

Лабораторная работа №7

Адресация IPv4 и IPv6. Настройка DHCP / DHCPv6

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20 декабря 2025

Цель работы

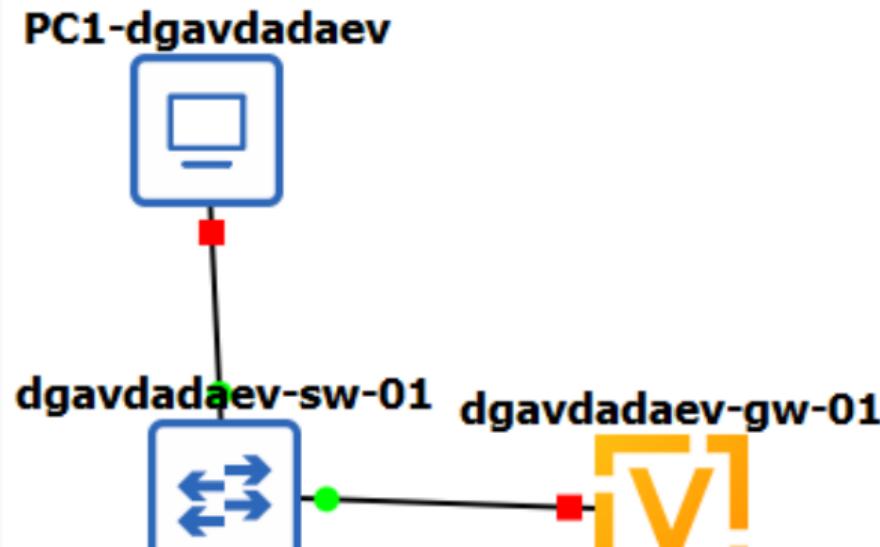
Цель

Получить навыки настройки службы DHCP на сетевом оборудовании для распределения адресов IPv4 и IPv6:

- DHCP (IPv4)
- DHCPv6 Stateless (SLAAC + доп. параметры)
- DHCPv6 Stateful (выдача IPv6-адресов)

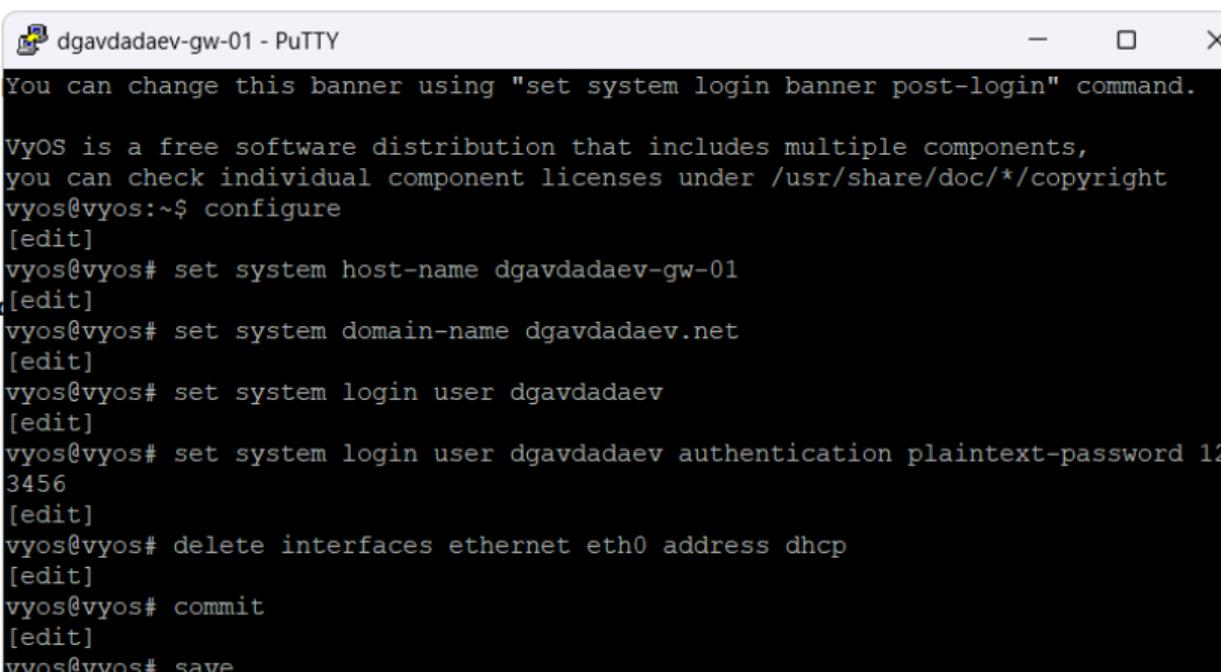
DHCP для IPv4

- Сегмент: PC1 → sw-01 → gw-01
- Шлюз: 10.0.0.1/24
- Клиент получает параметры по DHCP



Базовая настройка VyOS

- Заданы host-name и domain-name
- Создан пользователь dgavdadaev
- Отключён DHCP на eth0

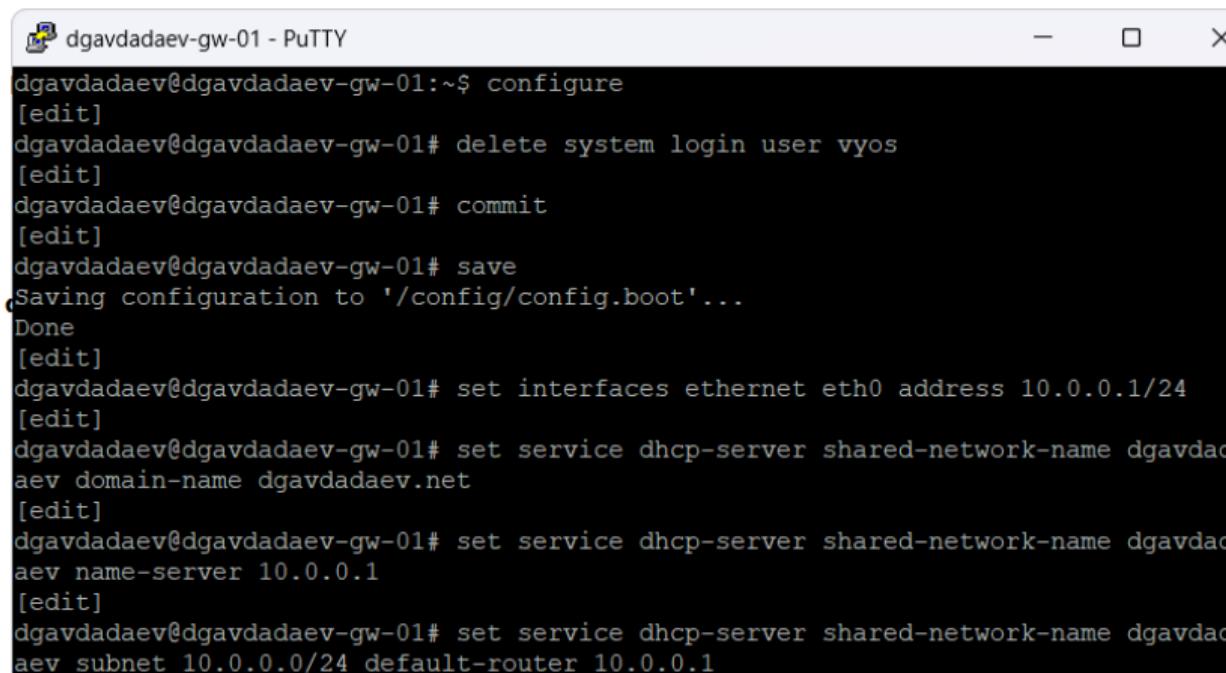


```
You can change this banner using "set system login banner post-login" command.

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 dgavdadaev-gw-01
[edit]
vyos@vyos# set system domain-name dgavdadaev.net
[edit]
vyos@vyos# set system login user dgavdadaev
[edit]
vyos@vyos# set system login user dgavdadaev authentication plaintext-password 12
3456
[edit]
vyos@vyos# delete interfaces ethernet eth0 address dhcp
[edit]
vyos@vyos# commit
[edit]
vyos@vyos# save
```

Адресация и DHCP-сервер (IPv4)

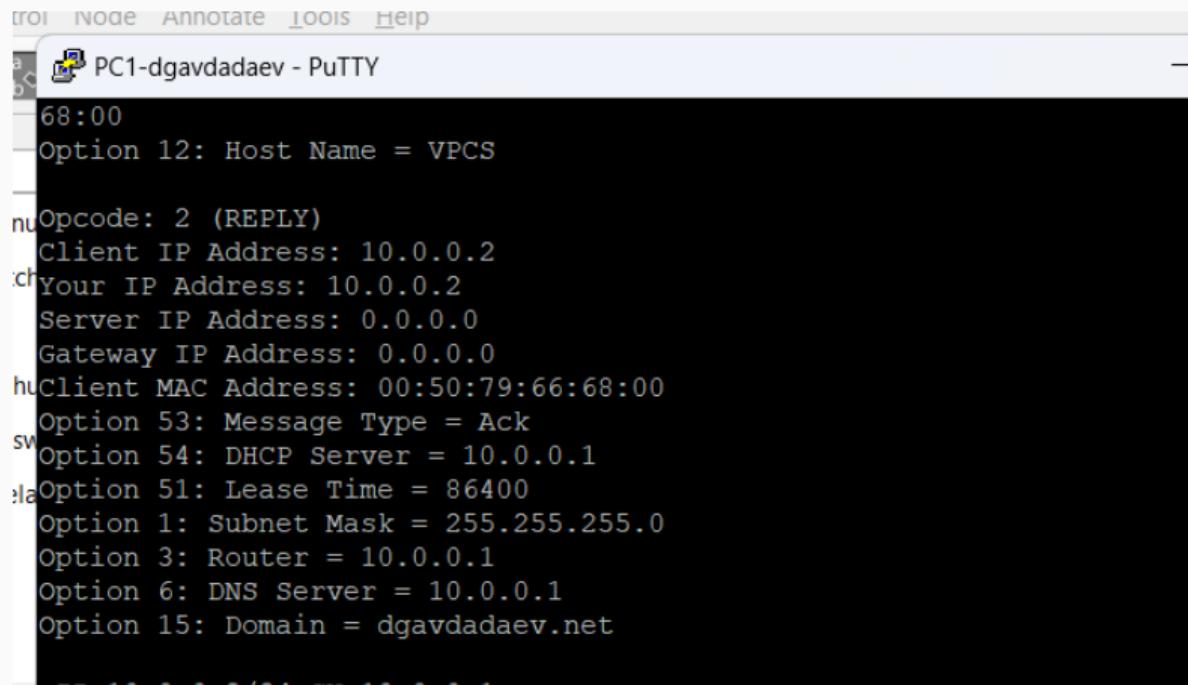
- eth0: 10.0.0.1/24
- Пул: 10.0.0.2–10.0.0.253
- DNS/Router: 10.0.0.1



```
dgavdadaev@dgavdadaev-gw-01:~$ configure
[edit]
dgavdadaev@dgavdadaev-gw-01# delete system login user vyos
[edit]
dgavdadaev@dgavdadaev-gw-01# commit
[edit]
dgavdadaev@dgavdadaev-gw-01# save
Saving configuration to '/config/config.boot'...
Done
[edit]
dgavdadaev@dgavdadaev-gw-01# set interfaces ethernet eth0 address 10.0.0.1/24
[edit]
dgavdadaev@dgavdadaev-gw-01# set service dhcp-server shared-network-name dgavdadaev domain-name dgavdadaev.net
[edit]
dgavdadaev@dgavdadaev-gw-01# set service dhcp-server shared-network-name dgavdadaev name-server 10.0.0.1
[edit]
dgavdadaev@dgavdadaev-gw-01# set service dhcp-server shared-network-name dgavdadaev subnet 10.0.0.0/24 default-router 10.0.0.1
```

Получение параметров на PC1 (DHCP)

- Назначен IP: 10.0.0.2/24
- Lease Time: 86400 секунд
- Выданы: DNS, шлюз, домен

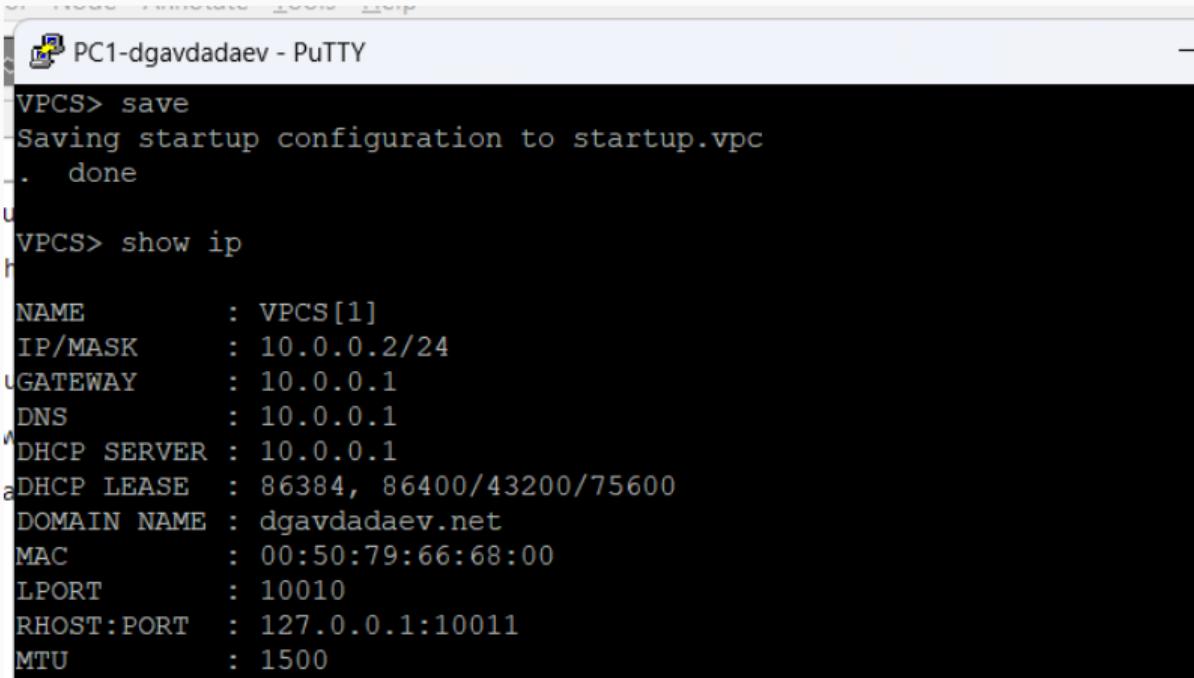


The screenshot shows a PuTTY terminal window titled "PC1-dgavdadaev - PuTTY". The terminal displays a DHCP reply message. The message includes the following details:

- 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 = dgavdadaev.net

Проверка конфигурации и связности

- show ip подтверждает параметры
- Шлюз: 10.0.0.1
- ping 10.0.0.1 успешен



```
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  : 86384, 86400/43200/75600
DOMAIN NAME : dgavdadaev.net
MAC        : 00:50:79:66:68:00
LPORT      : 10010
RHOST:PORT : 127.0.0.1:10011
MTU        : 1500
```

DHCP-статистика и аренды (VyOS)

- Pool size: 252
- Active leases: 1
- Клиент: 10.0.0.2 (VPCS)

```
exit
dgavdadaev@dgavdadaev-gw-01:~$ show dhcp server statistics
Pool      Size   Leases   Available   Usage
-----  -----  -----  -----  -----
dgavdadaev    252       1        251   0%
dgavdadaev@dgavdadaev-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   2025/12/20 07:27:51   2025/12/21 07:27
:51 23:58:45      dgavdadaev  VPCS
dgavdadaev@dgavdadaev-gw-01:~$
```

Рис. 6: Статистика DHCP-сервера и активные аренды

Лог DHCP-сервера

- Discover → Offer
- Request → ACK
- Назначение адреса подтверждено

```
Dec 20 07:26:53 dhcpcd[3014]: 
Dec 20 07:26:53 dhcpcd[3014]: Server starting service.
Dec 20 07:27:47 dhcpcd[3014]: DHCPDISCOVER from 00:50:79:66:68:00 via eth0
Dec 20 07:27:48 dhcpcd[3014]: DHCPOFFER on 10.0.0.2 to 00:50:79:66:68:00 (VPCS) v
ia eth0
Dec 20 07:27:51 dhcpcd[3014]: DHCPREQUEST for 10.0.0.2 (10.0.0.1) from 00:50:79:6
6:68:00 (VPCS) via eth0
Dec 20 07:27:51 dhcpcd[3014]: DHCPACK on 10.0.0.2 to 00:50:79:66:68:00 (VPCS) via
eth0
Dec 20 07:29:02 sudo[3107]: dgavdadaev : TTY=ttyS0 ; PWD=/home/dgavdadaev ; USER
=root ; COMMAND=/usr/libexec/vyos/op_mode/show_dhcp.py --statistics
Dec 20 07:29:05 sudo[3151]: dgavdadaev : TTY=ttyS0 ; PWD=/home/dgavdadaev ; USER
=root ; COMMAND=/usr/libexec/vyos/op_mode/show_dhcp.py --leases
dgavdadaev@dgavdadaev-gw-01:~$
```

Рис. 7: Журнал работы DHCP-сервера

Анализ DHCP-трафика (Wireshark)

- Последовательность DORA
- Опции: mask/router/DNS/domain/lease
- Корректная выдача параметров

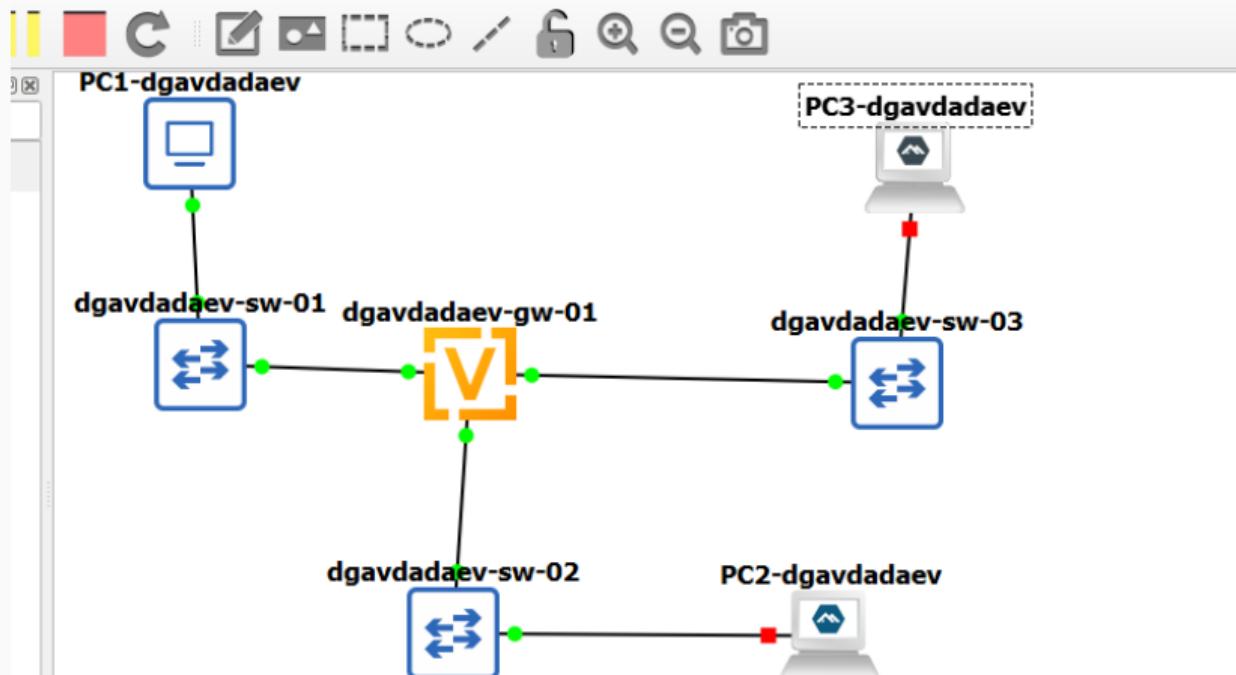
| dhcp | | | | | | |
|------|-----------|----------|-----------------|----------|--------|---|
| No. | Time | Source | Destination | Protocol | Length | Info |
| 2 | 11.103117 | 0.0.0.0 | 255.255.255.255 | DHCP | 406 | DHCP Discover - Transaction ID 0xc0fd3851 |
| 4 | 12.103385 | 0.0.0.0 | 255.255.255.255 | DHCP | 406 | DHCP Discover - Transaction ID 0xc0fd3851 |
| 5 | 12.127295 | 10.0.0.1 | 10.0.0.2 | DHCP | 342 | DHCP Offer - Transaction ID 0xc0fd3851 |
| 8 | 15.104100 | 0.0.0.0 | 255.255.255.255 | DHCP | 406 | DHCP Request - Transaction ID 0xc0fd3851 |
| 9 | 15.119353 | 10.0.0.1 | 10.0.0.2 | DHCP | 342 | DHCP ACK - Transaction ID 0xc0fd3851 |


```
[Stream index: 1]
[Stream Packet Number: 1]
> [Timestamps]
  UDP payload (300 bytes)
  ✓ Dynamic Host Configuration Protocol (Offer)
    Message type: Boot Reply (2)
    Hardware type: Ethernet (0x01)
    Hardware address length: 6
    Hops: 0
    Transaction ID: 0xc0fd3851
    Seconds elapsed: 0
    > Bootp flags: 0x0000 (Unicast)
      Client IP address: 0.0.0.0
      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 (Offer)
      > Option: (54) DHCP Server Identifier (10.0.0.1)
```

DHCPv6 Stateless

Расширенная топология для IPv6

- Добавлены сегменты через sw-02 и sw-03
- Клиенты: PC2 и PC3 (Kali Linux CLI)
- Захват трафика на линиях gw-01—sw-02 и gw-01—sw-03



IPv6-адресация интерфейсов VyOS

- eth1: 2000::1/64
- eth2: 2001::1/64
- Проверка через show interfaces

The screenshot shows a PuTTY terminal window titled "dgavdadaev-gw-01 - PuTTY". The session log displays the following commands:

```
esdgavdadaev@dgavdadaev-gw-01:~$ configuire
      Invalid command: [configuire]
Mdgavdadaev@dgavdadaev-gw-01:~$ con
  configure connect
>u dgavdadaev@dgavdadaev-gw-01:~$ configure
[edit]
dgavdadaev@dgavdadaev-gw-01# set interfaces ethernet eth1 address 2000::1/64
[edit]
dgavdadaev@dgavdadaev-gw-01# set interfaces ethernet eth2 address 2001::1/64
[edit]
Rdgavdadaev@dgavdadaev-gw-01# show interfaces
  ethernet eth0 {
    address 10.0.0.1/24
    hw-id 0c:6e:7f:a7:00:00
  }
O  ethernet eth1 {
+    address 2000::1/64
    hw-id 0c:6e:7f:a7:00:01
}
```

Stateless: RA + DHCPv6 (настройка)

- RA prefix 2000::/64 (eth1)
- other-config-flag: доп. параметры через DHCPv6
- DHCPv6: DNS 2000::1 и domain-search

```
[edit]
sdgavdadaev@dgavdadaev-gw-01#
[edit]
dgavdadaev@dgavdadaev-gw-01# set service router-advert interface eth1 prefix 200
0::/64
[edit]
dgavdadaev@dgavdadaev-gw-01# set service router-advert interface eth1 other-conf
ig-flag
[edit]
dgavdadaev@dgavdadaev-gw-01# set service dhcipv6-server shared-network-name dgavd
adaev-stateless
[edit]
dgavdadaev@dgavdadaev-gw-01# set service dhcipv6-server shared-network-name dgavd
adaev-stateless subnet 2000::0/64
[edit]
dgavdadaev@dgavdadaev-gw-01# set service dhcipv6-server shared-network-name dgavd
adaev-stateless common-options name-server 2000::1
[edit]
dgavdadaev@dgavdadaev-gw-01# set service dhcipv6-server shared-network-name dgavd
adaev-stateless common-options domain-search dgavdadaev.net
[edit]
```

Stateless: проверка конфигурации (VyOS)

- В конфигурации присутствуют dhcpcv6-server и router-advert
- Shared-network-name: dgavdadaev-stateless
- Передаются общие опции (DNS, domain-search)

```
domain-name dgavdadaev.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
    }
}
dhcpcv6-server {
    shared-network-name dgavdadaev-stateless {
        common-options {
            domain-search dgavdadaev.net
            name-server 2000::1
        }
        subnet 2000::0/64 {
        }
    }
}
```

PC2: IPv6-автоконфигурация (SLAAC)

- Получен глобальный адрес из 2000::/64
- Есть link-local fe80::/64
- Маршрут по умолчанию через RA

```
PC2-dgavdadaev - PuTTY
You can setup the system with the command: setup-alpine
L
You may change this message by editing /etc/motd.
W
alpine:~# ip address
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
    R    inet6 ::1/128 scope host
        valid_lft forever preferred_lft forever
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP qlen 1000
    link/ether 0c:27:3d:56:00:00 brd ff:ff:ff:ff:ff:ff
    inet6 2000::e27:3dff:fe56:0/64 scope global dynamic flags 100
        valid_lft 2591984sec preferred_lft 14384sec
    inet6 fe80::e27:3dff:fe56:0/64 scope link
        valid_lft forever preferred_lft forever
alpine:~# ip -6 route show
2000::/64 dev eth0 metric 256 expires 0sec
5: 2000::/64 dev eth0 metric 256 expires 0sec
```

PC2: проверка связности

- ping 2000::1 успешен
- Подтверждена работа RA/SLAAC
- Доступность шлюза обеспечена

```
alpine:~#  
alpine:~# ping 2000::1 -c 2  
PING 2000::1 (2000::1): 56 data bytes  
64 bytes from 2000::1: seq=0 ttl=64 time=3.052 ms  
64 bytes from 2000::1: seq=1 ttl=64 time=1.964 ms  
  
--- 2000::1 ping statistics ---  
2 packets transmitted, 2 packets received, 0% packet loss  
round-trip min/avg/max = 1.964/2.508/3.052 ms  
alpine:~# cat /etc/resolv.conf  
nameserver 10.0.2.3  
alpine:~#
```

Рис. 14: Ping 2000::1 с PC2

PC2: DNS-параметры (Stateless)

- До DHCPv6: DNS может быть отсутствующим/дефолтным
- После запроса: применяется DNS из DHCPv6
- Проверка через /etc/resolv.conf

```
alpine:~# udhcpc6 -i eth0
udhcpc6: started, v1.36.1
wiudhcpc6: sending discover
udhcpc6: sending select
udhcpc6: no IAADDR option, ignoring packet
ietudhcpc6: sending select
ietudhcpc6: sending select
ietudhcpc6: sending select
.Rudhcpc6: sending select
udhcpc failed to get a DHCP lease

udhcpc6: sending discover
udhcpc6: sending select
udhcpc6: no IAADDR option, ignoring packet
udhcpc6: sending select
udhcpc6: sending select
udhcpc6: sending select
^C
alpine:~# ping 2000::1 -c 2
PING 2000::1 (2000::1): 56 data bytes
64 bytes from 2000::1: seq=0 ttl=64 time=1.808 ms
64 bytes from 2000::1: seq=1 ttl=64 time=0.277 ms
```

Stateless: аренды DHCPv6 на VyOS

- Таблица leases без выданных IPv6-адресов
- Stateless не распределяет адреса
- DHCPv6 используется для «неадресных» параметров

```
[edit]
dgavdadaev@dgavdadaev-gw-01# run show dhcpv6 server leases
IPv6 address      State      Last communication      Lease expiration      Remaining
Type    Pool      IAID_DUID
-----  -----  -----
[edit]
dgavdadaev@dgavdadaev-gw-01# [REDACTED]
IS3 management console.
```

Рис. 16: DHCPv6 leases (Stateless)

Stateless: анализ трафика (Wireshark)

- Solicit/Reply для параметров
- IAADDR отсутствует (адрес не выдаётся)
- Адрес формируется по SLAAC

| No. | Time | Source | Destination | Protocol | Length | Info |
|-----|-----------|------------------------|------------------------|----------|--------|---|
| 22 | 66.651887 | fe80::e6e:7fff:fea7... | fe80::e27:3dff:fe56... | ICMPv6 | 78 | Neighbor Advertisement fe80::e6e:7fff:fea7:1 (rtr, s) |
| 23 | 71.881880 | fe80::e6e:7fff:fea7... | fe80::e27:3dff:fe56... | ICMPv6 | 86 | Neighbor Solicitation for fe80::e27:3dff:fe56:0 from |
| 24 | 71.882695 | fe80::e27:3dff:fe56... | fe80::e6e:7fff:fea7... | ICMPv6 | 78 | Neighbor Advertisement fe80::e27:3dff:fe56:0 (sol) |
| 25 | 90.640951 | fe80::e27:3dff:fe56... | ff02::1:2 | DHCPv6 | 116 | Solicit XID: 0x6d9a22 [ROOT-ONLY DOMAIN NAME]CID: 0 |
| 26 | 90.651281 | fe80::e6e:7fff:fea7... | fe80::e27:3dff:fe56... | ICMPv6 | 162 | Advertise XID: 0x6d9a22 CID: 000300010c273d560000 |
| 27 | 90.651973 | fe80::e27:3dff:fe56... | fe80::e6e:7fff:fea7... | ICMPv6 | 210 | Destination Unreachable (Port unreachable) |
| 28 | 90.760398 | fe80::e27:3dff:fe56... | ff02::1:2 | DHCPv6 | 134 | Request XID: 0x6d9a22 [ROOT-ONLY DOMAIN NAME]CID: 0 |
| 29 | 90.764693 | fe80::e6e:7fff:fea7... | fe80::e27:3dff:fe56... | DHCPv6 | 162 | Reply XID: 0x6d9a22 CID: 000300010c273d560000 |
| 30 | 90.766209 | fe80::e27:3dff:fe56... | fe80::e6e:7fff:fea7... | ICMPv6 | 210 | Destination Unreachable (Port unreachable) |
| 31 | 93.850864 | fe80::e27:3dff:fe56... | ff02::1:2 | DHCPv6 | 182 | Request XID: 0x6d9a22 [ROOT-ONLY DOMAIN NAME]CID: 0 |
| 32 | 93.852489 | fe80::e6e:7fff:fea7... | fe80::e27:3dff:fe56... | DHCPv6 | 162 | Reply XID: 0x6d9a22 CID: 000300010c273d560000 |
| 33 | 93.853109 | fe80::e27:3dff:fe56... | fe80::e6e:7fff:fea7... | ICMPv6 | 210 | Destination Unreachable (Port unreachable) |
| 34 | 96.910394 | fe80::e27:3dff:fe56... | ff02::1:2 | DHCPv6 | 182 | Request XID: 0x6d9a22 [ROOT-ONLY DOMAIN NAME]CID: 0 |
| 35 | 96.912111 | fe80::e6e:7fff:fea7... | fe80::e27:3dff:fe56... | DHCPv6 | 162 | Reply XID: 0x6d9a22 CID: 000300010c273d560000 |
| 36 | 96.912441 | fe80::e27:3dff:fe56... | fe80::e6e:7fff:fea7... | ICMPv6 | 210 | Destination Unreachable (Port unreachable) |

```
Status Code: NoAddrAvail (2)
Status Message: No addresses available for this interface.

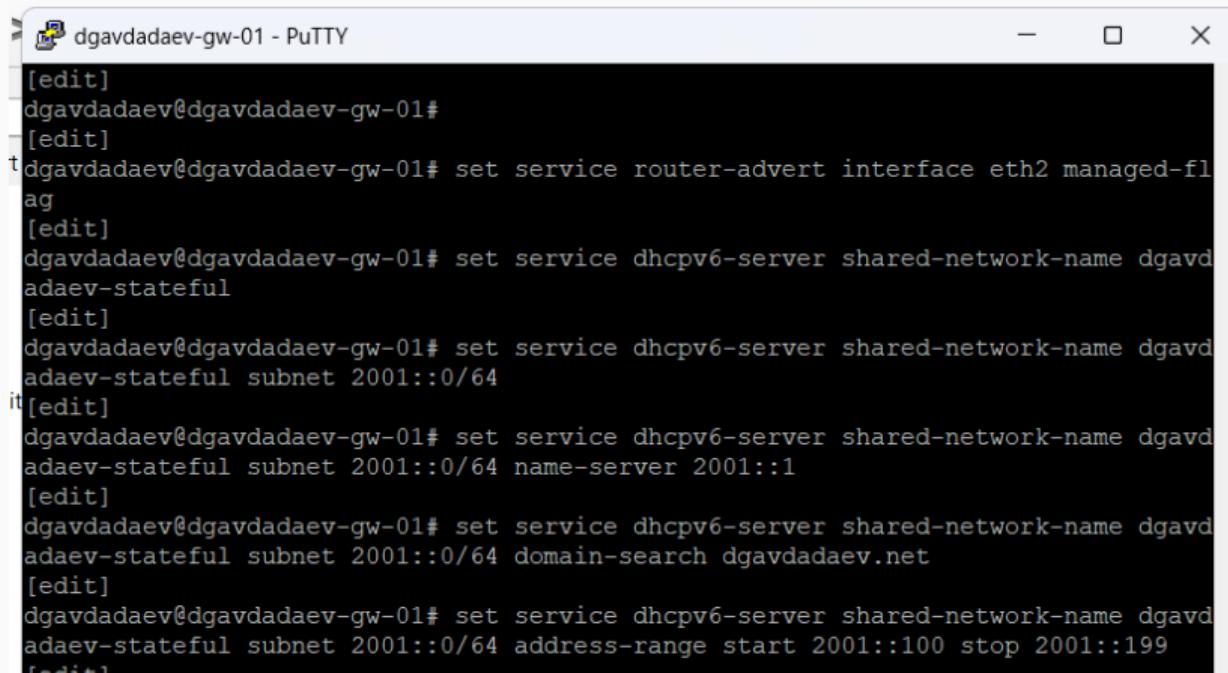
Client Identifier
  Option: Client Identifier (1)
  Length: 10
  DUID: 000300010c273d560000
  DUID Type: link-layer address (3)
  Hardware type: Ethernet (1)
  Link-layer address: 0c:27:3d:56:00:00
  Link-layer address (Ethernet): 0c:27:3d:56:00:00 (0c:27:3d:56:00:00)

Server Identifier
  Option: Server Identifier (2)
```

DHCPv6 Stateful

Stateful: настройка RA и DHCPv6 (eth2)

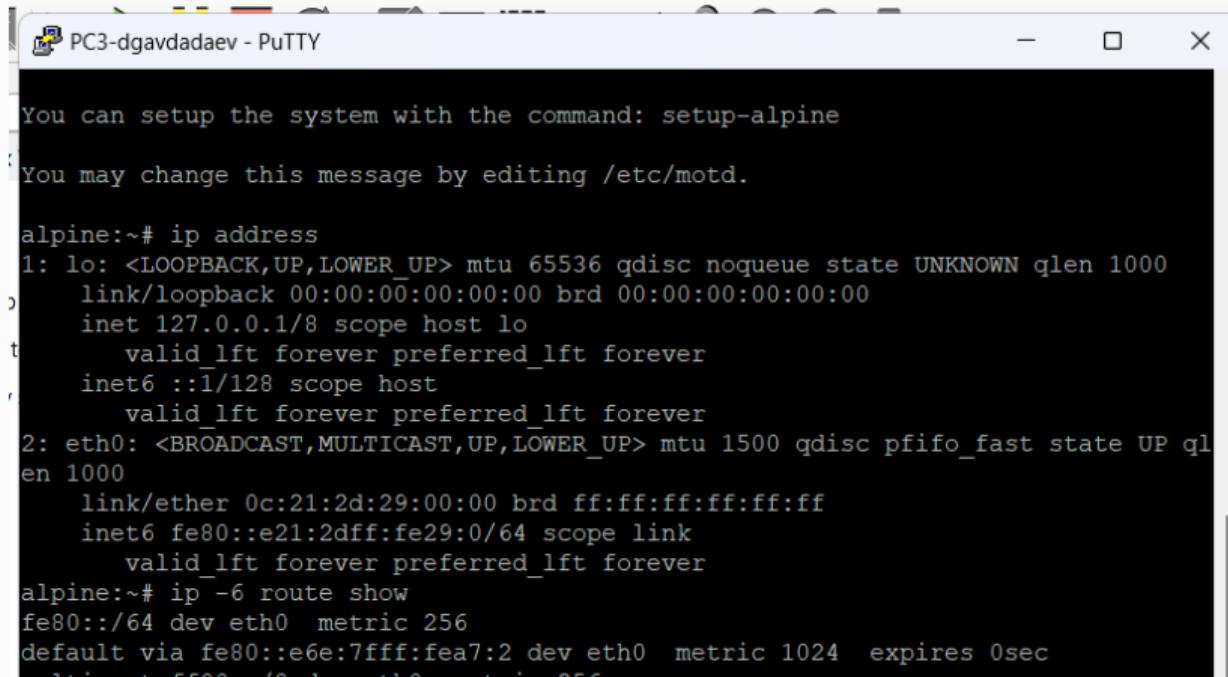
- managed-flag: адрес через DHCPv6
- Пул: 2001::100–2001::199
- DNS: 2001::1, domain-search: dgavdadaev.net



```
[edit]
dgavdadaev@gavdadaev-gw-01#
[edit]
dgavdadaev@gavdadaev-gw-01# set service router-advert interface eth2 managed-flag
[edit]
dgavdadaev@gavdadaev-gw-01# set service dhcpcv6-server shared-network-name dgavdadaev-stateful
[edit]
dgavdadaev@gavdadaev-gw-01# set service dhcpcv6-server shared-network-name dgavdadaev-stateful subnet 2001::0/64
[edit]
dgavdadaev@gavdadaev-gw-01# set service dhcpcv6-server shared-network-name dgavdadaev-stateful subnet 2001::0/64 name-server 2001::1
[edit]
dgavdadaev@gavdadaev-gw-01# set service dhcpcv6-server shared-network-name dgavdadaev-stateful subnet 2001::0/64 domain-search dgavdadaev.net
[edit]
dgavdadaev@gavdadaev-gw-01# set service dhcpcv6-server shared-network-name dgavdadaev-stateful subnet 2001::0/64 address-range start 2001::100 stop 2001::199
[edit]
```

Stateful: аренды DHCPv6 на VyOS

- Появляются активные leases
- Видны IAID/DUID клиента
- Адрес из диапазона 2001::100–2001::199



```
You can setup the system with the command: setup-alpine
You may change this message by editing /etc/motd.

alpine:~# ip address
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
        valid_lft forever preferred_lft forever
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP qlen 1000
    link/ether 0c:21:2d:29:00:00 brd ff:ff:ff:ff:ff:ff
    inet6 fe80::e21:2dff:fe29:0/64 scope link
        valid_lft forever preferred_lft forever
alpine:~# ip -6 route show
fe80::/64 dev eth0 metric 256
default via fe80::e6e:7fff:fea7:2 dev eth0 metric 1024 expires 0sec
    linklayer 5520 (S) linklayer 256
```

PC3: состояние до DHCPv6

- Присутствует link-local адрес
- Маршрут по умолчанию через RA
- DNS ещё не задан по IPv6

```
alpine:~# udhcpc6 -i eth0
ubudhcpc6: started, v1.36.1
udhcpc6: sending discover
vitudhcpc6: sending select
ayudhcpc6: IPv6 obtained, lease time 43200
alpine:~# ip address
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
        valid_lft forever preferred_lft forever
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP qlen 1000
    link/ether 0c:21:2d:29:00:00 brd ff:ff:ff:ff:ff:ff
    inet6 fe80::e21:2dff:fe29:0/64 scope link
        valid_lft forever preferred_lft forever
alpine:~#
```

Рис. 20: IPv6 и маршруты на PC3 до DHCPv6

PC3: получение IPv6 по DHCPv6

- DHCPv6-клиент получает IPv6-адрес
- Адрес относится к 2001::/64
- Процедура выдачи завершена успешно

```
alpine:~# ip -6 route show
fe80::/64 dev eth0 metric 256
    default via fe80::e6e:7fff:fea7:2 dev eth0 metric 1024 expires 0sec
    multicast ff00::/8 dev eth0 metric 256
alpine:~# cat /etc/resolv.conf
search dgavdadaev.net
nameserver 2001:0000:0000:0000:0000:0000:0001
alpine:~# ping 2001::1 -c 2
PING 2001::1 (2001::1): 56 data bytes
64 bytes from 2001::1: seq=0 ttl=64 time=1.402 ms
64 bytes from 2001::1: seq=1 ttl=64 time=3.708 ms

--- 2001::1 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 1.402/2.555/3.708 ms
alpine:~#
```

Рис. 21: Получение IPv6 по DHCPv6 на PC3

PC3: проверка после DHCPv6

- ping 2001::1 успешен
- DNS и search применены
- Маршрутизация корректна

```
[edit]
dgavdadaev@dgavdadaev-gw-01# run show dhcpv6 server leases
IPv6 address      State      Last communication      Lease expiration      Remaining
Type      Pool      IAID_DUID
p-----[edit]
Hdgavdadaev@dgavdadaev-gw-01# run show dhcpv6 server leases
DIPv6 address      State      Last communication      Lease expiration      Remaining
D Type      Pool      IAID_DUID
-----[edit]
a2001::199      active      2025/12/20 07:47:10      2025/12/20 19:47:10      11:59:02
non-temporary      dgavdadaev-stateful      05:6e:f2:a9:00:03:00:01:0c:21:2d:29:00:00
w[edit]
0dgavdadaev@dgavdadaev-gw-01#
```

Рис. 22: Проверка IPv6/DNS на PC3

Stateful: анализ трафика (Wireshark)

- Solicit → Advertise → Request → Reply
- В Reply присутствует IA_NA (выдача адреса)
- Передаются DNS-параметры сервера

| No. | Time | Source | Destination | Protocol | Length | Info |
|-----|----------|------------------------|------------------------|----------|--------|---|
| 1 | 0.000000 | fe80::e21:2dff:fe29... | ff02::1:2 | DHCPv6 | 116 | Solicit XID: 0x266d1e [ROOT-ONLY DOMAIN NAME] CID: 000 |
| 2 | 0.002259 | fe80::e6e:7fff:fea7... | fe80::e21:2dff:fe29... | DHCPv6 | 182 | Advertise XID: 0x266d1e IAA: 2001::198 CID: 000300010c |
| 3 | 0.004220 | fe80::e21:2dff:fe29... | fe80::e6e:7fff:fea7... | ICMPv6 | 230 | Destination Unreachable (Port unreachable) |
| 4 | 0.119415 | fe80::e21:2dff:fe29... | ff02::1:2 | DHCPv6 | 134 | Request XID: 0x266d1e [ROOT-ONLY DOMAIN NAME] CID: 000 |
| 5 | 0.120812 | fe80::e6e:7fff:fea7... | fe80::e21:2dff:fe29... | DHCPv6 | 182 | Reply XID: 0x266d1e IAA: 2001::193 CID: 000300010c212d |
| 6 | 0.121169 | fe80::e21:2dff:fe29... | fe80::e6e:7fff:fea7... | ICMPv6 | 230 | Destination Unreachable (Port unreachable) |
| 7 | 5.125024 | fe80::e6e:7fff:fea7... | fe80::e21:2dff:fe29... | ICMPv6 | 86 | Neighbor Solicitation for fe80::e21:2dff:fe29:0 from 0 |
| 8 | 5.125945 | fe80::e21:2dff:fe29... | fe80::e6e:7fff:fea7... | ICMPv6 | 78 | Neighbor Advertisement fe80::e21:2dff:fe29:0 (sol) |
| 9 | 6.560167 | fe80::e21:2dff:fe29... | 2001::1 | ICMPv6 | 118 | Echo (ping) request id=0x06cf, seq=0, hop limit=64 (req |
| 10 | 6.561032 | 2001::1 | fe80::e21:2dff:fe29... | ICMPv6 | 118 | Echo (ping) reply id=0x06cf, seq=0, hop limit=64 (requ |
| 11 | 7.561271 | fe80::e21:2dff:fe29... | 2001::1 | ICMPv6 | 118 | Echo (ping) request id=0x06cf, seq=1, hop limit=64 (req |
| 12 | 7.562949 | 2001::1 | fe80::e21:2dff:fe29... | ICMPv6 | 118 | Echo (ping) reply id=0x06cf, seq=1, hop limit=64 (requ |

```
> Frame 5: 182 bytes on wire (1456 bits), 182 bytes captured (1456 bits) on interface -, id 0
> Ethernet II, Src: 0c:6e:7f:a7:00:02 (0c:6e:7f:a7:00:02), Dst: 0c:21:2d:29:00:00 (0c:21:2d:29:00:00)
> Internet Protocol Version 6, Src: fe80::e6e:7fff:fea7:2, Dst: fe80::e21:2dff:fe29:0
> User Datagram Protocol, Src Port: 547, Dst Port: 546
<--> DHCPv6
    Message type: Reply (7)
    Transaction ID: 0x266d1e
    <--> Identity Association for Non-temporary Address
    <--> Client Identifier
    <--> Server Identifier
```

Итоги

- DHCP (IPv4) корректно распределяет адреса и параметры сети
- DHCPv6 Stateless: SLAAC выдаёт адрес, DHCPv6 — DNS/домен
- DHCPv6 Stateful: DHCPv6 выдаёт IPv6-адреса и ведёт учёт аренд