# Lab 4-1

## TCP and UDP Port Numbers

Diagram

Description automatically generated

Port number 53 is used for DNS that associates domain name with IP address while Port 80 is for HTTP that supports web pages. HTTP uses TCP while DNS uses UDP.

DNS

1- The PC encapsulates the PDU into an UDP segment and sends a DNS query (udptcpexample.com) to the DNS server.

2- The DNS Server receives the query,finds the requested domain and sends back a response.

3- The DNS client (PC) receives the DNS response which contains a resolved IP address (192.168.1.2) for the queried domain.

HTTP

1- The HTTP client (PC) sends a HTTP request to the server with segment information as follows: the sequence number 1, the ACK number 1, and the data length 106.

2- The Server receives a HTTP request and sends a HTTP reply to the client with segment information as follows: the sequence number 1, the ACK number 107, and the data length 391.

3- The HTTP client receives the reply from the server and displays the page in web browser.

# Lab 4-2

## TCP Session Establishment and Termination

Diagram

Description automatically generated

Three Way Handshake

1. The PC client tries to make a TCP connection to 192.168.1.2 on port 80. The device sets the connection state to SYN\_SENT and sends a TCP SYN segment.

2. The Server receives a TCP SYN segment on server port 80 an sets the state to SYN\_RECEIVE. Then, the server sends a TCP SYN+ACK segment.

3. The PC receives a TCP SYN+ACK segment on the connection to 192.168.1.2 on port 80 and sets the state to ESTABLISHED. Then, the client sends a TCP ACK segment.

4. The Server receives a TCP ACK segment on the connection to 192.168.1.1 on port 1026 and sets the connection state to ESTABLISHED.

5. The HTTP client sends a HTTP request to the server on port 80.

6. The server receives a HTTP request. The device receives a TCP PUSH+ACK segment on the connection to 192.168.1.1 on port 1026. The server sends back a HTTP reply to the client.

7. The HTTP client receives a HTTP reply from the server. It displays the page in the web browser. The device receives a TCP PUSH+ACK segment on the connection to 192.168.1.2 on port 80.

# Lab 4-3

## UDP Operation

Text

Description automatically generated with low confidence

DNS Operation

1- The DNS client sends a DNS query (udptcpexample.com) to the DNS server. The device encapsulates the PDU into an UDP segment with src port 1026 and dest port 53.

2- The DNS server receives a DNS query and resolved it locally. The device decapsulates the PDU from the UDP segment. The DNS server finds a domain with this name. It sends back a response.

3- The DNS client receives a DNS response. The received DNS response contains a resolved IP address for the queried domain.

# Lab 4-4

## Application and Transport Layer Protocols Examination

A DNS request needed to resolve the URL to the IP address of the server and an ARP request needed to resolve the IP address of the server to its hardware MAC address.

1- The DNS client sends a DNS query (www.example.com) to the DNS server . DNS query is encapsulated as data in an UDP segment, which is encapsulated in an IP packet.

2- The ARP process constructs a request for the target IP address. The device encapsulates the PDU into an Ethernet frame.

3- At the server, the frame's destination MAC address matches the receiving port's MAC address. The device decapsulates the PDU from the Ethernet frame. The frame is an ARP frame. The ARP process processes it. The ARP request's target IP address matches the receiving port's IP address. The ARP process updates the ARP table with received information.

4- The ARP process replies to the request with the receiving port's MAC address. The device encapsulates the PDU into an Ethernet frame.

5- At the client, the frame's destination MAC address matches the receiving port's MAC address. The device decapsulates the PDU from the Ethernet frame. The frame is an ARP frame. The ARP process processes it. The ARP process updates the ARP table with received information. The ARP process takes out and sends buffer packets waiting for this ARP reply.

6- The ARP process takes out this packet from the buffer and resends it. The device encapsulates the PDU into an Ethernet frame.

7- The DNS server receives a DNS query. The device decapsulates the PDU from the UDP segment. The DNS server resolves the name and send back a reply. The device encapsulates the PDU into an UDP segment.

8- The DNS client receives a DNS response. The received DNS response contains the resolved IP address for the queried domain.

9- Then, there will be TCP connection to be established using three-way handshake.

8- The HTTP client sends a HTTP request to the server and receives a reply. Then displays the web page.

# Lab 4-5

## Analyzing the Application and Transport Layers Learning Objective

1. The DNS client tries to send a DNS query to the DNS server. The device encapsulates the PDU into an UDP segment.

2. The frame source MAC address was found in the MAC table of Switch. Then, the switch sends the frame out that port.

3. At the first router, the device looks up the destination IP address in the CEF table and does not have an entry for the destination IP address. Then, it looks up the destination IP address in the routing table and finds a routing entry to the destination IP address. The device decrements the TTL on the packet.

4. At the second router, the device looks up the destination IP address in the CEF table and does not have an entry for the destination IP address. Then, it looks up the destination IP address in the routing table and finds a routing entry to the destination IP address. The destination network is directly connected. The device sets destination as the next-hop. The device decrements the TTL on the packet.

5. Receiving the second DNS query, the second router looks up the destination IP address in the CEF table and finds destination IP address.

6. The DNS server receives the DNS query and resolves it locally, then send back a reply containing the requested IP address.

7. Now the client initiate a TCP connection using the IP address and establish a connection. After that the client sends a HTTP request to the server.

8. The client receives the HTTP reply and displays the web page.