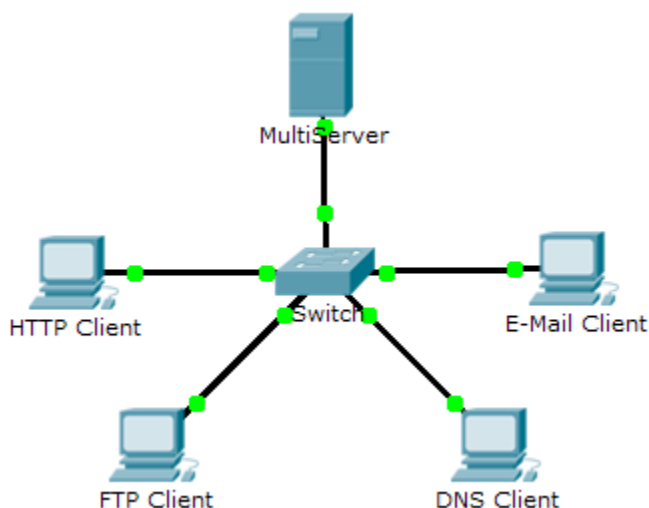


Packet Tracer Simulation - TCP and UDP Communications

Topology



Objectives

Part 1: Generate Network Traffic in Simulation Mode

Part 2: Examine the Functionality of the TCP and UDP Protocols

Background

This simulation activity is intended to provide a foundation for understanding the TCP and UDP in detail. Simulation mode provides the ability to view the functionality of the different protocols.

As data moves through the network, it is broken down into smaller pieces and identified in some fashion so that the pieces can be put back together. Each of these pieces is assigned a specific name (protocol data unit [PDU]) and associated with a specific layer. Packet Tracer Simulation mode enables the user to view each of the protocols and the associated PDU. The steps outlined below lead the user through the process of requesting services using various applications available on a client PC.

This activity provides an opportunity to explore the functionality of the TCP and UDP protocols, multiplexing and the function of port numbers in determining which local application requested the data or is sending the data.

1. Generate Network Traffic in Simulation Mode

1. Generate traffic to populate Address Resolution Protocol (ARP) tables.

Perform the following tasks task to reduce the amount of network traffic viewed in the simulation.

- Click **MultiServer** and click the **Desktop** tab > **Command Prompt**.
- Enter the **ping 192.168.1.255** command. This will take a few seconds as every device on the network responds to **MultiServer**.
- Close the **MultiServer** window.

```

C:\> ping 192.168.1.255

Pinging 192.168.1.255 with 32 bytes of data:

Reply from 192.168.1.2: bytes=32 time=1ms TTL=128
Reply from 192.168.1.3: bytes=32 time=1ms TTL=128
Reply from 192.168.1.4: bytes=32 time=1ms TTL=128
Reply from 192.168.1.1: bytes=32 time=1ms TTL=128
Reply from 192.168.1.2: bytes=32 time=1ms TTL=128
Reply from 192.168.1.3: bytes=32 time=1ms TTL=128
Reply from 192.168.1.4: bytes=32 time=1ms TTL=128
Reply from 192.168.1.1: bytes=32 time=1ms TTL=128
Reply from 192.168.1.2: bytes=32 time=1ms TTL=128
Reply from 192.168.1.3: bytes=32 time=1ms TTL=128
Reply from 192.168.1.4: bytes=32 time=1ms TTL=128
Reply from 192.168.1.1: bytes=32 time=1ms TTL=128
Reply from 192.168.1.2: bytes=32 time=1ms TTL=128
Reply from 192.168.1.3: bytes=32 time=1ms TTL=128
Reply from 192.168.1.4: bytes=32 time=1ms TTL=128

Ping statistics for 192.168.1.255:
    Packets: Sent = 4, Received = 16, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 2ms

```

2. Generate web (HTTP) traffic.

- a. Switch to Simulation mode.
- b. Click **HTTP Client** and click the **Desktop** tab > **Web Browser**.
- c. In the URL field, enter **192.168.1.254** and click **Go**. Envelopes (PDUs) will appear in the simulation window.
- d. Minimize, but do not close, the **HTTP Client** configuration window.

3. Generate FTP traffic.

- a. Click **FTP Client** and click the **Desktop** tab > **Command Prompt**.
- b. Enter the **ftp 192.168.1.254** command. PDUs will appear in the simulation window.
- c. Minimize, but do not close, the **FTP Client** configuration window.

4. Generate DNS traffic.

- a. Click **DNS Client** and click the **Desktop** tab > **Command Prompt**.
- b. Enter the **nslookup multiserver.pt.ptu** command. A PDU will appear in the simulation window.
- c. Minimize, but do not close, the **DNS Client** configuration window.

5. Generate Email traffic.

- a. Click **E-Mail Client** and click the **Desktop** tab > **E Mail** tool.
- b. Click **Compose** and enter the following information:
 - 1) **To:** user@multiserver.pt.ptu
 - 2) **Subject:** Personalize the subject line
 - 3) **E-Mail Body:** Personalize the Email
- c. Click **Send**.
- d. Minimize, but do not close, the **E-Mail Client** configuration window.

6. Verify that the traffic is generated and ready for simulation.

Every client computer should have PDUs listed in the Simulation Panel.

2. Examine Functionality of the TCP and UDP Protocols

1. Examine multiplexing as all of the traffic crosses the network.

You will now use the **Capture/Forward** button and the **Back** button in the Simulation Panel.

- a. Click **Capture/Forward** once. All of the PDUs are transferred to the switch.
- b. Click **Capture/Forward** again. Some of the PDUs disappear. What do you think happened to them?
 - They might be stored in the switch
- c. Click **Capture/Forward** six times. All clients should have received a reply. Note that only one PDU can cross a wire in each direction at any given time. What is this called?
 - Multiplexing: divides the data into smaller segments and enables communications from many different users to be interleaved (multiplexed) on the same network; A process where multiple digital data streams are combined into one signal.
 - Introduction to Networks v6
- d. A variety of PDUs appears in the event list in the upper right pane of the simulation window. Why are they so many different colors?

Packet Tracer Simulation - TCP and UDP Communications

- They might represent different types of protocols;
- Protocol – Field is used to identify the next level protocol. This 8-bit binary value indicates the data payload type that the packet is carrying, which enables the network layer to pass the data to the appropriate upper-layer protocol. Common values include ICMP (1), TCP (6), and UDP (17).
- Transport protocols specify how to transfer messages between hosts. TCP/IP provides two transport layer protocols, Transmission Control Protocol (TCP) and User Datagram Protocol (UDP). IP uses these transport protocols to enable hosts to communicate and transfer data.
- Written specifications that define what tasks a service or device should perform. Each protocol defines messages, often in the form of headers, plus the rules and processes by which these messages are used to achieve some stated purpose - Protocols.
- Introduction to Networks v6

e. Click **Back** eight times. This should reset the simulation.

Note: Do not click **Reset Simulation** any time during this activity; if you do, you will need to repeat the steps in Part 1.

2. Examine HTTP traffic as the clients communicate with the server.

- Filter the traffic that is currently displayed to display only **HTTP** and **TCP** PDUs filter the traffic that is currently displayed:
 - Click **Edit Filters** and toggle the **Show All/None** check box.
 - Select **HTTP** and **TCP**. Click anywhere outside of the Edit Filters box to hide it. The Visible Events should now display only **HTTP** and **TCP** PDUs.
- Click **Capture/Forward**. Hold your mouse above each PDU until you find one that originates from **HTTP Client**. Click the PDU envelope to open it.
- Click the **Inbound PDU Details** tab and scroll down to the last section. What is the section labeled?

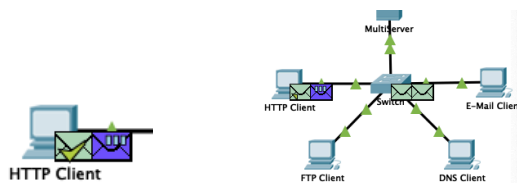
- TCP;

Are these communications considered to be reliable?

- Apparently so;
- Reliability and flow control are two of the main features of TCP, not present in UDP.
- Introduction to Networks v6

TCP	
SOURCE PORT: 1025	DESTINATION PORT: 80
SEQUENCE NUMBER: 0	
ACKNOWLEDGEMENT NUMBER: 0	
OFFSET: 0x0	RESERVED: 0
CHECKSUM: 0x0000	URGENT POINTER: 0x0000
OPTION	
DATA (VARIABLE LENGTH)	PADDING: 0b000 ...000

- Record the **SRC PORT**, **DEST PORT**, **SEQUENCE NUM**, and **ACK NUM** values. What is written in the field to the left of the **WINDOW** field?
 - SRC PORT: 1025;
 - DEST PORT: 80;
 - SEQUENCE NUM: 0;
 - ACK NUM: 0;
 - WINDOW: 65535;
- Close the PDU and click **Capture/Forward** until a PDU returns to the **HTTP Client** with a checkmark.
- Click the PDU envelope and select **Inbound PDU Details**. How are the port and sequence numbers different than before?

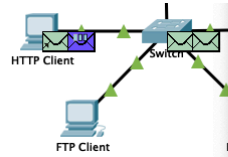


TCP	
SOURCE PORT: 80	DESTINATION PORT: 1025
SEQUENCE NUMBER: 0	
ACKNOWLEDGEMENT NUMBER: 1	
OFFSET: 0x0	RESERVED: 0
CHECKSUM: 0x0000	URGENT POINTER: 0x0000
OPTION	
DATA (VARIABLE LENGTH)	PADDING: 0b000 ...000

- There is a second **PDU** of a different color, which **HTTP Client** has prepared to send to **MultiServer**. This is the beginning of the HTTP communication. Click this second PDU envelope and select **Outbound PDU Details**.

- h. What information is now listed in the TCP section? How are the port and sequence numbers different from the previous two PDUs?

- SRC PORT: 1025;
- DEST PORT: 80;
- SEQUENCE NUM: 1;
- ACK NUM: 1;
- WINDOW: 65535;



TCP																																																															
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Bits																															
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SEQUENCE NUMBER:1																																																															
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CHECKSUM:0x0000																URGENT POINTER:0x0000																																															
OPTION																																																															
DATA (VARIABLE LENGTH)																								PADDING: 0b000 ...000																																							

- Click **Back** until the simulation is reset.

3. **Examine FTP traffic as the clients communicate with the server.**

- In the Simulation Panel, change **Edit Filters** to display only **FTP** and **TCP**.
- Click **Capture/Forward**. Hold your cursor above each PDU until you find one that originates from **FTP Client**. Click that PDU envelope to open it.
- Click the **Inbound PDU Details** tab and scroll down to the last section. What is the section labeled?
-TCP:


Are these communications considered to be reliable?

- Apparently so;
- Reliability and flow control are two of the main features of TCP, not present in UDP.
- Introduction to Networks v6

- d. Record the **SRC PORT**, **DEST PORT**, **SEQUENCE NUM**, and **ACK NUM** values. What is written in the field to the left of the **WINDOW** field?

- SRC PORT: 1025;
- DEST PORT: 21;
- SEQUENCE NUM: 0;
- ACK NUM: 0;
- WINDOW: 65535;

TCP																																Bits															
0				1				4				10				16				24																											
SOURCE PORT:1025																DESTINATION PORT:21																															
SEQUENCE NUMBER:0																																															
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OFFSET :0x0				RESERVED:0 b0000000				FLAGS:0b00 0010								WINDOW:65535																															
CHECKSUM:0x0000																URGENT POINTER:0x0000																															
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DATA (VARIABLE LENGTH)																								PADDING: 0b000 ...000																							

- e. Close the PDU and click **Capture/Forward** until a PDU returns to the **FTP Client** with a checkmark.
- f. Click the PDU envelope and select **Inbound PDU Details**.
How are the port and sequence numbers different than before?
- 
- | TCP | |
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| 4 | 5 |
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- SRC PORT: 21;
- DEST PORT: 1025;
- SEQUENCE NUM: 0;
- ACK NUM: 1;
- WINDOW: 65535;

TCP																																Bits																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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- g. Click the **Outbound PDU Details** tab. How are the port and sequence numbers different from the previous two results?

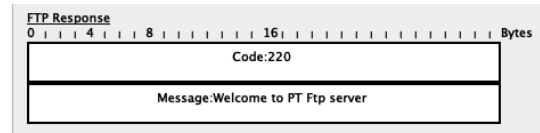
- SRC PORT: 1025;
- DEST PORT: 21;
- SEQUENCE NUM: 1;
- ACK NUM: 1;
- WINDOW: 65535;

TCP																																Bits	
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31		
SOURCE PORT:1025																DESTINATION PORT:21																	
SEQUENCE NUMBER:1																																	
ACKNOWLEDGEMENT NUMBER:1																																	
OFFSET :0x0				RESERVED: 0 b000000				FLAGS:0b01 0000				WINDOW:65535																					
CHECKSUM:0x0000																URGENT POINTER:0x0000																	
OPTION																																	
DATA (VARIABLE LENGTH)																								PADDING: 0b000 ...000									

- h. Close the PDU and click **Capture/Forward** until a second PDU returns to the **FTP Client**. The PDU is a different color.
- i. Open the PDU and select **Inbound PDU Details**. Scroll down past the TCP section. What is the message from the server?

- Message: Welcome to PT FTP server;

- j. Click **Back** until the simulation is reset.



4. Examine DNS traffic as the clients communicate with the server.

- a. In the Simulation Panel, change **Edit Filters** to display only **DNS** and **UDP**.
- b. Click the PDU envelope to open it.
- c. Click the **Inbound PDU Details** tab and scroll down to the last section. What is the section labeled?

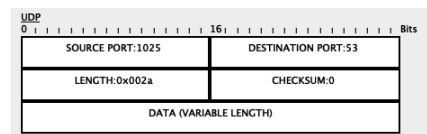
-UDP;

Are these communications considered to be reliable?

- Apparently not;
- Reliability and flow control are two of the main features of TCP, not present in UDP.
- Introduction to Networks v6

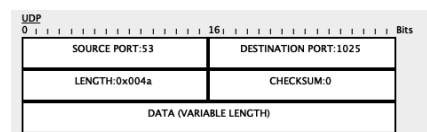
- d. Record the **SRC PORT** and **DEST PORT** values. Why is there no sequence and acknowledgement number?

- SRC PORT: 1025;
- DEST PORT: 53;
- UDP does not need to establish a reliable connection;
- UDP is a simpler transport layer protocol that does not provide for reliability.
- Introduction to Networks v6



- e. Close the **PDU** and click **Capture/Forward** until a PDU returns to the **DNS Client** with a checkmark.
- f. Click the PDU envelope and select **Inbound PDU Details**. How are the port and sequence numbers different than before?

- SRC PORT: 53;
- DEST PORT: 1025;



- g. What is the last section of the **PDU** called?

- DNS Answer;

- h. Click **Back** until the simulation is reset.

5. Examine email traffic as the clients communicate with the server.

- a. In the Simulation Panel, change **Edit Filters** to display only **POP3**, **SMTP** and **TCP**.
- b. Click **Capture/Forward**. Hold your cursor above each PDU until you find one that originates from **E-mail Client**. Click that PDU envelope to open it.
- c. Click the **Inbound PDU Details** tab and scroll down to the last section. What transport layer protocol does email traffic use?

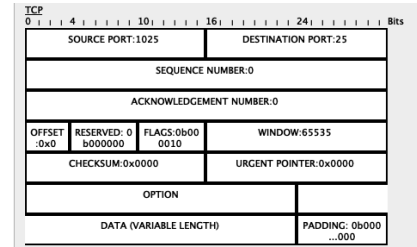
- TCP;
- TCP/IP provides two transport layer protocols, Transmission Control Protocol (TCP) and User Datagram Protocol (UDP). IP uses these transport protocols to enable hosts to communicate and transfer data.
- Introduction to Networks v6

Are these communications considered to be reliable?

- Apparently so;
- Reliability and flow control are two of the main features of TCP, not present in UDP.
- Introduction to Networks v6

- d. Record the **SRC PORT**, **DEST PORT**, **SEQUENCE NUM**, and **ACK NUM** values. What is written in the field to the left of the **WINDOW** field?

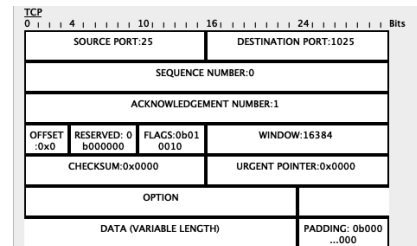
- SRC PORT: 1025;
- DEST PORT: 25;
- SEQUENCE NUM: 0;
- ACK NUM: 0;
- WINDOW: 65535;



- e. Close the **PDU** and click **Capture/Forward** until a PDU returns to the **E-Mail Client** with a checkmark.

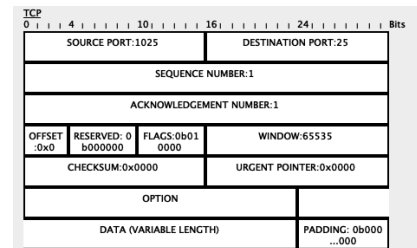
- f. Click the PDU envelope and select **Inbound PDU Details**. How are the port and sequence numbers different than before?

- SRC PORT: 25;
- DEST PORT: 1025;
- SEQUENCE NUM: 0;
- ACK NUM: 1;
- WINDOW: 16384;



- g. Click the **Outbound PDU Details** tab. How are the port and sequence numbers different from the previous two results?

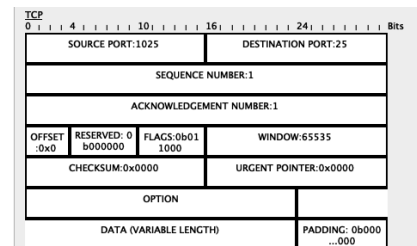
- SRC PORT: 1025;
- DEST PORT: 25;
- SEQUENCE NUM: 1;
- ACK NUM: 1;
- WINDOW: 65535;



- h. There is a second **PDU** of a different color that **HTTP Client** has prepared to send to **MultiServer**. This is the beginning of the email communication. Click this second PDU envelope and select **Outbound PDU Details**.

- i. How are the port and sequence numbers different from the previous two **PDU**s?

- SRC PORT: 1025;
- DEST PORT: 25;
- SEQUENCE NUM: 1;
- ACK NUM: 1;
- WINDOW: 65535;



- j. What email protocol is associated with TCP port 25? What protocol is associated with TCP port 110?

-SMTP and POP3;

- k. Click **Back** until the simulation is reset.

6. Examine the use of port numbers from the server.

- a. To see TCP active sessions, perform the following steps in quick succession:

- 1) Switch back to **Realtime** mode.
- 2) Click **MultiServer** and click the **Desktop** tab > **Command Prompt**.

- b. Enter the **netstat** command. What protocols are listed in the left column? -TCP;

- c. What port numbers are being used by the server?

- 21;

- d. What states are the sessions in?

- Established;

- e. Repeat the **netstat** command several times until you see only one session still ESTABLISHED. For which service is this connection still open? -FTP Client;

Why doesn't this session close like the other three? (Hint: Check the minimized clients)

-The server is waiting for a username and password from the client;

```
C:\>netstat

Active Connections

Proto Local Address           Foreign Address         State
TCP   192.168.1.254:21        192.168.1.2:1025       ESTABLISHED
```

```
Packet Tracer PC Command Line 1.0
C:\>ftp 192.168.1.254
Trying to connect...192.168.1.254
Connected to 192.168.1.254
220- Welcome to PT Ftp server
Username:|
```

Suggested Scoring Rubric

Activity Section	Question Location	Possible Points	Earned Points
Part 2: Examine Functionality of the TCP and UDP Protocols	Step 1	15	
	Step 2	15	
	Step 3	15	
	Step 4	15	
	Step 5	15	
	Step 6	25	
Total Score		100	