

Лабораторная работа №5

Сетевые технологии

Мишина А. А.

8 ноября 2024

Цель работы

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

Выполнение лабораторной работы

Анализ трафика в GNS3 посредством Wireshark

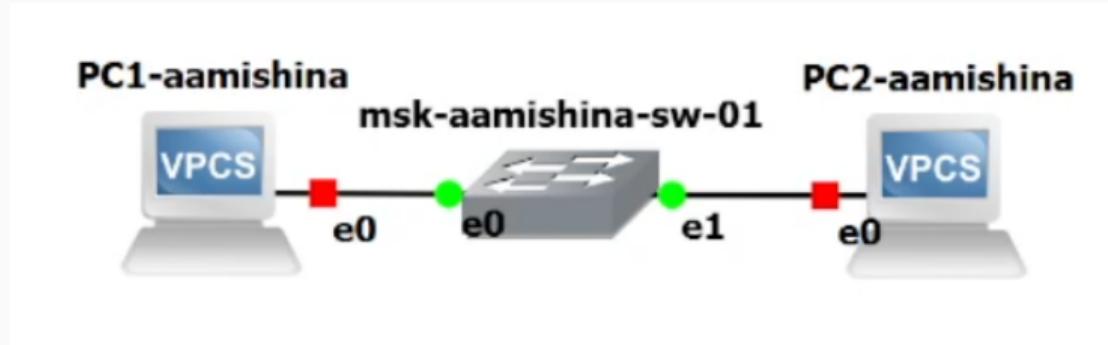


Рис. 1: Топология простейшей сети в GNS3

Анализ трафика

```
arp                                         Shortcut for: show arp. Show arp table
clear ARG                                     Clear IPv4/IPv6, arp/neighbor cache, command history
dhcp [OPTION]                                  Shortcut for: ip dhcp. Get IPv4 address via DHCP
disconnect                                     Exit the telnet session (daemon mode)
echo TEXT                                     Display TEXT in output. See also set echo ?
help                                         Print help
history                                      Shortcut for: show history. List the command history
ip ARG ... [OPTION]                           Configure the current VNC'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                             Relogin to host on host at ip (relative to host PC)
save [FILENAME]                                Save the configuration to the file FILENAME
set ARG ...                                   Set VNC name and other options. Try set ?
show [ARG ...]                                Print the information of VNC (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.
VPCB> ip /?

ip ARG ... [OPTION]
Configure the current VNC's IP settings
ARG ...
address [mask] [gateway]
address [gateway] [mask]
      Set the VNC's ip, default gateway ip and network mask
      Note: the VNC's ip is /24, the IPv6 is /64. Example:
      ip 10.1.1.70/26 10.1.1.65 set the VNC's ip to 10.1.1.70,
      the gateway to 10.1.1.65, the netmask to 255.255.255.192.
      In tap mode, the ip of the tapx is the maximum host ID
      of the subnet. In the example above the tapx ip would be
      10.1.1.128
      mask must be written as /26, 26 or 255.255.255.192
auto                                         Attempt to obtain IPv4 address, mask and gateway using SLAAC
dhcpc [OPTION]                                Attempt to obtain IPv4 address, mask, gateway, DNS via DHCP
-d                                           Show DHCP packet decode
-r                                           Renew DHCP lease
-x                                           Release DHCP lease
dns ip                                       Set DNS server ip, delete if ip is '0'
domain NAME                                    Set local domain name to NAME

VPCB> 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

VPCB> save
Saving startup configuration to startup.vnc
. done
VPCB>
```



Рис. 2: Задание IP-адреса для РС-1

Анализ трафика

The screenshot shows a PuTTY session window titled "PC2-aamishina - PuTTY". The terminal output displays the startup sequence of the VPCS (Virtual PC Simulator) software. It includes the welcome message, build information, license terms, and configuration steps for setting up a virtual machine (PC1). The configuration involves specifying an IP address (192.168.1.12), subnet mask (255.255.255.0), and gateway (192.168.1.1). After saving the configuration, a ping command is issued to 192.168.1.11, showing five successful ICMP echo requests with their respective times.

```
Welcome to Virtual PC Simulator, version 0.6.2
Dedicated to Daling.
Build time: Apr 10 2019 02:42:20
Copyright (c) 2007-2014, Paul Meng (mirnshi@gmail.com)
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 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=1.602 ms
84 bytes from 192.168.1.11 icmp_seq=2 ttl=64 time=1.899 ms
84 bytes from 192.168.1.11 icmp_seq=3 ttl=64 time=1.941 ms
84 bytes from 192.168.1.11 icmp_seq=4 ttl=64 time=2.136 ms
84 bytes from 192.168.1.11 icmp_seq=5 ttl=64 time=1.342 ms

VPCS>
```

Рис. 3: Задание IP-адреса для РС-2

Анализ трафика

```
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.

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=
84 bytes from 192.168.1.12 icmp_seq=2 ttl=64 time=
84 bytes from 192.168.1.12 icmp_seq=3 ttl=64 time=
84 bytes from 192.168.1.12 icmp_seq=4 ttl=64 time=
84 bytes from 192.168.1.12 icmp_seq=5 ttl=64 time=
```

Рис. 4: Пингование PC-2

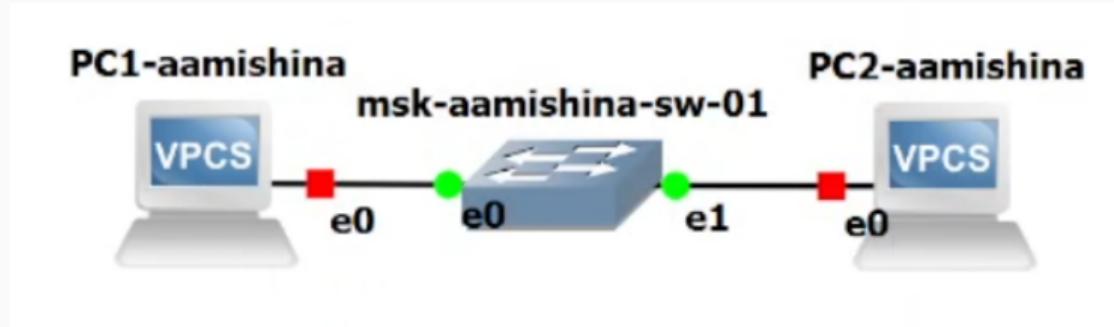


Рис. 5: Остановка всех узлов

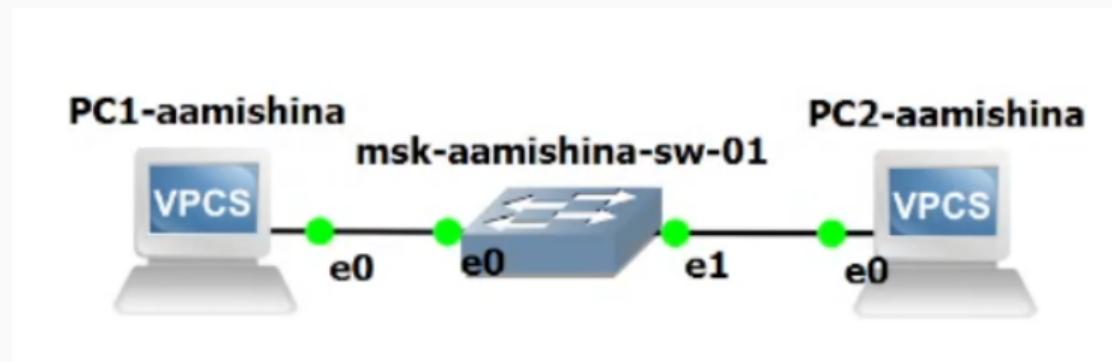


Рис. 6: Захват трафика, старт узлов

Анализ трафика

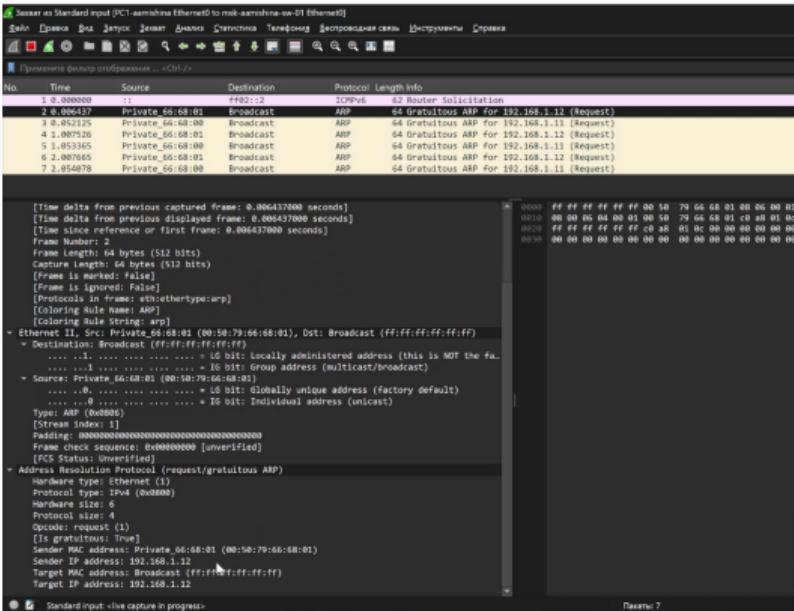


Рис. 7: Информация по протоколу ARP

```
VPCS> ping 192.168.1.11 -1
84 bytes from 192.168.1.11 icmp_seq=1 ttl=64 time=
84 bytes from 192.168.1.11 icmp_seq=2 ttl=64 time=
84 bytes from 192.168.1.11 icmp_seq=3 ttl=64 time=
84 bytes from 192.168.1.11 icmp_seq=4 ttl=64 time=
84 bytes from 192.168.1.11 icmp_seq=5 ttl=64 time=
```

```
VPCS> █
```

Рис. 8: Эхо-запрос в ICMP-моде

Анализ трафика

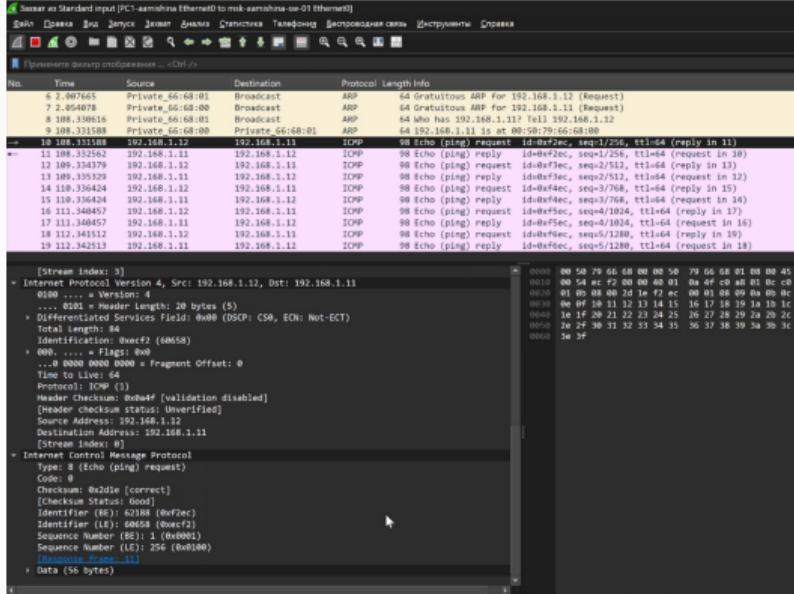


Рис. 9: Полученная информация по эхо-запросу в ICMP-моде к узлу PC-1

Анализ трафика

```
84 bytes from 192.168.1.11 icmp_seq=5 ttl=64 time=1  
VPCS> ping 192.168.1.11 -2  
84 bytes from 192.168.1.11 udp_seq=1 ttl=64 time=1  
84 bytes from 192.168.1.11 udp_seq=2 ttl=64 time=1  
84 bytes from 192.168.1.11 udp_seq=3 ttl=64 time=0  
84 bytes from 192.168.1.11 udp_seq=4 ttl=64 time=1  
84 bytes from 192.168.1.11 udp_seq=5 ttl=64 time=2  
VPCS>
```

Рис. 10: Эхо-запрос в UDP-моде

Анализ трафика

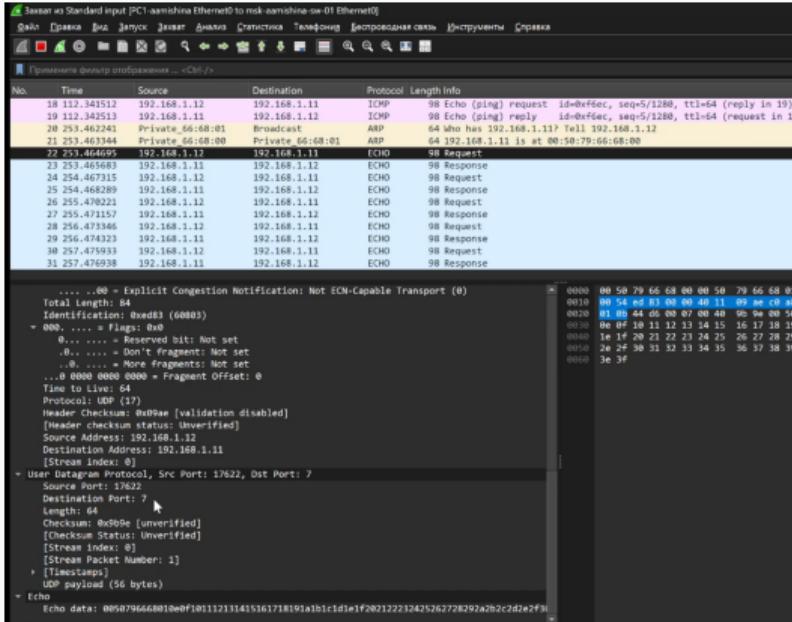


Рис. 11: Полученная информация по эхо-запросу в UDP-моде к узлу РС-1

Анализ трафика

```
VPCS> ping 192.168.1.11 -3
Connect 7@192.168.1.11 seq=1 ttl=64 time=3.025 ms
SendData 7@192.168.1.11 seq=1 ttl=64 time=2.063 ms
Close    7@192.168.1.11 seq=1 ttl=64 time=2.842 ms
Connect 7@192.168.1.11 seq=2 ttl=64 time=2.998 ms
SendData 7@192.168.1.11 seq=2 ttl=64 time=2.675 ms
Close    7@192.168.1.11 seq=2 ttl=64 time=4.240 ms
Connect 7@192.168.1.11 seq=3 ttl=64 time=1.876 ms
SendData 7@192.168.1.11 seq=3 ttl=64 time=1.936 ms
Close    7@192.168.1.11 seq=3 ttl=64 time=4.037 ms
Connect 7@192.168.1.11 seq=4 ttl=64 time=2.293 ms
SendData 7@192.168.1.11 seq=4 ttl=64 time=1.544 ms
Close    7@192.168.1.11 seq=4 ttl=64 time=3.530 ms
Connect 7@192.168.1.11 seq=5 ttl=64 time=2.934 ms
SendData 7@192.168.1.11 seq=5 ttl=64 time=8.425 ms
Close    7@192.168.1.11 seq=5 ttl=64 time=3.152 ms
```

```
VPCS> █
```

Рис. 12: Эхо-запрос в TCP-моде

Анализ трафика

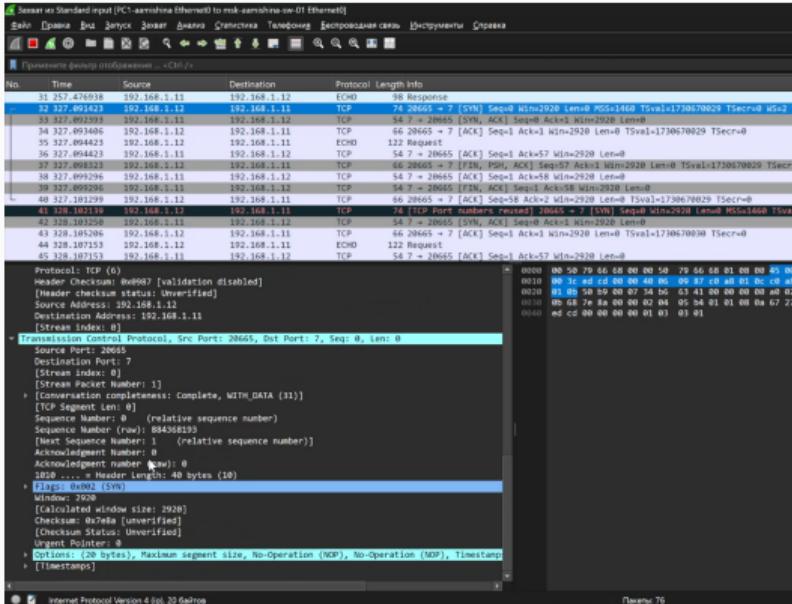


Рис. 13: Полученная информация по эхо-запросу в TCP-моде к узлу PC-1

Анализ трафика

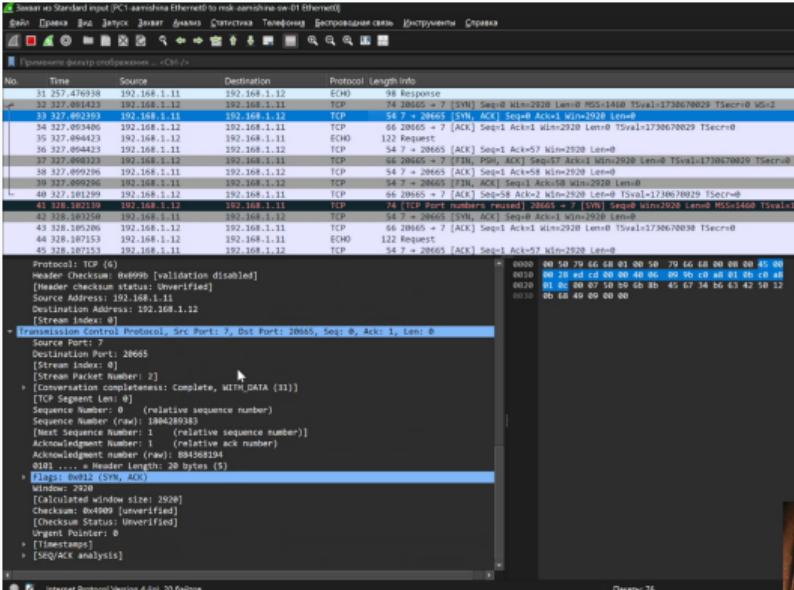


Рис. 14: Полученная информация по эхо-запросу в TCP-режиме к узлу PC-1

Анализ трафика

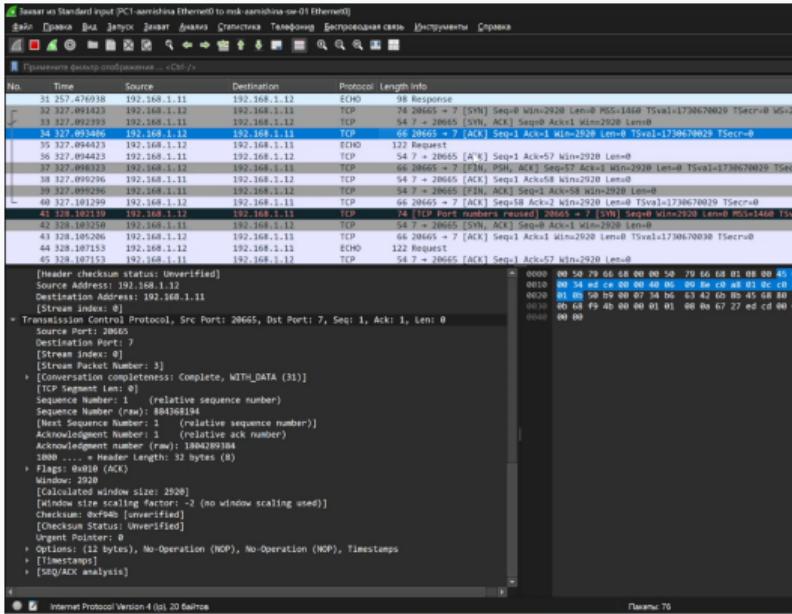


Рис. 15: Полученная информация по эхо-запросу в TCP-моде к узлу PC-1

Моделирование простейшей сети на базе маршрутизатора FRR в GNS3

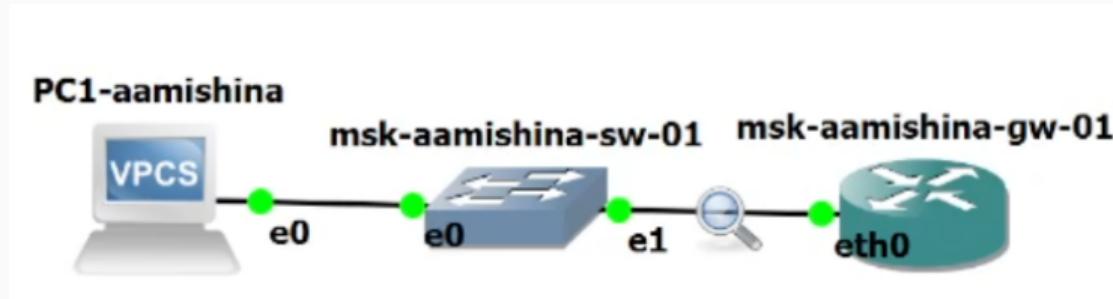


Рис. 16: Топология сети с маршрутизатором FRR

```
Welcome to Virtual PC Simulator, version 0.6.2
Dedicated to Daling.
Build time: Apr 10 2019 02:42:20
Copyright (c) 2007-2014, Paul Meng (mirnshi@gmail.com)
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 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       :
MAC       : 00:50:79:66:68:00
LPORT     : 10003
RHOST:PORT: 127.0.0.1:10004
MTU:      : 1500

VPCS>
```

Рис. 17: Настройка IP-адресации для интерфейса узла PC-1

FRR

```
m$ msk-amamishina-gw-01# PuTTY
1 Unknown command: Router# configure terminal
frfr
frfr
frfr
frfr
frfr configure terminal
frr(config)# hostname msk-amamishina-gw-01
msk-amamishina-gw-01(config)# exit
msk-amamishina-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-amamishina-gw-01# configure terminal
msk-amamishina-gw-01(config)# interface eth0
msk-amamishina-gw-01(config-if)# ip address 192.168.1.1/24
msk-amamishina-gw-01(config-if)# no shutdown
msk-amamishina-gw-01(config-if)# exit
msk-amamishina-gw-01(config)# exit
msk-amamishina-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-amamishina-gw-01# show running-config
Building configuration...
Current configuration:
!
frr version 8.2.2
frr defaults traditional
hostname frr
hostname msk-amamishina-gw-01
service integrated-vtysh-config
!
interface eth0
    ip address 192.168.1.1/24
    exit
!
end
msk-amamishina-gw-01# show interface brief
Interface          Status      VRF       Addresses
-----  -----
eth0              up        default   192.168.1.1/24
eth1              down      default
eth2              down      default
eth3              down      default
eth4              down      default
eth5              down      default
eth6              down      default
eth7              down      default
lo               up        default
pimseg            up        default

msk-amamishina-gw-01#
```

Рис. 18: Настройка IP-адресации для интерфейса локальной сети маршрутизатора. Проверка конфигурации.

```
VPCS> ping 192.168.1.1
84 bytes from 192.168.1.1 icmp_seq=1 ttl=64 time=14.388 ms
84 bytes from 192.168.1.1 icmp_seq=2 ttl=64 time=7.265 ms
84 bytes from 192.168.1.1 icmp_seq=3 ttl=64 time=5.302 ms
84 bytes from 192.168.1.1 icmp_seq=4 ttl=64 time=8.868 ms
84 bytes from 192.168.1.1 icmp_seq=5 ttl=64 time=3.492 ms
```

```
VPCS> █
```

т

Рис. 19: Отправка эхо-запросов с узла РС1 на адрес маршрутизатора

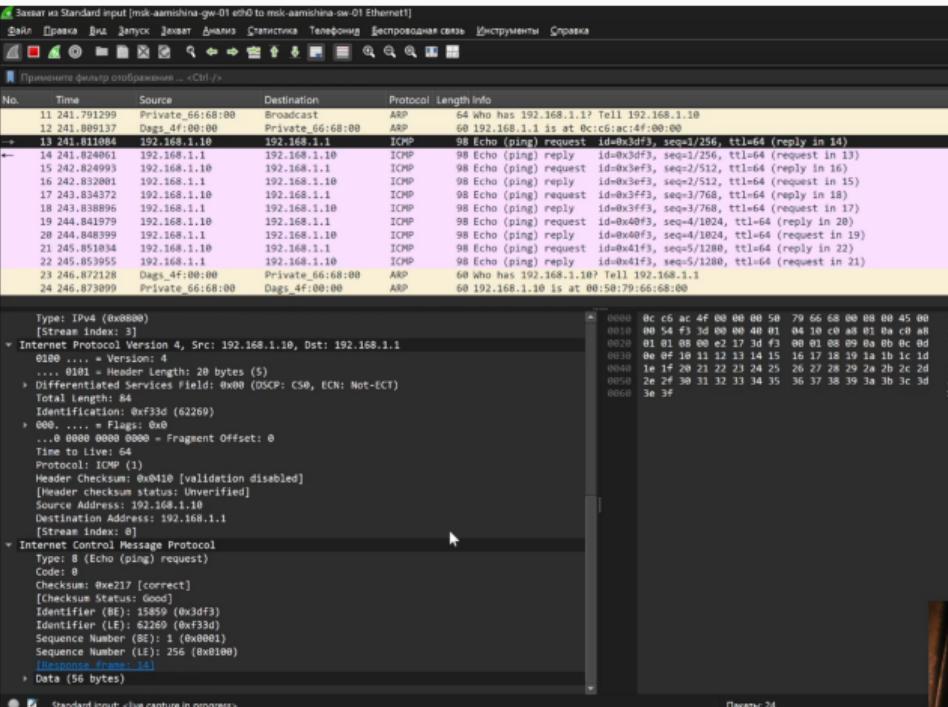


Рис. 20: Полученная информация в Wireshark по ICMP-сообщениям

Моделирование простейшей сети на базе маршрутизатора VyOS в GNS3

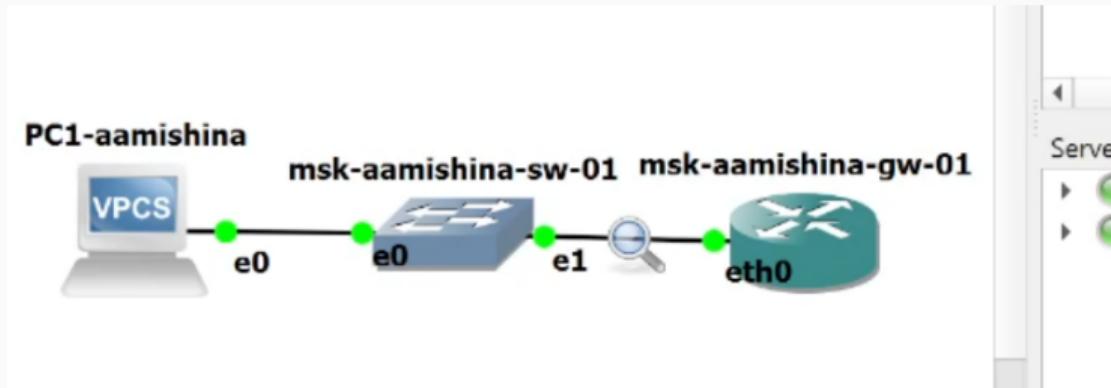


Рис. 21: Топология сети с маршрутизатором VyOS

```
Welcome to Virtual PC Simulator, version 0.6.2
Dedicated to Daling.
Build time: Apr 10 2019 02:42:20
Copyright (c) 2007-2014, Paul Meng (mirnshi@gmail.com)
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 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       :
MAC       : 00:50:79:66:68:00
LPORT     : 10003
RHOST:PORT: 127.0.0.1:10004
MTU:      : 1500

VPCS>
```

Рис. 22: Настройка IP-адресации для интерфейса узла PC-1

VyOS

The screenshot shows a terminal window titled "msk-aamishina-ge-01 - PuTTY". The window displays the boot log of the VyOS system. The log includes messages from various kernel modules like ext4, loop, and squashfs, along with systemd startup logs. It also shows the configuration of network interfaces (eth0, eth1) and the loading of the mpls_gso module. After the log, a standard Linux-style login prompt is shown:

```
Welcome to VyOS - vyos ttyS0
vyos login: vyos
Password:
Welcome to VyOS!
```

Following the login, a banner message is displayed:

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

The banner also provides instructions for changing the login banner:

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

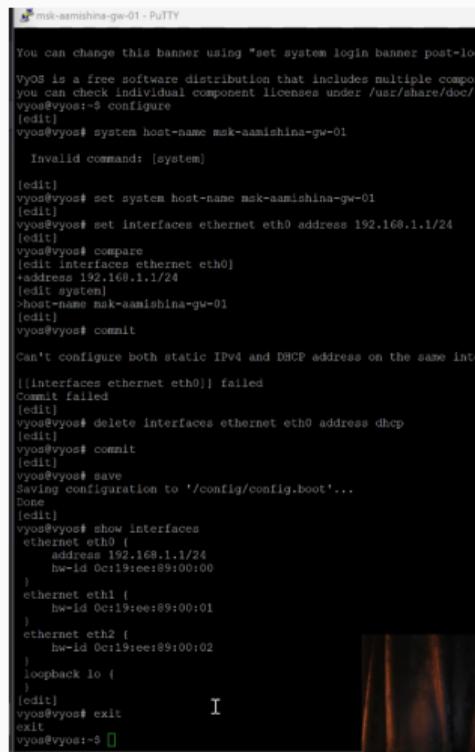
At the bottom of the terminal, a message from the kernel indicates that the current image is an install image:

```
VyOS is a free software distribution that includes multiple components.
You can check individual component licenses under /usr/share/licenses/
vyos/vyos-5 install image
You are trying to install from an already installed image file or URL must be specified.
```

The user then types "reboot" and is prompted for confirmation:

```
Exiting...
vyos@vyos:~$ reboot
Are you sure you want to reboot this system? [y/N]
vyos@vyos:~$
```

Рис. 23: Логин, проверка установки системы на диск



```
[msk-aamishina-gw-01 ~] You can change this banner using "set system login banner post-login"
VyOS is a free software distribution that includes multiple components
you can check individual component licenses under /usr/share/doc/*
vyos@vyos:~$ configure
[edit]
vyos@vyos# system host-name msk-aamishina-gw-01
    Invalid command: [system]
[edit]
vyos@vyos# set system host-name msk-aamishina-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-aamishina-gw-01
[edit]
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]
vyos@vyos# show interfaces
ethernet eth0 {
    address 192.168.1.1/24
    hw-id 0c:19:ee:89:00:00
}
ethernet eth1 {
    hw-id 0c:19:ee:89:00:01
}
ethernet eth2 {
    hw-id 0c:19:ee:89:00:02
}
loopback lo {
}
[edit]
vyos@vyos# exit
exit
vyos@vyos:~$
```

Рис. 24: Режим конфигурирования: имя устройства, ip-адрес на интерфейсе eth0. Просмотр изменений, применение изменений, сохранение.

```
VPCS> ping 192.168.1.1
84 bytes from 192.168.1.1 icmp_seq=1 ttl=64 time=4.476 ms
84 bytes from 192.168.1.1 icmp_seq=2 ttl=64 time=5.166 ms
84 bytes from 192.168.1.1 icmp_seq=3 ttl=64 time=4.886 ms
84 bytes from 192.168.1.1 icmp_seq=4 ttl=64 time=19.533 ms
84 bytes from 192.168.1.1 icmp_seq=5 ttl=64 time=6.896 ms
```

T

VPCS>

Рис. 25: Пингование маршрутизатора

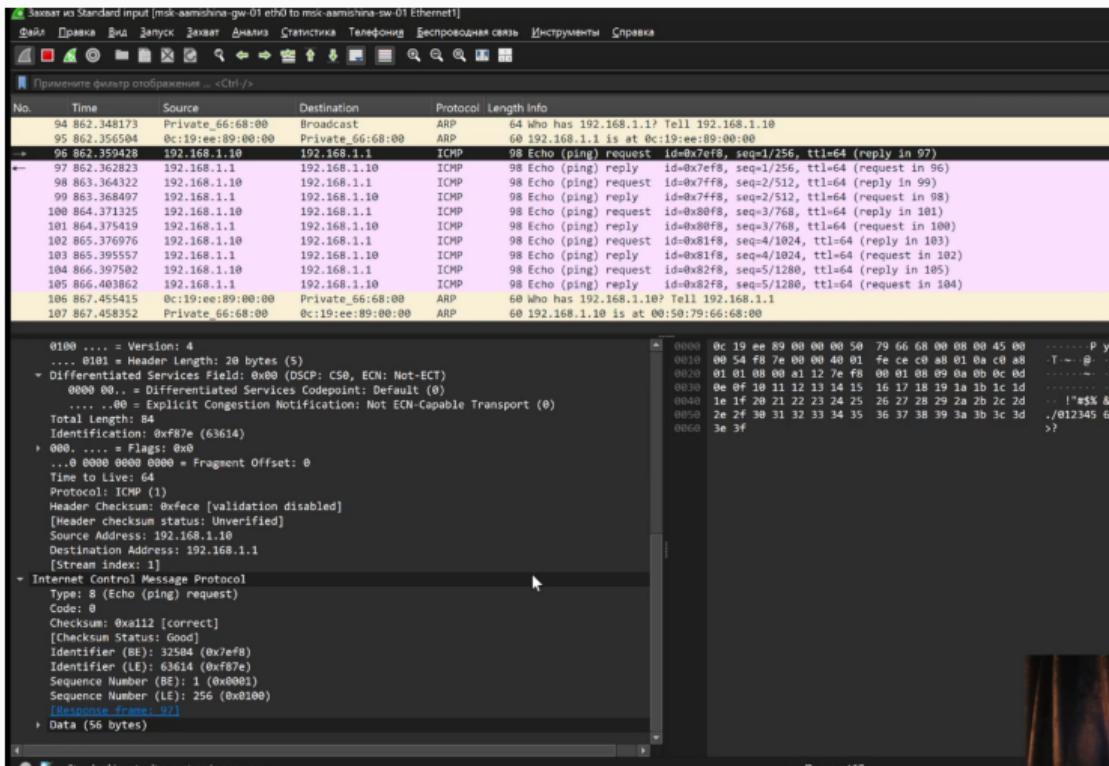


Рис. 26: Полученная информация в Wireshark по ICMP-сообщению

Выводы

- В процессе выполнения лабораторной работы мы построили простейшие модели сетей на базе коммутатора и маршрутизаторов FRR и VyOS в GNS3, проанализировали трафик посредством Wireshark.