Computer Networks Lab

UE19CS256

Week 2

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Semester: 4 Section: G

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Objectives:

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

Procedure:

1. Create a web page with N (eg. 10) embedded images. Each image should be of minimum 2MB size. Configure your browser (Firefox) with the 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. 8 persistent Connections
   f. 10 persistent Connections
2. Note the time taken to display the entire page in each setting and ensure **cache is cleared** before starting the web request.

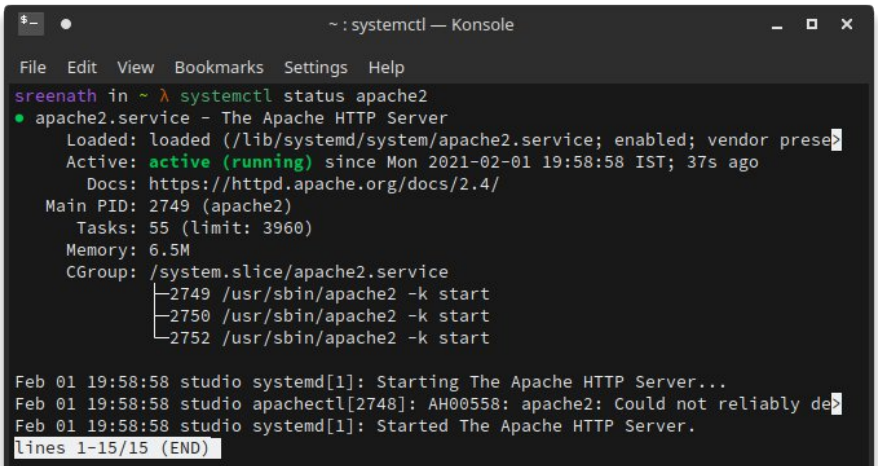
Step 1: Setting up the Apache Server

Ensure that the `apache2` server package is installed by using the command:

```
sudo <package manager> install apache2
```

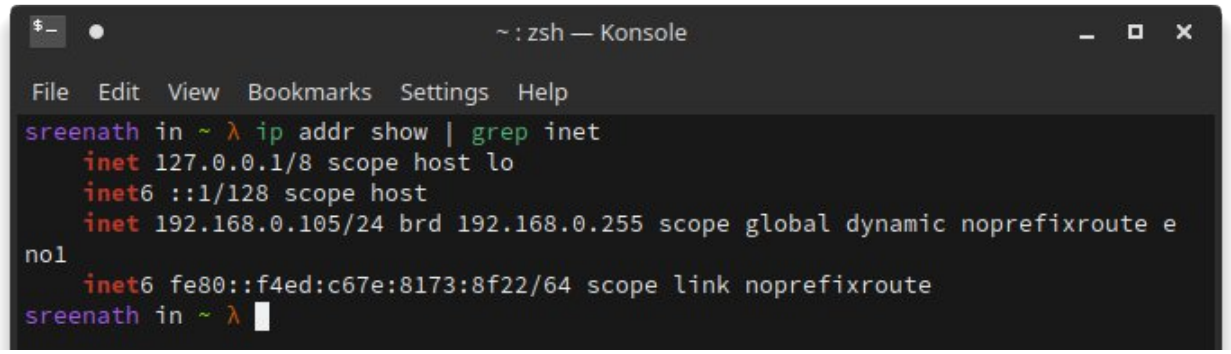
Now to check if the server is running, use the following command if using a machine with `systemd`:

```
sudo systemctl status apache2
```

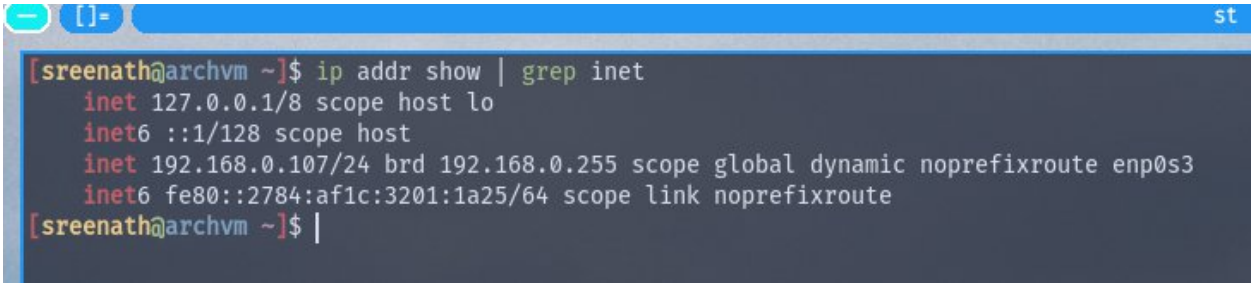


Step 2: Setting the IP addresses

Since both devices are connected to a router, we will be using the predefined IP's that have been allocated by the router on both the server and client side.



Server Side IP



Client Side IP

IP addresses used:

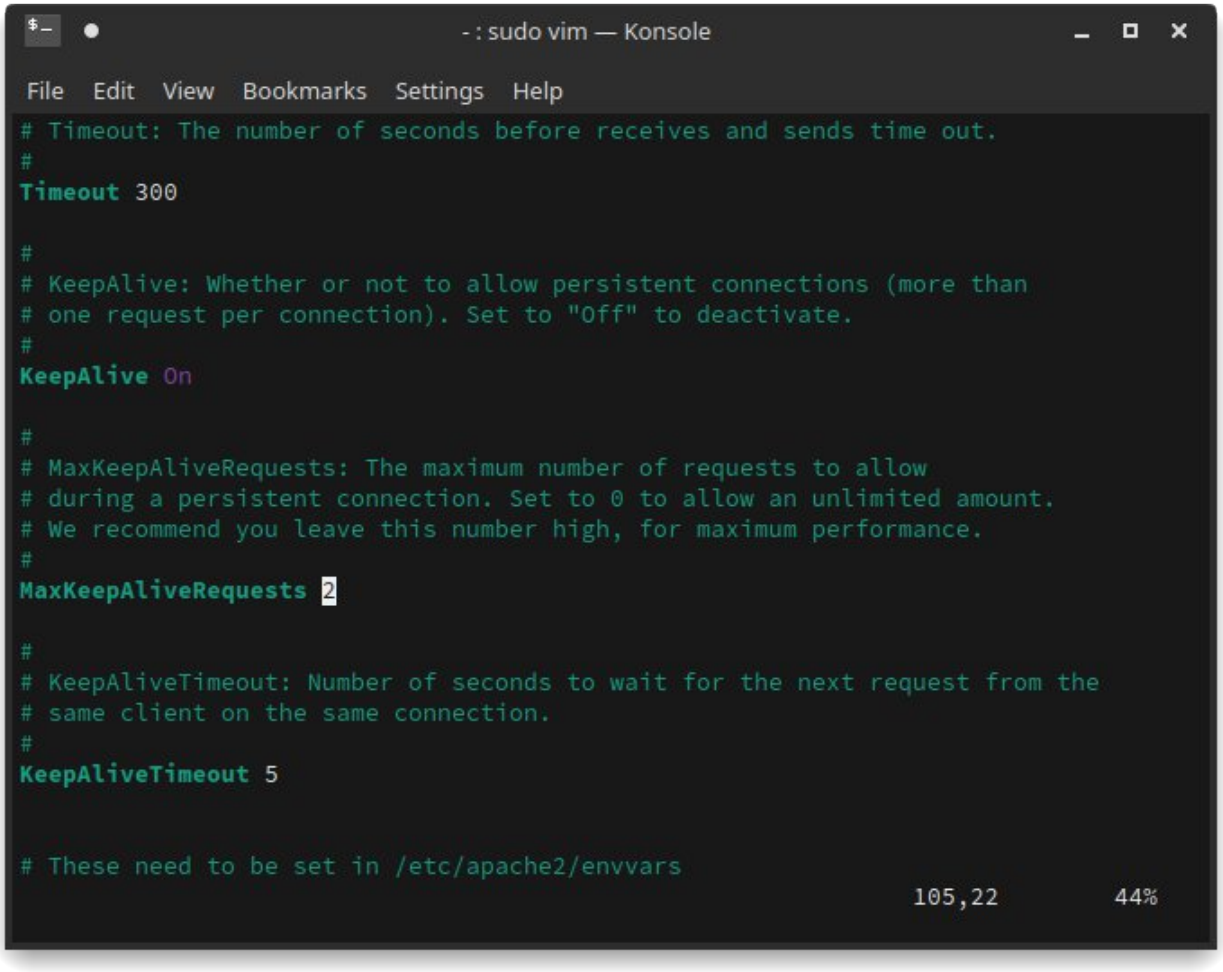
192.168.0.105 - Server

192.168.0.107 - Client

Step 3: Editing `apache2.conf`

In the `/etc/apache2/` directory, modify the `apache2.conf` file which is the configuration file for the apache2 server using any text editor, for example:

```
sudo vim /etc/apache2/apache2.conf
```

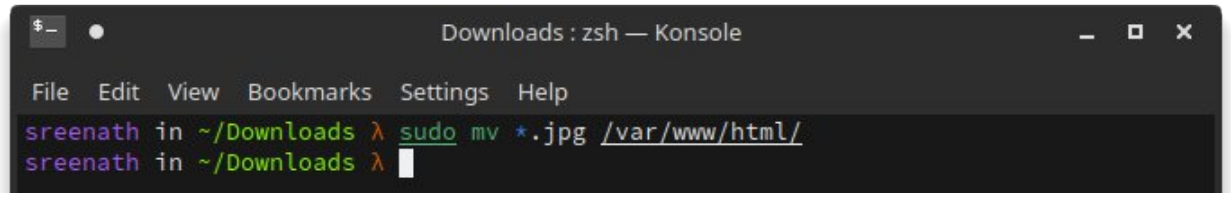


Ensure that the `KeepAlive` value is set to `On` and that the `MaxKeepAliveRequests` value is set to `2`.

Step 4: Moving Images to the server path and creating a webpage

Assuming the provided images are in the Downloads folder of the server system, execute the following command:

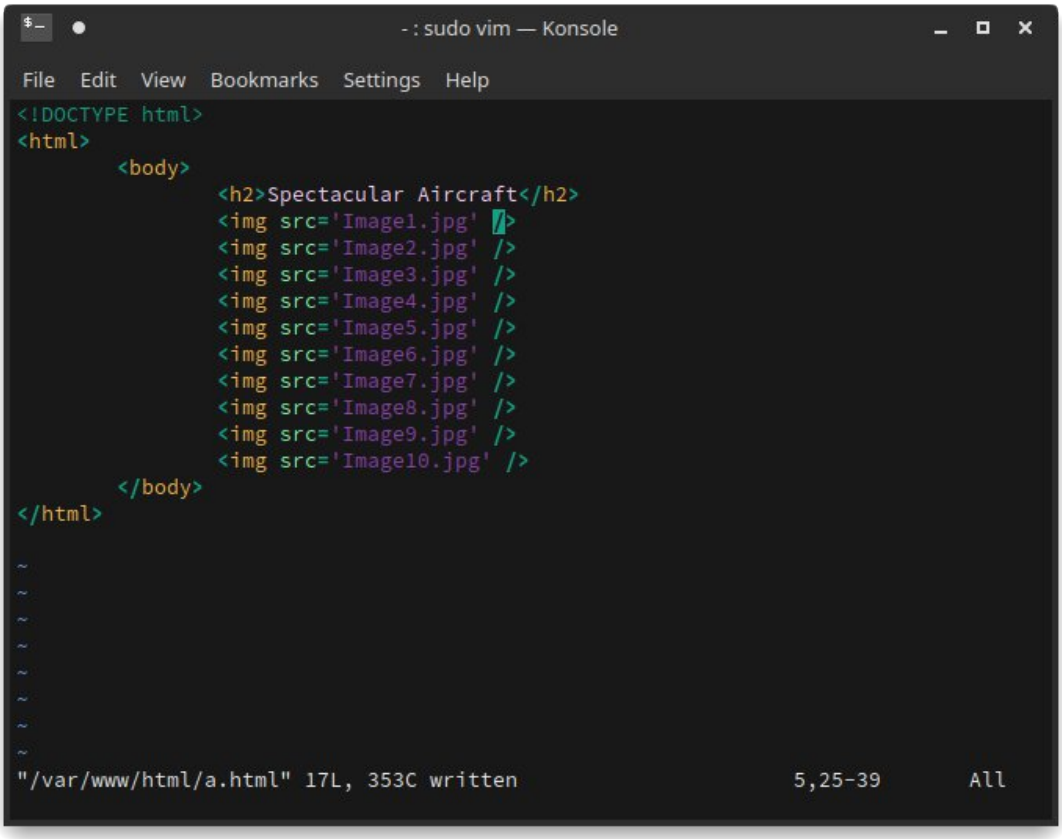
```
sudo mv *.jpg /var/www/html/
```



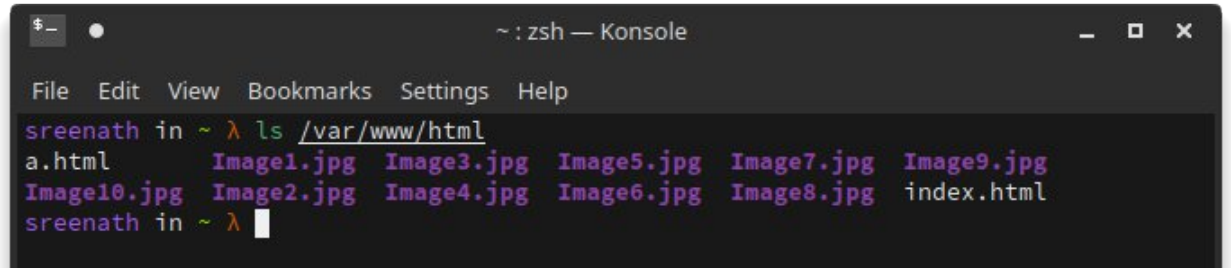
This will move any jpg file in the Downloads folder to the server path.

Now create a file called `a.html` which will serve as our webpage which includes all the images:

```
sudo vim /var/www/html/a.html
```



Now the `/var/www/html/` directory should look like this:



Step 4: Client Side Settings

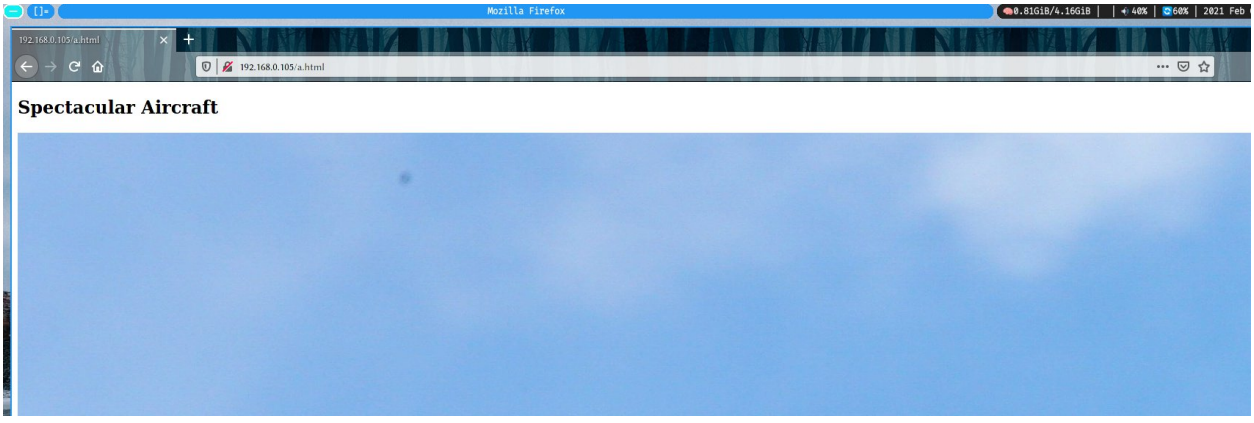
On the client side, open the Firefox browser and type in `about:config` in the search box and search for the term `persistent.`

- While using a non-persistent connection, ensure that the `max-persistent-connections-per-server` has a value of 0 and the `persistent-settings` flag is set to `false.`
- While using persistent connections, `max-persistent-connections-per-server` should have a value that is greater than 0 and the `persistent-settings` flag is set to `true.`

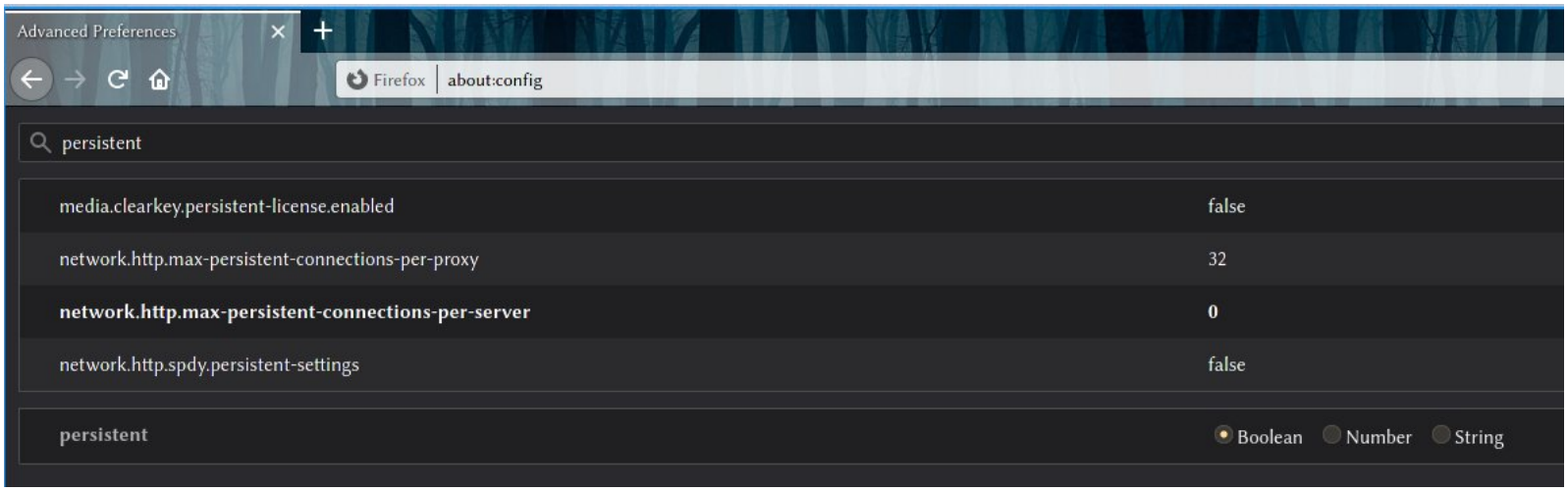
To access the webpage created on the server, simply type in:

`192.168.0.105/a.html`

in the browser to connect to the webpage.



PART 1: NON-PERSISTENT CONNECTION

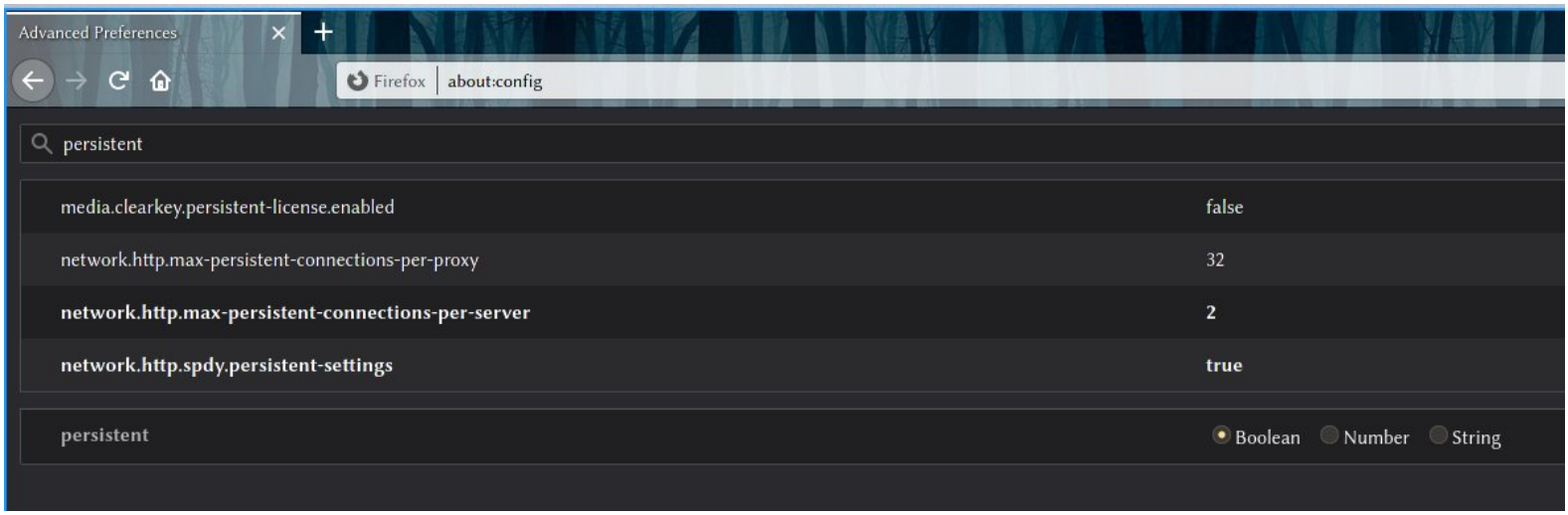


http

No.	Time	Source	Destination	Protocol	Length	Info
8	23.289742381	192.168.0.107	192.168.0.105	HTTP	398	GET /a.html HTTP/1.1
10	23.290629517	192.168.0.105	192.168.0.107	HTTP	546	HTTP/1.1 200 OK (text/html)
12	23.840139535	192.168.0.107	192.168.0.105	HTTP	350	GET /Image1.jpg HTTP/1.1
1497	24.017203697	192.168.0.105	192.168.0.107	HTTP	201	HTTP/1.1 200 OK (JPEG JFIF image)
1501	24.019604917	192.168.0.107	192.168.0.105	HTTP	350	GET /Image2.jpg HTTP/1.1
2240	24.105519411	192.168.0.105	192.168.0.107	HTTP	1025	HTTP/1.1 200 OK (JPEG JFIF image)
2254	24.148977479	192.168.0.107	192.168.0.105	HTTP	350	GET /Image3.jpg HTTP/1.1
3291	24.339838634	192.168.0.105	192.168.0.107	HTTP	155	HTTP/1.1 200 OK (JPEG JFIF image)
3296	24.348109180	192.168.0.107	192.168.0.105	HTTP	350	GET /Image4.jpg HTTP/1.1
4349	24.486153539	192.168.0.105	192.168.0.107	HTTP	1513	HTTP/1.1 200 OK (JPEG JFIF image)
4351	24.491122866	192.168.0.107	192.168.0.105	HTTP	350	GET /Image5.jpg HTTP/1.1
5252	24.612084746	192.168.0.105	192.168.0.107	HTTP	912	HTTP/1.1 200 OK (JPEG JFIF image)
5262	24.637465641	192.168.0.107	192.168.0.105	HTTP	350	GET /Image6.jpg HTTP/1.1
6342	24.771427342	192.168.0.105	192.168.0.107	HTTP	172	HTTP/1.1 200 OK (JPEG JFIF image)
6346	24.779659712	192.168.0.107	192.168.0.105	HTTP	350	GET /Image7.jpg HTTP/1.1
7126	24.868129399	192.168.0.105	192.168.0.107	HTTP	1167	HTTP/1.1 200 OK (JPEG JFIF image)
7130	24.874909671	192.168.0.107	192.168.0.105	HTTP	350	GET /Image8.jpg HTTP/1.1
8076	24.980380947	192.168.0.105	192.168.0.107	HTTP	180	HTTP/1.1 200 OK (JPEG JFIF image)
8088	25.002782766	192.168.0.107	192.168.0.105	HTTP	350	GET /Image9.jpg HTTP/1.1
9576	25.203470197	192.168.0.105	192.168.0.107	HTTP	1036	HTTP/1.1 200 OK (JPEG JFIF image)
9581	25.211944703	192.168.0.107	192.168.0.105	HTTP	351	GET /Image10.jpg HTTP/1.1
11861	25.471370123	192.168.0.105	192.168.0.107	HTTP	165	HTTP/1.1 200 OK (JPEG JFIF image)
11871	25.473431319	192.168.0.107	192.168.0.105	HTTP	351	GET /favicon.ico HTTP/1.1
11873	25.473825573	192.168.0.105	192.168.0.107	HTTP	523	HTTP/1.1 404 Not Found (text/html)

PART 2: PERSISTENT CONNECTIONS

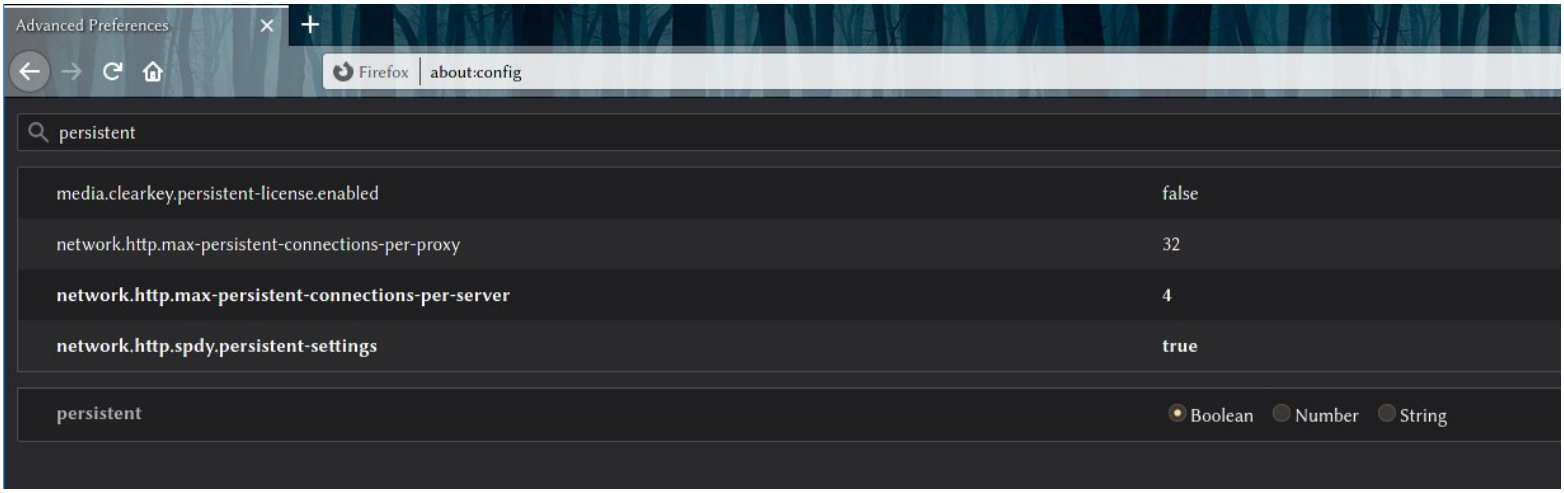
i) 2 Persistent Connections:



http

No.	Time	Source	Destination	Protocol	Length	Info
9	21.451555354	192.168.0.107	192.168.0.105	HTTP	398	GET /a.html HTTP/1.1
11	21.452471407	192.168.0.105	192.168.0.107	HTTP	546	HTTP/1.1 200 OK (text/html)
13	21.968300664	192.168.0.107	192.168.0.105	HTTP	350	GET /Image1.jpg HTTP/1.1
133	21.998589606	192.168.0.107	192.168.0.105	HTTP	350	GET /Image2.jpg HTTP/1.1
1756	22.181342724	192.168.0.105	192.168.0.107	HTTP	1060	HTTP/1.1 200 OK (JPEG JFIF image)
1931	22.224415739	192.168.0.107	192.168.0.105	HTTP	350	GET /Image3.jpg HTTP/1.1
2496	22.333229855	192.168.0.105	192.168.0.107	HTTP	201	HTTP/1.1 200 OK (JPEG JFIF image)
2645	22.369982454	192.168.0.107	192.168.0.105	HTTP	350	GET /Image4.jpg HTTP/1.1
3649	22.515247633	192.168.0.105	192.168.0.107	HTTP	155	HTTP/1.1 200 OK (JPEG JFIF image)
3884	22.556970818	192.168.0.107	192.168.0.105	HTTP	350	GET /Image5.jpg HTTP/1.1
4471	22.626218916	192.168.0.105	192.168.0.107	HTTP	1478	HTTP/1.1 200 OK (JPEG JFIF image)
5338	22.808631198	192.168.0.105	192.168.0.107	HTTP	912	HTTP/1.1 200 OK (JPEG JFIF image)
5352	22.840196750	192.168.0.107	192.168.0.105	HTTP	350	GET /Image6.jpg HTTP/1.1
6438	22.985174112	192.168.0.105	192.168.0.107	HTTP	172	HTTP/1.1 200 OK (JPEG JFIF image)
6476	23.040514607	192.168.0.107	192.168.0.105	HTTP	350	GET /Image7.jpg HTTP/1.1
7362	23.139836139	192.168.0.105	192.168.0.107	HTTP	1167	HTTP/1.1 200 OK (JPEG JFIF image)
7385	23.164895522	192.168.0.107	192.168.0.105	HTTP	350	GET /Image8.jpg HTTP/1.1
7538	23.179396179	192.168.0.107	192.168.0.105	HTTP	350	GET /Image9.jpg HTTP/1.1
8765	23.322093670	192.168.0.105	192.168.0.107	HTTP	180	HTTP/1.1 200 OK (JPEG JFIF image)
8983	23.383172216	192.168.0.107	192.168.0.105	HTTP	351	GET /Image10.jpg HTTP/1.1
10482	23.550900514	192.168.0.105	192.168.0.107	HTTP	1036	HTTP/1.1 200 OK (JPEG JFIF image)
11567	23.673259426	192.168.0.107	192.168.0.105	HTTP	351	GET /favicon.ico HTTP/1.1
11590	23.676391385	192.168.0.105	192.168.0.107	HTTP	558	HTTP/1.1 404 Not Found (text/html)
12047	23.728619668	192.168.0.105	192.168.0.107	HTTP	165	HTTP/1.1 200 OK (JPEG JFIF image)

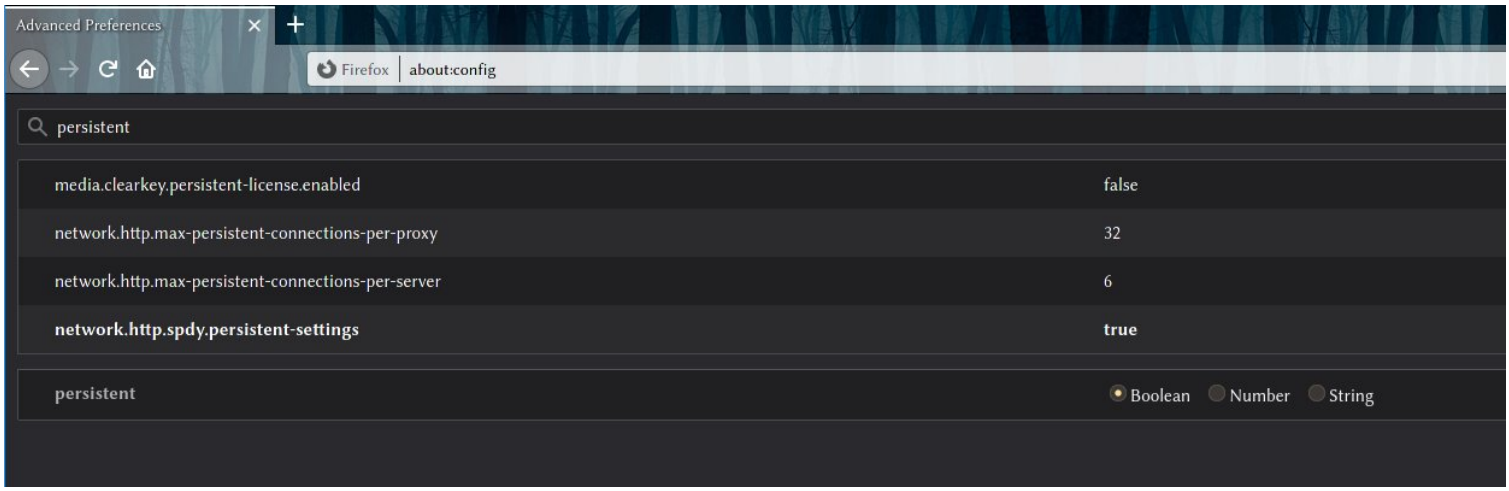
ii) 4 Persistent Connections:



http

No.	Time	Source	Destination	Protocol	Length	Info
8	24.206413978	192.168.0.107	192.168.0.105	HTTP	398	GET /a.html HTTP/1.1
10	24.207214984	192.168.0.105	192.168.0.107	HTTP	546	HTTP/1.1 200 OK (text/html)
12	24.568508034	192.168.0.107	192.168.0.105	HTTP	350	GET /Image1.jpg HTTP/1.1
152	24.608453165	192.168.0.107	192.168.0.105	HTTP	350	GET /Image2.jpg HTTP/1.1
179	24.613287323	192.168.0.107	192.168.0.105	HTTP	350	GET /Image4.jpg HTTP/1.1
180	24.613287417	192.168.0.107	192.168.0.105	HTTP	350	GET /Image3.jpg HTTP/1.1
3574	25.013549231	192.168.0.105	192.168.0.107	HTTP	1060	HTTP/1.1 200 OK (JPEG JFIF image)
3736	25.031419363	192.168.0.107	192.168.0.105	HTTP	350	GET /Image5.jpg HTTP/1.1
4155	25.079608827	192.168.0.105	192.168.0.107	HTTP	1513	HTTP/1.1 200 OK (JPEG JFIF image)
4188	25.087260774	192.168.0.107	192.168.0.105	HTTP	350	GET /Image6.jpg HTTP/1.1
4897	25.160036427	192.168.0.105	192.168.0.107	HTTP	155	HTTP/1.1 200 OK (JPEG JFIF image)
5007	25.174462494	192.168.0.107	192.168.0.105	HTTP	350	GET /Image7.jpg HTTP/1.1
7008	25.394484837	192.168.0.105	192.168.0.107	HTTP	201	HTTP/1.1 200 OK (JPEG JFIF image)
7080	25.398616832	192.168.0.107	192.168.0.105	HTTP	350	GET /Image8.jpg HTTP/1.1
8108	25.510271474	192.168.0.105	192.168.0.107	HTTP	947	HTTP/1.1 200 OK (JPEG JFIF image)
8210	25.518653385	192.168.0.105	192.168.0.107	HTTP	172	HTTP/1.1 200 OK (JPEG JFIF image)
8241	25.525357118	192.168.0.107	192.168.0.105	HTTP	350	GET /Image9.jpg HTTP/1.1
8268	25.525684568	192.168.0.107	192.168.0.105	HTTP	351	GET /Image10.jpg HTTP/1.1
8361	25.534461160	192.168.0.105	192.168.0.107	HTTP	1167	HTTP/1.1 200 OK (JPEG JFIF image)
10703	25.770397578	192.168.0.105	192.168.0.107	HTTP	180	HTTP/1.1 200 OK (JPEG JFIF image)
12428	25.947836943	192.168.0.105	192.168.0.107	HTTP	1001	HTTP/1.1 200 OK (JPEG JFIF image)
13166	26.028032927	192.168.0.105	192.168.0.107	HTTP	130	HTTP/1.1 200 OK (JPEG JFIF image)
13173	26.061256812	192.168.0.107	192.168.0.105	HTTP	351	GET /favicon.ico HTTP/1.1
13175	26.061749464	192.168.0.105	192.168.0.107	HTTP	523	HTTP/1.1 404 Not Found (text/html)

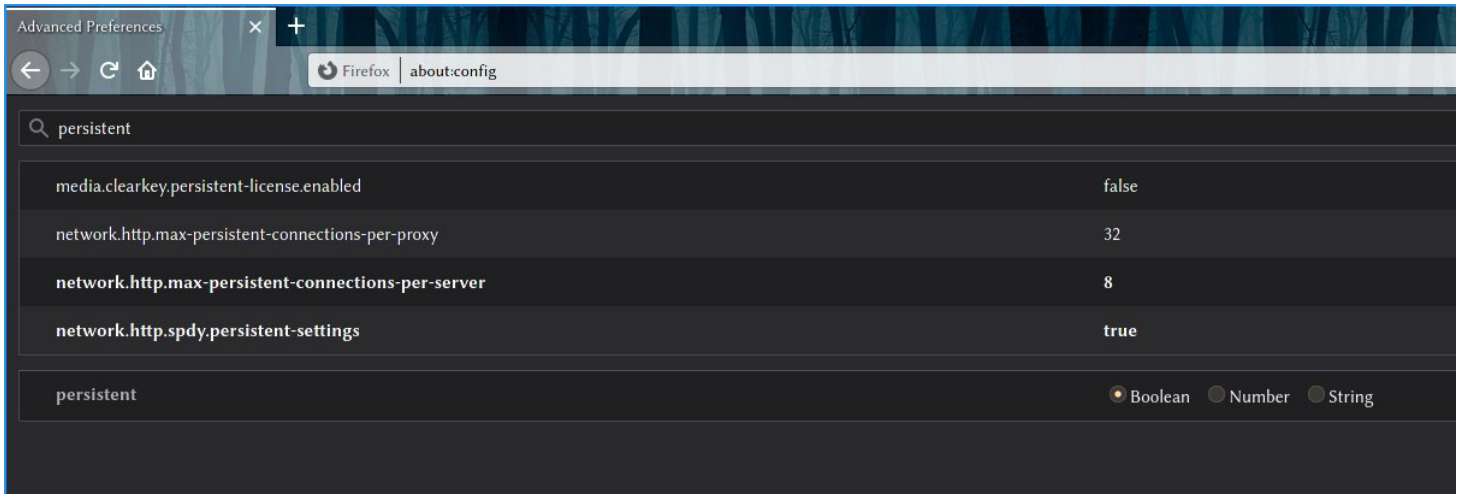
iii) 6 Persistent Connections:



http

No.	Time	Source	Destination	Protocol	Length	Info
7	16.965441761	192.168.0.107	192.168.0.105	HTTP	398	GET /a.html HTTP/1.1
9	16.966425515	192.168.0.105	192.168.0.107	HTTP	546	HTTP/1.1 200 OK (text/html)
11	17.470708027	192.168.0.107	192.168.0.105	HTTP	350	GET /Image1.jpg HTTP/1.1
161	17.492803906	192.168.0.107	192.168.0.105	HTTP	350	GET /Image2.jpg HTTP/1.1
162	17.492804039	192.168.0.107	192.168.0.105	HTTP	350	GET /Image6.jpg HTTP/1.1
163	17.492894137	192.168.0.107	192.168.0.105	HTTP	350	GET /Image5.jpg HTTP/1.1
165	17.492894274	192.168.0.107	192.168.0.105	HTTP	350	GET /Image4.jpg HTTP/1.1
166	17.492894375	192.168.0.107	192.168.0.105	HTTP	350	GET /Image3.jpg HTTP/1.1
5293	18.097855292	192.168.0.105	192.168.0.107	HTTP	1060	HTTP/1.1 200 OK (JPEG JFIF image)
5796	18.154419326	192.168.0.107	192.168.0.105	HTTP	350	GET /Image7.jpg HTTP/1.1
6258	18.204284548	192.168.0.105	192.168.0.107	HTTP	947	HTTP/1.1 200 OK (JPEG JFIF image)
6515	18.232417339	192.168.0.105	192.168.0.107	HTTP	201	HTTP/1.1 200 OK (JPEG JFIF image)
6646	18.246240479	192.168.0.105	192.168.0.107	HTTP	1513	HTTP/1.1 200 OK (JPEG JFIF image)
6733	18.255231583	192.168.0.105	192.168.0.107	HTTP	155	HTTP/1.1 200 OK (JPEG JFIF image)
6779	18.282812281	192.168.0.107	192.168.0.105	HTTP	350	GET /Image8.jpg HTTP/1.1
6867	18.289646176	192.168.0.107	192.168.0.105	HTTP	350	GET /Image9.jpg HTTP/1.1
6997	18.304008357	192.168.0.107	192.168.0.105	HTTP	351	GET /Image10.jpg HTTP/1.1
7925	18.404120027	192.168.0.105	192.168.0.107	HTTP	172	HTTP/1.1 200 OK (JPEG JFIF image)
9698	18.597459257	192.168.0.105	192.168.0.107	HTTP	1167	HTTP/1.1 200 OK (JPEG JFIF image)
10915	18.733886921	192.168.0.105	192.168.0.107	HTTP	215	HTTP/1.1 200 OK (JPEG JFIF image)
11878	18.836924301	192.168.0.105	192.168.0.107	HTTP	1001	HTTP/1.1 200 OK (JPEG JFIF image)
12775	18.949242711	192.168.0.107	192.168.0.105	HTTP	351	GET /favicon.ico HTTP/1.1
12777	18.951646718	192.168.0.105	192.168.0.107	HTTP	558	HTTP/1.1 404 Not Found (text/html)
12783	18.952362734	192.168.0.105	192.168.0.107	HTTP	165	HTTP/1.1 200 OK (JPEG JFIF image)

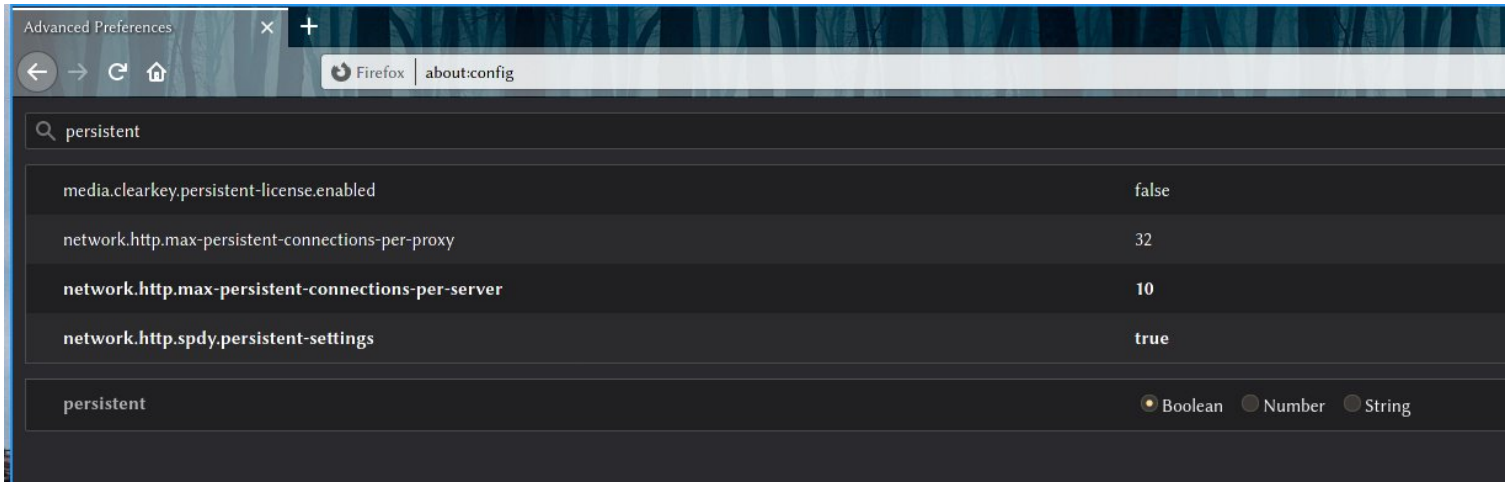
iv) 8 Persistent Connections:

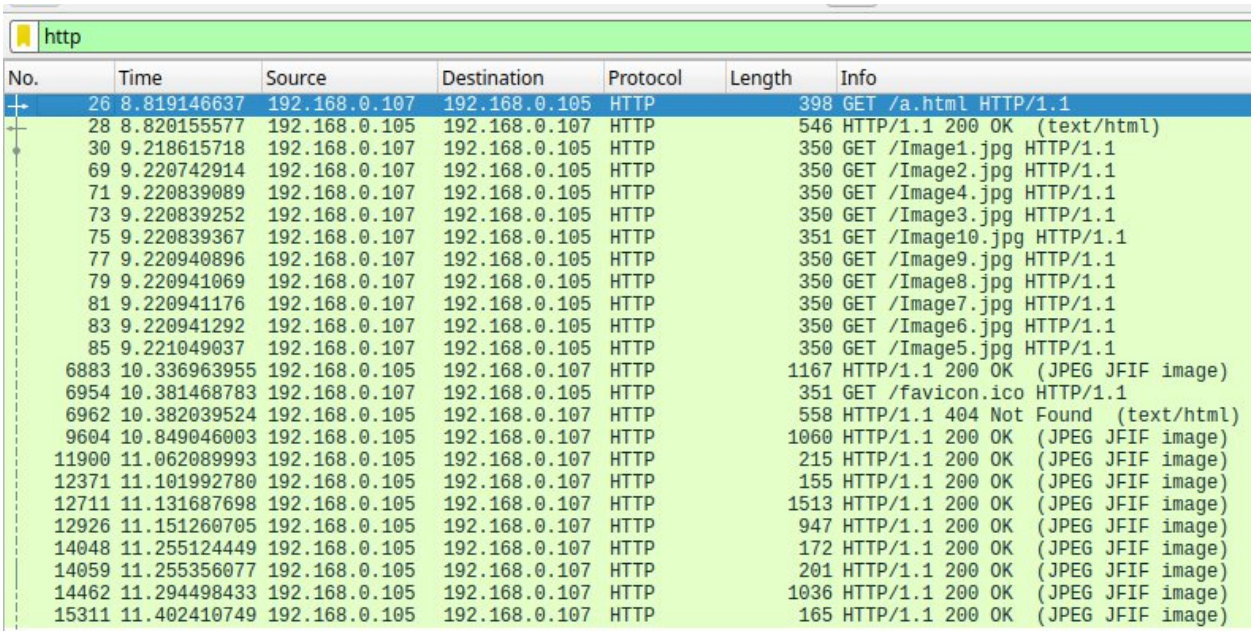


http

No.	Time	Source	Destination	Protocol	Length	Info
4	0.001445670	192.168.0.107	192.168.0.105	HTTP	398	GET /a.html HTTP/1.1
6	0.002260591	192.168.0.105	192.168.0.107	HTTP	546	HTTP/1.1 200 OK (text/html)
8	0.169194228	192.168.0.107	192.168.0.105	HTTP	350	GET /Image1.jpg HTTP/1.1
209	0.224501108	192.168.0.107	192.168.0.105	HTTP	350	GET /Image2.jpg HTTP/1.1
254	0.232993828	192.168.0.107	192.168.0.105	HTTP	350	GET /Image8.jpg HTTP/1.1
255	0.233420145	192.168.0.107	192.168.0.105	HTTP	350	GET /Image7.jpg HTTP/1.1
256	0.233469230	192.168.0.107	192.168.0.105	HTTP	350	GET /Image6.jpg HTTP/1.1
257	0.233505784	192.168.0.107	192.168.0.105	HTTP	350	GET /Image5.jpg HTTP/1.1
258	0.233558069	192.168.0.107	192.168.0.105	HTTP	350	GET /Image4.jpg HTTP/1.1
260	0.233558249	192.168.0.107	192.168.0.105	HTTP	350	GET /Image3.jpg HTTP/1.1
7055	0.879793329	192.168.0.105	192.168.0.107	HTTP	1060	HTTP/1.1 200 OK (JPEG JFIF image)
7581	0.948565881	192.168.0.107	192.168.0.105	HTTP	350	GET /Image9.jpg HTTP/1.1
8359	1.020139697	192.168.0.105	192.168.0.107	HTTP	1167	HTTP/1.1 200 OK (JPEG JFIF image)
8691	1.058027703	192.168.0.107	192.168.0.105	HTTP	351	GET /Image10.jpg HTTP/1.1
9142	1.099884340	192.168.0.105	192.168.0.107	HTTP	947	HTTP/1.1 200 OK (JPEG JFIF image)
9470	1.134289987	192.168.0.105	192.168.0.107	HTTP	215	HTTP/1.1 200 OK (JPEG JFIF image)
9839	1.171735493	192.168.0.105	192.168.0.107	HTTP	1513	HTTP/1.1 200 OK (JPEG JFIF image)
9875	1.176161917	192.168.0.105	192.168.0.107	HTTP	155	HTTP/1.1 200 OK (JPEG JFIF image)
9985	1.188010659	192.168.0.105	192.168.0.107	HTTP	201	HTTP/1.1 200 OK (JPEG JFIF image)
10482	1.251583182	192.168.0.105	192.168.0.107	HTTP	172	HTTP/1.1 200 OK (JPEG JFIF image)
12242	1.443016010	192.168.0.105	192.168.0.107	HTTP	1036	HTTP/1.1 200 OK (JPEG JFIF image)
13139	1.556252135	192.168.0.107	192.168.0.105	HTTP	351	GET /favicon.ico HTTP/1.1
13158	1.556549484	192.168.0.105	192.168.0.107	HTTP	523	HTTP/1.1 404 Not Found (text/html)
13465	1.593562519	192.168.0.105	192.168.0.107	HTTP	165	HTTP/1.1 200 OK (JPEG JFIF image)

v) 10 Persistent Connections:





Persistent Connections	Time at 1st GET	Time at final response	TIME
0	23.289742381	25.471370123	2.181626842
2	21.451555354	23.728619668	2.277064314
4	24.206413978	26.028032927	1.821618949
6	16.965441761	18.952362734	1.986920973
8	0.001445670	1.593562519	1.592116849
10	8.819146637	11.402410749	2.583264112

We notice that in general, the time taken reduces as we increase the number of persistent connections due to **HTTP pipelining** and we note that **8 connections** is optimal for my setup. We also notice that with an increase in connections to 10, more resources are kept occupied hence time increases as a result. We notice that the non-persistent connection is slow comparatively as it needs to setup the connection repeatedly.