

Практика 4

1. Планирование и документирование адресного пространства.

R1 — основной маршрутизатор

R2 - DHCP-сервер

LAN1 — PC1, PC2 через switch1

LAN2 — PC3, PC4 через switch2

LAN3 — R1 и R2

Сеть	Диапазон	Шлюз	Назначение
LAN1	192.168.1.0/24	192.168.1.1	PC1, PC2
LAN2	192.168.2.0/24	192.168.2.1	PC3, PC4
LAN3	192.168.3.0/30		R1, R2

2. Настройка DHCP-сервера (R2) и DHCP-Relay (R1)

Настройка R2:

Интерфейс Fa0/0 (к R1)

```
en
conf t
interface Fa0/0
description Link to R1
ip address 192.168.3.2 255.255.255.252
exit
```

Создание DHCP для LAN1

```
ip dhcp pool LAN1_POOL
network 192.168.1.0 255.255.255.0
domain-name lan1.local
default-router 192.168.1.1
exit
```

Создание DHCP для LAN2

```
ip dhcp pool LAN2_POOL
network 192.168.2.0 255.255.255.0
domain-name lan2.local
default-router 192.168.2.1
exit
```

Исключение из пула адресов шлюза,

```
ip dhcp excluded-address 192.168.1.1
ip dhcp excluded-address 192.168.2.1
```

Настройка статической маршрутизации:

```
ip route 192.168.1.0 255.255.255.0 192.168.3.1
ip route 192.168.2.0 255.255.255.0 192.168.3.1
ip routing
end
write memory
DHCP-pool
```

```
R2#show ip dhcp pool

Pool LAN1_POOL :
  Utilization mark (high/low)      : 100 / 0
  Subnet size (first/next)        : 0 / 0
  Total addresses                 : 254
  Leased addresses                : 0
  Pending event                   : none
  1 subnet is currently in the pool :
    Current index          IP address range           Leased addresses
    192.168.1.1            192.168.1.1 - 192.168.1.254      0

Pool LAN2_POOL :
  Utilization mark (high/low)      : 100 / 0
  Subnet size (first/next)        : 0 / 0
  Total addresses                 : 254
  Leased addresses                : 0
  Pending event                   : none
  1 subnet is currently in the pool :
    Current index          IP address range           Leased addresses
    192.168.2.1            192.168.2.1 - 192.168.2.254      0
```

Таблица маршрутизации:

```
R2#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
      E1 - OSPF external type 1, E2 - OSPF external type 2
      i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
      ia - IS-IS inter area, * - candidate default, U - per-user static route
      o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

S      192.168.1.0/24 [1/0] via 192.168.3.1
S      192.168.2.0/24 [1/0] via 192.168.3.1
      192.168.3.0/30 is subnetted, 1 subnets
C          192.168.3.0 is directly connected, FastEthernet0/0
```

Настройка R1 (как DHCP-Relay):

```
en
conf t
interface Fa1/0
```

```

description Link to R2
ip address 192.168.3.1 255.255.255.252
no shutdown
exit
interface Fa0/0
description LAN1 to Switch1
ip address 192.168.1.1 255.255.255.0
ip helper-address 192.168.3.2
no shutdown
exit
interface Fa2/0
description LAN2 to Switch2
ip address 192.168.2.1 255.255.255.0
ip helper-address 192.168.3.2
no shutdown
exit
ip routing
end
write memory

```

Interface	IP-Address	OK?	Method	Status	Prot
FastEthernet0/0	192.168.1.1	YES	manual	up	
FastEthernet1/0	192.168.3.1	YES	manual	up	
FastEthernet2/0	192.168.2.1	YES	manual	up	

3)Проверка DHCP:

Выдача ip адреса ПК1

dhcp

```

PC1> dhcp
DDORA IP 192.168.1.2/24 GW 192.168.1.1
PC1> show ip

NAME      : PC1[1]
IP/MASK   : 192.168.1.2/24
GATEWAY   : 192.168.1.1
DNS       :
DHCP SERVER : 192.168.3.2
DHCP LEASE  : 86390, 86400/43200/75600
DOMAIN NAME : lan1.local
MAC       : 00:50:79:66:68:00
LPORT     : 22126
RHOST:PORT : 127.0.0.1:22127
MTU      : 1500

```

DHCP-сервер выдал правильный ip адрес из пула LAN1

Проверим передачу пакетов в wireshark

29 38.596531	0.0.0.0	255.255.255.255	DHCP	406 DHCP Discover - Transaction ID 0x4b25fd0f
30 38.626947	cc:01:6a:45:00:00	Broadcast	ARP	60 Who has 192.168.1.2? Tell 192.168.1.1
31 40.329925	0c:03:68:8e:00:00	Spanning-tree-(for...)	STP	60 Conf. Root = 32768/1:0c:03:68:8e:00:00 Cost = 0 Port = 0x80...
32 40.339559	192.168.1.1	192.168.1.2	DHCP	342 DHCP Offer - Transaction ID 0x4b25fd0f
33 41.596637	0.0.0.0	255.255.255.255	DHCP	406 DHCP Request - Transaction ID 0x4b25fd0f
34 41.610174	192.168.1.1	192.168.1.2	DHCP	342 DHCP ACK - Transaction ID 0x4b25fd0f

Сначала ПК1 отправляет широковещательный запрос DISCOVER (ищет DHCP-сервер). IP адресс 0.0.0.0, т. к. ПК1 еще не получил адрес от DHCP-сервера.

► Ethernet II, Src: 00:50:79:66:68:00 (00:50:79:66:68:00), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
► Internet Protocol Version 4, Src: 0.0.0.0, Dst: 255.255.255.255
► User Datagram Protocol, Src Port: 68, Dst Port: 67
▼ Dynamic Host Configuration Protocol (Discover)
Message type: Boot Request (1)
Hardware type: Ethernet (0x01)
Hardware address length: 6
Hops: 0
Transaction ID: 0x4b25fd0f
Seconds elapsed: 0
► Bootp flags: 0x0000 (Unicast)
Client IP address: 0.0.0.0
Your (client) IP address: 0.0.0.0
Next server IP address: 0.0.0.0
Relay agent IP address: 0.0.0.0
Client MAC address: 00:50:79:66:68:00 (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 (Discover)
► Option: (12) Host Name
► Option: (61) Client identifier

Затем DHCP-сервер высыпает OFFER, выбирает доступный IP-адрес из пула (192.168.1.2) и отправляет его клиенту. R1 служит как DHCP-Relay.

► Frame 32: 342 bytes on wire (2736 bits), 342 bytes captured (2736 bits) on interface -, id 0
► Ethernet II, Src: cc:01:6a:45:00:00 (cc:01:6a:45:00:00), Dst: 00:50:79:66:68:00 (00:50:79:66:68:00)
► Internet Protocol Version 4, Src: 192.168.1.1, Dst: 192.168.1.2
► User Datagram Protocol, Src Port: 67, Dst Port: 68
▼ Dynamic Host Configuration Protocol (Offer)
Message type: Boot Reply (2)
Hardware type: Ethernet (0x01)
Hardware address length: 6
Hops: 0
Transaction ID: 0x4b25fd0f
Seconds elapsed: 0
► Bootp flags: 0x0000 (Unicast)
Client IP address: 0.0.0.0
Your (client) IP address: 192.168.1.2
Next server IP address: 0.0.0.0
Relay agent IP address: 192.168.1.1 DHCP-Relay
Client MAC address: 00:50:79:66:68:00 (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 (192.168.3.2)
► Option: (51) IP Address Lease Time
► Option: (58) Renewal Time Value
► Option: (59) Rebinding Time Value
► Option: (1) Subnet Mask (255.255.255.0)
► Option: (3) Router
► Option: (15) Domain Name
Length: 10
Domain Name: lan1.local
► Option: (255) End
Padding: 0000000000000000

ПК1 посыпает REQUEST, он принимает предложение и отправляет серверу запрос на использование предложенных параметров. Ир-адрес все еще 0.0.0.0, т. к. сервер еще не подтвердил запрос.

```
▶ Frame 33: 406 bytes on wire (3248 bits), 406 bytes captured (3248 bits) on interface -, id 0
▶ Ethernet II, Src: 00:50:79:66:68:00 (00:50:79:66:68:00), Dst: cc:01:6a:45:00:00 (cc:01:6a:45:00:00)
▶ Internet Protocol Version 4, Src: 0.0.0.0, Dst: 255.255.255.255
▶ User Datagram Protocol, Src Port: 68, Dst Port: 67
└ Dynamic Host Configuration Protocol (Request)
    Message type: Boot Request (1)
    Hardware type: Ethernet (0x01)
    Hardware address length: 6
    Hops: 0
    Transaction ID: 0x4b25fd0f
    Seconds elapsed: 0
    Boot flags: 0x0000 (Unicast)
    Client IP address: 192.168.1.2
    Your (client) IP address: 0.0.0.0
    Next server IP address: 0.0.0.0
    Relay agent IP address: 0.0.0.0
    Client MAC address: 00:50:79:66:68:00 (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 (Request)
        Length: 1
        DHCP: Request (3)
    ▼ Option: (54) DHCP Server Identifier (192.168.3.2)
        Length: 4
        DHCP Server Identifier: 192.168.3.2
    ▼ Option: (50) Requested IP Address (192.168.1.2)
        Length: 4
        Requested IP Address: 192.168.1.2
    ▼ Option: (61) Client identifier
        Length: 7
```

DHCP-сервер посыпает ACK, подтверждает запрос и закрепляет у ПК1 выданный ip-адрес.

```
▶ Frame 34: 342 bytes on wire (2736 bits), 342 bytes captured (2736 bits) on interface -, id 0
▶ Ethernet II, Src: cc:01:6a:45:00:00 (cc:01:6a:45:00:00), Dst: 00:50:79:66:68:00 (00:50:79:66:68:00)
▶ Internet Protocol Version 4, Src: 192.168.1.1, Dst: 192.168.1.2
▶ 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: 0x4b25fd0f
    Seconds elapsed: 0
    Boot flags: 0x0000 (Unicast)
    Client IP address: 192.168.1.2
    Your (client) IP address: 192.168.1.2
    Next server IP address: 0.0.0.0
    Relay agent IP address: 192.168.1.1
    Client MAC address: 00:50:79:66:68:00 (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)
        Length: 1
        DHCP: ACK (5)
    ▼ Option: (54) DHCP Server Identifier (192.168.3.2)
        Length: 4
        DHCP Server Identifier: 192.168.3.2
    ▼ Option: (51) IP Address Lease Time
        Length: 4
        IP Address Lease Time: 1 day (86400)
    ▼ Option: (58) Renewal Time Value
        Length: 4
        Renewal Time Value: 12 hours (43200)
```

Проверим выдачу ip-адресов на других ПК

ПК2:

dhcp

```
PC2> dhcp
DDORA IP 192.168.1.3/24 GW 192.168.1.1

PC2> show ip

NAME      : PC2[1]
IP/MASK   : 192.168.1.3/24
GATEWAY   : 192.168.1.1
DNS       :
DHCP SERVER : 192.168.3.2
DHCP LEASE  : 86389, 86400/43200/75600
DOMAIN NAME : lan1.local
MAC        : 00:50:79:66:68:01
LPORT      : 22128
RHOST:PORT : 127.0.0.1:22129
MTU       : 1500
```

ПК3:

dhcp

```
PC3> dhcp
DDORA IP 192.168.2.2/24 GW 192.168.2.1

PC3> show ip

NAME      : PC3[1]
IP/MASK   : 192.168.2.2/24
GATEWAY   : 192.168.2.1
DNS       :
DHCP SERVER : 192.168.3.2
DHCP LEASE  : 86393, 86400/43200/75600
DOMAIN NAME : lan2.local
MAC        : 00:50:79:66:68:02
LPORT      : 22130
RHOST:PORT : 127.0.0.1:22131
MTU       : 1500
```

ПК4:

dhcp

```
PC4> dhcp
DDORA IP 192.168.2.3/24 GW 192.168.2.1

PC4> show ip

NAME      : PC4[1]
IP/MASK   : 192.168.2.3/24
GATEWAY   : 192.168.2.1
DNS       :
DHCP SERVER : 192.168.3.2
DHCP LEASE  : 86393, 86400/43200/75600
DOMAIN NAME : lan2.local
MAC        : 00:50:79:66:68:03
LPORT      : 22138
RHOST:PORT : 127.0.0.1:22139
MTU        : 1500
```

DHCP-сервер выдает правильный IP-адреса, можно сделать вывод, что он работает правильно.

4) Проверка ping

Проверка доступности ПК2, ПК3, ПК4 с ПК1

ping 192.168.1.3

ping 192.168.2.2

ping 192.168.2.3

```
PC1> ping 192.168.1.3

84 bytes from 192.168.1.3 icmp_seq=1 ttl=64 time=1.767 ms
84 bytes from 192.168.1.3 icmp_seq=2 ttl=64 time=2.544 ms
84 bytes from 192.168.1.3 icmp_seq=3 ttl=64 time=9.185 ms
84 bytes from 192.168.1.3 icmp_seq=4 ttl=64 time=0.859 ms
84 bytes from 192.168.1.3 icmp_seq=5 ttl=64 time=0.735 ms

PC1> ping 192.168.2.2

84 bytes from 192.168.2.2 icmp_seq=1 ttl=63 time=30.172 ms
84 bytes from 192.168.2.2 icmp_seq=2 ttl=63 time=20.414 ms
84 bytes from 192.168.2.2 icmp_seq=3 ttl=63 time=14.934 ms
84 bytes from 192.168.2.2 icmp_seq=4 ttl=63 time=17.887 ms
84 bytes from 192.168.2.2 icmp_seq=5 ttl=63 time=17.173 ms

PC1> ping 192.168.2.3

84 bytes from 192.168.2.3 icmp_seq=1 ttl=63 time=30.591 ms
84 bytes from 192.168.2.3 icmp_seq=2 ttl=63 time=16.441 ms
84 bytes from 192.168.2.3 icmp_seq=3 ttl=63 time=18.151 ms
84 bytes from 192.168.2.3 icmp_seq=4 ttl=63 time=28.323 ms
84 bytes from 192.168.2.3 icmp_seq=5 ttl=63 time=17.839 ms
```

Проверка доступности ПК1, ПК2, ПК3 с ПК4

```
ping 192.168.1.2
```

```
ping 192.168.1.3
```

```
ping 192.168.2.2
```

```
PC4> ping 192.168.1.2

84 bytes from 192.168.1.2 icmp_seq=1 ttl=63 time=33.212 ms
84 bytes from 192.168.1.2 icmp_seq=2 ttl=63 time=15.696 ms
84 bytes from 192.168.1.2 icmp_seq=3 ttl=63 time=17.001 ms
84 bytes from 192.168.1.2 icmp_seq=4 ttl=63 time=17.880 ms
84 bytes from 192.168.1.2 icmp_seq=5 ttl=63 time=17.992 ms

PC4> ping 192.168.1.3

84 bytes from 192.168.1.3 icmp_seq=1 ttl=63 time=37.644 ms
84 bytes from 192.168.1.3 icmp_seq=2 ttl=63 time=16.655 ms
84 bytes from 192.168.1.3 icmp_seq=3 ttl=63 time=26.587 ms
84 bytes from 192.168.1.3 icmp_seq=4 ttl=63 time=17.765 ms
84 bytes from 192.168.1.3 icmp_seq=5 ttl=63 time=17.280 ms

PC4> ping 192.168.2.2

84 bytes from 192.168.2.2 icmp_seq=1 ttl=64 time=0.444 ms
84 bytes from 192.168.2.2 icmp_seq=2 ttl=64 time=0.696 ms
84 bytes from 192.168.2.2 icmp_seq=3 ttl=64 time=3.567 ms
84 bytes from 192.168.2.2 icmp_seq=4 ttl=64 time=2.798 ms
84 bytes from 192.168.2.2 icmp_seq=5 ttl=64 time=2.237 ms
```

Все ПК успешно пингуются.