

Настройки ПК:

Ip-адреса:

PC1 – 192.168.1.1

PC2 – 192.168.1.2

```
PC1 - PuTTY
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For more information, please visit wiki.freecode.com.cn.

Press '?' to get help.

Executing the startup file

Checking for duplicate address...
VPCS : 192.168.1.1 255.0.0.0

PC1> ping 192.168.1.2

84 bytes from 192.168.1.2 icmp_seq=1 ttl=64 time=0.194 ms
84 bytes from 192.168.1.2 icmp_seq=2 ttl=64 time=0.429 ms
84 bytes from 192.168.1.2 icmp_seq=3 ttl=64 time=0.134 ms
84 bytes from 192.168.1.2 icmp_seq=4 ttl=64 time=0.134 ms
84 bytes from 192.168.1.2 icmp_seq=5 ttl=64 time=0.126 ms

PC1>
PC1> 
```

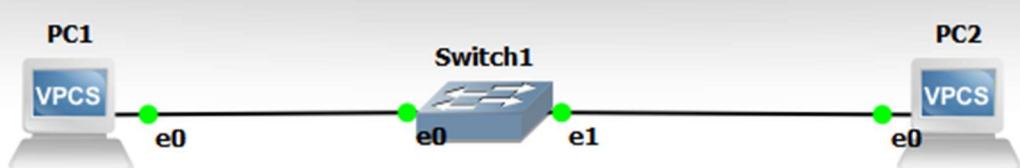


Рисунок 1 – проверка достижимости PC2 через SW1

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	Private_66:68:00	Broadcast	ARP	64	Who has 192.168.1.2? Tell 192.168.1.1
2	0.000071	Private_66:68:01	Private_66:68:00	ARP	64	192.168.1.2 is at 00:50:79:66:68:01

Frame 1: Packet, 64 bytes on wire (512 bits), 64 bytes captured (512 bits) on
Section number: 1
> Interface id: 0 (-)
Encapsulation type: Ethernet (1)
Arrival Time: Dec 23, 2025 19:16:55.684792000 Новосибирское стандартное время
UTC Arrival Time: Dec 23, 2025 12:16:55.684792000 UTC
Epoch Arrival Time: 1766492215.684792000
[Time shift for this packet: 0.000000000 seconds]
[Time since reference or first frame: 0.000000000 seconds]
Frame Number: 1
Frame Length: 64 bytes (512 bits)
Capture Length: 64 bytes (512 bits)
[Frame is marked: False]
[Frame is ignored: False]
[Protocols in frame: eth:ethertype:arp]
Character encoding: ASCII (0)
[Coloring Rule Name: ARP]
[Coloring Rule String: arp]

Ethernet II, Src: Private_66:68:00 (00:50:79:66:68:00), Dst: Broadcast (ff:ff:
> Destination: Broadcast (ff:ffff:ff:ff:ff:ff)
> Source: Private_66:68:00 (00:50:79:66:68:00)
Type: ARP (0x0806)
[Stream index: 0]
Padding: 00000000000000000000000000000000
Frame check sequence: 0x00000000 [unverified]
[FCS Status: Unverified]

> Address Resolution Protocol (request)

Рисунок 2 – ARP-кадры, отправляемые для поиска PC2

2	0.000071	Private_66:68:01	Private_66:68:00	ARP	64	192.168.1.2 is at 00:50:79:66:68:01
>	Frame 2: Packet, 64 bytes on wire (512 bits), 64 bytes captured (512 bits) on Section number: 1 > Interface id: 0 (-) Encapsulation type: Ethernet (1) Arrival Time: Dec 23, 2025 19:16:55.684863000 Новосибирское стандартное время UTC Arrival Time: Dec 23, 2025 12:16:55.684863000 UTC Epoch Arrival Time: 1766492215.684863000 [Time shift for this packet: 0.000000000 seconds] [Time delta from previous captured frame: 71.000 microseconds] [Time delta from previous displayed frame: 71.000 microseconds] [Time since reference or first frame: 71.000 microseconds] Frame Number: 2 Frame Length: 64 bytes (512 bits) Capture Length: 64 bytes (512 bits) [Frame is marked: False] [Frame is ignored: False] [Protocols in frame: eth:ethertype:arp] Character encoding: ASCII (0) [Coloring Rule Name: ARP] [Coloring Rule String: arp]	0000 00 50 79 66 68 00 00 50 79 66 68 01 08 06 00 01 ·Pyfh ·P yfh··· 0010 08 00 06 04 00 02 00 50 79 66 68 01 c0 a8 01 02 ·Pyfh··· 0020 00 50 79 66 68 00 c0 a8 01 01 00 00 00 00 00 00 ·Pyfh··· 0030 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ·Pyfh···				

Ethernet II, Src: Private_66:68:01 (00:50:79:66:68:01), Dst: Private_66:68:00
> Destination: Private_66:68:00 (00:50:79:66:68:00)
.... .0. = LG bit: Globally unique address (factory)
.... .0. = IG bit: Individual address (unicast)
Source: Private_66:68:01 (00:50:79:66:68:01)
.... .0. = LG bit: Globally unique address (factory)
.... .0. = IG bit: Individual address (unicast)
Type: ARP (0x0806)
[Stream index: 1]
Padding: 00000000000000000000000000000000
Frame check sequence: 0x00000000 [unverified]
[FCS Status: Unverified]

> Address Resolution Protocol (reply)

Рисунок 3 – Ответный ARP-кадр

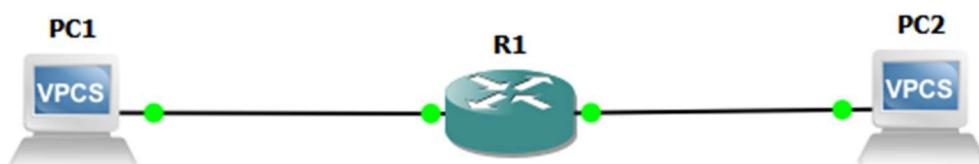


Рисунок 4 – Вторая сеть

Настройки интерфейсов:

PC1 – 192.168.1.1

PC2 – 192.168.2.1

R1 – 192.168.1.2; 192.168.2.2

Рисунок 5 – ARP-кадр для поиска PC2 между PC1 и R1

Рисунок 6 – Ответный ARP-кадр между PC1 и R1

→	8 30.786697	192.168.1.1	192.168.2.1	ICMP	98 Echo (ping) request	id=0xfba2, seq=2/512, ttl=64 (reply in 9)
←	9 30.806538	192.168.2.1	192.168.1.1	ICMP	98 Echo (ping) reply	id=0xfba2, seq=2/512, ttl=63 (request in 8)
> Frame 8: Packet, 98 bytes on wire (784 bits), 98 bytes captured (784 bits) on interface eth0 Ethernet II, Src: Private_66:68:00 (00:50:79:66:68:00), Dst: cc:01:59:15:00:00 > Destination: cc:01:59:15:00:00 (cc:01:59:15:00:00) > Source: Private_66:68:00 (00:50:79:66:68:00) Type: IPv4 (0x0800) [Stream index: 3]						
> Internet Protocol Version 4, Src: 192.168.1.1, Dst: 192.168.2.1 0100 = Version: 4 0101 = Header Length: 20 bytes (5) > Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT) Total Length: 84 Identification: 0xa2fa (41722) > 000. = Flags: 0x0 ...0 0000 0000 0000 = Fragment Offset: 0 Time to Live: 64 Protocol: ICMP (1) Header Checksum: 0x535c [validation disabled] [Header checksum status: Unverified] Source Address: 192.168.1.1 Destination Address: 192.168.2.1 [Stream index: 0]						
> Internet Control Message Protocol Type: Echo (ping) request (8) Code: 0 Checksum: 0x2467 [correct] [Checksum Status: Good] Identifier (BE): 64418 (0xfba2) Identifier (LE): 41723 (0xa2fb) Sequence Number (BE): 2 (0x0002) Sequence Number (LE): 512 (0x0200) [Response frame: 9] > Data (56 bytes)						

Рисунок 7 – Исходящий ICMP-пакет между PC1 и R1

←	9 30.806538	192.168.2.1	192.168.1.1	ICMP	98 Echo (ping) reply	id=0xfba2, seq=2/512, ttl=63 (request in 8)
→	10 30.937290	cc:01:59:15:00:00	cc:01:59:15:00:00	LOOP	60 Reply	
> Frame 9: Packet, 98 bytes on wire (784 bits), 98 bytes captured (784 bits) on interface eth0 Ethernet II, Src: cc:01:59:15:00:00 (cc:01:59:15:00:00), Dst: Private_66:68:00 Destination: Private_66:68:00 (00:50:79:66:68:00) 0. = LG bit: Globally unique address (factory) 0. = IG bit: Individual address (unicast) Source: cc:01:59:15:00:00 (cc:01:59:15:00:00) 0. = LG bit: Globally unique address (factory) 0. = IG bit: Individual address (unicast) Type: IPv4 (0x0800) [Stream index: 3]						
> Internet Protocol Version 4, Src: 192.168.2.1, Dst: 192.168.1.1 0100 = Version: 4 0101 = Header Length: 20 bytes (5) > Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT) Total Length: 84 Identification: 0xa2fa (41722) > 000. = Flags: 0x0 ...0 0000 0000 0000 = Fragment Offset: 0 Time to Live: 63 Protocol: ICMP (1) Header Checksum: 0x545c [validation disabled] [Header checksum status: Unverified] Source Address: 192.168.2.1 Destination Address: 192.168.1.1 [Stream index: 0]						
> Internet Control Message Protocol Type: Echo (ping) reply (0) Code: 0 Checksum: 0x2c67 [correct] [Checksum Status: Good] Identifier (BE): 64418 (0xfba2) Identifier (LE): 41723 (0xa2fb) Sequence Number (BE): 2 (0x0002) Sequence Number (LE): 512 (0x0200) [Request frame: 8] > Data (56 bytes)						

Рисунок 8 – Ответный ICMP-пакет между PC1 и R1

Frame Number:	Source MAC:	Destination MAC:	Type:	Length:	Data
4	18.375193	cc:01:59:15:00:10	Broadcast	ARP	60 Who has 192.168.2.1? Tell 192.168.2.2
5	18.375246	Private_66:68:01	cc:01:59:15:00:10	ARP	60 192.168.2.1 is at 00:50:79:66:68:01
6	20.376104	192.168.1.1	192.168.2.1	ICMP	98 Echo (ping) request id=0x0fba2, seq=2/512, ttl=63 (reply in 7)
7	20.376171	192.168.2.1	192.168.1.1	ICMP	98 Echo (ping) reply id=0x0fba2, seq=2/512, ttl=64 (request in 6)
8	20.516940	cc:01:59:15:00:10	cc:01:59:15:00:10	LOOP	60 Reply
9	20.516940	cc:01:59:15:00:10	cc:01:59:15:00:10	LOOP	60 Reply

Рисунок 9 – ARP-кадр для поиска PC2 между PC2 и R1

Рисунок 10 – Ответный ARP-кадр между PC2 и R1

→	6 20.376104	192.168.1.1	192.168.2.1	ICMP	98 Echo (ping) request id=0xfba2, seq=2/512, ttl=63 (reply in 7)	
←	7 20.376171	192.168.2.1	192.168.1.1	ICMP	98 Echo (ping) reply id=0xfba2, seq=2/512, ttl=64 (request in 6)	
8 20.516940	cc:01:59:15:00:10	cc:01:59:15:00:10	LOOP	60 Reply		
Frame 6: Packet, 98 bytes on wire (784 bits), 98 bytes captured (784 bits) on						
Ethernet II, Src: cc:01:59:15:00:10 (cc:01:59:15:00:10), Dst: Private_66:68:01 (00:50:79:66:68:01)						
> Destination: Private_66:68:01 (00:50:79:66:68:01)						
> Source: cc:01:59:15:00:10 (cc:01:59:15:00:10)						
Type: IPv4 (0x0800)						
[Stream index: 3]						
Internet Protocol Version 4, Src: 192.168.1.1, Dst: 192.168.2.1						
0100 = Version: 4						
.... 0101 = Header Length: 20 bytes (5)						
> Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)						
Total Length: 84						
Identification: 0xa2fa (41722)						
000. = Flags: 0x0						
...0 0000 0000 0000 = Fragment Offset: 0						
Time to Live: 63						
Protocol: ICMP (1)						
Header Checksum: 0x545c [validation disabled]						
[Header checksum status: Unverified]						
Source Address: 192.168.1.1						
Destination Address: 192.168.2.1						
[Stream index: 0]						
Internet Control Message Protocol						
Type: Echo (ping) request (8)						
Code: 0						
Checksum: 0x2467 [correct]						
[Checksum Status: Good]						
Identifier (BE): 64418 (0xfba2)						
Identifier (LE): 41723 (0xa2fb)						
Sequence Number (BE): 2 (0x0002)						
Sequence Number (LE): 512 (0x0200)						
[Response frame: 7]						
> Data (56 bytes)						

Рисунок 11 – Исходящий ICMP-пакет между PC2 и R1

7 20.376171	192.168.2.1	192.168.1.1	ICMP	98 Echo (ping) reply id=0xfba2, seq=2/512, ttl=64 (request in 6)		
8 20.516940	cc:01:59:15:00:10	cc:01:59:15:00:10	LOOP	60 Reply		
Frame 7: Packet, 98 bytes on wire (784 bits), 98 bytes captured (784 bits) on						
Ethernet II, Src: Private_66:68:01 (00:50:79:66:68:01), Dst: cc:01:59:15:00:10 (cc:01:59:15:00:10)						
> Destination: cc:01:59:15:00:10 (cc:01:59:15:00:10)						
> Source: Private_66:68:01 (00:50:79:66:68:01)						
Type: IPv4 (0x0800)						
[Stream index: 3]						
Internet Protocol Version 4, Src: 192.168.2.1, Dst: 192.168.1.1						
0100 = Version: 4						
.... 0101 = Header Length: 20 bytes (5)						
> Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)						
Total Length: 84						
Identification: 0xa2fa (41722)						
000. = Flags: 0x0						
...0 0000 0000 0000 = Fragment Offset: 0						
Time to Live: 64						
Protocol: ICMP (1)						
Header Checksum: 0x545c [validation disabled]						
[Header checksum status: Unverified]						
Source Address: 192.168.2.1						
Destination Address: 192.168.1.1						
[Stream index: 0]						
Internet Control Message Protocol						
Type: Echo (ping) reply (8)						
Code: 0						
Checksum: 0x2c67 [correct]						
[Checksum Status: Good]						
Identifier (BE): 64418 (0xfba2)						
Identifier (LE): 41723 (0xa2fb)						
Sequence Number (BE): 2 (0x0002)						
Sequence Number (LE): 512 (0x0200)						
[Request frame: 6]						
[Response time: 0,067 ms]						
> Data (56 bytes)						

Рисунок 12 – Ответный ICMP-пакет между PC2 и R1

В заголовках исходящего ARP-кадра находится MAC-адрес источника, а вместо адреса получателя – широковещательный адрес, так как ещё не известен MAC-адрес устройства с указанным ip. В ответном же кадре уже явно

указаны MAC-адреса как источника, так и получателя. Также в обоих заголовках есть указание типа кадра, а именно ARP.

ICMP-пакет содержит информацию о ip-адресах источника и получателя, тип ICMP и контрольную сумму. Исходящий ICMP имеет тип request, а ответный – reply.