernet-enp0s9      5a89a0f4-582a-4224-b6d1-ee67f05bcd7  ethernet  --
rita@client-1:~$ nmcli con mod ethernet-enp0s9 +ipv4.addr "10.2.89.10/24"
```

```
rita@client-1: ~
GNU nano 6.2 /etc/netplan/01-network-manager-all.yaml
# Let NetworkManager manage all devices on this system
network:
  version: 2
  renderer: NetworkManager
  ethernets:
    enp0s3:
      addresses: [10.89.28.10/24]
      dhcp4: no
    enp0s8:
      addresses: [172.16.28.10/24]
      dhcp4: no
```

Device configuration client-2

```
$ sudo vi /etc/sysconfig/network-scripts/ifcfg-enp0s3

TYPE="Ethernet"
PROXY_METHOD="none"
BROWSER_ONLY="no"
BOOTPROTO="none"
DEFROUTE="yes"
IPV4_FAILURE_FATAL="no"
IPV6INIT="yes"
IPV6_AUTOCONF="yes"
IPV6_DEFROUTE="yes"
IPV6_FAILURE_FATAL="no"
IPV6_ADDR_GEN_MODE="stable-privacy"
NAME="enp0s3"
UUID="f4da4cf1-d3e7-4266-b701-927fa6ca63d9"
DEVICE="enp0s3"
ONBOOT="yes"
IPV6_PRIVACY="no"

IPADDR0="10.2.89.20"
PREFIX0="24"
GATEWAY0="10.2.89.10"
DNS1="8.8.8.8"
```

```
File Edit View Bookmarks Settings Help
TYPE=Ethernet
PROXY_METHOD=none
BROWSER_ONLY=no
BOOTPROTO=none
DEFROUTE=yes
IPV4_FAILURE_FATAL=no
IPV6INIT=yes
IPV6_AUTOCONF=yes
IPV6_DEFROUTE=yes
IPV6_FAILURE_FATAL=no
IPV6_ADDR_GEN_MODE=stable-privacy
NAME=int2
UUID=cfd7526c-4c42-4097-9545-f47b5e212050
DEVICE=enp0s8
ONBOOT=yes

IPADDR0=172.16.28.20
PREFIX0=24
GATEWAY0=172.16.28.1
DNS1="8.8.8.8"
```

Permanent routing configuration in client`s-1configure file

```

rita@client-1: ~
GNU nano 6.2 /etc/netplan/01-network-manager-all.yaml
# Let NetworkManager manage all devices on this system
network:
  version: 2
  renderer: NetworkManager
  ethernets:
    enp0s3:
      routes:
        - to: 192.168.0.0/24
          via: 10.89.28.20
        - to: 10.2.89.0/24
          via: 10.89.28.20
          metric: 100
      nameservers:
        addresses: [8.8.8.8, 192.168.0.1]
      dhcp4: yes
    enp0s8:
      addresses: [172.16.28.10/24]
      dhcp4: no
      routes:
        - to: 10.2.89.0/24
          via: 172.16.28.20
          metric: 10

```

```

rita@client-1:~$ ip route
default via 10.89.28.20 dev enp0s3 proto dhcp metric 20100
10.2.89.0/24 via 172.16.28.20 dev enp0s8 proto static metric 10
10.2.89.0/24 via 10.89.28.20 dev enp0s3 proto static metric 100
10.89.28.0/24 dev enp0s3 proto kernel scope link src 10.89.28.5 metric 100
10.89.28.20 dev enp0s3 proto static scope link metric 100
169.254.0.0/16 dev enp0s8 scope link metric 1000
172.16.28.0/24 dev enp0s8 proto kernel scope link src 172.16.28.10 metric 101
192.168.0.0/24 via 10.89.28.20 dev enp0s3 proto static metric 100

```

Permanent routing configuration in client`s-2 configure file

```

[marharita@client-2 ~]$ sudo cat /etc/sysconfig/network-scripts/route-enp0s3
ADDRESS0=10.2.89.0
NETMASK0=255.255.255.0
GATEWAY0=10.2.89.5

ADDRESS1=192.168.0.0
NETMASK1=255.255.255.0
GATEWAY1=10.2.89.10

ADDRESS2=10.89.28.0
NETMASK2=255.255.255.0
GATEWAY2=10.89.28.20

```

```

[marharita@client-2 network-scripts]$ sudo cat route-enp0s8
ADDRESS0=172.16.28.0
NETMASK0=255.255.255.0
GATEWAY0=172.16.28.20

ADDRESS1=10.89.28.0
NETMASK1=255.255.255.0
GATEWAY1=172.16.28.10

```

```

[marharita@client-2 network-scripts]$ route -v
Kernel IP routing table

```

Destination	Gateway	Genmask	Flags	Metric	Ref	Use	Iface
default	gateway	0.0.0.0	UG	0	0	0	enp0s3
10.2.89.0	0.0.0.0	255.255.255.0	U	0	0	0	enp0s3
10.89.28.0	172.16.28.10	255.255.255.0	UG	0	0	0	enp0s8
link-local	0.0.0.0	255.255.0.0	U	1002	0	0	enp0s3
link-local	0.0.0.0	255.255.0.0	U	1003	0	0	enp0s8
172.16.28.0	0.0.0.0	255.255.255.0	U	0	0	0	enp0s8

Check internal net connection

NET2 setver1 – client1, client1 – server1

```
rita@client-1:~$ ping 10.89.28.20
PING 10.89.28.20 (10.89.28.20) 56(84) bytes of data.
64 bytes from 10.89.28.20: icmp_seq=1 ttl=64 time=0.384 ms
64 bytes from 10.89.28.20: icmp_seq=2 ttl=64 time=0.520 ms
64 bytes from 10.89.28.20: icmp_seq=3 ttl=64 time=0.540 ms
^C
--- 10.89.28.20 ping statistics ---
```

```
rita@server-1:~$ ping 10.89.28.10
PING 10.89.28.10 (10.89.28.10) 56(84) bytes of data.
64 bytes from 10.89.28.10: icmp_seq=1 ttl=64 time=0.410 ms
64 bytes from 10.89.28.10: icmp_seq=2 ttl=64 time=0.617 ms
64 bytes from 10.89.28.10: icmp_seq=3 ttl=64 time=0.534 ms
64 bytes from 10.89.28.10: icmp_seq=4 ttl=64 time=0.587 ms
^Z
```

NET3 setver1 – client2, client2 – server1

```
rita@server-1:~$ ping 10.2.89.20
PING 10.2.89.20 (10.2.89.20) 56(84) bytes of data.
64 bytes from 10.2.89.20: icmp_seq=1 ttl=64 time=0.384 ms
64 bytes from 10.2.89.20: icmp_seq=2 ttl=64 time=1.46 ms
64 bytes from 10.2.89.20: icmp_seq=3 ttl=64 time=1.18 ms
64 bytes from 10.2.89.20: icmp_seq=4 ttl=64 time=0.960 ms
64 bytes from 10.2.89.20: icmp_seq=5 ttl=64 time=1.80 ms
^Z
[9]+  Stopped                  ping 10.2.89.20
rita@server-1:~$
```

```
[marharita@client-2 ~]$ ping 10.2.89.10
PING 10.2.89.10 (10.2.89.10) 56(84) bytes of data.
64 bytes from 10.2.89.10: icmp_seq=1 ttl=64 time=0.779 ms
64 bytes from 10.2.89.10: icmp_seq=2 ttl=64 time=1.76 ms
64 bytes from 10.2.89.10: icmp_seq=3 ttl=64 time=1.44 ms
64 bytes from 10.2.89.10: icmp_seq=4 ttl=64 time=1.75 ms
64 bytes from 10.2.89.10: icmp_seq=5 ttl=64 time=1.67 ms
^Z
[1]+  Stopped                  ping 10.2.89.10
[marharita@client-2 ~]$
```

NET4 client1 – client2, client2 – client1

```
rita@client-1:~$ ping 172.16.28.20
PING 172.16.28.20 (172.16.28.20) 56(84) bytes of data.
64 bytes from 172.16.28.20: icmp_seq=1 ttl=64 time=0.350 ms
64 bytes from 172.16.28.20: icmp_seq=2 ttl=64 time=1.08 ms
64 bytes from 172.16.28.20: icmp_seq=3 ttl=64 time=1.43 ms
64 bytes from 172.16.28.20: icmp_seq=4 ttl=64 time=1.38 ms
64 bytes from 172.16.28.20: icmp_seq=5 ttl=64 time=1.29 ms
^Z
[5]+  Stopped                  ping 172.16.28.20
```

```
[marharita@client-2 ~]$ ping 172.16.28.10
PING 172.16.28.10 (172.16.28.10) 56(84) bytes of data.
64 bytes from 172.16.28.10: icmp_seq=1 ttl=64 time=0.413 ms
64 bytes from 172.16.28.10: icmp_seq=2 ttl=64 time=1.46 ms
64 bytes from 172.16.28.10: icmp_seq=3 ttl=64 time=0.945 ms
64 bytes from 172.16.28.10: icmp_seq=4 ttl=64 time=1.38 ms
64 bytes from 172.16.28.10: icmp_seq=5 ttl=64 time=1.47 ms
^Z
[3]+  Stopped                  ping 172.16.28.10
```


2. Configure the DHCP service on Server_1, which will configure the Int1 addresses of Client_1 and Client_2

<pre>GNU nano 6.2 /etc/sysctl.conf # Uncomment the next line to enable packet forwarding for IPv4 net.ipv4.ip_forward=1</pre>	<pre>GNU nano 6.2 /etc/default/isc-dhcp-server * # Defaults for isc-dhcp-server (sourced by /etc/init.d/isc-dhcp-server) # Path to dhcpd's config file (default: /etc/dhcp/dhcpd.conf). #DHCPDv4_CONF=/etc/dhcp/dhcpd.conf #DHCPDv6_CONF=/etc/dhcp/dhcpd6.conf # Path to dhcpd's PID file (default: /var/run/dhcpd.pid). #DHCPDv4_PID=/var/run/dhcpd.pid #DHCPDv6_PID=/var/run/dhcpd6.pid # Additional options to start dhcpd with. # Don't use options -cf or -pf here; use DHCPD_CONF/ DHCPD_PID instead #OPTIONS="" # On what interfaces should the DHCP server (dhcpd) serve DHCP requests? # Separate multiple interfaces with spaces, e.g. "eth0 eth1". INTERFACESv4="enp0s8 enp0s9" INTERFACESv6="enp0s8 enp0s9"</pre>
<pre>rita@server-1: ~ GNU nano 6.2 /etc/dhcp/dhcpd.conf * # dhcpd.conf # # Sample configuration file for ISC dhcpd # # Attention: If /etc/ltsp/dhcpd.conf exists, that will be used as # configuration file instead of this file. # # option definitions common to all supported networks... option domain-name "myserv1.ubu"; option domain-name-servers internal2.myserv1.ubu, internal3.myserv1.ubu; default-lease-time 720; max-lease-time 7200; # The ddns-updates-style parameter controls whether or not the server will # attempt to do a DNS update when a lease is confirmed. We default to the # behavior of the version 2 packages ('none', since DHCP v2 didn't # have support for DDNS.) ddns-update-style none; # If this DHCP server is the official DHCP server for the local # network, the authoritative directive should be uncommented. authoritative;</pre>	<pre>rita@server-1: ~ GNU nano 6.2 /etc/dhcp/dhcpd.conf ##### client-1 Ubuntu ##### subnet 10.89.28.0 netmask 255.255.255.0 { range 10.89.28.5 10.89.28.30; # option domain-name-servers 192.168.0.1; # option domain-name "internal.example.org"; option subnet-mask 255.255.255.0; option routers 10.89.28.20; option broadcast-address 10.89.28.255; # default-lease-time 720; # max-lease-time 7200; } ##### client-2 Centos7 ##### subnet 10.2.89.0 netmask 255.255.255.0 { range 10.2.89.5 10.2.89.30; # option domain-name-servers 192.168.0.1; # option domain-name "internal.example.org"; option subnet-mask 255.255.255.0; option routers 10.2.89.10; option broadcast-address 10.2.89.255; #default-lease-time 720; #max-lease-time 7200; }</pre>

DHCP configuration client1 client2

```

rita@client-1: ~
GNU nano 6.2 /etc/netplan/01-network-manager-all.yaml
# Let NetworkManager manage all devices on this system
network:
  version: 2
  renderer: NetworkManager
  ethernets:
    enp0s3:
      routes:
        - to: 192.168.0.0/24
          via: 10.89.28.20
        - to: 10.2.89.0/24
          via: 10.89.28.20
          metric: 100
      nameservers:
        addresses: [8.8.8.8, 192.168.0.1]
      dhcp4: yes
    enp0s8:
      addresses: [172.16.28.10/24]
      dhcp4: no
      routes:
        - to: 10.2.89.0/24
          via: 172.16.28.20
          metric: 10

```

```

rita@client-1:~$ ip addr sh dev enp0s3
2: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 08:00:27:7d:79:33 brd ff:ff:ff:ff:ff:ff
    inet 10.89.28.5/24 brd 10.89.28.255 scope global dynamic noprefixroute enp0s3
        valid_lft 555sec preferred_lft 555sec
    inet6 fe80::a00:27ff:fe7d:7933/64 scope link
        valid_lft forever preferred_lft forever

```

File Edit View Bookmarks Settings Help

```

TYPE="Ethernet"
PROXY_METHOD="none"
BROWSER_ONLY="no"
BOOTPROTO="dhcp"
DEFROUTE="yes"
IPV4_FAILURE_FATAL="no"
IPV6INIT="yes"
IPV6_AUTOCONF="yes"
IPV6_DEFROUTE="yes"
IPV6_FAILURE_FATAL="no"
IPV6_ADDR_GEN_MODE="stable-privacy"
NAME="enp0s3"
UUID="f4da4cf1-d3e7-4266-b701-927fa6ca63d9"
DEVICE="enp0s3"
ONBOOT="yes"
IPV6_PRIVACY="no"

#IPADDR0="10.2.89.20"
#PREFIX0="24"
GATEWAY0="10.2.89.10"
DNS1="8.8.8.8"
DNS0="192.168.0.103"

```

```

marharita@client-2 ~]$ ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.2.89.5 netmask 255.255.255.0 broadcast 10.2.89.255
    inet6 fe80::a00:27ff:fe76:206c prefixlen 64 scopeid 0x20<link>
    ether 08:00:27:76:20:6c txqueuelen 1000 (Ethernet)
    RX packets 5 bytes 864 (864.0 B)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 54 bytes 4684 (4.5 KiB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

```


Ubuntu DHCP server verification

To review all actual leased IP-addresses:

```
$ dhcp-lease-list
```

```
rita@server-1:~$ dhcp-lease-list
To get manufacturer names please download http://standards.ieee.org/regauth/oui/oui.txt to /usr/local/etc/oui.txt
Reading leases from /var/lib/dhcp/dhcpd.leases
MAC                IP                hostname          valid until        manufactu
rer
=====
=====
08:00:27:76:20:6c   10.2.89.5         client-2          2022-12-06 04:00:12 -NA-
08:00:27:7d:79:33   10.89.28.5        client-1          2022-12-06 03:51:40 -NA-
```

3. Using the ping and traceroute commands, check the connection between VM. Explain the result

Server-1 – client-1

client-1 – server-1

```
rita@server-1:~$ ping 10.89.28.5
PING 10.89.28.5 (10.89.28.5) 56(84) bytes of data.
64 bytes from 10.89.28.5: icmp_seq=1 ttl=64 time=0.425 ms
64 bytes from 10.89.28.5: icmp_seq=2 ttl=64 time=0.576 ms
64 bytes from 10.89.28.5: icmp_seq=3 ttl=64 time=0.746 ms
64 bytes from 10.89.28.5: icmp_seq=4 ttl=64 time=0.737 ms
```

```
rita@client-1:~$ ping 10.89.28.20
PING 10.89.28.20 (10.89.28.20) 56(84) bytes of data.
64 bytes from 10.89.28.20: icmp_seq=1 ttl=64 time=0.517 ms
64 bytes from 10.89.28.20: icmp_seq=2 ttl=64 time=0.787 ms
64 bytes from 10.89.28.20: icmp_seq=3 ttl=64 time=0.667 ms
64 bytes from 10.89.28.20: icmp_seq=4 ttl=64 time=0.663 ms
```

Server-1 – client-2

client-2 – server-1

```
rita@server-1:~$ ping 10.2.89.5
PING 10.2.89.5 (10.2.89.5) 56(84) bytes of data.
64 bytes from 10.2.89.5: icmp_seq=1 ttl=64 time=0.373 ms
64 bytes from 10.2.89.5: icmp_seq=2 ttl=64 time=0.621 ms
64 bytes from 10.2.89.5: icmp_seq=3 ttl=64 time=0.531 ms
64 bytes from 10.2.89.5: icmp_seq=4 ttl=64 time=0.737 ms
```

```
[marharita@client-2 ~]$ ping 10.2.89.10
PING 10.2.89.10 (10.2.89.10) 56(84) bytes of data.
64 bytes from 10.2.89.10: icmp_seq=1 ttl=64 time=0.444 ms
64 bytes from 10.2.89.10: icmp_seq=2 ttl=64 time=0.637 ms
64 bytes from 10.2.89.10: icmp_seq=3 ttl=64 time=0.606 ms
64 bytes from 10.2.89.10: icmp_seq=4 ttl=64 time=0.663 ms
```

Client-2 – server-1 (enp0s3)

Client-1 – server-1 (enp0s3)

```
rtt min/avg/max/mdev = 0.796/1.042/1.288/0.246 ms
[marharita@client-2 ~]$ ping 192.168.0.104
PING 192.168.0.104 (192.168.0.104) 56(84) bytes of data.
64 bytes from 192.168.0.104: icmp_seq=1 ttl=64 time=0.465 ms
64 bytes from 192.168.0.104: icmp_seq=2 ttl=64 time=1.48 ms
64 bytes from 192.168.0.104: icmp_seq=3 ttl=64 time=1.44 ms
^C
--- 192.168.0.104 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2004ms
```

```
rita@client-1:~$ ping 192.168.0.104
PING 192.168.0.104 (192.168.0.104) 56(84) bytes of data.
64 bytes from 192.168.0.104: icmp_seq=1 ttl=64 time=0.487 ms
64 bytes from 192.168.0.104: icmp_seq=2 ttl=64 time=1.47 ms
64 bytes from 192.168.0.104: icmp_seq=3 ttl=64 time=1.82 ms
^C
--- 192.168.0.104 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2007ms
```

client-1 – client-2

```
rita@client-1:~$ ping 172.16.28.20
PING 172.16.28.20 (172.16.28.20) 56(84) bytes of data.
64 bytes from 172.16.28.20: icmp_seq=1 ttl=64 time=0.812 ms
64 bytes from 172.16.28.20: icmp_seq=2 ttl=64 time=0.405 ms
64 bytes from 172.16.28.20: icmp_seq=3 ttl=64 time=0.699 ms
^C
--- 172.16.28.20 ping statistics ---
```

client-2 – client-1

```
[marharita@client-2 ~]$ ping 172.16.28.10
PING 172.16.28.10 (172.16.28.10) 56(84) bytes of data.
64 bytes from 172.16.28.10: icmp_seq=1 ttl=64 time=0.411 ms
64 bytes from 172.16.28.10: icmp_seq=2 ttl=64 time=0.377 ms
64 bytes from 172.16.28.10: icmp_seq=3 ttl=64 time=0.377 ms
64 bytes from 172.16.28.10: icmp_seq=4 ttl=64 time=0.404 ms
64 bytes from 172.16.28.10: icmp_seq=5 ttl=64 time=0.393 ms
^C
```

Traceroute server-1

```
rita@server-1:~$ traceroute 172.16.28.10
traceroute to 172.16.28.10 (172.16.28.10), 30 hops max, 60 byte packet
 1 172.16.28.10 (172.16.28.10) 0.795 ms 0.753 ms 0.732 ms
rita@server-1:~$ traceroute 172.16.28.20
traceroute to 172.16.28.20 (172.16.28.20), 30 hops max, 60 byte packet
 1 10.89.28.6 (10.89.28.6) 1.888 ms 1.776 ms 1.717 ms
 2 172.16.28.20 (172.16.28.20) 1.406 ms !X 1.258 ms !X 1.221 ms !X
rita@server-1:~$ traceroute 172.16.28.20
rita@server-1:~$ traceroute 10.2.89.5
traceroute to 10.2.89.5 (10.2.89.5), 30 hops max, 60 byte packets
 1 10.2.89.5 (10.2.89.5) 46.271 ms !X 46.287 ms !X 46.177 ms !X
rita@server-1:~$ traceroute 172.16.28.20
traceroute to 172.16.28.20 (172.16.28.20), 30 hops max, 60 byte packet
 1 10.89.28.6 (10.89.28.6) 0.716 ms 0.679 ms 0.663 ms
 2 172.16.28.20 (172.16.28.20) 2.910 ms !X 2.879 ms !X 3.148 ms !X
rita@server-1:~$ traceroute 172.16.28.10
traceroute to 172.16.28.10 (172.16.28.10), 30 hops max, 60 byte packet
 1 172.16.28.10 (172.16.28.10) 0.932 ms 0.894 ms 0.867 ms
rita@server-1:~$ traceroute 10.89.28.6
traceroute to 10.89.28.6 (10.89.28.6), 30 hops max, 60 byte packets
 1 10.89.28.6 (10.89.28.6) 2.242 ms 0.513 ms 0.381 ms
rita@server-1:~$ traceroute 10.89.28.20
traceroute to 10.89.28.20 (10.89.28.20), 30 hops max, 60 byte packets
 1 server-1 (10.89.28.20) 0.492 ms 0.453 ms 0.437 ms
```

```
rita@server-1:~$ traceroute 192.168.0.104
traceroute to 192.168.0.104 (192.168.0.104), 30 hops max, 60 byte packets
 1 server-1 (192.168.0.104) 0.388 ms 0.331 ms 0.314 ms
rita@server-1:~$ traceroute 192.168.0.1
traceroute to 192.168.0.1 (192.168.0.1), 30 hops max, 60 byte packets
 1 _gateway (192.168.0.1) 4.804 ms 5.500 ms 5.477 ms
rita@server-1:~$ traceroute 8.8.8.8
traceroute to 8.8.8.8 (8.8.8.8), 30 hops max, 60 byte packets
 1 _gateway (192.168.0.1) 6.174 ms 6.117 ms 6.095 ms
 2 10.2.13.1 (10.2.13.1) 8.067 ms 9.359 ms 8.765 ms
 3 178.158.194.161 (178.158.194.161) 10.254 ms 9.832 ms 9.793 ms
 4 10.255.253.15 (10.255.253.15) 10.558 ms 10.536 ms 11.744 ms
 5 10.255.249.1 (10.255.249.1) 10.367 ms 11.026 ms 11.004 ms
 6 google.1-ix.net (185.1.213.44) 18.336 ms google-gw.ix.net.ua (185.1.5
5.912 ms dtel-ix-3.google.com (193.25.181.70) 7.072 ms
 7 108.170.248.138 (108.170.248.138) 6.398 ms 108.170.248.155 (108.170.2
5.783 ms 108.170.248.138 (108.170.248.138) 9.330 ms
 8 72.14.239.111 (72.14.239.111) 10.309 ms 142.251.242.39 (142.251.242.3
2.939 ms 23.892 ms
 9 142.250.46.55 (142.250.46.55) 24.879 ms 108.170.250.209 (108.170.250.
25.797 ms 142.251.77.181 (142.251.77.181) 24.828 ms
10 172.253.65.37 (172.253.65.37) 24.811 ms 216.239.40.43 (216.239.40.43)
573 ms 74.125.242.225 (74.125.242.225) 27.714 ms
11 142.251.228.27 (142.251.228.27) 25.685 ms 142.250.238.1 (142.250.238.
7.683 ms 108.170.234.101 (108.170.234.101) 19.074 ms
12 dns.google (8.8.8.8) 18.990 ms 17.984 ms 20.937 ms
rita@server-1:~$
```

Traceroute client-1

```

rita@client-1:~$ traceroute 10.89.28.6
traceroute to 10.89.28.6 (10.89.28.6), 30 hops max, 60 byte packets
 1  10.89.28.6 (10.89.28.6)  0.551 ms  0.513 ms  0.496 ms
rita@client-1:~$ traceroute 10.89.28.20
traceroute to 10.89.28.20 (10.89.28.20), 30 hops max, 60 byte packets
 1  10.89.28.20 (10.89.28.20)  0.933 ms  0.838 ms  0.811 ms
rita@client-1:~$ traceroute 192.168.0.104
traceroute to 192.168.0.104 (192.168.0.104), 30 hops max, 60 byte packets
 1  192.168.0.104 (192.168.0.104)  0.846 ms  1.478 ms  1.456 ms
rita@client-1:~$ traceroute 10.2.89.10
traceroute to 10.2.89.10 (10.2.89.10), 30 hops max, 60 byte packets
 1  10.2.89.10 (10.2.89.10)  0.852 ms  0.818 ms  0.801 ms
rita@client-1:~$ traceroute 10.2.89.5
traceroute to 10.2.89.5 (10.2.89.5), 30 hops max, 60 byte packets
 1  10.89.28.20 (10.89.28.20)  0.679 ms  0.629 ms  10019.382 ms
 2  10.2.89.5 (10.2.89.5)  2.004 ms !X 1.970 ms !X 1.940 ms
rita@client-1:~$ traceroute 172.16.28.20
traceroute to 172.16.28.20 (172.16.28.20), 30 hops max, 60 byte packets
 1  172.16.28.20 (172.16.28.20)  1.614 ms !X 1.545 ms !X 1.41
rita@client-1:~$ traceroute 172.16.28.10
traceroute to 172.16.28.10 (172.16.28.10), 30 hops max, 60 byte packets
 1  172.16.28.10 (172.16.28.10)  0.349 ms  0.343 ms  0.330 ms

```

Traceroute client-2

```

[marharita@client-2 ~]$ traceroute 172.16.28.20
traceroute to 172.16.28.20 (172.16.28.20), 30 hops max, 60 byte packets
 1  client-2 (172.16.28.20)  0.046 ms  0.055 ms  0.015 ms
[marharita@client-2 ~]$ traceroute 172.16.28.10
traceroute to 172.16.28.10 (172.16.28.10), 30 hops max, 60 byte packets
 1  172.16.28.10 (172.16.28.10)  0.395 ms  0.504 ms  0.276 ms
[marharita@client-2 ~]$ traceroute 10.89.28.6
traceroute to 10.89.28.6 (10.89.28.6), 30 hops max, 60 byte packets
 1  gateway (10.2.89.10)  0.501 ms  0.318 ms  0.369 ms
 2  10.89.28.6 (10.89.28.6)  0.617 ms  0.713 ms  0.551 ms
[marharita@client-2 ~]$ traceroute 10.89.28.20
traceroute to 10.89.28.20 (10.89.28.20), 30 hops max, 60 byte packets
 1  10.89.28.20 (10.89.28.20)  0.820 ms  0.719 ms  0.615 ms
[marharita@client-2 ~]$ traceroute 192.168.0.104
traceroute to 192.168.0.104 (192.168.0.104), 30 hops max, 60 byte packets
 1  192.168.0.104 (192.168.0.104)  1.215 ms  1.247 ms  1.063 ms
[marharita@client-2 ~]$ traceroute 10.2.89.10
traceroute to 10.2.89.10 (10.2.89.10), 30 hops max, 60 byte packets
 1  gateway (10.2.89.10)  0.497 ms  0.433 ms  0.670 ms

```


4. On the virtual interface lo Client_1, assign two IP addresses according to the following rule:

172.17.D+10.1/24 172.17.38.1/24 172.17.D+20.1/24. 172.17.48.1/24

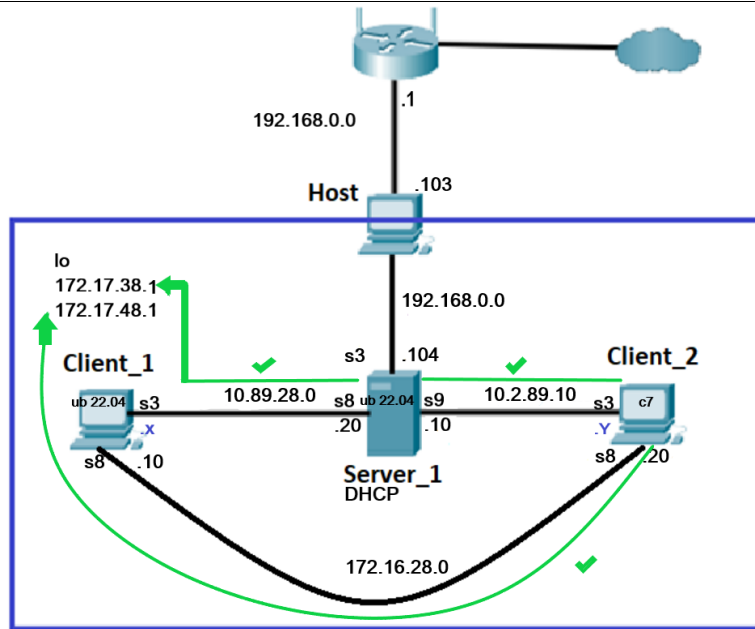


Fig. 2

Client-1

```
rita@client-1:~$ sudo ip addr add 172.17.38.1/24 dev lo
[sudo] password for rita:
rita@client-1:~$ sudo ip addr add 172.17.48.1/24 dev lo
rita@client-1:~$ ip addr
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
    inet 172.17.38.1/24 scope global lo
        valid_lft forever preferred_lft forever
    inet 172.17.48.1/24 scope global lo
        valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
        valid_lft forever preferred_lft forever
```

Configure routing so that traffic from Client_2 to 172.17.38.1 goes through Server_1, and to 172.17.48.1 through Net4. To check, use traceroute.

Routing setting client-1

```
rita@client-1:~$ ip route
default via 10.89.28.20 dev enp0s3 proto dhcp metric 20100
10.2.89.0/24 via 10.89.28.20 dev enp0s3
10.2.89.0/24 via 172.16.28.20 dev enp0s8 proto static metric 50
10.89.28.0/24 dev enp0s3 proto kernel scope link src 10.89.28.5 metric 100
10.89.28.20 dev enp0s3 proto static scope link metric 100
169.254.0.0/16 dev enp0s8 scope link metric 1000
172.16.28.0/24 dev enp0s8 proto kernel scope link src 172.16.28.10 metric 101
192.168.0.0/24 via 10.89.28.20 dev enp0s3 proto static metric 100
```

Routing setting server-1

```
rita@server-1:~$ sudo ip route add 172.17.38.0/24 via 10.89.28.5
rita@server-1:~$ ip route
default via 192.168.0.1 dev enp0s3 proto static metric 20100
10.2.89.0/24 dev enp0s9 proto kernel scope link src 10.2.89.10 metric 102
10.89.28.0/24 dev enp0s8 proto kernel scope link src 10.89.28.20 metric 101
169.254.0.0/16 dev enp0s3 scope link metric 1000
172.16.28.0/24 via 10.2.89.5 dev enp0s9
172.17.38.0/24 via 10.89.28.5 dev enp0s8
192.168.0.0/24 dev enp0s3 proto kernel scope link src 192.168.0.104 metric 100
rita@server-1:~$ ping 172.17.38.1
PING 172.17.38.1 (172.17.38.1) 56(84) bytes of data.
64 bytes from 172.17.38.1: icmp_seq=1 ttl=64 time=0.489 ms
64 bytes from 172.17.38.1: icmp_seq=2 ttl=64 time=1.34 ms
64 bytes from 172.17.38.1: icmp_seq=3 ttl=64 time=1.61 ms
^C
```

Client-2

```
$ sudo ip route add 172.17.48.0/24 via 172.15.28.10
$ sudo ip route add 172.17.38.0/24 via 10.2.89.10
```

```
[marharita@client-2 ~]$ route -v
Kernel IP routing table
Destination      Gateway          Genmask          Flags Metric Ref    Use Iface
default          gateway          0.0.0.0          UG    0      0      0 enp0s3
10.2.89.0         0.0.0.0          255.255.255.0    U      0      0      0 enp0s3
10.89.28.0        0.0.0.0          255.255.255.0    U      0      0      0 enp0s3
link-local        0.0.0.0          255.255.0.0      U     1002   0      0 enp0s3
link-local        0.0.0.0          255.255.0.0      U     1003   0      0 enp0s8
172.16.28.0       0.0.0.0          255.255.255.0    U      0      0      0 enp0s8
172.17.38.0       gateway          255.255.255.0    UG      0      0      0 enp0s3
172.17.48.0       172.16.28.10    255.255.255.0    UG      0      0      0 enp0s8
192.168.0.0       0.0.0.0          255.255.255.0    U      0      0      0 enp0s3
```

Traceroute

```
[marharita@client-2 ~]$ ip route
default via 10.2.89.10 dev enp0s3
10.2.89.0/24 dev enp0s3 proto kernel scope link src 10.2.89.5
10.89.28.0/24 dev enp0s3 scope link
169.254.0.0/16 dev enp0s3 scope link metric 1002
169.254.0.0/16 dev enp0s8 scope link metric 1003
172.16.28.0/24 dev enp0s8 proto kernel scope link src 172.16.28.20
172.17.38.0/24 via 10.2.89.10 dev enp0s3
172.17.48.0/24 via 172.16.28.10 dev enp0s8
192.168.0.0/24 dev enp0s3 scope link

[marharita@client-2 ~]$ traceroute 172.17.38.1
traceroute to 172.17.38.1 (172.17.38.1), 30 hops max, 60 byte packets
 1 gateway (10.2.89.10)  0.455 ms  0.386 ms  0.346 ms
 2 172.17.38.1 (172.17.38.1)  0.868 ms  0.864 ms  0.913 ms

[marharita@client-2 ~]$ traceroute 172.17.48.1
traceroute to 172.17.48.1 (172.17.48.1), 30 hops max, 60 byte packets
 1 172.17.48.1 (172.17.48.1)  0.473 ms  0.483 ms  0.364 ms

[marharita@client-2 ~]$
```

5 Calculate the common address and mask (summarizing) addresses 172.17.D+10.1 and 172.17.D+20.1, and the prefix should be as large as possible. Delete the routes set in the previous step and replace them with the combined route that should go through Server_1

172.17.38.1	10101100 00010001 00100110 00000001
172.17.48.1	10101100 00010001 00110000 00000001
172.17.32.0	10101100 00010001 00100000 00000000 /19

5.1 Delete the routes set in the previous step

5.2 Add summarizing address

```

rita@server-1:~$ sudo ip route del 172.17.38.0/24 via 10.89.28.5
[sudo] password for rita:
rita@server-1:~$ sudo ip route add 172.17.32.0/19 via 10.89.28.5
rita@server-1:~$ ping 172.17.38.1
PING 172.17.38.1 (172.17.38.1) 56(84) bytes of data.
64 bytes from 172.17.38.1: icmp_seq=1 ttl=64 time=0.532 ms
64 bytes from 172.17.38.1: icmp_seq=2 ttl=64 time=1.57 ms
64 bytes from 172.17.38.1: icmp_seq=3 ttl=64 time=1.31 ms
^C
-- 172.17.38.1 ping statistics --
2 packets transmitted, 3 received, 0% packet loss, time 2035ms
rtt min/avg/max/mdev = 0.532/1.137/1.573/0.441 ms
rita@server-1:~$ ping 172.17.48.1
PING 172.17.48.1 (172.17.48.1) 56(84) bytes of data.
64 bytes from 172.17.48.1: icmp_seq=1 ttl=64 time=0.467 ms
64 bytes from 172.17.48.1: icmp_seq=2 ttl=64 time=1.18 ms
^C
-- 172.17.48.1 ping statistics --
2 packets transmitted, 2 received, 0% packet loss, time 1021ms
rtt min/avg/max/mdev = 0.467/0.827/1.180/0.356 ms

```

```

marharita@client-2 ~]$ sudo ip route del 172.17.48.0/24 via 172.16.28.10
marharita@client-2 ~]$ sudo ip route del 172.17.38.0/24 via 10.2.89.10
marharita@client-2 ~]$ sudo ip route add 172.17.32.0/19 via 10.2.89.10
marharita@client-2 ~]$ ping 172.17.48.1
PING 172.17.48.1 (172.17.48.1) 56(84) bytes of data.
64 bytes from 172.17.48.1: icmp_seq=1 ttl=63 time=0.957 ms
64 bytes from 172.17.48.1: icmp_seq=2 ttl=63 time=1.62 ms
^C
-- 172.17.48.1 ping statistics --
2 packets transmitted, 2 received, 0% packet loss, time 1001ms
rtt min/avg/max/mdev = 0.957/1.288/1.620/0.333 ms
marharita@client-2 ~]$ ping 172.17.38.1
PING 172.17.38.1 (172.17.38.1) 56(84) bytes of data.
64 bytes from 172.17.38.1: icmp_seq=1 ttl=63 time=0.852 ms
64 bytes from 172.17.38.1: icmp_seq=2 ttl=63 time=2.31 ms
^C
-- 172.17.38.1 ping statistics --
2 packets transmitted, 2 received, 0% packet loss, time 1000ms
rtt min/avg/max/mdev = 0.852/1.582/2.313/0.731 ms

```

```

marharita@client-2 ~]$ traceroute 172.17.38.1
traceroute to 172.17.38.1 (172.17.38.1), 30 hops max, 60 byte packets
 1 gateway (10.2.89.10) 0.395 ms 0.315 ms 0.289 ms
 2 172.17.38.1 (172.17.38.1) 0.579 ms 0.575 ms 0.719 ms
marharita@client-2 ~]$ traceroute 172.17.48.1
traceroute to 172.17.48.1 (172.17.48.1), 30 hops max, 60 byte packets
 1 gateway (10.2.89.10) 0.404 ms 0.330 ms 0.431 ms
 2 172.17.48.1 (172.17.48.1) 0.632 ms 0.749 ms 0.770 ms

```


6. Configure the SSH service so that Client_1 and Client_2 can connect to Server_1 and each other.

6.1 SSH installation

SSH server installation for Ubuntu:

```
$ sudo apt-get install openssh-server
```

for Centos 7:

```
$ sudo yum -y install openssh-server openssh-clients
```

6.2 First SSH connecting

client-1 to server-1

```
rita@client-1:~$ ssh rita@10.89.28.20
The authenticity of host '10.89.28.20 (10.89.28.20)' can't be established.
ED25519 key fingerprint is SHA256:uLTC+4RWyhlM6Eh8HvH09+BKgpovsI5Zh2fv+ZAa43g.
This key is not known by any other names
Are you sure you want to continue connecting (yes/no/[fingerprint])? Yes^[D^[[
Please type 'yes', 'no' or the fingerprint: yes
Warning: Permanently added '10.89.28.20' (ED25519) to the list of known hosts.
rita@10.89.28.20's password:
Permission denied, please try again.
rita@10.89.28.20's password:
Welcome to Ubuntu 22.04 LTS (GNU/Linux 5.15.0-56-generic x86_64)

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

236 updates can be applied immediately.
48 of these updates are standard security updates.
To see these additional updates run: apt list --upgradable
```

```
161 updates could not be installed automatically. For more details,
see /var/log/unattended-upgrades/unattended-upgrades.log
```

```
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.
```

```
rita@server-1:~$
```

client-2 to server-1

```
[marharita@client-2 ~]$ ssh rita@10.2.89.10
rita@10.2.89.10's password:
Welcome to Ubuntu 22.04 LTS (GNU/Linux 5.15.0-56-generic x86_64)

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

236 updates can be applied immediately.
48 of these updates are standard security updates.
To see these additional updates run: apt list --upgradable

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

161 updates could not be installed automatically. For more details,
see /var/log/unattended-upgrades/unattended-upgrades.log
Last login: Sat Dec 10 10:05:04 2022 from 10.89.28.5
rita@server-1:~$
```

```
rita@server-1:~$ ls
Desktop  Downloads  Music      Public  Templates
Documents EPAM        Pictures   snap    Videos
rita@server-1:~$ cd EPAM
rita@server-1:~/EPAM$ ls
server-1.txt
rita@server-1:~/EPAM$ cd ..
rita@server-1:~$ exit
logout
Connection to 10.89.28.20 closed.
rita@client-1:~$
```

```
rita@server-1:~$ ls ~/EPAM
server-1.txt
rita@server-1:~$ exit
logout
Connection to 10.2.89.10 closed.
[marharita@client-2 ~]$
```

6.3. Key authentication config

\$ ssh-keygen

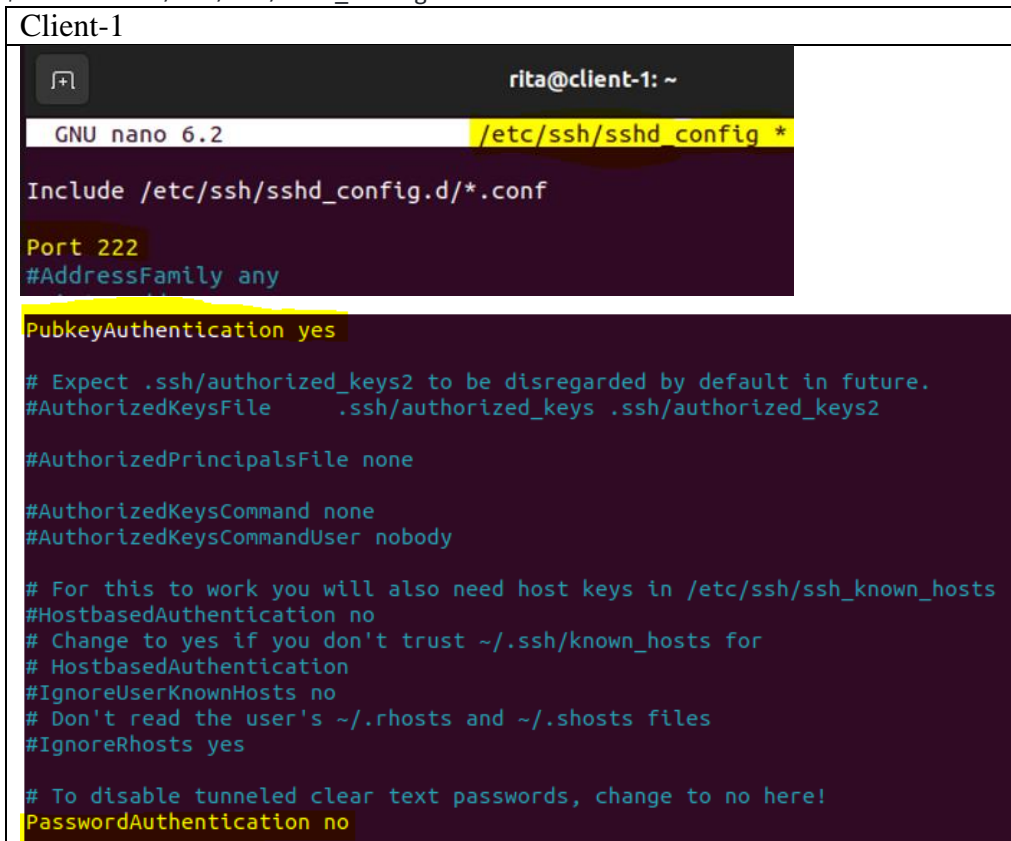
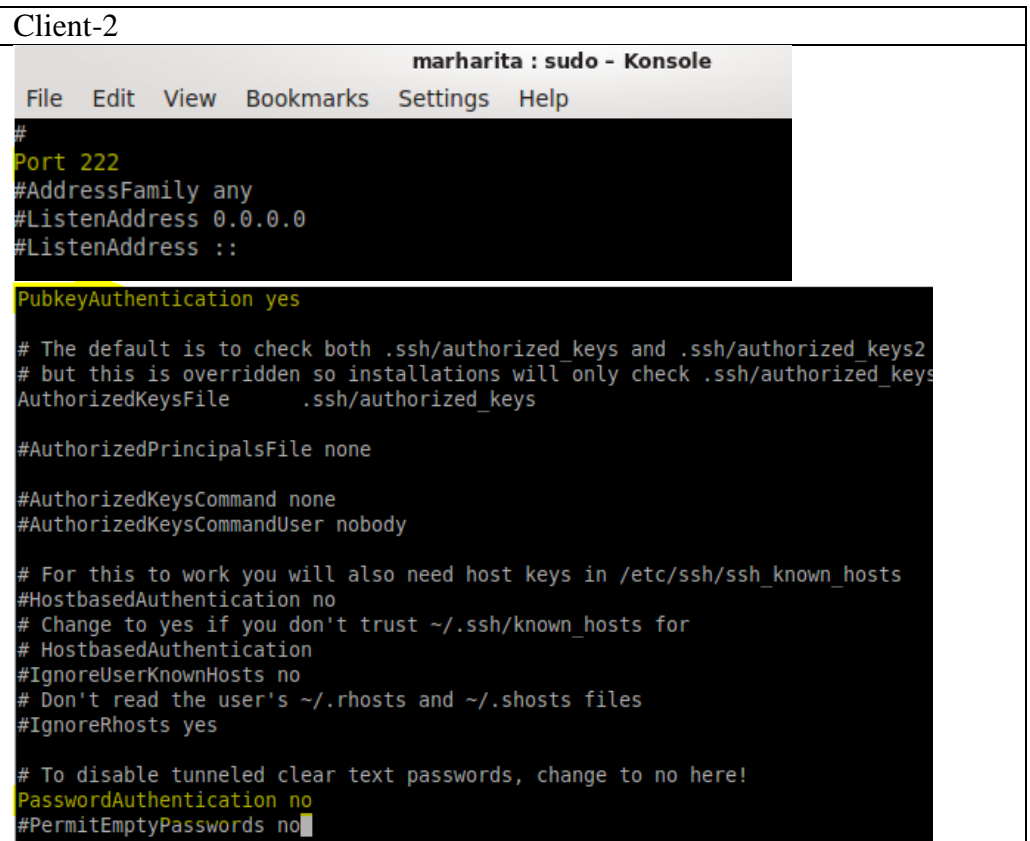
```
rita@client-1:~$ ssh-keygen
Generating public/private rsa key pair.
Enter file in which to save the key (/home/rita/.ssh/id_rsa): key_cl1
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in key_cl1
Your public key has been saved in key_cl1.pub
The key fingerprint is:
SHA256:elMVotVct97fEwHFItKvbNGrZ+uVcyc717LpMKYK3as rita@client-1
The key's randomart image is:
+---[RSA 3072]---+
|                 +0.O+..|
|                + +00.O.|
|               . . = .O |
|              o o . o |
|             S o o .O.|
|            o o + . =|
|           o + o = .=*|
|          o . = ++B|
|         Eoo ++*=|
+-----[SHA256]-----+
```

```
[marharita@client-2 ~]$ ssh-keygen
Generating public/private rsa key pair.
Enter file in which to save the key (/home/marharita/.ssh/id_rsa): key_cl2
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in key_cl2.
Your public key has been saved in key_cl2.pub.
The key fingerprint is:
SHA256:Bge62m/BFTNLUe+szpeiIzU6V5iN/eX28+r0teN5dYU marharita@client-2
The key's randomart image is:
+---[RSA 2048]---+
|      . .+0.      |
|      . .+.      |
|     . .+. .      |
|    . .+.  oE .    |
|   . .S *  o .    |
|  o o . * +. +    |
| . . . o o...++   |
| .. + 00...++B    |
| .. +.00++*X      |
+-----[SHA256]-----+
```

<pre>\$ ssh-copy-id -i key_cl1.pub rita@10.89.28.20 rita@client-1:~\$ dir Desktop Downloads key_cl1 Music Public Templates Documents EPAM key_cl1.pub Pictures snap Videos rita@client-1:~\$ ssh-copy-id -i key_cl1.pub rita@10.89.28.20 /usr/bin/ssh-copy-id: INFO: Source of key(s) to be installed: "key_cl1.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 prompt ed now it is to install the new keys rita@10.89.28.20's password: Number of key(s) added: 1 Now try logging into the machine, with: "ssh 'rita@10.89.28.20'" and check to make sure that only the key(s) you wanted were added.</pre>	<pre>\$ ssh-copy-id -i key_cl2.pub rita@10.2.89.10 [marharita@client-2 ~]\$ ssh-copy -i key_cl2.pub rita@10.2.89.10 bash: ssh-copy: command not found [marharita@client-2 ~]\$ ssh-copy-id -i key_cl2.pub rita@10.2.89.10 /usr/bin/ssh-copy-id: INFO: Source of key(s) to be installed: "key_cl2.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 prompt ed now it is to install the new keys rita@10.2.89.10's password: Number of key(s) added: 1 Now try logging into the machine, with: "ssh 'rita@10.2.89.10'" and check to make sure that only the key(s) you wanted were added.</pre>
---	--

Change the port on which the ssh server is running. Enable public key authentication and disable password authentication on the server

\$ sudo nano /etc/ssh/sshd_config

Client-1	Client-2
	

Connection to Server

```
rita@client-1:~$ ssh -i key_cl1.pub rita@10.89.28.20
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
@           WARNING: UNPROTECTED PRIVATE KEY FILE!           @
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
Permissions 0644 for 'key_cl1.pub' are too open.
It is required that your private key files are NOT accessible by others.
This private key will be ignored.
Load key "key_cl1.pub": bad permissions
rita@10.89.28.20's password:
Welcome to Ubuntu 22.04 LTS (GNU/Linux 5.15.0-56-generic x86_64)

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

236 updates can be applied immediately.
48 of these updates are standard security updates.
To see these additional updates run: apt list --upgradable

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

161 updates could not be installed automatically. For more details,
see /var/log/unattended-upgrades/unattended-upgrades.log
Last login: Sat Dec 10 09:53:26 2022 from 10.89.28.5
rita@server-1:~$
```

```
[marharita@client-2 ~]$ sudo vi /etc/ssh/sshd_config
[marharita@client-2 ~]$ sudo systemctl restart sshd
[marharita@client-2 ~]$ ssh -i key_cl2 rita@10.2.89.10
Welcome to Ubuntu 22.04 LTS (GNU/Linux 5.15.0-56-generic x86_64)

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

236 updates can be applied immediately.
48 of these updates are standard security updates.
To see these additional updates run: apt list --upgradable

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

161 updates could not be installed automatically. For more details,
see /var/log/unattended-upgrades/unattended-upgrades.log
Last login: Sat Dec 10 19:33:55 2022 from 10.2.89.5
rita@server-1:~$
```

(rita) 10.2.89.10

6.4 To simple SSH connection add a new entry to /etc/ssh/ssh_config file

Client-1	Client-2
<pre>Host server User rita HostName 10.89.28.20 IdentityFile ~/.key_cl1</pre>	<pre>Host server User rita HostName 10.2.89.10 IdentityFile ~/.key_cl2</pre>

To connect to the server: `$ ssh server`

Client-1	Client-2
<pre>rita@client-1:~\$ sudo nano /etc/ssh/ssh_config rita@client-1:~\$ sudo systemctl restart ssh rita@client-1:~\$ ssh server Welcome to Ubuntu 22.04 LTS (GNU/Linux 5.15.0-56-generic x86_64) * Documentation: https://help.ubuntu.com * Management: https://landscape.canonical.com * Support: https://ubuntu.com/advantage 236 updates can be applied immediately. 48 of these updates are standard security updates. To see these additional updates run: apt list --upgradable Failed to connect to https://changelogs.ubuntu.com/meta-release-lts. Check your Internet connection or proxy settings 161 updates could not be installed automatically. For more details, see /var/log/unattended-upgrades/unattended-upgrades.log Last login: Sat Dec 10 09:57:45 2022 from 10.89.28.5 rita@server-1:~\$</pre>	<pre>[marharita@client-2 ~]\$ sudo vi /etc/ssh/ssh_config [marharita@client-2 ~]\$ ssh server rita@10.2.89.10's password: Welcome to Ubuntu 22.04 LTS (GNU/Linux 5.15.0-56-generic x86_64) * Documentation: https://help.ubuntu.com * Management: https://landscape.canonical.com * Support: https://ubuntu.com/advantage 236 updates can be applied immediately. 48 of these updates are standard security updates. To see these additional updates run: apt list --upgradable Failed to connect to https://changelogs.ubuntu.com/meta-release-lts. Check your Internet connection or proxy settings 161 updates could not be installed automatically. For more details, see /var/log/unattended-upgrades/unattended-upgrades.log Last login: Sat Dec 10 21:12:02 2022 from 10.2.89.5 rita@server-1:~\$</pre>

6.5 Client_1 and Client_2 connect to each other.

Client-2 to client-1	Client-1 to client-2
<pre>[marharita@client-2 ~]\$ ssh rita@172.16.28.10 rita@172.16.28.10's password: Welcome to Ubuntu 22.04 LTS (GNU/Linux 5.15.0-56-generic x86_64) * Documentation: https://help.ubuntu.com * Management: https://landscape.canonical.com * Support: https://ubuntu.com/advantage 233 updates can be applied immediately. 41 of these updates are standard security updates. To see these additional updates run: apt list --upgradable 161 updates could not be installed automatically. For more details, see /var/log/unattended-upgrades/unattended-upgrades.log Last login: Sun Dec 11 10:40:04 2022 from 10.89.28.5 rita@client-1:~\$ rita@client-1:~\$ exit logout Connection to 172.16.28.10 closed. [marharita@client-2 ~]\$ ssh server rita@10.2.89.10's password: Welcome to Ubuntu 22.04 LTS (GNU/Linux 5.15.0-56-generic x86_64)</pre>	<pre>rita@server-1:~\$ exit logout Connection to 10.89.28.20 closed. rita@client-1:~\$ ssh marharita@172.16.28.20 marharita@172.16.28.20's password: Last login: Sun Dec 11 22:43:57 2022 from 172.16.28.10 [marharita@client-2 ~]\$ ls Desktop hello.sh my_backups RPM-GPG-KEY.art.txt Documents inotify.sh Pictures RPM-GPG-KEY.atomicorp.txt Downloads key_cl2 Public task_backup.sh EPAM-hw_centOS_Bash- key_cl2.pub repo Templates git Music Rita_Romaniuk Videos [marharita@client-2 ~]\$ exit logout Connection to 172.16.28.20 closed. rita@client-1:~\$</pre>

7. Configure the firewall on Server_1 as follows:

- Allowed to connect via SSH from Client_1 and forbidden from Client_2
- From Client_2 to 172.17.D+10.1 the ping was successful, but to 172.17.D+20.1 it was not successful

Before configure of firewall	After configure of firewall
<pre>\$ sudo iptables -L</pre>	<pre>\$ sudo iptables -A INPUT -p tcp -d 10.2.89.0/255.255.255.0 --dport ssh -j DROP \$ sudo iptables -A FORWARD -p icmp -d 172.17.48.1 -j DROP</pre>
<pre>rita@server-1:~\$ sudo iptables -L [sudo] password for rita: Chain INPUT (policy ACCEPT) target prot opt source destination Chain FORWARD (policy ACCEPT) target prot opt source destination Chain OUTPUT (policy ACCEPT) target prot opt source destination</pre>	<pre>rita@server-1:~\$ sudo iptables -L Chain INPUT (policy ACCEPT) target prot opt source destination DROP tcp -- anywhere 10.2.89.0/24 tcp dpt:ssh Chain FORWARD (policy ACCEPT) target prot opt source destination DROP icmp -- anywhere 172.17.48.1 Chain OUTPUT (policy ACCEPT) target prot opt source destination</pre>

Before configure of firewall	After configure of firewall
Client-2	Client-2
<pre>[marharita@client-2 ~]\$ ping 172.17.38.1 PING 172.17.38.1 (172.17.38.1) 56(84) bytes of data. 64 bytes from 172.17.38.1: icmp_seq=1 ttl=63 time=0.758 ms 64 bytes from 172.17.38.1: icmp_seq=2 ttl=63 time=2.00 ms 64 bytes from 172.17.38.1: icmp_seq=3 ttl=63 time=4.27 ms ^C --- 172.17.38.1 ping statistics --- 3 packets transmitted, 3 received, 0% packet loss, time 2003ms rtt min/avg/max/mdev = 0.758/2.345/4.276/1.457 ms [marharita@client-2 ~]\$ ping 172.17.48.1 PING 172.17.48.1 (172.17.48.1) 56(84) bytes of data. 64 bytes from 172.17.48.1: icmp_seq=1 ttl=63 time=1.14 ms 64 bytes from 172.17.48.1: icmp_seq=2 ttl=63 time=3.70 ms ^C --- 172.17.48.1 ping statistics --- 2 packets transmitted, 2 received, 0% packet loss, time 1001ms rtt min/avg/max/mdev = 1.145/2.424/3.704/1.280 ms [marharita@client-2 ~]\$ ssh server rita@10.2.89.10's password: Welcome to Ubuntu 22.04 LTS (GNU/Linux 5.15.0-56-generic x86_64)</pre>	<pre>[marharita@client-2 ~]\$ ping 172.17.48.1 PING 172.17.48.1 (172.17.48.1) 56(84) bytes of data. ^C --- 172.17.48.1 ping statistics --- 15 packets transmitted, 0 received, 100% packet loss, time 14003ms [marharita@client-2 ~]\$ ping 172.17.38.1 PING 172.17.38.1 (172.17.38.1) 56(84) bytes of data. 64 bytes from 172.17.38.1: icmp_seq=1 ttl=63 time=0.976 ms 64 bytes from 172.17.38.1: icmp_seq=2 ttl=63 time=3.31 ms ^C --- 172.17.38.1 ping statistics --- 2 packets transmitted, 2 received, 0% packet loss, time 1002ms rtt min/avg/max/mdev = 0.976/2.147/3.318/1.171 ms rita@server-1:~\$ exit logout Connection to 10.2.89.10 closed. [marharita@client-2 ~]\$ ssh rita@10.2.89.10 123 ^C [marharita@client-2 ~]\$ ssh server ^C [marharita@client-2 ~]\$</pre>


```

161 updates could not be installed automatically. For more details,
see /var/log/unattended-upgrades/unattended-upgrades.log
*** System restart required ***
Last login: Sun Dec 11 22:46:19 2022 from 10.89.28.6
rita@server-1:~$ exit
logout
Connection to 10.2.89.10 closed.
[marharita@client-2 ~]$

```

Client-1

```

rita@client-1:~$ ssh rita@10.89.28.20
rita@10.89.28.20's password:
Welcome to Ubuntu 22.04 LTS (GNU/Linux 5.15.0-56-generic x86_64)

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

```

```

210 updates can be applied immediately.
17 of these updates are standard security updates.
To see these additional updates run: apt list --upgradable

```

```

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

```

```

161 updates could not be installed automatically. For more details,
see /var/log/unattended-upgrades/unattended-upgrades.log
*** System restart required ***
Last login: Mon Dec 12 10:32:27 2022 from 10.2.89.5
rita@server-1:~$

```

Client-1

```

rita@client-1:~$ ssh rita@10.89.28.20
rita@10.89.28.20's password:
Permission denied, please try again.
rita@10.89.28.20's password:
Welcome to Ubuntu 22.04 LTS (GNU/Linux 5.15.0-56-generic x86_64)

```

```

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

```

```

210 updates can be applied immediately.
17 of these updates are standard security updates.
To see these additional updates run: apt list --upgradable

```

```

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

```

```

161 updates could not be installed automatically. For more details,
see /var/log/unattended-upgrades/unattended-upgrades.log
*** System restart required ***
Last login: Mon Dec 12 11:44:37 2022 from 10.2.89.5
rita@server-1:~$

```

For deleting rules

```

rita@server-1:~$ sudo iptables -F
rita@server-1:~$ sudo iptables -L
Chain INPUT (policy ACCEPT)
target     prot opt source                destination

Chain FORWARD (policy ACCEPT)
target     prot opt source                destination

Chain OUTPUT (policy ACCEPT)
target     prot opt source                destination
rita@server-1:~$

```

8. Configure NAT on Server_1 service in such a way that Client_1 and Client_2 ping the Internet

10.89.28.5	00001010 01011001 00011100 00000101
10.2.89.5	00001010 00000010 01011001 00000101
10.0.0.0/9	00001010 00000000 00000000 00000000 /9

```
sudo iptables -t nat -A POSTROUTING -s 10.0.0.0/9 -j SNAT --to-source 192.168.0.103
sudo iptables -t nat -D POSTROUTING 1
sudo iptables -t nat -A POSTROUTING -o enp0s3 -j MASQUERADE
```

```
rita@server-1:~$ sudo iptables -t nat -A POSTROUTING -s 10.0.0.0/9 -j SNAT --to
-source 192.168.0.103
rita@server-1:~$ sudo iptables -t nat -A POSTROUTING -o enp0s3 -j MASQUERADE
rita@server-1:~$ sudo iptables -t nat -L
Chain PREROUTING (policy ACCEPT)
target      prot opt source                destination

Chain INPUT (policy ACCEPT)
target      prot opt source                destination

Chain OUTPUT (policy ACCEPT)
target      prot opt source                destination

Chain POSTROUTING (policy ACCEPT)
target      prot opt source                destination
SNAT        all  --  10.0.0.0/9            anywhere             to:192.168.0.103
MASQUERADE  all  --  anywhere              anywhere
rita@server-1:~$ sudo iptables -t nat -D POSTROUTING 1
```

After setting NAT

```
rita@client-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=1 ttl=116 time=19.5 ms
64 bytes from 8.8.8.8: icmp_seq=2 ttl=116 time=18.9 ms
64 bytes from 8.8.8.8: icmp_seq=3 ttl=116 time=22.0 ms
^C
--- 8.8.8.8 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2127ms
rtt min/avg/max/mdev = 18.901/20.145/21.993/1.332 ms
rita@client-1:~$ ping google.com
PING google.com (142.250.186.206) 56(84) bytes of data.
64 bytes from waw07s05-in-f14.1e100.net (142.250.186.206): icmp_seq=1 ttl=116
time=17.2 ms
64 bytes from waw07s05-in-f14.1e100.net (142.250.186.206): icmp_seq=2 ttl=116
time=18.2 ms
^C
--- google.com ping statistics ---
3 packets transmitted, 2 received, 33.3333% packet loss, time 2004ms
rtt min/avg/max/mdev = 17.229/17.705/18.181/0.476 ms
rita@client-1:~$ ping 192.168.0.1
PING 192.168.0.1 (192.168.0.1) 56(84) bytes of data.
64 bytes from 192.168.0.1: icmp_seq=1 ttl=63 time=1.98 ms
64 bytes from 192.168.0.1: icmp_seq=2 ttl=63 time=1.96 ms
64 bytes from 192.168.0.1: icmp_seq=3 ttl=63 time=2.24 ms
^C
--- 192.168.0.1 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2009ms
rtt min/avg/max/mdev = 1.964/2.061/2.236/0.123 ms
```

```
rita@client-1:~$ traceroute 8.8.8.8
traceroute to 8.8.8.8 (8.8.8.8), 64 hops max
 1  10.89.28.20 1,290ms 0,440ms 0,313ms
 2  192.168.0.1 2,773ms 1,915ms 1,900ms
 3  10.2.13.1 5,429ms 9,318ms 4,199ms
 4  178.158.194.161 5,069ms 3,916ms 4,984ms
 5  10.255.253.15 4,859ms 9,784ms 7,004ms
 6  10.255.249.1 4,997ms 5,406ms 5,140ms
 7  193.25.181.70 5,162ms 5,276ms 7,735ms
 8  108.170.248.138 6,697ms 4,242ms 5,036ms
 9  142.251.242.39 18,504ms 18,700ms 19,802ms
10  216.239.35.133 21,821ms 21,401ms 19,808ms
11  108.170.250.209 19,995ms 19,653ms 19,636ms
12  142.250.224.91 19,951ms 19,713ms 20,383ms
13  8.8.8.8 18,321ms 20,948ms 53,077ms
```

```
[marharita@client-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=18.8 ms
64 bytes from 8.8.8.8: icmp_seq=2 ttl=116 time=21.4 ms
64 bytes from 8.8.8.8: icmp_seq=3 ttl=116 time=20.7 ms
^C
--- 8.8.8.8 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2007ms
rtt min/avg/max/mdev = 18.862/20.343/21.436/1.092 ms
[marharita@client-2 ~]$ ping google.com
PING google.com (142.250.186.206) 56(84) bytes of data.
64 bytes from waw07s05-in-f14.1e100.net (142.250.186.206): icmp_seq=1 ttl=1
me=18.3 ms
64 bytes from waw07s05-in-f14.1e100.net (142.250.186.206): icmp_seq=2 ttl=1
me=18.7 ms
64 bytes from waw07s05-in-f14.1e100.net (142.250.186.206): icmp_seq=3 ttl=1
me=19.0 ms
^C
--- google.com ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2003ms
rtt min/avg/max/mdev = 18.397/18.733/19.047/0.288 ms
[marharita@client-2 ~]$ ping 192.168.0.1
PING 192.168.0.1 (192.168.0.1) 56(84) bytes of data.
64 bytes from 192.168.0.1: icmp_seq=1 ttl=63 time=2.06 ms
64 bytes from 192.168.0.1: icmp_seq=2 ttl=63 time=2.76 ms
^C
--- 192.168.0.1 ping statistics ---
```

```
[marharita@client-2 ~]$ traceroute 8.8.8.8
traceroute to 8.8.8.8 (8.8.8.8), 30 hops max, 60 byte packets
 1  gateway (10.2.89.10) 0.596 ms 0.530 ms 0.494 ms
 2  192.168.0.1 (192.168.0.1) 31.209 ms 31.128 ms 30.771 ms
 3  10.2.13.1 (10.2.13.1) 13.566 ms 13.526 ms 18.504 ms
 4  178.158.194.161 (178.158.194.161) 30.344 ms 30.212 ms 30.048 ms
 5  10.255.253.15 (10.255.253.15) 29.998 ms 29.846 ms 29.697 ms
 6  10.255.249.1 (10.255.249.1) 29.650 ms 18.967 ms 18.894 ms
 7  google-gw.ix.net.ua (185.1.50.166) 18.821 ms google.1-ix.net (185.1.213.4
e-gw.ix.net.ua (185.1.50.166) 9.840 ms
 8  108.170.248.138 (108.170.248.138) 17.285 ms 9.522 ms 108.170.248.155 (10
485 ms
 9  142.251.224.82 (142.251.224.82) 21.252 ms 72.14.239.111 (72.14.239.111)
242.39 (142.251.242.39) 20.833 ms
10  142.251.77.181 (142.251.77.181) 21.176 ms 108.170.250.209 (108.170.250.20
251.242.37 (142.251.242.37) 20.830 ms
11  108.170.250.209 (108.170.250.209) 22.055 ms 142.250.37.193 (142.250.37.19
250.37.209 (142.250.37.209) 19.636 ms
12  172.253.65.37 (172.253.65.37) 19.794 ms dns.google (8.8.8.8) 20.118 ms
.251.228.31) 45.380 ms _
```