Lab Cycle: 2
Experiment No.: 0
Date: 24-05-2022

Aim : Draw the file structure of the root folder in the Linux file system. Write a description of each important folder.

Solution :

Linux File System Hierarchy Structure(FHS)

All files on a Linux system are stored on file systems which are organized into a single inverted tree of directories, know as a file system hierarchy. In the inverted tree, root lies at the top and the branches of directories and sub-directories stretch below the root.

Directories :

Root Directory (/)

All the directories in the Linux system comes under the root directory which is represented by a forward slash (/).

Binary Directories

Binary directory contains binary files which are compiled source code(or machine code).

1. /bin

/bin directory contains user binaries, executable files, Linux commands that are used in single user mode, and common commands that are used by all the users, like cat, cp, ls, etc.

2. /sbin

/sbin is similar to /bin, but only contains system binaries which require root privilege to perform certain tasks and are helpful for system maintenance purpose. e.g. fsck, root, init, ifconfig, etc.

3. /lib

/lib directory contains shared libraries which are often used by the '/bin' and '/sbin' directories. Libraries are files containing code that applications can use. It also contains kernel modules. The kernel modules are drivers that make things like video card, sound card, WiFi, printer, and so on, work.

4. /opt

The term 'opt' is short for optional. Its main purpose is to store optional application software packages. Add-on applications from individual vendors should be installed under either /opt or opt/ sub-directory. Eg: /opt/lampp/htdocs

Configuration Directories

The configuration directories contain configured files which configures the parameters and initial settings for some computer programs.

1. /boot

/boot directory contains boot loader files which are essential to boot the system.

2. /etc

All the machine related configurtion files are kept in '/etc'. It also contain startup and shutdown shell script which is used to start and stop a program. Earlier it was referred to as 'Et cetera' because it could contain all the files that did not belong from anywhere else. But recently its most likely meaning is 'Editable Text Configuration' or 'Extended Tool chest'.

Data Directories

Data directory is used to store data of the system.

1. /home

/home directory stores users personnel files. After the '/home' there is a directory which is generally named at the user's name like /home/manu.

2. /root

/root is the home directory of the superuser of the system.

3. /srv

The term 'srv' stands for service. Contains server specific data for services provided by the system like cvs, ftp, etc.

4. /media

/media directory acts as a mount point for removable media devices such as CD-Rom, floppy, USB devices, etc.

5. /mnt

The 'mnt' term stands for mount. /mnt directory is used for manually mount devices.

6. /tmp

The term 'tmp' stands for temporary. Data stored in '/tmp' is temporary and may use either disk space or RAM. When system is rebooted, files under this directory is automatically deleted.

Memory Directories

Memory directory contains files for the whole system. All the device information, process running data or system related information are stored in this directory.

1. /dev

The term 'dev' is short for device. Files which are used to represent and access devices are stored here including terminal devices like usb. Many of these are generated at boot time or even on the fly.

2. /proc

The term 'proc' is short for process. It is a Virtual filesystem providing process and kernel information as files.

3. /sys

The term 'sys' is short for system. It is used for directly accessing the hardware present in the system. Example: GPIO pins of Raspberry Pi are accessed directly by using /sys directory (/sys/class/gpio/).

User System Resources (/usr)

The /usr directory was where user's home directories were originally kept back in the early days of UNIX. However, now '/home' is where users kept their files. It is also called secondary hierarchy as it contains binaries, libraries, documentation for all the user applications.

/usr sub-directories :

- /usr/bin : Contains binary files for user programs.

- /usr/sbin : Contains binary files for system administrators.

- /usr/lib : Contains libraries for /usr/bin and /usr/sbin.

- /usr/src : Holds the source code including Linux kernel, header-files and documentation.

- /usr/include : Contains standard include files for C.

Variable Directory (/var)

The term 'var' is short for variable. Files that have an unexpected size and whose content is expected to change continuously during normal operation of the system are stored here. Eg: /var/www/html

/var sub-directories :

- /usr/log : Contains all log files.

- /usr/cache : Stores application cache data. Cache data are locally generated by I/O or calculation.

- /usr/spool : Used to spool the files waiting to be processed. Eg: printing queues and mail queues.
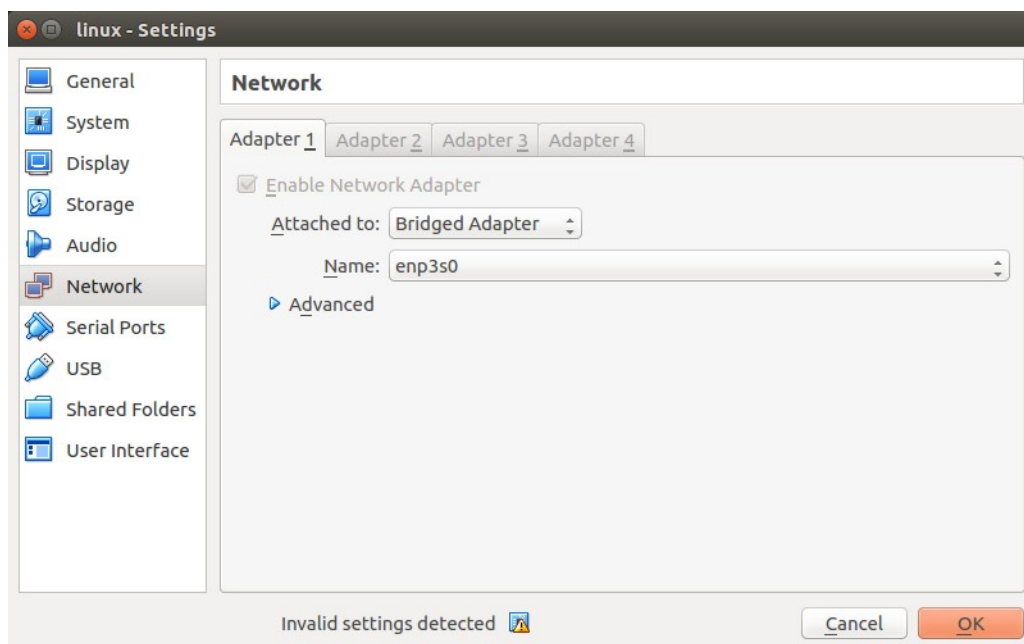
Lab Cycle: 2
Experiment No.: 3
Date: 24-05-2022

1.Attach the network interface of the virtual machine to a Bridged Adapter and verify the Guest and Host are accessible from each other.

```
user@user-VirtualBox:~$ ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 10.9.1.2  netmask 255.255.248.0  broadcast 10.9.7.255
        inet6 fe80::c602:c145:c7cd:d70  prefixlen 64  scopeid 0x20<link>
        ether 08:00:27:34:00:ff  txqueuelen 1000  (Ethernet)
        RX packets 350  bytes 239843 (239.8 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 200  bytes 21214 (21.2 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 230  bytes 19454 (19.4 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 230  bytes 19454 (19.4 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

```
student@mcarit-H97M-D3H:~$ ping 10.9.1.2
PING 10.9.1.2 (10.9.1.2) 56(84) bytes of data.
64 bytes from 10.9.1.2: icmp_seq=1 ttl=64 time=0.333 ms
64 bytes from 10.9.1.2: icmp_seq=2 ttl=64 time=0.187 ms
64 bytes from 10.9.1.2: icmp_seq=3 ttl=64 time=0.262 ms
64 bytes from 10.9.1.2: icmp_seq=4 ttl=64 time=0.142 ms
64 bytes from 10.9.1.2: icmp_seq=5 ttl=64 time=0.240 ms
^C
--- 10.9.1.2 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4089ms
rtt min/avg/max/mdev = 0.142/0.232/0.333/0.068 ms
```

```
user@user-VirtualBox:~$ ping 10.9.0.136
PING 10.9.0.136 (10.9.0.136) 56(84) bytes of data.
64 bytes from 10.9.0.136: icmp_seq=1 ttl=64 time=0.121 ms
64 bytes from 10.9.0.136: icmp_seq=2 ttl=64 time=0.120 ms
64 bytes from 10.9.0.136: icmp_seq=3 ttl=64 time=0.153 ms
64 bytes from 10.9.0.136: icmp_seq=4 ttl=64 time=0.118 ms
64 bytes from 10.9.0.136: icmp_seq=5 ttl=64 time=0.121 ms
^C
--- 10.9.0.136 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4095ms
rtt min/avg/max/mdev = 0.118/0.126/0.153/0.013 ms
```

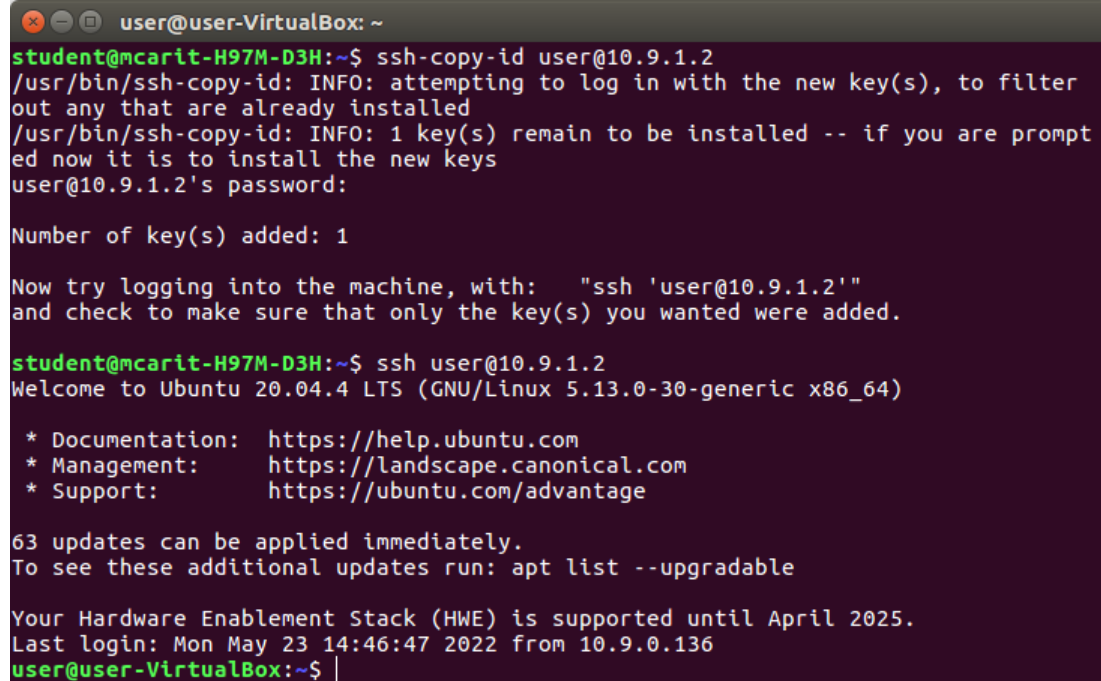2. Install ssh server program inside Guest and login from Host.

```
user@user-VirtualBox:~$ sshd

Command 'sshd' not found, but can be installed with:

sudo apt install openssh-server

user@user-VirtualBox:~$ sudo apt install openssh-server
[sudo] password for user:
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
  ncurses-term openssh-client openssh-sftp-server ssh-import-id
Suggested packages:
  keychain libpam-ssh monkeysphere ssh-askpass molly-guard
The following NEW packages will be installed:
  ncurses-term openssh-server openssh-sftp-server ssh-import-id
The following packages will be upgraded:
  openssh-client
1 upgraded, 4 newly installed, 0 to remove and 177 not upgraded.
Need to get 1,359 kB of archives.
After this operation, 6,010 kB of additional disk space will be used.
Do you want to continue? [Y/n]
```

4.Setup passwordless **ssh**.