Сетевые технологии

Простые сети в GNS3. Анализ трафика

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Цель работы

Основная цель

Построение простейших моделей сети на базе коммутатора и маршрутизаторов **FRR** и **VyOS** в **GNS3**, анализ трафика посредством **Wireshark**.

Простая сеть на базе коммутатора

Топология сети

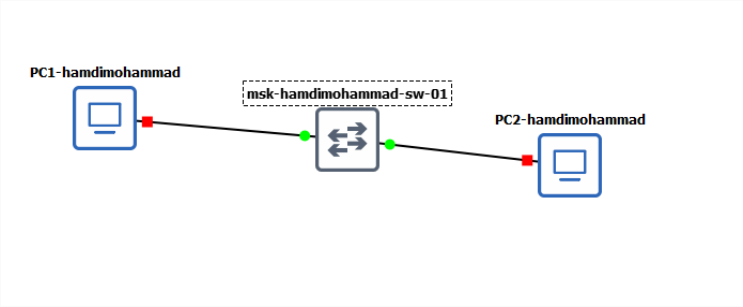


Рис. 1: Топология сети в GNS3

Назначение IP-адресов

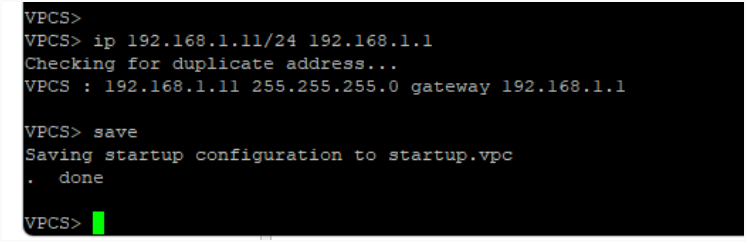


Рис. 2: Настройка IP-адреса на PC1

Проверка связности

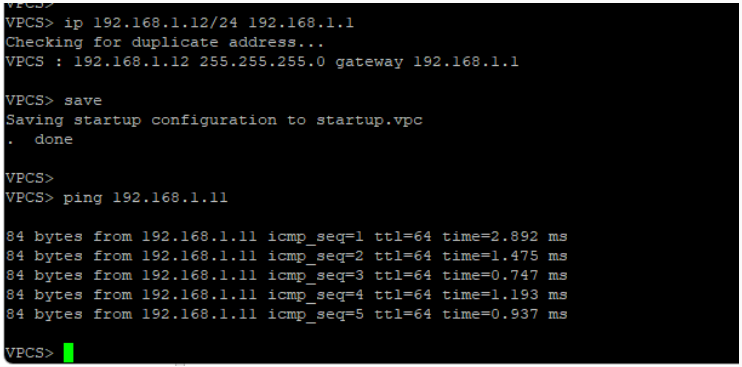
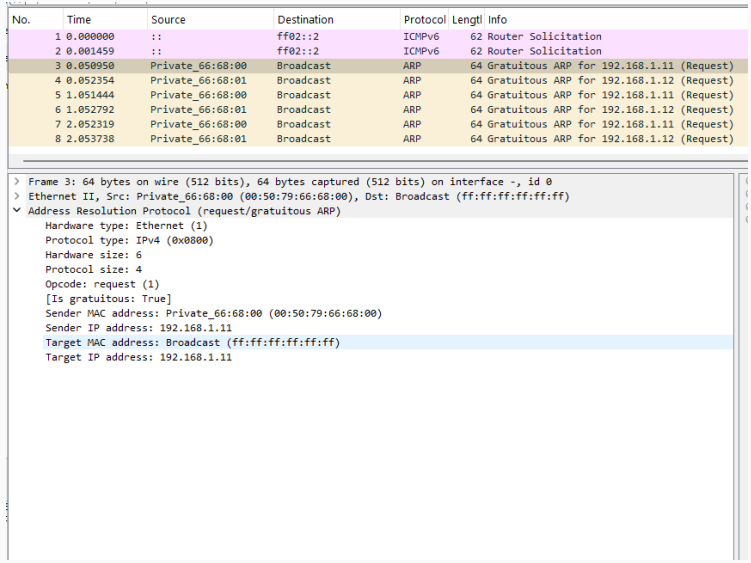


Рис. 3: Проверка связности между PC1 и PC2

Анализ трафика Wireshark

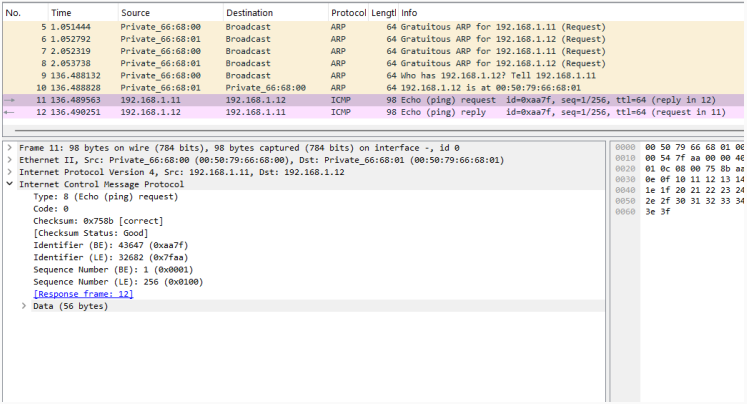
ARP-пакеты



No.	Time	Source	Destination	Protocol	Lengtl	Info
1	0.000000	::	ff02::2	ICMPv6	62	Router Solicitation
2	0.001459	::	ff02::2	ICMPv6	62	Router Solicitation
3	0.050950	Private_66:68:00	Broadcast	ARP	64	Gratuitous ARP for 192.168.1.11 (Request)
4	0.052354	Private_66:68:01	Broadcast	ARP	64	Gratuitous ARP for 192.168.1.12 (Request)
5	1.051444	Private_66:68:00	Broadcast	ARP	64	Gratuitous ARP for 192.168.1.11 (Request)
6	1.052792	Private_66:68:01	Broadcast	ARP	64	Gratuitous ARP for 192.168.1.12 (Request)
7	2.052319	Private_66:68:00	Broadcast	ARP	64	Gratuitous ARP for 192.168.1.11 (Request)
8	2.053738	Private_66:68:01	Broadcast	ARP	64	Gratuitous ARP for 192.168.1.12 (Request)

```
> Frame 3: 64 bytes on wire (512 bits), 64 bytes captured (512 bits) on interface -, id 0
> Ethernet II, Src: Private_66:68:00 (00:50:79:66:68:00), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
v Address Resolution Protocol (request/gratuitous ARP)
    Hardware type: Ethernet (1)
    Protocol type: IPv4 (0x0800)
    Hardware size: 6
    Protocol size: 4
    Opcode: request (1)
    [Is gratuitous: True]
    Sender MAC address: Private_66:68:00 (00:50:79:66:68:00)
    Sender IP address: 192.168.1.11
    Target MAC address: Broadcast (ff:ff:ff:ff:ff:ff)
    Target IP address: 192.168.1.11
```

ICMP-пакеты



No.	Time	Source	Destination	Protocol	Length	Info
5	1.051444	Private_66:68:00	Broadcast	ARP	64	Gratuitous ARP for 192.168.1.11 (Request)
6	1.052792	Private_66:68:01	Broadcast	ARP	64	Gratuitous ARP for 192.168.1.12 (Request)
7	2.052319	Private_66:68:00	Broadcast	ARP	64	Gratuitous ARP for 192.168.1.11 (Request)
8	2.053738	Private_66:68:01	Broadcast	ARP	64	Gratuitous ARP for 192.168.1.12 (Request)
9	136.488132	Private_66:68:00	Broadcast	ARP	64	Who has 192.168.1.12? Tell 192.168.1.11
10	136.488828	Private_66:68:01	Private_66:68:00	ARP	64	192.168.1.12 is at 00:50:79:66:68:01
11	136.489563	192.168.1.11	192.168.1.12	ICMP	98	Echo (ping) request id=0xaa7f, seq=1/256, ttl=64 (reply in 12)
12	136.490251	192.168.1.12	192.168.1.11	ICMP	98	Echo (ping) reply id=0xaa7f, seq=1/256, ttl=64 (request in 11)

```
> Frame 11: 98 bytes on wire (784 bits), 98 bytes captured (784 bits) on interface -, id 0
> Ethernet II, Src: Private_66:68:00 (00:50:79:66:68:00), Dst: Private_66:68:01 (00:50:79:66:68:01)
> Internet Protocol Version 4, Src: 192.168.1.11, Dst: 192.168.1.12
v Internet Control Message Protocol
    Type: 8 (Echo (ping) request)
    Code: 0
    Checksum: 0x758b [correct]
    [Checksum Status: Good]
    Identifier (BE): 43647 (0xaa7f)
    Identifier (LE): 32682 (0x7faa)
    Sequence Number (BE): 1 (0x0001)
    Sequence Number (LE): 256 (0x0100)
    [Response frame: 12]
  > Data (56 bytes)
```

```
0000  00 50 79 66 68 01 00
0010  00 54 7f aa 00 00 40
0020  01 0c 08 00 75 8b aa
0030  0e 0f 10 11 12 13 14
0040  1e 1f 20 21 22 23 24
0050  2e 2f 30 31 32 33 34
0060  3e 3f
```

Рис. 5: ICMP-запрос и ответ

UDP и TCP-запросы

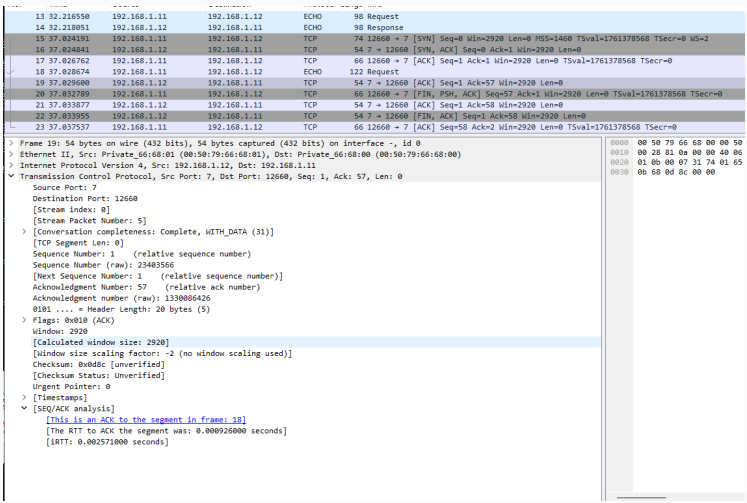


Рис. 6: TCP-эхо-запрос

Сеть с маршрутизатором FRR

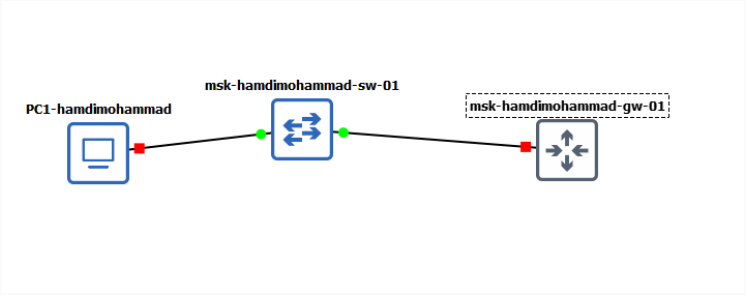


Рис. 7: Топология сети с маршрутизатором FRR

Конфигурация FRR

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

frr# configure terminal
frr(config)# hostname msk-hamdimohammad-gw-01
msk-hamdimohammad-gw-01(config)# exit
msk-hamdimohammad-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-hamdimohammad-gw-01# configure terminal
msk-hamdimohammad-gw-01(config)# interface eth0
msk-hamdimohammad-gw-01(config-if)# ip address 192.168.1.1/24
msk-hamdimohammad-gw-01(config-if)# no shutdown
msk-hamdimohammad-gw-01(config-if)# exit
msk-hamdimohammad-gw-01(config)# exit
msk-hamdimohammad-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-hamdimohammad-gw-01#
```


Рис. 8: Настройка маршрутизатора FRR

Проверка соединения

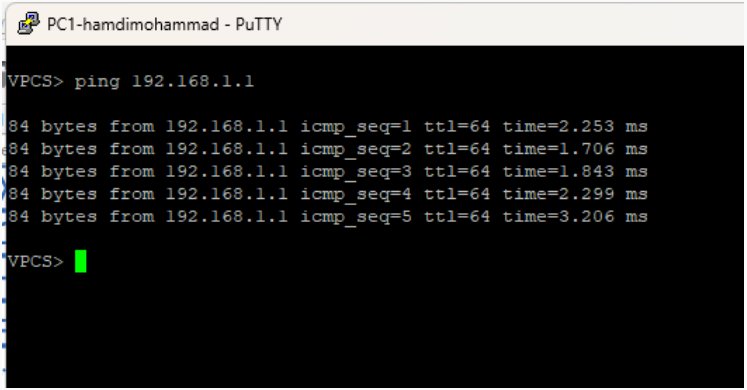
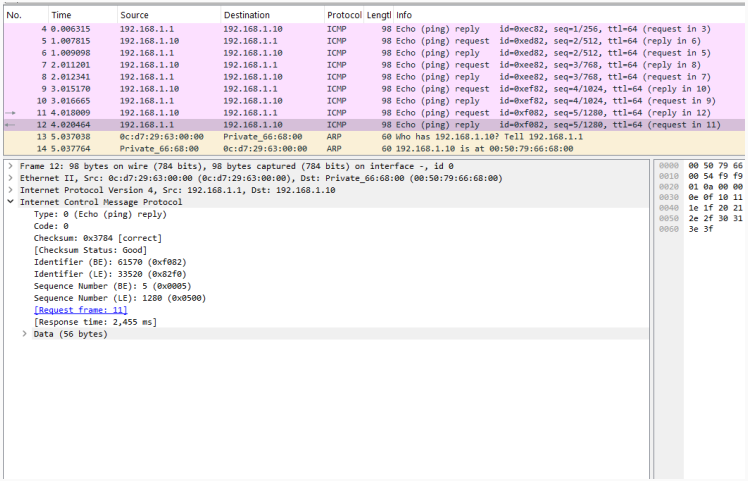


Рис. 9: Проверка соединения между ПК и маршрутизатором

Анализ трафика FRR

ICMP-тест и ARP-обмен



No.	Time	Source	Destination	Protocol	Length	Info
4	0.006315	192.168.1.1	192.168.1.10	ICMP	98	Echo (ping) reply id=0xec82, seq=1/256, ttl=64 (request in 3)
5	1.007815	192.168.1.10	192.168.1.1	ICMP	98	Echo (ping) request id=0xed82, seq=2/512, ttl=64 (reply in 6)
6	1.009098	192.168.1.1	192.168.1.10	ICMP	98	Echo (ping) reply id=0xed82, seq=2/512, ttl=64 (request in 5)
7	2.011201	192.168.1.10	192.168.1.1	ICMP	98	Echo (ping) request id=0xee82, seq=3/768, ttl=64 (reply in 8)
8	2.012341	192.168.1.1	192.168.1.10	ICMP	98	Echo (ping) reply id=0xee82, seq=3/768, ttl=64 (request in 7)
9	3.015170	192.168.1.10	192.168.1.1	ICMP	98	Echo (ping) request id=0xef82, seq=4/1024, ttl=64 (reply in 10)
10	3.016665	192.168.1.1	192.168.1.10	ICMP	98	Echo (ping) reply id=0xef82, seq=4/1024, ttl=64 (request in 9)
11	4.018009	192.168.1.10	192.168.1.1	ICMP	98	Echo (ping) request id=0xf082, seq=5/1280, ttl=64 (reply in 12)
12	4.020464	192.168.1.1	192.168.1.10	ICMP	98	Echo (ping) reply id=0xf082, seq=5/1280, ttl=64 (request in 11)
13	5.037038	0c:d7:29:63:00:00	Private_66:68:00	ARP	60	Who has 192.168.1.10? Tell 192.168.1.1
14	5.037764	Private_66:68:00	0c:d7:29:63:00:00	ARP	60	192.168.1.10 is at 00:50:79:66:68:00

```
> Frame 12: 98 bytes on wire (784 bits), 98 bytes captured (784 bits) on interface -, id 0
> Ethernet II, Src: 0c:d7:29:63:00:00 (0c:d7:29:63:00:00), Dst: Private_66:68:00 (00:50:79:66:68:00)
> Internet Protocol Version 4, Src: 192.168.1.1, Dst: 192.168.1.10
v Internet Control Message Protocol
    Type: 0 (Echo (ping) reply)
    Code: 0
    Checksum: 0x3784 [correct]
    [Checksum Status: Good]
    Identifier (BE): 61570 (0xf082)
    Identifier (LE): 33520 (0x82f0)
    Sequence Number (BE): 5 (0x0005)
    Sequence Number (LE): 1280 (0x0500)
    [Request frame: 11]
    [Response time: 2,455 ms]
  > Data (56 bytes)
```

```
0000  00 50 79 66
0010  00 54 f9 f9
0020  01 0a 00 00
0030  0e 0f 10 11
0040  1e 1f 20 21
0050  2e 2f 30 31
0060  3e 3f
```

Рис. 10: Анализ ICMP-трафика в Wireshark

Сеть с маршрутизатором VyOS

Топология сети

```
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@vyos:~$ install image
You are trying to install from an already installed system. An ISO
image file to install or URL must be specified.
Exiting...
vyos@vyos:~$ configure
[edit]
vyos@vyos# set system host-name msk-hamdimohammad-gw-01
[edit]
vyos@vyos# set interfaces ethernet eth0 address 192.168.1.1/24
[edit]
vyos@vyos# compare
[edit interfaces ethernet eth0]
+address 192.168.1.1/24
[edit system]
>host-name msk-hamdimohammad-gw-01
[edit]
vyos@vyos# commit
```

Рис. 11: Настройка маршрутизатора VyOS

Интерфейсы маршрутизатора

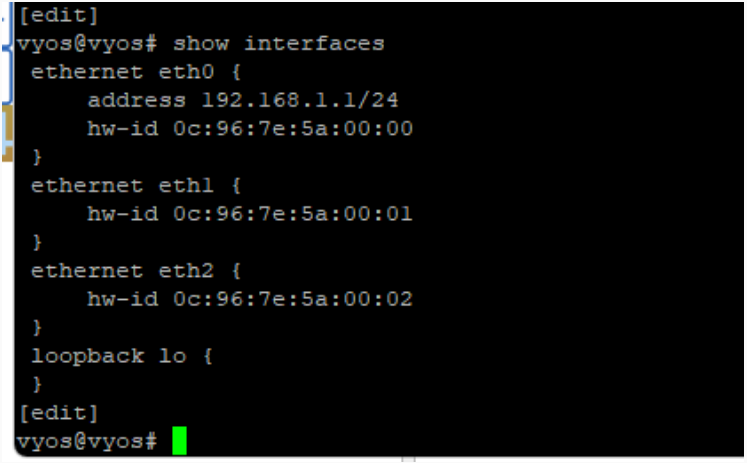


Рис. 12: Просмотр интерфейсов VyOS

Проверка соединения

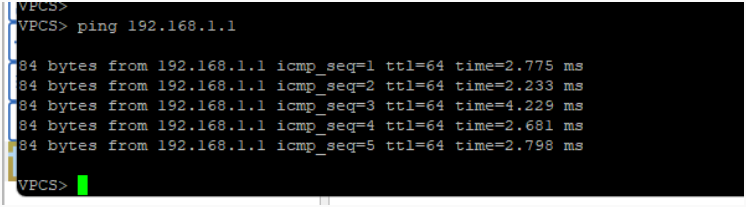


Рис. 13: Проверка связи между ПК и маршрутизатором VyOS

Анализ трафика VyOS

Обмен ICMP Echo

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	192.168.1.10	192.168.1.1	ICMP	98	Echo (ping) request id=0xa584, seq=1/256, ttl=64 (reply in 2)
2	0.002004	192.168.1.1	192.168.1.10	ICMP	98	Echo (ping) reply id=0xa584, seq=1/256, ttl=64 (request in 1)
3	1.003784	192.168.1.10	192.168.1.1	ICMP	98	Echo (ping) request id=0xa684, seq=2/512, ttl=64 (reply in 4)
4	1.005253	192.168.1.1	192.168.1.10	ICMP	98	Echo (ping) reply id=0xa684, seq=2/512, ttl=64 (request in 3)
5	2.008156	192.168.1.10	192.168.1.1	ICMP	98	Echo (ping) request id=0xa784, seq=3/768, ttl=64 (reply in 6)
6	2.011016	192.168.1.1	192.168.1.10	ICMP	98	Echo (ping) reply id=0xa784, seq=3/768, ttl=64 (request in 5)
7	3.012660	192.168.1.10	192.168.1.1	ICMP	98	Echo (ping) request id=0xa884, seq=4/1024, ttl=64 (reply in 8)
8	3.014549	192.168.1.1	192.168.1.10	ICMP	98	Echo (ping) reply id=0xa884, seq=4/1024, ttl=64 (request in 7)
9	4.017875	192.168.1.10	192.168.1.1	ICMP	98	Echo (ping) request id=0xa984, seq=5/1280, ttl=64 (reply in 10)
10	4.019807	192.168.1.1	192.168.1.10	ICMP	98	Echo (ping) reply id=0xa984, seq=5/1280, ttl=64 (request in 9)

```
> Frame 10: 98 bytes on wire (784 bits), 98 bytes captured (784 bits) on interface -, id 0
> Ethernet II, Src: 0c:96:7e:5a:00:00 (0c:96:7e:5a:00:00), Dst: Private_66:68:00 (00:50:79:66:68:00)
v Internet Protocol Version 4, Src: 192.168.1.1, Dst: 192.168.1.10
    0100 .... = Version: 4
    .... 0101 = Header Length: 20 bytes (5)
  > Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
    Total Length: 84
    Identification: 0xeb51 (60241)
  > 000. .... = Flags: 0x0
    ...0 0000 0000 0000 = Fragment Offset: 0
    Time to Live: 64
    Protocol: ICMP (1)
    Header Checksum: 0x0bfc [validation disabled]
    [Header checksum status: Unverified]
    Source Address: 192.168.1.1
    Destination Address: 192.168.1.10
    [Stream index: 0]
v Internet Control Message Protocol
    Type: 0 (Echo (ping) reply)
    Code: 0
    Checksum: 0x7e82 [correct]
    [Checksum Status: Good]
    Identifier (BE): 43396 (0xa984)
    Identifier (LE): 33961 (0x84a9)
    Sequence Number (BE): 5 (0x0005)
    Sequence Number (LE): 1280 (0x0500)
    [Request frame: 9]
    [Response time: 1,932 ms]
  > Data (56 bytes)
```

```
0000  00 50 79
0010  00 54 eb
0020  01 0a 00
0030  0e 0f 10
0040  1e 1f 20
0050  2e 2f 30
0060  3e 3f
```

Заключение

Выводы

В результате лабораторной работы:

- Смоделированы три топологии сети — на базе коммутатора, FRR и VyOS.
- Выполнена настройка IP-адресации и проверена связность между устройствами.
- Проанализированы пакеты **ARP** и **ICMP** в **Wireshark**.
- Все конфигурации работали корректно, подтверждая правильность сетевых настроек.