

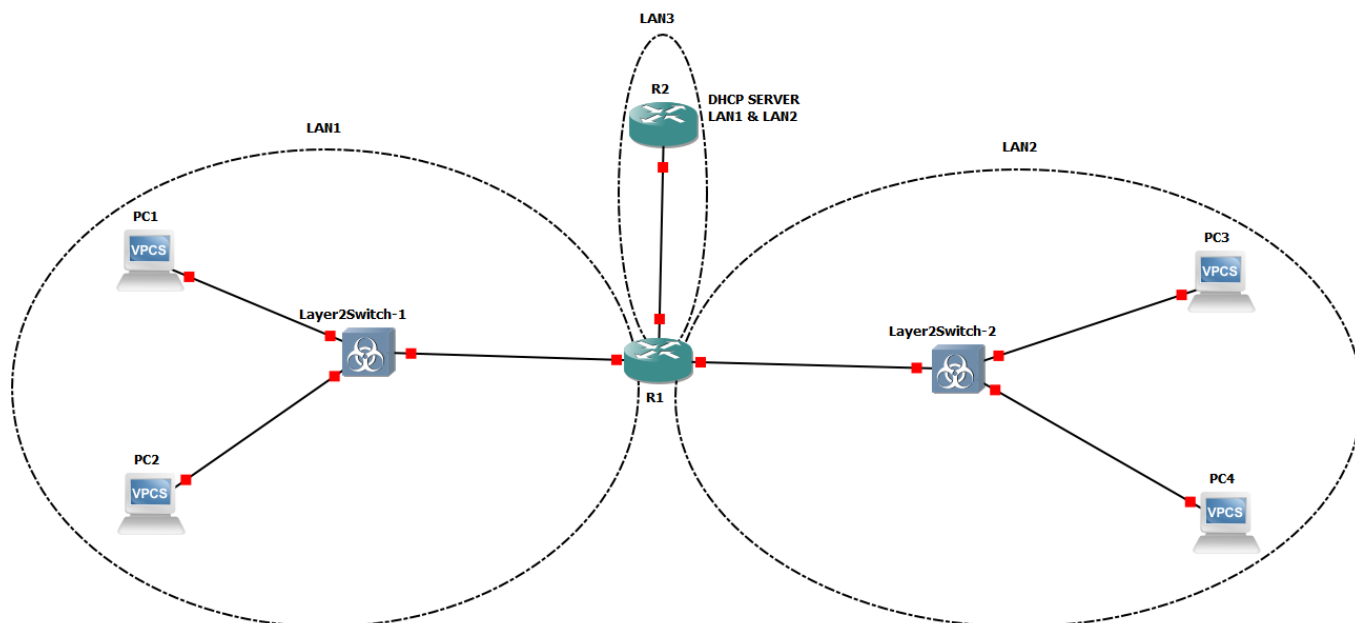
Тема: Настройка протокола DHCP

Все команды для настройки включаются в отчет в текстовом виде, не скриншоты.

nb! - отметка в тексте, "обратите особое внимание"

1) Для заданной на схеме schema-lab4 сети, состоящей из управляемых коммутаторов, маршрутизаторов и персональных компьютеров выполнить планирование и документирование адресного пространства в подсетях LAN1, LAN2, LAN3 и назначить статические адреса маршрутизаторам и динамическое конфигурирование адресов для VPC

Топология выглядит следующим образом



Настройку сети начнём с коммутатора 1, он же **Layer2Switch-1**:

Обращаем внимание на физическую топологию, чтобы правильный порт подключить и назвать правильно, а то в Layer2Switch-2 они иначе присоединены (В коммутаторе1 e0 к VPCS, а в коммутаторе2 e0 к маршрутизатору).

КОМАНДНЫ:

```
enable
configure terminal
vlan 1
name VLAN1
exit
```

```
interface Gi0/0
switchport mode access
switchport access vlan 1
description "TO_PC1"
no shutdown
exit
```

```
interface Gi0/1
switchport mode access
switchport access vlan 1
description "TO_PC2"
no shutdown
exit
```

```
interface Gi0/2
switchport mode access
switchport access vlan 1
description "TO_R1"
no shutdown
exit
```

```
end
write memory
```

```
vIOS-L2-01>show ip interface
GigabitEthernet0/0 is up, line protocol is up
  Inbound access list is not set
  Outgoing access list is not set
GigabitEthernet0/1 is up, line protocol is up
  Inbound access list is not set
  Outgoing access list is not set
GigabitEthernet0/2 is up, line protocol is up
  Inbound access list is not set
  Outgoing access list is not set
vIOS-L2-01>Q
vIOS-L2-01>QP8P4Q
vIOS-L2-01>enable
vIOS-L2-01#
vIOS-L2-01#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
vIOS-L2-01(config)#vlan 1
vIOS-L2-01(config-vlan)#name VLAN1
%Default VLAN 1 may not have its name changed.
vIOS-L2-01(config-vlan)#exit
vIOS-L2-01(config)#P5QQ
vIOS-L2-01#P:
*Dec 12 04:03:47.432: %SYS-5-CONFIG_I: Configured from console by console
vIOS-L2-01#P:interface Gi0/0
      ^
% Invalid input detected at '^' marker.

vIOS-L2-01#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
vIOS-L2-01(config)#interface Gi0/0
vIOS-L2-01(config-if)#switchport mode access
vIOS-L2-01(config-if)#switchport access vlan 1
vIOS-L2-01(config-if)#description "TO_PC1"
vIOS-L2-01(config-if)#no shutdown
vIOS-L2-01(config-if)#exit
vIOS-L2-01(config)#interface Gi0/1
```

```

vIOS-L2-01(config)#interface Gi0/1
vIOS-L2-01(config-if)#switchport mode access
vIOS-L2-01(config-if)#switchport access vlan 1
vIOS-L2-01(config-if)#description "TO_PC2"
vIOS-L2-01(config-if)#no shutdown
vIOS-L2-01(config-if)#exit
vIOS-L2-01(config)#interface Gi0/2
vIOS-L2-01(config-if)#switchport mode access
vIOS-L2-01(config-if)#switchport access vlan 1
vIOS-L2-01(config-if)#description "TO_R1"
vIOS-L2-01(config-if)#no shutdown
vIOS-L2-01(config-if)#exit
vIOS-L2-01(config)#end
vIOS-L2-01#w
*Dec 12 04:06:30.237: %SYS-5-CONFIG_I: Configured from console by console
vIOS-L2-01#write memory
Building configuration...
Compressed configuration from 4914 bytes to 1888 bytes[OK]
vIOS-L2-01#
*Dec 12 04:06:42.247: %GRUB-5-CONFIG_WRITING: GRUB configuration is being updated on disk. Please wait...
*Dec 12 04:06:42.995: %GRUB-5-CONFIG_WRITTEN: GRUB configuration was written to disk successfully.
vIOS-L2-01#

```

Можно наблюдать, что VLAN1 и так был по дефолту для коммутатора 1 по:

%Default VLAN 1 may not have its name changed.

КОМАНДОЙ show interfaces description получили:

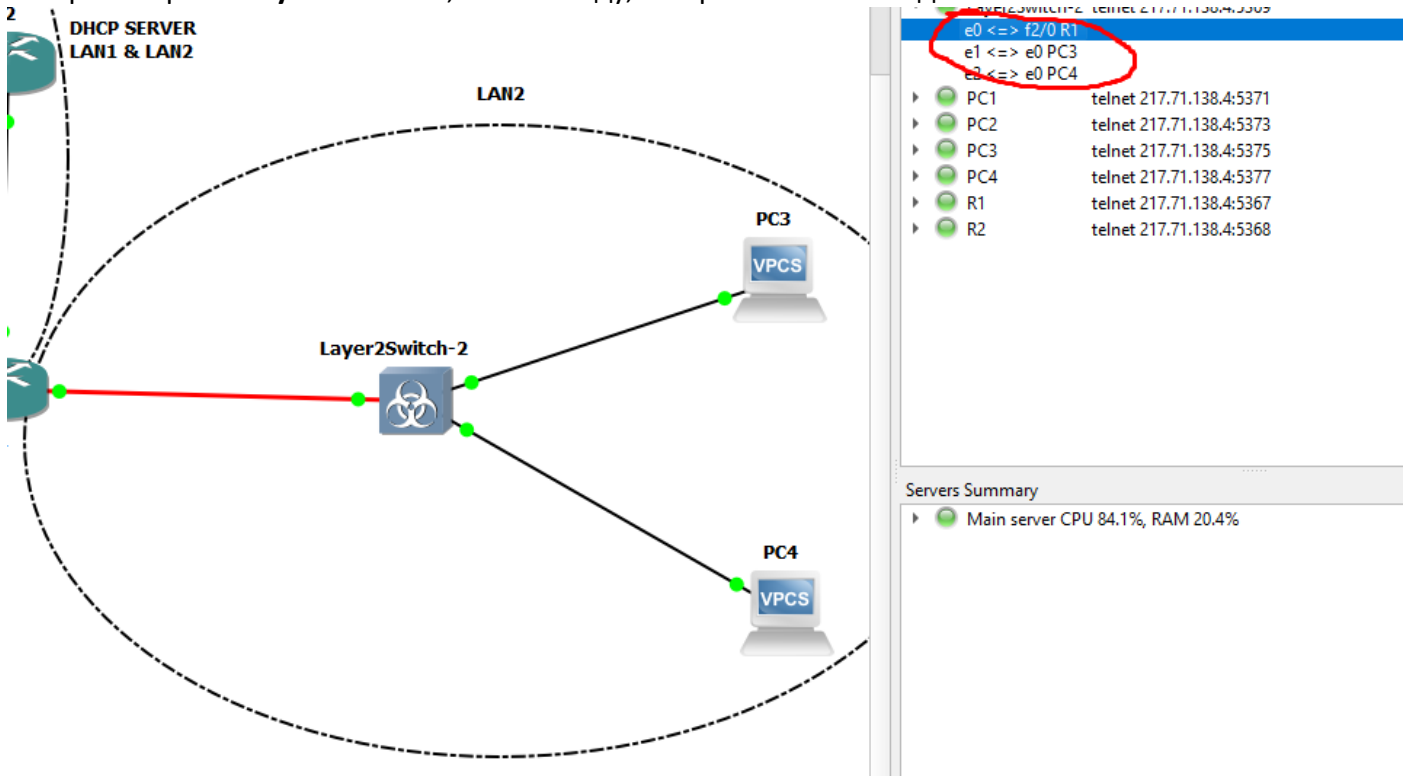
```

vIOS-L2-01#show interfaces description

```

Interface	Status	Protocol	Description
Gi0/0	up	up	"TO_PC1"
Gi0/1	up	up	"TO_PC2"
Gi0/2	up	up	"To_R1"

Теперь настроим Layer2Switch-2, имея в виду, что физически он подключён иначе:



КОМАНДЫ:

```
enable
configure terminal
vlan 2
name VLAN2
exit
```

```
interface Gi0/0
switchport mode access
switchport access vlan 2
description "TO_R1"
no shutdown
exit
```

```
interface Gi0/1
switchport mode access
switchport access vlan 2
description "TO_PC3"
no shutdown
exit
```

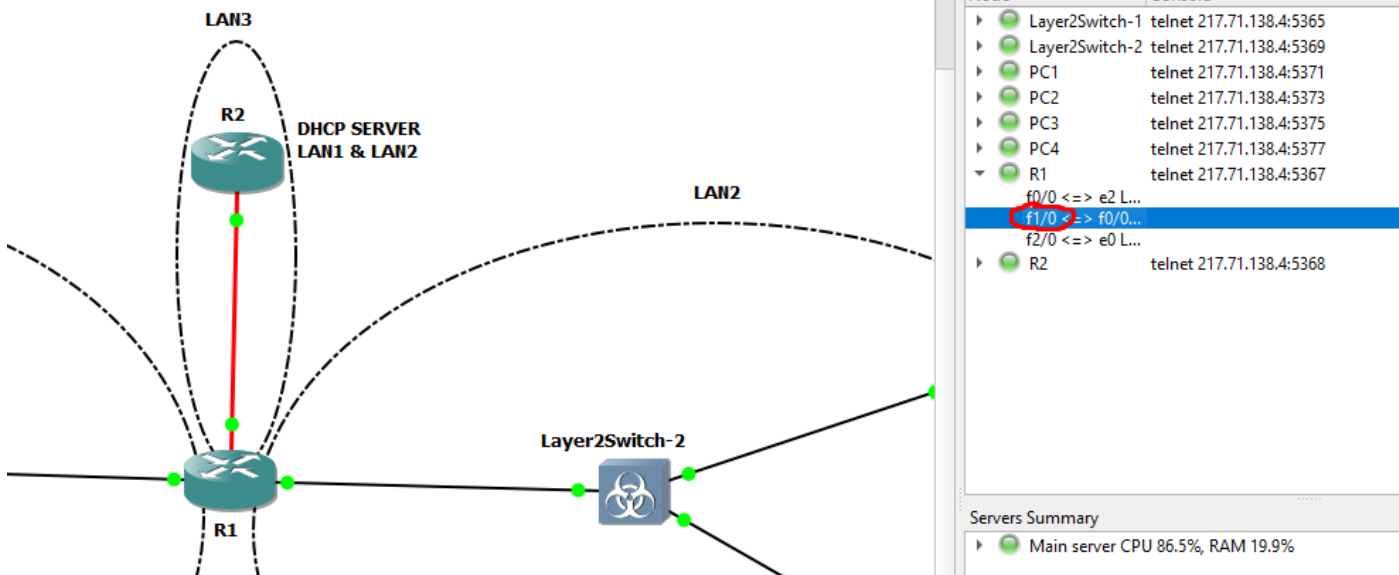
```
interface Gi0/2
switchport mode access
switchport access vlan 2
description "TO_PC4"
no shutdown
exit
```

```
end
write memory
```

```
Layer2Switch-2 - PuTTY
* http://www.cisco.com/go/eula
*
* Unauthorized use or distribution of this software is expressly
* Prohibited.
*****
vIOS-L2-01>
vIOS-L2-01>enable
vIOS-L2-01#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
vIOS-L2-01(config)#vlan 2
vIOS-L2-01(config-vlan)#name VLAN2
vIOS-L2-01(config-vlan)#exit
vIOS-L2-01(config)#
vIOS-L2-01(config)#interface Gi0/0
vIOS-L2-01(config-if)#switchport mode access
vIOS-L2-01(config-if)#switchport access vlan 2
vIOS-L2-01(config-if)#description "TO_R1"
vIOS-L2-01(config-if)#no shutdown
vIOS-L2-01(config-if)#exit
vIOS-L2-01(config)#
vIOS-L2-01(config)#interface Gi0/1
vIOS-L2-01(config-if)#switchport mode access
vIOS-L2-01(config-if)#switchport access vlan 2
vIOS-L2-01(config-if)#description "TO_PC3"
vIOS-L2-01(config-if)#no shutdown
vIOS-L2-01(config-if)#exit
vIOS-L2-01(config)#
vIOS-L2-01(config)#interface Gi0/2
vIOS-L2-01(config-if)#switchport mode access
vIOS-L2-01(config-if)#switchport access vlan 2
vIOS-L2-01(config-if)#description "TO_PC4"
vIOS-L2-01(config-if)#no shutdown
vIOS-L2-01(config-if)#exit
vIOS-L2-01(config)#
vIOS-L2-01(config)#end
vIOS-L2-01#write memory
*Dec 12 04:19:42.344: %SYS-5-CONFIG_I: Configured from console by console
vIOS-L2-01#write memory
Building configuration...
Compressed configuration from 5008 bytes to 1943 bytes[OK]
*Dec 12 04:20:03.228: %GRUB-5-CONFIG_WRITING: GRUB configuration is being updated on disk. Please wait...
*Dec 12 04:20:03.980: %GRUB-5-CONFIG_WRITTEN: GRUB configuration was written to disk successfully.
vIOS-L2-01#show interfaces description
Interface                Status        Protocol Description
Gi0/0                    up            up        "TO_R1"
Gi0/1                    up            up        "TO_PC3"
Gi0/2                    up            up        "TO_PC4"
vIOS-L2-01#
```

Тут всё готово

Настроим маршрутизатор 1. Помним, что и куда подключено.



КОМАНДЫ:

enable

configure terminal

interface f0/0

ip address 192.168.10.1 255.255.255.0

no shutdown

exit

interface f1/0

ip address 10.0.0.1 255.255.255.252

no shutdown

exit

interface f2/0

ip address 192.168.20.1 255.255.255.0

no shutdown

exit

end

write memory

Маска 255.255.255.252 позволяет иметь 4 адреса, 1 из которых широковещательный, 2 для двух маршрутизаторов, 1 не используется, он как адрес сети.

```
R1#enable
R1#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#
R1(config)#interface f0/0
R1(config-if)#ip address 192.168.10.1 255.255.255.0
R1(config-if)#no shutdown
R1(config-if)#exit
R1(config)#
R1(config)#interface f1/0
R1(config-if)#ip address 10.0.0.1 255.255.255.252
R1(config-if)#no shutdown
R1(config-if)#exit
R1(config)#
R1(config)#interface f2/0
R1(config-if)#ip address 192.168.20.1 255.255.255.0
R1(config-if)#no shutdown
R1(config-if)#exit
R1(config)#
R1(config)#end
R1#write memory
Building configuration...
[OK]
R1#
*Mar  1 00:25:29.287: %SYS-5-CONFIG_I: Configured from console by console
R1#
*Mar  1 00:25:30.507: %LINK-3-UPDOWN: Interface FastEthernet0/0, changed state t
o up
*Mar  1 00:25:31.027: %LINK-3-UPDOWN: Interface FastEthernet1/0, changed state t
o up
*Mar  1 00:25:31.123: %LINK-3-UPDOWN: Interface FastEthernet2/0, changed state t
o up
*Mar  1 00:25:31.507: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthern
et0/0, changed state to up
R1#
*Mar  1 00:25:32.027: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthern
et1/0, changed state to up
*Mar  1 00:25:32.123: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthern
et2/0, changed state to up
R1#
```

Пришла очередь R2

КОМАНДЫ:

enable

configure terminal

interface f0/0

ip address 10.0.0.2 255.255.255.252

no shutdown

exit

end

write memory

```

R2#enable
R2#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)#
R2(config)#interface f0/0
R2(config-if)# ip address 10.0.0.2 255.255.255.252
R2(config-if)# no shutdown
R2(config-if)# exit
R2(config)#
R2(config)#end
R2#write memory
Building configuration...

*Mar  1 00:21:17.447: %SYS-5-CONFIG_I: Configured from console by console
*Mar  1 00:21:19.263: %LINK-3-UPDOWN: Interface FastEthernet0/0, changed state to up[OK]
R2#
*Mar  1 00:21:20.271: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
R2#

```

2) Настроить сервер DHCP на маршрутизаторе R2 для обслуживания адресных пулов адресного пространства подсетей LAN1 и LAN2

Настроим DHCP пулы на R2

КОМАНДЫ:

enable

configure terminal

ip dhcp pool LAN1_POOL

network 192.168.10.0 255.255.255.0

default-router 192.168.10.1

dns-server 8.8.8.8 8.8.4.4

domain-name example.com

lease 7

exit

ip dhcp pool LAN2_POOL

network 192.168.20.0 255.255.255.0

default-router 192.168.20.1

dns-server 8.8.8.8 8.8.4.4

domain-name example.com

lease 7

exit

ip dhcp excluded-address 192.168.10.1

ip dhcp excluded-address 192.168.20.1

end

write memory

Здесь dns-server – гугловские обычные-публичные 8.8.8.8 и 8.8.4.4. lease 7 – аренда IP на 7 дней. excluded-address – исключить адрес из пула.


```

R2#enable
R2#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#
R2(config)#ip dhcp pool LAN1_POOL
R2(dhcp-config)#network 192.168.10.0 255.255.255.0
R2(dhcp-config)#default-router 192.168.10.1
R2(dhcp-config)#dns-server 8.8.8.8 8.8.4.4
R2(dhcp-config)#domain-name example.com
R2(dhcp-config)#lease 7
R2(dhcp-config)#exit
R2(config)#
R2(config)#ip dhcp pool LAN2_POOL
R2(dhcp-config)#network 192.168.20.0 255.255.255.0
R2(dhcp-config)#default-router 192.168.20.1
R2(dhcp-config)#dns-server 8.8.8.8 8.8.4.4
R2(dhcp-config)#domain-name example.com
R2(dhcp-config)#lease 7
R2(dhcp-config)#exit
R2(config)#
R2(config)#ip dhcp excluded-address 192.168.10.1
R2(config)#ip dhcp excluded-address 192.168.20.1
R2(config)#
R2(config)#end
R2#write memory
Building configuration...
[OK]
R2#
*Mar  1 00:38:04.699: %SYS-5-CONFIG_I: Configured from console by console
R2#

```

«Полезная информация: возможно, что вам потребуется DHCP Relay»

DHCP запросы от VPCS не дойдут до R2 без DHCP Relay, потому что они в разных broadcast-доменах, так что явно требуется Relay. Настроим его КОМАНДАМИ:

enable

configure terminal

interface f0/0

ip helper-address 10.0.0.2

exit

interface f2/0

ip helper-address 10.0.0.2

exit

end

write memory

```

R1#enable
R1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#
R1(config)#interface f0/0
R1(config-if)#ip helper-address 10.0.0.2
R1(config-if)#exit
R1(config)#
R1(config)#interface f2/0
R1(config-if)#ip helper-address 10.0.0.2
R1(config-if)#exit
R1(config)#
R1(config)#end
R1#write memory
Building configuration...
[OK]
R1#
*Mar  1 00:56:07.907: %SYS-5-CONFIG_I: Configured from console by console
R1#

```

```

R1#ping 10.0.0.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.0.0.2, timeout is 2 seconds:
.!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 52/58/60 ms
R1#ping 10.0.0.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.0.0.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 56/60/64 ms
R1#

```

КОМАНДА

ping 10.0.0.2

На R1, чтобы убедиться, что маршрутизаторы видят друг друга на всякий

Теперь идём на VPCS, прописываем им КОМАНДЫ:

ip dhcp

show ip

```

PC1> ip dhcp
DDD
Can't find dhcp server
PC1>

```

Ну, или нет

Забыл, что нужна статическая маршрутизация между подсетями

Значит, идём выполнять 3)

3) Настроить статическую (nb!) маршрутизацию между подсетями

КОМАНДЫ:

enable

configure terminal

ip route 192.168.10.0 255.255.255.0 10.0.0.1

ip route 192.168.20.0 255.255.255.0 10.0.0.1

end

write memory

```

R2#enable
R2#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)#
R2(config)#ip route 192.168.10.0 255.255.255.0 10.0.0.1
R2(config)#ip route 192.168.20.0 255.255.255.0 10.0.0.1
R2(config)#
R2(config)#end
R2#write memory
Building configuration...

*Mar  1 00:50:13.211: %SYS-5-CONFIG_I: Configured from console by console[OK]
R2#

```

Было

```
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

    10.0.0.0/30 is subnetted, 1 subnets
C       10.0.0.0 is directly connected, FastEthernet0/0
R2#
```

Стало

```
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       192.168.10.0/24 [1/0] via 10.0.0.1
S       192.168.20.0/24 [1/0] via 10.0.0.1
    10.0.0.0/30 is subnetted, 1 subnets
C       10.0.0.0 is directly connected, FastEthernet0/0
R2#
```

4) Проверить работоспособность протокола DHCP и маршрутизации, выполнив ping между всеми VPC

Вот теперь идём на VPCS, прописываем им КОМАНДЫ:

ip dhcp

show ip

PC1> ip dhcp DDORA IP 192.168.10.3/24 GW 192.168.10.1	PC2> ip dhcp DDORA IP 192.168.10.4/24 GW 192.168.10.1	PC3> ip dhcp DDORA IP 192.168.20.2/24 GW 192.168.20.1	PC4> ip dhcp DDORA IP 192.168.20.3/24 GW 192.168.20.1
PC1> show ip NAME : PC1[1] IP/MASK : 192.168.10.3/24 GATEWAY : 192.168.10.1 DNS : 8.8.8.8 8.8.4.4 DHCP SERVER : 10.0.0.2 DHCP LEASE : 604790, 604800/302400/529200 DOMAIN NAME : example.com MAC : 00:50:79:66:68:00 LPORT : 20480 RHOST:PORT : 127.0.0.1:20481 MTU : 1500	PC2> show ip NAME : PC2[1] IP/MASK : 192.168.10.4/24 GATEWAY : 192.168.10.1 DNS : 8.8.8.8 8.8.4.4 DHCP SERVER : 10.0.0.2 DHCP LEASE : 604797, 604800/302400/529200 DOMAIN NAME : example.com MAC : 00:50:79:66:68:01 LPORT : 20482 RHOST:PORT : 127.0.0.1:20483 MTU : 1500	PC3> show ip NAME : PC3[1] IP/MASK : 192.168.20.2/24 GATEWAY : 192.168.20.1 DNS : 8.8.8.8 8.8.4.4 DHCP SERVER : 10.0.0.2 DHCP LEASE : 604773, 604800/302400/529200 DOMAIN NAME : example.com MAC : 00:50:79:66:68:02 LPORT : 20490 RHOST:PORT : 127.0.0.1:20491 MTU : 1500	PC4> show ip NAME : PC4[1] IP/MASK : 192.168.20.3/24 GATEWAY : 192.168.20.1 DNS : 8.8.8.8 8.8.4.4 DHCP SERVER : 10.0.0.2 DHCP LEASE : 604798, 604800/302400/529200 DOMAIN NAME : example.com MAC : 00:50:79:66:68:03 LPORT : 20492 RHOST:PORT : 127.0.0.1:20493 MTU : 1500

Причём DDORA

D – Discovery – ищем DHCP сервер широковещательным бродкастом.

O – Offer – предложение от сервера для VSCP с IP

R – Request – VSCP выбирает один из предложенных, их может быть не один, и запрашивает у одного себе IP.

A – ACK – подтверждение сервером запроса пользователем, после чего VSCP ставит себе этот IP.

Два раза D, на первый широковещательный D сервер не ответил, бывает.

Ещё интересно, что VPCS1 получил 192.168.10.3, VPCS3 получил 192.168.20.2. Так решил DHCP.

Теперь пингуем

VPCS1:

ping 192.168.10.4

ping 192.168.20.2

ping 192.168.20.3

VPCS2:

ping 192.168.20.2

ping 192.168.20.3

VPCS3:

ping 192.168.20.3

```
PC1> ping 192.168.10.4

84 bytes from 192.168.10.4 icmp_seq=1 ttl=64 time=4.889 ms
84 bytes from 192.168.10.4 icmp_seq=2 ttl=64 time=3.677 ms
84 bytes from 192.168.10.4 icmp_seq=3 ttl=64 time=1.008 ms
84 bytes from 192.168.10.4 icmp_seq=4 ttl=64 time=9.273 ms
84 bytes from 192.168.10.4 icmp_seq=5 ttl=64 time=3.539 ms

PC1> ping 192.168.20.2

84 bytes from 192.168.20.2 icmp_seq=1 ttl=63 time=27.332 ms
84 bytes from 192.168.20.2 icmp_seq=2 ttl=63 time=16.503 ms
84 bytes from 192.168.20.2 icmp_seq=3 ttl=63 time=26.452 ms
84 bytes from 192.168.20.2 icmp_seq=4 ttl=63 time=17.224 ms
84 bytes from 192.168.20.2 icmp_seq=5 ttl=63 time=16.004 ms

PC1> ping 192.168.20.3

84 bytes from 192.168.20.3 icmp_seq=1 ttl=63 time=30.303 ms
84 bytes from 192.168.20.3 icmp_seq=2 ttl=63 time=16.838 ms
84 bytes from 192.168.20.3 icmp_seq=3 ttl=63 time=17.020 ms
84 bytes from 192.168.20.3 icmp_seq=4 ttl=63 time=17.807 ms
84 bytes from 192.168.20.3 icmp_seq=5 ttl=63 time=16.335 ms

PC1>
```

```
PC2> ping 192.168.20.2

84 bytes from 192.168.20.2 icmp_seq=1 ttl=63 time=19.173 ms
84 bytes from 192.168.20.2 icmp_seq=2 ttl=63 time=16.713 ms
84 bytes from 192.168.20.2 icmp_seq=3 ttl=63 time=15.795 ms
84 bytes from 192.168.20.2 icmp_seq=4 ttl=63 time=16.338 ms
84 bytes from 192.168.20.2 icmp_seq=5 ttl=63 time=15.777 ms

PC2> ping 192.168.20.3

84 bytes from 192.168.20.3 icmp_seq=1 ttl=63 time=14.289 ms
84 bytes from 192.168.20.3 icmp_seq=2 ttl=63 time=26.288 ms
84 bytes from 192.168.20.3 icmp_seq=3 ttl=63 time=16.519 ms
84 bytes from 192.168.20.3 icmp_seq=4 ttl=63 time=17.393 ms
84 bytes from 192.168.20.3 icmp_seq=5 ttl=63 time=16.800 ms

PC2>
```

```
PC3> ping 192.168.20.3

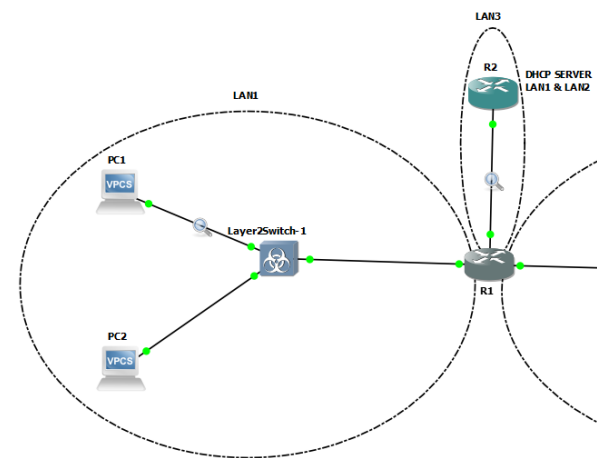
84 bytes from 192.168.20.3 icmp_seq=1 ttl=64 time=0.741 ms
84 bytes from 192.168.20.3 icmp_seq=2 ttl=64 time=9.216 ms
84 bytes from 192.168.20.3 icmp_seq=3 ttl=64 time=2.440 ms
84 bytes from 192.168.20.3 icmp_seq=4 ttl=64 time=1.948 ms
84 bytes from 192.168.20.3 icmp_seq=5 ttl=64 time=2.532 ms

PC3>
```

Артхаос скринов

5) Перехватить в wireshark диалог одного из VPC с сервером DHCP, разобрать с комментариями

Перехватим сразу после отправки на линке к коммутатору и посмотрим на линке R1-R2



Пропишем КОМАНДУ ip dhcp у VPCS1

```
PC1> ip dhcp
DORA IP 192.168.10.3/24 GW 192.168.10.1

PC1>
```

Wireshark - Standard input [PC1 (Ethernet) to Layer2Switch-1 (Ethernet)]									
File Edit View Capture Analysis Statistics Help Ethernet capture file Instrument Settings									
Применить фильтр отображения... «Ctrl+F»									
No.	Time	Source	Destination	Protocol	Length	Info			
10	0.000000	192.168.10.3	192.168.10.1	DHCP	60	DHCP Discover - Transaction ID 0x72a0b441			
11	0.000000	192.168.10.1	192.168.10.3	DHCP	60	DHCP Offer - Transaction ID 0x72a0b441			
12	0.000000	192.168.10.3	192.168.10.1	DHCP	60	DHCP Request - Transaction ID 0x72a0b441			
13	0.000000	192.168.10.1	192.168.10.3	DHCP	60	DHCP Ack - Transaction ID 0x72a0b441			
14	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
15	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
16	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
17	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
18	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
19	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
20	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
21	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
22	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
23	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
24	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
25	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
26	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
27	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
28	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
29	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
30	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
31	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
32	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
33	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
34	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
35	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
36	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
37	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
38	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
39	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
40	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
41	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
42	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
43	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
44	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
45	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
46	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
47	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
48	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
49	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
50	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
51	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
52	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
53	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
54	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
55	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
56	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
57	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
58	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
59	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
60	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
61	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
62	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
63	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
64	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
65	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
66	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
67	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
68	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
69	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
70	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
71	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
72	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
73	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
74	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
75	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
76	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
77	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
78	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
79	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
80	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
81	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
82	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
83	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
84	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
85	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
86	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
87	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
88	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
89	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
90	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
91	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
92	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
93	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
94	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
95	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
96	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
97	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
98	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
99	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
100	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
101	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
102	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
103	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
104	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
105	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
106	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
107	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
108	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
109	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
110	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
111	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
112	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
113	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
114	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
115	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
116	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
117	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
118	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
119	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
120	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
121	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
122	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
123	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
124	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
125	0.000000	192.168.10.3	192.168.10.1	DHCP	60	Gratuitous ARP for 192.168.10.3 (Request)			
126	0.000000	192.168.10.3	192.168.10.1						

```

# Frame 42: Packet, 486 bytes on wire (324B bits), 486 bytes captured (324B bits) on interface
Ethernet II, Src: Private-66:08:00 (cc:81:79:66:08:00), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
    > Source: Private-66:08:00 (08:00:50:79:66:08:00)
      Type: IPv4 (0x0008)
        Stream Index: 4
Internet Protocol Version 4, Src: 0.0.0.0, Dst: 255.255.255.255
    > 0.0.0.0 = Version: 4
    > ... 0.0.0.0 = Header Length: 20 bytes (5)
    > Differentiated Services Field: 0x00 (DSCP: Unknown, ECN: Not-ECT)
      Total Length: 392
      Identification: 0x0000 (0)
    > 0.0.0.0 = Flags: 0xb
    > ... 0.0.0.0 0.0.0.0 = Fragment Offset: 0
    Time to Live: 36
    Protocol: UDP (17)
Header Checksum: b4956 [validation disabled]
[Header checksum status: Unverified]
Source Address: 0.0.0.0
Destination Address: 255.255.255.255
Stream Index: 0
User Datagram Protocol, Src Port: 67, Dst Port: 67

0000 ff ff ff ff ff ff 50 79 66 08 00 00 00 45 30 p yfh
0001 00 00 00 00 00 00 11 01 00 00 00 00 00 f2 ad C t d
0002 ff ff ff ff ff ff 50 79 66 08 00 00 00 f2 ad C t d
0003 54 41 00 00 00 00 00 00 00 00 00 00 00 00 A y fh
0004 00 00 00 00 00 00 00 00 79 66 08 00 00 00 00
0005 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0006 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0007 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0008 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0009 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0010 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0011 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0012 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0013 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0014 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0015 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0016 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0017 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0018 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0019 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0020 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0021 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0022 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0023 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0024 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0025 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0026 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0027 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0028 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0029 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0030 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0031 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0032 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0033 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0034 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0035 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0036 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0037 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0038 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0039 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0040 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0041 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0042 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0043 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0044 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0045 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0046 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0047 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0048 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0049 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0050 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0051 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0052 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0053 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0054 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0055 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0056 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0057 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0058 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0059 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
0061 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0062 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0063 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0064 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0065 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0066 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0067 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0068 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0069 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
0071 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0072 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0073 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0074 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0075 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0076 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0077 00 00 00 00 00 00 00 00
```

Видим 4 транзакции DORA, которые я разобрал ранее. Теперь с одной D.

На линке 1:

Сообщение от 0.0.0.0, ip уже очистили, на широковещательный адрес.

Сервер предлагает ip 192.168.10.3

Потом VPCS соглашается, а сервер подтверждает

На линке 2 пересылка идёт через 10.0.0.2, в остальном всё так же.

Про всякие addr

1. ciaddr (Client IP Address)

ciaddr = 0.0.0.0

Что: IP-адрес клиента до получения нового адреса

Когда заполняется:

- При обновлении аренды (renew) — содержит текущий IP клиента
- При первоначальном запросе — 0.0.0.0 (клиент без IP)

В нашем случае: 0.0.0.0 — VPCS1 ещё не имеет IP

2. yiaddr (Your IP Address)

yiaddr = 0.0.0.0 (в DISCOVER) -> 192.168.10.3 (в OFFER/ACK)

Что: IP-адрес, который сервер предлагает/подтверждает клиенту

Когда заполняется:

- DISCOVER/REQUEST: 0.0.0.0 (клиент ещё не знает свой IP)
- OFFER/ACK: 192.168.10.3 (предложенный/подтверждённый IP)

Обращение сервера к клиенту: "Предлагаю тебе вот такой IP" / "Вот **твой** IP"

3. siaddr (Server IP Address)

siaddr = 0.0.0.0 (B DISCOVER) -> 10.0.0.2 (B OFFER)

Что: IP-адрес DHCP сервера

Когда заполняется:

- DISCOVER: 0.0.0.0 (клиент не знает, какой сервер ответит)
- OFFER/ACK: 10.0.0.2 (адрес R2 — DHCP сервера)

Важно: Это адрес следующего сервера в процессе загрузки

4. giaddr (Gateway IP Address)

```
giaddr = 192.168.10.1
```

Что: IP-адрес DHCP Relay Agent (R1 в вашем случае)

Кто заполняет: Только DHCP Relay Agent

Зачем: Чтобы сервер знал, куда отправить ответ (unicast на этот адрес)

б) Сохранить файлы конфигураций устройств в виде набора файлов с именами, соответствующими именам устройств

Сохранил