

# Сетевые технологии

## Лабораторная работа №7

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## Цель работы

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

## Ход выполнения

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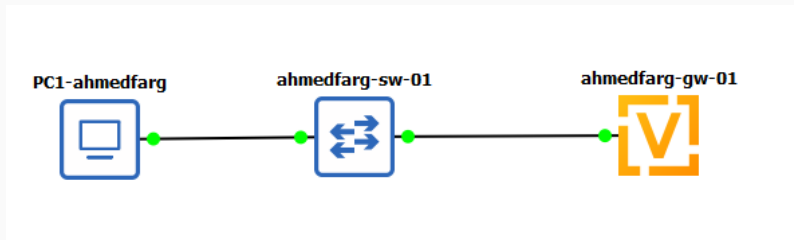
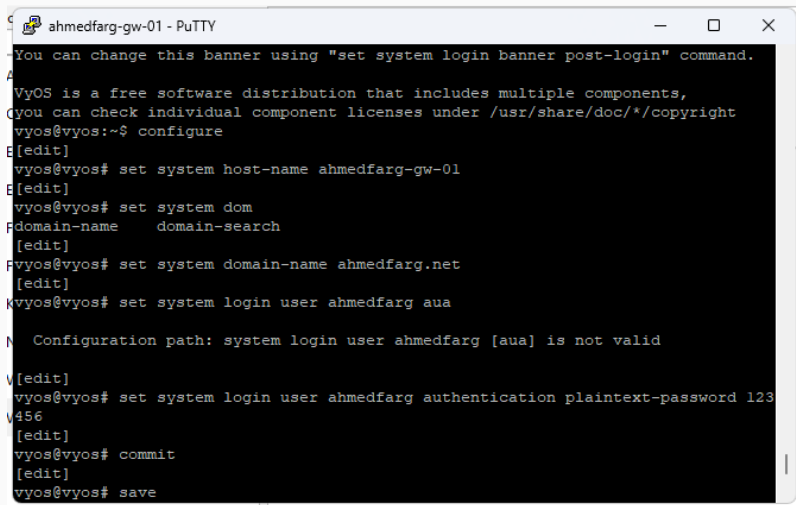


Рис. 1: Топология DHCPv4

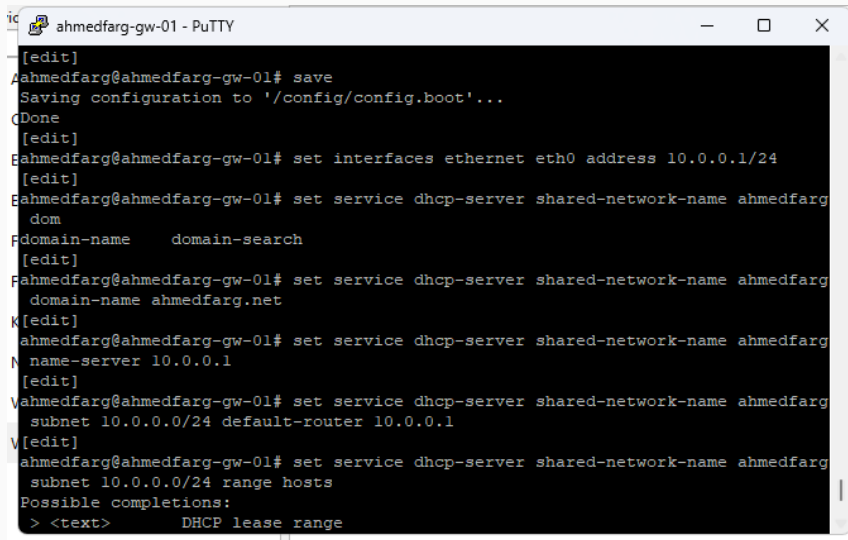
## Первичная настройка маршрутизатора VyOS



```
ahmedfarg-gw-01 - PuTTY
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 ahmedfarg-gw-01
[edit]
vyos@vyos# set system dom
domain-name      domain-search
[edit]
vyos@vyos# set system domain-name ahmedfarg.net
[edit]
vyos@vyos# set system login user ahmedfarg aia
Configuration path: system login user ahmedfarg [aia] is not valid
[edit]
vyos@vyos# set system login user ahmedfarg authentication plaintext-password 123456
[edit]
vyos@vyos# commit
[edit]
vyos@vyos# save
```

Рис. 2: Hostname и домен

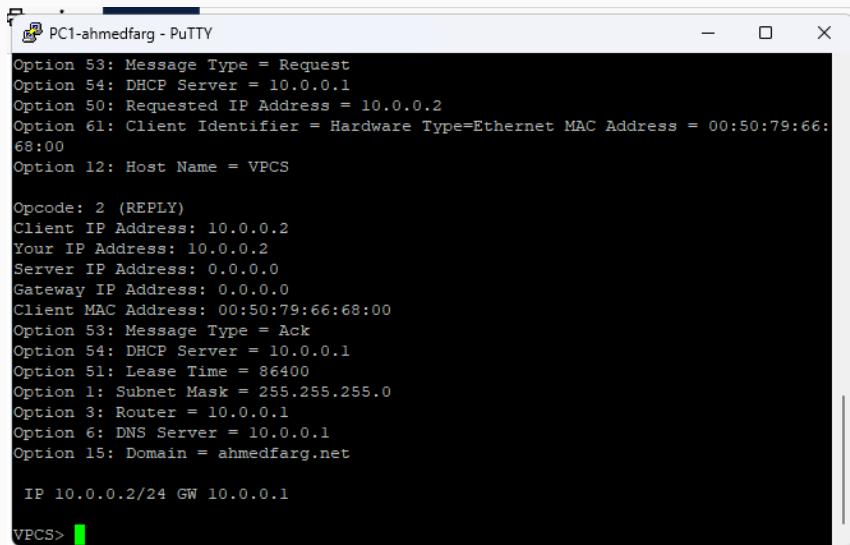
## Конфигурация DHCPv4 на маршрутизаторе



The screenshot shows a PuTTY terminal window titled "ahmedfarg-gw-01 - PuTTY". The terminal displays the following commands and output:

```
[edit]
Ahmedfarg@ahmedfarg-gw-01# save
Saving configuration to '/config/config.boot'...
Done
[edit]
Ahmedfarg@ahmedfarg-gw-01# set interfaces ethernet eth0 address 10.0.0.1/24
[edit]
Ahmedfarg@ahmedfarg-gw-01# set service dhcp-server shared-network-name ahmedfarg
dom
domain-name      domain-search
[edit]
Ahmedfarg@ahmedfarg-gw-01# set service dhcp-server shared-network-name ahmedfarg
domain-name ahmedfarg.net
[edit]
Ahmedfarg@ahmedfarg-gw-01# set service dhcp-server shared-network-name ahmedfarg
name-server 10.0.0.1
[edit]
Ahmedfarg@ahmedfarg-gw-01# set service dhcp-server shared-network-name ahmedfarg
subnet 10.0.0.0/24 default-router 10.0.0.1
[edit]
Ahmedfarg@ahmedfarg-gw-01# set service dhcp-server shared-network-name ahmedfarg
subnet 10.0.0.0/24 range hosts
Possible completions:
> <text>          DHCP lease range
```

## Клиент PC1 получает адрес по DHCP



```
PC1-ahmedfarg - PuTTY
Option 53: Message Type = Request
Option 54: DHCP Server = 10.0.0.1
Option 50: Requested IP Address = 10.0.0.2
Option 61: Client Identifier = Hardware Type=Ethernet MAC Address = 00:50:79:66:68:00
Option 12: Host Name = VPCS

Opcode: 2 (REPLY)
Client IP Address: 10.0.0.2
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 = Ack
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 = ahmedfarg.net

IP 10.0.0.2/24 GW 10.0.0.1
VPCS>
```

Рис. 4: DHCP-пакеты PC1



## Проверка IP и связности

```
PC1-ahmedfarg - PuTTY
VPCS> save
Saving startup configuration to startup.vpc
. done

VPCS> show ip

NAME       : VPCS[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  : 86383, 86400/43200/75600
DOMAIN NAME : ahmedfarg.net
MAC         : 00:50:79:66:68:00
LPORT      : 10004
RHOST:PORT  : 127.0.0.1:10005
MTU         : 1500

VPCS> ping 10.0.0.1 -c 2

84 bytes from 10.0.0.1 icmp_seq=1 ttl=64 time=0.767 ms
84 bytes from 10.0.0.1 icmp_seq=2 ttl=64 time=1.458 ms

VPCS> 
```

```
ahmedfarg@ahmedfarg-gw-01:~$  
ahmedfarg@ahmedfarg-gw-01:~$ show dhcp server statistics  
Pool      Size    Leases   Available  Usage  
-----  
ahmedfarg    252      1        251      0%  
ahmedfarg@ahmedfarg-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   2025/11/25 06:23:49 2025/11/26 06:23:49  
23:59:02      ahmedfarg VPCS  
ahmedfarg@ahmedfarg-gw-01:~$
```

Рис. 6: Leases DHCPv4

# Анализ DHCPv4 и ARP в Wireshark

1	0.000000	0.0.0.0	255.255.255.255	DHCP	406 DHCP Discover - Transaction ID 0x80a58331
2	0.001192	10.0.0.1	10.0.0.2	DHCP	342 DHCP Offer - Transaction ID 0x80a58331
3	1.000395	0.0.0.0	255.255.255.255	DHCP	406 DHCP Request - Transaction ID 0x80a58331
4	1.002173	10.0.0.1	10.0.0.2	DHCP	342 DHCP ACK - Transaction ID 0x80a58331
5	2.000738	Private_66:68:00	Broadcast	ARP	64 Gratuitous ARP for 10.0.0.2 (Request)
6	3.002848	Private_66:68:00	Broadcast	ARP	64 Gratuitous ARP for 10.0.0.2 (Request)
7	4.002979	Private_66:68:00	Broadcast	ARP	64 Gratuitous ARP for 10.0.0.2 (Request)

<ul style="list-style-type: none"> <li>Frame 4: 342 bytes on wire (2736 bits), 342 bytes captured (2736 bits) on interface -, id 0</li> <li>Ethernet II, Src: 0c:0d:cd:2c:00:00 (0c:0d:cd:2c:00:00), Dst: Private_66:68:00 (00:50:79:66:68:00)</li> <li>Internet Protocol Version 4, Src: 10.0.0.1, Dst: 10.0.0.2</li> <li>User Datagram Protocol, Src Port: 67, Dst Port: 68</li> <li>Dynamic Host Configuration Protocol (ACK) <ul style="list-style-type: none"> <li>Message type: Boot Reply (2)</li> <li>Hardware type: Ethernet (0x01)</li> <li>Hardware address length: 6</li> <li>Hops: 0</li> <li>Transaction ID: 0x80a58331</li> <li>Seconds elapsed: 0</li> <li>Bootp flags: 0x0000 (Unicast)</li> <li>Client IP address: 10.0.0.2</li> <li>Your (client) IP address: 10.0.0.2</li> <li>Next server IP address: 0.0.0.0</li> <li>Relay agent IP address: 0.0.0.0</li> <li>Client MAC address: Private_66:68:00 (00:50:79:66:68:00)</li> <li>Client hardware address padding: 00000000000000000000</li> <li>Server host name not given</li> <li>Boot file name not given</li> <li>Magic cookie: DHCP</li> <li>Option: (53) DHCP Message Type (ACK)</li> <li>Option: (54) DHCP Server Identifier (10.0.0.1)</li> <li>Option: (51) IP Address Lease Time</li> <li>Option: (1) Subnet Mask (255.255.255.0)</li> <li>Option: (3) Router</li> <li>Option: (6) Domain Name Server</li> <li>Option: (15) Domain Name</li> <li>Option: (255) End</li> <li>Padding: 0000000000000000000000000000</li> </ul> </li> </ul>	0000	00 50 79
	0010	01 48 00
	0020	00 02 00
	0030	83 31 00
	0040	00 00 00
	0050	00 00 00
	0060	00 00 00
	0070	00 00 00
	0080	00 00 00
	0090	00 00 00
	00a0	00 00 00
	00b0	00 00 00
	00c0	00 00 00
	00d0	00 00 00
	00e0	00 00 00
	00f0	00 00 00
	0100	00 00 00
	0110	00 00 00
	0120	00 00 01
	0130	04 0a 00
	0140	65 64 66
	0150	00 00 00

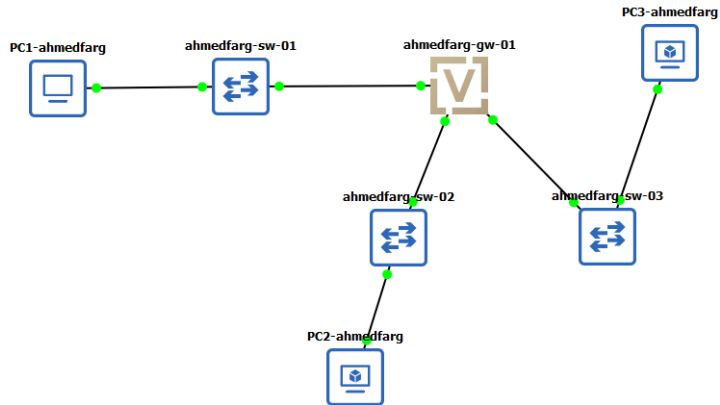
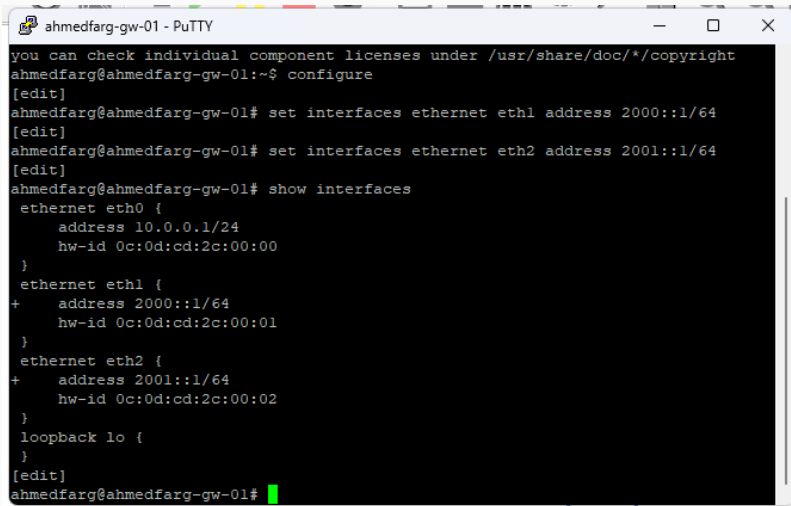


Рис. 8: Топология IPv6

## Настройка IPv6 интерфейсов

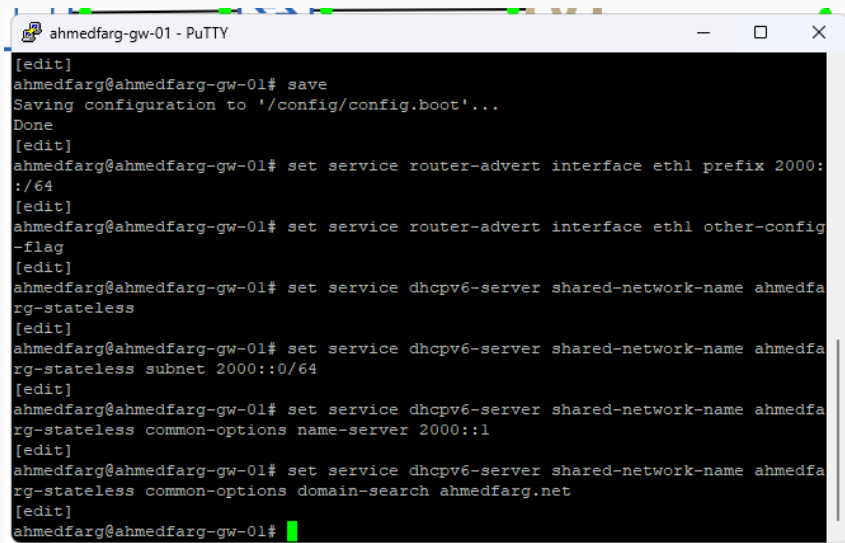


A screenshot of a PuTTY terminal window titled "ahmedfarg-gw-01 - PuTTY". The terminal shows a sequence of commands and their outputs for configuring IPv6 on a router. The user starts by typing "configure" to enter configuration mode, then "set interfaces ethernet eth1 address 2000::1/64" and "set interfaces ethernet eth2 address 2001::1/64" to assign IPv6 addresses. Finally, they type "show interfaces" to display the current configuration, which shows the assigned IPv6 addresses and hardware IDs for eth0, eth1, and eth2, along with the loopback interface lo.

```
ahmedfarg-gw-01 - PuTTY
you can check individual component licenses under /usr/share/doc/*/copyright
ahmedfarg@ahmedfarg-gw-01:~$ configure
[edit]
ahmedfarg@ahmedfarg-gw-01# set interfaces ethernet eth1 address 2000::1/64
[edit]
ahmedfarg@ahmedfarg-gw-01# set interfaces ethernet eth2 address 2001::1/64
[edit]
ahmedfarg@ahmedfarg-gw-01# show interfaces
  ethernet eth0 {
    address 10.0.0.1/24
    hw-id 0c:0d:cd:2c:00:00
  }
  ethernet eth1 {
+   address 2000::1/64
    hw-id 0c:0d:cd:2c:00:01
  }
  ethernet eth2 {
+   address 2001::1/64
    hw-id 0c:0d:cd:2c:00:02
  }
  loopback lo {
  }
[edit]
ahmedfarg@ahmedfarg-gw-01#
```

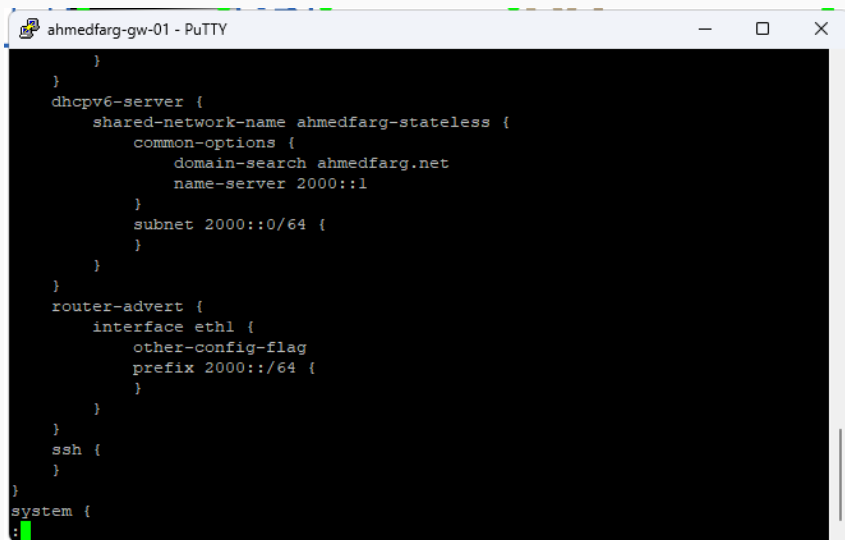
Рис. 9: IPv6 интерфейсы

## Настройка Router Advertisements и DHCPv6 Stateless



```
[edit]
ahmedfarg@ahmedfarg-gw-01# save
Saving configuration to '/config/config.boot'...
Done
[edit]
ahmedfarg@ahmedfarg-gw-01# set service router-advert interface eth1 prefix 2000:
:/64
[edit]
ahmedfarg@ahmedfarg-gw-01# set service router-advert interface eth1 other-config
-flag
[edit]
ahmedfarg@ahmedfarg-gw-01# set service dhcpv6-server shared-network-name ahmedfa
rg-stateless
[edit]
ahmedfarg@ahmedfarg-gw-01# set service dhcpv6-server shared-network-name ahmedfa
rg-stateless subnet 2000::0/64
[edit]
ahmedfarg@ahmedfarg-gw-01# set service dhcpv6-server shared-network-name ahmedfa
rg-stateless common-options name-server 2000::1
[edit]
ahmedfarg@ahmedfarg-gw-01# set service dhcpv6-server shared-network-name ahmedfa
rg-stateless common-options domain-search ahmedfarg.net
[edit]
ahmedfarg@ahmedfarg-gw-01#
```

## Конфигурация RA/DHCPv6 на маршрутизаторе



```
ahmedfarg-gw-01 - PuTTY
}
}
dhcpv6-server {
    shared-network-name ahmedfarg-stateless {
        common-options {
            domain-search ahmedfarg.net
            name-server 2000::1
        }
        subnet 2000::0/64 {
        }
    }
}
router-advert {
    interface eth1 {
        other-config-flag
        prefix 2000::/64 {
        }
    }
}
ssh {
}
}
system {
:

```

Рис. 11: Статическая конфигурация

## Начальные параметры IPv6 на PC2

```
(kali㉿kali)-[~]
$ ifconfig eth0
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    ether 0c:9f:29:f1:00:00 txqueuelen 1000 (Ethernet)
    RX packets 3 bytes 354 (354.0 B)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 60 bytes 9728 (9.5 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	1	0	lo
::/0	::	!n	-1	1	0	lo
::1/128	::	Un	0	3	0	lo
ff00::/8	::	U	256	2	0	eth0
::/0	::	!n	-1	1	0	lo

```
(kali㉿kali)-[~]
$ ping 2000::1 -c 2
ping: connect: Network is unreachable

(kali㉿kali)-[~]
$ cat /etc/resolv.conf

(kali㉿kali)-[~]
$
```

Рис. 12: Начальные IPv6 PC2



## Получение DHCPv6 Stateless параметров

```
(kali㉿kali)-[~]  
$ sudo dhclient -6 -S -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\003\000\001\014\237)\361\000\000".  
PRC: Requesting information (INIT).  
XMT: Forming Info-Request, 0 ms elapsed.  
XMT: Info-Request on eth0, interval 930ms.  
RCV: Reply message on eth0 from fe80::e0d:cdff:fe2c:1.  
PRC: Done.  
  
(kali㉿kali)-[~]  
$
```

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.
```

```
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

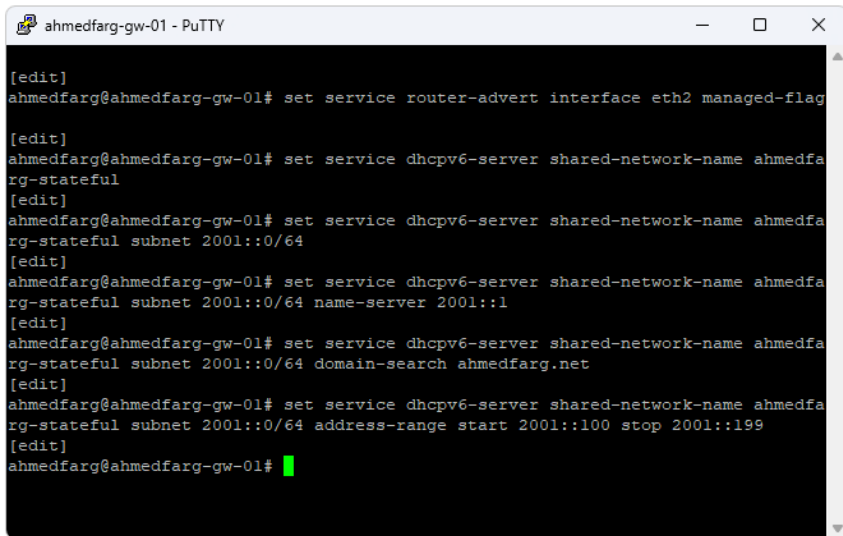
No.	Time	Source	Destination	Protocol	Length	Info
21	4.454807	fe80::9d2e:210a:55c...	ff02::16	ICMPv6	110	Multicast Listener Report Message v2
22	6.218270	0.0.0.0	255.255.255.255	DHCP	324	DHCP Discover - Transaction ID 0x2aeb89c
23	7.206758	fe80::9d2e:210a:55c...	fe80::e0d:cdff:fe2c...	ICMPv6	86	Neighbor Solicitation for fe80::e0d:cdff:fe2c:1 from 0c:9f:29:f1:00:00
24	7.207413	fe80::e0d:cdff:fe2c...	fe80::9d2e:210a:55c...	ICMPv6	78	Neighbor Advertisement fe80::e0d:cdff:fe2c:1 (rtr, sol)
25	14.904434	0.0.0.0	255.255.255.255	DHCP	324	DHCP Discover - Transaction ID 0x4b4dee53
26	31.128123	0.0.0.0	255.255.255.255	DHCP	324	DHCP Discover - Transaction ID 0xefddb1c7
27	47.307445	fe80::9d2e:210a:55c...	ff02::1:2	DHCPv6	98	Information-request XID: 0x2cb372 CID: 000300010c9f29f10000
28	47.309433	fe80::e0d:cdff:fe2c...	fe80::9d2e:210a:55c...	DHCPv6	137	Reply XID: 0x2cb372 CID: 000300010c9f29f10000
29	52.617402	fe80::e0d:cdff:fe2c...	fe80::9d2e:210a:55c...	ICMPv6	86	Neighbor Solicitation for fe80::9d2e:210a:55c0:e5a6 from 0c:0d:cd:2c:00:01
30	52.619005	fe80::9d2e:210a:55c...	fe80::e0d:cdff:fe2c...	ICMPv6	78	Neighbor Advertisement fe80::9d2e:210a:55c0:e5a6 (sol)
31	57.638779	fe80::9d2e:210a:55c...	fe80::e0d:cdff:fe2c...	ICMPv6	86	Neighbor Solicitation for fe80::e0d:cdff:fe2c:1 from 0c:9f:29:f1:00:00
32	57.639367	fe80::e0d:cdff:fe2c...	fe80::9d2e:210a:55c...	ICMPv6	78	Neighbor Advertisement fe80::e0d:cdff:fe2c:1 (rtr, sol)
33	63.950108	0.0.0.0	255.255.255.255	DHCP	324	DHCP Discover - Transaction ID 0x7f6477c0
34	82.154052	2000::23b2:bbe6:71c...	ff02::1:ff00:1	ICMPv6	86	Neighbor Solicitation for 2000::1 from 0c:9f:29:f1:00:00

▶ Frame 28: 137 bytes on wire (1096 bits), 137 bytes captured (1096 bits) on interface -, id 0  
 ▶ Ethernet II, Src: 0c:0d:cd:2c:00:01 (0c:0d:cd:2c:00:01), Dst: 0c:9f:29:f1:00:00 (0c:9f:29:f1:00:00)  
 ▶ Internet Protocol Version 6, Src: fe80::e0d:cdff:fe2c:1, Dst: fe80::9d2e:210a:55c0:e5a6  
 ▶ User Datagram Protocol, Src Port: 547, Dst Port: 546

▼ DHCPv6  
 Message type: Reply (7)  
 Transaction ID: 0x2cb372  
 ▼ Client Identifier  
 Option: Client Identifier (1)  
 Length: 10  
 DUID: 000300010c9f29f10000  
 DUID Type: link-layer address (3)  
 Hardware type: Ethernet (1)  
 Link-layer address: 0c:9f:29:f1:00:00  
 Link-layer address (Ethernet): 0c:9f:29:f1:00:00 (0c:9f:29:f1:00:00)  
 ▼ Server Identifier  
 Option: Server Identifier (2)  
 Length: 14  
 DUID: 0001000130b8af50c0dcd2c0001  
 DUID Type: link-layer address plus time (1)  
 Hardware type: Ethernet (1)  
 DUID Time: Nov 25, 2025 09:36:37.000000000 RTZ 2 (зима)  
 Link-layer address: 0c:0d:cd:2c:00:01  
 Link-layer address (Ethernet): 0c:0d:cd:2c:00:01 (0c:0d:cd:2c:00:01)  
 ▼ DNS recursive name server  
 Option: DNS recursive name server (23)  
 Length: 16  
 1 DNS server address: 2000::1  
 ▼ Domain Search List  
 Option: Domain Search List (24)  
 Length: 15  
 ▶ Domain name suffix search list

## DHCPv6 Stateful на маршрутизаторе



The image shows a PuTTY terminal window titled "ahmedfarg-gw-01 - PuTTY". The terminal displays a series of configuration commands for DHCPv6 Stateful on a router. Each command is preceded by a "[edit]" prompt. The commands configure the router-adv interface, set the shared-network-name to "ahmedfarg-stateful", define a subnet "2001::0/64", set the name-server to "2001::1", configure domain-search to "ahmedfarg.net", and set the address-range start to "2001::100" and stop to "2001::199". The terminal ends with a green cursor on the prompt "ahmedfarg@ahmedfarg-gw-01#".

```
[edit]
ahmedfarg@ahmedfarg-gw-01# set service router-advert interface eth2 managed-flag

[edit]
ahmedfarg@ahmedfarg-gw-01# set service dhcpv6-server shared-network-name ahmedfa
rg-stateful
[edit]
ahmedfarg@ahmedfarg-gw-01# set service dhcpv6-server shared-network-name ahmedfa
rg-stateful subnet 2001::0/64
[edit]
ahmedfarg@ahmedfarg-gw-01# set service dhcpv6-server shared-network-name ahmedfa
rg-stateful subnet 2001::0/64 name-server 2001::1
[edit]
ahmedfarg@ahmedfarg-gw-01# set service dhcpv6-server shared-network-name ahmedfa
rg-stateful subnet 2001::0/64 domain-search ahmedfarg.net
[edit]
ahmedfarg@ahmedfarg-gw-01# set service dhcpv6-server shared-network-name ahmedfa
rg-stateful subnet 2001::0/64 address-range start 2001::100 stop 2001::199
[edit]
ahmedfarg@ahmedfarg-gw-01#
```

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<global>  
    inet6 fe80::2928:e90c:c789:bb87 prefixlen 64 scopeid 0<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<global>
    inet6 fe80::2928:e90c:c789:bb87 prefixlen 64 scopeid 0<link>
    inet6 2001::199 prefixlen 128 scopeid 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

```
[edit]
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# run show dhcpv6 server leases
IPv6 address      State      Last communication      Lease expiration      Remaining
Type      Pool      IAID_DUID
-----
2001::198         active    2025/11/25 06:46:49    2025/11/25 18:46:49    11:57:56
non-temporary    ahmedfarg-stateful    35:67:50:2b:00:04:3c:30:8b:06:f9:cd:9e:09:21
:de:71:70:66:87:22:c2
2001::199         active    2025/11/25 06:48:04    2025/11/25 08:53:04    2:04:11
non-temporary    ahmedfarg-stateful    00:00:e8:64:00:01:00:01:30:b8:0d:a3:0c:ce:64
:e8:00:00
[edit]
ahmedfarg@ahmedfarg-gw-01#
```

Рис. 21: Leases DHCPv6 Stateful

# Анализ DHCPv6 Stateful в Wireshark

Примените фильтр отображения ... <Ctrl-/>

No.	Time	Source	Destination	Protocol	Length	Info
27	21.034059	fe80::e0d:cdf:fe2c...	fe80::2928:e90c:c78...	ICMPv6	78	Neighbor Advertisement fe80::e0d:cdf:fe2c:2 (rtr, sol)
28	29.090842	0.0.0.0	255.255.255.255	DHCP	324	DHCP Discover - Transaction ID 0x269e8d77
29	46.039810	0.0.0.0	255.255.255.255	DHCP	324	DHCP Discover - Transaction ID 0x4b63db1c
30	78.384823	0.0.0.0	255.255.255.255	DHCP	324	DHCP Discover - Transaction ID 0xc94fa69
31	90.912473	fe80::2928:e90c:c78...	ff02::1:2	DHCPv6	118	Solicit XID: 0x5dd5aa CID: 0001000130b80da30cce64e80000
32	90.914553	fe80::e0d:cdf:fe2c...	fe80::2928:e90c:c78...	DHCPv6	185	Advertise XID: 0x5dd5aa IAA: 2001::199 CID: 0001000130b80da30cce64e80000
33	91.924541	fe80::2928:e90c:c78...	ff02::1:2	DHCPv6	164	Request XID: 0x8ee497 CID: 0001000130b80da30cce64e80000 IAA: 2001::199
34	91.929099	fe80::e0d:cdf:fe2c...	fe80::2928:e90c:c78...	DHCPv6	185	Reply XID: 0x8ee497 IAA: 2001::199 CID: 0001000130b80da30cce64e80000
35	91.955364	fe80::2928:e90c:c78...	ff02::1:6	ICMPv6	130	Multicast Listener Report Message v2
36	92.047479	::	ff02::1:ff00:199	ICMPv6	86	Neighbor Solicitation for 2001::199
37	92.143550	fe80::2928:e90c:c78...	ff02::1:6	ICMPv6	130	Multicast Listener Report Message v2
38	96.018932	fe80::e0d:cdf:fe2c...	fe80::2928:e90c:c78...	ICMPv6	86	Neighbor Solicitation for fe80::2928:e90c:c789:bb87 from 0c:0d:cd:2c:00:02
39	96.019286	fe80::2928:e90c:c78...	fe80::e0d:cdf:fe2c...	ICMPv6	78	Neighbor Advertisement fe80::2928:e90c:c789:bb87 (sol)
40	101.159343	fe80::2928:e90c:c78...	fe80::e0d:cdf:fe2c...	ICMPv6	86	Neighbor Solicitation for fe80::e0d:cdf:fe2c:2 from 0c:ce:64:e8:00:00

Frame 34: 185 bytes on wire (1480 bits), 185 bytes captured (1480 bits) on interface -, id 0

Ethernet II, Src: 0c:0d:cd:2c:00:02 (0c:0d:cd:2c:00:02), Dst: 0c:ce:64:e8:00:00 (0c:ce:64:e8:00:00)

Internet Protocol Version 6, Src: fe80::e0d:cdf:fe2c:2, Dst: fe80::2928:e90c:c789:bb87

User Datagram Protocol, Src Port: 547, Dst Port: 546

DHCPv6

- Message type: Reply (7)
- Transaction ID: 0x8ee497
- Identity Association for Non-temporary Address
  - Client Identifier
    - Option: Client Identifier (1)
    - Length: 14
    - DUID: 0001000130b80da30cce64e80000
    - DUID Type: link-layer address plus time (1)
    - Hardware type: Ethernet (1)
    - DUID Time: Nov 25, 2025 09:48:03.000000000 RTZ 2 (Зима)
    - Link-layer address: 0c:ce:64:e8:00:00
    - Link-layer address (Ethernet): 0c:ce:64:e8:00:00 (0c:ce:64:e8:00:00)
  - Server Identifier
    - Option: Server Identifier (2)
    - Length: 14
    - DUID: 0001000130b80af50cdcd2c0001
    - DUID Type: link-layer address plus time (1)
    - Hardware type: Ethernet (1)
    - DUID Time: Nov 25, 2025 09:36:37.000000000 RTZ 2 (Зима)
    - Link-layer address: 0c:0d:cd:2c:00:01
    - Link-layer address (Ethernet): 0c:0d:cd:2c:00:01 (0c:0d:cd:2c:00:01)
  - DNS recursive name server
    - Option: DNS recursive name server (23)
    - Length: 16
    - 1 DNS server address: 2001::1
  - Domain Search List
    - Option: Domain Search List (24)
    - Length: 15
    - Domain name suffix search list

## 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.