

# COMPUTER NETWORK LAB WEEK-2

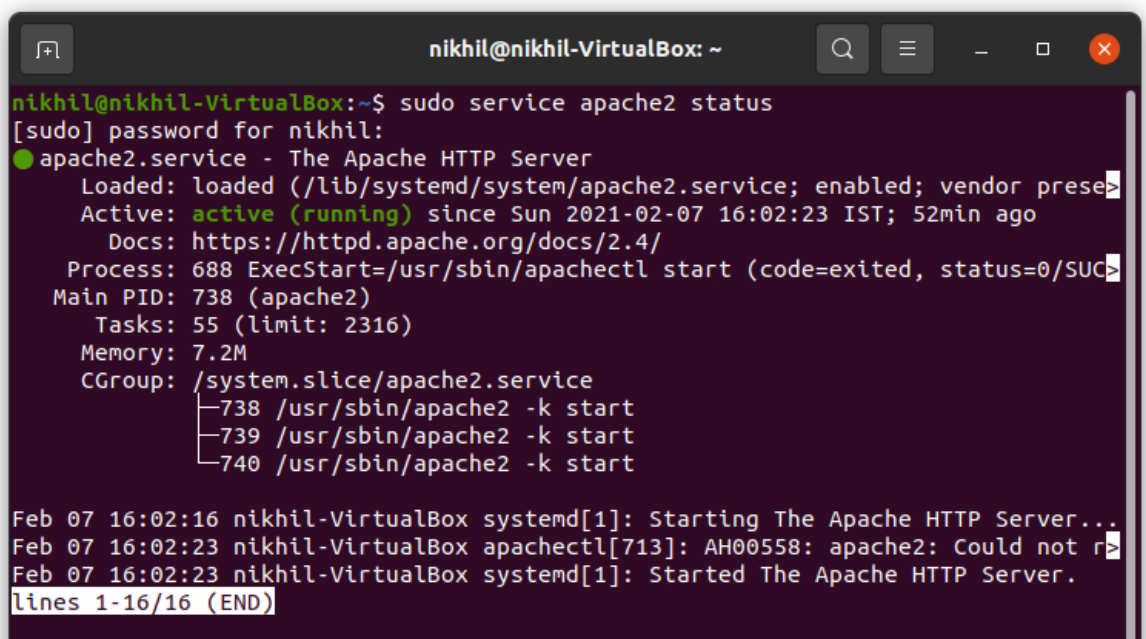
PES1UG20CS821

NIKHIL T M

## Understanding Persistent and Non-persistent HTTP Connections

Server Side:

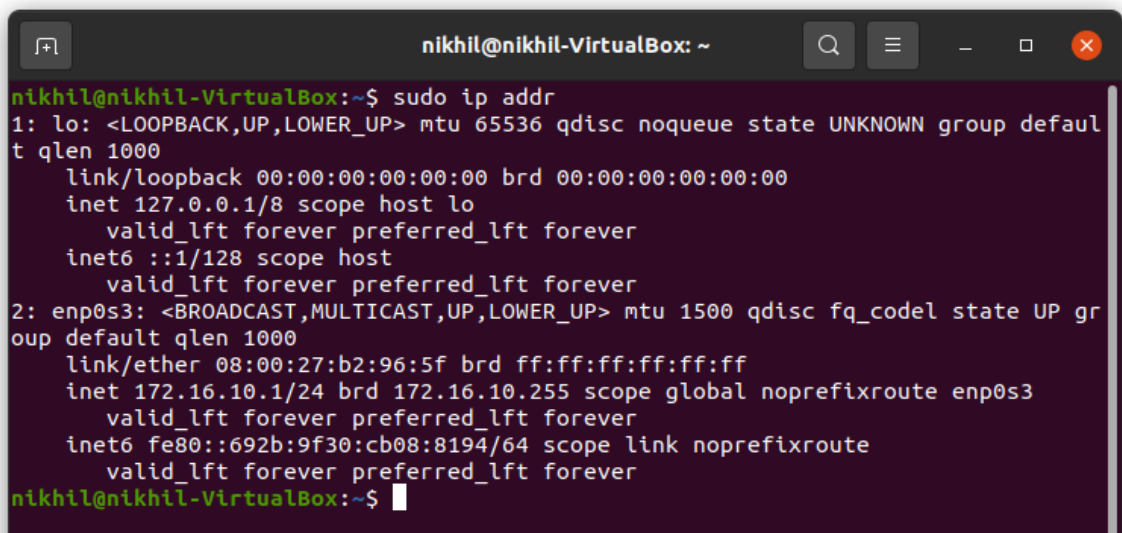
`sudo service apache2 status`



```
nikhil@nikhil-VirtualBox: ~  
nikhil@nikhil-VirtualBox:~$ sudo service apache2 status  
[sudo] password for nikhil:  
● apache2.service - The Apache HTTP Server  
   Loaded: loaded (/lib/systemd/system/apache2.service; enabled; vendor prese  
   Active: active (running) since Sun 2021-02-07 16:02:23 IST; 52min ago  
     Docs: https://httpd.apache.org/docs/2.4/  
   Process: 688 ExecStart=/usr/sbin/apachectl start (code=exited, status=0/SUC  
   Main PID: 738 (apache2)  
     Tasks: 55 (limit: 2316)  
    Memory: 7.2M  
     CGroup: /system.slice/apache2.service  
             └─738 /usr/sbin/apache2 -k start  
               └─739 /usr/sbin/apache2 -k start  
                 └─740 /usr/sbin/apache2 -k start  
  
Feb 07 16:02:16 nikhil-VirtualBox systemd[1]: Starting The Apache HTTP Server...  
Feb 07 16:02:23 nikhil-VirtualBox apachectl[713]: AH00558: apache2: Could not r  
Feb 07 16:02:23 nikhil-VirtualBox systemd[1]: Started The Apache HTTP Server.  
lines 1-16/16 (END)
```

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

`$sudo ip addr`



```
nikhil@nikhil-VirtualBox: ~$ sudo ip addr  
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default  
    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: enps0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP gr  
    link/ether 08:00:27:b2:96:5f brd ff:ff:ff:ff:ff:ff  
    inet 172.16.10.1/24 brd 172.16.10.255 scope global noprefixroute enps0  
        valid_lft forever preferred_lft forever  
    inet6 fe80::692b:9f30:cb08:8194/64 scope link noprefixroute  
        valid_lft forever preferred_lft forever  
nikhil@nikhil-VirtualBox:~$
```

## \$sudo nano /etc/apache2/apache2.conf

Set KeepAlive ON and MaxKeepAliveRequests to 2

```

nikhil@nikhil-VirtualBox: ~
GNU nano 4.8 /etc/apache2/apache2.conf
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

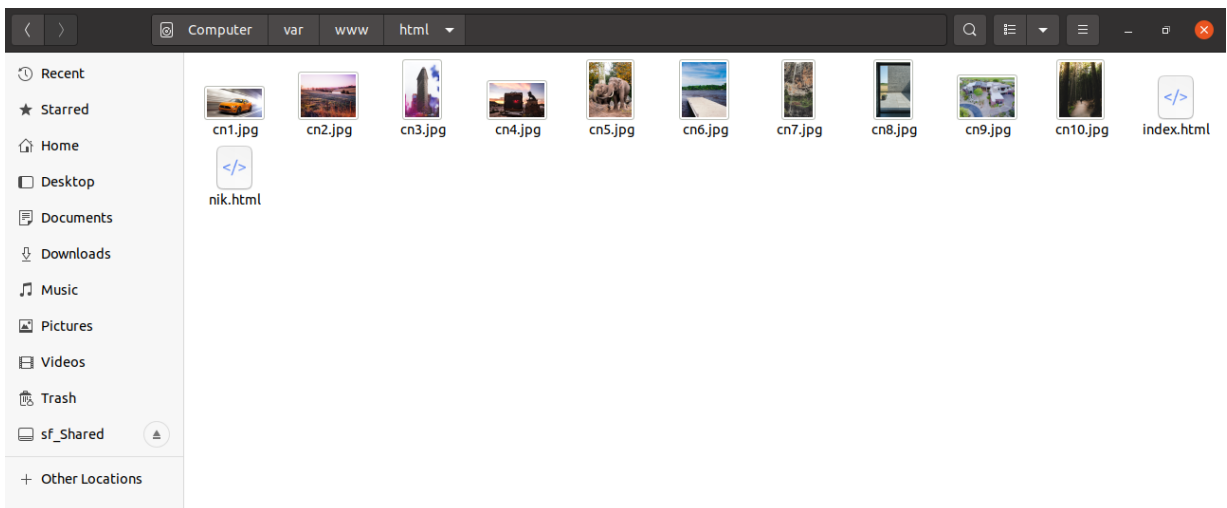
# These need to be set in /etc/apache2/envvars
User ${APACHE_RUN_USER}
Group ${APACHE_RUN_GROUP}

#
# HostnameLookups: Log the names of clients or just their IP addresses
# e.g., www.apache.org (on) or 204.62.129.132 (off).
# The default is off because it'd be overall better for the net if people
# had to knowingly turn this feature on, since enabling it means that
# each client request will result in AT LEAST one lookup request to the
# nameserver.
#

^G Get Help      ^O Write Out    ^W Where Is     ^K Cut Text      ^J Justify      ^C Cur Pos      M-U Undo        M-A Mark Text    M-I To Bracket
^X Exit          ^R Read File    ^\ Replace      ^U Paste Text   ^T To Spell     ^_ Go To Line    M-E Redo        M-B Copy Text   M-O Where Was

```

Store images in the server path `/var/www/html/`



## Prepare a web page

```
nik.html
/var/www/html

Open Save

1 <html>
2 <head>
3 <title> CN LAB </title>
4 </head>
5 <body>
6 
7 
8 
9 
10 
11 
12 
13 
14 
15 
16 </body>
17 </html>
```

## Client side:

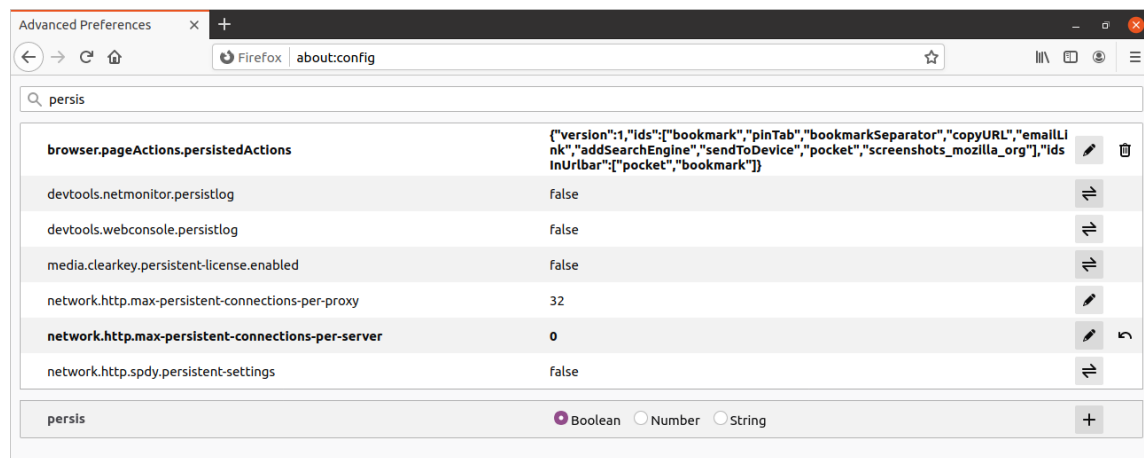
```
$sudo ip addr add 172.16.10.2/24 dev enps0
```

```
$sudo addr
```

```
nikhil@nikhil-VirtualBox: ~  
nikhil@nikhil-VirtualBox:~$ 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: enps0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000  
    link/ether 08:00:27:bd:2f:ab brd ff:ff:ff:ff:ff:ff  
    inet 172.16.10.2/24 brd 172.16.10.255 scope global noprefixroute enps0s3  
        valid_lft forever preferred_lft forever  
    inet6 fe80::26df:484b:1138:e598/64 scope link noprefixroute  
        valid_lft forever preferred_lft forever  
nikhil@nikhil-VirtualBox:~$
```

## PART 1: NON-PERSISTENT CONNECTION

set the value of max-persistent-connection-per-server to 0



use wireshark and capture the packets.

The screenshot shows a Wireshark packet capture on interface \*enps0s3. The packet list table is displayed with columns: No., Time, Source, Destination, Protocol, and Length. The packets are HTTP GET requests to various resources on 172.16.10.1.

No.	Time	Source	Destination	Protocol	Length
9	15.511124329	172.16.10.2	172.16.10.1	HTTP	404
11	15.511608923	172.16.10.1	172.16.10.2	HTTP	522
13	15.974206750	172.16.10.2	172.16.10.1	HTTP	351
780	16.978278205	172.16.10.1	172.16.10.2	HTTP	35389
786	17.073377623	172.16.10.2	172.16.10.1	HTTP	351
1379	17.724647774	172.16.10.1	172.16.10.2	HTTP	602
1386	17.846429724	172.16.10.2	172.16.10.1	HTTP	351
2253	18.627352634	172.16.10.1	172.16.10.2	HTTP	31045
2259	18.727653770	172.16.10.2	172.16.10.1	HTTP	351
3033	20.098544843	172.16.10.1	172.16.10.2	HTTP	23453
3038	20.216805439	172.16.10.2	172.16.10.1	HTTP	355
3040	20.427109682	172.16.10.1	172.16.10.2	HTTP	519
3048	20.428221175	172.16.10.2	172.16.10.1	HTTP	351
3806	21.288718684	172.16.10.1	172.16.10.2	HTTP	38285
3811	21.423349520	172.16.10.2	172.16.10.1	HTTP	351
4504	22.360582495	172.16.10.1	172.16.10.2	HTTP	28149
4509	22.470340965	172.16.10.2	172.16.10.1	HTTP	351
4695	23.125162896	172.16.10.2	172.16.10.1	HTTP	351
5430	23.715679405	172.16.10.1	172.16.10.2	HTTP	32213
5436	23.816565107	172.16.10.2	172.16.10.1	HTTP	351
6092	24.508732797	172.16.10.1	172.16.10.2	HTTP	38285
6098	24.613814712	172.16.10.2	172.16.10.1	HTTP	352

Here it is 24.613814712 - 15.511124329 = **9.102690383**

## PART 2: PERSISTENT CONNECTIONS

For 2 persistent connection

No.	Time	Source	Destination	Protocol	Length	Info
4	0.000794893	172.16.10.2	172.16.10.1	HTTP	404	GET /nik.html HTTP/1.1
6	0.001247874	172.16.10.1	172.16.10.2	HTTP	522	HTTP/1.1 200 OK (text/html)
8	0.752351600	172.16.10.2	172.16.10.1	HTTP	351	GET /cn1.jpg HTTP/1.1
175	0.818393237	172.16.10.2	172.16.10.1	HTTP	351	GET /cn2.jpg HTTP/1.1
1701	2.218835974	172.16.10.1	172.16.10.2	HTTP	26893	HTTP/1.1 200 OK (JPEG JFIF image)
1989	2.475653748	172.16.10.1	172.16.10.2	HTTP	6429	HTTP/1.1 200 OK (JPEG JFIF image)
1991	2.512434567	172.16.10.2	172.16.10.1	HTTP	355	GET /favicon.ico HTTP/1.1
1993	2.512746940	172.16.10.1	172.16.10.2	HTTP	519	HTTP/1.1 404 Not Found (text/html)
2001	2.519109880	172.16.10.2	172.16.10.1	HTTP	351	GET /cn3.jpg HTTP/1.1
2200	2.589646904	172.16.10.2	172.16.10.1	HTTP	351	GET /cn4.jpg HTTP/1.1
3413	3.288089953	172.16.10.1	172.16.10.2	HTTP	23805	HTTP/1.1 200 OK (JPEG JFIF image)
4028	3.820982582	172.16.10.1	172.16.10.2	HTTP	4981	HTTP/1.1 200 OK (JPEG JFIF image)
4035	3.923770123	172.16.10.2	172.16.10.1	HTTP	351	GET /cn5.jpg HTTP/1.1
4490	4.281545166	172.16.10.2	172.16.10.1	HTTP	351	GET /cn6.jpg HTTP/1.1
5085	4.683227177	172.16.10.1	172.16.10.2	HTTP	2085	HTTP/1.1 200 OK (JPEG JFIF image)
5396	4.979146858	172.16.10.2	172.16.10.1	HTTP	351	GET /cn7.jpg HTTP/1.1
6231	5.531890235	172.16.10.1	172.16.10.2	HTTP	42594	HTTP/1.1 200 OK (JPEG JFIF image)
6565	5.838108585	172.16.10.1	172.16.10.2	HTTP	55626	HTTP/1.1 200 OK (JPEG JFIF image)
6572	5.936401831	172.16.10.2	172.16.10.1	HTTP	351	GET /cn8.jpg HTTP/1.1
6797	6.037055977	172.16.10.2	172.16.10.1	HTTP	351	GET /cn9.jpg HTTP/1.1
8334	7.161406508	172.16.10.1	172.16.10.2	HTTP	21701	HTTP/1.1 200 OK (JPEG JFIF image)
8343	7.17124450	172.16.10.1	172.16.10.2	HTTP	13861	HTTP/1.1 200 OK (JPEG JFIF image)
8351	7.303254939	172.16.10.2	172.16.10.1	HTTP	352	GET /cn10.jpg HTTP/1.1
9669	7.942841606	172.16.10.1	172.16.10.2	HTTP	18013	HTTP/1.1 200 OK (JPEG JFIF image)

Frame 4: 404 bytes on wire (3232 bits), 404 bytes captured (3232 bits) on interface enp0s3, id 0  
Ethernet II, Src: PcsCompu\_bd:2f:ab (08:00:27:bd:2f:ab), Dst: PcsCompu\_b2:96:5f (08:00:27:b2:96:5f)  
Internet Protocol Version 4, Src: 172.16.10.2, Dst: 172.16.10.1  
Transmission Control Protocol, Src Port: 45116, Dst Port: 80, Seq: 1, Ack: 1, Len: 338

0000 08 00 27 b2 96 5f 08 00 27 bd 2f ab 08 00 45 00 ..'..\_..'/...E.

enp0s3: <live capture in progress> Packets: 9081 · Displayed: 24 (0.3%) Profile: Default

Here it is  $7.942841606 - 0.000794893 = 7.942046713$

For 4 persistent connection

No.	Time	Source	Destination	Protocol	Length	Info
4	0.000511912	172.16.10.2	172.16.10.1	HTTP	404	GET /nik.html HTTP/1.1
6	0.000862155	172.16.10.1	172.16.10.2	HTTP	522	HTTP/1.1 200 OK (text/html)
8	0.810004941	172.16.10.2	172.16.10.1	HTTP	351	GET /cn1.jpg HTTP/1.1
325	1.000620171	172.16.10.2	172.16.10.1	HTTP	351	GET /cn3.jpg HTTP/1.1
329	1.001090422	172.16.10.2	172.16.10.1	HTTP	351	GET /cn2.jpg HTTP/1.1
330	1.001090530	172.16.10.2	172.16.10.1	HTTP	351	GET /cn4.jpg HTTP/1.1
4154	3.025661340	172.16.10.1	172.16.10.2	HTTP	2277	HTTP/1.1 200 OK (JPEG JFIF image)
4617	3.321341838	172.16.10.1	172.16.10.2	HTTP	8965	HTTP/1.1 200 OK (JPEG JFIF image)
4723	3.429016464	172.16.10.1	172.16.10.2	HTTP	23805	HTTP/1.1 200 OK (JPEG JFIF image)
4828	3.530680043	172.16.10.2	172.16.10.1	HTTP	355	GET /favicon.ico HTTP/1.1
4830	3.530905814	172.16.10.1	172.16.10.2	HTTP	554	HTTP/1.1 404 Not Found (text/html)
4832	3.531337397	172.16.10.2	172.16.10.1	HTTP	351	GET /cn5.jpg HTTP/1.1
5172	3.764008855	172.16.10.1	172.16.10.2	HTTP	29965	HTTP/1.1 200 OK (JPEG JFIF image)
5318	3.936467827	172.16.10.2	172.16.10.1	HTTP	351	GET /cn6.jpg HTTP/1.1
5320	3.936773771	172.16.10.2	172.16.10.1	HTTP	351	GET /cn7.jpg HTTP/1.1
6116	4.284865766	172.16.10.2	172.16.10.1	HTTP	351	GET /cn8.jpg HTTP/1.1
8049	5.841437029	172.16.10.1	172.16.10.2	HTTP	602	HTTP/1.1 200 OK (JPEG JFIF image)
8283	6.006220791	172.16.10.1	172.16.10.2	HTTP	12221	HTTP/1.1 200 OK (JPEG JFIF image)
8642	6.353312085	172.16.10.1	172.16.10.2	HTTP	28149	HTTP/1.1 200 OK (JPEG JFIF image)
8812	6.592910565	172.16.10.2	172.16.10.1	HTTP	352	GET /cn10.jpg HTTP/1.1
8959	6.688175553	172.16.10.2	172.16.10.1	HTTP	351	GET /cn9.jpg HTTP/1.1
10093	7.199672770	172.16.10.1	172.16.10.2	HTTP	23770	HTTP/1.1 200 OK (JPEG JFIF image)
10863	7.575292810	172.16.10.1	172.16.10.2	HTTP	39698	HTTP/1.1 200 OK (JPEG JFIF image)
11451	7.984917770	172.16.10.1	172.16.10.2	HTTP	31269	HTTP/1.1 200 OK (JPEG JFIF image)

enp0s3: <live capture in progress> Packets: 11466 · Displayed: 24 (0.2%) Profile: Default

Here is it  $7.984917770 - 0.000511912 = 7.984405858$

For 6 persistent connection

No.	Time	Source	Destination	Protocol	Length	Info
4	0.000642497	172.16.10.2	172.16.10.1	HTTP	404	GET /nik.html HTTP/1.1
6	0.001060352	172.16.10.1	172.16.10.2	HTTP	522	HTTP/1.1 200 OK (text/html)
8	1.087222199	172.16.10.2	172.16.10.1	HTTP	351	GET /cn1.jpg HTTP/1.1
201	1.161675593	172.16.10.2	172.16.10.1	HTTP	351	GET /cn2.jpg HTTP/1.1
315	1.204521050	172.16.10.2	172.16.10.1	HTTP	351	GET /cn3.jpg HTTP/1.1
563	1.276481684	172.16.10.2	172.16.10.1	HTTP	351	GET /cn4.jpg HTTP/1.1
876	1.350623363	172.16.10.2	172.16.10.1	HTTP	351	GET /cn5.jpg HTTP/1.1
908	1.357336988	172.16.10.2	172.16.10.1	HTTP	351	GET /cn6.jpg HTTP/1.1
4629	2.808677618	172.16.10.1	172.16.10.2	HTTP	33941	HTTP/1.1 200 OK (JPEG JFIF image)
5770	3.658191606	172.16.10.1	172.16.10.2	HTTP	17093	HTTP/1.1 200 OK (JPEG JFIF image)
6214	3.973147900	172.16.10.2	172.16.10.1	HTTP	355	GET /favicon.ico HTTP/1.1
6216	3.973582860	172.16.10.1	172.16.10.2	HTTP	554	HTTP/1.1 404 Not Found (text/html)
7096	4.652175417	172.16.10.1	172.16.10.2	HTTP	15205	HTTP/1.1 200 OK (JPEG JFIF image)
7100	4.670512422	172.16.10.2	172.16.10.1	HTTP	351	GET /cn7.jpg HTTP/1.1
7452	4.860843367	172.16.10.1	172.16.10.2	HTTP	22357	HTTP/1.1 200 OK (JPEG JFIF image)
7547	4.927141085	172.16.10.2	172.16.10.1	HTTP	351	GET /cn8.jpg HTTP/1.1
8910	5.452219408	172.16.10.1	172.16.10.2	HTTP	3533	HTTP/1.1 200 OK (JPEG JFIF image)
9117	5.553265266	172.16.10.2	172.16.10.1	HTTP	351	GET /cn9.jpg HTTP/1.1
9205	5.562433172	172.16.10.2	172.16.10.1	HTTP	352	GET /cn10.jpg HTTP/1.1
9393	5.619327342	172.16.10.1	172.16.10.2	HTTP	15341	HTTP/1.1 200 OK (JPEG JFIF image)
11363	6.471522655	172.16.10.1	172.16.10.2	HTTP	13669	HTTP/1.1 200 OK (JPEG JFIF image)
12243	6.994852772	172.16.10.1	172.16.10.2	HTTP	602	HTTP/1.1 200 OK (JPEG JFIF image)
12977	7.567947682	172.16.10.1	172.16.10.2	HTTP	23770	HTTP/1.1 200 OK (JPEG JFIF image)
13254	7.831999115	172.16.10.1	172.16.10.2	HTTP	20909	HTTP/1.1 200 OK (JPEG JFIF image)

Frame 4: 404 bytes on wire (3232 bits), 404 bytes captured (3232 bits) on interface enp0s3, id 0  
Ethernet II, Src: PcsCompu\_bd:2f:ab (08:00:27:bd:2f:ab), Dst: PcsCompu\_b2:96:5f (08:00:27:b2:96:5f)  
Internet Protocol Version 4, Src: 172.16.10.2, Dst: 172.16.10.1  
Transmission Control Protocol, Src Port: 50370, Dst Port: 80, Seq: 1, Ack: 1, Len: 338

0000 08 00 27 b2 96 5f 08 00 27 bd 2f ab 08 00 45 00 ... ..E

enp0s3: <live capture in progress> Packets: 13273 · Displayed: 24 (0.2%) Profile: Default

Here it is  $7.831999115 - 0.000642497 = 7.831356618$

For 10 persistent connection

No.	Time	Source	Destination	Protocol	Length	Info
4	0.000678916	172.16.10.2	172.16.10.1	HTTP	404	GET /nik.html HTTP/1.1
6	0.001098162	172.16.10.1	172.16.10.2	HTTP	522	HTTP/1.1 200 OK (text/html)
8	0.984485229	172.16.10.2	172.16.10.1	HTTP	351	GET /cn1.jpg HTTP/1.1
114	1.008812794	172.16.10.2	172.16.10.1	HTTP	351	GET /cn2.jpg HTTP/1.1
323	1.093113931	172.16.10.2	172.16.10.1	HTTP	351	GET /cn3.jpg HTTP/1.1
453	1.139049872	172.16.10.2	172.16.10.1	HTTP	351	GET /cn4.jpg HTTP/1.1
618	1.201586163	172.16.10.2	172.16.10.1	HTTP	351	GET /cn5.jpg HTTP/1.1
847	1.268894740	172.16.10.2	172.16.10.1	HTTP	351	GET /cn6.jpg HTTP/1.1
1045	1.327514276	172.16.10.2	172.16.10.1	HTTP	351	GET /cn8.jpg HTTP/1.1
1047	1.327858654	172.16.10.2	172.16.10.1	HTTP	351	GET /cn7.jpg HTTP/1.1
1049	1.327977949	172.16.10.2	172.16.10.1	HTTP	351	GET /cn9.jpg HTTP/1.1
1826	1.549845887	172.16.10.2	172.16.10.1	HTTP	352	GET /cn10.jpg HTTP/1.1
8616	6.563475478	172.16.10.1	172.16.10.2	HTTP	60197	HTTP/1.1 200 OK (JPEG JFIF image)
9379	6.866205331	172.16.10.1	172.16.10.2	HTTP	12221	HTTP/1.1 200 OK (JPEG JFIF image)
9407	6.885329706	172.16.10.1	172.16.10.2	HTTP	3533	HTTP/1.1 200 OK (JPEG JFIF image)
9840	7.109468529	172.16.10.1	172.16.10.2	HTTP	52765	HTTP/1.1 200 OK (JPEG JFIF image)
10057	7.211385264	172.16.10.1	172.16.10.2	HTTP	29317	HTTP/1.1 200 OK (JPEG JFIF image)
10411	7.424949724	172.16.10.1	172.16.10.2	HTTP	23997	HTTP/1.1 200 OK (JPEG JFIF image)
10413	7.439275644	172.16.10.2	172.16.10.1	HTTP	355	GET /favicon.ico HTTP/1.1
10415	7.439503641	172.16.10.1	172.16.10.2	HTTP	554	HTTP/1.1 404 Not Found (text/html)
10609	7.600965831	172.16.10.1	172.16.10.2	HTTP	7597	HTTP/1.1 200 OK (JPEG JFIF image)
10711	7.676434861	172.16.10.1	172.16.10.2	HTTP	25701	HTTP/1.1 200 OK (JPEG JFIF image)
10995	7.869037027	172.16.10.1	172.16.10.2	HTTP	4653	HTTP/1.1 200 OK (JPEG JFIF image)
11298	8.129192639	172.16.10.1	172.16.10.2	HTTP	34301	HTTP/1.1 200 OK (JPEG JFIF image)

enp0s3: <live capture in progress> Packets: 11335 · Displayed: 24 (0.2%) Profile: Default

Here it is  $8.129192639 - 0.000678916 = 8.128513723$

## OBSERVATIONS

Persistent Type	End Time	Start Time	Total Time Elapsed (End Time-Start Time)
Non Persistent	24.613814712	15.511124329	9.102690383
2 persistent	7.942841606	0.000794893	7.942046713
4 persistent	7.984917770	0.000511912	7.984405858
6 persistent	7.831999115	0.000642497	7.831356618
10 persistent	8.129192639	0.000678916	8.128513723

According to my observations based on the above results the 6 Persistent connection is optimal for best performance as it have less time elapsed compared to zero persistent and others.so I conclude 6 persistent connection is optimal for best performance.