

Лабораторная работа №6

Адресация IPv4 и IPv6. Двойной стек

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Цель работы

Изучить принципы распределения IPv4- и IPv6-адресов
и выполнить настройку адресного пространства на устройствах сети.

Настройка в GNS3

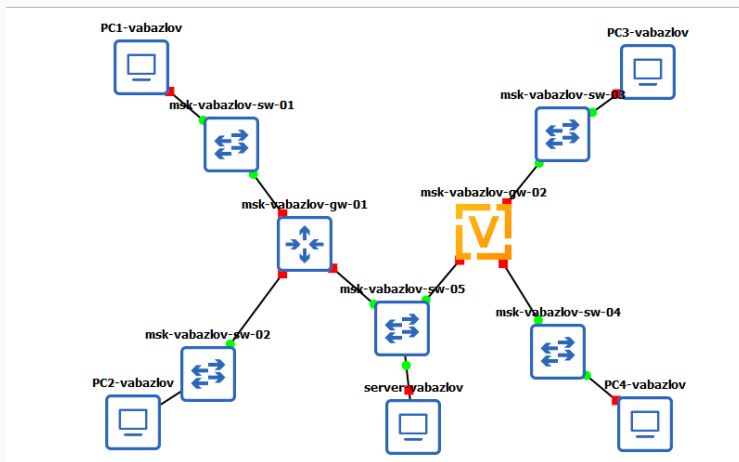


Рис. 1: Топология сети

Проверка сетевой связности

```
server-vabazlov - PuTTY

VPCS> ping 172.16.20.10

84 bytes from 172.16.20.10 icmp_seq=1 ttl=63 time=2.365 ms
84 bytes from 172.16.20.10 icmp_seq=2 ttl=63 time=4.191 ms
84 bytes from 172.16.20.10 icmp_seq=3 ttl=63 time=3.351 ms
84 bytes from 172.16.20.10 icmp_seq=4 ttl=63 time=4.044 ms
84 bytes from 172.16.20.10 icmp_seq=5 ttl=63 time=3.637 ms

VPCS> trace 172.16.20.10
trace to 172.16.20.10, 8 hops max, press Ctrl+C to stop
 1  64.100.1.1    2.416 ms  1.283 ms  0.977 ms
 2  *172.16.20.10  1.636 ms (ICMP type:3, code:3, Destination port unreachable)
)

VPCS> ping 172.16.20.138

84 bytes from 172.16.20.138 icmp_seq=1 ttl=63 time=6.067 ms
84 bytes from 172.16.20.138 icmp_seq=2 ttl=63 time=3.727 ms
84 bytes from 172.16.20.138 icmp_seq=3 ttl=63 time=3.543 ms
84 bytes from 172.16.20.138 icmp_seq=4 ttl=63 time=2.887 ms
84 bytes from 172.16.20.138 icmp_seq=5 ttl=63 time=2.254 ms

VPCS> trace 172.16.20.138
trace to 172.16.20.138, 8 hops max, press Ctrl+C to stop
 1  64.100.1.1    2.572 ms  1.020 ms  1.166 ms
 2  *172.16.20.138  1.594 ms (ICMP type:3, code:3, Destination port unreachable)
e)

VPCS> █
```

```
PC3-vabazlov - PuTTY
Executing the startup file

PC3-vabazlov> ip 2001:db8:c0de:12::a/64
PC1 : 2001:db8:c0de:12::a/64

PC3-vabazlov> save
Saving startup configuration to startup.vpc
. done

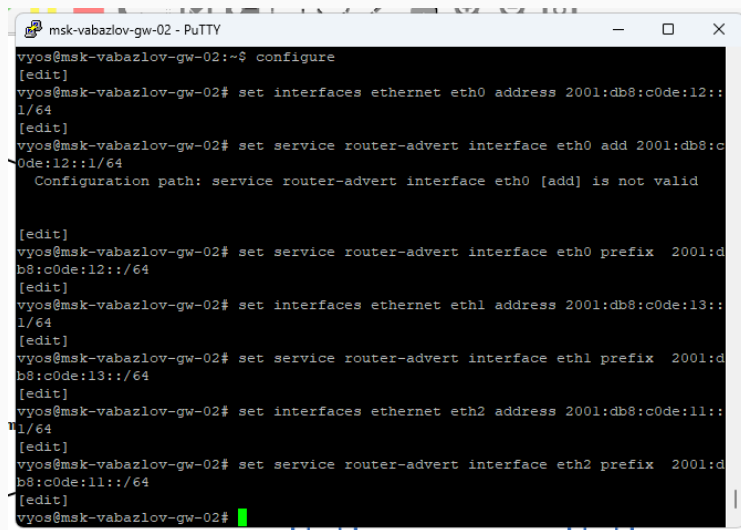
PC3-vabazlov> show ip

NAME           : PC3-vabazlov[1]
IP/MASK        : 0.0.0.0/0
GATEWAY        : 0.0.0.0
DNS            :
MAC            : 00:50:79:66:68:02
LPORT         : 10044
RHOST:PORT     : 127.0.0.1:10045
MTU            : 1500

PC3-vabazlov> show ipv6

NAME           : PC3-vabazlov[1]
LINK-LOCAL SCOPE : fe80::250:79ff:fe66:6802/64
GLOBAL SCOPE    : 2001:db8:c0de:12::a/64
DNS            :
ROUTER LINK-LAYER :
MAC            : 00:50:79:66:68:02
LPORT         : 10044
RHOST:PORT     : 127.0.0.1:10045
MTU            : 1500

PC3-vabazlov>
```



```
msk-vabazlov-gw-02 - PuTTY
vyos@msk-vabazlov-gw-02:~$ configure
[edit]
vyos@msk-vabazlov-gw-02# set interfaces ethernet eth0 address 2001:db8:c0de:12::
1/64
[edit]
vyos@msk-vabazlov-gw-02# set service router-advert interface eth0 add 2001:db8:c
0de:12::1/64
Configuration path: service router-advert interface eth0 [add] is not valid

[edit]
vyos@msk-vabazlov-gw-02# set service router-advert interface eth0 prefix 2001:d
b8:c0de:12::/64
[edit]
vyos@msk-vabazlov-gw-02# set interfaces ethernet eth1 address 2001:db8:c0de:13::
1/64
[edit]
vyos@msk-vabazlov-gw-02# set service router-advert interface eth1 prefix 2001:d
b8:c0de:13::/64
[edit]
vyos@msk-vabazlov-gw-02# set interfaces ethernet eth2 address 2001:db8:c0de:11::
1/64
[edit]
vyos@msk-vabazlov-gw-02# set service router-advert interface eth2 prefix 2001:d
b8:c0de:11::/64
[edit]
vyos@msk-vabazlov-gw-02#
```

Рис. 4: VyOS IPv6 config


```
PC3-vabazlov - PuTTY
2001:db8:c0de:12::a icmp_seq=1 ttl=64 time=0.001 ms
2001:db8:c0de:12::a icmp_seq=2 ttl=64 time=0.001 ms
2001:db8:c0de:12::a icmp_seq=3 ttl=64 time=0.001 ms
2001:db8:c0de:12::a icmp_seq=4 ttl=64 time=0.001 ms
2001:db8:c0de:12::a icmp_seq=5 ttl=64 time=0.001 ms

PC3-vabazlov>
PC3-vabazlov> ping 2001:db8:c0de:13::a

2001:db8:c0de:13::a icmp6_seq=1 ttl=62 time=3.644 ms
2001:db8:c0de:13::a icmp6_seq=2 ttl=62 time=3.274 ms
2001:db8:c0de:13::a icmp6_seq=3 ttl=62 time=2.642 ms
2001:db8:c0de:13::a icmp6_seq=4 ttl=62 time=2.286 ms
2001:db8:c0de:13::a icmp6_seq=5 ttl=62 time=1.408 ms

PC3-vabazlov> ping 2001:db8:c0de:11::a

2001:db8:c0de:11::a icmp6_seq=1 ttl=62 time=4.961 ms
2001:db8:c0de:11::a icmp6_seq=2 ttl=62 time=2.127 ms
2001:db8:c0de:11::a icmp6_seq=3 ttl=62 time=3.241 ms
2001:db8:c0de:11::a icmp6_seq=4 ttl=62 time=1.797 ms
2001:db8:c0de:11::a icmp6_seq=5 ttl=62 time=1.787 ms

PC3-vabazlov>
```

Анализ сетевого трафика

Захват из Standard input [msk-vabazlov-sw-05 Ethernet7 to server-vabazlov Ethernet0]

Файл Правка Вид Запуск Захват Анализ Статистика Телефония Беспроводная связь Инструменты Справка

Примените фильтр отображения ... <Ctrl-/>

No.	Time	Source	Destination	Protocol	Length	Info
6	2.008290	2001:db8:c0de:12::a	2001:db8:c0de:11::a	ICMPv6	118	Echo (ping) reply id=0x8510, seq=3, hop limit=62 (re
7	3.009675	2001:db8:c0de:11::a	2001:db8:c0de:12::a	ICMPv6	118	Echo (ping) request id=0x8510, seq=4, hop limit=64 (re
8	3.011087	2001:db8:c0de:12::a	2001:db8:c0de:11::a	ICMPv6	118	Echo (ping) reply id=0x8510, seq=4, hop limit=62 (re
9	4.012852	2001:db8:c0de:11::a	2001:db8:c0de:12::a	ICMPv6	118	Echo (ping) request id=0x8510, seq=5, hop limit=64 (re
10	4.014237	2001:db8:c0de:12::a	2001:db8:c0de:11::a	ICMPv6	118	Echo (ping) reply id=0x8510, seq=5, hop limit=62 (re
11	5.374008	fe80::e0b:36ff:fece...	2001:db8:c0de:11::a	ICMPv6	86	Neighbor Solicitation for 2001:db8:c0de:11::a from e
12	6.398311	fe80::e0b:36ff:fece...	2001:db8:c0de:11::a	ICMPv6	86	Neighbor Solicitation for 2001:db8:c0de:11::a from e
13	7.421921	fe80::e0b:36ff:fece...	2001:db8:c0de:11::a	ICMPv6	86	Neighbor Solicitation for 2001:db8:c0de:11::a from e
14	16.255722	Private_66:68:04	Broadcast	ARP	64	Who has 64.100.1.1? Tell 64.100.1.10
15	16.258788	0c:f7:4d:1b:00:02	Private_66:68:04	ARP	60	64.100.1.1 is at 0c:f7:4d:1b:00:02
16	16.260150	64.100.1.10	172.16.20.138	ICMP	98	Echo (ping) request id=0x9510, seq=1/256, ttl=64 (r
17	16.265717	172.16.20.138	64.100.1.10	ICMP	98	Echo (ping) reply id=0x9510, seq=1/256, ttl=63 (r
18	17.266724	64.100.1.10	172.16.20.138	ICMP	98	Echo (ping) request id=0x9610, seq=2/512, ttl=64 (r
19	17.268891	172.16.20.138	64.100.1.10	ICMP	98	Echo (ping) reply id=0x9610, seq=2/512, ttl=63 (r
20	18.270722	64.100.1.10	172.16.20.138	ICMP	98	Echo (ping) request id=0x9710, seq=3/768, ttl=64 (r
21	18.272268	172.16.20.138	64.100.1.10	ICMP	98	Echo (ping) reply id=0x9710, seq=3/768, ttl=63 (r
22	19.273535	64.100.1.10	172.16.20.138	ICMP	98	Echo (ping) request id=0x9810, seq=4/1024, ttl=64 (r

> Frame 14: 64 bytes on wire (512 bits), 64 bytes captured (512 bits) on interface -, id 0

> Ethernet II, Src: Private_66:68:04 (00:50:79:66:68:04), Dst: Broadcast (ff:ff:ff:ff:ff:ff)

▼ Address Resolution Protocol (request)

Hardware type: Ethernet (1)

Protocol type: IPv4 (0x0800)

Hardware size: 6

Protocol size: 4

Opcode: request (1)

Sender MAC address: Private_66:68:04 (00:50:79:66:68:04)

Sender IP address: 64.100.1.10

Target MAC address: Broadcast (ff:ff:ff:ff:ff:ff)

Target IP address: 64.100.1.1

0000 ff ff ff ff
0010 08 00 06 04
0020 ff ff ff ff
0030 00 00 00 00

Захват из Standard input [msk-vabazlov-sw-05 Ethernet7 to server-vabazlov Ethernet0]

Файл Правка Вид Запуск Захват Анализ Статистика Телефония Беспроводная связь Инструменты Справка

Примените фильтр отображения ... < Ctrl-/>

No.	Time	Source	Destination	Protocol	Length	Info
13	7.421921	fe80::e0b:36ff:fece...	2001:db8:c0de:11::a	ICMPv6	86	Neighbor Solicitation for 2001:db8:c0de:11::a from 0
14	16.255722	Private_66:68:04	Broadcast	ARP	64	Who has 64.100.1.1? Tell 64.100.1.10
15	16.258788	0c:f7:4d:1b:00:02	Private_66:68:04	ARP	60	64.100.1.1 is at 0c:f7:4d:1b:00:02
16	16.260150	64.100.1.10	172.16.20.138	ICMP	98	Echo (ping) request id=0x9510, seq=1/256, ttl=64 (r
17	16.265717	172.16.20.138	64.100.1.10	ICMP	98	Echo (ping) reply id=0x9510, seq=1/256, ttl=63 (r
18	17.266724	64.100.1.10	172.16.20.138	ICMP	98	Echo (ping) request id=0x9610, seq=2/512, ttl=64 (r
19	17.268891	172.16.20.138	64.100.1.10	ICMP	98	Echo (ping) reply id=0x9610, seq=2/512, ttl=63 (r
20	18.270722	64.100.1.10	172.16.20.138	ICMP	98	Echo (ping) request id=0x9710, seq=3/768, ttl=64 (r
21	18.272268	172.16.20.138	64.100.1.10	ICMP	98	Echo (ping) reply id=0x9710, seq=3/768, ttl=63 (r
22	19.273535	64.100.1.10	172.16.20.138	ICMP	98	Echo (ping) request id=0x9810, seq=4/1024, ttl=64 (r
23	19.274741	172.16.20.138	64.100.1.10	ICMP	98	Echo (ping) reply id=0x9810, seq=4/1024, ttl=63 (r
24	20.276784	64.100.1.10	172.16.20.138	ICMP	98	Echo (ping) request id=0x9910, seq=5/1280, ttl=64 (r
25	20.277902	172.16.20.138	64.100.1.10	ICMP	98	Echo (ping) reply id=0x9910, seq=5/1280, ttl=63 (r
26	21.270495	0c:f7:4d:1b:00:02	Private_66:68:04	ARP	60	Who has 64.100.1.10? Tell 64.100.1.1
27	21.270674	Private_66:68:04	0c:f7:4d:1b:00:02	ARP	60	64.100.1.10 is at 00:50:79:66:68:04
28	140.164447	fe80::e0b:36ff:fece...	ff02::1	ICMPv6	118	Router Advertisement from 0c:0b:36:cd:00:02

> Frame 18: 98 bytes on wire (784 bits), 98 bytes captured (784 bits) on interface -, id 0

> Ethernet II, Src: Private_66:68:04 (00:50:79:66:68:04), Dst: 0c:f7:4d:1b:00:02 (0c:f7:4d:1b:00:02)

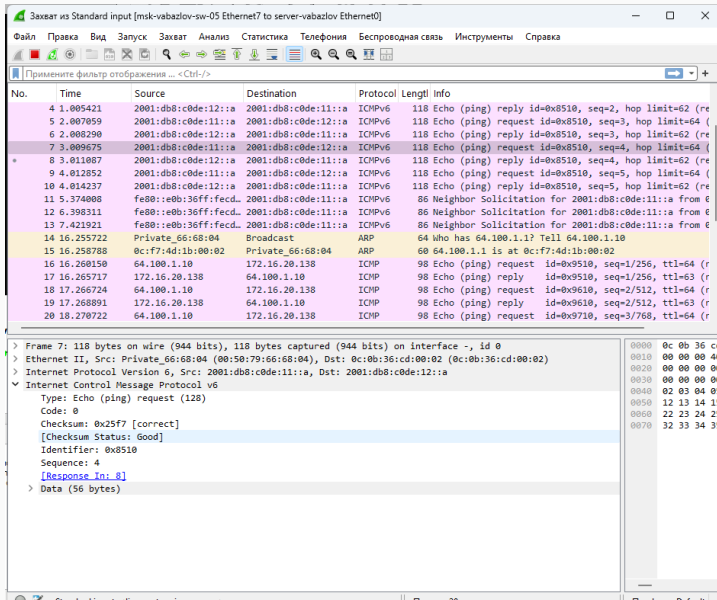
> Internet Protocol Version 4, Src: 64.100.1.10, Dst: 172.16.20.138

> Internet Control Message Protocol

- Type: 8 (Echo (ping) request)
- Code: 0
- Checksum: 0x89f9 [correct]
- [Checksum Status: Good]
- Identifier (BE): 38416 (0x9610)
- Identifier (LE): 4246 (0x1096)
- Sequence Number (BE): 2 (0x0002)
- Sequence Number (LE): 512 (0x0200)
- [\[Response frame: 19\]](#)
- > Data (56 bytes)

```

0000  0c f7 4d 1b
0010  00 54 10 9e
0020  14 8a 08 0e
0030  0e 0f 10 11
0040  1e 1f 20 21
0050  2e 2f 30 31
0060  3e 3f
  
```



Самостоятельная часть

IPv4 - Подсеть 1: **10.10.1.96/27**

- Подсеть 2: **10.10.1.16/28**

IPv6 - 2001:db8:1:1::/64

- 2001:db8:1:4::/64

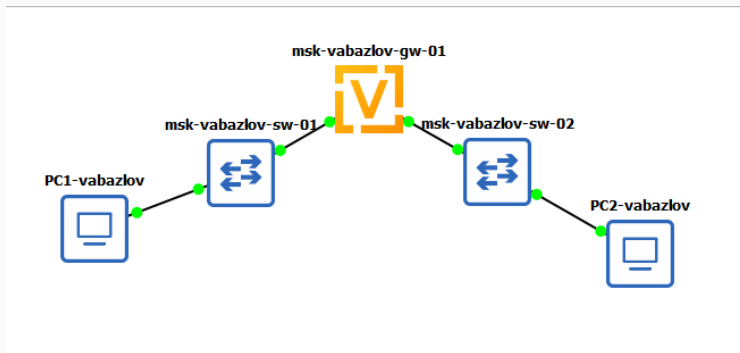
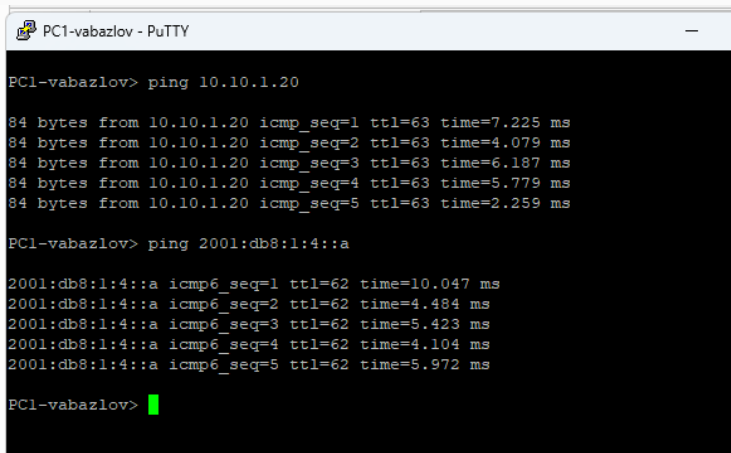


Рис. 9: Топология сети



```
PC1-vabazlov> ping 10.10.1.20

84 bytes from 10.10.1.20 icmp_seq=1 ttl=63 time=7.225 ms
84 bytes from 10.10.1.20 icmp_seq=2 ttl=63 time=4.079 ms
84 bytes from 10.10.1.20 icmp_seq=3 ttl=63 time=6.187 ms
84 bytes from 10.10.1.20 icmp_seq=4 ttl=63 time=5.779 ms
84 bytes from 10.10.1.20 icmp_seq=5 ttl=63 time=2.259 ms

PC1-vabazlov> ping 2001:db8:1:4::a

2001:db8:1:4::a icmp6_seq=1 ttl=62 time=10.047 ms
2001:db8:1:4::a icmp6_seq=2 ttl=62 time=4.484 ms
2001:db8:1:4::a icmp6_seq=3 ttl=62 time=5.423 ms
2001:db8:1:4::a icmp6_seq=4 ttl=62 time=4.104 ms
2001:db8:1:4::a icmp6_seq=5 ttl=62 time=5.972 ms

PC1-vabazlov> █
```

Рис. 10: Проверка ping IPv4 и IPv6

Итоги работы

- Выполнено разбиение подсетей IPv4 и IPv6
- Настроена адресация в топологии GNS3
- Проверена связность для обоих протоколов
- Изучены механизмы ARP, ICMP и ICMPv6
- Реализована работа сети с **двойным стеком IPv4/IPv6**