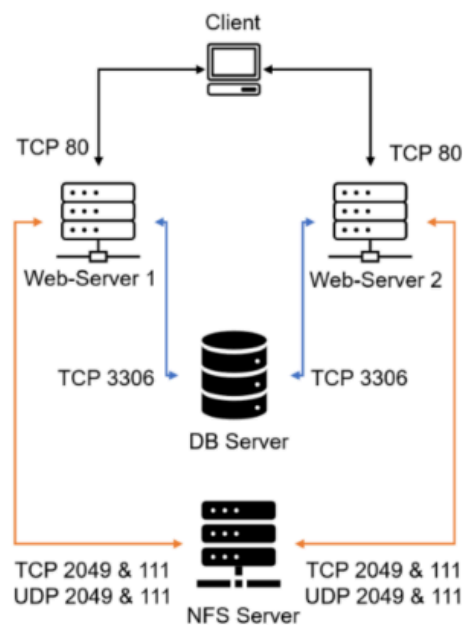


Load Balancer Solution With Apache

A Load Balancer (LB) distributes clients' requests among underlying Servers and makes sure that the load is distributed optimally.

The diagram below shows the architecture of the solution



← Client traffic
← DB traffic
← NFS traffic

Prerequisite configuration:

- Apache (httpd) process is up and **running** on both Web Servers
- '/var/www' directories of both Web servers are mounted to '/mnt/apps' of NFS server
- All necessary TCP/UDP ports are open on Web, DB and NFS servers
- Client browser can access both Web Servers by their respective Public IP addresses or Public DNS names and can open the **Tooling Website** (e.g. <http://<Public-IP-Address-or-Public-DNS-Name>/index.php>)

Task

Deploy and configure an Apache Load Balancer for Tooling Website solution on a separate Ubuntu EC2 instance. Make sure that users can be served by Web servers through the Load Balancer.

Prerequisites

Ensure that the following servers are installed and configured already.

- Two RHEL9 Web Servers
- One MySQL DB Server (based on Ubuntu 24.04)
- One RHEL9 NFS Server

Prerequisites Configurations

- Apache (httpd) is up and running on both Web Servers.
- '/var/www' directories of both Web Servers are mounted to '/mnt/apps' of the NFS Server.
- All necessary TCP/UDP ports are opened on Web, DB and NFS Servers.

- Client browsers can access both Web Servers by their Public IP addresses or Public DNS names and can open the 'Tooling Website' (e.g, 'http://<Public-IP-Address-or-Public-DNS-Name>/index.php')

Step 1 - Configure Apache As A Load Balancer

1. Create an Ubuntu Server 24.04 EC2 instance and name it Project-8-apache-lb

following the simple steps below.

Name and tags [Info](#)

Name

Project-8-apache-lb

[Add tags](#)

2. Open TCP port 80 on Project-8-apache-lb by creating an Inbound Rule in the Security Group

Security group rule ID	Type Info	Protocol Info	Port range Info	Source Info
r-04a8289d5671c25b8	SSH ▼	TCP	22	Cust... ▼ <div>0.0.0.0/0 ✕</div>
r-06b7aef6f8696dae1	HTTPS ▼	TCP	443	Cust... ▼ <div>0.0.0.0/0 ✕</div>
	HTTP ▼	TCP	80	Any... ▼ <div>0.0.0.0/0 ✕</div>

3. Install Apache Load Balancer on Project-8-apache-lb and configure it to point traffic coming to LB to both Web Servers.

i. Install Apache2

- Access the instance

```
ssh -i "MEAN.pem" ubuntu@ec2-54-145-97-90.compute-1.amazonaws.com
```

The programs included with the Ubuntu system are free software; the exact distribution terms for each program are described in the individual files in /usr/share/doc/*/copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by applicable law.

To run a command as administrator (user "root"), use "sudo <command>". See "man sudo_root" for details.

```
ubuntu@ip-172-31-34-168:~$ sudo apt update && sudo apt upgrade -y
```

- Update and upgrade Ubuntu

```
sudo apt update && sudo apt upgrade -y
```

- Install Apache

```
sudo apt install apache2 -y
```

Restarting the system to load the new kernel will not be handled automatically. Consider rebooting.

Restarting services...

Service restarts being deferred:

```
systemctl restart unattended-upgrades.service
```

No containers need to be restarted.

No user sessions are running outdated binaries.

No VM guests are running outdated hypervisor (qemu) binaries on this host.

```
ubuntu@ip-172-31-34-168:~$ sudo apt install apache2 -y
```

```
sudo apt-get install libxml2-dev -y
```

```
*** System restart required ***
Last login: Sat Oct 26 14:34:12 2024 from 102.88.81.235
ubuntu@ip-172-31-34-168:~$ sudo apt-get install libxml2-dev -y
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  fontconfig-config fonts-dejavu-core fonts-dejavu-mono icu-devtools libaom3
  libcrypt-dev libde265-0 libdeflate0 libfontconfig1 libgd3 libheif-plugin-aom
  libheif-plugin-libde265 libheif1 libicu-dev libjbig0 libjpeg-turbo8 libjpeg
  libxpm4 linux-libc-dev manpages-dev rpcsvc-proto
Suggested packages:
  glibc-doc libgd-tools libheif-plugin-x265 libheif-plugin-ffmpegdec libheif-
  libheif-plugin-j2kdec libheif-plugin-j2kenc libheif-plugin-rav1e libheif-pl
The following NEW packages will be installed:
  fontconfig-config fonts-dejavu-core fonts-dejavu-mono icu-devtools libaom3
  libcrypt-dev libde265-0 libdeflate0 libfontconfig1 libgd3 libheif-plugin-aom
  libheif-plugin-libde265 libheif1 libicu-dev libjbig0 libjpeg-turbo8 libjpeg
```

ii. Enable the following modules

```
,
sudo a2enmod rewrite

sudo a2enmod proxy

sudo a2enmod proxy_balancer

sudo a2enmod proxy_http

sudo a2enmod headers

sudo a2enmod lbmethod_bytraffic
,
```

```

ubuntu@ip-172-31-34-168:~$ sudo a2enmod proxy_balancer
Considering dependency proxy for proxy_balancer:
Module proxy already enabled
Considering dependency alias for proxy_balancer:
Module alias already enabled
Considering dependency slotmem_shm for proxy_balancer:
Enabling module slotmem_shm.
Enabling module proxy_balancer.
To activate the new configuration, you need to run:
    systemctl restart apache2
ubuntu@ip-172-31-34-168:~$ sudo a2enmod proxy_http
Considering dependency proxy for proxy_http:
Module proxy already enabled
Enabling module proxy_http.
To activate the new configuration, you need to run:
    systemctl restart apache2
ubuntu@ip-172-31-34-168:~$
sudo a2enmod lbmethod_bytraffic
Considering dependency proxy_balancer for lbmethod_bytraffic:
Considering dependency proxy for proxy_balancer:
Module proxy already enabled
Considering dependency alias for proxy_balancer:
Module alias already enabled
Considering dependency slotmem_shm for proxy_balancer:
Module slotmem_shm already enabled
Module proxy_balancer already enabled

```

iii. Restart Apache2 Service

```

,
sudo systemctl restart apache2
sudo systemctl status apache2
,

```

```

ubuntu@ip-172-31-34-168:~$ sudo systemctl status apache2
● apache2.service - The Apache HTTP Server
   Loaded: loaded (/usr/lib/systemd/system/apache2.service; enabled; preset: enabled)
   Active: active (running) since Sat 2024-10-26 19:16:11 UTC; 1min 8s ago
     Docs: https://httpd.apache.org/docs/2.4/
  Process: 13978 ExecStart=/usr/sbin/apachectl start (code=exited, status=0/SUCCESS)
 Main PID: 13981 (apache2)
    Tasks: 55 (limit: 1130)
   Memory: 5.5M (peak: 5.6M)
      CPU: 27ms
   CGroup: /system.slice/apache2.service
           └─13981 /usr/sbin/apache2 -k start
             └─13983 /usr/sbin/apache2 -k start
               └─13984 /usr/sbin/apache2 -k start

```

Configure Load Balancing

- i. Open the file 000-default.conf in sites-available

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

- ii. Add this configuration into the section '<VirtualHost *:80>
</VirtualHost>'

```
'apache  
<Proxy "balancer://mycluster">  
    BalancerMember http://18.209.173.19:80 loadfactor=5 timeout=1  
    BalancerMember http://54.162.250.21:80 loadfactor=5 timeout=1  
    ProxySet lbmethod=bytraffic  
</Proxy>
```

```
ProxyPreserveHost on  
ProxyPass / balancer://mycluster/  
ProxyPassReverse / balancer://mycluster/  
'  
![Server config](./images/9.png)
```

- iii. Restart Apache

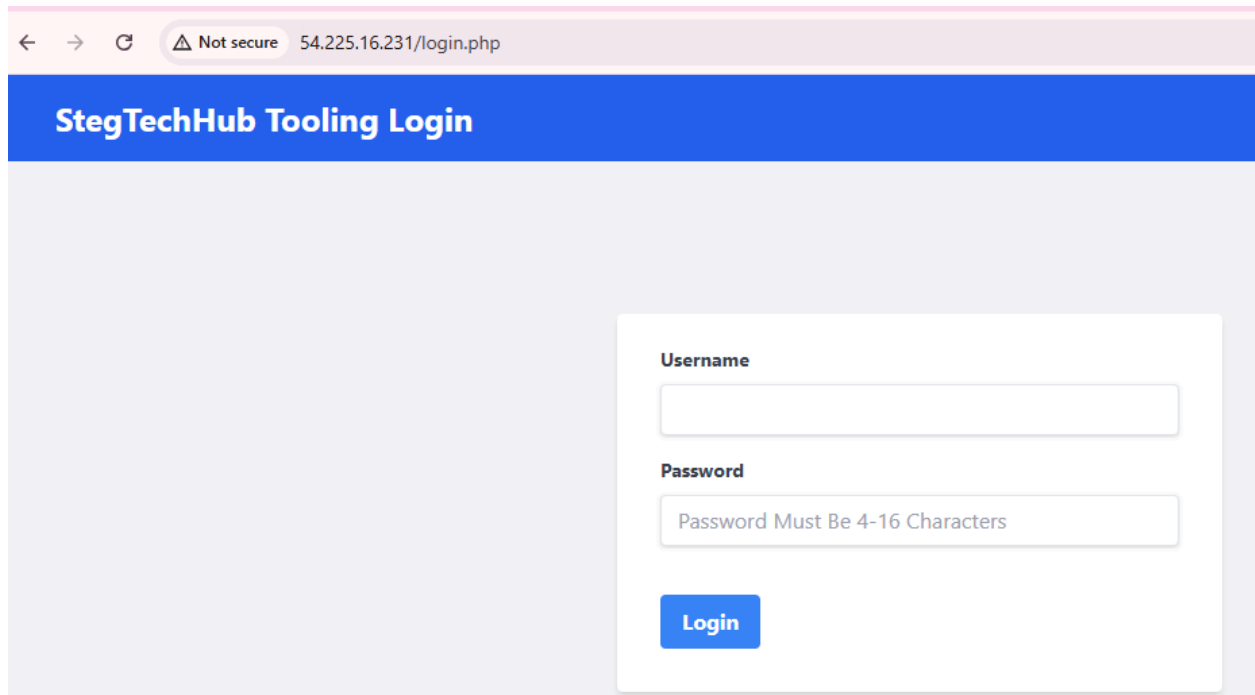
```
'  
sudo systemctl restart apache2  
'  
![Restart apache](./images/10.png)
```

'bytraffic' balancing method with distributing incoming loads between the Web Servers according to current traffic load. The proportion in which traffic must be distributed can be controlled by 'loadfactor' parameter.

Other methods such as 'bybusyness', 'byrequests', 'heartbeat' can also be adopted.

4. Verify that the configuration works

- i. Access the website using the LB's Public IP address or the Public DNS name from a browser



← → ↻ ⚠ Not secure 54.225.16.231/login.php

StegTechHub Tooling Login

Username

Password

Password Must Be 4-16 Characters

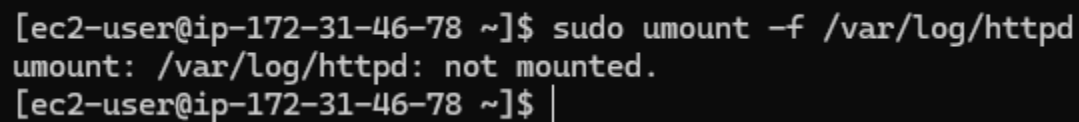
Login

Note: If in the previous project, '/var/log/httpd' was mounted from the Web Server to the NFS Server, unmount them and ensure that each Web Servers has its own log directory.

ii. Unmount the NFS directory

- Check if the Web Server's log directory is mounted to NSF

```
'  
df -h  
sudo umount -f /var/log/httpd
```



```
[ec2-user@ip-172-31-46-78 ~]$ sudo umount -f /var/log/httpd  
umount: /var/log/httpd: not mounted.  
[ec2-user@ip-172-31-46-78 ~]$ |
```

If the directory is busy, the services using it need to be stopped first.

```
'  
sudo systemctl stop httpd  
sudo umount -f /var/log/httpd  
sudo systemctl start httpd  
df -h
```

```
sudo systemctl status httpd
```

```
,
```

```
- Check that the directory is unmounted
```

```
,
```

```
df -h
```

```
,
```

```
Last login: Sun Oct 27 19:03:30 2024 from 102.00.71.122
[ec2-user@ip-172-31-37-220 ~]$ df -h
Filesystem                Size      Used Avail Use% Mounted on
devtmpfs                   4.0M         0   4.0M   0% /dev
tmpfs                      1.8G         0   1.8G   0% /dev/shm
tmpfs                      732M       17M   715M   3% /run
/dev/xvda4                 8.8G       2.5G   6.3G  29% /
/dev/xvda3                 960M       264M   697M  28% /boot
/dev/xvda2                 200M        7.1M   193M   4% /boot/efi
tmpfs                      366M         0   366M   0% /run/user/1000
172.31.33.202:/mnt/apps    9.0G       97M   8.9G   2% /var/www
[ec2-user@ip-172-31-37-220 ~]$ sudo umount -f /var/log/httpd
umount: /var/log/httpd: not mounted.
[ec2-user@ip-172-31-37-220 ~]$
```

iii. Open two ssh consoles for both Web Server and run the command:

```
,
```

```
sudo tail -f /var/log/httpd/access_log
```

```
,
```

```
Web Server 1 & 2 'access_log'
```

```
Weserver 1
```



```

172.31.33.202:/mnt/apps 9.0G 97M 8.9G 2% /var/www
[ec2-user@ip-172-31-37-220 ~]$ sudo umount -f /var/log/httpd
umount: /var/log/httpd: not mounted.
[ec2-user@ip-172-31-37-220 ~]$ sudo tail -f /var/log/httpd/access_log
102.88.71.122 - - [27/Oct/2024:20:37:18 +0000] "GET /img/prometheus.png HTTP/1.1" 200 22884 "http://54.197.214.62/admin_tooling.php" "Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/130.0.0.0 Safari/537.36"
102.88.71.122 - - [27/Oct/2024:20:37:18 +0000] "GET /img/rancher.png HTTP/1.1" 200 13649 "http://54.197.214.62/admin_tooling.php" "Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/130.0.0.0 Safari/537.36"
102.88.71.122 - - [27/Oct/2024:20:37:18 +0000] "GET /img/kibana.png HTTP/1.1" 200 43059 "http://54.197.214.62/admin_tooling.php" "Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/130.0.0.0 Safari/537.36"
102.88.71.122 - - [27/Oct/2024:20:37:18 +0000] "GET /img/jfrog.png HTTP/1.1" 200 62998 "http://54.197.214.62/admin_tooling.php" "Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/130.0.0.0 Safari/537.36"
222.247.115.36 - - [27/Oct/2024:20:44:23 +0000] "POST /GponForm/diag_Form?images/ HTTP/1.1" 404 196 "-" "Hello, World"
46.174.191.28 - - [27/Oct/2024:20:46:07 +0000] "GET / HTTP/1.0" 302 2116 "-" "Mozilla/5.0 (Windows NT 6.1; WOW64; Trident/7.0; AS; rv:11.0) like Gecko"
172.31.34.168 - - [27/Oct/2024:20:52:23 +0000] "GET / HTTP/1.1" 302 2116 "-" "Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/130.0.0.0 Safari/537.36"
172.31.34.168 - - [27/Oct/2024:20:52:28 +0000] "GET /favicon.ico HTTP/1.1" 404 196 "http://54.225.16.231/login.php" "Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko"

```

Webserver 2

```

[ec2-user@ip-172-31-46-78 ~]$ sudo umount -f /var/log/httpd
umount: /var/log/httpd: not mounted.
[ec2-user@ip-172-31-46-78 ~]$ sudo tail -f /var/log/httpd/access_log
89.217.53.239 - - [27/Oct/2024:20:01:05 +0000] "GET / HTTP/1.0" 403 5909 "-" "Mozilla/5.0 (Linux; U; Android 4.0.3; ko-kr; LG-L160L Build/IML74K) AppleWebKit/534.30 (KHTML, like Gecko) Version/4.0 Mobile Safari/534.30"
93.174.93.12 - - [27/Oct/2024:20:05:36 +0000] "GET / HTTP/1.0" 403 5909 "-" "Mozilla/5.0 (X11; Linux x86_64) AppleWebKit/537.36 (KHTML, like Gecko) Ubuntu Chromium/75.0.3770.142 Chrome/75.0.3770.142 Safari/537.36"
102.88.71.122 - - [27/Oct/2024:20:08:03 +0000] "GET / HTTP/1.1" 403 5909 "-" "Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/130.0.0.0 Safari/537.36"
102.88.71.122 - - [27/Oct/2024:20:09:58 +0000] "GET / HTTP/1.1" 302 638 "-" "Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/130.0.0.0 Safari/537.36"
102.88.71.122 - - [27/Oct/2024:20:09:59 +0000] "GET /login.php HTTP/1.1" 200 2283 "-" "Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/130.0.0.0 Safari/537.36"
102.88.71.122 - - [27/Oct/2024:20:17:01 +0000] "GET /login.php HTTP/1.1" 200 2283 "-" "Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/130.0.0.0 Safari/537.36"
102.88.71.122 - - [27/Oct/2024:20:32:44 +0000] "GET /login.php HTTP/1.1" 200 2283 "-" "Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/130.0.0.0 Safari/537.36"
102.88.71.122 - - [27/Oct/2024:20:33:36 +0000] "-" 408 - "-" "-"
172.31.34.168 - - [27/Oct/2024:20:52:23 +0000] "GET /login.php HTTP/1.1" 200 2283 "-" "Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/130.0.0.0 Safari/537.36"
172.31.34.168 - - [27/Oct/2024:20:52:34 +0000] "GET /login.php HTTP/1.1" 200 2283 "-" "Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/130.0.0.0 Safari/537.36"

```

iv. Refresh the browser page several times and ensure both Web Servers receive HTTP and GET requests. New records must appear in each web server log files. The number of request to each servers will be approximately the

same since 'loadfactor' is set to the same value for both servers. This means that traffic will be evenly distributed between them. After the refresh.

```
172.31.34.168 - - [27/Oct/2024:21:14:16 +0000] "GET /login.php HTTP/1.1" 200 2283 "-" "Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/130.0.0.0 Safari/537.36"
172.31.34.168 - - [27/Oct/2024:21:14:17 +0000] "GET /login.php HTTP/1.1" 200 2283 "-" "Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/130.0.0.0 Safari/537.36"
172.31.34.168 - - [27/Oct/2024:21:14:19 +0000] "GET /login.php HTTP/1.1" 200 2283 "-" "Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/130.0.0.0 Safari/537.36"
```

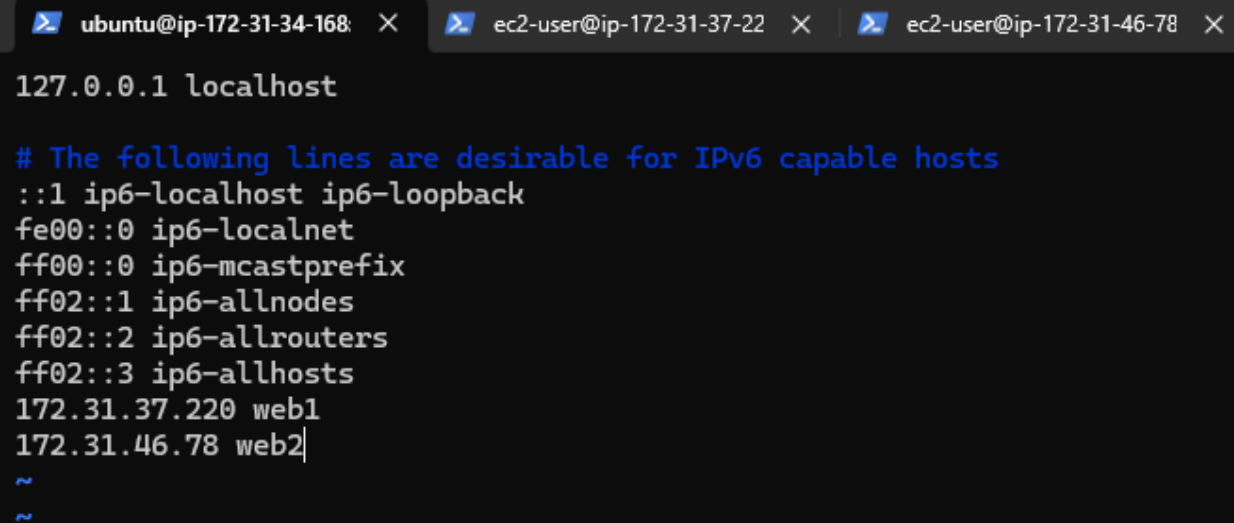
Sometimes it is tedious to remember and switch between IP addresses, especially if there are lots of servers to manage. It is best to configure local domain name resolution. The easiest way is use '/etc/hosts' file, although this approach is not very scalable, but it is very easy to configure and shows the concept well.

Configure the IP address to domain name mapping for our Load Balancer.

Open the hosts file on your lb server

```
'
sudo vi /etc/hosts
'
```

Add two records into file with Local IP address and arbitrary name for the Web Servers



```
ubuntu@ip-172-31-34-168 × ec2-user@ip-172-31-37-22 × ec2-user@ip-172-31-46-78 ×
127.0.0.1 localhost

# The following lines are desirable for IPv6 capable hosts
::1 ip6-localhost ip6-loopback
fe00::0 ip6-localnet
ff00::0 ip6-mcastprefix
ff02::1 ip6-allnodes
ff02::2 ip6-allrouters
ff02::3 ip6-allhosts
172.31.37.220 web1
172.31.46.78 web2
~
~
```

Update the LB config file with those arbitrary names instead of IP addresses on the LB server.

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

```
'  
'  
BalancerMember http://webserver1:80 loadfactor=5 timeout=1  
BalancerMember http://webserver2:80 loadfactor=5 timeout=1  
'
```

```
ErrorLog ${APACHE_LOG_DIR}/error.log  
CustomLog ${APACHE_LOG_DIR}/access.log combined  
  
# 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  
# following line enables the CGI configuration for this host only  
# after it has been globally disabled with "a2disconf".  
#Include conf-available/serve-cgi-bin.conf  
  
<Proxy "balancer://mycluster">  
    BalancerMember http://web1:80 loadfactor=5 timeout=1  
    BalancerMember http://web2:80 loadfactor=5 timeout=1  
    ProxySet lbmethod=bytraffic  
</Proxy>
```

Try to curl the Web Servers from LB locally

```
'  
curl http://web1
```

```

"/etc/apache2/sites-available/000-default.conf" 42L, 1691B Written
ubuntu@ip-172-31-34-168:~$ curl http://web1
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <title>StegTechHub Tooling</title>
  <link href="https://cdn.jsdelivr.net/npm/tailwindcss@2.2.19/dist/tailwind.min.css" rel="stylesheet">
</head>
<body class="bg-gray-100 min-h-screen flex flex-col justify-between">
  <header class="bg-blue-600 text-white p-4">
    <div class="container mx-auto flex justify-between items-center">
      <h1 class="text-2xl font-bold">StegTechHub TOOLING</h1>
      <nav>
        <span class="text-white hover:text-gray-200 mr-4"> ()</span>
        <a href="index.php?logout='1'" class="bg-white text-blue-600 px-4 py-2 rounded hover:bg-gray-100">Logout</a>
      </nav>
    </div>
  </header>

  <main class="container mx-auto mt-8">

    <div class="bg-white shadow-md rounded px-8 pt-6 pb-8 mb-4">
      <div class="">
        <strong class="text-gray-700">Welcome, </strong>
        <p class="text-sm text-gray-600">()</p>
      </div>
    </div>

```

```

'
curl http://web2
'

```

```

ubuntu@ip-172-31-34-168:~$ curl http://web2
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <title>StegTechHub Tooling</title>
  <link href="https://cdn.jsdelivr.net/npm/tailwindcss@2.2.19/dist/tailwind.min.css" rel="stylesheet">
</head>
<body class="bg-gray-100 min-h-screen flex flex-col justify-between">
  <header class="bg-blue-600 text-white p-4">
    <div class="container mx-auto flex justify-between items-center">
      <h1 class="text-2xl font-bold">StegTechHub TOOLING</h1>
      <nav>
        <span class="text-white hover:text-gray-200 mr-4"> ()</span>
        <a href="index.php?logout='1'" class="bg-white text-blue-600 px-4 py-2 rounded hover:bg-gray-100">Logout</a>
      </nav>
    </div>
  </header>

  <main class="container mx-auto mt-8">

```

Remember, This is only internal configuration and also local to the LB server, these names will neither be 'resolvable' from other servers internally nor from the Internet.

Now your set up looks like this:

