

# CMPE 207 HW1 Pradeep Patil SID 011483277

## Part 1 WEBCLIENT

### 1 a. Apache2 Server Status

```
pradeep@pradeep-VirtualBox: ~  
pradeep@pradeep-VirtualBox:~$ systemctl status apache2  
● apache2.service - LSB: Apache2 web server  
   Loaded: loaded (/etc/init.d/apache2; bad; vendor preset: enabled)  
   Drop-In: /lib/systemd/system/apache2.service.d  
            └─apache2-systemd.conf  
   Active: active (running) since Wed 2018-09-19 11:47:39 PDT; 9h ago  
     Docs: man:systemd-sysv-generator(8)  
  Process: 3072 ExecReload=/etc/init.d/apache2 reload (code=exited, status=0/SUCCESS)  
  Process: 1031 ExecStart=/etc/init.d/apache2 start (code=exited, status=0/SUCCESS)  
   CGroup: /system.slice/apache2.service  
           └─1097 /usr/sbin/apache2 -k start  
             3179 /usr/sbin/apache2 -k start  
             3180 /usr/sbin/apache2 -k start  
  
Sep 19 11:47:36 pradeep-VirtualBox systemd[1]: Starting LSB: Apache2 web server...  
Sep 19 11:47:36 pradeep-VirtualBox apache2[1031]: * Starting Apache httpd web server apache2  
Sep 19 11:47:38 pradeep-VirtualBox apache2[1031]: AH00558: apache2: Could not reliably determine the server's fully qualified domain name, usi  
Sep 19 11:47:39 pradeep-VirtualBox apache2[1031]: *  
Sep 19 11:47:39 pradeep-VirtualBox systemd[1]: Started LSB: Apache2 web server.  
Sep 19 11:52:25 pradeep-VirtualBox systemd[1]: Reloading LSB: Apache2 web server.  
Sep 19 11:52:25 pradeep-VirtualBox apache2[3072]: * Reloading Apache httpd web server apache2  
Sep 19 11:52:26 pradeep-VirtualBox apache2[3072]: *  
Sep 19 11:52:26 pradeep-VirtualBox systemd[1]: Reloaded LSB: Apache2 web server.  
lines 1-22/22 (END)
```

### 1 b. Program Exicution

```
pradeep@pradeep-VirtualBox: ~/Desktop/H1 compare  
pradeep@pradeep-VirtualBox:~/Desktop/H1 compare$ ./webclient http://localhost/  
CMPE 207 HW1 webclient Bapugouda urf Pradeep Patil 277  
HTTP/1.1 200 OK  
Date: Wed, 19 Sep 2018 09:30:28 GMT  
Server: Apache/2.4.18 (Ubuntu)  
Last-Modified: Sun, 16 Sep 2018 22:33:37 GMT  
ETag: "2c39-57604a5ca8126"  
Accept-Ranges: bytes  
Content-Length: 11321  
Vary: Accept-Encoding  
Connection: close  
Content-Type: text/html  
  
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">  
<html xmlns="http://www.w3.org/1999/xhtml">  
  <!--  
    Modified from the Debian original for Ubuntu  
    Last updated: 2014-03-19  
    See: https://launchpad.net/bugs/1288690  
  -->  
  <head>  
    <meta http-equiv="Content-Type" content="text/html; charset=UTF-8" />  
    <title>Apache2 Ubuntu Default Page: It works</title>  
    <style type="text/css" media="screen">  
      * {  
        margin: 0px 0px 0px 0px;  
        padding: 0px 0px 0px 0px;  
      }  
      body, html {  
        padding: 3px 3px 3px 3px;  
        background-color: #D8DBE2;  
        font-family: Verdana, sans-serif;  
        font-size: 11pt;  
        text-align: center;  
      }  
    </style>  
  </head>  
</html>
```

The screenshot displays the Wireshark network protocol analyzer interface. The top status bar indicates the capture is on the 'eth0' interface, with a packet rate of 0.000000 packets/sec and 0 bytes captured. The filter bar shows the active filter 'tcp.port == 80 || udp.port == 80'. The packet list pane shows a list of 10 captured packets, with packet 4 selected, which is an HTTP GET request. The packet details pane shows the structure of the selected packet, including the Ethernet II header, Internet Protocol Version 4 header, Transmission Control Protocol header, and Hypertext Transfer Protocol header. The packet bytes pane shows the raw data of the selected packet, including the Ethernet II header, Internet Protocol Version 4 header, Transmission Control Protocol header, and Hypertext Transfer Protocol header.

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	127.0.0.1	127.0.0.1	TCP	74	52110 → 80 [SYN] Seq=0 Win=43690 Len=0 MSS=65495 SACK_PERM=1 TS...
2	0.000015320	127.0.0.1	127.0.0.1	TCP	74	80 → 52110 [SYN, ACK] Seq=0 Ack=1 Win=43690 Len=0 MSS=65495 SACK...
3	0.000030243	127.0.0.1	127.0.0.1	TCP	66	52110 → 80 [ACK] Seq=1 Ack=1 Win=43776 Len=0 TSval=2570074473 TS...
4	0.000042685	127.0.0.1	127.0.0.1	HTTP	99	GET http://localhost HTTP/1.0
5	0.000055682	127.0.0.1	127.0.0.1	TCP	66	80 → 52110 [ACK] Seq=1 Ack=34 Win=43776 Len=0 TSval=2570074473 TS...
6	0.000296822	127.0.0.1	127.0.0.1	HTTP	11661	HTTP/1.1 200 OK (text/html)
7	0.000381824	127.0.0.1	127.0.0.1	TCP	66	80 → 52110 [FIN, ACK] Seq=11596 Ack=34 Win=43776 Len=0 TSval=25...
8	0.000724303	127.0.0.1	127.0.0.1	TCP	66	52110 → 80 [ACK] Seq=34 Ack=11596 Win=174720 Len=0 TSval=257007...
9	0.000743899	127.0.0.1	127.0.0.1	TCP	66	52110 → 80 [FIN, ACK] Seq=34 Ack=11597 Win=174720 Len=0 TSval=25...
10	0.000752370	127.0.0.1	127.0.0.1	TCP	66	80 → 52110 [ACK] Seq=11597 Ack=35 Win=43776 Len=0 TSval=2570074...

Frame 4: 99 bytes on wire (792 bits), 99 bytes captured (792 bits) on interface 0  
 Ethernet II, Src: 00:00:00:00:00:00 (00:00:00:00:00:00), Dst: 00:00:00:00:00:00 (00:00:00:00:00:00)  
 Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1  
 Transmission Control Protocol, Src Port: 52110, Dst Port: 80, Seq: 1, Ack: 1, Len: 33  
 Hypertext Transfer Protocol  
 GET http://localhost HTTP/1.0\r\n\r\n  
 [HTTP request 1/1]  
 [Response in frame: 6]

Offset	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000	2010	2020	2030	2040	2050	2060	2070	2080	2090	2100	2110	2120	2130	2140	2150	2160	2170	2180	2190	2200	2210	2220	2230	2240	2250	2260	2270	2280	2290	2300	2310	2320	2330	2340	2350	2360	2370	2380	2390	
--------	---	----	----	----	----	----	----	----	----	----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	--

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## 1 c. 2 Capture of Response Packet Expanded

The image shows a Wireshark packet capture interface. The top toolbar includes icons for file operations, network analysis, and display filters. A filter bar at the top shows the expression `tcp.port == 80 || udp.port == 80`. The packet list on the left shows 10 packets, with packet 6 selected. The packet details pane on the right shows the expanded contents of packet 6, which is an HTTP 200 OK response. The raw data pane at the bottom shows the hexadecimal and ASCII representation of the packet data.

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	127.0.0.1	127.0.0.1	TCP	74	52110 → 80 [SYN] Seq=0 Win=43690 Len=0 MSS=65495 SACK_PERM=1 TS...
2	0.000015320	127.0.0.1	127.0.0.1	TCP	74	80 → 52110 [SYN, ACK] Seq=0 Ack=1 Win=43690 Len=0 MSS=65495 SAC...
3	0.000030243	127.0.0.1	127.0.0.1	TCP	66	52110 → 80 [ACK] Seq=1 Ack=1 Win=43776 Len=0 TSval=2570074473 T...
4	0.000042685	127.0.0.1	127.0.0.1	HTTP	99	GET http://localhost HTTP/1.0
5	0.000055682	127.0.0.1	127.0.0.1	TCP	66	80 → 52110 [ACK] Seq=1 Ack=34 Win=43776 Len=0 TSval=2570074473 ...
6	0.000296822	127.0.0.1	127.0.0.1	HTTP	11661	HTTP/1.1 200 OK (text/html)
7	0.000381824	127.0.0.1	127.0.0.1	TCP	66	80 → 52110 [FIN, ACK] Seq=11596 Ack=34 Win=43776 Len=0 TSval=25...
8	0.000724303	127.0.0.1	127.0.0.1	TCP	66	52110 → 80 [ACK] Seq=34 Ack=11596 Win=174720 Len=0 TSval=257007...
9	0.000743899	127.0.0.1	127.0.0.1	TCP	66	52110 → 80 [FIN, ACK] Seq=34 Ack=11597 Win=174720 Len=0 TSval=2...
10	0.000752370	127.0.0.1	127.0.0.1	TCP	66	80 → 52110 [ACK] Seq=11597 Ack=35 Win=43776 Len=0 TSval=2570074...

Frame 6: 11661 bytes on wire (93288 bits), 11661 bytes captured (93288 bits) on interface 0  
▶ Ethernet II, Src: 00:00:00:00:00:00 (00:00:00:00:00:00), Dst: 00:00:00:00:00:00 (00:00:00:00:00:00)  
▶ Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1  
▶ Transmission Control Protocol, Src Port: 80, Dst Port: 52110, Seq: 1, Ack: 34, Len: 11595  
▶ Hypertext Transfer Protocol  
▶ HTTP/1.1 200 OK\r\n  
Date: Thu, 20 Sep 2018 03:42:52 GMT\r\n  
Server: Apache/2.4.18 (Ubuntu)\r\n  
Last-Modified: Sun, 16 Sep 2018 22:33:37 GMT\r\n  
ETag: "2c39-57604a5ca8126"\r\n  
Accept-Ranges: bytes\r\n

## 1 d. Comparison between the Webclient output and Curl Output.

The image shows a terminal window with the following commands and output:

```
pradeep@pradeep-VirtualBox: ~/Desktop/H1 compare
pradeep@pradeep-VirtualBox:~/Desktop/H1 compare$ ./webclient http://localhost/ > webclient-out
pradeep@pradeep-VirtualBox:~/Desktop/H1 compare$ curl -i http://localhost/ > curl-out
% Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
           Dload  Upload  Total   Spent    Left   Speed
100 11321  100 11321    0     0  669k    0  0:00:00  0:00:00  0:00:00  690k
pradeep@pradeep-VirtualBox:~/Desktop/H1 compare$ ls -l webclient-out curl-out
-rw-rw-r-- 1 pradeep pradeep 11576 Sep 19 02:36 curl-out
-rw-rw-r-- 1 pradeep pradeep 11650 Sep 19 02:36 webclient-out
pradeep@pradeep-VirtualBox:~/Desktop/H1 compare$ diff webclient-out curl-out
1d0
< CMPE 207 HW1 webclient Bapugouda urf Pradeep Patil 277
3c2
< Date: Wed, 19 Sep 2018 09:36:36 GMT
...
> Date: Wed, 19 Sep 2018 09:36:41 GMT
10d8
< Connection: close
pradeep@pradeep-VirtualBox:~/Desktop/H1 compare$
```

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## Part 2 UDPCLIENT

### 2 a. XINETD Server Status

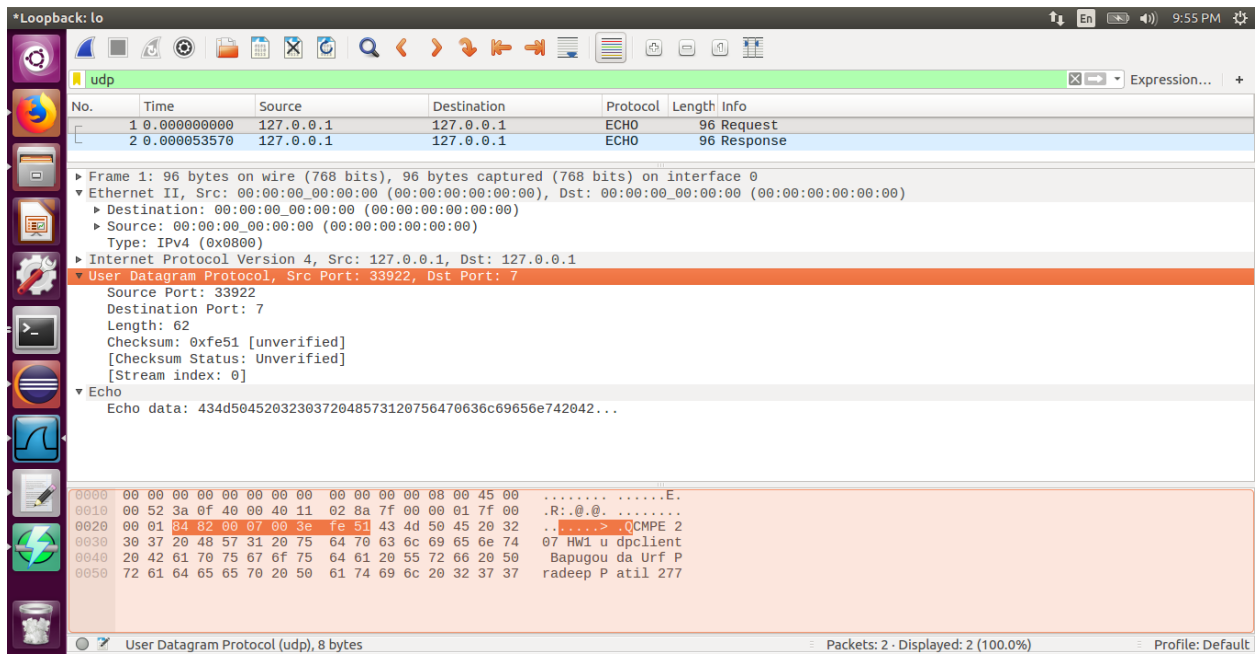
```
pradeep@pradeep-VirtualBox: ~  
pradeep@pradeep-VirtualBox:~$ systemctl status xinetd  
● xinetd.service - LSB: Starts or stops the xinetd daemon.  
   Loaded: loaded (/etc/init.d/xinetd; bad; vendor preset: enabled)  
   Active: active (running) since Wed 2018-09-19 11:47:37 PDT; 9h ago  
     Docs: man:systemd-sysv-generator(8)  
  Process: 4790 ExecReload=/etc/init.d/xinetd reload (code=exited, status=0/SUCCESS)  
  Process: 1029 ExecStart=/etc/init.d/xinetd start (code=exited, status=0/SUCCESS)  
   CGroup: /system.slice/xinetd.service  
           └─1075 /usr/sbin/xinetd -pidfile /run/xinetd.pid -stayalive -inetd_compat -inetd_ipv6  
  
Sep 19 12:49:57 pradeep-VirtualBox xinetd[1075]: Reading included configuration file: /etc/xinetd.d/echo [file=/etc/xinetd.d/echo] [line=25]  
Sep 19 12:49:57 pradeep-VirtualBox xinetd[1075]: Reading included configuration file: /etc/xinetd.d/time [file=/etc/xinetd.d/time] [line=26]  
Sep 19 12:49:57 pradeep-VirtualBox xinetd[1075]: removing chargen  
Sep 19 12:49:57 pradeep-VirtualBox xinetd[1075]: removing discard  
Sep 19 12:49:57 pradeep-VirtualBox xinetd[1075]: removing discard  
Sep 19 12:49:57 pradeep-VirtualBox xinetd[1075]: removing discard  
Sep 19 12:49:57 pradeep-VirtualBox xinetd[1075]: Swapping defaults  
Sep 19 12:49:57 pradeep-VirtualBox xinetd[1075]: Reconfigured: new=6 old=0 dropped=0 (services)  
Sep 19 12:49:57 pradeep-VirtualBox xinetd[4790]: ...done.  
Sep 19 12:49:57 pradeep-VirtualBox systemd[1]: Reloaded LSB: Starts or stops the xinetd daemon..  
pradeep@pradeep-VirtualBox:~$
```

### 2 b. Program Execution udpclient

```
pradeep@pradeep-VirtualBox: ~/Desktop/H1 compare  
pradeep@pradeep-VirtualBox:~/Desktop/H1 compare$ gcc udpclient.c -o udpclient  
pradeep@pradeep-VirtualBox:~/Desktop/H1 compare$ ./udpclient localhost echo "CMP  
E 207 HW1 udpclient Bapugouda Urf Pradeep Patil 277"  
CMPE 207 HW1 udpclient Bapugouda urf Pradeep Patil 277  
Client's Current Time: 19 9 2018 21:49:36 PDT  
length (54): CMPE 207 HW1 udpclient Bapugouda Urf Pradeep Patil 277  
pradeep@pradeep-VirtualBox:~/Desktop/H1 compare$ ./udpclient localhost daytime "  
CMPE 207 HW1 udpclient Bapugouda Urf Pradeep Patil 277"  
CMPE 207 HW1 udpclient Bapugouda urf Pradeep Patil 277  
Client's Current Time: 19 9 2018 21:50:22 PDT  
length (26): 19 SEP 2018 21:50:22 PDT  
pradeep@pradeep-VirtualBox:~/Desktop/H1 compare$
```

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## 2 c. WireShark Capture of Request

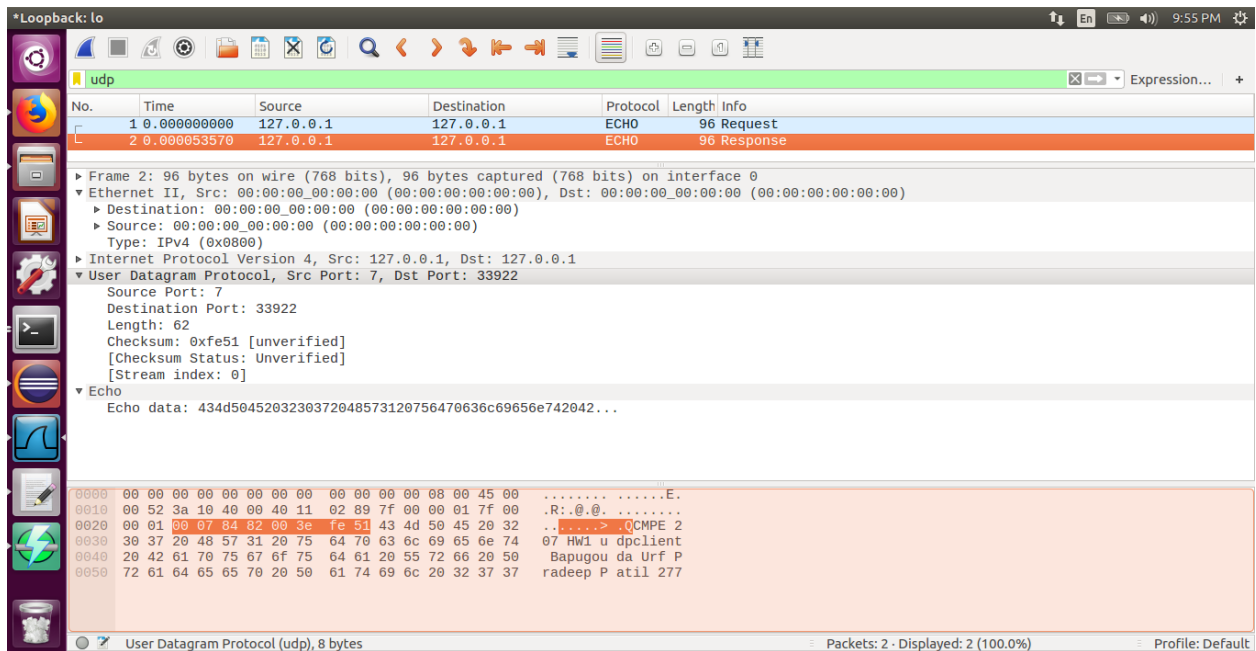


The screenshot shows a Wireshark capture of a request packet. The packet list on the left shows two packets: a request (No. 1) and a response (No. 2). The packet details pane on the right shows the structure of the request packet, including Ethernet II, Internet Protocol Version 4, and User Datagram Protocol (UDP). The packet bytes pane at the bottom shows the raw data of the packet, including the Ethernet header, IP header, and UDP header.

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	127.0.0.1	127.0.0.1	ECHO	96	Request
2	0.000053570	127.0.0.1	127.0.0.1	ECHO	96	Response

Frame 1: 96 bytes on wire (768 bits), 96 bytes captured (768 bits) on interface 0  
Ethernet II, Src: 00:00:00:00:00:00 (00:00:00:00:00:00), Dst: 00:00:00:00:00:00 (00:00:00:00:00:00)  
Destination: 00:00:00:00:00:00 (00:00:00:00:00:00)  
Source: 00:00:00:00:00:00 (00:00:00:00:00:00)  
Type: IPv4 (0x0800)  
Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1  
User Datagram Protocol, Src Port: 33922, Dst Port: 7  
Source Port: 33922  
Destination Port: 7  
Length: 62  
Checksum: 0xfe51 [unverified]  
[Checksum Status: Unverified]  
[Stream index: 0]  
Echo  
Echo data: 434d5045203230372048573120756470636c69656e742042...

## 2 c. Wireshark Capture of Response



The screenshot shows a Wireshark capture of a response packet. The packet list on the left shows two packets: a request (No. 1) and a response (No. 2). The packet details pane on the right shows the structure of the response packet, including Ethernet II, Internet Protocol Version 4, and User Datagram Protocol (UDP). The packet bytes pane at the bottom shows the raw data of the packet, including the Ethernet header, IP header, and UDP header.

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	127.0.0.1	127.0.0.1	ECHO	96	Request
2	0.000053570	127.0.0.1	127.0.0.1	ECHO	96	Response

Frame 2: 96 bytes on wire (768 bits), 96 bytes captured (768 bits) on interface 0  
Ethernet II, Src: 00:00:00:00:00:00 (00:00:00:00:00:00), Dst: 00:00:00:00:00:00 (00:00:00:00:00:00)  
Destination: 00:00:00:00:00:00 (00:00:00:00:00:00)  
Source: 00:00:00:00:00:00 (00:00:00:00:00:00)  
Type: IPv4 (0x0800)  
Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1  
User Datagram Protocol, Src Port: 7, Dst Port: 33922  
Source Port: 7  
Destination Port: 33922  
Length: 62  
Checksum: 0xfe51 [unverified]  
[Checksum Status: Unverified]  
[Stream index: 0]  
Echo  
Echo data: 434d5045203230372048573120756470636c69656e742042...

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## Part 3 Capture Compare

3. (4 pts each, 20 pts) Use your Wireshark screenshots for TCP and UDP, and compare the differences of client-server packet exchange between TCP and UDP. In particular, other than the request and response packets, explain the following “additional” packets of TCP (when compared with UDP):

- Initiate connection
- Destroy connection
- After the client sends a request to the server but before server sends the response
- After the server sends a response to the client

### TCP Packets

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	127.0.0.1	127.0.0.1	TCP	74	52110 → 80 [SYN] Seq=0 Win=43690 Len=0 MSS=65495 SACK_PERM=1 TS...
2	0.000015320	127.0.0.1	127.0.0.1	TCP	74	80 → 52110 [SYN, ACK] Seq=0 Ack=1 Win=43690 Len=0 MSS=65495 SAC...
3	0.000030243	127.0.0.1	127.0.0.1	TCP	66	52110 → 80 [ACK] Seq=1 Ack=1 Win=43776 Len=0 TSval=2570074473 T...
4	0.000042685	127.0.0.1	127.0.0.1	HTTP	99	GET http://localhost HTTP/1.0
5	0.000055682	127.0.0.1	127.0.0.1	TCP	66	80 → 52110 [ACK] Seq=1 Ack=34 Win=43776 Len=0 TSval=2570074473 ...
6	0.000296822	127.0.0.1	127.0.0.1	HTTP	11661	HTTP/1.1 200 OK (text/html)
7	0.000381824	127.0.0.1	127.0.0.1	TCP	66	80 → 52110 [FIN, ACK] Seq=11596 Ack=34 Win=43776 Len=0 TSval=25...
8	0.000724303	127.0.0.1	127.0.0.1	TCP	66	52110 → 80 [ACK] Seq=34 Ack=11596 Win=174720 Len=0 TSval=257007...
9	0.000743899	127.0.0.1	127.0.0.1	TCP	66	52110 → 80 [FIN, ACK] Seq=34 Ack=11597 Win=174720 Len=0 TSval=2...
10	0.000752370	127.0.0.1	127.0.0.1	TCP	66	80 → 52110 [ACK] Seq=11597 Ack=35 Win=43776 Len=0 TSval=2570074...

### UDP Packets

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	127.0.0.1	127.0.0.1	DAYTIME	96	DAYTIME Request
2	0.000110622	127.0.0.1	127.0.0.1	DAYTIME	68	DAYTIME Response

#### a. Initiate connection

The first 3 packets are responsible for the TCP 3-way handshake to create a connection between the client and server. To establish a connection, TCP uses a three-way handshake. Before a client attempts to connect with a server, the server must first bind to and listen at a port to open it up for connections: this is called a passive open. Once the passive open is established, a client may initiate an active open. Resulting 3 packets: 1. [SYN] 2. [SYN,ACK] 3. [ACK]

#### b. Destroy connection

Once the transfer is completed, the active connection between client and server is closed, and all the associated resources are released. The connection termination phase uses a four-way handshake, with each side of the connection terminating independently. When an endpoint wishes to stop its half of the connection, it transmits a FIN packet, which the other end acknowledges with an ACK. Therefore, a typical tear-down requires a pair of FIN and ACK segments from each TCP endpoint. After the side that sent the first FIN has responded with the final ACK, it waits for a timeout before finally closing the connection, during which time the local port is unavailable for new connections.

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**c. After the client sends a request to the server but before server sends the response**

This packet is an acknowledgement sent from server to client to assert that the request was successfully received. As TCP is connection oriented all the incoming packets are acknowledged by the receiving end.

**d. After the server sends a response to the client**

After the response is sent we have two cases, I. if all the data requested by the client is sent, the server sends a signal to indicate the requested. II. If data is sent partially the server sends the number of bytes sent as a parameter and then sends the remaining data in parts and continues. All the packets from the server are acknowledged by the client. Once the transfer is complete one of the end points initiate the close of the connection and the connection is closed as explained in b.