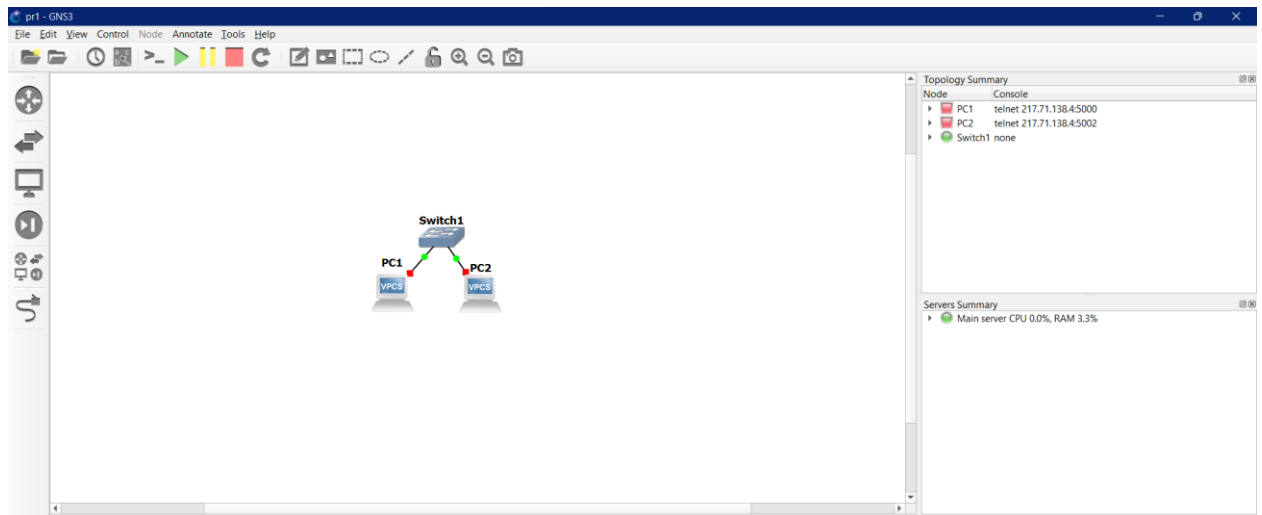


Создали сеть из 1 коммутатора и 2х компьютеров



Задаём адреса клиентам:

ip 89.189.178.1/24 89.189.178.50

ip 89.189.178.2/24 89.189.178.50

```
PC1 - PuTTY

Welcome to Virtual PC Simulator, version 0.8.3
Dedicated to Daling.
Build time: Sep  9 2023 11:15:00
Copyright (c) 2007-2015, Paul Meng (mirnshi@gmail.com)
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VPCS is free software, distributed under the terms of the
Source code and license can be found at vpcs.sf.net.
For more information, please visit wiki.freecode.com.cn.

Press '?' to get help.

Executing the startup file

PC1> ip 89.189.178.1/24 89.189.178.50
Checking for duplicate address...
PC1 : 89.189.178.1 255.255.255.0 gateway 89.189.178.50
```

```
PC2 - PuTTY

Welcome to Virtual PC Simulator, version 0.8.3
Dedicated to Daling.
Build time: Sep  9 2023 11:15:00
Copyright (c) 2007-2015, Paul Meng (mirnshi@gmail.com)
All rights reserved.

VPCS is free software, distributed under the terms of the "BS
Source code and license can be found at vpcs.sf.net.
For more information, please visit wiki.freecode.com.cn.

Press '?' to get help.

Executing the startup file

PC2> ip 89.189.178.2/24 89.189.178.50
Checking for duplicate address...
PC2 : 89.189.178.2 255.255.255.0 gateway 89.189.178.50
```

Пингуем PC1 -> PC2:

```
PC1> ping 89.189.178.2

84 bytes from 89.189.178.2 icmp_seq=1 ttl=64 time=0.376 ms
84 bytes from 89.189.178.2 icmp_seq=2 ttl=64 time=0.358 ms
84 bytes from 89.189.178.2 icmp_seq=3 ttl=64 time=0.425 ms
84 bytes from 89.189.178.2 icmp_seq=4 ttl=64 time=0.401 ms
84 bytes from 89.189.178.2 icmp_seq=5 ttl=64 time=0.390 ms
```

PC1 <-> Switch и PC2 <-> Switch соотв.

Захват из Standard input (PC1 Ethernet0 to Switch1 Ethernet0)						
Файл Правка Вид Запуск Захват Анализ Статистика Телефония Беспроводная связь Инструменты Справка						
arp						
No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	Private_66:68:01	Broadcast	ARP	64	Who has 89.189.178.2? Tell 89.189.178.1
2	0.000202	Private_66:68:00	Private_66:68:01	ARP	64	89.189.178.2 is at 00:50:79:66:68:00

Захват из Standard input (Switch1 Ethernet1 to PC2 Ethernet0)						
Файл Правка Вид Запуск Захват Анализ Статистика Телефония Беспроводная связь Инструменты Справка						
arp						
No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	Private_66:68:01	Broadcast	ARP	64	Who has 89.189.178.2? Tell 89.189.178.1
2	0.000169	Private_66:68:00	Private_66:68:01	ARP	64	89.189.178.2 is at 00:50:79:66:68:00

PC1 отправляет пакет, запрашивая MAC-адрес устройства с адресом, который мы пингуем, PC2 отправляет ответ со своим MAC-адресом

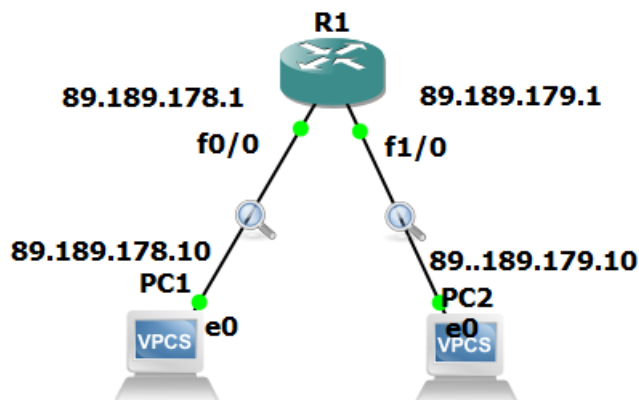
<pre> &gt; Frame 1: 64 bytes on wire (512 bits), 64 bytes captured (512 bits) on interface -, id 0 &gt; Ethernet II, Src: Private_66:68:01 (00:50:79:66:68:01), Dst: Broadcast (ff:ff:ff:ff:ff:ff)   Address Resolution Protocol (request)     Hardware type: Ethernet (1)     Protocol type: IPv4 (0x0800)     Hardware size: 6     Protocol size: 4     Opcode: request (1)     Sender MAC address: Private_66:68:01 (00:50:79:66:68:01)     Sender IP address: 89.189.178.1     Target MAC address: Broadcast (ff:ff:ff:ff:ff:ff)     Target IP address: 89.189.178.2 </pre>	<pre> 0000 ff ff ff ff ff ff 00 50 79 66 68 01 00 00 00 01 ..... P yfh... 0010 00 00 06 04 00 01 00 50 79 66 68 01 59 bd b2 02 ..... P yfh-Y... 0020 ff ff ff ff ff 59 bd b2 02 00 00 00 00 00 00 00 ..... Y ..... 0030 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..... </pre>
---	---

Заголовок запроса. PC1 отправляет этот запрос по указанному адресу, по фиксированному MAC-адресу (ff:ff:ff:ff:ff:ff)

<pre> &gt; Frame 2: 64 bytes on wire (512 bits), 64 bytes captured (512 bits) on interface -, id 0 &gt; Ethernet II, Src: Private_66:68:00 (00:50:79:66:68:00), Dst: Private_66:68:01 (00:50:79:66:68:01)   Address Resolution Protocol (reply)     Hardware type: Ethernet (1)     Protocol type: IPv4 (0x0800)     Hardware size: 6     Protocol size: 4     Opcode: reply (2)     Sender MAC address: Private_66:68:00 (00:50:79:66:68:00)     Sender IP address: 89.189.178.2     Target MAC address: Private_66:68:01 (00:50:79:66:68:01)     Target IP address: 89.189.178.1 </pre>	<pre> 0000 00 50 79 66 68 01 00 50 79 66 68 00 08 06 00 01 ..Pyfh..P yfh.... 0010 08 00 06 04 00 02 00 50 79 66 68 00 59 bd b2 02 .....P yfh-Y... 0020 00 50 79 66 68 01 59 bd b2 01 00 00 00 00 00 00 .....Pyfh-Y..... 0030 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..... </pre>
---	--

Заголовок ответа. PC2 отвечает PC1. Таким образом, в ARP таблицы обоих устройств вносятся MAC-адреса друг друга.

Собираем сеть с маршрутизатором:



Задаём адреса клиентам (разные подсети):

ip 89.189.178.10/24 89.189.178.1

ip 89.189.179.10/24 89.189.179.1

Настраиваем роутер:

Добавили 2 интерфейса

Настраиваем интерфейсы:

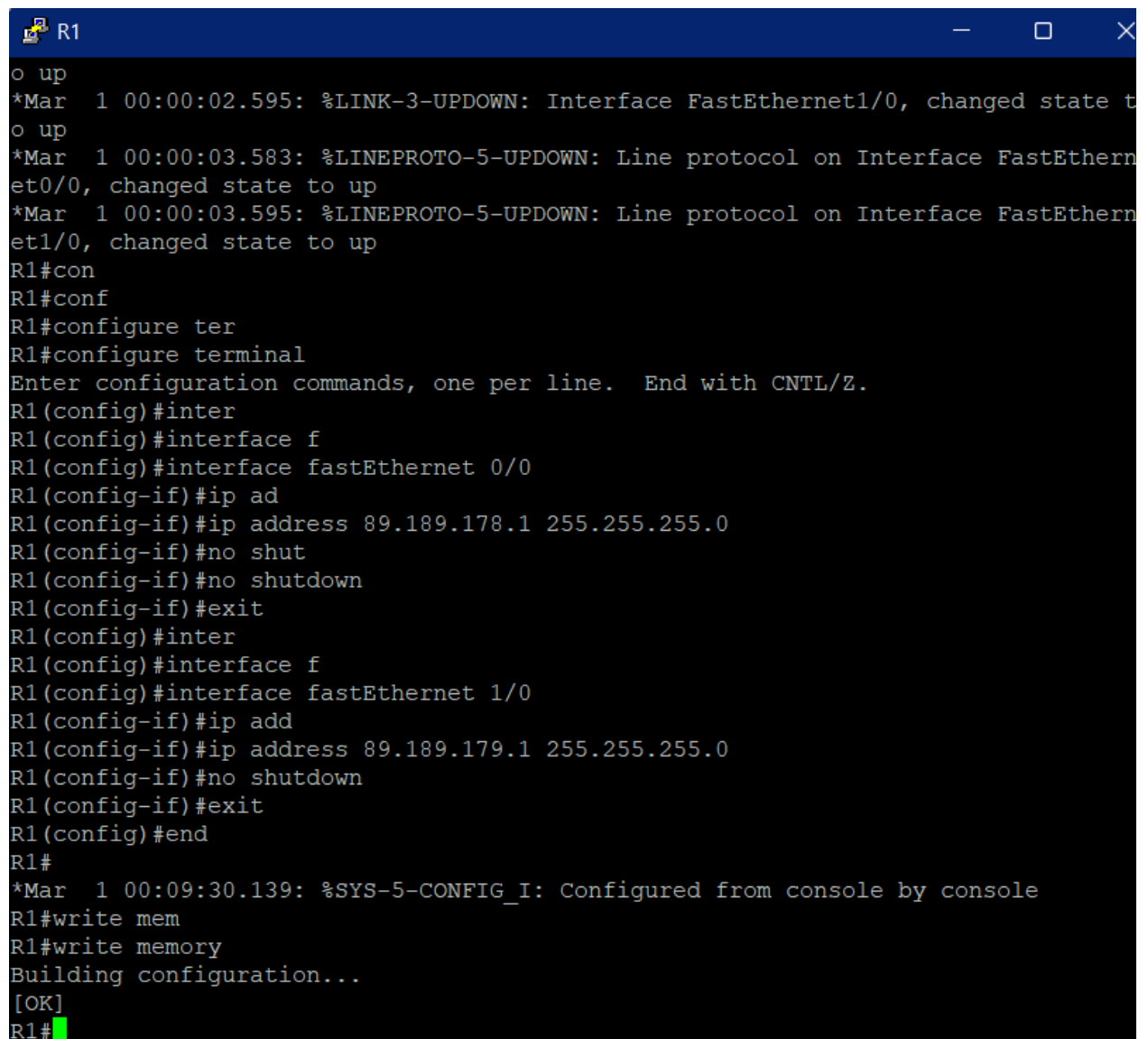
configure terminal

interface fastEthernet 0/0

address 89.189.178.1 255.255.255.0

no shutdown

Аналогично для интерфейса 1/0, но адрес – адрес шлюза для 2 ПК



```
R1
o up
*Mar  1 00:00:02.595: %LINK-3-UPDOWN: Interface FastEthernet1/0, changed state to up
o up
*Mar  1 00:00:03.583: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
*Mar  1 00:00:03.595: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet1/0, changed state to up
R1#con
R1#conf
R1#configure ter
R1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#inter
R1(config)#interface f
R1(config)#interface fastEthernet 0/0
R1(config-if)#ip ad
R1(config-if)#ip address 89.189.178.1 255.255.255.0
R1(config-if)#no shut
R1(config-if)#no shutdown
R1(config-if)#exit
R1(config)#inter
R1(config)#interface f
R1(config)#interface fastEthernet 1/0
R1(config-if)#ip add
R1(config-if)#ip address 89.189.179.1 255.255.255.0
R1(config-if)#no shutdown
R1(config-if)#exit
R1(config)#end
R1#
*Mar  1 00:09:30.139: %SYS-5-CONFIG_I: Configured from console by console
R1#write mem
R1#write memory
Building configuration...
[OK]
R1#
```

Проверяем, что всё сохранилось:

show ip route

```

R1#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

      89.0.0.0/24 is subnetted, 2 subnets
C       89.189.178.0 is directly connected, FastEthernet0/0
C       89.189.179.0 is directly connected, FastEthernet1/0

```

Пингуем с машины 1 машину 2:

```

PC1> ping 89.189.179.10

89.189.179.10 icmp_seq=1 timeout
89.189.179.10 icmp_seq=2 timeout
84 bytes from 89.189.179.10 icmp_seq=3 ttl=63 time=16.666 ms
84 bytes from 89.189.179.10 icmp_seq=4 ttl=63 time=15.748 ms
84 bytes from 89.189.179.10 icmp_seq=5 ttl=63 time=15.477 ms

```

Перехватываем пакеты

PC1 <-> Router и PC2 <-> Router соответственно

Захват из Standard input [PC1 Ethernet0 to R1 FastEthernet0/0]									
No.	Time	Source	Destination	Prot	Leng	Info			
3	33.	89.189.178.10	89.189.179.10	ICMP	98	Echo (ping) request id=0xb88a, seq=1/256, ttl=63			
4	35.	89.189.178.10	89.189.179.10	ICMP	98	Echo (ping) request id=0xba8a, seq=2/512, ttl=63			
5	35.	cc:01:32:e5:00:00	Broadcast	ARP	60	Who has 89.189.178.10? Tell 89.189.178.1			
6	35.	Private_66:68:00	cc:01:32:e5:00:00	ARP	60	89.189.178.10 is at 00:50:79:66:68:00			
7	37.	89.189.178.10	89.189.179.10	ICMP	98	Echo (ping) request id=0xbc8a, seq=3/768, ttl=63			
8	37.	89.189.179.10	89.189.178.10	ICMP	98	Echo (ping) reply id=0xbc8a, seq=3/768, ttl=63			
9	38.	89.189.178.10	89.189.179.10	ICMP	98	Echo (ping) request id=0xbd8a, seq=4/1024, ttl=63			
10	38.	89.189.179.10	89.189.178.10	ICMP	98	Echo (ping) reply id=0xbd8a, seq=4/1024, ttl=63			
11	39.	89.189.178.10	89.189.179.10	ICMP	98	Echo (ping) request id=0xbe8a, seq=5/1280, ttl=63			
12	39.	89.189.179.10	89.189.178.10	ICMP	98	Echo (ping) reply id=0xbe8a, seq=5/1280, ttl=63			

На скриншотах видно, что при пинге первые 2 пакета не дошли, они были отправлены до ARP запроса, после того, как стали известны MAC адреса PC1 и PC2, пинг прошёл успешно.

Первый ARP пакет PC1 <-> Router

Hardware size: 6	0000	ff ff ff ff ff ff cc 01 32 e5 00 00 08 06 00
Protocol size: 4	0010	08 00 06 04 00 01 cc 01 32 e5 00 00 59 bd b2
Opcode: request (1)	0020	00 00 00 00 00 00 59 bd b2 0a 00 00 00 00 00
Sender MAC address: cc:01:32:e5:00:00 (cc:01:32:e5:00:00)	0030	00 00 00 00 00 00 00 00 00 00 00 00
Sender IP address: 89.189.178.1		
Target MAC address: 00:00:00:00:00:00 (00:00:00:00:00:00)		
Target IP address: 89.189.178.10		

Мы видим, что роутер отправил запрос с целью узнать MAC адрес PC1

Аналогично и с PC2:

Hardware size: 6	0000	ff ff ff ff ff ff cc 01 32 e5 00 10 08 06 00
Protocol size: 4	0010	08 00 06 04 00 01 cc 01 32 e5 00 10 59 bd b3
Opcode: request (1)	0020	00 00 00 00 00 00 59 bd b3 0a 00 00 00 00 00
Sender MAC address: cc:01:32:e5:00:10 (cc:01:32:e5:00:10)	0030	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Sender IP address: 89.189.179.1		
Target MAC address: 00:00:00_00:00:00 (00:00:00:00:00:00)		
Target IP address: 89.189.179.10		

Первый (недошедший) пакет ICMP:

```
> Frame 3: 98 bytes on wire (784 bits), 98 bytes captured (784 bits) on interface
  Ethernet II, Src: Private_66:68:00 (00:50:79:66:68:00), Dst: cc:01:32:e5:00:00 (
    > Destination: cc:01:32:e5:00:00 (cc:01:32:e5:00:00)
    > Source: Private_66:68:00 (00:50:79:66:68:00)
    Type: IP (0x0800)
```

Видно, что MAC адрес назначения – MAC адрес интерфейса роутера. Судя по всему, в таблице маршрутизации роутера нет MAC адресов этих устройств, поэтому ему необходимо отправить ARP запросы.