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Course/Section: CPE232 - CPE31S22	**Date Submitted: 8/16/2022**
Instructor: Dr. Jonathan Taylar	**Semester and SY: 1st Sem 2022-2023**

Activity 1: Configure Network using Virtual Machines

1. **Objectives:**

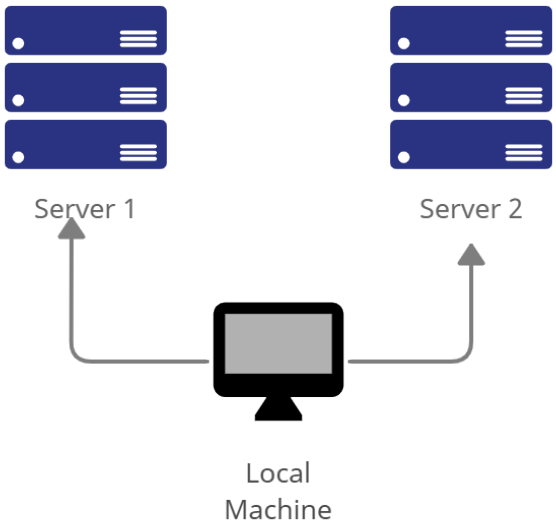
1.1. Create and configure Virtual Machines in Microsoft Azure or VirtualBox

1.2. Set-up a Virtual Network and Test Connectivity of VMs

2. **Discussion:**

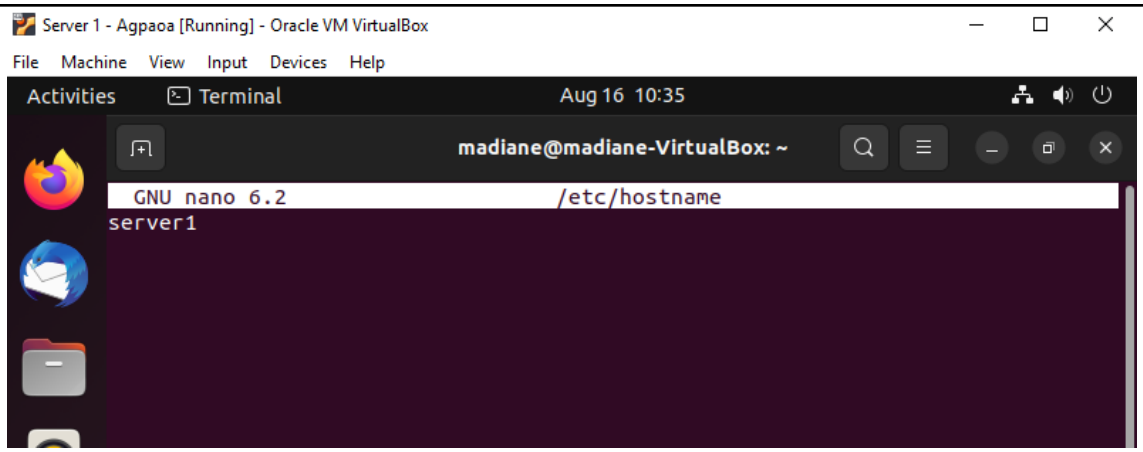
Network Topology:

Assume that you have created the following network topology in Virtual Machines, *provide screenshots for each task*. (Note: *it is assumed that you have the prior knowledge of cloning and creating snapshots in a virtual machine*).

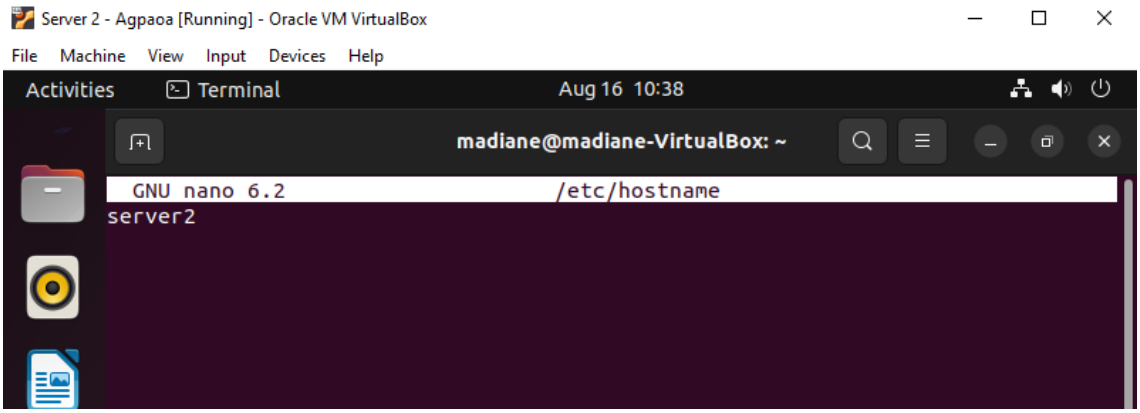


Task 1: Do the following on Server 1, Server 2, and Local Machine. In editing the file using nano command, press control + O to write out (save the file). Press enter when asked for the name of the file. Press control + X to end.

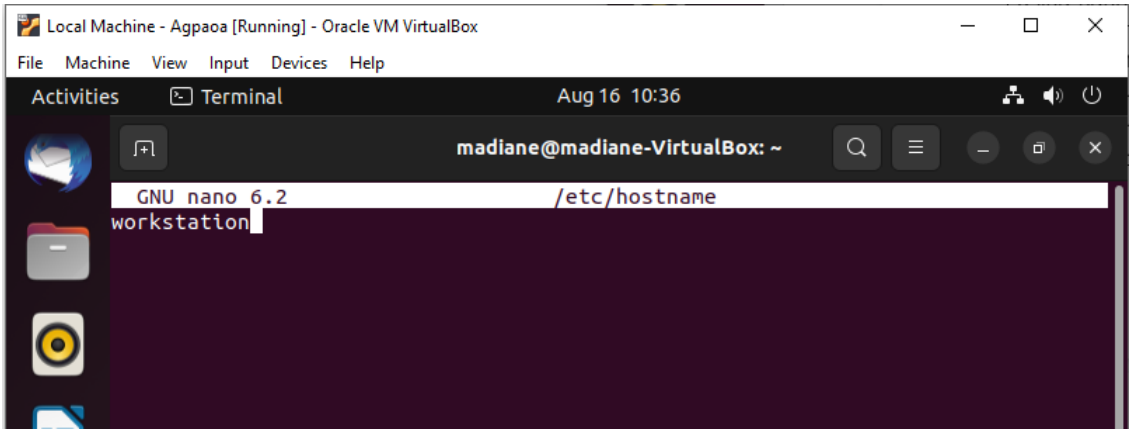
1. Change the hostname using the command *sudo nano /etc/hostname*
   1.1 Use server1 for Server 1
   1.2 Use server2 for Server 2
   1.3 Use workstation for the Local Machine



Changing the hostname to server1 for Server 1.

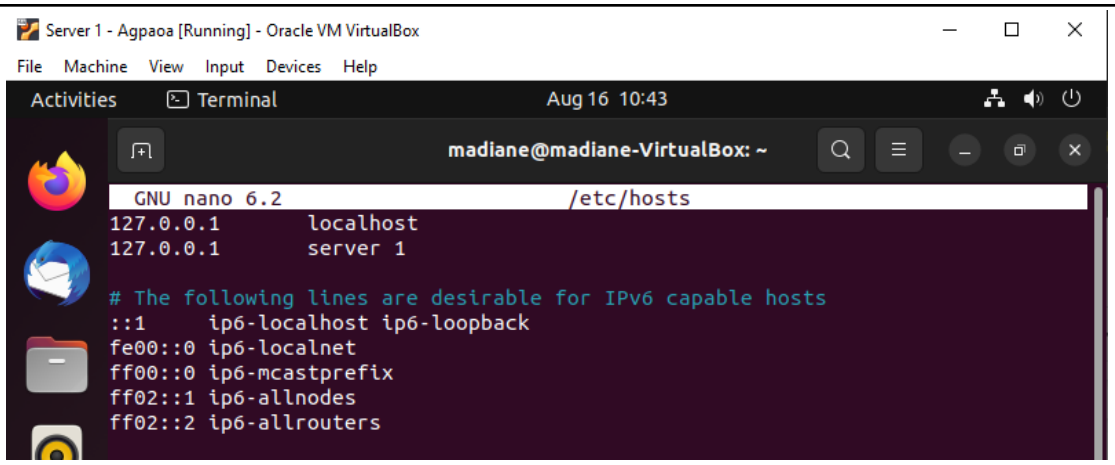


Changing the hostname to server2 for Server 2.

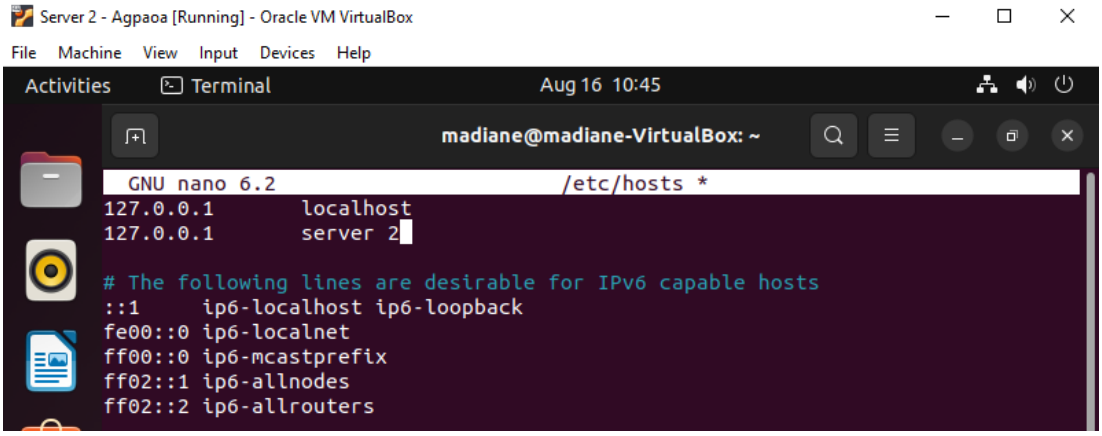


Changing the hostname to workstation for Local Machine.

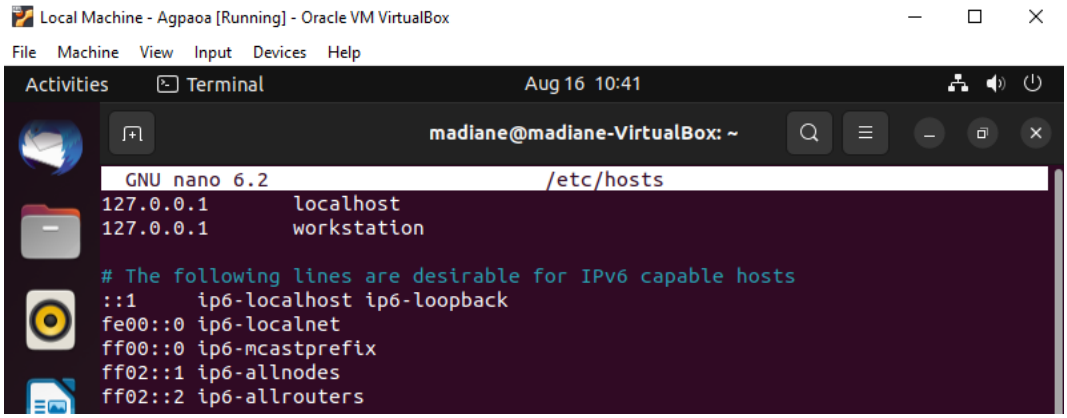
2. Edit the hosts using the command *sudo nano /etc/hosts*. Edit the second line.
   2.1 Type 127.0.0.1 server 1 for Server 1
   2.2 Type 127.0.0.1 server 2 for Server 2
   2.3 Type 127.0.0.1 workstation for the Local Machine



Edited the second line to 127.0.0.1 server 1 for Server 1.



Edited the second line to 127.0.0.1 server 2 for Server 2.



Edited the second line to 127.0.0.1 workstation for Local Machine.

Task 2: Configure SSH on Server 1, Server 2, and Local Machine. Do the following:

1. Upgrade the packages by issuing the command *sudo apt update* and *sudo apt upgrade* respectively.

```
madiane@server1:~$ sudo apt update
[sudo] password for madiane:
Hit:1 http://security.ubuntu.com/ubuntu jammy-security InRelease
Hit:2 http://ph.archive.ubuntu.com/ubuntu jammy InRelease
Hit:3 http://ph.archive.ubuntu.com/ubuntu jammy-updates InRelease
Hit:4 http://ph.archive.ubuntu.com/ubuntu jammy-backports InRelease
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
3 packages can be upgraded. Run 'apt list --upgradable' to see them.
madiane@server1:~$ sudo apt upgrade
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
Calculating upgrade... Done
The following packages have been kept back:
  python3-software-properties software-properties-common
  software-properties-gtk
0 upgraded, 0 newly installed, 0 to remove and 3 not upgraded.
```

Server 1

```
madiane@server2:~$ sudo apt update
[sudo] password for madiane:
Hit:1 http://security.ubuntu.com/ubuntu jammy-security InRelease
Hit:2 http://ph.archive.ubuntu.com/ubuntu jammy InRelease
Hit:3 http://ph.archive.ubuntu.com/ubuntu jammy-updates InRelease
Hit:4 http://ph.archive.ubuntu.com/ubuntu jammy-backports InRelease
Files g package lists... Done
Building dependency tree... Done
Reading state information... Done
3 packages can be upgraded. Run 'apt list --upgradable' to see them.
madiane@server2:~$ sudo apt upgrade
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
Calculating upgrade... Done
The following packages have been kept back:
  python3-software-properties software-properties-common
  software-properties-gtk
0 upgraded, 0 newly installed, 0 to remove and 3 not upgraded.
madiane@server2:~$
```

Server 2

```
madiane@workstation:~$ sudo apt update
[sudo] password for madiane:
Hit:1 http://ph.archive.ubuntu.com/ubuntu jammy InRelease
Hit:2 http://security.ubuntu.com/ubuntu jammy-security InRelease
Hit:3 http://ph.archive.ubuntu.com/ubuntu jammy-updates InRelease
Hit:4 http://ph.archive.ubuntu.com/ubuntu jammy-backports InRelease
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
3 packages can be upgraded. Run 'apt list --upgradable' to see them.
madiane@workstation:~$ sudo apt upgrade
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
Calculating upgrade... Done
The following packages have been kept back:
  python3-software-properties software-properties-common
  software-properties-gtk
0 upgraded, 0 newly installed, 0 to remove and 3 not upgraded.
madiane@workstation:~$
```

Local Machine

I upgrade the packages of Server 1, Server 2 and Local Machine using the command sudo apt update and sudo apt upgrade.

2. Install the SSH server using the command *sudo apt install openssh-server*.

```
madiane@server1:~$ sudo apt install openssh-server
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
openssh-server is already the newest version (1:8.9p1-3).
0 upgraded, 0 newly installed, 0 to remove and 3 not upgraded.
```

Server 1

```
madiane@server2:~$ sudo apt install openssh-server
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
openssh-server is already the newest version (1:8.9p1-3).
0 upgraded, 0 newly installed, 0 to remove and 3 not upgraded.
```

Server 2

```
madiane@workstation:~$ sudo apt install openssh-server
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
openssh-server is already the newest version (1:8.9p1-3).
0 upgraded, 0 newly installed, 0 to remove and 3 not upgraded.
```

Local Machine

I installed the SSH server in Server 1, Server 2, and Local Machine using the command sudo apt install openssh-server.

3. Verify if the SSH service has started by issuing the following commands:
   3.1 sudo service ssh start
   3.2 sudo systemctl status ssh

```
madiane@madiane-VirtualBox:~$ sudo service ssh start
madiane@madiane-VirtualBox:~$ sudo systemctl status ssh
● ssh.service - OpenBSD Secure Shell server
     Loaded: loaded (/lib/systemd/system/ssh.service; enabled; vendor preset: >
     Active: active (running) since Tue 2022-08-16 10:55:55 PST; 6min ago
       Docs: man:sshd(8)
             man:sshd_config(5)
   Main PID: 4040 (sshd)
      Tasks: 1 (limit: 1079)
     Memory: 1.7M
        CPU: 33ms
     CGroup: /system.slice/ssh.service
             └─4040 "sshd: /usr/sbin/sshd -D [listener] 0 of 10-100 startups"

Aug 16 10:55:55 madiane-VirtualBox systemd[1]: Starting OpenBSD Secure Shell s>
Aug 16 10:55:55 madiane-VirtualBox sshd[4040]: Server listening on 0.0.0.0 por>
Aug 16 10:55:55 madiane-VirtualBox sshd[4040]: Server listening on :: port 22.
Aug 16 10:55:55 madiane-VirtualBox systemd[1]: Started OpenBSD Secure Shell se>
lines 1-16/16 (END)
```

Server 1

```
madiane@server1:~$ sudo service ssh start
sumadiane@server1:~$
madiane@server1:~$ sudo systemctl status ssh
● ssh.service - OpenBSD Secure Shell server
     Loaded: loaded (/lib/systemd/system/ssh.service; enabled; vendor preset: >
     Active: active (running) since Tue 2022-08-16 11:39:22 PST; 9min ago
       Docs: man:sshd(8)
             man:sshd_config(5)
   Main PID: 819 (sshd)
      Tasks: 1 (limit: 1079)
     Memory: 1.0M
        CPU: 34ms
     CGroup: /system.slice/ssh.service
             └─819 "sshd: /usr/sbin/sshd -D [listener] 0 of 10-100 startups"

Aug 16 11:39:22 server1 systemd[1]: Starting OpenBSD Secure Shell server...
Aug 16 11:39:22 server1 sshd[819]: Server listening on 0.0.0.0 port 22.
Aug 16 11:39:22 server1 sshd[819]: Server listening on :: port 22.
Aug 16 11:39:22 server1 systemd[1]: Started OpenBSD Secure Shell server.
lines 1-16/16 (END)
```

Server 2

```
madiane@workstation:~$ sudo service ssh start
madiane@workstation:~$ sudo systemctl status ssh
● ssh.service - OpenBSD Secure Shell server
     Loaded: loaded (/lib/systemd/system/ssh.service; enabled; vendor preset: >
     Active: active (running) since Tue 2022-08-16 10:52:31 PST; 54min ago
       Docs: man:sshd(8)
             man:sshd_config(5)
   Main PID: 3020 (sshd)
      Tasks: 1 (limit: 1079)
     Memory: 1.9M
        CPU: 26ms
     CGroup: /system.slice/ssh.service
             └─3020 "sshd: /usr/sbin/sshd -D [listener] 0 of 10-100 startups"

Aug 16 10:52:31 madiane-VirtualBox systemd[1]: Starting OpenBSD Secure Shell s>
Aug 16 10:52:31 madiane-VirtualBox sshd[3020]: Server listening on 0.0.0.0 por>
Aug 16 10:52:31 madiane-VirtualBox sshd[3020]: Server listening on :: port 22.
Aug 16 10:52:31 madiane-VirtualBox systemd[1]: Started OpenBSD Secure Shell se>
lines 1-16/16 (END)
```

Local Machine

I verified that the SSH service has started in Server 1, Server 2, and Local Machine by issuing the commands sudo service ssh start and sudo systemctl status ssh.

4. Configure the firewall to all port 22 by issuing the following commands:
   4.1 sudo ufw allow ssh
   4.2 sudo ufw enable
   4.3 sudo ufw status

```
madiane@server1:~$ sudo ufw allow ssh
Skipping adding existing rule
Skipping adding existing rule (v6)
madiane@server1:~$ sudo ufw enable
Firewall is active and enabled on system startup
madiane@server1:~$ sudo ufw status
Status: active

To                         Action      From
--                         ------      ----
22/tcp                     ALLOW       Anywhere
22/tcp (v6)                ALLOW       Anywhere (v6)
```

Server 1

```
madiane@server2:~$ sudo ufw allow ssh
Skipping adding existing rule
Skipping adding existing rule (v6)
madiane@server2:~$ sudo ufw enable
Firewall is active and enabled on system startup
madiane@server2:~$ sudo ufw status
Status: active

To                         Action      From
--                         ------      ----
22/tcp                     ALLOW       Anywhere
22/tcp (v6)                ALLOW       Anywhere (v6)
```

Server 2

```
madiane@workstation:~$ sudo ufw allow ssh
sudSkipping adding existing rule
Skipping adding existing rule (v6)
madiane@workstation:~$ sudo ufw enable
Firewall is active and enabled on system startup
madiane@workstation:~$ sudo ufw status
Status: active

To                         Action      From
--                         ------      ----
22/tcp                     ALLOW       Anywhere
22/tcp (v6)                ALLOW       Anywhere (v6)
```

Local Machine

I configured the firewall to all port 22 in Server 1, Server 2, and Local Machine by issuing the commands sudo ufw allow ssh, sudo ufw enable and sudo ufw status.

Task 3: Verify network settings on Server 1, Server 2, and Local Machine. On each device, do the following:

1. Record the ip address of Server 1, Server 2, and Local Machine. Issue the command *ifconfig* and check network settings. Note that the ip addresses of all the machines are in this network 192.168.56.XX.
   1.1 Server 1 IP address: 192.168.56.___
   1.2 Server 2 IP address: 192.168.56.___
   1.3 Server 3 IP address: 192.168.56.___

```
madiane@server1:~$ ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 10.0.2.15  netmask 255.255.255.0  broadcast 10.0.2.255
        inet6 fe80::f574:47b:f0f1:56f8  prefixlen 64  scopeid 0x20<link>
        ether 08:00:27:75:c6:f6  txqueuelen 1000  (Ethernet)
        RX packets 26469  bytes 38844167 (38.8 MB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 6108  bytes 406817 (406.8 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

enp0s8: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.56.101  netmask 255.255.255.0  broadcast 192.168.56.255
        inet6 fe80::bb3e:a0cb:d3e2:10ba  prefixlen 64  scopeid 0x20<link>
        ether 08:00:27:b4:91:0d  txqueuelen 1000  (Ethernet)
        RX packets 7  bytes 2384 (2.3 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 80  bytes 9996 (9.9 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        inet6 ::1  prefixlen 128  scopeid 0x10<host>
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 366  bytes 68756 (68.7 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 366  bytes 68756 (68.7 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

Server 1

```
madiane@server2:~$ ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 10.0.2.15  netmask 255.255.255.0  broadcast 10.0.2.255
        inet6 fe80::5318:e24e:f4da:d5a6  prefixlen 64  scopeid 0x20<link>
        ether 08:00:27:1d:9d:90  txqueuelen 1000  (Ethernet)
        RX packets 1160  bytes 1218690 (1.2 MB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 827  bytes 68516 (68.5 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

enp0s8: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.56.103  netmask 255.255.255.0  broadcast 192.168.56.255
        inet6 fe80::17d3:ed40:8af6:ae68  prefixlen 64  scopeid 0x20<link>
        ether 08:00:27:26:8e:d5  txqueuelen 1000  (Ethernet)
        RX packets 234  bytes 36661 (36.6 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 207  bytes 26799 (26.7 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        inet6 ::1  prefixlen 128  scopeid 0x10<host>
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 551  bytes 102934 (102.9 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 551  bytes 102934 (102.9 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

Server 2

```
madiane@workstation:~$ ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 10.0.2.15  netmask 255.255.255.0  broadcast 10.0.2.255
        inet6 fe80::745b:adac:ee9:2215  prefixlen 64  scopeid 0x20<link>
        ether 08:00:27:75:90:28  txqueuelen 1000  (Ethernet)
        RX packets 1135  bytes 1219404 (1.2 MB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 729  bytes 61802 (61.8 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

enp0s8: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.56.102  netmask 255.255.255.0  broadcast 192.168.56.255
        inet6 fe80::b43f:db22:105a:b463  prefixlen 64  scopeid 0x20<link>
        ether 08:00:27:da:4b:e9  txqueuelen 1000  (Ethernet)
        RX packets 323  bytes 47138 (47.1 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 255  bytes 31005 (31.0 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        inet6 ::1  prefixlen 128  scopeid 0x10<host>
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 475  bytes 99561 (99.5 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 475  bytes 99561 (99.5 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

Local Machine

After installing the net-tools, I issued the command ifconfig for Server 1, Server 2, and Local Machine.

2. Make sure that they can ping each other.

   2.1 Connectivity test for Local Machine 1 to Server 1: ☐ Successful ☐ Not Successful

```
madiane@workstation:~$ ping 192.168.56.101
PING 192.168.56.101 (192.168.56.101) 56(84) bytes of data.
64 bytes from 192.168.56.101: icmp_seq=1 ttl=64 time=1.84 ms
64 bytes from 192.168.56.101: icmp_seq=2 ttl=64 time=0.313 ms
64 bytes from 192.168.56.101: icmp_seq=3 ttl=64 time=0.881 ms
64 bytes from 192.168.56.101: icmp_seq=4 ttl=64 time=1.14 ms
^Z
[2]+  Stopped                 ping 192.168.56.101
```

Local Machine 1 to Server 1: Successful

   2.2 Connectivity test for Local Machine 1 to Server 2: ☐ Successful ☐ Not Successful

```
madiane@workstation:~$ ping 192.168.56.103
PING 192.168.56.103 (192.168.56.103) 56(84) bytes of data.
64 bytes from 192.168.56.103: icmp_seq=1 ttl=64 time=0.383 ms
64 bytes from 192.168.56.103: icmp_seq=2 ttl=64 time=0.480 ms
64 bytes from 192.168.56.103: icmp_seq=3 ttl=64 time=0.414 ms
64 bytes from 192.168.56.103: icmp_seq=4 ttl=64 time=0.750 ms
^Z
[3]+  Stopped                 ping 192.168.56.103
```

Local Machine 1 to Server 2: Successful

2.3 Connectivity test for Server 1 to Server 2: ☐ Successful ☐ Not Successful

```
madiane@server1:~$ ping 192.168.56.103
PING 192.168.56.103 (192.168.56.103) 56(84) bytes of data.
64 bytes from 192.168.56.103: icmp_seq=1 ttl=64 time=0.734 ms
64 bytes from 192.168.56.103: icmp_seq=2 ttl=64 time=0.506 ms
64 bytes from 192.168.56.103: icmp_seq=3 ttl=64 time=0.391 ms
64 bytes from 192.168.56.103: icmp_seq=4 ttl=64 time=0.318 ms
64 bytes from 192.168.56.103: icmp_seq=5 ttl=64 time=0.866 ms
^Z
[2]+  Stopped                 ping 192.168.56.103
```

Server 1 to Server 2: Successful

Task 4: Verify SSH connectivity on Server 1, Server 2, and Local Machine.

1. On the Local Machine, issue the following commands:

1.1 ssh username@ip_address_server1 for example, *ssh jvtaylar@192.168.56.120*

1.2 Enter the password for server 1 when prompted

1.3 Verify that you are in server 1. The user should be in this format user@server1. For example, *jvtaylar@server1*

2. Logout of Server 1 by issuing the command *control + D.*

```
madiane@workstation:~$ ssh madiane@192.168.56.101
The authenticity of host '192.168.56.101 (192.168.56.101)' can't be established
.
ED25519 key fingerprint is SHA256:TEYh4AmPZymJTrBHGdSY3AxlPkZiZeB3KTXJ1eoytc0.
This key is not known by any other names
Are you sure you want to continue connecting (yes/no/[fingerprint])? y
Please type 'yes', 'no' or the fingerprint: yes
Warning: Permanently added '192.168.56.101' (ED25519) to the list of known host
s.
madiane@192.168.56.101's password:
Welcome to Ubuntu 22.04.1 LTS (GNU/Linux 5.15.0-46-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage

0 updates can be applied immediately.


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.

madiane@server1:~$
```

Successfully logged-in to Server 1.

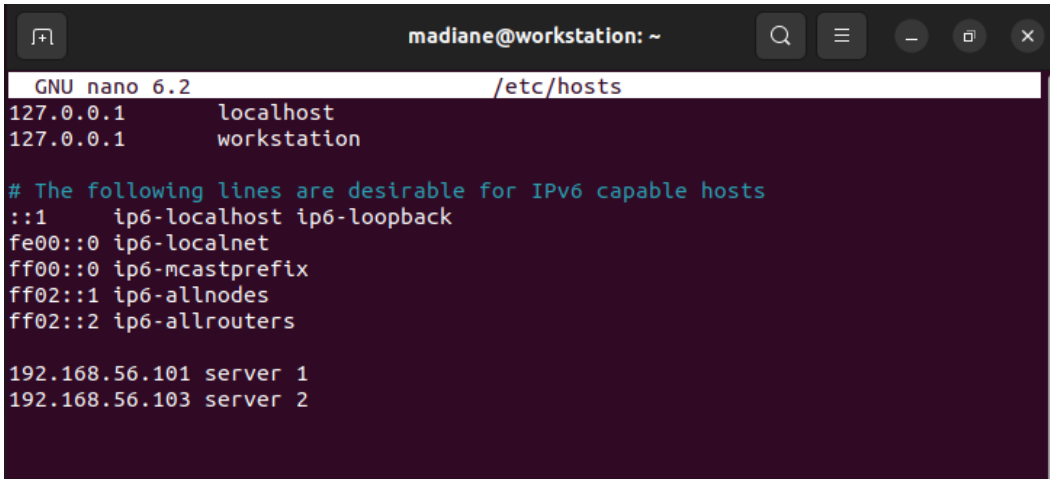
3. Do the same for Server 2.

```
madiane@workstation:~$ ssh madiane@192.168.56.103
The authenticity of host '192.168.56.103 (192.168.56.103)' can't be established
.
ED25519 key fingerprint is SHA256:XU7AF6y/k5px3MVd49PDRNUnwsm97k4+T2DHA2UCu6s.
This key is not known by any other names
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '192.168.56.103' (ED25519) to the list of known host
s.
madiane@192.168.56.103's password:
Welcome to Ubuntu 22.04.1 LTS (GNU/Linux 5.15.0-46-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage

0 updates can be applied immediately.


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.
```

Successfully logged-in to Server 2.

4. Edit the hosts of the Local Machine by issuing the command *sudo nano /etc/hosts.* Below all texts type the following:

4.1 IP_address server 1 (provide the ip address of server 1 followed by the hostname)
4.2 IP_address server 2 (provide the ip address of server 2 followed by the hostname)
4.3 Save the file and exit.



5. On the local machine, verify that you can do the SSH command but this time, use the hostname instead of typing the IP address of the servers. For example, try to do *ssh jvtaylar@server1*. Enter the password when prompted. Verify that you have entered Server 1. Do the same for Server 2.

Server 1

```
madiane@workstation:~$ ssh madiane@server2
The authenticity of host 'server2 (192.168.56.103)' can't be established.
ED25519 key fingerprint is SHA256:XU7AF6y/k5px3MVd49PDRNUnwsm97k4+T2DHA2UCu6s.
This host key is known by the following other names/addresses:
    ~/.ssh/known_hosts:4: [hashed name]
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added 'server2' (ED25519) to the list of known hosts.
madiane@server2's password:
Welcome to Ubuntu 22.04.1 LTS (GNU/Linux 5.15.0-46-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage

0 updates can be applied immediately.

Last login: Tue Aug 16 12:04:50 2022 from 192.168.56.102
madiane@server2:~$
```

Server 2

Reflections:

Answer the following:

1. How are we able to use the hostname instead of IP address in SSH commands?
   We are able to use the hostname instead of IP address in SSH commands by putting the IP address and the hostname in /etc/hosts.
2. How secured is SSH?

   The SSH used the encryption algorithms for the security of the connectivity between the servers.