

1-2. ARP + IP

На компьютерах сети прописываем IP-адреса, маски и шлюз. Из консоли 1го компьютера пингуем 4ый

The screenshot shows the Cisco Packet Tracer interface. On the left, a network topology is visible with a 2411 Router0 connected to a 2960-24TT Switch1, which is connected to a 2960-24TT Switch0. Switch0 is connected to PC1, PC2, PC3, and PC4. Switch1 is connected to PC5 and PC6. The Simulation Panel in the center shows an Event List with three entries: an ICMP packet at 0:00 from PC1, and two ARP packets at 0:00 from PC1 to Switch0. The PDU Information at Device: PC1 on the right shows the Outbound PDU Details for an ARP packet. The ARP packet details are as follows:

Arp			
0	8	16	Bits
HARDWARE TYPE: 0x0001		PROTOCOL TYPE: 0x0800	
HLEN: 0x06		PLEN: 0x04	
SOURCE MAC: 0001.C707.2A71		SOURCE IP: 192.168.1.1	
TARGET MAC: 0000.0000.0000		TARGET IP: 192.168.1.4	

Протокол ARP опрашивает все хосты в локальной сети, и только PC4 отвечает на этот запрос.

The screenshot shows the Cisco Packet Tracer interface. On the left, the same network topology is visible. The Simulation Panel in the center shows an Event List with six entries: an Ethernet II packet at 0:00 from PC1, and five ARP packets at 0:00 from PC1 to Switch0, PC2, PC3, PC4, and Switch1. The PDU Information at Device: Router0 on the right shows the Inbound PDU Details for an Ethernet II packet. The Ethernet II packet details are as follows:

Ethernet II			
0	4	8	Bytes
PREAMBLE: 101010..10		DEST ADDR: FFFF.FF.FF.FF	
SRC ADDR: 0001.C707.2A		FCS: 0x0000	
HLEN: 0x06		PLEN: 0x04	
SOURCE MAC: 0001.C707.2A71		SOURCE IP: 192.168.1.1	
TARGET MAC: 0000.0000.0000		TARGET IP: 192.168.1.4	

Компьютер передаёт на коммутатор сообщение: в поле источника протокола Ethernet теперь записан MAC-адрес PC4, а в поле назначения MAC-адрес инициатора - PC1. Когда эта информация достигнет PC1, он сразу формирует ICMP-сообщение - блок данных, состоящий из работы 3-х протоколов: Ethernet, IP и Ping.

Cisco Packet Tracer - C:\Users\glik\Downloads\full_net.pkt

File Edit Options View Tools Extensions Window Help

Logical Physical x: 469, y: 423

Simulation Panel

Event List

Vis.	Time(sec)	Last Dev
	0.000	--
	0.000	--
	0.001	PC1
	0.002	Switch0
	0.002	Switch0
	0.002	Switch0
	0.002	Switch0
	0.003	PC4

Reset Simulation ☒ Constant

Play Controls

Event List Filters - Visible Events
ACL Filter, ARP, BGP, CDP, DHCP, IPSec, ISAKMP, LACP, NDP, NTP, STP, SYSLOG, TACACS, TCP, UDP

Time: 00:00:30.509 PLAY CONTROLS: [Back] [Play] [Forward]

PDU Information at Device: Switch0

OSI Model Inbound PDU Details Outbound PDU Details

PDU Formats

EthernetII

Bytes	
PREAMBLE: 101010..10	SFD
DEST ADDR: 0001.C707.2A71	
SRC ADDR: 000B.BE40.B9AA	TYP E: 0x
DATA (VARIABLE LENGTH)	FCS: 0x00000000

ARP

Bits	
HARDWARE TYPE: 0x0001	PROTOCOL TYPE: 0x0800
HLEN: 0x06	PLEN: 0x04
OPCODE: 0x0002	
SOURCE MAC : 000B.BE40.B9AA	
SOURCE IP : 192.168.1.4	
TARGET MAC: 0001.C707.2A71	
TARGET IP: 192.168.1.1	

PDU Information at Device: PC1

OSI Model Outbound PDU Details

PDU Formats

EthernetII

Bytes	
PREAMBLE: 101010..10	SFD
DEST ADDR: 000B.BE40.B9AA	
SRC ADDR: 0001.C707.2A71	TYPE: 0x0800
DATA (VARIABLE LENGTH)	FCS: 0x00000000

IP

Bits	
VER: 4	IHL: 5
DSCP: 0x00	TL: 128
ID: 0x0003	FLAGS: 0x0
FRAG OFFSET: 0x000	
TTL: 128	PRO: 0x01
CHKSUM	
SRC IP: 192.168.1.1	
DST IP: 192.168.1.4	
DATA (VARIABLE LENGTH)	

ICMP

Bits	
TYPE: 0x08	CODE: 0x00
CHECKSUM	
ID: 0x0003	SEQ NUMBER: 3

Посылается эхо-запрос. Как только этот ответ достигнет PC1, в консоли появится запись.

The top screenshot shows the Cisco Packet Tracer interface. The network topology includes a 2411 Router0 connected to a 2960-24TT Switch1, which is connected to PC-PT PC5 and PC-PT PC6. Another 2960-24TT Switch0 is connected to PC-PT PC1, PC-PT PC2, PC-PT PC3, and PC-PT PC4. The Simulation Panel on the right shows an Event List with the following entries:

Vis.	Time(sec)	Last Device
	0.002	Switch0
	0.002	Switch0
	0.002	Switch0
	0.003	PC4
	0.004	Switch0
	0.004	--
	0.005	PC1
	0.006	Switch0

The PDU Information at Device: PC4 window is open, showing the Outbound PDU Details. The Ethernet II section shows:

Bytes	
PREAMBLE: 101010..10	DEST ADDR: 0001.C707.2A71
SRC ADDR: 000B.BE40	FCS: 0x0000

The IP section shows:

Bits	
VER: 4	TL: 128
IHL: 5	DSCP: 0x00
ID: 0x0001	FRAG OFFSET: 0x000
TTL: 128	CHKSUM
SRC IP: 192.168.1.4	
DST IP: 192.168.1.1	
DATA (VARIABLE LENGTH)	

The ICMP section shows:

Bits	
TYPE: 0x00	CHECKSUM
ID: 0x0003	SEQ NUMBER: 3

По умолчанию пинг отправляет 4 запроса. Следовательно, PC1 сформирует еще 3 аналогичных ICMP.

The bottom screenshot shows the same Cisco Packet Tracer interface. The Command Prompt window on PC1 is open, showing the results of a ping command:

```

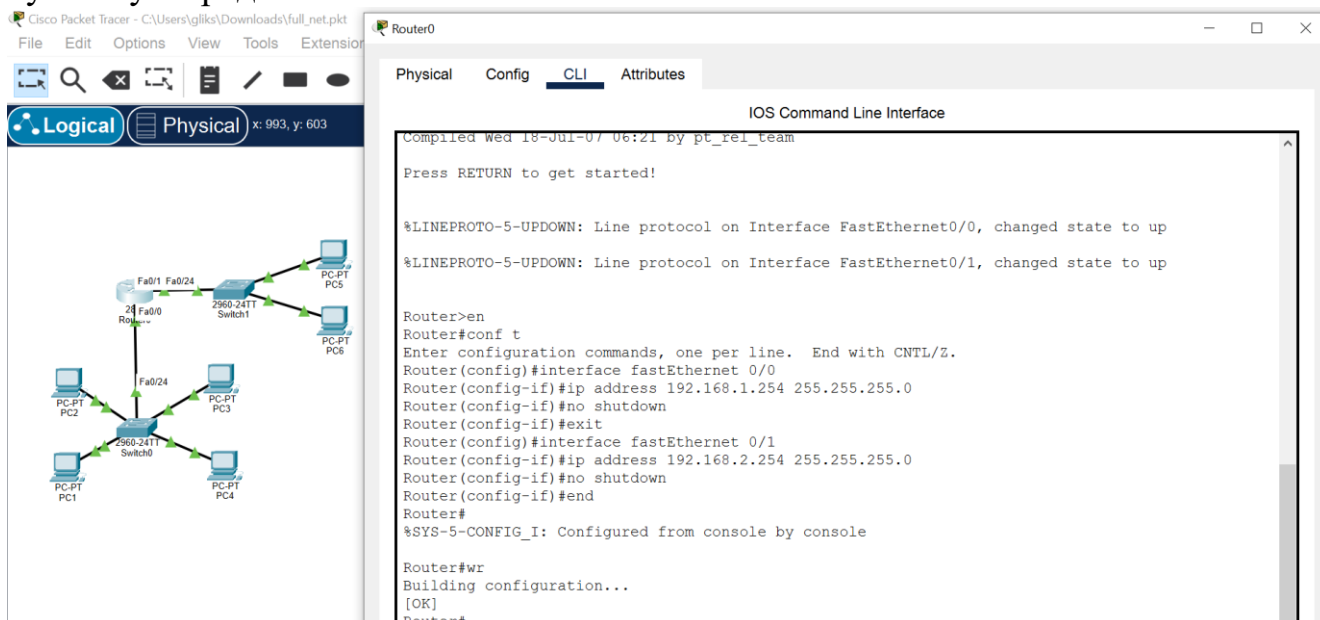
Packet Tracer PC Command Line 1.0
C:\>ping 192.168.1.4

Pinging 192.168.1.4 with 32 bytes of data:

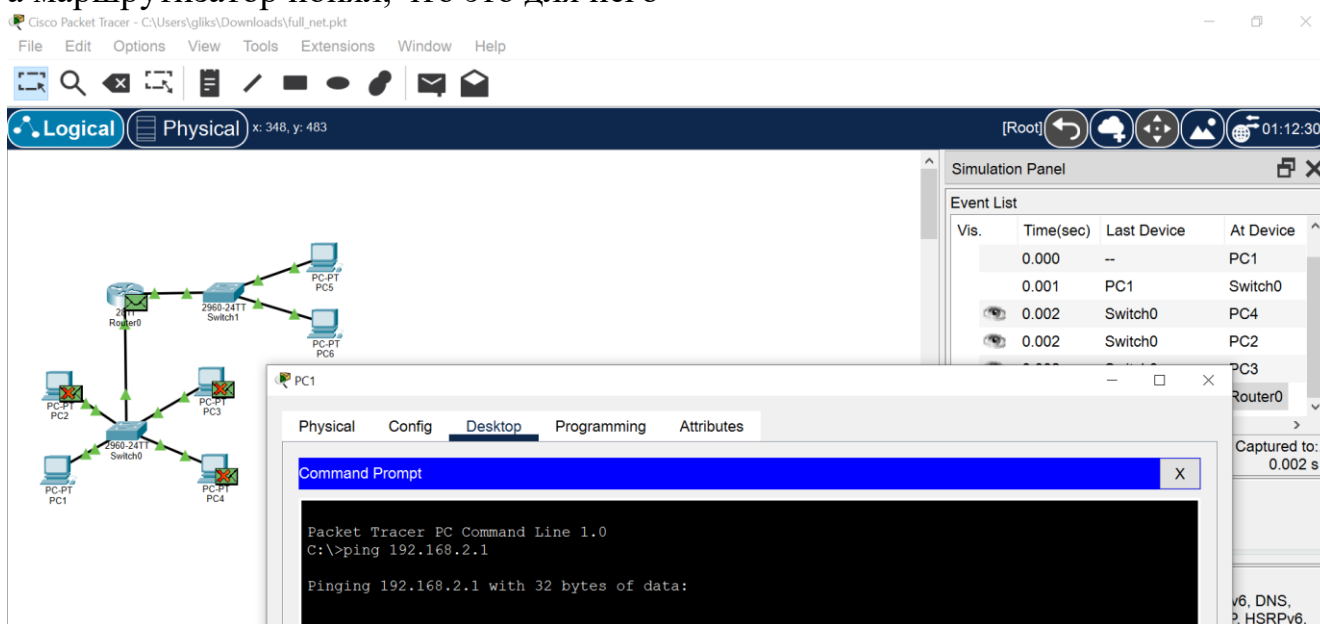
Reply from 192.168.1.4: bytes=32 time=8ms TTL=128
Reply from 192.168.1.4: bytes=32 time=4ms TTL=128
Reply from 192.168.1.4: bytes=32 time=4ms TTL=128
Reply from 192.168.1.4: bytes=32 time=4ms TTL=128

Ping statistics for 192.168.1.4:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 4ms, Maximum = 8ms, Average = 5ms
  
```

Для возможности общения настраиваем маршрутизатор, который соединяет 1ую и 2ую среды.



Проверяем доступность PC5 из консоли PC1. Компьютеры отбросили пакет, а маршрутизатор понял, что это для него



Как только ARP доходит от маршрутизатора к PC1, то сразу компьютер отправляет ICMP сообщение на основной шлюз.

Outbound PDU Details

Ethernet II

PREAMBLE: 101010...10	DEST ADDR: 0040.0B4C.8901
SRC ADDR: 0001.C707.2	DATA (VARIABLE LENGTH)
TYPE: 0x08	FCS: 0x0000

IP

VER: 4	IHL: 5	DSCP: 0x00	TL: 128
ID: 0x0001	FLAG: 0	FRAG OFFSET: 0x000	
TTL: 128	PRO: 0x01	CHKSUM	
SRC IP: 192.168.1.1			
DST IP: 192.168.2.1			
DATA (VARIABLE LENGTH)			

ICMP

TYPE: 0x08	CODE: 0x00	CHECKSUM
ID: 0x0002	SEQ NUMBER: 1	

Event List

Time(sec)	Last Device	At Device	Type
0.005	PC1	Switch0	ICMP
0.006	Switch0	Router0	ICMP
0.007	Router0	Switch1	ARP
0.008	Switch1	PC5	ARP
0.008	Switch1	PC6	ARP

Пакет доходит до маршрутизатора, и сразу перечеркивается, так как он не знает MAC-адрес PC5.

Inbound PDU Details

Ethernet II

PREAMBLE: 101010...10	DEST ADDR: FFFF.FF.FFFF
SRC ADDR: 0040.0B4C.8902	DATA (VARIABLE LENGTH)
TYPE: 0x06	FCS: 0x0000

ARP

HARDWARE TYPE: 0x0001	PROTOCOL TYPE: 0x0800
HLEN: 0x06	PLEN: 0x04
OPCODE: 0x0001	
SOURCE MAC : 0040.0B4C.8902	
SOURCE IP : 192.168.2.254	
TARGET MAC: 0000.0000.0000	
TARGET IP: 192.168.2.1	

Event List

Time(sec)	Last Device	At Device	Type
0.005	PC1	Switch0	ICMP
0.006	Switch0	Router0	ICMP
0.007	Router0	Switch1	ARP
0.008	Switch1	PC5	ARP
0.008	Switch1	PC6	ARP

Теперь маршрутизатор формирует ARP-запрос, чтобы узнать его.

Outbound PDU Details

Ethernet II

PREAMBLE: 101010...10	DEST ADDR: FFFF.FF.FFFF
SRC ADDR: 0040.0B4C.8902	DATA (VARIABLE LENGTH)
TYPE: 0x06	FCS: 0x0000

ARP

HARDWARE TYPE: 0x0001	PROTOCOL TYPE: 0x0800
HLEN: 0x06	PLEN: 0x04
OPCODE: 0x0001	
SOURCE MAC : 0040.0B4C.8902	
SOURCE IP : 192.168.2.254	
TARGET MAC: 0000.0000.0000	
TARGET IP: 192.168.2.1	

Event List

Time(sec)	Last Device	At Device	Type
0.005	PC1	Switch0	ICMP
0.006	Switch0	Router0	ICMP
0.007	Router0	Switch1	ARP
0.008	Switch1	PC5	ARP
0.008	Switch1	PC6	ARP

Далее PC5 получит его и сформирует ответ. Как только этот ответ дойдет до маршрутизатора, он будет знать канальный адрес PC5

The screenshot shows the Cisco Packet Tracer interface. On the left, a network topology is visible with a central router (Router0) connected to several switches (Switch0, Switch1) and PCs (PC1, PC2, PC3, PC4, PC5, PC6). The main window displays the 'Simulation Panel' with an 'Event List' table showing the sequence of events. The 'PDU Information at Device: Router0' window is open, showing 'Inbound PDU Details' for an ARP request. The details include: Hardware Type: 0x0001, Protocol Type: 0x0800, HLEN: 0x06, PLEN: 0x04, Opcode: 0x0002, Source MAC: 0001.4214.2803, Source IP: 192.168.2.1, Target MAC: 0040.0B4C.8902, and Target IP: 192.168.2.254.

Vis.	Time(sec)	Last Device	At Device
	0.006	--	Router0
	0.007	Router0	Switch1
	0.008	Switch1	PC5
	0.008	Switch1	PC6
	0.009	PC5	Switch1
	0.010	Switch1	Router0

The screenshot shows the Cisco Packet Tracer interface. On the left, the same network topology is visible. The main window displays the 'Simulation Panel' with an 'Event List' table showing the sequence of events. The 'PDU Information at Device: Router0' window is open, showing 'Inbound PDU Details' for an ARP request. The details include: Hardware Type: 0x0001, Protocol Type: 0x0800, HLEN: 0x06, PLEN: 0x04, Opcode: 0x0002, Source MAC: 0001.4214.2803, Source IP: 192.168.2.1, Target MAC: 0040.0B4C.8902, and Target IP: 192.168.2.254. A 'PC1' window is open, showing a 'Command Prompt' with the following output:

```

Packet Tracer PC Command Line 1.0
C:\>ping 192.168.2.1

Pinging 192.168.2.1 with 32 bytes of data:

Request timed out.
Reply from 192.168.2.1: bytes=32 time=8ms TTL=127
Reply from 192.168.2.1: bytes=32 time=8ms TTL=127
Reply from 192.168.2.1: bytes=32 time=8ms TTL=127

Ping statistics for 192.168.2.1:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 8ms, Maximum = 8ms, Average = 8ms
  
```

3. UDP

Добавляем в сеть сервер с включенной службой TFTP, прописываем IP-адрес. Сохраняем конфигурацию маршрутизатора на TFTP-сервер. Маршрутизатор формирует пакеты TFTP и ARP.

Cisco Packet Tracer - C:\Users\glks\Downloads\full_net.pkt

File Edit Options View Tools Extensions Window Help

Logical Physical x: 243, y: 160 [Root] 21:21:00

Simulation Panel

Event List

Vis.	Time(sec)	Last Device	At Device	Type
	0.000	--	Server0	ARP
	0.000	--	Router0	TFTP
	0.000	--	Router0	ARP

Router0

Physical Config CLI Attributes

IOS Command Line Interface

third-party authority to import, export, distribute or use encryption. Importers, exporters, distributors and users are responsible for compliance with U.S. and local country laws. By using this product you agree to comply with applicable laws and regulations. If you are unable to comply with U.S. and local laws, return this product immediately.

A summary of U.S. laws governing Cisco cryptographic products may be found at: <http://www.cisco.com/wwl/export/crypto/tool/stgr.html>

If you require further assistance please contact us by sending email to export@cisco.com.

cisco 2811 (MPC860) processor (revision 0x200) with 60416K/5120K bytes of memory
Processor board ID JAD05190MTZ (4292891495)

Time: 00:01:20.480 PLAY CONTROLS

UDP не устанавливает сессии, не требует подтверждения доставки, а если что-то потеряется, он не запрашивает повторно. Его работа — это указать номер порта и отправить

Cisco Packet Tracer - C:\Users\glks\Downloads\full_net (1).pkt

File Edit Options View Tools Extensions Window Help

Logical Physical x: 528, y: 501

PDU Information at Device: Server0

OSI Model Inbound PDU Details Outbound PDU Details

PDU Formats

PREAMBLE: 101010...10		DEST ADDR: 0040:0B4C:8901	
SRC ADDR: 0030:F251.6	TY: PE	DATA (VARIABLE LENGTH)	FCS: 0x0000 0000

IP

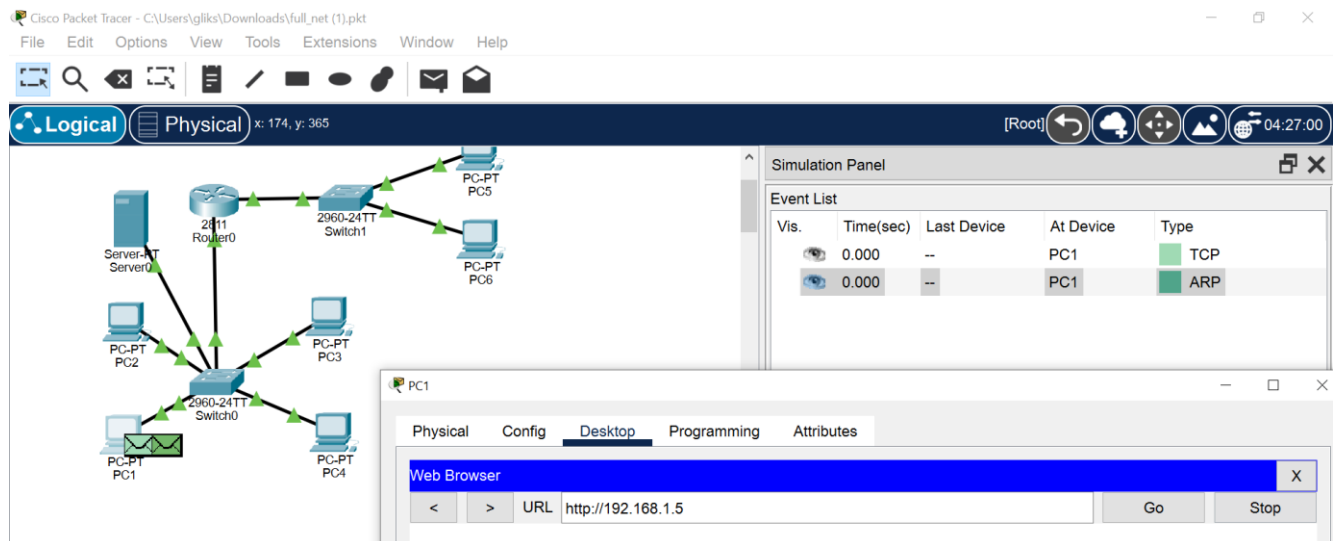
0 4 8 16 20 24 Bits			
VER: 4	IHL: 5	DSCP: 0x00	TL: 32
ID: 0x0001		GS: 0x0	FRAG OFFSET: 0x000
TTL: 128	PRO: 0x11	CHKSUM	
SRC IP: 192.168.1.5			
DST IP: 192.168.1.254			
DATA (VARIABLE LENGTH)			

UDP

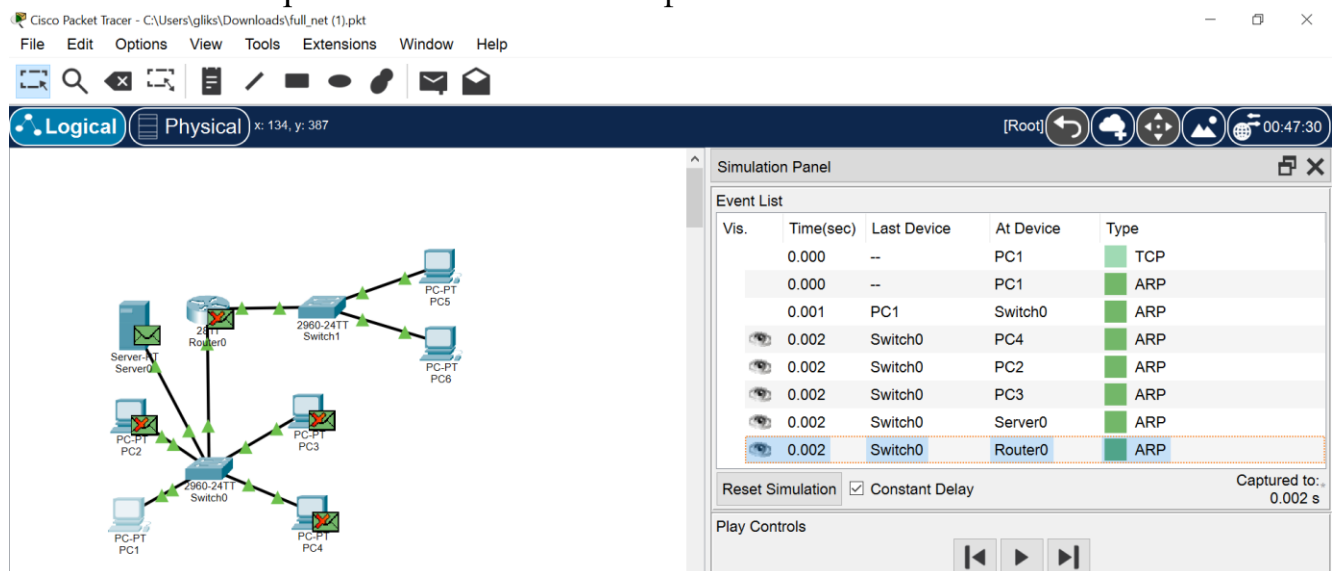
0 16 Bits	
SOURCE PORT: 1025	DESTINATION PORT: 1025
LENGTH: 0x000c	CHECKSUM: 0
DATA (VARIABLE LENGTH)	

Time: 00:02:10.438 PLAY CONTROLS

4. TCP



Клиент отправляет TCP-сегмент с флагом «SYN».



Получив сегмент, сервер принимает решение: он согласен установить соединение, отправляет ответный сегмент с соответствующим флагом

