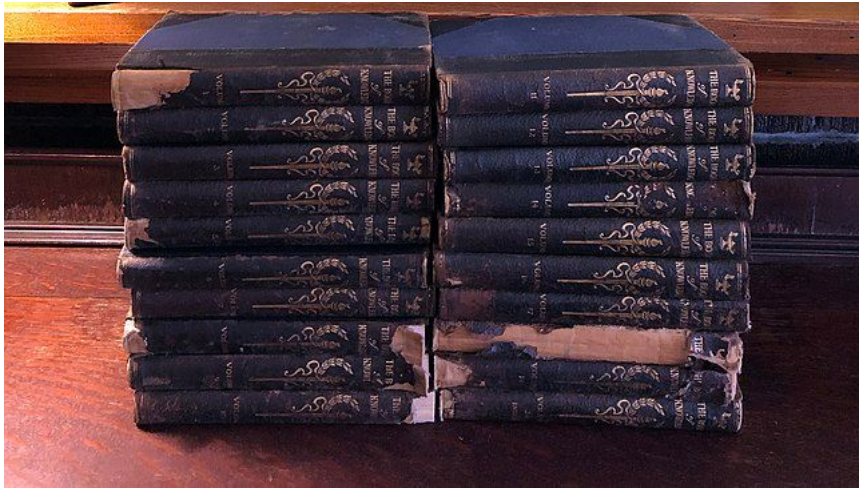
Logical Volume Management



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Managing disks is a pain

- MBR…GPT…
- *Primary* partitions…
- *Extended* partitions…
- *Logical* partitions…
- Partition types…flags…
- Reboots…
- Moving…resizing…removing…`fdisk`…`gdisk`…`parted`…*ack*!

Logical volume management—1/2

- Allocate physical disks
- Group them together
- Put “logical units” on them
- Treat *those* as disk partitions
- Size’em, RAID’em, stick’em in a group…

Logical volume management—2/2

- Actually a *general* concept; many approaches:
  - ZFS, bioctl, btrfs, Stratis…
- We'll focus on a widely-deployed Linux kernel implementation:
  - **LVM2**, available since Linux v2.6
- **Free software**, of course!

Advantages—1/2

- Create new volumes at run time
- Address volumes by *name*, not kernel device number
- Remove a volume from the middle of the disk
- Add or remove space from a volume
  - Without having to move the others…
- All online, no reboots required

Advantages—2/2

- 50 volumes? 100 volumes? No problem.
- Optional software “RAID” per logical unit
  - Compare: mdadm: more conventional, less flexible
- Volume snapshots
  - Great for backups
- Thin provisioning
  - Use space only when actually allocated

Setup example—1/4

- Specify **physical disks**:
  - `/dev/sda`: 128 GB SSD
  - `/dev/sdb`: 1 TB HDD
  - `/dev/sdc`: 2 TB HDD

```
$ sudo pvcreate /dev/sda /dev/sdb /dev/sdc
$ sudo pvs
```

Setup example—2/4

- Create **volume groups**:
  - `system`: `/dev/sda`
  - `media`: `/dev/sdb`, `/dev/sdc`

```
$ sudo vgcreate system /dev/sda
$ sudo vgcreate media /dev/sdb /dev/sdc
$ sudo vgs
```

Setup example—3/4

- Create **logical volumes**:
  - `logs`: 32 GB
  - `swap`: 4 GB
  - `music`: 512 GB

```
$ sudo lvcreate -n logs -L 32G system
$ sudo lvcreate -n swap -L 4G system
$ sudo lvcreate --type raid1 -n music -L 512G media
$ sudo lvs
```

Setup example—4/4

Format and mount! It's all there in `/dev`.

```
$ sudo mkfs.ext4 /dev/system/logs
$ sudo mount /dev/system/logs /var/log

$ sudo mkswap /dev/system/swap
$ sudo swapon /dev/system/swap

$ sudo mkfs.ext4 /dev/media/music
$ sudo mkdir -p /media/music
$ sudo mount /dev/media/music /media/music
```

Resizing

- “Hmm, need more room for logs…”

```
$ sudo lvextend -L 48G -r system/logs
```

  Done.

- “Remount? *Reboot*?”
- Eh…what for?

Example outputs—pvs(8)

```
$ sudo pvs
  PV                        VG         Fmt  Attr PSize  PFree
  /dev/mapper/sda5_crypt    arjuna-vg  lvm2 a--  29.57g    0
  /dev/mapper/temba_crypt   temba      lvm2 a--  <2.64t 1.10t
```

Example outputs—vgs(8)

```
$ sudo vgs
  VG         #PV #LV #SN Attr   VSize  VFree
  arjuna-vg    1   2   0 wz--n- 29.57g    0
  temba        1  10   0 wz--n- <2.64t 1.10t
```

Example outputs—`lvs(8)`

```
$ sudo lvs
  LV                   VG        Attr       Lsize  …
  root                 arjuna-vg -wi-ao----  28.57g
  swap_1               arjuna-vg -wi-ao----   1.00g
  backup-host-arjuna   temba     -wi-ao----  50.00g
  backup-host-darmok   temba     -wi-ao---- 200.00g
  backup-host-sanctum  temba     -wi-ao----  25.00g
  …
  download             temba     -wi-ao---- 120.00g
  media                temba     -wi-ao----   1.00t
  systems              temba     -wi-ao----  50.00g
  web                  temba     -wi-ao----  50.00g
```

Snapshots—1/2

- Some busy logical volume changes all the time: logs, database server data…
- Need to freeze it in place in a *consistent* state for a filesystem backup.
- Can’t copy a file halfway through an operation…

Snapshots—2/2

- Create a snapshot (instant):

```
$ sudo lvcreate -s -n logs_snap /dev/system/logs
```

- Mount it read-only:

```
$ sudo mount -o ro /dev/system/logs /backup/logs
```

- Back it up:

```
$ sudo rsync -aH -- /backup/logs backup:
```

- Unmount it:

```
$ sudo umount /backup/logs
```

- Remove it:

```
$ sudo lvremove system/logs_snap
```

LVM on OS installation

- Modern GNU/Linux distributions allow installing LVM on boot
- It’s not the default in most cases (yet)
  - But it should be
- Do use it, and trust the guided partitioner
  - Color within the lines here
- Save yourself some space for resizing later

Encryption—1/2

- Works with LUKS/dm-crypt (`cryptsetup(8)`)
- Encrypt a disk (FDE), make it a PV
- Encrypt specific logical volumes on a plaintext PV
- Works out of the box with modern OS installers (Debian, Ubuntu, Fedora…)
- Passphrase on boot…
  …and your volumes appear!

Encryption—2/2

- LVM makes this too easy *not* to do.
- It costs very little in performance speed with any modern CPU.
- If your laptop is stolen, the data on it is useless to the thief. Think: laptop thieves, *not* the NSA/GCSB!
- See: I’m not paranoid, you’re just foolish

Questions?

- Wikipedia: Logical Volume Manager (Linux)
- TLDP: LVM HOWTO

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