

Сетевые технологии

Лабораторная работа №7

Метвалли Ахмед Фарг Набеех

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Российский университет дружбы народов, Москва, Россия

Цель работы

Основная цель

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

Ход выполнения

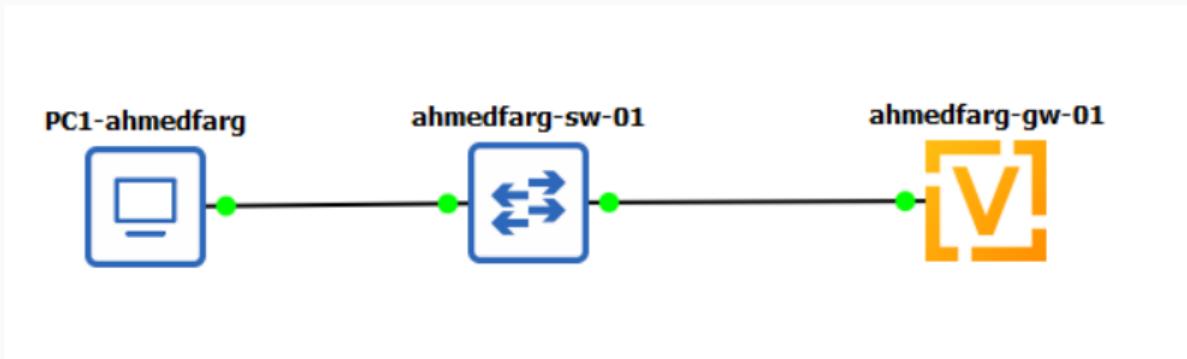
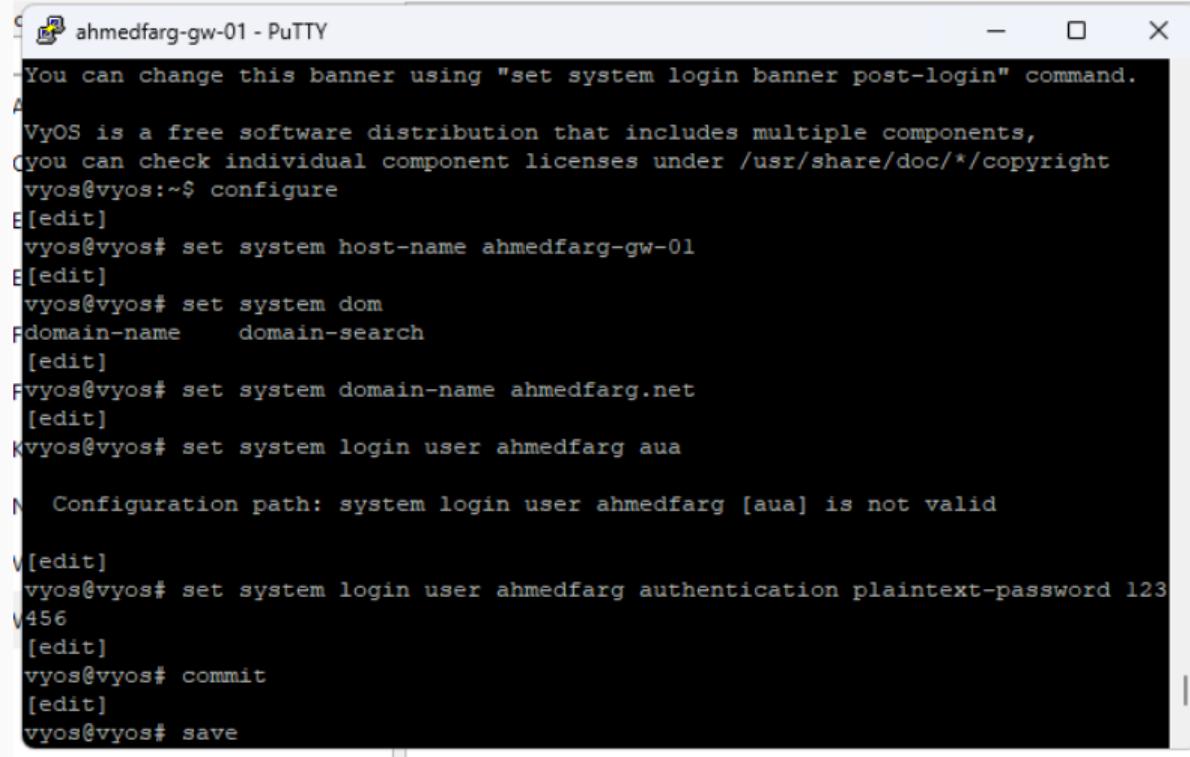


Рис. 1: Топология DHCPv4

Первичная настройка маршрутизатора VyOS



```
You can change this banner using "set system login banner post-login" command.
A
VyOS is a free software distribution that includes multiple components,
you can check individual component licenses under /usr/share/doc/*copyright
vyos@vyos:~$ configure
E[edit]
vyos@vyos# set system host-name ahmedfarg-gw-01
E[edit]
vyos@vyos# set system domain-name ahmedfarg.net
E[edit]
vyos@vyos# set system login user auu
M Configuration path: system login user ahmedfarg [auu] is not valid
V[edit]
vyos@vyos# set system login user ahmedfarg authentication plaintext-password 123
V456
E[edit]
vyos@vyos# commit
E[edit]
vyos@vyos# save
```

Рис. 2: Hostname и домен

Конфигурация DHCPv4 на маршрутизаторе

```
[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
Fdomain-name      domain-search
[edit]
ahmedfarg@ahmedfarg-gw-01# set service dhcp-server shared-network-name ahmedfarg
    domain-name ahmedfarg.net
K[edit]
ahmedfarg@ahmedfarg-gw-01# set service dhcp-server shared-network-name ahmedfarg
N    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
V[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
```

Рис. 3: Настройка DHCPv4

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

```
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>
```

Статистика DHCP-сервера

```
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

Frame ID	Source IP	Destination IP	Protocol	Description	Hex	Dec
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)		
.....						
▶ Frame 4: 342 bytes on wire (2736 bits), 342 bytes captured (2736 bits) on interface -, id 0						
▶ 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)						
▶ 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 (ACK)						
Message type: Boot Reply (2)						
Hardware type: Ethernet (0x01)						
Hardware address length: 6						
Hops: 0						
Transaction ID: 0x80a58331						
Seconds elapsed: 0						
▶ Bootp flags: 0x0000 (Unicast)						
Client IP address: 10.0.0.2						
Your (client) IP address: 10.0.0.2						
Next server IP address: 0.0.0.0						
Relay agent IP address: 0.0.0.0						
Client MAC address: Private_66:68:00 (00:50:79:66:68:00)						
Client hardware address padding: 000000000000000000000000						
Server host name not given						
Boot file name not given						
Magic cookie: DHCP						
▶ Option: (53) DHCP Message Type (ACK)						
▶ Option: (54) DHCP Server Identifier (10.0.0.1)						
▶ Option: (51) IP Address Lease Time						
▶ Option: (1) Subnet Mask (255.255.255.0)						
▶ Option: (3) Router						
▶ Option: (6) Domain Name Server						
▶ Option: (15) Domain Name						
▶ Option: (255) End						
Padding: 000000000000000000000000						

Топология IPv6

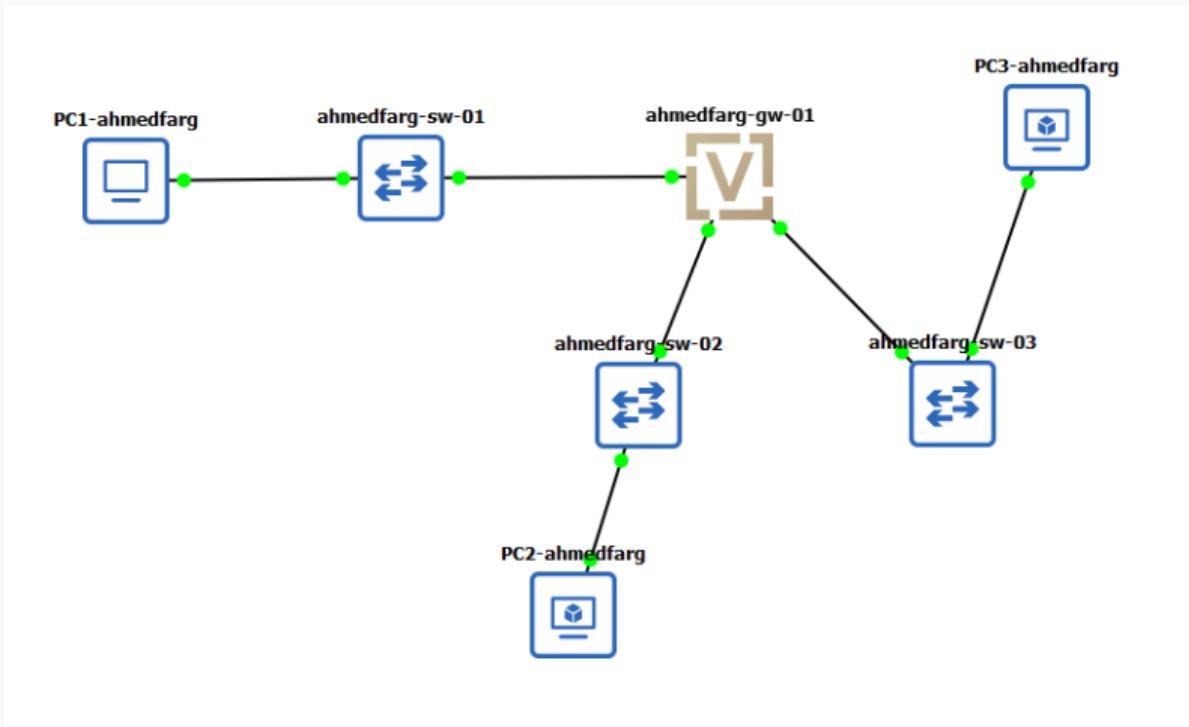
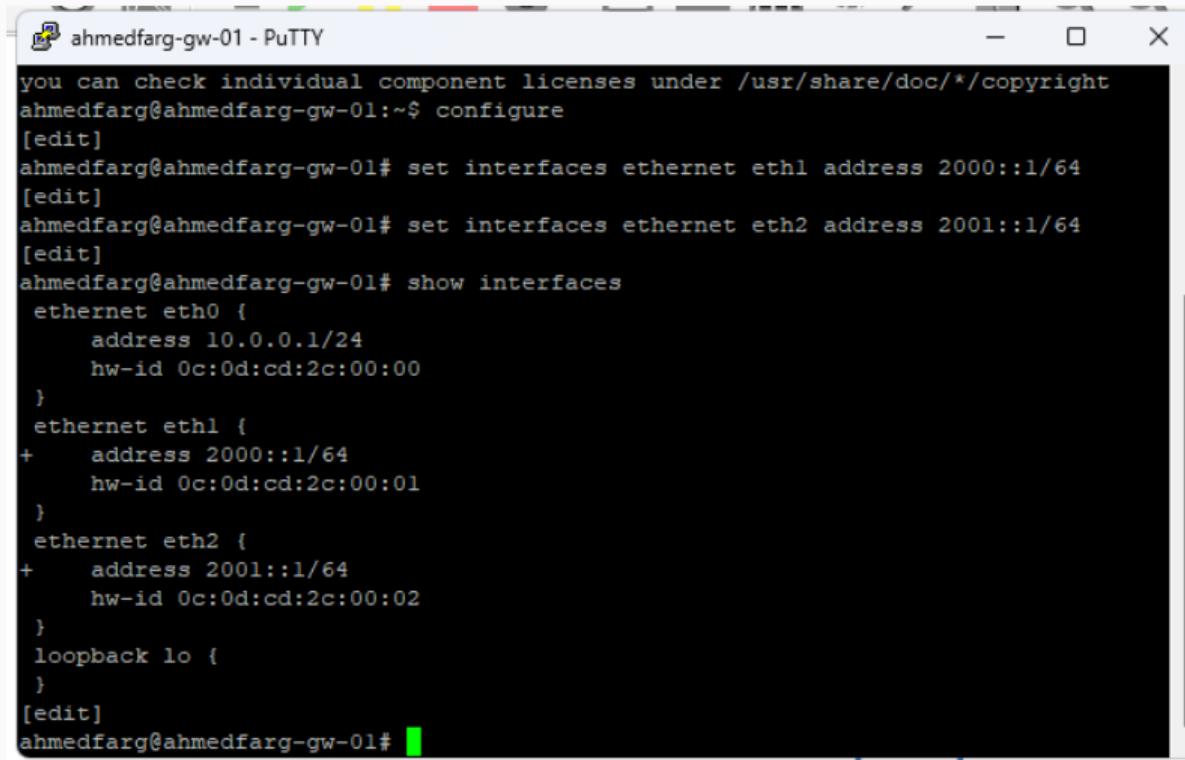


Рис. 8: Топология IPv6

Настройка IPv6 интерфейсов



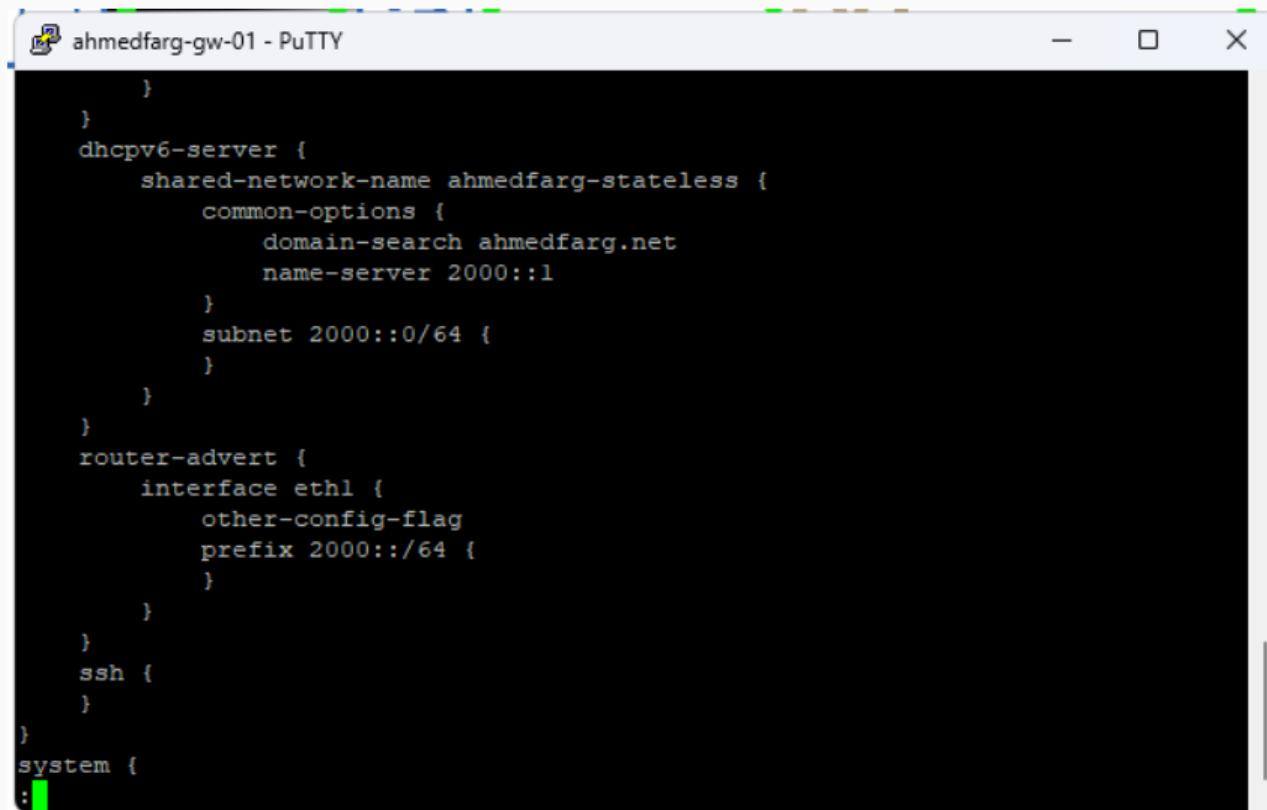
```
you can check individual component licenses under /usr/share/doc/*/copyright
ahmedfarg@ahmedfarg-gw-01:~$ configure
[edit]
ahmedfarg@ahmedfarg-gw-01# set interfaces ethernet eth1 address 2000::1/64
[edit]
ahmedfarg@ahmedfarg-gw-01# set interfaces ethernet eth2 address 2001::1/64
[edit]
ahmedfarg@ahmedfarg-gw-01# 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 dhcipv6-server shared-network-name ahmedfarg-stateless
[edit]
ahmedfarg@ahmedfarg-gw-01# set service dhcipv6-server shared-network-name ahmedfarg-stateless subnet 2000::0/64
[edit]
ahmedfarg@ahmedfarg-gw-01# set service dhcipv6-server shared-network-name ahmedfarg-stateless common-options name-server 2000::1
[edit]
ahmedfarg@ahmedfarg-gw-01# set service dhcipv6-server shared-network-name ahmedfarg-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:cdf: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

No.	Time	Source	Destination	Protocol	Length Info
21	4.454807	fe80::9d2e:210a:55c.. ff02::1:16		ICMPv6	110 Multicast Listener Report Message v2
22	6.218270	0.0.0.0	255.255.255.255	DHCP	324 DHCP Discover - Transaction ID 0x2aebe89c
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 0x4b4de53
26	31.128123	0.0.0.0	255.255.255.255	DHCP	324 DHCP Discover - Transaction ID 0xeffddbc7
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	63.958108	0.0.0.0	255.255.255.255	DHCP	324 DHCP Discover - Transaction ID 0x7f647c0
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: 0001000130b80af50c0dc02c0001
 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
 1 Domain name suffix search list

DHCPv6 Stateful на маршрутизаторе

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

[edit]
ahmedfarg@ahmedfarg-gw-01# set service dhcpcv6-server shared-network-name ahmedfarg-stateful
[edit]
ahmedfarg@ahmedfarg-gw-01# set service dhcpcv6-server shared-network-name ahmedfarg-stateful subnet 2001::0/64
[edit]
ahmedfarg@ahmedfarg-gw-01# set service dhcpcv6-server shared-network-name ahmedfarg-stateful subnet 2001::0/64 name-server 2001::1
[edit]
ahmedfarg@ahmedfarg-gw-01# set service dhcpcv6-server shared-network-name ahmedfarg-stateful subnet 2001::0/64 domain-search ahmedfarg.net
[edit]
ahmedfarg@ahmedfarg-gw-01# set service dhcpcv6-server shared-network-name ahmedfarg-stateful subnet 2001::0/64 address-range start 2001::100 stop 2001::199
[edit]
ahmedfarg@ahmedfarg-gw-01#
```

Начальное состояние PC3

```
(kali㉿kali)-[~]
└─$ ifconfig eth0
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
      inet6 2001::198  prefixlen 128  scopeid 0x0<global>
      inet6 fe80::2928:e90c:c789:bb87  prefixlen 64  scopeid 0x20<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:cdf: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:cdf: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 0x0<global>
              inet6 fe80::2928:e90c:c789:bb87  prefixlen 64  scopeid 0x20<link>
        inet6 2001::199  prefixlen 128  scopeid 0x0<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
```

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
-----
-----
```

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:cdff:fe2c..	fe80::2928:e90c:c78..	ICMPv6	78	Neighbor Advertisement fe80::e0d:cdff: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:cdff: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	91.929899	fe80::e0d:cdff:fe2c..	fe80::2928:e90c:c78..	DHCPv6	185	Reply XID: 0x8ee497 IAA: 2001::199 CID: 0001000130b80da30cce64e80000
35	91.955364	fe80::2928:e90c:c78..	ff02::16	ICMPv6	130	Multicast Listener Report Message v2
36	92.847479	::	ff02::1:ff00:199	ICMPv6	86	Neighbor Solicitation for 2001::199
37	92.143550	fe80::2928:e90c:c78..	ff02::16	ICMPv6	130	Multicast Listener Report Message v2
38	96.018932	fe80::e0d:cdff:fe2c..	fe80::2928:e90c:c78..	ICMPv6	86	Neighbor Solicitation for fe80::2928:e90c:c789:bb87 from 0c:0:d:cd:2:c:0:0:02
39	96.019286	fe80::2928:e90c:c78..	fe80::e0d:cdff:fe2c..	ICMPv6	78	Neighbor Advertisement fe80::2928:e90c:c789:bb87 (sol)
40	101.159343	fe80::2928:e90c:c78..	fe80::e0d:cdff:fe2c:2	ICMPv6	86	Neighbor Solicitation for fe80::e0d:cdff: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:0:d:cd:2:c:0:0:02 (0c:0:d:cd:2:c:0:0:02), Dst: 0:c:ce:64:e8:00:00 (0:c:ce:64:e8:00:00)
Internet Protocol Version 6, Src: fe80::e0d:cdff: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
 GUID: 0001000130b80da30cce64e80000
 GUID Type: link-layer address plus time (1)
 Hardware type: Ethernet (1)
 GUID Time: Nov 25, 2025 09:48:03.000000000 RTZ 2 (зима)
 Link-layer address: 0:c:ce:64:e8:00:00
 Link-layer address (Ethernet): 0:c:ce:64:e8:00:00 (0:c:ce:64:e8:00:00)
 Server Identifier
 Option: Server Identifier (2)
 Length: 14
 GUID: 0001000130b80af50c0dc02c0001
 GUID Type: link-layer address plus time (1)
 Hardware type: Ethernet (1)
 GUID Time: Nov 25, 2025 09:36:37.000000000 RTZ 2 (зима)
 Link-layer address: 0:c:0:d:cd:2:c:0:0:01
 Link-layer address (Ethernet): 0:c:0:d:cd:2:c:0:0:01 (0:c:0:d:cd:2:c:0:0:01)
 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

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.