

# Лабораторная работа №5

## Администрирование сетевых подсистем

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## Цель работы

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Построить простейшие модели сетей на базе коммутатора и маршрутизаторов FRR и VyOS в GNS3, проанализировать трафик посредством Wireshark.

## Выполнение лабораторной работы

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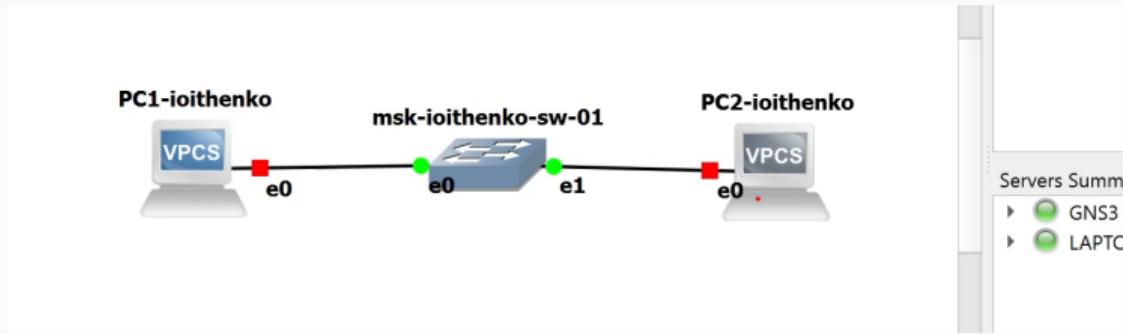


Рис. 1: Топология простейшей сети в GNS3

```
PC1-iothenko - PuTTY

ip ARG ... [OPTION]      Configure the current VPC's IP settings. See ip ?
load [FILENAME]          Load the configuration/script from the file FILENAME
ping HOST [OPTION ...]   Ping HOST with ICMP (default) or TCP/UDP. See ping ?
quit                      Quit program
relay ARG ...             Configure packet relay between UDP ports. See relay ?
rlogin [ip] port          Telnet to port on host at ip (relative to host PC)
save [FILENAME]           Save the configuration to the file FILENAME
set ARG ...                Set VPC name and other options. Try set ?
show [ARG ...]            Print the information of VPCs (default). See show ?
sleep [seconds] [TEXT]    Print TEXT and pause running script for seconds
trace HOST [OPTION ...]  Print the path packets take to network HOST
version                   Shortcut for: show version

To get command syntax help, please enter '?' as an argument of the command.

VPCS> ip 192.168.1.11/24 192.168.1.1
Checking for duplicate address...
PC1 : 192.168.1.11 255.255.255.0 gateway 192.168.1.1

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

VPCS>
```

Рис. 2: Задание IP-адреса для РС-1

PC2-ioithenko - PuTTY

For more information, please visit [wiki.freecode.com.cn](http://wiki.freecode.com.cn).

Press '?' to get help.

Executing the startup file

Hostname is too long. (Maximum 12 characters)

VPCS> ip 192.168.1.12/24 192.168.1.1  
Checking for duplicate address...  
PC1 : 192.168.1.12 255.255.255.0 gateway 192.168.1.1

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

VPCS> ping 192.168.1.11  
84 bytes from 192.168.1.11 icmp\_seq=1 ttl=64 time=2.194 ms  
84 bytes from 192.168.1.11 icmp\_seq=2 ttl=64 time=1.582 ms  
84 bytes from 192.168.1.11 icmp\_seq=3 ttl=64 time=1.753 ms  
84 bytes from 192.168.1.11 icmp\_seq=4 ttl=64 time=3.804 ms  
84 bytes from 192.168.1.11 icmp\_seq=5 ttl=64 time=1.647 ms

VPCS> █

Рис. 3: Задание IP-адреса для РС-2

```
PC1-ioithenko - PuTTY

set ARG ...          Set VPC name and other options. Try set ?
show [ARG ...]       Print the information of VPCs (default). See show ?
sleep [seconds] [TEXT] Print TEXT and pause running script for seconds
trace HOST [OPTION ...] Print the path packets take to network HOST
version             Shortcut for: show version

To get command syntax help, please enter '?' as an argument of the command.

VPCS> ip 192.168.1.11/24 192.168.1.1
Checking for duplicate address...
PC1 : 192.168.1.11 255.255.255.0 gateway 192.168.1.1

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

VPCS> ping 192.168.1.12
84 bytes from 192.168.1.12 icmp_seq=1 ttl=64 time=2.098 ms
84 bytes from 192.168.1.12 icmp_seq=2 ttl=64 time=1.978 ms
84 bytes from 192.168.1.12 icmp_seq=3 ttl=64 time=1.923 ms
84 bytes from 192.168.1.12 icmp_seq=4 ttl=64 time=1.612 ms
84 bytes from 192.168.1.12 icmp_seq=5 ttl=64 time=2.767 ms

VPCS> █
```

Рис. 4: Пингование PC-2

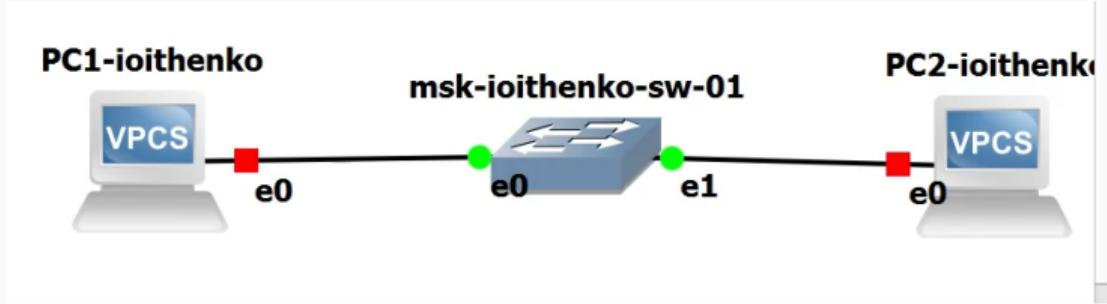


Рис. 5: Остановка всех узлов

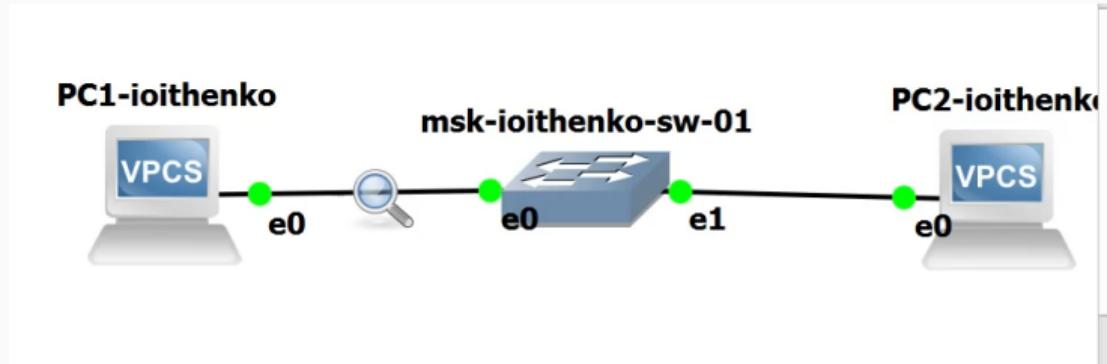


Рис. 6: Захват трафика, старт узлов

Захват из Standard input [PC1-ioithenko Ethernet0 to msk-ioithenko-sw-01 Ethernet0]

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

Примените фильтр отображения ... <Ctrl-/>

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	Private_66:68:01	Broadcast	ARP	64	Gratuitous ARP for 192.
2	0.096113	Private_66:68:00	Broadcast	ARP	64	Gratuitous ARP for 192.
3	1.000319	Private_66:68:01	Broadcast	ARP	64	Gratuitous ARP for 192.
4	1.097378	Private_66:68:00	Broadcast	ARP	64	Gratuitous ARP for 192.

[Frame is marked: False]  
[Frame is ignored: False]  
[Protocols in frame: eth:ethertype:arp]  
[Coloring Rule Name: ARP]  
[Coloring Rule String: arp]  
▼ Ethernet II, Src: Private\_66:68:01 (00:50:79:66:68:01), Dst: Broadcast (ff:ff:ff:ff:ff:ff)  
  ▼ Destination: Broadcast (ff:ff:ff:ff:ff:ff)  
    .... ..1 ..... .... .... = LG bit: Locally administered address (this  
    .... ..1 ..... .... .... = IG bit: Group address (multicast/broadcast)  
  ▼ Source: Private\_66:68:01 (00:50:79:66:68:01)  
    .... ..0 ..... .... .... = LG bit: Globally unique address (factory d  
    .... ..0 ..... .... .... = IG bit: Individual address (unicast)  
  Type: ARP (0x0806)  
  [Stream index: 0]  
  Padding: 00  
  Frame check sequence: 0x00000000 [unverified]  
  [FCS Status: Unverified]  
▼ 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)  
  Sender IP address: 192.168.1.12  
  Target MAC address: Broadcast (ff:ff:ff:ff:ff:ff)  
  Target IP address: 192.168.1.12

Рис. 7: Информация по протоколу ARP

```
VPCS> ping 192.168.1.11 -1
84 bytes from 192.168.1.11 icmp_seq=1 ttl=64 time=1.833 ms
84 bytes from 192.168.1.11 icmp_seq=2 ttl=64 time=2.260 ms
84 bytes from 192.168.1.11 icmp_seq=3 ttl=64 time=1.811 ms
84 bytes from 192.168.1.11 icmp_seq=4 ttl=64 time=1.695 ms
84 bytes from 192.168.1.11 icmp_seq=5 ttl=64 time=1.423 ms
```

```
VPCS> █
```

Рис. 8: Эхо-запрос в ICMP-моде

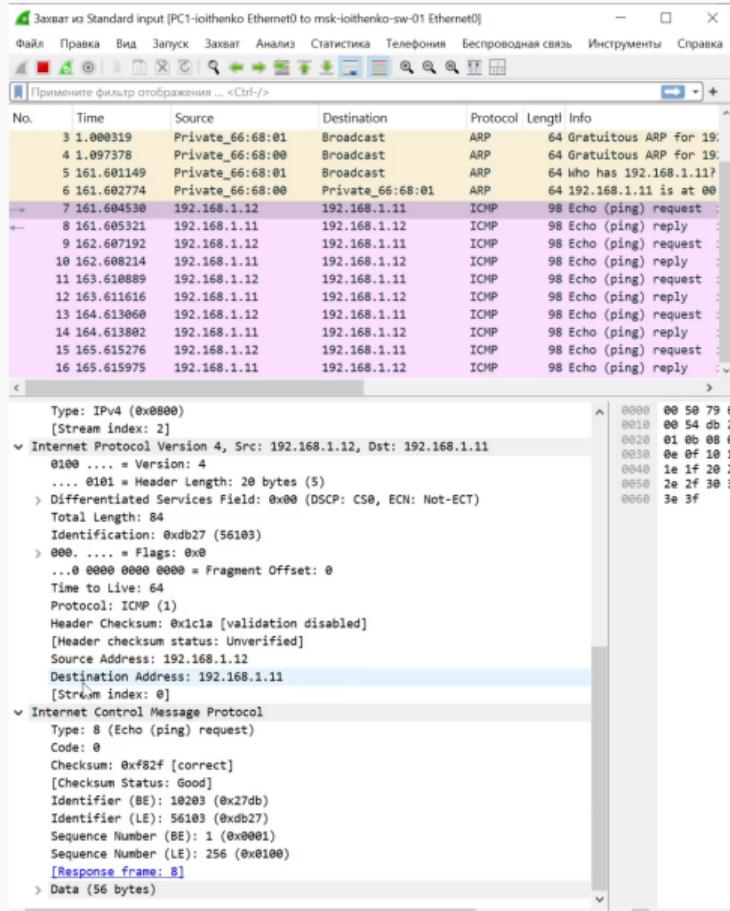


Рис. 9: Полученная информация по эхо-запросу в ICMP-моде к узлу PC-1

```
VPCS> ping 192.168.1.11 -2
84 bytes from 192.168.1.11 udp_seq=1 ttl=64 time=2.028 ms
84 bytes from 192.168.1.11 udp_seq=2 ttl=64 time=1.957 ms
84 bytes from 192.168.1.11 udp_seq=3 ttl=64 time=2.253 ms
84 bytes from 192.168.1.11 udp_seq=4 ttl=64 time=1.948 ms
84 bytes from 192.168.1.11 udp_seq=5 ttl=64 time=2.669 ms
```

```
VPCS> █
```

Рис. 10: Эхо-запрос в UDP-моде

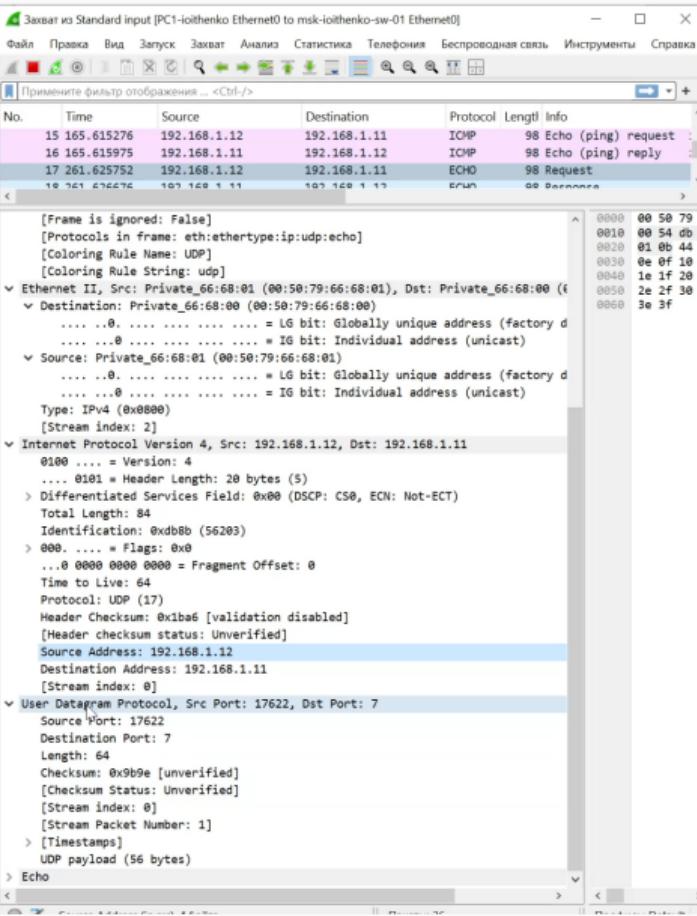


Рис. 11: Полученная информация по эхо-запросу в UDP-моде к узлу РС-1

```
VPCS> ping 192.168.1.11 -3
Connect 7@192.168.1.11 seq=1 ttl=64 time=5.556 ms
SendData 7@192.168.1.11 seq=1 ttl=64 time=2.111 ms
Close 7@192.168.1.11 seq=1 ttl=64 time=3.191 ms
Connect 7@192.168.1.11 seq=2 ttl=64 time=4.305 ms
SendData 7@192.168.1.11 seq=2 ttl=64 time=2.131 ms
Close 7@192.168.1.11 seq=2 ttl=64 time=4.309 ms
Connect 7@192.168.1.11 seq=3 ttl=64 time=3.283 ms
SendData 7@192.168.1.11 seq=3 ttl=64 time=3.378 ms
Close 7@192.168.1.11 seq=3 ttl=64 time=4.270 ms
Connect 7@192.168.1.11 seq=4 ttl=64 time=2.145 ms
SendData 7@192.168.1.11 seq=4 ttl=64 time=2.472 ms
Close 7@192.168.1.11 seq=4 ttl=64 time=5.371 ms
Connect 7@192.168.1.11 seq=5 ttl=64 time=7.589 ms
SendData 7@192.168.1.11 seq=5 ttl=64 time=5.494 ms
Close 7@192.168.1.11 seq=5 ttl=64 time=4.358 ms

VPCS>
```

Рис. 12: Эхо-запрос в TCP-моде

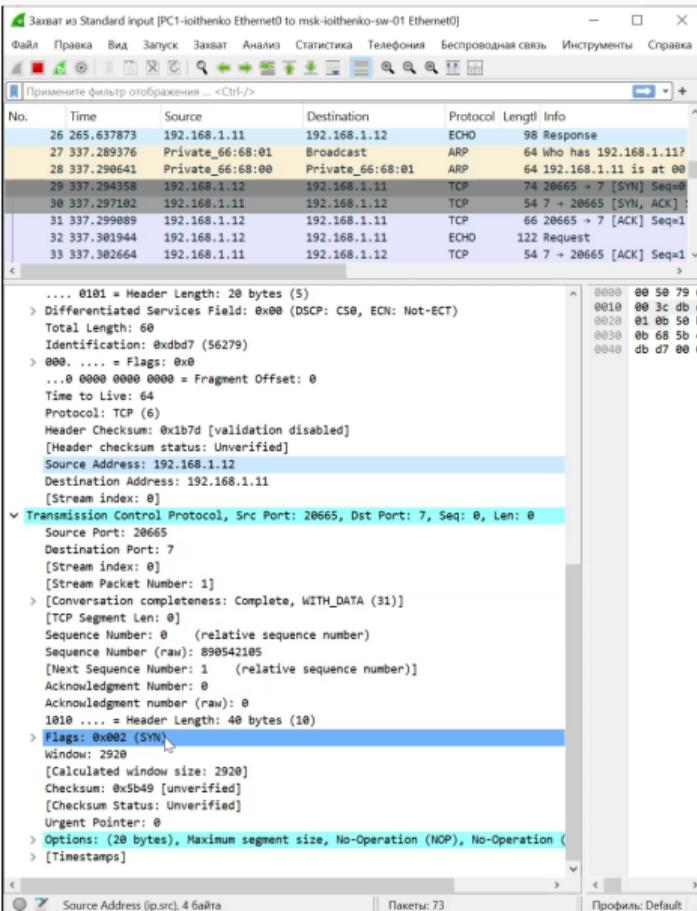


Рис. 13: Полученная информация по эхо-запросу в TCP-моде к узлу PC-1

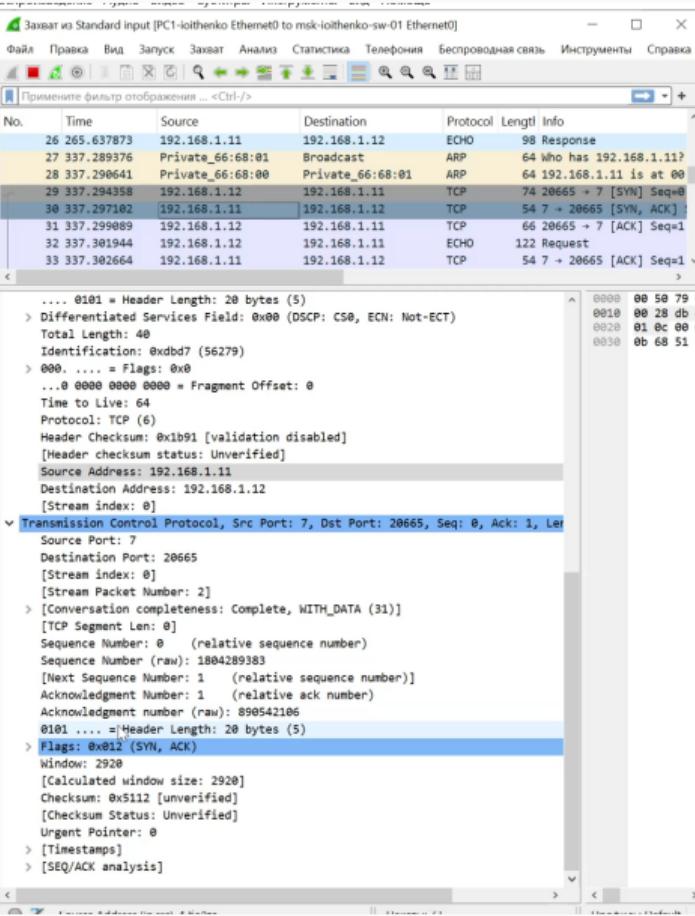


Рис. 14: Полученная информация по эхо-запросу в TCP-моде к узлу PC-1

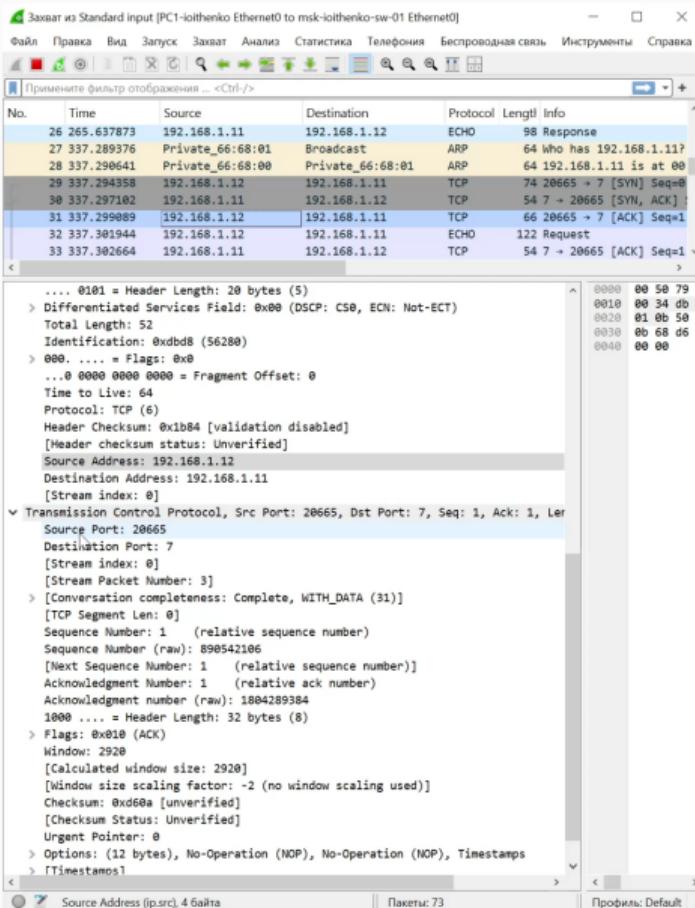


Рис. 15: Полученная информация по эхо-запросу в TCP-моде к узлу PC-1

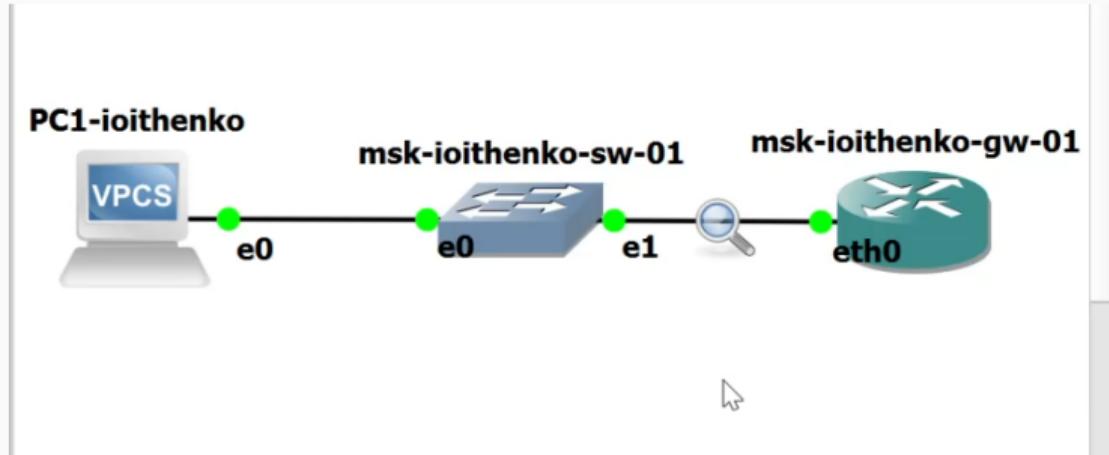


Рис. 16: Топология сети с маршрутизатором FRR

```
[ 2.115198] kernel_init+0x11/0x120
[ 2.115198] ret_from_fork+0x22/0x30
[ 2.115198] </TASK>
[ 2.115198] Modules linked in:
[ 2.115198] ---[ end trace b197cb4e10a7bbf0 ]---
[ 2.115198] RIP: 0010:native_write_msr+0x6/0x30
[ 2.115198] Code: b8 40 00 00 00 f0 00 d8 89 ef e8 a5 56 fe ff eb ca e8 4e 25
78 00 66 66 2e 0f 1f 84 00 00 00 00 0f 1f 00 89 f0 89 f9 0f 30 <66> 90 31 c0
89 c2 89 c1 89 c6 89 c7 c3 cc cc cc cc 48 c1 e2 20 48
[ 2.115198] RSP: 0018:fffffa91080013e30 EFLAGS: 00010056
[ 2.115198] RAX: 00000000000000400 RBX: 0000000000000000 RCX: 00000000000000830
[ 2.115198] RDX: 00000000000000000000 RSI: 00000000000000400 RDI: 00000000000000830
[ 2.115198] RBP: 00000000000000400 R08: 00000000000000000000 R09: 00000000000000000000
[ 2.115198] R10: 00000000000000000000 R11: 00000000000000000000 R12: ffffffff8855f0e0
[ 2.115198] R13: 0000000000080000 R14: 00000000000151c0 R15: 00000000000000000000
[ 2.115198] FS: 0000000000000000(0000) GS:ffff8bc44f20000(0000) knlGS:00000
0000000000000000
[ 2.115198] CS: 0010 DS: 0000 ES: 0000 CR0: 0000000080050033
[ 2.115198] CR2: ffff8bc447801000 CR3: 00000000700a000 CR4: 00000000000006b0
[ 2.115198] Kernel panic - not syncing: Attempted to kill init! exitcode=0x00
00000b
[ 2.115198] ---[ end Kernel panic - not syncing: Attempted to kill init! exit
code=0x0000000b ]---
```

Рис. 17: Терминал маршрутизатора FRR

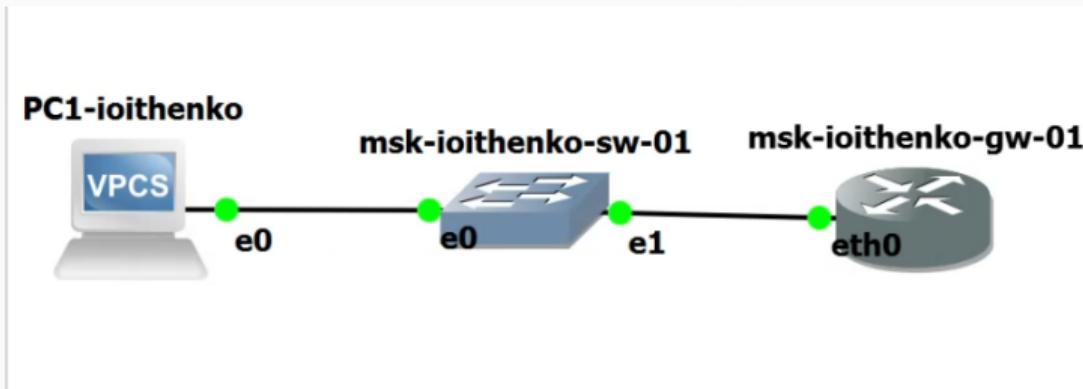
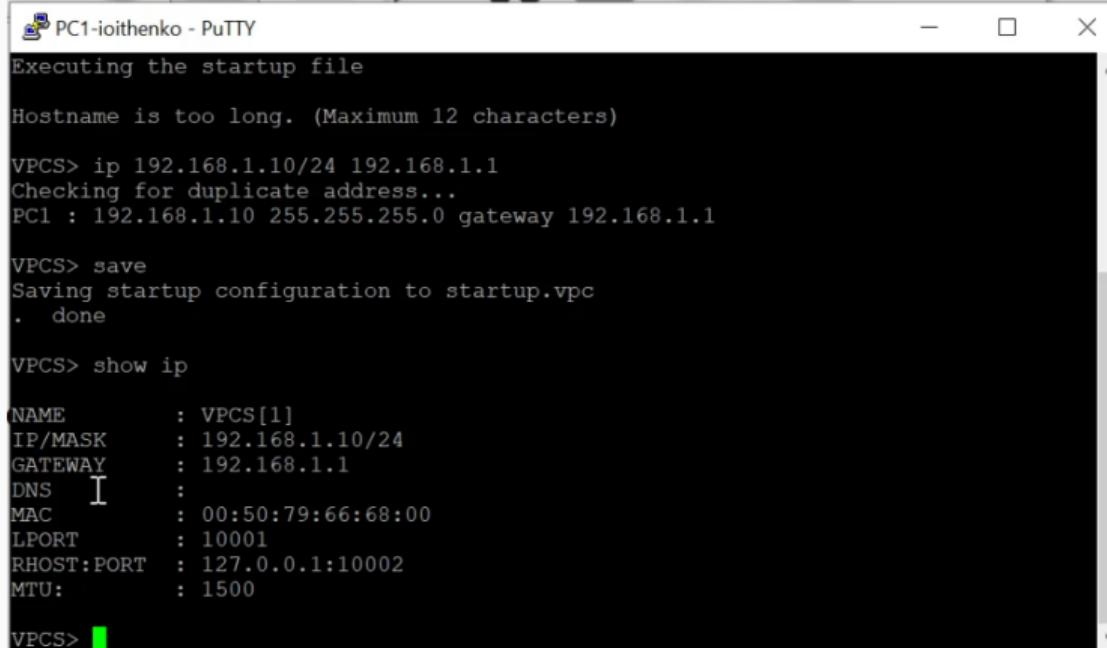


Рис. 18: Топология сети с маршрутизатором VyOS



Executing the startup file

Hostname is too long. (Maximum 12 characters)

VPCS> ip 192.168.1.10/24 192.168.1.1  
Checking for duplicate address...  
PC1 : 192.168.1.10 255.255.255.0 gateway 192.168.1.1

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

VPCS> show ip

NAME	:	VPCS[1]
IP/MASK	:	192.168.1.10/24
GATEWAY	:	192.168.1.1
DNS	I	:
MAC	:	00:50:79:66:68:00
LPORT	:	10001
RHOST:PORT	:	127.0.0.1:10002
MTU:	:	1500

VPCS>

Рис. 19: Настройка IP-адресации для интерфейса узла РС-1

```
default. Update your scripts to load br_netfilter if you need this.  
[ 32.847120] Bridge firewalling registered  
[ 32.919748] mpls_gso: MPLS GSO support  
  
Welcome to VyOS - vyos ttyS0  
  
vyos 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@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...
```

Рис. 20: Логин, проверка установки системы на диск

```
You can change this banner using "set system login banner post-login" command.

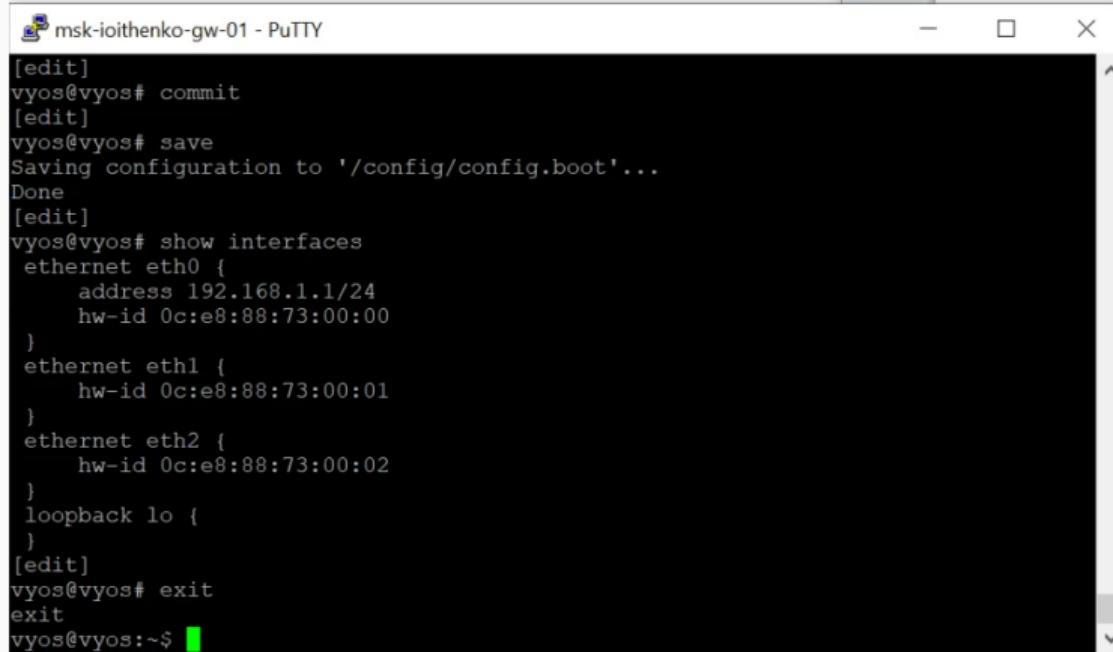
VyOS is a free software distribution that includes multiple components,
you can check individual component licenses under /usr/share/doc/*copyright
vyos@vyos:~$ configure
[edit]
vyos@vyos# set system host-name msk-ioithenko-gw-01
[edit]
vyos@vyos# set interfaces ethernet eth0 address
    Configuration path: [interfaces ethernet eth0 address] requires a value
    Set failed

[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-ioithenko-gw-01
[edit]
vyos@vyos#
```

Рис. 21: Режим конфигурирования

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

Рис. 22: Режим конфигурирования



```
[edit]
vyos@vyos# commit
[edit]
vyos@vyos# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@vyos# show interfaces
 ethernet eth0 {
     address 192.168.1.1/24
     hw-id 0c:e8:88:73:00:00
 }
 ethernet eth1 {
     hw-id 0c:e8:88:73:00:01
 }
 ethernet eth2 {
     hw-id 0c:e8:88:73:00:02
 }
 loopback lo {
 }
[edit]
vyos@vyos# exit
exit
vyos@vyos:~$
```

Рис. 23: Режим конфигурирования

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

VPCS> show ip

NAME      : VPCS[1]
IP/MASK   : 192.168.1.10/24
GATEWAY   : 192.168.1.1
DNS       :
MAC       : 00:50:79:66:68:00
LPORT     : 10001
RHOST:PORT : 127.0.0.1:10002
MTU:      : 1500

VPCS> ping 192.168.1.1
84 bytes from 192.168.1.1 icmp_seq=1 ttl=64 time=1.705 ms
84 bytes from 192.168.1.1 icmp_seq=2 ttl=64 time=1.599 ms
84 bytes from 192.168.1.1 icmp_seq=3 ttl=64 time=1.494 ms
84 bytes from 192.168.1.1 icmp_seq=4 ttl=64 time=2.205 ms
84 bytes from 192.168.1.1 icmp_seq=5 ttl=64 time=1.041 ms
```

Рис. 24: Пингование маршрутизатора

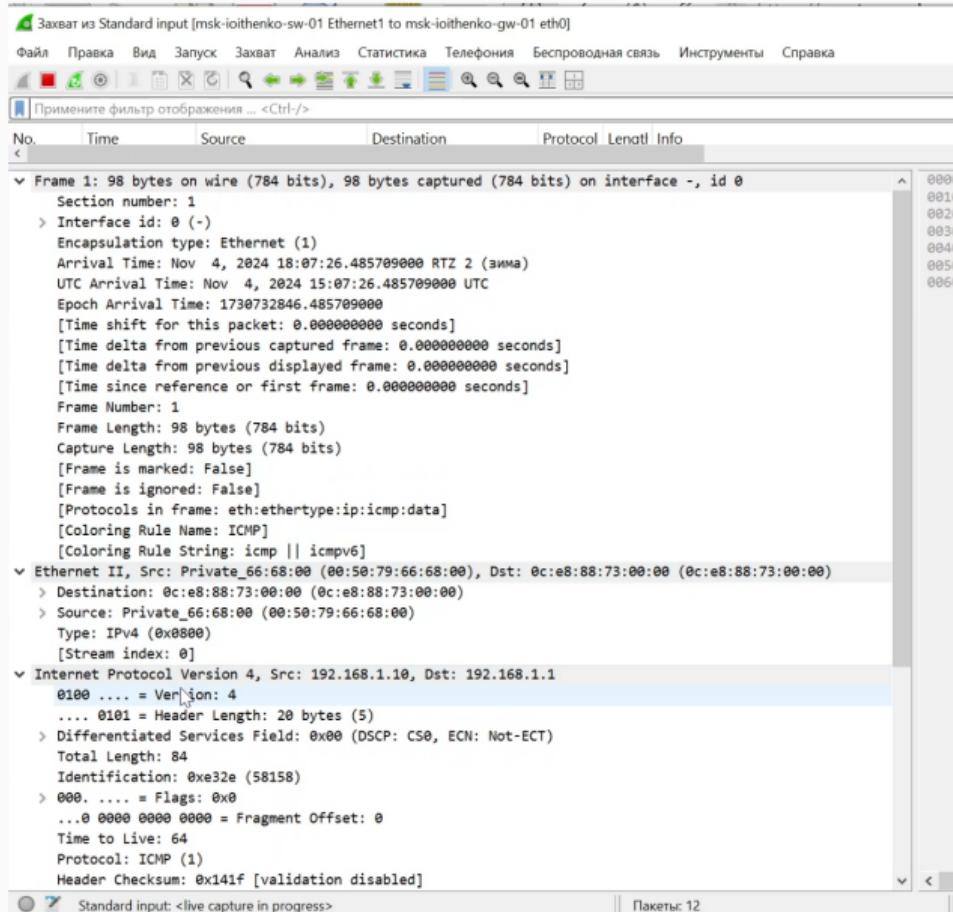


Рис. 25: Полученная информация в Wireshark по ICMP-сообщению

## Выводы

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В процессе выполнения лабораторной работы я построила простейшие модели сети на базе коммутатора и маршрутизатора VyOS в GNS3, проанализировала трафик посредством Wireshark.