



**Department of Computer Science and
Engineering**

Islamic University of Technology (IUT)

A subsidiary organ of OIC

Laboratory Report

**CSE 4412: Data Communication and Networking
Lab**

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Section : BSc in SWE

Semester : 4th Semester

Academic Year : 2022-23

Date : 13/01/2023

Lab No : 02

Title: Understanding the basics of OSI Model

Objective:

1. Examine HTTP Web Traffic
2. Display Elements of the TCP/IP Protocol Suite

Devices/ Software Used:

We used the Cisco Packet Tracer simulated on our laptops for this lab. Cisco Packet Tracer is basically a packet path simulator that can be run on local computers to simulate and understand different network connections.

Working Procedure:

At first, we learned about a basic overview of the OSI(Open Systems Interconnected) Model which consists of 7 layers namely the physical layer, data link layer, network layer, transport layer, session layer, presentation layer, and the application layer. But in practice, only 5 layers are traditionally used that make up the TCP/IP(Transmission Control Protocol/Internet Protocol) protocol suite which consists of the physical layer, data link layer, network layer, transport layer, and application layer with the session layer and presentation layer fused with the application layer. Firstly we realize that the HTTP protocol involves the use of the application layer but the main observable idea was that the packet is created and transmitted to and from the server.

The first step in this project was to observe the internal configuration of the web server and the web client. For that, we double-clicked on the web server and were taken to the config menu which had a form of navigation that allowed us to go to the services menu. The services menu had options for different protocols but our focus was mainly on the HTTP protocol and thus we observed the contents of the HTTP protocol that included the index.html or the entry page for that web server.

We learned that the web server had the DNS feature turned on and we learned about a basic idea of the DNS and that it is able to translate the web address or URL to an IP address that helps locate the page similar to how different pages are located in the world wide web.

Next in the web client, we observed a similar manner by double-clicking and then moving on to the desktop option that had a variety of features. Features that are similar to a typical lightweight operating system. Our focus for this experiment was the browser. We entered the address www.osi.local which was an address whose IP address was present in the server to be resolved

using the DNS feature. Upon entering the IP address we reached the index.html contents in the presentable format in the web client.

This part of the experiment was carried out in real-time.

After this part, we reached the main goals of the experiment. Simulating how packets are transferred and understanding the HTTP web traffic. For that we first observe the simulation mode, the previous tests were done in real-time mode. In the simulation mode, we can observe the additional packet transfers as a form of simulation.

The first observation in simulation mode was that the web client sent a request to the server and the server returned packets to the web client. The packet contained details of the web page hosted by the web server in place. The first request results in some packet transfer from client to server and it is shown as a purple envelope that goes to the server from the client in the form of a request. In the second stage, the server returns the data that was requested in our case the web page to the client as a packet also shown as a purple envelope.

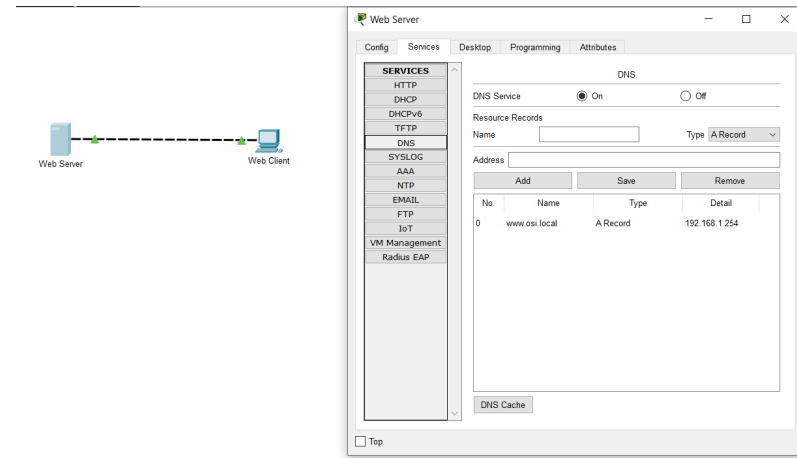
The second observation is when we look at the simulation panel. We see 4 sets of data every time we access the URL www.osi.local. These 4 sets of data are transferred within a span of 0.004 seconds.

Upon clicking on each set of data we can come across some more information regarding each of the 7 layers and how it is working. In the Cisco packet manager, each of the layers can be observed as an in-layer and an out-layer. For the in-layer, we also have an associated Inbound PDU option. PDU stands for Protocol Data Unit which is essentially units of exchange between components on a network that communicate via various networking protocols. For the out-layer, we also have an associated outbound PDU. Which shows the protocols involved in transferring data into and out of a sender or receiver.

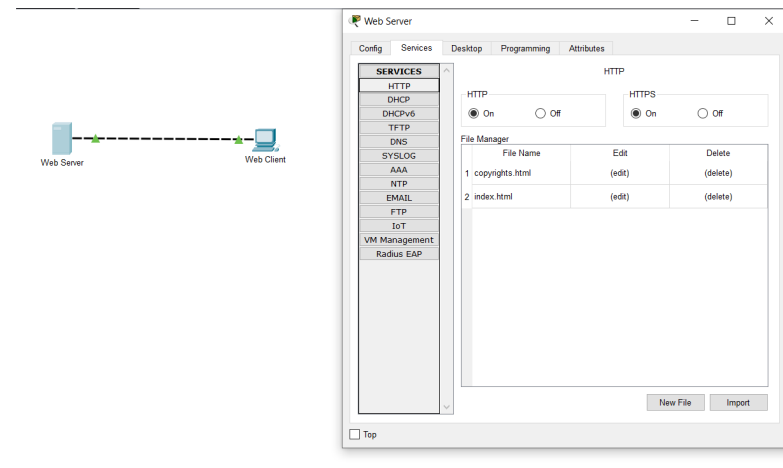
The layers also display the detailed set of activities being performed in those layers and the PDU options show the details of the different packets being transferred along with the number of bits, the different segments of the packets, etc. Now let's observe the diagrams related to the experiment.

Diagram of the experiment:

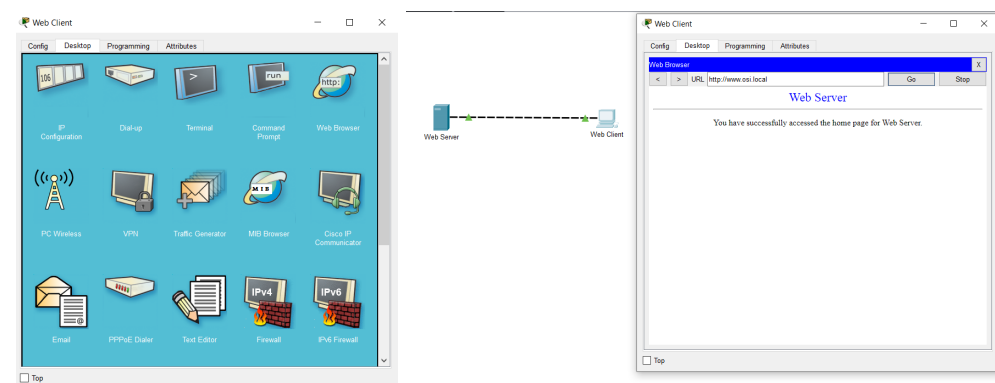
Initially, we observe the DNS option of the web server



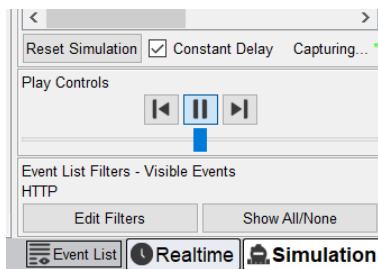
Then we observe the HTTP information about the web server



We access the desktop option of the web client followed by the web browser option where we access the URL www.osi.local



Then we shift from our current realtime mode to simulation mode



Then in simulation mode, we observe the transfer of packets from the client computer to the server computer and vice versa in the simulation mode



Then we move on to the simulation panel where there are 4 rows representing 4 states of the simulation within a span of 0.004 seconds.

Simulation Panel					
Event List					
Vis.	Time(sec)	Last Device	At Device	Type	
	390.786	--	Web Client	HTTP	
	390.787	--	Web Client	HTTP	
	390.788	Web Client	Web Server	HTTP	
	390.789	Web Server	Web Client	HTTP	

We see the information for the first set or state, this shows that 5 of the 7 layers of the OSI model are active. Followed by the information shown for each set. Only the out layer is active in this case.

PDU Information at Device: Web Client

OSI Model Outbound PDU Details

At Device: Web Client
Source: Web Client
Destination: HTTP CLIENT

In Layers	Out Layers
Layer7	Layer 7: HTTP
Layer6	Layer6
Layer5	Layer5
Layer4	Layer 4: TCP Src Port: 1026, Dst Port: 80
Layer3	Layer 3: IP Header Src. IP: 192.168.1.1, Dst. IP: 192.168.1.254
Layer2	Layer 2: Ethernet II Header 0060.47CA.4DEE >> 0001.96A9.401D
Layer1	Layer 1: Port(s):

1. The port FastEthernet0 is sending another frame at this time. The device buffers the frame to be sent later.

Challenge Me << Previous Layer Next Layer >>

PDU Information at Device: Web Client

OSI Model Outbound PDU Details

At Device: Web Client
Source: Web Client
Destination: HTTP CLIENT

In Layers	Out Layers
Layer7	Layer 7: HTTP
Layer6	Layer6
Layer5	Layer5
Layer4	Layer 4: TCP Src Port: 1026, Dst Port: 80
Layer3	Layer 3: IP Header Src. IP: 192.168.1.1, Dst. IP: 192.168.1.254
Layer2	Layer 2: Ethernet II Header 0060.47CA.4DEE >> 0001.96A9.401D
Layer1	Layer 1: Port(s):

1. The next-hop IP address is a unicast. The ARP process looks it up in the ARP table.
2. The next-hop IP address is in the ARP table. The ARP process sets the frame's destination MAC address to the one found in the table.
3. The device encapsulates the PDU into an Ethernet frame.

Challenge Me << Previous Layer Next Layer >>

PDU Information at Device: Web Client

OSI Model Outbound PDU Details

At Device: Web Client
Source: Web Client
Destination: HTTP CLIENT

In Layers	Out Layers
Layer7	Layer 7: HTTP
Layer6	Layer6
Layer5	Layer5
Layer4	Layer 4: TCP Src Port: 1026, Dst Port: 80
Layer3	Layer 3: IP Header Src. IP: 192.168.1.1, Dest. IP: 192.168.1.254
Layer2	Layer 2: Ethernet II Header 0060.47CA.4DEE >> 0001.96A9.401D
Layer1	Layer 1: Port(s):

1. The destination IP address is in the same subnet. The device sets the next-hop to destination.

Challenge Me << Previous Layer Next Layer >>

PDU Information at Device: Web Client

OSI Model Outbound PDU Details

At Device: Web Client
Source: Web Client
Destination: HTTP CLIENT

In Layers	Out Layers
Layer7	Layer 7: HTTP
Layer6	Layer6
Layer5	Layer5
Layer4	Layer 4: TCP Src Port: 1026, Dst Port: 80
Layer3	Layer 3: IP Header Src. IP: 192.168.1.1, Dest. IP: 192.168.1.254
Layer2	Layer 2: Ethernet II Header 0060.47CA.4DEE >> 0001.96A9.401D
Layer1	Layer 1: Port(s):

1. Sent segment information: the sequence number 1, the ACK number 1, and the data length 102.

Challenge Me << Previous Layer Next Layer >>

In this phase, we also see the outbound PDU as well as the information on the outbound PDU

PDU Information at Device: Web Client

OSI Model Outbound PDU Details

At Device: Web Client
Source: Web Client
Destination: HTTP CLIENT

In Layers	Out Layers
Layer7	Layer 7: HTTP
Layer6	Layer6
Layer5	Layer5
Layer4	Layer 4: TCP Src Port: 1026, Dst Port: 80
Layer3	Layer 3: IP Header Src. IP: 192.168.1.1, Dest. IP: 192.168.1.254
Layer2	Layer 2: Ethernet II Header 0060.47CA.4DEE >> 0001.96A9.401D
Layer1	Layer 1: Port(s):

1. The HTTP client sends a HTTP request to the server.

Challenge Me << Previous Layer Next Layer >>

PDU Information at Device: Web Client

OSI Model Outbound PDU Details

PDU Formats

EthernetII

0		4		8		16		24		32		40		48		56		64		72		80		88		96		104		112		120		128		136		144		152		160		168		176		184		192		200		208		216		224		232		240		248		256	
PREAMBLE: 101010...10																SF		D		DEST ADDR: 0001.96A9.401D																																															
SRC ADDR: 0060.47CA.4DEE																TYPE: 0		x0800		DATA (VARIABLE LENGTH)																FCS: 0x00000000																															

IP

0		4		8		16		24		32		40		48		56		64		72		80		88		96		104		112		120		128		136		144		152		160		168		176		184		192		200		208		216		224		232		240		248		256	
VER: 4				IHL: 5				DSCP: 0x00								TL: 122																																																			
ID: 0x000b																FLAGS: 0x2								FRAG OFFSET: 0x000																																											
TTL: 128																PRO: 0x06								CHKSUM																																											
SRC IP: 192.168.1.1																																																																			
DST IP: 192.168.1.254																																																																			
DATA (VARIABLE LENGTH)																																																																			

TCP

0		4		8		16		24		32		40		48		56		64		72		80		88		96		104		112		120		128		136		144		152		160		168		176		184		192		200		208		216		224		232		240		248		256	
SOURCE PORT: 1026																DESTINATION PORT: 80																																																			
SEQUENCE NUMBER: 1																																																																			
ACKNOWLEDGEMENT NUMBER: 1																																																																			
OFFSET: 0x0				RESER: 0				FLAGS: 0b0001100								WINDOW: 65535																																																			
CHECKSUM: 0x0000																URGENT POINTER: 0x0000																																																			
OPTION																																																																			
DATA (VARIABLE LENGTH)																								PADDING: 0																																											

HTTP REQUEST

0		4		8		16		24		32		40		48		56		64		72		80		88		96		104		112		120		128		136		144		152		160		168		176		184		192		200		208		216		224		232		240		248		256	
HTTP Data: Accept-Language: en-us																																																																			
Accept: */*																																																																			

PDU Information at Device: Web Client

OSI Model Outbound PDU Details

PDU Formats

TCP

0		4		8		16		24		32		40		48		56		64		72		80		88		96		104		112		120		128		136		144		152		160		168		176		184		192		200		208		216		224		232		240		248		256	
SOURCE PORT: 1026																DESTINATION PORT: 80																																																			
SEQUENCE NUMBER: 1																																																																			
ACKNOWLEDGEMENT NUMBER: 1																																																																			
OFFSET: 0x0				RESER: 0				FLAGS: 0b0001100								WINDOW: 65535																																																			
CHECKSUM: 0x0000																URGENT POINTER: 0x0000																																																			
OPTION																																																																			
DATA (VARIABLE LENGTH)																								PADDING: 0																																											

HTTP REQUEST

0		4		8		16		24		32		40		48		56		64		72		80		88		96		104		112		120		128		136		144		152		160		168		176		184		192		200		208		216		224		232		240		248		256	
HTTP Data: Accept-Language: en-us																																																																			
Accept: */*																																																																			

This represents the next stage in the simulation panel. This state only shows one active out-layer layer 1.

PDU Information at Device: Web Client

OSI Model Outbound PDU Details

At Device: Web Client
Source: Web Client
Destination: HTTP CLIENT

In Layers	Out Layers
Layer7	Layer7
Layer6	Layer6
Layer5	Layer5
Layer4	Layer4
Layer3	Layer3
Layer2	Layer2
Layer1	Layer1

Layer 1: Port(s): FastEthernet0

1. The device takes out this frame from the buffer and sends it.
2. FastEthernet0 sends out the frame.

Challenge Me << Previous Layer Next Layer >>

PDU Information at Device: Web Client

OSI Model Outbound PDU Details

PDU Formats

EthernetII

Bytes			
0	4	8	
PREAMBLE: 101010...10		SF D	DEST ADDR:0001.96A9.401D
SRC ADDR:0060.47CA.4DEE	TYPE:0x0800	DATA (VARIABLE LENGTH)	FCS:0x00000000

IP

Bits			
0	4	8	
VER:4	IHL:5	DSCP:0x00	TL:122
ID:0x000b		FLAGS:0x2	FRAG OFFSET:0x000
TTL:128	PRO:0x06	CHKSUM	
SRC IP:192.168.1.1			
DST IP:192.168.1.254			
DATA (VARIABLE LENGTH)			

PDU Information at Device: Web Client

OSI Model Outbound PDU Details

PDU Formats

TCP

Bits			
0	4	8	
SOURCE PORT:1026		DESTINATION PORT:80	
SEQUENCE NUMBER:1			
ACKNOWLEDGEMENT NUMBER:1			
OFFSET:0x0	RESERVED:0	FLAGS:0b00011000	WINDOW:65535
CHECKSUM:0x0000		URGENT POINTER:0x0000	
OPTION			
DATA (VARIABLE LENGTH)			PADDING: 0

HTTP REQUEST

Bytes			
0	4	8	
HTTP Data:Accept-Language: en-us Accept: */*			

Then we move on to the next stage in the web server. The pictures show the details of the different layers, its activities and the bits of data transferred for the In Layer and the Out Layer.

PDU Information at Device: Web Server

OSI Model

Inbound PDU Details

Outbound PDU Details

At Device: Web Server

Source: Web Client

Destination: HTTP CLIENT

In Layers

Layer 7: HTTP

Layer6

Layer5

Layer 4: TCP Src Port: 1026, Dst Port: 80

Layer 3: IP Header Src. IP: 192.168.1.1, Dest. IP: 192.168.1.254

Layer 2: Ethernet II Header 0060.47CA.4DEE >> 0001.96A9.401D

Layer 1: Port FastEthernet0

Out Layers

Layer 7: HTTP

Layer6

Layer5

Layer 4: TCP Src Port: 80, Dst Port: 1026

Layer 3: IP Header Src. IP: 192.168.1.254, Dest. IP: 192.168.1.1

Layer 2: Ethernet II Header 0001.96A9.401D >> 0060.47CA.4DEE

Layer 1: Port(s): FastEthernet0

1. FastEthernet0 receives the frame.

Challenge Me

<< Previous Layer

Next Layer >>

PDU Information at Device: Web Server

OSI Model

Inbound PDU Details

Outbound PDU Details

At Device: Web Server

Source: Web Client

Destination: HTTP CLIENT

In Layers

Layer 7: HTTP

Layer6

Layer5

Layer 4: TCP Src Port: 1026, Dst Port: 80

Layer 3: IP Header Src. IP: 192.168.1.1, Dest. IP: 192.168.1.254

Layer 2: Ethernet II Header 0060.47CA.4DEE >> 0001.96A9.401D

Layer 1: Port FastEthernet0

Out Layers

Layer 7: HTTP

Layer6

Layer5

Layer 4: TCP Src Port: 80, Dst Port: 1026

Layer 3: IP Header Src. IP: 192.168.1.254, Dest. IP: 192.168.1.1

Layer 2: Ethernet II Header 0001.96A9.401D >> 0060.47CA.4DEE

Layer 1: Port(s): FastEthernet0

1. The frame's destination MAC address matches the receiving port's MAC address, the broadcast address, or a multicast address.

2. The device decapsulates the PDU from the Ethernet frame.

Challenge Me

<< Previous Layer

Next Layer >>

PDU Information at Device: Web Server

OSI Model

Inbound PDU Details

Outbound PDU Details

At Device: Web Server

Source: Web Client

Destination: HTTP CLIENT

In Layers

Layer 7: HTTP

Layer6

Layer5

Layer 4: TCP Src Port: 1026, Dst Port: 80

Layer 3: IP Header Src. IP: 192.168.1.1, Dest. IP: 192.168.1.254

Layer 2: Ethernet II Header 0060.47CA.4DEE >> 0001.96A9.401D

Layer 1: Port FastEthernet0

Out Layers

Layer 7: HTTP

Layer6

Layer5

Layer 4: TCP Src Port: 80, Dst Port: 1026

Layer 3: IP Header Src. IP: 192.168.1.254, Dest. IP: 192.168.1.1

Layer 2: Ethernet II Header 0001.96A9.401D >> 0060.47CA.4DEE

Layer 1: Port(s): FastEthernet0

1. The packet's destination IP address matches the device's IP address or the broadcast address. The device de-encapsulates the packet.

Challenge Me

<< Previous Layer

Next Layer >>

PDU Information at Device: Web Server

OSI Model

Inbound PDU Details

Outbound PDU Details

At Device: Web Server

Source: Web Client

Destination: HTTP CLIENT

In Layers

Layer 7: HTTP

Layer6

Layer5

Layer 4: TCP Src Port: 1026, Dst Port: 80

Layer 3: IP Header Src. IP: 192.168.1.1, Dest. IP: 192.168.1.254

Layer 2: Ethernet II Header 0060.47CA.4DEE >> 0001.96A9.401D

Layer 1: Port FastEthernet0

Out Layers

Layer 7: HTTP

Layer6

Layer5

Layer 4: TCP Src Port: 80, Dst Port: 1026

Layer 3: IP Header Src. IP: 192.168.1.254, Dest. IP: 192.168.1.1

Layer 2: Ethernet II Header 0001.96A9.401D >> 0060.47CA.4DEE

Layer 1: Port(s): FastEthernet0

1. The device receives a TCP PUSH+ACK segment on the connection to 192.168.1.1 on port 1026.

2. Received segment information: the sequence number 1, the ACK number 1, and the data length 102

3. The TCP segment has the expected peer sequence number.

4. TCP processes payload data.

5. TCP reassembles all data segments and passes to the upper layer.

Challenge Me

<< Previous Layer

Next Layer >>

PDU Information at Device: Web Server

OSI Model Inbound PDU Details Outbound PDU Details

At Device: Web Server
Source: Web Client
Destination: HTTP CLIENT

In Layers

- Layer 7: HTTP
- Layer 6
- Layer 5
- Layer 4: TCP Src Port: 1026, Dst Port: 80
- Layer 3: IP Header Src. IP: 192.168.1.1, Dest. IP: 192.168.1.254
- Layer 2: Ethernet II Header 0060.47CA.4DEE >> 0001.96A9.401D
- Layer 1: Port FastEthernet0

Out Layers

- Layer 7: HTTP
- Layer 6
- Layer 5
- Layer 4: TCP Src Port: 80, Dst Port: 1026
- Layer 3: IP Header Src. IP: 192.168.1.254, Dest. IP: 192.168.1.1
- Layer 2: Ethernet II Header 0001.96A9.401D >> 0060.47CA.4DEE
- Layer 1: Port(s): FastEthernet0

1. The server receives a HTTP request.

Challenge Me << Previous Layer Next Layer >>

PDU Information at Device: Web Server

OSI Model Inbound PDU Details Outbound PDU Details

PDU Formats

Ethernet II

0 4 8 16 20 24 28 32 36 40 44 48 52 56 60 64 68 72 76 80 84 88 92 96 100 104 108 112 116 120 124 128 132 136 140 144 148 152 156 160 164 168 172 176 180 184 188 192 196 200 204 208 212 216 220 224 228 232 236 240 244 248 252 256 260 264 268 272 276 280 284 288 292 296 300 304 308 312 316 320 324 328 332 336 340 344 348 352 356 360 364 368 372 376 380 384 388 392 396 400 404 408 412 416 420 424 428 432 436 440 444 448 452 456 460 464 468 472 476 480 484 488 492 496 500 504 508 512 516 520 524 528 532 536 540 544 548 552 556 560 564 568 572 576 580 584 588 592 596 600 604 608 612 616 620 624 628 632 636 640 644 648 652 656 660 664 668 672 676 680 684 688 692 696 700 704 708 712 716 720 724 728 732 736 740 744 748 752 756 760 764 768 772 776 780 784 788 792 796 800 804 808 812 816 820 824 828 832 836 840 844 848 852 856 860 864 868 872 876 880 884 888 892 896 900 904 908 912 916 920 924 928 932 936 940 944 948 952 956 960 964 968 972 976 980 984 988 992 996 1000 1004 1008 1012 1016 1020 1024 1028 1032 1036 1040 1044 1048 1052 1056 1060 1064 1068 1072 1076 1080 1084 1088 1092 1096 1100 1104 1108 1112 1116 1120 1124 1128 1132 1136 1140 1144 1148 1152 1156 1160 1164 1168 1172 1176 1180 1184 1188 1192 1196 1200 1204 1208 1212 1216 1220 1224 1228 1232 1236 1240 1244 1248 1252 1256 1260 1264 1268 1272 1276 1280 1284 1288 1292 1296 1300 1304 1308 1312 1316 1320 1324 1328 1332 1336 1340 1344 1348 1352 1356 1360 1364 1368 1372 1376 1380 1384 1388 1392 1396 1400 1404 1408 1412 1416 1420 1424 1428 1432 1436 1440 1444 1448 1452 1456 1460 1464 1468 1472 1476 1480 1484 1488 1492 1496 1500 1504 1508 1512 1516 1520 1524 1528 1532 1536 1540 1544 1548 1552 1556 1560 1564 1568 1572 1576 1580 1584 1588 1592 1596 1600 1604 1608 1612 1616 1620 1624 1628 1632 1636 1640 1644 1648 1652 1656 1660 1664 1668 1672 1676 1680 1684 1688 1692 1696 1700 1704 1708 1712 1716 1720 1724 1728 1732 1736 1740 1744 1748 1752 1756 1760 1764 1768 1772 1776 1780 1784 1788 1792 1796 1800 1804 1808 1812 1816 1820 1824 1828 1832 1836 1840 1844 1848 1852 1856 1860 1864 1868 1872 1876 1880 1884 1888 1892 1896 1900 1904 1908 1912 1916 1920 1924 1928 1932 1936 1940 1944 1948 1952 1956 1960 1964 1968 1972 1976 1980 1984 1988 1992 1996 2000 2004 2008 2012 2016 2020 2024 2028 2032 2036 2040 2044 2048 2052 2056 2060 2064 2068 2072 2076 2080 2084 2088 2092 2096 2100 2104 2108 2112 2116 2120 2124 2128 2132 2136 2140 2144 2148 2152 2156 2160 2164 2168 2172 2176 2180 2184 2188 2192 2196 2200 2204 2208 2212 2216 2220 2224 2228 2232 2236 2240 2244 2248 2252 2256 2260 2264 2268 2272 2276 2280 2284 2288 2292 2296 2300 2304 2308 2312 2316 2320 2324 2328 2332 2336 2340 2344 2348 2352 2356 2360 2364 2368 2372 2376 2380 2384 2388 2392 2396 2400 2404 2408 2412 2416 2420 2424 2428 2432 2436 2440 2444 2448 2452 2456 2460 2464 2468 2472 2476 2480 2484 2488 2492 2496 2500 2504 2508 2512 2516 2520 2524 2528 2532 2536 2540 2544 2548 2552 2556 2560 2564 2568 2572 2576 2580 2584 2588 2592 2596 2600 2604 2608 2612 2616 2620 2624 2628 2632 2636 2640 2644 2648 2652 2656 2660 2664 2668 2672 2676 2680 2684 2688 2692 2696 2700 2704 2708 2712 2716 2720 2724 2728 2732 2736 2740 2744 2748 2752 2756 2760 2764 2768 2772 2776 2780 2784 2788 2792 2796 2800 2804 2808 2812 2816 2820 2824 2828 2832 2836 2840 2844 2848 2852 2856 2860 2864 2868 2872 2876 2880 2884 2888 2892 2896 2900 2904 2908 2912 2916 2920 2924 2928 2932 2936 2940 2944 2948 2952 2956 2960 2964 2968 2972 2976 2980 2984 2988 2992 2996 3000 3004 3008 3012 3016 3020 3024 3028 3032 3036 3040 3044 3048 3052 3056 3060 3064 3068 3072 3076 3080 3084 3088 3092 3096 3100 3104 3108 3112 3116 3120 3124 3128 3132 3136 3140 3144 3148 3152 3156 3160 3164 3168 3172 3176 3180 3184 3188 3192 3196 3200 3204 3208 3212 3216 3220 3224 3228 3232 3236 3240 3244 3248 3252 3256 3260 3264 3268 3272 3276 3280 3284 3288 3292 3296 3300 3304 3308 3312 3316 3320 3324 3328 3332 3336 3340 3344 3348 3352 3356 3360 3364 3368 3372 3376 3380 3384 3388 3392 3396 3400 3404 3408 3412 3416 3420 3424 3428 3432 3436 3440 3444 3448 3452 3456 3460 3464 3468 3472 3476 3480 3484 3488 3492 3496 3500 3504 3508 3512 3516 3520 3524 3528 3532 3536 3540 3544 3548 3552 3556 3560 3564 3568 3572 3576 3580 3584 3588 3592 3596 3600 3604 3608 3612 3616 3620 3624 3628 3632 3636 3640 3644 3648 3652 3656 3660 3664 3668 3672 3676 3680 3684 3688 3692 3696 3700 3704 3708 3712 3716 3720 3724 3728 3732 3736 3740 3744 3748 3752 3756 3760 3764 3768 3772 3776 3780 3784 3788 3792 3796 3800 3804 3808 3812 3816 3820 3824 3828 3832 3836 3840 3844 3848 3852 3856 3860 3864 3868 3872 3876 3880 3884 3888 3892 3896 3900 3904 3908 3912 3916 3920 3924 3928 3932 3936 3940 3944 3948 3952 3956 3960 3964 3968 3972 3976 3980 3984 3988 3992 3996 4000 4004 4008 4012 4016 4020 4024 4028 4032 4036 4040 4044 4048 4052 4056 4060 4064 4068 4072 4076 4080 4084 4088 4092 4096 4100 4104 4108 4112 4116 4120 4124 4128 4132 4136 4140 4144 4148 4152 4156 4160 4164 4168 4172 4176 4180 4184 4188 4192 4196 4200 4204 4208 4212 4216 4220 4224 4228 4232 4236 4240 4244 4248 4252 4256 4260 4264 4268 4272 4276 4280 4284 4288 4292 4296 4300 4304 4308 4312 4316 4320 4324 4328 4332 4336 4340 4344 4348 4352 4356 4360 4364 4368 4372 4376 4380 4384 4388 4392 4396 4400 4404 4408 4412 4416 4420 4424 4428 4432 4436 4440 4444 4448 4452 4456 4460 4464 4468 4472 4476 4480 4484 4488 4492 4496 4500 4504 4508 4512 4516 4520 4524 4528 4532 4536 4540 4544 4548 4552 4556 4560 4564 4568 4572 4576 4580 4584 4588 4592 4596 4600 4604 4608 4612 4616 4620 4624 4628 4632 4636 4640 4644 4648 4652 4656 4660 4664 4668 4672 4676 4680 4684 4688 4692 4696 4700 4704 4708 4712 4716 4720 4724 4728 4732 4736 4740 4744 4748 4752 4756 4760 4764 4768 4772 4776 4780 4784 4788 4792 4796 4800 4804 4808 4812 4816 4820 4824 4828 4832 4836 4840 4844 4848 4852 4856 4860 4864 4868 4872 4876 4880 4884 4888 4892 4896 4900 4904 4908 4912 4916 4920 4924 4928 4932 4936 4940 4944 4948 4952 4956 4960 4964 4968 4972 4976 4980 4984 4988 4992 4996 5000 5004 5008 5012 5016 5020 5024 5028 5032 5036 5040 5044 5048 5052 5056 5060 5064 5068 5072 5076 5080 5084 5088 5092 5096 5100 5104 5108 5112 5116 5120 5124 5128 5132 5136 5140 5144 5148 5152 5156 5160 5164 5168 5172 5176 5180 5184 5188 5192 5196 5200 5204 5208 5212 5216 5220 5224 5228 5232 5236 5240 5244 5248 5252 5256 5260 5264 5268 5272 5276 5280 5284 5288 5292 5296 5300 5304 5308 5312 5316 5320 5324 5328 5332 5336 5340 5344 5348 5352 5356 5360 5364 5368 5372 5376 5380 5384 5388 5392 5396 5400 5404 5408 5412 5416 5420 5424 5428 5432 5436 5440 5444 5448 5452 5456 5460 5464 5468 5472 5476 5480 5484 5488 5492 5496 5500 5504 5508 5512 5516 5520 5524 5528 5532 5536 5540 5544 5548 5552 5556 5560 5564 5568 5572 5576 5580 5584 5588 5592 5596 5600 5604 5608 5612 5616 5620 5624 5628 5632 5636 5640 5644 5648 5652 5656 5660 5664 5668 5672 5676 5680 5684 5688 5692 5696 5700 5704 5708 5712 5716 5720 5724 5728 5732 5736 5740 5744 5748 5752 5756 5760 5764 5768 5772 5776 5780 5784 5788 5792 5796 5800 5804 5808 5812 5816 5820 5824 5828 5832 5836 5840 5844 5848 5852 5856 5860 5864 5868 5872 5876 5880 5884 5888 5892 5896 5900 5904 5908 5912 5916 5920 5924 5928 5932 5936 5940 5944 5948 5952 5956 5960 5964 5968 5972 5976 5980 5984 5988 5992 5996 6000 6004 6008 6012 6016 6020 6024 6028 6032 6036 6040 6044 6048 6052 6056 6060 6064 6068 6072 6076 6080 6084 6088 6092 6096 6100 6104 6108 6112 6116 6120 6124 6128 6132 6136 6140 6144 6148 6152 6156 6160 6164 6168 6172 6176 6180 6184 6188 6192 6196 6200 6204 6208 6212 6216 6220 6224 6228 6232 6236 6240 6244 6248 6252 6256 6260 6264 6268 6272 6276 6280 6284 6288 6292 6296 6300 6304 6308 6312 6316 6320 6324 6328 6332 6336 6340 6344 6348 6352 6356 6360 6364 6368 6372 6376 6380 6384 6388 6392 6396 6400 6404 6408 6412 6416 6420 6424 6428 6432 6436 6440 6444 6448 6452 6456 6460 6464 6468 6472 6476 6480 6484 6488 6492 6496 6500 6504 6508 6512 6516 6520 6524 6528 6532 6536 6540 6544 6548 6552 6556 6560 6564 6568 6572 6576 6580 6584 6588 6592 6596 6600 6604 6608 6612 6616 6620 6624 6628 6632 6636 6640 6644 6648 6652 6656 6660 6664 6668 6672 6676 6680 6684 6688 6692 6696 6700 6704 6708 6712 6716 6720 6724 6728 6732 6736 6740 6744 6748 6752 6756 6760 6764 6768 6772 6776 6780 6784 6788 6792 6796 6800 6804 6808 6812 6816 6820 6824 6828 6832 6836 6840 6844 6848 6852 6856 6860 6864 6868 6872 6876 6880 6884 6888 6892 6896 6900 6904 6908 6912 6916 6920 6924 6928 6932 6936 6940 6944 6948 6952 6956 6960 6964 6968 6972 6976 6980 6984 6988 6992 6996 7000 7004 7008 7012 7016 7020 7024 7028 7032 7036 7040 7044 7048 7052 7056 7060 7064 7068 7072 7076 7080 7084 7088 7092 7096 7100 7104 7108 7112 7116 7120 7124 7128 7132 7136 7140 7144 7148 7152 7156 7160 7164 7168 7172 7176 7180 7184 7188 7192 7196 7200 7204 7208 7212 7216 7220 7224 7228 7232 7236 7240 7244 7248 7252 7256 7260 7264 7268 7272 7276 7280 7284 7288 7292 7296 7300 7304 7308 7312 7316 7320 7324 7328 7332 7336 7340 7344 7348 7352 7356 7360 7364 7368 7372 7376 7380 7384 7388 7392 7396 7400 7404 7408 7412 7416 7420 7424 7428 7432 7436 7440 7444 7448 7452 7456 7460 7464 7468 7472 7476 7480 7484 7488 7492 7496 7500 7504 7508 7512 7516 7520 7524 7528 7532 7536 7540 7544 7548 7552 7556 7560 7564 7568 7572 7576 7580 7584 7588 7592 7596 7600 7604 7608 7612 7616 7620 7624 7628 7632 7636 7640 7644 7648 7652 7656 7660 7664 7668 7672 7676 7680 7684 7688 7692 7696 7700 7704 7708 7712 7716 7720 7724 7728 7732 7736 7740 7744 7748 7752 7756 7760 7764 7768 7772 7776 7780 7784 7788 7792 7796 7800 7804 7808 7812 7816 7820 7824 7828 7832 7836 7840 7844 7848 7852 7856 7860 7864 7868 7872 7876 7880 7884 7888 7892 7896 7900 7904 7908 7912 7916 7920 7924 7928 7932 7936 7940 7944 7948 7952 7956 7960 7964 7968 7972 7976 7980 7984 7988 7992 7996 8000 8004 8008 8012 8016 8020 8024 8028 8032 8036 8040 8044 8048 8052 8056 8060 8064 8068 8072 8076 8080 8084 8088 8092 8096 8100 8104 8108 8112 8116 8120 8124 8128 8132 8136 8140 8144 8148 8152 8156 8160 8164 8168 8172 8176 8180 8184 8188 8192 8196 8200 8204 8208 8212 8216 8220 8224 8228 8232 8236 8240 8244 8248 8252 8256 8260 8264 8268 8272 8276 8280 8284 8288 8292 8296 8300 8304 8308 8312 8316 8320 8324 8328 8332 8336 8340 8344 8348 8352 8356 8360 8364 8368 8372 8376 8380 8384 8388 8392 8396 8400 8404 8408 8412 8416 8420 8424 8428 8432 8436 8440 8444 8448 8452 8456 8460 8464 8468 8472 8476 8480 8484 8488 8492 8496 8500 8504 8508 8512 8516 8520 8524 8528 8532 8536 8540 8544 8548 8552 8556 8560 8564 8568 8572 8576 8580 8584 8588 8592 8596 8600 8604 8608 8612 8616 8620 8624 8628 8632 8636 8640 8644 8648 8652 8656 8660 8664 8668 8672 8676 8680 8684 8688 8692 8696 8700 8704 8708 8712 8716 8720 8724 8728 8732 8736 8740 8744 8748 8752 8756 8760 8764 8768 8772 8776 8780 8784 8788 8792 8796 8800 8804 8808 8812 8816 8820 8824 8828 8832 8836 8840 8844 8848 8852 8856 8860 8864 8868 8872 8876 8880 8884 8888 8892 8896 8900 8904 8908 8912 8916 8920 8924 8928 8932 8936 8940 8944 8948 8952 8956 8960 8964 8968 8972 8976 8980 8984 8988 8992 8996 9000 9004 9008 9012 9016 9020 9024 9028 9032 9036 9040 9044 9048 9052 9056 9060 9064 9068 9072 9076 9080 9084 9088 9092 9096 9100 9104 9108 9112 9116 9120 9124 9128 9132 9136 9140 9144 9148 9152 9156 9160 9164 9168 9172 9176 9180 9184 9188 9192 9196 9200 9204 9208 9212 9216 9220 9224 9228 9232 9236 9240 9244 9248 9252 9256 9260 9264 9268 9272 9276 9280 9284 9288 9292 9296 9300 9304 9308 9312 9316 9320 9324 9328 9332 9336 9340 9344 9348 9352 9356 9360 9364 9368 9372 9376 9380 9384 9388 9392 9396 9400 9404 9408 9412 9416 9420 9424 9428 9432 9436 9440 9444 9448 9452 9456 9460 9464 9468 9472 9476 9480 9484 9488 9492 9496 9500 9504 9508 9512 9516 9520 9524 9528 9532 9536 9540 9544 9548 9552 9556 9560 9564 9568 9572 9576 9580 9584 9588 9592 9596 9600 9604 9608 9612 9616 9620 9624 9628 9632 9636 9640 9644 9648 9652 9656 9660 9664 9668 9672 9676 9680 9684 9688 9692 9696

PDU Information at Device: Web Server

OSI Model Inbound PDU Details Outbound PDU Details

At Device: Web Server
Source: Web Client
Destination: HTTP CLIENT

In Layers

Layer 7: HTTP
Layer6
Layer5
Layer 4: TCP Src Port: 1026, Dst Port: 80
Layer 3: IP Header Src. IP: 192.168.1.1, Dest. IP: 192.168.1.254
Layer 2: Ethernet II Header 0060.47CA.4DEE >> 0001.96A9.401D
Layer 1: Port FastEthernet0

Out Layers

Layer 7: HTTP
Layer6
Layer5
Layer 4: TCP Src Port: 80, Dst Port: 1026
Layer 3: IP Header Src. IP: 192.168.1.254, Dest. IP: 192.168.1.1
Layer 2: Ethernet II Header 0001.96A9.401D >> 0060.47CA.4DEE
Layer 1: Port(s): FastEthernet0

1. Sent segment information: the sequence number 1, the ACK number 103, and the data length 272.

Challenge Me << Previous Layer Next Layer >>

PDU Information at Device: Web Server

OSI Model Inbound PDU Details Outbound PDU Details

At Device: Web Server
Source: Web Client
Destination: HTTP CLIENT

In Layers

Layer 7: HTTP
Layer6
Layer5
Layer 4: TCP Src Port: 1026, Dst Port: 80
Layer 3: IP Header Src. IP: 192.168.1.1, Dest. IP: 192.168.1.254
Layer 2: Ethernet II Header 0060.47CA.4DEE >> 0001.96A9.401D
Layer 1: Port FastEthernet0

Out Layers

Layer 7: HTTP
Layer6
Layer5
Layer 4: TCP Src Port: 80, Dst Port: 1026
Layer 3: IP Header Src. IP: 192.168.1.254, Dest. IP: 192.168.1.1
Layer 2: Ethernet II Header 0001.96A9.401D >> 0060.47CA.4DEE
Layer 1: Port(s): FastEthernet0

1. The server sends back a HTTP reply to the client.

Challenge Me << Previous Layer Next Layer >>

PDU Information at Device: Web Server

OSI Model Inbound PDU Details Outbound PDU Details

PDU Formats

EthernetII
0 4 8 Bytes
PREAMBLE: 101010..10 SF D DEST ADDR: 0060.47CA.4DEE
SRC ADDR: 0001.96A9.401D TYPE: 0x0800 DATA (VARIABLE LENGTH) FCS: 0x00000000

IP
0 4 8 16 20 24 Bits
VER: 4 IHL: 5 DSCP: 0x00 TL: 292
ID: 0x0008 FLAGS: 0x2 FRAG OFFSET: 0x000
TTL: 128 PRO: 0x06 CHKSUM
SRC IP: 192.168.1.254
DST IP: 192.168.1.1
DATA (VARIABLE LENGTH)

TCP
0 4 8 16 24 Bits
SOURCE PORT: 80 DESTINATION PORT: 1026

PDU Information at Device: Web Server

OSI Model Inbound PDU Details Outbound PDU Details

PDU Formats

DATA (VARIABLE LENGTH)

TCP
0 4 8 16 24 Bits
SOURCE PORT: 80 DESTINATION PORT: 1026
SEQUENCE NUMBER: 1
ACKNOWLEDGEMENT NUMBER: 103
OFFSET: 0x0 RESER: 0 VED: 0 FLAGS: 0b00011000 WINDOW: 16384
CHECKSUM: 0x0000 URGENT POINTER: 0x0000
OPTION
DATA (VARIABLE LENGTH) PADDING: 0

HTTP RESPONSE
0 4 8 16 Bytes
HTTP Data: Connection: close
Content-Length: 170

Then we move on to the next and final stage for this transfer of packets that is in the web client. We see that only the in layer is active.

PDU Information at Device: Web Client

OSI Model Inbound PDU Details

At Device: Web Client
Source: Web Client
Destination: HTTP CLIENT

In Layers	Out Layers
Layer 7: HTTP	Layer7
Layer6	Layer6
Layer5	Layer5
Layer4: TCP Src Port: 80, Dst Port: 1026	Layer4
Layer 3: IP Header Src. IP: 192.168.1.254, Dest. IP: 192.168.1.1	Layer3
Layer 2: Ethernet II Header 0001.96A9.401D >> 0060.47CA.4DEE	Layer2
Layer 1: Port FastEthernet0	Layer1

1. FastEthernet0 receives the frame.

Challenge Me << Previous Layer Next Layer >>

PDU Information at Device: Web Client

OSI Model Inbound PDU Details

At Device: Web Client
Source: Web Client
Destination: HTTP CLIENT

In Layers	Out Layers
Layer 7: HTTP	Layer7
Layer6	Layer6
Layer5	Layer5
Layer4: TCP Src Port: 80, Dst Port: 1026	Layer4
Layer 3: IP Header Src. IP: 192.168.1.254, Dest. IP: 192.168.1.1	Layer3
Layer 2: Ethernet II Header 0001.96A9.401D >> 0060.47CA.4DEE	Layer2
Layer 1: Port FastEthernet0	Layer1

1. The frame's destination MAC address matches the receiving port's MAC address, the broadcast address, or a multicast address.
2. The device decapsulates the PDU from the Ethernet frame.

Challenge Me << Previous Layer Next Layer >>

PDU Information at Device: Web Client

OSI Model Inbound PDU Details

At Device: Web Client
Source: Web Client
Destination: HTTP CLIENT

In Layers	Out Layers
Layer 7: HTTP	Layer7
Layer6	Layer6
Layer5	Layer5
Layer4: TCP Src Port: 80, Dst Port: 1026	Layer4
Layer 3: IP Header Src. IP: 192.168.1.254, Dest. IP: 192.168.1.1	Layer3
Layer 2: Ethernet II Header 0001.96A9.401D >> 0060.47CA.4DEE	Layer2
Layer 1: Port FastEthernet0	Layer1

1. The packet's destination IP address matches the device's IP address or the broadcast address. The device de-encapsulates the packet.

Challenge Me << Previous Layer Next Layer >>

PDU Information at Device: Web Client

OSI Model Inbound PDU Details

At Device: Web Client
Source: Web Client
Destination: HTTP CLIENT

In Layers	Out Layers
Layer 7: HTTP	Layer7
Layer6	Layer6
Layer5	Layer5
Layer4: TCP Src Port: 80, Dst Port: 1026	Layer4
Layer 3: IP Header Src. IP: 192.168.1.254, Dest. IP: 192.168.1.1	Layer3
Layer 2: Ethernet II Header 0001.96A9.401D >> 0060.47CA.4DEE	Layer2
Layer 1: Port FastEthernet0	Layer1

1. The device receives a TCP PUSH+ACK segment on the connection to 192.168.1.254 on port 80.
2. Received segment information: the sequence number 1, the ACK number 103, and the data length 272.
3. The TCP segment has the expected peer sequence number.
4. The TCP segment has the expected ACK number. The device pops the last sent segment from the buffer.
5. TCP processes payload data.
6. TCP reassembles all data segments and passes to the upper layer.

Challenge Me << Previous Layer Next Layer >>

PDU Information at Device: Web Client

OSI Model Inbound PDU Details

At Device: Web Client
Source: Web Client
Destination: HTTP CLIENT

In Layers	Out Layers
Layer 7: HTTP	Layer7
Layer6	Layer6
Layer5	Layer5
Layer4: TCP Src Port: 80, Dst Port: 1026	Layer4
Layer 3: IP Header Src. IP: 192.168.1.254, Dest. IP: 192.168.1.1	Layer3
Layer 2: Ethernet II Header 0001.96A9.401D >> 0060.47CA.4DEE	Layer2
Layer 1: Port FastEthernet0	Layer1

1. The HTTP client receives a HTTP reply from the server. It displays the page in the web browser.

Challenge Me << Previous Layer Next Layer >>

PDU Information at Device: Web Client

OSI Model Inbound PDU Details

PDU Formats

Ethernet II

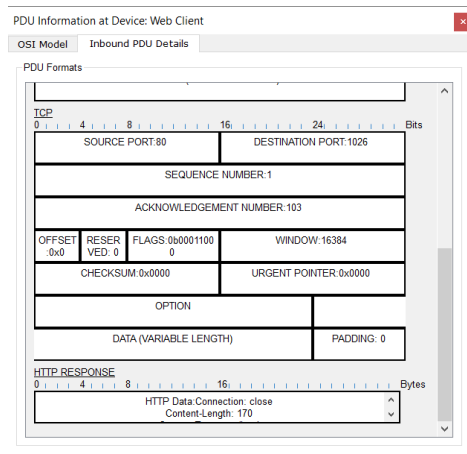
0	4	8	12	16	20	24	Bytes
PREAMBLE: 101010...10		SF D	DEST ADDR: 0060.47CA.4DEE				
SRC ADDR: 0001.96A9.401D		TYPE: 0x0800	DATA (VARIABLE LENGTH)		FCS: 0x00000000		

IP

0	4	8	12	16	20	24	Bits
VER: 4		IHL: 5		DSCP: 0x00		TL: 292	
ID: 0x0008				FLAGS: 0x2		FRAG OFFSET: 0x000	
TTL: 128		PRO: 0x06		CHKSUM			
SRC IP: 192.168.1.254							
DST IP: 192.168.1.1							
DATA (VARIABLE LENGTH)							

TCP

0	4	8	12	16	20	24	Bits
---	---	---	----	----	----	----	------



Observation:

The first observation would be during the simulation mode we could see a purple envelope move from the client to the server and back. It is essentially an example of a client-server model where the client requests a packet from the server, after which the server returns an appropriate packet based on the request from the client.

This exchange of packets is seen in the application layer perspective but to scrutinize it even further we see that all the layers except the 5th and 6th layers, that being the session layer and the presentation layers were active. This can be the main reason why in most cases we consider the TCP/IP protocol suite over the more typical OSI model as the TCP/IP protocol suite involves 5 layers excluding the 5th and 6th layers by merging them with the 7th layer of the OSI model.

We observe the first stage of packet transfer. If we observe the in a layer in a top-down manner. The first layer or the application layer sends an HTTP request to the server. The HTTP request abides by the HTTP protocol which accepts data with language en-us and it may contain '/'. Then the Transport layer breaks that information into segments with each segment having a sequence number, ACK number, and data. The transport layer also identifies the source port and the destination port. Then we move on to the network layer, which fixes the source IP address and the destination IP address. Since in this case, the client and the server are in the same subnet so the IP address for the source and the destination can be directly evaluated without involving a NAT(Network Address Translator). The destination IP address is set as the next-hop IP address. This layer also translates the segments to packets with a network layer header, called a datagram with appropriate information about the source and destination IP address in the header. After which we have the data link layer. The packets are translated to data frames that can be passed to the physical layer. First, the next-hop IP address is looked up in the ARP(Address Resolution Protocol) table. For sending a request, the next-hop IP address

is unicast and upon looking at the ARP table, the MAC(Media Access Control) address for the receiver device can be obtained. So the destination MAC address can be added to an ethernet frame or the data frame and then it can be passed on to the physical layer. In our case, the physical layer made use of port FastEthernet0. In the first stage, the device buffers the frames from the link layer to be sent layer.

In the second stage, the device takes out this frame from the buffer and sends it via FastEthernet0.

In the third stage, we deal with the web server. In the web server, both the in layer and the out layers are active. The in layer receives the request and the out layer generates data as per the received request. First, the physical layer of the in-layer receives the ethernet frames from the client. The frame's destination port address is used to evaluate the receiver's destination MAC address, unicast address, or broadcast address. Then in this layer, the device de-encapsulates or evaluates the data of the data frame to be passed to the network layer. In the network layer, the IP address is matched with the device's IP address or the broadcast address. Then the de-encapsulated data frame is converted into packets which are again de-encapsulated into segments that can be evaluated by the transport layer. In the transport layer, the device receives a TCP PUSH+ACK on the sender's IP address and port number 1026. The transport layer then evaluates the data before passing it to the application layer as a data segment. The server then receives an HTTP request from the data segment. Then in the out layer, the server sends back an HTTP response. The application layer prepares and passes the HTTP reply to the transport layer. And then in a similar way to the first stage, the HTTP reply is translated into ethernet frames and passed to the physical layer which transmits the HTTP reply to the client.

The last and final stage for a single request involves only the in-layer. In the in-layer, the physical layer receives the ethernet frames, evaluates them, and then sends them to its corresponding layers. It is similar to how the in-layer worked in the third stage but the key difference lies in the transport layer. The difference is that the device pops the last sent request from the buffer queue so that the same request isn't sent again by the out layer because an appropriate response is received. This is essentially a form of automatic repeat request if the package isn't received with integrity. The rest of the application of the transport layer is similar to the third stage but the data segment now contains the response which is the data for the index.html in various segments. The various segments are accumulated and processed and then passed to the application layer. The application layer then receives the processed data and displays it on the web browser of the client. And thus a request is evaluated.

Challenges:

First and foremost, I don't really know how the PUSH+ACK works and it seems a bit perplexing for me to evaluate how the bits are actually segmented, I would have to learn that further. Moreover, I am still having confusion regarding how the IP addresses are routed if there are multiple devices connected to the router. Although it requires a network address translator but in which layer the network address translator operates, and how it deals with subnets is still baffling to me. The other issue was resizing the screenshots for this document and remembering all the contents of the class, my notes weren't satisfactory and I hope to change my noting style from the next class to better accommodate the information I have to write in the report.