**ProLUG – LVM and RAID**

**Required Materials**

Rocky 9.3 – ProLUG Lab

root or sudo command access

**EXERCISES (Warmup to quickly run through your system and familiarize yourself)**

1. cd ~
2. mkdir lvm\_lab
3. cd lvm\_lab
4. touch somefile
5. echo “this is a string of text” > somefile
6. cat somefile
7. echo “this is a string of text” > somefile

Repeat 3 times

1. cat somefile

How many lines are there?

1. Echo “this is a string of text” >> somefile

Repeat 3 times

1. cat somefile

how many lines are there?

cheat with `cat somefile | wc –l`

1. echo “this is our other test text” >> somefile

repeat 3 times

1. cat somefile | nl

how many lines are there?

1. cat somefile | nl | grep test

compare that with #14

1. cat somefile | grep test | nl

If you want to preserve positional lines in file (know how much you’ve cut out when you grep something, or generally be able to find it in the unfiltered file for context, always | nl | before your grep

Pre Lab – Disk Speed tests

When using the ProLUG lab environment, you should always check that there are no other users on the system `w` or `who`.

After this, you may want to check the current state of the disks, as they retain their information even after a reboot resets the rest of the machine. `lsblk /dev/xvda`.

If you need to wipe the disks, you should use fdisk or a similar partition utility.

fdisk /dev/xvda

p #print to see partitions

d #delete partitions or information

w #Write out the changes to the disk.

This is an aside, before the lab. This is a way to test different read or writes into or out of your filesystems as you create them. Different types of raid and different disk setups will give different speed of read and write. This is a simple way to test them. Use these throughout the lab in each mount for fun and understanding.

**Write tests (saving off write data – rename /tmp/file each time):**

1. Check /dev/xvda for a filesystem

* blkid /dev/xvda

 2. If it does not have one, make one

* mkfs.ext4 /dev/xvda

3. mkdir /space (If you don’t have it. Lab will tell you to later as well)

4. mount /dev/xvda /space

**Write Test:**

5. for i in `seq 1 10`; do time dd if=/dev/zero of=/space/testfile$i bs=1024k count=1000 | tee -a /tmp/speedtest1.basiclvm; done

**Read tests:**

6. for i in `seq 1 10`; do time dd if=/space/testfile$i of=/dev/null; done

**Cleanup:**

7. for i in `seq 1 10`; do rm -rf /space/testfile$i; done

\*IF you are re-creating a test without blowing away the filesystem, change the name or counting numbers of testfile\* because that’s the only way to be sure there is not some type of filesystem caching going on to optimize. This is especially true in SAN write tests.\*

**LAB –** start in root (#); cd /root

LVM explanation and use within the system

1. Check physical volumes on your server (my output may vary)

[root@rocky1 ~]#fdisk -l | grep -i xvd

Disk /dev/xvda: 15 GiB, 16106127360 bytes, 31457280 sectors

Disk /dev/xvdb: 3 GiB, 3221225472 bytes, 6291456 sectors

Disk /dev/xvdc: 3 GiB, 3221225472 bytes, 6291456 sectors

Disk /dev/xvde: 3 GiB, 3221225472 bytes, 6291456 sectors

1. Looking at Logical Volume Management –

Logical Volume Management is an abstraction layer that looks a lot like how we carve up SAN disks for storage management. We have Physical Volumes that get grouped up into Volume Groups. We carve Volume Groups up to be presented as Logical Volumes. Here at the Logical Volume layer we can assign RAID functionality from our Physical Volumes attached to a Volume Group or do all kinds of different things that are “under the hood”. Logical Volumes get filesystems formatting and are mounted to the OS.

There are many important commands for showing your physical volumes, volume groups, and logical volumes. The three simplest and easiest are:

[root@rocky1 ~]#pvs

[root@ rocky1 ~]#vgs

[root@ rocky1 ~]#lvs

With these you can see basic information that allows you to see how the disks are allocated. Why do you think there is no output from these commands the first time you run them? Try these next commands to see if you can figure out what is happening? To see more in depth information try pvdisplay, vgdisplay, and lvdisplay.

If there is still no output, it’s because this system is not configured for LVM. You will notice that none of the disk you verified are attached are allocated to LVM yet. We’ll do that next.

1. Creating and Carving up your LVM resources

Disks for this lab are /dev/xvdb, /dev/xvdc, and /dev/xvdd. (but verify before continuing and adjust accordingly.)

We can do individual pvcreates for each disk `pvcreate /dev/xvdb` but we can also loop over them with a simple loop as below. Use your drive letters.

[root@Rocky1 ~]#for disk in b c d

> do

> pvcreate /dev/xvd$disk

> done

 Physical volume "/dev/xvdb" successfully created.

 Creating devices file /etc/lvm/devices/system.devices

 Physical volume "/dev/xvdc" successfully created.

 Physical volume "/dev/xvde" successfully created.

[root@rocky1 ~]#pvs #to see what we made

 PV VG Fmt Attr PSize PFree

 /dev/xvdb lvm2 --- 3.00g 3.00g

 /dev/xvdc lvm2 --- 3.00g 3.00g

 /dev/xvde lvm2 --- 3.00g 3.00g

[root@ROCKY1 ~]#vgcreate VolGroupTest /dev/xvdb /dev/xvdc /dev/xvde

 Volume group "VolGroupTest" successfully created

[root@ROCKY1 ~]#vgs

 VG #PV #LV #SN Attr VSize VFree

 VolGroupTest 3 0 0 wz--n- <8.99g <8.99g

[root@ROCKY1 ~]#lvcreate -l +100%FREE -n lv\_test VolGroupTest

 Logical volume "lv\_test" created.

[root@ROCKY1 ~]#lvs

 LV VG Attr LSize Pool Origin Data% Meta% Move Log Cpy%Sync Convert

 lv\_test VolGroupTest -wi-a----- <8.99g

1. Formatting and mounting the filesystem

[root@ROCKY1 ~]#mkfs.ext4 /dev/mapper/VolGroupTest-lv\_test

mke2fs 1.42.9 (28-Dec-2013)

Filesystem label=

OS type: Linux

Block size=4096 (log=2)

Fragment size=4096 (log=2)

Stride=0 blocks, Stripe width=0 blocks

983040 inodes, 3929088 blocks

196454 blocks (5.00%) reserved for the super user

First data block=0

Maximum filesystem blocks=2151677952

120 block groups

32768 blocks per group, 32768 fragments per group

8192 inodes per group

Superblock backups stored on blocks:

 32768, 98304, 163840, 229376, 294912, 819200, 884736, 1605632, 2654208

Allocating group tables: done

Writing inode tables: done

Creating journal (32768 blocks): done

Writing superblocks and filesystem accounting information: done

[root@ROCKY1 ~]#mkdir /space #Created earlier

[root@ROCKY1 ~]#vi /etc/fstab

Add the following line

/dev/mapper/VolGroupTest-lv\_test /space ext4 defaults 0 0

[root@ROCKY1 ~]#mount -a

#If this command works, there will be no output. We use the df –h in the next command to verify the new filesystem exists. The use of mount -a and not manually mounting the filesystem from the command line is an old administration trick I picked up over the years. By setting our mount in /etc/fstab and then telling the system to mount everything we verify that this will come back up properly during a reboot. We have mounted and verified we have a persistent mount in one step.

[root@ROCKY1 ~]#df -h

[root@rocky1 ~]# df -h

Filesystem Size Used Avail Use% Mounted on

devtmpfs 4.0M 0 4.0M 0% /dev

tmpfs 2.0G 0 2.0G 0% /dev/shm

tmpfs 2.0G 8.5M 1.9G 1% /run

tmpfs 2.0G 1.4G 557M 72% /

tmpfs 2.0G 0 2.0G 0% /run/shm

192.168.200.25:/home 44G 15G 30G 34% /home

192.168.200.25:/opt 44G 15G 30G 34% /opt

tmpfs 390M 0 390M 0% /run/user/0

/dev/mapper/VolGroupTest-lv\_test 8.8G 24K 8.3G 1% /space

\*Good place to speed test and save off your data\*

1. Removing and breaking down the LVM to raw disks

The following command is one way to comment out the line in /etc/fstab. If you had to do this across multiple servers this could be useful. (OR YOU CAN JUST USE VI FOR SIMPLICITY)

[root@ROCKY1 ~]#grep lv\_test /etc/fstab; perl -pi -e "s/\/dev\/mapper\/VolGroupTest/#removed \/dev\/mapper\/VolGroupTest/" /etc/fstab; grep removed /etc/fstab

/dev/mapper/VolGroupTest-lv\_test /space ext4 defaults 0 0

#removed dev/mapper/VolGroupTest-lv\_test /space ext4 defaults 0 0

[root@ROCKY1 ~]#umount /space

[root@ROCKY1 ~]#lvremove /dev/mapper/VolGroupTest-lv\_test

Do you really want to remove active logical volume VolGroupTest/lv\_test? [y/n]: y

 Logical volume "lv\_test" successfully removed

[root@ROCKY1 ~]#vgremove VolGroupTest

 Volume group "VolGroupTest" successfully removed

[root@ROCKY1 ~]#for disk in c e f; do pvremove /dev/sd$disk; done

 Labels on physical volume "/dev/sdc" successfully wiped.

 Labels on physical volume "/dev/sde" successfully wiped.

 Labels on physical volume "/dev/sdf" successfully wiped.

Use your `pvs;vgs;lvs` commands to verify those volumes no longer exist.

[root@ROCKY1 ~]#pvs;vgs;lvs

 PV VG Fmt Attr PSize PFree

 /dev/sda2 VolGroup00 lvm2 a-- 17.48g 4.00m

 /dev/sdb VolGroup01 lvm2 a-- 20.00g 96.00m

 VG #PV #LV #SN Attr VSize VFree

 VolGroup00 1 9 0 wz--n- 17.48g 4.00m

 VolGroup01 1 1 0 wz--n- 20.00g 96.00m

 LV VG Attr LSize Pool Origin Data% Meta% Move Log

 LogVol00 VolGroup00 -wi-ao---- 2.50g

 LogVol01 VolGroup00 -wi-ao---- 1000.00m

 LogVol02 VolGroup00 -wi-ao---- 5.00g

 LogVol03 VolGroup00 -wi-ao---- 1.00g

 LogVol04 VolGroup00 -wi-ao---- 5.00g

 LogVol05 VolGroup00 -wi-ao---- 1.00g

 LogVol06 VolGroup00 -wi-ao---- 1.00g

 LogVol07 VolGroup00 -wi-ao---- 512.00m

 LogVol08 VolGroup00 -wi-ao---- 512.00m

 lv\_app VolGroup01 -wi-ao---- 19.90g

**More complex types of LVM**

LVM can also be used to raid disks

1. Create a RAID 5 filesystem and mount it to the OS (For brevity’s sake we will be limiting show commands from here on out, please use pvs,vgs,lvs often for your own understanding)

[root@ROCKY1 ~]#for disk in c e f; do pvcreate /dev/sd$disk; done

 Physical volume "/dev/sdc" successfully created.

 Physical volume "/dev/sde" successfully created.

 Physical volume "/dev/sdf" successfully created.

vgcreate VolGroupTest /dev/sdc /dev/sde /dev/sdf

lvcreate -l +100%FREE --type raid5 -n lv\_test VolGroupTest

mkfs.xfs /dev/mapper/VolGroupTest-lv\_test

vi /etc/fstab

fix the /space directory to have these parameters (change ext4 to xfs)

/dev/mapper/VolGroupTest-lv\_test /space xfs defaults 0 0

[root@ROCKY1 ~]#df -h

Filesystem Size Used Avail Use% Mounted on

/dev/mapper/VolGroup00-LogVol08 488M 34M 419M 8% /var/log/audit

/dev/mapper/VolGroupTest-lv\_test 10G 33M 10G 1% /space

Since we’re now using RAID 5 we would expect to see the size no longer match the full 15GB, 10GB is much more of a RAID 5 value 66% of raw disk space.

To verify our raid levels we use lvs

[root@ROCKY1 ~]#lvs

 LV VG Attr LSize Pool Origin Data% Meta% Move Log Cpy%Sync

 LogVol00 VolGroup00 -wi-ao---- 2.50g

 LogVol01 VolGroup00 -wi-ao---- 1000.00m

 LogVol02 VolGroup00 -wi-ao---- 5.00g

 LogVol03 VolGroup00 -wi-ao---- 1.00g

 LogVol04 VolGroup00 -wi-ao---- 5.00g

 LogVol05 VolGroup00 -wi-ao---- 1.00g

 LogVol06 VolGroup00 -wi-ao---- 1.00g

 LogVol07 VolGroup00 -wi-ao---- 512.00m

 LogVol08 VolGroup00 -wi-ao---- 512.00m

 lv\_app VolGroup01 -wi-ao---- 19.90g

 lv\_test VolGroupTest rwi-aor--- 9.98g 100.00

Spend 5 min reading the `man lvs` page to read up on raid levels and what they can accomplish. To run RAID 5 3 disks are needed. To run RAID 6 at least 4 disks are needed.

\*Good place to speed test and save off your data\*

1. Set the system back to raw disks

 Unmount /space and remove entry from /etc/fstab

[root@ROCKY1 ~]#lvremove /dev/mapper/VolGroupTest-lv\_test

Do you really want to remove active logical volume VolGroupTest/lv\_test? [y/n]: y

 Logical volume "lv\_test" successfully removed

[root@ROCKY1 ~]#vgremove VolGroupTest

 Volume group "VolGroupTest" successfully removed

[root@ROCKY1 ~]#for disk in c e f; do pvremove /dev/sd$disk; done

 Labels on physical volume "/dev/sdc" successfully wiped.

 Labels on physical volume "/dev/sde" successfully wiped.

 Labels on physical volume "/dev/sdf" successfully wiped.

**Working with MDADM as another RAID option**

There could be a reason to use MDADM on the system. For example you want raid handled outside of your LVM so that you can bring in sets of new disks already raided and treat them as their own Physical Volumes. Think, “I want to add another layer of abstraction so that even my LVM is unaware of the RAID levels.” This has special use case, but is still useful to understand.

May have to install mdadm yum: yum install mdadm

1. Create a raid5 with MDADM

[root@ROCKY1 ~]#mdadm --create -l raid5 /dev/md0 -n 3 /dev/sdc /dev/sde /dev/sdf

mdadm: Defaulting to version 1.2 metadata

mdadm: array /dev/md0 started.

1. Add newly created /dev/md0 raid to LVM

This is same as any other add. The only difference here is that LVM is unaware of the lower level RAID that is happening.

[root@ROCKY1 ~]#pvcreate /dev/md0

 Physical volume "/dev/md0" successfully created.

[root@ROCKY1 ~]#vgcreate VolGroupTest /dev/md0

 Volume group "VolGroupTest" successfully created

[root@ROCKY1 ~]#lvcreate -l +100%Free -n lv\_test VolGroupTest

 Logical volume "lv\_test" created.

[root@ROCKY1 ~]#lvs

 LV VG Attr LSize Pool Origin Data% Meta% Move Log

 LogVol00 VolGroup00 -wi-ao---- 2.50g

 LogVol01 VolGroup00 -wi-ao---- 1000.00m

 LogVol02 VolGroup00 -wi-ao---- 5.00g

 LogVol03 VolGroup00 -wi-ao---- 1.00g

 LogVol04 VolGroup00 -wi-ao---- 5.00g

 LogVol05 VolGroup00 -wi-ao---- 1.00g

 LogVol06 VolGroup00 -wi-ao---- 1.00g

 LogVol07 VolGroup00 -wi-ao---- 512.00m

 LogVol08 VolGroup00 -wi-ao---- 512.00m

 lv\_app VolGroup01 -wi-ao---- 19.90g

 lv\_test VolGroupTest -wi-a----- 9.99g

Note that LVM does not see that it is dealing with a raid system, but the size is still 10g instead of 15g

Fix your /etc/fstab to read

/dev/mapper/VolGroupTest-lv\_test /space xfs defaults 0 0

[root@ROCKY1 ~]#mkfs.xfs /dev/mapper/VolGroupTest-lv\_test

meta-data=/dev/mapper/VolGroupTest-lv\_test isize=512 agcount=16, agsize=163712 blks

 = sectsz=512 attr=2, projid32bit=1

 = crc=1 finobt=0, sparse=0

data = bsize=4096 blocks=2618368, imaxpct=25

 = sunit=128 swidth=256 blks

naming =version 2 bsize=4096 ascii-ci=0 ftype=1

log =internal log bsize=4096 blocks=2560, version=2

 = sectsz=512 sunit=8 blks, lazy-count=1

realtime =none extsz=4096 blocks=0, rtextents=0

[root@ROCKY1 ~]#mount –a

\*Good place to speed test and save off your data\*

1. **Setting the MDADM to persist through reboots #not in our lab environment though#**

[root@ROCKY1 space]#mdadm --detail --scan >> /etc/mdadm.conf

 [root@ROCKY1 space]#cat /etc/mdadm.conf

ARRAY /dev/md0 metadata=1.2 name=ROCKY1:0 UUID=03583924:533e5338:8d363715:09a8b834

Verify with `df -h` ensure that your /space is mounted.

There is no procedure in this lab for breaking down this MDADM RAID.

You are root/administrator on your machine, and you do not care about the data on this RAID. Can you use the internet/man pages/or other documentation to take this raid down safely and clear those disks?

Can you document your steps so that you or others could come back and do this process again?