Сетевые технологии

Настройка DHCP, DHCPv6, SLAAC и IPv6 в GNS3

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Цель работы

Основная цель

Получить навыки настройки DHCP, DHCPv6 Stateless и Stateful, SLAAC и IPv6-адресации в виртуальной среде GNS3.

Выполнение работы

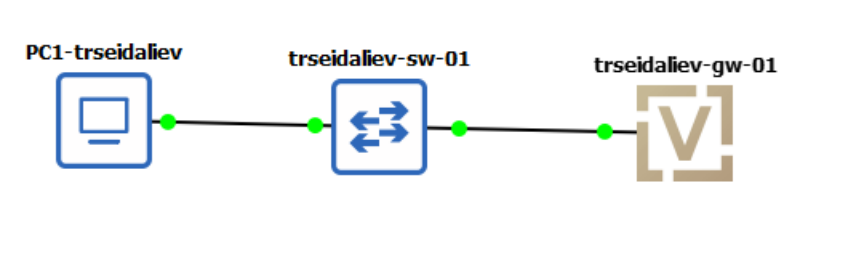
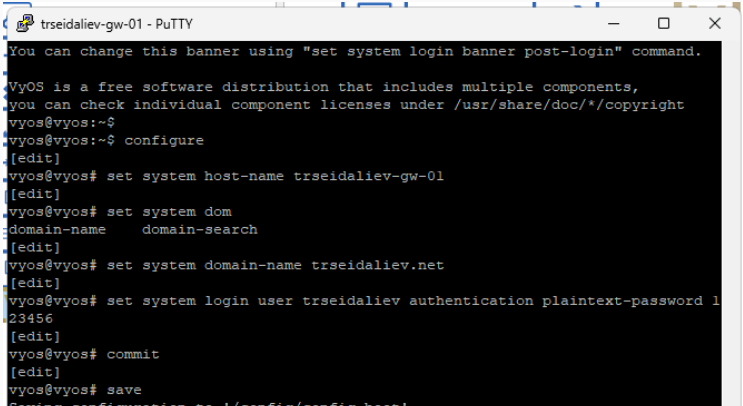


Рис. 1: Топология

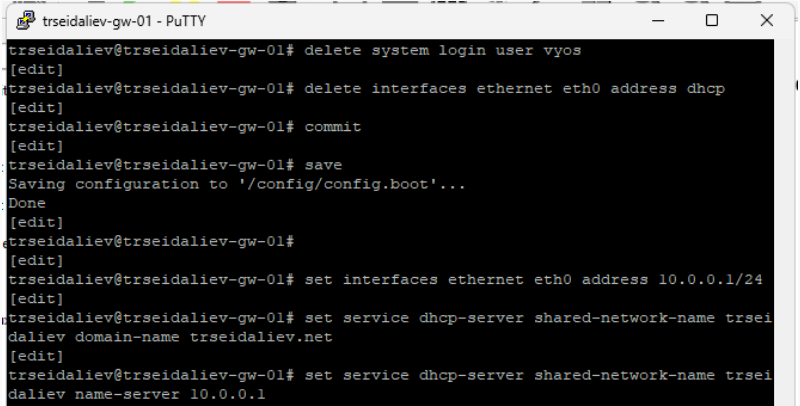
Настройка VyOS

- Смена имени хоста и доменного имени
- Создание нового пользователя
- Назначение адреса 10.0.0.1/24
- Настройка DHCP-сервера



DHCP-сервер

- Подсеть: 10.0.0.0/24
- Диапазон: 10.0.0.2–10.0.0.253
- DNS: 10.0.0.1
- Домен: trseidaliev.net

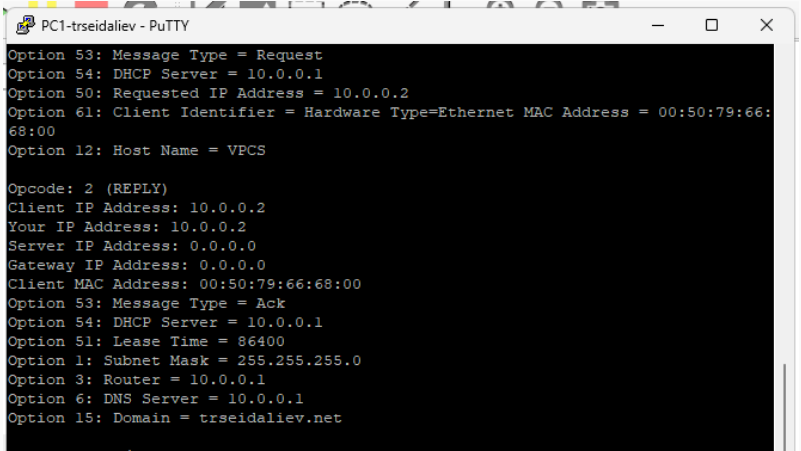


Клиент PC1

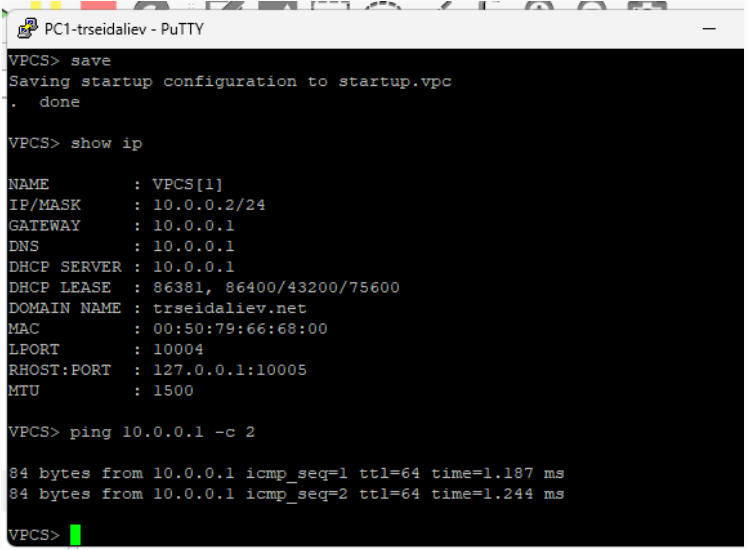
IP: 10.0.0.2/24

Gateway: 10.0.0.1

DNS: 10.0.0.1

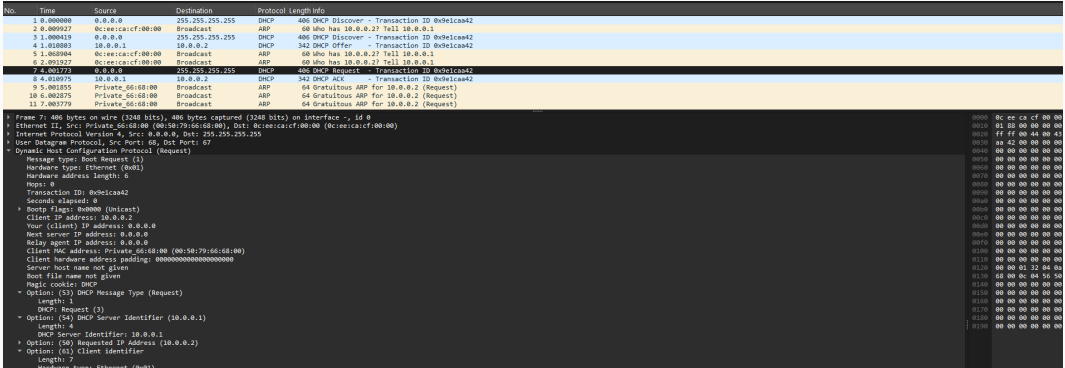


Проверка работы DHCP



Последовательность обмена

- Discover
- Offer
- Request
- ACK



Новая расширенная топология

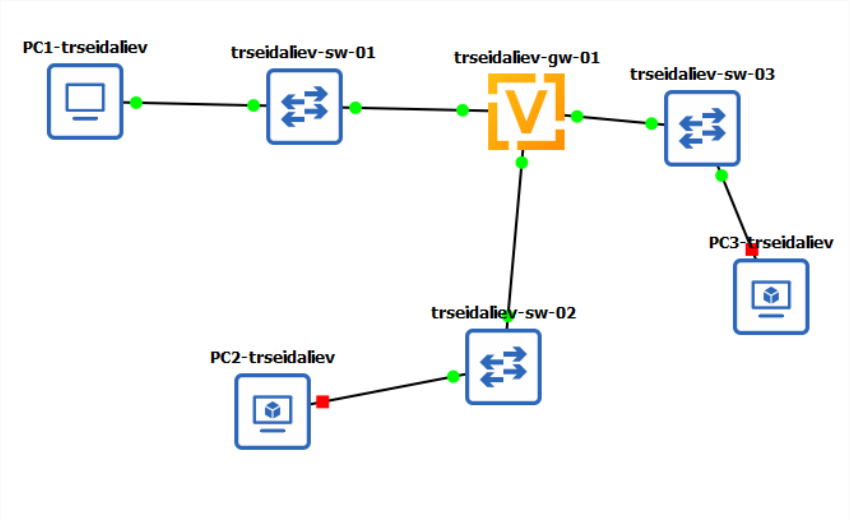
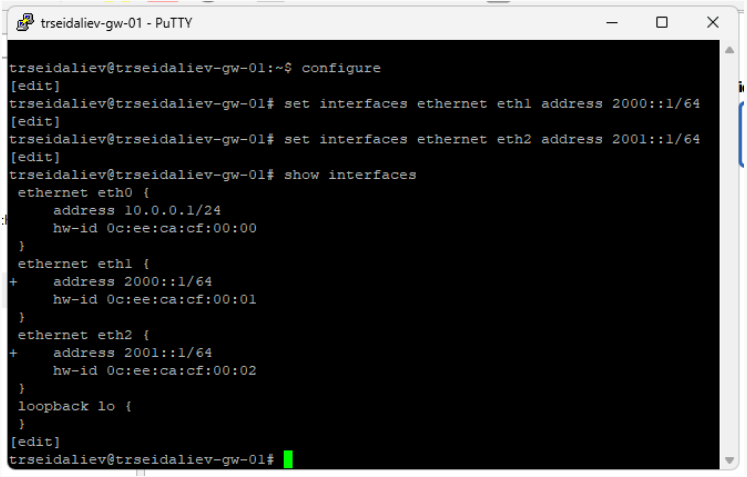


Рис. 7: Топология IPv6

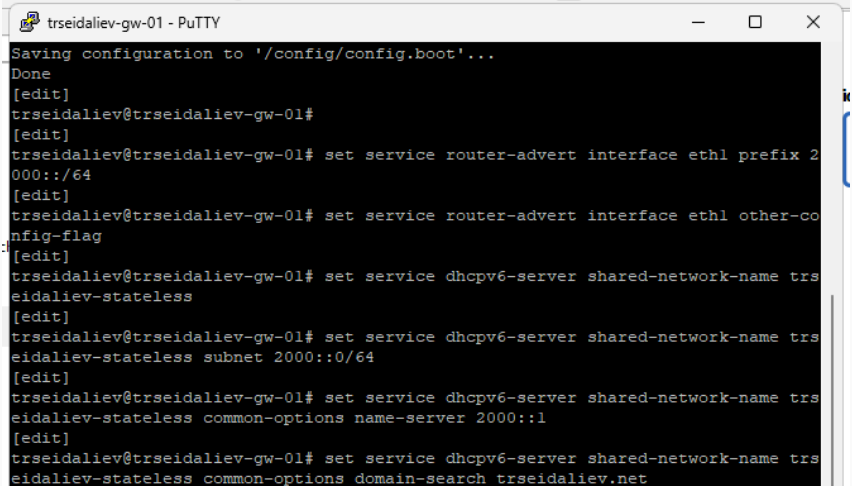
Настройка адресов IPv6

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



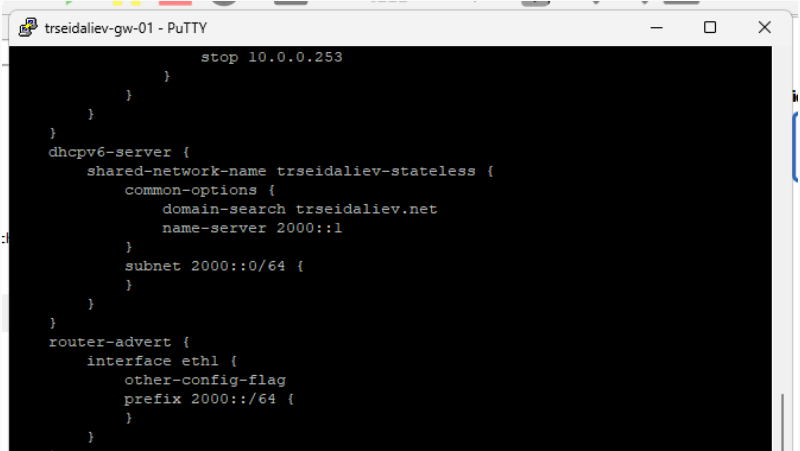
Router Advertisement (RA)

- Префикс 2000::/64
- other-config-flag: получение DNS через DHCPv6



Параметры выдаются:

- DNS: 2000::1
- Domain-search: trseidaliev.net



Клиент PC2 (SLAAC)

Адрес: SLAAC (2000::/64)

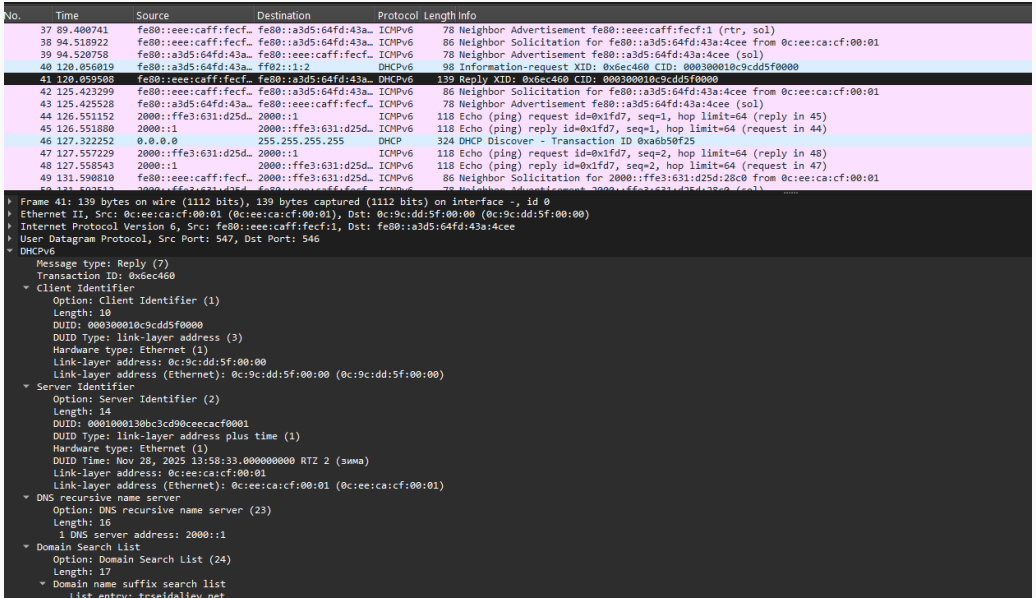
Маршруты добавлены автоматически

```
┌──(kali㉿kali)-[~]
└─$ ifconfig eth0
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet6 2000::ffe3:631:d25d:28c0  prefixlen 64  scopeid 0x0<global>
        inet6 fe80::a3d5:64fd:43a:4cee  prefixlen 64  scopeid 0x20<link>
        ether 0c:9c:dd:5f:00:00  txqueuelen 1000  (Ethernet)
        RX packets 5  bytes 576 (576.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 21  bytes 3168 (3.0 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
2000::/64                      ::                         U    100 1     0 eth0
fe80::/64                      ::                         U    100 1     0 eth0
::/0                           fe80::eee:caff:fecf:1      UG   100 1     0 eth0
::1/128                        ::                         Un   0   4     0 lo
2000::ffe3:631:d25d:28c0/128   ::                         Un   0   2     0 eth0
fe80::a3d5:64fd:43a:4cee/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=4.49 ms
64 bytes from 2000::1: icmp_seq=2 ttl=64 time=2.45 ms

--- 2000::1 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1002ms
```

DHCPv6 Stateless: получение DNS

```
┌──(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\234\335_\000\000".
PRC: Requesting information (INIT).
XMT: Forming Info-Request, 0 ms elapsed.
XMT: Info-Request on eth0, interval 1010ms.
RCV: Reply message on eth0 from fe80::eee:caff:fecf:1.
PRC: Done.

┌──(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=1.53 ms
64 bytes from 2000::1: icmp_seq=2 ttl=64 time=2.82 ms

--- 2000::1 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1002ms
rtt min/avg/max/mdev = 1.531/2.174/2.818/0.643 ms

┌──(kali㉿kali)-[~]
└─$ cat /etc/resolv.conf
search trseidaliev.net.
nameserver 2000::1

┌──(kali㉿kali)-[~]
└─$
```

Анализ DHCPv6 Stateless



No.	Time	Source	Destination	Protocol	Length	Info
37	89.400741	fe80::eee:caff:fecf…	fe80::a3d5:64fd:43a…	ICMPv6	78	Neighbor Advertisement fe80::eee:caff:fecf:1 (rtr, sol)
38	94.518922	fe80::eee:caff:fecf…	fe80::a3d5:64fd:43a…	ICMPv6	86	Neighbor Solicitation for fe80::a3d5:64fd:43a:4cee from 0c:ee:ca:cf:00:01
39	94.520758	fe80::a3d5:64fd:43a…	fe80::eee:caff:fecf…	ICMPv6	78	Neighbor Advertisement fe80::a3d5:64fd:43a:4cee (sol)
40	120.056019	fe80::a3d5:64fd:43a…	ff02::1:2	DHCPv6	98	Information-request XID: 0x6ec460 CID: 000300010c9cdd5f0000
41	120.059508	fe80::eee:caff:fecf…	fe80::a3d5:64fd:43a…	DHCPv6	139	Reply XID: 0x6ec460 CID: 000300010c9cdd5f0000
42	125.423299	fe80::eee:caff:fecf…	fe80::a3d5:64fd:43a…	ICMPv6	86	Neighbor Solicitation for fe80::a3d5:64fd:43a:4cee from 0c:ee:ca:cf:00:01
43	125.425528	fe80::a3d5:64fd:43a…	fe80::eee:caff:fecf…	ICMPv6	78	Neighbor Advertisement fe80::a3d5:64fd:43a:4cee (sol)
44	126.551152	2000::ffe3:631:d25d…	2000::1	ICMPv6	118	Echo (ping) request id=0x1fd7, seq=1, hop limit=64 (reply in 45)
45	126.551880	2000::1	2000::ffe3:631:d25d…	ICMPv6	118	Echo (ping) reply id=0x1fd7, seq=1, hop limit=64 (request in 44)
46	127.522252	0.0.0.0	255.255.255.255	DHCP	324	DHCP Discover - Transaction ID 0xa6b50f25
47	127.557229	2000::ffe3:631:d25d…	2000::1	ICMPv6	118	Echo (ping) request id=0x1fd7, seq=2, hop limit=64 (reply in 48)
48	127.558543	2000::1	2000::ffe3:631:d25d…	ICMPv6	118	Echo (ping) reply id=0x1fd7, seq=2, hop limit=64 (request in 47)
49	131.590810	fe80::eee:caff:fecf…	2000::ffe3:631:d25d…	ICMPv6	86	Neighbor Solicitation for 2000::ffe3:631:d25d:28c0 from 0c:ee:ca:cf:00:01
50	131.592512	2000::ffe3:631:d25d…	fe80::eee:caff:fecf…	ICMPv6	78	Neighbor Advertisement 2000::ffe3:631:d25d:28c0 (sol)

```
▸ Frame 41: 139 bytes on wire (1112 bits), 139 bytes captured (1112 bits) on interface -, id 0
▸ Ethernet II, Src: 0c:ee:ca:cf:00:01 (0c:ee:ca:cf:00:01), Dst: 0c:9c:dd:5f:00:00 (0c:9c:dd:5f:00:00)
▸ Internet Protocol Version 6, Src: fe80::eee:caff:fecf:1, Dst: fe80::a3d5:64fd:43a:4cee
▸ User Datagram Protocol, Src Port: 547, Dst Port: 546
▾ DHCPv6
    Message type: Reply (7)
    Transaction ID: 0x6ec460
  ▾ Client Identifier
      Option: Client Identifier (1)
      Length: 10
      DUID: 000300010c9cdd5f0000
      DUID Type: link-layer address (3)
      Hardware type: Ethernet (1)
      Link-layer address: 0c:9c:dd:5f:00:00
      Link-layer address (Ethernet): 0c:9c:dd:5f:00:00 (0c:9c:dd:5f:00:00)
  ▾ Server Identifier
      Option: Server Identifier (2)
      Length: 14
      DUID: 0001000130bc3cd90ceecacf0001
      DUID Type: link-layer address plus time (1)
      Hardware type: Ethernet (1)
      DUID Time: Nov 28, 2025 13:58:33.000000000 RTZ 2 (зима)
      Link-layer address: 0c:ee:ca:cf:00:01
      Link-layer address (Ethernet): 0c:ee:ca:cf:00:01 (0c:ee:ca:cf: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: 17
    ▾ Domain name suffix search list
        List entry: tpseidaliev.net
```

Включение режима Stateful

- RA: managed-flag
- Диапазон адресов: **2001::100 – 2001::199**
- DNS: 2001::1
- Domain-search: trseidaliev.net

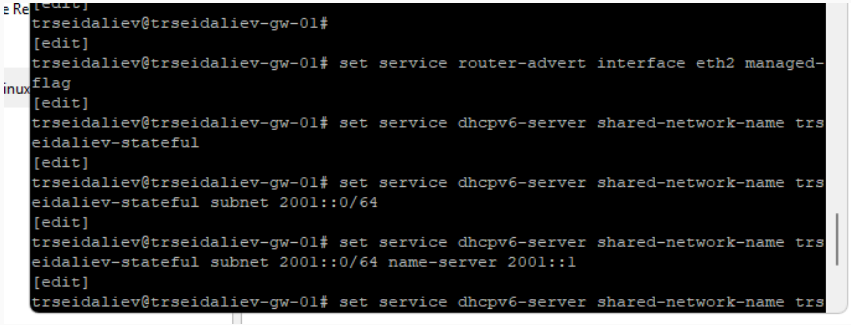


Рис. 14: Stateful настройки

PC3 — до получения адреса

```
┌──(kali㉿kali)-[~]
└─$ ifconfig eth0
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet6 2001::199  prefixlen 128  scopeid 0×0<global>
        inet6 fe80::a572:e73f:51ff:904a  prefixlen 64  scopeid 0×20<link>
        ether 0c:17:39:a2:00:00  txqueuelen 1000  (Ethernet)
        RX packets 5  bytes 632 (632.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 25  bytes 3824 (3.7 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::199/128                  ::                         U    100 1     0 eth0
fe80::/64                      ::                         U    100 1     0 eth0
::/0                           fe80::eee:caff:fecf:2      UG   100 1     0 eth0
::1/128                        ::                         Un   0   4     0 lo
2001::199/128                  ::                         Un   0   2     0 eth0
fe80::a572:e73f:51ff:904a/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 trseidaliev.net
nameserver 2001::1

┌──(kali㉿kali)-[~]
└─$
```

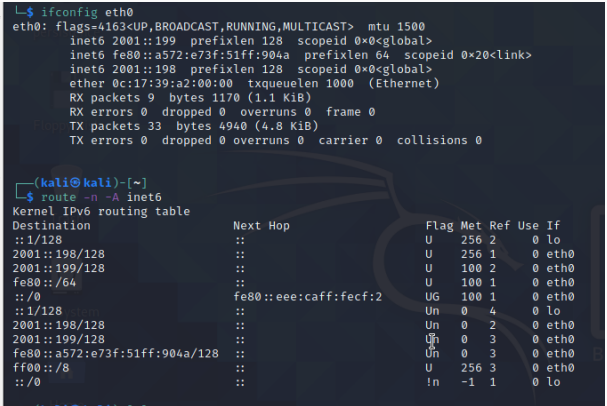
PC3 — получение адреса DHCPv6 Stateful

```
┌──(kali㉿kali)-[~]
└─$ 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\274@\004\014\0279\242\000\000".
PRC: Soliciting for leases (INIT).
XMT: Forming Solicit, 0 ms elapsed.
XMT:  X-- IA_NA 39:a2:00:00
XMT:  | X-- Request renew in  +3600
XMT:  | X-- Request rebind in +5400
XMT: Solicit on eth0, interval 1030ms.
RCV: Advertise message on eth0 from fe80::eee:caff:fecf:2.
RCV:  X-- IA_NA 39:a2:00:00
RCV:  | X-- starts 1764328325
RCV:  | X-- t1 - renew  +0
RCV:  | X-- t2 - rebind +0
RCV:  | X-- [Options]
RCV:  | | X-- IAADDR 2001::198
RCV:  | | | X-- Preferred lifetime 27000.
RCV:  | | | X-- Max lifetime 43200.
RCV:  X-- Server ID: 00:01:00:01:30:bc:3c:d9:0c:ee:ca:cf:00:01
RCV:  Advertisement recorded.
PRC: Selecting best advertised lease.
PRC: Considering best lease.
PRC:  X-- Initial candidate 00:01:00:01:30:bc:3c:d9:0c:ee:ca:cf:00:01 (s: 10105, p: 0).
XMT: Forming Request, 0 ms elapsed.
XMT:  X-- IA_NA 39:a2:00:00
XMT:  | X-- Requested renew  +3600
XMT:  | X-- Requested rebind +5400
XMT:  | | X-- IAADDR 2001::198
XMT:  | | | X-- Preferred lifetime +7200
XMT:  | | | X-- Max lifetime +7500
XMT:  V IA_NA appended.
```

PC3 — после получения адреса

Полная конфигурация:

- IPv6: 2001::198 или 2001::199
- DNS: 2001::1
- Пинг до 2001::1 успешен



Просмотр аренд DHCPv6 Stateful

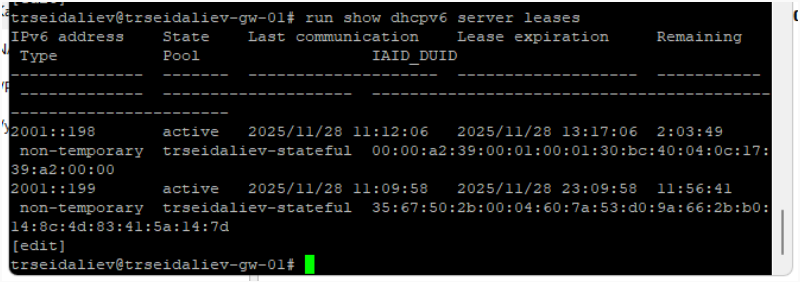
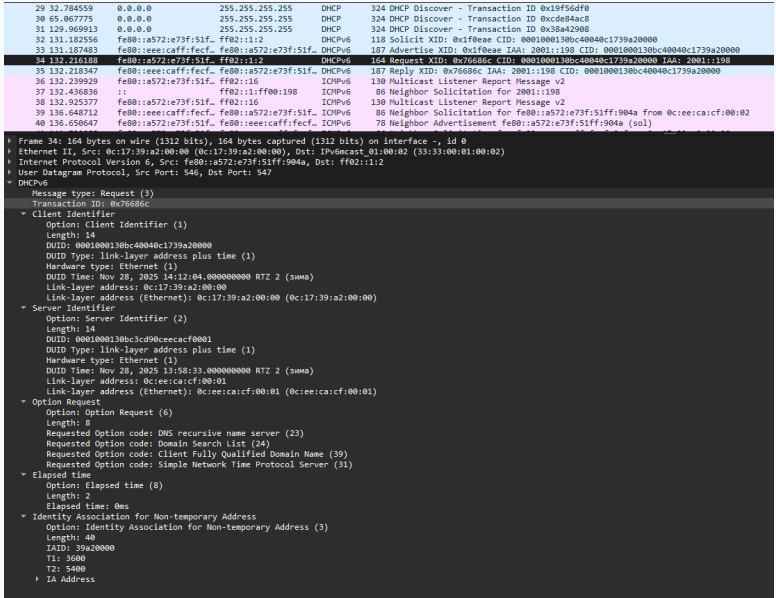


Рис. 18: Stateful leases

Пакеты Solicit, Advertise, Request, Reply



Итоги

Основные достижения

- Настроен DHCP для IPv4
- Настроены SLAAC, DHCPv6 Stateless и Stateful
- Выполнена полная проверка маршрутизации и связности
- Проанализирован сетевой трафик всех DHCP-механизмов
- Подтверждена корректная работа всех служб распределения адресов