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LVM in a nutshell

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ma per seguir virtute e canoscenza
Scuola Internazionale Superiore
di Studi Avanzati

ICTP
The Abdus Salam
International Centre
for Theoretical Physics

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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
```

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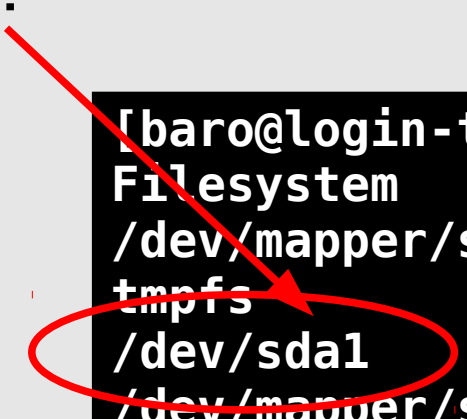
???



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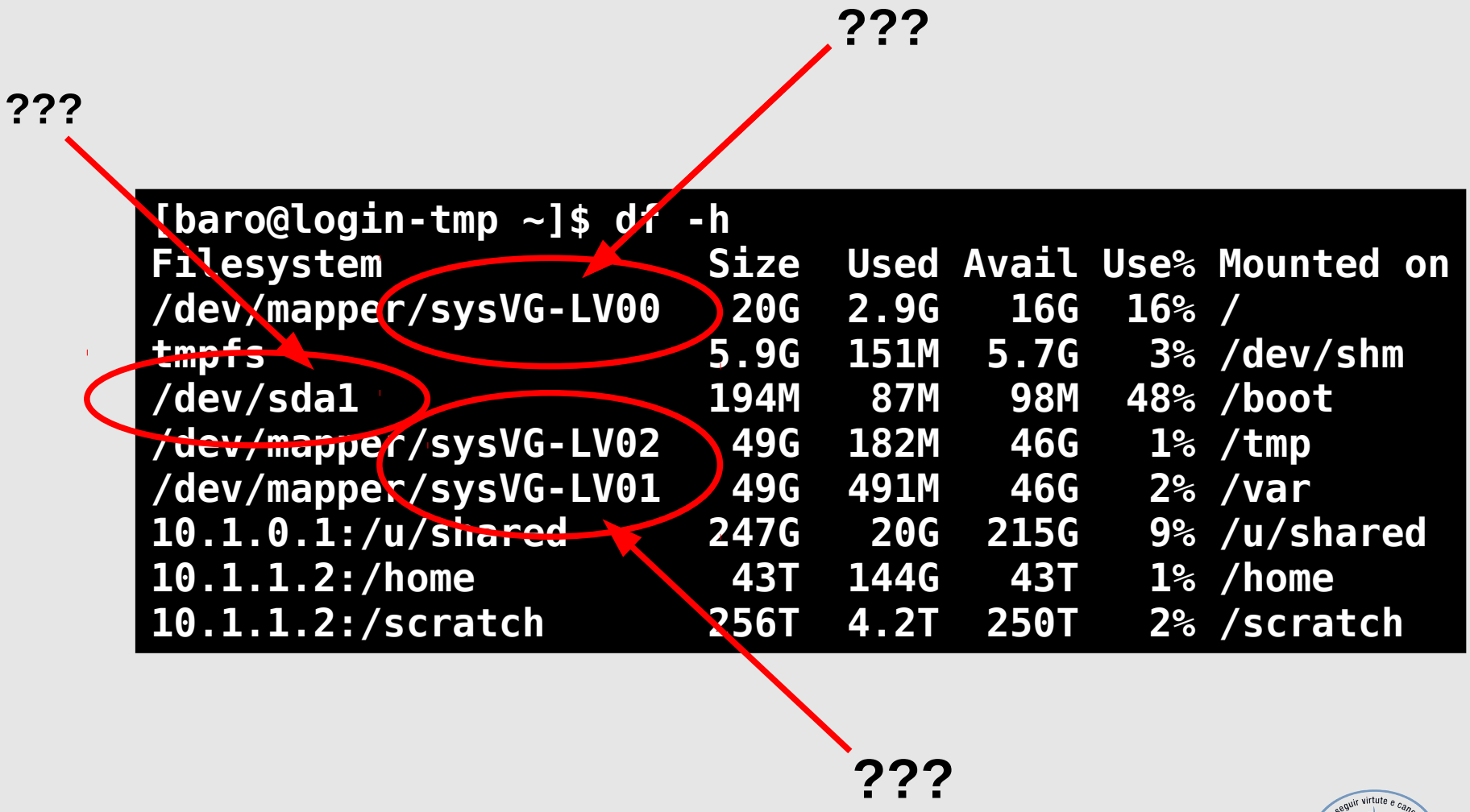

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Background

- a hard disk can be seen as a continuous row of logical blocks

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  - several small partitions on one disk
  - a combination over several disks

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- 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

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What is LVM?

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- greater flexibility (live create / remove / resize)
- allows disks aggregation (MD compatible)
- live snapshots (*copy-on-write*) and cloning (mirror)

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Cons? Additional layers of complexity.

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

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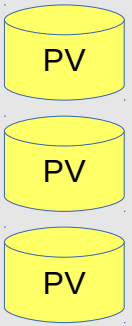
New terms

PV – Physical Volume

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



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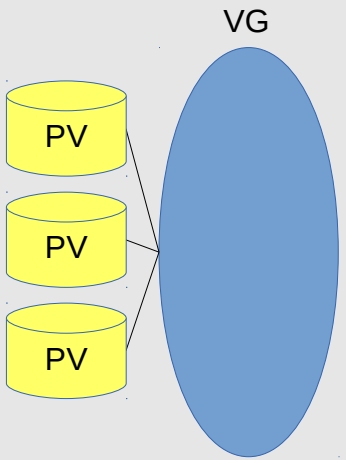
VG – Volume Group

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



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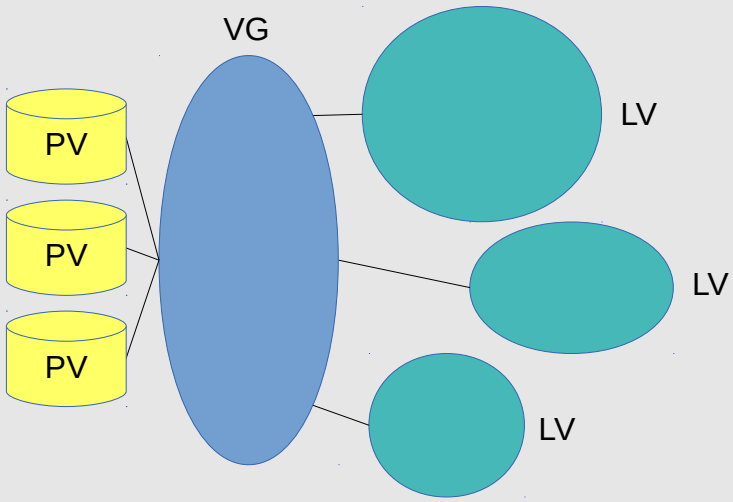
LV – Logical Volume

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)



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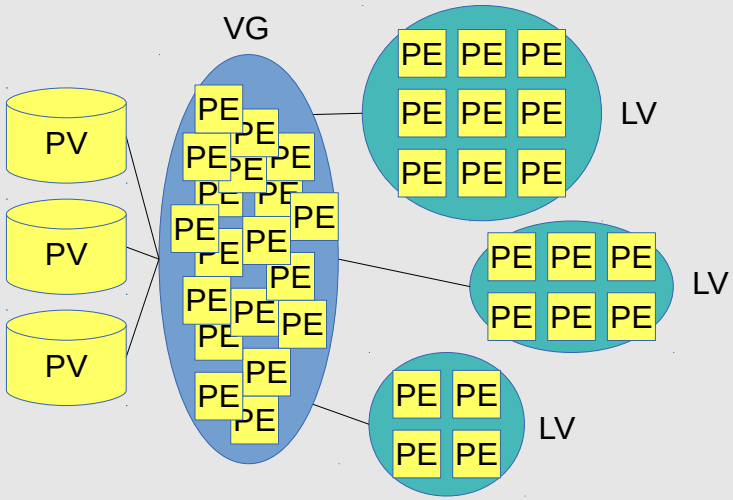

PE – Physical Extent

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

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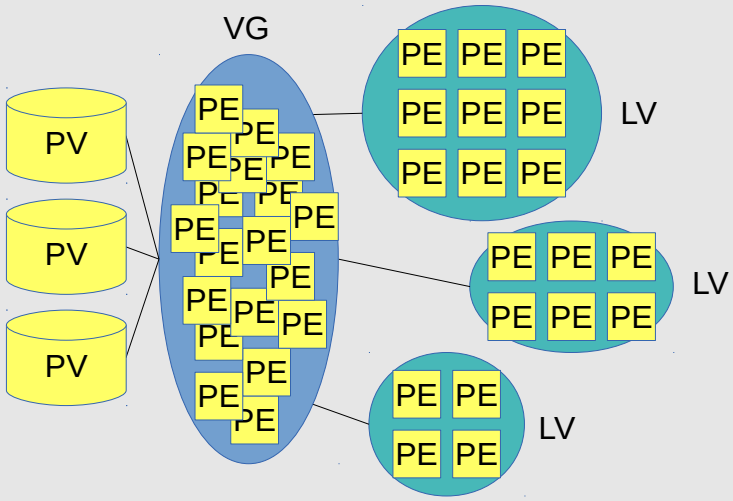

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/dev/vg-sys/lv-root == /dev/mapper/vg-sys-lv-root

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

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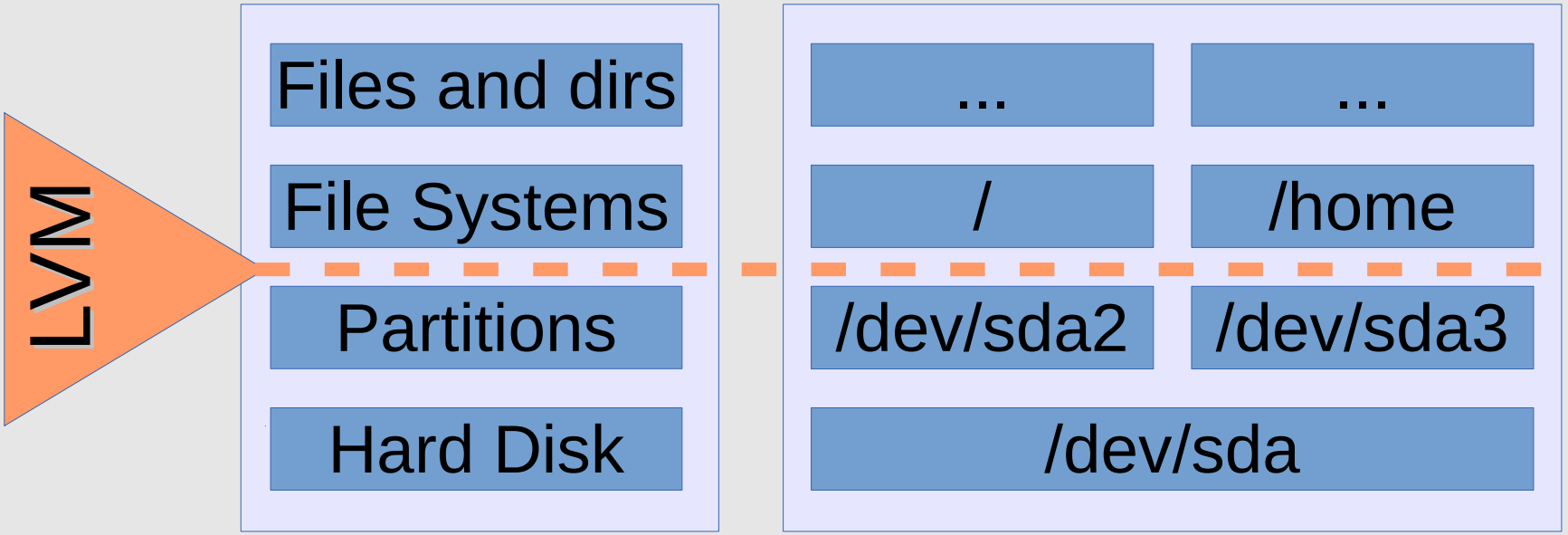
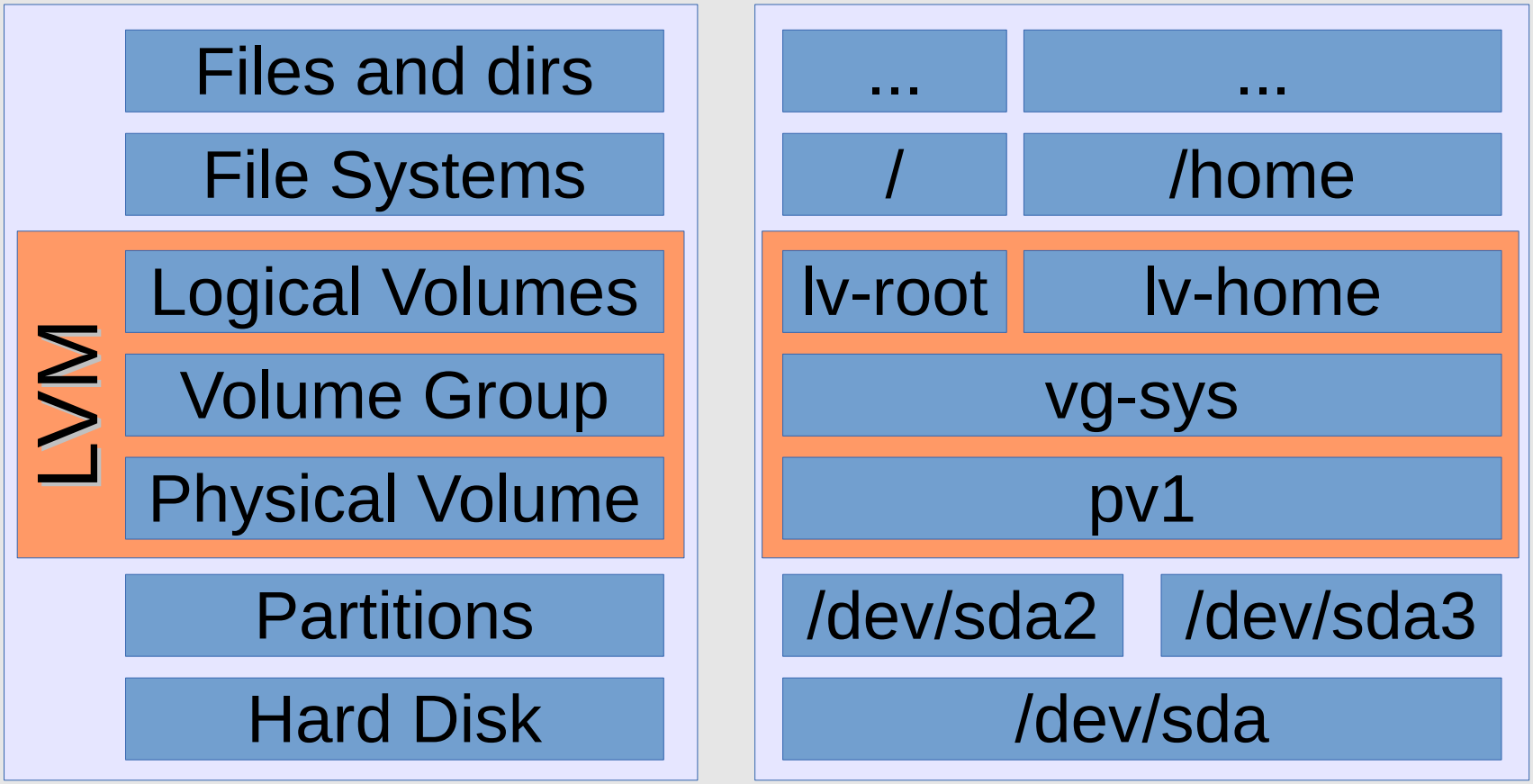
Standard layout

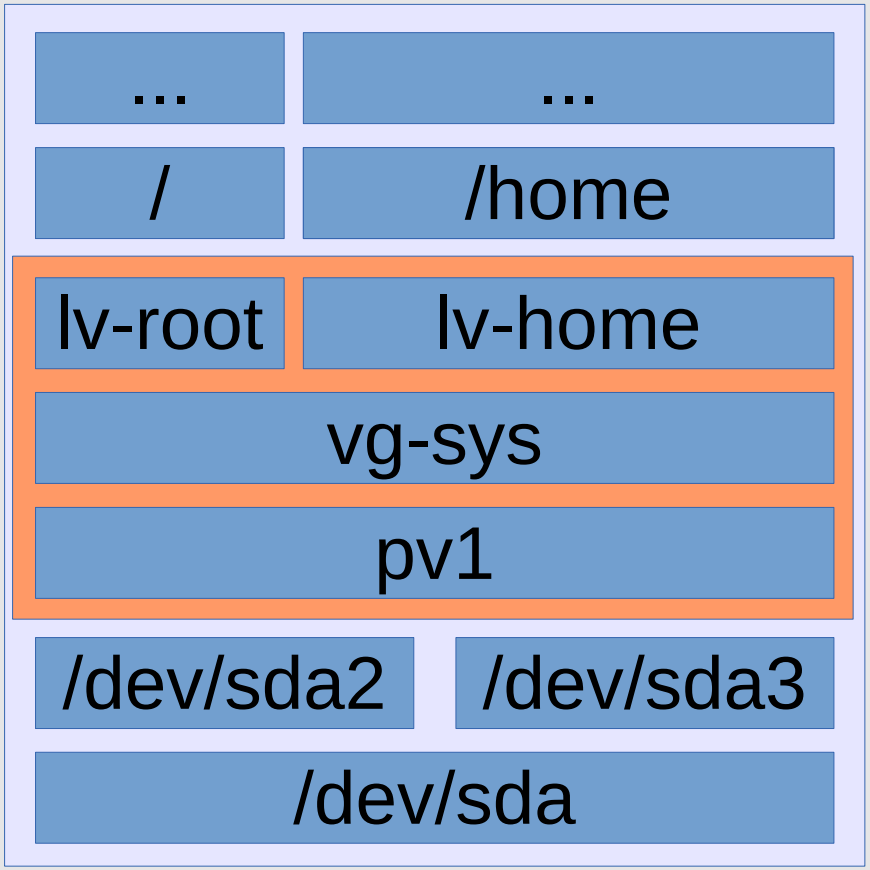
Standard layout



LVM layout

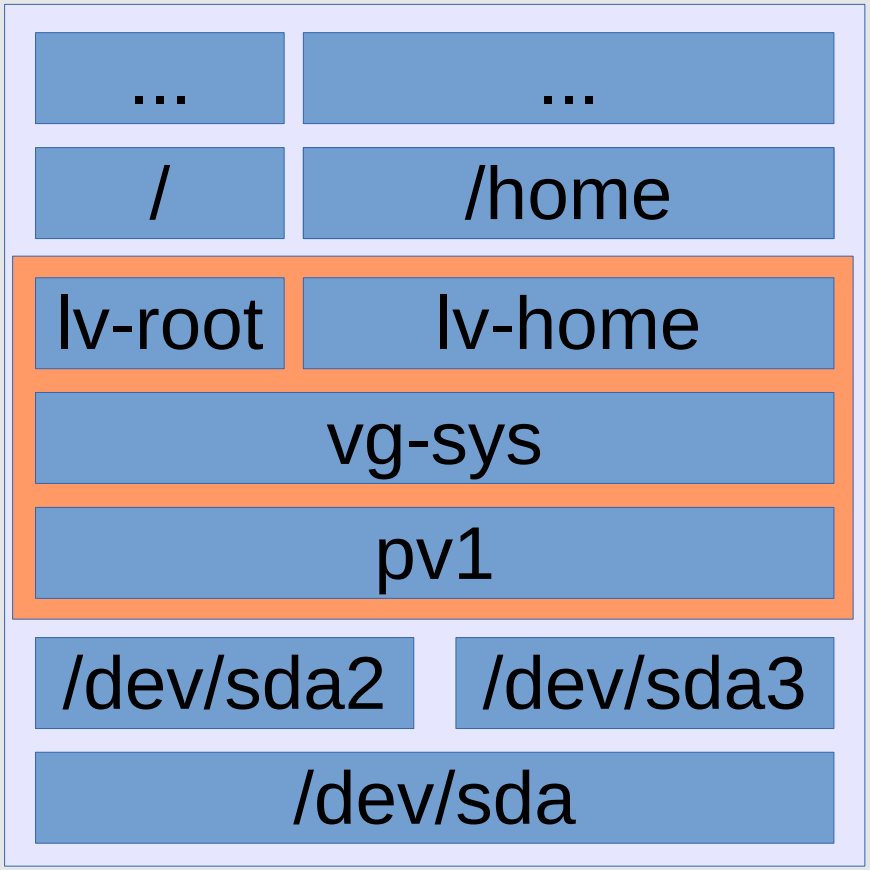

Files and dirs
File Systems
LVM
Logical Volumes
Volume Group
Physical Volume
Partitions
Hard Disk
...
...
/
/home
lv-root
lv-home
vg-sys
pv1
/dev/sda2
/dev/sda3
/dev/sda

Example: expand



Example: expand

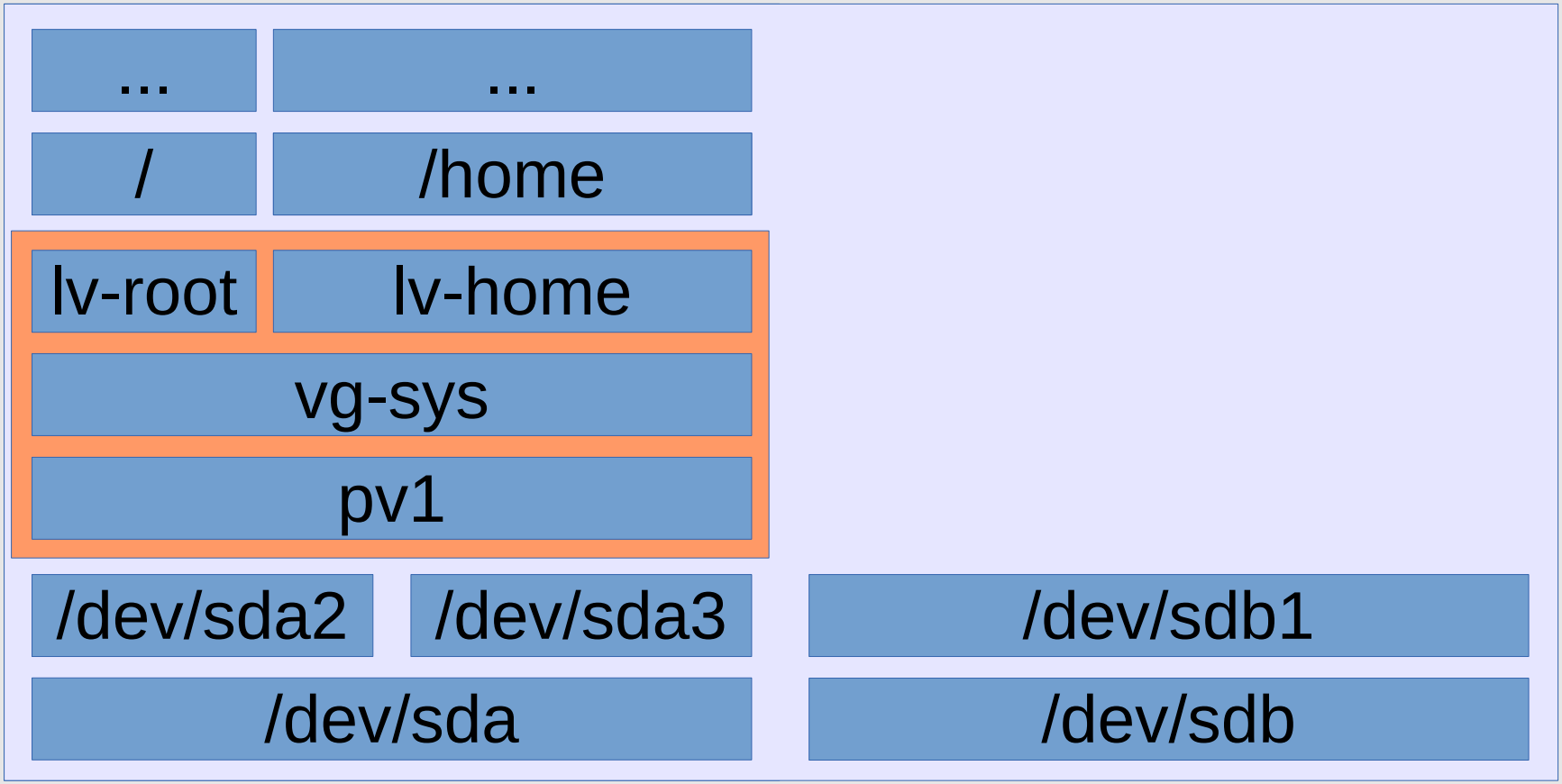
No space left on lv-home



Example: expand

No space left on lv-home

Add a new physical disk (sdb)



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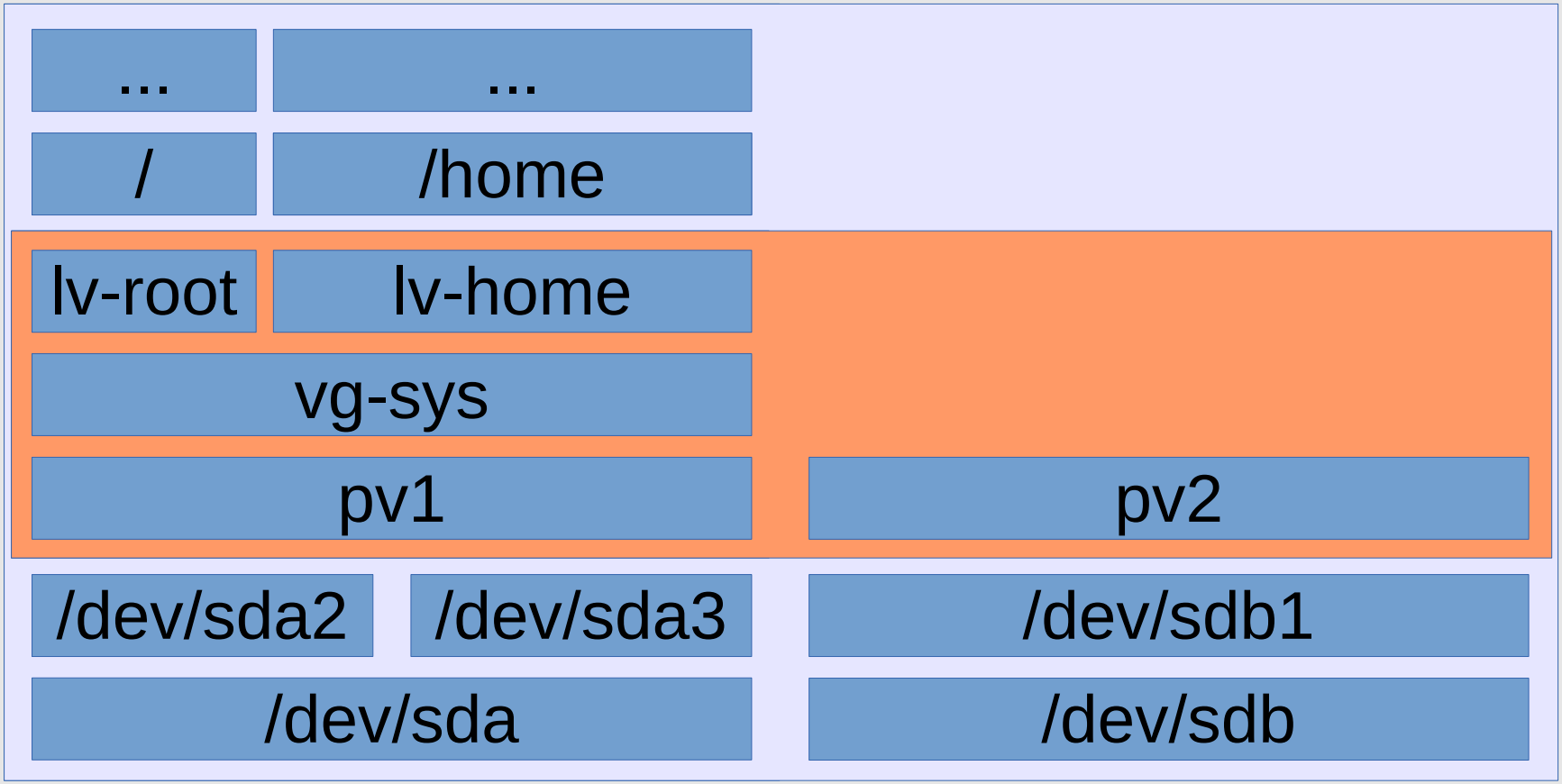
Add a new physical disk (sdb)

Add the new disk to LVM as new PV



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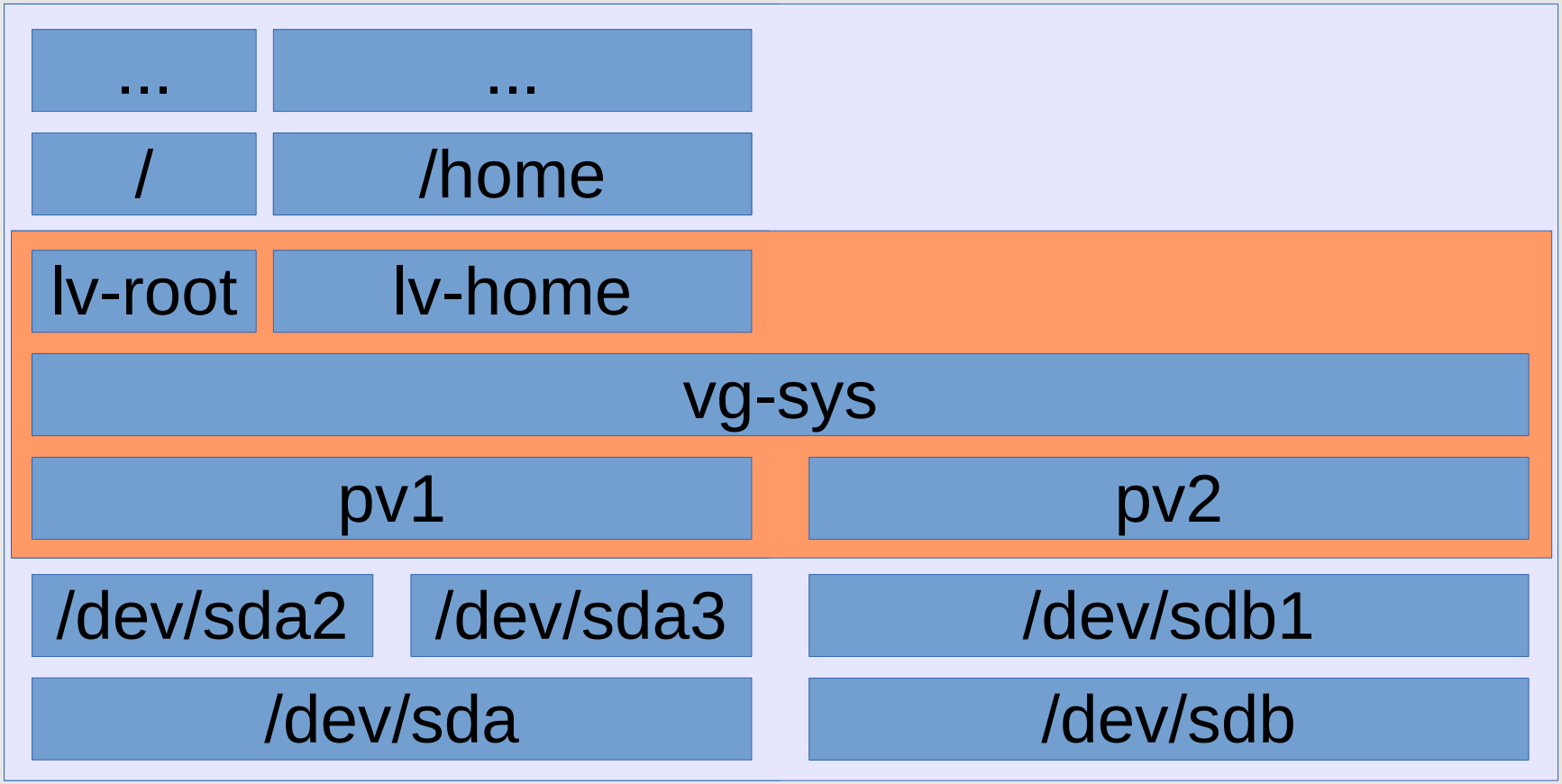
Expand the VG



Example: expand

No space left on lv-home
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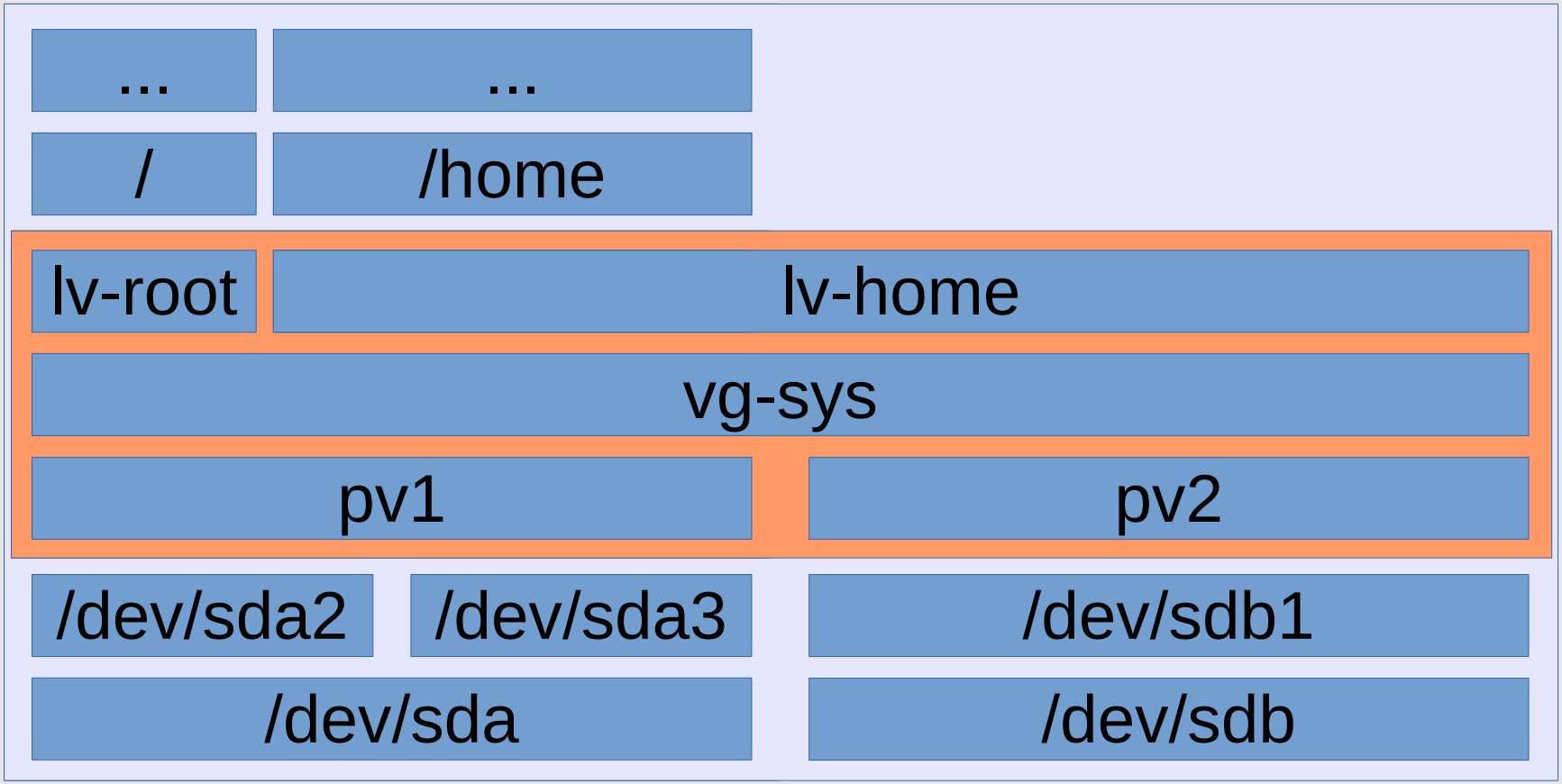
Add the new disk to LVM as new PV

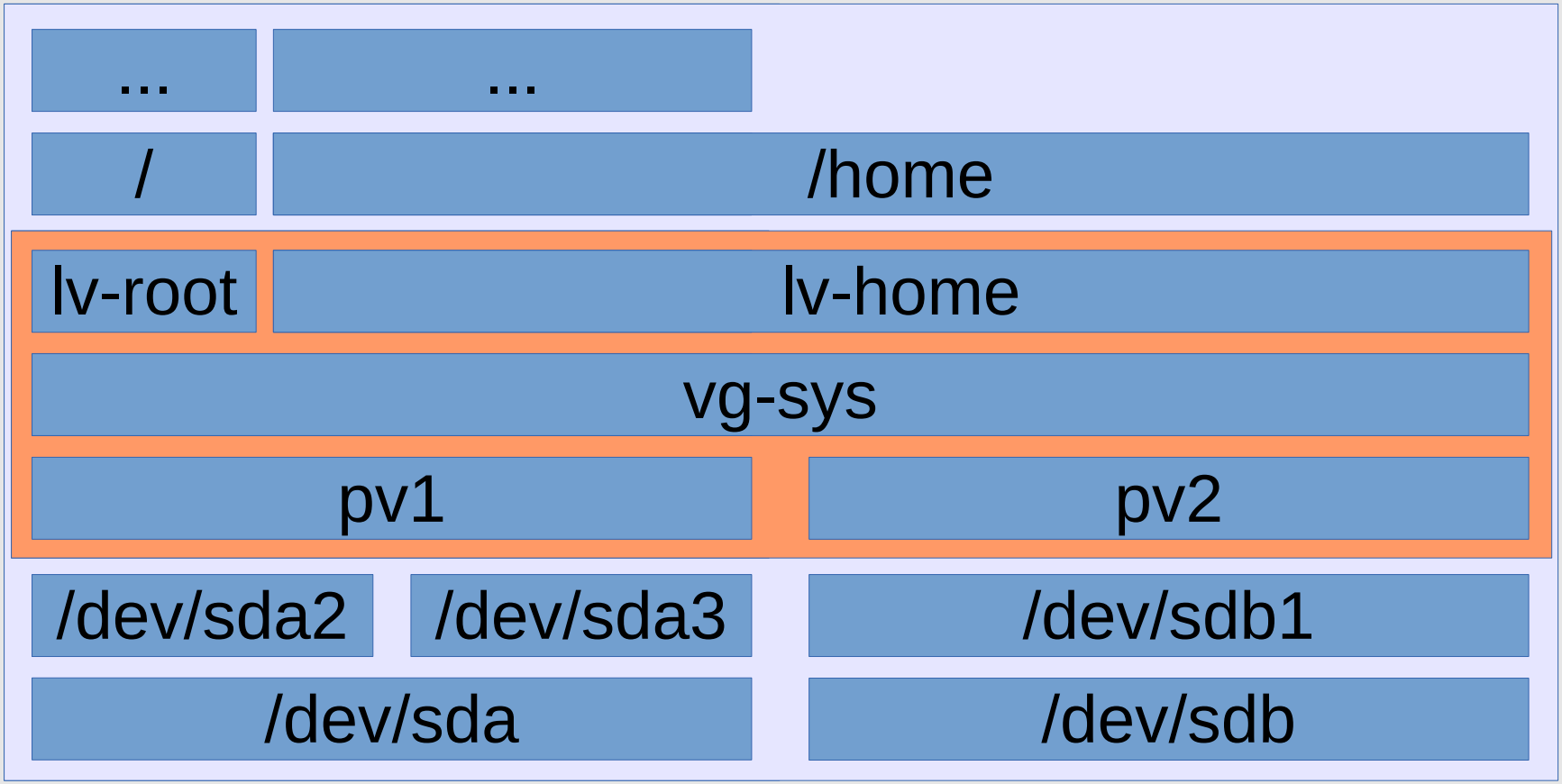
Expand the VG
Expand the LV



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



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LVM is not RAID

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

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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

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- 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]
```