WEEK-2 SUBMISSION

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Week #2

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.

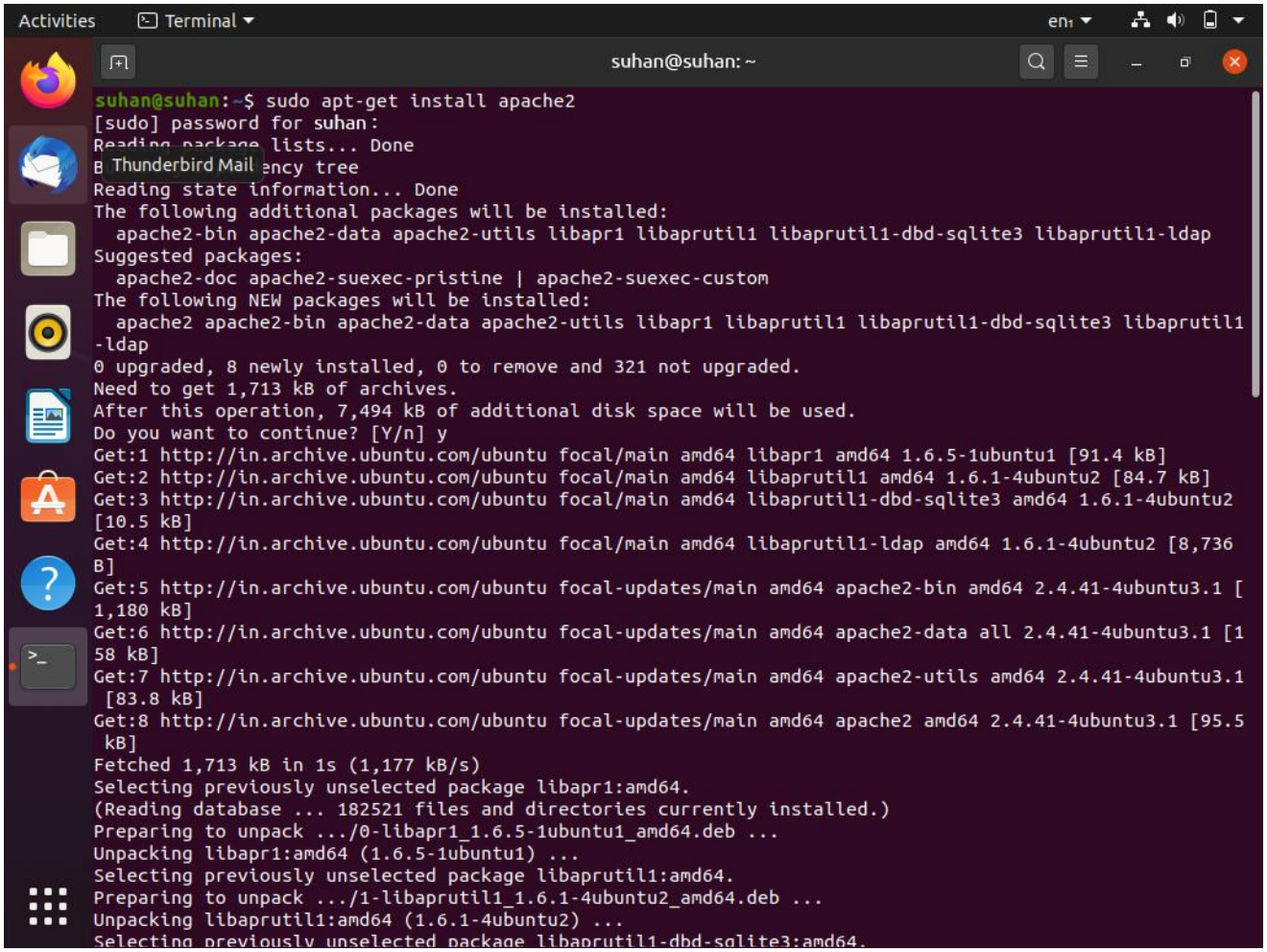
Experiment: Create a web page with N (e.g. 10) embedded images. Each image should be of minimum 2 MB size. Configure your browser (Firefox) with following settings (each setting requires repeat of experiment)

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
```



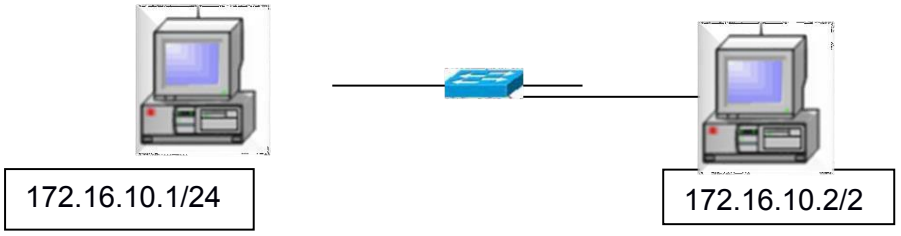
If there is any error during installation, update the package manager by issuing the command,

```
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.)

Server **Client**



Server Side:

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

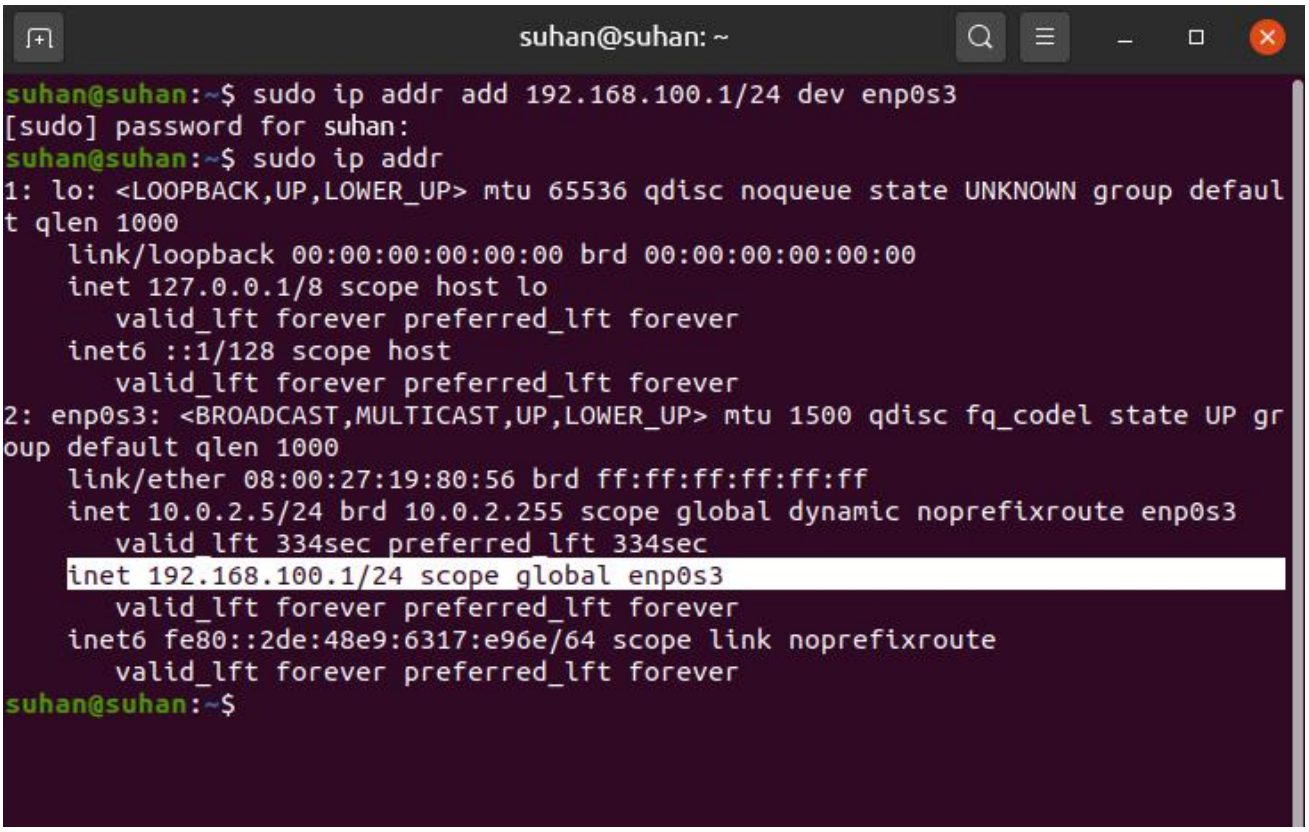
sudo service apache2 status

```
0 upgraded, 0 newly installed, 0 to remove and 321 not upgraded.
suhan@suhan:~$ sudo systemctl status apache2
● apache2.service - The Apache HTTP Server
     Loaded: loaded (/lib/systemd/system/apache2.service; enabled; vendor preset: enabled)
     Active: active (running) since Sat 2021-02-06 15:23:30 IST; 16min ago
       Docs: https://httpd.apache.org/docs/2.4/
   Main PID: 3457 (apache2)
      Tasks: 55 (limit: 1109)
     Memory: 4.8M
     CGroup: /system.slice/apache2.service
             ├─3457 /usr/sbin/apache2 -k start
             ├─3458 /usr/sbin/apache2 -k start
             └─3460 /usr/sbin/apache2 -k start

Feb 08 16:45:24 suhan systemd[1]: Starting The Apache HTTP Server...
Feb 08 16:45:24 suhan apachectl[3456]: AH00558: apache2: Could not reliably determine th>
Feb 08 16:45:24 suhan systemd[1]: Started The Apache HTTP Server.
lines 1-15/15 (END)
```

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

$sudo ip addr add 192.168.100.1/24 dev enp0s3
$sudo ip addr

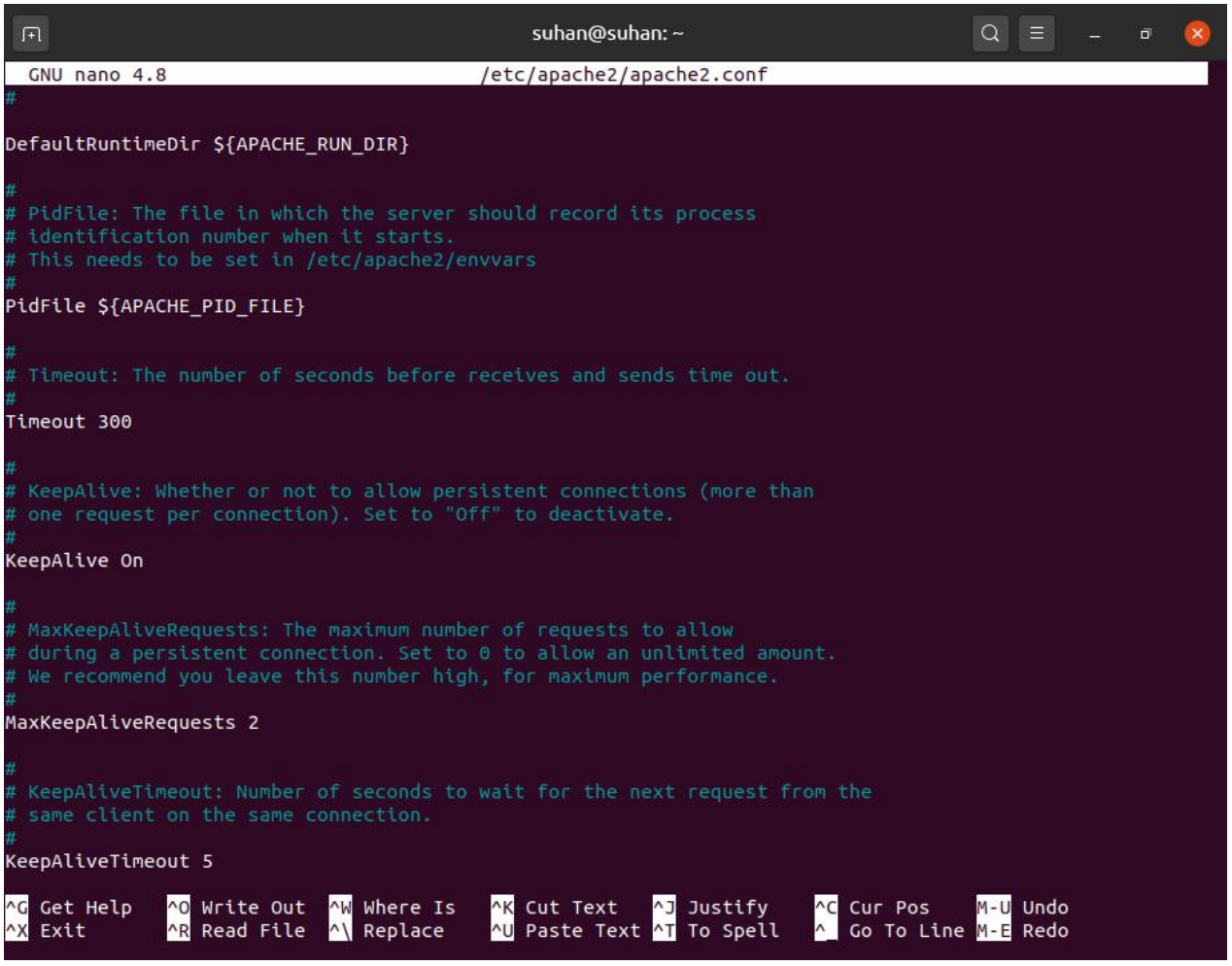


Step 4: The **apache2.conf** file present in the **etc/apache2** directory is modified as:

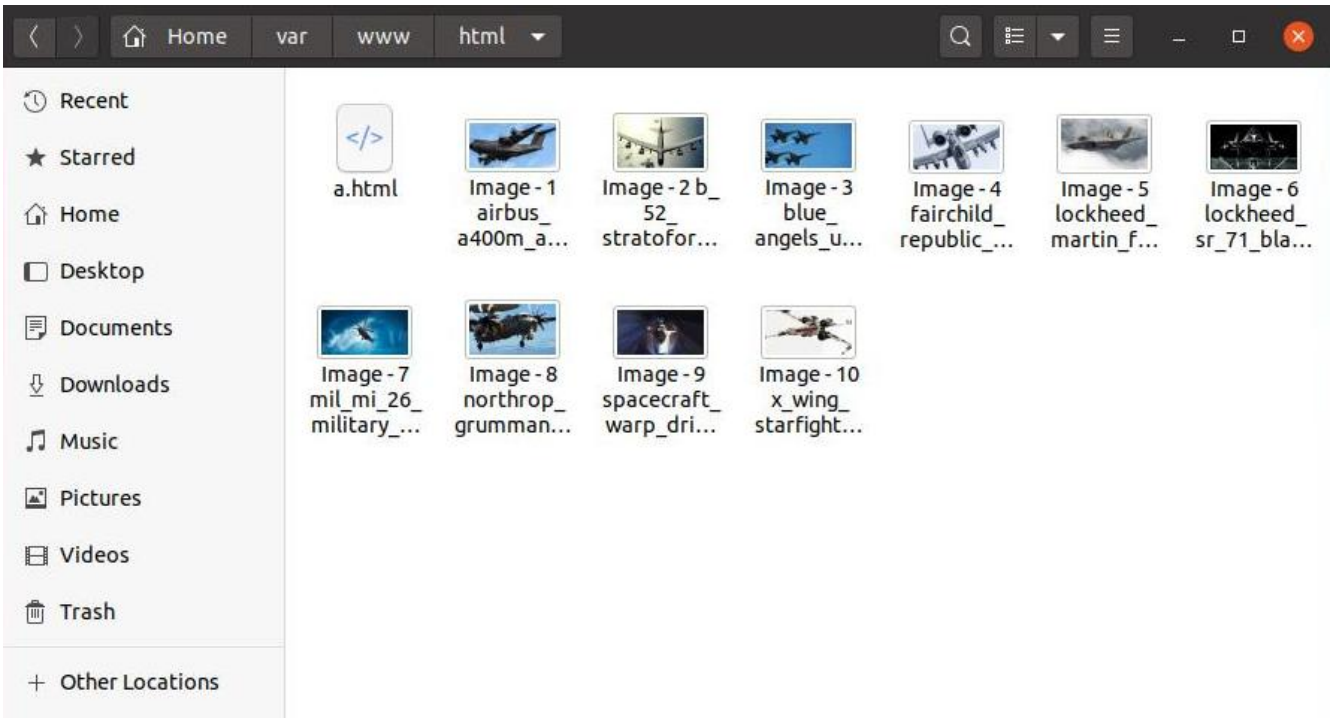
a) The **keep-alive** option was set (i.e. value was made **ON**)

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

$sudo nano /etc/apache2/apache2.conf



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**.



Step 6: Prepare a web page as shown below. The html file needs to add 10 images.

Text Editor — Open — a.html ~/var/www/html — Save

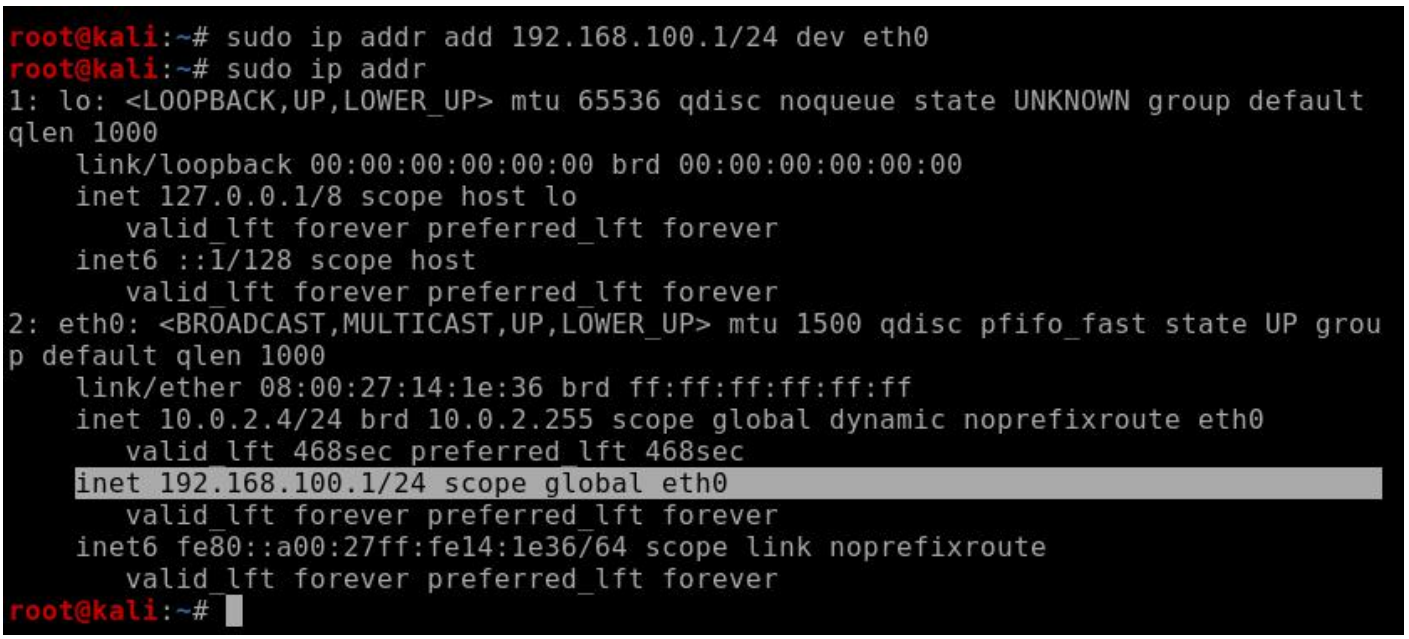
```
<!DOCTYPE html>
<html>
<body>
<h2>FIGHTER PLANES</h2>
<img src="Image - 1 airbus_a400m_atlas_military_transport_aircraft-5120x2880.jpg" alt="planes"></img>
<img src="Image - 2 b_52_stratofortress_bomber.jpg" alt="planes"></img>
<img src="Image - 3 blue_angels_us_navy_4k-3840x2160.jpg" alt="planes"></img>
<img src="Image - 4 fairchild_republic_a_10_thunderbolt_ii_4k-3840x2160.jpg" alt="planes"></img>
<img src="Image - 5 lockheed_martin_f_35_lightning_ii_stealth_fighter.jpg" alt="planes"></img>
<img src="Image - 6 lockheed_sr_71_blackbird_4k-5120x2880.jpg" alt="planes"></img>
<img src="Image - 7 mil_mi_26_military_helicopter_4k-3840x2160.jpg" alt="planes"></img>
<img src="Image - 8 northrop_grumman_e_2_hawkeye_amercian_military_aircraft.jpg" alt="planes"></img>
<img src="Image - 9 spacecraft_warp_drive.jpg" alt="planes"></img>
<img src="Image - 10 x_wing_starfighter_4k_8k-7680x4320.jpg" alt="planes"></img>
</body>
</html>
```

Client side:

Client IP address can be set by the following command.

$sudo ip addr add 192.168.100.1/24 dev eth0

$sudo ip addr


root@kali:~# sudo ip addr add 192.168.100.1/24 dev eth0
root@kali:~# sudo ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default
qlen 1000
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: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP grou
p default qlen 1000
link/ether 08:00:27:14:1e:36 brd ff:ff:ff:ff:ff:ff
inet 10.0.2.4/24 brd 10.0.2.255 scope global dynamic noprefixroute eth0
valid_lft 468sec preferred_lft 468sec
inet 192.168.100.1/24 scope global eth0
valid_lft forever preferred_lft forever
inet6 fe80::a00:27ff:fe14:1e36/64 scope link noprefixroute
valid_lft forever preferred_lft forever
root@kali:~#

There are broadly two parts of execution:

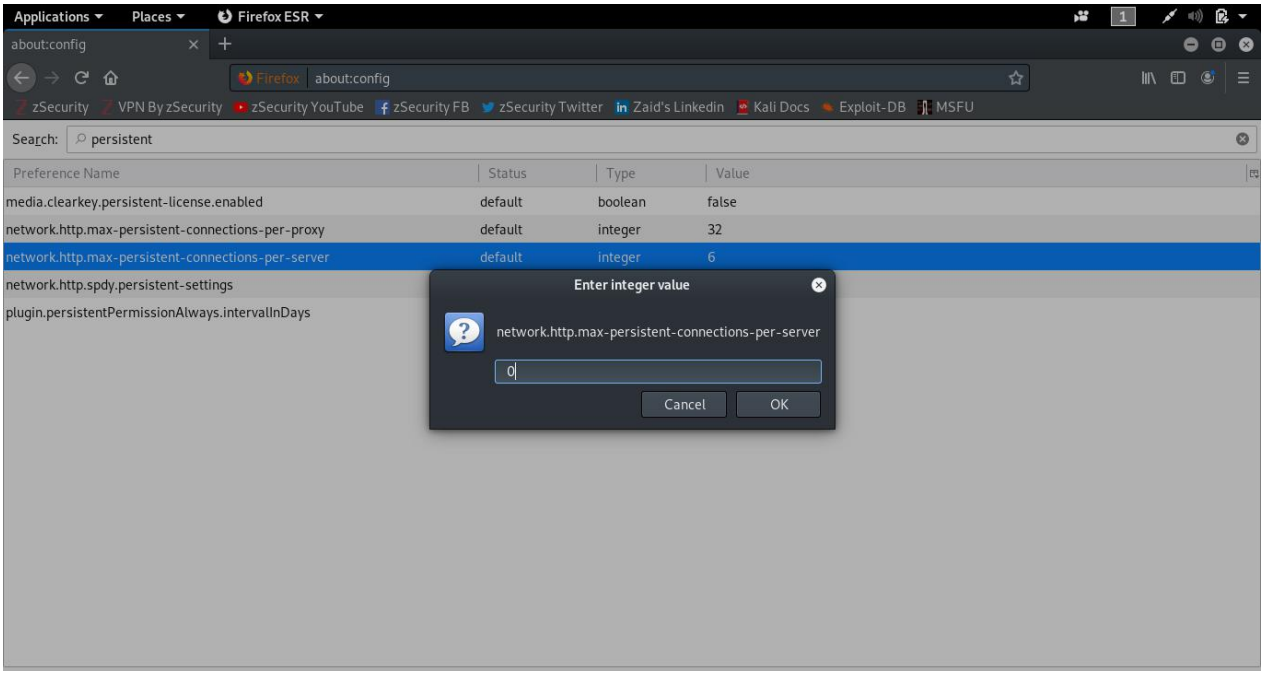
1. Dealing with non-persistent connections
2. Dealing with persistent connections

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.

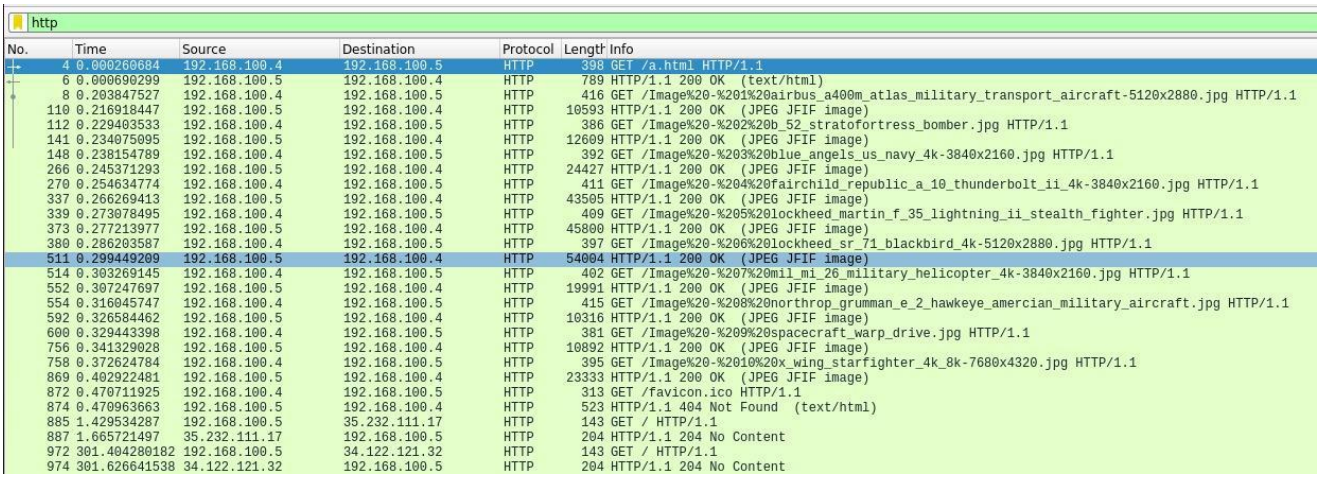
PART 1: NON-PERSISTENT CONNECTION

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



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

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.



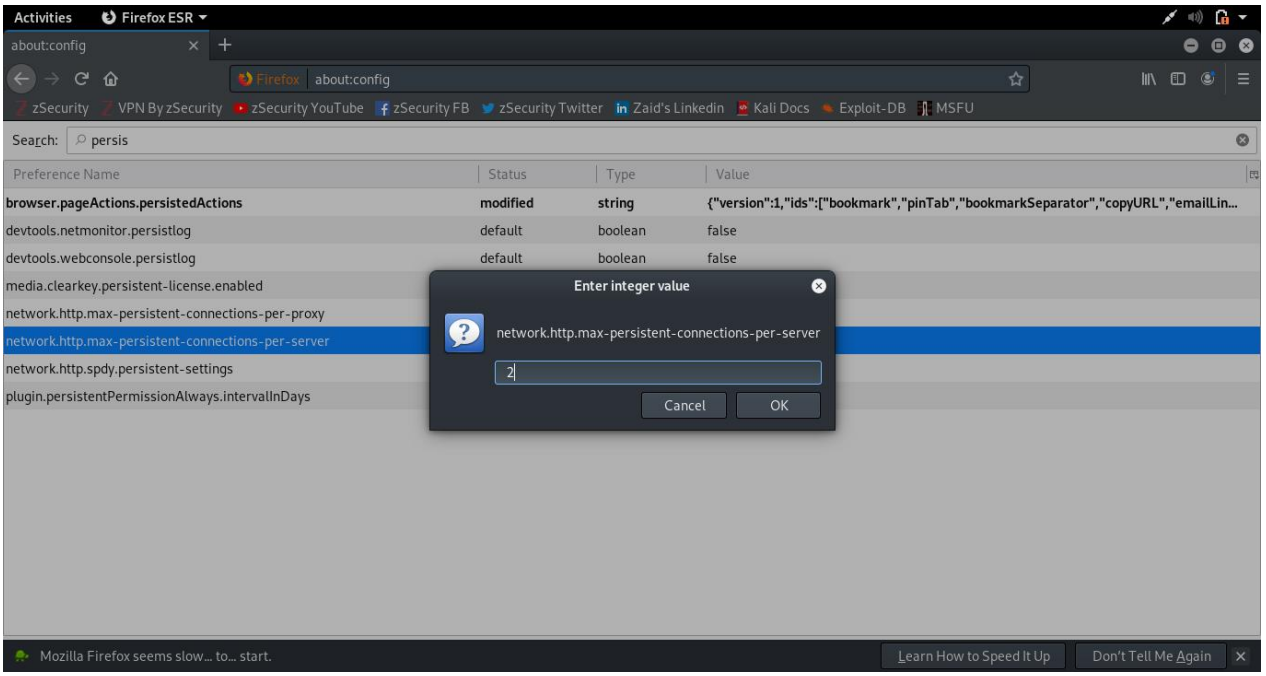
http

No.	Time	Source	Destination	Protocol	Length	Info
4	0.000260684	192.168.100.4	192.168.100.5	HTTP	398	GET /a.html HTTP/1.1
6	0.000690299	192.168.100.5	192.168.100.4	HTTP	789	HTTP/1.1 200 OK (text/html)
8	0.203847527	192.168.100.4	192.168.100.5	HTTP	416	GET /Image%20-%201%20airbus_a400m_atlas_military_transport_aircraft-5120x2880.jpg HTTP/1.1
110	0.216918447	192.168.100.5	192.168.100.4	HTTP	10593	HTTP/1.1 200 OK (JPEG JFIF image)
112	0.229403533	192.168.100.4	192.168.100.5	HTTP	386	GET /Image%20-%202%20b_52_stratofortress_bomber.jpg HTTP/1.1
141	0.234075095	192.168.100.5	192.168.100.4	HTTP	12609	HTTP/1.1 200 OK (JPEG JFIF image)
148	0.238154789	192.168.100.4	192.168.100.5	HTTP	392	GET /Image%20-%203%20blue_angels_us_navy_4k-3840x2160.jpg HTTP/1.1
266	0.245371293	192.168.100.5	192.168.100.4	HTTP	24427	HTTP/1.1 200 OK (JPEG JFIF image)
270	0.254634774	192.168.100.4	192.168.100.5	HTTP	411	GET /Image%20-%204%20fairchild_republic_a_10_thunderbolt_ii_4k-3840x2160.jpg HTTP/1.1
337	0.266269413	192.168.100.5	192.168.100.4	HTTP	43505	HTTP/1.1 200 OK (JPEG JFIF image)
339	0.273078495	192.168.100.4	192.168.100.5	HTTP	409	GET /Image%20-%205%20lockheed_martin_f_35_lightning_ii_stealth_fighter.jpg HTTP/1.1
373	0.277213977	192.168.100.5	192.168.100.4	HTTP	45800	HTTP/1.1 200 OK (JPEG JFIF image)
380	0.286203587	192.168.100.4	192.168.100.5	HTTP	397	GET /Image%20-%206%20lockheed_sr_71_blackbird_4k-5120x2880.jpg HTTP/1.1
511	0.299449209	192.168.100.5	192.168.100.4	HTTP	54004	HTTP/1.1 200 OK (JPEG JFIF image)
514	0.303269145	192.168.100.4	192.168.100.5	HTTP	402	GET /Image%20-%207%20mil_mi_26_military_helicopter_4k-3840x2160.jpg HTTP/1.1
552	0.307247697	192.168.100.5	192.168.100.4	HTTP	19991	HTTP/1.1 200 OK (JPEG JFIF image)
554	0.316045747	192.168.100.4	192.168.100.5	HTTP	415	GET /Image%20-%208%20northrop_grumman_e_2_hawkeye_amercian_military_aircraft.jpg HTTP/1.1
592	0.326584462	192.168.100.5	192.168.100.4	HTTP	10316	HTTP/1.1 200 OK (JPEG JFIF image)
600	0.329443398	192.168.100.4	192.168.100.5	HTTP	381	GET /Image%20-%209%20spacecraft_warp_drive.jpg HTTP/1.1
756	0.341329028	192.168.100.5	192.168.100.4	HTTP	10892	HTTP/1.1 200 OK (JPEG JFIF image)
758	0.372624784	192.168.100.4	192.168.100.5	HTTP	395	GET /Image%20-%2010%20x_wing_starfighter_4k_8k-7680x4320.jpg HTTP/1.1
869	0.402922481	192.168.100.5	192.168.100.4	HTTP	23333	HTTP/1.1 200 OK (JPEG JFIF image)
872	0.470711925	192.168.100.4	192.168.100.5	HTTP	313	GET /favicon.ico HTTP/1.1
874	0.470963663	192.168.100.5	192.168.100.4	HTTP	523	HTTP/1.1 404 Not Found (text/html)
885	1.429534287	192.168.100.5	35.232.111.17	HTTP	143	GET / HTTP/1.1
887	1.665721497	35.232.111.17	192.168.100.5	HTTP	204	HTTP/1.1 204 No Content
972	301.404280182	192.168.100.5	34.122.121.32	HTTP	143	GET / HTTP/1.1
974	301.626641538	34.122.121.32	192.168.100.5	HTTP	204	HTTP/1.1 204 No Content

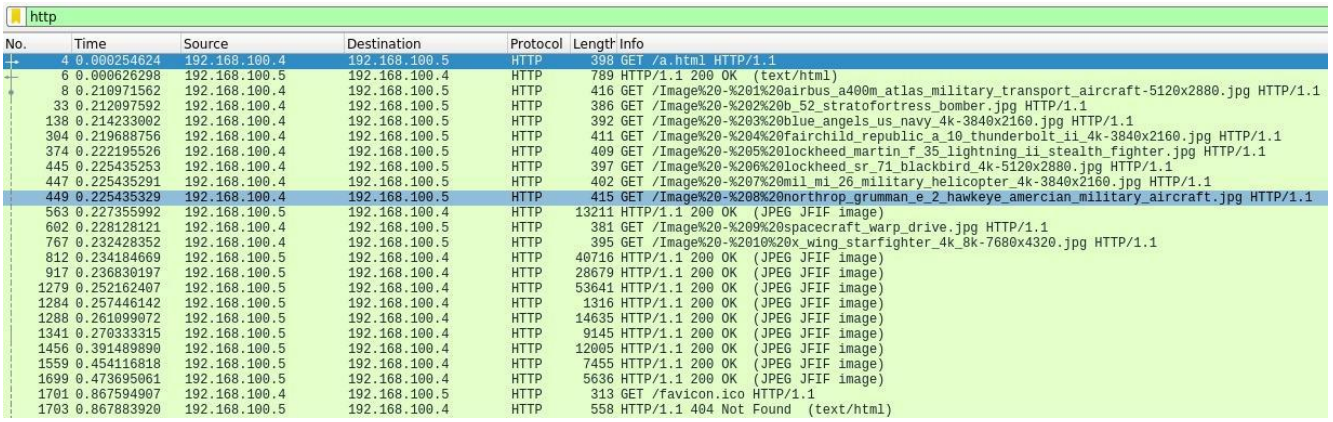
Here it is 0.402922481-0.00026084=0.402661797

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.

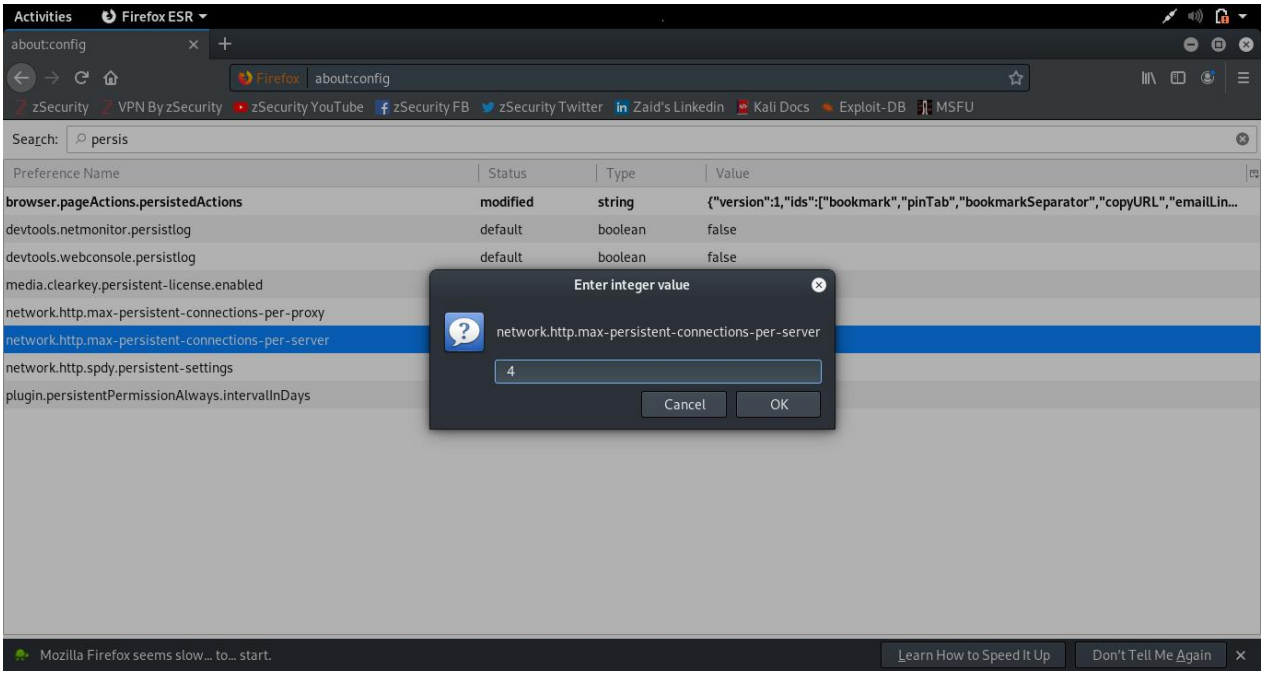


http

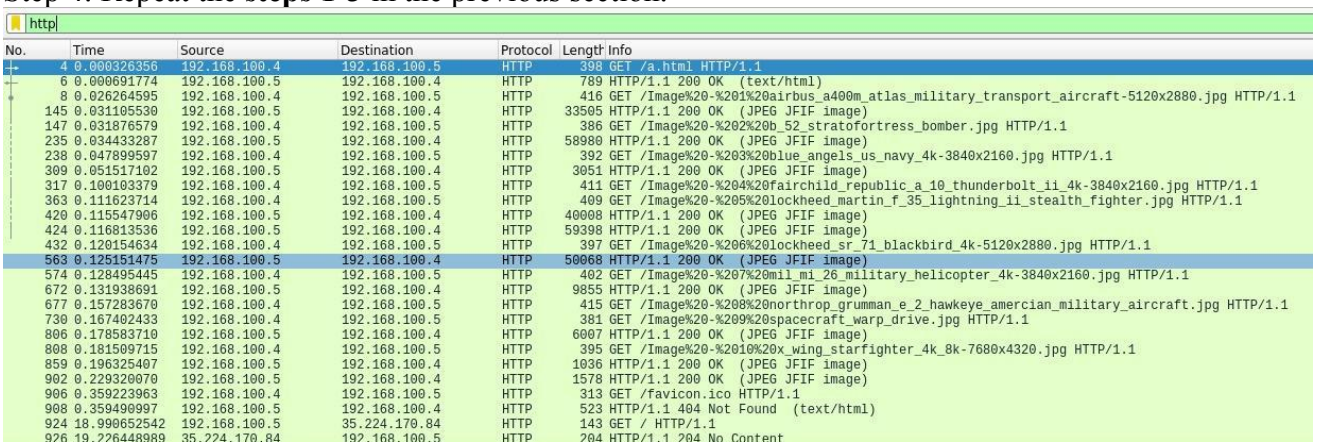
No.	Time	Source	Destination	Protocol	Length	Info
4	0.000254624	192.168.100.4	192.168.100.5	HTTP	398	GET /a.html HTTP/1.1
6	0.000626298	192.168.100.5	192.168.100.4	HTTP	789	HTTP/1.1 200 OK (text/html)
8	0.210971562	192.168.100.4	192.168.100.5	HTTP	416	GET /Image%20-%201%20airbus_a400m_atlas_military_transport_aircraft-5120x2880.jpg HTTP/1.1
33	0.212097592	192.168.100.4	192.168.100.5	HTTP	386	GET /Image%20-%202%20b_52_stratofortress_bomber.jpg HTTP/1.1
138	0.214233002	192.168.100.4	192.168.100.5	HTTP	392	GET /Image%20-%203%20blue_angels_us_navy_4k-3840x2160.jpg HTTP/1.1
304	0.219688756	192.168.100.4	192.168.100.5	HTTP	411	GET /Image%20-%204%20fairchild_republic_a_10_thunderbolt_ii_4k-3840x2160.jpg HTTP/1.1
374	0.222195526	192.168.100.4	192.168.100.5	HTTP	409	GET /Image%20-%205%20lockheed_martin_f_35_lightning_ii_stealth_fighter.jpg HTTP/1.1
445	0.225435253	192.168.100.4	192.168.100.5	HTTP	397	GET /Image%20-%206%20lockheed_sr_71_blackbird_4k-5120x2880.jpg HTTP/1.1
447	0.225435291	192.168.100.4	192.168.100.5	HTTP	402	GET /Image%20-%207%20mil_mi_26_military_helicopter_4k-3840x2160.jpg HTTP/1.1
449	0.225435329	192.168.100.4	192.168.100.5	HTTP	415	GET /Image%20-%208%20northrop_grumman_e_2_hawkeye_amercian_military_aircraft.jpg HTTP/1.1
563	0.227355992	192.168.100.5	192.168.100.4	HTTP	13211	HTTP/1.1 200 OK (JPEG JFIF image)
602	0.228128121	192.168.100.4	192.168.100.5	HTTP	381	GET /Image%20-%209%20spacecraft_warp_drive.jpg HTTP/1.1
767	0.232428352	192.168.100.4	192.168.100.5	HTTP	395	GET /Image%20-%2010%20x_wing_starfighter_4k_8k-7680x4320.jpg HTTP/1.1
812	0.234184669	192.168.100.5	192.168.100.4	HTTP	40716	HTTP/1.1 200 OK (JPEG JFIF image)
917	0.236830197	192.168.100.5	192.168.100.4	HTTP	28679	HTTP/1.1 200 OK (JPEG JFIF image)
1279	0.252162407	192.168.100.5	192.168.100.4	HTTP	53641	HTTP/1.1 200 OK (JPEG JFIF image)
1284	0.257446142	192.168.100.5	192.168.100.4	HTTP	1316	HTTP/1.1 200 OK (JPEG JFIF image)
1288	0.261099072	192.168.100.5	192.168.100.4	HTTP	14635	HTTP/1.1 200 OK (JPEG JFIF image)
1341	0.270333315	192.168.100.5	192.168.100.4	HTTP	9145	HTTP/1.1 200 OK (JPEG JFIF image)
1456	0.391489890	192.168.100.5	192.168.100.4	HTTP	12005	HTTP/1.1 200 OK (JPEG JFIF image)
1559	0.454116818	192.168.100.5	192.168.100.4	HTTP	7455	HTTP/1.1 200 OK (JPEG JFIF image)
1699	0.473695061	192.168.100.5	192.168.100.4	HTTP	5636	HTTP/1.1 200 OK (JPEG JFIF image)
1701	0.867594907	192.168.100.4	192.168.100.5	HTTP	313	GET /favicon.ico HTTP/1.1
1703	0.867883920	192.168.100.5	192.168.100.4	HTTP	558	HTTP/1.1 404 Not Found (text/html)

Here it is 0.473695061-0.210971562=0.262723499

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

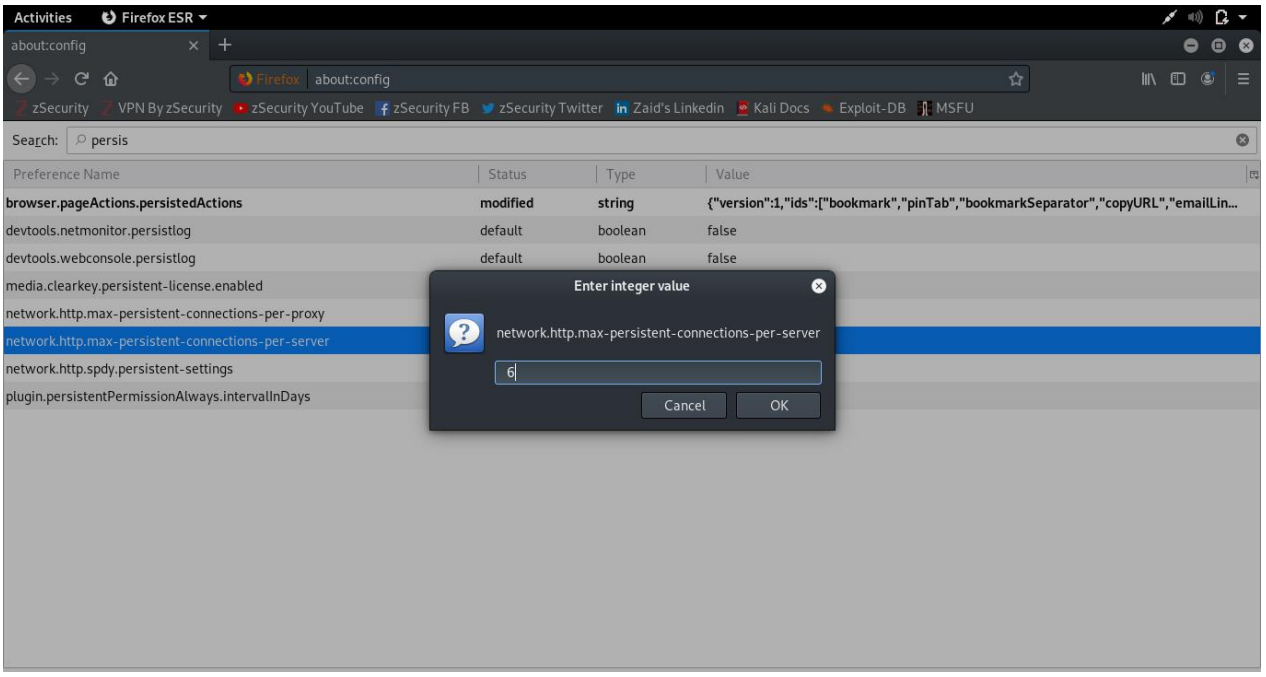


Step 4: Repeat the **steps 1-3** in the previous section.

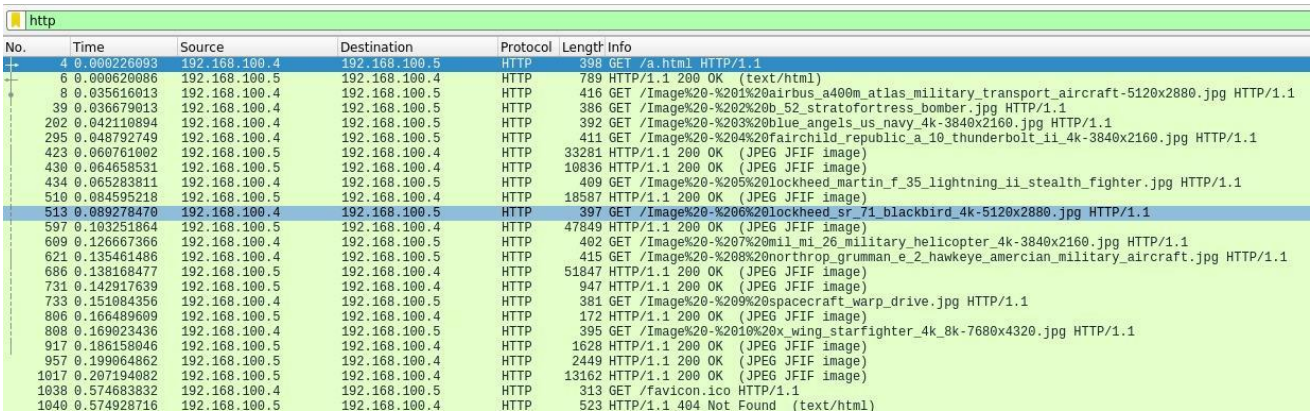


Here it is 0.229320070-0.026264595=0.203055475

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

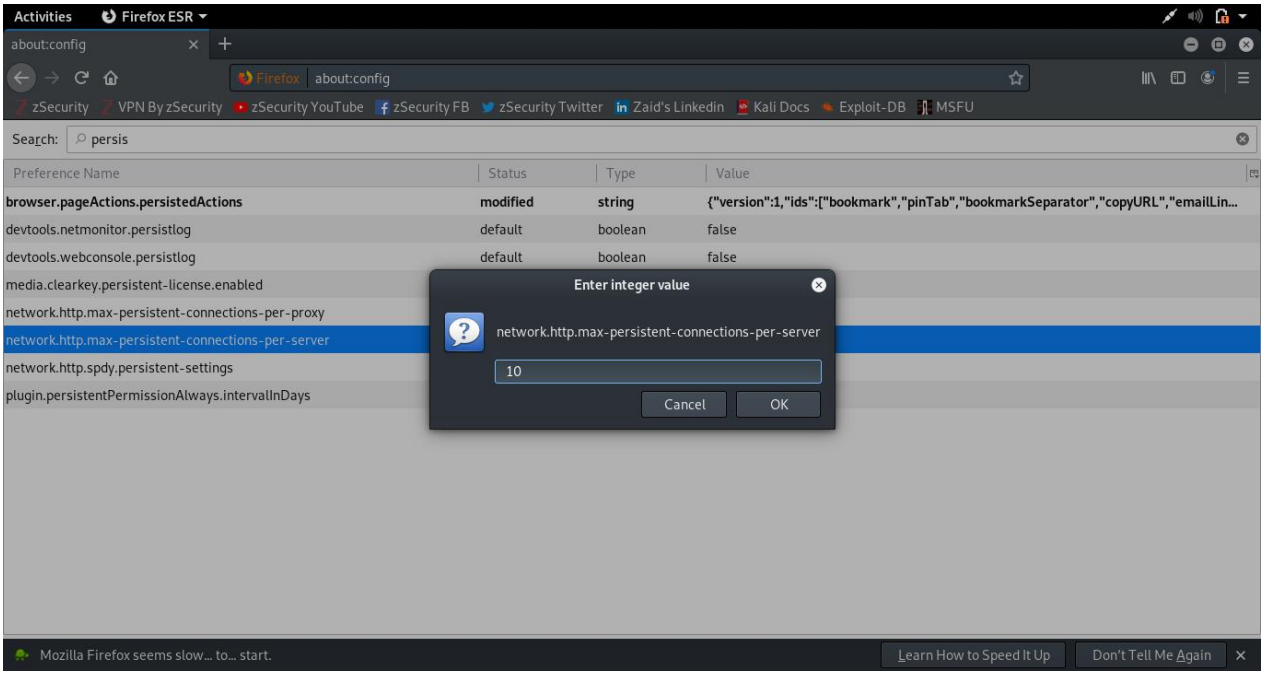


Step 6: Repeat the **steps 1-3** in the previous section.

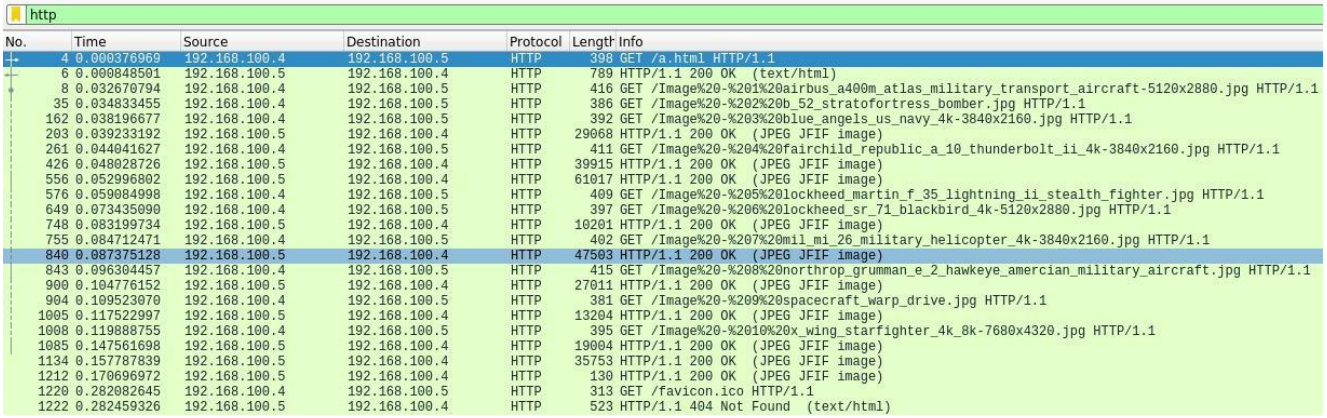


Here it is 0.207194082-0.035616013=0.171578069

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.



Here is it 0.170696972-0.032670794=0.138026178

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.

ANS: Time taken to load images for 2,4,6 is greater than the time taken to load images for 10 persistent connections because 10 connections takes lesser time to load than the rest.so the optimal persistent is 10