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SYSMGMT Laboratory Manual

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6.0 Volume, Partition and Storage Management

This section focuses on managing storage on your system. As a system gets utilized, storage space needs to be regularly monitored for utilization. An administrator must be able to add and configure additional storage space for the system as the need to increase storage arises.

6.1. Lshw Utility

The Lshw utility lists hardware information on your Ubuntu Linux. The name stands for “Hardware Lister”. The utility can show processor, memory, device and bus system configuration.

Step 1 Login to your account and type the command ‘`sudo apt-get install lshw`’ and ‘`sudo apt-get install hwdetect`’. These commands install the ‘lshw’ and ‘hwdetect’ utilities.

1a. At the command prompt, type in the command ‘`sudo lshw -short`’. What was the output? What does it do?
It displays the system specs of the virtual machine.

1b. At the command prompt, type in the command ‘`sudo lshw -short | hwdetect`’. What did the command do? What does the file ‘hwdetect’ contain?

Specific info about the system.

1c. At the command prompt, type in the command ‘`sudo lshw -class disk`’. What did the command do?

Showed specific info about the size and specifications of the disk as well as a DVD reader.

1d. Based on the output of the previous command, what is the logical name and capacity of the hard drive of your system?

The name is `/dev/sda` and the description is the ATA disk.

1e. At the command prompt, type in the command ‘`sudo lshw -class disk > diskinfo`’. What did the command do? What does the file ‘diskinfo’ contain?

USB and SCSI

1f. At the command prompt, type in the command ‘`sudo lshw -html > hwdetect.html`’. What did the command do? What does the file ‘hwdetect.html’ contain?

USB and SCSI

6.2. Disk Usage and Disk Free

The Unix environment allows the user to check his disk usage and the available disk space in the file system. The commands are “du” and “df” respectively.

The “du” command allows a user to his/her disk usage including usage in subdirectories. By default, the disk usage is presented in 1024 bytes per block. If a user sees that his/her disk usage is 108 blocks, this means that it is really 110592 bytes total (108*1024 bytes per block).

The “df” command shows the disk statistics of a file system. Typing “df” on the command prompt will produce an output on the screen:

Filesystem	1k-blocks	Used	Available	Use%	Mounted on
/dev/sda2	3826584	368332	3263868	11%	/
/dev/sda1	46636	6064	38164	14%	/boot
None	63352	0	63352	0%	/dev/shm

Looking at the sample output above, the *filesystem* column shows the partition/s on the server. The next column, *1k-blocks*, shows the capacity (total size) of the partition. The *Used* column shows how much is already used on the partition, while *Available* shows how much can still be used. The *Use%* shows how much percentage is used on the partition. The *Mounted on* column shows what is the directory name of the partition.

In the example above, partition /dev/sda2 shows that it has a capacity of around 3.6Gbyte. On the same partition, around 359Mbyte is already used with still 3.1Gbyte available. Data on the partition occupies only 11% of the disk space. This partition is mounted as the root (the meaning of mounted will be discussed later in the course). Before starting the exercise, delete all files in your home directory by entering the command “rm *”.

Step 2 At the command prompt, type the command “ls -arl /etc > testfile” and press enter. This command should be done at your home directory. After the copying the file, type the command “du” at the command prompt. Observe the numbers.

- 2a. How many directories do you have? How many blocks are you using in your directory?
A total of 8 directories, and I am currently 112 blocks.

- 2b. At the command prompt, type the command “du -k”. The switch used in the command defines that each block is 1024 bytes. How many bytes are you using in your home directory?

A total of 114,688 bytes.

- 2c. At the command prompt, type the command “du -ck”. How is this different from the previous command?
It prints the total number of blocks you are currently using.

Step 3 At the command prompt, type the command “ls -arl /bin > testfile2” and press enter.

- 3a. Type the command “du -ck” on the command prompt and press enter. Did the total number of blocks used increase?

Yes, from 112, it increased to 124.

- 3b. How many bytes are you using?

126,976 bytes.

Step 4 At the command prompt, type the command “df”.

4a. How many bytes is one block in the command?
1K.

4b. How many bytes is the capacity of /dev/sda1?
10252564.

4c. How many bytes are used on /dev/sda1?
4433416

4d. How many bytes are available on /dev/sda1?
5278632

4e. What is the percentage of data used in /dev/sda1?
46%

4f. At the command prompt type the command “df -m”. What is the size of each block in this command?
1M

6.3. Adding and Partitioning a Hard Disk

Additional disk space is usually needed to increase the capacity of the system. In the Ubuntu Linux system, creating partitions can be through the logical volume manager. This sections shows how to add additional hard disk space on your Ubuntu Linux system.

Note: Before proceeding, add an additional 1GB hard disk to your virtual machine. Edit virtual machine settings then select Add. Create a new SCSI hard drive (split into multiple files) then reboot the Linux VM. The additional hard disk is where you will use the volume manager and create partitions.

Step 5 Login to your user account. At the command prompt, type in the command ‘sudo apt-get install lvm2’. This will install the necessary tools to manage logical volumes. After installing, you may need to reboot the system.

5a. After installing the ‘lvm2’ utilities. At the command prompt, type in the command ‘sudo lshw - class disk’. You can save the output in a file to be able to see the result. Look for the additional hard disk you have connected to the system. Take note of its logical device name.

5b. At the command prompt, type in the command ‘sudo fdisk <device name>’ where the ‘<device name>’ is the device name of your new hard disk. The command will execute the disk formatting utility of the Linux system.

5c. At the command prompt of the fdisk utility, type ‘m’. This will show the commands available in the fdisk utility. What are the available commands? Name at least three commands that allow you to create a new partition.

G is to create a new empty SGI (IRIX) partition table. o is create a new empty DOS partition table
s is to create a new empty sun partition table

- 5d. At the command prompt of the fdisk utility, type 'n' and then 'p'. This command creates a new primary partition. Partition number should be '1'. Select the default for the first sector. If prompted for the last sector, type in '+500M'
- 5e. To be able to use the partition, you will need to change the disk type. To check particular disk types that can be created, press 't' at the fdisk utility prompt then press 'L'. Notice that the type '8e' is the Linux LVM disk type.
- 5f. At the command prompt of the fdisk utility, type in 't' and then '8e'. This changes the disk type to "Linux LVM". How can you confirm that the disk type is "Linux LVM"?

You use the command i in the utility. There you can see the size of the made partition(500M) as well as the type, and ID - which is Linux LVM and 8e respectively.

- 5g. At the command prompt of the fdisk utility, type in 'p'. What do you see? What does this command do?
- The command gives information about the partition table. I can see the made partitions as well as the device name, boot start, end, sectors, size, id and type.
- 5h. Although you have created the partition with the partition type, the fdisk utility has not yet written in to the disk. To finalize the created partition, type in 'w' at the fdisk utility prompt. This will also exit the fdisk utility.
- 5i. At the command prompt, type in the command 'fdisk -l <device name>' where the '<device name>' is the device name of your new hard disk. What does the '-l' switch do?

It shows the details of the partitioning.

- 5j. What is the name of the partition created on the new hard drive?

/dev/sdb1

6.4. Using the Linux Volume Manager to Manage Disk Space

The Linux Volume Manager (LVM) can be used to dynamically manage disk space on a system. Using the LVM, disk partitions can be configured as physical volumes (PV) which can later be pooled together to create a unified volume group (VG) to be later divided into logical volumes (LV). Logical volumes can then be formatted with a filesystem to serve as storage space. Unlike traditional disk partitions, LVM-managed LVs can be resized as needed should there be a need to increase the capacity of an LV.

Step 6 Use the LVM to manage the new partition and create a logical volume on it.

- 6a. At the command prompt, type in the command 'sudo pvdisplay'. What is the output? What does this command do? Can you see your newly created partitions?

There was no output. And No I could not. Perhaps because I created a logical volume instead of a physical volume..

- 6b. The fdisk utility has created the partition but the physical disk has not yet been created. Use the 'pvcreate' command to create physical disk/s. At the command prompt, type in the command 'sudo pvcreate <device name>'.

- 6c. At the command prompt, type in the command 'sudo pvdisplay'. What is the output of the command? Do you see the newly created partition?

yes I can, even the size and its UUID.

- 6d. After creating the physical disk, you will need to create the volume group and specify the physical volumes that will make up the volume group. The following command creates the volume group:

```
vgcreate      [pool name]      [device name]
where:
  pool name    -   name of the volume group
  device name  -   device name of the hard disk
```

At the command prompt, type in the command 'sudo vgcreate diskpool [device name]'. this creates the volume group with the name "diskpool" in the hard disk. Take note that you need to change the '[device name]' to device name of your new partition.

- 6e. At the command prompt, type in the command 'sudo pvdisplay'. What are the volume groups and the volume size in your Ubuntu Linux system?

there is only one volyme group and that is diskpool. the size is 500 MB

- 6f. At the command prompt, type in the command 'sudo vgdisplay'. What are the volume groups and the volume size in your Ubuntu Linux system? What is the difference of using this command against the previous command in reference to volume groups?

there is only one volumegroup and that is diskpool, and has a size of 496 mb with a PE size of 4 mb. The Difference of this is basically - The PVdisplay shows the physical volumes individually but not necessarily all of the volume groups. VG display summarizes all volume groups - and displays he information such as vg size.

- 6g. After creating the volume group, you can now create the logical volume. The following command creates the logical volume:

```
lvcreate -L [size][M/G/T] -n [volume name] [volume group]
where:
  sizeMGT      -   size of the volume to be create in, example: 5M – 5
                  Megabytes, 3G – 3 Gigabytes, 1T – 1 Terabyte
  volume name  -   name of the volume, this is a string
  volume group -   the volume group where the volume is to be created
```

At the command prompt, type in the command 'sudo lvcreate -L 200M -n disk01 diskpool'. The command creates a volume named "disk01" in the volume group "disk pool" with a size of 5 Gigabytes.

- 6h. At the command prompt, type in the command 'sudo vgdisplay | more'. What are the logical volume or volumes and their respective sizes in your Ubuntu Linux system?

THe logical volume is disk01 at the moment, and it occupies 200M of space.

- 6i. At the command prompt, type in the command 'sudo lvdisplay | more'. What are the logical volume or volumes and the size in your Ubuntu Linux system? What is the difference of using this command against the previous command in reference to logical volume?

lv display is basically the split details of all the logical volumes that are not merged into a volume group that they are assigned in.

- 6j. At the command prompt, type in the command 'sudo lvs'. What is the information you can see? Write down the details.

LV	VG	Attr	LSize	Pool	Origin	Data%	Meta%	Move	Log	CPY%	Sync	Convert
disk01	diskpool	-wi	-a-----	200m.								

- 6k. The logical volume is still not usable because it still has to be formatted with a file system. The following command formats the logical volume with a file system:

```
mkfs -t [file system type] [logical volume path]
```

where:

- | | | |
|---------------------|---|--|
| file system type | - | type file system type the logical volume to be formatted with, usual can be (ext2, ext3 ext4, reiserfs) |
| logical volume path | - | full path of the logical volume. which is normally '/dev/[volume pool name]/[logical volume name]', example can be '/dev/vpool0/disk0' |

At the command prompt, type in the command 'sudo mkfs -t ext3 /dev/diskpool/disk01'. What did the command do?

First it created the filesystem with the necessary blocks, with additional superblock backups, allocated group tables, wrote inode tables, created journals and wrote superblocks and filesystem accounting.

6.5. Mounting Filesystems

For a new filesystem to be usable as additional storage, it has to be mounted and mapped to the Linux Virtual Filesystem. This requires creation of an empty directory and use of the `mount` command to specify the empty directory as the mount point of the filesystem. Once mounted, the filesystem appears seamlessly as additional space on a unified virtual filesystem even if it is physically on a different disk.

Using the `mount` command to mount a filesystem results in a temporary mapping to the virtual filesystem which lasts only while the system is running. Modifying the '/etc/fstab' file allows you to configure the system to automatically mount a filesystem each time the system is booted

Step 7 After creating the volume with the file system, it has to be mounted on an empty directory. At the command prompt, create a new directory under the '/mnt' directory called 'new-disk'.

- 7a. To mount the volume in the directory, the command 'mount' can be used. The command has the following format:

```
mount -t [file system type] [logical volume path] [mount directory]
```

where:

- | | | |
|---------------------|---|--|
| file system type | - | type file system type the logical volume to be formatted with, usual can be (ext2, ext3 ext4, reiserfs) |
| logical volume path | - | full path of the logical volume. which is normally '/dev/[volume pool name]/[logical volume name]', example can be '/dev/vpool0/disk0' |
| mount directory | | empty directory where the volume is to be mounted in |

At the command prompt, type in the command 'sudo mount -t ext3 /dev/diskpool/disk01 /mnt/new-disk'. What does the command do? Which directory is the volume mounted in?

I guess it mounts the logical volume onto a directory?

- 7b. Run the command 'df' and look for the entry representing your new logical volume mounted in the new-disk directory. What is the capacity of the filesystem in 1K-blocks?

194241.

- 7c. Go inside the '/mnt/new-disk'. Are there any directories inside the directory? What is the name of the directory?

lost+found

- 7d. Create several files or directories in the directory '/mnt/new-disk'. Create several files named 'newfiles01', 'newfiles02' and 'newfiles03'. Also create directories called 'newdir01' and 'newdir02'. You may also create your own files anywhere inside the '/mnt/new-disk' directory. Are you able to create files and directories?

Yes I am able to do so.

- 7a. Reboot the system. Once rebooted, log in to your account and list the contents of the '/mnt/new-disk' directory. Are you still able to access the files you created? Why or why not?

WHAT. There is no such file or directory.

Step 8 To mount the volume automatically every time you power up the system, an entry in the '/etc/fstab' file must be created.

- 8a. Create a directory '/data02'. This is where the volume created will be mounted every time the system is powered up.

- 8b. Edit the '/etc/fstab' file and create an entry that looks like:

```
/dev/diskpool/disk01 /data02 ext4 defaults 0 0
```

After editing the '/etc/fstab' file, reboot the system.

- 8c. After rebooting the system, login and go into the '/data02' directory. Can you see the files and directory you created earlier?

Indeed I can.

- 8d. Did the volume mount correctly? Why?

I think so, since I was able to see the old files that was in the mounted drive earlier.

- 8e. At the command prompt, go to your home directory and type in the command 'sudo umount /mnt/new-disk'. What do you think does this command do?

Unmounts the disk that we have just mounted. :(

- 8f. Can you still see the files and directories you created inside the '/mnt/new-disk' directory?

Nope, there is no such file or directory.

6.6. Reallocating Space

Additional disk space is usually needed to increase the capacity of the system. This may be done through the logical volume manager by adding physical volumes and extending or reducing the size of volume groups and logical volumes as necessary. This sections shows how to add additional hard disk space on your Ubuntu Linux system.

Step 9 The succeeding steps show how to use the LVM to reallocate space on the system. This is may be necessary as disk space gets used up to store user data. A logical volume may be allocated more space as long as there is unallocated space remaining on the volume group.

- 9a. At the command prompt, type in the command `'sudo lvextend -L +200M /dev/diskpool/disk01'`. Did the command run successfully? What does this command do?

Yes it did. this resizes/adds more size to the volumes we have currently made.

- 9b. What is the current capacity of the disk01 logical volume?

400MB.

- 9c. Type in the command `'sudo lvextend -L +200M /dev/diskpool/disk01'` again. Did the command run successfully this time? Why or why not?

Insufficient free space, 50 extents needed, but only 24 available.

It is important to note that logical volumes can be extended only up the remaining unallocated space on the volume group. If there is insufficient space in the volume group, new physical volumes need to be added to further increase the capacity of the volume group.

- 9d. Do the steps to create a new 500MB partition from the remaining space of your new hard drive. Convert this into a new physical volume for the LVM using the `pvcreate` command.

- 9e. Enter the command `'sudo pvs'`. What is the name of the new physical volume. Does it have a new Volume group associated with it? Why or why not?

~~the new one is /dev/sdb2, and no it doesnt have a volume group because we have not assigned one to it yet~~

- 9f. Enter the command `sudo vgextend diskpool [device name]'` where device name is the new physical volume you created. What does this command do?

It adds the physical volume to a volume group.

- 9g. Enter the command `'sudo pvs'`. What is the new size of the diskpool volume group?

496 MB.

- 9h. Try increasing the size of the disk01 logical volume again. Type in the command `'sudo lvextend -L +200M /dev/diskpool/disk01'`. Did the command run successfully this time? Why or why not?

yes it was sucessful, and dispool/disk 1 has been sucessfully resized.

- 9i. Enter the command 'sudo lvs'. What is the new size of the logical volume disk01?

600 MB.

- 9j. Try mounting the logical volume to the 'new-disk' directory again. Enter the 'df' command. What is the capacity of the filesystem in 1K-blocks?

194241

- 9k. Does the output reflect the new size of the filesystem (Compare against Step 7b)? Why or why not?

It seems not. I am not sure, as it says taht the disk01 has already been mounted on the device.

- 9l. Enter the command 'sudo resize2fs /dev/diskpool/disk01'. What does this command do?

I think it ~~resizes the old blocks with the new blocks?~~

- 9m. Enter the 'df' command again. What is the capacity of the filesystem in 1K-blocks this time?

590917

- 9n. Does the output reflect the new size of the filesystem now? Why or why not?

~~yes it does, as the old size had onley 190k left, but with the addition of the new partition, the size jumped to almost 600k, and I think that is why.~~
