

# Лабораторная работа №7

## Дисциплина: Сетевые технологии

Ибрахим Мохсейн Алькамаль

2026-01-31

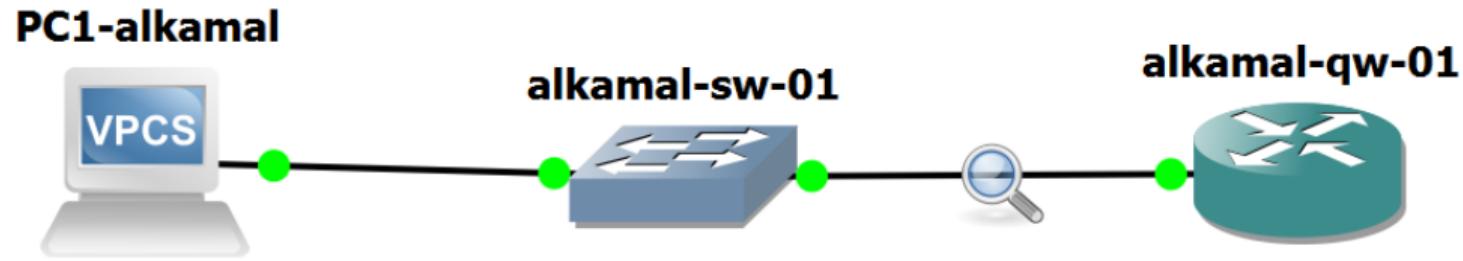
# Содержание I

# 1 Цель работы

- Настройка службы DHCP
- Распределение адресов IPv4 и IPv6
- Анализ DHCP-трафика

## 2 Топология и захват трафика (IPv4 DHCP)

- Переименование устройств по шаблону
- PC1-alkamal, alkamal-sw-01, alkamal-qw-01
- Включён захват трафика между коммутатором и маршрутизатором



### 3 Системные параметры VyOS и пользователи

- Задано имя маршрутизатора
- Настроено доменное имя
- Создан пользователь alkamal
- Удалён пользователь vyos

```
vyos@vyos:~$ configure
[edit]
vyos@vyos# set system host-name alkamal-gw-01
[edit]
vyos@vyos# set system domain-name alkamal.net
[edit]
mal12345s# set system login user alkamal authentication plaintext-password alka
```

```
[edit]
mal12345s# set system login user alkamal authentication plaintext-password alka
[edit]
vyos@vyos# commit
[edit]
vyos@vyos# save
Saving configuration to '/config/config.boot'...
Done
[edit]
vyos@vyos# exit
exit
vyos@vyos:~$ exit
```

## 4 Назначение IPv4-адреса интерфейсу eth0

- Интерфейс eth0
- Адрес: 10 . 0 . 0 . 1 /24
- Маршрутизатор — шлюз по умолчанию

```
[edit]
alkamal@alkamal-gw-01# set interfaces ethernet eth0 address 10.0.0.1/24
[edit]
alkamal@alkamal-gw-01#
```

Рисунок 2: Назначение статического IPv4-адреса 10.0.0.1/24 интерфейсу eth0

## 5 Настройка DHCP-сервера (IPv4)

- Создан shared-network alkamal
- DNS: 10.0.0.1
- Gateway: 10.0.0.1
- Диапазон: 10.0.0.2–10.0.0.253

```
n-name alkamal.net-01# set service dhcp-server shared-network-name alkamal domain
[edit]
server 10.0.0.1-gw-01# set service dhcp-server shared-network-name alkamal name-
[edit]
t 10.0.0.0/24 default-router 10.0.0.1cp-server shared-network-name alkamal subnet
[edit]
t 10.0.0.0/24 range hosts start 10.0.0.2server shared-network-name alkamal subnet
[edit]
t 10.0.0.0/24 range hosts stop 10.0.0.253server shared-network-name alkamal subnet
[edit]
alkamal@alkamal-gw-01# commit
[edit]
alkamal@alkamal-gw-01# save
Saving configuration to '/config/config.boot'...
Done
```

Рисунок 3: Конфигурация DHCP-сервера на маршрутизаторе VyOS для сети 10.0.0.0/24

## 6 Статистика DHCP-сервера (до клиентов)

- Всего адресов: 252
- Активных аренд: 0
- Все адреса доступны

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

```

Рисунок 4: Статистика DHCP-сервера и отсутствие активных аренд IP-адресов

## 7 DHCP-процесс на узле PC1 (Discover / Offer)

- DHCP Discover
- DHCP Offer
- Клиент без IP (0.0.0.0)

```
PC1-alkamal> 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-alkamal
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-alkamal
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
```



## 8 DHCP-процесс на узле PC1 (Request / ACK)

- DHCP Request
- DHCP ACK
- Назначен IP 10.0.0.2/24

```
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
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 = PC1-alkamal

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
```



## 9 Проверка IP и связности PC1

- IP получен по DHCP
- Gateway: 10.0.0.1
- Ping маршрутизатора успешен

```
PC1-alkamal> show ip

NAME          : PC1-alkamal[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    : 85902, 86014/43007/75262
DOMAIN NAME   : alkamal.net
MAC           : 00:50:79:66:68:00
LPORT          : 20004
RHOST:PORT    : 127.0.0.1:20005
MTU           : 1500
```



# 10 DHCP-статистика после выдачи адреса

- Активных аренд: 1
- IP: 10.0.0.2
- Клиент: PC1-alkamal

```
alkamal@alkamal-gw-01:~$ show dhcp server statistics
Pool      Size     Leases     Available     Usage
-----  -----
alkamal    252       0        252   0%
alkamal@alkamal-gw-01:~$ show dhcp server leases
IP address      Hardware address      State      Lease start      Lease expiration      Remaining      Pool      Hostname
-----  -----
alkamal@alkamal-gw-01:~$ show dhcp server statistics
Pool      Size     Leases     Available     Usage
-----  -----
alkamal    252       1        251   0%
alkamal@alkamal-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    2026/01/23 04:25:35  2026/01/24 04:25:35  23:51:03      alkamal      PC1-alkamal
alkamal@alkamal-gw-01:~$
```

Рисунок 8: Статистика DHCP-сервера и информация о выданной аренде на маршрутизаторе

# 11 Журнал DHCP-сервера

- DHCPDISCOVER
- DHCPOFFER
- DHCPREQUEST
- DHCPACK
- Обслуживание клиента PC1

```
alkamal@alkamal-gw-01:~$ show log | grep dhcp
Jan 23 04:13:46 dhclient-script-vyos[1661]: Deleting search domains with tag "dhcp-eth0" via vyos-hostsd-client
Jan 23 04:13:47 vyos-hostsd[608]: Request data: {"type": "search_domains", "op": "delete", "data": ["dhcp-eth0"]}
Jan 23 04:13:47 dhclient-script-vyos[1661]: Deleting nameservers with tag "dhcp-eth0" via vyos-hostsd-client
Jan 23 04:13:48 vyos-hostsd[608]: Request data: {"type": "name_servers", "op": "delete", "data": ["dhcp-eth0"]}
Jan 23 04:13:57 dhclient-script-vyos[1829]: Deleting search domains with tag "dhcp-eth0" via vyos-hostsd-client
Jan 23 04:13:59 vyos-hostsd[608]: Request data: {"type": "search_domains", "op": "delete", "data": ["dhcp-eth0"]}
Jan 23 04:13:59 dhclient-script-vyos[1829]: Deleting nameservers with tag "dhcp-eth0" via vyos-hostsd-client
Jan 23 04:14:00 vyos-hostsd[608]: Request data: {"type": "name_servers", "op": "delete", "data": ["dhcp-eth0"]}
Jan 23 04:14:11 dhclient-script-vyos[2028]: Deleting search domains with tag "dhcp-eth0" via vyos-hostsd-client
Jan 23 04:14:13 vyos-hostsd[608]: Request data: {"type": "search_domains", "op": "delete", "data": ["dhcp-eth0"]}
Jan 23 04:14:13 dhclient-script-vyos[2028]: Deleting nameservers with tag "dhcp-eth0" via vyos-hostsd-client
Jan 23 04:14:14 vyos-hostsd[608]: Request data: {"type": "name_servers", "op": "delete", "data": ["dhcp-eth0"]}
Jan 23 04:14:24 dhclient-script-vyos[2208]: Deleting search domains with tag "dhcp-eth0" via vyos-hostsd-client
Jan 23 04:14:24 vyos-hostsd[608]: Request data: {"type": "search_domains", "op": "delete", "data": ["dhcp-eth0"]}
Jan 23 04:14:24 dhclient-script-vyos[2208]: Deleting nameservers with tag "dhcp-eth0" via vyos-hostsd-client
Jan 23 04:14:25 vyos-hostsd[608]: Request data: {"type": "name_servers", "op": "delete", "data": ["dhcp-eth0"]}
Jan 23 04:14:28 dhclient-script-vyos[2301]: Deleting search domains with tag "dhcp-eth0" via vyos-hostsd-client
Jan 23 04:14:29 vyos-hostsd[608]: Request data: {"type": "search_domains", "op": "delete", "data": ["dhcp-eth0"]}
Jan 23 04:14:29 dhclient-script-vyos[2301]: Deleting nameservers with tag "dhcp-eth0" via vyos-hostsd-client
Jan 23 04:14:30 vyos-hostsd[608]: Request data: {"type": "name_servers", "op": "delete", "data": ["dhcp-eth0"]}
Jan 23 04:14:34 dhclient-script-vyos[2394]: Deleting search domains with tag "dhcp-eth0" via vyos-hostsd-client
```



# 12 Анализ DHCP-трафика (IPv4)

- Discover → Offer → Request → ACK
- ARP и Gratuitous ARP
- ICMP Echo

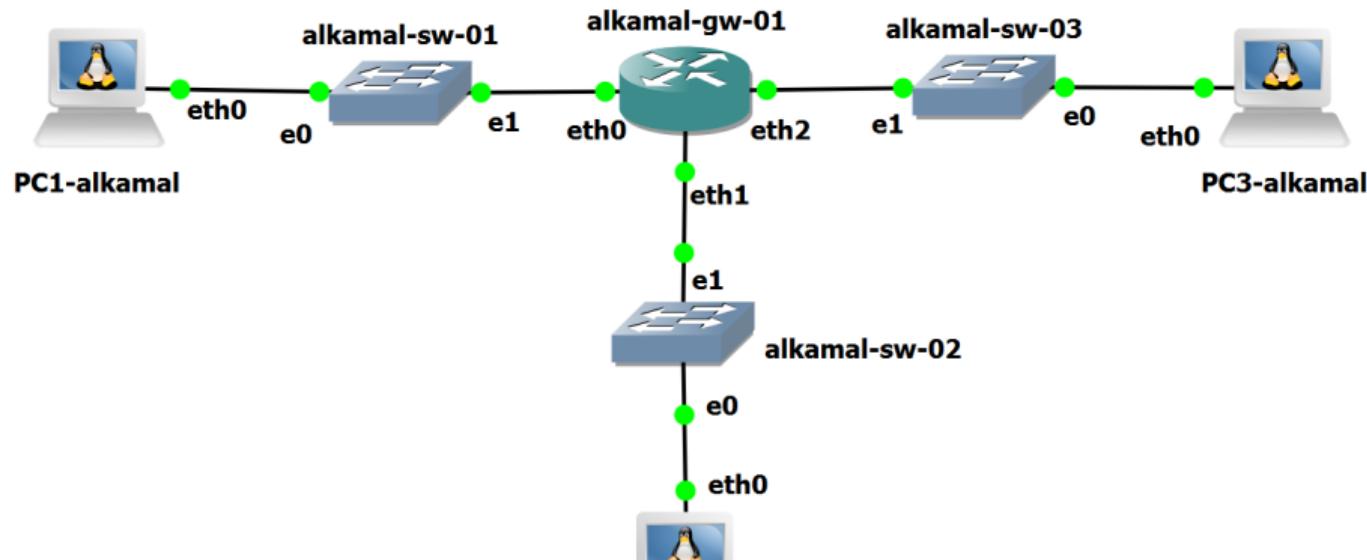
No.	Time	Source	Destination	Protocol	Length	Info
1	0... 0.0.0		255.255.255.255	DHCP	406	DHCP Discover - Transaction ID 0x3b2ecc50
2	0:42:84:74:00:00	00:42:84:74:00:00	Broadcast	ARP	68	who has 10.0.0.2? Tell 10.0.0.1
3	0.0.0.0		255.255.255.255	DHCP	406	DHCP Discover - Transaction ID 0x3b2ecc50
4	1... 10.0.0.1		10.0.0.2	DHCP	342	DHCP Offer - Transaction ID 0x3b2ecc50
5	1:42:84:74:00:00	00:42:84:74:00:00	Broadcast	ARP	68	who has 10.0.0.2? Tell 10.0.0.1
6	2... 0.0.0.0		255.255.255.255	ARP	68	who has 10.0.0.2? Tell 10.0.0.1
7	4:42:84:74:00:00	00:42:84:74:00:00	Broadcast	DHCP	406	DHCP Request - Transaction ID 0x3b2ecc50
8	4.0.0.0		10.0.0.2	DHCP	342	DHCP ACK - Transaction ID 0x3b2ecc50
9	5... Private_66:68:00		Broadcast	ARP	64	Gratuitous ARP for 10.0.0.2 (Request)
10	6... Private_66:68:00		Broadcast	ARP	64	Gratuitous ARP for 10.0.0.2 (Request)
11	7... Private_66:68:00		Broadcast	ARP	64	Gratuitous ARP for 10.0.0.2 (Request)
12	-1. 0.0.0.0		255.255.255.255	DHCP	406	DHCP Request - Transaction ID 0xa2c9fd02
13	-1. 10.0.0.1		10.0.0.2	DHCP	342	DHCP ACK - Transaction ID 0xa2c9fd02
14	10. Private_66:68:00		Broadcast	ARP	68	who has 10.0.0.1? Tell 10.0.0.2
15	10:42:84:74:00:00	00:42:84:74:00:00	Private_66:68:00	ARP	68	10.0.0.1 is at 0c:42:84:74:00:00
16	10.0.0.2		10.0.0.1	ICMP	98	Echo (ping) request id=0xa7f8, seq=1/256, ttl=64 (reply in 17)
17	10.0.0.1		10.0.0.2	ICMP	98	Echo (ping) reply id=0xa7f8, seq=1/256, ttl=64 (request in 16)
18	10.0.0.2		10.0.0.1	ICMP	98	Echo (ping) request id=0xa8f8, seq=2/512, ttl=64 (reply in 19)
19	10.0.0.1		10.0.0.2	ICMP	98	Echo (ping) reply id=0xa8f8, seq=2/512, ttl=64 (request in 18)
20	11:42:84:74:00:00	00:42:84:74:00:00	Private_66:68:00	ARP	68	who has 10.0.0.2? Tell 10.0.0.1
21	11. Private_66:68:00		00:42:84:74:00:00	ARP	68	10.0.0.2 is at 00:50:79:66:68:00

```
> Frame 1: Packet, 406 bytes on wire (3248 bits), 406 bytes captured (3248 bits) on interface -, id 0
> Ethernet II, Src: Private_66:68:00 (00:50:79:66:68:00), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
> Internet Protocol Version 4, Src Port: 0.0.0.0, Dst Port: 67
> User Datagram Protocol, Src Port: 68, Dst Port: 67
> Dynamic Host Configuration Protocol (Discover)
```

0000	ff ff ff ff ff ff	00 50	79 66 68 00 00 45 10	P yfh
0010	01 88 00 00 00 10 11	a9 56 00 00 00 ff ff	V	
0020	ff ff 00 44 00 43 01 74	7e 46 01 01 06 00 3b 2e	D C t -F	
0030	cc 50 00 00 00 00 00 00	00 00 00 00 00 00 00 00	P	
0040	00 00 00 00 00 00 00 00	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		

# 13 IPv6: топология и захват трафика

- Использован Alpine Linux
- Захват ICMPv6 и DHCPv6
- Подсети IPv6



# 14 Системные параметры VyOS (IPv6)

- Имя устройства
- Доменное имя
- Пользователь alkamal

```
vyos@vyos:~$ configure
[edit]
vyos@vyos# set system host-name alkamal-gw-01
[edit]
vyos@vyos# set system domain-name alkamal.net
[edit]
vyos@vyos# set system login user alkamal
[edit]
mal12345s# set system login user alkamal authentication plaintext-password alka
[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 - alkamal-gw-01 ttyS0

alkamal-gw-01 login: alkamal
Password:
```



# 15 Назначение IPv6-адресов интерфейсам

- eth1: 2000 :: 1/64
- eth2: 2001 :: 1/64

```
alkamal@alkamal-gw-01:~$ configure
[edit]
alkamal@alkamal-gw-01# set interfaces ethernet eth1 address 2000::1/64
[edit]
alkamal@alkamal-gw-01# set interfaces ethernet eth2 address 2001::1/64
[edit]
alkamal@alkamal-gw-01# show interfaces
  ethernet eth0 {
    address dhcp
    hw-id 0c:df:93:f5:00:00
  }
  ethernet eth1 {
+    address 2000::1/64
    hw-id 0c:df:93:f5:00:01
  }
  ethernet eth2 {
+    address 2001::1/64
    hw-id 0c:df:93:f5:00:02
  }
```



# 16 Stateless DHCPv6 + Router Advertisement

- SLAAC
- other-config-flag
- DNS и домен по DHCPv6

```
64kamal@alkamal-gw-01# set service router-advert interface eth1 prefix 2000::/
[edit]
akamal@alkamal-gw-01# set service router-advert interface eth1 other-config-fl
[edit]
ateless@alkamal-gw-01# set service dhcpcv6-server shared-network-name alkamal-st
[edit]
ateless@alkamal-gw-01# set service dhcpcv6-server shared-network-name alkamal-st

    Configuration path: [service dhcpcv6-server shared-network-name alkamal-stateless] already exists

[edit]
ateless subnet 2000::0/64 service dhcpcv6-server shared-network-name alkamal-st
[edit]
ateless common-options name-server 2000::1 rver shared-network-name alkamal-st
[edit]
teless common-options domain-search alkamal.net shared-network-name alkamal-sta
[edit]
alkamal@alkamal-gw-01# commit
[edit]
alkamal@alkamal-gw-01# save
Saving configuration to '/config/config.boot'...
Done
```

# 17 Проверка IPv6 на PC2 (Stateless)

- SLAAC-адрес
- Link-local адрес
- Ping успешен

```
/ # 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
9: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UNKNOWN qlen 1000
    link/ether 02:42:9b:bb:db:00 brd ff:ff:ff:ff:ff:ff
    inet6 2000::42:9bff:febb:db00/64 scope global dynamic flags 100
        valid_lft 2591841sec preferred_lft 14241sec
    inet6 fe80::42:9bff:febb:db00/64 scope link
        valid_lft forever preferred_lft forever
/ # ip -6 route show
2000::/64 dev eth0 metric 256 expires 0sec
fe80::/64 dev eth0 metric 256
default via fe80::edf:93ff:fef5:1 dev eth0 metric 1024 expires 0sec
/ # ping 2000::1 -c 2
PING 2000::1 (2000::1): 56 data bytes
64 bytes from 2000::1: seq=0 ttl=64 time=12.583 ms
64 bytes from 2000::1: seq=1 ttl=64 time=4.518 ms

--- 2000::1 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 4.518/8.550/12.583 ms
/ # cat /etc/resolv.conf
/ # udhcpc -i eth0
```



# 18 Анализ IPv6-трафика (Stateless)

- Router Solicitation
- Router Advertisement
- DHCPv6 Solicit / Reply

No.	Time	Source	Destination	Protocol	Length	Info
27	11.. 2000:42:9bff:febb:db00		2000::1:1	ICMPv6	118	Echo (ping) request id=0x013c, seq=1, hop limit=64 (reply in 28)
28	11.. 2000:42:9bff:febb:db00		2000::42:9bff:febb:db00	ICMPv6	118	Echo (ping) reply id=0x013c, seq=1, hop limit=64 (request in 27)
29	11.. fe80::edf:93ff:fe:f5:1		2000::42:9bff:febb:db00	ICMPv6	86	Neighbor Solicitation for 2000::42:9bff:febb:db00 from 0c:df:93:f5:00:01
30	11.. 2000:42:9bff:febb:db00		fe80::edf:93ff:fe:f5:1	ICMPv6	78	Neighbor Advertisement 2000::42:9bff:febb:db00 to 0c:df:93:f5:00:01 (sol)
31	11.. fe80::edf:93ff:febb:db00		fe80::edf:93ff:fe:f5:1	ICMPv6	86	Neighbor Solicitation for fe80::edf:93ff:fe:f5:1 from 02:42:9b:bb:db:00
32	11.. fe80::edf:93ff:febb:db00		fe80::edf:93ff:fe:f5:1	ICMPv6	78	Neighbor Advertisement fe80::edf:93ff:fe:f5:1 (rtr, sol)
33	12.. fe80::edf:93ff:fe:f5:1		fe80::42:9bff:febb:db00	ICMPv6	86	Neighbor Solicitation for fe80::42:9bff:febb:db00 from 0c:df:93:f5:00:01
34	12.. fe80::edf:93ff:febb:db00		fe80::edf:93ff:fe:f5:1	ICMPv6	78	Neighbor Advertisement fe80::42:9bff:febb:db00 (sol)
35	14.. fe80::42:9bff:febb:db00		ff02::1:2	DHC Pv6	116	Solicit XID: 0x81ba6f [ROOT-ONLY DOMAIN NAME] CID: 0003000102429bbdb00
36	14.. fe80::edf:93ff:fe:f5:1		fe80::42:9bff:febb:db00	DHC Pv6	162	Advertise XID: 0x81ba6f CID: 0003000102429bbdb00
37	14.. fe80::42:9bff:febb:db00		fe80::edf:93ff:fe:f5:1	ICMPv6	210	Destination Unreachable (Port unreachable)
38	14.. fe80::42:9bff:febb:db00		ff02::1:2	DHC Pv6	134	Request XID: 0x81ba6f [ROOT-ONLY DOMAIN NAME] CID: 0003000102429bbdb00
39	14.. fe80::edf:93ff:fe:f5:1		fe80::42:9bff:febb:db00	DHC Pv6	162	Reply XID: 0x81ba6f CID: 0003000102429bbdb00
40	14.. fe80::42:9bff:febb:db00		fe80::edf:93ff:fe:f5:1	ICMPv6	210	Destination Unreachable (Port unreachable)
41	14.. fe80::42:9bff:febb:db00		ff02::1:2	DHC Pv6	182	Request XID: 0x81ba6f [ROOT-ONLY DOMAIN NAME] CID: 0003000102429bbdb00
42	14.. fe80::edf:93ff:fe:f5:1		fe80::42:9bff:febb:db00	DHC Pv6	162	Reply XID: 0x81ba6f CID: 0003000102429bbdb00
43	14.. fe80::42:9bff:febb:db00		fe80::edf:93ff:fe:f5:1	ICMPv6	210	Destination Unreachable (Port unreachable)
44	14.. fe80::42:9bff:febb:db00		fe80::edf:93ff:fe:f5:1	ICMPv6	86	Neighbor Solicitation for fe80::edf:93ff:fe:f5:1 from 02:42:9b:bb:db:00
45	14.. fe80::edf:93ff:fe:f5:1		fe80::42:9bff:febb:db00	ICMPv6	78	Neighbor Advertisement fe80::edf:93ff:fe:f5:1 (rtr, sol)
46	14.. fe80::edf:93ff:febb:db00		fe80::42:9bff:febb:db00	ICMPv6	86	Neighbor Solicitation for fe80::42:9bff:febb:db00 from 0c:df:93:f5:00:01
47	14.. fe80::42:9bff:febb:db00		fe80::edf:93ff:fe:f5:1	ICMPv6	78	Neighbor Advertisement fe80::42:9bff:febb:db00 (sol)
48	14.. fe80::42:9bff:febb:db00		ff02::1:2	DHC Pv6	182	Request XID: 0x81ba6f [ROOT-ONLY DOMAIN NAME] CID: 0003000102429bbdb00
49	14.. fe80::edf:93ff:fe:f5:1		fe80::42:9bff:febb:db00	DHC Pv6	162	Reply XID: 0x81ba6f CID: 0003000102429bbdb00
50	14.. fe80::42:9bff:febb:db00		fe80::edf:93ff:fe:f5:1	ICMPv6	210	Destination Unreachable (Port unreachable)
51	14.. fe80::42:9bff:febb:db00		ff02::1:2	DHC Pv6	182	Request XID: 0x81ba6f [ROOT-ONLY DOMAIN NAME] CID: 0003000102429bbdb00
52	14.. fe80::edf:93ff:fe:f5:1		fe80::42:9bff:febb:db00	DHC Pv6	162	Reply XID: 0x81ba6f CID: 0003000102429bbdb00
53	14.. fe80::42:9bff:febb:db00		fe80::edf:93ff:fe:f5:1	ICMPv6	210	Destination Unreachable (Port unreachable)
54	14.. fe80::42:9bff:febb:db00		ff02::1:2	DHC Pv6	182	Request XID: 0x81ba6f [ROOT-ONLY DOMAIN NAME] CID: 0003000102429bbdb00
55	14.. fe80::edf:93ff:fe:f5:1		fe80::42:9bff:febb:db00	DHC Pv6	162	Reply XID: 0x81ba6f CID: 0003000102429bbdb00
56	14.. fe80::42:9bff:febb:db00		fe80::edf:93ff:fe:f5:1	ICMPv6	210	Destination Unreachable (Port unreachable)
57	14.. fe80::42:9bff:febb:db00		ff02::1:2	DHC Pv6	116	Solicit XID: 0x8266e [ROOT-ONLY DOMAIN NAME] CID: 0003000102429bbdb00
58	14.. fe80::edf:93ff:fe:f5:1		fe80::42:9bff:febb:db00	DHC Pv6	162	Advertise XID: 0x8266e CID: 0003000102429bbdb00
59	14.. fe80::42:9bff:febb:db00		fe80::edf:93ff:fe:f5:1	ICMPv6	210	Destination Unreachable (Port unreachable)
60	14.. fe80::42:9bff:febb:db00		ff02::1:2	DHC Pv6	134	Request XID: 0x8266e [ROOT-ONLY DOMAIN NAME] CID: 0003000102429bbdb00

# 19 Настройка Stateful DHCPv6

- managed-flag
- Диапазон: 2001::100–2001::199
- DNS и домен

```
[edit]
atefull@alkamal-gw-01# set service dhcpcv6-server shared-network-name alkamal-st
[edit]
ateful subnet 2001::0/64t service dhcpcv6-server shared-network-name alkamal-st
[edit]
ateful subnet 2001::0/64 name-server 2001::1ver shared-network-name alkamal-st
[edit]
ateful subnet 2001::0/64 domain-search alkamal.nethared-network-name alkamal-st
[edit]
ateful subnet 2001::0/64 address-range start 2001::100 stop 2001::199lcamal-st
[edit]
alkamal@alkamal-gw-01# commit
[edit]
alkamal@alkamal-gw-01# save
Saving configuration to '/config/config.boot'...
Done
[edit]
```

## 20 Получение IPv6-адреса PC3

- До запроса: только link-local
- После udhcpc6: глобальный IPv6

```
alkamal@alkamal-gw-01# run show dhcpcv6 server leases
IPv6 address      State      Last communication      Lease expiration      Remaining      Type      Pool      IAID_DUID
-----[edit]-----[edit]-----[edit]-----[edit]-----[edit]-----[edit]-----[edit]
[edit]
alkamal@alkamal-gw-01# █
```

```
PC3-alkamal console is now available... Press RETURN to get started.
/ # 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
10: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UNKNOWN qlen 1000
    link/ether 02:42:88:32:29:00 brd ff:ff:ff:ff:ff:ff
    inet6 fe80::42:88ff:fe32:2900/64 scope link
        valid_lft forever preferred_lft forever
/ # ip -6 route show
fe80::/64 dev eth0  metric 256
/ # cat /etc/resolv.conf
```

## 21 Проверка IPv6 PC3 после DHCPv6

- Глобальный IPv6
- Default route
- DNS получен

```
/ # 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
10: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UNKNOWN qlen 1000
    link/ether 02:42:88:32:29:00 brd ff:ff:ff:ff:ff:ff
        inet6 fe80::42:88ff:fe32:2900/64 scope link
            valid_lft forever preferred_lft forever
/ # ip -6 route show
fe80::/64 dev eth0 metric 256
/ # ping 2001::1 -c 2
PING 2001::1 (2001::1): 56 data bytes
ping: sendto: Network unreachable
/ # cat /etc/resolv.conf
search alkamal.net
nameserver 2001:0000:0000:0000:0000:0000:0001
/ #
```

alkamal@alkamal-gw-01:~\$ show dhcp server leases

# 22 Анализ DHCPv6 Stateful-трафика

- RA с managed-flag
- Solicit → Advertise → Request → Reply
- Адрес успешно выдан

No.	Time	Source	Destination	Protocol	Length	Info
1	0..	fe80::42:8bff:fe32:2900	ff02::2	ICMPv6	70	Router Solicitation from 02:42:88:32:29:00
2	94..	fe80::edf:93ff:fe5:2	ff02::1:6	ICMPv6	110	Multicast Listener Report Message v2
3	94..	fe80::edf:93ff:fe5:2	ff02::1:6	ICMPv6	110	Multicast Listener Report Message v2
4	10..	fe80::42:8bff:fe32:2900	ff02::1:2	DHCPv6	116	Solicit XID: 0xb0281f [ROOT-ONLY DOMAIN NAME] CID: 00030001024288322900
5	10..	fe80::edf:93ff:fe5:2	fe80::42:8bff:fe32:2900	DHCPv6	179	Advertise XID: 0xb0281f IAA: 2001::199 CID: 00030001024288322900
6	10..	fe80::42:8bff:fe32:2900	ff02::1:ffff5:2	ICMPv6	88	Neighbor Solicitation for fe80::edf:93ff:fe5:2 from 02:42:88:32:29:00
7	10..	fe80::edf:93ff:fe5:2	fe80::42:8bff:fe32:2900	ICMPv6	88	Neighbor Advertisement fe80::edf:93ff:fe5:2 (rtr, sol, ovr) is at 0c:df:93:f5:00:02
8	10..	fe80::42:8bff:fe32:2900	fe80::edf:93ff:fe5:2	ICMPv6	227	Destination Unreachable (Port unreachable)
9	10..	fe80::42:8bff:fe32:2900	ff02::1:2	DHCPv6	134	Request XID: 0xb0281f [ROOT-ONLY DOMAIN NAME] CID: 00030001024288322900
10	10..	fe80::edf:93ff:fe5:2	fe80::42:8bff:fe32:2900	DHCPv6	179	Reply XID: 0xb0281f IAA: 2001::199 CID: 00030001024288322900
11	10..	fe80::42:8bff:fe32:2900	fe80::edf:93ff:fe5:2	ICMPv6	227	Destination Unreachable (Port unreachable)
12	10..	fe80::edf:93ff:fe5:2	fe80::42:8bff:fe32:2900	ICMPv6	86	Neighbor Solicitation for fe80::42:8bff:fe32:2900 from 0c:df:93:f5:00:02
13	10..	fe80::42:8bff:fe32:2900	fe80::edf:93ff:fe5:2	ICMPv6	78	Neighbor Advertisement fe80::42:8bff:fe32:2900 (sol)
14	13..	fe80::edf:93ff:fe5:2	ff02::1	ICMPv6	86	Router Advertisement from 0c:df:93:f5:00:02
15	13..	fe80::edf:93ff:fe5:2	ff02::1	ICMPv6	86	Router Advertisement from 0c:df:93:f5:00:02
16	13..	fe80::42:8bff:fe32:2900	ff02::1:2	DHCPv6	116	Solicit XID: 0xbad27e [ROOT-ONLY DOMAIN NAME] CID: 00030001024288322900
17	13..	fe80::edf:93ff:fe5:2	fe80::42:8bff:fe32:2900	DHCPv6	179	Advertise XID: 0xbad27e IAA: 2001::198 CID: 00030001024288322900
18	13..	fe80::42:8bff:fe32:2900	fe80::edf:93ff:fe5:2	ICMPv6	227	Destination Unreachable (Port unreachable)
19	13..	fe80::42:8bff:fe32:2900	ff02::1:2	DHCPv6	134	Request XID: 0xbad27e [ROOT-ONLY DOMAIN NAME] CID: 00030001024288322900
20	13..	fe80::edf:93ff:fe5:2	fe80::42:8bff:fe32:2900	DHCPv6	179	Reply XID: 0xbad27e IAA: 2001::198 CID: 00030001024288322900
21	13..	fe80::42:8bff:fe32:2900	fe80::edf:93ff:fe5:2	ICMPv6	227	Destination Unreachable (Port unreachable)
22	13..	fe80::42:8bff:fe32:2900	fe80::edf:93ff:fe5:2	ICMPv6	86	Neighbor Solicitation for fe80::edf:93ff:fe5:2 from 02:42:88:32:29:00
23	13..	fe80::edf:93ff:fe5:2	fe80::42:8bff:fe32:2900	ICMPv6	78	Neighbor Advertisement fe80::edf:93ff:fe5:2 (rtr, sol)
24	13..	fe80::edf:93ff:fe5:2	fe80::42:8bff:fe32:2900	ICMPv6	86	Neighbor Solicitation for fe80::42:8bff:fe32:2900 from 0c:df:93:f5:00:02
25	13..	fe80::42:8bff:fe32:2900	fe80::edf:93ff:fe5:2	ICMPv6	78	Neighbor Advertisement fe80::42:8bff:fe32:2900 (sol)
26	14..	fe80::edf:93ff:fe5:2	ff02::1	ICMPv6	86	Router Advertisement from 0c:df:93:f5:00:02
27	14..	fe80::42:8bff:fe32:2900	2001::1	ICMPv6	118	Echo (ping) request id=0x0157, seq=0, hop limit=64 (reply in 28)
28	14..	2001::1	fe80::42:8bff:fe32:2900	ICMPv6	118	Echo (ping) reply id=0x0157, seq=0, hop limit=64 (request in 27)
29	14..	fe80::42:8bff:fe32:2900	2001::1	ICMPv6	118	Echo (ping) request id=0x0157, seq=1, hop limit=64 (reply in 30)
30	14..	2001::1	fe80::42:8bff:fe32:2900	ICMPv6	118	Echo (ping) reply id=0x0157, seq=1, hop limit=64 (request in 29)