Сетевые технологии

Лабораторная работа №7

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Цель работы

Основная цель

Получение навыков настройки DHCP для распределения адресов **IPv4** и **IPv6** в среде **GNS3**.

Ход выполнения

Топология сети

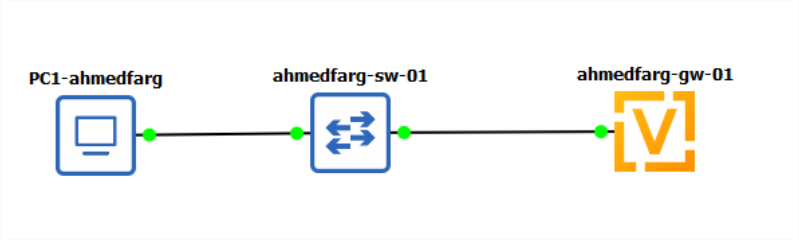


Рис. 1: Топология DHCPv4

Первичная настройка маршрутизатора VyOS

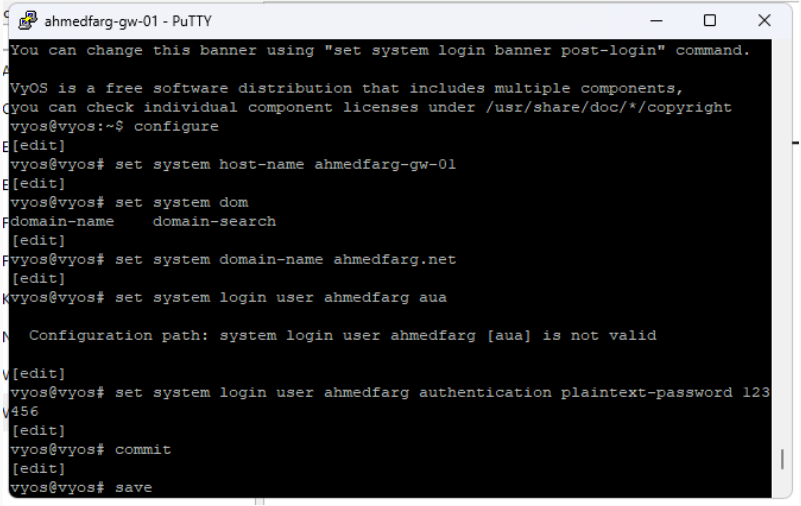


Рис. 2: Hostname и домен

Конфигурация DHCPv4 на маршрутизаторе

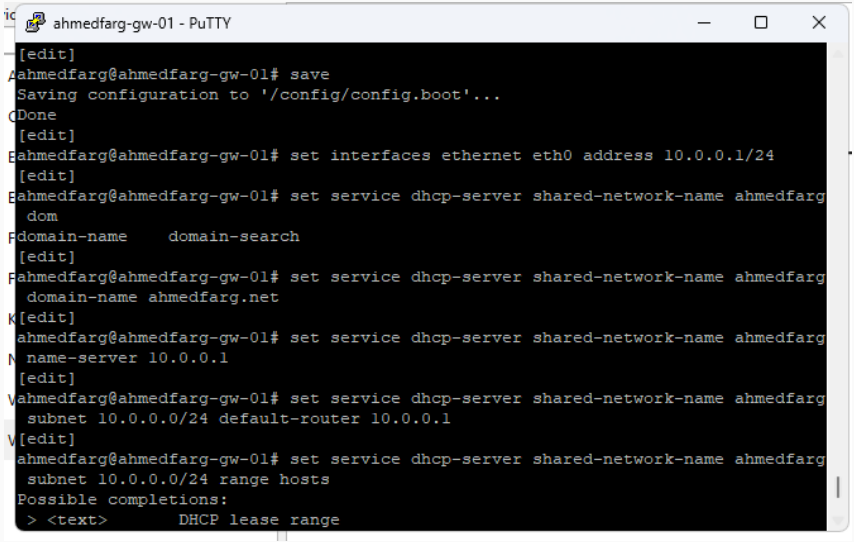


Рис. 3: Настройка DHCPv4

Клиент PC1 получает адрес по DHCP

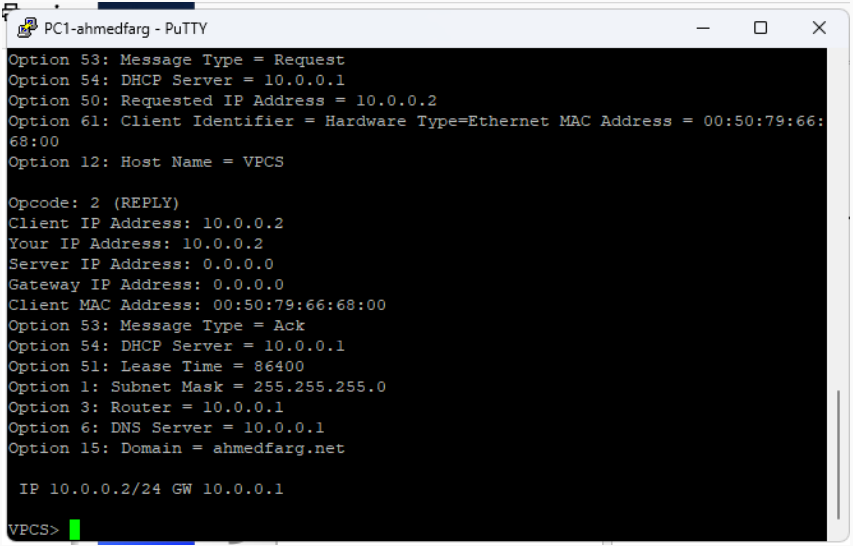
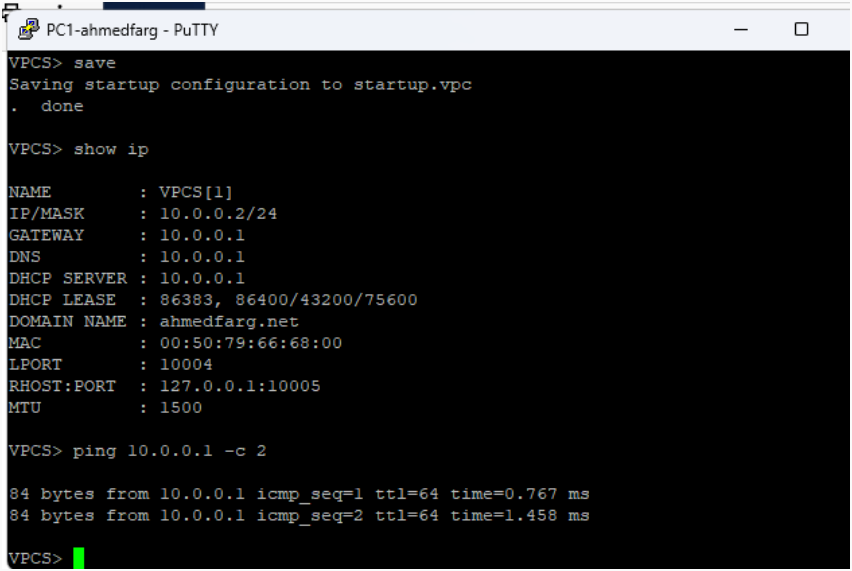


Рис. 4: DHCP-пакеты PC1

Проверка IP и связности



Статистика DHCP-сервера

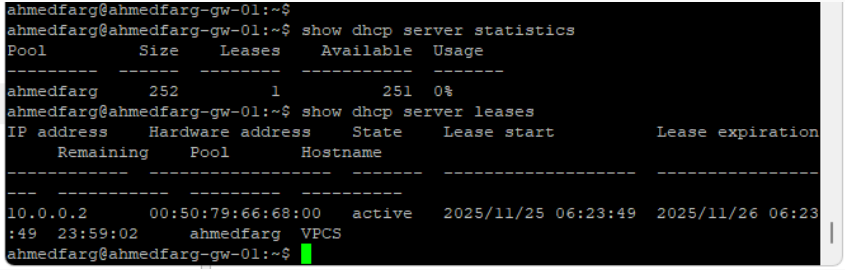
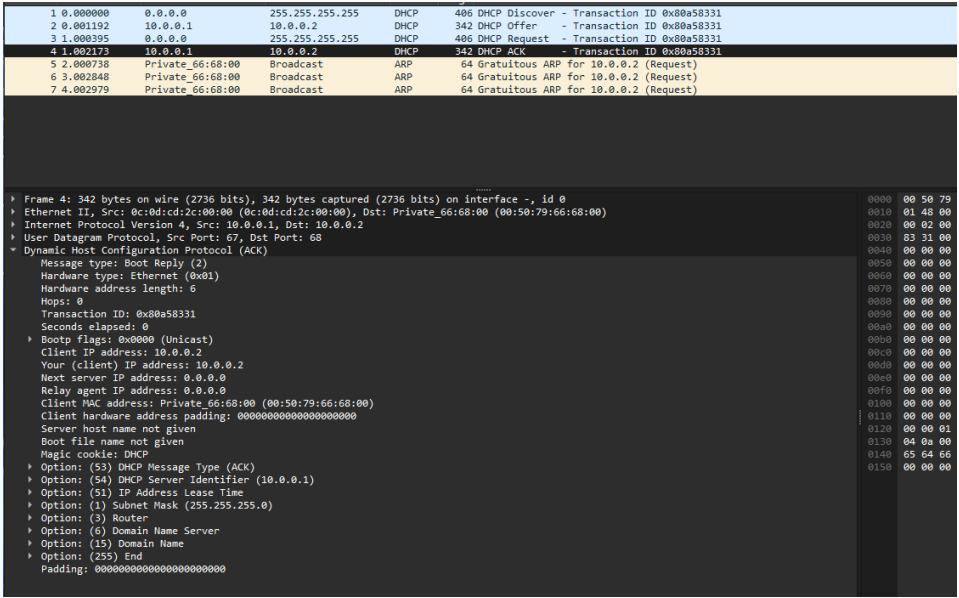


Рис. 6: Leases DHCPv4

Анализ DHCPv4 и ARP в Wireshark



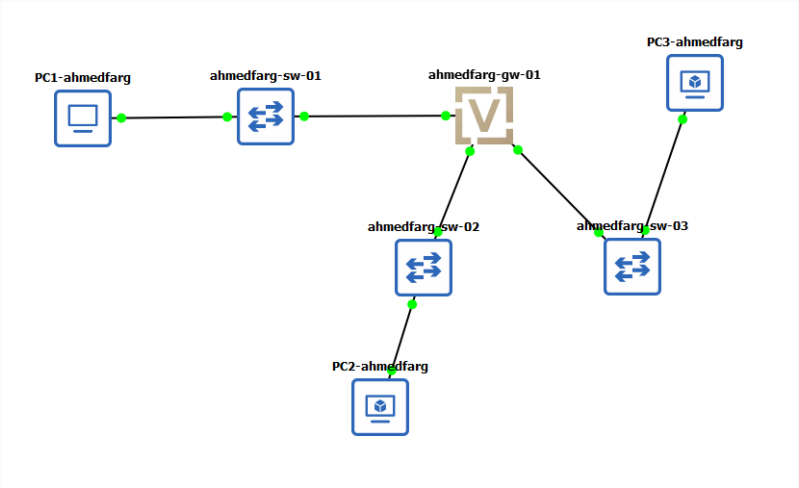


Рис. 8: Топология IPv6

Настройка IPv6 интерфейсов

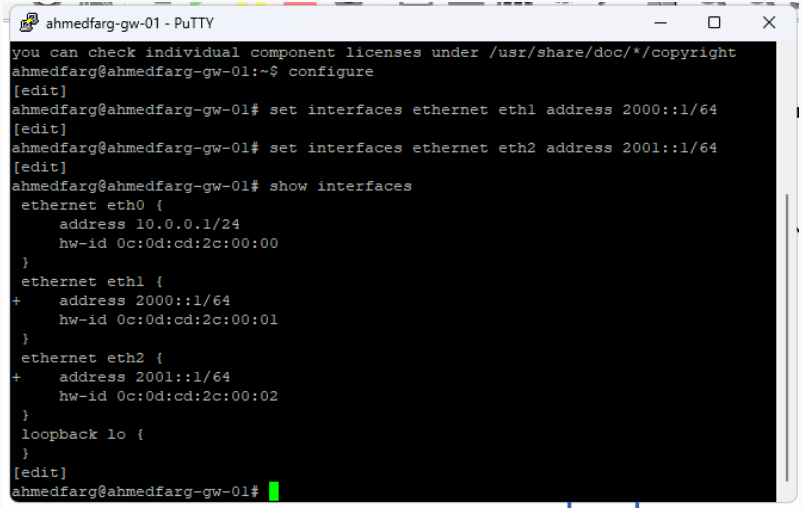


Рис. 9: IPv6 интерфейсы

Настройка Router Advertisements и DHCPv6 Stateless

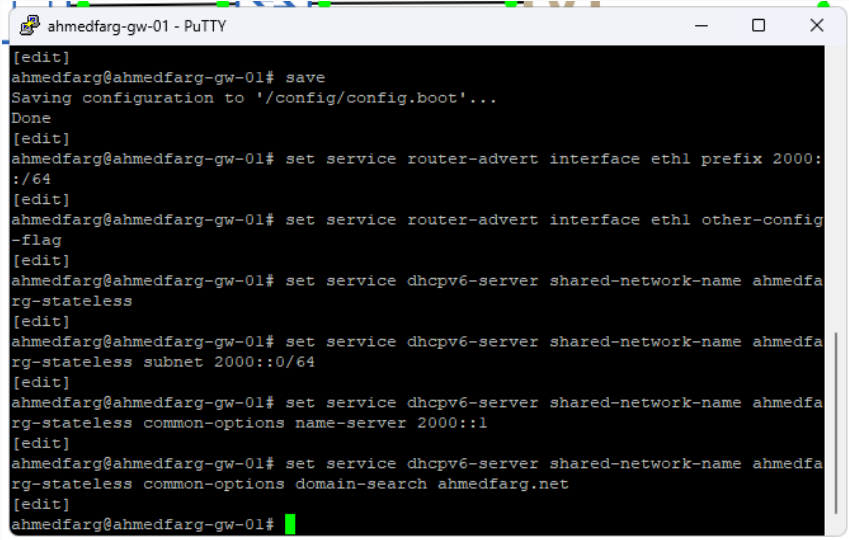


Рис. 10: RA + DHCPv6 Stateless

Конфигурация RA/DHCPv6 на маршрутизаторе

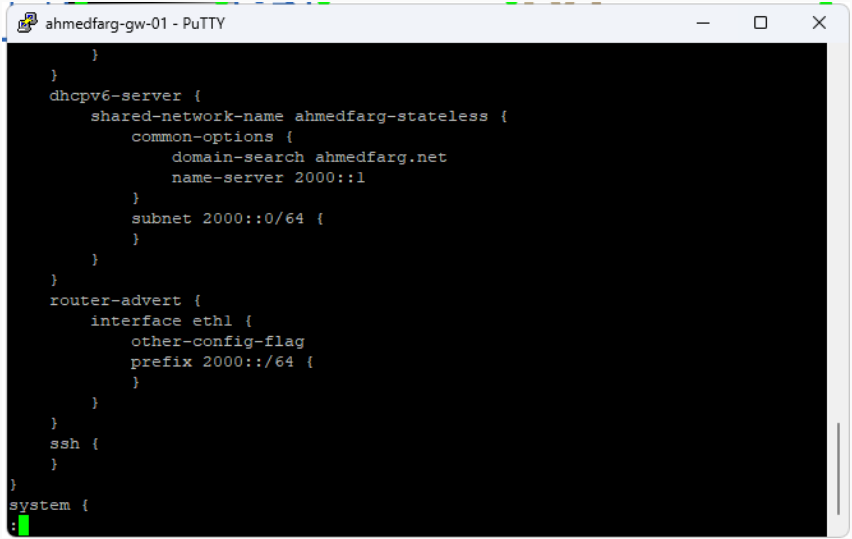


Рис. 11: Статическая конфигурация

Начальные параметры IPv6 на PC2

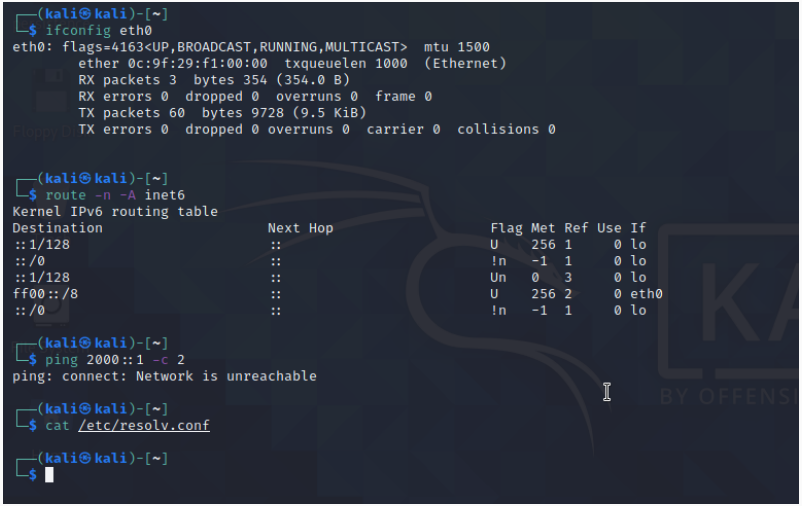


Рис. 12: Начальные IPv6 PC2

Получение DHCPv6 Stateless параметров

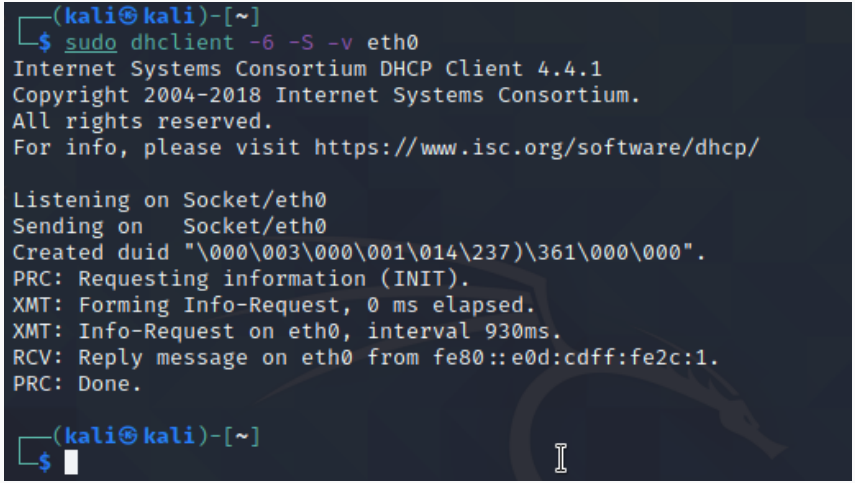


Рис. 13: DHCPv6 Stateless клиент

SLAAC + DNS после DHCPv6

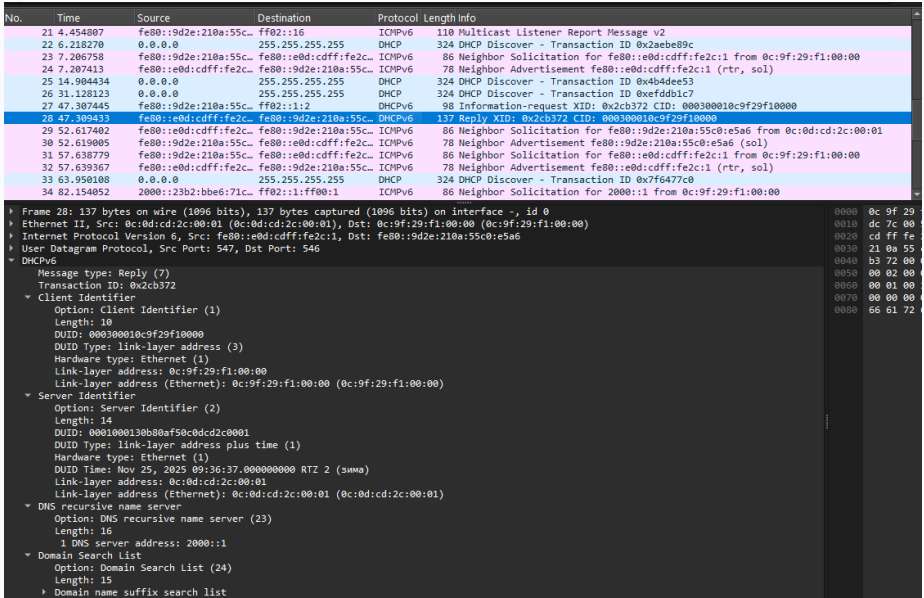
```
└─$ ifconfig eth0
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet6 2000::23b2:bbe6:71c0:d80b  prefixlen 64  scopeid 0x0<global>
        inet6 fe80::9d2e:210a:55c0:e5a6  prefixlen 64  scopeid 0x20<link>
        ether 0c:9f:29:f1:00:00  txqueuelen 1000  (Ethernet)
        RX packets 7  bytes 728 (728.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 25  bytes 3524 (3.4 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0


┌──(kali㉿kali)-[~]
└─$ route -n -A inet6
Kernel IPv6 routing table
Destination                    Next Hop                   Flag Met Ref Use If
::1/128                        ::                         U    256 2     0 lo
2000::/64                      ::                         U    100 1     0 eth0
fe80::/64                      ::                         U    100 1     0 eth0
::/0                           fe80::e0d:cdff:fe2c:1      UG   100 1     0 eth0
::1/128                        ::                         Un   0   4     0 lo
2000::23b2:bbe6:71c0:d80b/128  ::                         Un   0   2     0 eth0
fe80::9d2e:210a:55c0:e5a6/128  ::                         Un   0   3     0 eth0
ff00::/8                       ::                         U    256 3     0 eth0
::/0                           ::                         !n   -1  1     0 lo

┌──(kali㉿kali)-[~]
└─$ ping 2000::1 -c 2
PING 2000::1(2000::1) 56 data bytes
64 bytes from 2000::1: icmp_seq=1 ttl=64 time=2.82 ms
64 bytes from 2000::1: icmp_seq=2 ttl=64 time=1.32 ms

--- 2000::1 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1003ms
rtt min/avg/max/mdev = 1.317/2.067/2.817/0.750 ms

┌──(kali㉿kali)-[~]
└─$ cat /etc/resolv.conf
search ahmedfarg.net.
```

DHCPv6 Stateless — leases

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

Рис. 15: Leases DHCPv6 Stateless

Анализ DHCPv6 Stateless в Wireshark



DHCPv6 Stateful на маршрутизаторе

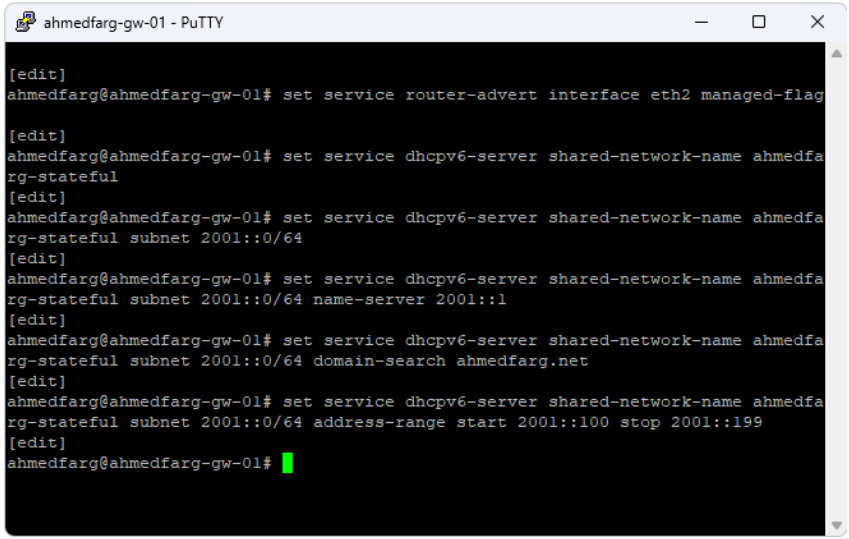


Рис. 17: Конфигурация DHCPv6 Stateful

Начальное состояние PC3

```
┌──(kali㉿kali)-[~]
└─$ ifconfig eth0
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet6 2001::198  prefixlen 128  scopeid 0×0<global>
        inet6 fe80::2928:e90c:c789:bb87  prefixlen 64  scopeid 0×20<link>
        ether 0c:ce:64:e8:00:00  txqueuelen 1000  (Ethernet)
        RX packets 8  bytes 886 (886.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 142  bytes 22542 (22.0 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0


┌──(kali㉿kali)-[~]
└─$ route -n -A inet6
Kernel IPv6 routing table
Destination                    Next Hop                   Flag Met Ref Use If
::1/128                        ::                         U    256 2     0 lo
2001::198/128                  ::                         U    100 1     0 eth0
fe80::/64                      ::                         U    100 1     0 eth0
::/0                           fe80::e0d:cdff:fe2c:2      UG   100 1     0 eth0
::1/128                        ::                         Un   0   4     0 lo
2001::198/128                  ::                         Un   0   2     0 eth0
fe80::2928:e90c:c789:bb87/128  ::                         Un   0   3     0 eth0
ff00::/8                       ::                         U    256 3     0 eth0
::/0                           ::                         !n   -1  1     0 lo

┌──(kali㉿kali)-[~]
└─$ cat /etc/resolv.conf
# Generated by NetworkManager
search ahmedfarg.net
nameserver 2001::1

┌──(kali㉿kali)-[~]
└─$
```

Получение stateful IPv6-адреса

```
└─$ sudo dhclient -6 -v eth0
Internet Systems Consortium DHCP Client 4.4.1
Copyright 2004-2018 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\001\000\0010\270\015\243\014\316d\350\000\000".
PRC: Soliciting for leases (INIT).
XMT: Forming Solicit, 0 ms elapsed.
XMT:  X-- IA_NA 64:e8:00:00
XMT:  | X-- Request renew in  +3600
XMT:  | X-- Request rebind in +5400
XMT: Solicit on eth0, interval 1010ms.
RCV: Advertise message on eth0 from fe80::e0d:cdff:fe2c:2.
RCV:  X-- IA_NA 64:e8:00:00
RCV:  | X-- starts 1764053284
RCV:  | X-- t1 - renew  +0
RCV:  | X-- t2 - rebind +0
RCV:  | X-- [Options]
RCV:  | | X-- IAADDR 2001::199
RCV:  | | | X-- Preferred lifetime 27000.
RCV:  | | | X-- Max lifetime 43200.
RCV:  X-- Server ID: 00:01:00:01:30:b8:0a:f5:0c:0d:cd:2c:00:01
RCV:  Advertisement recorded.
PRC: Selecting best advertised lease.
PRC: Considering best lease.
PRC:  X-- Initial candidate 00:01:00:01:30:b8:0a:f5:0c:0d:cd:2c:00:01 (s: 10105, p: 0).
XMT: Forming Request, 0 ms elapsed.
XMT:  X-- IA_NA 64:e8:00:00
XMT:  | X-- Requested renew  +3600
XMT:  | X-- Requested rebind +5400
XMT:  | | X-- IAADDR 2001::199
XMT:  | | | X-- Preferred lifetime +7200
XMT:  | | | X-- Max lifetime +7500
XMT:  V IA_NA appended.
XMT: Request on eth0, interval 1040ms.
RCV: Reply message on eth0 from fe80::e0d:cdff:fe2c:2.
RCV:  X-- IA_NA 64:e8:00:00
```

IPv6 после получения DHCPv6 адреса

```
┌──(kali㉿kali)-[~]
└─$ ifconfig eth0
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet6 2001::198  prefixlen 128  scopeid 0×0<global>
        inet6 fe80::2928:e90c:c789:bb87  prefixlen 64  scopeid 0×20<link>
        inet6 2001::199  prefixlen 128  scopeid 0×0<global>
        ether 0c:ce:64:e8:00:00  txqueuelen 1000  (Ethernet)
        RX packets 12  bytes 1420 (1.3 KiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 151  bytes 23982 (23.4 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0


┌──(kali㉿kali)-[~]
└─$ route -n -A inet6
Kernel IPv6 routing table
Destination                    Next Hop                   Flag Met Ref Use If
::1/128                        ::                         U    256 2     0 lo
2001::198/128                  ::                         U    100 2     0 eth0
2001::199/128                  ::                         U    256 1     0 eth0
fe80::/64                      ::                         U    100 1     0 eth0
::/0                           fe80::e0d:cdff:fe2c:2      UG   100 1     0 eth0
::1/128                        ::                         Un   0   4     0 lo
2001::198/128                  ::                         Un   0   3     0 eth0
2001::199/128                  ::                         Un   0   2     0 eth0
fe80::2928:e90c:c789:bb87/128  ::                         Un   0   3     0 eth0
ff00::/8                       ::                         U    256 3     0 eth0
::/0                           ::                         !n   -1  1     0 lo

┌──(kali㉿kali)-[~]
└─$ ping 2001::1 -c 2
PING 2001::1(2001::1) 56 data bytes
64 bytes from 2001::1: icmp_seq=1 ttl=64 time=2.39 ms
64 bytes from 2001::1: icmp_seq=2 ttl=64 time=1.69 ms

--- 2001::1 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1002ms
rtt min/avg/max/mdev = 1.687/2.040/2.393/0.353 ms

┌──(kali㉿kali)-[~]
└─$
```

Список выданных IPv6-адресов

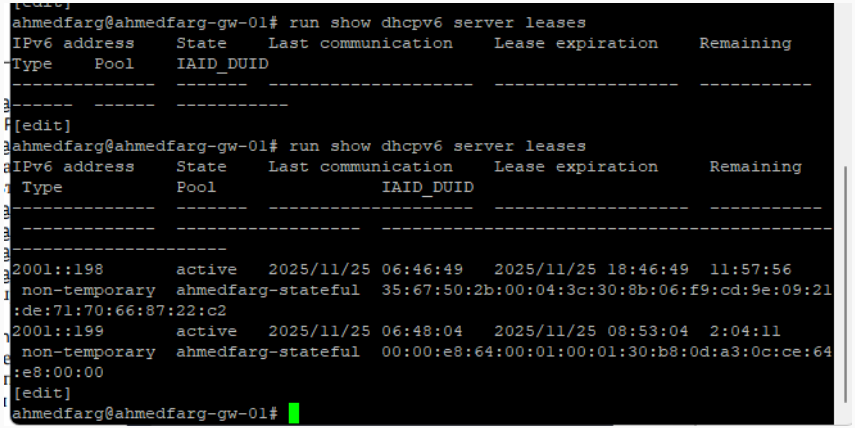
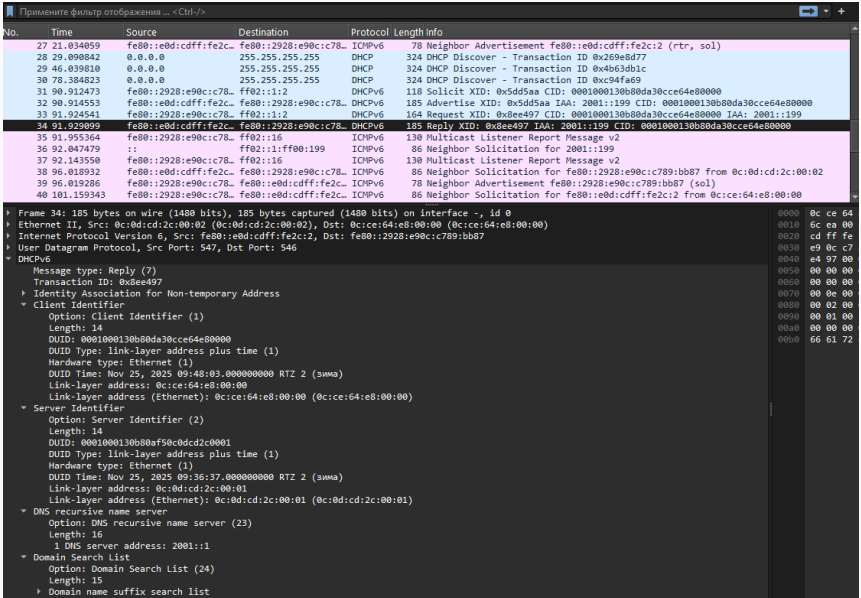


Рис. 21: Leases DHCPv6 Stateful

Анализ DHCPv6 Stateful в Wireshark



Заключение

Заключение

Настроены службы **DHCPv4**, **DHCPv6 Stateless** и **DHCPv6 Stateful** в виртуальной среде **GNS3**.

Все клиенты успешно получили адреса и сетевые параметры.

Анализ трафика в **Wireshark** подтвердил корректность работы протоколов DHCP и ICMP в сетях IPv4 и IPv6.