MHPC
Master in High Performance Computing

LVM in a nutshell

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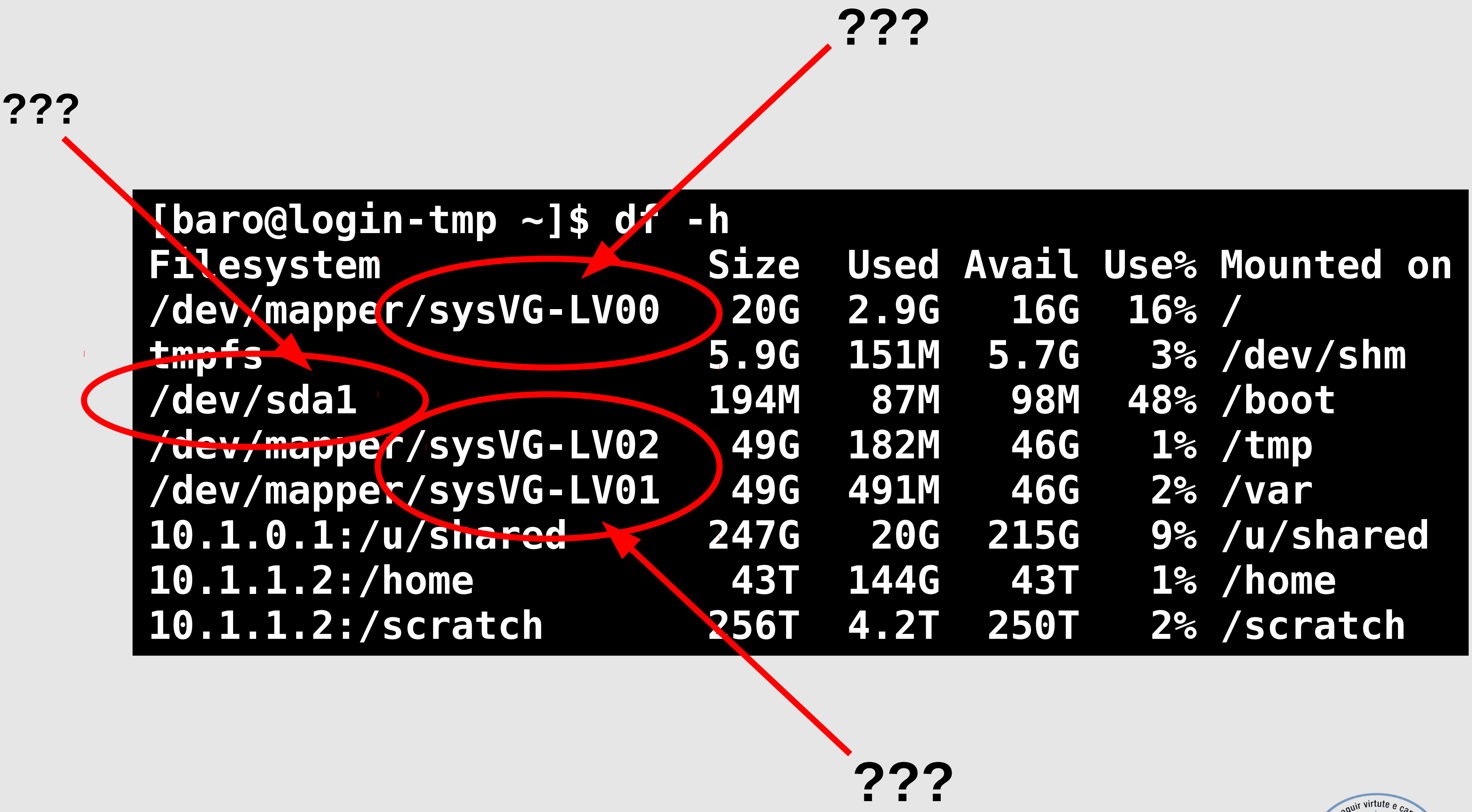
What are we talking about?



???

???

```
[baro@login-tmp ~]$ df -h
Filesystem              Size  Used Avail Use% Mounted on
/dev/mapper/sysVG-LV00   20G  2.9G   16G  16% /
tmpfs                   5.9G  151M  5.7G   3% /dev/shm
/dev/sda1               194M   87M   98M  48% /boot
/dev/mapper/sysVG-LV02   49G  182M   46G   1% /tmp
/dev/mapper/sysVG-LV01   49G  491M   46G   2% /var
10.1.0.1:/u/shared      247G   20G  215G   9% /u/shared
10.1.1.2:/home           43T  144G   43T   1% /home
10.1.1.2:/scratch       256T  4.2T  250T   2% /scratch
```

???

Background

- a hard disk can be seen as a continuous row of logical blocks
- in order to store data on a disk this row needs to be cut in sections called partitions
- it can be
  - one huge partition covering the whole disk
  - several small partitions on one disk
  - a combination over several disks
- a partition must be a continuous chunk of blocks (here lies part of the problem)
- a partition is forever (ok, not really...)

What is LVM?

Logical Volume Manager

- a logical layer placed between disk partitions and file systems
- breaks filesystem / physical partition binding
- provides logical partitions called volumes
- greater flexibility (live create / remove / resize)
- allows disks aggregation (MD compatible)
- live snapshots (*copy-on-write*) and cloning (mirror)

Cons? Additional layers of complexity.

- disaster recovery becomes more difficult
- another abstraction layer in I/O operations
- advanced skills required

New terms

PV – Physical Volume

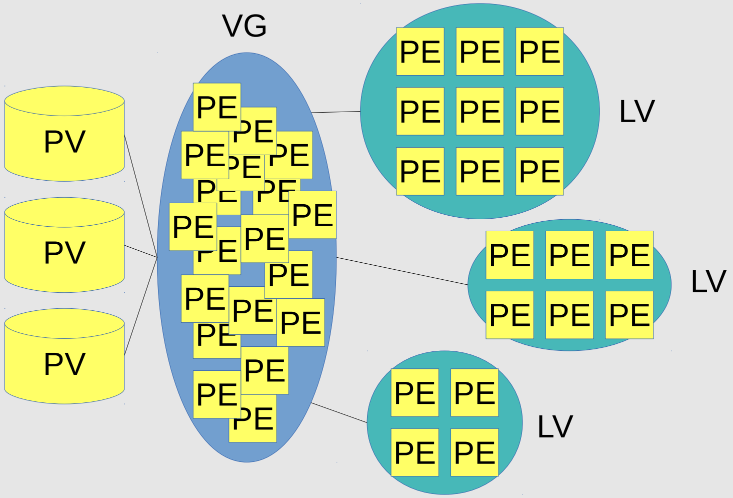
collects one or more disk partitions or whole disks (/dev/sda, /dev/sdc3, /dev/loop0, ...)

VG – Volume Group

creates one big virtual disk out of one or more PVs (vg-sys, vg-data)

LV – Logical Volume

the VG can be split up into several LVs and each of them can host a different filesystem (as for physical partitions) (lv-root, lv-home)



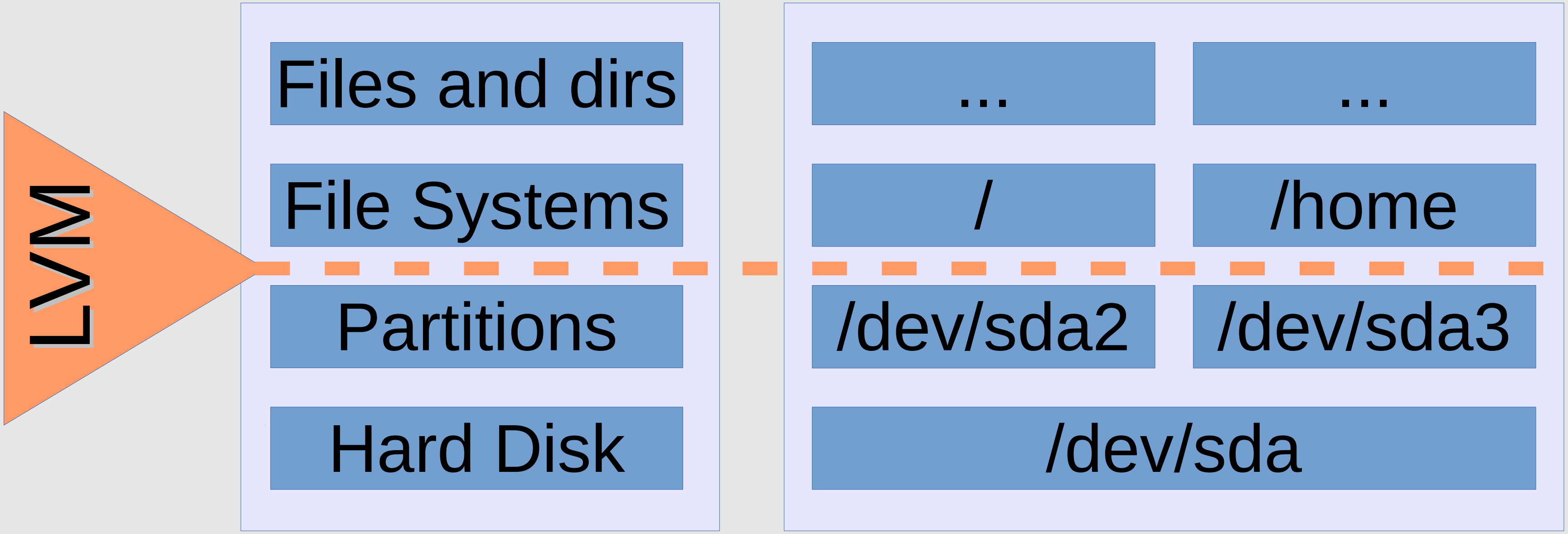
PE – Physical Extent

smallest allocatable chunk for LVs in a VG (default 4MiB, min 1KiB)

/dev/vg-sys/lv-root == /dev/mapper/vg-sys-lv-root

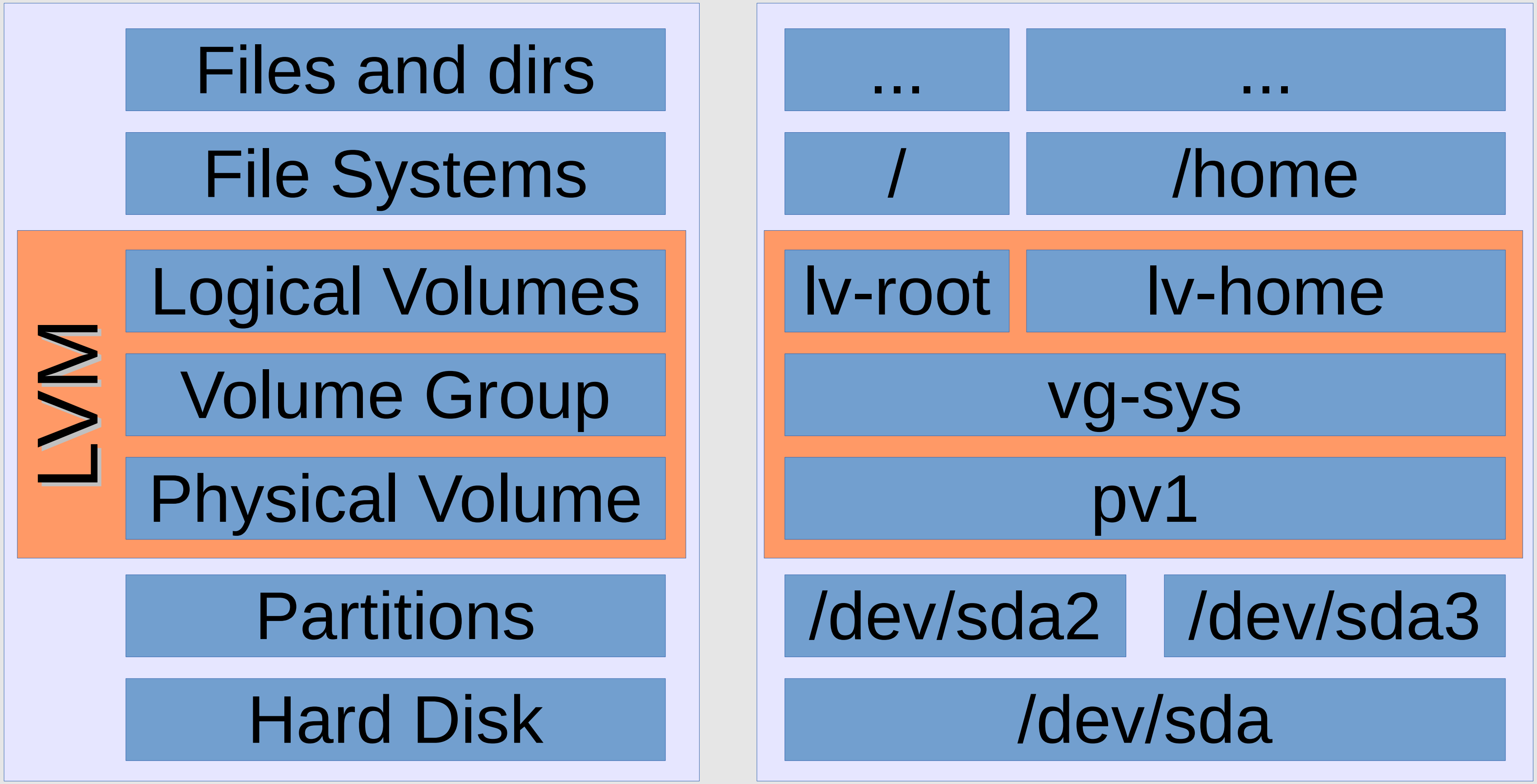
/dev/vg-sys/lv-home == /dev/mapper/vg-sys-lv-home

Standard layout



Files and dirs	...	...
File Systems	/	/home
Partitions	/dev/sda2	/dev/sda3
Hard Disk	/dev/sda	

LVM layout

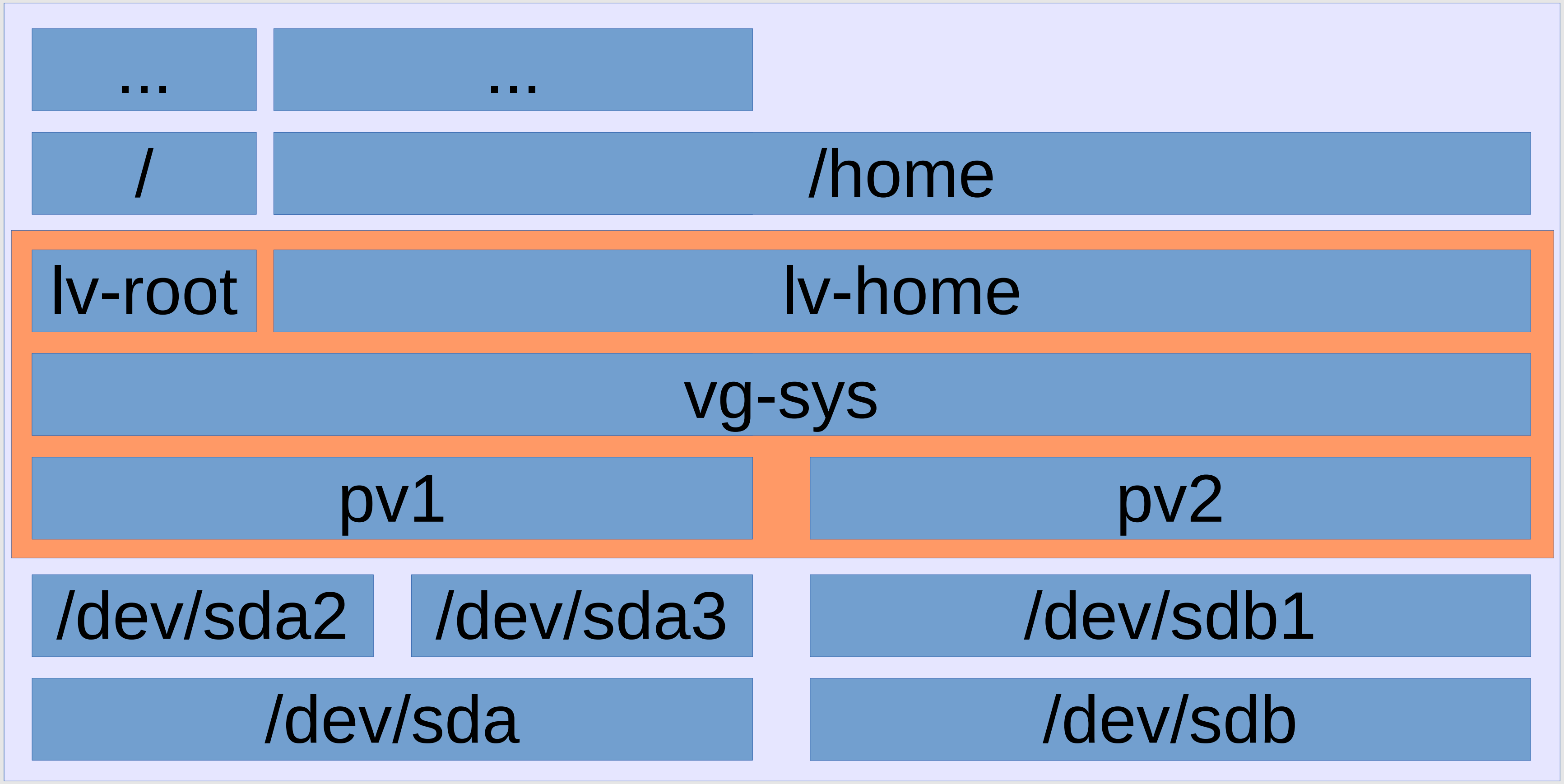


	Files and dirs	...	...
	File Systems	/	/home
LVM	Logical Volumes	lv-root	lv-home
LVM	Volume Group	vg-sys	
LVM	Physical Volume	pv1	
	Partitions	/dev/sda2	/dev/sda3
	Hard Disk	/dev/sda	

Example: expand

No space left on lv-home
Add a new physical disk (sdb)
Add the new disk to LVM as new PV

Expand the VG
Expand the LV
Resize the filesystem



LVM is not RAID

Not yet, but getting closer. LVM is now almost fully compatible with linux kernel MD interface (without *mdadm*):

- *lvcreate* supports --type raid[0-6,10], stripes, recovery rate, ...
- not well documented, not yet widely used as RAID solution, not supported by *grub*, less reliable (less tested) than *mdadm*
- manual rebuild vs automatic rebuild

mdadm + LVM is still “best practice”

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Questions?

ma per seguir virtute e canoscenza
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Commands:

test env setup, create, mkfs, mount

```
# dd if=/dev/zero of=/dev/shm/disk1 bs=1M count=0 seek=100
# dd if=/dev/zero of=/dev/shm/disk2 bs=1M count=0 seek=100
# losetup /dev/loop1 /dev/shm/disk1
# losetup /dev/loop2 /dev/shm/disk2
# pvcreate /dev/loop1
# pvcreate /dev/loop2
# vgcreate VGTEST /dev/loop1 /dev/loop2
# lvcreate -l 50%FREE -n LVTEST VGTEST
# lvresize -l+100%FREE /dev/VGTEST/LVTEST
# mkfs.ext4 -v /dev/VGTEST/LVTEST
# mkdir -vp /mnt/tmp
# mount /dev/VGTEST/LVTEST /mnt/tmp
# df /mnt/tmp
```

Commands:

display, lvextend, resizefs

```
# pvdisplay
# vgdisplay
# lvdisplay

# lvextend --extents +100%FREE /dev/VGTEST/LVTEST
# lvdisplay /dev/VGTEST/LVTEST

# umount /mnt/tmp
# fsck.ext4 -f -v /dev/VGTEST/LVTEST
# resize2fs /dev/VGTEST/LVTEST
# dumpe2fs -h /dev/VGTEST/LVTEST
# mount /dev/VGTEST/LVTEST /mnt/tmp
# df
```

Commands:

add disk, vg/lv extend, resizefs

```
# dd if=/dev/zero of=/dev/shm/disk3 bs=1M count=0 seek=100
# losetup /dev/loop3 /dev/shm/disk3
# pvcreate /dev/loop3
# vgdisplay
# vgextend VGTEST /dev/loop3
# vgdisplay
# lvextend --extents +100%FREE /dev/VGTEST/LVTEST
# lvdisplay
# umount /mnt/tmp
# fsck.ext4 -f -v /dev/VGTEST/LVTEST
# resize2fs /dev/VGTEST/LVTEST
```

Commands:

snapshot, remove, destroy test env

```
# mkdir -vp /mnt/tmp2
# lvcreate --size 10m --snapshot
--name SNAP /dev/VGTEST/LVTEST
# mount -r  /dev/VGTEST/SNAP
/mnt/tmp2/
# echo ciao > /mnt/tmp/testfile
# ls /mnt/tmp
# ls /mnt/tmp2
# umount /mnt/tmp2
# lvremove -f /dev/VGTEST/SNAP
```

```
# umount /mnt/tmp
# vgchange -a n VGTEST
```

(up to this point, non-destructive ops)

```
# lvremove /dev/VGTEST/LVTEST
# vgremove VGTEST
```

```
# losetup -d /dev/loop1
# losetup -d /dev/loop2
# losetup -a
# vgdisplay
# pvdisplay
# rm -fv /dev/shm/disk[12]
```