федеральное государственное автономное образовательное учреждение
высшего образования

«НАЦИОНАЛЬНЫЙ ИССЛЕДОВАТЕЛЬСКИЙ УНИВЕРСИТЕТ ИТМО»

ОТЧЕТ

по лабораторной работе №7

«Создание сети IPv6»

по дисциплине «**Администрирование систем и сетей**»

Вариант на оценку 5

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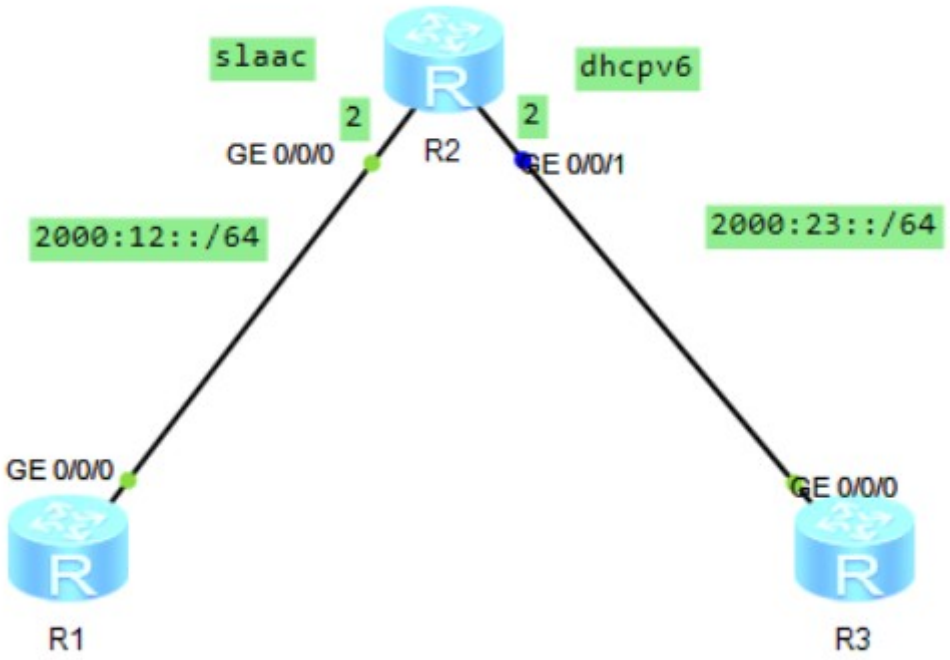
1. Лабораторная работа

1.1. Задачи

- Настройка статических адресов IPv6.
- Настройка сервера DHCPv6.
- Настройка назначения адресов IPv6 без отслеживания состояния.
- Вывод на экран адресов IPv6

1.2. Топология



1.3. Настраивание и диагностические команды

Шаг 1,2.

Настроить имена на устройствах, включить ipv6.

Шаг 3.

Настроить локальные адреса канала на устройствах. Генерируются автоматически.

```
[R1-GigabitEthernet0/0/0]ipv6 addr auto link-local

[R1]dis ipv6 interface
GigabitEthernet0/0/0 current state : UP
IPv6 protocol current state : UP
IPv6 is enabled, link-local address is FE80::2E0:FCFF:FE4F:3BBD
  No global unicast address configured
  Joined group address(es):
    FF02::1:FF4F:3BBD
    FF02::2
    FF02::1
  MTU is 1500 bytes
  ND DAD is enabled, number of DAD attempts: 1
  ND reachable time is 30000 milliseconds
  ND retransmit interval is 1000 milliseconds
  Hosts use stateless autoconfig for addresses

[R2-GigabitEthernet0/0/1]dis ipv6 interface
GigabitEthernet0/0/0 current state : UP
IPv6 protocol current state : UP
IPv6 is enabled, link-local address is FE80::2E0:FCFF:FE18:3CF6
  No global unicast address configured
  Joined group address(es):
    FF02::1:FF18:3CF6
    FF02::2
    FF02::1
  MTU is 1500 bytes
  ND DAD is enabled, number of DAD attempts: 1
  ND reachable time is 30000 milliseconds
  ND retransmit interval is 1000 milliseconds
  Hosts use stateless autoconfig for addresses

GigabitEthernet0/0/1 current state : UP
IPv6 protocol current state : UP
IPv6 is enabled, link-local address is FE80::2E0:FCFF:FE18:3CF7
  No global unicast address configured
  Joined group address(es):
    FF02::1:FF18:3CF7
    FF02::2
```

```
    FF02::1
  MTU is 1500 bytes
  ND DAD is enabled, number of DAD attempts: 1
  ND reachable time is 30000 milliseconds
  ND retransmit interval is 1000 milliseconds
  Hosts use stateless autoconfig for addresses

[R3-GigabitEthernet0/0/0]dis ipv6 interface
GigabitEthernet0/0/0 current state : UP
IPv6 protocol current state : UP
IPv6 is enabled, link-local address is FE80::2E0:FCFF:FE10:8A6
  No global unicast address configured
  Joined group address(es):
    FF02::1:FF10:8A6
    FF02::2
    FF02::1
  MTU is 1500 bytes
  ND DAD is enabled, number of DAD attempts: 1
  ND reachable time is 30000 milliseconds
  ND retransmit interval is 1000 milliseconds
  Hosts use stateless autoconfig for addresses

[R1]ping ipv6 FE80::2E0:FCFF:FE18:3CF6 -i GigabitEthernet 0/0/0
  PING FE80::2E0:FCFF:FE18:3CF6 : 56  data bytes, press CTRL_C to break
    Reply from FE80::2E0:FCFF:FE18:3CF6
    bytes=56 Sequence=1 hop limit=64  time = 450 ms
    Reply from FE80::2E0:FCFF:FE18:3CF6
    bytes=56 Sequence=2 hop limit=64  time = 30 ms
    Reply from FE80::2E0:FCFF:FE18:3CF6
    bytes=56 Sequence=3 hop limit=64  time = 20 ms
    Reply from FE80::2E0:FCFF:FE18:3CF6
    bytes=56 Sequence=4 hop limit=64  time = 20 ms
    Reply from FE80::2E0:FCFF:FE18:3CF6
    bytes=56 Sequence=5 hop limit=64  time = 30 ms

  --- FE80::2E0:FCFF:FE18:3CF6 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 20/110/450 ms
```

Шаг 4.

Настроить статические IPv6 адреса на R2:

```
[R2-GigabitEthernet0/0/0]ipv6 address 2000:0012::2 64
[R2-GigabitEthernet0/0/1]ipv6 address 2000:0023::2 64
```

Шаг 5.

Настроить функцию сервера DHCPv6 на R2 и настроить R3 для получения IPv6-адресов через DHCPv6.

```
interface GigabitEthernet0/0/1
 ipv6 enable
 ipv6 address 2000:23::2/64
 ipv6 address auto link-local
 undo ipv6 nd ra halt
 ipv6 nd autoconfig managed-address-flag
 dhcpv6 server pool1
#
return

[R3-GigabitEthernet0/0/0]dis this
[V200R003C00]
#
interface GigabitEthernet0/0/0
 ipv6 enable
 ipv6 address auto link-local
 ipv6 address auto global default
 ipv6 address auto dhcp
#
return

[R3-GigabitEthernet0/0/0]dis ipv6 ro
Routing Table : Public
      Destinations : 4  Routes : 4

 Destination  : ::                                PrefixLength : 0
 NextHop      : FE80::2E0:FCFF:FE18:3CF7          Preference   : 64
 Cost         : 0                                 Protocol     : Unr
 RelayNextHop : ::                                TunnelID     : 0x0
 Interface    : GigabitEthernet0/0/0              Flags        : D

 Destination  : ::1                               PrefixLength : 128
 NextHop      : ::1                               Preference   : 0
```

```
 Cost         : 0                                 Protocol     : Direct
 RelayNextHop : ::                                TunnelID     : 0x0
 Interface    : InLoopBack0                       Flags        : D

 Destination  : 2000:23::1                        PrefixLength : 128
 NextHop      : ::1                               Preference   : 0
 Cost         : 0                                 Protocol     : Direct
 RelayNextHop : ::                                TunnelID     : 0x0
 Interface    : GigabitEthernet0/0/0              Flags        : D

 Destination  : FE80::                            PrefixLength : 10
 NextHop      : ::                                Preference   : 0
 Cost         : 0                                 Protocol     : Direct
 RelayNextHop : ::                                TunnelID     : 0x0
 Interface    : NULL0                             Flags        : D
```

Шаг 6.

Настроить R1 для получения IPv6-адреса в режиме без отслеживания состояния.

```
[R2-GigabitEthernet0/0/0]undo ipv6 nd ra halt

[R1-GigabitEthernet0/0/0]ipv6 address auto global
[R1-GigabitEthernet0/0/0]display ipv6 interface brief
*down: administratively down
(l): loopback
(s): spoofing
Interface                   Physical              Protocol
GigabitEthernet0/0/0        up                    up
[IPv6 Address] 2000:12::2E0:FCFF:FE4F:3BBD
```

Шаг 7.

Настроить статический маршрут IPv6:

```
[R1-GigabitEthernet0/0/0]ipv6 route-static 2000:23:: 64 2000:12::2

[R1]ping ipv6 2000:23::1
  PING 2000:23::1 : 56  data bytes, press CTRL_C to break
    Request time out
    Reply from 2000:23::1
```

```
    bytes=56 Sequence=2 hop limit=63  time = 90 ms
    Reply from 2000:23::1
    bytes=56 Sequence=3 hop limit=63  time = 30 ms
    Reply from 2000:23::1
    bytes=56 Sequence=4 hop limit=63  time = 40 ms
    Reply from 2000:23::1
    bytes=56 Sequence=5 hop limit=63  time = 40 ms

  --- 2000:23::1 ping statistics ---
    5 packet(s) transmitted
    4 packet(s) received
    20.00% packet loss
    round-trip min/avg/max = 30/50/90 ms
```

1.4. Конфигурации

```
[V200R003C00]
#
 sysname R1
#
ipv6
#
interface GigabitEthernet0/0/0
 ipv6 enable
 ipv6 address auto link-local
 ipv6 address auto global
#
interface GigabitEthernet0/0/1
#
interface GigabitEthernet0/0/2
#
interface NULL0
#
ipv6 route-static 2000:23:: 64 2000:12::2
#
user-interface con 0
 authentication-mode password
 idle-timeout 0 0
user-interface vty 0 4
user-interface vty 16 20
#
return
```

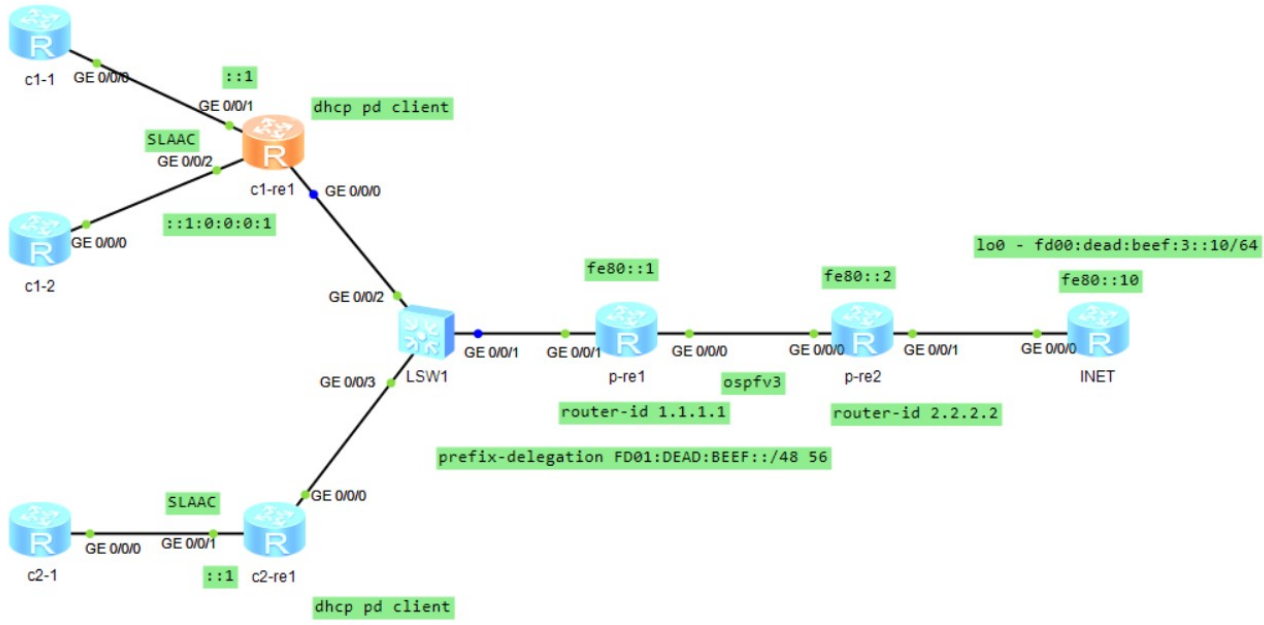
```
[V200R003C00]
#
 sysname R2
#
ipv6
#
dhcp enable
#
dhcpv6 pool pool1
 address prefix 2000:23::/64
 dns-server 2000:23::2
#
interface GigabitEthernet0/0/0
 ipv6 enable
 ipv6 address 2000:12::2/64
 ipv6 address auto link-local
 undo ipv6 nd ra halt
#
interface GigabitEthernet0/0/1
 ipv6 enable
 ipv6 address 2000:23::2/64
 ipv6 address auto link-local
 undo ipv6 nd ra halt
 ipv6 nd autoconfig managed-address-flag
 dhcpv6 server pool1
#
interface GigabitEthernet0/0/2
#
interface NULL0
#
user-interface con 0
 authentication-mode password
 idle-timeout 0 0
user-interface vty 0 4
user-interface vty 16 20
#
return

[V200R003C00]
#
 sysname R3
#
```

```
ipv6
#
dhcp enable
#
interface GigabitEthernet0/0/0
 ipv6 enable
 ipv6 address auto link-local
 ipv6 address auto global default
 ipv6 address auto dhcp
#
interface GigabitEthernet0/0/1
#
interface GigabitEthernet0/0/2
#
interface NULL0
#
user-interface con 0
 authentication-mode password
 idle-timeout 0 0
user-interface vty 0 4
user-interface vty 16 20
#
return
```

2. Дополнительное задание. DHCP-pd и наличие записей о подсетях клиентов на ISP router

2.1. Топология



2.2. Конфигурации

```
[V200R003C00]
#
 sysname INET
#
ipv6
#
interface GigabitEthernet0/0/0
 ipv6 enable
 ipv6 address FE80::10 link-local
#
interface GigabitEthernet0/0/1
#
interface GigabitEthernet0/0/2
#
interface NULL0
#
interface LoopBack0
```

```
 ipv6 enable
 ipv6 address FD00:DEAD:BEEF:3::10/64
#
ipv6 route-static :: 0 GigabitEthernet0/0/0 FE80::2
#
return

[V200R003C00]
#
 sysname p-re2
#
ipv6
#
ospfv3 1
 router-id 2.2.2.2
 silent-interface GigabitEthernet0/0/1
 import-route static
#
interface GigabitEthernet0/0/0
 ipv6 enable
 ipv6 address FE80::2 link-local
 ospfv3 1 area 0.0.0.0
#
interface GigabitEthernet0/0/1
 ipv6 enable
 ipv6 address FE80::2 link-local
#
interface GigabitEthernet0/0/2
#
interface NULL0
#
ipv6 route-static FD00:DEAD:BEEF:3:: 64 GigabitEthernet0/0/1
ipv6 route-static FD00:DEAD:BEEF:3:: 64 GigabitEthernet0/0/1 FE80::10
#
return

[V200R003C00]
#
 sysname p-re1
#
ipv6
#
dhcp enable
```

```
#
dhcpv6 pool clients
 prefix-delegation FD01:DEAD:BEEF::/48 56
#
ospfv3 1
 router-id 1.1.1.1
 silent-interface GigabitEthernet0/0/1
 import-route static
#
interface GigabitEthernet0/0/0
 ipv6 enable
 ipv6 address FE80::1 link-local
 ospfv3 1 area 0.0.0.0
#
interface GigabitEthernet0/0/1
 ipv6 enable
 ipv6 address FE80::1 link-local
 undo ipv6 nd ra halt
 dhcpv6 server clients
#
interface GigabitEthernet0/0/2
#
interface NULL0
#
ipv6 route-static FD01:DEAD:BEEF:: 56 GigabitEthernet0/0/1 FE80::2E0:FCFF:FEEF:1
8DC
ipv6 route-static FD01:DEAD:BEEF:100:: 56 GigabitEthernet0/0/1 FE80::2E0:FCFF:FE
65:AF8
#
return

[V200R003C00]
#
 sysname c1-re1
#
ipv6
#
dhcp enable
#
interface GigabitEthernet0/0/0
 ipv6 enable
 ipv6 address auto global default
 dhcpv6 client pd c1
```

```
#
interface GigabitEthernet0/0/1
 ipv6 enable
 ipv6 address c1 ::1/64
 ipv6 address auto link-local
 undo ipv6 nd ra halt
#
interface GigabitEthernet0/0/2
 ipv6 enable
 ipv6 address c1 ::1:0:0:0:1/64
 ipv6 address auto link-local
 undo ipv6 nd ra halt
#
interface NULL0
#
return

[V200R003C00]
#
 sysname c2-re1
#
ipv6
#
 set cpu-usage threshold 80 restore 75
#
dhcp enable
#
interface GigabitEthernet0/0/0
 ipv6 enable
 ipv6 address auto global default
 dhcpv6 client pd c2
#
interface GigabitEthernet0/0/1
 ipv6 enable
 ipv6 address c2 ::1/64
 ipv6 address auto link-local
 undo ipv6 nd ra halt
#
interface GigabitEthernet0/0/2
#
interface NULL0
#
return
```

```
[V200R003C00]
#
 sysname c1-1
#
ipv6
#
interface GigabitEthernet0/0/0
 ipv6 enable
 ipv6 address auto global default
#
interface GigabitEthernet0/0/1
#
interface GigabitEthernet0/0/2
#
interface NULL0
#
return

[V200R003C00]
#
 sysname c1-2
#
ipv6
#
interface GigabitEthernet0/0/0
 ipv6 enable
 ipv6 address auto global default
#
interface GigabitEthernet0/0/1
#
interface GigabitEthernet0/0/2
#
interface NULL0
#
return

[V200R003C00]
#
 sysname c2-1
#
ipv6
#
```

```
interface GigabitEthernet0/0/0
 ipv6 enable
 ipv6 address auto global default
#
interface GigabitEthernet0/0/1
#
interface GigabitEthernet0/0/2
#
interface NULL0
#
return
```

2.3. Настраивание и диагностические команды

В данной топологии p-re1 и p-re2 используются как граничные маршрутизаторы провайдера. На них включен ospfv3 с импортом статических маршрутов на обоих.

На p-re1 настроен prefix-delegation FD01:DEAD:BEEF::/48 56. Поскольку по умолчанию маршруты до подсетей клиентов, для которых выдается префикс, не добавляются на данный маршрутизатор, эти маршруты добавлены статически.

На «компьютерах» клиентов получение глобального (ULA) адреса осуществляется через SLAAC.

После добавления статических маршрутов (указано в конфигурациях стоит проверить маршруты и выделенные префиксы на p-re1:

```
[p-re1]dis dhcpv6 pool clients
DHCPv6 pool: clients
  Prefix delegation: FD01:DEAD:BEEF::/48 56
    Lifetime valid 172800 seconds, preferred 86400 seconds
    2 in use
  Information refresh time: 86400
  Conflict-address expire-time: 172800
  Active pd clients: 2

[p-re1]dis dhcpv6 pool clients allocated prefix
Prefix/length                           Valid    Expires             Left

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

```
FD01:DEAD:BEEF::/56                          172800   2023-12-10 10:43:50 158517

FD01:DEAD:BEEF:100::/56                      172800   2023-12-10 10:44:00 158527
------------------------------------------------------------------------------
Total : 2
```

Как видно, префикс был выделен для двух клиентов. Таблица маршрутизации на нем следующая:

```
[p-re1]dis ipv6 routing-table
Routing Table : Public
      Destinations : 5  Routes : 5

 Destination  : ::1                              PrefixLength : 128
 NextHop      : ::1                              Preference   : 0
 Cost         : 0                                Protocol     : Direct
 RelayNextHop : ::                               TunnelID     : 0x0
 Interface    : InLoopBack0                      Flags        : D

 Destination  : FD00:DEAD:BEEF:3::               PrefixLength : 64
 NextHop      : FE80::2                          Preference   : 150
 Cost         : 1                                Protocol     : OSPFv3ASE
 RelayNextHop : ::                               TunnelID     : 0x0
 Interface    : GigabitEthernet0/0/0             Flags        : D

 Destination  : FD01:DEAD:BEEF::                 PrefixLength : 56
 NextHop      : FE80::2E0:FCFF:FEEF:18DC         Preference   : 60
 Cost         : 0                                Protocol     : Static
 RelayNextHop : ::                               TunnelID     : 0x0
 Interface    : GigabitEthernet0/0/1             Flags        : D

 Destination  : FD01:DEAD:BEEF:100::             PrefixLength : 56
 NextHop      : FE80::2E0:FCFF:FE65:AF8          Preference   : 60
 Cost         : 0                                Protocol     : Static
 RelayNextHop : ::                               TunnelID     : 0x0
 Interface    : GigabitEthernet0/0/1             Flags        : D

 Destination  : FE80::                           PrefixLength : 10
 NextHop      : ::                               Preference   : 0
 Cost         : 0                                Protocol     : Direct
 RelayNextHop : ::                               TunnelID     : 0x0
```

```
 Interface    : NULL0                            Flags        : D
```

Проверка достучаться до INET с c1-1:

```
<c1-1>ping ipv6 fd00:dead:beef:3::10
  PING fd00:dead:beef:3::10 : 56  data bytes, press CTRL_C to break
    Reply from FD00:DEAD:BEEF:3::10
    bytes=56 Sequence=1 hop limit=61  time = 310 ms
    Reply from FD00:DEAD:BEEF:3::10
    bytes=56 Sequence=2 hop limit=61  time = 70 ms
    Reply from FD00:DEAD:BEEF:3::10
    bytes=56 Sequence=3 hop limit=61  time = 40 ms
    Reply from FD00:DEAD:BEEF:3::10
    bytes=56 Sequence=4 hop limit=61  time = 50 ms
    Reply from FD00:DEAD:BEEF:3::10
    bytes=56 Sequence=5 hop limit=61  time = 60 ms

  --- fd00:dead:beef:3::10 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 40/106/310 ms

<c1-1>tracert ipv6 fd00:dead:beef:3::10

 traceroute to fd00:dead:beef:3::10  30 hops max,60 bytes packet

 1 FD01:DEAD:BEEF:100::1 120 ms  60 ms  20 ms

 2  *  *  *

 3  *  *  *

 4 FD00:DEAD:BEEF:3::10 190 ms  60 ms  80 ms
```

На 2 и 3 звездочки, потому что на маршрутизаторах провайдера только link-local адреса.