

**РОССИЙСКИЙ УНИВЕРСИТЕТ ДРУЖБЫ НАРОДОВ**  
**ИМЕНИ ПАТРИСА ЛУМУМБЫ**

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**ОТЧЕТ**  
**ПО ЛАБОРАТОРНОЙ РАБОТЕ № 8**

*Дисциплина «Сетевые технологии»*

*Тема «Адресация IPv4 и IPv6. Настройка маршрутизации»*

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## Цель работы

Изучение принципов маршрутизации в IPv4- и IPv6-сетях и принципов настройки сетевого оборудования.

## Выполнение работы

### 1. Настройка динамической маршрутизации в сетях IPv4 и IPv6

#### 1.1. Постановка задачи

Задана сеть, адреса сегментов сети и адреса, назначаемые интерфейсам устройств. Требуется настроить динамическую маршрутизацию по протоколам RIP, OSPF.

#### 1.2. Выполнение

1. Запустила GNS3 VM и GNS3. Создала новый проект Lab8. В рабочем пространстве разместила и соединила устройства в соответствии с заданной топологией сети. Использовала маршрутизаторы FRR. Изменила отображаемые названия устройств в соответствии с требованиями. Включила захват трафика на соединении между коммутатором sw-01 и маршрутизатором gw-01, а также между коммутатором sw-02 и маршрутизатором gw-03. (рис.1.1).

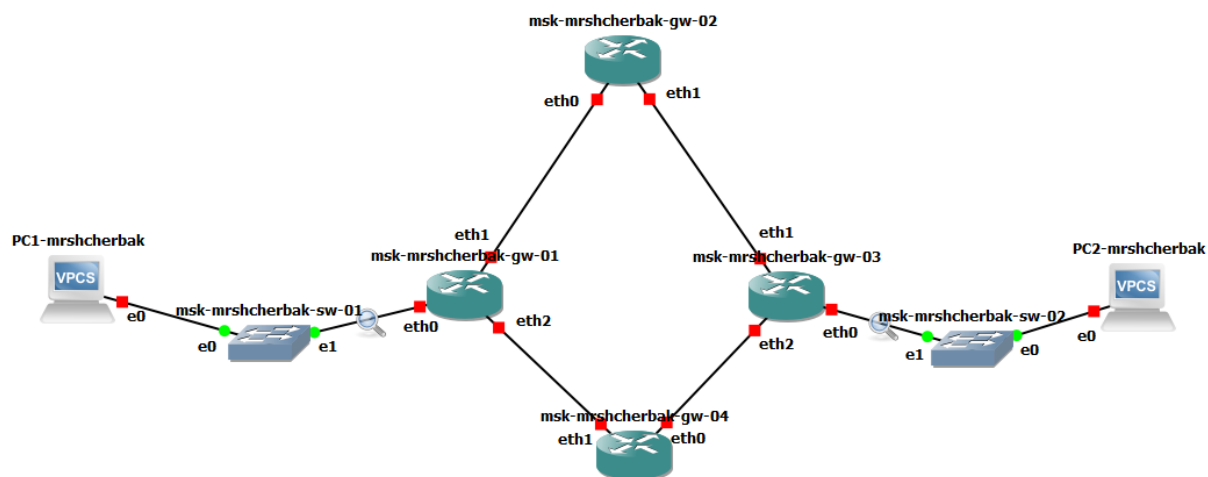


Рис.1.1. Топология сети

2. Присвоила IPv4-адреса конечным устройствам PC1 и PC2 (рис.1.2).

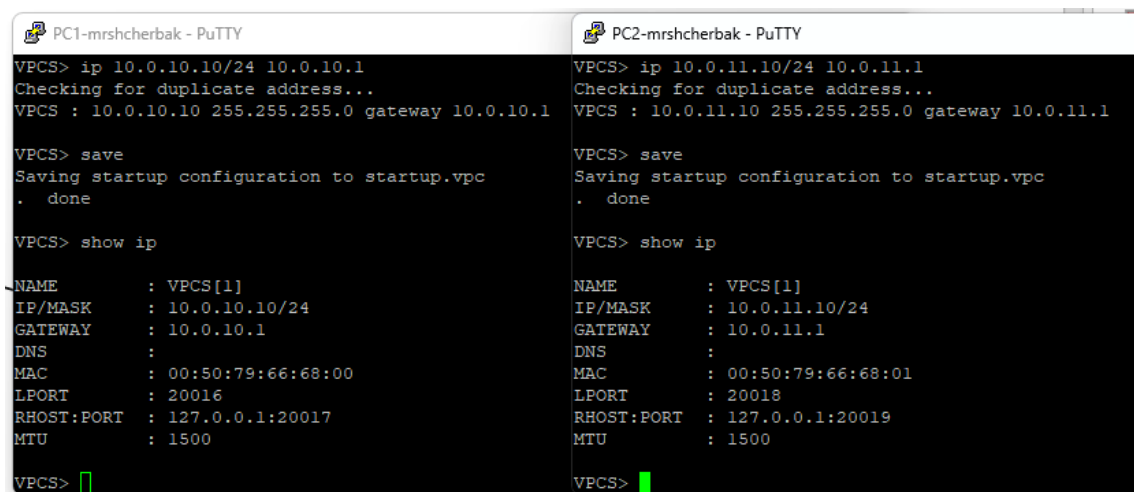


Рис.1.2. Назначение IPv4-адресов оконечным устройствам

3. Настроила IPv4-адреса на интерфейсах маршрутизаторов (рис.1.3 – рис.1.7).

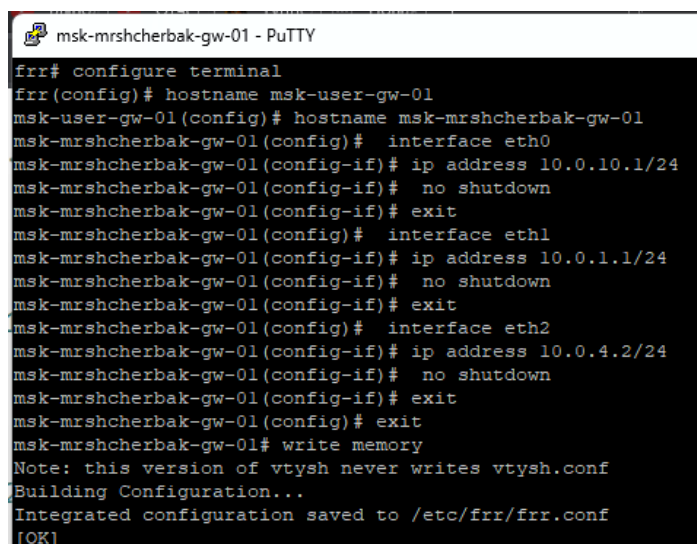


Рис.1.3. Настройка IPv4-адреса на интерфейсе первого маршрутизатора

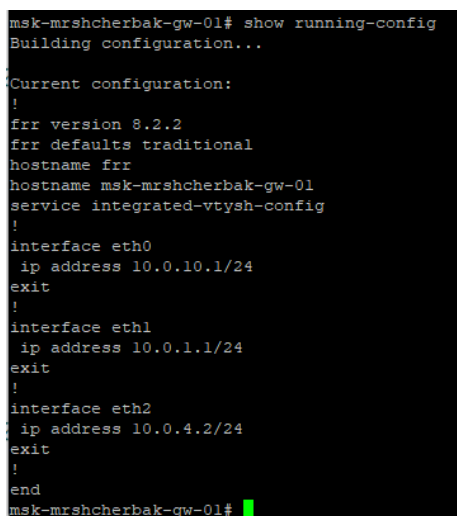


Рис.1.4. Просмотр настроек на интерфейсе первого маршрутизатора

```
msk-mrshcherbak-gw-02 - PuTTY

Hello, this is FRRouting (version 8.2.2).
Copyright 1996-2005 Kunihiro Ishiguro, et al.

frr# configure terminal
frr(config)# hostname msk-mrshcherbak-gw-02
msk-mrshcherbak-gw-02(config)# interface eth0
msk-mrshcherbak-gw-02(config-if)# ip address 10.0.1.2/24
msk-mrshcherbak-gw-02(config-if)# no shutdown
msk-mrshcherbak-gw-02(config-if)# exit
msk-mrshcherbak-gw-02(config)# interface eth1
msk-mrshcherbak-gw-02(config-if)# ip address 10.0.2.1/24
msk-mrshcherbak-gw-02(config-if)# no shutdown
msk-mrshcherbak-gw-02(config-if)# exit
msk-mrshcherbak-gw-02(config)# exit
msk-mrshcherbak-gw-02# write memory
Note: this version of vtysh never writes vtysh.conf
Building Configuration...
Integrated configuration saved to /etc/frr/frr.conf
[OK]
msk-mrshcherbak-gw-02# show running-config
Building configuration...

Current configuration:
!
frr version 8.2.2
frr defaults traditional
hostname frr
hostname msk-mrshcherbak-gw-02
service integrated-vtysh-config
!
interface eth0
 ip address 10.0.1.2/24
exit
!
interface eth1
 ip address 10.0.2.1/24
exit
!
end
msk-mrshcherbak-gw-02#
```

Рис.1.5. Настройка IPv4-адреса на интерфейсе второго маршрутизатора

```
msk-mrshcherbak-gw-03 - PuTTY

frr# configure terminal
frr(config)# hostname msk-user-gw-03
msk-user-gw-03(config)# hostname msk-mrshcherbak-gw-03
msk-mrshcherbak-gw-03(config)# interface eth0
msk-mrshcherbak-gw-03(config-if)# ip address 10.0.11.1/24
msk-mrshcherbak-gw-03(config-if)# no shutdown
msk-mrshcherbak-gw-03(config-if)# exit
msk-mrshcherbak-gw-03(config)# interface eth1
msk-mrshcherbak-gw-03(config-if)# ip address 10.0.2.2/24
msk-mrshcherbak-gw-03(config-if)# no shutdown
msk-mrshcherbak-gw-03(config-if)# exit
msk-mrshcherbak-gw-03(config)# interface eth2
msk-mrshcherbak-gw-03(config-if)# ip address 10.0.3.1/24
msk-mrshcherbak-gw-03(config-if)# no shutdown
msk-mrshcherbak-gw-03(config-if)# exit
msk-mrshcherbak-gw-03(config)# exit
msk-mrshcherbak-gw-03# write memory
Note: this version of vtysh never writes vtysh.conf
Building Configuration...
Integrated configuration saved to /etc/frr/frr.conf
[OK]
msk-mrshcherbak-gw-03# show running-config
Building configuration...

Current configuration:
!
frr version 8.2.2
frr defaults traditional
hostname frr
hostname msk-mrshcherbak-gw-03
service integrated-vtysh-config
!
interface eth0
 ip address 10.0.11.1/24
exit
!
interface eth1
 ip address 10.0.2.2/24
exit
!
interface eth2
 ip address 10.0.3.1/24
exit
```

Рис.1.6. Настройка IPv4-адреса на интерфейсе третьего маршрутизатора

```
msk-mrshcherbak-gw-04 - PuTTY
frr# configure terminal
frr(config)# hostname msk-mrshcherbak-gw-04
msk-mrshcherbak-gw-04(config)# interface eth0
msk-mrshcherbak-gw-04(config-if)# ip address 10.0.3.2/24
msk-mrshcherbak-gw-04(config-if)# no shutdown
msk-mrshcherbak-gw-04(config-if)# exit
msk-mrshcherbak-gw-04(config)# interface eth1
msk-mrshcherbak-gw-04(config-if)# ip address 10.0.4.1/24
msk-mrshcherbak-gw-04(config-if)# no shutdown
msk-mrshcherbak-gw-04(config-if)# exit
msk-mrshcherbak-gw-04(config)# exit
msk-mrshcherbak-gw-04# write memory
Note: this version of vtysh never writes vtysh.conf
Building Configuration...
Integrated configuration saved to /etc/frr/frr.conf
[OK]
msk-mrshcherbak-gw-04# show running-config
Building configuration...

Current configuration:
!
frr version 8.2.2
frr defaults traditional
hostname frr
hostname msk-mrshcherbak-gw-04
service integrated-vtysh-config
!
interface eth0
 ip address 10.0.3.2/24
exit
!
interface eth1
 ip address 10.0.4.1/24
exit
!
end
msk-mrshcherbak-gw-04#
```

Рис.1.7. Настройка IPv4-адреса на интерфейсе четвертого маршрутизатора

4. Присвоила IPv6-адреса конечным устройствам PC1 и PC2 (рис.1.8).

PC1-mrshcherbak - PuTTY	PC2-mrshcherbak - PuTTY
<pre>VPCS&gt; ip 2001:10::a/64 PC1 : 2001:10::a/64  VPCS&gt; save Saving startup configuration to startup.vpc . done  VPCS&gt; show ipv6  NAME                : VPCS[1] LINK-LOCAL SCOPE    : fe80::250:79ff:fe66:6800/64 GLOBAL SCOPE        : 2001:10::a/64 DNS                  : ROUTER LINK-LAYER   : MAC                  : 00:50:79:66:68:00 LPORT                : 20016 RHOST:PORT           : 127.0.0.1:20017 MTU                  : 1500  VPCS&gt;</pre>	<pre>VPCS&gt; ip 2001:11::a/64 PC1 : 2001:11::a/64  VPCS&gt; save Saving startup configuration to startup.vpc . done  VPCS&gt; show ipv6  NAME                : VPCS[1] LINK-LOCAL SCOPE    : fe80::250:79ff:fe66:6801/64 GLOBAL SCOPE        : 2001:11::a/64 DNS                  : ROUTER LINK-LAYER   : MAC                  : 00:50:79:66:68:01 LPORT                : 20018 RHOST:PORT           : 127.0.0.1:20019 MTU                  : 1500  VPCS&gt;</pre>

Рис.1.8. Назначение IPv6-адресов конечным устройствам

5. Настроила IPv6-адреса на интерфейсах маршрутизаторов (рис.1.9 – рис.1.14).

```
msk-mrshcherbak-gw-01 - PuTTY
msk-mrshcherbak-gw-01# configure terminal
msk-mrshcherbak-gw-01(config)# ipv6 forwarding
msk-mrshcherbak-gw-01(config)# interface eth0
msk-mrshcherbak-gw-01(config-if)# ipv6 address 2001:10::1/64
msk-mrshcherbak-gw-01(config-if)# no ipv6 nd suppress-ra
msk-mrshcherbak-gw-01(config-if)# ipv6 nd prefix 2001:10::/64
msk-mrshcherbak-gw-01(config-if)# no shutdown
msk-mrshcherbak-gw-01(config-if)# exit
msk-mrshcherbak-gw-01(config)# interface eth1
msk-mrshcherbak-gw-01(config-if)# ipv6 address 2001:1::1/64
msk-mrshcherbak-gw-01(config-if)# no shutdown
msk-mrshcherbak-gw-01(config-if)# exit
msk-mrshcherbak-gw-01(config)# interface eth2
msk-mrshcherbak-gw-01(config-if)# ipv6 address 2001:4::2/64
msk-mrshcherbak-gw-01(config-if)# no shutdown
msk-mrshcherbak-gw-01(config-if)# exit
msk-mrshcherbak-gw-01(config)# exit
msk-mrshcherbak-gw-01# write memory
Note: this version of vtysh never writes vtysh.conf
Building Configuration...
Integrated configuration saved to /etc/frr/frr.conf
[OK]
```

Рис.1.9. Настройка IPv6-адреса на интерфейсе первого маршрутизатора

```
msk-mrshcherbak-gw-01# show running-config
Building configuration...

Current configuration:
!
frr version 8.2.2
frr defaults traditional
hostname frr
hostname msk-mrshcherbak-gw-01
service integrated-vtysh-config
!
interface eth0
 ip address 10.0.10.1/24
 ipv6 address 2001:10::1/64
 ipv6 nd prefix 2001:10::/64
 no ipv6 nd suppress-ra
exit
!
interface eth1
 ip address 10.0.1.1/24
 ipv6 address 2001:1::1/64
exit
!
interface eth2
 ip address 10.0.4.2/24
 ipv6 address 2001:4::2/64
exit
!
end
msk-mrshcherbak-gw-01#
```

Рис.1.10. Просмотр настроек на интерфейсе первого маршрутизатора

```

msk-mrshcherbak-gw-02 - PuTTY
msk-mrshcherbak-gw-02# configure terminal
msk-mrshcherbak-gw-02(config)# ipv6 forwarding
msk-mrshcherbak-gw-02(config)# interface eth0
msk-mrshcherbak-gw-02(config-if)# ipv6 address 2001:1::2/64
msk-mrshcherbak-gw-02(config-if)# no shutdown
msk-mrshcherbak-gw-02(config-if)# exit
msk-mrshcherbak-gw-02(config)# interface eth1
msk-mrshcherbak-gw-02(config-if)# ipv6 address 2001:2::1/64
msk-mrshcherbak-gw-02(config-if)# no shutdown
msk-mrshcherbak-gw-02(config-if)# exit
msk-mrshcherbak-gw-02(config)# exit
msk-mrshcherbak-gw-02# write memory
Note: this version of vtysh never writes vtysh.conf
Building Configuration...
Integrated configuration saved to /etc/frr/frr.conf
[OK]
msk-mrshcherbak-gw-02# show running-config
Building configuration...

Current configuration:
!
frr version 8.2.2
frr defaults traditional
hostname frr
hostname msk-mrshcherbak-gw-02
service integrated-vtysh-config
!
interface eth0
 ip address 10.0.1.2/24
 ipv6 address 2001:1::2/64
exit
!
interface eth1
 ip address 10.0.2.1/24
 ipv6 address 2001:2::1/64
exit
!
end
msk-mrshcherbak-gw-02#

```

Рис.1.11. Настройка IPv6-адреса на интерфейсе второго маршрутизатора

```

msk-mrshcherbak-gw-03 - PuTTY
msk-mrshcherbak-gw-03# configure terminal
msk-mrshcherbak-gw-03(config)# ipv6 forwarding
msk-mrshcherbak-gw-03(config)# interface eth0
msk-mrshcherbak-gw-03(config-if)# ipv6 address 2001:11::1/64
msk-mrshcherbak-gw-03(config-if)# no ipv6 nd suppress-ra
msk-mrshcherbak-gw-03(config-if)# ipv6 nd prefix 2001:11::/64
msk-mrshcherbak-gw-03(config-if)# no shutdown
msk-mrshcherbak-gw-03(config-if)# exit
msk-mrshcherbak-gw-03(config)# interface eth1
msk-mrshcherbak-gw-03(config-if)# ipv6 address 2001:2::2/64
msk-mrshcherbak-gw-03(config-if)# no shutdown
msk-mrshcherbak-gw-03(config-if)# exit
msk-mrshcherbak-gw-03(config)# interface eth2
msk-mrshcherbak-gw-03(config-if)# ipv6 address 2001:3::1/64
msk-mrshcherbak-gw-03(config-if)# no shutdown
msk-mrshcherbak-gw-03(config-if)# exit
msk-mrshcherbak-gw-03(config)# exit
msk-mrshcherbak-gw-03# write memory
Note: this version of vtysh never writes vtysh.conf
Building Configuration...
Integrated configuration saved to /etc/frr/frr.conf
[OK]

```

Рис.1.12. Настройка IPv6-адреса на интерфейсе третьего маршрутизатора

```

msk-mrshcherbak-gw-03# show running-config
Building configuration...

Current configuration:
!
frr version 8.2.2
frr defaults traditional
hostname frr
hostname msk-mrshcherbak-gw-03
service integrated-vtysh-config
!
interface eth0
 ip address 10.0.11.1/24
 ipv6 address 2001:11::1/64
 ipv6 nd prefix 2001:11::/64
 no ipv6 nd suppress-ra
exit
!
interface eth1
 ip address 10.0.2.2/24
 ipv6 address 2001:2::2/64
exit
!
interface eth2
 ip address 10.0.3.1/24
 ipv6 address 2001:3::1/64
exit
!
end
msk-mrshcherbak-gw-03#

```

Рис.1.13. Просмотр настроек на интерфейсе третьего маршрутизатора

```

msk-mrshcherbak-gw-04 - PuTTY
msk-mrshcherbak-gw-04# configure terminal
msk-mrshcherbak-gw-04(config)# ipv6 forwarding
msk-mrshcherbak-gw-04(config)# interface eth0
msk-mrshcherbak-gw-04(config-if)# ipv6 address 2001:3::2/64
msk-mrshcherbak-gw-04(config-if)# no shutdown
msk-mrshcherbak-gw-04(config-if)# exit
msk-mrshcherbak-gw-04(config)# interface eth1
msk-mrshcherbak-gw-04(config-if)# ipv6 address 2001:4::1/64
msk-mrshcherbak-gw-04(config-if)# no shutdown
msk-mrshcherbak-gw-04(config-if)# exit
msk-mrshcherbak-gw-04(config)# exit
msk-mrshcherbak-gw-04# write memory
Note: this version of vtysh never writes vtysh.conf
Building Configuration...
Integrated configuration saved to /etc/frr/frr.conf
[OK]
msk-mrshcherbak-gw-04# show running-config
Building configuration...

Current configuration:
!
frr version 8.2.2
frr defaults traditional
hostname frr
hostname msk-mrshcherbak-gw-04
service integrated-vtysh-config
!
interface eth0
 ip address 10.0.3.2/24
 ipv6 address 2001:3::2/64
exit
!
interface eth1
 ip address 10.0.4.1/24
 ipv6 address 2001:4::1/64
exit
!
end
msk-mrshcherbak-gw-04#

```

Рис.1.14. Настройка IPv6-адреса на интерфейсе четвертого маршрутизатора



6. На маршрутизаторах настроила RIP в качестве протокола динамической маршрутизации (рис.1.15).

```

msk-mrshcherbak-gw-01 - PuTTY
msk-mrshcherbak-gw-01# configure terminal
msk-mrshcherbak-gw-01(config)# router rip
msk-mrshcherbak-gw-01(config-router)# version 2
msk-mrshcherbak-gw-01(config-router)# network eth0
msk-mrshcherbak-gw-01(config-router)# network eth1
msk-mrshcherbak-gw-01(config-router)# network eth2
msk-mrshcherbak-gw-01(config-router)# exit
msk-mrshcherbak-gw-01(config)# exit
msk-mrshcherbak-gw-01# write memory
Note: this version of vtysh never writes vtysh.conf
Building Configuration...
Integrated configuration saved to /etc/frr/frr.conf
[OK]
msk-mrshcherbak-gw-01#

msk-mrshcherbak-gw-02 - PuTTY
msk-mrshcherbak-gw-02# configure terminal
msk-mrshcherbak-gw-02(config)# router rip
msk-mrshcherbak-gw-02(config-router)# version 2
msk-mrshcherbak-gw-02(config-router)# network eth0
msk-mrshcherbak-gw-02(config-router)# network eth1
msk-mrshcherbak-gw-02(config-router)# exit
msk-mrshcherbak-gw-02# write memory
Note: this version of vtysh never writes vtysh.conf
Building Configuration...
Integrated configuration saved to /etc/frr/frr.conf
[OK]
msk-mrshcherbak-gw-02#

msk-mrshcherbak-gw-03 - PuTTY
msk-mrshcherbak-gw-03# configure terminal
msk-mrshcherbak-gw-03(config)# router rip
msk-mrshcherbak-gw-03(config-router)# version 2
msk-mrshcherbak-gw-03(config-router)# network eth0
msk-mrshcherbak-gw-03(config-router)# network eth1
msk-mrshcherbak-gw-03(config-router)# network eth2
msk-mrshcherbak-gw-03(config-router)# exit
msk-mrshcherbak-gw-03(config)# exit
msk-mrshcherbak-gw-03# write memory
Note: this version of vtysh never writes vtysh.conf
Building Configuration...
Integrated configuration saved to /etc/frr/frr.conf
[OK]
msk-mrshcherbak-gw-03#

msk-mrshcherbak-gw-04 - PuTTY
msk-mrshcherbak-gw-04# configure terminal
msk-mrshcherbak-gw-04(config)# router rip
msk-mrshcherbak-gw-04(config-router)# version 2
msk-mrshcherbak-gw-04(config-router)# network eth0
msk-mrshcherbak-gw-04(config-router)# network eth1
msk-mrshcherbak-gw-04(config-router)# exit
msk-mrshcherbak-gw-04# write memory
Note: this version of vtysh never writes vtysh.conf
Building Configuration...
Integrated configuration saved to /etc/frr/frr.conf
[OK]
msk-mrshcherbak-gw-04#

```

Рис.1.15. Настройка RIP как протокола динамической маршрутизации

7. Убедилась, что маршрутизация по RIP настроена (рис.1.16 – рис.1.19).

```

msk-mrshcherbak-gw-01 - PuTTY
msk-mrshcherbak-gw-01# show ip route rip
Codes: K - kernel route, C - connected, S - static, R - RIP,
       O - OSPF, I - IS-IS, B - BGP, E - EIGRP, N - NHRP,
       T - Table, v - VNC, V - VNC-Direct, A - Babel, F - PBR,
       f - OpenFabric,
       > - selected route, * - FIB route, q - queued, r - reject
       ed, b - backup
       t - trapped, o - offload failure

R>* 10.0.2.0/24 [120/2] via 10.0.1.2, eth1, weight 1, 00:05:46
R>* 10.0.3.0/24 [120/2] via 10.0.4.1, eth2, weight 1, 00:03:45
R>* 10.0.11.0/24 [120/3] via 10.0.1.2, eth1, weight 1, 00:04:35
msk-mrshcherbak-gw-01# show ip rip
Codes: R - RIP, C - connected, S - Static, O - OSPF, B - BGP
Sub-codes:
          (n) - normal, (s) - static, (d) - default, (r) - redistrib
          ute,
          (i) - interface

          Network          Next Hop          Metric From
Tag Time
C(i) 10.0.1.0/24          0.0.0.0          1 self
0
R(n) 10.0.2.0/24          10.0.1.2          2 10.0.1.2
0 02:39
R(n) 10.0.3.0/24          10.0.4.1          2 10.0.4.1
0 02:52
C(i) 10.0.4.0/24          0.0.0.0          1 self
0
C(i) 10.0.10.0/24         0.0.0.0          1 self
0
R(n) 10.0.11.0/24         10.0.1.2          3 10.0.1.2
0 02:39

```

Рис.1.16. Проверка настройки маршрутизации по RIP

```

msk-mrshcherbak-gw-01# show ip rip status
Routing Protocol is "rip"
  Sending updates every 30 seconds with +/-50%, next due in 0 se
conds
  Timeout after 180 seconds, garbage collect after 120 seconds
  Outgoing update filter list for all interface is not set
  Incoming update filter list for all interface is not set
  Default redistribution metric is 1
  Redistributing:
  Default version control: send version 2, receive version 2
    Interface        Send  Recv  Key-chain
    eth0              2    2
    eth1              2    2
    eth2              2    2
  Routing for Networks:
    eth0
    eth1
    eth2
  Routing Information Sources:
    Gateway          BadPackets  BadRoutes   Distance  Last Update
    10.0.1.2          0           0           120      00:00:00
    10.0.4.1          0           0           120      00:00:13
  Distance: (default is 120)
msk-mrshcherbak-gw-01#

```

Рис.1.17. Проверка настройки маршрутизации по RIP

```

msk-mrshcherbak-gw-04 - PuTTY
msk-mrshcherbak-gw-04# show ip route rip
Codes: K - kernel route, C - connected, S - static, R - RIP,
       O - OSPF, I - IS-IS, B - BGP, E - EIGRP, N - NHRP,
       T - Table, v - VNC, V - VNC-Direct, A - Babel, F - PBR,
       f - OpenFabric,
       > - selected route, * - FIB route, q - queued, r - rejected, b - backup
       t - trapped, o - offload failure

R>* 10.0.1.0/24 [120/2] via 10.0.4.2, eth1, weight 1, 00:09:27
R>* 10.0.2.0/24 [120/2] via 10.0.3.1, eth0, weight 1, 00:09:31
R>* 10.0.10.0/24 [120/2] via 10.0.4.2, eth1, weight 1, 00:09:27
R>* 10.0.11.0/24 [120/2] via 10.0.3.1, eth0, weight 1, 00:09:31
msk-mrshcherbak-gw-04# show ip rip
Codes: R - RIP, C - connected, S - Static, O - OSPF, B - BGP
Sub-codes:
  (n) - normal, (s) - static, (d) - default, (r) - redistribute,
  (i) - interface

    Network          Next Hop          Metric From          Tag Time
R(n) 10.0.1.0/24      10.0.4.2           2 10.0.4.2           0 02:47
R(n) 10.0.2.0/24      10.0.3.1           2 10.0.3.1           0 02:33
C(i) 10.0.3.0/24      0.0.0.0            1 self              0
C(i) 10.0.4.0/24      0.0.0.0            1 self              0
R(n) 10.0.10.0/24     10.0.4.2           2 10.0.4.2           0 02:47
R(n) 10.0.11.0/24     10.0.3.1           2 10.0.3.1           0 02:33

```

Рис.1.18. Проверка настройки маршрутизации по RIP

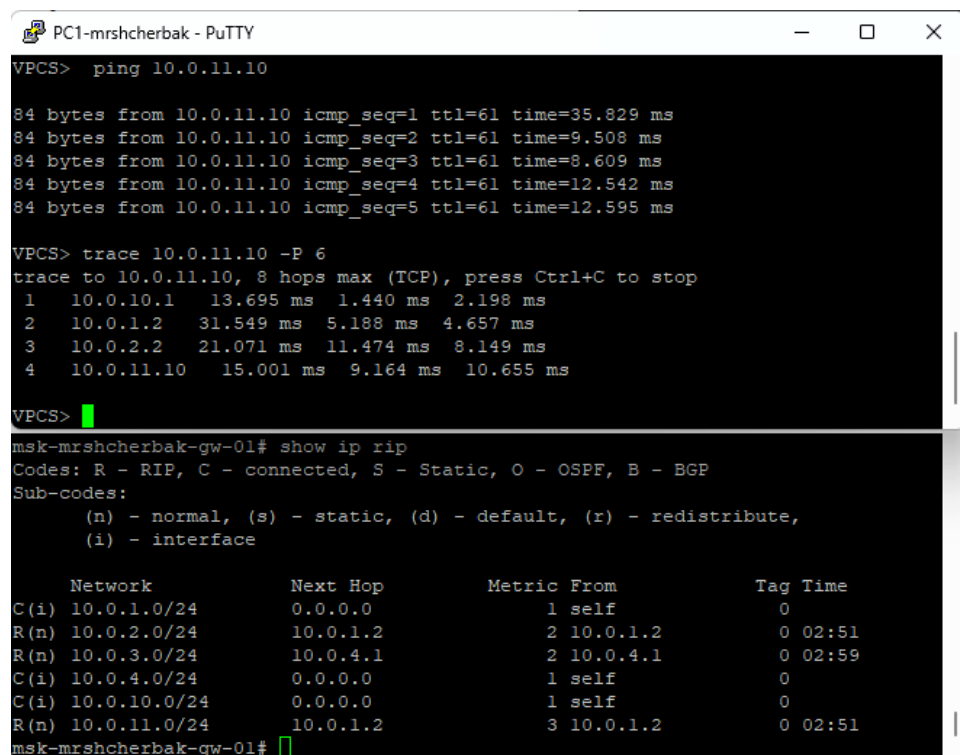
```

msk-mrshcherbak-gw-04# show ip rip status
Routing Protocol is "rip"
  Sending updates every 30 seconds with +/-50%, next due in 4 seconds
  Timeout after 180 seconds, garbage collect after 120 seconds
  Outgoing update filter list for all interface is not set
  Incoming update filter list for all interface is not set
  Default redistribution metric is 1
  Redistributing:
  Default version control: send version 2, receive version 2
    Interface        Send  Recv  Key-chain
    eth0              2    2
    eth1              2    2
  Routing for Networks:
    eth0
    eth1
  Routing Information Sources:
    Gateway          BadPackets  BadRoutes   Distance  Last Update
    10.0.3.1          0           0           120      00:00:04
    10.0.4.2          0           0           120      00:00:21
  Distance: (default is 120)
msk-mrshcherbak-gw-04#

```

Рис.1.19. Проверка настройки маршрутизации по RIP

8. Проверила пути прохождения пакетов и метрики протокола RIP (рис.1.20).



```
PC1-mrshcherbak - PuTTY
VPCS> ping 10.0.11.10

84 bytes from 10.0.11.10 icmp_seq=1 ttl=61 time=35.829 ms
84 bytes from 10.0.11.10 icmp_seq=2 ttl=61 time=9.508 ms
84 bytes from 10.0.11.10 icmp_seq=3 ttl=61 time=8.609 ms
84 bytes from 10.0.11.10 icmp_seq=4 ttl=61 time=12.542 ms
84 bytes from 10.0.11.10 icmp_seq=5 ttl=61 time=12.595 ms

VPCS> trace 10.0.11.10 -P 6
trace to 10.0.11.10, 8 hops max (TCP), press Ctrl+C to stop
 1  10.0.10.1   13.695 ms  1.440 ms  2.198 ms
 2  10.0.1.2   31.549 ms  5.188 ms  4.657 ms
 3  10.0.2.2   21.071 ms  11.474 ms  8.149 ms
 4  10.0.11.10 15.001 ms  9.164 ms  10.655 ms

VPCS>

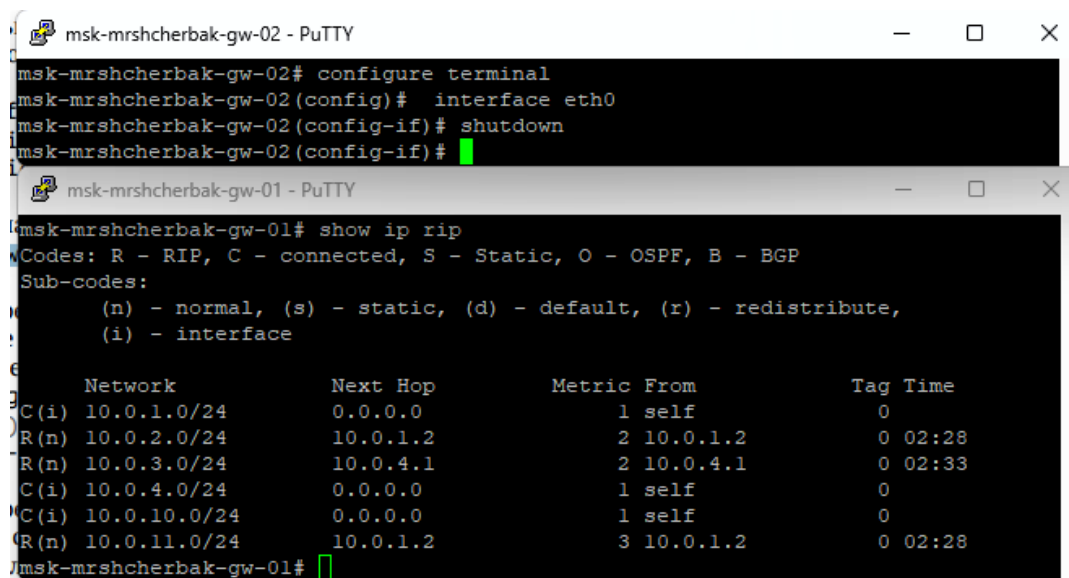
msk-mrshcherbak-gw-01# show ip rip
Codes: R - RIP, C - connected, S - Static, O - OSPF, B - BGP
Sub-codes:
      (n) - normal, (s) - static, (d) - default, (r) - redistribute,
      (i) - interface

      Network        Next Hop        Metric From      Tag Time
C(i) 10.0.1.0/24     0.0.0.0         1 self           0
R(n) 10.0.2.0/24     10.0.1.2        2 10.0.1.2        0 02:51
R(n) 10.0.3.0/24     10.0.4.1        2 10.0.4.1        0 02:59
C(i) 10.0.4.0/24     0.0.0.0         1 self           0
C(i) 10.0.10.0/24    0.0.0.0         1 self           0
R(n) 10.0.11.0/24    10.0.1.2        3 10.0.1.2        0 02:51

msk-mrshcherbak-gw-01#
```

Рис.1.20. Выполнение команд

9. Отключила на маршрутизаторе msk-mrshcherbak-gw-02 интерфейс и проверила метрики протокола RIP (рис.1.21).



```
msk-mrshcherbak-gw-02 - PuTTY
msk-mrshcherbak-gw-02# configure terminal
msk-mrshcherbak-gw-02(config)# interface eth0
msk-mrshcherbak-gw-02(config-if)# shutdown
msk-mrshcherbak-gw-02(config-if)#

msk-mrshcherbak-gw-01 - PuTTY
msk-mrshcherbak-gw-01# show ip rip
Codes: R - RIP, C - connected, S - Static, O - OSPF, B - BGP
Sub-codes:
      (n) - normal, (s) - static, (d) - default, (r) - redistribute,
      (i) - interface

      Network        Next Hop        Metric From      Tag Time
C(i) 10.0.1.0/24     0.0.0.0         1 self           0
R(n) 10.0.2.0/24     10.0.1.2        2 10.0.1.2        0 02:28
R(n) 10.0.3.0/24     10.0.4.1        2 10.0.4.1        0 02:33
C(i) 10.0.4.0/24     0.0.0.0         1 self           0
C(i) 10.0.10.0/24    0.0.0.0         1 self           0
R(n) 10.0.11.0/24    10.0.1.2        3 10.0.1.2        0 02:28

msk-mrshcherbak-gw-01#
```

Рис.1.21. Выполнение команд

10. С PC1 пропинговала PC2 и определила путь следования пакетов (рис.1.22). Затем включила на маршрутизаторе msk-mrshcherbak-gw-02 интерфейс и снова с PC1 пропинговала PC2 и определите путь следования пакетов (рис.1.23).

```
PC1-mrshcherbak - PuTTY
VPCS> ping 10.0.11.10

84 bytes from 10.0.11.10 icmp_seq=1 ttl=61 time=10.751 ms
84 bytes from 10.0.11.10 icmp_seq=2 ttl=61 time=8.507 ms
84 bytes from 10.0.11.10 icmp_seq=3 ttl=61 time=7.958 ms
84 bytes from 10.0.11.10 icmp_seq=4 ttl=61 time=5.583 ms
84 bytes from 10.0.11.10 icmp_seq=5 ttl=61 time=22.743 ms

VPCS> trace 10.0.11.10 -P 6
trace to 10.0.11.10, 8 hops max (TCP), press Ctrl+C to stop
 1  10.0.10.1    2.578 ms   0.446 ms   2.087 ms
 2  10.0.4.1     9.178 ms   4.578 ms   4.308 ms
 3  10.0.3.1     8.745 ms   6.012 ms   6.383 ms
 4  10.0.11.10   8.067 ms   5.572 ms   9.418 ms
```

Рис.1.22. Выполнение команд

```
msk-mrshcherbak-gw-02 - PuTTY
msk-mrshcherbak-gw-02(config-if)# configure terminal
% Unknown command: configure terminal
msk-mrshcherbak-gw-02(config-if)# interface eth0
msk-mrshcherbak-gw-02(config-if)# no shutdown
msk-mrshcherbak-gw-02(config-if)#

PC1-mrshcherbak - PuTTY
VPCS> ping 10.0.11.10

84 bytes from 10.0.11.10 icmp_seq=1 ttl=61 time=109.564 ms
84 bytes from 10.0.11.10 icmp_seq=2 ttl=61 time=20.573 ms
84 bytes from 10.0.11.10 icmp_seq=3 ttl=61 time=13.753 ms
84 bytes from 10.0.11.10 icmp_seq=4 ttl=61 time=10.784 ms
84 bytes from 10.0.11.10 icmp_seq=5 ttl=61 time=9.019 ms

VPCS> trace 10.0.11.10 -P 6
trace to 10.0.11.10, 8 hops max (TCP), press Ctrl+C to stop
 1  10.0.10.1    14.612 ms  13.581 ms  14.280 ms
 2  10.0.4.1    118.224 ms 11.763 ms   6.251 ms
 3  10.0.3.1    14.155 ms  19.677 ms  30.463 ms
 4  10.0.11.10  33.933 ms  30.874 ms  23.026 ms

VPCS>
```

Рис.1.23. Выполнение команд

11. На маршрутизаторах настроила RIPng для сетей IPv6 (рис.1.24).

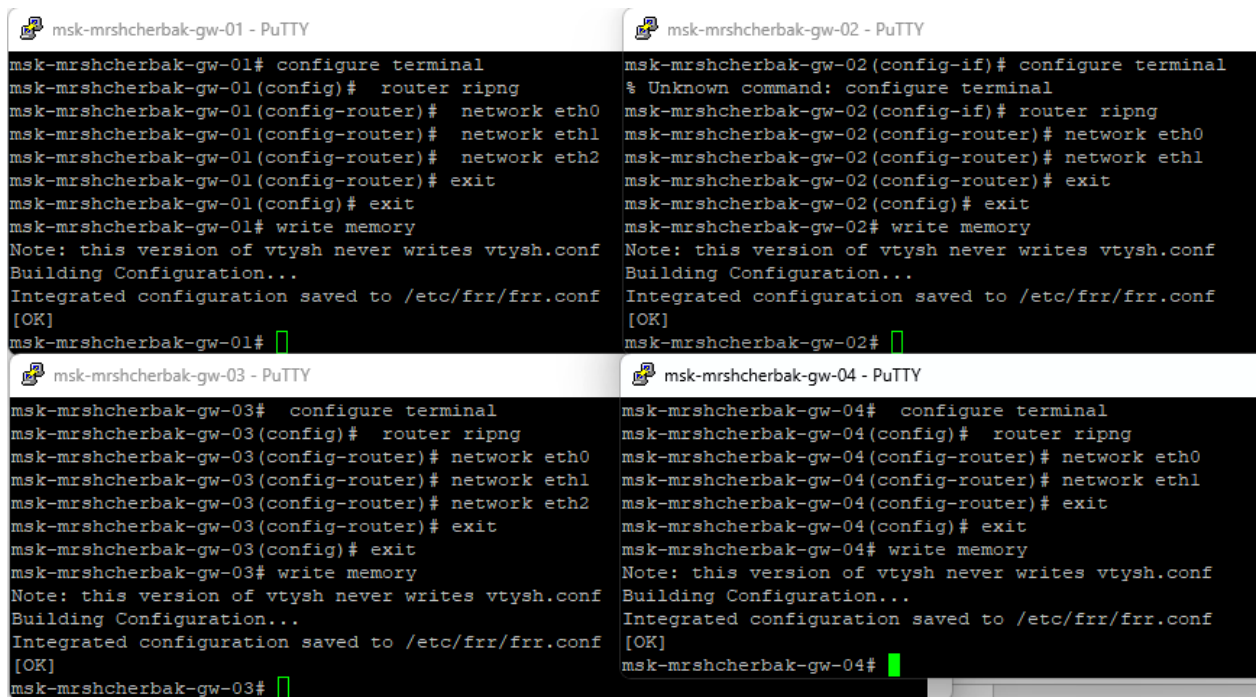


Рис.1.24. Выполнение команд

12. Проверила пути прохождения пакетов: с PC1 пропинговала PC2 и определила путь следования пакетов. Затем проверила метрики протокола RIPng (рис.1.25).

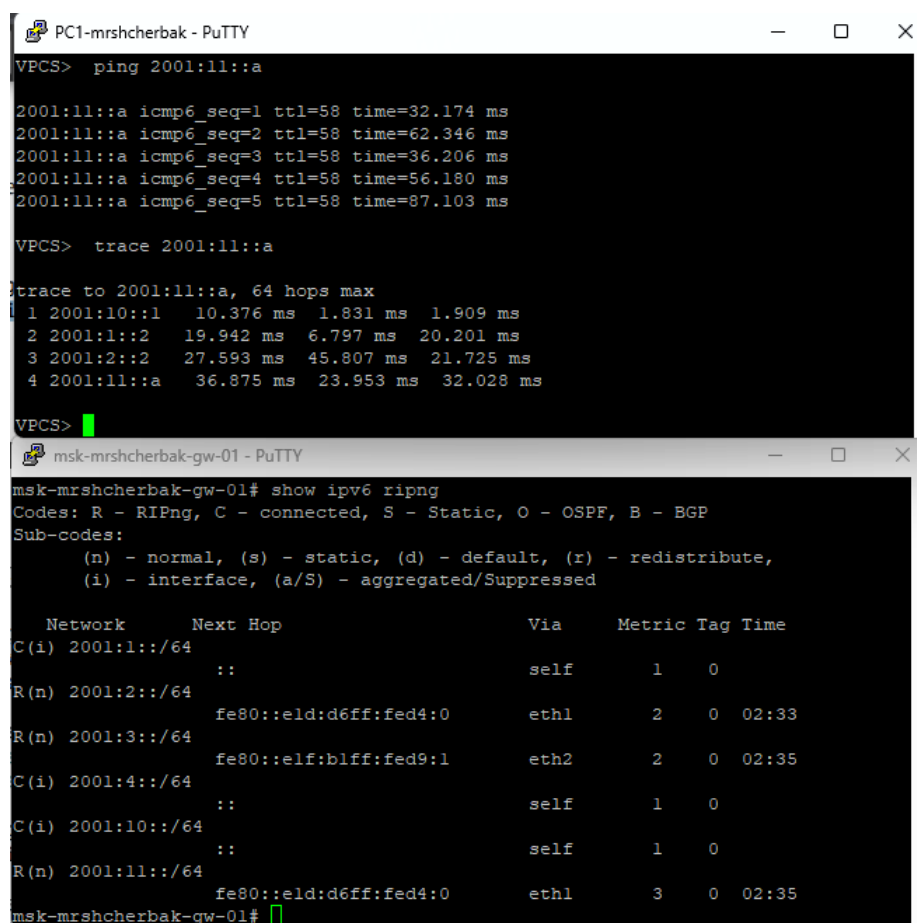
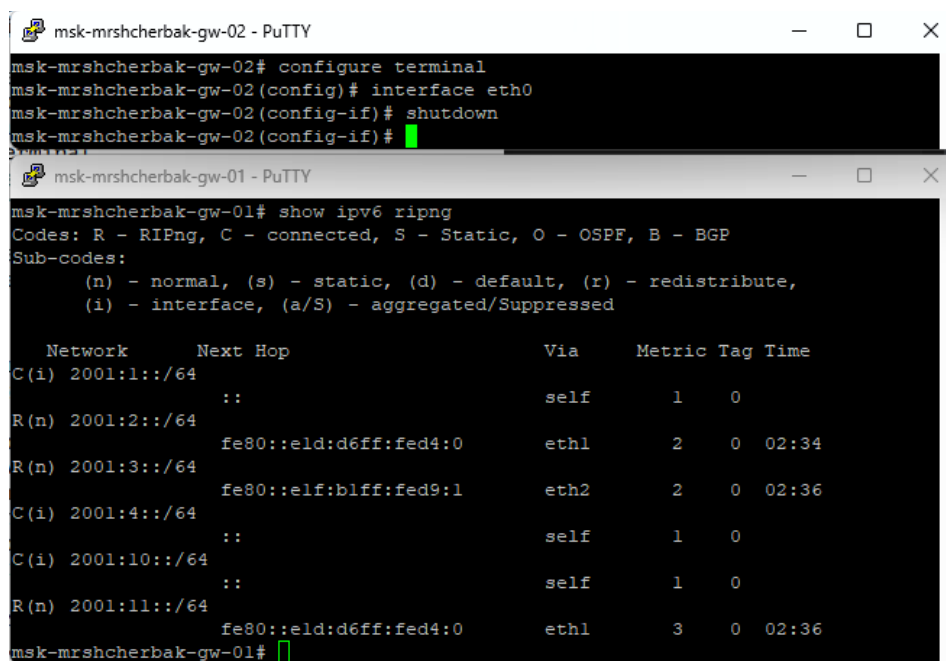


Рис.1.25. Выполнение команд

13. Отключила на маршрутизаторе msk-mrshcherbak-gw-02 интерфейс и проверила метрики протокола RIPng (рис.1.26). Затем с PC1 пропинговала PC2 и определила путь следования пакетов (рис.1.27).

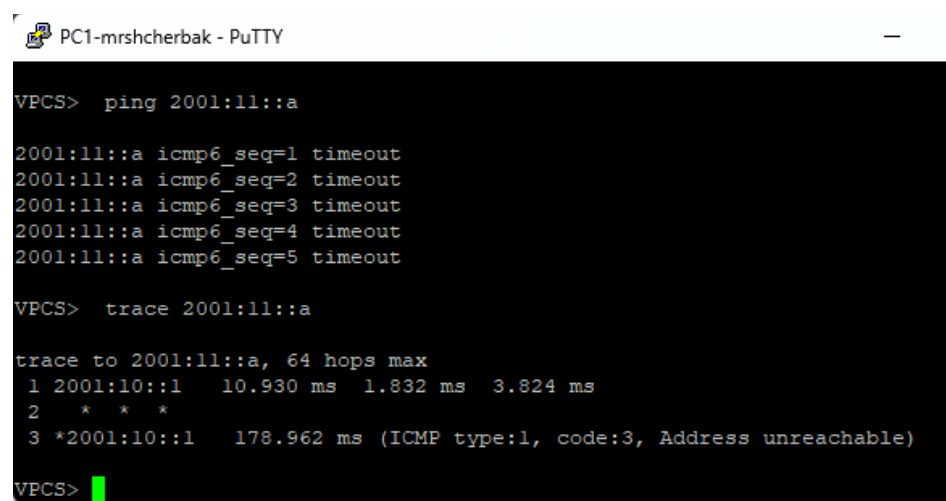


```
msk-mrshcherbak-gw-02 - PuTTY
msk-mrshcherbak-gw-02# configure terminal
msk-mrshcherbak-gw-02(config)# interface eth0
msk-mrshcherbak-gw-02(config-if)# shutdown
msk-mrshcherbak-gw-02(config-if)#

msk-mrshcherbak-gw-01 - PuTTY
msk-mrshcherbak-gw-01# show ipv6 ripng
Codes: R - RIPng, C - connected, S - Static, O - OSPF, B - BGP
Sub-codes:
  (n) - normal, (s) - static, (d) - default, (r) - redistribute,
  (i) - interface, (a/S) - aggregated/Suppressed

Network      Next Hop          Via      Metric Tag Time
C(i) 2001:1::/64      ::              self      1    0
R(n) 2001:2::/64      fe80::eld:d6ff:fed4:0 eth1      2    0 02:34
R(n) 2001:3::/64      fe80::elf:blff:fed9:1 eth2      2    0 02:36
C(i) 2001:4::/64      ::              self      1    0
C(i) 2001:10::/64     ::              self      1    0
R(n) 2001:11::/64     fe80::eld:d6ff:fed4:0 eth1      3    0 02:36
msk-mrshcherbak-gw-01#
```

Рис.1.26. Выполнение команд



```
PC1-mrshcherbak - PuTTY

VPCS> ping 2001:11::a

2001:11::a icmp6_seq=1 timeout
2001:11::a icmp6_seq=2 timeout
2001:11::a icmp6_seq=3 timeout
2001:11::a icmp6_seq=4 timeout
2001:11::a icmp6_seq=5 timeout

VPCS> trace 2001:11::a

trace to 2001:11::a, 64 hops max
 1 2001:10::1  10.930 ms  1.832 ms  3.824 ms
 2 * * *
 3 *2001:10::1  178.962 ms (ICMP type:1, code:3, Address unreachable)
VPCS>
```

Рис.1.27. Выполнение команд

14. Включила на маршрутизаторе msk-mrshcherbak -gw-02 интерфейс. Затем с PC1 пропинговала PC2 и определила путь следования пакетов (рис.1.28).



```
msk-mrshcherbak-gw-02 (config-if) #
msk-mrshcherbak-gw-02 (config-if) #
msk-mrshcherbak-gw-02 (config-if) # no shutdown
msk-mrshcherbak-gw-02 (config-if) #

VPCS> ping 2001:11::a

2001:11::a icmp6_seq=1 ttl=58 time=23.629 ms
2001:11::a icmp6_seq=2 ttl=58 time=8.979 ms
2001:11::a icmp6_seq=3 ttl=58 time=26.504 ms
2001:11::a icmp6_seq=4 ttl=58 time=14.471 ms
2001:11::a icmp6_seq=5 ttl=58 time=11.418 ms

VPCS> trace 2001:11::a

trace to 2001:11::a, 64 hops max
 1 2001:10::1  4.863 ms  1.067 ms  45.399 ms
 2 2001:1::2   10.217 ms  6.339 ms  8.513 ms
 3 2001:2::2   35.863 ms  8.596 ms  10.519 ms
 4 2001:11::a  18.730 ms  27.967 ms  13.533 ms

VPCS>
```

Рис.1.28. Выполнение команд

15. На маршрутизаторах настроила OSPFv2 для сетей IPv4 (рис.1.29).

```
msk-mrshcherbak-gw-01# configure terminal
msk-mrshcherbak-gw-01(config)# router ospf
msk-mrshcherbak-gw-01(config-router)# network 10.0.10.0/24 area 0.0.0.0
msk-mrshcherbak-gw-01(config-router)# network 10.0.1.0/24 area 0.0.0.0
msk-mrshcherbak-gw-01(config-router)# network 10.0.4.0/24 area 0.0.0.0
msk-mrshcherbak-gw-01(config-router)# exit
msk-mrshcherbak-gw-01(config)# exit
msk-mrshcherbak-gw-01# write memory
Note: this version of vtysh never writes vtysh.conf
Building Configuration...
Integrated configuration saved to /etc/frr/frr.conf
[OK]
msk-mrshcherbak-gw-01#

msk-mrshcherbak-gw-02(config-if)# configure terminal
% Unknown command: configure terminal
msk-mrshcherbak-gw-02(config-if)# router ospf
msk-mrshcherbak-gw-02(config-router)# network 10.0.1.0/24 area 0.0.0.0
msk-mrshcherbak-gw-02(config-router)# network 10.0.2.0/24 area 0.0.0.0
msk-mrshcherbak-gw-02(config-router)# exit
msk-mrshcherbak-gw-02(config)# exit
msk-mrshcherbak-gw-02# write memory
Note: this version of vtysh never writes vtysh.conf
Building Configuration...
Integrated configuration saved to /etc/frr/frr.conf
[OK]
msk-mrshcherbak-gw-02#

msk-mrshcherbak-gw-03# configure terminal
msk-mrshcherbak-gw-03(config)# router ospf
msk-mrshcherbak-gw-03(config-router)# network 10.0.11.0/24 area 0.0.0.0
msk-mrshcherbak-gw-03(config-router)# network 10.0.2.0/24 area 0.0.0.0
msk-mrshcherbak-gw-03(config-router)# network 10.0.3.0/24 area 0.0.0.0
msk-mrshcherbak-gw-03(config-router)# exit
msk-mrshcherbak-gw-03(config)# exit
msk-mrshcherbak-gw-03# write memory
Note: this version of vtysh never writes vtysh.conf
Building Configuration...
Integrated configuration saved to /etc/frr/frr.conf
[OK]
msk-mrshcherbak-gw-03#

msk-mrshcherbak-gw-04# configure terminal
msk-mrshcherbak-gw-04(config)# router ospf
msk-mrshcherbak-gw-04(config-router)# network 10.0.3.0/24 area 0.0.0.0
msk-mrshcherbak-gw-04(config-router)# network 10.0.4.0/24 area 0.0.0.0
msk-mrshcherbak-gw-04(config-router)# exit
msk-mrshcherbak-gw-04(config)# exit
msk-mrshcherbak-gw-04# write memory
Note: this version of vtysh never writes vtysh.conf
Building Configuration...
Integrated configuration saved to /etc/frr/frr.conf
[OK]
msk-mrshcherbak-gw-04#
```

Рис.1.29. Настройка OSPFv2 для сетей IPv4 на маршрутизаторах

16. С PC1 пропинговала PC2 и определила путь следования пакетов. Затем проверила таблицу маршрутизации протокола OSPFv2 (рис.1.30).

```
msk-mrshcherbak-gw-01# show ip ospf neighbor
```

Neighbor ID	Pri	State	Up Time	Dead Time	Address	In
10.0.2.1	1	Full/Backup	4m15s	33.162s	10.0.1.2	eth
h1:10.0.1.1			0 0 0			
10.0.4.1	1	Full/Backup	1m32s	33.342s	10.0.4.1	eth
h2:10.0.4.2			0 0 0			

```
msk-mrshcherbak-gw-01# show ip ospf route
```

```
===== OSPF network routing table =====
```

N	10.0.1.0/24	[100] area: 0.0.0.0
		directly attached to eth1
N	10.0.2.0/24	[200] area: 0.0.0.0
		via 10.0.1.2, eth1
N	10.0.3.0/24	[200] area: 0.0.0.0
		via 10.0.4.1, eth2
N	10.0.4.0/24	[100] area: 0.0.0.0
		directly attached to eth2
N	10.0.10.0/24	[100] area: 0.0.0.0
		directly attached to eth0
N	10.0.11.0/24	[300] area: 0.0.0.0
		via 10.0.1.2, eth1
		via 10.0.4.1, eth2

```
===== OSPF router routing table =====
```

```
===== OSPF external routing table =====
```

```
msk-mrshcherbak-gw-01#
```

PC1-mrshcherbak - PuTTY

```
VPCS> ping 10.0.11.10
```

```
84 bytes from 10.0.11.10 icmp_seq=1 ttl=61 time=227.557 ms
```

```
84 bytes from 10.0.11.10 icmp_seq=2 ttl=61 time=36.562 ms
```

```
84 bytes from 10.0.11.10 icmp_seq=3 ttl=61 time=224.372 ms
```

```
84 bytes from 10.0.11.10 icmp_seq=4 ttl=61 time=36.045 ms
```

```
84 bytes from 10.0.11.10 icmp_seq=5 ttl=61 time=416.871 ms
```

```
VPCS> trace 10.0.11.10 -P 6
```

```
trace to 10.0.11.10, 8 hops max (TCP), press Ctrl+C to stop
```

	10.0.10.1	8.478 ms	3.340 ms	1.772 ms
1	10.0.1.2	12.681 ms	5.145 ms	6.029 ms
2	10.0.3.1	29.336 ms	14.050 ms	12.702 ms
3	10.0.11.10	17.567 ms	44.948 ms	32.786 ms

```
VPCS>
```

Рис.1.30. Выполнение команд

17. Отключила на маршрутизаторе msk-mrshcherbak-gw-02 интерфейс и проверила таблицу маршрутизации протокола OSPFv2 (рис.1.31).

```
msk-mrshcherbak-gw-01# show ip ospf neighbor
```

Neighbor ID	Pri	State	Up Time	Dead Time	Address	Int
10.0.2.1	1	Full/Backup	6m46s	22.083s	10.0.1.2	eth
1:10.0.1.1			1 0 0			
10.0.4.1	1	Full/Backup	4m03s	32.278s	10.0.4.1	eth
2:10.0.4.2			0 0 0			

```
msk-mrshcherbak-gw-01# show ip ospf route
```

```
===== OSPF network routing table =====
```

N	10.0.1.0/24	[100] area: 0.0.0.0
		directly attached to eth1
N	10.0.2.0/24	[300] area: 0.0.0.0
		via 10.0.4.1, eth2
N	10.0.3.0/24	[200] area: 0.0.0.0
		via 10.0.4.1, eth2
N	10.0.4.0/24	[100] area: 0.0.0.0
		directly attached to eth2
N	10.0.10.0/24	[100] area: 0.0.0.0
		directly attached to eth0
N	10.0.11.0/24	[300] area: 0.0.0.0
		via 10.0.4.1, eth2

```
===== OSPF router routing table =====
```

```
===== OSPF external routing table =====
```

```
msk-mrshcherbak-gw-01#
```

msk-mrshcherbak-gw-02 - PuTTY

```
msk-mrshcherbak-gw-02# configure terminal
```

```
msk-mrshcherbak-gw-02(config)# interface eth0
```

```
msk-mrshcherbak-gw-02(config-if)# shutdown
```

```
msk-mrshcherbak-gw-02(config-if)#
```

Рис.1.31. Выполнение команд

18. С PC1 пропинговала PC2 и определила путь следования пакетов (рис.1.32).



```
PC1-mrshcherbak - PuTTY

VPCS> ping 10.0.11.10

84 bytes from 10.0.11.10 icmp_seq=1 ttl=61 time=98.732 ms
84 bytes from 10.0.11.10 icmp_seq=2 ttl=61 time=444.168 ms
84 bytes from 10.0.11.10 icmp_seq=3 ttl=61 time=239.086 ms
84 bytes from 10.0.11.10 icmp_seq=4 ttl=61 time=36.303 ms
84 bytes from 10.0.11.10 icmp_seq=5 ttl=61 time=84.896 ms

VPCS> trace 10.0.11.10 -P 6
trace to 10.0.11.10, 8 hops max (TCP), press Ctrl+C to stop
 1  10.0.10.1  27.626 ms  30.218 ms  96.665 ms
 2  10.0.4.1   108.612 ms  166.180 ms  5.880 ms
 3  10.0.3.1   105.864 ms  32.216 ms  16.226 ms
 4  10.0.11.10  43.344 ms  16.675 ms  67.295 ms

VPCS>
```

Рис.1.32. Выполнение команд

19. Включила на маршрутизаторе msk-mrshcherbak-gw-02 интерфейс и с PC1 пропинговала PC2 и определила путь следования пакетов (рис.1.33).

```
msk-mrshcherbak-gw-02 - PuTTY

msk-mrshcherbak-gw-02(config)# interface eth0
msk-mrshcherbak-gw-02(config-if)# shutdown
msk-mrshcherbak-gw-02(config-if)# no shutdown
msk-mrshcherbak-gw-02(config-if)#

PC1-mrshcherbak - PuTTY

VPCS> ping 10.0.11.10

84 bytes from 10.0.11.10 icmp_seq=1 ttl=61 time=181.631 ms
84 bytes from 10.0.11.10 icmp_seq=2 ttl=61 time=75.881 ms
84 bytes from 10.0.11.10 icmp_seq=3 ttl=61 time=26.319 ms
84 bytes from 10.0.11.10 icmp_seq=4 ttl=61 time=51.391 ms
84 bytes from 10.0.11.10 icmp_seq=5 ttl=61 time=42.897 ms

VPCS> trace 10.0.11.10 -P 6
trace to 10.0.11.10, 8 hops max (TCP), press Ctrl+C to stop
 1  10.0.10.1  3.310 ms  3.007 ms  4.686 ms
 2  10.0.4.1   18.790 ms  9.652 ms  74.062 ms
 3  10.0.2.2   29.865 ms  14.149 ms  111.636 ms
 4  10.0.11.10  44.637 ms  88.188 ms  418.833 ms

VPCS>
```

Рис.1.33. Выполнение команд

20. На маршрутизаторах настроила OSPFv3 для сетей IPv6 (рис.1.34 – рис.1.35).

```
msk-mrshcherbak-gw-01 - PuTTY
msk-mrshcherbak-gw-01# configure terminal
msk-mrshcherbak-gw-01(config)# router ospf6
msk-mrshcherbak-gw-01(config-ospf6)# ospf6 router-id 1.1.1.1
msk-mrshcherbak-gw-01(config-ospf6)# exit
msk-mrshcherbak-gw-01(config)# interface eth0
msk-mrshcherbak-gw-01(config-if)# ipv6 ospf6 area 0
msk-mrshcherbak-gw-01(config-if)# exit
msk-mrshcherbak-gw-01(config)# interface eth1
msk-mrshcherbak-gw-01(config-if)# ipv6 ospf6 area 0
msk-mrshcherbak-gw-01(config-if)# exit
msk-mrshcherbak-gw-01(config)# interface eth2
msk-mrshcherbak-gw-01(config-if)# ipv6 ospf6 area 0
msk-mrshcherbak-gw-01(config-if)# exit
msk-mrshcherbak-gw-01(config)# exit
msk-mrshcherbak-gw-01# write memory
Note: this version of vtysh never writes vtysh.conf
Building Configuration...
Integrated configuration saved to /etc/frr/frr.conf
[OK]
msk-mrshcherbak-gw-01#

msk-mrshcherbak-gw-02 - PuTTY
msk-mrshcherbak-gw-02(config-if)# configure terminal
% Unknown command: configure terminal
msk-mrshcherbak-gw-02(config-if)# router ospf6
msk-mrshcherbak-gw-02(config-ospf6)# ospf6 router-id 2.2.2.2
msk-mrshcherbak-gw-02(config-ospf6)# exit
msk-mrshcherbak-gw-02(config)# interface eth0
msk-mrshcherbak-gw-02(config-if)# ipv6 ospf6 area 0
msk-mrshcherbak-gw-02(config-if)# exit
msk-mrshcherbak-gw-02(config)# interface eth1
msk-mrshcherbak-gw-02(config-if)# ipv6 ospf6 area 0
msk-mrshcherbak-gw-02(config-if)# exit
msk-mrshcherbak-gw-02(config)# exit
msk-mrshcherbak-gw-02# write memory
Note: this version of vtysh never writes vtysh.conf
Building Configuration...
Integrated configuration saved to /etc/frr/frr.conf
[OK]
msk-mrshcherbak-gw-02#
```

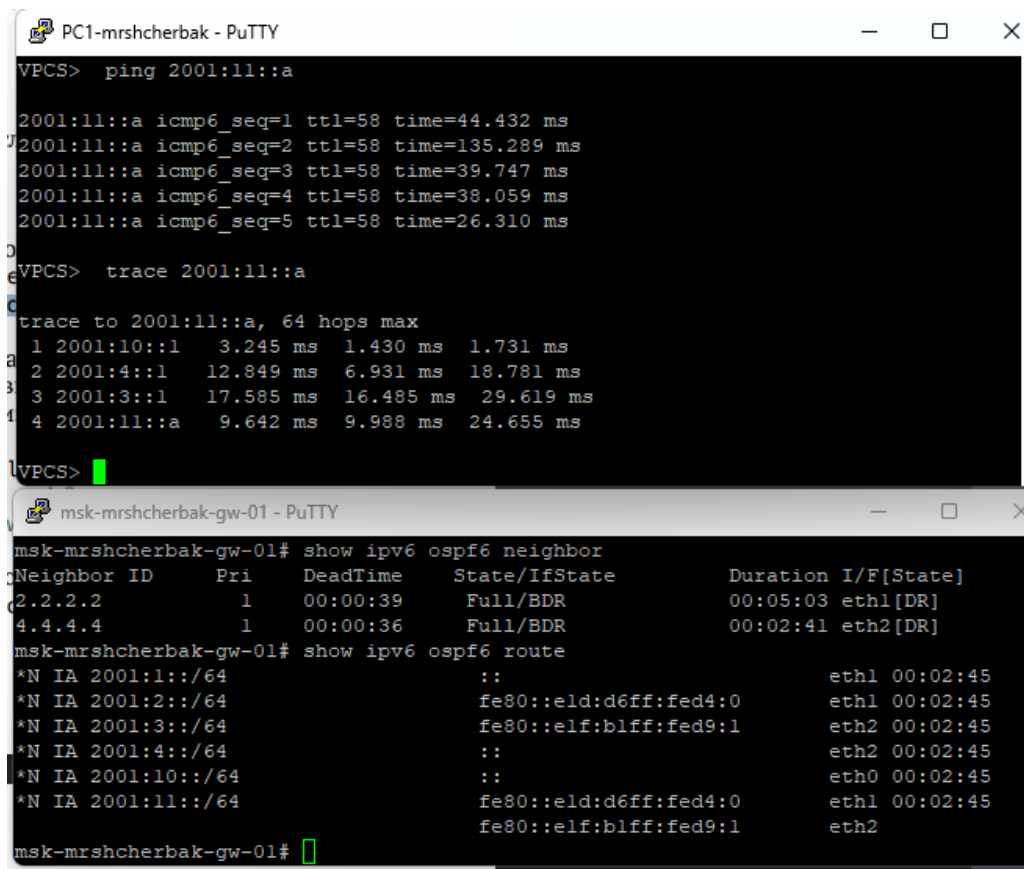
Рис.1.34. Настойка OSPFv3 для сетей IPv6 на маршрутизаторах 1 и 2

```
msk-mrshcherbak-gw-03 - PuTTY
msk-mrshcherbak-gw-03# configure terminal
msk-mrshcherbak-gw-03(config)# router ospf6
msk-mrshcherbak-gw-03(config-ospf6)# ospf6 router-id 3.3.3.3
msk-mrshcherbak-gw-03(config-ospf6)# exit
msk-mrshcherbak-gw-03(config)# interface eth0
msk-mrshcherbak-gw-03(config-if)# ipv6 ospf6 area 0
msk-mrshcherbak-gw-03(config-if)# exit
msk-mrshcherbak-gw-03(config)# interface eth1
msk-mrshcherbak-gw-03(config-if)# ipv6 ospf6 area 0
msk-mrshcherbak-gw-03(config-if)# exit
msk-mrshcherbak-gw-03(config)# interface eth2
msk-mrshcherbak-gw-03(config-if)# ipv6 ospf6 area 0
msk-mrshcherbak-gw-03(config-if)# exit
msk-mrshcherbak-gw-03(config)# exit
msk-mrshcherbak-gw-03# write memory
Note: this version of vtysh never writes vtysh.conf
Building Configuration...
Integrated configuration saved to /etc/frr/frr.conf
[OK]
msk-mrshcherbak-gw-03#

msk-mrshcherbak-gw-04 - PuTTY
msk-mrshcherbak-gw-04# configure terminal
msk-mrshcherbak-gw-04(config)# router ospf6
msk-mrshcherbak-gw-04(config-ospf6)# ospf6 router-id 4.4.4.4
msk-mrshcherbak-gw-04(config-ospf6)# exit
msk-mrshcherbak-gw-04(config)# interface eth0
msk-mrshcherbak-gw-04(config-if)# ipv6 ospf6 area 0
msk-mrshcherbak-gw-04(config-if)# exit
msk-mrshcherbak-gw-04(config)# interface eth1
msk-mrshcherbak-gw-04(config-if)# ipv6 ospf6 area 0
msk-mrshcherbak-gw-04(config-if)# exit
msk-mrshcherbak-gw-04(config)# exit
msk-mrshcherbak-gw-04# write memory
Note: this version of vtysh never writes vtysh.conf
Building Configuration...
Integrated configuration saved to /etc/frr/frr.conf
[OK]
msk-mrshcherbak-gw-04#
```

Рис.1.35. Настойка OSPFv3 для сетей IPv6 на маршрутизаторах 3 и 4

21. С PC1 пропинговала PC2 и определила путь следования пакетов. Затем проверила таблицу маршрутизации протокола OSPFv3 (рис.1.36).



The image shows two PuTTY terminal windows. The top window, titled 'PC1-mrshcherbak - PuTTY', shows a user at the 'VPCS' prompt performing a ping and a trace to the IPv6 address 2001:11::a. The ping results show five successful attempts with varying times. The trace shows a path of four hops. The bottom window, titled 'msk-mrshcherbak-gw-01 - PuTTY', shows a user at the 'msk-mrshcherbak-gw-01#' prompt running 'show ipv6 ospf6 neighbor' and 'show ipv6 ospf6 route'. The neighbor table shows two neighbors (2.2.2.2 and 4.4.4.4) in a Full/BDR state. The route table shows several IPv6 routes, including the destination 2001:11::/64.

```
PC1-mrshcherbak - PuTTY
VPCS> ping 2001:11::a

2001:11::a icmp6_seq=1 ttl=58 time=44.432 ms
2001:11::a icmp6_seq=2 ttl=58 time=135.289 ms
2001:11::a icmp6_seq=3 ttl=58 time=39.747 ms
2001:11::a icmp6_seq=4 ttl=58 time=38.059 ms
2001:11::a icmp6_seq=5 ttl=58 time=26.310 ms

VPCS> trace 2001:11::a

trace to 2001:11::a, 64 hops max
 1 2001:10::1  3.245 ms  1.430 ms  1.731 ms
 2 2001:4::1   12.849 ms  6.931 ms  18.781 ms
 3 2001:3::1   17.585 ms  16.485 ms  29.619 ms
 4 2001:11::a  9.642 ms  9.988 ms  24.655 ms

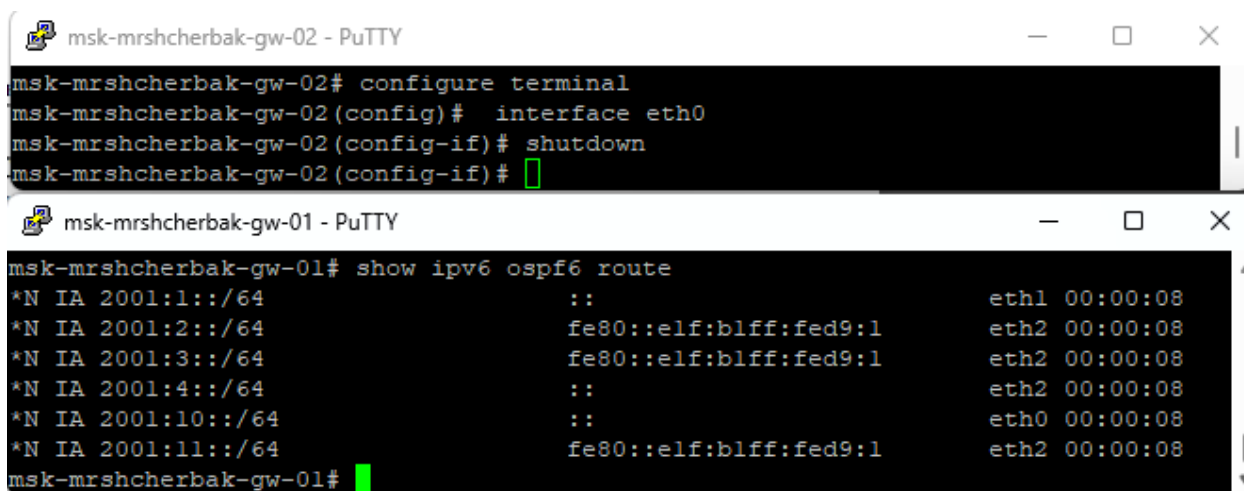
VPCS>

msk-mrshcherbak-gw-01 - PuTTY
msk-mrshcherbak-gw-01# show ipv6 ospf6 neighbor
Neighbor ID  Pri  DeadTime  State/IfState  Duration I/F[State]
2.2.2.2      1    00:00:39  Full/BDR      00:05:03 eth1[DR]
4.4.4.4      1    00:00:36  Full/BDR      00:02:41 eth2[DR]

msk-mrshcherbak-gw-01# show ipv6 ospf6 route
*N IA 2001:1::/64      ::          eth1 00:02:45
*N IA 2001:2::/64      fe80::eld:d6ff:fed4:0 eth1 00:02:45
*N IA 2001:3::/64      fe80::elf:blff:fed9:1 eth2 00:02:45
*N IA 2001:4::/64      ::          eth2 00:02:45
*N IA 2001:10::/64     ::          eth0 00:02:45
*N IA 2001:11::/64     fe80::eld:d6ff:fed4:0 eth1 00:02:45
                        fe80::elf:blff:fed9:1 eth2
```

Рис.1.36. Выполнение команд

22. Отключила на маршрутизаторе msk-mrshcherbak-gw-02 интерфейс и проверила таблицу маршрутизации протокола OSPFv3 (рис.1.37).



The image shows two PuTTY terminal windows. The top window, titled 'msk-mrshcherbak-gw-02 - PuTTY', shows a user at the 'msk-mrshcherbak-gw-02#' prompt configuring the terminal, then entering configuration mode for interface 'eth0' and shutting it down. The bottom window, titled 'msk-mrshcherbak-gw-01 - PuTTY', shows a user at the 'msk-mrshcherbak-gw-01#' prompt running 'show ipv6 ospf6 route'. The route table now shows that the routes to 2001:11::/64 are no longer present, and the routes to 2001:10::/64 and 2001:11::/64 are now marked as unreachable (indicated by '08' in the last column).

```
msk-mrshcherbak-gw-02 - PuTTY
msk-mrshcherbak-gw-02# configure terminal
msk-mrshcherbak-gw-02(config)# interface eth0
msk-mrshcherbak-gw-02(config-if)# shutdown
msk-mrshcherbak-gw-02(config-if)#

msk-mrshcherbak-gw-01 - PuTTY
msk-mrshcherbak-gw-01# show ipv6 ospf6 route
*N IA 2001:1::/64      ::          eth1 00:00:08
*N IA 2001:2::/64      fe80::elf:blff:fed9:1 eth2 00:00:08
*N IA 2001:3::/64      fe80::elf:blff:fed9:1 eth2 00:00:08
*N IA 2001:4::/64      ::          eth2 00:00:08
*N IA 2001:10::/64     ::          eth0 00:00:08
*N IA 2001:11::/64     fe80::elf:blff:fed9:1 eth2 00:00:08

msk-mrshcherbak-gw-01#
```

Рис.1.37. Выполнение команд

23. С PC1 пропинговала PC2 и определила путь следования пакетов. Включила на

маршрутизаторе msk-mrshcherbak-gw-02 интерфейс. С PC1 пропинговала PC2 и определила путь следования пакетов. Действия показаны на рис.1.38.

```
VPCS> ping 2001:11::a

2001:11::a icmp6_seq=1 ttl=58 time=85.856 ms
2001:11::a icmp6_seq=2 ttl=58 time=16.247 ms
2001:11::a icmp6_seq=3 ttl=58 time=426.252 ms
2001:11::a icmp6_seq=4 ttl=58 time=678.650 ms
2001:11::a icmp6_seq=5 ttl=58 time=216.164 ms

VPCS> trace 2001:11::a

trace to 2001:11::a, 64 hops max
 1 2001:10::1  3.620 ms  7.528 ms  152.897 ms
 2 2001:4::1   11.267 ms  18.535 ms  106.854 ms
 3 2001:3::1   272.186 ms  192.606 ms  14.513 ms
 4 2001:11::a  158.895 ms  12.133 ms  202.916 ms

VPCS> ping 2001:11::a

2001:11::a icmp6_seq=1 ttl=58 time=89.095 ms
2001:11::a icmp6_seq=2 ttl=58 time=79.371 ms
2001:11::a icmp6_seq=3 ttl=58 time=55.524 ms
2001:11::a icmp6_seq=4 ttl=58 time=12.317 ms
2001:11::a icmp6_seq=5 ttl=58 time=19.811 ms

VPCS> trace 2001:11::a

trace to 2001:11::a, 64 hops max
 1 2001:10::1  3.987 ms  5.723 ms  2.959 ms
 2 2001:4::1   5.625 ms  7.661 ms  7.307 ms
 3 2001:3::1   10.914 ms  20.408 ms  11.986 ms
 4 2001:11::a  12.434 ms  15.457 ms  86.364 ms

VPCS> 
```

msk-mrshcherbak-gw-02 - PuTTY

```
msk-mrshcherbak-gw-02(config)# interface eth0
msk-mrshcherbak-gw-02(config-if)# shutdown
msk-mrshcherbak-gw-02(config-if)# no shutdown
msk-mrshcherbak-gw-02(config-if)# 
```

Рис.1.38. Выполнение команд

**Вывод:** таким образом, в ходе выполнения л/р №8 я изучила принципы маршрутизации в IPv4- и IPv6-сетях и принципы настройки сетевого оборудования.