

# **Отчёт по лабораторной работе №8**

**Сетевые технологии**

Ищенко Ирина НПИбд-02-22

# Содержание

<b>1</b>	<b>Цель работы</b>	<b>7</b>
<b>2</b>	<b>Выполнение лабораторной работы</b>	<b>8</b>
<b>3</b>	<b>Самостоятельная работа</b>	<b>41</b>
<b>4</b>	<b>Выводы</b>	<b>55</b>

## Список иллюстраций

2.1	Топология сети . . . . .	8
2.2	IPv4 на PC1 . . . . .	9
2.3	IPv4 на PC2 . . . . .	9
2.4	IPv4-адреса . . . . .	10
2.5	IPv4-адреса . . . . .	11
2.6	IPv4-адреса . . . . .	11
2.7	IPv4-адреса . . . . .	12
2.8	IPv6 на PC1 . . . . .	12
2.9	IPv6 на PC2 . . . . .	13
2.10	IPv6-адреса . . . . .	13
2.11	IPv6-адреса . . . . .	14
2.12	IPv6-адреса . . . . .	14
2.13	IPv6-адреса . . . . .	15
2.14	RIP . . . . .	15
2.15	RIP . . . . .	15
2.16	RIP . . . . .	16
2.17	RIP . . . . .	16
2.18	RIP . . . . .	16
2.19	RIP . . . . .	17
2.20	RIP . . . . .	17
2.21	Пинг . . . . .	17
2.22	Метрики протокола RIP . . . . .	18
2.23	Отключение интерфейса . . . . .	18
2.24	RIP . . . . .	18
2.25	Пинг . . . . .	18
2.26	Восстановление интерфейса . . . . .	19
2.27	Пинг . . . . .	19
2.28	Захваченный трафик . . . . .	20
2.29	RIPng . . . . .	20
2.30	RIPng . . . . .	21
2.31	RIPng . . . . .	21
2.32	RIPng . . . . .	21
2.33	Пинг . . . . .	22
2.34	Метрики протокола . . . . .	22
2.35	Отключение интерфейса . . . . .	22
2.36	Метрики протокола . . . . .	23
2.37	Пинг . . . . .	23

2.38 Включение интерфейса . . . . .	23
2.39 Пинг . . . . .	23
2.40 Захваченный трафик . . . . .	24
2.41 Настройка OSPF . . . . .	25
2.42 Пинг . . . . .	26
2.43 Отключение интерфейса . . . . .	26
2.44 Пинг . . . . .	26
2.45 Метрики протокола . . . . .	27
2.46 Включение интерфейса . . . . .	27
2.47 Пинг . . . . .	27
2.48 Захваченный трафик . . . . .	28
2.49 Настройка OSPFv3 . . . . .	29
2.50 Пинг . . . . .	30
2.51 Отключение . . . . .	30
2.52 Метрики протокола . . . . .	30
2.53 Пинг . . . . .	31
2.54 Включение . . . . .	31
2.55 Пинг . . . . .	31
2.56 Захваченный трафик . . . . .	32
2.57 Топология сети . . . . .	32
2.58 Адрес на PC1 . . . . .	33
2.59 Адрес на PC2 . . . . .	33
2.60 Настройка адресов . . . . .	34
2.61 Настройка адресов . . . . .	34
2.62 Настройка адресов . . . . .	35
2.63 Проверка адресов ближайших маршрутизаторов . . . . .	35
2.64 Проверка адресов ближайших маршрутизаторов . . . . .	36
2.65 Проверка маршрутов . . . . .	36
2.66 Настройка маршрутизации . . . . .	36
2.67 Проверка маршрутов . . . . .	37
2.68 Создание туннеля . . . . .	37
2.69 Создайте туннель IPv6 через сеть IPv4 . . . . .	38
2.70 Пинг . . . . .	39
2.71 Захваченный трафик . . . . .	40
3.1 Топология сети . . . . .	42
3.2 Адреса на PC1 . . . . .	43
3.3 Адреса на PC2 . . . . .	44
3.4 Настройка адресов . . . . .	45
3.5 Настройка адресов . . . . .	46
3.6 Настройка адресов . . . . .	46
3.7 Настройка адресов . . . . .	47
3.8 Настройка RIP . . . . .	47
3.9 Метрики протокола . . . . .	48

3.10 Пинг . . . . .	48
3.11 Захваченный трафик . . . . .	49
3.12 RIPvng . . . . .	49
3.13 Метрики протокола . . . . .	50
3.14 Пинг . . . . .	50
3.15 Настройка OSPF . . . . .	51
3.16 Метрики протокола . . . . .	51
3.17 Пинг . . . . .	51
3.18 Захваченный трафик . . . . .	52
3.19 Настройка OSPFv3 . . . . .	52
3.20 Метрики протокола . . . . .	53
3.21 Пинг . . . . .	53
3.22 Захваченный трафик . . . . .	54

## Список таблиц

3.1	Таблица адресов сетей . . . . .	41
3.2	Таблица адресации . . . . .	41

# 1 Цель работы

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

## 2 Выполнение лабораторной работы

Строим заданную топологию сети, используя Vyos мфршрутизаторы, так как FRR у меня не работают. Стартуем все вершины и запускаем захват трафика на соединениях между коммутаторами и маршрутизаторами (рис. 2.1).

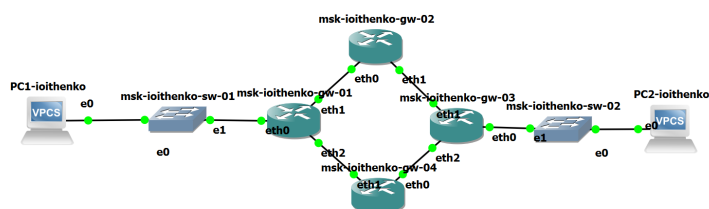


Рис. 2.1: Топология сети

Задаем IPv4 адреса конечным устройствам (рис. 2.2) и (рис. 2.3).



```

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

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

PC1> show ip

NAME       : PC1[1]
IP/MASK    : 10.0.10.10/24
GATEWAY    : 10.0.10.1
DNS        :
MAC        : 00:50:79:66:68:00
LPORT      : 20008
RHOST:PORT : 127.0.0.1:20009
MTU        : 1500

PC1>

```

Рис. 2.2: IPv4 на PC1

```

PC2> ip 10.0.11.10/24 10.0.11.1
Checking for duplicate address...
PC2 : 10.0.11.10 255.255.255.0 gateway 10.0.11.1

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

PC2> show io
Invalid arguments

PC2> show ip

NAME       : PC2[1]
IP/MASK    : 10.0.11.10/24
GATEWAY    : 10.0.11.1
DNS        :
MAC        : 00:50:79:66:68:01
LPORT      : 20010
RHOST:PORT : 127.0.0.1:20011
MTU        : 1500

PC2>

```

Рис. 2.3: IPv4 на PC2

Настроим IPv4-адреса на интерфейсах маршрутизаторов (рис. 2.4), (рис. 2.5), (рис. 2.6) и (рис. 2.7).

```

[edit]
vyos@msk-ioithenko-gw-01# set interfaces ethernet eth0 address 10.0.10.1/24
[edit]
vyos@msk-ioithenko-gw-01# set interfaces ethernet eth1 address 10.0.1.1/24
[edit]
vyos@msk-ioithenko-gw-01# set interfaces ethernet eth2 address 10.0.4.2/24
[edit]
vyos@msk-ioithenko-gw-01# compare
[edit interfaces ethernet eth0]
+address 10.0.10.1/24
[edit interfaces ethernet eth1]
+address 10.0.1.1/24
[edit interfaces ethernet eth2]
+address 10.0.4.2/24
[edit]
vyos@msk-ioithenko-gw-01# commit

Can't configure both static IPv4 and DHCP address on the same interface

[[interfaces ethernet eth0]] failed
Commit failed
[edit]
vyos@msk-ioithenko-gw-01# delete interfaces ethernet eth0 address dhcp
[edit]
vyos@msk-ioithenko-gw-01# commit
[edit]
vyos@msk-ioithenko-gw-01# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@msk-ioithenko-gw-01# show interfaces
  ethernet eth0 {
    address 10.0.10.1/24
    hw-id 0c:ad:66:8f:00:00
  }
  ethernet eth1 {
    address 10.0.1.1/24
    hw-id 0c:ad:66:8f:00:01
  }
  ethernet eth2 {
    address 10.0.4.2/24
    hw-id 0c:ad:66:8f:00:02
  }
  loopback lo {
  }
[edit]
vyos@msk-ioithenko-gw-01#

```

Рис. 2.4: IPv4-адреса

```

vyos@msk-ioithenko-gw-02:~$ configure
[edit]
vyos@msk-ioithenko-gw-02# set interfaces ethernet eth0 address 10.0.1.2/24
[edit]
vyos@msk-ioithenko-gw-02# delete interfaces ethernet eth0 address dhcp
[edit]
vyos@msk-ioithenko-gw-02# set interfaces ethernet eth1 address 10.0.2.1/24
[edit]
vyos@msk-ioithenko-gw-02# compare
[edit interfaces ethernet eth0]
- address dhcp
+ address 10.0.1.2/24
[edit interfaces ethernet eth1]
+ address 10.0.2.1/24
[edit]
vyos@msk-ioithenko-gw-02# commit
[edit]
vyos@msk-ioithenko-gw-02# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@msk-ioithenko-gw-02# show interfaces
  ethernet eth0 {
    address 10.0.1.2/24
    hw-id 0c:7a:d0:48:00:00
  }
  ethernet eth1 {
    address 10.0.2.1/24
    hw-id 0c:7a:d0:48:00:01
  }
  ethernet eth2 {
    hw-id 0c:7a:d0:48:00:02
  }
  loopback lo {
  }
[edit]
vyos@msk-ioithenko-gw-02#

```

Рис. 2.5: IPv4-адреса

```

vyos@msk-ioithenko-gw-03# set interfaces ethernet eth0 address 10.0.11.1/24
[edit]
vyos@msk-ioithenko-gw-03# set interfaces ethernet eth1 address 10.0.2.2/24
[edit]
vyos@msk-ioithenko-gw-03# set interfaces ethernet eth2 address 10.0.3.1/24
[edit]
vyos@msk-ioithenko-gw-03# delete interfaces ethernet eth0 address dhcp
[edit]
vyos@msk-ioithenko-gw-03# compare
[edit interfaces ethernet eth0]
- address dhcp
+ address 10.0.11.1/24
[edit interfaces ethernet eth1]
+ address 10.0.2.2/24
[edit interfaces ethernet eth2]
+ address 10.0.3.1/24
[edit]
vyos@msk-ioithenko-gw-03# commit
[edit]
vyos@msk-ioithenko-gw-03# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@msk-ioithenko-gw-03# show interfaces
  ethernet eth0 {
    address 10.0.11.1/24
    hw-id 0c:15:87:6d:00:00
  }
  ethernet eth1 {
    address 10.0.2.2/24
    hw-id 0c:15:87:6d:00:01
  }
  ethernet eth2 {
    address 10.0.3.1/24
    hw-id 0c:15:87:6d:00:02
  }
  loopback lo {
  }
[edit]
vyos@msk-ioithenko-gw-03#

```

Рис. 2.6: IPv4-адреса

```

you can check individual component licenses under /usr/share/doc/ for more info
vyos@misk-ioithenko-gw-04:~$ configure
[edit]
vyos@misk-ioithenko-gw-04# set interfaces ethernet eth0 address 10.0.3.2/24
[edit]
vyos@misk-ioithenko-gw-04# set interfaces ethernet eth1 address 10.0.4.1/24
[edit]
vyos@misk-ioithenko-gw-04# delete interfaces ethernet eth0 address shcp
Nothing to delete (the specified value does not exist)

[edit]
vyos@misk-ioithenko-gw-04# delete interfaces ethernet eth0 address dhcp
[edit]
vyos@misk-ioithenko-gw-04# compare
[edit interfaces ethernet eth0]
- address dhcp
+ address 10.0.3.2/24
[edit interfaces ethernet eth1]
+ address 10.0.4.1/24
[edit]
vyos@misk-ioithenko-gw-04# commit
[edit]
vyos@misk-ioithenko-gw-04# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@misk-ioithenko-gw-04# show interfaces
  ethernet eth0 {
    address 10.0.3.2/24
    hw-id 0c:1b:7c:75:00:00
  }
  ethernet eth1 {
    address 10.0.4.1/24
    hw-id 0c:1b:7c:75:00:01
  }
  ethernet eth2 {
    hw-id 0c:1b:7c:75:00:02
  }
  loopback lo {
  }
[edit]
vyos@misk-ioithenko-gw-04#

```

Рис. 2.7: IPv4-адреса

Присваиваем IPv6-адреса оконечным устройствам PC1 и PC2 (рис. 2.8) и (рис. 2.9).

```

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

PC1> show ipv6

NAME                : PC1[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                : 20008
RHOST:PORT           : 127.0.0.1:20009
MTU                  : 1500

PC1>
iw-04# save

```

Рис. 2.8: IPv6 на PC1

```

PC2> ip 2001:11::a/64
PC1 : 2001:11::a/64

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

PC2> show ipv6

NAME                : PC2[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                : 20010
RHOST:PORT           : 127.0.0.1:20011
MTU                  : 1500

PC2> █

```

Рис. 2.9: IPv6 на PC2

Настроим IPv6-адреса на интерфейсах маршрутизаторов (рис. 2.10), (рис. 2.11), (рис. 2.12) и (рис. 2.13).

```

vyos@msk-ioithenko-gw-01:~$ configure
[edit]
vyos@msk-ioithenko-gw-01# set interfaces ethernet eth0 address 2001:10::1/64
[edit]
vyos@msk-ioithenko-gw-01# set service router-advert interface eth0 prefix 2001:10::1/64

Configuration path: [service router-advert interface eth0 prefix 2001:10::1/64] already exists

[edit]
vyos@msk-ioithenko-gw-01# set interfaces ethernet eth1 address 2001:1::1/64
[edit]
vyos@msk-ioithenko-gw-01# set interfaces ethernet eth2 address 2001:4::2/64
[edit]
vyos@msk-ioithenko-gw-01# compare
[edit interfaces ethernet eth0]
+address 2001:10::1/64
[edit interfaces ethernet eth1]
+address 2001:1::1/64
[edit interfaces ethernet eth2]
+address 2001:4::2/64
[edit service]
+router-advert {
+  interface eth0 {
+    prefix 2001:10::1/64 {
+    }
+  }
+}
[edit]
vyos@msk-ioithenko-gw-01# commit
[edit]
vyos@msk-ioithenko-gw-01# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@msk-ioithenko-gw-01# █

```

Рис. 2.10: IPv6-адреса

```

vyos@msk-ioithenko-gw-02# set interfaces ethernet eth0 address 2001:1::2/64
[edit]
vyos@msk-ioithenko-gw-02# set interfaces ethernet eth1 address 2001:2::1/64
[edit]
vyos@msk-ioithenko-gw-02# compare
[edit interfaces ethernet eth0]
+address 2001:1::2/64
[edit interfaces ethernet eth1]
+address 2001:2::1/64
[edit]
vyos@msk-ioithenko-gw-02# commit
[edit]
vyos@msk-ioithenko-gw-02# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@msk-ioithenko-gw-02# show interfaces
  ethernet eth0 {
    address 10.0.1.2/24
    address 2001:1::2/64
    hw-id 0c:7a:d0:48:00:00
  }
  ethernet eth1 {
    address 10.0.2.1/24
    address 2001:2::1/64
    hw-id 0c:7a:d0:48:00:01
  }
  ethernet eth2 {
    hw-id 0c:7a:d0:48:00:02
  }
  loopback lo {
  }
[edit]
vyos@msk-ioithenko-gw-02# █

```

Рис. 2.11: IPv6-адреса

```

[edit]
vyos@msk-ioithenko-gw-03# set interfaces ethernet eth0 address 2001:11::1/64
[edit]
1::/64msk-ioithenko-gw-03# set service router-advert interface eth0 prefix 2001:1
[edit]
vyos@msk-ioithenko-gw-03# set interfaces ethernet eth1 address 2001:2::2/64
[edit]
vyos@msk-ioithenko-gw-03# set interfaces ethernet eth2 address 2001:3::1/64
[edit]
vyos@msk-ioithenko-gw-03# compare
[edit interfaces ethernet eth0]
+address 2001:11::1/64
[edit interfaces ethernet eth1]
+address 2001:2::2/64
[edit interfaces ethernet eth2]
+address 2001:3::1/64
[edit service]
+router-advert {
+  interface eth0 {
+    prefix 2001:11::/64 {
+    }
+  }
+}
[edit]
vyos@msk-ioithenko-gw-03# commit
[edit]
vyos@msk-ioithenko-gw-03# save
Saving configuration to '/config/config.boot'...
Done
[edit]

```

Рис. 2.12: IPv6-адреса

```
vyos@misk-ioithenko-gw-04# set interfaces ethernet eth0 address 2001:3::2/64
[edit]
vyos@misk-ioithenko-gw-04# set interfaces ethernet eth1 address 2001:4::1/64
[edit]
vyos@misk-ioithenko-gw-04# compare
[edit interfaces ethernet eth0]
+address 2001:3::2/64
[edit interfaces ethernet eth1]
+address 2001:4::1/64
[edit]
vyos@misk-ioithenko-gw-04# commit
[edit]
vyos@misk-ioithenko-gw-04# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@misk-ioithenko-gw-04#
```

Рис. 2.13: IPv6-адреса

На маршрутизаторах настроим RIP в качестве протокола динамической и проверим метрики протокола RIP маршрутизации (рис. 2.14), (рис. 2.15), (рис. 2.16), (рис. 2.17), (рис. 2.18), (рис. 2.19) и (рис. 2.20).

```
[edit]
vyos@misk-ioithenko-gw-01# set protocols rip interface eth0
[edit]
vyos@misk-ioithenko-gw-01# set protocols rip interface eth1
[edit]
vyos@misk-ioithenko-gw-01# set protocols rip interface eth2
[edit]
```

Рис. 2.14: RIP

```
you can check individual component licenses under /usr/share/doc/*/copyright
vyos@misk-ioithenko-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
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
vyos@misk-ioithenko-gw-01:~$ show ip rip status
Routing Protocol is "rip"
  Sending updates every 30 seconds with +/-50%, next due in 29 seconds
  Timeout after 180 seconds, garbage collect after 120 seconds
  Outgoing update filter list for all interface is not set
  Incoming update filter list for all interface is not set
  Default redistribution metric is 1
  Redistributing:
  Default version control: send version 2, receive any version
    Interface      Send  Recv  Key-chain
    eth0            2    1 2
    eth1            2    1 2
    eth2            2    1 2
  Routing for Networks:
    eth0
    eth1
    eth2
  Routing Information Sources:
    Gateway          BadPackets BadRoutes  Distance Last Update
  Distance: (default is 120)
vyos@misk-ioithenko-gw-01:~$
```

Рис. 2.15: RIP

```
vyos@msk-ioithenko-gw-02# set protocols rip interface eth0
[edit]
vyos@msk-ioithenko-gw-02# set protocols rip interface eth1
[edit]
```

Рис. 2.16: RIP

```
you can check individual component licenses under /usr/share/doc/*/copyright
vyos@msk-ioithenko-gw-02:~$ 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
C(i) 10.0.2.0/24    0.0.0.0        1 self          0
R(n) 10.0.3.0/24    10.0.2.2        2 10.0.2.2       0 02:26
R(n) 10.0.4.0/24    10.0.1.1        2 10.0.1.1       0 02:45
R(n) 10.0.10.0/24   10.0.1.1        2 10.0.1.1       0 02:45
vyos@msk-ioithenko-gw-02:~$ show ip rip status
Routing Protocol is "rip"
  Sending updates every 30 seconds with +/-50%, next due in 6 seconds
  Timeout after 180 seconds, garbage collect after 120 seconds
  Outgoing update filter list for all interface is not set
  Incoming update filter list for all interface is not set
  Default redistribution metric is 1
  Redistributing:
    Default version control: send version 2, receive any version
    Interface      Send  Recv  Key-chain
    eth0           2    1 2
    eth1           2    1 2
  Routing for Networks:
    eth0
    eth1
  Routing Information Sources:
    Gateway      BadPackets  BadRoutes  Distance  Last Update
    10.0.1.1      0           0          120       00:00:02
    10.0.2.2      0           0          120       00:00:23
  Distance: (default is 120)
vyos@msk-ioithenko-gw-02:~$
```

Рис. 2.17: RIP

```
you can check individual component licenses under /usr/share/doc/*/copyright
vyos@msk-ioithenko-gw-03:~$ 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    10.0.2.1        2 10.0.2.1       0 02:31
C(i) 10.0.2.0/24    0.0.0.0        1 self          0
C(i) 10.0.3.0/24    0.0.0.0        1 self          0
R(n) 10.0.4.0/24    10.0.3.2        2 10.0.3.2       0 02:43
R(n) 10.0.10.0/24   10.0.2.1        3 10.0.2.1       0 02:31
C(i) 10.0.11.0/24   0.0.0.0        1 self          0
vyos@msk-ioithenko-gw-03:~$ show ip rip status
Routing Protocol is "rip"
  Sending updates every 30 seconds with +/-50%, next due in 0 seconds
  Timeout after 180 seconds, garbage collect after 120 seconds
  Outgoing update filter list for all interface is not set
  Incoming update filter list for all interface is not set
  Default redistribution metric is 1
  Redistributing:
    Default version control: send version 2, receive any version
    Interface      Send  Recv  Key-chain
    eth0           2    1 2
    eth1           2    1 2
    eth2           2    1 2
  Routing for Networks:
    eth0
    eth1
    eth2
  Routing Information Sources:
    Gateway      BadPackets  BadRoutes  Distance  Last Update
    10.0.2.1      0           0          120       00:00:08
    10.0.3.2      0           0          120       00:00:25
  Distance: (default is 120)
vyos@msk-ioithenko-gw-03:~$
```

Рис. 2.18: RIP



```
vyos@misk-ioithenko-gw-04# set protocols rip interface eth0
[edit]
vyos@misk-ioithenko-gw-04# set protocols rip interface eth1
[edit]
```

Рис. 2.19: RIP

```
you can check individual component licenses under /usr/share/doc/*/copyright
shvyos@misk-ioithenko-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 02:58
R(n) 10.0.2.0/24    10.0.3.1      2 10.0.3.1      0 02:46
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 02:58
R(n) 10.0.11.0/24   10.0.3.1      2 10.0.3.1      0 02:46
vyos@misk-ioithenko-gw-04:~$ show ip rip status
Routing Protocol is "rip"
  Sending updates every 30 seconds with +/-50%, next due in 9 seconds
  Timeout after 180 seconds, garbage collect after 120 seconds
  Outgoing update filter list for all interface is not set
  Incoming update filter list for all interface is not set
  Default redistribution metric is 1
  Redistributing:
  Default version control: send version 2, receive any version
    Interface      Send Recv      Key-chain
    eth0           2    1 2
    eth1           2    1 2
  Routing for Networks:
    eth0
    eth1
  Routing Information Sources:
    Gateway      BadPackets BadRoutes  Distance Last Update
    10.0.3.1      0           0         120     00:00:24
    10.0.4.2      0           0         120     00:00:12
  Distance: (default is 120)
vyos@misk-ioithenko-gw-04:~$
```

Рис. 2.20: RIP

С PC1 пропингуем PC2 и определим путь следования пакетов(рис. 2.21). Пакеты следуют по маршруту через маршрутизаторы gw-01 -> gw-02 -> gw-03.

```
PC1> ping 10.0.11.10

84 bytes from 10.0.11.10 icmp_seq=1 ttl=61 time=17.334 ms
84 bytes from 10.0.11.10 icmp_seq=2 ttl=61 time=7.790 ms
84 bytes from 10.0.11.10 icmp_seq=3 ttl=61 time=9.447 ms
84 bytes from 10.0.11.10 icmp_seq=4 ttl=61 time=9.039 ms
84 bytes from 10.0.11.10 icmp_seq=5 ttl=61 time=7.950 ms

PC1> 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    1.768 ms  1.571 ms  1.585 ms
 2  10.0.1.2     6.082 ms  3.723 ms  5.089 ms
 3  10.0.2.2     8.075 ms  5.957 ms  9.347 ms
 4  10.0.11.10   12.315 ms 6.623 ms 12.046 ms

PC1>
```

Рис. 2.21: Пинг

Проверим метрики протокола RIP(рис. 2.22).

```

Distance: (default is 120)
vyos@msk-ioithenko-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 02:57
R(n) 10.0.3.0/24    10.0.4.1       2 10.0.4.1       0 02:56
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 02:57
vyos@msk-ioithenko-gw-01:~$

```

Рис. 2.22: Метрики протокола RIP

Отключим интерфейс на маршрутизаторе(рис. 2.23).

```

[edit]
vyos@msk-ioithenko-gw-04# set interfaces ethernet eth0 disable
[edit]
vyos@msk-ioithenko-gw-04# commit
[edit]
vyos@msk-ioithenko-gw-04# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@msk-ioithenko-gw-04#

```

Рис. 2.23: Отключение интерфейса

Проверим метрики протокола (рис. 2.24).

```

R(n) 10.0.11.0/24    10.0.1.2       3 10.0.1.2       0 02:56
vyos@msk-ioithenko-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    10.0.4.1      16 10.0.4.1       0 01:45
R(n) 10.0.3.0/24    10.0.4.1      16 10.0.4.1       0 01:45
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   10.0.4.1      16 10.0.4.1       0 01:45
vyos@msk-ioithenko-gw-01:~$

```

Рис. 2.24: RIP

Пропингуем PC2 (рис. 2.25).

```

PC1> ping 10.0.11.10

*10.0.10.1 icmp_seq=1 ttl=64 time=2.834 ms (ICMP type:3, code:0, Destination net
work unreachable)
*10.0.10.1 icmp_seq=2 ttl=64 time=1.891 ms (ICMP type:3, code:0, Destination net
work unreachable)
*10.0.10.1 icmp_seq=3 ttl=64 time=1.359 ms (ICMP type:3, code:0, Destination net
work unreachable)
*10.0.10.1 icmp_seq=4 ttl=64 time=2.658 ms (ICMP type:3, code:0, Destination net
work unreachable)
*10.0.11.10 icmp_seq=5 timeout

PC1>

```

Рис. 2.25: Пинг

Восстановим интерфейс(рис. 2.26).

```
[edit]
vyos@msk-ioithenko-gw-04# delete interfaces ethernet eth0 disable
[edit]
vyos@msk-ioithenko-gw-04# commit
[edit]
vyos@msk-ioithenko-gw-04# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@msk-ioithenko-gw-04# show interfaces
  ethernet eth0 {
    address 10.0.3.2/24
    address 2001:3::2/64
    hw-id 0c:1b:7c:75:00:00
  }
  ethernet eth1 {
    address 10.0.4.1/24
    address 2001:4::1/64
    hw-id 0c:1b:7c:75:00:01
  }
  ethernet eth2 {
    hw-id 0c:1b:7c:75:00:02
  }
  loopback lo {
  }
[edit]
vyos@msk-ioithenko-gw-04#
```

Рис. 2.26: Восстановление интерфейса

Проверим, что пинг также восстановлен (рис. 2.27).

```
PC1> ping 10.0.11.10

84 bytes from 10.0.11.10 icmp_seq=1 ttl=61 time=11.724 ms
84 bytes from 10.0.11.10 icmp_seq=2 ttl=61 time=7.351 ms
84 bytes from 10.0.11.10 icmp_seq=3 ttl=61 time=7.990 ms
84 bytes from 10.0.11.10 icmp_seq=4 ttl=61 time=5.870 ms
84 bytes from 10.0.11.10 icmp_seq=5 ttl=61 time=10.921 ms

PC1>
```

Рис. 2.27: Пинг

Посмотрим захваченный трафик по протоколу RIP(рис. 2.28).



```
vyos@msk-ioithenko-gw-02# set protocols ripng interface eth0
[edit]
vyos@msk-ioithenko-gw-02# set protocols ripng interface eth1
[edit]
vyos@msk-ioithenko-gw-02# compare
[edit protocols]
+ripng {
+  interface eth0
+  interface eth1
+}
[edit]
vyos@msk-ioithenko-gw-02# commit
[edit]
vyos@msk-ioithenko-gw-02# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@msk-ioithenko-gw-02#
```

Рис. 2.30: RIPng

```
vyos@msk-ioithenko-gw-03:~$ configure
[edit]
vyos@msk-ioithenko-gw-03# set protocols ripng interface eth0
[edit]
vyos@msk-ioithenko-gw-03# set protocols ripng interface eth1
[edit]
vyos@msk-ioithenko-gw-03# set protocols ripng interface eth2
[edit]
vyos@msk-ioithenko-gw-03# compare
[edit protocols]
+ripng {
+  interface eth0
+  interface eth1
+  interface eth2
+}
[edit]
vyos@msk-ioithenko-gw-03# commit
[edit]
vyos@msk-ioithenko-gw-03# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@msk-ioithenko-gw-03#
```

Рис. 2.31: RIPng

```
[edit]
vyos@msk-ioithenko-gw-04# set protocols ripng interface eth0
[edit]
vyos@msk-ioithenko-gw-04# set protocols ripng interface eth1
[edit]
vyos@msk-ioithenko-gw-04# compare
[edit protocols]
+ripng {
+  interface eth0
+  interface eth1
+}
[edit]
vyos@msk-ioithenko-gw-04# commit
[edit]
vyos@msk-ioithenko-gw-04# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@msk-ioithenko-gw-04#
```

Рис. 2.32: RIPng

С PC1 пропингуем PC2 и определим путь следования пакетов (рис. 2.33). Пакеты следуют по маршруту через маршрутизаторы gw-01 -> gw-02 -> gw-03.

```

PC1> ping 2001:11::a
2001:11::a icmp6_seq=1 ttl=58 time=6.748 ms
2001:11::a icmp6_seq=2 ttl=58 time=5.435 ms
2001:11::a icmp6_seq=3 ttl=58 time=3.540 ms
2001:11::a icmp6_seq=4 ttl=58 time=4.657 ms
2001:11::a icmp6_seq=5 ttl=58 time=5.139 ms

PC1> trace 2001:11::a
trace to 2001:11::a, 64 hops max
 1 2001:10::1 1.911 ms 0.982 ms 0.511 ms
 2 2001:1::2 1.412 ms 1.294 ms 1.878 ms
 3 2001:2::2 5.230 ms 5.916 ms 3.377 ms
 4 2001:11::a 2.825 ms 3.816 ms 3.599 ms

PC1>

```

Рис. 2.33: Пинг

Проверим метрики протокола RIPvng (рис. 2.34).

```

vyos@msk-ioithenko-gw-01:~$ show ipv6 ripng
Codes: R - RIPvng, 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::e7a:d0ff:fe48:0 eth1        2    0 02:46
R(n) 2001:3::/64      fe80::e1b:7cff:fe75:1 eth2        2    0 02:42
C(i) 2001:4::/64      ::          self       1    0
C(i) 2001:10::/64     ::          self       1    0
R(n) 2001:11::/64     fe80::e7a:d0ff:fe48:0 eth1        3    0 02:46
vyos@msk-ioithenko-gw-01:~$

```

Рис. 2.34: Метрики протокола

Отключаем интерфейс на маршрутизаторе (рис. 2.35).

```

[edit]
vyos@msk-ioithenko-gw-02# set interfaces ethernet eth0 disable
[edit]
vyos@msk-ioithenko-gw-02# commit
[edit]
vyos@msk-ioithenko-gw-02# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@msk-ioithenko-gw-02#

```

Рис. 2.35: Отключение интерфейса

Просматриваем информацию о протоколе (рис. 2.36).

```
vyos@msk-ioithenko-gw-01:~$ show ipv6 ripng
Codes: R - RIPvng, 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::e7a:d0ff:fe48:0      eth1      2      0 01:11
R(n) 2001:3::/64      fe80::e1b:7cff:fe75:1      eth2      2      0 02:46
C(i) 2001:4::/64      ::      self      1      0
C(i) 2001:10::/64      ::      self      1      0
R(n) 2001:11::/64      fe80::e7a:d0ff:fe48:0      eth1      3      0 02:46
vyos@msk-ioithenko-gw-01:~$
```

Рис. 2.36: Метрики протокола

Пингуем (рис. 2.37). Пинг идет не сразу.

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

2001:11::a icmp6_seq=1 timeout
2001:11::a icmp6_seq=2 timeout
*2001:10::1 icmp6_seq=3 ttl=64 time=0.000 ms (ICMP type:1, code:3, Address unrea
chable)
*2001:10::1 icmp6_seq=4 ttl=64 time=0.000 ms (ICMP type:1, code:3, Address unrea
chable)
2001:11::a icmp6_seq=5 timeout
PC1>
```

Рис. 2.37: Пинг

Включаем интерфейс (рис. 2.38).

```
[edit]
vyos@msk-ioithenko-gw-02# delete interfaces ethernet eth0 disable
[edit]
vyos@msk-ioithenko-gw-02# commit
[edit]
vyos@msk-ioithenko-gw-02# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@msk-ioithenko-gw-02#
```

Рис. 2.38: Включение интерфейса

Пингуем (рис. 2.39).

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

2001:11::a icmp6_seq=1 ttl=58 time=6.547 ms
2001:11::a icmp6_seq=2 ttl=58 time=4.192 ms
2001:11::a icmp6_seq=3 ttl=58 time=5.607 ms
2001:11::a icmp6_seq=4 ttl=58 time=3.962 ms
2001:11::a icmp6_seq=5 ttl=58 time=5.033 ms

PC1>
gw-02:~$ configure
```

Рис. 2.39: Пинг

Просматриваем захваченный трафик(рис. 2.40).

```
Frame 18: 186 bytes on wire (1488 bits), 186 bytes captured (1488 bits) on interface -, id 0
Ethernet II, Src: 0c:ad:66:8f:00:00 (0c:ad:66:8f:00:00), Dst: IPv6mcast_09 (33:33:00:00:00:09)
  > Destination: IPv6mcast_09 (33:33:00:00:00:09)
  > Source: 0c:ad:66:8f:00:00 (0c:ad:66:8f:00:00)
  Type: IPv6 (0x86dd)
  [Stream index: 1]
  Internet Protocol Version 6, Src: fe80::ead:66ff:fe8f:0, Dst: ff02::9
    0110 .... = Version: 6
    > .... 1100 0000 .... = Traffic Class: 0xc0 (DSCP: CS6, ECN: Not-ECT)
    .... 1010 1110 0110 0001 1110 = Flow Label: 0xae61e
    Payload Length: 132
    Next Header: UDP (17)
    Hop Limit: 255
    > Source Address: fe80::ead:66ff:fe8f:0
    > Destination Address: ff02::9
    [Source SLAAC MAC: 0c:ad:66:8f:00:00 (0c:ad:66:8f:00:00)]
    [Stream index: 0]
  User Datagram Protocol, Src Port: 521, Dst Port: 521
    Source Port: 521
    Destination Port: 521
    Length: 132
    Checksum: 0x46cd [unverified]
    [Checksum Status: Unverified]
    [Stream index: 1]
    [Stream Packet Number: 2]
    > [Timestamps]
    UDP payload (124 bytes)
  RIPng
    Command: Response (2)
    Version: 1
    Reserved: 0000
    > Route Table Entry: IPv6 Prefix: 2001:1::/64 Metric: 1
      IPv6 Prefix: 2001:1::
      Route Tag: 0x0000
      Prefix Length: 64
      Metric: 1
    > Route Table Entry: IPv6 Prefix: 2001:2::/64 Metric: 2
    > Route Table Entry: IPv6 Prefix: 2001:3::/64 Metric: 2
    > Route Table Entry: IPv6 Prefix: 2001:4::/64 Metric: 1
    > Route Table Entry: IPv6 Prefix: 2001:10::/64 Metric: 1
    > Route Table Entry: IPv6 Prefix: 2001:11::/64 Metric: 3
```

Рис. 2.40: Захваченный трафик

На маршрутизаторах настроим OSPFv2 для сетей IPv4 и посмотрим информа-  
цию (рис. 2.41).



```

[edit]
vyos@msk-ioithenko-gw-01# set protocols ospf area 0 network 10.0.10.0/24
[edit]
vyos@msk-ioithenko-gw-01# set protocols ospf area 0 network 10.0.1.0/24
[edit]
vyos@msk-ioithenko-gw-01# set protocols ospf area 0 network 10.0.4.0/24
[edit]
vyos@msk-ioithenko-gw-01# compare
[edit protocols]
+ospf {
+  area 0 {
+    network 10.0.10.0/24
+    network 10.0.1.0/24
+    network 10.0.4.0/24
+  }
+}
[edit]
vyos@msk-ioithenko-gw-01# commit
[edit]
vyos@msk-ioithenko-gw-01# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@msk-ioithenko-gw-01# show ip ospf neighbor

Configuration path: [ip] is not valid
Show failed

[edit]
vyos@msk-ioithenko-gw-01# exit
exit
vyos@msk-ioithenko-gw-01:~$ show ip ospf neighbor

Neighbor ID      Pri State          Dead Time Address      Interface
  RXmtL RqstL DBsmL
10.0.2.1         0  1 Full/Backup    38.660s 10.0.1.2      eth1:10.0.1.1
                  0  0
10.0.4.1         0  1 Full/Backup    30.123s 10.0.4.1      eth2:10.0.4.2
                  0  0

vyos@msk-ioithenko-gw-01:~$ show ip ospf route
===== OSPF network routing table =====
N   10.0.1.0/24      [100] area: 0.0.0.0
                        directly attached to eth1
N   10.0.2.0/24      [200] area: 0.0.0.0
                        via 10.0.1.2, eth1
N   10.0.3.0/24      [200] area: 0.0.0.0
                        via 10.0.4.1, eth2
N   10.0.4.0/24      [100] area: 0.0.0.0
                        directly attached to eth2
N   10.0.10.0/24     [100] area: 0.0.0.0
                        directly attached to eth0
N   10.0.11.0/24     [300] area: 0.0.0.0
                        via 10.0.1.2, eth1
                        via 10.0.4.1, eth2

===== OSPF router routing table =====
===== OSPF external routing table =====
vyos@msk-ioithenko-gw-01:~$

```

Рис. 2.41: Настройка OSPF

Пропингуем PC2 (рис. 2.42).

```

PC1> ping 10.0.11.10

84 bytes from 10.0.11.10 icmp_seq=1 ttl=61 time=5.843 ms
84 bytes from 10.0.11.10 icmp_seq=2 ttl=61 time=5.015 ms
84 bytes from 10.0.11.10 icmp_seq=3 ttl=61 time=4.898 ms
84 bytes from 10.0.11.10 icmp_seq=4 ttl=61 time=3.736 ms
84 bytes from 10.0.11.10 icmp_seq=5 ttl=61 time=3.622 ms

PC1> 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    4.274 ms  0.482 ms  0.848 ms
 2  10.0.1.2     2.166 ms  1.067 ms  1.927 ms
 3  10.0.2.2     2.952 ms  4.456 ms  3.083 ms
 4  10.0.11.10   6.403 ms  5.479 ms  3.093 ms

PC1>

```

Рис. 2.42: Пинг

Отключаем интерфейс (рис. 2.43).

```

Done
[edit]
vyos@msk-ioithenko-gw-04# set interfaces ethernet eth0 disable
[edit]
vyos@msk-ioithenko-gw-04# commit
[edit]
vyos@msk-ioithenko-gw-04# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@msk-ioithenko-gw-04#

```

Рис. 2.43: Отключение интерфейса

Пингуем (рис. 2.44).

```

PC1> ping 10.0.11.10

10.0.11.10 icmp_seq=1 timeout
84 bytes from 10.0.11.10 icmp_seq=2 ttl=61 time=5.991 ms
84 bytes from 10.0.11.10 icmp_seq=3 ttl=61 time=4.674 ms
84 bytes from 10.0.11.10 icmp_seq=4 ttl=61 time=4.300 ms
84 bytes from 10.0.11.10 icmp_seq=5 ttl=61 time=4.947 ms

PC1>

```

Рис. 2.44: Пинг

Просматриваем информацию (рис. 2.45).

```

vyos@msk-ioithenko-gw-01:~$ show ip ospf neighbor
Neighbor ID      Pri State          Dead Time Address      Interface
  RXmtL  RqstL DBsmL
10.0.2.1         0    0 1 Full/Backup    38.561s 10.0.1.2      eth1:10.0.1.1
10.0.4.1         0    0 1 Full/Backup    37.449s 10.0.4.1      eth2:10.0.4.2

vyos@msk-ioithenko-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      [300] area: 0.0.0.0
      via 10.0.1.2, eth1
N   10.0.4.0/24      [100] area: 0.0.0.0
      directly attached to eth2
N   10.0.10.0/24     [100] area: 0.0.0.0
      directly attached to eth0
N   10.0.11.0/24     [300] area: 0.0.0.0
      via 10.0.1.2, eth1

===== OSPF router routing table =====
===== OSPF external routing table =====
vyos@msk-ioithenko-gw-01:~$

```

Рис. 2.45: Метрики протокола

Включаем интерфейс(рис. 2.46).

```

[edit]
vyos@msk-ioithenko-gw-04# delete interfaces ethernet eth0 disable
[edit]
vyos@msk-ioithenko-gw-04# commit
[edit]
vyos@msk-ioithenko-gw-04# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@msk-ioithenko-gw-04#

```

Рис. 2.46: Включение интерфейса

Проверяем корректность пинга(рис. 2.47).

```

PC1> ping 10.0.11.10

64 bytes from 10.0.11.10 icmp_seq=1 ttl=61 time=5.772 ms
64 bytes from 10.0.11.10 icmp_seq=2 ttl=61 time=7.021 ms
64 bytes from 10.0.11.10 icmp_seq=3 ttl=61 time=5.174 ms
64 bytes from 10.0.11.10 icmp_seq=4 ttl=61 time=3.739 ms
64 bytes from 10.0.11.10 icmp_seq=5 ttl=61 time=4.238 ms

PC1>

```

Рис. 2.47: Пинг

Просматриваем захваченный трафик(рис. 2.48).

```
> Frame 247: 78 bytes on wire (624 bits), 78 bytes captured (624 bits) on interface -, id 0
  Ethernet II, Src: 0c:ad:66:8f:00:00 (0c:ad:66:8f:00:00), Dst: IPv4mcast_05 (01:00:5e:00:00:05)
    > Destination: IPv4mcast_05 (01:00:5e:00:00:05)
    > Source: 0c:ad:66:8f:00:00 (0c:ad:66:8f:00:00)
    Type: IPv4 (0x0800)
    [Stream index: 5]
  Internet Protocol Version 4, Src: 10.0.10.1, Dst: 224.0.0.5
    0100 .... = Version: 4
    .... 0101 = Header Length: 20 bytes (5)
    > Differentiated Services Field: 0xc0 (DSCP: CS6, ECN: Not-ECT)
    Total Length: 64
    Identification: 0x6df2 (28146)
    > 000. .... = Flags: 0x0
    ...0 0000 0000 0000 = Fragment Offset: 0
    Time to Live: 1
    Protocol: OSPF IGP (89)
    Header Checksum: 0x56ad [validation disabled]
    [Header checksum status: Unverified]
    Source Address: 10.0.10.1
    Destination Address: 224.0.0.5
    [Stream index: 2]
  Open Shortest Path First
    > OSPF Header
      Version: 2
      Message Type: Hello Packet (1)
      Packet Length: 44
      Source OSPF Router: 10.0.10.1
      Area ID: 0.0.0.0 (Backbone)
      Checksum: 0xd49c [correct]
      Auth Type: Null (0)
      Auth Data (none): 0000000000000000
    > OSPF Hello Packet
      Network Mask: 255.255.255.0
      Hello Interval [sec]: 10
      > Options: 0x02, (E) External Routing
      Router Priority: 1
      Router Dead Interval [sec]: 40
      Designated Router: 10.0.10.1
      Backup Designated Router: 0.0.0.0
```

Рис. 2.48: Захваченный трафик

На маршрутизаторах настроим OSPFv3 для сетей IPv6(рис. 2.49).

```

[edit]
vyos@msk-ioithenko-gw-01# set protocols ospfv3 parameters router-id 1.1.1.1
[edit]
vyos@msk-ioithenko-gw-01# set protocols ospfv3 interface eth0 area 0

Configuration path: protocols ospfv3 [interface] is not valid
Set failed

[edit]
vyos@msk-ioithenko-gw-01# set protocols ospfv3 area 0 interface eth0
[edit]
vyos@msk-ioithenko-gw-01# set protocols ospfv3 area 0 interface eth1
[edit]
vyos@msk-ioithenko-gw-01# set protocols ospfv3 area 0 interface eth2
[edit]
vyos@msk-ioithenko-gw-01# compare
[edit protocols]
+ospfv3 {
+   area 0 {
+       interface eth0
+       interface eth1
+       interface eth2
+   }
+   parameters {
+       router-id 1.1.1.1
+   }
+}
[edit]
vyos@msk-ioithenko-gw-01# commit
[edit]
vyos@msk-ioithenko-gw-01# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@msk-ioithenko-gw-01# show ipv6 ospfv3 neighbor

Configuration path: [ipv6] is not valid
Show failed

[edit]
vyos@msk-ioithenko-gw-01# exit
exit
vyos@msk-ioithenko-gw-01:~$ show ipv6 ospfv3 neighbor
Neighbor ID      Pri   DeadTime   State/IfState   Duration I/F[State]
2.2.2.2          1     00:00:39    Full/BDR        00:05:45 eth1[DR]
4.4.4.4          1     00:00:31    Full/BDR        00:01:44 eth2[DR]
vyos@msk-ioithenko-gw-01:~$ show ipv6 ospfv3 route
*N IA 2001:1::/64      ::          eth1 00:06:07
*N IA 2001:2::/64      fe80::e7a:d0ff:fe48:0 eth1 00:04:20
*N IA 2001:3::/64      fe80::e1b:7cff:fe75:1 eth2 00:01:57
*N IA 2001:4::/64      ::          eth2 00:02:07
*N IA 2001:10::/64     ::          eth0 00:07:18
*N IA 2001:11::/64     fe80::e7a:d0ff:fe48:0 eth1 00:01:57
                        fe80::e1b:7cff:fe75:1 eth2
vyos@msk-ioithenko-gw-01:~$

```

Рис. 2.49: Настройка OSPFv3

Пропингуем PC2 (рис. 2.50).

```

PC1> ping 2001:11::a

2001:11::a icmp6_seq=1 ttl=58 time=6.304 ms
2001:11::a icmp6_seq=2 ttl=58 time=3.845 ms
2001:11::a icmp6_seq=3 ttl=58 time=5.644 ms
2001:11::a icmp6_seq=4 ttl=58 time=4.401 ms
2001:11::a icmp6_seq=5 ttl=58 time=4.860 ms

PC1> trace 2001:11::a

trace to 2001:11::a, 64 hops max
 1 2001:10::1 1.137 ms 0.556 ms 0.868 ms
 2 2001:4::1 1.480 ms 1.569 ms 1.557 ms
 3 2001:3::1 5.192 ms 2.038 ms 1.745 ms
 4 2001:11::a 2.259 ms 2.695 ms 3.111 ms

PC1>

```

Рис. 2.50: Пинг

Отключаем интерфейс (рис. 2.51).

```

[edit]
vyos@msk-ioithenko-gw-04# set interfaces ethernet eth0 disable
[edit]
vyos@msk-ioithenko-gw-04# commit
[edit]
vyos@msk-ioithenko-gw-04# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@msk-ioithenko-gw-04#

```

Рис. 2.51: Отключение

Просматриваем информацию (рис. 2.52).

```

vyos@msk-ioithenko-gw-01:~$ show ipv6 ospfv3 route
*N IA 2001:1::/64 :: eth1 00:00:03
*N IA 2001:2::/64 fe80::e7a:d0ff:fe48:0 eth1 00:00:26
*N IA 2001:3::/64 fe80::e7a:d0ff:fe48:0 eth1 00:00:10
*N IA 2001:4::/64 :: eth2 00:04:47
*N IA 2001:10::/64 :: eth0 00:01:03
*N IA 2001:11::/64 fe80::e7a:d0ff:fe48:0 eth1 00:00:10
vyos@msk-ioithenko-gw-01:~$

```

Рис. 2.52: Метрики протокола

Пингуем (рис. 2.53).

```

PC1> ping 2001:11::a

2001:11::a icmp6_seq=1 ttl=58 time=4.904 ms
2001:11::a icmp6_seq=2 ttl=58 time=3.642 ms
2001:11::a icmp6_seq=3 ttl=58 time=4.336 ms
2001:11::a icmp6_seq=4 ttl=58 time=4.339 ms
2001:11::a icmp6_seq=5 ttl=58 time=3.379 ms

PC1>

```

Рис. 2.53: Пинг

Включаем интерфейс (рис. 2.54).

```

vyos@msk-ioithenko-gw-04# delete interfaces ethernet eth0 disable
[edit]
vyos@msk-ioithenko-gw-04# commit
[edit]
vyos@msk-ioithenko-gw-04# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@msk-ioithenko-gw-04#

```

Рис. 2.54: Включение

Проверяем пинг (рис. 2.55).

```

PC1> ping 2001:11::a

2001:11::a icmp6_seq=1 ttl=58 time=12.062 ms
2001:11::a icmp6_seq=2 ttl=58 time=3.720 ms
2001:11::a icmp6_seq=3 ttl=58 time=7.113 ms
2001:11::a icmp6_seq=4 ttl=58 time=4.787 ms
2001:11::a icmp6_seq=5 ttl=58 time=7.785 ms

PC1>

```

Рис. 2.55: Пинг

Просматриваем захваченный трафик (рис. 2.56).

```

[Time delta from previous captured frame: 4.779135000 seconds]
[Time delta from previous displayed frame: 4.779135000 seconds]
[Time since reference or first frame: 2728.155907000 seconds]
Frame Number: 710
Frame Length: 90 bytes (720 bits)
Capture Length: 90 bytes (720 bits)
[Frame is marked: False]
[Frame is ignored: False]
[Protocols in frame: eth:ethertype:ipv6:ospf]
[Coloring Rule Name: Routing]
[Coloring Rule String: hsrp || eigrp || ospf || bgp || cdp || vrrp || carp || gvrp || igmp || ismp]
▼ Ethernet II, Src: 0c:ad:66:8f:00:00 (0c:ad:66:8f:00:00), Dst: IPv6mcast_05 (33:33:00:00:00:05)
  > Destination: IPv6mcast_05 (33:33:00:00:00:05)
  > Source: 0c:ad:66:8f:00:00 (0c:ad:66:8f:00:00)
  Type: IPv6 (0x86dd)
  [Stream index: 8]
▼ Internet Protocol Version 6, Src: fe80::ead:66ff:fe8f:0, Dst: ff02::5
  0110 .... = Version: 6
  > .... 1100 0000 .... = Traffic Class: 0xc0 (DSCP: CS6, ECN: Not-ECT)
  .... 1010 1100 0000 1010 = Flow Label: 0xac90a
  Payload Length: 36
  Next Header: OSPF IGP (89)
  Hop Limit: 1
  > Source Address: fe80::ead:66ff:fe8f:0
  > Destination Address: ff02::5
  [Source SLAAC MAC: 0c:ad:66:8f:00:00 (0c:ad:66:8f:00:00)]
  [Stream index: 5]
▼ Open Shortest Path First
  ▼ OSPF Header
    Version: 3
    Message Type: Hello Packet (1)
    Packet Length: 36
    Source OSPF Router: 1.1.1.1
    Area ID: 0.0.0.0 (Backbone)
    Checksum: 0x854d [correct]
    Instance ID: IPv6 unicast AF (0)
    Reserved: 00
  ▼ OSPF Hello Packet
    Interface ID: 2
    Router Priority: 1
    > Options: 0x00013, R, E, V6
    Hello Interval [sec]: 10
    Router Dead Interval [sec]: 40
    Designated Router: 1.1.1.1
    Backup Designated Router: 0.0.0.0

```

Рис. 2.56: Захваченный трафик

Заданы две IPv6-сети и IPv4-сеть. Перенесем заданную топологию(рис. 2.57).

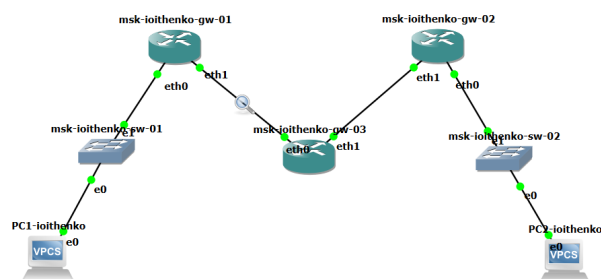


Рис. 2.57: Топология сети

Присвоим адреса оконечным устройствам PC1 и PC2 (рис. 2.58) и (рис. 2.59).



```

VPCS> ip 1000::a/64
PC1 : 1000::a/64

VPCS> save
Saving startup configuration to startup.vpc
. done

VPCS> show ipv6

NAME                : VPCS[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

VPCS>

```

Рис. 2.58: Адрес на PC1

```

VPCS> ip 1002::a/64
PC1 : 1002::a/64

VPCS> save
Saving startup configuration to startup.vpc
. done

VPCS> show ipv6

NAME                : VPCS[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

VPCS>

```

Рис. 2.59: Адрес на PC2

На маршрутизаторах перейдем в режим конфигурирования, изменим имя устройства. Настроим адреса на интерфейсах маршрутизаторов (рис. 2.60), (рис. 2.61), (рис. 2.62).

```

vyos@misk-ioithenko-gw-01# set interfaces ethernet eth0 address 1000::1/64
[edit]
vyos@misk-ioithenko-gw-01# compare
[edit interfaces ethernet eth0]
+address 1000::1/64
[edit]
vyos@misk-ioithenko-gw-01# set interfaces ethernet eth1 address 10.0.0.1/8
[edit]
/64s@misk-ioithenko-gw-01# set service router-advert interface eth0 prefix 1000::
[edit]
vyos@misk-ioithenko-gw-01# compare
[edit interfaces ethernet eth0]
+address 1000::1/64
[edit interfaces ethernet eth1]
+address 10.0.0.1/8
[edit service]
+router-advert {
+  interface eth0 {
+    prefix 1000::/64 {
+    }
+  }
+}
[edit]
vyos@misk-ioithenko-gw-01# commit
[edit]
vyos@misk-ioithenko-gw-01# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@misk-ioithenko-gw-01#

```

Рис. 2.60: Настройка адресов

```

you can check individual component licenses under /usr/share/doc/*/copyright
vyos@vyos:~$ configure
[edit]
vyos@vyos# set system host-name misk-ioithenko-gw-02
[edit]
vyos@vyos# commit
[edit]
vyos@vyos# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@vyos# exit
exit
vyos@vyos:~$ exit
logout

Welcome to VyOS - misk-ioithenko-gw-02 ttyS0

misk-ioithenko-gw-02 login: vyos
Password:
Welcome to VyOS!

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

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
vyos@misk-ioithenko-gw-02:~$ configure
[edit]
vyos@misk-ioithenko-gw-02# set interfaces ethernet eth0 address 1002::1/64
[edit]
vyos@misk-ioithenko-gw-02# set interfaces ethernet eth1 address 20.0.0.2/8
[edit]
/64s@misk-ioithenko-gw-02# set service router-advert interface eth0 prefix 1002::
[edit]
vyos@misk-ioithenko-gw-02# commit
[edit]
vyos@misk-ioithenko-gw-02# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@misk-ioithenko-gw-02#

```

Рис. 2.61: Настройка адресов

```

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

Welcome to VyOS - msk-ioithenko-gw-03 ttyS0

msk-ioithenko-gw-03 login: vyos
Password:
Welcome to VyOS!

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

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
vyos@msk-ioithenko-gw-03:~$ configure
[edit]
vyos@msk-ioithenko-gw-03# set interfaces ethernet eth0 address 10.0.0.2/8
[edit]
vyos@msk-ioithenko-gw-03# set interfaces ethernet eth1 address 20.0.0.1/8
[edit]
vyos@msk-ioithenko-gw-03# commit

Can't configure both static IPv4 and DHCP address on the same interface
[[interfaces ethernet eth0]] failed
Commit failed
[edit]
vyos@msk-ioithenko-gw-03# delete interfaces ethernet eth0 address dhcp
[edit]
vyos@msk-ioithenko-gw-03# commit
[edit]
vyos@msk-ioithenko-gw-03# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@msk-ioithenko-gw-03# █

```

Рис. 2.62: Настройка адресов

Убедимся, что на PC появились адреса ближайших к ним маршрутизаторов (рис. 2.63) и (рис. 2.64).

```

VPCS> show ipv6

NAME                : VPCS[1]
LINK-LOCAL SCOPE    : fe80::250:79ff:fe66:6800/64
GLOBAL SCOPE        : 1000::a/64
DNS                 :
ROUTER LINK-LAYER   : 0c:f2:3c:b8:00:00
MAC                 : 00:50:79:66:68:00
LPORT               : 20030
RHOST:PORT           : 127.0.0.1:20031
MTU                 : 1500

VPCS> █

```

Рис. 2.63: Проверка адресов ближайших маршрутизаторов

```

VPCS> show ipv6

NAME                : VPCS[1]
LINK-LOCAL SCOPE    : fe80::250:79ff:fe66:6801/64
GLOBAL SCOPE        : 1002::a/64
DNS                 :
ROUTER LINK-LAYER   : 0c:a7:41:89:00:00
MAC                 : 00:50:79:66:68:01
LPORT               : 20032
RHOST:PORT          : 127.0.0.1:20033
MTU                 : 1500

VPCS>

```

Рис. 2.64: Проверка адресов ближайших маршрутизаторов

Проверим маршруты с маршрутизатора R1(рис. 2.65).

```

exit
vyos@msk-ioithenko-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=5.90 ms
64 bytes from 10.0.0.2: icmp_seq=2 ttl=64 time=2.30 ms
64 bytes from 10.0.0.2: icmp_seq=3 ttl=64 time=2.36 ms
64 bytes from 10.0.0.2: icmp_seq=4 ttl=64 time=1.97 ms
64 bytes from 10.0.0.2: icmp_seq=5 ttl=64 time=4.16 ms
64 bytes from 10.0.0.2: icmp_seq=6 ttl=64 time=3.84 ms
64 bytes from 10.0.0.2: icmp_seq=7 ttl=64 time=3.21 ms
^C
--- 10.0.0.2 ping statistics ---
7 packets transmitted, 7 received, 0% packet loss, time 16ms
rtt min/avg/max/mdev = 1.969/3.390/5.900/1.276 ms
vyos@msk-ioithenko-gw-01:~$ ping 20.0.0.1
connect: Network is unreachable
vyos@msk-ioithenko-gw-01:~$ ping 20.0.0.2
connect: Network is unreachable
vyos@msk-ioithenko-gw-01:~$

```

Рис. 2.65: Проверка маршрутов

Настроим маршрутизацию IPv4 по протоколу RIP(рис. 2.66).

```

vyos@msk-ioithenko-gw-01# set protocols rip network 10.0.0.0/8
[edit]
vyos@msk-ioithenko-gw-01# commit save
[edit]
vyos@msk-ioithenko-gw-01# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@msk-ioithenko-gw-01#

```

Рис. 2.66: Настройка маршрутизации

Проверим маршруты с маршрутизатора R1 (рис. 2.67).

```

[edit]
vyos@msk-ioithenko-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=3.73 ms
64 bytes from 10.0.0.2: icmp_seq=2 ttl=64 time=2.94 ms
64 bytes from 10.0.0.2: icmp_seq=3 ttl=64 time=4.22 ms
64 bytes from 10.0.0.2: icmp_seq=4 ttl=64 time=2.66 ms
64 bytes from 10.0.0.2: icmp_seq=5 ttl=64 time=2.91 ms
^C
--- 10.0.0.2 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 12ms
rtt min/avg/max/mdev = 2.659/3.291/4.215/0.587 ms
[edit]
vyos@msk-ioithenko-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=6.13 ms
64 bytes from 20.0.0.1: icmp_seq=2 ttl=64 time=3.14 ms
64 bytes from 20.0.0.1: icmp_seq=3 ttl=64 time=2.06 ms
64 bytes from 20.0.0.1: icmp_seq=4 ttl=64 time=2.26 ms
^C
--- 20.0.0.1 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 9ms
rtt min/avg/max/mdev = 2.061/3.396/6.127/1.628 ms
[edit]
vyos@msk-ioithenko-gw-01# ping 20.0.0.2
PING 20.0.0.2 (20.0.0.2) 56(84) bytes of data.
64 bytes from 20.0.0.2: icmp_seq=1 ttl=63 time=5.11 ms
64 bytes from 20.0.0.2: icmp_seq=2 ttl=63 time=6.62 ms
64 bytes from 20.0.0.2: icmp_seq=3 ttl=63 time=5.27 ms
64 bytes from 20.0.0.2: icmp_seq=4 ttl=63 time=6.29 ms
^C
--- 20.0.0.2 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 9ms
rtt min/avg/max/mdev = 5.110/5.824/6.624/0.650 ms
[edit]
vyos@msk-ioithenko-gw-01#

```

Рис. 2.67: Проверка маршрутов

Создадим туннель IPv6 через сеть IPv4 (рис. 2.68) и (рис. 2.69).

```

[edit]
vyos@msk-ioithenko-gw-01# set interfaces tunnel tun0 encapsulation sit
[edit]
vyos@msk-ioithenko-gw-01# set interfaces tunnel tun0 source-address 10.0.0.1
[edit]
vyos@msk-ioithenko-gw-01# set interfaces tunnel tun0 remote 20.0.0.2
[edit]
vyos@msk-ioithenko-gw-01# set interfaces tunnel tun0 address 1001::1/64
[edit]
vyos@msk-ioithenko-gw-01# commit
[edit]
vyos@msk-ioithenko-gw-01# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@msk-ioithenko-gw-01# set protocols static route6 1002::0/64 next-hop 1001::
[edit]
vyos@msk-ioithenko-gw-01# commit
[edit]
vyos@msk-ioithenko-gw-01# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@msk-ioithenko-gw-01#

```

Рис. 2.68: Создание туннеля

```

vyos@msk-ioithenko-gw-02# set interfaces tunnel tun0 encapsulation sit
[edit]
vyos@msk-ioithenko-gw-02# set interfaces tunnel tun0 source-address 20.0.0.2
[edit]
vyos@msk-ioithenko-gw-02# set interfaces tunnel tun0 remote 10.0.0.1
[edit]
vyos@msk-ioithenko-gw-02# set interfaces tunnel tun0 address 1001::2/64
[edit]
vyos@msk-ioithenko-gw-02# commit
[edit]
vyos@msk-ioithenko-gw-02# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@msk-ioithenko-gw-02# set protocols static route6 1000::0/64 next-hop 1001::
[edit]
vyos@msk-ioithenko-gw-02# commit
[edit]
vyos@msk-ioithenko-gw-02# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@msk-ioithenko-gw-02# █

```

Рис. 2.69: Создайте туннель IPv6 через сеть IPv4

Проверим доступность конечных устройств (рис. 2.70).

```
PC1-ioithenko - PuTTY
GLOBAL SCOPE      : 1000::a/64
DNS               :
ROUTER LINK-LAYER : 0c:f2:3c:b8:00:00
MAC               : 00:50:79:66:68:00
LPORT             : 20030
RHOST:PORT        : 127.0.0.1:20031
MTU               : 1500

VPCS> ping 1002::a

1002::a icmp6_seq=1 ttl=60 time=11.773 ms
1002::a icmp6_seq=2 ttl=60 time=7.787 ms
1002::a icmp6_seq=3 ttl=60 time=19.261 ms
1002::a icmp6_seq=4 ttl=60 time=7.870 ms
1002::a icmp6_seq=5 ttl=60 time=8.945 ms

VPCS> trace 1002::a

trace to 1002::a, 64 hops max
 1 1000::1  2.260 ms  0.993 ms  0.789 ms
 2 1001::2  9.936 ms  8.526 ms  7.092 ms
 3 1002::a  10.825 ms  6.589 ms  14.810 ms

PC2-ioithenko - PuTTY
GLOBAL SCOPE      : 1002::a/64
DNS               :
ROUTER LINK-LAYER : 0c:a7:41:89:00:00
MAC               : 00:50:79:66:68:01
LPORT             : 20032
RHOST:PORT        : 127.0.0.1:20033
MTU               : 1500

VPCS> ping 1000::a

1000::a icmp6_seq=1 ttl=60 time=8.134 ms
1000::a icmp6_seq=2 ttl=60 time=7.093 ms
1000::a icmp6_seq=3 ttl=60 time=8.221 ms
1000::a icmp6_seq=4 ttl=60 time=9.031 ms
1000::a icmp6_seq=5 ttl=60 time=13.097 ms

VPCS> trace 1000::a

trace to 1000::a, 64 hops max
 1 1002::1  3.720 ms  1.170 ms  1.050 ms
 2 1001::1  8.869 ms  5.594 ms  8.527 ms
 3 1000::a  13.513 ms  6.743 ms  12.992 ms

VPCS> █
```

Рис. 2.70: Пинг

Посмотрим захваченный трафик (рис. 2.71).

```

[Coloring Rule Name: IPv6 hop limit low or unexpected]
[Coloring Rule String: (ipv6.dst != ff00::/8 && ipv6.hlim < 5 && !( ospf|| bgp || tcp.port==179)) ||
> Ethernet II, Src: 0c:db:4c:60:00:00 (0c:db:4c:60:00:00), Dst: 0c:f2:3c:b8:00:01 (0c:f2:3c:b8:00:01)
✓ Internet Protocol Version 4, Src: 20.0.0.2, Dst: 10.0.0.1
    0100 .... = Version: 4
    .... 0101 = Header Length: 20 bytes (5)
    > Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
        Total Length: 132
        Identification: 0x8402 (33794)
    > 010. .... = Flags: 0x2, Don't fragment
        ... 0 0000 0000 0000 = Fragment Offset: 0
        Time to Live: 63
        Protocol: IPv6 (41)
        Header Checksum: 0x994c [validation disabled]
        [Header checksum status: Unverified]
        Source Address: 20.0.0.2
        Destination Address: 10.0.0.1
        [Stream index: 7]
✓ Internet Protocol Version 6, Src: 1002::a, Dst: 1000::a
    0110 .... = Version: 6
    > .... 0000 0000 .... = Traffic Class: 0x00 (DSCP: CS0, ECN: Not-ECT)
        .... 0000 0000 0000 0000 = Flow Label: 0x0000
        Payload Length: 72
        Next Header: UDP (17)
        Hop Limit: 1
    > Source Address: 1002::a
    > Destination Address: 1000::a
        [Stream index: 0]
✓ User Datagram Protocol, Src Port: 46417, Dst Port: 46418
    Source Port: 46417
    Destination Port: 46418
    Length: 72
    Checksum: 0xcc08 [unverified]
    [Checksum Status: Unverified]
    [Stream index: 4]
    [Stream Packet Number: 1]
    > [Timestamps]
    UDP payload (64 bytes)
✓ Data (64 bytes)
    Data: 0050796668010e0f101112131415161718191a1b1c1d1e1f202122232425262728292a2b2c2d2e2f30313233343536
    [Length: 64]

```

Рис. 2.71: Захваченный трафик



### 3 Самостоятельная работа

По таблице адресов сетей (табл. 3.1) разработаем таблицу адресации (табл. 3.2).

Таблица 3.1: Таблица адресов сетей

Устройства	Сеть IPv4	Сеть IPv6
PC1–gw-01	10.10.1.96/27	2001:db8:1:1::/64
PC2–gw-02	10.10.1.64/28	2001:db8:1:6::/64
gw-01–gw-03	10.10.1.4/30	2001:db8:1:2::/64
gw-03–gw-02	10.10.1.8/30	2001:db8:1:3::/64
gw-02–gw-04	10.10.1.16/30	2001:db8:1:4::/64
gw-04–gw-01	10.10.1.32/30	2001:db8:1:5::/64

Таблица 3.2: Таблица адресации

Устрой- ство	Интер- фейс	Адрес IP/префикс	Шлюз по умолчанию	Следующее устройство
<b>gw-01</b>	eth0	10.10.1.97/27	n/a	PC1
<b>gw-01</b>	eth0	2001:db8:1:1::1/64	n/a	PC1
<b>gw-01</b>	eth1	10.10.1.5/30	n/a	gw-03
<b>gw-01</b>	eth1	2001:db8:1:2::1/64	n/a	gw-03
<b>gw-01</b>	eth2	10.10.1.33/30	n/a	gw-04
<b>gw-01</b>	eth2	2001:db8:1:5::1/64	n/a	gw-04
<b>gw-02</b>	eth0	10.10.1.65/28	n/a	PC2

Устрой- ство	Интер- фейс	Адрес IP/префикс	Шлюз по умолчанию	Следующее устройство
<b>gw-02</b>	eth0	2001:db8:1:6::1/64	n/a	PC2
<b>gw-02</b>	eth1	10.10.1.18/30	n/a	gw-03
<b>gw-02</b>	eth1	2001:db8:1:4::2/64	n/a	gw-03
<b>gw-02</b>	eth2	10.10.1.9/30	n/a	gw-04
<b>gw-02</b>	eth2	2001:db8:1:3::1/64	n/a	gw-04
<b>gw-03</b>	eth0	10.10.1.6/30	n/a	gw-01
<b>gw-03</b>	eth0	2001:db8:1:2::2/64	n/a	gw-01
<b>gw-03</b>	eth1	10.10.1.17/30	n/a	gw-02
<b>gw-03</b>	eth1	2001:db8:1:4::1/64	n/a	gw-02
<b>gw-04</b>	eth0	10.10.1.10/30	n/a	gw-02
<b>gw-04</b>	eth0	2001:db8:1:3::2/64	n/a	gw-02
<b>gw-04</b>	eth1	10.10.1.34/30	n/a	gw-01
<b>gw-04</b>	eth1	2001:db8:1:5::2/64	n/a	gw-01
<b>PC1</b>	NIC	10.10.1.98/27	10.10.1.97	gw-01
<b>PC1</b>	NIC	2001:db8:1:1::2/64	n/a	gw-01
<b>PC2</b>	NIC	10.10.1.66/28	10.10.1.65	gw-02
<b>PC2</b>	NIC	2001:db8:1:6::2/64	n/a	gw-02

Перенесем топологию сети и включим захват трафика на соединениях коммутатора и маршрутизатора(рис. 3.1).

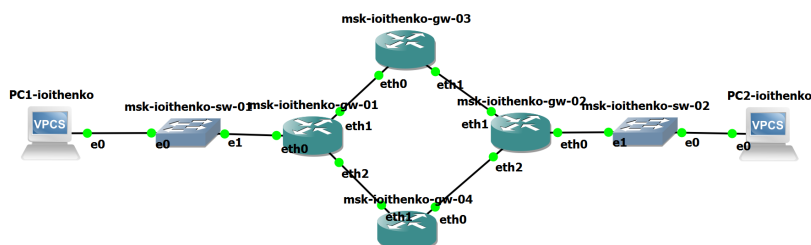
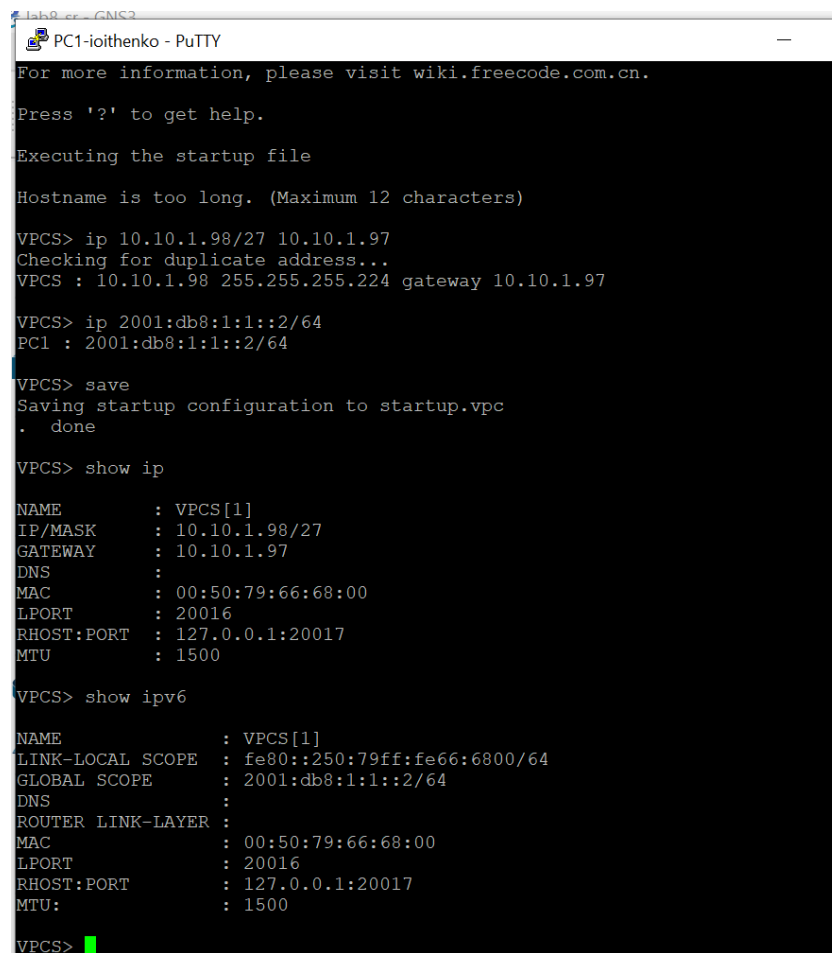


Рис. 3.1: Топология сети

Зададим адреса на PC1(рис. 3.2).



```
lab8 er - GNS3
PC1-ioithenko - PuTTY
For more information, please visit wiki.freecode.com.cn.
Press '?' to get help.
Executing the startup file
Hostname is too long. (Maximum 12 characters)
VPCS> ip 10.10.1.98/27 10.10.1.97
Checking for duplicate address...
VPCS : 10.10.1.98 255.255.255.224 gateway 10.10.1.97

VPCS> ip 2001:db8:1:1::2/64
PC1 : 2001:db8:1:1::2/64

VPCS> save
Saving startup configuration to startup.vpc
. done

VPCS> show ip

NAME          : VPCS[1]
IP/MASK       : 10.10.1.98/27
GATEWAY       : 10.10.1.97
DNS           :
MAC           : 00:50:79:66:68:00
LPORT        : 20016
RHOST:PORT    : 127.0.0.1:20017
MTU           : 1500

VPCS> show ipv6

NAME          : VPCS[1]
LINK-LOCAL SCOPE : fe80::250:79ff:fe66:6800/64
GLOBAL SCOPE    : 2001:db8:1:1::2/64
DNS             :
ROUTER LINK-LAYER :
MAC             : 00:50:79:66:68:00
LPORT           : 20016
RHOST:PORT      : 127.0.0.1:20017
MTU             : 1500

VPCS>
```

Рис. 3.2: Адреса на PC1

Зададим адреса на PC2(рис. 3.3).

```
PC2-ioithenko - PuTTY
All rights reserved.

VPCS is free software, distributed under the terms of the "BSD" licence.
Source code and license can be found at vpcs.sf.net.
For more information, please visit wiki.freecode.com.cn.

Press '?' to get help.

Executing the startup file

Hostname is too long. (Maximum 12 characters)

VPCS> ip 10.10.1.66/28 10.10.1.65
Checking for duplicate address...
VPCS : 10.10.1.66 255.255.255.240 gateway 10.10.1.65

VPCS> ip 2001:db8:1:6::2/64
PC1 : 2001:db8:1:6::2/64

VPCS> show ip
NAME          : VPCS[1]
IP/MASK       : 10.10.1.66/28
GATEWAY       : 10.10.1.65
DNS           :
MAC           : 00:50:79:66:68:01
LPORT        : 20018
RHOST:PORT    : 127.0.0.1:20019
MTU           : 1500

VPCS> show ipv6
NAME          : VPCS[1]
LINK-LOCAL SCOPE : fe80::250:79ff:fe66:6801/64
GLOBAL SCOPE    : 2001:db8:1:6::2/64
DNS             :
ROUTER LINK-LAYER :
MAC             : 00:50:79:66:68:01
LPORT          : 20018
RHOST:PORT      : 127.0.0.1:20019
MTU             : 1500

VPCS> █
```

Рис. 3.3: Адреса на PC2

Настроим IPv4-адреса и IPv6-адреса на интерфейсах маршрутизаторов (рис. 3.4), (рис. 3.5), (рис. 3.6) и (рис. 3.7).

```

vyos@msk-ioithenko-gw-01:~$ configure
[edit]
vyos@msk-ioithenko-gw-01# delete interfaces ethernet eth0 address dhcp
[edit]
vyos@msk-ioithenko-gw-01# set interfaces ethernet eth0 address 10.10.1.97/27
[edit]
vyos@msk-ioithenko-gw-01# set interfaces ethernet eth1 address 10.10.1.5/30
[edit]
vyos@msk-ioithenko-gw-01# set interfaces ethernet eth2 address 10.10.1.33/30
[edit]
4yos@msk-ioithenko-gw-01# set interfaces ethernet eth0 address 2001:db8:1:1::1/6
[edit]
b8:1:1::/64ithenko-gw-01# set service router-advert interface eth0 prefix 2001:d
[edit]
vyos@msk-ioithenko-gw-01# set interfaces ethernet eth1 address 2001:db8:1:2::1
Possible completions:
  <x.x.x.x/x> IPv4 address and prefix length
  <h:h:h:h:h:h/x> IPv6 address and prefix length
  dhcp Dynamic Host Configuration Protocol
  dhcpv6 Dynamic Host Configuration Protocol for IPv6

[edit]
4yos@msk-ioithenko-gw-01# set interfaces ethernet eth1 address 2001:db8:1:2::1/6
[edit]
4yos@msk-ioithenko-gw-01# set interfaces ethernet eth2 address 2001:db8:1:5::1/6
[edit]
vyos@msk-ioithenko-gw-01# compare
[edit interfaces ethernet eth0]
- address dhcp
+ address 10.10.1.97/27
+ address 2001:db8:1:1::1/64
[edit interfaces ethernet eth1]
+ address 10.10.1.5/30
+ address 2001:db8:1:2::1/64
[edit interfaces ethernet eth2]
+ address 10.10.1.33/30
+ address 2001:db8:1:5::1/64
[edit service]
+ router-advert {
+   interface eth0 {
+     prefix 2001:db8:1:1::/64 {
+     }
+   }
+ }
[edit]

```

Рис. 3.4: Настройка адресов

```

vyos@msk-ioithenko-gw-02:~$ configure
[edit]
vyos@msk-ioithenko-gw-02# delete interfaces ethernet eth0 address dhcp
[edit]
vyos@msk-ioithenko-gw-02# set interfaces ethernet eth0 address 10.10.1.65/28
[edit]
vyos@msk-ioithenko-gw-02# set interfaces ethernet eth1 address 10.10.1.18/30
[edit]
vyos@msk-ioithenko-gw-02# set interfaces ethernet eth2 address 10.10.1.9/30
[edit]
4yos@msk-ioithenko-gw-02# set interfaces ethernet eth0 address 2001:db8:1:6::1/64
[edit]
b8:1:6::/64ithenko-gw-02# set service router-advert interface eth0 prefix 2001:d
[edit]
4yos@msk-ioithenko-gw-02# set interfaces ethernet eth1 address 2001:db8:1:4::2/64
[edit]
4yos@msk-ioithenko-gw-02# set interfaces ethernet eth2 address 2001:db8:1:3::1/64
[edit]
vyos@msk-ioithenko-gw-02# compare
[edit interfaces ethernet eth0]
- address dhcp
+ address 10.10.1.65/28
+ address 2001:db8:1:6::1/64
[edit interfaces ethernet eth1]
+ address 10.10.1.18/30
+ address 2001:db8:1:4::2/64
[edit interfaces ethernet eth2]
+ address 10.10.1.9/30
+ address 2001:db8:1:3::1/64
[edit service]
+ router-advert {
+   interface eth0 {
+     prefix 2001:db8:1:6::/64 {
+     }
+   }
+ }
[edit]

```

Рис. 3.5: Настройка адресов

```

vyos@msk-ioithenko-gw-03:~$ configure
[edit]
vyos@msk-ioithenko-gw-03# delete interfaces ethernet eth0 address dhcp
[edit]
vyos@msk-ioithenko-gw-03# set interfaces ethernet eth0 address 10.10.1.6/30
[edit]
vyos@msk-ioithenko-gw-03# set interfaces ethernet eth1 address 10.10.1.17/30
[edit]
4yos@msk-ioithenko-gw-03# set interfaces ethernet eth0 address 2001:db8:1:2::2/64
[edit]
4yos@msk-ioithenko-gw-03# set interfaces ethernet eth1 address 2001:db8:1:4::1/64
[edit]
vyos@msk-ioithenko-gw-03# compare
[edit interfaces ethernet eth0]
- address dhcp
+ address 10.10.1.6/30
+ address 2001:db8:1:2::2/64
[edit interfaces ethernet eth1]
+ address 10.10.1.17/30
+ address 2001:db8:1:4::1/64
[edit]

```

Рис. 3.6: Настройка адресов

```

VyOS is a free software distribution that includes multiple components,
you can check individual component licenses under /usr/share/doc/*/copyright
vyos@msk-ioithenko-gw-04:~$ configure
[edit]
vyos@msk-ioithenko-gw-04# delete interfaces ethernet eth0 address dhcp
[edit]
vyos@msk-ioithenko-gw-04# set interfaces ethernet eth0 address 10.10.1.10/30
[edit]
vyos@msk-ioithenko-gw-04# set interfaces ethernet eth1 address 10.10.1.34/30
[edit]
4yos@msk-ioithenko-gw-04# set interfaces ethernet eth0 address 2001:db8:1:3::2/6
[edit]
4yos@msk-ioithenko-gw-04# set interfaces ethernet eth1 address 2001:db8:1:5::2/6
[edit]
vyos@msk-ioithenko-gw-04# compare
[edit interfaces ethernet eth0]
- address dhcp
+ address 10.10.1.10/30
+ address 2001:db8:1:3::2/64
[edit interfaces ethernet eth1]
+ address 10.10.1.34/30
+ address 2001:db8:1:5::2/64
[edit]

```

Рис. 3.7: Настройка адресов

Настроим маршрутизацию по протоколу RIP и посмотрим метрики протокола (рис. 3.8) и (рис. 3.9).

```

vyos@msk-ioithenko-gw-01# set protocols rip interface eth0
[edit]
vyos@msk-ioithenko-gw-01# set protocols rip interface eth1
[edit]
vyos@msk-ioithenko-gw-01# set protocols rip interface eth2
[edit]
vyos@msk-ioithenko-gw-01# commit
[edit]
vyos@msk-ioithenko-gw-01# save
Saving configuration to '/config/config.boot'...
Done
[edit]

```

Рис. 3.8: Настройка RIP

```
vyos@msk-ioithenko-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) 10.10.1.4/30   0.0.0.0       1 self           0
R(n) 10.10.1.8/30   10.10.1.6     3 10.10.1.6       0 02:39
R(n) 10.10.1.16/30  10.10.1.6     2 10.10.1.6       0 02:39
C(i) 10.10.1.32/30  0.0.0.0       1 self           0
R(n) 10.10.1.64/28  10.10.1.6     3 10.10.1.6       0 02:39
C(i) 10.10.1.96/27  0.0.0.0       1 self           0
vyos@msk-ioithenko-gw-01:~$ show ip rip status
Routing Protocol is "rip"
  Sending updates every 30 seconds with +/-50%, next due in 27 seconds
  Timeout after 180 seconds, garbage collect after 120 seconds
  Outgoing update filter list for all interface is not set
  Incoming update filter list for all interface is not set
  Default redistribution metric is 1
  Redistributing:
    Default version control: send version 2, receive any version
    Interface      Send  Recv  Key-chain
    eth0           2    1 2
    eth1           2    1 2
    eth2           2    1 2
  Routing for Networks:
    eth0
    eth1
    eth2
  Routing Information Sources:
    Gateway      BadPackets  BadRoutes  Distance Last Update
    10.10.1.6     0           0          120      00:00:06
    10.10.1.34    0           0          120      00:00:12
  Distance: (default is 120)
vyos@msk-ioithenko-gw-01:~$
```

Рис. 3.9: Метрики протокола

Пропингуем оконечное устройство (рис. 3.10).

```
VPCS> ping 10.10.1.66
84 bytes from 10.10.1.66 icmp_seq=1 ttl=61 time=9.034 ms
84 bytes from 10.10.1.66 icmp_seq=2 ttl=61 time=8.103 ms
84 bytes from 10.10.1.66 icmp_seq=3 ttl=61 time=9.337 ms
84 bytes from 10.10.1.66 icmp_seq=4 ttl=61 time=9.109 ms
84 bytes from 10.10.1.66 icmp_seq=5 ttl=61 time=12.983 ms

VPCS> trace 10.10.1.66
trace to 10.10.1.66, 8 hops max, press Ctrl+C to stop
 1 10.10.1.97 6.406 ms 1.724 ms 1.572 ms
 2 10.10.1.6 5.292 ms 5.133 ms 3.560 ms
 3 10.10.1.18 10.520 ms 7.547 ms 5.831 ms
 4 *10.10.1.66 7.414 ms (ICMP type:3, code:3, Destination port unreachable)

VPCS>
```

Рис. 3.10: Пинг

Просмотрим захваченный трафик(рис. 3.11).



153	2171.740328	10.10.1.97	224.0.0.9	RIPv2	146	Response
154	2204.745837	10.10.1.97	224.0.0.9	RIPv2	146	Response
155	2234.749475	10.10.1.97	224.0.0.9	RIPv2	146	Response
156	2265.757202	10.10.1.97	224.0.0.9	RIPv2	146	Response
157	2290.764452	10.10.1.97	224.0.0.9	RIPv2	146	Response

```

0100 .... = Version: 4
.... 0101 = Header Length: 20 bytes (5)
> Differentiated Services Field: 0xc0 (DSCP: CS6, ECN: Not-ECT)
Total Length: 132
Identification: 0xdb1a (56090)
> 0100 .... = Flags: 0x2, Don't fragment
...0 0000 0000 0000 = Fragment Offset: 0
Time to Live: 1
Protocol: UDP (17)
Header Checksum: 0xb21a [validation disabled]
[Header checksum status: Unverified]
Source Address: 10.10.1.97
Destination Address: 224.0.0.9
[Stream index: 4]
✓ User Datagram Protocol, Src Port: 520, Dst Port: 520
Source Port: 520
Destination Port: 520
Length: 112
Checksum: 0xd5e1 [unverified]
[Checksum Status: Unverified]
[Stream index: 1]
[Stream Packet Number: 19]
> [Timestamps]
UDP payload (104 bytes)
✓ Routing Information Protocol
Command: Response (2)
Version: RIPv2 (2)
✓ IP Address: 10.10.1.4, Metric: 1
Address Family: IP (2)
Route Tag: 0
IP Address: 10.10.1.4
Netmask: 255.255.255.252
Next Hop: 0.0.0.0
Metric: 1
> IP Address: 10.10.1.8, Metric: 2
> IP Address: 10.10.1.16, Metric: 2
> IP Address: 10.10.1.32, Metric: 1
> IP Address: 10.10.1.64, Metric: 3

```

Standard input: <live capture in progress> | Пакеты: 157

Рис. 3.11: Захваченный трафик

Настроим маршрутизацию по протоколу RIPvng и посмотрим метрики протокола (рис. 3.12) и (рис. 3.13).

```

rtt min/avg/max/mdev = 1.347/2.414/3.269/0.600 ms
[edit]
vyos@msk-ioithenko-gw-02# set protocols ripng interface eth0
[edit]
vyos@msk-ioithenko-gw-02# set protocols ripng interface eth1
[edit]
vyos@msk-ioithenko-gw-02# set protocols ripng interface eth2
[edit]
vyos@msk-ioithenko-gw-02# commit
[edit]
vyos@msk-ioithenko-gw-02# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@msk-ioithenko-gw-02#

```

Рис. 3.12: RIPvng

```

Exit
vyos@msk-ioithenko-gw-01:~$ show ipv6 ripng
Codes: R - RIPvng, 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:db8:1:1::/64
      ::
      self      1      0
C(i) 2001:db8:1:2::/64
      ::
      self      1      0
R(n) 2001:db8:1:3::/64
      fe80::ed4:c0ff:fe14:0 eth1      3      0 02:30
R(n) 2001:db8:1:4::/64
      fe80::ed4:c0ff:fe14:0 eth1      2      0 02:30
C(i) 2001:db8:1:5::/64
      ::
      self      1      0
R(n) 2001:db8:1:6::/64
      fe80::ed4:c0ff:fe14:0 eth1      3      0 02:31
vyos@msk-ioithenko-gw-01:~$ show ipv6 ripng status
Routing Protocol is "RIPvng"
  Sending updates every 30 seconds with +/-50%, next due in 37 seconds
  Timeout after 180 seconds, garbage collect after 120 seconds
  Outgoing update filter list for all interface is not set
  Incoming update filter list for all interface is not set
  Default redistribution metric is 1
  Redistributing:
  Default version control: send version 1, receive version 1
    Interface      Send      Recv
    eth0            1          1
    eth1            1          1
    eth2            1          1
  Routing for Networks:
    eth0
    eth1
    eth2
  Routing Information Sources:
    Gateway      BadPackets BadRoutes      Distance Last Update
    fe80::ed4:c0ff:fe14:0
      0          0          120      00:00:20
    fe80::ed5:9eff:fe02:1
      0          0          120      00:00:19
vyos@msk-ioithenko-gw-01:~$

```

Рис. 3.13: Метрики протокола

Пропингуем оконечное устройство (рис. 3.14).

```

VPCS> ping 2001:db8:1:6::2/64

2001:db8:1:6::2 icmp6_seq=1 ttl=58 time=9.183 ms
2001:db8:1:6::2 icmp6_seq=2 ttl=58 time=7.411 ms
2001:db8:1:6::2 icmp6_seq=3 ttl=58 time=7.673 ms
2001:db8:1:6::2 icmp6_seq=4 ttl=58 time=7.507 ms
2001:db8:1:6::2 icmp6_seq=5 ttl=58 time=8.005 ms

VPCS> trace 2001:db8:1:6::2/64

trace to 2001:db8:1:6::2, 64 hops max
 1 2001:db8:1:1::1 2.220 ms 1.620 ms 1.208 ms
 2 2001:db8:1:2::2 4.589 ms 7.167 ms 3.345 ms
 3 2001:db8:1:4::2 9.445 ms 5.799 ms 7.223 ms
 4 2001:db8:1:6::2 7.613 ms 7.246 ms 8.289 ms

VPCS>

```

Рис. 3.14: Пинг

Настроим маршрутизацию по протоколу OSPF и посмотрим метрики протокола (рис. 3.15) и (рис. 3.16).

```

vyos@msk-ioithenko-gw-02# set protocols ospf area 0 network 10.10.1.64/28
[edit]
vyos@msk-ioithenko-gw-02# set protocols ospf area 0 network 10.10.1.17/30

10.10.1.17/30 is an IPv4 host address, not a network address. Did you mean 10.10.1.16
/30?

Value validation failed
Set failed

[edit]
vyos@msk-ioithenko-gw-02# set protocols ospf area 0 network 10.10.1.16/30
[edit]
vyos@msk-ioithenko-gw-02# set protocols ospf area 0 network 10.10.1.8/30
[edit]
vyos@msk-ioithenko-gw-02# commit
[edit]
vyos@msk-ioithenko-gw-02# save
Saving configuration to '/config/config.boot'...
^pDone
[edit]
vyos@msk-ioithenko-gw-02#

```

Рис. 3.15: Настройка OSPF

```

vyos@msk-ioithenko-gw-01:~$ show ip ospf route
===== OSPF network routing table =====
N   10.10.1.4/30      [100] area: 0.0.0.0
                        directly attached to eth1
N   10.10.1.8/30      [200] area: 0.0.0.0
                        via 10.10.1.34, eth2
N   10.10.1.16/30     [200] area: 0.0.0.0
                        via 10.10.1.6, eth1
N   10.10.1.32/30     [100] area: 0.0.0.0
                        directly attached to eth2
N   10.10.1.64/28     [300] area: 0.0.0.0
                        via 10.10.1.6, eth1
                        via 10.10.1.34, eth2
N   10.10.1.96/27     [100] area: 0.0.0.0
                        directly attached to eth0

===== OSPF router routing table =====
===== OSPF external routing table =====

vyos@msk-ioithenko-gw-01:~$ show ip ospf neighbor

Neighbor ID      Pri State          Dead Time Address          Interface
  RXmtL RqstL DBsmL
10.10.1.17        0   1 Full/Backup    38.679s 10.10.1.6         eth1:10.10.1.5
10.10.1.34        0   1 Full/Backup    33.249s 10.10.1.34        eth2:10.10.1.33
vyos@msk-ioithenko-gw-01:~$

```

Рис. 3.16: Метрики протокола

Пропингуем оконечное устройство(рис. 3.17).

```

VPCS> ping 10.10.1.66

84 bytes from 10.10.1.66 icmp_seq=1 ttl=61 time=16.224 ms
84 bytes from 10.10.1.66 icmp_seq=2 ttl=61 time=10.827 ms
84 bytes from 10.10.1.66 icmp_seq=3 ttl=61 time=6.673 ms
84 bytes from 10.10.1.66 icmp_seq=4 ttl=61 time=11.135 ms
84 bytes from 10.10.1.66 icmp_seq=5 ttl=61 time=11.529 ms

VPCS> trace 10.10.1.66
trace to 10.10.1.66, 8 hops max, press Ctrl+C to stop
 1  10.10.1.97    2.932 ms  1.428 ms  1.587 ms
 2  10.10.1.6     7.244 ms  3.600 ms  2.325 ms
 3  10.10.1.18    5.275 ms  6.671 ms  8.907 ms
 4  *10.10.1.66   9.631 ms  (ICMP type:3, code:3, Destination port unreachable)

VPCS>

```

Рис. 3.17: Пинг

Просмотрим захваченный трафик (рис. 3.18).

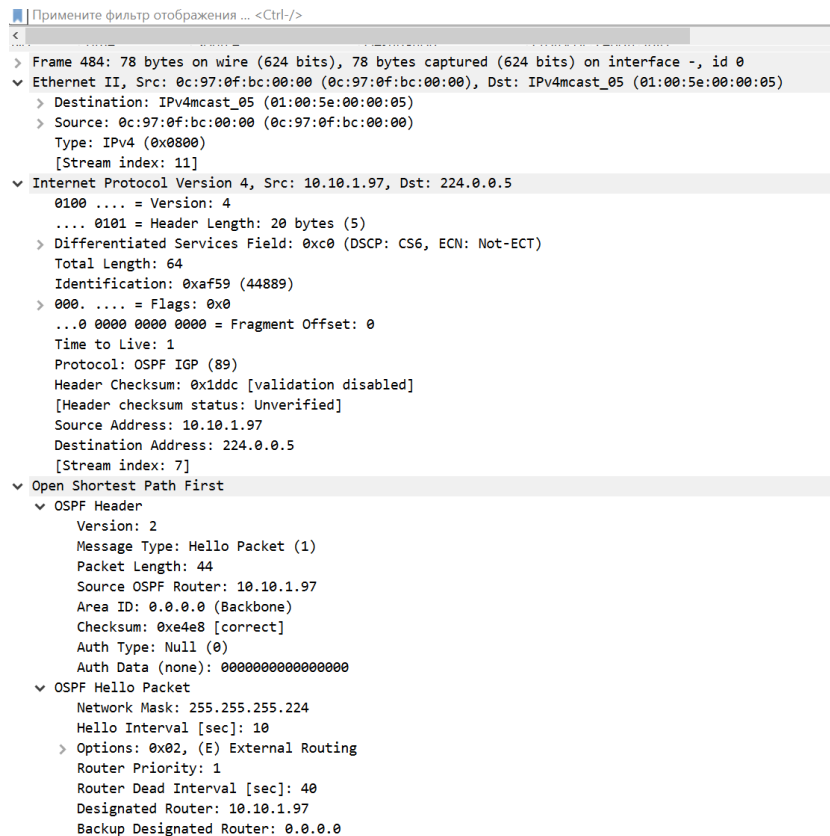


Рис. 3.18: Захваченный трафик

Настроим маршрутизацию по протоколу OSPFv3 и посмотрим метрики протокола (рис. 3.19) и (рис. 3.20).

```
vyos@mzk-ioithenko-gw-02# set protocols ospfv3 parameters router-id 2.2.2.2
[edit]
vyos@mzk-ioithenko-gw-02# set protocols ospfv3 area 0 interface eth0
[edit]
vyos@mzk-ioithenko-gw-02# set protocols ospfv3 area 0 interface eth1
[edit]
vyos@mzk-ioithenko-gw-02# set protocols ospfv3 area 0 interface eth2
[edit]
vyos@mzk-ioithenko-gw-02# commit
[edit]
vyos@mzk-ioithenko-gw-02# save
Saving configuration to '/config/config.boot'...
```

Рис. 3.19: Настройка OSPFv3

```

exit
vyos@msk-ioithenko-gw-01:~$ show ipv6 ospfv3 route
*N IA 2001:db8:1:1::/64      ::      eth0 00:04:54
*N IA 2001:db8:1:2::/64      ::      eth1 00:02:24
*N IA 2001:db8:1:3::/64      fe80::ed5:9eff:fe02:1    eth2 00:00:28
*N IA 2001:db8:1:4::/64      fe80::ed4:c0ff:fe14:0    eth1 00:02:19
*N IA 2001:db8:1:5::/64      ::      eth2 00:00:33
*N IA 2001:db8:1:6::/64      fe80::ed4:c0ff:fe14:0    eth1 00:00:28
                                fe80::ed5:9eff:fe02:1    eth2
vyos@msk-ioithenko-gw-01:~$ show ipv6 ospfv3 neighbor
Neighbor ID  Pri   DeadTime  State/IfState  Duration I/F[State]
3.3.3.3      1     00:00:37  Full/BDR      00:02:36 eth1[DR]
4.4.4.4      1     00:00:30  Full/BDR      00:00:45 eth2[DR]
vyos@msk-ioithenko-gw-01:~$

```

Рис. 3.20: Метрики протокола

Пропингуем оконечное устройство(рис. 3.21).

```

VPCS> ping 2001:db8:1:6::2/64

2001:db8:1:6::2 icmp6_seq=1 ttl=58 time=10.307 ms
2001:db8:1:6::2 icmp6_seq=2 ttl=58 time=8.431 ms
2001:db8:1:6::2 icmp6_seq=3 ttl=58 time=8.552 ms
2001:db8:1:6::2 icmp6_seq=4 ttl=58 time=8.048 ms
2001:db8:1:6::2 icmp6_seq=5 ttl=58 time=7.648 ms

VPCS> trace 2001:db8:1:6::2/64

trace to 2001:db8:1:6::2, 64 hops max
 1 2001:db8:1:1::1 1.829 ms 1.709 ms 1.799 ms
 2 2001:db8:1:2::2 6.514 ms 6.769 ms 2.457 ms
 3 2001:db8:1:4::2 5.795 ms 11.174 ms 6.924 ms
 4 2001:db8:1:6::2 5.476 ms 11.976 ms 11.812 ms

VPCS>

```

Рис. 3.21: Пинг

Просмотрим захваченный трафик (рис. 3.22).

Примените фильтр отображения ... <Ctrl-/>					
No.	Time	Source	Destination	Protocol	Length Info
> Frame 557: 90 bytes on wire (720 bits), 90 bytes captured (720 bits) on interface -, id 0 > Ethernet II, Src: 0c:8e:91:83:00:00 (0c:8e:91:83:00:00), Dst: IPv6mcast_05 (33:33:00:00:00:05) > Destination: IPv6mcast_05 (33:33:00:00:00:05) > Source: 0c:8e:91:83:00:00 (0c:8e:91:83:00:00) Type: IPv6 (0x86dd) [Stream index: 12] > Internet Protocol Version 6, Src: fe80::e8e:91ff:fe83:0, Dst: ff02::5 0110 .... = Version: 6 > .... 1100 0000 .... .... .... = Traffic Class: 0xc0 (DSCP: CS6, ECN: Not-ECT) .... 0100 1011 1011 1010 1000 = Flow Label: 0x4bba8 Payload Length: 36 Next Header: OSPF IGP (89) Hop Limit: 1 > Source Address: fe80::e8e:91ff:fe83:0 > Destination Address: ff02::5 [Source SLAAC MAC: 0c:8e:91:83:00:00 (0c:8e:91:83:00:00)] [Stream index: 8] > Open Shortest Path First < OSPF Header Version: 3 Message Type: Hello Packet (1) Packet Length: 36 Source OSPF Router: 2.2.2.2 Area ID: 0.0.0.0 (Backbone) Checksum: 0x5674 [correct] Instance ID: IPv6 unicast AF (0) Reserved: 00 < OSPF Hello Packet Interface ID: 2 Router Priority: 1 > Options: 0x000013, R, E, V6 Hello Interval [sec]: 10 Router Dead Interval [sec]: 40 Designated Router: 2.2.2.2 Backup Designated Router: 0.0.0.0					

Рис. 3.22: Захваченный трафик

## **4 Выводы**

В ходе лабораторной работы я изучила принципы маршрутизации в IPv4- и IPv6-сетях и принципы настройки сетевого оборудования.