MHPC
Master in High Performance Computing

LVM in a nutshell

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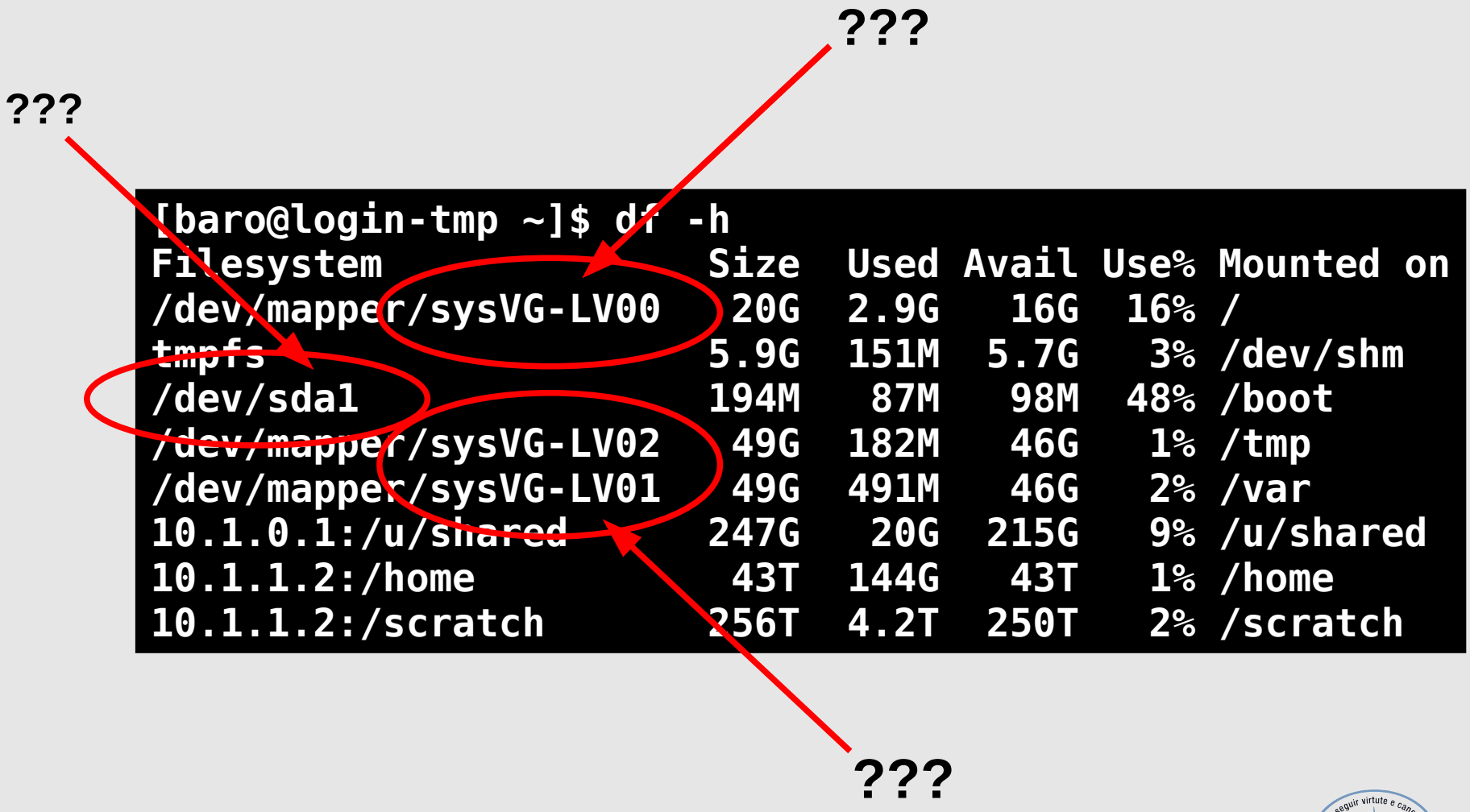
What are we talking about?



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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...)

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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

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New terms

PV – Physical Volume

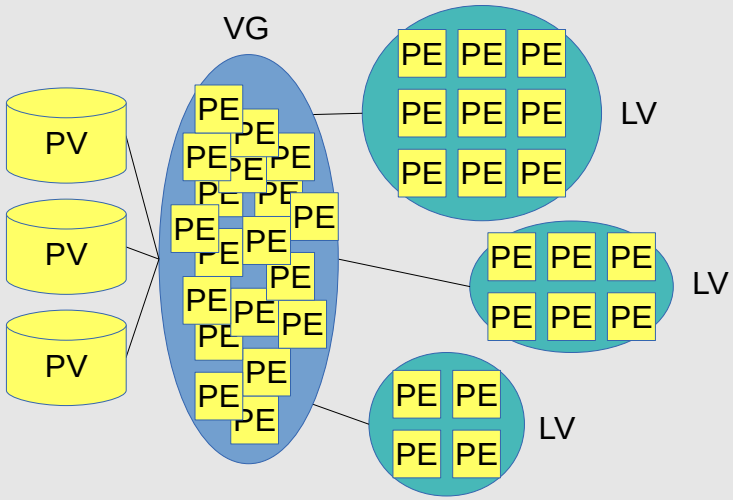
collects one or more disk partitions or whole disks (/dev/sda, /dev/sdc3, /dev/loop0, ...)

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)



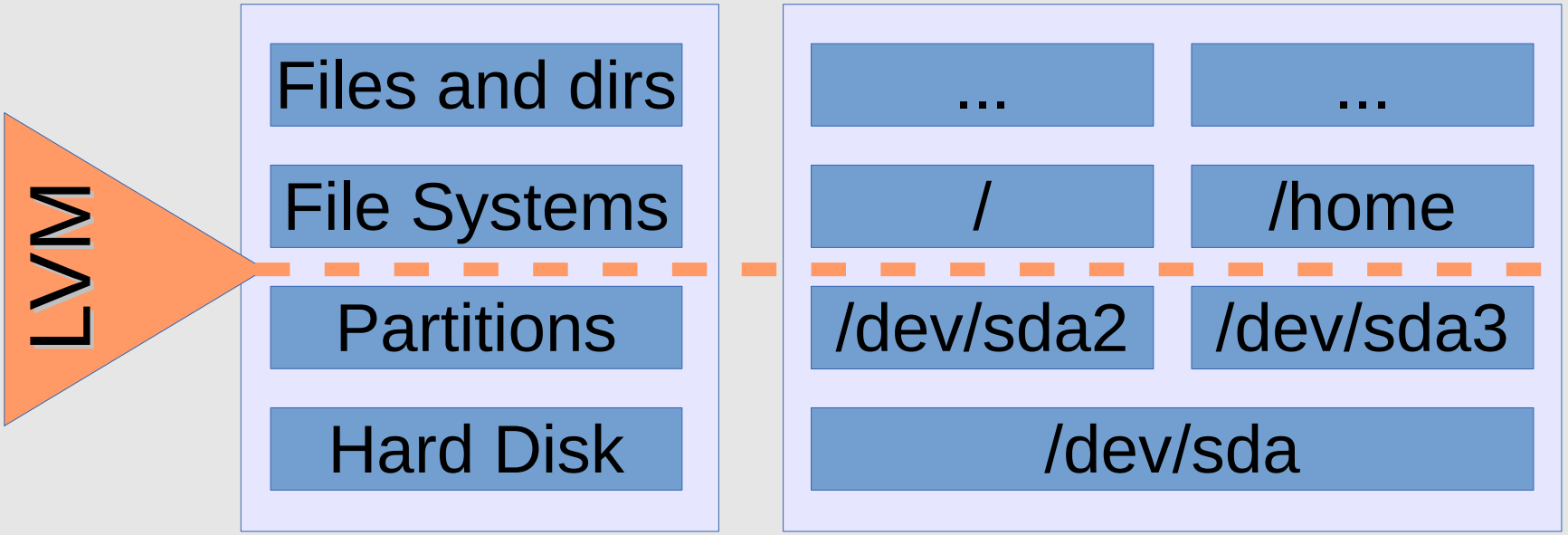
PE – Physical Extent

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

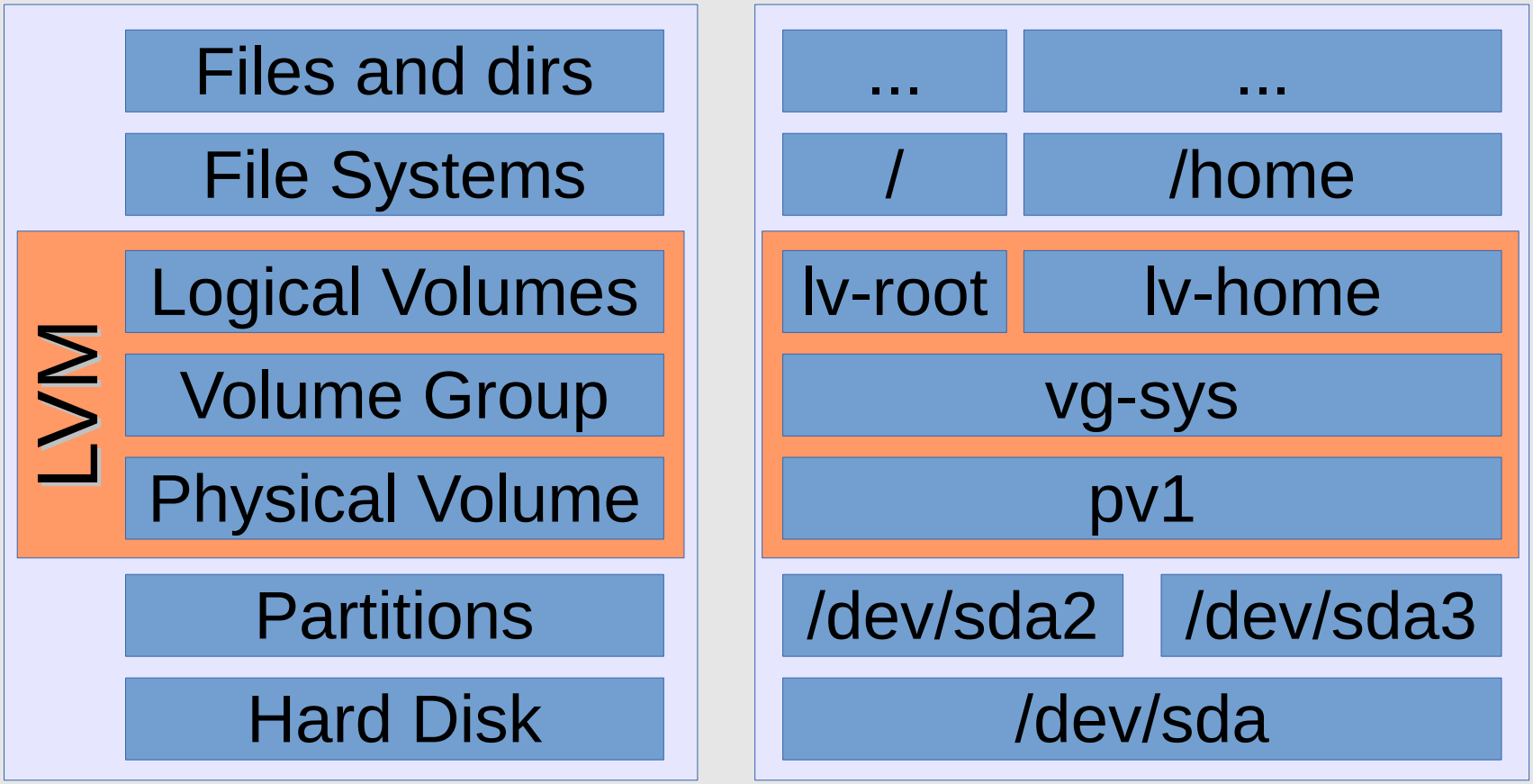
/dev/vg-sys/lv-root == /dev/mapper/vg-sys-lv-root

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

Standard layout



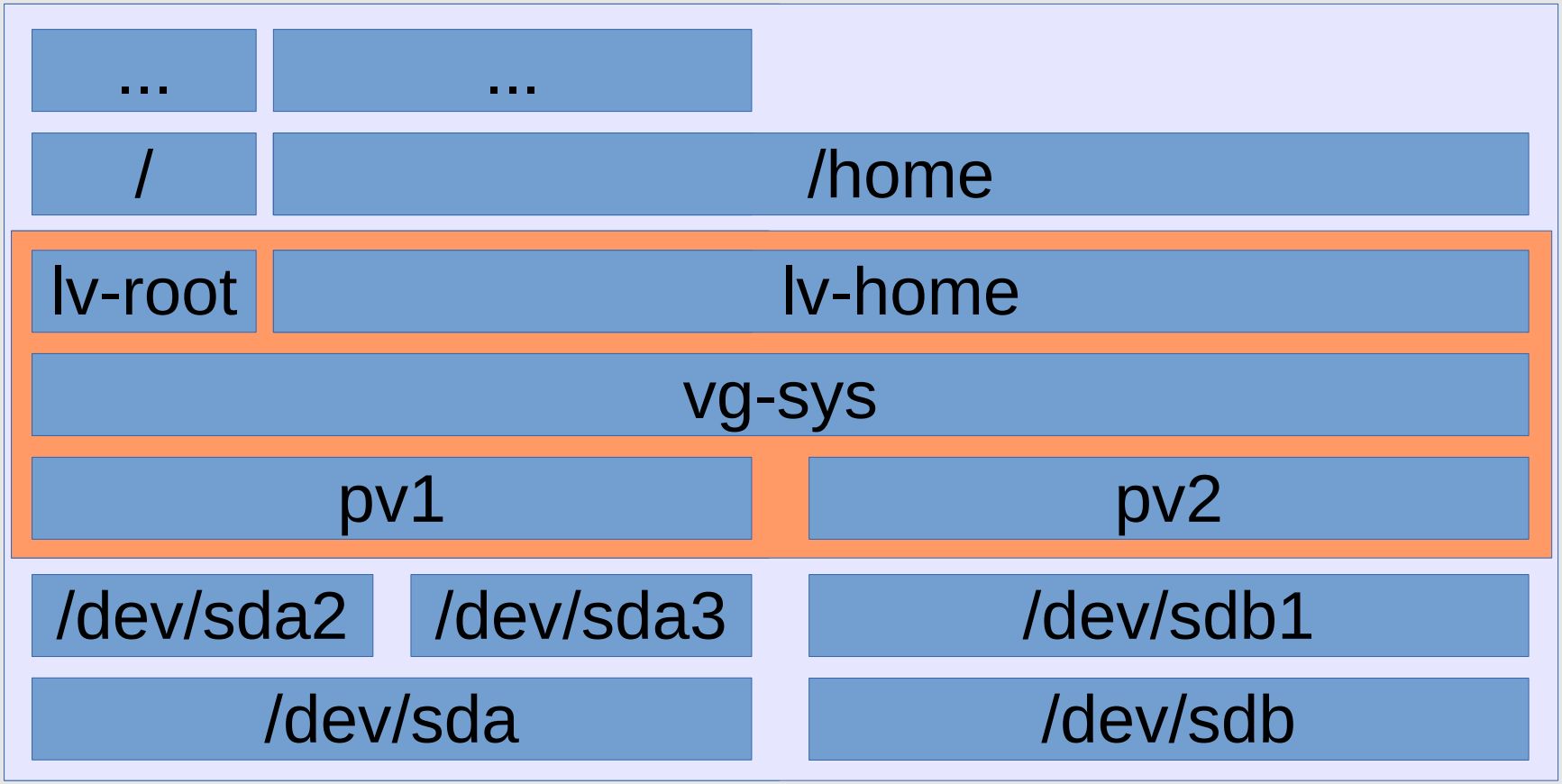
LVM layout


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

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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
```

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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
```

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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]
```