РОССИЙСКИЙ УНИВЕРСИТЕТ ДРУЖБЫ НАРОДОВ

Факультет физико-математических и естественных наук

Кафедра прикладной информатики и теории вероятностей

ОТЧЕТ
ПО ЛАБОРАТОРНОЙ РАБОТЕ № 8

Адресация IPv4 и IPv6. Настройка маршрутизации

дисциплина: Сетевые технологии

Студент: Саргсян Арам Грачьяевич

Группа: НПИбд 02-20

МОСКВА

2022 г.

ЦЕЛЬ РАБОТЫ:

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

ХОД РАБОТЫ

1. Запустил GNS3 VM и GNS3. Реализовал заданную топологию, задал устройствам свои имена. Подключил захват трафика (Рис. 1).

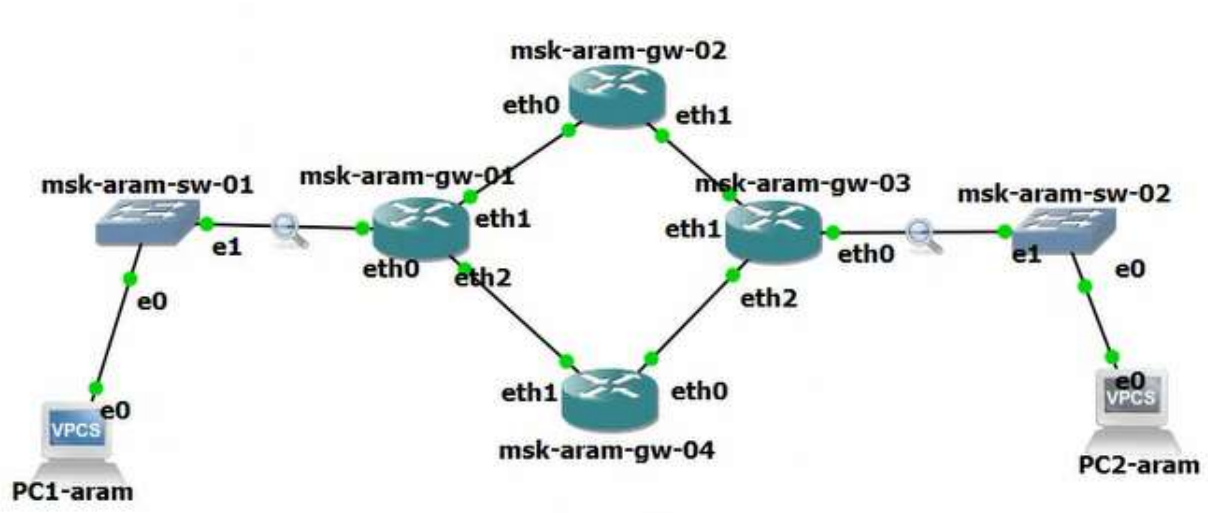

Рис. 1

2. Продублировал в отчёт таблицы маршрутизации (Таблица 1-2).

Устройства	Сеть	СетьV6
PC1 – gw-01	10.0.10.0/24	2001:10::/64
PC2 – gw-03	10.0.11.0/24	2001:11::/64
gw-01 – gw-02	10.0.1.0/24	2001:1::/64
gw-02 – gw-03	10.0.2.0/24	2001:2::/64
gw-03 – gw-04	10.0.3.0/24	2001:3::/64
gw-04 – gw-01	10.0.4.0/24	2001:4::/64

Таблица 1

Устройство	**Интерфейс**	**Адрес IP/префикс**	**Шлюз по умолчанию**	**Следующее устройство**
gw-01	eth0	10.0.10.1/24	n/a	PC1
gw-01	eth0	2001:10::1/64	n/a	PC1
gw-01	eth1	10.10.1.1/24	n/a	gw-02
gw-01	eth1	2001:1::1/64	n/a	gw-02
gw-01	eth2	10.0.4.2/24	n/a	gw-04
gw-01	eth2	2001:4::2/64	n/a	gw-04
gw-02	eth0	10.0.1.2/24	n/a	gw-01
gw-02	eth0	2001:1::2/64	n/a	gw-01
gw-02	eth1	10.0.2.1/24	n/a	gw-03
gw-02	eth1	2001:2::1/64	n/a	gw-03
gw-03	eth0	10.0.11.1/24	n/a	PC2
gw-03	eth0	2001:11::1/64	n/a	PC2
gw-03	eth1	10.0.2.2/24	n/a	gw-02
gw-03	eth1	2001:2::2/64	n/a	gw-02
gw-03	eth2	10.0.3.1/24	n/a	gw-04
gw-03	eth2	2001:3::1/64	n/a	gw-04
gw-04	eth0	10.10.1.9/30	n/a	gw-01
gw-04	eth0	2001:3::2/64	n/a	gw-01
gw-04	eth1	10.0.4.1/24	n/a	gw-02
gw-04	eth1	2001:4::1/64	n/a	gw-02
PC1	NIC	10.0.10.10/24	10.0.10.1	gw-01
PC1	NIC	2001:10::a/64	n/a	gw-01
PC2	NIC	10.10.11.10/24	10.0.11.1	gw-03
PC2	NIC	2001:11::a/64	n/a	gw-03

Таблица 2

3. Присвоил IPv4-адреса оконечным устройствам PC1 и PC2(Рис. 2).

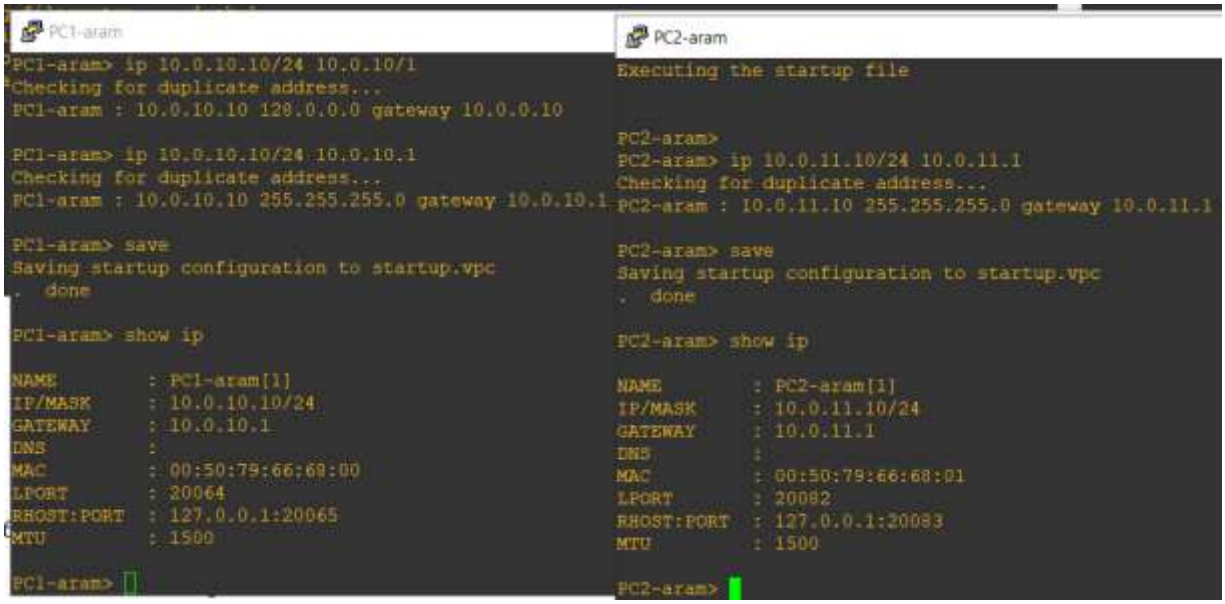

Рис. 2

4. Настройте IPv4-адреса на интерфейсах маршрутизаторов (Рис. 3-6).

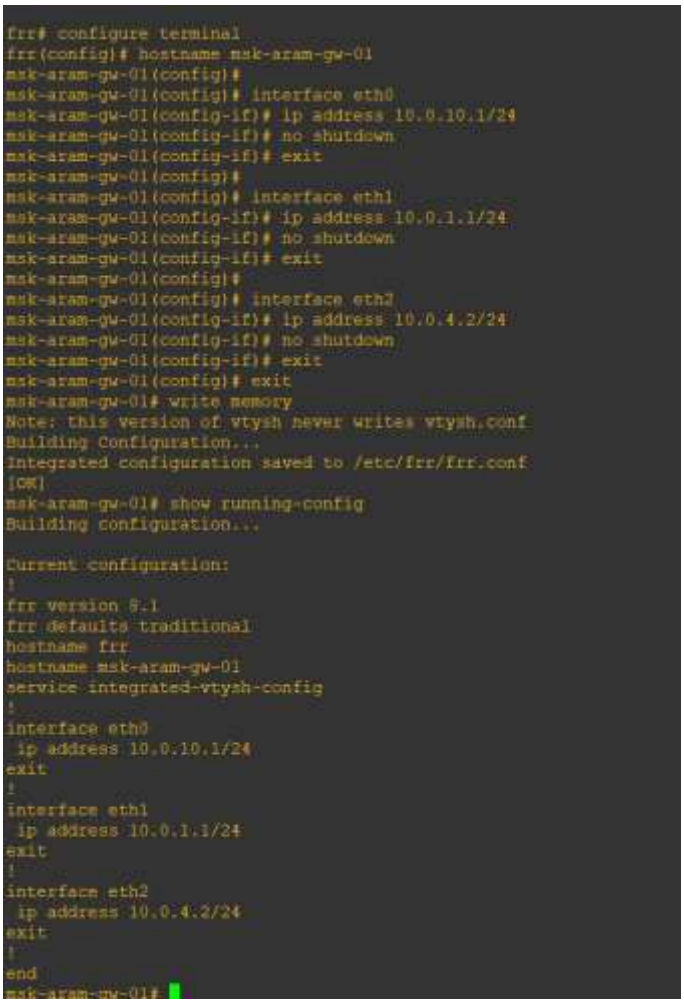

Рис. 3

```
frr# configure terminal
frr(config)# hostname msk-aram-gw-02
msk-aram-gw-02(config)#
msk-aram-gw-02(config)# interface eth0
msk-aram-gw-02(config-if)# ip address 10.0.1.2/24
msk-aram-gw-02(config-if)# no shutdown
msk-aram-gw-02(config-if)# exit
msk-aram-gw-02(config)#
msk-aram-gw-02(config)# interface eth1
msk-aram-gw-02(config-if)# ip address 10.0.2.1/24
msk-aram-gw-02(config-if)# no shutdown
msk-aram-gw-02(config-if)# exit
msk-aram-gw-02(config)# exit
msk-aram-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-aram-gw-02# show running-config
Building configuration...

Current configuration:
!
frr version 8.1
frr defaults traditional
hostname frr
hostname msk-aram-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-aram-gw-02#
```

Рис. 4

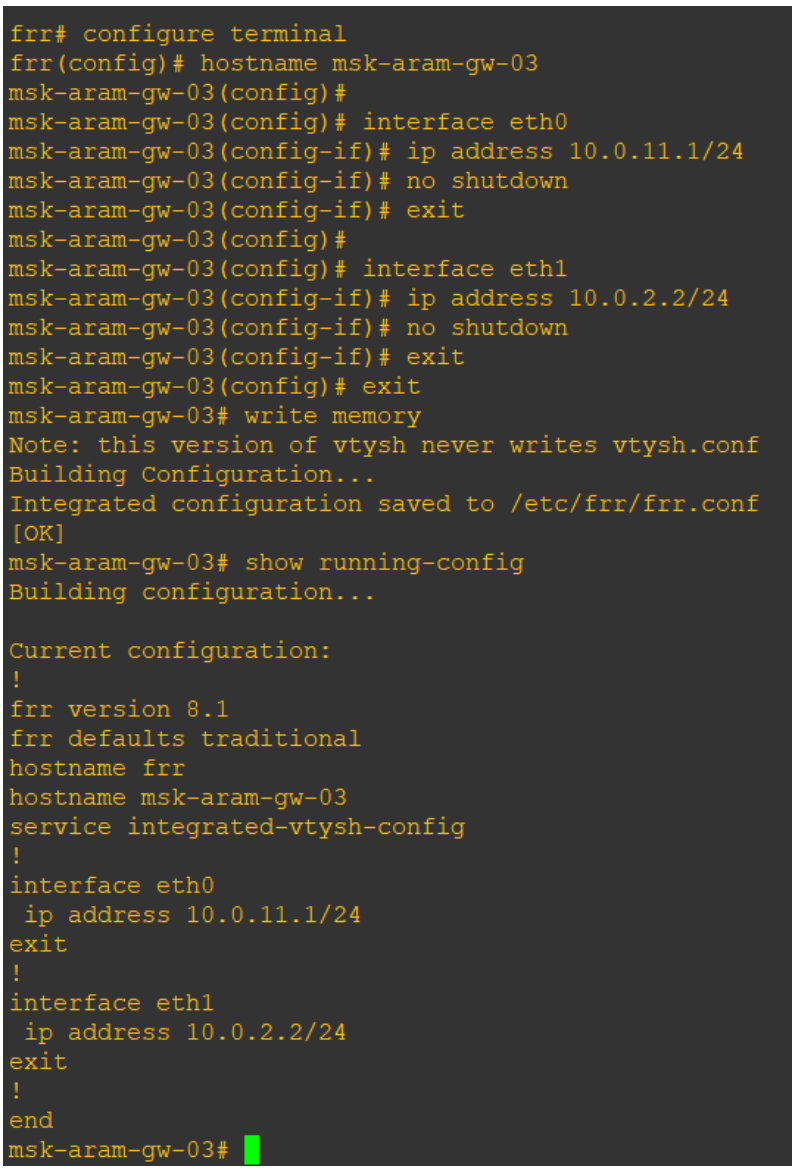
frr# configure terminal
frr(config)# hostname msk-aram-gw-03
msk-aram-gw-03(config)#
msk-aram-gw-03(config)# interface eth0
msk-aram-gw-03(config-if)# ip address 10.0.11.1/24
msk-aram-gw-03(config-if)# no shutdown
msk-aram-gw-03(config-if)# exit
msk-aram-gw-03(config)#
msk-aram-gw-03(config)# interface eth1
msk-aram-gw-03(config-if)# ip address 10.0.2.2/24
msk-aram-gw-03(config-if)# no shutdown
msk-aram-gw-03(config-if)# exit
msk-aram-gw-03(config)# exit
msk-aram-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-aram-gw-03# show running-config
Building configuration...
Current configuration:
!
frr version 8.1
frr defaults traditional
hostname frr
hostname msk-aram-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
!
end
msk-aram-gw-03#

Рис. 5

```
frr# configure terminal
frr(config)# hostname msk-aram-gw-04
msk-aram-gw-04(config)#
msk-aram-gw-04(config)# interface eth0
msk-aram-gw-04(config-if)# ip address 10.0.3.2/24
msk-aram-gw-04(config-if)# no shutdown
msk-aram-gw-04(config-if)# exit
msk-aram-gw-04(config)#
msk-aram-gw-04(config)# interface eth1
msk-aram-gw-04(config-if)# ip address 10.0.4.1/24
msk-aram-gw-04(config-if)# no shutdown
msk-aram-gw-04(config-if)# exit
msk-aram-gw-04(config)# exit
msk-aram-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-aram-gw-04# show running-config
Building configuration...

Current configuration:
!
frr version 8.1
frr defaults traditional
hostname frr
hostname msk-aram-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-aram-gw-04#
```

Рис. 6

5. Присвоил IPv6-адреса оконечным устройствам PC1 и PC2(Рис. 7).

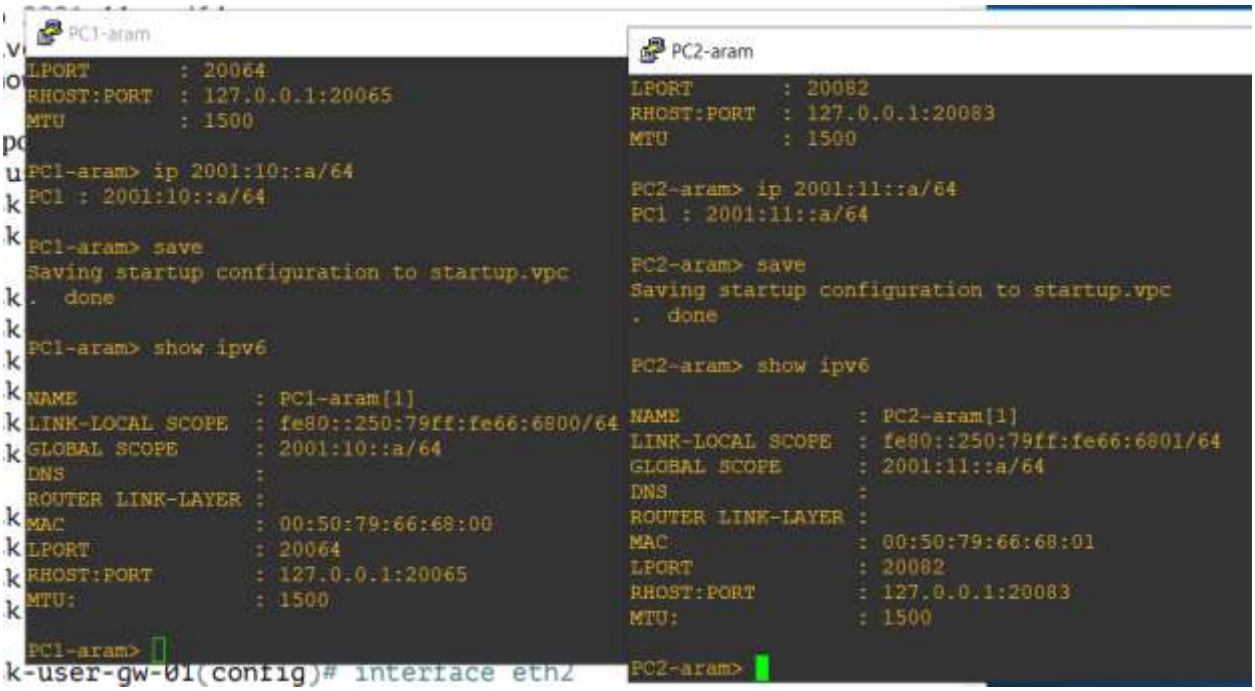

Рис. 7

6. Настроил IPv6-адреса на интерфейсах маршрутизаторов. (Рис. 8-11).

```
end
msk-aram-gw-01# configure terminal
msk-aram-gw-01(config)# ipv6 forwarding
msk-aram-gw-01(config)#
msk-aram-gw-01(config)# interface eth0
msk-aram-gw-01(config-if)# ipv6 address 2001:10::1/64
msk-aram-gw-01(config-if)# no ipv6 nd suppress-ra
msk-aram-gw-01(config-if)# ipv6 nd prefix 2001:10::/64
msk-aram-gw-01(config-if)# no shutdown
msk-aram-gw-01(config-if)# exit
msk-aram-gw-01(config)#
msk-aram-gw-01(config)# interface eth1
msk-aram-gw-01(config-if)# ipv6 address 2001:1::1/64
msk-aram-gw-01(config-if)# no shutdown
msk-aram-gw-01(config-if)# exit
msk-aram-gw-01(config)#
msk-aram-gw-01(config)# interface eth2
msk-aram-gw-01(config-if)# ipv6 address 2001:4::2/64
msk-aram-gw-01(config-if)# no shutdown
msk-aram-gw-01(config-if)# exit
msk-aram-gw-01(config)# exit
msk-aram-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-aram-gw-01# show running-config
Building configuration...

Current configuration:
!
frr version 8.1
frr defaults traditional
hostname frr
hostname msk-aram-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
```

Рис. 8

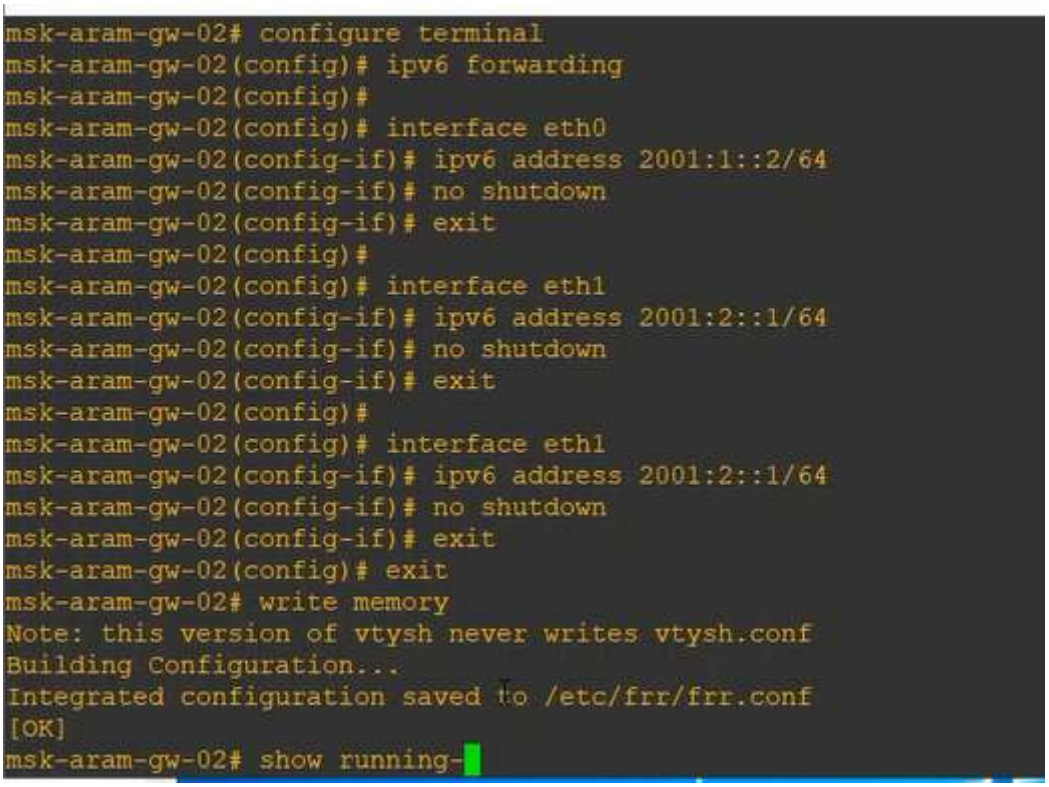
msk-aram-gw-02# configure terminal
msk-aram-gw-02(config)# ipv6 forwarding
msk-aram-gw-02(config)#
msk-aram-gw-02(config)# interface eth0
msk-aram-gw-02(config-if)# ipv6 address 2001:1::2/64
msk-aram-gw-02(config-if)# no shutdown
msk-aram-gw-02(config-if)# exit
msk-aram-gw-02(config)#
msk-aram-gw-02(config)# interface eth1
msk-aram-gw-02(config-if)# ipv6 address 2001:2::1/64
msk-aram-gw-02(config-if)# no shutdown
msk-aram-gw-02(config-if)# exit
msk-aram-gw-02(config)#
msk-aram-gw-02(config)# interface eth1
msk-aram-gw-02(config-if)# ipv6 address 2001:2::1/64
msk-aram-gw-02(config-if)# no shutdown
msk-aram-gw-02(config-if)# exit
msk-aram-gw-02(config)# exit
msk-aram-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-aram-gw-02# show running-

Рис. 9

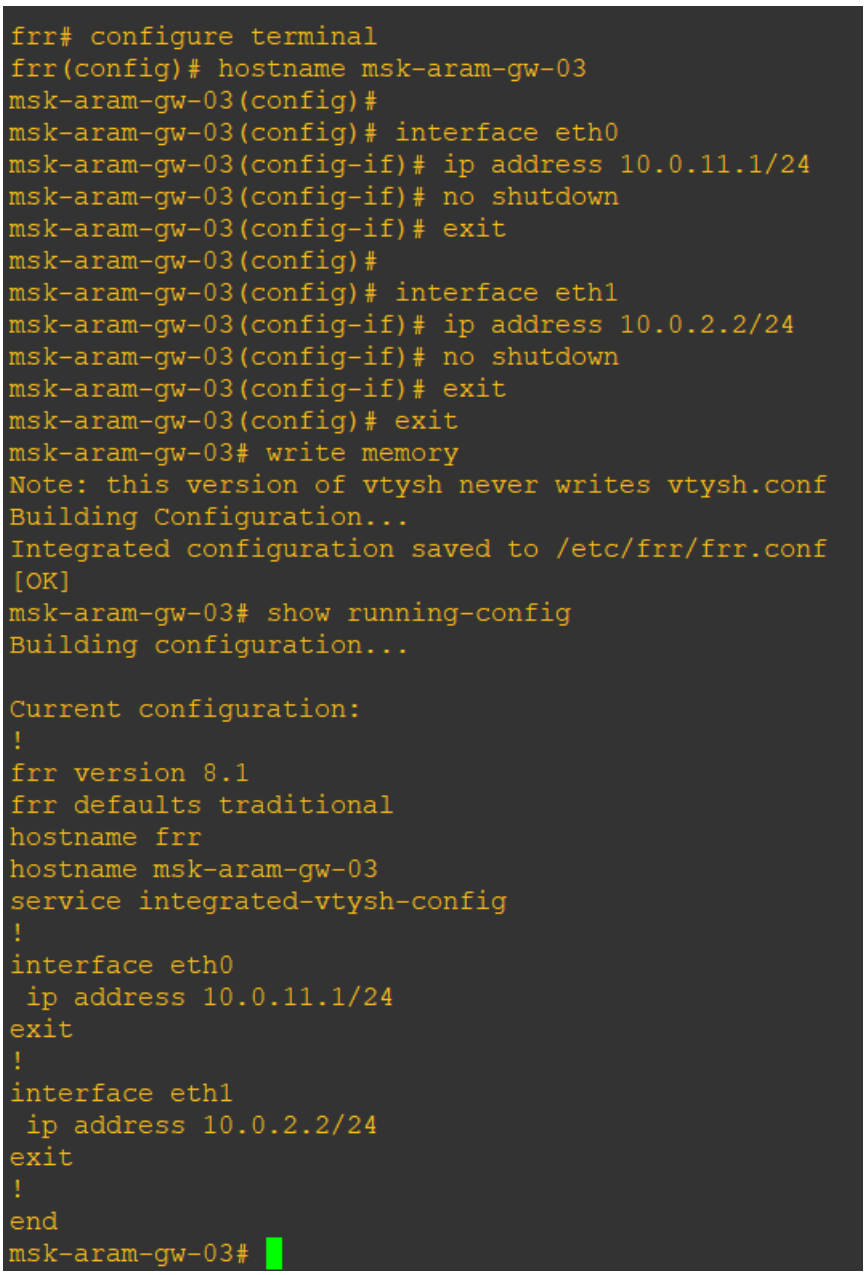
frr# configure terminal
frr(config)# hostname msk-aram-gw-03
msk-aram-gw-03(config)#
msk-aram-gw-03(config)# interface eth0
msk-aram-gw-03(config-if)# ip address 10.0.11.1/24
msk-aram-gw-03(config-if)# no shutdown
msk-aram-gw-03(config-if)# exit
msk-aram-gw-03(config)#
msk-aram-gw-03(config)# interface eth1
msk-aram-gw-03(config-if)# ip address 10.0.2.2/24
msk-aram-gw-03(config-if)# no shutdown
msk-aram-gw-03(config-if)# exit
msk-aram-gw-03(config)# exit
msk-aram-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-aram-gw-03# show running-config
Building configuration...
Current configuration:
!
frr version 8.1
frr defaults traditional
hostname frr
hostname msk-aram-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
!
end
msk-aram-gw-03#

Рис. 10

```
frr# configure terminal
frr(config)# hostname msk-aram-gw-04
msk-aram-gw-04(config)#
msk-aram-gw-04(config)# interface eth0
msk-aram-gw-04(config-if)# ip address 10.0.3.2/24
msk-aram-gw-04(config-if)# no shutdown
msk-aram-gw-04(config-if)# exit
msk-aram-gw-04(config)#
msk-aram-gw-04(config)# interface eth1
msk-aram-gw-04(config-if)# ip address 10.0.4.1/24
msk-aram-gw-04(config-if)# no shutdown
msk-aram-gw-04(config-if)# exit
msk-aram-gw-04(config)# exit
msk-aram-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-aram-gw-04# show running-config
Building configuration...

Current configuration:
!
frr version 8.1
frr defaults traditional
hostname frr
hostname msk-aram-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-aram-gw-04#
```

Рис. 11

7. Настроил динамическую маршрутизацию по протоколу RIP (Рис. 12-15).

```
end
msk-aram-gw-01# configure terminal
msk-aram-gw-01(config)# router rip
msk-aram-gw-01(config-router)# version 2
msk-aram-gw-01(config-router)# network eth0
msk-aram-gw-01(config-router)# network eth1
msk-aram-gw-01(config-router)# network eth1
msk-aram-gw-01(config-router)# network eth2
msk-aram-gw-01(config-router)# exit
msk-aram-gw-01(config)# exit
msk-aram-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-aram-gw-01#
```

Рис. 12

```
msk-aram-gw-02# configure terminal
msk-aram-gw-02(config)# router rip
msk-aram-gw-02(config-router)# version 2
msk-aram-gw-02(config-router)# network eth0
msk-aram-gw-02(config-router)# network eth1
msk-aram-gw-02(config-router)# exit
msk-aram-gw-02(config)# exit
msk-aram-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-aram-gw-02#
```

Рис. 13

```
msk-aram-gw-03# configure terminal
msk-aram-gw-03(config)# router rip
msk-aram-gw-03(config-router)# version 2
msk-aram-gw-03(config-router)# network eth0
msk-aram-gw-03(config-router)# network eth1
msk-aram-gw-03(config-router)# network eth2
msk-aram-gw-03(config-router)# exit
msk-aram-gw-03(config)# exit
msk-aram-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-aram-gw-03#
```

Рис. 14

```
msk-aram-gw-04# configure terminal
msk-aram-gw-04(config)# router rip
msk-aram-gw-04(config-router)# version 2
msk-aram-gw-04(config-router)# network eth 0
% Unknown command: network eth 0
msk-aram-gw-04(config-router)# network eth1
msk-aram-gw-04(config-router)# ^C
msk-aram-gw-04(config-router)# network eth0
msk-aram-gw-04(config-router)# exit
msk-aram-gw-04(config)# exit
msk-aram-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-aram-gw-04#
```

Рис. 15

8. Проверил маршрутизацию RIP (Рис. 16).

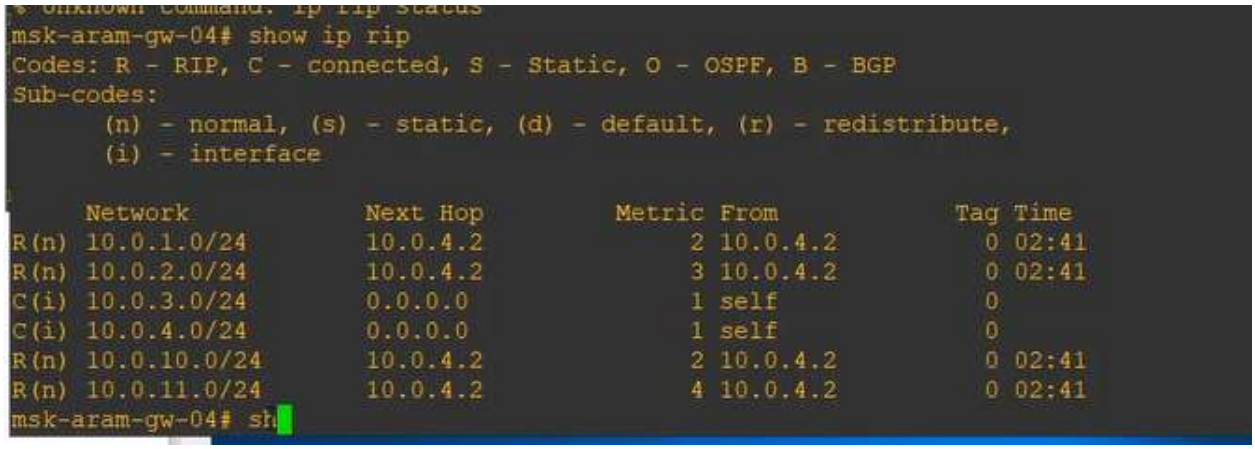

Рис. 16

9. Пропинговал соединение (Рис. 17).

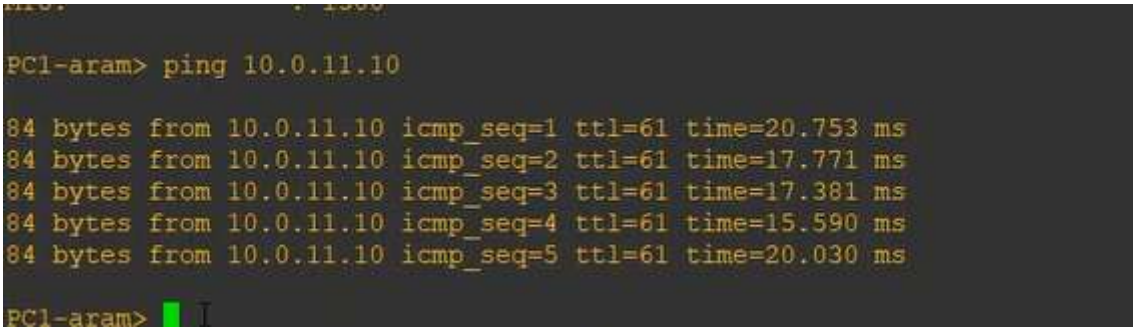

Рис. 17

10. Отключил второй маршрутизатор (Рис. 18).

Рис. 18

11. Проверил метрики протокола RIP (Рис. 19).

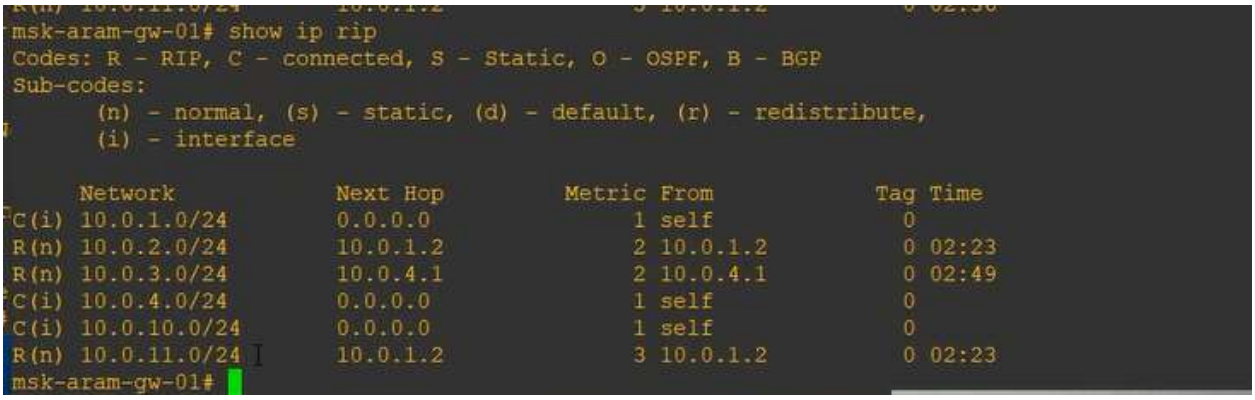

Рис. 19

12. Включил на маршрутизаторе msk-user-gw-02 интерфейс (Рис. 20).

```
[OK]
msk-aram-gw-02# configure terminal
msk-aram-gw-02(config)# interface eth0
msk-aram-gw-02(config-if)# shutdown
msk-aram-gw-02(config-if)# interface eth0
msk-aram-gw-02(config-if)# no shutdown
msk-aram-gw-02(config-if)#
```

Рис. 20

13. На маршрутизаторах настройте RIPng для сетей IPv6 (Рис. 21-24).

```
msk-aram-gw-01# configure terminal
msk-aram-gw-01(config)# router ripng
msk-aram-gw-01(config-router)# network eth0
msk-aram-gw-01(config-router)# network et1
msk-aram-gw-01(config-router)# network eth1
msk-aram-gw-01(config-router)# network eth2
msk-aram-gw-01(config-router)# exit
msk-aram-gw-01(config)# exit
msk-aram-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-aram-gw-01#
```

Рис. 21

```
msk-aram-gw-02(config)# router ripng
msk-aram-gw-02(config-router)# network eth0
msk-aram-gw-02(config-router)# network eth1
msk-aram-gw-02(config-router)# exit
msk-aram-gw-02(config)# exit
msk-aram-gw-02# write memory
Note: this version of vtysh never writes vtysh.conf
```

Рис. 22

```
msk-aram-gw-03# configure terminal
msk-aram-gw-03(config)# router ripng eth0
% Unknown command: router ripng eth0
msk-aram-gw-03(config)# router ripng
msk-aram-gw-03(config-router)# network eth0
msk-aram-gw-03(config-router)# network eth1
msk-aram-gw-03(config-router)# network eth2
msk-aram-gw-03(config-router)# exit
msk-aram-gw-03(config)# exit
msk-aram-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-aram-gw-03#
```

Рис. 23

```
msk-aram-gw-04(config)# router ripng
msk-aram-gw-04(config-router)# network eth0
msk-aram-gw-04(config-router)# network eth1
msk-aram-gw-04(config-router)# exit
msk-aram-gw-04(config)# exit
msk-aram-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-aram-gw-04#
```

Рис. 24

14. Пропинговал PC1 (Рис. 25).

```
PC1-aram> ping 2001:11::a

2001:11::a icmp6_seq=1 ttl=58 time=25.410 ms
2001:11::a icmp6_seq=2 ttl=58 time=12.148 ms
2001:11::a icmp6_seq=3 ttl=58 time=11.351 ms
2001:11::a icmp6_seq=4 ttl=58 time=15.966 ms
2001:11::a icmp6_seq=5 ttl=58 time=15.182 ms

PC1-aram> trace 2001:11::a

trace to 2001:11::a, 64 hops max
 1 2001:10::1    3.417 ms  2.109 ms  4.314 ms
 2 2001:1::2     8.564 ms  7.388 ms  3.214 ms
 3 2001:2::2    11.915 ms  24.706 ms  9.050 ms
 4 2001:11::a    9.566 ms  13.060 ms  13.215 ms
```

Рис. 25

15. Проверил метрики RIPng (Рис. 26).

```
msk-aram-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::eae:c3ff:fe38:0       eth1         2    0  02:47
R(n) 2001:3::/64
                  fe80::eda:aeff:fe66:1       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::eae:c3ff:fe38:0       eth1         3    0  02:47
msk-aram-gw-01#
```

Рис. 26

16. Просмотрел в Wireshark результаты перехвата RIP и RIPng протоколов (Рис. 27).

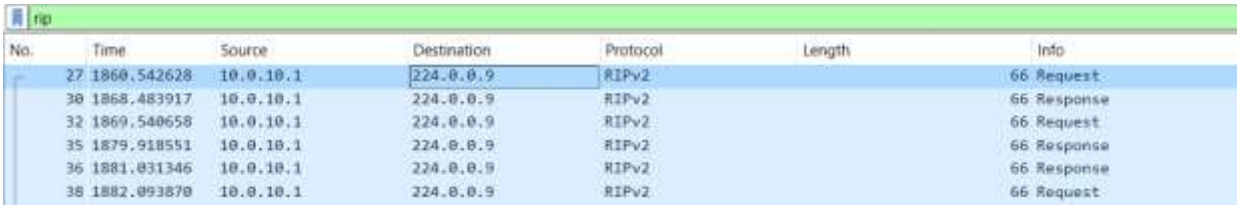

Рис. 27

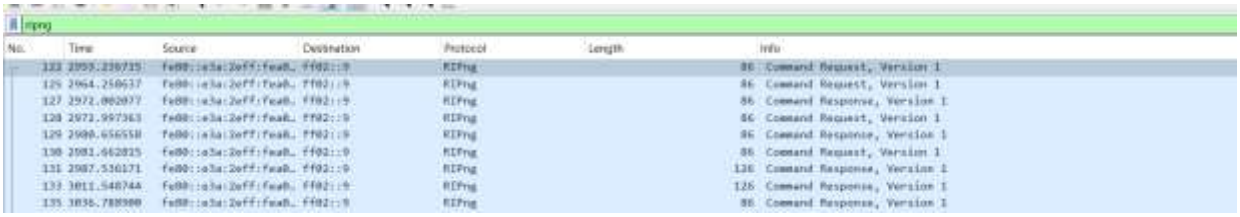

Рис. 28

17. Настроил динамическую маршрутизацию по протоколу OSPF (Рис. 29-32).

```
msk-aram-gw-01# configure terminal
msk-aram-gw-01(config)# router ospf
msk-aram-gw-01(config-router)# network 10.0.10.0/24 area 0.0.0.0
msk-aram-gw-01(config-router)# network 10.0.1.0/24 area 0.0.0.0
msk-aram-gw-01(config-router)# network 10.0.4.0/24 area 0.0.0.0
msk-aram-gw-01(config-router)# exit
msk-aram-gw-01(config)# exit
msk-aram-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-aram-gw-01#
```

Рис. 29

```
msk-aram-gw-02# configure terminal
msk-aram-gw-02(config)# router ospf
msk-aram-gw-02(config-router)# network 10.0.1.0/24 area 0.0.0.0
msk-aram-gw-02(config-router)# network 10.0.2.0/24 area 0.0.0.0
msk-aram-gw-02(config-router)# exit
msk-aram-gw-02(config)# exit
msk-aram-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-aram-gw-02#
```

Рис. 30

```
msk-aram-gw-03(config)# router ospf
ospfd is not running
msk-aram-gw-03(config-router)# network 10.0.11.0/24 area 0.0.0.0
ospfd is not running
msk-aram-gw-03(config-router)# network 10.0.2.0/24 area 0.0.0.0
ospfd is not running
msk-aram-gw-03(config-router)# network 10.0.3.0/24 area 0.0.0.0
ospfd is not running
msk-aram-gw-03(config-router)# exit
ospfd is not running
msk-aram-gw-03(config)#
```

Рис. 31

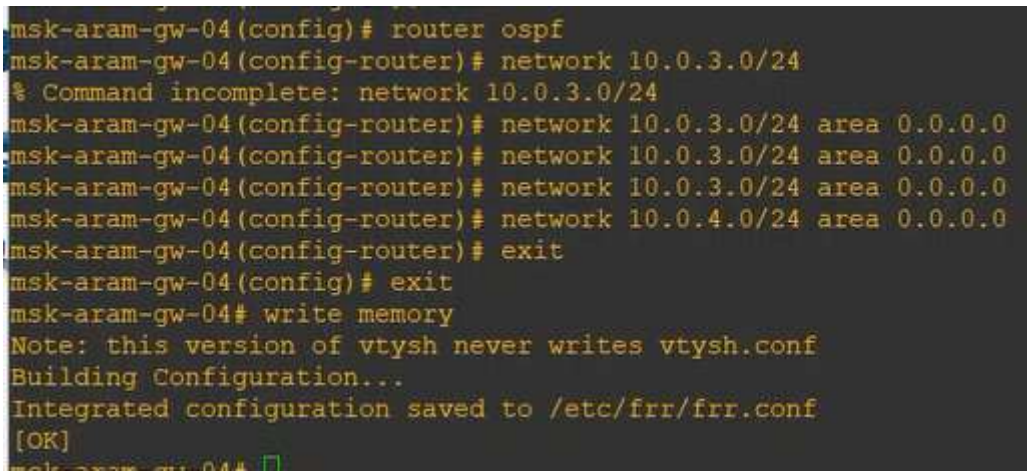

Рис. 32

18. С PC1 пропинговал PC2. Передача через второй маршрутизатор (Рис. 33).

Рис. 33

19. Проверил таблицу маршрутизации протокола OSPFv2 (Рис. 34-35).

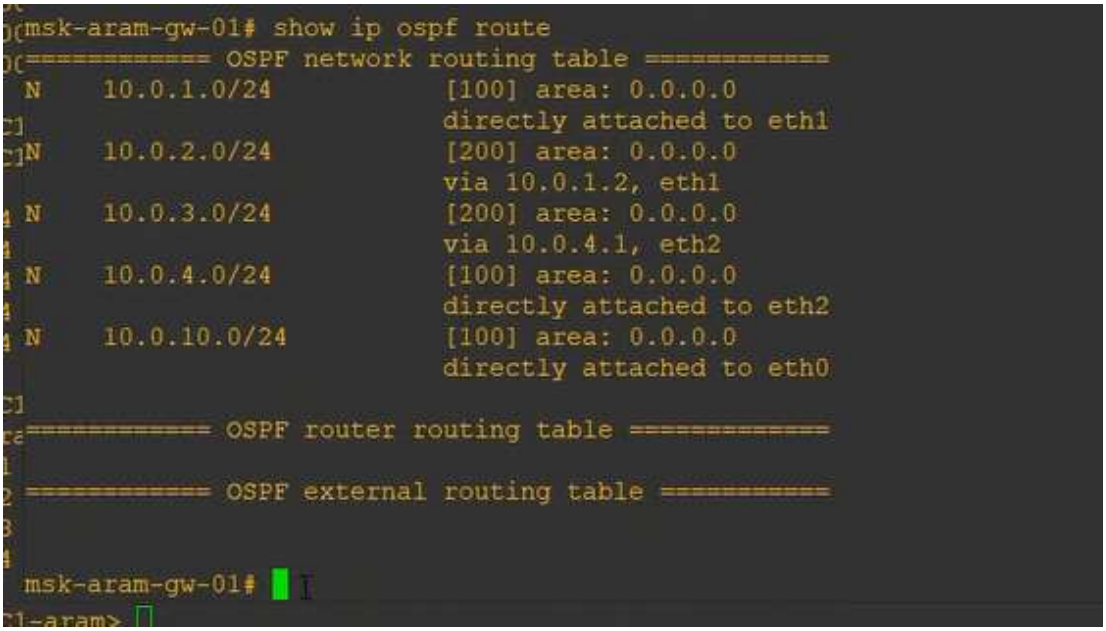

Рис. 34

```
[OK]
msk-aram-gw-01# show ip ospf neighbor

Neighbor ID     Pri State           Dead Time Address         Interface
10.0.2.1          1 Full/Backup       39.872s 10.0.1.2        eth1:10.0.1.1
10.0.4.1          1 Full/Backup       39.589s 10.0.4.1        eth2:10.0.4.2

msk-aram-gw-01# show ip
```

Рис. 35

20. Посмотрел в Wireshark перехваченную информацию по протоколам OSPF. Из них можно извлечь информацию про состояние канала (Рис. 36).

No.	Time	Source	Destination	Protocol	Length	Info
229	3560.050052	10.0.10.1	224.0.0.5	OSPF		78 Hello Packet
232	3570.046466	10.0.10.1	224.0.0.5	OSPF		78 Hello Packet
234	3580.050873	10.0.10.1	224.0.0.5	OSPF		78 Hello Packet
236	3590.052266	10.0.10.1	224.0.0.5	OSPF		78 Hello Packet

Рис. 36

21. На маршрутизаторах настройте OSPFv3 для сетей IPv6 (Рис. 37-40).

```
msk-aram-gw-01# configure terminal
msk-aram-gw-01(config)# router ospf6
msk-aram-gw-01(config-ospf6)# ospf6 router-id 1.1.1.1
msk-aram-gw-01(config-ospf6)# exit
msk-aram-gw-01(config)#
msk-aram-gw-01(config)# interface eth0
msk-aram-gw-01(config-if)# ipv6 pspf6 area 0
% Unknown command: ipv6 pspf6 area 0
msk-aram-gw-01(config-if)# exit
msk-aram-gw-01(config)#
msk-aram-gw-01(config)# interface eth1
msk-aram-gw-01(config-if)# ipv6 ospf6 area 0
msk-aram-gw-01(config-if)# exit
msk-aram-gw-01(config)#
msk-aram-gw-01(config)# interface eth2
msk-aram-gw-01(config-if)# ipv6 ospf6 area 0
msk-aram-gw-01(config-if)# exit
msk-aram-gw-01(config)# exit write memory
% Unknown command: exit write memory
msk-aram-gw-01(config)#
```

Рис. 37

```
msk-aram-gw-02# configure terminal
msk-aram-gw-02(config)# router ospf6
msk-aram-gw-02(config-ospf6)# ospf6 router-id 2.2.2.2
msk-aram-gw-02(config-ospf6)# exit
msk-aram-gw-02(config)#
msk-aram-gw-02(config)# interface eth0
msk-aram-gw-02(config-if)# ipv6 ospf6 area 0
msk-aram-gw-02(config-if)# exit
msk-aram-gw-02(config)# write memory
% Unknown command: write memory
msk-aram-gw-02(config)# interface eth1
msk-aram-gw-02(config-if)# ipv6 ospf6 area 0
msk-aram-gw-02(config-if)# exit
msk-aram-gw-02(config)# exit
msk-aram-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-aram-gw-02#
```

Рис. 38

```
msk-aram-gw-03# configure terminal
msk-aram-gw-03(config)# router ospf
ospfd is not running
msk-aram-gw-03(config-router)# router ospf
ospfd is not running
ospfd is not running
msk-aram-gw-03(config-router)# exit
ospfd is not running
msk-aram-gw-03(config)# router ospf6
msk-aram-gw-03(config-ospf6)# ospf6 router-id 3.3.3.3
msk-aram-gw-03(config-ospf6)# exit
msk-aram-gw-03(config)#
msk-aram-gw-03(config)# interface eth0
msk-aram-gw-03(config-if)# ipv6 ospf6 area 0
msk-aram-gw-03(config-if)# exit
msk-aram-gw-03(config)#
msk-aram-gw-03(config)# interface eth1
msk-aram-gw-03(config-if)# ipv6 ospf6 area 0
msk-aram-gw-03(config-if)# exit
msk-aram-gw-03(config)#
msk-aram-gw-03(config)# interface eth2
msk-aram-gw-03(config-if)# ipv6 ospf6 area 0
msk-aram-gw-03(config-if)# exit
msk-aram-gw-03(config)# exit
msk-aram-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-aram-gw-03#
```

Рис. 39

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

Рис. 40

22. Отключил маршрутизатор №4 (Рис. 41).

```
[OK]
msk-aram-gw-04# configure terminal
msk-aram-gw-04(config)# interface eth0
msk-aram-gw-04(config-if)# shutdown
msk-aram-gw-04(config-if)#
```

Рис. 41

23. Проверил таблицу маршрутизации. Eth0 отключен.

```
msk-aram-gw-01# show ipv6 ospf6 route
*N IA 2001:1::/64                    ::                        eth1 00:07:24
*N IA 2001:2::/64                    fe80::eae:c3ff:fe38:0     eth1 00:04:30
*N IA 2001:3::/64                    fe80::eae:c3ff:fe38:0     eth1 00:00:16
*N IA 2001:4::/64                    ::                        eth2 00:01:22
*N IA 2001:11::/64                   fe80::eae:c3ff:fe38:0     eth1 00:00:16
msk-aram-gw-01#
```

Рис. 42

24. Пропинговали соединение. Пакет идёт через второй маршрутизатор (Рис. 43).

```
PC1-aram> ping 2001:11::a

2001:11::a icmp6_seq=1 ttl=58 time=15.231 ms
2001:11::a icmp6_seq=2 ttl=58 time=22.679 ms
2001:11::a icmp6_seq=3 ttl=58 time=11.038 ms
2001:11::a icmp6_seq=4 ttl=58 time=16.576 ms
2001:11::a icmp6_seq=5 ttl=58 time=11.318 ms

PC1-aram> trace 2001:11::a

trace to 2001:11::a, 64 hops max
 1 2001:10::1   2.457 ms  1.406 ms  2.148 ms
 2 2001:4::1   7.887 ms  8.830 ms  3.260 ms
 3 2001:3::1   8.326 ms  13.872 ms  11.747 ms
 4 2001:11::a   10.165 ms  4.436 ms  8.889 ms

PC1-aram>
```

Рис. 43

25. Создал новый проект в GNS3. Реализовал необходимую топологию для создания туннеля IPv4-IPv6 (Рис. 44).

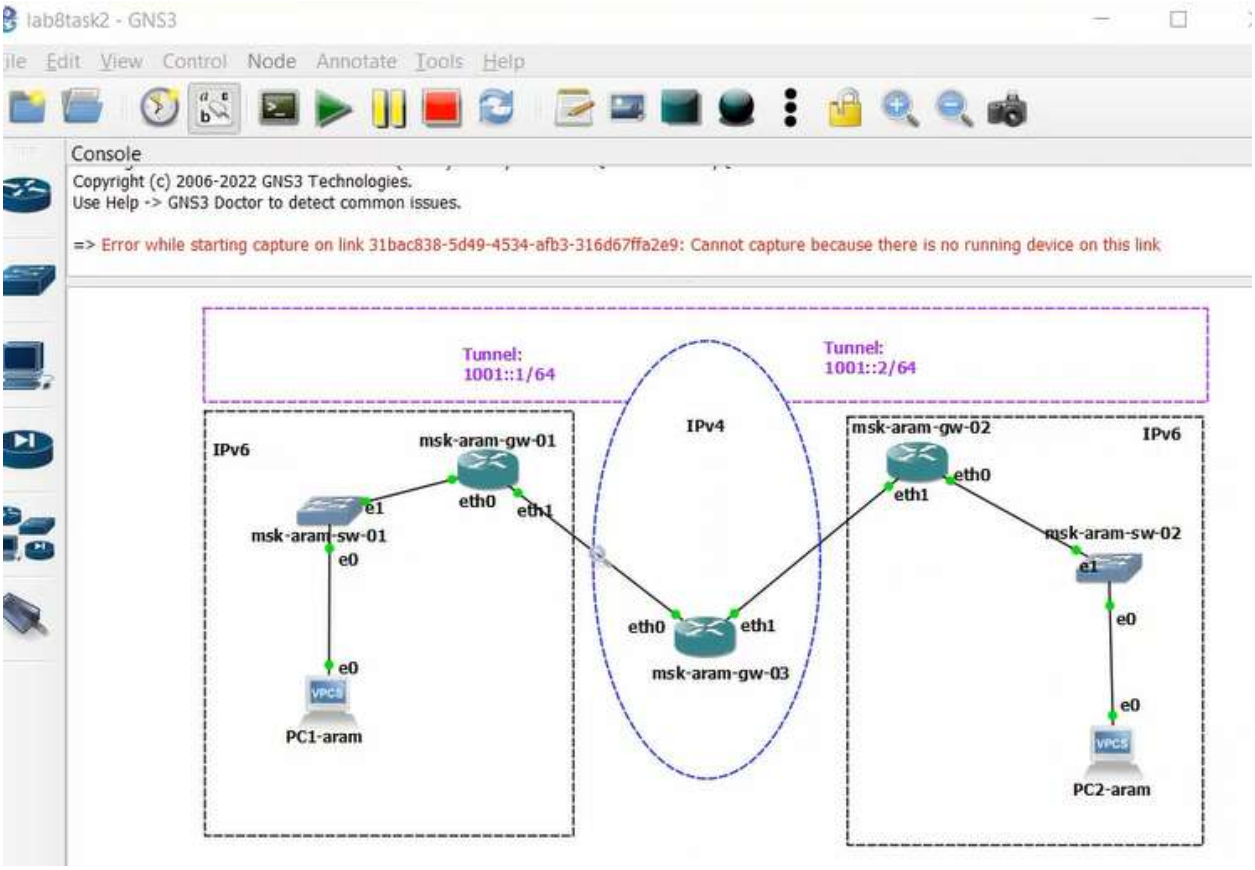

Рис. 44

26. Присвоил адреса оконечным устройствам PC1 и PC2 (Рис. 45-46).

```
PC1 : 1000::a/64

PC1-aram>
PC1-aram>  show ipv6

NAME              : PC1-aram[1]
LINK-LOCAL SCOPE  : fe80::250:79ff:fe66:6800/64
GLOBAL SCOPE      : 1000::a/64
DNS               :
ROUTER LINK-LAYER :
MAC               : 00:50:79:66:68:00
LPORT             : 20030
RHOST:PORT        : 127.0.0.1:20031
MTU:              : 1500

PC1-aram>
```

Рис. 45

```
PC2-aram> show ipv6

NAME                : PC2-aram[1]
LINK-LOCAL SCOPE    : fe80::250:79ff:fe66:6801/64
GLOBAL SCOPE        : 1002::a/64
DNS                 :
ROUTER LINK-LAYER   :
MAC                 : 00:50:79:66:68:01
LPORT               : 20032
RHOST:PORT          : 127.0.0.1:20033
MTU:                : 1500

PC2-aram>
```

Рис. 46

27. Установил систему на маршрутизаторы VyOS и перезагрузил их (Рис. 47-49).

```
msk-aram-gw-01
[   70.631448] systemd[1]: Starting Create System Users...
[   71.062153] systemd[1]: Started VyOS DNS configuration
[   72.929015] systemd[1]: Started Load/Save Random Seed.

Welcome to VyOS - vyos ttyS0

vyos login: vyos
Password:
Linux vyos 5.4.156-amd64-vyos #1 SMP Thu Oct 28 18:19:14 U
Welcome to VyOS!

Check out project news at https://blog.vyos.io
and feel free to report bugs at https://phabricator.vyos.n

Visit https://support.vyos.io to create a support ticket.

You can change this banner using "set system login banner

VyOS is a free software distribution that includes multipl
you can check individual component licenses under /usr/sha
Use of this pre-built image is governed by the EULA you ca
/usr/share/vyos/EULA
vyos@vyos:~$ install image
Welcome to the VyOS install program. This script
will walk you through the process of installing the
VyOS image to a local hard drive.
Would you like to continue? (Yes/No) [Yes]: Yes
```

Рис. 47

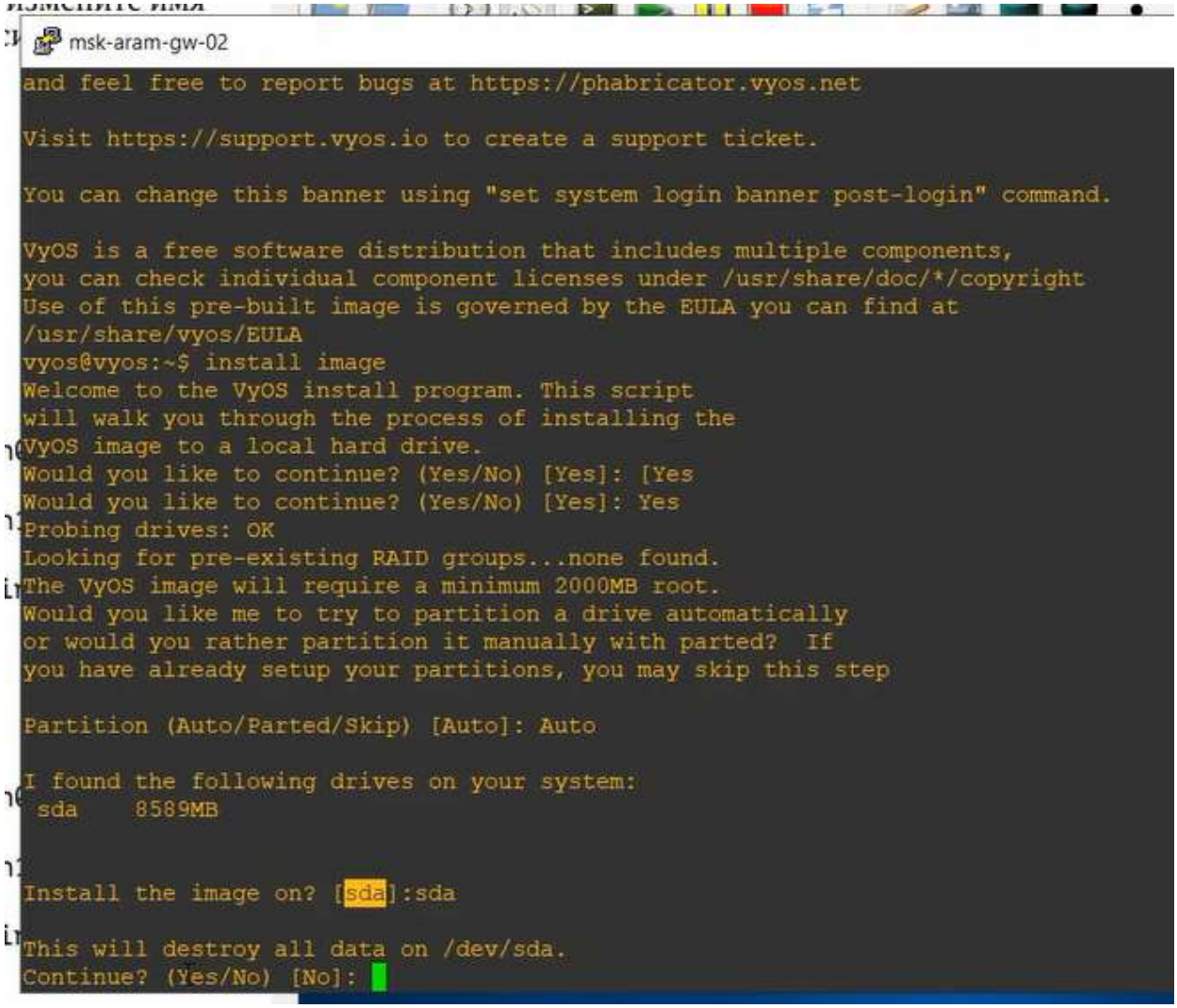
msk-aram-gw-02
and feel free to report bugs at https://phabricator.vyos.net
Visit https://support.vyos.io to create a support ticket.
You can change this banner using "set system login banner post-login" command.
VyOS is a free software distribution that includes multiple components,
you can check individual component licenses under /usr/share/doc/*/copyright
Use of this pre-built image is governed by the EULA you can find at
/usr/share/vyos/EULA
vyos@vyos:~$ install image
Welcome to the VyOS install program. This script
will walk you through the process of installing the
VyOS image to a local hard drive.
Would you like to continue? (Yes/No) [Yes]: [Yes
Would you like to continue? (Yes/No) [Yes]: Yes
Probing drives: OK
Looking for pre-existing RAID groups...none found.
The VyOS image will require a minimum 2000MB root.
Would you like me to try to partition a drive automatically
or would you rather partition it manually with parted? If
you have already setup your partitions, you may skip this step
Partition (Auto/Parted/Skip) [Auto]: Auto
I found the following drives on your system:
sda 8589MB
Install the image on? [sda]:sda
This will destroy all data on /dev/sda.
Continue? (Yes/No) [No]:

Рис. 48

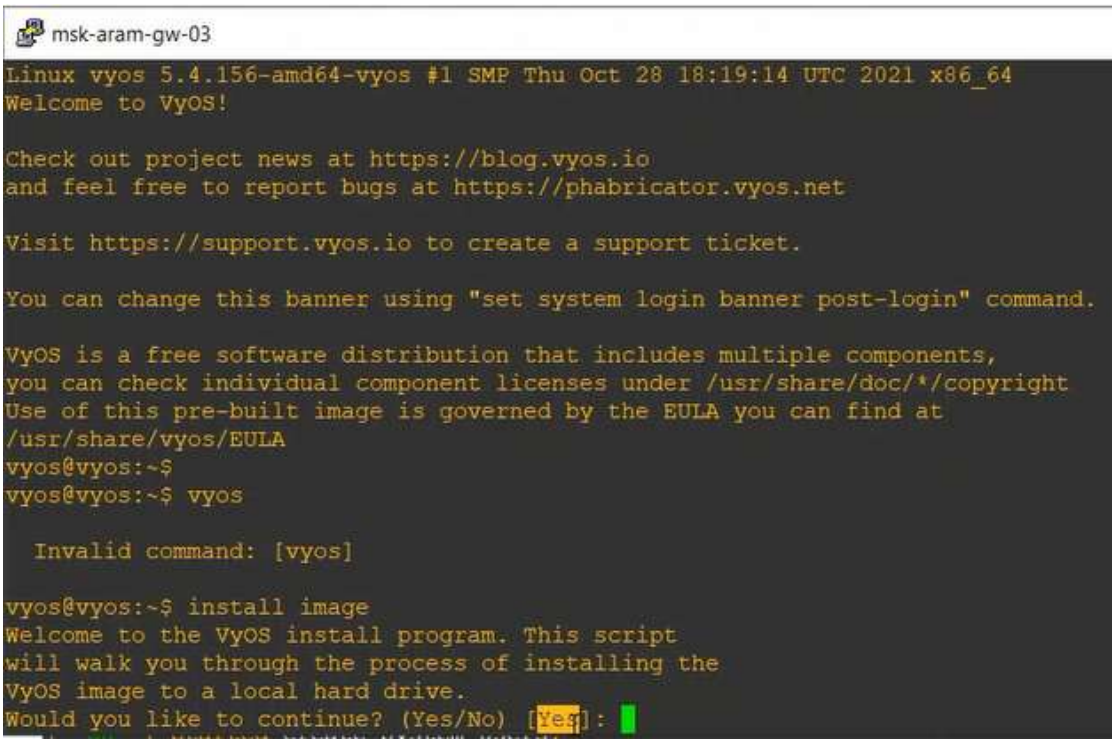
msk-aram-gw-03
Linux vyos 5.4.156-amd64-vyos #1 SMP Thu Oct 28 18:19:14 UTC 2021 x86_64
Welcome to VyOS!
Check out project news at https://blog.vyos.io
and feel free to report bugs at https://phabricator.vyos.net
Visit https://support.vyos.io to create a support ticket.
You can change this banner using "set system login banner post-login" command.
VyOS is a free software distribution that includes multiple components,
you can check individual component licenses under /usr/share/doc/*/copyright
Use of this pre-built image is governed by the EULA you can find at
/usr/share/vyos/EULA
vyos@vyos:~$
vyos@vyos:~$ vyos
Invalid command: [vyos]
vyos@vyos:~$ install image
Welcome to the VyOS install program. This script
will walk you through the process of installing the
VyOS image to a local hard drive.
Would you like to continue? (Yes/No) [Yes]:

Рис. 49

28. Изменил имена устройств маршрутизаторов (Рис. 50-52).

```
vyos@vyos# set system host-name msk-aram-gw-01
[edit]
vyos@vyos# compare
[edit system]
>host-name msk-aram-gw-01
[edit]
vyos@vyos# commit
[edit]
vyos@vyos# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@vyos# exit
exit
vyos@vyos:~$ reboot
```

Рис. 50

```
vyos@vyos# set system host-name msk-aram-gw-02
[edit]
vyos@vyos# compare
[edit system]
>host-name msk-aram-gw-02
[edit]
vyos@vyos# commit
[edit]
vyos@vyos# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@vyos# exit
exit
vyos@vyos:~$ reboot
```

Рис. 51

```
vyos@vyos:~$ configure
[edit]
vyos@vyos# set system host-name msk-aram-gw-03
[edit]
vyos@vyos# compare
[edit system]
>host-name msk-aram-gw-03
[edit]
vyos@vyos# commit
[edit]
vyos@vyos# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@vyos# exit
exit
vyos@vyos:~$ reboot
```

Рис. 52

29. Настроил адреса на интерфейсах маршрутизаторов. (Рис. 53-55).

```
/usr/share/vyos/EULA
vyos@msk-aram-gw-01:~$ configure
[edit]
vyos@msk-aram-gw-01# set interfaces ethernet eth0 address 1000::1/64
[edit]
vyos@msk-aram-gw-01# set interfaces ethernet eth1 address 10.0.0.1/8
[edit]
vyos@msk-aram-gw-01# set service router-advert interface eth0 prefix 1000::/64
[edit]
vyos@msk-aram-gw-01# commit
[edit]
vyos@msk-aram-gw-01# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@msk-aram-gw-01#
```

Рис. 53

```
vyos@msk-aram-gw-02:~$ configure
[edit]
vyos@msk-aram-gw-02# set interfaces ethernet eth0 address 10.0.0.2/8
[edit]
vyos@msk-aram-gw-02# set interfaces ethernet eth0 address 1002::1/64
[edit]
vyos@msk-aram-gw-02# set interfaces ethernet eth1 address 20.0.0.2/8
[edit]
vyos@msk-aram-gw-02# set servicw router-advert interface eth0 prefix 1002::/64

  Configuration path: [servicw] is not valid
  Set failed

[edit]
vyos@msk-aram-gw-02# set service router-advert interface eth0 prefix 1002::/64
[edit]
vyos@msk-aram-gw-02# commit
[edit]
vyos@msk-aram-gw-02# save
```

Рис. 54

```
/usr/share/vyos/EULA
vyos@msk-aram-gw-03:~$ configure
[edit]
vyos@msk-aram-gw-03# set interfaces ethernet eth0 address 10.0.0.2/8
[edit]
vyos@msk-aram-gw-03# set interfaces ethernet eth1 address 20.0.0.1/8
[edit]
vyos@msk-aram-gw-03# commit
[edit]
vyos@msk-aram-gw-03# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@msk-aram-gw-03#
```

Рис. 55

30. Проверил маршруты с первого маршрутизатора (Рис. 56).

```
vyos@msk-aram-gw-01# ping 10.0.0.2
PING 10.0.0.2 (10.0.0.2) 56(84) bytes of data.
64 bytes from 10.0.0.2: icmp_seq=1 ttl=64 time=15.1 ms
64 bytes from 10.0.0.2: icmp_seq=2 ttl=64 time=2.98 ms
64 bytes from 10.0.0.2: icmp_seq=3 ttl=64 time=3.50 ms
64 bytes from 10.0.0.2: icmp_seq=4 ttl=64 time=2.03 ms
```

Рис. 56

31. Настроил маршрутизацию IPv4 (Рис. 57-59).

```
vyos@msk-aram-gw-01# set protocols rip network 10.0.0.0/8
[edit]
vyos@msk-aram-gw-01# commit
[edit]
vyos@msk-aram-gw-01# save
```

Рис. 57

```
vyos@msk-aram-gw-02# set protocols rip network 20.0.0.0/8
[edit]
vyos@msk-aram-gw-02# commit
[edit]
vyos@msk-aram-gw-02# save
```

Рис. 58

```
[edit]
vyos@msk-aram-gw-03# set protocols rip network 10.0.0.0/8
[edit]
vyos@msk-aram-gw-03# set protocols rip network 20.0.0.0/8
[edit]
vyos@msk-aram-gw-03# commit
[edit]
vyos@msk-aram-gw-03# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@msk-aram-gw-03#
```

Рис. 59

32. Проверил маршруты. Всё начало работать (Рис. 60).

```
64 bytes from 10.0.0.2: icmp_seq=7 ttl=64 time=2.10 ms
64 bytes from 10.0.0.2: icmp_seq=8 ttl=64 time=4.33 ms
^C
--- 10.0.0.2 ping statistics ---
8 packets transmitted, 8 received, 0% packet loss, time 21ms
rtt min/avg/max/mdev = 2.101/4.500/8.726/1.954 ms
vyos@msk-aram-gw-01:~$ ping 20.0.0.1
PING 20.0.0.1 (20.0.0.1) 56(84) bytes of data.
64 bytes from 20.0.0.1: icmp_seq=1 ttl=64 time=6.33 ms
64 bytes from 20.0.0.1: icmp_seq=2 ttl=64 time=3.13 ms
64 bytes from 20.0.0.1: icmp_seq=3 ttl=64 time=3.92 ms
64 bytes from 20.0.0.1: icmp_seq=4 ttl=64 time=2.75 ms
64 bytes from 20.0.0.1: icmp_seq=5 ttl=64 time=5.99 ms
64 bytes from 20.0.0.1: icmp_seq=6 ttl=64 time=4.44 ms
64 bytes from 20.0.0.1: icmp_seq=7 ttl=64 time=4.16 ms
64 bytes from 20.0.0.1: icmp_seq=8 ttl=64 time=3.28 ms
64 bytes from 20.0.0.1: icmp_seq=9 ttl=64 time=2.86 ms
64 bytes from 20.0.0.1: icmp_seq=10 ttl=64 time=3.80 ms
64 bytes from 20.0.0.1: icmp_seq=11 ttl=64 time=4.73 ms
64 bytes from 20.0.0.1: icmp_seq=12 ttl=64 time=3.65 ms
64 bytes from 20.0.0.1: icmp_seq=13 ttl=64 time=7.66 ms
^C
--- 20.0.0.1 ping statistics ---
13 packets transmitted, 13 received, 0% packet loss, time 51ms
rtt min/avg/max/mdev = 2.750/4.361/7.660/1.418 ms
vyos@msk-aram-gw-01:~$ ping 20.0.0.2 -C2

  Invalid command: /usr/libexec/vyos/op_mode/ping.py 20.0.0.2 -C2 [-C2]

<nocomps>vyos@msk-aram-gw-01:~$  ping 20.0.0.2
PING 20.0.0.2 (20.0.0.2) 56(84) bytes of data.
 ^C
--- 20.0.0.2 ping statistics ---
17 packets transmitted, 0 received, 100% packet loss, time 396ms

vyos@msk-aram-gw-01:~$
```

Рис. 60

33. Создал туннель IPv6 через сеть IPv4 (Рис. 61-63).

```
vyos@msk-aram-gw-01:~$ set interfaces tunnel tun0 encapsulation sit

  Invalid command: set [interfaces]

vyos@msk-aram-gw-01:~$ configure
[edit]
vyos@msk-aram-gw-01# set interfaces tunnel tun0 encapsulation sit
[edit]
vyos@msk-aram-gw-01# set interfaces tunnel tun0 source address 10.0.0.1

  Configuration path: interfaces tunnel tun0 [source] is ambiguous

  Possible completions:
  source-address
                Source IP address used to initiate connection
  source-interface
                Interface used to establish connection

  Set failed

[edit]
vyos@msk-aram-gw-01# set interfaces tunnel tun0 source-address 10.0.0.1
[edit]
vyos@msk-aram-gw-01# set interfaces tunnel tun0 remote 20.0.0.2
[edit]
vyos@msk-aram-gw-01# commit
[edit]
vyos@msk-aram-gw-01# save
```

Рис. 61

```
[edit]
vyos@msk-aram-gw-02# set interfaces tunnel tun0
^C
[edit]
vyos@msk-aram-gw-02# set interfaces tunnel tun0 encapsulation sit
[edit]
vyos@msk-aram-gw-02#  set interfaces tunnel tun0 source-address 20.0.0.2
[edit]
vyos@msk-aram-gw-02# set interfaces tunnel tun0 remote 10.0.0.1
[edit]
vyos@msk-aram-gw-02# set interfaces tunnel tun0 address 1001::2/64
[edit]
vyos@msk-aram-gw-02# commit
```

Рис. 62

34. Настроил статическую маршрутизацию IPv6 (Рис. 63-64).

```
[edit]
vyos@msk-aram-gw-01# set protocols static route6 1002::0/64 next-hop 1001::2
[edit]
vyos@msk-aram-gw-01# commit
[edit]
vyos@msk-aram-gw-01# save
```

Рис. 63

```
[edit]
vyos@msk-aram-gw-02# set protocols static route6 1000::0/64 next-hop 1001::1
[edit]
vyos@msk-aram-gw-02# commit
[edit]
vyos@msk-aram-gw-02# save
```

Рис. 64

35. Проверил доступность оконечных устройств (Рис. 65).

PC1-aram

```
PC1-aram> ping 1002::a

1002::a icmp6_seq=1 timeout
1002::a icmp6_seq=2 timeout
1002::a icmp6_seq=3 timeout
1002::a icmp6_seq=4 timeout
1002::a icmp6_seq=5 timeout

PC1-aram> trace 1002::a

trace to 1002::a, 64 hops max
 1 1000::1   8.612 ms  6.853 ms  1.287 ms
 2   *  *  *
 3   *  *  *
 4   *  *  *
 5   *  *  *
 6   *  *  *
 7   *  *  *
 8   *  *  *
 9   *  *  *
10   *  *  *
^C11   *

PC1-aram>
```

PC2-aram

```
For more information, please visit wiki.freecode.com.cn.

Press '?' to get help.

Executing the startup file


PC1 : 1002::a/64

PC2-aram>
PC2-aram> ping 1000::a

1000::a icmp6_seq=1 timeout
1000::a icmp6_seq=2 timeout
1000::a icmp6_seq=3 timeout
1000::a icmp6_seq=4 timeout
1000::a icmp6_seq=5 timeout

PC2-aram> trace 1000::a

trace to 1000::a, 64 hops max
 1 1002::1   4.305 ms  7.077 ms  1.415 ms
 2   *  *  *
```

Рис. 65

36. Просмотрел информацию по захваченным пакетам (Рис. 66).

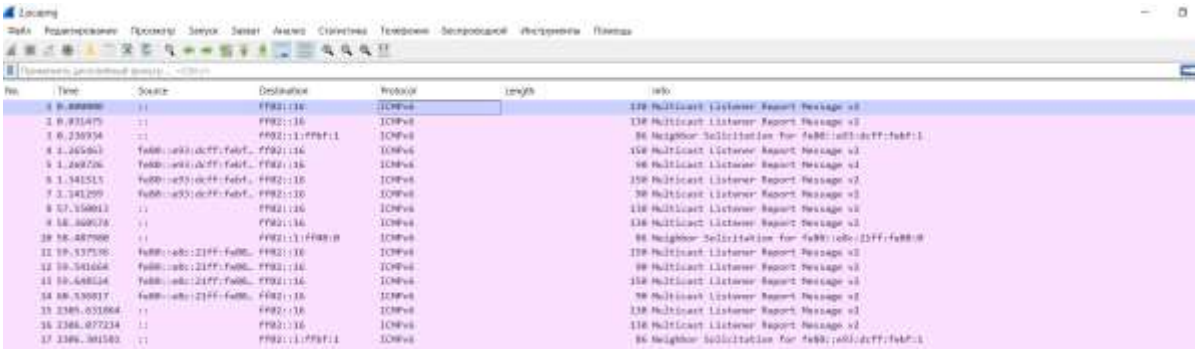

Рис. 66

37. Начал самостоятельную работу, реализовал топологию сети (Рис. 67).

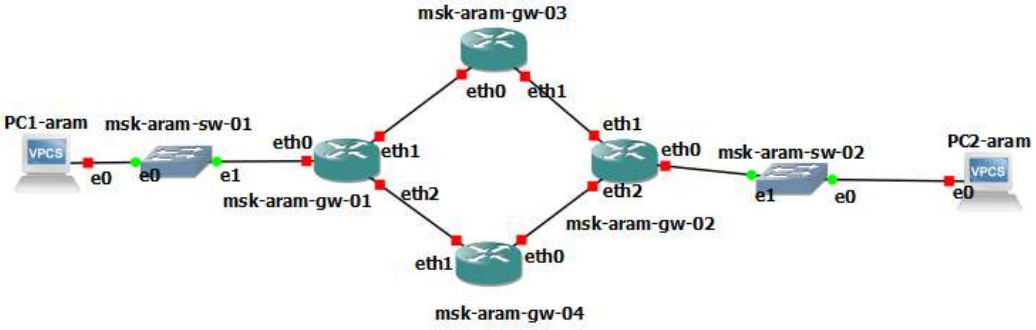

Рис. 67

38. Заполнил таблицу адресации (Таблица 3).

Устройство	**Интерфейс**	**Адрес IP/префикс**	**Шлюз по умолчанию**	**Следующее устройство**
gw-01	eth0	10.10.1.97/27	n/a	PC1
gw-01	eth0	2001:DB8:1:1::1/64	n/a	PC1
gw-01	eth1	10.10.1.5/27	n/a	gw-03
gw-01	eth1	2001:DB8:1:2::1/64	n/a	gw-03
gw-01	eth2	10.10.1.10/30	n/a	gw-04
gw-01	eth2	2001:DB8:1:3::2/64	n/a	gw-04
gw-02	eth0	10.10.1.65/28	n/a	PC2
gw-02	eth0	2001:DB8:1:6::1/64	n/a	PC2
gw-02	eth1	10.10.1.18/30	n/a	gw-03
gw-02	eth1	2001:DB8:1:4::2/64	n/a	gw-03
gw-02	eth2	10.10.1.33/30	n/a	gw-04
gw-02	eth2	2001:DB8:1:5::1/64	n/a	gw-04
gw-03	eth0	10.10.1.6/30	n/a	gw-01
gw-03	eth0	2001:DB8:1:2::2/64	n/a	gw-01
gw-03	eth1	10.10.1.17/30	n/a	gw-02
gw-03	eth1	2001:DB8:1:4::1/64	n/a	gw-02
gw-04	eth0	10.10.1.9/30	n/a	gw-01
gw-04	eth0	2001:DB8:1::3::1/64	n/a	gw-01
gw-04	eth1	10.10.1.34/30	n/a	gw-02
gw-04	eth1	2001:DB8::5::2/64	n/a	gw-02
PC1	NIC	10.10.1.106/27	10.10.1.97	gw-01
PC1	NIC	2001:DB8:1:1::a/64	n/a	gw-01
PC2	NIC	10.10.1.74/28	10.10.1.65	gw-02
PC2	NIC	2001:DB8:1:6::a/64	n/a	gw-02

Таблица 3

39. Настроил адреса оконечных устройств (Рис. 68).

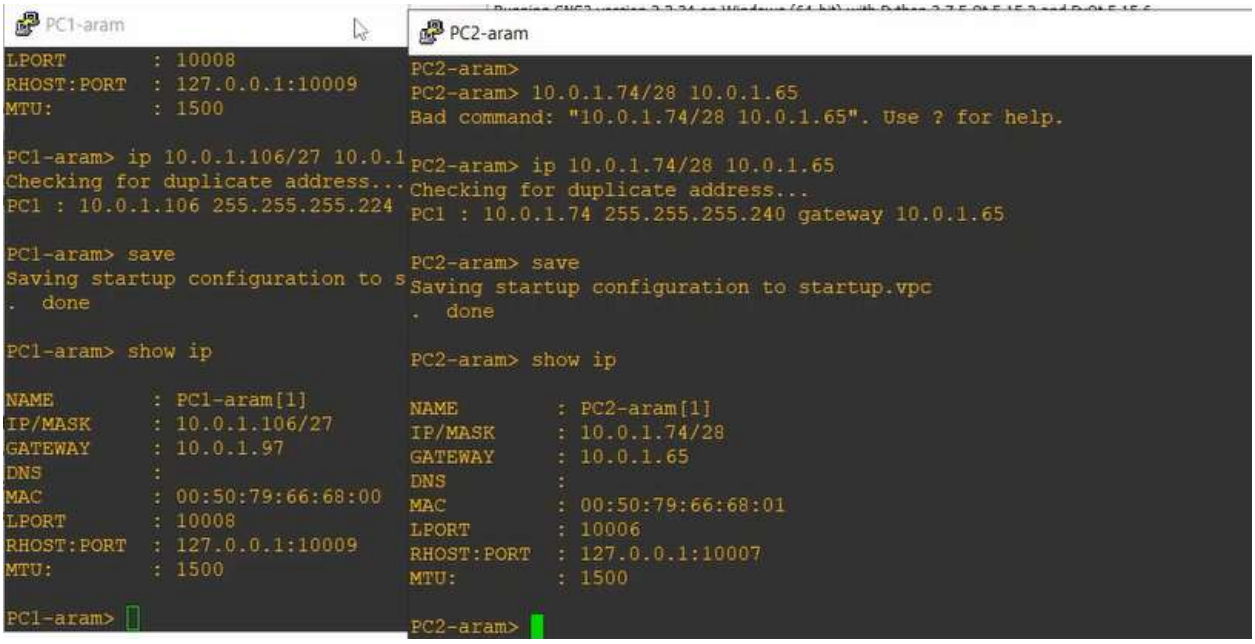

Рис. 68

40. Задал имена маршрутизаторам и настроил адреса (Рис. 69-72).

Рис. 69

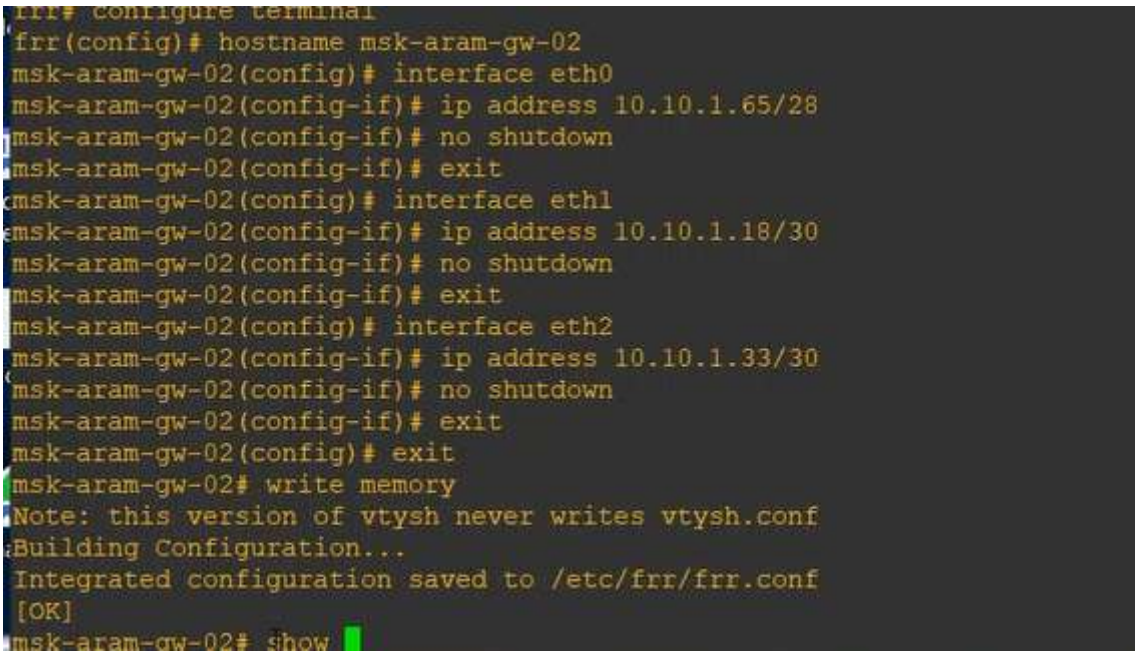

Рис. 70

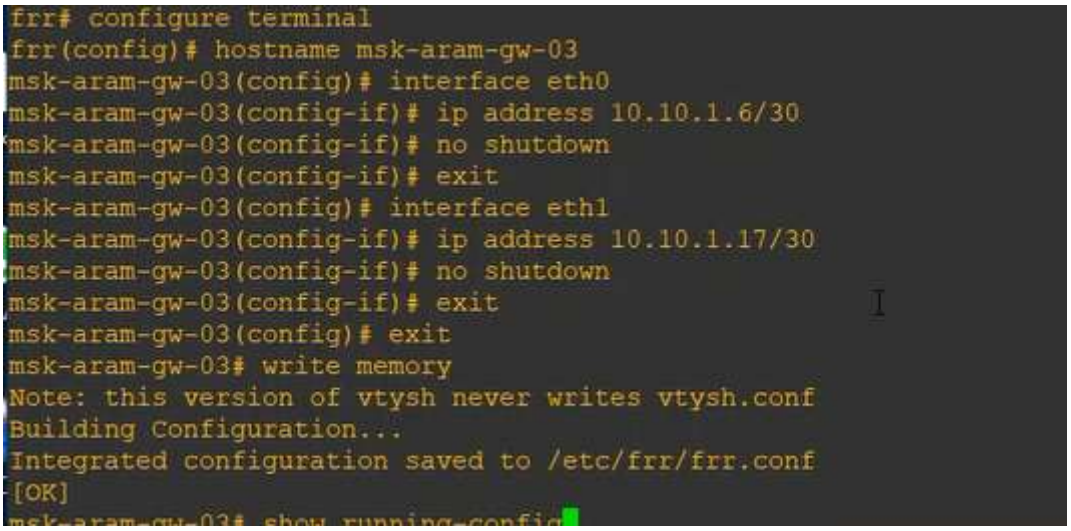

Рис. 71

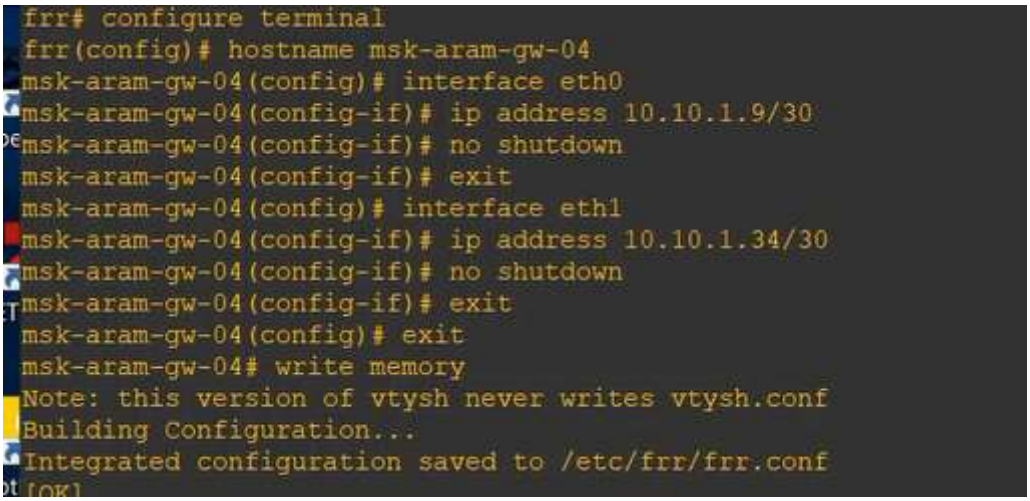

Рис. 72

41. Настроил оконечным устройствам IPv6 адреса (Рис. 73).

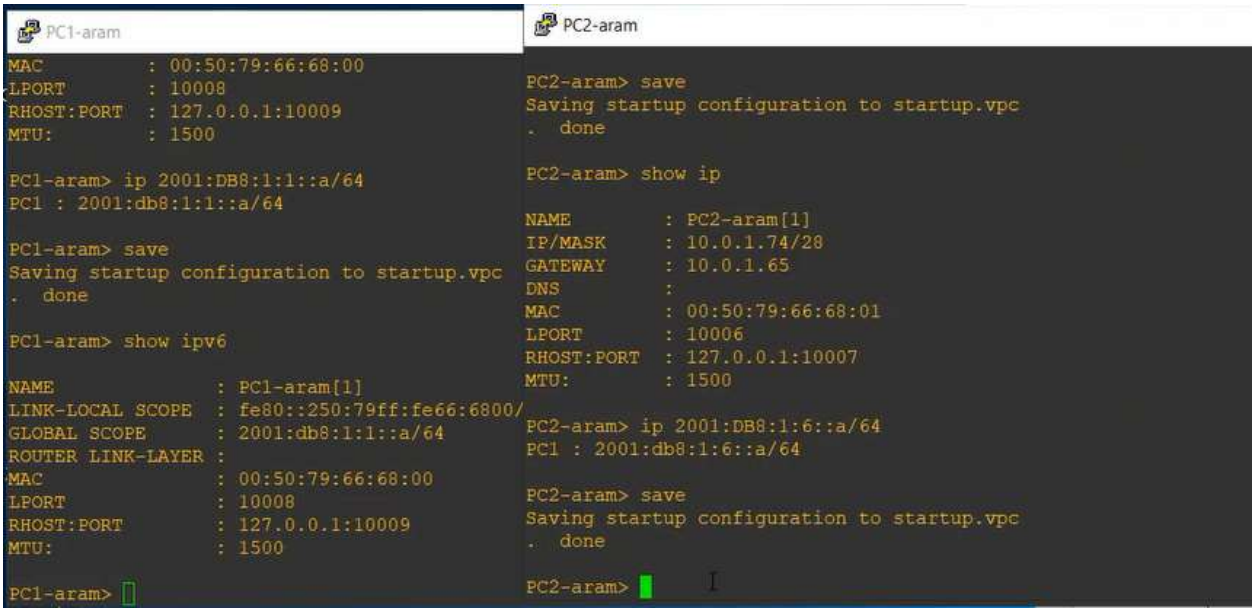

Рис. 73

42. Настроил IPv6 адресацию маршрутизаторов (Рис. 74-77).

```
msk-aram-gw-01# configure terminal
msk-aram-gw-01(config)# ipv6 forwarding
msk-aram-gw-01(config)# interface eth0
msk-aram-gw-01(config-if)# ipv6 address 2001:DB8:1:1::1/64
msk-aram-gw-01(config-if)# no ipv6 nd suppress-ra
msk-aram-gw-01(config-if)# ipv6 nd prefix 2001:DB8:1:1::1/6
msk-aram-gw-01(config-if)# ipv6 nd prefix 2001:DB8:1:1::1/64
msk-aram-gw-01(config-if)# no shutdown
msk-aram-gw-01(config-if)# exit
msk-aram-gw-01(config)# interface eth1
msk-aram-gw-01(config-if)# ipv6 address 2001:DB8:1:2::1/64
msk-aram-gw-01(config-if)# no shutdown
msk-aram-gw-01(config-if)# exit
msk-aram-gw-01(config)# interface eth2
msk-aram-gw-01(config-if)# ipv6 address 2001:DB8:1:3::2/64
msk-aram-gw-01(config-if)# no shutdown
msk-aram-gw-01(config-if)# exit
msk-aram-gw-01(config)# exit
msk-aram-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-aram-gw-01#
```

Рис. 74

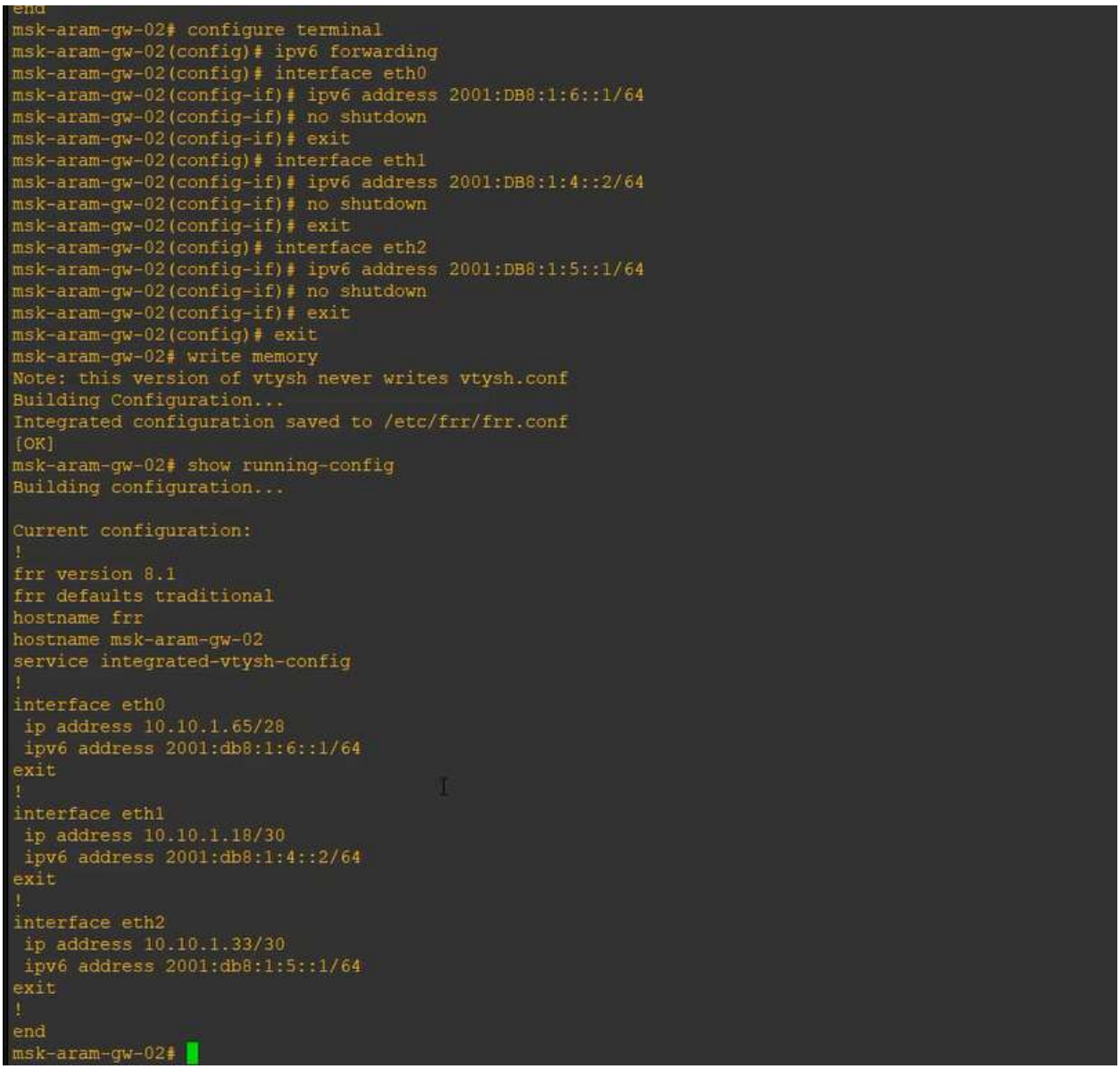
end
msk-aram-gw-02# configure terminal
msk-aram-gw-02(config)# ipv6 forwarding
msk-aram-gw-02(config)# interface eth0
msk-aram-gw-02(config-if)# ipv6 address 2001:DB8:1:6::1/64
msk-aram-gw-02(config-if)# no shutdown
msk-aram-gw-02(config-if)# exit
msk-aram-gw-02(config)# interface eth1
msk-aram-gw-02(config-if)# ipv6 address 2001:DB8:1:4::2/64
msk-aram-gw-02(config-if)# no shutdown
msk-aram-gw-02(config-if)# exit
msk-aram-gw-02(config)# interface eth2
msk-aram-gw-02(config-if)# ipv6 address 2001:DB8:1:5::1/64
msk-aram-gw-02(config-if)# no shutdown
msk-aram-gw-02(config-if)# exit
msk-aram-gw-02(config)# exit
msk-aram-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-aram-gw-02# show running-config
Building configuration...
Current configuration:
!
frr version 8.1
frr defaults traditional
hostname frr
hostname msk-aram-gw-02
service integrated-vtysh-config
!
interface eth0
 ip address 10.10.1.65/28
 ipv6 address 2001:db8:1:6::1/64
exit
!
interface eth1
 ip address 10.10.1.18/30
 ipv6 address 2001:db8:1:4::2/64
exit
!
interface eth2
 ip address 10.10.1.33/30
 ipv6 address 2001:db8:1:5::1/64
exit
!
end
msk-aram-gw-02#

Рис. 75

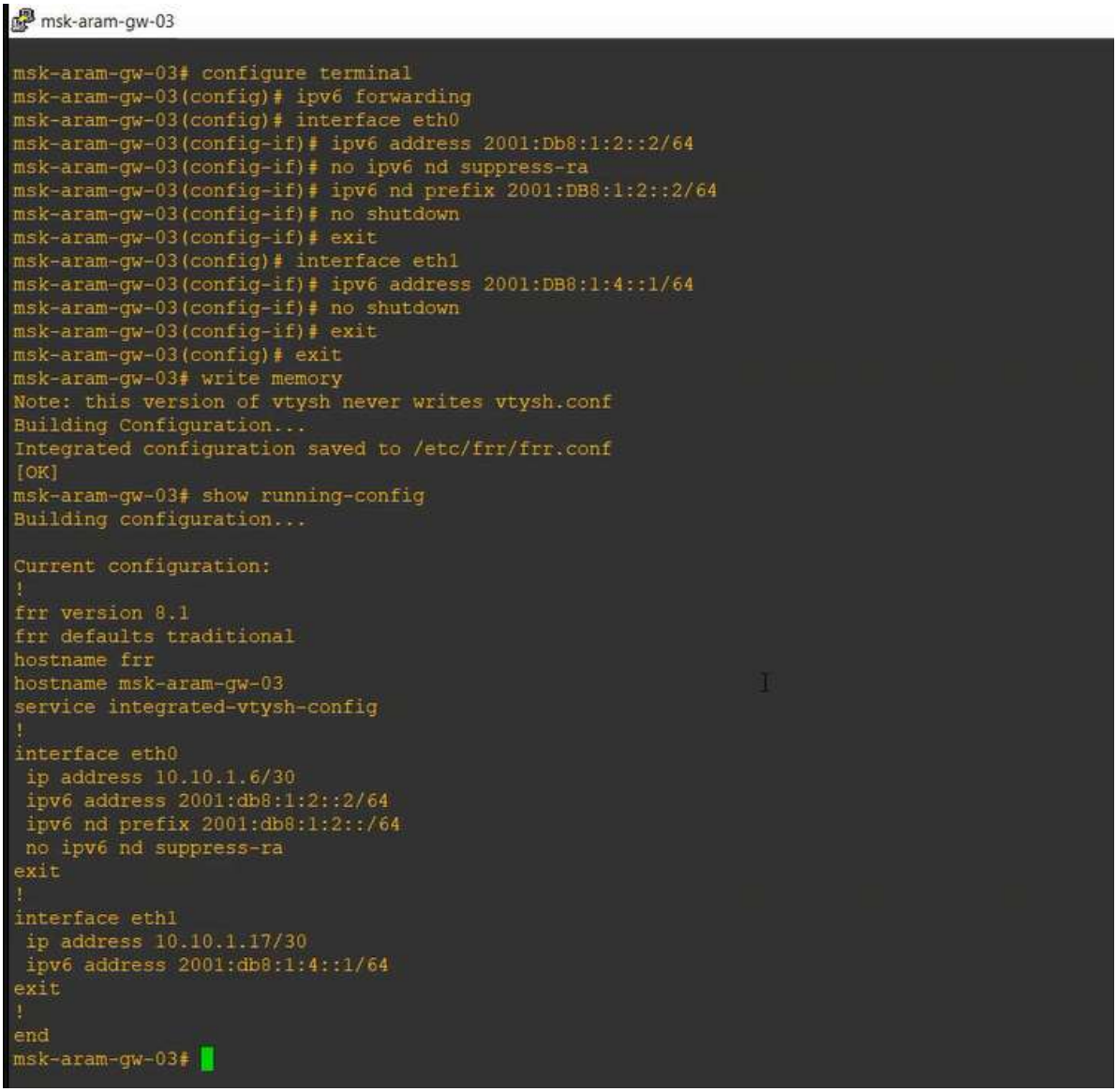

Рис. 76

Рис. 77

43. Настроил динамическую маршрутизацию по протоколу RIP (Рис. 78-81).

```
msk-aram-gw-01# configure terminal
msk-aram-gw-01(config)# router rip
msk-aram-gw-01(config-router)# version 2
msk-aram-gw-01(config-router)# network eth0
msk-aram-gw-01(config-router)# network eth1
msk-aram-gw-01(config-router)# network et2
msk-aram-gw-01(config-router)#  network eth2
msk-aram-gw-01(config-router)# exit
msk-aram-gw-01(config)# exit
msk-aram-gw-01#
```

Рис. 78

```
msk-aram-gw-02# configure terminal
msk-aram-gw-02(config)# router rip
msk-aram-gw-02(config-router)# version 2
msk-aram-gw-02(config-router)# network eth0
msk-aram-gw-02(config-router)# network eth1
msk-aram-gw-02(config-router)# network eth2
msk-aram-gw-02(config-router)# exit
msk-aram-gw-02(config)# exit
msk-aram-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-aram-gw-02#
```

Рис. 79

```
msk-aram-gw-03# configure terminal
msk-aram-gw-03(config)# router rip
msk-aram-gw-03(config-router)# version 2
msk-aram-gw-03(config-router)# network eth0
msk-aram-gw-03(config-router)# network eth1
msk-aram-gw-03(config-router)# exit
msk-aram-gw-03(config)# exit
msk-aram-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-aram-gw-03#
```

Рис. 80

```
msk-aram-gw-04# configure terminal
msk-aram-gw-04(config)# router rip
msk-aram-gw-04(config-router)# version 2
msk-aram-gw-04(config-router)# network eth0
msk-aram-gw-04(config-router)# network eth1
msk-aram-gw-04(config-router)# exit
msk-aram-gw-04(config)# exit
msk-aram-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-aram-gw-04#
```

Рис. 81

44. Настроил RIP маршрутизацию для сетей IPv6 (Рис. 82-85)

```
msk-aram-gw-01# configure terminal
msk-aram-gw-01(config)# router ripng
msk-aram-gw-01(config-router)# network eth0
msk-aram-gw-01(config-router)# network eth1
msk-aram-gw-01(config-router)# network eth2
msk-aram-gw-01(config-router)# exit
msk-aram-gw-01(config)# exit
msk-aram-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-aram-gw-01#
```

Рис. 82

```
msk-aram-gw-02# configure terminal
msk-aram-gw-02(config)# router ripng
msk-aram-gw-02(config-router)# network eth0
msk-aram-gw-02(config-router)# network eth1
msk-aram-gw-02(config-router)# network eth2
msk-aram-gw-02(config-router)# exit
msk-aram-gw-02(config)# exit
msk-aram-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-aram-gw-02#
```

Рис. 83

```
msk-aram-gw-03# configure terminal
msk-aram-gw-03(config)# roter ripng
% Unknown command: roter ripng
msk-aram-gw-03(config)# router ripng
msk-aram-gw-03(config-router)# network eth0
msk-aram-gw-03(config-router)# network eth1
msk-aram-gw-03(config-router)# exit
msk-aram-gw-03(config)# exit
msk-aram-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-aram-gw-03#
```

Рис. 84

```
msk-aram-gw-04# configure terminal
msk-aram-gw-04(config)# router ripng
msk-aram-gw-04(config-router)# network eth0
msk-aram-gw-04(config-router)# network eth1
msk-aram-gw-04(config-router)# exit
msk-aram-gw-04(config)# exit
msk-aram-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-aram-gw-04#
```

Рис. 85

45. Настроил маршрутизацию по протоколу OSPF (Рис. 86-89).

```
msk-aram-gw-01# configure terminal
msk-aram-gw-01(config)# router ospf
msk-aram-gw-01(config-router)# network 10.10.1.97/27 area 0.0.0.0
msk-aram-gw-01(config-router)# network 10.10.1.10/27 area 0.0.0.0
msk-aram-gw-01(config-router)# network 10.10.1.5/27 area 0.0.0.0
msk-aram-gw-01(config-router)# exit
msk-aram-gw-01(config)# exit
msk-aram-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-aram-gw-01#
```

Рис. 86

```
msk-aram-gw-02# configure terminal
msk-aram-gw-02(config)# router ospf
msk-aram-gw-02(config-router)# network 10.10.1.65/28 area 0.0.0.0
msk-aram-gw-02(config-router)# network 10.10.1.18/30 area 0.0.0.0
msk-aram-gw-02(config-router)# network 10.10.1.33/30 area 0.0.0.0
msk-aram-gw-02(config-router)# exit
msk-aram-gw-02(config)# exit
msk-aram-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-aram-gw-02#
```

Рис. 87

```
msk-aram-gw-03#
msk-aram-gw-03# configure terminal
msk-aram-gw-03(config)# router ospf
msk-aram-gw-03(config-router)# network 10.10.1.6/30 area 0.0.0.0
msk-aram-gw-03(config-router)# network 10.10.1.17/30 area 0.0.0.0
msk-aram-gw-03(config-router)# exit
msk-aram-gw-03(config)# exit
msk-aram-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-aram-gw-03#
```

Рис. 88

```
msk-aram-gw-04# configure terminal
msk-aram-gw-04(config)# router ospf
msk-aram-gw-04(config-router)# network 10.10.1.9/30 area 0.0.0.0
msk-aram-gw-04(config-router)# network 10.10.1.34/30 area 0.0.0.0
msk-aram-gw-04(config-router)# exit
msk-aram-gw-04(config)# exit
msk-aram-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-aram-gw-04#
```

Рис. 89

46. Настроил OSPF для сетей IPv6 (Рис. 90-93).

```
msk-aram-gw-01# configure terminal
msk-aram-gw-01(config)# router ospf6
msk-aram-gw-01(config-ospf6)# ospf6 router-id 1.1.1.1
msk-aram-gw-01(config-ospf6)# exit
msk-aram-gw-01(config)# interface eth0
msk-aram-gw-01(config-if)# ipv6 ospf6 area 0
msk-aram-gw-01(config-if)# exit
msk-aram-gw-01(config)# interface eth1
msk-aram-gw-01(config-if)# ipv6 ospf6 area 0
msk-aram-gw-01(config-if)# exit
msk-aram-gw-01(config)# interface eth2
msk-aram-gw-01(config-if)# ipv6 ospf6 area 0
msk-aram-gw-01(config-if)# exit
msk-aram-gw-01(config)# exit
msk-aram-gw-01#
```

Рис. 90

```
msk-aram-gw-04# configure terminal
msk-aram-gw-04(config)# router ospf6
msk-aram-gw-04(config-ospf6)# ospf6 router-id 4.4.4.4
msk-aram-gw-04(config-ospf6)# exit
msk-aram-gw-04(config)# interface eth0
msk-aram-gw-04(config-if)# ipv6 ospf6 area
% Command incomplete: ipv6 ospf6 area
msk-aram-gw-04(config-if)# ipv6 ospf6 area 0
msk-aram-gw-04(config-if)# exit
msk-aram-gw-04(config)# interface eth1
msk-aram-gw-04(config-if)# ipv6 ospf6 area 0
msk-aram-gw-04(config-if)# exit
msk-aram-gw-04(config)# exit
msk-aram-gw-04# write memory
Note: this version of vtysh never writes vtysh.conf
```

Рис. 91

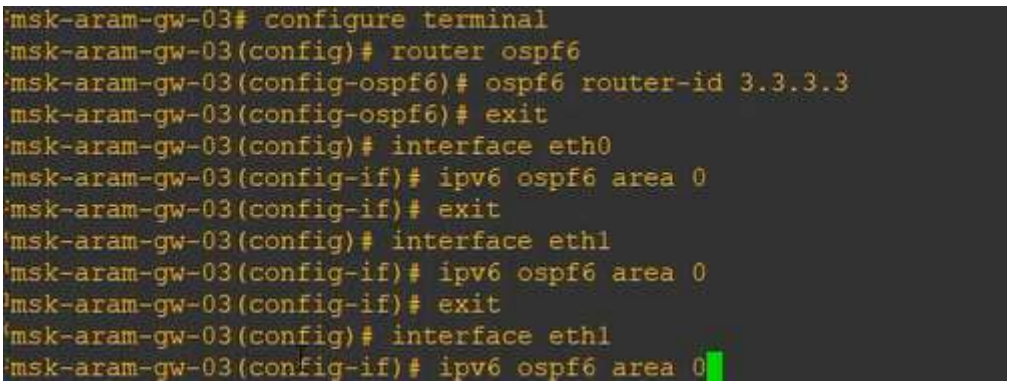

Рис. 92

ВЫВОД

Я изучил основные принципы маршрутизации в IPv4- и IPv6-сетях и настройки сетевого оборудования, разобрался с построением туннеля IPv6–IPv4, а также научился самостоятельно настраивать маршрутизацию.