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SUB: COMPUTER NETWORKS LAB

Week #4

Understanding Persistent and Non-persistent HTTP Connections

To understand persistent and non-persistent HTTP connections and corresponding performance impact.

Create a web page with N (e.g. 10) embedded images. Each image should be of minimum 2 MB size. Configure your browser (Firefox) with following settings (each setting requires repeat of experiment)

- Non persistent connection
- 2 persistent connections
- 4 persistent connections
- 6 persistent connections
- 10 persistent connections.

Observation: Note down the time taken to display the entire page in each of the settings. Ensure that (cache is cleared before starting the web request). Explain the response time differences. What is the optimal number of persistent connections for best performance? Explain your answer.

Introduction

The Apache HTTP server is the most widely-used web server in the world. It provides many powerful features including dynamically loadable modules, robust media support, and extensive integration with other popular software.

Objective: Understand persistent and non-persistent HTTP connections and corresponding performance impact.

Experiment: Create a web page with N (e.g. 10) embedded images. Each image should be of minimum 2 MB size. Configure your browser (Firefox) with following settings (each setting requires repeat of experiment)

a) Non-persistent connection
b) 2 persistent connections
c) 4 persistent connections
d) 6 persistent connections
e) 10 persistent connections

Note down the time taken to display the entire page in each of the settings. Ensure that cache is cleared before starting the web request. Explain the response time differences. What is the optimal number of persistent connections for best performance? Explain your answer.

Note: To install Apache server, use the following command,

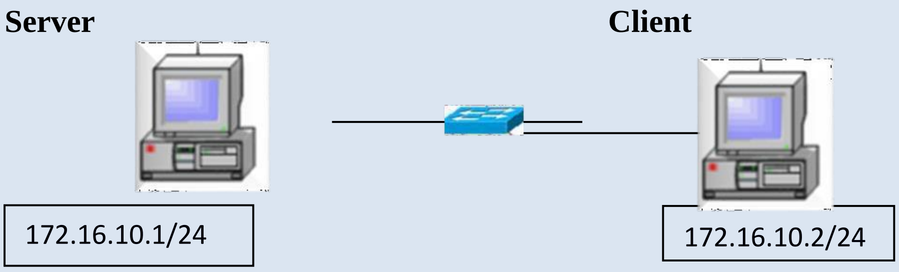
```
sudo apt-get install apache2
```

If there is any error during installation, update the package manager by issuing the command,

```
sudo apt-get update
```

EXECUTION STEPS

Step 1: Connect 2 desktops using switch and cables as shown below. (Use 2 VMs on Virtualbox or VMware instead of physical connections.)



<u>Server Side:</u>

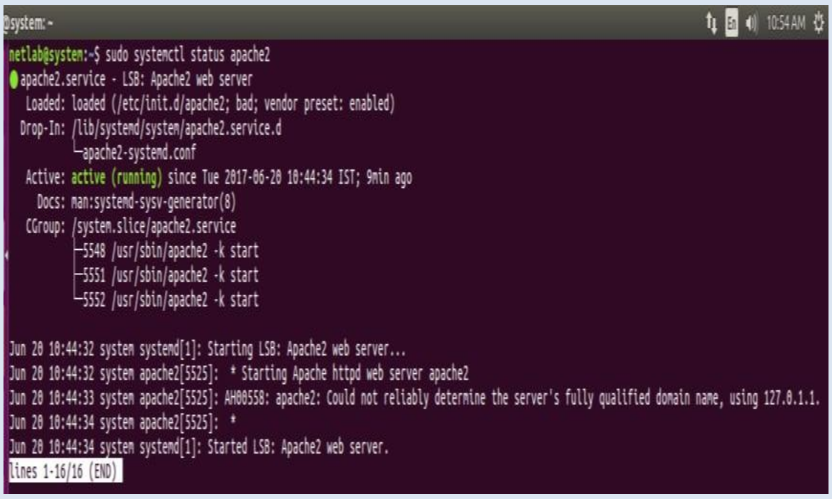
Step 2: Check your Web Server

At the end of the installation process, Ubuntu 16.04 starts Apache. The web server should already be up and running. We can check with the `systemctl` command to make sure the service is running by typing:

sudo systemctl status apache2

or

sudo service apache2 status



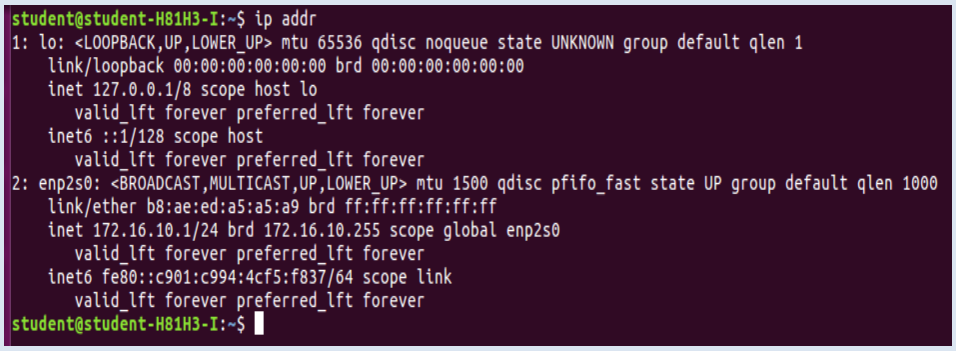
```
@system: ~
netlab@system:~$ sudo systemctl status apache2
● apache2.service - LSB: Apache2 web server
   Loaded: loaded (/etc/init.d/apache2; bad; vendor preset: enabled)
  Drop-In: /lib/systemd/system/apache2.service.d
           └─apache2-systemd.conf
   Active: active (running) since Tue 2017-06-20 10:44:34 IST; 9min ago
     Docs: man:systemd-sysv-generator(8)
   CGroup: /system.slice/apache2.service
           ├─5548 /usr/sbin/apache2 -k start
           ├─5551 /usr/sbin/apache2 -k start
           └─5552 /usr/sbin/apache2 -k start

Jun 20 10:44:32 system systemd[1]: Starting LSB: Apache2 web server...
Jun 20 10:44:32 system apache2[5525]:  * Starting Apache httpd web server apache2
Jun 20 10:44:33 system apache2[5525]: AH00558: apache2: Could not reliably determine the server's fully qualified domain name, using 127.0.1.1.
Jun 20 10:44:34 system apache2[5525]:  *
Jun 20 10:44:34 system systemd[1]: Started LSB: Apache2 web server.
lines 1-16/16 (END)
```

As you can see above, the service appears to have started successfully. However, the best way to test this is to actually request a page from Apache. You can access the default Apache landing page to confirm that the software is running properly. You can access this through your server's domain name or IP address.

Step 3: Server IP address can be set by the following command

$sudo ip addr add 172.16.10.1/24 dev enps0
$sudo ip addr

Note: If IP address fluctuates, kindly setup the IP address manually using 'Edit connections'.



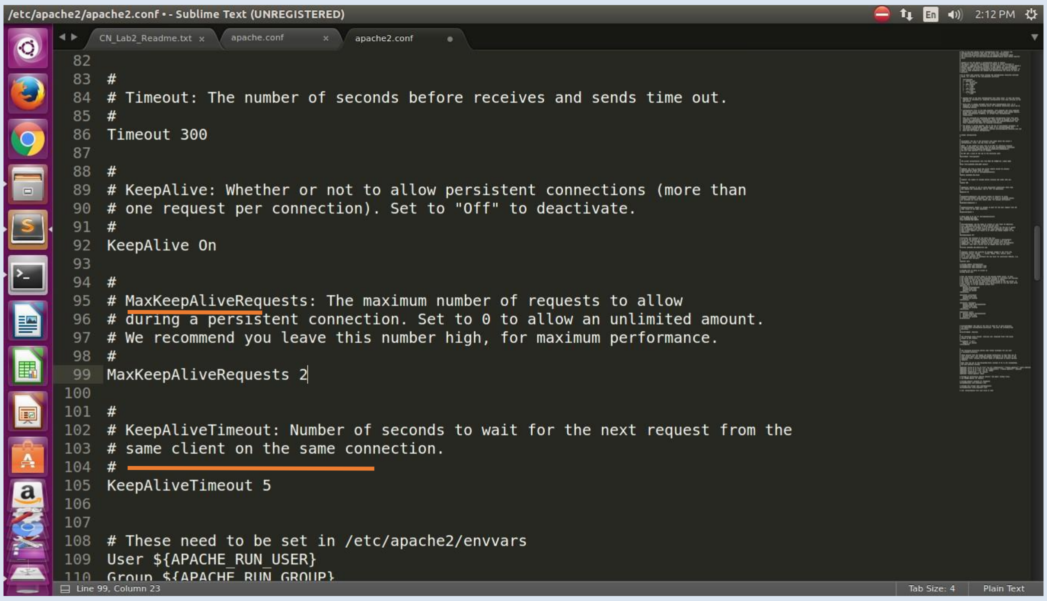
```
student@student-H81H3-I:~$ ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
2: enp2s0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether b8:ae:ed:a5:a5:a9 brd ff:ff:ff:ff:ff:ff
    inet 172.16.10.1/24 brd 172.16.10.255 scope global enp2s0
       valid_lft forever preferred_lft forever
    inet6 fe80::c901:c994:4cf5:f837/64 scope link
       valid_lft forever preferred_lft forever
student@student-H81H3-I:~$
```

Step 4: The **apache2.conf** file present in the **etc/apache2** directory is modified as:

a) The **keep-alive** option was set (i.e. value was made **ON**)

b) The **MaximumKeepAliveRequests** were set to **2**

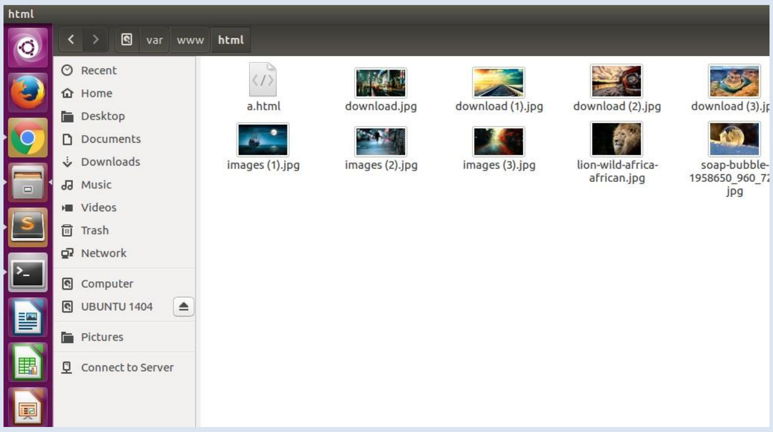
$sudo nano /etc/apache2/apache2.conf



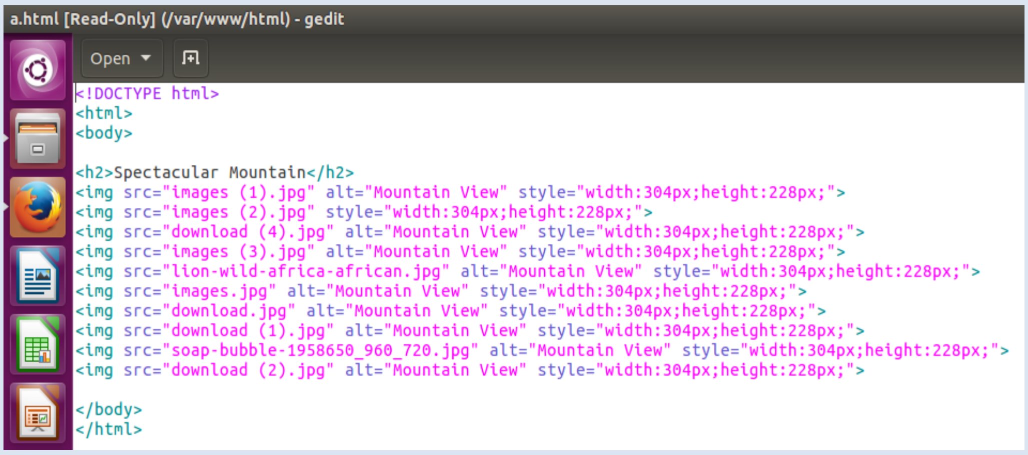
```

#
# Timeout: The number of seconds before receives and sends time out.
#
Timeout 300

#
# KeepAlive: Whether or not to allow persistent connections (more than
# one request per connection). Set to "Off" to deactivate.
#
KeepAlive On

#
# MaxKeepAliveRequests: The maximum number of requests to allow
# during a persistent connection. Set to 0 to allow an unlimited amount.
# We recommend you leave this number high, for maximum performance.
#
MaxKeepAliveRequests 2

#
# KeepAliveTimeout: Number of seconds to wait for the next request from the
# same client on the same connection.
#
KeepAliveTimeout 5


# These need to be set in /etc/apache2/envvars
User ${APACHE_RUN_USER}
Group ${APACHE_RUN_GROUP}
```

Step 5: Store images in the server path. A html page consisting of 10 images having size > 2MB were placed and accessed by the client. This html page is stored in the location - **/var/www/html/file_name.html**.

Note: Use the images provided by faculty incharges.



Step 6: Prepare a web page as shown below. The html file needs to add 10 images. (Kindly skip the style attribute in the below image)



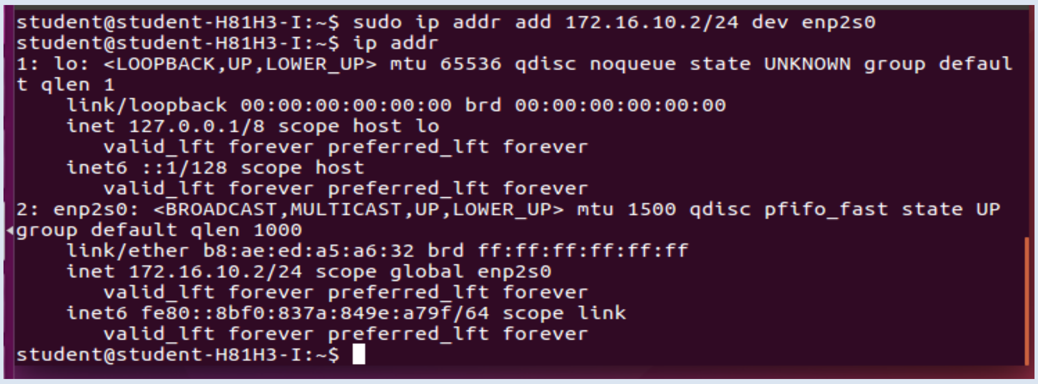
```
<!DOCTYPE html>
<html>
<body>

<h2>Spectacular Mountain</h2>
<img src="images (1).jpg" alt="Mountain View" style="width:304px;height:228px;">
<img src="images (2).jpg" style="width:304px;height:228px;">
<img src="download (4).jpg" alt="Mountain View" style="width:304px;height:228px;">
<img src="images (3).jpg" alt="Mountain View" style="width:304px;height:228px;">
<img src="lion-wild-africa-african.jpg" alt="Mountain View" style="width:304px;height:228px;">
<img src="images.jpg" alt="Mountain View" style="width:304px;height:228px;">
<img src="download.jpg" alt="Mountain View" style="width:304px;height:228px;">
<img src="download (1).jpg" alt="Mountain View" style="width:304px;height:228px;">
<img src="soap-bubble-1958650_960_720.jpg" alt="Mountain View" style="width:304px;height:228px;">
<img src="download (2).jpg" alt="Mountain View" style="width:304px;height:228px;">

</body>
</html>
```

<u>**Client side:**</u>

Client IP address can be set by the following command.

$sudo ip addr add 172.16.10.2/24 dev enps0
$sudo ip addr

Note: If IP address fluctuates, kindly setup the IP address manually using ‘Edit connections’.



```
student@student-H81H3-I:~$ sudo ip addr add 172.16.10.2/24 dev enp2s0
student@student-H81H3-I:~$ ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group defaul
t qlen 1
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
2: enp2s0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP
group default qlen 1000
    link/ether b8:ae:ed:a5:a6:32 brd ff:ff:ff:ff:ff:ff
    inet 172.16.10.2/24 scope global enp2s0
       valid_lft forever preferred_lft forever
    inet6 fe80::8bf0:837a:849e:a79f/64 scope link
       valid_lft forever preferred_lft forever
student@student-H81H3-I:~$
```

There are broadly two parts of execution:

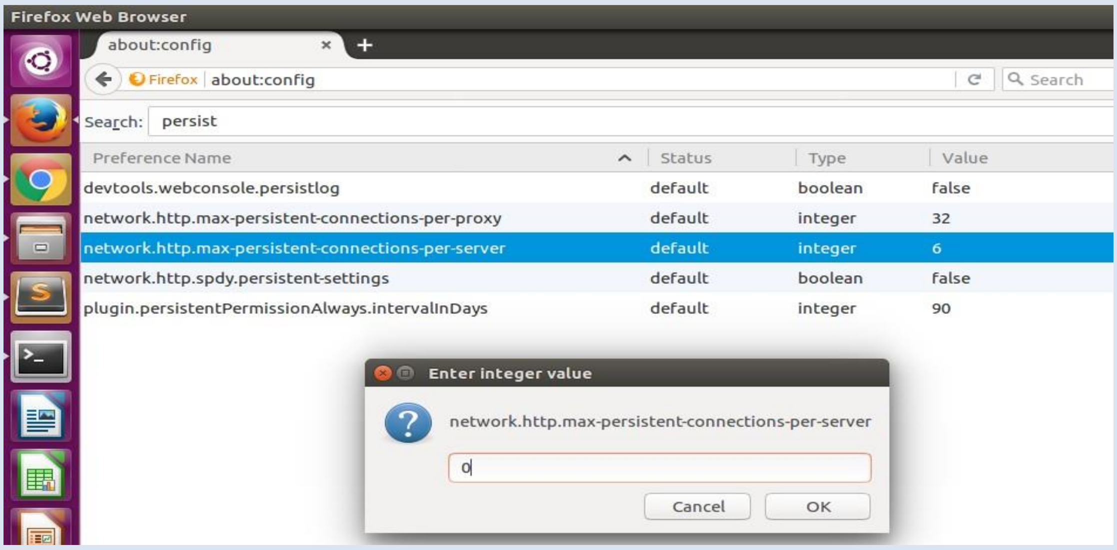
1. Dealing with non-persistent connections
2. Dealing with persistent connections

Open Firefox browser to configure for persistent option. Go to browser and type **about:config** and search for the term **‘persistent’**

- While using non-persistent connection experiment, the **max-persistent-connections-per-server** has the value set to **0** and **persistent-settings** value set to false.
- While using persistent connection experiment, the **max-persistent-connections-per-server** should have value greater than 0 (depending on the number of persistent connections needed) and **persistent-settings** value set to true.

PART 1: NON-PERSISTENT CONNECTION

Step 1: This is done by setting the value of max-persistent-connection-per-server to 0 in the client computer.



Firefox Web Browser

about:config

Search: persist

Preference Name	Status	Type	Value
devtools.webconsole.persistlog	default	boolean	false
network.http.max-persistent-connections-per-proxy	default	integer	32
network.http.max-persistent-connections-per-server	default	integer	6
network.http.spdy.persistent-settings	default	boolean	false
plugin.persistentPermissionAlways.intervalInDays	default	integer	90

Enter integer value

network.http.max-persistent-connections-per-server

0

Step 2: Access web page on client-side browser (Firefox)

The client could access the file as:

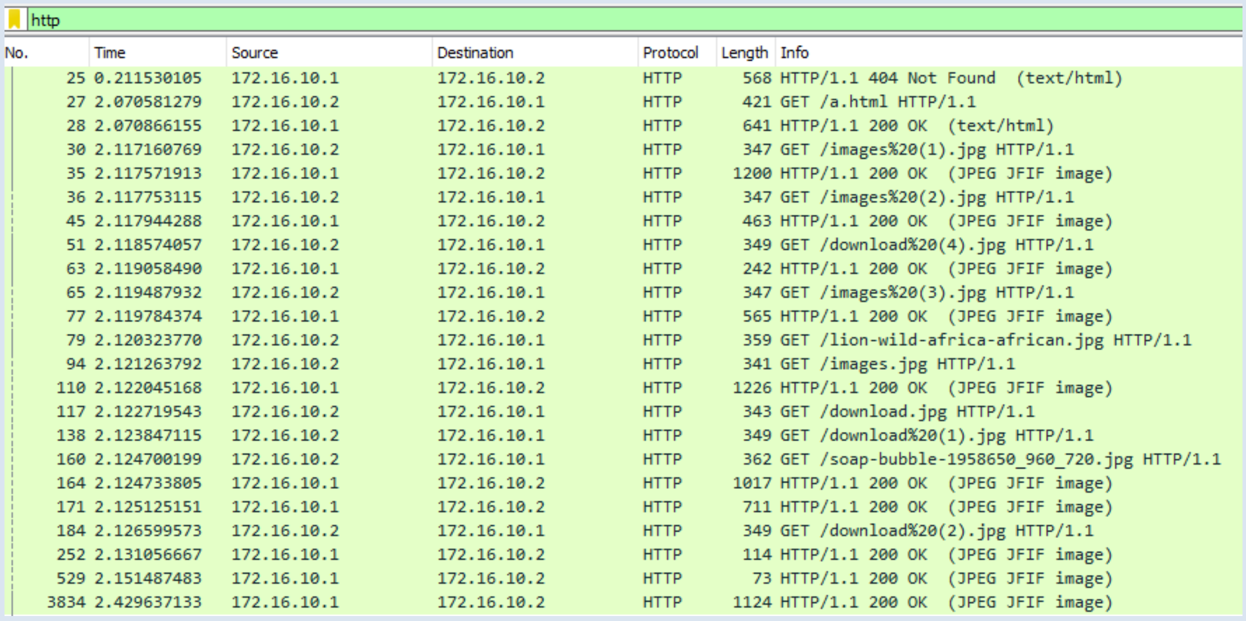
172.16.10.1 /file_name.html where--> **172.16.10.1** is Server’s IP

Here the file name is **a.html** present in server. So, by tying **172.16.10.1/a.html** in client browser, we will be able to open the requested web page.

Note 1: The wireshark should capture the packets between the client and the server while the file is accessed.

Note 2: The images in the HTML page should have all the permissions specified through the server for the proper access.

Step 3: Use wireshark**.** Open wireshark in the server computer while client is trying to access the server's local host webpage. Apply 'http' filter and note the time to capture all the 10 images.



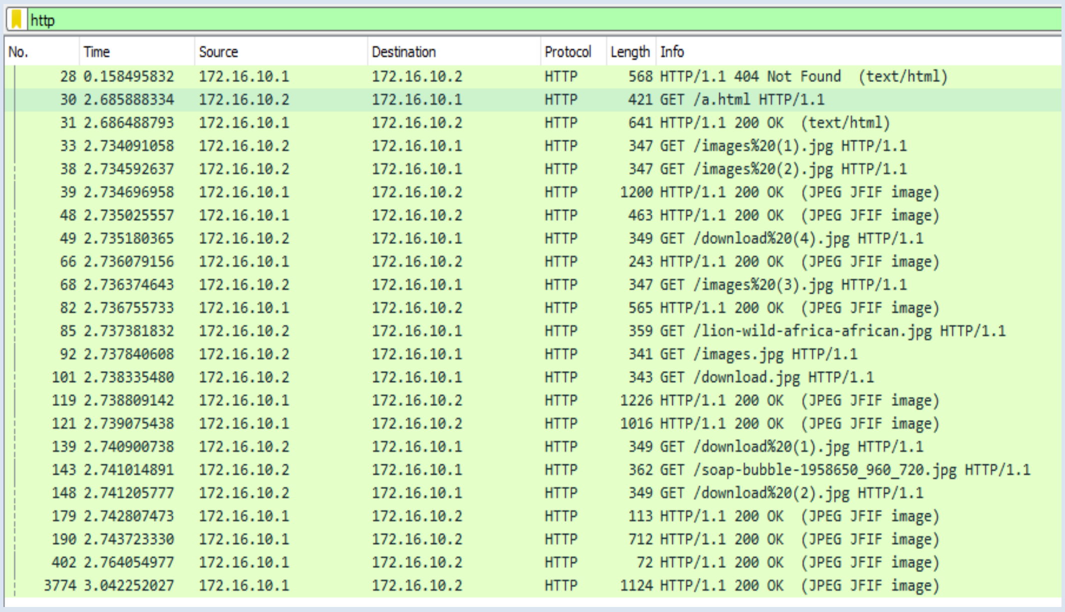
```
http
No.    Time         Source        Destination   Protocol Length Info
   25 0.211530105  172.16.10.1   172.16.10.2   HTTP      568 HTTP/1.1 404 Not Found  (text/html)
   27 2.070581279  172.16.10.2   172.16.10.1   HTTP      421 GET /a.html HTTP/1.1
   28 2.070866155  172.16.10.1   172.16.10.2   HTTP      641 HTTP/1.1 200 OK  (text/html)
   30 2.117160769  172.16.10.2   172.16.10.1   HTTP      347 GET /images%20(1).jpg HTTP/1.1
   35 2.117571913  172.16.10.1   172.16.10.2   HTTP     1200 HTTP/1.1 200 OK  (JPEG JFIF image)
   36 2.117753115  172.16.10.2   172.16.10.1   HTTP      347 GET /images%20(2).jpg HTTP/1.1
   45 2.117944288  172.16.10.1   172.16.10.2   HTTP      463 HTTP/1.1 200 OK  (JPEG JFIF image)
   51 2.118574057  172.16.10.2   172.16.10.1   HTTP      349 GET /download%20(4).jpg HTTP/1.1
   63 2.119058490  172.16.10.1   172.16.10.2   HTTP      242 HTTP/1.1 200 OK  (JPEG JFIF image)
   65 2.119487932  172.16.10.2   172.16.10.1   HTTP      347 GET /images%20(3).jpg HTTP/1.1
   77 2.119784374  172.16.10.1   172.16.10.2   HTTP      565 HTTP/1.1 200 OK  (JPEG JFIF image)
   79 2.120323770  172.16.10.2   172.16.10.1   HTTP      359 GET /lion-wild-africa-african.jpg HTTP/1.1
   94 2.121263792  172.16.10.2   172.16.10.1   HTTP      341 GET /images.jpg HTTP/1.1
  110 2.122045168  172.16.10.1   172.16.10.2   HTTP     1226 HTTP/1.1 200 OK  (JPEG JFIF image)
  117 2.122719543  172.16.10.2   172.16.10.1   HTTP      343 GET /download.jpg HTTP/1.1
  138 2.123847115  172.16.10.2   172.16.10.1   HTTP      349 GET /download%20(1).jpg HTTP/1.1
  160 2.124700199  172.16.10.2   172.16.10.1   HTTP      362 GET /soap-bubble-1958650_960_720.jpg HTTP/1.1
  164 2.124733805  172.16.10.1   172.16.10.2   HTTP     1017 HTTP/1.1 200 OK  (JPEG JFIF image)
  171 2.125125151  172.16.10.1   172.16.10.2   HTTP      711 HTTP/1.1 200 OK  (JPEG JFIF image)
  184 2.126599573  172.16.10.2   172.16.10.1   HTTP      349 GET /download%20(2).jpg HTTP/1.1
  252 2.131056667  172.16.10.1   172.16.10.2   HTTP      114 HTTP/1.1 200 OK  (JPEG JFIF image)
  529 2.151487483  172.16.10.1   172.16.10.2   HTTP       73 HTTP/1.1 200 OK  (JPEG JFIF image)
 3834 2.429637133  172.16.10.1   172.16.10.2   HTTP     1124 HTTP/1.1 200 OK  (JPEG JFIF image)
```

Here it is 2.429637133 - 2.070581279 = 0.359055854

PART 2: PERSISTENT CONNECTIONS

Step 1: For 2 persistent connections, set the value of **max-persistent-connection-per-server to 2** in the client computer.

Step 2: Repeat the **steps 1-3** in the previous section.



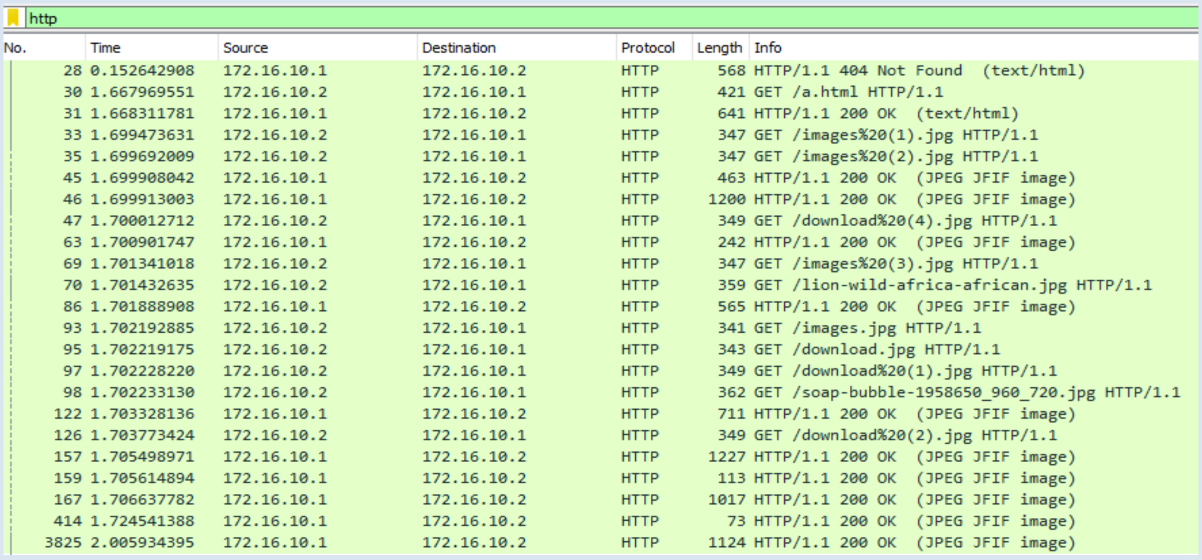
http

No.	Time	Source	Destination	Protocol	Length	Info
28	0.158495832	172.16.10.1	172.16.10.2	HTTP	568	HTTP/1.1 404 Not Found (text/html)
30	2.685888334	172.16.10.2	172.16.10.1	HTTP	421	GET /a.html HTTP/1.1
31	2.686488793	172.16.10.1	172.16.10.2	HTTP	641	HTTP/1.1 200 OK (text/html)
33	2.734091058	172.16.10.2	172.16.10.1	HTTP	347	GET /images%20(1).jpg HTTP/1.1
38	2.734592637	172.16.10.2	172.16.10.1	HTTP	347	GET /images%20(2).jpg HTTP/1.1
39	2.734696958	172.16.10.1	172.16.10.2	HTTP	1200	HTTP/1.1 200 OK (JPEG JFIF image)
48	2.735025557	172.16.10.1	172.16.10.2	HTTP	463	HTTP/1.1 200 OK (JPEG JFIF image)
49	2.735180365	172.16.10.2	172.16.10.1	HTTP	349	GET /download%20(4).jpg HTTP/1.1
66	2.736079156	172.16.10.1	172.16.10.2	HTTP	243	HTTP/1.1 200 OK (JPEG JFIF image)
68	2.736374643	172.16.10.2	172.16.10.1	HTTP	347	GET /images%20(3).jpg HTTP/1.1
82	2.736755733	172.16.10.1	172.16.10.2	HTTP	565	HTTP/1.1 200 OK (JPEG JFIF image)
85	2.737381832	172.16.10.2	172.16.10.1	HTTP	359	GET /lion-wild-africa-african.jpg HTTP/1.1
92	2.737840608	172.16.10.2	172.16.10.1	HTTP	341	GET /images.jpg HTTP/1.1
101	2.738335480	172.16.10.2	172.16.10.1	HTTP	343	GET /download.jpg HTTP/1.1
119	2.738809142	172.16.10.1	172.16.10.2	HTTP	1226	HTTP/1.1 200 OK (JPEG JFIF image)
121	2.739075438	172.16.10.1	172.16.10.2	HTTP	1016	HTTP/1.1 200 OK (JPEG JFIF image)
139	2.740900738	172.16.10.2	172.16.10.1	HTTP	349	GET /download%20(1).jpg HTTP/1.1
143	2.741014891	172.16.10.2	172.16.10.1	HTTP	362	GET /soap-bubble-1958650_960_720.jpg HTTP/1.1
148	2.741205777	172.16.10.2	172.16.10.1	HTTP	349	GET /download%20(2).jpg HTTP/1.1
179	2.742807473	172.16.10.1	172.16.10.2	HTTP	113	HTTP/1.1 200 OK (JPEG JFIF image)
190	2.743723330	172.16.10.1	172.16.10.2	HTTP	712	HTTP/1.1 200 OK (JPEG JFIF image)
402	2.764054977	172.16.10.1	172.16.10.2	HTTP	72	HTTP/1.1 200 OK (JPEG JFIF image)
3774	3.042252027	172.16.10.1	172.16.10.2	HTTP	1124	HTTP/1.1 200 OK (JPEG JFIF image)

Here it is 3.042252027 - 2.685888334 = 0.356363

Step 3: For 4 persistent connections, Set the value of **max-persistent-connection-per-server to 4** in the client computer.

Step 4: Repeat the **steps 1-3** in the previous section.



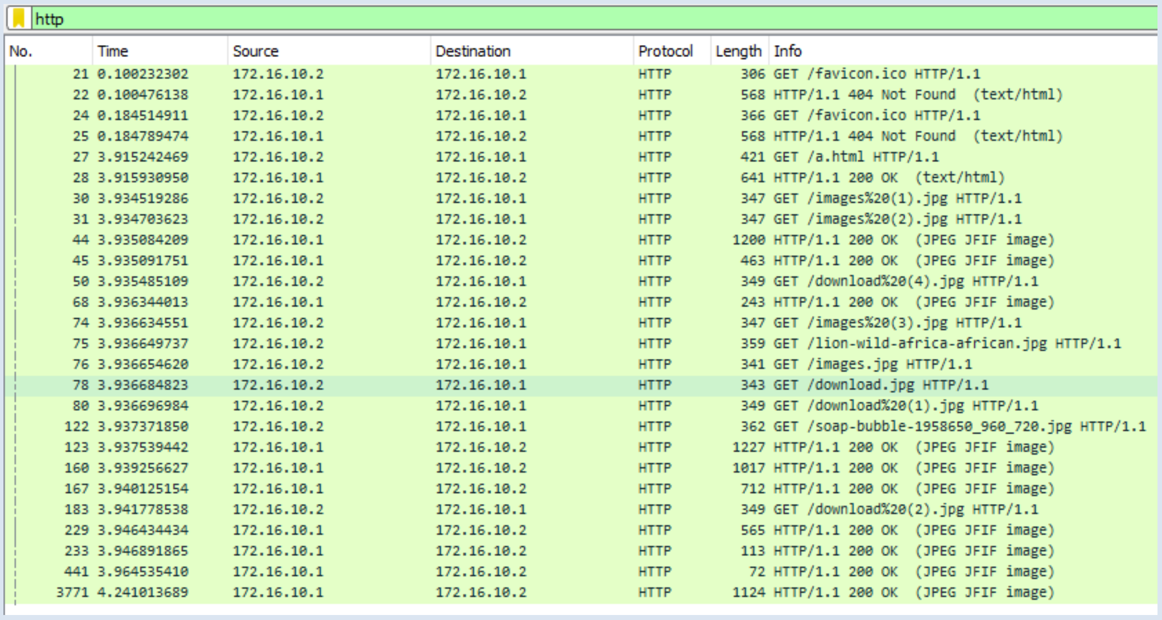
http

No.	Time	Source	Destination	Protocol	Length	Info
28	0.152642908	172.16.10.1	172.16.10.2	HTTP	568	HTTP/1.1 404 Not Found (text/html)
30	1.667969551	172.16.10.2	172.16.10.1	HTTP	421	GET /a.html HTTP/1.1
31	1.668311781	172.16.10.1	172.16.10.2	HTTP	641	HTTP/1.1 200 OK (text/html)
33	1.699473631	172.16.10.2	172.16.10.1	HTTP	347	GET /images%20(1).jpg HTTP/1.1
35	1.699692009	172.16.10.2	172.16.10.1	HTTP	347	GET /images%20(2).jpg HTTP/1.1
45	1.699908042	172.16.10.1	172.16.10.2	HTTP	463	HTTP/1.1 200 OK (JPEG JFIF image)
46	1.699913003	172.16.10.1	172.16.10.2	HTTP	1200	HTTP/1.1 200 OK (JPEG JFIF image)
47	1.700012712	172.16.10.2	172.16.10.1	HTTP	349	GET /download%20(4).jpg HTTP/1.1
63	1.700901747	172.16.10.1	172.16.10.2	HTTP	242	HTTP/1.1 200 OK (JPEG JFIF image)
69	1.701341018	172.16.10.2	172.16.10.1	HTTP	347	GET /images%20(3).jpg HTTP/1.1
70	1.701432635	172.16.10.2	172.16.10.1	HTTP	359	GET /lion-wild-africa-african.jpg HTTP/1.1
86	1.701888908	172.16.10.1	172.16.10.2	HTTP	565	HTTP/1.1 200 OK (JPEG JFIF image)
93	1.702192885	172.16.10.2	172.16.10.1	HTTP	341	GET /images.jpg HTTP/1.1
95	1.702219175	172.16.10.2	172.16.10.1	HTTP	343	GET /download.jpg HTTP/1.1
97	1.702228220	172.16.10.2	172.16.10.1	HTTP	349	GET /download%20(1).jpg HTTP/1.1
98	1.702233130	172.16.10.2	172.16.10.1	HTTP	362	GET /soap-bubble-1958650_960_720.jpg HTTP/1.1
122	1.703328136	172.16.10.1	172.16.10.2	HTTP	711	HTTP/1.1 200 OK (JPEG JFIF image)
126	1.703773424	172.16.10.2	172.16.10.1	HTTP	349	GET /download%20(2).jpg HTTP/1.1
157	1.705498971	172.16.10.1	172.16.10.2	HTTP	1227	HTTP/1.1 200 OK (JPEG JFIF image)
159	1.705614894	172.16.10.1	172.16.10.2	HTTP	113	HTTP/1.1 200 OK (JPEG JFIF image)
167	1.706637782	172.16.10.1	172.16.10.2	HTTP	1017	HTTP/1.1 200 OK (JPEG JFIF image)
414	1.724541388	172.16.10.1	172.16.10.2	HTTP	73	HTTP/1.1 200 OK (JPEG JFIF image)
3825	2.005934395	172.16.10.1	172.16.10.2	HTTP	1124	HTTP/1.1 200 OK (JPEG JFIF image)

Here is it 2.005934395 - 1.667969557 = 0.337964838

Step 5: For 6 persistent connections, set the value of **max-persistent-connection-per-server to 6** in the server computer.

Step 6: Repeat the **steps 1-3** in the previous section.

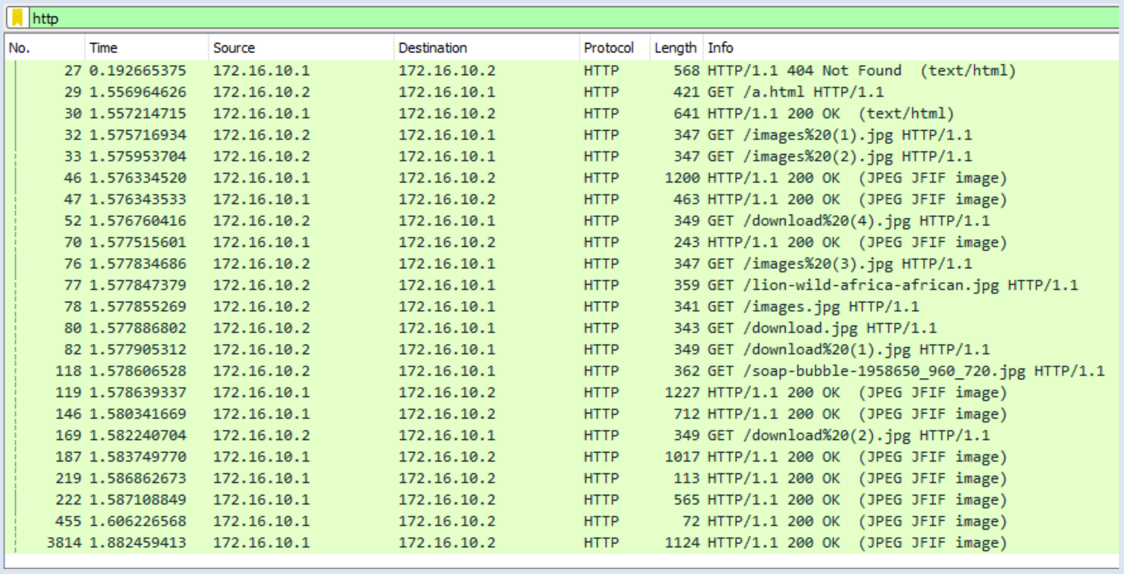

http

No.	Time	Source	Destination	Protocol	Length	Info
21	0.100232302	172.16.10.2	172.16.10.1	HTTP	306	GET /favicon.ico HTTP/1.1
22	0.100476138	172.16.10.1	172.16.10.2	HTTP	568	HTTP/1.1 404 Not Found (text/html)
24	0.184514911	172.16.10.2	172.16.10.1	HTTP	366	GET /favicon.ico HTTP/1.1
25	0.184789474	172.16.10.1	172.16.10.2	HTTP	568	HTTP/1.1 404 Not Found (text/html)
27	3.915242469	172.16.10.2	172.16.10.1	HTTP	421	GET /a.html HTTP/1.1
28	3.915930950	172.16.10.1	172.16.10.2	HTTP	641	HTTP/1.1 200 OK (text/html)
30	3.934519286	172.16.10.2	172.16.10.1	HTTP	347	GET /images%20(1).jpg HTTP/1.1
31	3.934703623	172.16.10.2	172.16.10.1	HTTP	347	GET /images%20(2).jpg HTTP/1.1
44	3.935084209	172.16.10.1	172.16.10.2	HTTP	1200	HTTP/1.1 200 OK (JPEG JFIF image)
45	3.935091751	172.16.10.1	172.16.10.2	HTTP	463	HTTP/1.1 200 OK (JPEG JFIF image)
50	3.935485109	172.16.10.2	172.16.10.1	HTTP	349	GET /download%20(4).jpg HTTP/1.1
68	3.936344013	172.16.10.1	172.16.10.2	HTTP	243	HTTP/1.1 200 OK (JPEG JFIF image)
74	3.936634551	172.16.10.2	172.16.10.1	HTTP	347	GET /images%20(3).jpg HTTP/1.1
75	3.936649737	172.16.10.2	172.16.10.1	HTTP	359	GET /lion-wild-africa-african.jpg HTTP/1.1
76	3.936654620	172.16.10.2	172.16.10.1	HTTP	341	GET /images.jpg HTTP/1.1
78	3.936684823	172.16.10.2	172.16.10.1	HTTP	343	GET /download.jpg HTTP/1.1
80	3.936696984	172.16.10.2	172.16.10.1	HTTP	349	GET /download%20(1).jpg HTTP/1.1
122	3.937371850	172.16.10.2	172.16.10.1	HTTP	362	GET /soap-bubble-1958650_960_720.jpg HTTP/1.1
123	3.937539442	172.16.10.1	172.16.10.2	HTTP	1227	HTTP/1.1 200 OK (JPEG JFIF image)
160	3.939256627	172.16.10.1	172.16.10.2	HTTP	1017	HTTP/1.1 200 OK (JPEG JFIF image)
167	3.940125154	172.16.10.1	172.16.10.2	HTTP	712	HTTP/1.1 200 OK (JPEG JFIF image)
183	3.941778538	172.16.10.2	172.16.10.1	HTTP	349	GET /download%20(2).jpg HTTP/1.1
229	3.946434434	172.16.10.1	172.16.10.2	HTTP	565	HTTP/1.1 200 OK (JPEG JFIF image)
233	3.946891865	172.16.10.1	172.16.10.2	HTTP	113	HTTP/1.1 200 OK (JPEG JFIF image)
441	3.964535410	172.16.10.1	172.16.10.2	HTTP	72	HTTP/1.1 200 OK (JPEG JFIF image)
3771	4.241013689	172.16.10.1	172.16.10.2	HTTP	1124	HTTP/1.1 200 OK (JPEG JFIF image)

Here it is 4.241013689 - 3.915242469 = 0.325771229

Step 7: For 10 persistent connections, set the value of **max-persistent-connection-per-server to 10** in the client computer.

Step 8: Repeat the **steps 1-3** in the previous section.


http

No.	Time	Source	Destination	Protocol	Length	Info
27	0.192665375	172.16.10.1	172.16.10.2	HTTP	568	HTTP/1.1 404 Not Found (text/html)
29	1.556964626	172.16.10.2	172.16.10.1	HTTP	421	GET /a.html HTTP/1.1
30	1.557214715	172.16.10.1	172.16.10.2	HTTP	641	HTTP/1.1 200 OK (text/html)
32	1.575716934	172.16.10.2	172.16.10.1	HTTP	347	GET /images%20(1).jpg HTTP/1.1
33	1.575953704	172.16.10.2	172.16.10.1	HTTP	347	GET /images%20(2).jpg HTTP/1.1
46	1.576334520	172.16.10.1	172.16.10.2	HTTP	1200	HTTP/1.1 200 OK (JPEG JFIF image)
47	1.576343533	172.16.10.1	172.16.10.2	HTTP	463	HTTP/1.1 200 OK (JPEG JFIF image)
52	1.576760416	172.16.10.2	172.16.10.1	HTTP	349	GET /download%20(4).jpg HTTP/1.1
70	1.577515601	172.16.10.1	172.16.10.2	HTTP	243	HTTP/1.1 200 OK (JPEG JFIF image)
76	1.577834686	172.16.10.2	172.16.10.1	HTTP	347	GET /images%20(3).jpg HTTP/1.1
77	1.577847379	172.16.10.2	172.16.10.1	HTTP	359	GET /lion-wild-africa-african.jpg HTTP/1.1
78	1.577855269	172.16.10.2	172.16.10.1	HTTP	341	GET /images.jpg HTTP/1.1
80	1.577886802	172.16.10.2	172.16.10.1	HTTP	343	GET /download.jpg HTTP/1.1
82	1.577905312	172.16.10.2	172.16.10.1	HTTP	349	GET /download%20(1).jpg HTTP/1.1
118	1.578606528	172.16.10.2	172.16.10.1	HTTP	362	GET /soap-bubble-1958650_960_720.jpg HTTP/1.1
119	1.578639337	172.16.10.1	172.16.10.2	HTTP	1227	HTTP/1.1 200 OK (JPEG JFIF image)
146	1.580341669	172.16.10.1	172.16.10.2	HTTP	712	HTTP/1.1 200 OK (JPEG JFIF image)
169	1.582240704	172.16.10.2	172.16.10.1	HTTP	349	GET /download%20(2).jpg HTTP/1.1
187	1.583749770	172.16.10.1	172.16.10.2	HTTP	1017	HTTP/1.1 200 OK (JPEG JFIF image)
219	1.586862673	172.16.10.1	172.16.10.2	HTTP	113	HTTP/1.1 200 OK (JPEG JFIF image)
222	1.587108849	172.16.10.1	172.16.10.2	HTTP	565	HTTP/1.1 200 OK (JPEG JFIF image)
455	1.606226568	172.16.10.1	172.16.10.2	HTTP	72	HTTP/1.1 200 OK (JPEG JFIF image)
3814	1.882459413	172.16.10.1	172.16.10.2	HTTP	1124	HTTP/1.1 200 OK (JPEG JFIF image)

Here it is 1.882459413-1.556964626=0.325494787

OBSERVATIONS REQUIRED ON EDMODO:

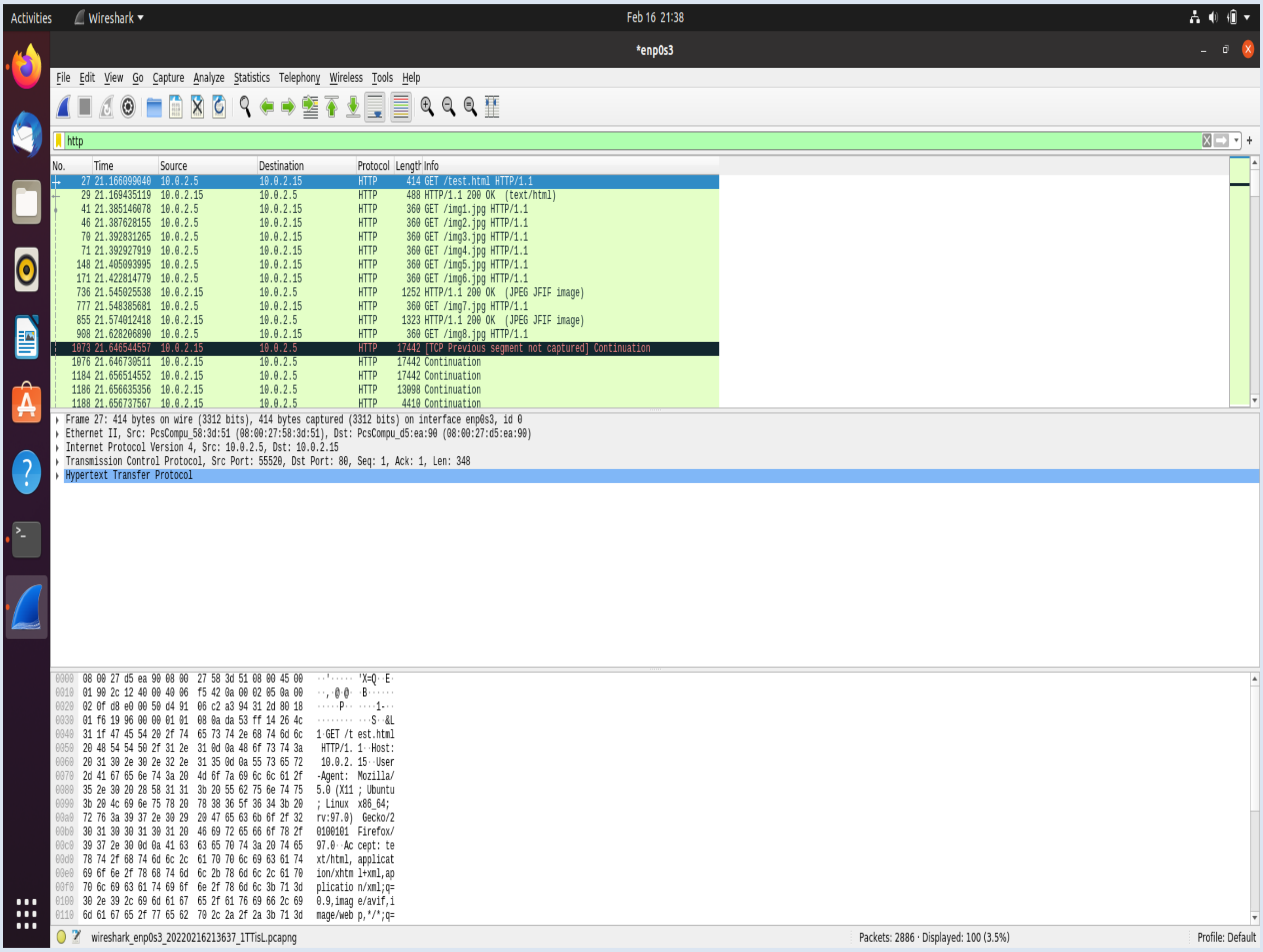
Find out the time taken to load images for 2 4 6 persistent connections is lesser or greater than 10 persistent compared to non-persistent. Why? Find out the optimal persistent connections.

SCREENSHOTS REQUIRED FOR EDMODO:

1) Non-persistent connection wireshark capture (should include all 10 images)
2) Persistent connections wireshark capture – 2, 4, 6 & 10 respectively (should include all 10 images).

SCREENSHOTS:

1)Non-Persistent :



Activities
Wireshark ▾
Feb 16 21:38
*enp0s3
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

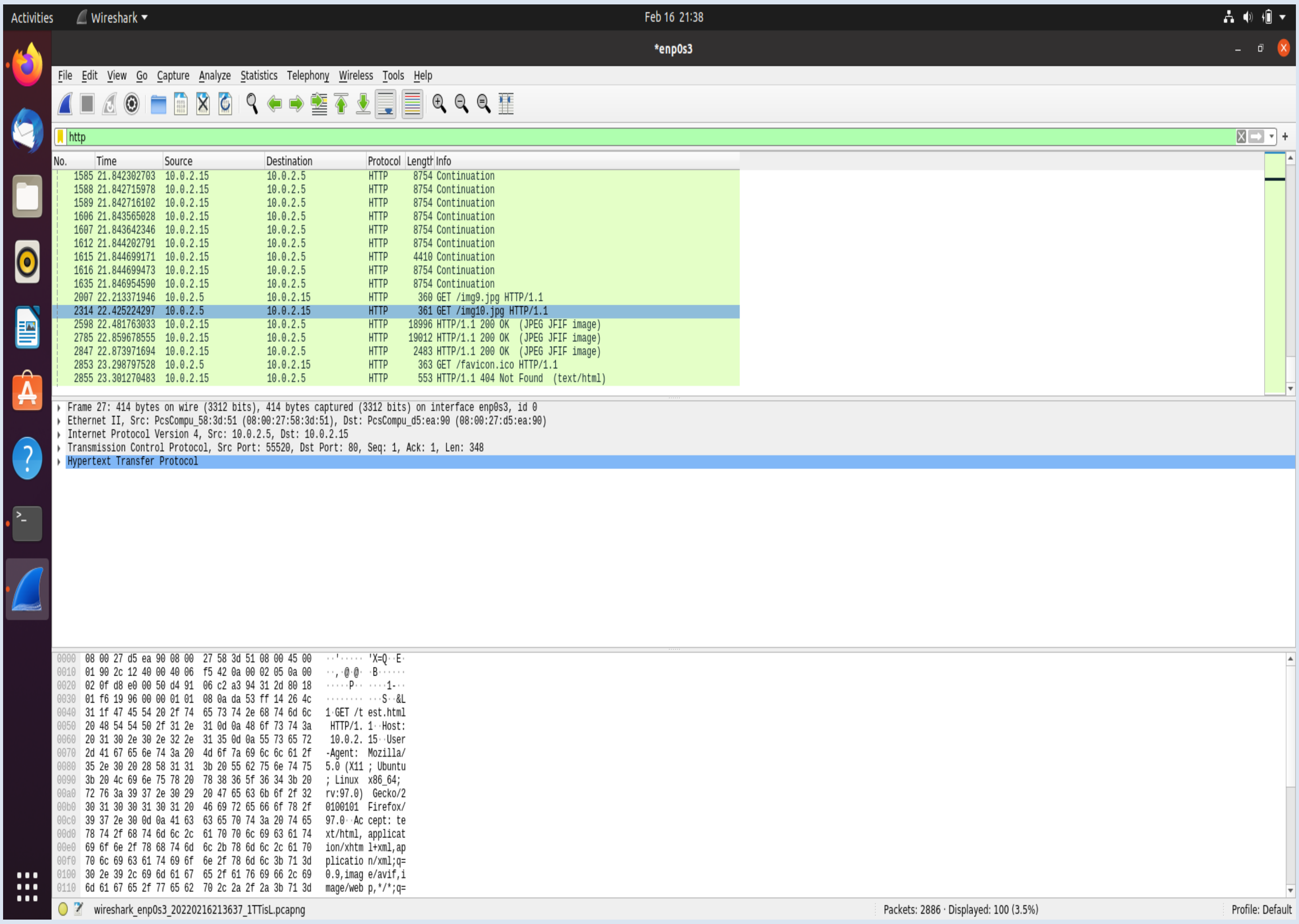
```
http
```

```
No.   Time          Source     Destination  Protocol Length Info
   27 21.166099040  10.0.2.5   10.0.2.15    HTTP     414 GET /test.html HTTP/1.1
   29 21.169435119  10.0.2.15  10.0.2.5     HTTP     488 HTTP/1.1 200 OK  (text/html)
   41 21.385146078  10.0.2.5   10.0.2.15    HTTP     360 GET /img1.jpg HTTP/1.1
   46 21.387628155  10.0.2.5   10.0.2.15    HTTP     360 GET /img2.jpg HTTP/1.1
   70 21.392831265  10.0.2.5   10.0.2.15    HTTP     360 GET /img3.jpg HTTP/1.1
   71 21.392927919  10.0.2.5   10.0.2.15    HTTP     360 GET /img4.jpg HTTP/1.1
  148 21.405093995  10.0.2.5   10.0.2.15    HTTP     360 GET /img5.jpg HTTP/1.1
  171 21.422814779  10.0.2.5   10.0.2.15    HTTP     360 GET /img6.jpg HTTP/1.1
  736 21.545025538  10.0.2.15  10.0.2.5     HTTP    1252 HTTP/1.1 200 OK  (JPEG JFIF image)
  777 21.548385681  10.0.2.5   10.0.2.15    HTTP     360 GET /img7.jpg HTTP/1.1
  855 21.574012418  10.0.2.15  10.0.2.5     HTTP    1323 HTTP/1.1 200 OK  (JPEG JFIF image)
  908 21.628206890  10.0.2.5   10.0.2.15    HTTP     360 GET /img8.jpg HTTP/1.1
 1073 21.646544557  10.0.2.15  10.0.2.5     HTTP   17442 [TCP Previous segment not captured] Continuation
 1076 21.646730511  10.0.2.15  10.0.2.5     HTTP   17442 Continuation
 1184 21.656514552  10.0.2.15  10.0.2.5     HTTP   17442 Continuation
 1186 21.656635356  10.0.2.15  10.0.2.5     HTTP   13098 Continuation
 1188 21.656737567  10.0.2.15  10.0.2.5     HTTP    4410 Continuation
```

```
▸ Frame 27: 414 bytes on wire (3312 bits), 414 bytes captured (3312 bits) on interface enp0s3, id 0
▸ Ethernet II, Src: PcsCompu_58:3d:51 (08:00:27:58:3d:51), Dst: PcsCompu_d5:ea:90 (08:00:27:d5:ea:90)
▸ Internet Protocol Version 4, Src: 10.0.2.5, Dst: 10.0.2.15
▸ Transmission Control Protocol, Src Port: 55520, Dst Port: 80, Seq: 1, Ack: 1, Len: 348
▸ Hypertext Transfer Protocol
```

```
0000  08 00 27 d5 ea 90 08 00  27 58 3d 51 08 00 45 00   ··'·····'X=Q··E·
0010  01 90 2c 12 40 00 40 06  f5 42 0a 00 02 05 0a 00   ··,·@·@··B······
0020  02 0f d8 e0 00 50 d4 91  06 c2 a3 94 31 2d 80 18   ·····P······1-··
0030  01 f6 19 96 00 00 01 01  08 0a da 53 ff 14 26 4c   ···········S··&L
0040  31 1f 47 45 54 20 2f 74  65 73 74 2e 68 74 6d 6c   1·GET /t est.html
0050  20 48 54 54 50 2f 31 2e  31 0d 0a 48 6f 73 74 3a    HTTP/1. 1··Host:
0060  20 31 30 2e 30 2e 32 2e  31 35 0d 0a 55 73 65 72    10.0.2. 15··User
0070  2d 41 67 65 6e 74 3a 20  4d 6f 7a 69 6c 6c 61 2f   -Agent:  Mozilla/
0080  35 2e 30 20 28 58 31 31  3b 20 55 62 75 6e 74 75   5.0 (X11 ; Ubuntu
0090  3b 20 4c 69 6e 75 78 20  78 38 36 5f 36 34 3b 20   ; Linux  x86_64;
00a0  72 76 3a 39 37 2e 30 29  20 47 65 63 6b 6f 2f 32   rv:97.0)  Gecko/2
00b0  30 31 30 30 31 30 31 20  46 69 72 65 66 6f 78 2f   0100101  Firefox/
00c0  39 37 2e 30 0d 0a 41 63  63 65 70 74 3a 20 74 65   97.0··Ac cept: te
00d0  78 74 2f 68 74 6d 6c 2c  61 70 70 6c 69 63 61 74   xt/html, applicat
00e0  69 6f 6e 2f 78 68 74 6d  6c 2b 78 6d 6c 2c 61 70   ion/xhtm l+xml,ap
00f0  70 6c 69 63 61 74 69 6f  6e 2f 78 6d 6c 3b 71 3d   plicatio n/xml;q=
0100  30 2e 39 2c 69 6d 61 67  65 2f 61 76 69 66 2c 69   0.9,imag e/avif,i
0110  6d 61 67 65 2f 77 65 62  70 2c 2a 2f 2a 3b 71 3d   mage/web p,*/*;q=
```

```
wireshark_enp0s3_20220216213637_1TTisL.pcapng          Packets: 2886 · Displayed: 100 (3.5%)          Profile: Default
```



```
No.  Time         Source     Destination Protocol Length Info
1585 21.842302703 10.0.2.15  10.0.2.5    HTTP     8754 Continuation
1588 21.842715978 10.0.2.15  10.0.2.5    HTTP     8754 Continuation
1589 21.842716102 10.0.2.15  10.0.2.5    HTTP     8754 Continuation
1606 21.843565028 10.0.2.15  10.0.2.5    HTTP     8754 Continuation
1607 21.843642346 10.0.2.15  10.0.2.5    HTTP     8754 Continuation
1612 21.844202791 10.0.2.15  10.0.2.5    HTTP     8754 Continuation
1615 21.844699171 10.0.2.15  10.0.2.5    HTTP     4410 Continuation
1616 21.844699473 10.0.2.15  10.0.2.5    HTTP     8754 Continuation
1635 21.846954590 10.0.2.15  10.0.2.5    HTTP     8754 Continuation
2007 22.213371946 10.0.2.5   10.0.2.15   HTTP      360 GET /img9.jpg HTTP/1.1
2314 22.425224297 10.0.2.5   10.0.2.15   HTTP      361 GET /img10.jpg HTTP/1.1
2598 22.481763033 10.0.2.15  10.0.2.5    HTTP    18996 HTTP/1.1 200 OK  (JPEG JFIF image)
2785 22.859678555 10.0.2.15  10.0.2.5    HTTP    19012 HTTP/1.1 200 OK  (JPEG JFIF image)
2847 22.873971694 10.0.2.15  10.0.2.5    HTTP     2483 HTTP/1.1 200 OK  (JPEG JFIF image)
2853 23.298797528 10.0.2.5   10.0.2.15   HTTP      363 GET /favicon.ico HTTP/1.1
2855 23.301270483 10.0.2.15  10.0.2.5    HTTP      553 HTTP/1.1 404 Not Found  (text/html)
```

```
Frame 27: 414 bytes on wire (3312 bits), 414 bytes captured (3312 bits) on interface enp0s3, id 0
Ethernet II, Src: PcsCompu_58:3d:51 (08:00:27:58:3d:51), Dst: PcsCompu_d5:ea:90 (08:00:27:d5:ea:90)
Internet Protocol Version 4, Src: 10.0.2.5, Dst: 10.0.2.15
Transmission Control Protocol, Src Port: 55520, Dst Port: 80, Seq: 1, Ack: 1, Len: 348
Hypertext Transfer Protocol
```

```
0000  08 00 27 d5 ea 90 08 00  27 58 3d 51 08 00 45 00   ··'····· 'X=Q··E·
0010  01 90 2c 12 40 00 40 06  f5 42 0a 00 02 05 0a 00   ··,·@·@· ·B······
0020  02 0f d8 e0 00 50 d4 91  06 c2 a3 94 31 2d 80 18   ·····P·· ····1-··
0030  01 f6 19 96 00 00 01 01  08 0a da 53 ff 14 26 4c   ········ ···S··&L
0040  31 1f 47 45 54 20 2f 74  65 73 74 2e 68 74 6d 6c   1·GET /t est.html
0050  20 48 54 54 50 2f 31 2e  31 0d 0a 48 6f 73 74 3a    HTTP/1. 1··Host:
0060  20 31 30 2e 30 2e 32 2e  31 35 0d 0a 55 73 65 72    10.0.2. 15··User
0070  2d 41 67 65 6e 74 3a 20  4d 6f 7a 69 6c 6c 61 2f   -Agent:  Mozilla/
0080  35 2e 30 20 28 58 31 31  3b 20 55 62 75 6e 74 75   5.0 (X11 ; Ubuntu
0090  3b 20 4c 69 6e 75 78 20  78 38 36 5f 36 34 3b 20   ; Linux  x86_64;
00a0  72 76 3a 39 37 2e 30 29  20 47 65 63 6b 6f 2f 32   rv:97.0)  Gecko/2
00b0  30 31 30 30 31 30 31 20  46 69 72 65 66 6f 78 2f   0100101  Firefox/
00c0  39 37 2e 30 0d 0a 41 63  63 65 70 74 3a 20 74 65   97.0··Ac cept: te
00d0  78 74 2f 68 74 6d 6c 2c  61 70 70 6c 69 63 61 74   xt/html, applicat
00e0  69 6f 6e 2f 78 68 74 6d  6c 2b 78 6d 6c 2c 61 70   ion/xhtm l+xml,ap
00f0  70 6c 69 63 61 74 69 6f  6e 2f 78 6d 6c 3b 71 3d   plicatio n/xml;q=
0100  30 2e 39 2c 69 6d 61 67  65 2f 61 76 69 66 2c 69   0.9,imag e/avif,i
0110  6d 61 67 65 2f 77 65 62  70 2c 2a 2f 2a 3b 71 3d   mage/web p,*/*;q=
```

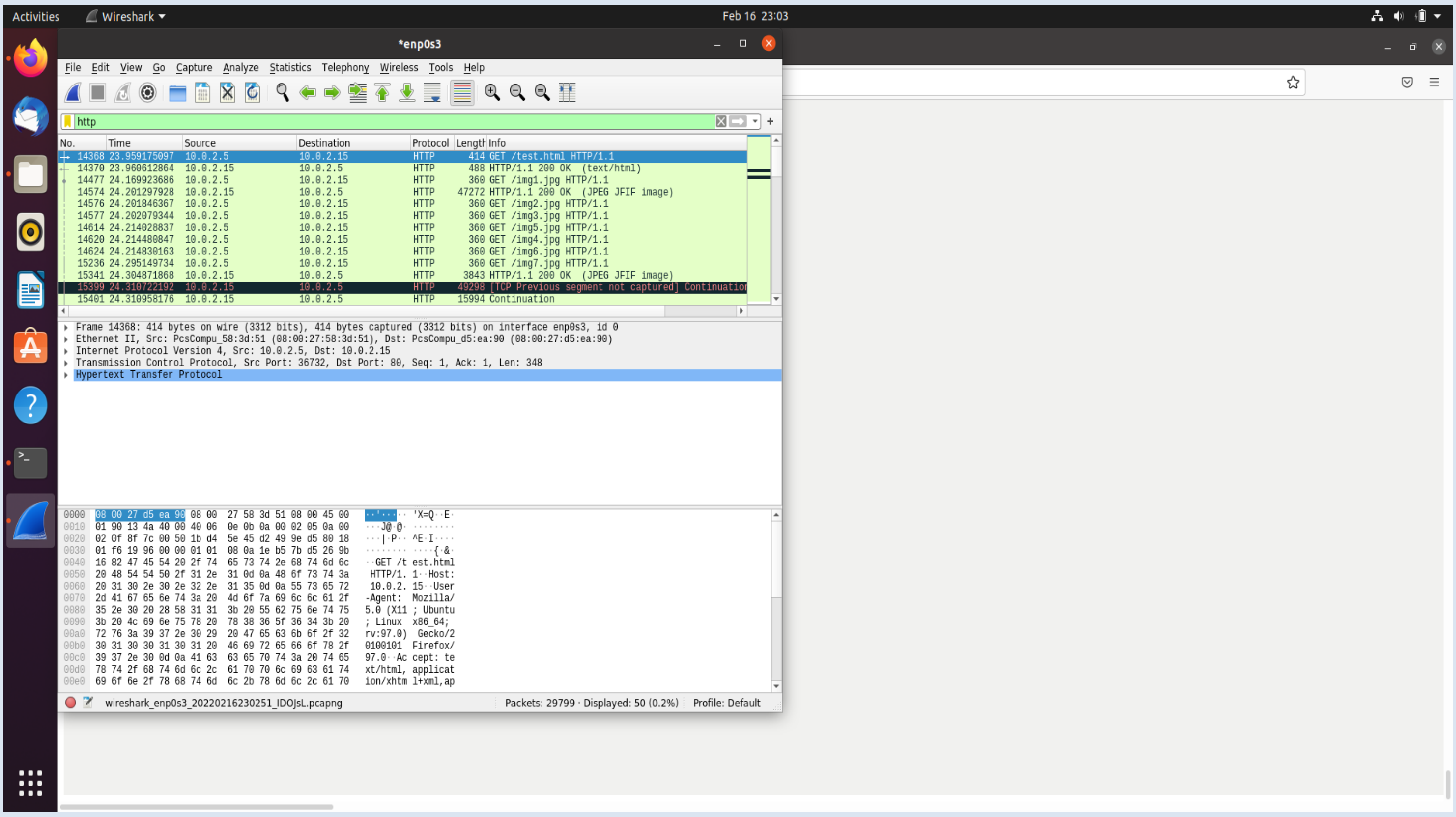
```
wireshark_enp0s3_20220216213637_1TTisL.pcapng     Packets: 2886 · Displayed: 100 (3.5%)     Profile: Default
```

Activities
Wireshark
Feb 16 21:38
*enp0s3
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
http

Here it is 22.425224297-21.385146078=1.040078219

2)Persistent Connection:

a) 2-persistent connection:

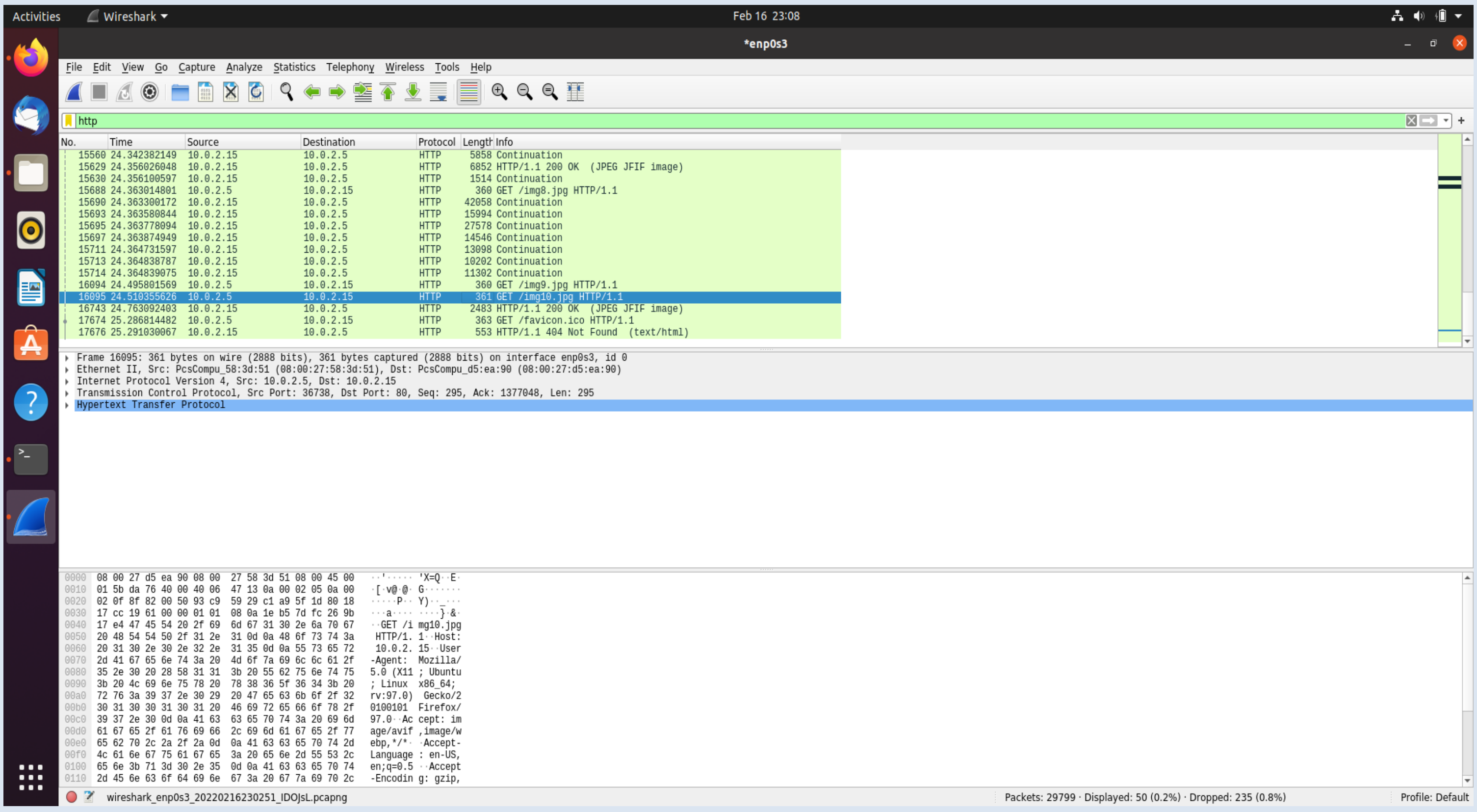

Activities
Wireshark
Feb 16 23:03
*enp0s3
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
http

```
No.   Time         Source     Destination Protocol Length Info
14368 23.959175097 10.0.2.5   10.0.2.15   HTTP       414 GET /test.html HTTP/1.1
14370 23.960612864 10.0.2.15  10.0.2.5    HTTP       488 HTTP/1.1 200 OK  (text/html)
14477 24.169923686 10.0.2.5   10.0.2.15   HTTP       360 GET /img1.jpg HTTP/1.1
14574 24.201297928 10.0.2.15  10.0.2.5    HTTP     47272 HTTP/1.1 200 OK  (JPEG JFIF image)
14576 24.201846367 10.0.2.5   10.0.2.15   HTTP       360 GET /img2.jpg HTTP/1.1
14577 24.202079344 10.0.2.5   10.0.2.15   HTTP       360 GET /img3.jpg HTTP/1.1
14614 24.214028837 10.0.2.5   10.0.2.15   HTTP       360 GET /img5.jpg HTTP/1.1
14620 24.214480847 10.0.2.5   10.0.2.15   HTTP       360 GET /img4.jpg HTTP/1.1
14624 24.214830163 10.0.2.5   10.0.2.15   HTTP       360 GET /img6.jpg HTTP/1.1
15236 24.295149734 10.0.2.5   10.0.2.15   HTTP       360 GET /img7.jpg HTTP/1.1
15341 24.304871868 10.0.2.15  10.0.2.5    HTTP      3843 HTTP/1.1 200 OK  (JPEG JFIF image)
15399 24.310722192 10.0.2.15  10.0.2.5    HTTP     49298 [TCP Previous segment not captured] Continuatio
15401 24.310958176 10.0.2.15  10.0.2.5    HTTP     15994 Continuation
```

```
Frame 14368: 414 bytes on wire (3312 bits), 414 bytes captured (3312 bits) on interface enp0s3, id 0
Ethernet II, Src: PcsCompu_58:3d:51 (08:00:27:58:3d:51), Dst: PcsCompu_d5:ea:90 (08:00:27:d5:ea:90)
Internet Protocol Version 4, Src: 10.0.2.5, Dst: 10.0.2.15
Transmission Control Protocol, Src Port: 36732, Dst Port: 80, Seq: 1, Ack: 1, Len: 348
Hypertext Transfer Protocol
```

```
0000  08 00 27 d5 ea 90 08 00  27 58 3d 51 08 00 45 00   ··'···· 'X=Q··E·
0010  01 90 13 4a 40 00 40 06  0e 0b 0a 00 02 05 0a 00   ···J@·@· ········
0020  02 0f 8f 7c 00 50 1b d4  5e 45 d2 49 9e d5 80 18   ···|·P·· ^E·I····
0030  01 f6 19 96 00 00 01 01  08 0a 1e b5 7b d5 26 9b   ········ ····{·&·
0040  16 82 47 45 54 20 2f 74  65 73 74 2e 68 74 6d 6c   ··GET /t est.html
0050  20 48 54 54 50 2f 31 2e  31 0d 0a 48 6f 73 74 3a    HTTP/1. 1··Host:
0060  20 31 30 2e 30 2e 32 2e  31 35 0d 0a 55 73 65 72    10.0.2. 15··User
0070  2d 41 67 65 6e 74 3a 20  4d 6f 7a 69 6c 6c 61 2f   -Agent:  Mozilla/
0080  35 2e 30 20 28 58 31 31  3b 20 55 62 75 6e 74 75   5.0 (X11 ; Ubuntu
0090  3b 20 4c 69 6e 75 78 20  78 38 36 5f 36 34 3b 20   ; Linux  x86_64;
00a0  72 76 3a 39 37 2e 30 29  20 47 65 63 6b 6f 2f 32   rv:97.0)  Gecko/2
00b0  30 31 30 30 31 30 31 20  46 69 72 65 66 6f 78 2f   0100101  Firefox/
00c0  39 37 2e 30 0d 0a 41 63  63 65 70 74 3a 20 74 65   97.0··Ac cept: te
00d0  78 74 2f 68 74 6d 6c 2c  61 70 70 6c 69 63 61 74   xt/html, applicat
00e0  69 6f 6e 2f 78 68 74 6d  6c 2b 78 6d 6c 2c 61 70   ion/xhtm l+xml,ap
```

wireshark_enp0s3_20220216230251_IDOJsL.pcapng   Packets: 29799 · Displayed: 50 (0.2%)   Profile: Default


Activities
Wireshark
Feb 16 23:08
*enp0s3
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
http

```
No.   Time         Source     Destination Protocol Length Info
15560 24.342382149 10.0.2.15  10.0.2.5    HTTP      5858 Continuation
15629 24.356026048 10.0.2.15  10.0.2.5    HTTP      6852 HTTP/1.1 200 OK  (JPEG JFIF image)
15630 24.356100597 10.0.2.15  10.0.2.5    HTTP      1514 Continuation
15688 24.363014801 10.0.2.5   10.0.2.15   HTTP       360 GET /img8.jpg HTTP/1.1
15690 24.363300172 10.0.2.15  10.0.2.5    HTTP     42058 Continuation
15693 24.363580844 10.0.2.15  10.0.2.5    HTTP     15994 Continuation
15695 24.363778094 10.0.2.15  10.0.2.5    HTTP     27578 Continuation
15697 24.363874949 10.0.2.15  10.0.2.5    HTTP     14546 Continuation
15711 24.364731597 10.0.2.15  10.0.2.5    HTTP     13098 Continuation
15713 24.364838787 10.0.2.15  10.0.2.5    HTTP     10202 Continuation
15714 24.364839075 10.0.2.15  10.0.2.5    HTTP     11302 Continuation
16094 24.495801569 10.0.2.5   10.0.2.15   HTTP       360 GET /img9.jpg HTTP/1.1
16095 24.510355626 10.0.2.5   10.0.2.15   HTTP       361 GET /img10.jpg HTTP/1.1
16743 24.763092403 10.0.2.15  10.0.2.5    HTTP      2483 HTTP/1.1 200 OK  (JPEG JFIF image)
17674 25.286814482 10.0.2.5   10.0.2.15   HTTP       363 GET /favicon.ico HTTP/1.1
17676 25.291030067 10.0.2.15  10.0.2.5    HTTP       553 HTTP/1.1 404 Not Found  (text/html)
```

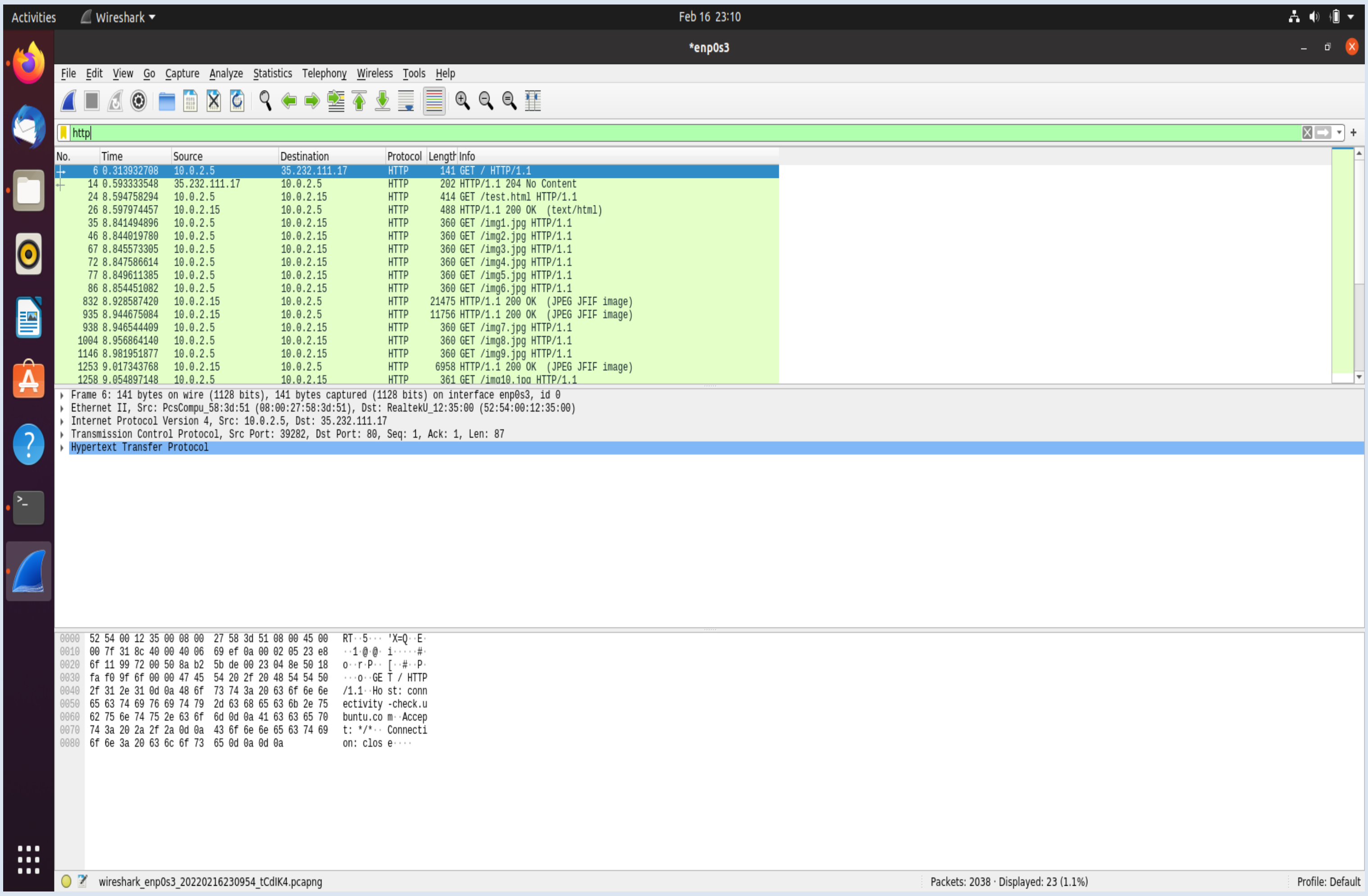
```
Frame 16095: 361 bytes on wire (2888 bits), 361 bytes captured (2888 bits) on interface enp0s3, id 0
Ethernet II, Src: PcsCompu_58:3d:51 (08:00:27:58:3d:51), Dst: PcsCompu_d5:ea:90 (08:00:27:d5:ea:90)
Internet Protocol Version 4, Src: 10.0.2.5, Dst: 10.0.2.15
Transmission Control Protocol, Src Port: 36738, Dst Port: 80, Seq: 295, Ack: 1377048, Len: 295
Hypertext Transfer Protocol
```

```
0000  08 00 27 d5 ea 90 08 00  27 58 3d 51 08 00 45 00   ··'····· 'X=Q··E·
0010  01 5b da 76 40 00 40 06  47 13 0a 00 02 05 0a 00   ·[·v@·@· G·······
0020  02 0f 8f 82 00 50 93 c9  59 29 c1 a9 5f 1d 80 18   ·····P·· Y)··_···
0030  17 cc 19 61 00 00 01 01  08 0a 1e b5 7d fc 26 9b   ···a···· ····}·&·
0040  17 e4 47 45 54 20 2f 69  6d 67 31 30 2e 6a 70 67   ··GET /i mg10.jpg
0050  20 48 54 54 50 2f 31 2e  31 0d 0a 48 6f 73 74 3a    HTTP/1. 1··Host:
0060  20 31 30 2e 30 2e 32 2e  31 35 0d 0a 55 73 65 72    10.0.2. 15··User
0070  2d 41 67 65 6e 74 3a 20  4d 6f 7a 69 6c 6c 61 2f   -Agent:  Mozilla/
0080  35 2e 30 20 28 58 31 31  3b 20 55 62 75 6e 74 75   5.0 (X11 ; Ubuntu
0090  3b 20 4c 69 6e 75 78 20  78 38 36 5f 36 34 3b 20   ; Linux  x86_64;
00a0  72 76 3a 39 37 2e 30 29  20 47 65 63 6b 6f 2f 32   rv:97.0)  Gecko/2
00b0  30 31 30 30 31 30 31 20  46 69 72 65 66 6f 78 2f   0100101  Firefox/
00c0  39 37 2e 30 0d 0a 41 63  63 65 70 74 3a 20 69 6d   97.0··Ac cept: im
00d0  61 67 65 2f 61 76 69 66  2c 69 6d 61 67 65 2f 77   age/avif ,image/w
00e0  65 62 70 2c 2a 2f 2a 0d  0a 41 63 63 65 70 74 2d   ebp,*/*· ·Accept-
00f0  4c 61 6e 67 75 61 67 65  3a 20 65 6e 2d 55 53 2c   Language : en-US,
0100  65 6e 3b 71 3d 30 2e 35  0d 0a 41 63 63 65 70 74   en;q=0.5 ··Accept
0110  2d 45 6e 63 6f 64 69 6e  67 3a 20 67 7a 69 70 2c   -Encodin g: gzip,
```

wireshark_enp0s3_20220216230251_IDOJsL.pcapng   Packets: 29799 · Displayed: 50 (0.2%) · Dropped: 235 (0.8%)   Profile: Default

Here it is 24.510355626-23.960612864=0.544226986

b)4 persistent connection:


Activities
Wireshark
Feb 16 23:10
*enp0s3
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
http

```
No.   Time         Source          Destination     Protocol Length Info
    6 0.313932708  10.0.2.5        35.232.111.17   HTTP     141 GET / HTTP/1.1
   14 0.593333548  35.232.111.17   10.0.2.5        HTTP     202 HTTP/1.1 204 No Content
   24 8.594758294  10.0.2.5        10.0.2.15       HTTP     414 GET /test.html HTTP/1.1
   26 8.597974457  10.0.2.15       10.0.2.5        HTTP     488 HTTP/1.1 200 OK  (text/html)
   35 8.841494896  10.0.2.5        10.0.2.15       HTTP     360 GET /img1.jpg HTTP/1.1
   46 8.844019780  10.0.2.5        10.0.2.15       HTTP     360 GET /img2.jpg HTTP/1.1
   67 8.845573305  10.0.2.5        10.0.2.15       HTTP     360 GET /img3.jpg HTTP/1.1
   72 8.847586614  10.0.2.5        10.0.2.15       HTTP     360 GET /img4.jpg HTTP/1.1
   77 8.849611385  10.0.2.5        10.0.2.15       HTTP     360 GET /img5.jpg HTTP/1.1
   86 8.854451082  10.0.2.5        10.0.2.15       HTTP     360 GET /img6.jpg HTTP/1.1
  832 8.928587420  10.0.2.15       10.0.2.5        HTTP   21475 HTTP/1.1 200 OK  (JPEG JFIF image)
  935 8.944675084  10.0.2.15       10.0.2.5        HTTP   11756 HTTP/1.1 200 OK  (JPEG JFIF image)
  938 8.946544409  10.0.2.5        10.0.2.15       HTTP     360 GET /img7.jpg HTTP/1.1
 1004 8.956864140  10.0.2.5        10.0.2.15       HTTP     360 GET /img8.jpg HTTP/1.1
 1146 8.981951877  10.0.2.5        10.0.2.15       HTTP     360 GET /img9.jpg HTTP/1.1
 1253 9.017343768  10.0.2.15       10.0.2.5        HTTP    6958 HTTP/1.1 200 OK  (JPEG JFIF image)
 1258 9.054897148  10.0.2.5        10.0.2.15       HTTP     361 GET /img10.jpg HTTP/1.1
```

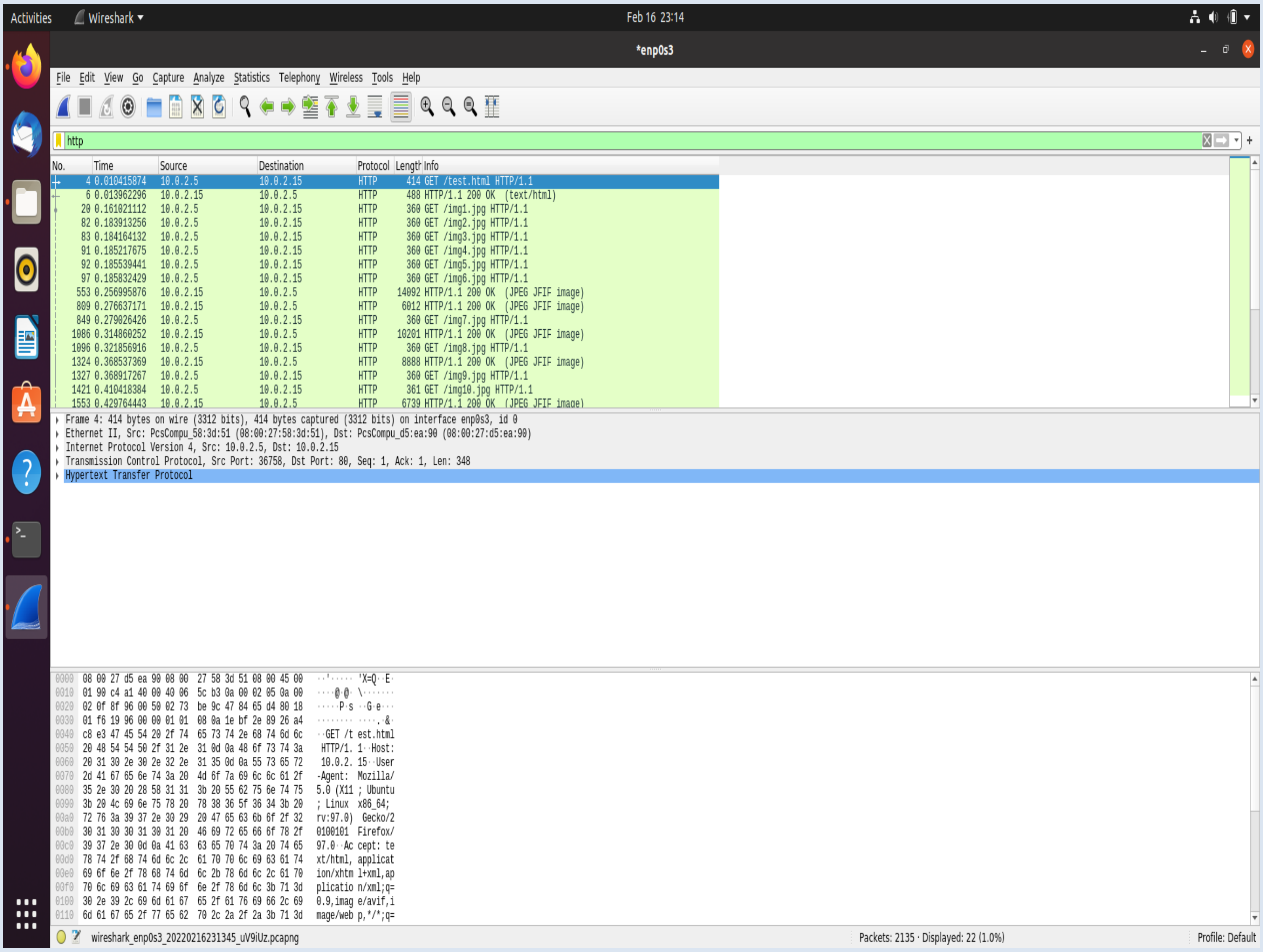
```
› Frame 6: 141 bytes on wire (1128 bits), 141 bytes captured (1128 bits) on interface enp0s3, id 0
› Ethernet II, Src: PcsCompu_58:3d:51 (08:00:27:58:3d:51), Dst: RealtekU_12:35:00 (52:54:00:12:35:00)
› Internet Protocol Version 4, Src: 10.0.2.5, Dst: 35.232.111.17
› Transmission Control Protocol, Src Port: 39282, Dst Port: 80, Seq: 1, Ack: 1, Len: 87
› Hypertext Transfer Protocol
```

```
0000  52 54 00 12 35 00 08 00  27 58 3d 51 08 00 45 00   RT··5··· 'X=Q··E·
0010  00 7f 31 8c 40 00 40 06  69 ef 0a 00 02 05 23 e8   ··1·@·@· i·····#·
0020  6f 11 99 72 00 50 8a b2  5b de 00 23 04 8e 50 18   o··r·P·· [··#··P·
0030  fa f0 9f 6f 00 00 47 45  54 20 2f 20 48 54 54 50   ···o··GE T / HTTP
0040  2f 31 2e 31 0d 0a 48 6f  73 74 3a 20 63 6f 6e 6e   /1.1··Ho st: conn
0050  65 63 74 69 76 69 74 79  2d 63 68 65 63 6b 2e 75   ectivity -check.u
0060  62 75 6e 74 75 2e 63 6f  6d 0d 0a 41 63 63 65 70   buntu.co m··Accep
0070  74 3a 20 2a 2f 2a 0d 0a  43 6f 6e 6e 65 63 74 69   t: */*·· Connecti
0080  6f 6e 3a 20 63 6c 6f 73  65 0d 0a 0d 0a            on: clos e····
```

```
wireshark_enp0s3_20220216230954_tCdIK4.pcapng        Packets: 2038 · Displayed: 23 (1.1%)        Profile: Default
```

Here it is 9.054897148-8.5947568294=0.4601403186

c)6 persistent connection:


Activities
Wireshark
Feb 16 23:14
*enp0s3
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
http

```
No.   Time        Source     Destination Protocol Length Info
   4 0.010415874 10.0.2.5   10.0.2.15   HTTP       414 GET /test.html HTTP/1.1
   6 0.013962296 10.0.2.15  10.0.2.5    HTTP       488 HTTP/1.1 200 OK  (text/html)
  20 0.161021112 10.0.2.5   10.0.2.15   HTTP       360 GET /img1.jpg HTTP/1.1
  82 0.183913256 10.0.2.5   10.0.2.15   HTTP       360 GET /img2.jpg HTTP/1.1
  83 0.184164132 10.0.2.5   10.0.2.15   HTTP       360 GET /img3.jpg HTTP/1.1
  91 0.185217675 10.0.2.5   10.0.2.15   HTTP       360 GET /img4.jpg HTTP/1.1
  92 0.185539441 10.0.2.5   10.0.2.15   HTTP       360 GET /img5.jpg HTTP/1.1
  97 0.185832429 10.0.2.5   10.0.2.15   HTTP       360 GET /img6.jpg HTTP/1.1
 553 0.256995876 10.0.2.15  10.0.2.5    HTTP     14092 HTTP/1.1 200 OK  (JPEG JFIF image)
 809 0.276637171 10.0.2.15  10.0.2.5    HTTP      6012 HTTP/1.1 200 OK  (JPEG JFIF image)
 849 0.279026426 10.0.2.5   10.0.2.15   HTTP       360 GET /img7.jpg HTTP/1.1
1086 0.314860252 10.0.2.15  10.0.2.5    HTTP     10201 HTTP/1.1 200 OK  (JPEG JFIF image)
1096 0.321856916 10.0.2.5   10.0.2.15   HTTP       360 GET /img8.jpg HTTP/1.1
1324 0.368537369 10.0.2.15  10.0.2.5    HTTP      8888 HTTP/1.1 200 OK  (JPEG JFIF image)
1327 0.368917267 10.0.2.5   10.0.2.15   HTTP       360 GET /img9.jpg HTTP/1.1
1421 0.410418384 10.0.2.5   10.0.2.15   HTTP       361 GET /img10.jpg HTTP/1.1
1553 0.429764443 10.0.2.15  10.0.2.5    HTTP      6739 HTTP/1.1 200 OK  (JPEG JFIF image)
```

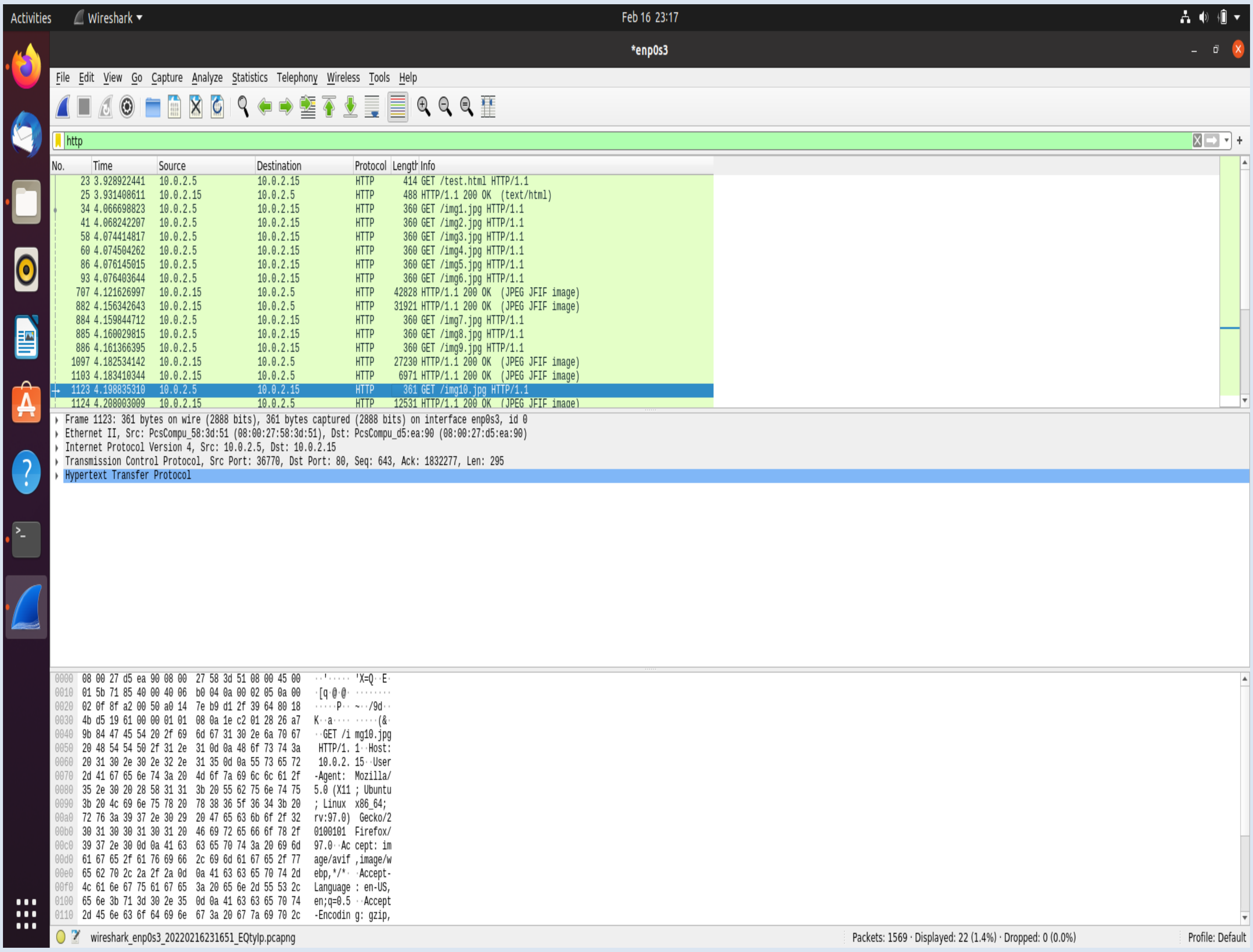
```
Frame 4: 414 bytes on wire (3312 bits), 414 bytes captured (3312 bits) on interface enp0s3, id 0
Ethernet II, Src: PcsCompu_58:3d:51 (08:00:27:58:3d:51), Dst: PcsCompu_d5:ea:90 (08:00:27:d5:ea:90)
Internet Protocol Version 4, Src: 10.0.2.5, Dst: 10.0.2.15
Transmission Control Protocol, Src Port: 36758, Dst Port: 80, Seq: 1, Ack: 1, Len: 348
Hypertext Transfer Protocol
```

```
0000  08 00 27 d5 ea 90 08 00  27 58 3d 51 08 00 45 00   ··'····· 'X=Q··E·
0010  01 90 c4 a1 40 00 40 06  5c b3 0a 00 02 05 0a 00   ····@·@· \·······
0020  02 0f 8f 96 00 50 02 73  be 9c 47 84 65 d4 80 18   ·····P·s ··G·e···
0030  01 f6 19 96 00 00 01 01  08 0a 1e bf 2e 89 26 a4   ········ ·····.&·
0040  c8 e3 47 45 54 20 2f 74  65 73 74 2e 68 74 6d 6c   ··GET /t est.html
0050  20 48 54 54 50 2f 31 2e  31 0d 0a 48 6f 73 74 3a    HTTP/1. 1··Host:
0060  20 31 30 2e 30 2e 32 2e  31 35 0d 0a 55 73 65 72    10.0.2. 15··User
0070  2d 41 67 65 6e 74 3a 20  4d 6f 7a 69 6c 6c 61 2f   -Agent:  Mozilla/
0080  35 2e 30 20 28 58 31 31  3b 20 55 62 75 6e 74 75   5.0 (X11 ; Ubuntu
0090  3b 20 4c 69 6e 75 78 20  78 38 36 5f 36 34 3b 20   ; Linux  x86_64;
00a0  72 76 3a 39 37 2e 30 29  20 47 65 63 6b 6f 2f 32   rv:97.0)  Gecko/2
00b0  30 31 30 30 31 30 31 20  46 69 72 65 66 6f 78 2f   0100101  Firefox/
00c0  39 37 2e 30 0d 0a 41 63  63 65 70 74 3a 20 74 65   97.0··Ac cept: te
00d0  78 74 2f 68 74 6d 6c 2c  61 70 70 6c 69 63 61 74   xt/html, applicat
00e0  69 6f 6e 2f 78 68 74 6d  6c 2b 78 6d 6c 2c 61 70   ion/xhtm l+xml,ap
00f0  70 6c 69 63 61 74 69 6f  6e 2f 78 6d 6c 3b 71 3d   plicatio n/xml;q=
0100  30 2e 39 2c 69 6d 61 67  65 2f 61 76 69 66 2c 69   0.9,imag e/avif,i
0110  6d 61 67 65 2f 77 65 62  70 2c 2a 2f 2a 3b 71 3d   mage/web p,*/*;q=
```

```
wireshark_enp0s3_20220216231345_uV9iUz.pcapng    Packets: 2135 · Displayed: 22 (1.0%)    Profile: Default
```

Here it is 0.4101418314 – 0.010415874 = 0.40000251

d)10 persistent connection:



```
No.   Time         Source      Destination  Protocol Length Info
   23 3.928922441  10.0.2.5    10.0.2.15    HTTP      414 GET /test.html HTTP/1.1
   25 3.931408611  10.0.2.15   10.0.2.5     HTTP      488 HTTP/1.1 200 OK  (text/html)
   34 4.066698823  10.0.2.5    10.0.2.15    HTTP      360 GET /img1.jpg HTTP/1.1
   41 4.068242207  10.0.2.5    10.0.2.15    HTTP      360 GET /img2.jpg HTTP/1.1
   58 4.074414817  10.0.2.5    10.0.2.15    HTTP      360 GET /img3.jpg HTTP/1.1
   60 4.074504262  10.0.2.5    10.0.2.15    HTTP      360 GET /img4.jpg HTTP/1.1
   86 4.076145015  10.0.2.5    10.0.2.15    HTTP      360 GET /img5.jpg HTTP/1.1
   93 4.076403644  10.0.2.5    10.0.2.15    HTTP      360 GET /img6.jpg HTTP/1.1
  707 4.121626997  10.0.2.15   10.0.2.5     HTTP    42828 HTTP/1.1 200 OK  (JPEG JFIF image)
  882 4.156342643  10.0.2.15   10.0.2.5     HTTP    31921 HTTP/1.1 200 OK  (JPEG JFIF image)
  884 4.159844712  10.0.2.5    10.0.2.15    HTTP      360 GET /img7.jpg HTTP/1.1
  885 4.160029815  10.0.2.5    10.0.2.15    HTTP      360 GET /img8.jpg HTTP/1.1
  886 4.161366395  10.0.2.5    10.0.2.15    HTTP      360 GET /img9.jpg HTTP/1.1
 1097 4.182534142  10.0.2.15   10.0.2.5     HTTP    27230 HTTP/1.1 200 OK  (JPEG JFIF image)
 1103 4.183410344  10.0.2.15   10.0.2.5     HTTP     6971 HTTP/1.1 200 OK  (JPEG JFIF image)
 1123 4.198835310  10.0.2.5    10.0.2.15    HTTP      361 GET /img10.jpg HTTP/1.1
 1124 4.208003009  10.0.2.15   10.0.2.5     HTTP    12531 HTTP/1.1 200 OK  (JPEG JFIF image)
```

```
Frame 1123: 361 bytes on wire (2888 bits), 361 bytes captured (2888 bits) on interface enp0s3, id 0
Ethernet II, Src: PcsCompu_58:3d:51 (08:00:27:58:3d:51), Dst: PcsCompu_d5:ea:90 (08:00:27:d5:ea:90)
Internet Protocol Version 4, Src: 10.0.2.5, Dst: 10.0.2.15
Transmission Control Protocol, Src Port: 36770, Dst Port: 80, Seq: 643, Ack: 1832277, Len: 295
Hypertext Transfer Protocol
```

```
0000  08 00 27 d5 ea 90 08 00  27 58 3d 51 08 00 45 00   ··'····· 'X=Q··E·
0010  01 5b 71 85 40 00 40 06  b0 04 0a 00 02 05 0a 00   ·[q·@·@· ········
0020  02 0f 8f a2 00 50 a0 14  7e b9 d1 2f 39 64 80 18   ·····P·· ~··/9d··
0030  4b d5 19 61 00 00 01 01  08 0a 1e c2 01 28 26 a7   K··a···· ·····(&·
0040  9b 84 47 45 54 20 2f 69  6d 67 31 30 2e 6a 70 67   ··GET /i mg10.jpg
0050  20 48 54 54 50 2f 31 2e  31 0d 0a 48 6f 73 74 3a    HTTP/1. 1··Host:
0060  20 31 30 2e 30 2e 32 2e  31 35 0d 0a 55 73 65 72    10.0.2. 15··User
0070  2d 41 67 65 6e 74 3a 20  4d 6f 7a 69 6c 6c 61 2f   -Agent:  Mozilla/
0080  35 2e 30 20 28 58 31 31  3b 20 55 62 75 6e 74 75   5.0 (X11 ; Ubuntu
0090  3b 20 4c 69 6e 75 78 20  78 38 36 5f 36 34 3b 20   ; Linux  x86_64;
00a0  72 76 3a 39 37 2e 30 29  20 47 65 63 6b 6f 2f 32   rv:97.0)  Gecko/2
00b0  30 31 30 30 31 30 31 20  46 69 72 65 66 6f 78 2f   0100101  Firefox/
00c0  39 37 2e 30 0d 0a 41 63  63 65 70 74 3a 20 69 6d   97.0··Ac cept: im
00d0  61 67 65 2f 61 76 69 66  2c 69 6d 61 67 65 2f 77   age/avif ,image/w
00e0  65 62 70 2c 2a 2f 2a 0d  0a 41 63 63 65 70 74 2d   ebp,*/*· ·Accept-
00f0  4c 61 6e 67 75 61 67 65  3a 20 65 6e 2d 55 53 2c   Language : en-US,
0100  65 6e 3b 71 3d 30 2e 35  0d 0a 41 63 63 65 70 74   en;q=0.5 ··Accept
0110  2d 45 6e 63 6f 64 69 6e  67 3a 20 67 7a 69 70 2c   -Encodin g: gzip,
```

wireshark_enp0s3_20220216231651_EQtylp.pcapng   Packets: 1569 · Displayed: 22 (1.4%) · Dropped: 0 (0.0%)   Profile: Default

Activities
Wireshark
Feb 16 23:17
*enp0s3
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
http

Here it is 4.198835310 – 3.928922441 = 0.269912869

TASK 2:
Understand working of HTTP Headers

	Understand working of HTTP headers: Conditional Get: If-Modified-Since HTTP Cookies: Cookie and Set-Cookie Authentication: Auth-Basic Design a web page that has one embedded page (e.g. image) and sets a cookie and enables authentication. You are required to configure the web server (e.g. apache) with authentication mechanism. Show the behavior of conditional get when embedded objects is modified and when it is not (you can just change the create date of the embedded object). Decode the Basic-Auth header using Base64 mechanism as per the password setup. **Observation**: Show the behavior of browser when is cookie is set and when cookie is removed.

Understanding Working of HTTP Headers

Question: Understand working of HTTP headers

Conditional Get: If-Modified-Since

HTTP Cookies: Cookie and Set-Cookie

Authentication: Auth-Basic

Design a web page that has one embedded page (e.g. image) and sets a cookie and enables authentication. You are required to configure the web server (e.g. apache) with authentication mechanism. Show the behavior of conditional get when embedded objects are modified and when it is not (you can just change the create date of the embedded object). Decode the Basic- Auth header using Base64 mechanism as per the password setup.

Observation: Show the behavior of browser when is cookie is set and when cookie is removed.

Solution: Analyzing Basic Authentication and Cookies

The three parts of experiment are:

1. Password Authentication
2. Cookie Setting
3. Conditional get

Steps of Execution (for Password Authentication)

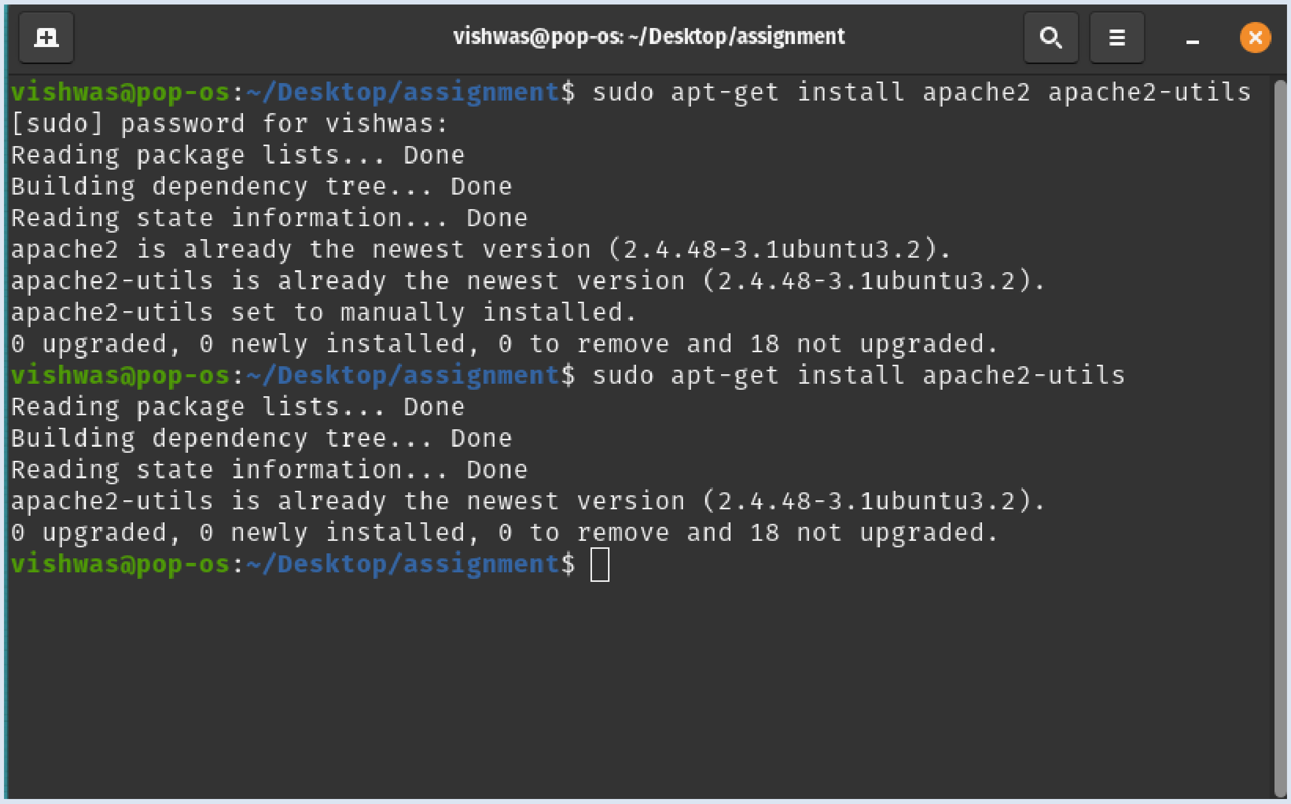
1. Executing the below commands on the terminal.

--> To update and integrate the existing softwares

```
sudo apt-get update
```

--> To install the apache utility

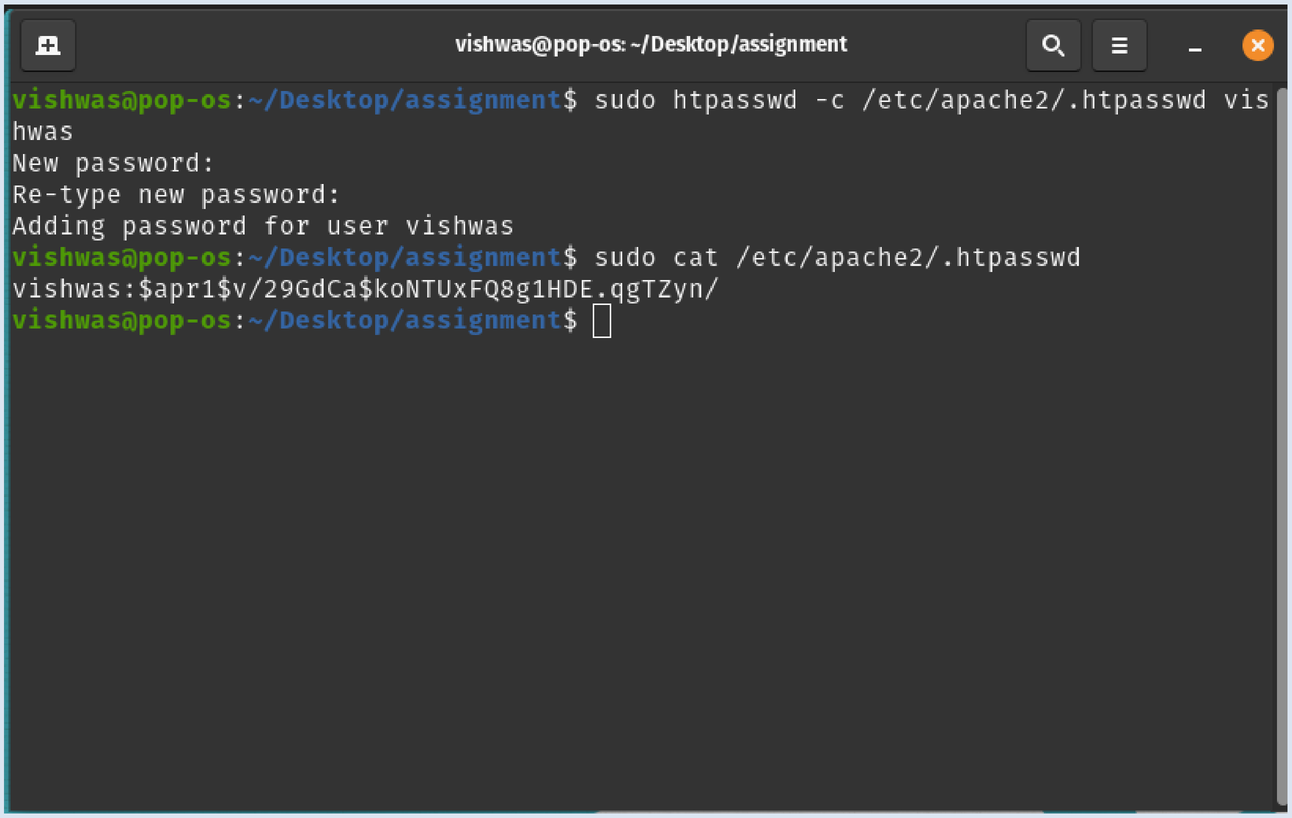
```
sudo apt-get install apache2 apache2-utils
```



```
vishwas@pop-os: ~/Desktop/assignment
vishwas@pop-os:~/Desktop/assignment$ sudo apt-get install apache2 apache2-utils
[sudo] password for vishwas:
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
apache2 is already the newest version (2.4.48-3.1ubuntu3.2).
apache2-utils is already the newest version (2.4.48-3.1ubuntu3.2).
apache2-utils set to manually installed.
0 upgraded, 0 newly installed, 0 to remove and 18 not upgraded.
vishwas@pop-os:~/Desktop/assignment$ sudo apt-get install apache2-utils
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
apache2-utils is already the newest version (2.4.48-3.1ubuntu3.2).
0 upgraded, 0 newly installed, 0 to remove and 18 not upgraded.
vishwas@pop-os:~/Desktop/assignment$ 
```

--> Provide username and password to set authentication

sudo htpasswd -c /etc/apache2/.htpasswd ANY_USERNAME



```
vishwas@pop-os: ~/Desktop/assignment
vishwas@pop-os:~/Desktop/assignment$ sudo htpasswd -c /etc/apache2/.htpasswd vis
hwas
New password:
Re-type new password:
Adding password for user vishwas
vishwas@pop-os:~/Desktop/assignment$ sudo cat /etc/apache2/.htpasswd
vishwas:$apr1$v/29GdCa$koNTUxFQ8g1HDE.qgTZyn/
vishwas@pop-os:~/Desktop/assignment$ 
```

Here “netwo” is the username. Also, password is entered twice.

--> View the authentication

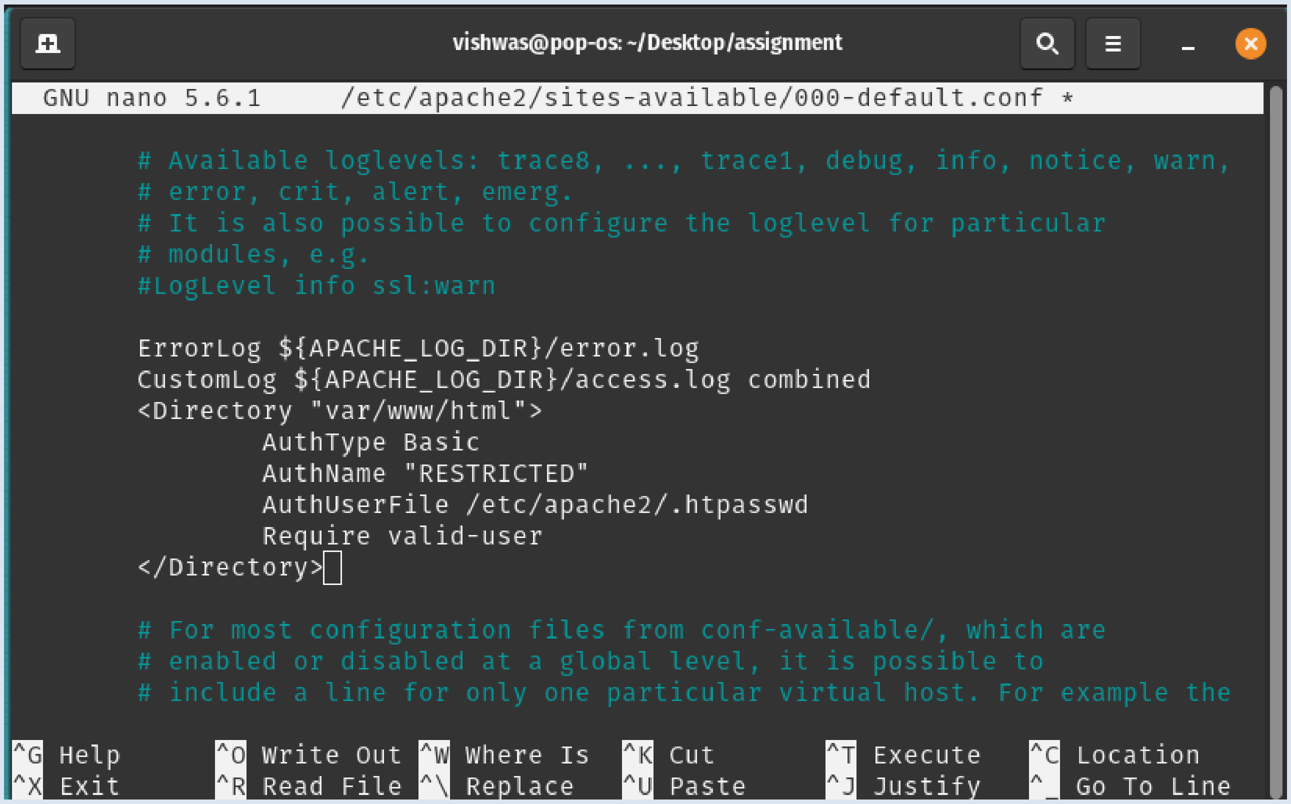
```
sudo cat /etc/apache2/.htpasswd
```

2. To setup the authentication phase, execute the following commands. Configuring Access control within the Virtual Host Definition.

--> Opening the file for setting authentication

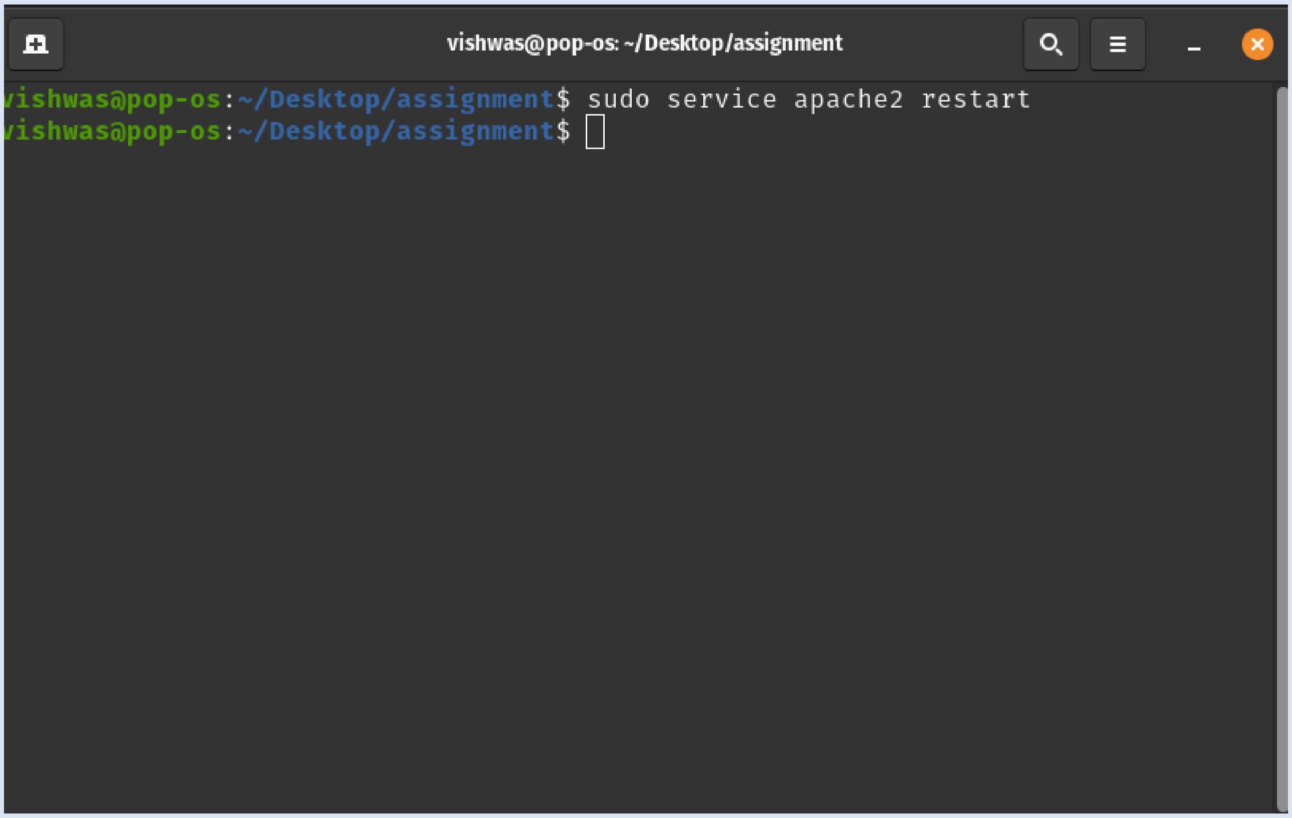
```
sudo nano  /etc/apache2/sites-available/000-default.conf
```

```
<VirtualHost*:80>
        ServerAdmin webmaster@localhost
        DocumentRoot  /var/www/html
        ErrorLog ${APACHE_LOG_DIR}/error.log
        CustomLog ${APACHE_LOG_DIR}/access.log combined
        <Directory "/var/www/html">
                AuthType Basic
                AuthName "RESTRICTED"
                AuthUserFile /etc/apache2/.htpasswd
                Require valid-user
        </Directory>
</VirtualHost>
```



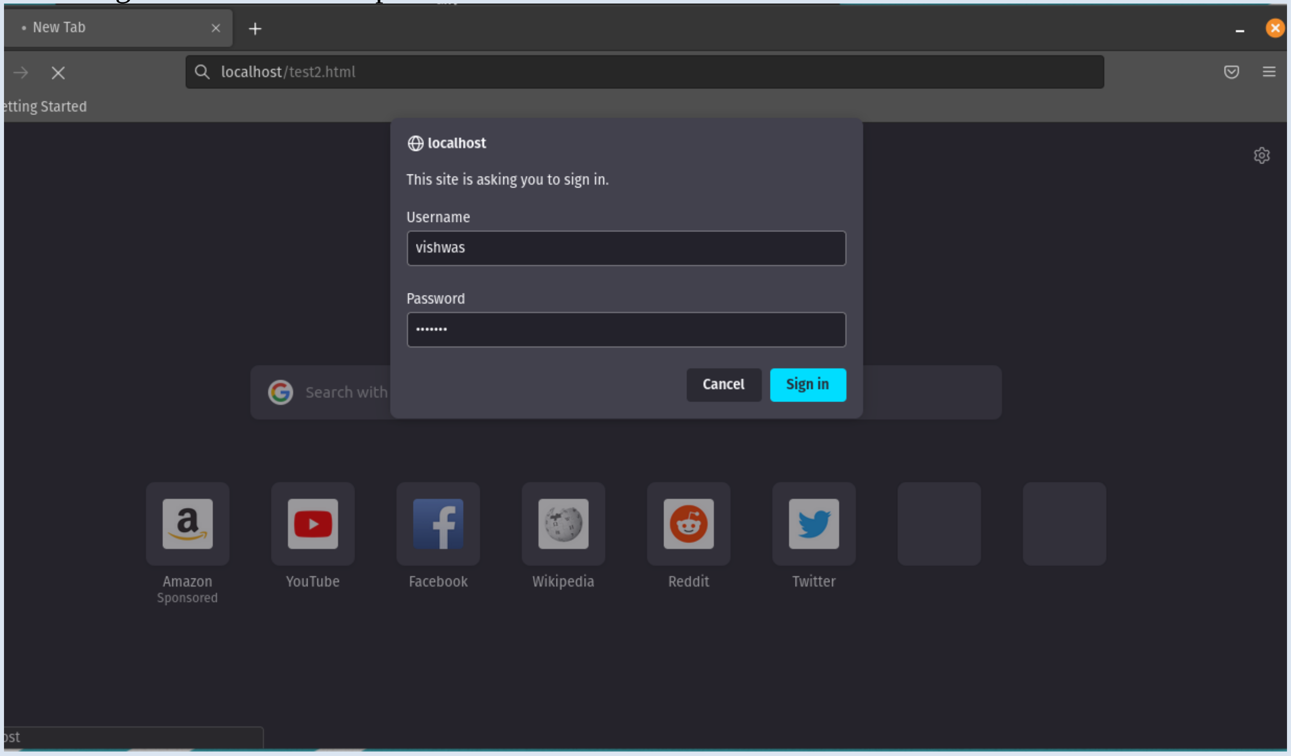
```
  GNU nano 5.6.1       /etc/apache2/sites-available/000-default.conf *

        # Available loglevels: trace8, ..., trace1, debug, info, notice, warn,
        # error, crit, alert, emerg.
        # It is also possible to configure the loglevel for particular
        # modules, e.g.
        #LogLevel info ssl:warn

        ErrorLog ${APACHE_LOG_DIR}/error.log
        CustomLog ${APACHE_LOG_DIR}/access.log combined
        <Directory "var/www/html">
                AuthType Basic
                AuthName "RESTRICTED"
                AuthUserFile /etc/apache2/.htpasswd
                Require valid-user
        </Directory>

        # For most configuration files from conf-available/, which are
        # enabled or disabled at a global level, it is possible to
        # include a line for only one particular virtual host. For example the

^G Help         ^O Write Out ^W Where Is  ^K Cut          ^T Execute    ^C Location
^X Exit         ^R Read File ^\ Replace   ^U Paste        ^J Justify    ^_ Go To Line
```

3. Password policy implementation is done by restarting the server as:
   sudo service apache2 restart



```
vishwas@pop-os:~/Desktop/assignment$ sudo service apache2 restart
vishwas@pop-os:~/Desktop/assignment$ 
```

4. The localhost is then accessed using the Firefox browser requiring a username and a password set during the authentication phase.



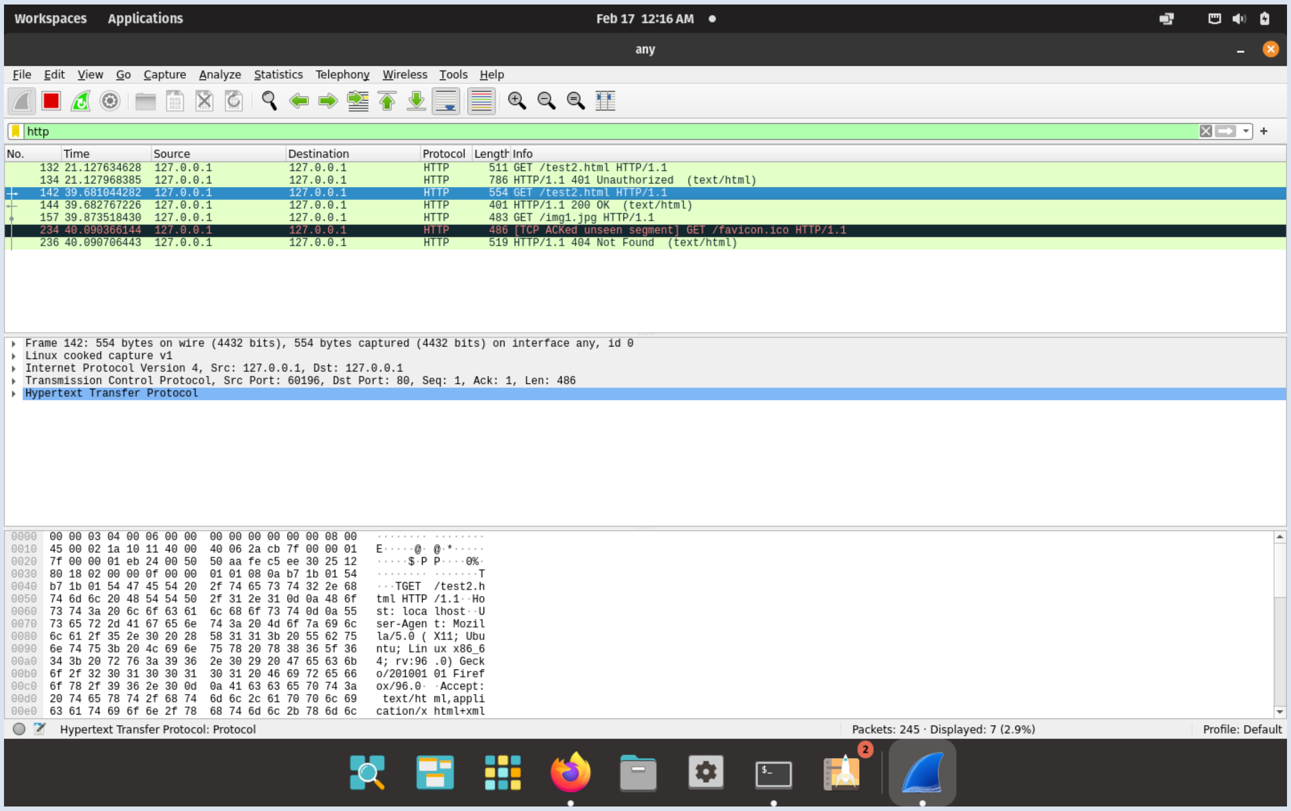
localhost

This site is asking you to sign in.

Username: vishwas

Password: •••••••

5. Wireshark is used to capture the packets sent upon the network.



Workspaces
Applications
Feb 17 12:16 AM
any
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
http
Packets: 245 · Displayed: 7 (2.9%)
Profile: Default

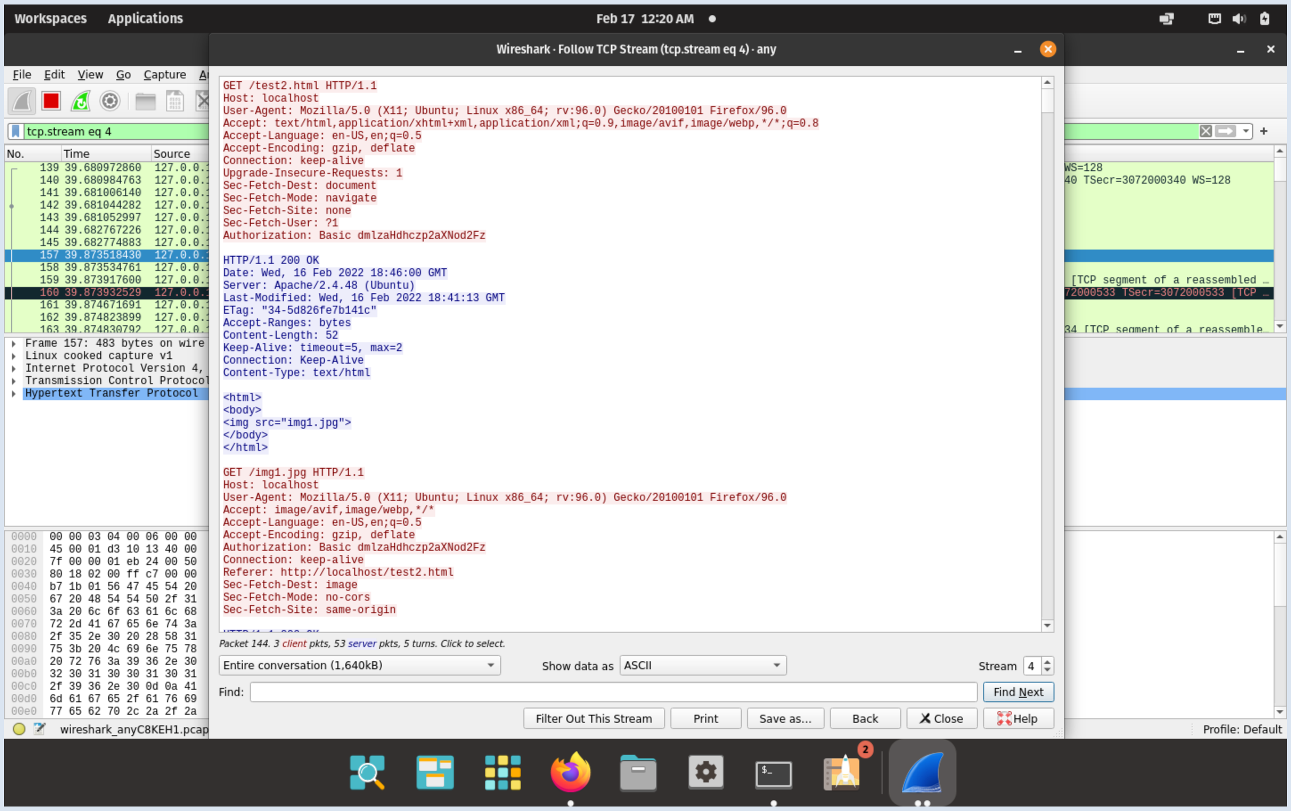
```
No.   Time          Source     Destination  Protocol Length Info
  132 21.127634628 127.0.0.1  127.0.0.1    HTTP     511 GET /test2.html HTTP/1.1
  134 21.127968385 127.0.0.1  127.0.0.1    HTTP     786 HTTP/1.1 401 Unauthorized  (text/html)
  142 39.681044282 127.0.0.1  127.0.0.1    HTTP     554 GET /test2.html HTTP/1.1
  144 39.682767226 127.0.0.1  127.0.0.1    HTTP     401 HTTP/1.1 200 OK  (text/html)
  157 39.873518430 127.0.0.1  127.0.0.1    HTTP     483 GET /img1.jpg HTTP/1.1
  234 40.090366144 127.0.0.1  127.0.0.1    HTTP     486 [TCP ACKed unseen segment] GET /favicon.ico HTTP/1.1
  236 40.090706443 127.0.0.1  127.0.0.1    HTTP     519 HTTP/1.1 404 Not Found  (text/html)
```

```
▸ Frame 142: 554 bytes on wire (4432 bits), 554 bytes captured (4432 bits) on interface any, id 0
▸ Linux cooked capture v1
▸ Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1
▸ Transmission Control Protocol, Src Port: 60196, Dst Port: 80, Seq: 1, Ack: 1, Len: 486
▸ Hypertext Transfer Protocol
```

```
0000  00 00 03 04 00 06 00 00  00 00 00 00 00 00 08 00   ········ ········
0010  45 00 02 1a 10 11 40 00  40 06 2a cb 7f 00 00 01   E·····@· @·*·····
0020  7f 00 00 01 eb 24 00 50  50 aa fe c5 ee 30 25 12   ·····$·P P····0%·
0030  80 18 02 00 00 0f 00 00  01 01 08 0a b7 1b 01 54   ········ ·······T
0040  b7 1b 01 54 47 45 54 20  2f 74 65 73 74 32 2e 68   ···TGET  /test2.h
0050  74 6d 6c 20 48 54 54 50  2f 31 2e 31 0d 0a 48 6f   tml HTTP /1.1··Ho
0060  73 74 3a 20 6c 6f 63 61  6c 68 6f 73 74 0d 0a 55   st: loca lhost··U
0070  73 65 72 2d 41 67 65 6e  74 3a 20 4d 6f 7a 69 6c   ser-Agen t: Mozil
0080  6c 61 2f 35 2e 30 20 28  58 31 31 3b 20 55 62 75   la/5.0 ( X11; Ubu
0090  6e 74 75 3b 20 4c 69 6e  75 78 20 78 38 36 5f 36   ntu; Lin ux x86_6
00a0  34 3b 20 72 76 3a 39 36  2e 30 29 20 47 65 63 6b   4; rv:96 .0) Geck
00b0  6f 2f 32 30 31 30 30 31  30 31 20 46 69 72 65 66   o/201001 01 Firef
00c0  6f 78 2f 39 36 2e 30 0d  0a 41 63 63 65 70 74 3a   ox/96.0· ·Accept:
00d0  20 74 65 78 74 2f 68 74  6d 6c 2c 61 70 70 6c 69    text/ht ml,appli
00e0  63 61 74 69 6f 6e 2f 78  68 74 6d 6c 2b 78 6d 6c   cation/x html+xml
```

Hypertext Transfer Protocol: Protocol

6. Using the “follow TCP stream” on the HTTP message segment the password was retrieved which was encrypted by the base64 algorithm and decryption could be done with same algorithm.



```
GET /test2.html HTTP/1.1
Host: localhost
User-Agent: Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:96.0) Gecko/20100101 Firefox/96.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Connection: keep-alive
Upgrade-Insecure-Requests: 1
Sec-Fetch-Dest: document
Sec-Fetch-Mode: navigate
Sec-Fetch-Site: none
Sec-Fetch-User: ?1
Authorization: Basic dmlzaHdhczp2aXNod2Fz

HTTP/1.1 200 OK
Date: Wed, 16 Feb 2022 18:46:00 GMT
Server: Apache/2.4.48 (Ubuntu)
Last-Modified: Wed, 16 Feb 2022 18:41:13 GMT
ETag: "34-5d826fe7b141c"
Accept-Ranges: bytes
Content-Length: 52
Keep-Alive: timeout=5, max=2
Connection: Keep-Alive
Content-Type: text/html

<html>
<body>
<img src="img1.jpg">
</body>
</html>

GET /img1.jpg HTTP/1.1
Host: localhost
User-Agent: Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:96.0) Gecko/20100101 Firefox/96.0
Accept: image/avif,image/webp,*/*
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Authorization: Basic dmlzaHdhczp2aXNod2Fz
Connection: keep-alive
Referer: http://localhost/test2.html
Sec-Fetch-Dest: image
Sec-Fetch-Mode: no-cors
Sec-Fetch-Site: same-origin
```

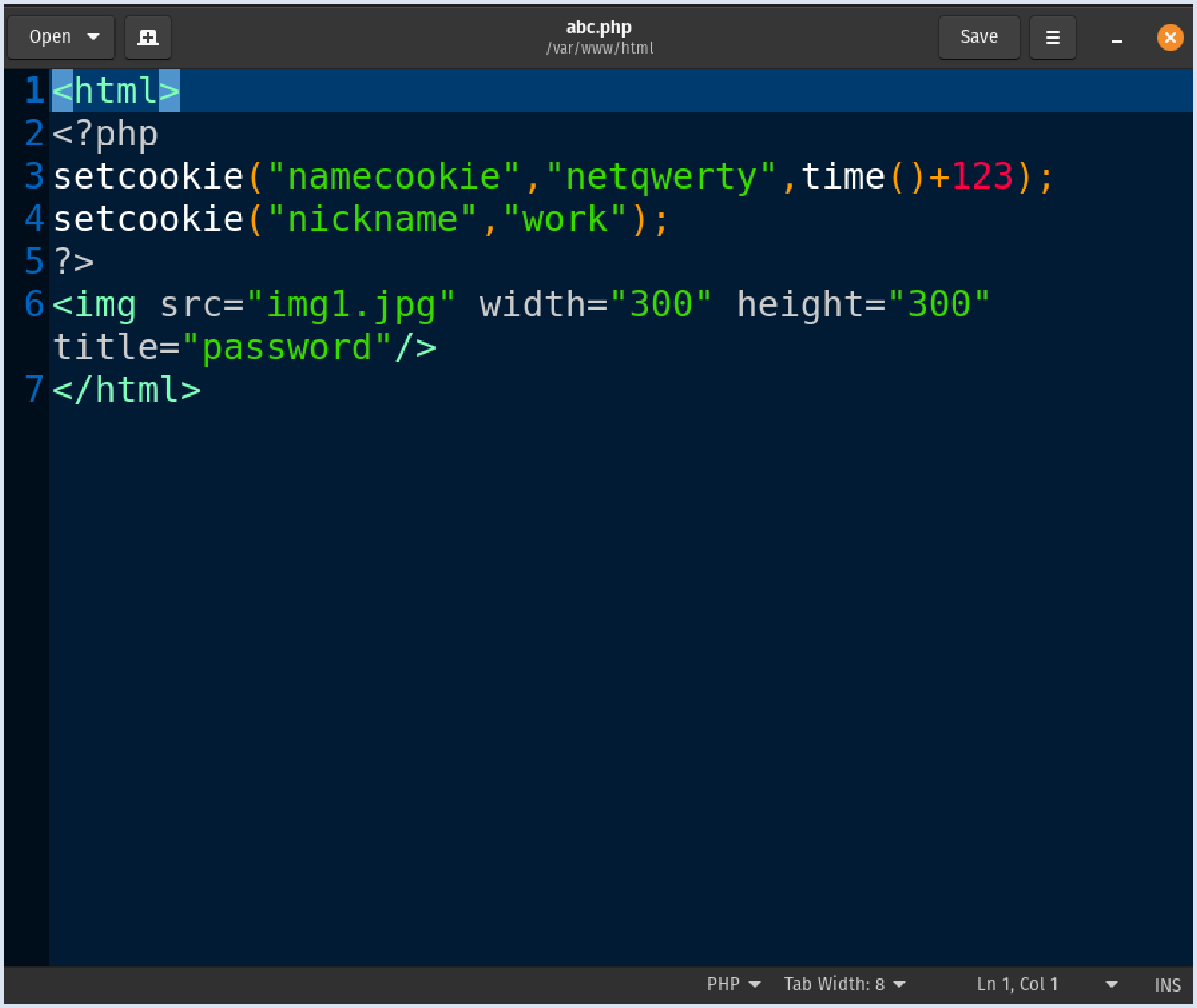
Packet 144. 3 client pkts, 53 server pkts, 5 turns. Click to select.

Entire conversation (1,640kB) Show data as ASCII Stream 4

Steps of Execution (Cookie Setting)

1. A PHP file to set the cookie is created which also contains an image in it (placed under the HTML directory) to be accessed once the cookie is set. The following code helped to set the cookie:

```
<html>
<?php
 setcookie("namecookie","netqwerty",time()+123);
 setcookie("nickname","work");
?>
<img src= “highres.png” width= “300” height= “300” title= “password” />
</html>
```

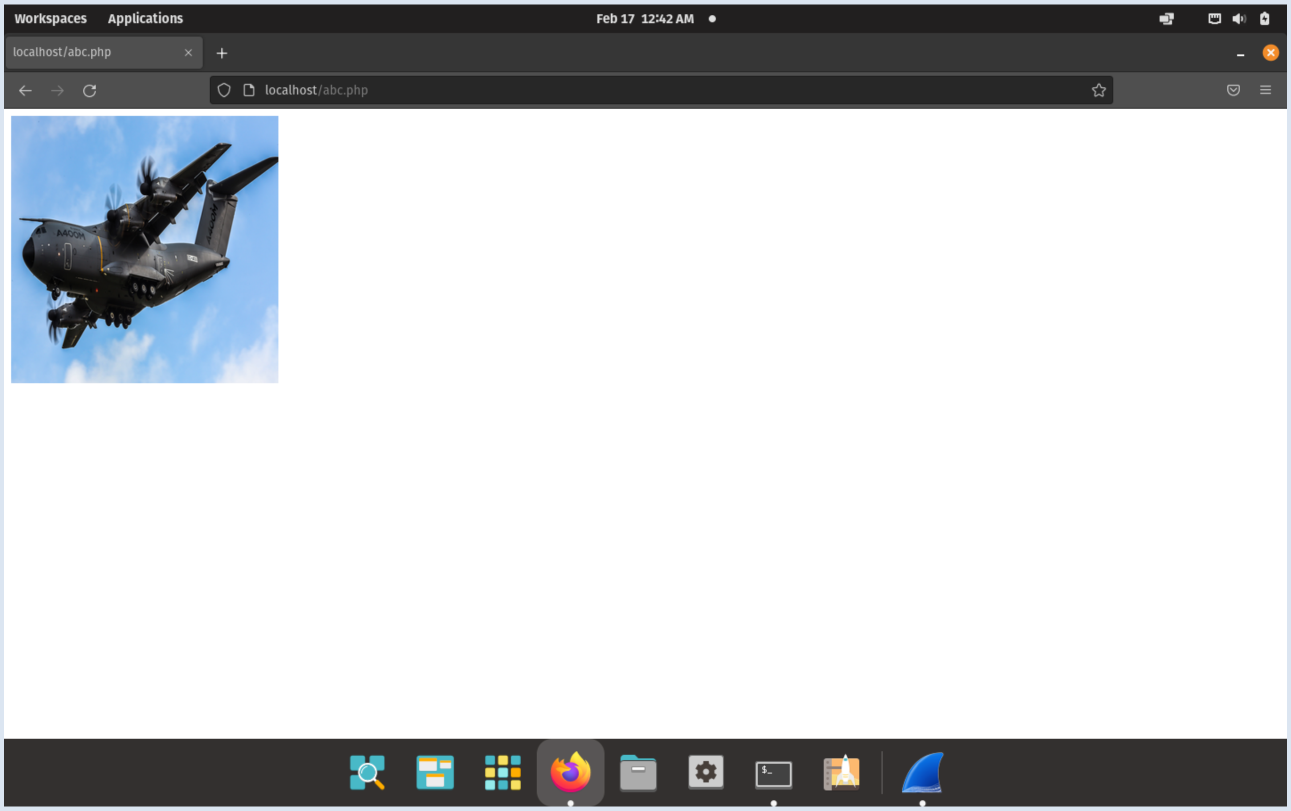


```
<html>
<?php
setcookie("namecookie","netqwerty",time()+123);
setcookie("nickname","work");
?>
<img src="img1.jpg" width="300" height="300"
title="password"/>
</html>
```

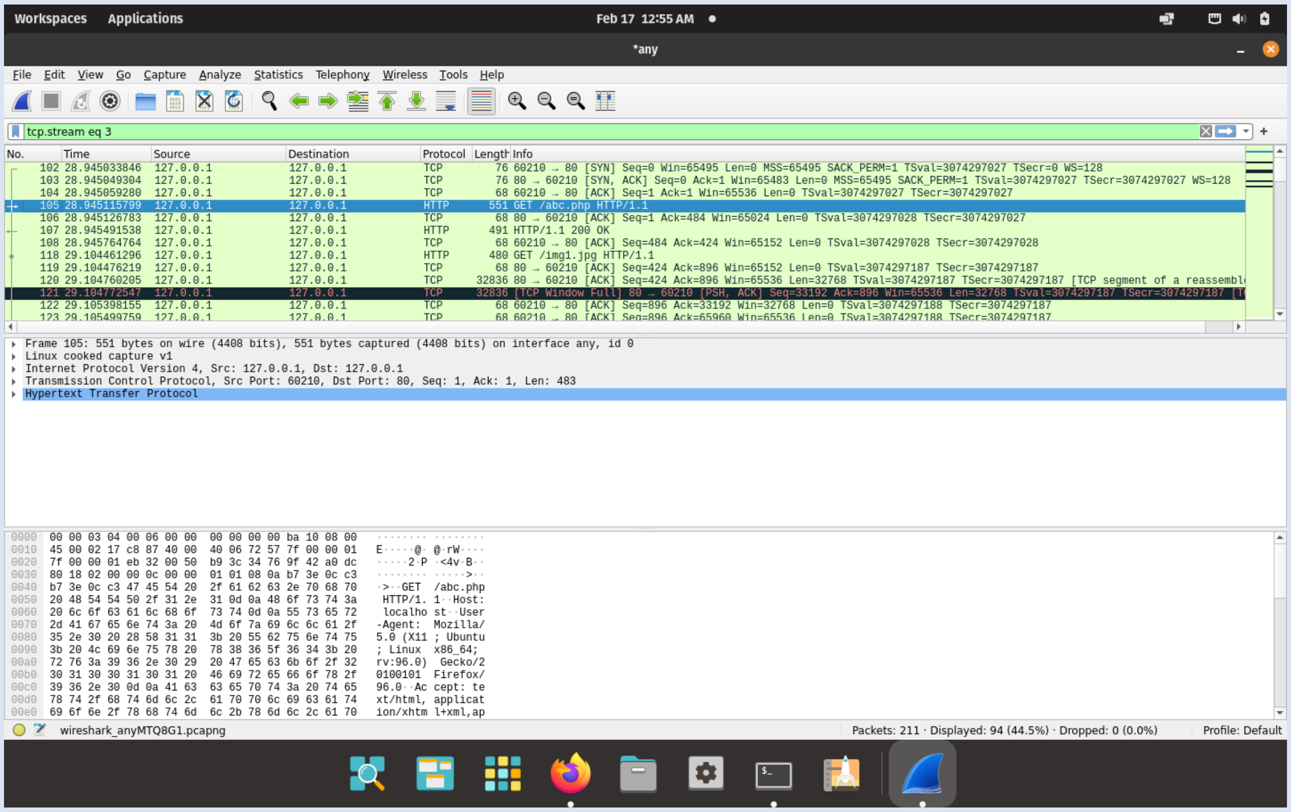
Note: Here you can add any image if required

Note: You can capture Cookies mostly during the first time of web access. Hence keep wireshark capture ready before executing the task for the first time.

2. The combined file saved with a .php extension is placed under **/var/www/html** for accessing.



3. The packets are captured using Wireshark and using the “follow TCP stream” which checks for the set-cookie field whether the cookie is set or not set.


Workspaces
Applications
Feb 17 12:55 AM
*any
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

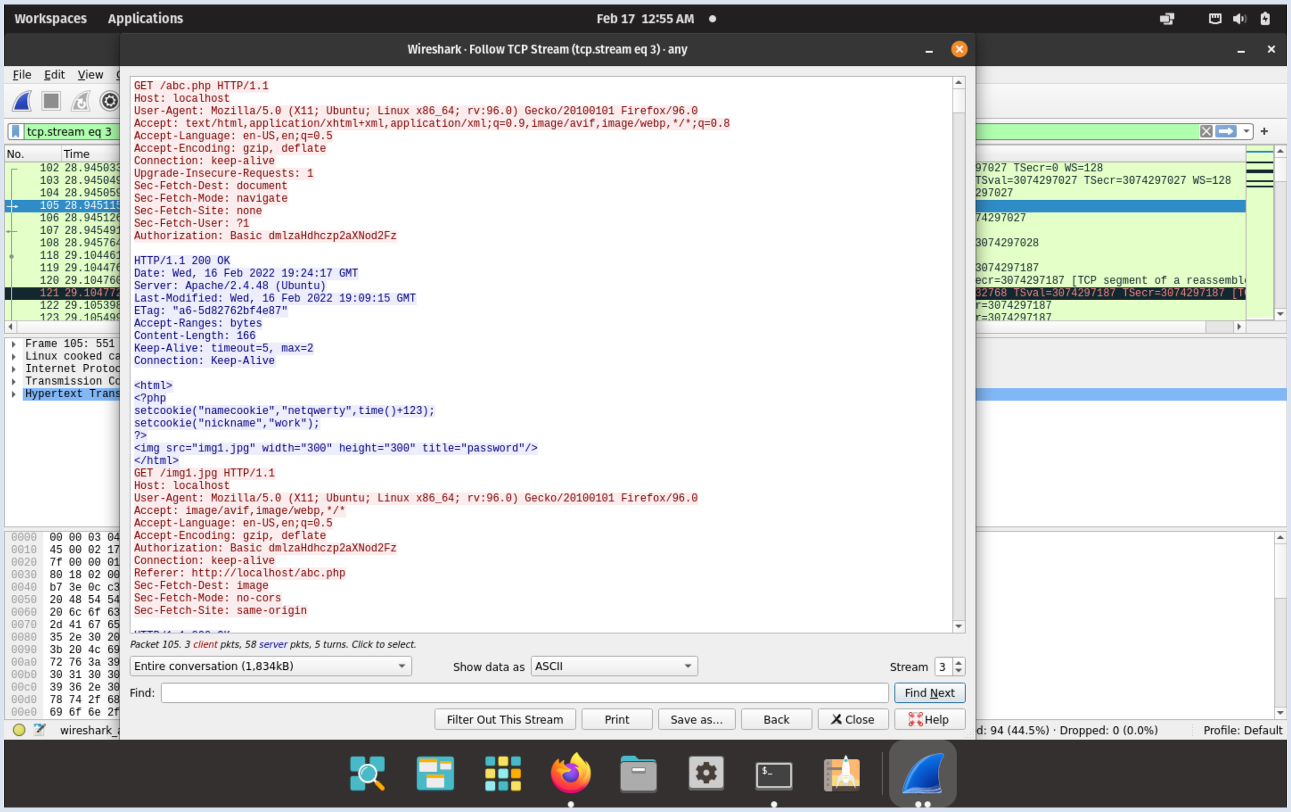
```
tcp.stream eq 3
```

```
No.  Time          Source     Destination Protocol Length Info
 102 28.945033846  127.0.0.1  127.0.0.1   TCP        76 60210 → 80 [SYN] Seq=0 Win=65495 Len=0 MSS=65495 SACK_PERM=1 TSval=3074297027 TSecr=0 WS=128
 103 28.945049304  127.0.0.1  127.0.0.1   TCP        76 80 → 60210 [SYN, ACK] Seq=0 Ack=1 Win=65483 Len=0 MSS=65495 SACK_PERM=1 TSval=3074297027 TSecr=3074297027 WS=128
 104 28.945059280  127.0.0.1  127.0.0.1   TCP        68 60210 → 80 [ACK] Seq=1 Ack=1 Win=65536 Len=0 TSval=3074297027 TSecr=3074297027
 105 28.945115799  127.0.0.1  127.0.0.1   HTTP      551 GET /abc.php HTTP/1.1
 106 28.945126783  127.0.0.1  127.0.0.1   TCP        68 80 → 60210 [ACK] Seq=1 Ack=484 Win=65024 Len=0 TSval=3074297028 TSecr=3074297027
 107 28.945491538  127.0.0.1  127.0.0.1   HTTP      491 HTTP/1.1 200 OK
 108 28.945764764  127.0.0.1  127.0.0.1   TCP        68 60210 → 80 [ACK] Seq=484 Ack=424 Win=65152 Len=0 TSval=3074297028 TSecr=3074297028
 118 29.104461296  127.0.0.1  127.0.0.1   HTTP      480 GET /img1.jpg HTTP/1.1
 119 29.104476219  127.0.0.1  127.0.0.1   TCP        68 80 → 60210 [ACK] Seq=424 Ack=896 Win=65152 Len=0 TSval=3074297187 TSecr=3074297187
 120 29.104760205  127.0.0.1  127.0.0.1   TCP     32836 80 → 60210 [ACK] Seq=424 Ack=896 Win=65536 Len=32768 TSval=3074297187 TSecr=3074297187 [TCP segment of a reassembl
 121 29.104772547  127.0.0.1  127.0.0.1   TCP     32836 [TCP Window Full] 80 → 60210 [PSH, ACK] Seq=33192 Ack=896 Win=65536 Len=32768 TSval=3074297187 TSecr=3074297187 [T
 122 29.105398155  127.0.0.1  127.0.0.1   TCP        68 60210 → 80 [ACK] Seq=896 Ack=33192 Win=32768 Len=0 TSval=3074297188 TSecr=3074297187
 123 29.105499759  127.0.0.1  127.0.0.1   TCP        68 60210 → 80 [ACK] Seq=896 Ack=65960 Win=65536 Len=0 TSval=3074297188 TSecr=3074297187
```

```
Frame 105: 551 bytes on wire (4408 bits), 551 bytes captured (4408 bits) on interface any, id 0
Linux cooked capture v1
Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1
Transmission Control Protocol, Src Port: 60210, Dst Port: 80, Seq: 1, Ack: 1, Len: 483
Hypertext Transfer Protocol
```

```
0000  00 00 03 04 00 06 00 00  00 00 00 00 ba 10 08 00   ········ ········
0010  45 00 02 17 c8 87 40 00  40 06 72 57 7f 00 00 01   E·····@· @·rW····
0020  7f 00 00 01 eb 32 00 50  b9 3c 34 76 9f 42 a0 dc   ·····2·P ·<4v·B··
0030  80 18 02 00 00 0c 00 00  01 01 08 0a b7 3e 0c c3   ········ ·····>··
0040  b7 3e 0c c3 47 45 54 20  2f 61 62 63 2e 70 68 70   ·>··GET  /abc.php
0050  20 48 54 54 50 2f 31 2e  31 0d 0a 48 6f 73 74 3a    HTTP/1. 1··Host:
0060  20 6c 6f 63 61 6c 68 6f  73 74 0d 0a 55 73 65 72    localho st··User
0070  2d 41 67 65 6e 74 3a 20  4d 6f 7a 69 6c 6c 61 2f   -Agent:  Mozilla/
0080  35 2e 30 20 28 58 31 31  3b 20 55 62 75 6e 74 75   5.0 (X11 ; Ubuntu
0090  3b 20 4c 69 6e 75 78 20  78 38 36 5f 36 34 3b 20   ; Linux  x86_64;
00a0  72 76 3a 39 36 2e 30 29  20 47 65 63 6b 6f 2f 32   rv:96.0)  Gecko/2
00b0  30 31 30 30 31 30 31 20  46 69 72 65 66 6f 78 2f   0100101  Firefox/
00c0  39 36 2e 30 0d 0a 41 63  63 65 70 74 3a 20 74 65   96.0··Ac cept: te
00d0  78 74 2f 68 74 6d 6c 2c  61 70 70 6c 69 63 61 74   xt/html, applicat
00e0  69 6f 6e 2f 78 68 74 6d  6c 2b 78 6d 6c 2c 61 70   ion/xhtm l+xml,ap
```

```
wireshark_anyMTQ8G1.pcapng          Packets: 211 · Displayed: 94 (44.5%) · Dropped: 0 (0.0%)          Profile: Default
```



```
GET /abc.php HTTP/1.1
Host: localhost
User-Agent: Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:96.0) Gecko/20100101 Firefox/96.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Connection: keep-alive
Upgrade-Insecure-Requests: 1
Sec-Fetch-Dest: document
Sec-Fetch-Mode: navigate
Sec-Fetch-Site: none
Sec-Fetch-User: ?1
Authorization: Basic dmlzaHdhczp2aXNod2Fz

HTTP/1.1 200 OK
Date: Wed, 16 Feb 2022 19:24:17 GMT
Server: Apache/2.4.48 (Ubuntu)
Last-Modified: Wed, 16 Feb 2022 19:09:15 GMT
ETag: "a6-5d82762bf4e87"
Accept-Ranges: bytes
Content-Length: 166
Keep-Alive: timeout=5, max=2
Connection: Keep-Alive

<html>
<?php
setcookie("namecookie","netqwerty",time()+123);
setcookie("nickname","work");
?>
<img src="img1.jpg" width="300" height="300" title="password"/>
</html>
GET /img1.jpg HTTP/1.1
Host: localhost
User-Agent: Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:96.0) Gecko/20100101 Firefox/96.0
Accept: image/avif,image/webp,*/*
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Authorization: Basic dmlzaHdhczp2aXNod2Fz
Connection: keep-alive
Referer: http://localhost/abc.php
Sec-Fetch-Dest: image
Sec-Fetch-Mode: no-cors
Sec-Fetch-Site: same-origin
```

Packet 105. 3 client pkts, 58 server pkts, 5 turns. Click to select.

Entire conversation (1,834kB) — Show data as: ASCII — Stream: 3

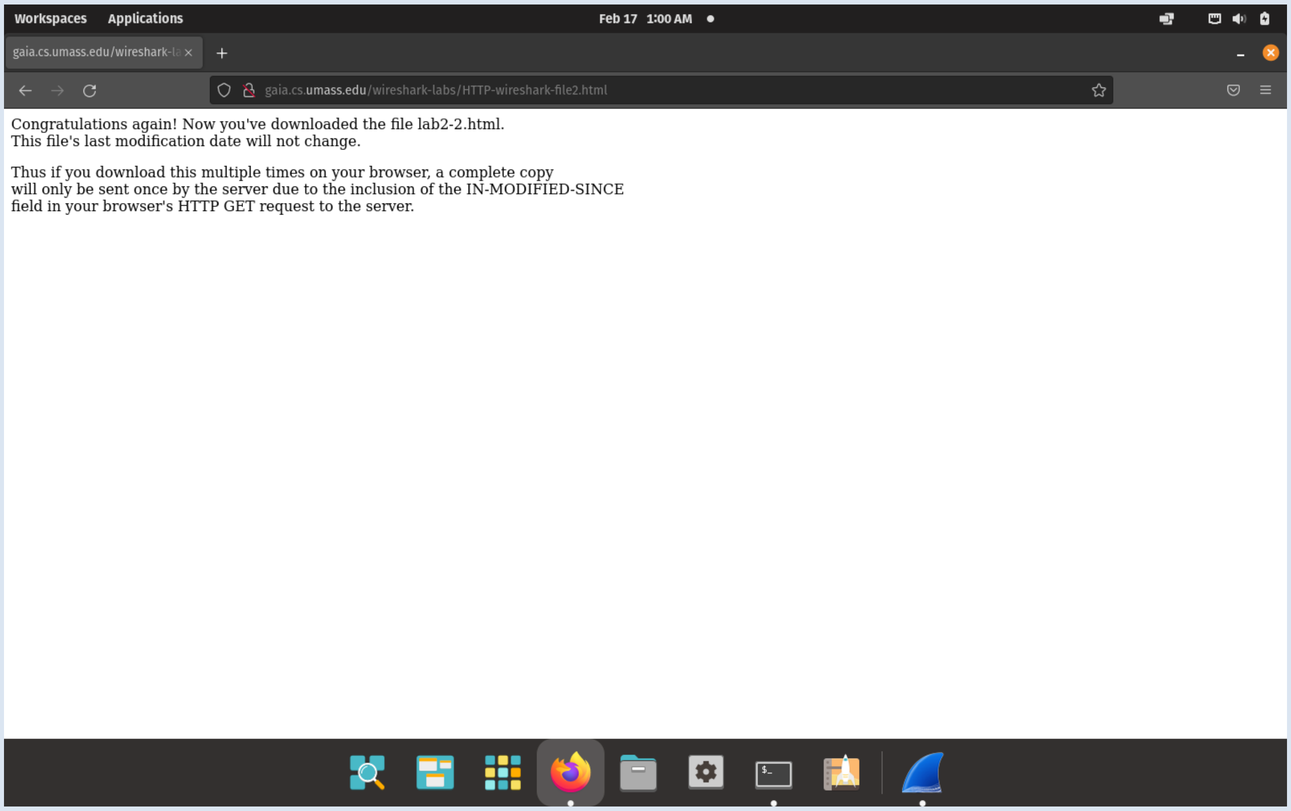
The cookie is set as shown in the above screenshot.

Here 'vishwas' is the admin and 'vishwas' is the password.

Conditional Get: If-Modified-Since

Before performing the steps below, make sure your browser's cache is empty. (To do this under Firefox, select Tools -> Clear Recent History and check the Cache box). Now do the following:

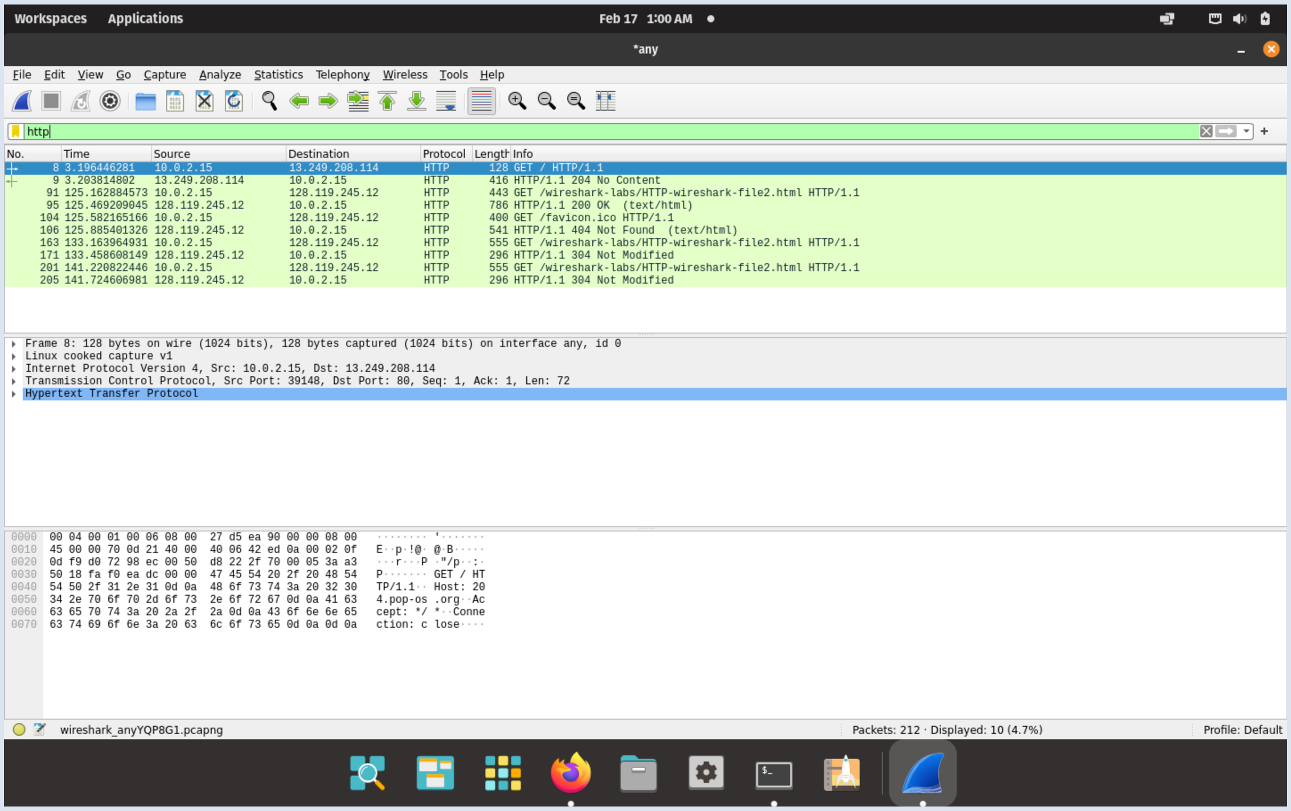
- Start up your web browser, and make sure your browser's cache is cleared, as discussed above.
- Start up the Wireshark packet sniffer.
- Enter the following URL into your browser http://gaia.cs.umass.edu/wireshark-labs/HTTP-wireshark-file2.html


Workspaces
Applications
Feb 17 1:00 AM
gaia.cs.umass.edu/wireshark-la
gaia.cs.umass.edu/wireshark-labs/HTTP-wireshark-file2.html

Congratulations again! Now you've downloaded the file lab2-2.html.
This file's last modification date will not change.

Thus if you download this multiple times on your browser, a complete copy
will only be sent once by the server due to the inclusion of the IN-MODIFIED-SINCE
field in your browser's HTTP GET request to the server.

- Your browser should display a very simple five-line HTML file.
- Quickly enter the same URL into your browser again (or simply select the refresh button on your browser)
- Stop Wireshark packet capture, and enter "http" in the display-filter-specification window, so that only captured HTTP messages will be displayed later in the packet-listing window.


Workspaces
Applications
Feb 17 1:00 AM
*any
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
http

```
No.   Time          Source          Destination     Protocol Length Info
    8 3.196446281   10.0.2.15       13.249.208.114  HTTP      128 GET / HTTP/1.1
    9 3.203814802   13.249.208.114  10.0.2.15       HTTP      416 HTTP/1.1 204 No Content
   91 125.162884573 10.0.2.15       128.119.245.12  HTTP      443 GET /wireshark-labs/HTTP-wireshark-file2.html HTTP/1.1
   95 125.469209045 128.119.245.12  10.0.2.15       HTTP      786 HTTP/1.1 200 OK  (text/html)
  104 125.582165166 10.0.2.15       128.119.245.12  HTTP      400 GET /favicon.ico HTTP/1.1
  106 125.885401326 128.119.245.12  10.0.2.15       HTTP      541 HTTP/1.1 404 Not Found  (text/html)
  163 133.163964931 10.0.2.15       128.119.245.12  HTTP      555 GET /wireshark-labs/HTTP-wireshark-file2.html HTTP/1.1
  171 133.458608149 128.119.245.12  10.0.2.15       HTTP      296 HTTP/1.1 304 Not Modified
  201 141.220822446 10.0.2.15       128.119.245.12  HTTP      555 GET /wireshark-labs/HTTP-wireshark-file2.html HTTP/1.1
  205 141.724606981 128.119.245.12  10.0.2.15       HTTP      296 HTTP/1.1 304 Not Modified
```

```
▸ Frame 8: 128 bytes on wire (1024 bits), 128 bytes captured (1024 bits) on interface any, id 0
▸ Linux cooked capture v1
▸ Internet Protocol Version 4, Src: 10.0.2.15, Dst: 13.249.208.114
▸ Transmission Control Protocol, Src Port: 39148, Dst Port: 80, Seq: 1, Ack: 1, Len: 72
▸ Hypertext Transfer Protocol
```

```
0000  00 04 00 01 00 06 08 00  27 d5 ea 90 00 00 08 00   ········ '·······
0010  45 00 00 70 0d 21 40 00  40 06 42 ed 0a 00 02 0f   E··p·!@· @·B·····
0020  0d f9 d0 72 98 ec 00 50  d8 22 2f 70 00 05 3a a3   ···r···P ·"/p··:·
0030  50 18 fa f0 ea dc 00 00  47 45 54 20 2f 20 48 54   P······· GET / HT
0040  54 50 2f 31 2e 31 0d 0a  48 6f 73 74 3a 20 32 30   TP/1.1·· Host: 20
0050  34 2e 70 6f 70 2d 6f 73  2e 6f 72 67 0d 0a 41 63   4.pop-os .org··Ac
0060  63 65 70 74 3a 20 2a 2f  2a 0d 0a 43 6f 6e 6e 65   cept: */ *··Conne
0070  63 74 69 6f 6e 3a 20 63  6c 6f 73 65 0d 0a 0d 0a   ction: c lose····
```

wireshark_anyYQP8G1.pcapng | Packets: 212 · Displayed: 10 (4.7%) | Profile: Default

Observation:

1) IF-Modified-Since line is not seen in the first HTTP get request but seen in the second request followed by the day,date and time of modification in the server.
2) The HTTP Status Code is 304 Not Modified.