Computer Networks Lab Report - Week 2

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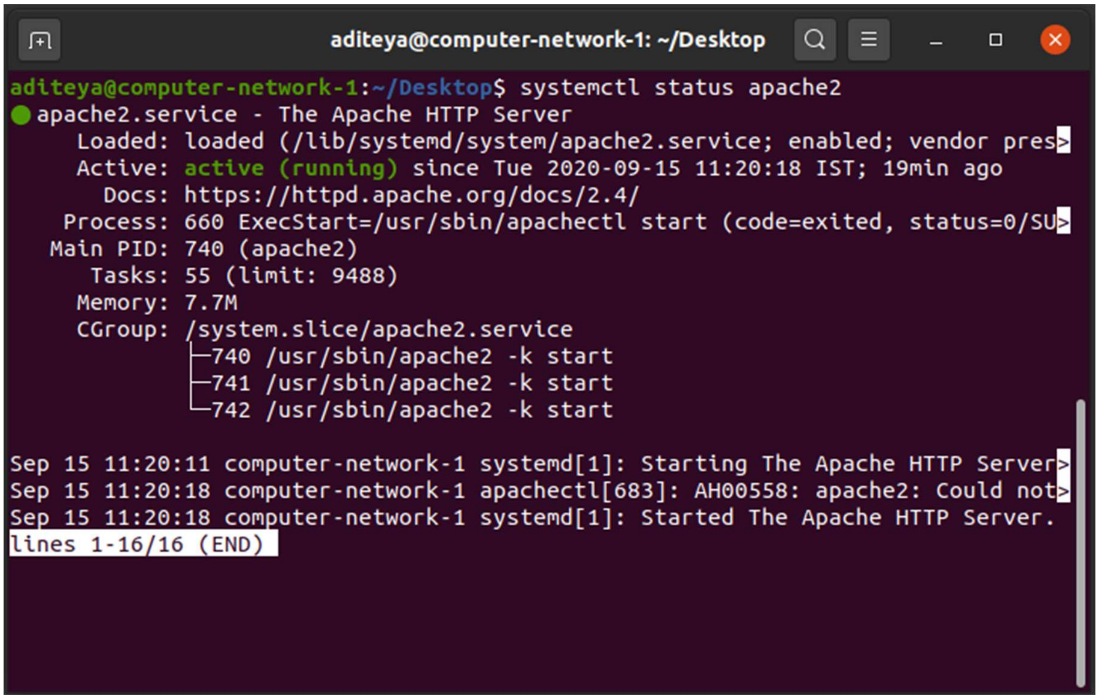
1. Configuration of Apache Server and Client Environment

- To create a server – client architecture, two Virtual Machines were setup. The former is referred to as the server machine and the latter is the client machine.
- Apache Server was installed and configured on the server machine, and a static webpage consisting of 10 objects (images) was created and hosted on the local network between these machines.
- We need to observe and determine the effect of the number of persistent connections on the load time of this static webpage.

1.1 Setting up Apache Server

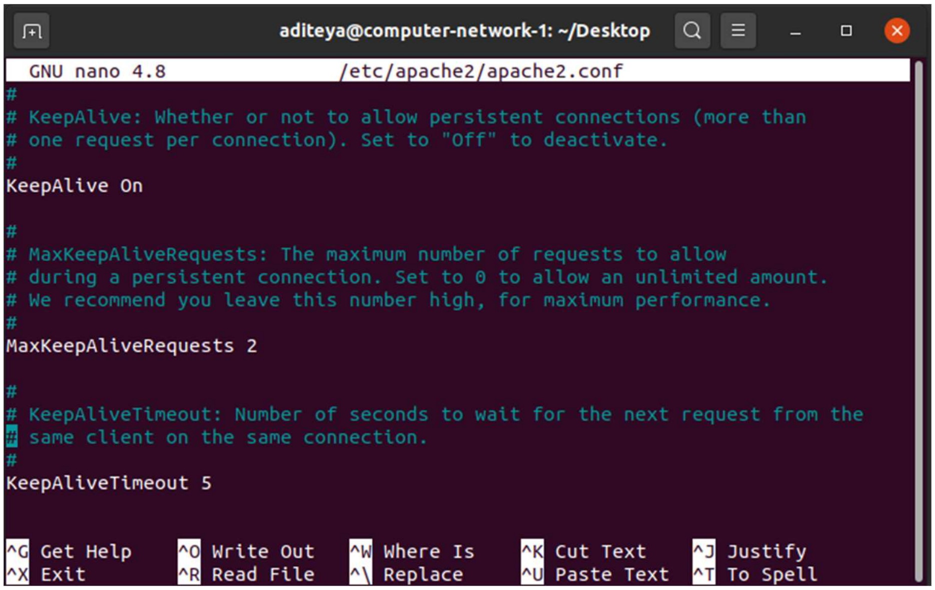
- The Apache Server can be installed with `sudo apt install apache2`
- The status of the newly installed server can be viewed using `systemctl status apache2`



```
aditeya@computer-network-1:~/Desktop$ systemctl status apache2
● apache2.service - The Apache HTTP Server
     Loaded: loaded (/lib/systemd/system/apache2.service; enabled; vendor pres>
     Active: active (running) since Tue 2020-09-15 11:20:18 IST; 19min ago
       Docs: https://httpd.apache.org/docs/2.4/
    Process: 660 ExecStart=/usr/sbin/apachectl start (code=exited, status=0/SU>
   Main PID: 740 (apache2)
      Tasks: 55 (limit: 9488)
     Memory: 7.7M
     CGroup: /system.slice/apache2.service
             ├─740 /usr/sbin/apache2 -k start
             ├─741 /usr/sbin/apache2 -k start
             └─742 /usr/sbin/apache2 -k start

Sep 15 11:20:11 computer-network-1 systemd[1]: Starting The Apache HTTP Server>
Sep 15 11:20:18 computer-network-1 apachectl[683]: AH00558: apache2: Could not>
Sep 15 11:20:18 computer-network-1 systemd[1]: Started The Apache HTTP Server.
lines 1-16/16 (END)
```

- The Apache Server also needs to be configured to allow persistent connections. This is done by editing the `apache2.conf` configuration file and setting the options
    - `KeepAlive` to `On`
    - `MaxKeepAliveRequests` to `2`



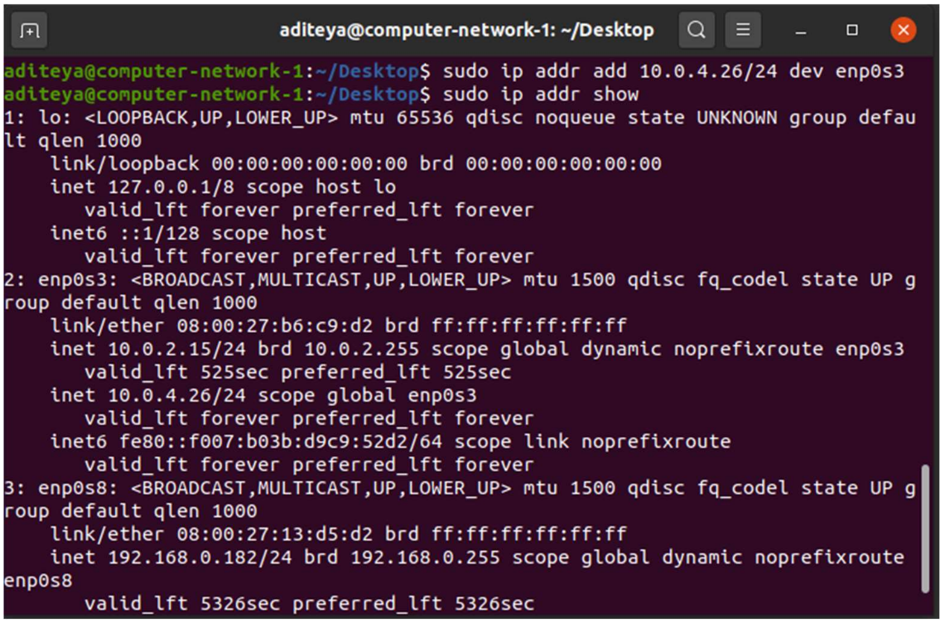
```
  GNU nano 4.8                  /etc/apache2/apache2.conf
#
# KeepAlive: Whether or not to allow persistent connections (more than
# one request per connection). Set to "Off" to deactivate.
#
KeepAlive On

#
# 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
```

1.2 Adding Custom IP Addresses for Server and Client

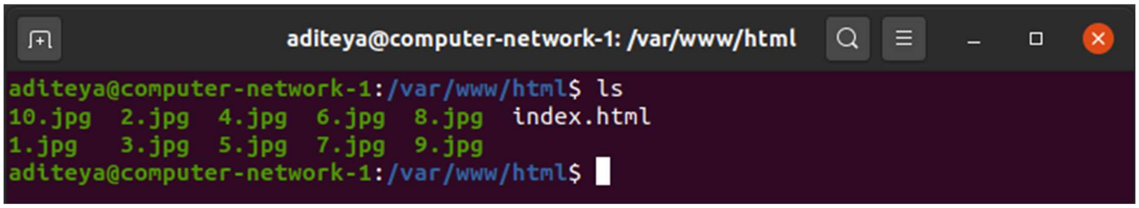
- A custom IP Address was set for both the Server and Client machines
- The Server IP Address was set to 10.0.4.26 and the Client IP Address was set to 10.0.4.27
- The IP address were assigned using the `sudo ip addr add` command



```
aditeya@computer-network-1:~/Desktop$ sudo ip addr add 10.0.4.26/24 dev enp0s3
aditeya@computer-network-1:~/Desktop$ sudo ip addr show
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group defau
lt 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: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP g
roup default qlen 1000
    link/ether 08:00:27:b6:c9:d2 brd ff:ff:ff:ff:ff:ff
    inet 10.0.2.15/24 brd 10.0.2.255 scope global dynamic noprefixroute enp0s3
       valid_lft 525sec preferred_lft 525sec
    inet 10.0.4.26/24 scope global enp0s3
       valid_lft forever preferred_lft forever
    inet6 fe80::f007:b03b:d9c9:52d2/64 scope link noprefixroute
       valid_lft forever preferred_lft forever
3: enp0s8: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP g
roup default qlen 1000
    link/ether 08:00:27:13:d5:d2 brd ff:ff:ff:ff:ff:ff
    inet 192.168.0.182/24 brd 192.168.0.255 scope global dynamic noprefixroute
enp0s8
       valid_lft 5326sec preferred_lft 5326sec
```

1.3 Hosting the Webpage

- The webpage can be hosted by moving the html script and the images to the server path
- The server path is `/var/www/html/`

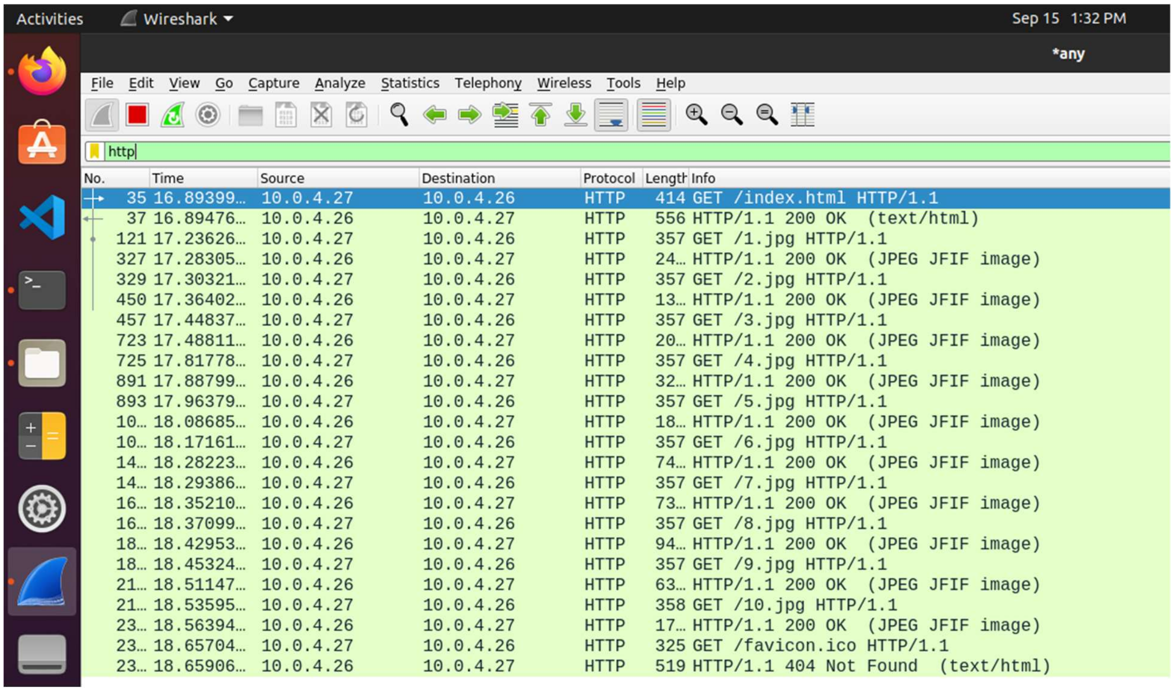


```
aditeya@computer-network-1:/var/www/html$ ls
10.jpg  2.jpg  4.jpg  6.jpg  8.jpg  index.html
1.jpg   3.jpg  5.jpg  7.jpg  9.jpg
aditeya@computer-network-1:/var/www/html$ 
```

2. Non-Persistent Connection

- To setup a non-persistent connection, we need to configure a few settings on our browser
- On Firefox, we set the `max-persistent-connections-per-server` to `0` and `persistent-settings` to `false`

2.1 Packet Capture Screenshot


Activities
Wireshark
Sep 15 1:32 PM
*any
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

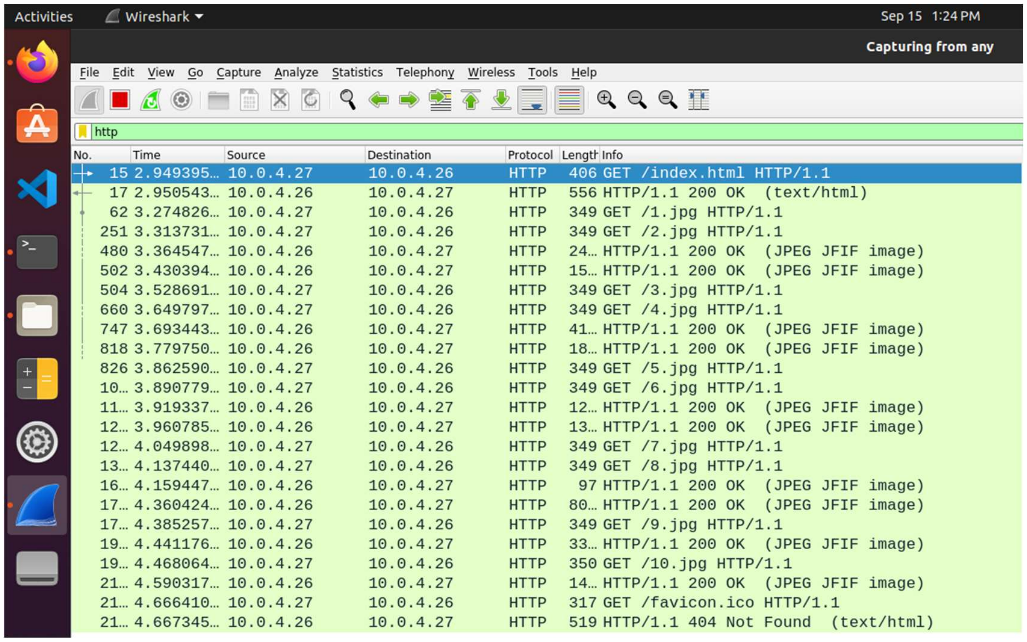
http

No.	Time	Source	Destination	Protocol	Length	Info
35	16.89399…	10.0.4.27	10.0.4.26	HTTP	414	GET /index.html HTTP/1.1
37	16.89476…	10.0.4.26	10.0.4.27	HTTP	556	HTTP/1.1 200 OK (text/html)
121	17.23626…	10.0.4.27	10.0.4.26	HTTP	357	GET /1.jpg HTTP/1.1
327	17.28305…	10.0.4.26	10.0.4.27	HTTP	24…	HTTP/1.1 200 OK (JPEG JFIF image)
329	17.30321…	10.0.4.27	10.0.4.26	HTTP	357	GET /2.jpg HTTP/1.1
450	17.36402…	10.0.4.26	10.0.4.27	HTTP	13…	HTTP/1.1 200 OK (JPEG JFIF image)
457	17.44837…	10.0.4.27	10.0.4.26	HTTP	357	GET /3.jpg HTTP/1.1
723	17.48811…	10.0.4.26	10.0.4.27	HTTP	20…	HTTP/1.1 200 OK (JPEG JFIF image)
725	17.81778…	10.0.4.27	10.0.4.26	HTTP	357	GET /4.jpg HTTP/1.1
891	17.88799…	10.0.4.26	10.0.4.27	HTTP	32…	HTTP/1.1 200 OK (JPEG JFIF image)
893	17.96379…	10.0.4.27	10.0.4.26	HTTP	357	GET /5.jpg HTTP/1.1
10…	18.08685…	10.0.4.26	10.0.4.27	HTTP	18…	HTTP/1.1 200 OK (JPEG JFIF image)
10…	18.17161…	10.0.4.27	10.0.4.26	HTTP	357	GET /6.jpg HTTP/1.1
14…	18.28223…	10.0.4.26	10.0.4.27	HTTP	74…	HTTP/1.1 200 OK (JPEG JFIF image)
14…	18.29386…	10.0.4.27	10.0.4.26	HTTP	357	GET /7.jpg HTTP/1.1
16…	18.35210…	10.0.4.26	10.0.4.27	HTTP	73…	HTTP/1.1 200 OK (JPEG JFIF image)
16…	18.37099…	10.0.4.27	10.0.4.26	HTTP	357	GET /8.jpg HTTP/1.1
18…	18.42953…	10.0.4.26	10.0.4.27	HTTP	94…	HTTP/1.1 200 OK (JPEG JFIF image)
18…	18.45324…	10.0.4.27	10.0.4.26	HTTP	357	GET /9.jpg HTTP/1.1
21…	18.51147…	10.0.4.26	10.0.4.27	HTTP	63…	HTTP/1.1 200 OK (JPEG JFIF image)
21…	18.53595…	10.0.4.27	10.0.4.26	HTTP	358	GET /10.jpg HTTP/1.1
23…	18.56394…	10.0.4.26	10.0.4.27	HTTP	17…	HTTP/1.1 200 OK (JPEG JFIF image)
23…	18.65704…	10.0.4.27	10.0.4.26	HTTP	325	GET /favicon.ico HTTP/1.1
23…	18.65906…	10.0.4.26	10.0.4.27	HTTP	519	HTTP/1.1 404 Not Found (text/html)

3. Persistent Connection

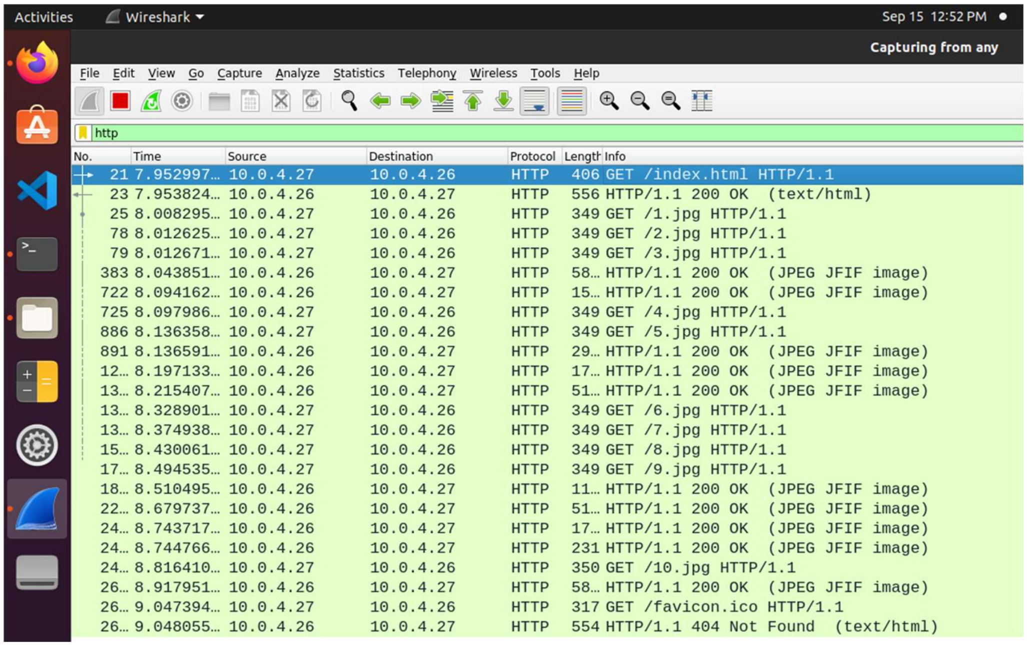
- To setup a persistent connection, we need to configure a few settings on our browser
- On Firefox, we set the `max-persistent-connections-per-server` to anything greater than `0` and `persistent-settings` to `true`

3.1. 2 Persistent Connections


Activities
Wireshark
Sep 15 1:24 PM
Capturing from any
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
http

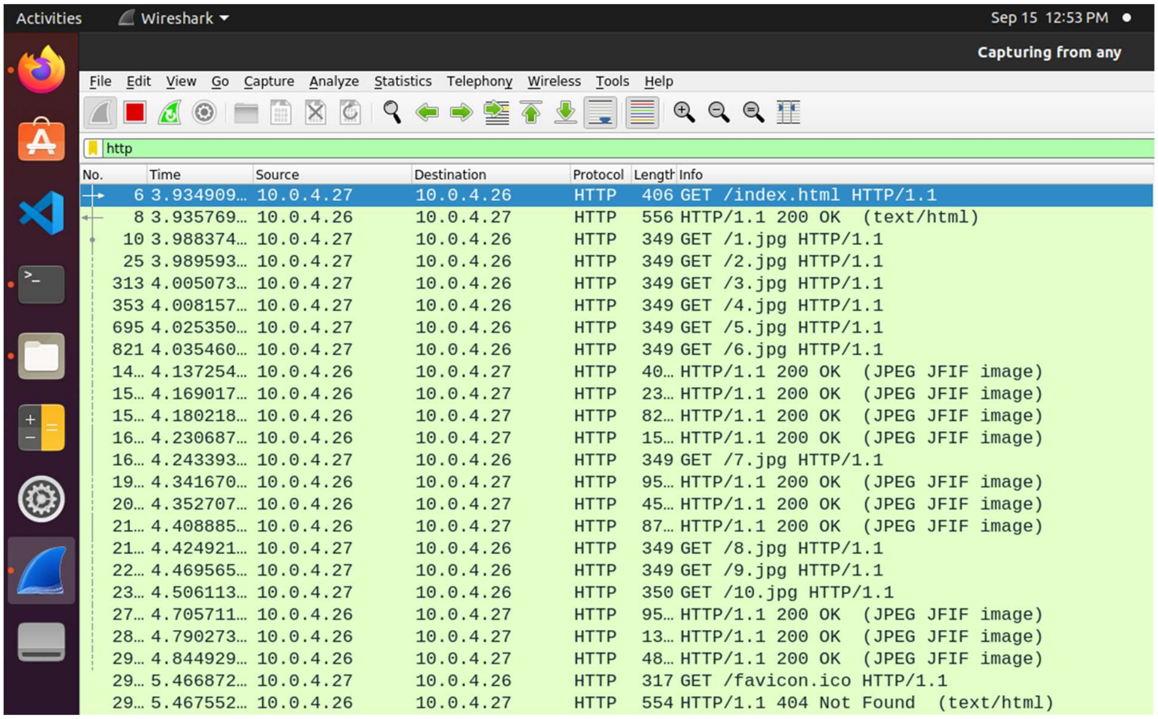
No.	Time	Source	Destination	Protocol	Length	Info
15	2.949395…	10.0.4.27	10.0.4.26	HTTP	406	GET /index.html HTTP/1.1
17	2.950543…	10.0.4.26	10.0.4.27	HTTP	556	HTTP/1.1 200 OK (text/html)
62	3.274826…	10.0.4.27	10.0.4.26	HTTP	349	GET /1.jpg HTTP/1.1
251	3.313731…	10.0.4.27	10.0.4.26	HTTP	349	GET /2.jpg HTTP/1.1
480	3.364547…	10.0.4.26	10.0.4.27	HTTP	24…	HTTP/1.1 200 OK (JPEG JFIF image)
502	3.430394…	10.0.4.26	10.0.4.27	HTTP	15…	HTTP/1.1 200 OK (JPEG JFIF image)
504	3.528691…	10.0.4.27	10.0.4.26	HTTP	349	GET /3.jpg HTTP/1.1
660	3.649797…	10.0.4.27	10.0.4.26	HTTP	349	GET /4.jpg HTTP/1.1
747	3.693443…	10.0.4.26	10.0.4.27	HTTP	41…	HTTP/1.1 200 OK (JPEG JFIF image)
818	3.779750…	10.0.4.26	10.0.4.27	HTTP	18…	HTTP/1.1 200 OK (JPEG JFIF image)
826	3.862590…	10.0.4.27	10.0.4.26	HTTP	349	GET /5.jpg HTTP/1.1
10…	3.890779…	10.0.4.27	10.0.4.26	HTTP	349	GET /6.jpg HTTP/1.1
11…	3.919337…	10.0.4.26	10.0.4.27	HTTP	12…	HTTP/1.1 200 OK (JPEG JFIF image)
12…	3.960785…	10.0.4.26	10.0.4.27	HTTP	13…	HTTP/1.1 200 OK (JPEG JFIF image)
12…	4.049898…	10.0.4.27	10.0.4.26	HTTP	349	GET /7.jpg HTTP/1.1
13…	4.137440…	10.0.4.27	10.0.4.26	HTTP	349	GET /8.jpg HTTP/1.1
16…	4.159447…	10.0.4.26	10.0.4.27	HTTP	97	HTTP/1.1 200 OK (JPEG JFIF image)
17…	4.360424…	10.0.4.26	10.0.4.27	HTTP	80…	HTTP/1.1 200 OK (JPEG JFIF image)
17…	4.385257…	10.0.4.27	10.0.4.26	HTTP	349	GET /9.jpg HTTP/1.1
19…	4.441176…	10.0.4.26	10.0.4.27	HTTP	33…	HTTP/1.1 200 OK (JPEG JFIF image)
19…	4.468064…	10.0.4.27	10.0.4.26	HTTP	350	GET /10.jpg HTTP/1.1
21…	4.590317…	10.0.4.26	10.0.4.27	HTTP	14…	HTTP/1.1 200 OK (JPEG JFIF image)
21…	4.666410…	10.0.4.27	10.0.4.26	HTTP	317	GET /favicon.ico HTTP/1.1
21…	4.667345…	10.0.4.26	10.0.4.27	HTTP	519	HTTP/1.1 404 Not Found (text/html)

3.2. 4 Persistent Connections


Activities
Wireshark
Sep 15 12:52 PM
Capturing from any
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
http

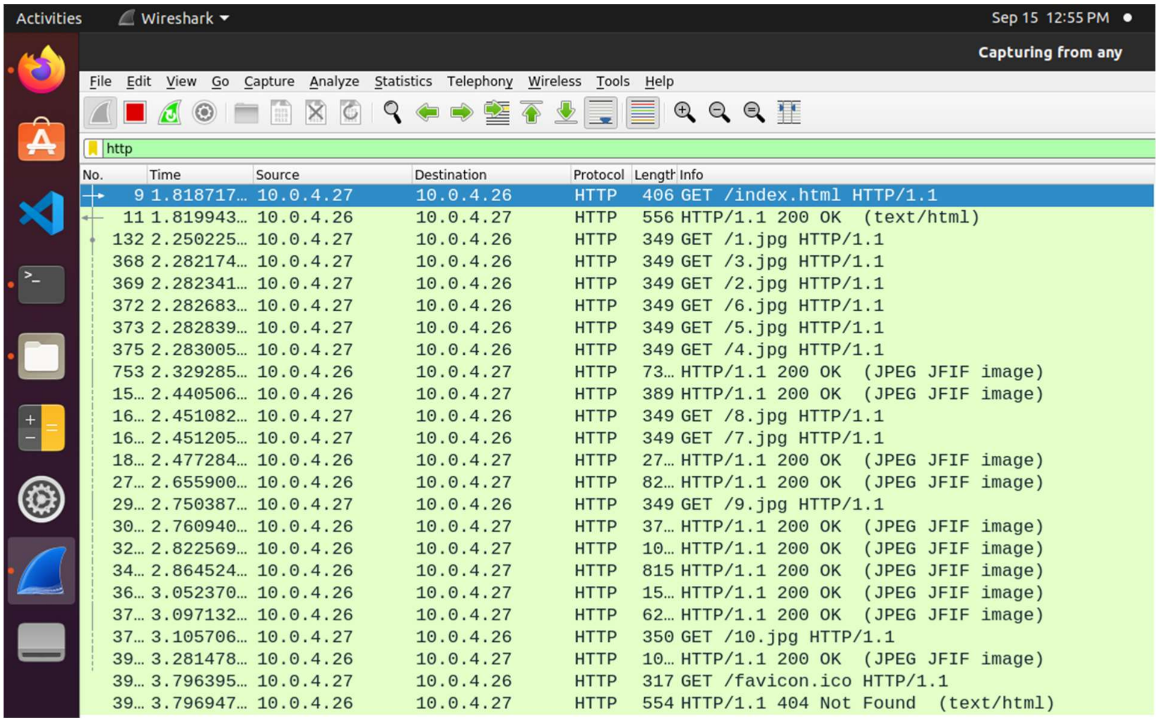
No.	Time	Source	Destination	Protocol	Length	Info
21	7.952997…	10.0.4.27	10.0.4.26	HTTP	406	GET /index.html HTTP/1.1
23	7.953824…	10.0.4.26	10.0.4.27	HTTP	556	HTTP/1.1 200 OK (text/html)
25	8.008295…	10.0.4.27	10.0.4.26	HTTP	349	GET /1.jpg HTTP/1.1
78	8.012625…	10.0.4.27	10.0.4.26	HTTP	349	GET /2.jpg HTTP/1.1
79	8.012671…	10.0.4.27	10.0.4.26	HTTP	349	GET /3.jpg HTTP/1.1
383	8.043851…	10.0.4.26	10.0.4.27	HTTP	58…	HTTP/1.1 200 OK (JPEG JFIF image)
722	8.094162…	10.0.4.26	10.0.4.27	HTTP	15…	HTTP/1.1 200 OK (JPEG JFIF image)
725	8.097986…	10.0.4.27	10.0.4.26	HTTP	349	GET /4.jpg HTTP/1.1
886	8.136358…	10.0.4.27	10.0.4.26	HTTP	349	GET /5.jpg HTTP/1.1
891	8.136591…	10.0.4.26	10.0.4.27	HTTP	29…	HTTP/1.1 200 OK (JPEG JFIF image)
12…	8.197133…	10.0.4.26	10.0.4.27	HTTP	17…	HTTP/1.1 200 OK (JPEG JFIF image)
13…	8.215407…	10.0.4.26	10.0.4.27	HTTP	51…	HTTP/1.1 200 OK (JPEG JFIF image)
13…	8.328901…	10.0.4.27	10.0.4.26	HTTP	349	GET /6.jpg HTTP/1.1
13…	8.374938…	10.0.4.27	10.0.4.26	HTTP	349	GET /7.jpg HTTP/1.1
15…	8.430061…	10.0.4.27	10.0.4.26	HTTP	349	GET /8.jpg HTTP/1.1
17…	8.494535…	10.0.4.27	10.0.4.26	HTTP	349	GET /9.jpg HTTP/1.1
18…	8.510495…	10.0.4.26	10.0.4.27	HTTP	11…	HTTP/1.1 200 OK (JPEG JFIF image)
22…	8.679737…	10.0.4.26	10.0.4.27	HTTP	51…	HTTP/1.1 200 OK (JPEG JFIF image)
24…	8.743717…	10.0.4.26	10.0.4.27	HTTP	17…	HTTP/1.1 200 OK (JPEG JFIF image)
24…	8.744766…	10.0.4.26	10.0.4.27	HTTP	231	HTTP/1.1 200 OK (JPEG JFIF image)
24…	8.816410…	10.0.4.27	10.0.4.26	HTTP	350	GET /10.jpg HTTP/1.1
26…	8.917951…	10.0.4.26	10.0.4.27	HTTP	58…	HTTP/1.1 200 OK (JPEG JFIF image)
26…	9.047394…	10.0.4.27	10.0.4.26	HTTP	317	GET /favicon.ico HTTP/1.1
26…	9.048055…	10.0.4.26	10.0.4.27	HTTP	554	HTTP/1.1 404 Not Found (text/html)

3.3. 6 Persistent Connections


Activities
Wireshark
Sep 15 12:53 PM
Capturing from any
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

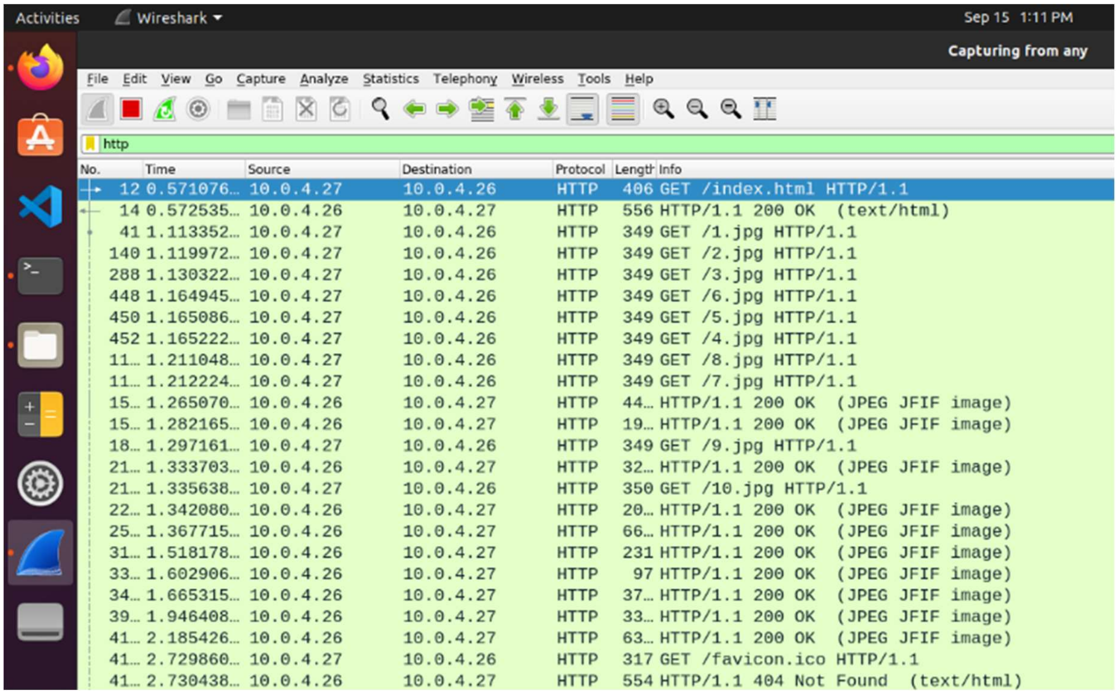
```
http
No.   Time         Source      Destination   Protocol Length Info
    6 3.934909…  10.0.4.27   10.0.4.26     HTTP     406 GET /index.html HTTP/1.1
    8 3.935769…  10.0.4.26   10.0.4.27     HTTP     556 HTTP/1.1 200 OK  (text/html)
   10 3.988374…  10.0.4.27   10.0.4.26     HTTP     349 GET /1.jpg HTTP/1.1
   25 3.989593…  10.0.4.27   10.0.4.26     HTTP     349 GET /2.jpg HTTP/1.1
  313 4.005073…  10.0.4.27   10.0.4.26     HTTP     349 GET /3.jpg HTTP/1.1
  353 4.008157…  10.0.4.27   10.0.4.26     HTTP     349 GET /4.jpg HTTP/1.1
  695 4.025350…  10.0.4.27   10.0.4.26     HTTP     349 GET /5.jpg HTTP/1.1
  821 4.035460…  10.0.4.27   10.0.4.26     HTTP     349 GET /6.jpg HTTP/1.1
  14… 4.137254…  10.0.4.26   10.0.4.27     HTTP     40… HTTP/1.1 200 OK  (JPEG JFIF image)
  15… 4.169017…  10.0.4.26   10.0.4.27     HTTP     23… HTTP/1.1 200 OK  (JPEG JFIF image)
  15… 4.180218…  10.0.4.26   10.0.4.27     HTTP     82… HTTP/1.1 200 OK  (JPEG JFIF image)
  16… 4.230687…  10.0.4.26   10.0.4.27     HTTP     15… HTTP/1.1 200 OK  (JPEG JFIF image)
  16… 4.243393…  10.0.4.27   10.0.4.26     HTTP     349 GET /7.jpg HTTP/1.1
  19… 4.341670…  10.0.4.26   10.0.4.27     HTTP     95… HTTP/1.1 200 OK  (JPEG JFIF image)
  20… 4.352707…  10.0.4.26   10.0.4.27     HTTP     45… HTTP/1.1 200 OK  (JPEG JFIF image)
  21… 4.408885…  10.0.4.26   10.0.4.27     HTTP     87… HTTP/1.1 200 OK  (JPEG JFIF image)
  21… 4.424921…  10.0.4.27   10.0.4.26     HTTP     349 GET /8.jpg HTTP/1.1
  22… 4.469565…  10.0.4.27   10.0.4.26     HTTP     349 GET /9.jpg HTTP/1.1
  23… 4.506113…  10.0.4.27   10.0.4.26     HTTP     350 GET /10.jpg HTTP/1.1
  27… 4.705711…  10.0.4.26   10.0.4.27     HTTP     95… HTTP/1.1 200 OK  (JPEG JFIF image)
  28… 4.790273…  10.0.4.26   10.0.4.27     HTTP     13… HTTP/1.1 200 OK  (JPEG JFIF image)
  29… 4.844929…  10.0.4.26   10.0.4.27     HTTP     48… HTTP/1.1 200 OK  (JPEG JFIF image)
  29… 5.466872…  10.0.4.27   10.0.4.26     HTTP     317 GET /favicon.ico HTTP/1.1
  29… 5.467552…  10.0.4.26   10.0.4.27     HTTP     554 HTTP/1.1 404 Not Found  (text/html)
```

3.4. 8 Persistent Connections


Activities
Wireshark
Sep 15 12:55 PM
Capturing from any
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

```
http
No.   Time         Source      Destination   Protocol Length Info
    9 1.818717…  10.0.4.27   10.0.4.26     HTTP     406 GET /index.html HTTP/1.1
   11 1.819943…  10.0.4.26   10.0.4.27     HTTP     556 HTTP/1.1 200 OK  (text/html)
  132 2.250225…  10.0.4.27   10.0.4.26     HTTP     349 GET /1.jpg HTTP/1.1
  368 2.282174…  10.0.4.27   10.0.4.26     HTTP     349 GET /3.jpg HTTP/1.1
  369 2.282341…  10.0.4.27   10.0.4.26     HTTP     349 GET /2.jpg HTTP/1.1
  372 2.282683…  10.0.4.27   10.0.4.26     HTTP     349 GET /6.jpg HTTP/1.1
  373 2.282839…  10.0.4.27   10.0.4.26     HTTP     349 GET /5.jpg HTTP/1.1
  375 2.283005…  10.0.4.27   10.0.4.26     HTTP     349 GET /4.jpg HTTP/1.1
  753 2.329285…  10.0.4.26   10.0.4.27     HTTP     73… HTTP/1.1 200 OK  (JPEG JFIF image)
  15… 2.440506…  10.0.4.26   10.0.4.27     HTTP     389 HTTP/1.1 200 OK  (JPEG JFIF image)
  16… 2.451082…  10.0.4.27   10.0.4.26     HTTP     349 GET /8.jpg HTTP/1.1
  16… 2.451205…  10.0.4.27   10.0.4.26     HTTP     349 GET /7.jpg HTTP/1.1
  18… 2.477284…  10.0.4.26   10.0.4.27     HTTP     27… HTTP/1.1 200 OK  (JPEG JFIF image)
  27… 2.655900…  10.0.4.26   10.0.4.27     HTTP     82… HTTP/1.1 200 OK  (JPEG JFIF image)
  29… 2.750387…  10.0.4.27   10.0.4.26     HTTP     349 GET /9.jpg HTTP/1.1
  30… 2.760940…  10.0.4.26   10.0.4.27     HTTP     37… HTTP/1.1 200 OK  (JPEG JFIF image)
  32… 2.822569…  10.0.4.26   10.0.4.27     HTTP     10… HTTP/1.1 200 OK  (JPEG JFIF image)
  34… 2.864524…  10.0.4.26   10.0.4.27     HTTP     815 HTTP/1.1 200 OK  (JPEG JFIF image)
  36… 3.052370…  10.0.4.26   10.0.4.27     HTTP     15… HTTP/1.1 200 OK  (JPEG JFIF image)
  37… 3.097132…  10.0.4.26   10.0.4.27     HTTP     62… HTTP/1.1 200 OK  (JPEG JFIF image)
  37… 3.105706…  10.0.4.27   10.0.4.26     HTTP     350 GET /10.jpg HTTP/1.1
  39… 3.281478…  10.0.4.26   10.0.4.27     HTTP     10… HTTP/1.1 200 OK  (JPEG JFIF image)
  39… 3.796395…  10.0.4.27   10.0.4.26     HTTP     317 GET /favicon.ico HTTP/1.1
  39… 3.796947…  10.0.4.26   10.0.4.27     HTTP     554 HTTP/1.1 404 Not Found  (text/html)
```

3.5. 10 Persistent Connections


Activities
Wireshark
Sep 15 1:11 PM
Capturing from any
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
http

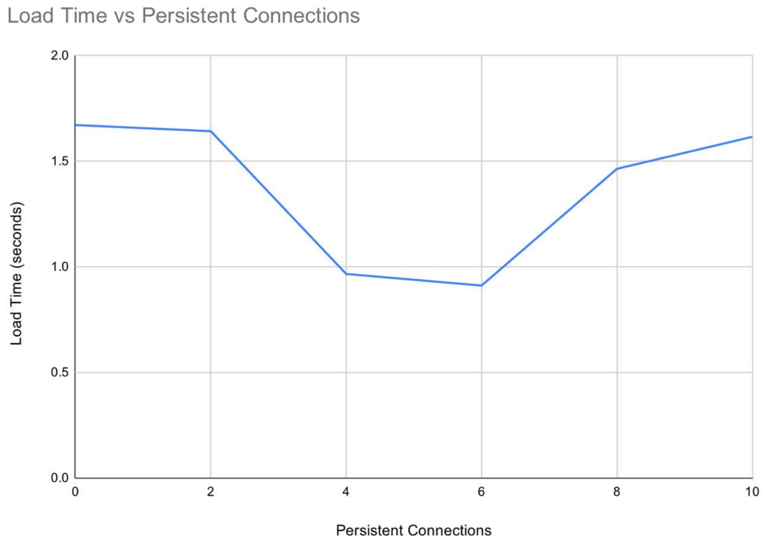
No.	Time	Source	Destination	Protocol	Length	Info
12	0.571076…	10.0.4.27	10.0.4.26	HTTP	406	GET /index.html HTTP/1.1
14	0.572535…	10.0.4.26	10.0.4.27	HTTP	556	HTTP/1.1 200 OK (text/html)
41	1.113352…	10.0.4.27	10.0.4.26	HTTP	349	GET /1.jpg HTTP/1.1
140	1.119972…	10.0.4.27	10.0.4.26	HTTP	349	GET /2.jpg HTTP/1.1
288	1.130322…	10.0.4.27	10.0.4.26	HTTP	349	GET /3.jpg HTTP/1.1
448	1.164945…	10.0.4.27	10.0.4.26	HTTP	349	GET /6.jpg HTTP/1.1
450	1.165086…	10.0.4.27	10.0.4.26	HTTP	349	GET /5.jpg HTTP/1.1
452	1.165222…	10.0.4.27	10.0.4.26	HTTP	349	GET /4.jpg HTTP/1.1
11…	1.211048…	10.0.4.27	10.0.4.26	HTTP	349	GET /8.jpg HTTP/1.1
11…	1.212224…	10.0.4.27	10.0.4.26	HTTP	349	GET /7.jpg HTTP/1.1
15…	1.265070…	10.0.4.26	10.0.4.27	HTTP	44…	HTTP/1.1 200 OK (JPEG JFIF image)
15…	1.282165…	10.0.4.26	10.0.4.27	HTTP	19…	HTTP/1.1 200 OK (JPEG JFIF image)
18…	1.297161…	10.0.4.27	10.0.4.26	HTTP	349	GET /9.jpg HTTP/1.1
21…	1.333703…	10.0.4.26	10.0.4.27	HTTP	32…	HTTP/1.1 200 OK (JPEG JFIF image)
21…	1.335638…	10.0.4.27	10.0.4.26	HTTP	350	GET /10.jpg HTTP/1.1
22…	1.342080…	10.0.4.26	10.0.4.27	HTTP	20…	HTTP/1.1 200 OK (JPEG JFIF image)
25…	1.367715…	10.0.4.26	10.0.4.27	HTTP	66…	HTTP/1.1 200 OK (JPEG JFIF image)
31…	1.518178…	10.0.4.26	10.0.4.27	HTTP	231	HTTP/1.1 200 OK (JPEG JFIF image)
33…	1.602906…	10.0.4.26	10.0.4.27	HTTP	97	HTTP/1.1 200 OK (JPEG JFIF image)
34…	1.665315…	10.0.4.26	10.0.4.27	HTTP	37…	HTTP/1.1 200 OK (JPEG JFIF image)
39…	1.946408…	10.0.4.26	10.0.4.27	HTTP	33…	HTTP/1.1 200 OK (JPEG JFIF image)
41…	2.185426…	10.0.4.26	10.0.4.27	HTTP	63…	HTTP/1.1 200 OK (JPEG JFIF image)
41…	2.729860…	10.0.4.27	10.0.4.26	HTTP	317	GET /favicon.ico HTTP/1.1
41…	2.730438…	10.0.4.26	10.0.4.27	HTTP	554	HTTP/1.1 404 Not Found (text/html)

4. Observations

- We can calculate the total **load time** as the difference between the first GET time which corresponds to the time when the html page was requested and the last response time, which corresponds to when the last image was sent back.
- On doing so, we can construct the following observations table –

Persistent Connections	Time at first GET	Time at last Response	Load Time
0	16.89399	18.56394	1.66995
2	2.949395	4.590317	1.640922
4	7.952997	8.917951	0.964954
6	3.934909	4.844929	0.91002
8	1.818717	3.281478	1.462761
10	0.571076	2.185426	1.61435

- We can also plot the values of Load Time against the number of Persistent Connections to obtain the following visualisation.



- We can hence see that the optimal number of persistent connections is 6, since it corresponds to the lowest load time.
- Initially as the number of persistent connections increase, we can observe that the load time decrease gradually and then steeply. This occurs due to the parallelism and pipelining performed while processing and requesting for image objects.
- This allows for multiple images to be requested at the same time, hence decreasing the load time taken and is much lesser than requesting each individual image serially and individually.
- However, as the number of persistent connections increase, the load time again starts increasing. This is due to the decrease in throughput of each connection with the constant link capacity. Hence the load times increase with an increase in number of persistent connections above a certain threshold.
- It is therefore not suggested to keep an exceedingly high number of persistent connections.