

# Простые сети в GNS3. Анализ трафика

Лабораторная работа №5

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## Цель работы

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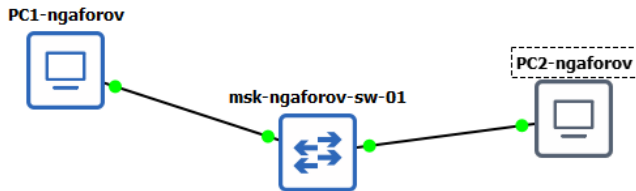
Изучить принципы построения простейших сетей на базе коммутатора и маршрутизаторов **FRR** и **VyOS** в среде **GNS3**, а также провести анализ сетевого трафика с помощью программы **Wireshark**.

## Ход выполнения



## Топология сети на коммутаторе

В GNS3 создана сеть, включающая коммутатор и два компьютера (PC1, PC2).  
Проверена связь между узлами с помощью ping.



# Настройка IP-адресов

- PC1 — 192.168.1.11/24
- PC2 — 192.168.1.12/24

Шлюз по умолчанию: 192.168.1.1

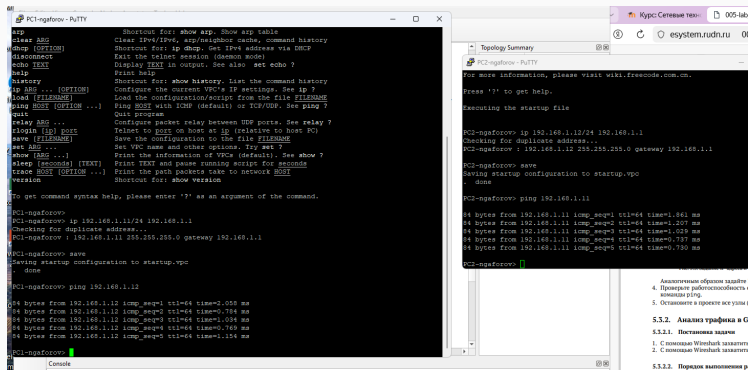


Рис. 2: Настройка IP-адресов

При захвате трафика в Wireshark зафиксированы ARP-запросы и ICMP Echo Request/Reply, подтверждающие успешную связность между узлами.

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	::	ff02::2	ICMPv6	62	Router Solicitation
2	0.001316	::	ff02::2	ICMPv6	62	Router Solicitation
3	0.050246	Private_66:68:01	Broadcast	ARP	64	Gratuitous ARP for 192.168.1.12 (Request)
4	0.051650	Private_66:68:00	Broadcast	ARP	64	Gratuitous ARP for 192.168.1.11 (Request)
5	1.051224	Private_66:68:01	Broadcast	ARP	64	Gratuitous ARP for 192.168.1.12 (Request)
6	1.052672	Private_66:68:00	Broadcast	ARP	64	Gratuitous ARP for 192.168.1.11 (Request)
7	2.052937	Private_66:68:01	Broadcast	ARP	64	Gratuitous ARP for 192.168.1.12 (Request)
8	2.056520	Private_66:68:00	Broadcast	ARP	64	Gratuitous ARP for 192.168.1.11 (Request)

> Frame 5: 64 bytes on wire (512 bits), 64 bytes captured (512 bits) on interface -, id 0

> Ethernet II, Src: Private\_66:68:01 (00:50:79:66:68:01), Dst: Broadcast (ff:ff:ff:ff:ff:ff)

▼ 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\_66:68:01 (00:50:79:66:68:01)

# Анализ UDP и TCP

В режимах `ping udp` и `ping tcp` зафиксированы пакеты с соответствующими протоколами. При TCP-соединении наблюдалась трёхфазная установка (SYN, SYN/ACK, ACK).

No.	Time	Source	Destination	Protocol	Length	Info
3	0.050246	Private_66:68:01	Broadcast	ARP	64	Gratuitous ARP for 192.168.1.12 (Request)
4	0.051650	Private_66:68:00	Broadcast	ARP	64	Gratuitous ARP for 192.168.1.11 (Request)
5	1.051224	Private_66:68:01	Broadcast	ARP	64	Gratuitous ARP for 192.168.1.12 (Request)
6	1.052672	Private_66:68:00	Broadcast	ARP	64	Gratuitous ARP for 192.168.1.11 (Request)
7	2.052937	Private_66:68:01	Broadcast	ARP	64	Gratuitous ARP for 192.168.1.12 (Request)
8	2.056520	Private_66:68:00	Broadcast	ARP	64	Gratuitous ARP for 192.168.1.11 (Request)
9	54.030194	Private_66:68:01	Broadcast	ARP	64	Who has 192.168.1.1? Tell 192.168.1.12
10	55.030911	Private_66:68:01	Broadcast	ARP	64	Who has 192.168.1.1? Tell 192.168.1.12
11	56.031626	Private_66:68:01	Broadcast	ARP	64	Who has 192.168.1.1? Tell 192.168.1.12
12	61.614174	Private_66:68:01	Broadcast	ARP	64	Who has 192.168.1.11? Tell 192.168.1.12
13	61.614599	Private_66:68:00	Private_66:68:01	ARP	64	192.168.1.11 is at 00:50:79:66:68:00
14	61.616298	192.168.1.12	192.168.1.11	ICMP	98	Echo (ping) request id=0x3341, seq=1/256, ttl=64 (reply in 15)
15	61.616941	192.168.1.11	192.168.1.12	ICMP	98	Echo (ping) reply id=0x3341, seq=1/256, ttl=64 (request in 14)
16	74.453887	192.168.1.12	192.168.1.11	ECHO	98	Request
17	74.454788	192.168.1.11	192.168.1.12	ECHO	98	Response
18	78.111416	192.168.1.12	192.168.1.11	TCP	74	17298 → 7 [SYN] Seq=0 Win=2920 Len=0 MSS=1460 TSval=1761558852 TSecr=0..
19	78.112282	192.168.1.11	192.168.1.12	TCP	54	7 → 17298 [SYN, ACK] Seq=0 Ack=1 Win=2920 Len=0
20	78.113918	192.168.1.12	192.168.1.11	TCP	66	17298 → 7 [ACK] Seq=1 Ack=1 Win=2920 Len=0 TSval=1761558852 TSecr=0
21	78.115400	192.168.1.12	192.168.1.11	ECHO	122	Request
22	78.115995	192.168.1.11	192.168.1.12	TCP	54	7 → 17298 [ACK] Seq=1 Ack=57 Win=2920 Len=0
23	78.119390	192.168.1.12	192.168.1.11	TCP	66	17298 → 7 [FIN, PSH, ACK] Seq=57 Ack=1 Win=2920 Len=0 TSval=1761558852..
24	78.121334	192.168.1.11	192.168.1.12	TCP	54	7 → 17298 [ACK] Seq=1 Ack=58 Win=2920 Len=0
25	78.121380	192.168.1.11	192.168.1.12	TCP	54	7 → 17298 [FIN, ACK] Seq=1 Ack=58 Win=2920 Len=0
26	78.123690	192.168.1.12	192.168.1.11	TCP	66	17298 → 7 [ACK] Seq=58 Ack=2 Win=2920 Len=0 TSval=1761558852 TSecr=0

> Frame 22: 54 bytes on wire (432 bits), 54 bytes captured (432 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

> Transmission Control Protocol, Src Port: 7, Dst Port: 17298, Seq: 1, Ack: 57, Len: 0

Source Port: 7

Destination Port: 17298

[Stream index: 0]

[Stream Packet Number: 5]

> [Conversation completeness: Complete, WITH\_DATA (31)]

[TCP Segment Len: 0]

Sequence Number: 1 (relative sequence number)

Sequence Number (raw): 962961661

[Next Sequence Number: 1 (relative sequence number)]

Acknowledgment Number: 57 (relative ack number)

Acknowledgment number (raw): 1816986863

0101 .... = Header Length: 20 bytes (5)

Flags: 0x010 (ACK)

0000 00 50 79 66

0010 00 28 41 46

0020 01 0c 00 07

0030 0b 68 9e c3



## Моделирование сети с FRR

Создана сеть с маршрутизатором FRR.

- PC1: IP 192.168.1.10/24
- FRR: интерфейс eth0 – 192.168.1.1/24

```
msk-ngaforov-gw-01 - PuTTY
Hello, this is FRRouting (version 8.2.2).
Copyright 1996-2005 Kunihiro Ishiguro, et al.

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

## Проверка связи

Проверка ping 192.168.1.1 показала отсутствие потерь.

В Wireshark видны пакеты ARP и ICMP, что подтверждает корректную маршрутизацию.

No.	Time	Source	Destination	Protocol	Length	Info
12	101.361525	fe80::ec2:7cff:fe0a...	ff02::16	ICMPv6	90	Multicast Listener Report Message v2
13	101.741813	fe80::ec2:7cff:fe0a...	ff02::16	ICMPv6	90	Multicast Listener Report Message v2
14	101.802640	fe80::ec2:7cff:fe0a...	ff02::16	ICMPv6	150	Multicast Listener Report Message v2
15	217.559924	Private_66:68:00	Broadcast	ARP	64	Who has 192.168.1.1? Tell 192.168.1.10
16	217.565553	0c:c2:7c:0a:00:00	Private_66:68:00	ARP	60	192.168.1.1 is at 0c:c2:7c:0a:00:00
17	217.567202	192.168.1.10	192.168.1.1	ICMP	98	Echo (ping) request id=0x3a43, seq=1/256, ttl=64 (repl
18	217.570148	192.168.1.1	192.168.1.10	ICMP	98	Echo (ping) reply id=0x3a43, seq=1/256, ttl=64 (requ
19	218.572339	192.168.1.10	192.168.1.1	ICMP	98	Echo (ping) request id=0x3b43, seq=2/512, ttl=64 (repl
20	218.573717	192.168.1.1	192.168.1.10	ICMP	98	Echo (ping) reply id=0x3b43, seq=2/512, ttl=64 (requ
21	219.575856	192.168.1.10	192.168.1.1	ICMP	98	Echo (ping) request id=0x3c43, seq=3/768, ttl=64 (repl
22	219.577190	192.168.1.1	192.168.1.10	ICMP	98	Echo (ping) reply id=0x3c43, seq=3/768, ttl=64 (requ
23	220.578974	192.168.1.10	192.168.1.1	ICMP	98	Echo (ping) request id=0x3d43, seq=4/1024, ttl=64 (rep
24	220.580321	192.168.1.1	192.168.1.10	ICMP	98	Echo (ping) reply id=0x3d43, seq=4/1024, ttl=64 (req
→	25 221.582242	192.168.1.10	192.168.1.1	ICMP	98	Echo (ping) request id=0x3e43, seq=5/1280, ttl=64 (rep
←	26 221.583207	192.168.1.1	192.168.1.10	ICMP	98	Echo (ping) reply id=0x3e43, seq=5/1280, ttl=64 (req
27	222.579565	0c:c2:7c:0a:00:00	Private_66:68:00	ARP	60	Who has 192.168.1.10? Tell 192.168.1.1
28	222.580170	Private_66:68:00	0c:c2:7c:0a:00:00	ARP	60	192.168.1.10 is at 00:50:79:66:68:00

> Frame 25: 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: 0c:c2:7c:0a:00:00 (0c:c2:7c:0a:00:00)  
> Internet Protocol Version 4, Src: 192.168.1.10, Dst: 192.168.1.1  
▼ Internet Control Message Protocol  
Type: 8 (Echo (ping) request)  
Code: 0  
Checksum: 0xe1c3 [correct]  
[Checksum Status: Good]  
Identifier (BE): 15939 (0x3e43)  
Identifier (LE): 17214 (0x433e)  
Sequence Number (BE): 5 (0x0005)  
Sequence Number (LE): 1280 (0x0500)  
[\[Response frame: 26\]](#)  
> Data (56 bytes)

0000 0c c2 7c 0a  
0010 00 54 43 3e  
0020 01 01 08 00  
0030 0e 0f 10 11  
0040 1e 1f 20 21  
0050 2e 2f 30 31  
0060 3e 3f

## Моделирование сети с VyOS

Создана аналогичная топология с маршрутизатором VyOS.

Задано имя устройства и IP-адрес 192.168.1.1/24 на интерфейсе eth0.

```
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-ngaforov-gw-01
[edit]
vyos@vyos# set interfaces ethernet eth0 address 192.168.1.1/24
[edit]
vyos@vyos# delete interfaces ethernet eth0 address dhcp
[edit]
vyos@vyos# compare
[edit interfaces ethernet eth0]
-address dhcp
+address 192.168.1.1/24
[edit system]
>host-name msk-ngaforov-gw-01
[edit]
vyos@vyos#
```

# Проверка ICMP-обмена

ПК успешно взаимодействует с маршрутизатором VyOS через ICMP-запросы.

Трафик фиксируется в Wireshark, что подтверждает правильность конфигурации сети.

The screenshot shows the Wireshark interface with a packet capture from the Ethernet1 interface. The packet list on the left shows several ICMP Echo (ping) requests and responses. The selected packet (No. 31) is an ICMP Echo (ping) request from 192.168.1.10 to 192.168.1.1. The packet details pane on the right shows the structure of the ICMP Echo request, including the type (8), code (0), checksum (0x7ac2), and sequence number (5).

No.	Time	Source	Destination	Protocol	Length	Info
18	72.853554	0.0.0.0	255.255.255.255	DHCP	342	DHCP Discover - Transaction ID 0xc13a4078
19	83.455776	0.0.0.0	255.255.255.255	DHCP	342	DHCP Discover - Transaction ID 0xc13a4078
20	98.672026	0.0.0.0	255.255.255.255	DHCP	342	DHCP Discover - Transaction ID 0xc13a4078
21	207.210746	Private_66:68:00	Broadcast	ARP	64	Who has 192.168.1.1? Tell 192.168.1.10
22	207.213784	0c:99:d0:40:00:00	Private_66:68:00	ARP	60	192.168.1.1 is at 0c:99:d0:40:00:00
23	207.215177	192.168.1.10	192.168.1.1	ICMP	98	Echo (ping) request id=0xa144, seq=1/256, ttl=64 (repl
24	207.217362	192.168.1.1	192.168.1.10	ICMP	98	Echo (ping) reply id=0xa144, seq=1/256, ttl=64 (requ
25	208.219714	192.168.1.10	192.168.1.1	ICMP	98	Echo (ping) request id=0xa244, seq=2/512, ttl=64 (repl
26	208.220549	192.168.1.1	192.168.1.10	ICMP	98	Echo (ping) reply id=0xa244, seq=2/512, ttl=64 (requ
27	209.222784	192.168.1.10	192.168.1.1	ICMP	98	Echo (ping) request id=0xa344, seq=3/768, ttl=64 (repl
28	209.224401	192.168.1.1	192.168.1.10	ICMP	98	Echo (ping) reply id=0xa344, seq=3/768, ttl=64 (requ
29	210.227624	192.168.1.10	192.168.1.1	ICMP	98	Echo (ping) request id=0xa444, seq=4/1024, ttl=64 (rep
30	210.230816	192.168.1.1	192.168.1.10	ICMP	98	Echo (ping) reply id=0xa444, seq=4/1024, ttl=64 (rec
31	211.232305	192.168.1.10	192.168.1.1	ICMP	98	Echo (ping) request id=0xa544, seq=5/1280, ttl=64 (rep
32	211.234336	192.168.1.1	192.168.1.10	ICMP	98	Echo (ping) reply id=0xa544, seq=5/1280, ttl=64 (rec
33	212.267261	0c:99:d0:40:00:00	Private_66:68:00	ARP	60	Who has 192.168.1.10? Tell 192.168.1.1
34	212.267465	Private_66:68:00	0c:99:d0:40:00:00	ARP	60	192.168.1.10 is at 00:50:79:66:68:00

Frame 31: 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: 0c:99:d0:40:00:00 (0c:99:d0:40:00:00)  
Internet Protocol Version 4, Src: 192.168.1.10, Dst: 192.168.1.1  
Internet Control Message Protocol  
Type: 8 (Echo (ping) request)  
Code: 0  
Checksum: 0x7ac2 [correct]  
[Checksum Status: Good]  
Identifier (BE): 42308 (0xa544)  
Identifier (LE): 17573 (0x44a5)  
Sequence Number (BE): 5 (0x0005)  
Sequence Number (LE): 1280 (0x0500)

0000 0c 99 d0  
0010 00 54 44  
0020 01 01 08  
0030 0e 0f 10  
0040 1e 1f 20  
0050 2e 2f 30  
0060 3e 3f

## Выводы

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В ходе лабораторной работы:

- Изучены принципы настройки сетей в **GNS3**.
- Проверена работа протоколов **ARP, ICMP, UDP, TCP**.
- Освоены базовые приёмы анализа трафика в **Wireshark**.
- Подтверждена корректность установки TCP-соединений по схеме **Three-Way Handshake**.

Результаты подтвердили надёжную работу сетевых протоколов и правильность построения модели сети.