Lab Exercises

Lab 6

Objective

You will explore the RAID array and create network shares using NFS.

Do not start VMs now.

1. **Adding disks to the server VM**

- Select the *server* VM in the VirtualBox manager main window and click at the **Storage** section from the **Details** pane;
- Under the **Storage Devices**, click at Controller: SATA. Then click at the **Add Hard Disk** button (the green plus sign) and select Create new disk. Choose the followings:
    - Hard disk file type: VDI (default)
    - Storage on physical hard disk: Dynamically allocated (default)
    - File location and size: myDisk1 and 1.0 GB
- Repeat the above to create another two disks called: myDisk2 and myDisk3 with the same 1.0 GB.

2. **Install RAID**

    The RAID software included with Ubuntu Linux is based on the `mdadm` driver.

- Now start the *server* VM;
- Identify the newly created disks

    ```
    lsblk -o NAME,SIZE,FSTYPE,TYPE,MOUNTPOINT
    ```

    You will have the output like the following:

    ```
    NAME     SIZE FSTYPE    TYPE MOUNTPOINT
    loop0   86.9M squashfs  loop /snap/core/4917
    loop1   87.9M squashfs  loop /snap/core/5328
    loop2     87M squashfs  loop /snap/core/5145
    sda       10G           disk
    ├─sda1     1M           part
    └─sda2    10G ext4      part /
    sdb        1G           disk
    sdc        1G           disk
    sdd        1G           disk
    sr0     1024M           rom
    ```

    As you can see above, the `sdb`, `sdc`, and `sdd` are the newly created disks without a filesystem, each 1G in size. These will be the raw disks we use to build a RAID5 array.

- Create the RAID5 array

    Watch out: Do not use `sda` !

    ```
    sudo mdadm --create --verbose /dev/md0 --level=5 --raid-devices=3 /dev/sdb
    ```

```
/dev/sdc /dev/sdd
```

The mdadm tool will configure the array. You can check the status of the array.

```
cat /proc/mdstat
```

```
Personalities : [linear] [multipath] [raid0] [raid1] [raid6] [raid5] [raid4] [raid10]
md0 : active raid5 sdd[3] sdc[1] sdb[0]
      2093056 blocks super 1.2 level 5, 512k chunk, algorithm 2 [3/3] [UUU]

unused devices: <none>
```

You will see the device md0 has been created in the RAID5 using sdb, sdc, and sdd disks.

- Create and mount the filesystem

  ```
  sudo mkfs.ext4 /dev/md0
  ```

- Create a mount point to attach the new filesystem

  ```
  sudo mkdir /mnt/md0
  ```

- Mount the filesystem

  ```
  sudo mount /dev/md0 /mnt/md0
  ```

You can check the new space by typing:

```
df -h
```

You will see:

```
Filesystem     Size    Used    Avail   Use%    Mounted on
/dev/md0       2.0G    6.0M    1.9G    1%      /mnt/md0
```

- Check the disks again

  ```
  lsblk -o NAME,SIZE,FSTYPE,TYPE,MOUNTPOINT
  ```

You will see that the three disks in the RAID array mounted at /mnt/md0 have the linux_riad_member type for the disks and ext4 filesystem on the partition md0 as the raid5 type. Note that the RAID 5 array has a capacity of 2GB instead of the total capacity of 3GB of all three disks.

```
sdb          1G linux_raid_member disk
└─md0        2G ext4              raid5 /mnt/md0
sdc          1G linux_raid_member disk
└─md0        2G ext4              raid5 /mnt/md0
sdd          1G linux_raid_member disk
└─md0        2G ext4              raid5 /mnt/md0
```

- Save the RAID array layout for automatic assembling and mounting at boot

  - To make sure that the array is reassembled automatically at boot, append the array configuration to /ect/mdadm/mdadm.confecho

    ```
    sudo mdadm --detail --scan | sudo tee -a /etc/mdadm/mdadm.conf
    sudo update-initramfs -u
    ```

○ Add the new filesystem mount options to the /etc/fstab file for automatic mounting at boot

```
echo '/dev/md0 /mnt/md0 ext4 defaults,nofail,discard 0 0' | sudo tee -a
/etc/fstab
```

- Create a file in the storage space

```
cd /mnt/md0
sudo pico readme.txt
```

enter the text: "This is my storage on RAID5.", save and exit.

```
ll
```

You will see the file readme.txt is created.

3. **Create a Network File System (NFS) share**

Continue work on your server VM.

- Update the system

It is a good practice to update your system each time before you install a package.

```
sudo apt update
sudo apt upgrade
```

- Install NFS server

```
sudo apt install nfs-kernel-server
```

- Configure the exports

Add the following line in the file /etc/exports using pico.

```
/mnt/md0  *(rw,sync,no_root_squash)
```

- Start the NFS server

```
sudo systemctl start nfs-kernel-server.service
```

- Reboot the server VM

```
sudo reboot
```

4. **Connect the NFS share from the *desktop* VM**

You can connect to the NFS server to browse and use files on the server as if they were on the local computer.

Now start the *desktop* VM.

- Install the NFS client from the Terminal
  ○ Update the system

```
sudo apt update
sudo apt upgrade
```

   ○ Install the NFS client

```
sudo apt install nfs-common
```

- Check the list of shares on the server

```
showmount -e server.abc123.test
```

You will see that the share /mnt/md0 is listed.

- Mount the NFS share
  ○ Create a mount point

```
sudo mkdir -p /share/md0
```

  ○ Mount the NFS share

```
sudo mount -t nfs server.abc123.test:/mnt/md0 /share/md0
```

  ○ List the files on the share

```
ll /share/md0
```

You will see the readme.txt file you created on the server. Display the content of it.

```
cat /share/md0/readme.txt
```

- Create a file in the new filesystem

```
sudo pico /share/md0/fromdesktop.txt
```

enter the text: "This is from desktop VM", save and exit.

```
ll
```

You will see the file fromdesktop.txt is created.

- Access the file from the *server* VM

On the server,

```
ll /mnt/md0
```

You will see the file fromdesktop.txt listed. Display the content of it.

```
cat /mnt/md0/fromdesktop.txt
```

- Mount the NFS share at boot

Add the following line to the end of the /etc/fstab file:

```
server.abc123.test:/mnt/md0 /share/md0 nfs defaults,user,exec 0 0
```

5. **Simulate a disk failure in the RAID array on the server VM**

- View the status

To view the status of an array:

```
sudo mdadm -D /dev/md0
```

To view the status of a disk in an array:

```
sudo mdadm -E /dev/sdd
```

- Simulate a disk failure in the RAID array
  - Shutdown the server VM (not power off but ACPI shutdown by sending shutdown signal).
  - Select the *server* VM in the VirtualBox manager main window and click at the **Storage** section from the **Details** pane;
  - Under the **Storage Devices**, click myDisk2.vdi and press the Remove selected storage attachment button (a disc with red minus sign).;
  - Start the server VM again;
  - Reassemble the array with a disk failure

```
sudo mdadm --stop /dev/md0
sudo mdadm --assemble --force /dev/md0
```

  - View the status of the array again:

```
sudo mdadm -D /dev/md0
```

   Now, there are only 2 **Active** devices with the array **state** as clean, degraded.

  - Display the file on the RAID5 array with a disk missing

```
cd /mnt/md0
ll
cat readme.txt
```

   The files are intact and accessible.

- Add a new disk to replace the failed disk in the RAID array

  - Shutdown the *server* VM and follow the steps in the Section 1 to add new disk called myDisk4 to the *server* VM;
  - Start the *server* VM;
  - Identify the new disk:

```
lsblk
```

   The new disk is likely /dev/sdc.

  - Add a new disk to the array

```
sudo mdadm --add /dev/md0 /dev/sdc
```

   This will cause the drive to re-sync with the array. It will normally take a considerable time to complete. you can use the command cat /proc/mdstat to check the progress. In our case, it completes instantly as the disk is only 1GB in size.

- View the status of the array:

```
sudo mdadm -D /dev/md0
```

 Now, there should be 3 **Active** devices with the array **state** as clean.

Submission and mark

Show your work to the teacher.

Of 6 marks, you can get

- 1.5 for showing the content of /etc/mdadm/mdadm.conf on the server VM;
- 1.5 for showing the content of /etc/fstab on the server VM;
- 1.5 for listing the files in the directory /share/md0 on the desktop VM;
- 1.5 for showing the new disk called myDisk4.vdi for the server VM in the VirtualBox manager.

You should be ready to answer any questions to demonstrate that all work is done by yourself otherwise you may receive 0 mark.

IMPORTANT NOTE: You will need to document all of your lab work in your wiki.