

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 Грачьевич

Группа: НПИбд 02-20

МОСКВА

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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).

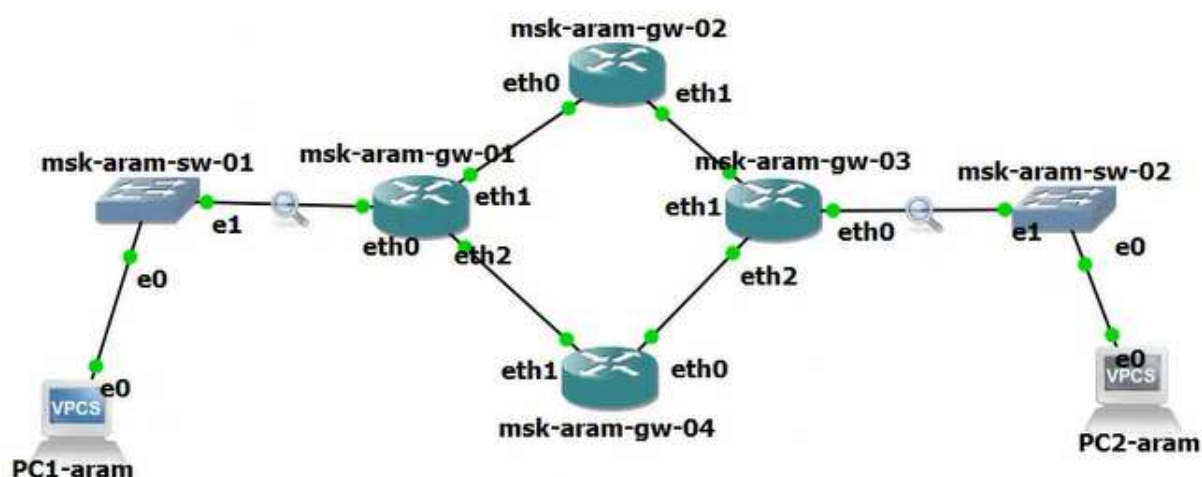


Рис. 1

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).



The image shows two terminal windows side-by-side. The left window is titled 'PC1-aram' and the right window is titled 'PC2-aram'. Both windows show the configuration of IP addresses and gateways for their respective devices. The PC1-aram window shows the configuration of IP 10.0.10.10/24 with gateway 10.0.10.1. The PC2-aram window shows the configuration of IP 10.0.11.10/24 with gateway 10.0.11.1. Both windows also show the 'show ip' command output, displaying the configured IP, mask, gateway, and other network parameters.

```
PC1-aram> ip 10.0.10.10/24 10.0.10.1
Checking for duplicate address...
PC1-aram : 10.0.10.10 128.0.0.0 gateway 10.0.10.1

PC1-aram> ip 10.0.10.10/24 10.0.10.1
Checking for duplicate address...
PC1-aram : 10.0.10.10 255.255.255.0 gateway 10.0.10.1

PC1-aram> save
Saving startup configuration to startup.vpc
. done

PC1-aram> show ip
NAME       : PC1-aram[1]
IP/MASK    : 10.0.10.10/24
GATEWAY    : 10.0.10.1
DNS        :
MAC        : 00:50:79:66:68:00
LPORT      : 20064
RHOST:PORT : 127.0.0.1:20065
MTU        : 1500

PC1-aram>

PC2-aram> Executing the startup file
PC2-aram> ip 10.0.11.10/24 10.0.11.1
Checking for duplicate address...
PC2-aram : 10.0.11.10 255.255.255.0 gateway 10.0.11.1

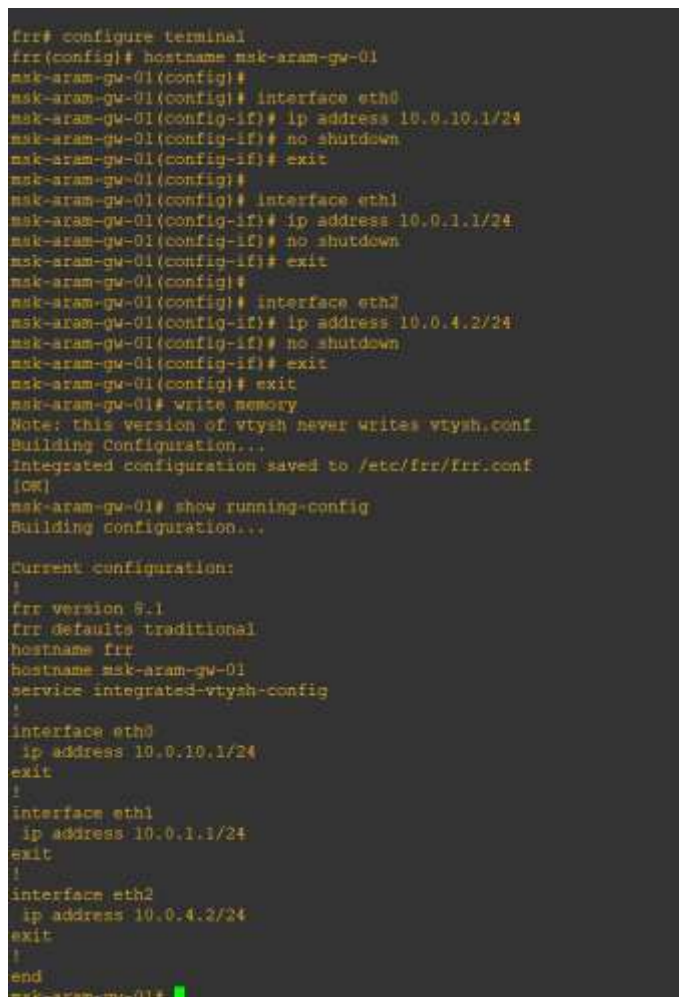
PC2-aram> save
Saving startup configuration to startup.vpc
. done

PC2-aram> show ip
NAME       : PC2-aram[1]
IP/MASK    : 10.0.11.10/24
GATEWAY    : 10.0.11.1
DNS        :
MAC        : 00:50:79:66:68:01
LPORT      : 20082
RHOST:PORT : 127.0.0.1:20083
MTU        : 1500

PC2-aram>
```

Рис. 2

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



The image shows a terminal window with the configuration of a router named 'msk-aram-gw-01'. The configuration includes setting the hostname, configuring three interfaces (eth0, eth1, eth2) with IP addresses and masks, and saving the configuration to the startup file. The 'show running-config' command is also executed, displaying the current configuration.

```
frr# configure terminal
frr(config)# hostname msk-aram-gw-01
msk-aram-gw-01(config)#
msk-aram-gw-01(config)# interface eth0
msk-aram-gw-01(config-if)# ip address 10.0.10.1/24
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)# ip address 10.0.1.1/24
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)# ip address 10.0.4.2/24
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 5.1
frr defaults traditional
hostname frr
hostname msk-aram-gw-01
service integrated-vtysh-config
!
interface eth0
 ip address 10.0.10.1/24
exit
!
interface eth1
 ip address 10.0.1.1/24
exit
!
interface eth2
 ip address 10.0.4.2/24
exit
!
end
msk-aram-gw-01#
```

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).

PC1-aram	PC2-aram
<pre> PC1-aram> ip 2001:10::a/64 PC1 : 2001:10::a/64 PC1-aram> save Saving startup configuration to startup.vpc . done PC1-aram> show ipv6 NAME : PC1-aram[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 : 20064 RHOST:PORT : 127.0.0.1:20065 MTU: : 1500 PC1-aram> </pre>	<pre> PC2-aram> ip 2001:11::a/64 PC1 : 2001:11::a/64 PC2-aram> save Saving startup configuration to startup.vpc . done PC2-aram> show ipv6 NAME : PC2-aram[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 : 20082 RHOST:PORT : 127.0.0.1:20083 MTU: : 1500 PC2-aram> </pre>

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).

```
* Unknown command: ip rip status
msk-aram-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 02:41
R(n) 10.0.2.0/24       10.0.4.2          3 10.0.4.2           0 02:41
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 02:41
R(n) 10.0.11.0/24      10.0.4.2          4 10.0.4.2           0 02:41
msk-aram-gw-04# sh
```

Рис. 16

9. Пропинговал соединение (Рис. 17).

```
PC1-aram> ping 10.0.11.10

84 bytes from 10.0.11.10 icmp_seq=1 ttl=61 time=20.753 ms
84 bytes from 10.0.11.10 icmp_seq=2 ttl=61 time=17.771 ms
84 bytes from 10.0.11.10 icmp_seq=3 ttl=61 time=17.381 ms
84 bytes from 10.0.11.10 icmp_seq=4 ttl=61 time=15.590 ms
84 bytes from 10.0.11.10 icmp_seq=5 ttl=61 time=20.030 ms

PC1-aram>
```

Рис. 17

10. Отключил второй маршрутизатор (Рис. 18).

```
[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)#
```

Рис. 18

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

```
R(n) 10.0.11.0/24      10.0.1.2          3 10.0.1.2           0 02:30
msk-aram-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 02:23
R(n) 10.0.3.0/24       10.0.4.1          2 10.0.4.1           0 02:49
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 02:23
msk-aram-gw-01#
```

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 RIPv6 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).

No.	Time	Source	Destination	Protocol	Length	Info
27	1868.542628	10.0.10.1	224.0.0.9	RIPv2		66 Request
30	1868.483917	10.0.10.1	224.0.0.9	RIPv2		66 Response
32	1869.540658	10.0.10.1	224.0.0.9	RIPv2		66 Request
35	1879.918551	10.0.10.1	224.0.0.9	RIPv2		66 Response
36	1881.031346	10.0.10.1	224.0.0.9	RIPv2		66 Response
38	1882.093870	10.0.10.1	224.0.0.9	RIPv2		66 Request

Рис. 27

No.	Time	Source	Destination	Protocol	Length	Info
122	2055.210735	fe80::a3a:2eff:feab::ff02::9		RIPng	86	Command Request, Version 1
125	2064.250637	fe80::a3a:2eff:feab::ff02::9		RIPng	86	Command Request, Version 1
127	2072.002077	fe80::a3a:2eff:feab::ff02::9		RIPng	86	Command Response, Version 1
128	2072.997363	fe80::a3a:2eff:feab::ff02::9		RIPng	86	Command Request, Version 1
129	2080.656558	fe80::a3a:2eff:feab::ff02::9		RIPng	86	Command Response, Version 1
130	2081.962025	fe80::a3a:2eff:feab::ff02::9		RIPng	86	Command Request, Version 1
131	2087.510171	fe80::a3a:2eff:feab::ff02::9		RIPng	126	Command Response, Version 1
133	3011.540744	fe80::a3a:2eff:feab::ff02::9		RIPng	126	Command Response, Version 1
135	3030.788900	fe80::a3a:2eff:feab::ff02::9		RIPng	86	Command Response, Version 1

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# configure terminal
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


```

msk-aram-gw-04(config)# router ospf
msk-aram-gw-04(config-router)# network 10.0.3.0/24
% Command incomplete: network 10.0.3.0/24
msk-aram-gw-04(config-router)# network 10.0.3.0/24 area 0.0.0.0
msk-aram-gw-04(config-router)# network 10.0.3.0/24 area 0.0.0.0
msk-aram-gw-04(config-router)# network 10.0.3.0/24 area 0.0.0.0
msk-aram-gw-04(config-router)# network 10.0.4.0/24 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. 32

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

```

PC1-aram>
PC1-aram> ping 10.0.11.10

84 bytes from 10.0.11.10 icmp_seq=1 ttl=61 time=19.798 ms
84 bytes from 10.0.11.10 icmp_seq=2 ttl=61 time=16.918 ms
84 bytes from 10.0.11.10 icmp_seq=3 ttl=61 time=10.501 ms
84 bytes from 10.0.11.10 icmp_seq=4 ttl=61 time=19.271 ms
84 bytes from 10.0.11.10 icmp_seq=5 ttl=61 time=14.942 ms

PC1-aram> 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   2.616 ms   3.174 ms   1.121 ms
 2  10.0.1.2    8.401 ms   8.155 ms   5.664 ms
 3  10.0.2.2   18.550 ms  11.583 ms  15.832 ms
 4  10.0.11.10  12.037 ms   9.743 ms  10.554 ms

PC1-aram>

```

Рис. 33

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

```

msk-aram-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
===== OSPF router routing table =====
===== OSPF external routing table =====

msk-aram-gw-01#

```

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
1-aram>

```

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	3580.050073	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 ospf6 area 0
% Unknown command: ipv6 ospf6 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
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.

```

[OK]
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).

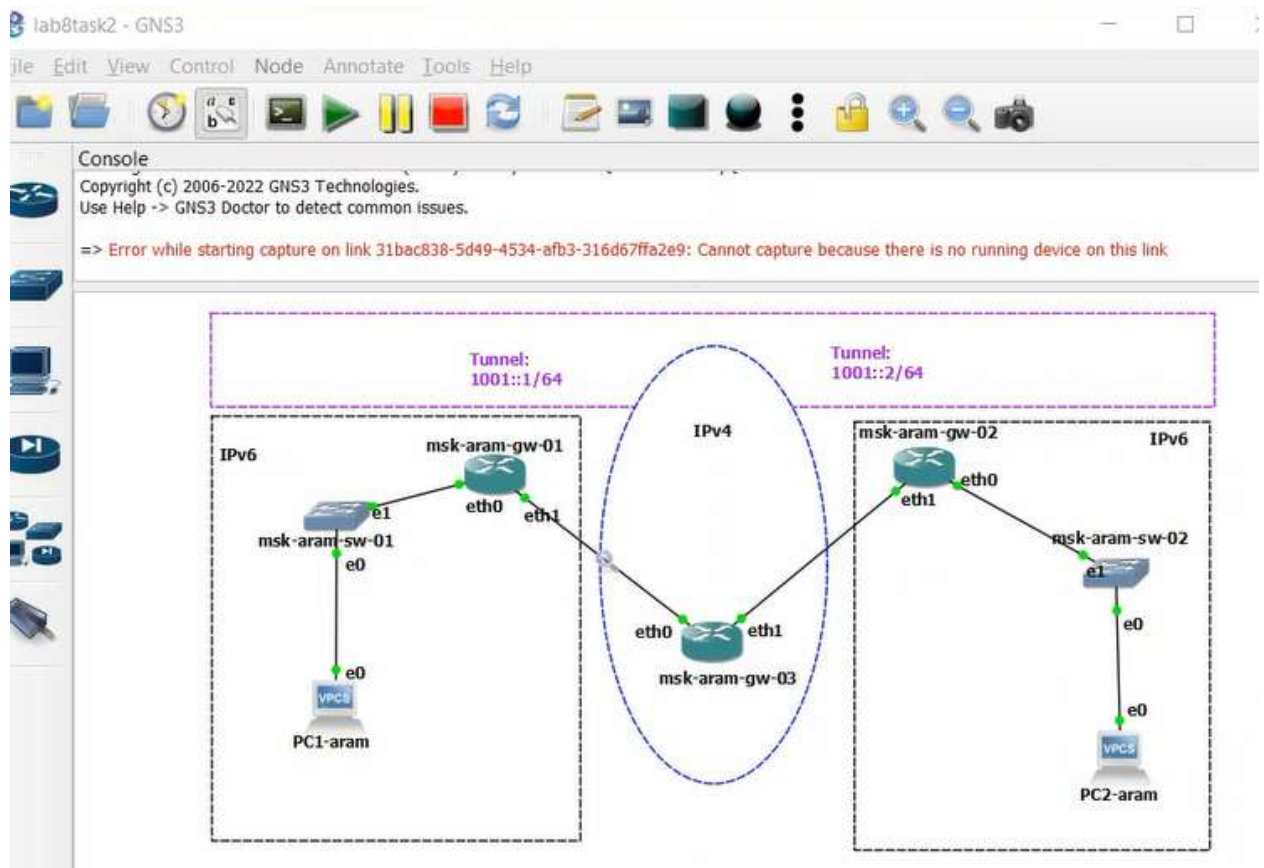


Рис. 44

26. Присвоил адреса конечным 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
PORT                 : 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 UTC 2021; root@vyos
Welcome to VyOS!

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

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 multiple components.
you can check individual component licenses under /usr/share/licenses
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
█

```

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).

```
[edit]
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> 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> 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).

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	:::	FF02::1::	ICMPv6		130 Multicast Listener Report Message v2
2	0.001475	:::	FF02::1::	ICMPv6		130 Multicast Listener Report Message v2
3	0.009354	:::	FF02::1::FF0F::1	ICMPv6		86 Neighbor Solicitation for fe80::a55:dcff:febf::1
4	0.014564	fe80::a55:dcff:febf::1	FF02::1::	ICMPv6		150 Multicast Listener Report Message v2
5	0.020726	fe80::a55:dcff:febf::1	FF02::1::	ICMPv6		98 Multicast Listener Report Message v2
6	0.0341515	fe80::a55:dcff:febf::1	FF02::1::	ICMPv6		150 Multicast Listener Report Message v2
7	0.041299	fe80::a55:dcff:febf::1	FF02::1::	ICMPv6		98 Multicast Listener Report Message v2
8	0.0559612	:::	FF02::1::	ICMPv6		130 Multicast Listener Report Message v2
9	0.060578	:::	FF02::1::	ICMPv6		130 Multicast Listener Report Message v2
10	0.067908	:::	FF02::1::FF0F::1	ICMPv6		86 Neighbor Solicitation for fe80::a55:dcff:febf::1
11	0.075735	fe80::a55:dcff:febf::1	FF02::1::	ICMPv6		130 Multicast Listener Report Message v2
12	0.081664	fe80::a55:dcff:febf::1	FF02::1::	ICMPv6		98 Multicast Listener Report Message v2
13	0.088034	fe80::a55:dcff:febf::1	FF02::1::	ICMPv6		150 Multicast Listener Report Message v2
14	0.093917	fe80::a55:dcff:febf::1	FF02::1::	ICMPv6		98 Multicast Listener Report Message v2
15	0.100064	:::	FF02::1::	ICMPv6		130 Multicast Listener Report Message v2
16	0.107234	:::	FF02::1::	ICMPv6		130 Multicast Listener Report Message v2
17	0.114503	:::	FF02::1::FF0F::1	ICMPv6		86 Neighbor Solicitation for fe80::a55:dcff:febf::1

Рис. 66

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

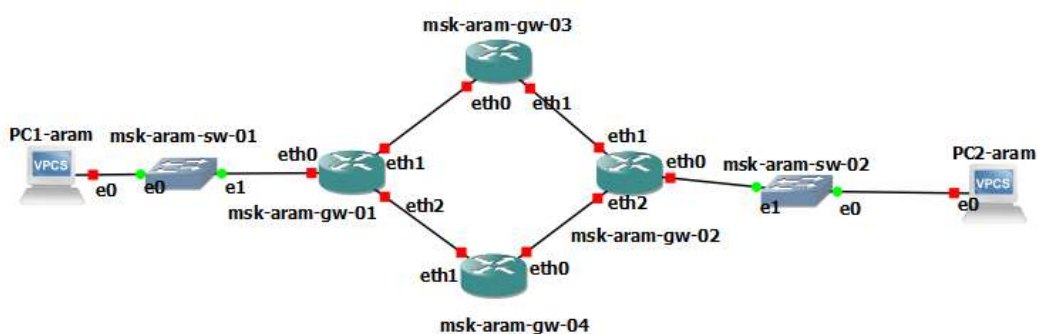


Рис. 67

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 конечных устройств (Рис. 68).

```

PC1-aram
LPORT      : 10008
RHOST:PORT  : 127.0.0.1:10009
MTU:        : 1500

PC1-aram> ip 10.0.1.106/27 10.0.1.97
Checking for duplicate address...
PC1 : 10.0.1.106 255.255.255.224 gateway 10.0.1.97

PC1-aram> save
Saving startup configuration to startup.vpc
. done

PC1-aram> show ip
NAME       : PC1-aram[1]
IP/MASK    : 10.0.1.106/27
GATEWAY    : 10.0.1.97
DNS        :
MAC        : 00:50:79:66:68:00
LPORT      : 10008
RHOST:PORT : 127.0.0.1:10009
MTU        : 1500
PC1-aram>

PC2-aram
PC2-aram>
PC2-aram> 10.0.1.74/28 10.0.1.65
Bad command: "10.0.1.74/28 10.0.1.65". Use ? for help.

PC2-aram> ip 10.0.1.74/28 10.0.1.65
Checking for duplicate address...
PC2 : 10.0.1.74 255.255.255.240 gateway 10.0.1.65

PC2-aram> save
Saving startup configuration to startup.vpc
. done

PC2-aram> show ip
NAME       : PC2-aram[1]
IP/MASK    : 10.0.1.74/28
GATEWAY    : 10.0.1.65
DNS        :
MAC        : 00:50:79:66:68:01
LPORT      : 10006
RHOST:PORT : 127.0.0.1:10007
MTU        : 1500
PC2-aram>

```

Рис. 68

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

```

frr# configure terminal
frr(config)# hostname-msk-aram-gw-01
% Unknown command: hostname-msk-aram-gw-01
frr(config)# hostname msk-aram-gw-01
msk-aram-gw-01(config)# interface eth0
msk-aram-gw-01(config-if)# ip address 10.10.1.97/27
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)# ip address 10.10.1.5/27
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)# ip address 10.10.1.10/30
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# sh

```

Рис. 69


```

frr# configure terminal
frr(config)# hostname msk-aram-gw-02
msk-aram-gw-02(config)# interface eth0
msk-aram-gw-02(config-if)# ip address 10.10.1.65/28
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)# ip address 10.10.1.18/30
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)# ip address 10.10.1.33/30
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

```

Рис. 70

```

frr# configure terminal
frr(config)# hostname msk-aram-gw-03
msk-aram-gw-03(config)# interface eth0
msk-aram-gw-03(config-if)# ip address 10.10.1.6/30
msk-aram-gw-03(config-if)# no shutdown
msk-aram-gw-03(config-if)# exit
msk-aram-gw-03(config)# interface eth1
msk-aram-gw-03(config-if)# ip address 10.10.1.17/30
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

```

Рис. 71

```

frr# configure terminal
frr(config)# hostname msk-aram-gw-04
msk-aram-gw-04(config)# interface eth0
msk-aram-gw-04(config-if)# ip address 10.10.1.9/30
msk-aram-gw-04(config-if)# no shutdown
msk-aram-gw-04(config-if)# exit
msk-aram-gw-04(config)# interface eth1
msk-aram-gw-04(config-if)# ip address 10.10.1.34/30
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]

```

Рис. 72

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

```
PC1-aram
MAC      : 00:50:79:66:68:00
LPORT    : 10008
RHOST:PORT : 127.0.0.1:10009
MTU:      : 1500

PC1-aram> ip 2001:DB8:1:1::a/64
PC1 : 2001:db8:1:1::a/64

PC1-aram> save
Saving startup configuration to startup.vpc
. done

PC1-aram> show ipv6

NAME          : PC1-aram[1]
LINK-LOCAL SCOPE : fe80::250:79ff:fe66:6800/
GLOBAL SCOPE    : 2001:db8:1:1::a/64
ROUTER LINK-LAYER :
MAC            : 00:50:79:66:68:00
LPORT         : 10008
RHOST:PORT     : 127.0.0.1:10009
MTU:           : 1500

PC1-aram>

PC2-aram
PC2-aram> save
Saving startup configuration to startup.vpc
. done

PC2-aram> show ip

NAME          : PC2-aram[1]
IP/MASK       : 10.0.1.74/28
GATEWAY       : 10.0.1.65
DNS           :
MAC          : 00:50:79:66:68:01
LPORT        : 10006
RHOST:PORT    : 127.0.0.1:10007
MTU:          : 1500

PC2-aram> ip 2001:DB8:1:6::a/64
PC1 : 2001:db8:1:6::a/64

PC2-aram> save
Saving startup configuration to startup.vpc
. done

PC2-aram>
```

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::1/64
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

```
msk-aram-gw-03# configure terminal
msk-aram-gw-03(config)# ipv6 forwarding
msk-aram-gw-03(config)# interface eth0
msk-aram-gw-03(config-if)# ipv6 address 2001:Db8:1:2::2/64
msk-aram-gw-03(config-if)# no ipv6 nd suppress-ra
msk-aram-gw-03(config-if)# ipv6 nd prefix 2001:DB8:1:2::2/64
msk-aram-gw-03(config-if)# no shutdown
msk-aram-gw-03(config-if)# exit
msk-aram-gw-03(config)# interface eth1
msk-aram-gw-03(config-if)# ipv6 address 2001:DB8:1:4::1/64
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 10.10.1.6/30
 ipv6 address 2001:db8:1:2::2/64
 ipv6 nd prefix 2001:db8:1:2::/64
 no ipv6 nd suppress-ra
exit
!
interface eth1
 ip address 10.10.1.17/30
 ipv6 address 2001:db8:1:4::1/64
exit
!
end
msk-aram-gw-03#
```

Рис. 76

```
msk-aram-gw-04# configure terminal
msk-aram-gw-04(config)# ipv6 forwarding
msk-aram-gw-04(config)# interface eth0
msk-aram-gw-04(config-if)# ipv6 address 2001:DB8:1:3::1/64
msk-aram-gw-04(config-if)# no shutdown
msk-aram-gw-04(config-if)# exit
msk-aram-gw-04(config)# interface eth1
msk-aram-gw-04(config-if)# ipv6 address 2001:DB8:1:5::2/64
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]
```

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 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# 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

```
msk-aram-gw-03# configure terminal
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)# interface eth0
msk-aram-gw-03(config-if)# ipv6 ospf6 area 0
msk-aram-gw-03(config-if)# exit
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)# interface eth1
msk-aram-gw-03(config-if)# ipv6 ospf6 area 0
```

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.