

**РОССИЙСКИЙ УНИВЕРСИТЕТ ДРУЖБЫ НАРОДОВ**

**Факультет физико-математических и естественных наук**

**Кафедра прикладной информатики и теории вероятностей**

**ОТЧЕТ**

**ПО ЛАБОРАТОРНОЙ РАБОТЕ № 7**

*дисциплина: Сетевые технологии*

Студент: Саинт-Амур Измаэль

Группа: НПИбд-02-20

**МОСКВА**

2022 г.

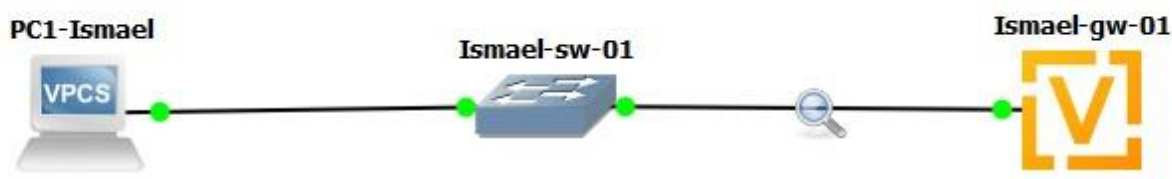
## Цель:

Получение навыков настройки службы DHCP на сетевом оборудовании для распределения адресов IPv4 и IPv6.

## Ход работы:

### 7.3.1. Настройка DHCP в случае IPv4

1. Запустите GNS3 VM и GNS3. Создайте новый проект.
2. В рабочем пространстве разместите и соедините устройства в соответствии с топологией, приведённой на рис. 7.1. Используйте маршрутизатор VyOS и хост (клиент) VPCS.
3. Измените отображаемые названия устройств. Коммутаторам присвойте названия по принципу username-sw-0x, маршрутизаторам — по принципу username-gw-0x, VPCS — по принципу PCx-username, где вместо username укажите имя вашей учётной записи, вместо x — порядковый номер устройства.
4. Включите захват трафика на соединении между коммутатором sw-01 и маршрутизатором gw-01.



5. Настройте образ VyOS (для входа в систему используйте логин vyos и пароль vyos):

– Установите систему на маршрутизаторы VyOS:

```
vyos@vyos:~$ install image
```

Далее ответьте на вопросы диалога установки. По завершении диалога перезапустите маршрутизатор, введя команду `reboot`.

```
VyOS is a free software distribution that includes multiple components,
you can check individual component licenses under /usr/share/doc/*/copyright
Use of this pre-built image is governed by the EULA you can find at
/usr/share/vyos/EULA
vyos@vyos:~$ install image
Welcome to the VyOS install program. This script
will walk you through the process of installing the
VyOS image to a local hard drive.
Would you like to continue? (Yes/No) [Yes]: y
Probing drives: OK
Looking for pre-existing RAID groups...none found.
The VyOS image will require a minimum 2000MB root.
Would you like me to try to partition a drive automatically
or would you rather partition it manually with parted? If
you have already setup your partitions, you may skip this step

Partition (Auto/Parted/Skip) [Auto]:
```

```
Setting up grub: OK
Done!
vyos@vyos:~$ reboot
Are you sure you want to reboot this system? [y/N] y

[ 337.864342] systemd-shutdown[1]: Failed to parse (null): No such file or directory
[ 337.875713] systemd-shutdown[1]: Failed to deactivate swaps: No such file or directory
[ 337.946218] [2289]: Failed to unmount /usr/lib/live/mount/medium: Device or resource busy
[ 338.288244] reboot: Restarting system

GNU GRUB version 2.02+dfsg1-20+deb10u4

+-----+
| VyOS 1.3.0-epa3 linux (KVM console) |
| *VyOS 1.3.0-epa3 linux (Serial console) |
| VyOS 1.3.0-epa3 linux (USB console) |
| Lost password change 1.3.0-epa3 (KVM console) |
| Lost password change 1.3.0-epa3 (Serial console) |
| Lost password change 1.3.0-epa3 (USB console) |
|
```

```
Welcome to VyOS - vyos ttyS0
```

```
vyos login: vyos
```

```
Password:
```

```
Linux vyos 5.4.156-amd64-vyos #1 SMP Thu Oct 28 18:19:14 UTC 2021 x86_64
```

```
Welcome to VyOS!
```

```
Check out project news at https://blog.vyos.io
```

```
and feel free to report bugs at https://phabricator.vyos.net
```

```
Visit https://support.vyos.io to create a support ticket.
```

```
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  
Use of this pre-built image is governed by the EULA you can find at
```

```
/usr/share/vyos/EULA
```

```
vyos@vyos:~$ configure
```

```
[edit]
```

```
vyos@vyos# set system host-name Ismael-gw-01
```

```
[edit]
```

```
vyos@vyos# set system host-name Ismael-gw-01
```

```
[edit]
```

```
vyos@vyos# set system domain-name Ismael.net
```

```
[edit]
```

```
vyos@vyos# set system login user Ismael
```

```
[edit]
```

```
vyos@vyos# set system login user Ismael authentication plaintext-password 123456
```

```
[edit]
```

```
vyos@vyos# commit
```

```
[edit]
```

```
vyos@vyos# save
```

```
Saving configuration to '/config/config.boot'...
```

```
Done
```

```
[edit]
```

```
vyos@vyos# exit
```

```
exit
```

```
vyos@vyos:~$ exit
```

```
logout
```

```
Welcome to VyOS - Ismael-gw-01 ttyS0
```

```
Ismael-gw-01 login: Ismael
```

```
Password:
```

```
Linux Ismael-gw-01 5.4.156-amd64-vyos #1 SMP Thu Oct 28 18:19:14 UTC 2021 x86_64
```

```
Welcome to VyOS!
```

```
Ismael@Ismael-gw-01:~$ configure
```

```
[edit]
```

```
Ismael@Ismael-gw-01# delete system login user vyos
```

```
[edit]
```

```
Ismael@Ismael-gw-01# commit
```

```
[edit]
```

```
Ismael@Ismael-gw-01# save
```

```
Saving configuration to '/config/config.boot'...
```

```
Done
```

```
[edit]
```

6. На маршрутизаторе под созданным пользователем перейдите в режим конфигурирования и настройте адресацию IPv4:
7. Добавьте конфигурацию DHCP-сервера на маршрутизаторе (вместо username укажите имя вашей учётной записи):

```
Ismael@Ismael-gw-01# set interfaces ethernet eth0 address 10.0.0.1/24
[edit]
Ismael@Ismael-gw-01# set service dhcp-server shared-network-name Ismael domain-name Ismael.net
[edit]
Ismael@Ismael-gw-01# set service dhcp-server shared-network-name Ismael name-server 10.0.0.1
[edit]
Ismael@Ismael-gw-01# set service dhcp-server shared-network-name Ismael subnet 1 0.0.0.0/24 default-router 10.0.0.1
[edit]
Ismael@Ismael-gw-01# set service dhcp-server shared-network-name Ismael subnet 1 0.0.0.0/24 range hosts start 10.0.0.2
[edit]
Ismael@Ismael-gw-01# set service dhcp-server shared-network-name Ismael subnet 1 0.0.0.0/24 range hosts stop 10.0.0.253
[edit]
Ismael@Ismael-gw-01# commit
[edit]
Ismael@Ismael-gw-01# save
Saving configuration to '/config/config.boot'...
Done
[edit]
Ismael@Ismael-gw-01# exit
exit
```

8. Для просмотра статистики DHCP-сервера и выданных адресов используйте команды:

```
Ismael@Ismael-gw-01:~$ show dhcp server statistics
Pool      Size      Leases      Available  Usage
-----
Ismael     252        0           252       0%
Ismael@Ismael-gw-01:~$ show dhcp server leases
IP address  Hardware address  State  Lease start  Lease expiration  Re
maining    Pool      Hostname
-----
-----
```

9. Настройте оконечное устройство PC1:

```
PC1-Ismael> ip dhcp -d
Opcode: 1 (REQUEST)
Client IP Address: 0.0.0.0
Your IP Address: 0.0.0.0
Server IP Address: 0.0.0.0
Gateway IP Address: 0.0.0.0
Client MAC Address: 00:50:79:66:68:00
Option 53: Message Type = Discover
Option 12: Host Name = PC1-Ismael
Option 61: Client Identifier = Hardware Type=Ethernet MAC Address = 00:50:79:66:
68:00

Opcode: 1 (REQUEST)
Client IP Address: 0.0.0.0
Your IP Address: 0.0.0.0
Server IP Address: 0.0.0.0
Gateway IP Address: 0.0.0.0
Client MAC Address: 00:50:79:66:68:00
Option 53: Message Type = Discover
Option 12: Host Name = PC1-Ismael
Option 61: Client Identifier = Hardware Type=Ethernet MAC Address = 00:50:79:66:
68:00

Opcode: 2 (REPLY)
Client IP Address: 0.0.0.0
Your IP Address: 10.0.0.2
Server IP Address: 0.0.0.0
Gateway IP Address: 0.0.0.0
Client MAC Address: 00:50:79:66:68:00
Option 53: Message Type = Offer
Option 54: DHCP Server = 10.0.0.1
Option 51: Lease Time = 86400
Option 1: Subnet Mask = 255.255.255.0
Option 3: Router = 10.0.0.1
Option 6: DNS Server = 10.0.0.1
Option 15: Domain = Ismael.net

Opcode: 1 (REQUEST)
Client IP Address: 10.0.0.2
Your IP Address: 0.0.0.0
Server IP Address: 0.0.0.0
Gateway IP Address: 0.0.0.0
Client MAC Address: 00:50:79:66:68:00
```

```
PC1-Ismael> save
Saving startup configuration to startup.vpc
. done
```

10. Проверьте конфигурацию IPv4 на узле, пропингуйте маршрутизатор:



```

PCl-Ismael> show ip

NAME       : PCl-Ismael[1]
IP/MASK    : 10.0.0.2/24
GATEWAY    : 10.0.0.1
DNS        : 10.0.0.1
DHCP SERVER: 10.0.0.1
DHCP LEASE : 86368, 86400/43200/75600
DOMAIN NAME: Ismael.net
MAC        : 00:50:79:66:68:00
LPORT      : 20004
RHOST:PORT : 127.0.0.1:20005
MTU        : 1500

PCl-Ismael> ping 10.0.0.1 -c 2

84 bytes from 10.0.0.1 icmp_seq=1 ttl=64 time=0.542 ms
84 bytes from 10.0.0.1 icmp_seq=2 ttl=64 time=0.535 ms

PCl-Ismael>

```

11. На маршрутизаторе вновь посмотрите статистику DHCP-сервера и выданные адреса, в отчёте поясните полученную информацию:

```

Ismael@Ismael-gw-01:~$ show dhcp server statistics
Pool      Size    Leases  Available  Usage
-----
Ismael    252      1       251      0%
Ismael@Ismael-gw-01:~$ show dhcp server leases
IP address  Hardware address  State  Lease start      Lease expiration  Remaining  Pool  Hostname
-----
10.0.0.2    00:50:79:66:68:00 active  2022/10/22 15:47:22  2022/10/23 15:47:22  23:58:04  Ismael  PCl-Ismael

```

12. На маршрутизаторе посмотрите журнал работы DHCP-сервера:

```

Ismael@Ismael-gw-01:~$ show log | grep dhcp
Oct 22 15:45:34 sudo[2789]:   Ismael : TTY=ttyS0 ; PWD=/home/Ismael ; USER=root
; COMMAND=/usr/bin/sh -c /usr/sbin/vysshim /usr/libexec/vyos/conf_mode/dhcp_serve
r.py
Oct 22 15:45:35 vyos-configd[592]: Received message: {"type": "node", "data": "/"
usr/libexec/vyos/conf_mode/dhcp_server.py"}
Oct 22 15:45:38 dhcpd[2806]: Wrote 0 leases to leases file.
Oct 22 15:45:38 dhcpd[2806]: Lease file test successful, removing temp lease fil
e: /config/dhcpd.leases.1666453538
Oct 22 15:45:39 dhcpd[2808]: Wrote 0 leases to leases file.
Oct 22 15:45:39 dhcpd[2808]:
Oct 22 15:45:39 dhcpd[2808]: No subnet declaration for eth2 (no IPv4 addresses).
Oct 22 15:45:39 dhcpd[2808]: ** Ignoring requests on eth2.  If this is not what
Oct 22 15:45:39 dhcpd[2808]:     you want, please write a subnet declaration
Oct 22 15:45:39 dhcpd[2808]:     in your dhcpd.conf file for the network segment
Oct 22 15:45:39 dhcpd[2808]:     to which interface eth2 is attached. **
Oct 22 15:45:39 dhcpd[2808]:
Oct 22 15:45:39 dhcpd[2808]: No subnet declaration for eth1 (no IPv4 addresses).
Oct 22 15:45:39 dhcpd[2808]: ** Ignoring requests on eth1.  If this is not what
Oct 22 15:45:39 dhcpd[2808]:     you want, please write a subnet declaration
Oct 22 15:45:39 dhcpd[2808]:     in your dhcpd.conf file for the network segment
Oct 22 15:45:39 dhcpd[2808]:     to which interface eth1 is attached. **
Oct 22 15:45:39 dhcpd[2808]:
Oct 22 15:45:39 dhcpd[2808]: Server starting service.
Oct 22 15:46:15 sudo[2885]:   Ismael : TTY=ttyS0 ; PWD=/home/Ismael ; USER=root
; COMMAND=/usr/libexec/vyos/op_mode/show_dhcp.py --statistics
Oct 22 15:46:33 sudo[2911]:   Ismael : TTY=ttyS0 ; PWD=/home/Ismael ; USER=root
; COMMAND=/usr/libexec/vyos/op_mode/show_dhcp.py --leases
Oct 22 15:47:18 dhcpd[2808]: DHCPDISCOVER from 00:50:79:66:68:00 via eth0
Oct 22 15:47:19 dhcpd[2808]: DHCPOFFER on 10.0.0.2 to 00:50:79:66:68:00 (PC1-Ism
ael) via eth0
Oct 22 15:47:22 dhcpd[2808]: DHCPREQUEST for 10.0.0.2 (10.0.0.1) from 00:50:79:6
6:68:00 (PC1-Ismael) via eth0
Oct 22 15:47:22 dhcpd[2808]: DHCPACK on 10.0.0.2 to 00:50:79:66:68:00 (PC1-Ism
ael) via eth0
Oct 22 15:48:52 sudo[2939]:   Ismael : TTY=ttyS0 ; PWD=/home/Ismael ; USER=root
; COMMAND=/usr/libexec/vyos/op_mode/show_dhcp.py --statistics
Oct 22 15:49:16 sudo[2965]:   Ismael : TTY=ttyS0 ; PWD=/home/Ismael ; USER=root
; COMMAND=/usr/libexec/vyos/op_mode/show_dhcp.py --leases
Ismael@Ismael-gw-01:~$

```

13. В отчёте проанализируйте захваченные анализатором трафика пакеты, относящиеся к работе DHCP и назначению адреса устройству.



Capture en cours de - [Ismael-sw-01 Ethernet1 to Ismael-gw-01 eth0]

Fichier Editer Vue Aller Capture Analyser Statistiques Telephonie Wireless Outils Aide

Appliquer un filtre d'affichage ... <Ctrl-/>

No.	Time	Source	Destination	Protocol	Length	Info
19	1307.916731	10.0.0.1	10.0.0.2	DHCP	342	DHCP Offer - Transaction ID 0x2f755f0c
20	1307.917780	0c:7b:14:4f:00:00	Broadcast	ARP	60	Who has 10.0.0.2? Tell 10.0.0.1
21	1308.941830	0c:7b:14:4f:00:00	Broadcast	ARP	60	Who has 10.0.0.2? Tell 10.0.0.1
22	1310.910352	0.0.0.0	255.255.255.255	DHCP	406	DHCP Request - Transaction ID 0x2f755f0c
23	1310.920693	10.0.0.1	10.0.0.2	DHCP	342	DHCP ACK - Transaction ID 0x2f755f0c
24	1311.910456	Private_66:68:00	Broadcast	ARP	64	Gratuitous ARP for 10.0.0.2 (Request)
25	1312.910576	Private_66:68:00	Broadcast	ARP	64	Gratuitous ARP for 10.0.0.2 (Request)
26	1313.911296	Private_66:68:00	Broadcast	ARP	64	Gratuitous ARP for 10.0.0.2 (Request)
27	1359.533800	Private_66:68:00	Broadcast	ARP	64	Who has 10.0.0.1? Tell 10.0.0.2
28	1359.534743	0c:7b:14:4f:00:00	Private_66:68:00	ARP	60	10.0.0.1 is at 0c:7b:14:4f:00:00
29	1359.534901	10.0.0.2	10.0.0.1	ICMP	98	Echo (ping) request id=0xbb10, seq=1/256, ttl=64 (repl
30	1359.535372	10.0.0.1	10.0.0.2	ICMP	98	Echo (ping) reply id=0xbb10, seq=1/256, ttl=64 (requ
31	1360.536066	10.0.0.2	10.0.0.1	ICMP	98	Echo (ping) request id=0xbc10, seq=2/512, ttl=64 (repl
32	1360.536493	10.0.0.1	10.0.0.2	ICMP	98	Echo (ping) reply id=0xbc10, seq=2/512, ttl=64 (requ

> Frame 19: 342 bytes on wire (2736 bits), 342 bytes captured (2736 bits) on interface -, id 0  
 > Ethernet II, Src: 0c:7b:14:4f:00:00 (0c:7b:14:4f:00:00), Dst: Private\_66:68:00 (00:50:79:66:68:00)  
 > Internet Protocol Version 4, Src: 10.0.0.1, Dst: 10.0.0.2  
 > User Datagram Protocol, Src Port: 67, Dst Port: 68  
 > Dynamic Host Configuration Protocol (Offer)

```

0000  00 50 79 66 68 00 0c 7b 14 4f 00 00 08 00 45 10  .Pyfh..{ .O....E.
0010  01 48 00 00 00 00 80 11 25 93 0a 00 00 01 0a 00  .H.....%.....
Wireshark: Paquet 19.-
  
```

> Frame 19: 342 bytes on wire (2736 bits), 342 bytes captured (2736 bits) on interface -, id 0  
 > Ethernet II, Src: 0c:7b:14:4f:00:00 (0c:7b:14:4f:00:00), Dst: Private\_66:68:00 (00:50:79:66:68:00)  
 > Internet Protocol Version 4, Src: 10.0.0.1, Dst: 10.0.0.2  
 > User Datagram Protocol, Src Port: 67, Dst Port: 68  
 > Dynamic Host Configuration Protocol (Offer)

```

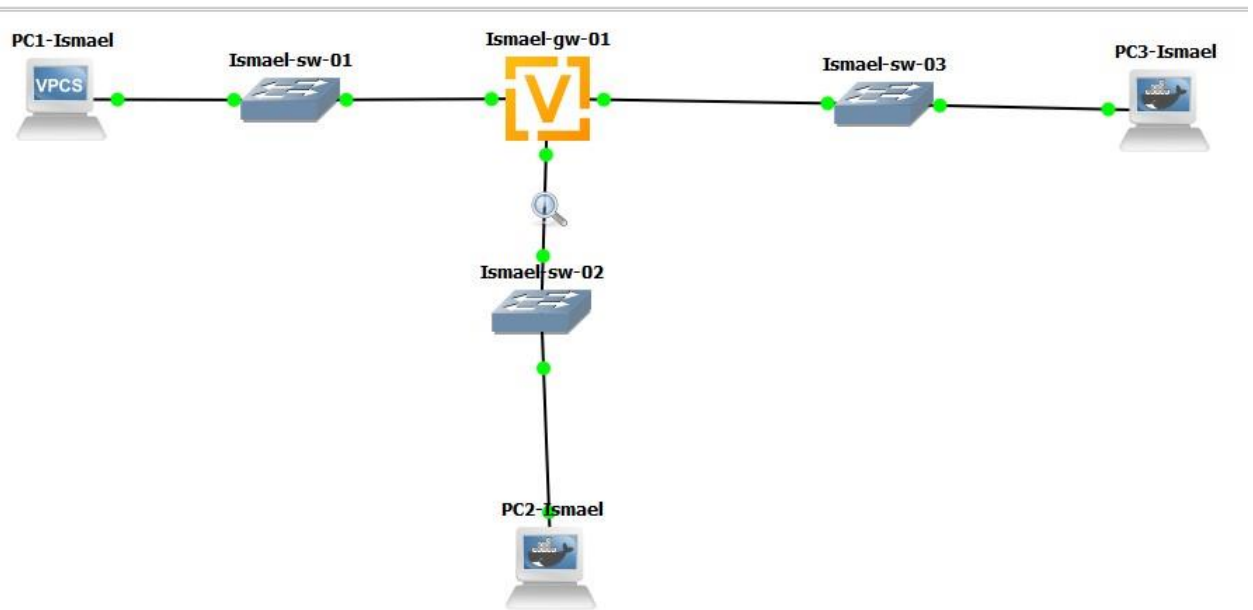
0000  00 50 79 66 68 00 0c 7b 14 4f 00 00 08 00 45 10  .Pyfh..{ .O....E.
0010  01 48 00 00 00 00 80 11 25 93 0a 00 00 01 0a 00  .H.....%.....
0020  00 02 00 43 00 44 01 34 b0 3a 02 01 06 00 2f 75  .C-D-4 .:....u
0030  5f 0c 00 00 00 00 00 00 00 00 0a 00 00 02 00 00  _.....P yfh....
0040  00 00 00 00 00 00 00 50 79 66 68 00 00 00 00 00  .....P yfh....
0050  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
0060  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
0070  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
0080  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
0090  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
00a0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
00b0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
00c0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
00d0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
00e0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
00f0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
0100  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
  
```

### 7.3.2. Настройка DHCP в случае IPv6

1. В предыдущем проекте в рабочем пространстве дополните сеть, разместив и соединив устройства в соответствии с топологией, приведённой на рис. 7.2. Используйте хост (клиент) Kali Linux CLI (добавьте образ Kali Linux CLI в перечень устройств в GNS3), поскольку клиент VPCS не поддерживает DHCPv6.

2. Измените отображаемые названия устройств. Коммутаторам присвойте названия по принципу username-sw-0x, маршрутизаторам — по принципу username-gw-0x, VPCS — по принципу PCx-username, где вместо username укажите имя вашей учётной записи, вместо x — порядковый номер устройства.

3. Включите захват трафика на соединениях между маршрутизатором gw-01 и коммутаторами sw-02 и sw-03.



4. Настройте адресацию IPv6 на маршрутизаторе:

```
Ismael-gw-01 login: Ismael
Password:
Linux Ismael-gw-01 5.4.156-amd64-vyos #1 SMP Thu Oct 28 18:19:14 UTC 2021 x86_64
Welcome to VyOS!

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

Visit https://support.vyos.io to create a support ticket.

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
Use of this pre-built image is governed by the EULA you can find at
/usr/share/vyos/EULA
Ismael@Ismael-gw-01:~$ configure
[edit]
Ismael@Ismael-gw-01# set interfaces ethernet eth1 address 2000::1/64
[edit]
Ismael@Ismael-gw-01# set interfaces ethernet eth2 address 2000::1/64
[edit]
Ismael@Ismael-gw-01# show interfaces
  ethernet eth0 {
```

```
Ismael@Ismael-gw-01# show interfaces
  ethernet eth0 {
    address 10.0.0.1/24
    hw-id 0c:7b:14:4f:00:00
  }
  ethernet eth1 {
+   address 2000::1/64
    hw-id 0c:7b:14:4f:00:01
  }
  ethernet eth2 {
+   address 2000::1/64
    hw-id 0c:7b:14:4f:00:02
  }
  loopback lo {
  }
[edit]
Ismael@Ismael-gw-01# commit
[edit]
Ismael@Ismael-gw-01# save
Saving configuration to '/config/config.boot'...
Done
[edit]
```

```
Ismael@Ismael-gw-01# show interfaces
  ethernet eth0 {
    address 10.0.0.1/24
    hw-id 0c:7b:14:4f:00:00
  }
  ethernet eth1 {
+   address 2000::1/64
    hw-id 0c:7b:14:4f:00:01
  }
  ethernet eth2 {
+   address 2000::1/64
    hw-id 0c:7b:14:4f:00:02
  }
  loopback lo {
  }
[edit]
Ismael@Ismael-gw-01# commit
[edit]
Ismael@Ismael-gw-01# save
Saving configuration to '/config/config.boot'...
Done
[edit]
```

5. На маршрутизаторе настройте DHCPv6 без отслеживания состояния (DHCPv6 Stateless configuration)

Ismael-gw-01 - PuTTY

```
Ismael@Ismael-gw-01# set service router-advert interface eth1 prefix 2000::/64
[edit]
Ismael@Ismael-gw-01# set service router-advert interface eth1 other-config-flag
[edit]
Ismael@Ismael-gw-01# set service dhcpv6-server shared-netwok-name Ismael-statele
ss

Configuration path: service dhcpv6-server [shared-netwok-name] is not valid
Set failed

[edit]
Ismael@Ismael-gw-01# set service dhcpv6-server shared-netwok-name Ismael-statele
ss subnet 2000::0/64

Configuration path: service dhcpv6-server [shared-netwok-name] is not valid
Set failed

[edit]
Ismael@Ismael-gw-01# set service dhcpv6-server shared-network-name Ismael-statel
ess
[edit]
Ismael@Ismael-gw-01# set service dhcpv6-server shared-network-name Ismael-statel
ess subnet 2000::0/64
[edit]
Ismael@Ismael-gw-01# set service dhcpv6-server shared-network-name Ismael-statel
ess common-options name-server 2000::1
[edit]
Ismael@Ismael-gw-01# set service dhcpv6-server shared-network-name Ismael-statel
ess common-options domain-search Ismael.net
[edit]
Ismael@Ismael-gw-01# commit
[edit]
Ismael@Ismael-gw-01# save
Saving configuration to '/config/config.boot'...
Done
[edit]
```



```

[edit]
Ismael@Ismael-gw-01# run show configuration
interfaces {
    ethernet eth0 {
        address 10.0.0.1/24
        hw-id 0c:7b:14:4f:00:00
    }
    ethernet eth1 {
        address 2000::1/64
        hw-id 0c:7b:14:4f:00:01
    }
    ethernet eth2 {
        address 2000::1/64
        hw-id 0c:7b:14:4f:00:02
    }
    loopback lo {
    }
}
service {
    dhcp-server {
        shared-network-name Ismael {
            domain-name Ismael.net
            name-server 10.0.0.1
            subnet 10.0.0.0/24 {
                default-router 10.0.0.1
                range hosts {
                    start 10.0.0.2
                    stop 10.0.0.253
                }
            }
        }
    }
    dhcpv6-server {
        shared-network-name Ismael-stateless {
            common-options {
                domain-search Ismael.net
                name-server 2000::1
            }
            subnet 2000::0/64 {
            }
        }
    }
}

```

6. На узле PC2 проверьте настройки сети:



```

PC2-Ismael console is now available... Press RETURN to get started.
root@PC2-Ismael:/# ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet6 2000::ef:10ff:fe28:a96a prefixlen 64 scopeid 0x0<global>
    inet6 fe80::ef:10ff:fe28:a96a prefixlen 64 scopeid 0x20<link>
    ether 02:ef:10:28:a9:6a txqueuelen 1000 (Ethernet)
    RX packets 10 bytes 1140 (1.1 KiB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 14 bytes 1092 (1.0 KiB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

eth1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet6 fe80::482:44ff:fe2b:399d prefixlen 64 scopeid 0x20<link>
    ether 06:82:44:2b:39:9d txqueuelen 1000 (Ethernet)
    RX packets 0 bytes 0 (0.0 B)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 0 bytes 0 (0.0 B)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
    inet6 ::1 prefixlen 128 scopeid 0x10<host>
    loop txqueuelen 1000 (Local Loopback)
    RX packets 0 bytes 0 (0.0 B)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 0 bytes 0 (0.0 B)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

root@PC2-Ismael:/# route -n -A inet6
Kernel IPv6 routing table

```

Destination	Next Hop	Flag	Met	Ref	Use	If
2000::/64	::	UAe	256	1	0	eth0
fe80::/64	::	U	256	1	0	eth0
fe80::/64	::	U	256	1	0	eth1
::/0	fe80::e7b:14ff:fe4f:1	UGDAe	1024	1	0	eth
0						
::1/128	::	Un	0	3	0	lo
2000::ef:10ff:fe28:a96a/128	::	Un	0	2	0	eth0
fe80::ef:10ff:fe28:a96a/128	::	Un	0	3	0	eth0
fe80::482:44ff:fe2b:399d/128	::	Un	0	2	0	eth1
ff00::/8	::	U	256	3	0	eth0
ff00::/8	::	U	256	1	0	eth1
::/0	::	!n	-1	1	0	lo

7. На узле PC2 пропингуйте маршрутизатор:
8. На узле PC2 проверьте настройки DNS:
9. На узле PC2 получите адрес по DHCPv6:
10. Вновь пропингуйте от узла PC2 маршрутизатор, проверьте настройки DNS:

```

root@PC2-Ismael:/# ping 2000::1 -c 2
PING 2000::1(2000::1) 56 data bytes
64 bytes from 2000::1: icmp_seq=1 ttl=64 time=4.01 ms
64 bytes from 2000::1: icmp_seq=2 ttl=64 time=0.951 ms

--- 2000::1 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1000ms
rtt min/avg/max/mdev = 0.951/2.484/4.018/1.534 ms
root@PC2-Ismael:/# cat /etc/resolv.conf
root@PC2-Ismael:/# dhclient -6 -S -v eth0
Internet Systems Consortium DHCP Client 4.3.5
Copyright 2004-2016 Internet Systems Consortium.
All rights reserved.
For info, please visit https://www.isc.org/software/dhcp/

Listening on Socket/eth0
Sending on Socket/eth0
Created duid "\000\003\000\001\002\357\020(\251j".
PRC: Requesting information (INIT).
XMT: Forming Info-Request, 0 ms elapsed.
XMT: Info-Request on eth0, interval 1070ms.
RCV: Reply message on eth0 from fe80::e7b:l4ff:fe4f:1.
PRC: Done.
root@PC2-Ismael:/# # ping 2000::1 -c2
root@PC2-Ismael:/# cat /etc/resolv.conf
search Ismael.net.
nameserver 2000::1
root@PC2-Ismael:/# ping 2000::1 -c2
PING 2000::1(2000::1) 56 data bytes
64 bytes from 2000::1: icmp_seq=1 ttl=64 time=1.56 ms
64 bytes from 2000::1: icmp_seq=2 ttl=64 time=0.625 ms

--- 2000::1 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1000ms
rtt min/avg/max/mdev = 0.625/1.094/1.564/0.470 ms
root@PC2-Ismael:/# cat /etc/resolv.conf
search Ismael.net.
nameserver 2000::1
root@PC2-Ismael:/# █

```

11. На маршрутизаторе посмотрите статистику DHCP-сервера и выданные адреса

```

Ismael@Ismael-gw-01# run show dhcpv6 server leases
IPv6 address      State      Last communication      Lease expiration      Remaining
Type      Pool      IAID_DUID
-----
[edit]

```

12. В отчёте поясните выведенную на маршрутизаторе и PC2 информацию, а также проанализируйте захваченные анализатором трафика пакеты, относящиеся к работе DHCPv6 и назначению адреса устройству.

No.	Time	Source	Destination	Protocol	Length	Info
12	247.113271	fe80::ef:10ff:fe28:...	ff02::2	ICMPv6	70	Router Solicitation from 02:ef:10:28:a9:6a
13	390.238440	fe80::e7b:14ff:fe4f:...	ff02::16	ICMPv6	150	Multicast Listener Report Message v2
14	390.241071	fe80::e7b:14ff:fe4f:...	ff02::16	ICMPv6	170	Multicast Listener Report Message v2
15	390.628268	fe80::e7b:14ff:fe4f:...	ff02::16	ICMPv6	90	Multicast Listener Report Message v2
16	391.244107	::	ff02::1:ff00:1	ICMPv6	86	Neighbor Solicitation for 2000::1
17	507.209903	fe80::ef:10ff:fe28:...	ff02::2	ICMPv6	70	Router Solicitation from 02:ef:10:28:a9:6a
18	852.175432	fe80::e7b:14ff:fe4f:...	ff02::16	ICMPv6	90	Multicast Listener Report Message v2
19	852.177866	fe80::e7b:14ff:fe4f:...	ff02::16	ICMPv6	110	Multicast Listener Report Message v2
20	852.385990	fe80::e7b:14ff:fe4f:...	ff02::16	ICMPv6	90	Multicast Listener Report Message v2
21	858.065250	fe80::e7b:14ff:fe4f:...	ff02::1	ICMPv6	118	Router Advertisement from 0c:7b:14:4f:00:01
22	858.473243	::	ff02::1:ff28:a96a	ICMPv6	86	Neighbor Solicitation for 2000::ef:10ff:fe28:a96a
23	874.407356	fe80::e7b:14ff:fe4f:...	ff02::1	ICMPv6	118	Router Advertisement from 0c:7b:14:4f:00:01
24	890.420547	fe80::e7b:14ff:fe4f:...	ff02::1	ICMPv6	118	Router Advertisement from 0c:7b:14:4f:00:01
25	966.366265	2000::ef:10ff:fe28:...	ff02::1:ff00:1	ICMPv6	86	Neighbor Solicitation for 2000::1 from 02:ef:10:28:a9:6a

< >

> Frame 37: 98 bytes on wire (784 bits), 98 bytes captured (784 bits) on interface -, id 0  
 > Ethernet II, Src: 02:ef:10:28:a9:6a (02:ef:10:28:a9:6a), Dst: IPv6mcast\_01:00:02 (33:33:00:01:00:02)  
 > Internet Protocol Version 6, Src: fe80::ef:10ff:fe28:a96a, Dst: ff02::1:2  
 > User Datagram Protocol, Src Port: 546, Dst Port: 547

13. На маршрутизаторе настройте DHCPv6 с отслеживанием состояния (DHCPv6 Stateful configuration):

14. На маршрутизаторе посмотрите статистику DHCP-сервера и выданные адреса:

```

ismael@ismael-gw-01# set service router-advert interface eth2 managed-flag
[edit]
ismael@ismael-gw-01# set service dhcpv6-server shared-network-name ismael-stateful
[edit]
ismael@ismael-gw-01# set service dhcpv6-server shared-network-name ismael-stateful
ul subnet 2001::0/64
[edit]
ismael@ismael-gw-01# set service dhcpv6-server shared-network-name ismael-stateful
ul subnet 2001::0/64 name-server 2001::1
[edit]
ismael@ismael-gw-01# set service dhcpv6-server shared-network-name ismael-stateful
ul subnet 2001::0/64 domain-search ismael.net
[edit]
ismael@ismael-gw-01# set service dhcpv6-server shared-network-name ismael-stateful
ul subnet 2001::0/64 address-range start 2001::100 stop 2001::199
[edit]
ismael@ismael-gw-01# commit
[edit]
ismael@ismael-gw-01# save
Saving configuration to '/config/config.boot'...
Done
[edit]
ismael@ismael-gw-01# # run show dhcpv6 server leases
[edit]
ismael@ismael-gw-01#

```

15. Подключитесь к узлу PC3 и проверьте настройки сети:



```
PC3-Ismael - PuTTY

ether ae:b9:a0:fd:9b:47 txqueuelen 1000 (Ethernet)
RX packets 15 bytes 1554 (1.5 KiB)
RX errors 0 dropped 0 overruns 0 frame 0
TX packets 14 bytes 1076 (1.0 KiB)
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

eth1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
inet6 fe80::fc4e:46ff:feeb:c419 prefixlen 64 scopeid 0x20<link>
ether fe:4e:46:eb:c4:19 txqueuelen 1000 (Ethernet)
RX packets 0 bytes 0 (0.0 B)
RX errors 0 dropped 0 overruns 0 frame 0
TX packets 0 bytes 0 (0.0 B)
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
inet 127.0.0.1 netmask 255.0.0.0
inet6 ::1 prefixlen 128 scopeid 0x10<host>
loop txqueuelen 1000 (Local Loopback)
RX packets 0 bytes 0 (0.0 B)
RX errors 0 dropped 0 overruns 0 frame 0
TX packets 0 bytes 0 (0.0 B)
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

root@PC3-Ismael:/#
```

```
root@PC3-Ismael:/# route -n -A inet6
Kernel IPv6 routing table

```

Destination	Next Hop	Flag	Met	Ref	Use	If
fe80::/64	::	U	256	1	0	eth0
fe80::/64	::	U	256	1	0	eth1
::/0	fe80::e7b:14ff:fe4f:2	UGDAe	1024	1	0	eth0
::1/128	::	Un	0	2	0	lo
fe80::ac9:a0ff:fe4d:9b47/128	::	Un	0	2	0	eth0
fe80::fc4e:46ff:feeb:c419/128	::	Un	0	3	0	eth1
ff00::/8	::	U	256	3	0	eth0
ff00::/8	::	U	256	1	0	eth1
::/0	::	In	-1	1	0	lo

```
root@PC3-Ismael:/#
```

17. На узле PC3 получите адрес по DHCPv6:

```
root@PC3-Ismael:/# cat /etc/resolv.conf
root@PC3-Ismael:/#
```

19. На маршрутизаторе посмотрите статистику DHCP-сервера и выданные адреса:

```
Ismael@Ismael-gw-01# run show dhcpv6 server leases
IPv6 address      State      Last communication      Lease expiration      Remaining
Type      Pool      IAID_DUID
-----
[edit]
Ismael@Ismael-gw-01#
```

20. В отчёте поясните выведенную на маршрутизаторе и PC3 информацию, а также проанализируйте захваченные анализатором трафика пакеты, относящиеся к работе DHCPv6 и назначению адреса устройству.

The top screenshot shows a Wireshark capture of network traffic on the interface 'eth1 to Ismael-sw-02 Ethernet1'. The packet list shows a DHCPv6 information request (packet 37) from source 'fe80::ef:10ff:fe28:a96a' to destination 'ff02::1:2'. The packet details show the Ethernet II header, Internet Protocol Version 6 header, and User Datagram Protocol header.

The bottom screenshot shows the detailed view of the selected packet (Frame 37). It displays the Ethernet II header, Internet Protocol Version 6 header, and User Datagram Protocol header. The packet is identified as a DHCPv6 information request (XID: 0xe6bcd8, CID: 0003000102ef1028).

## ВЫВОД:

Мы получили навыки настройки службы DHCP на сетевом оборудовании для распределения адресов IPv4 и IPv6.