LVM

Logical Volume Management

DE HOGESCHOOL
MET HET NETWERK

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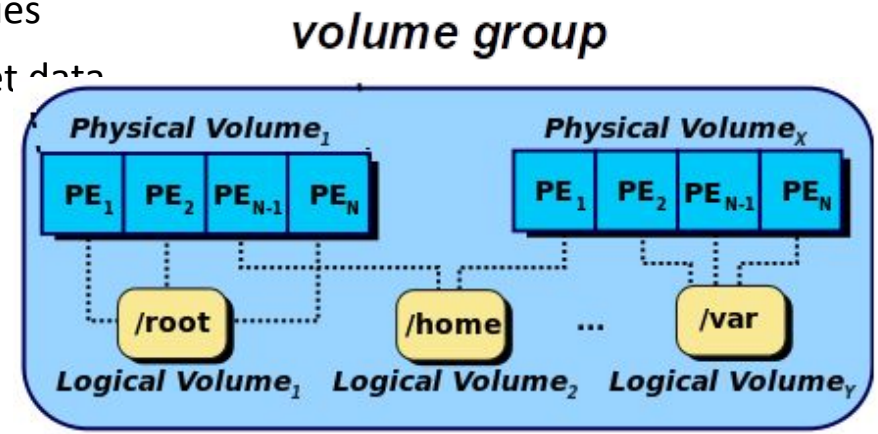
Beheer van devices en partities

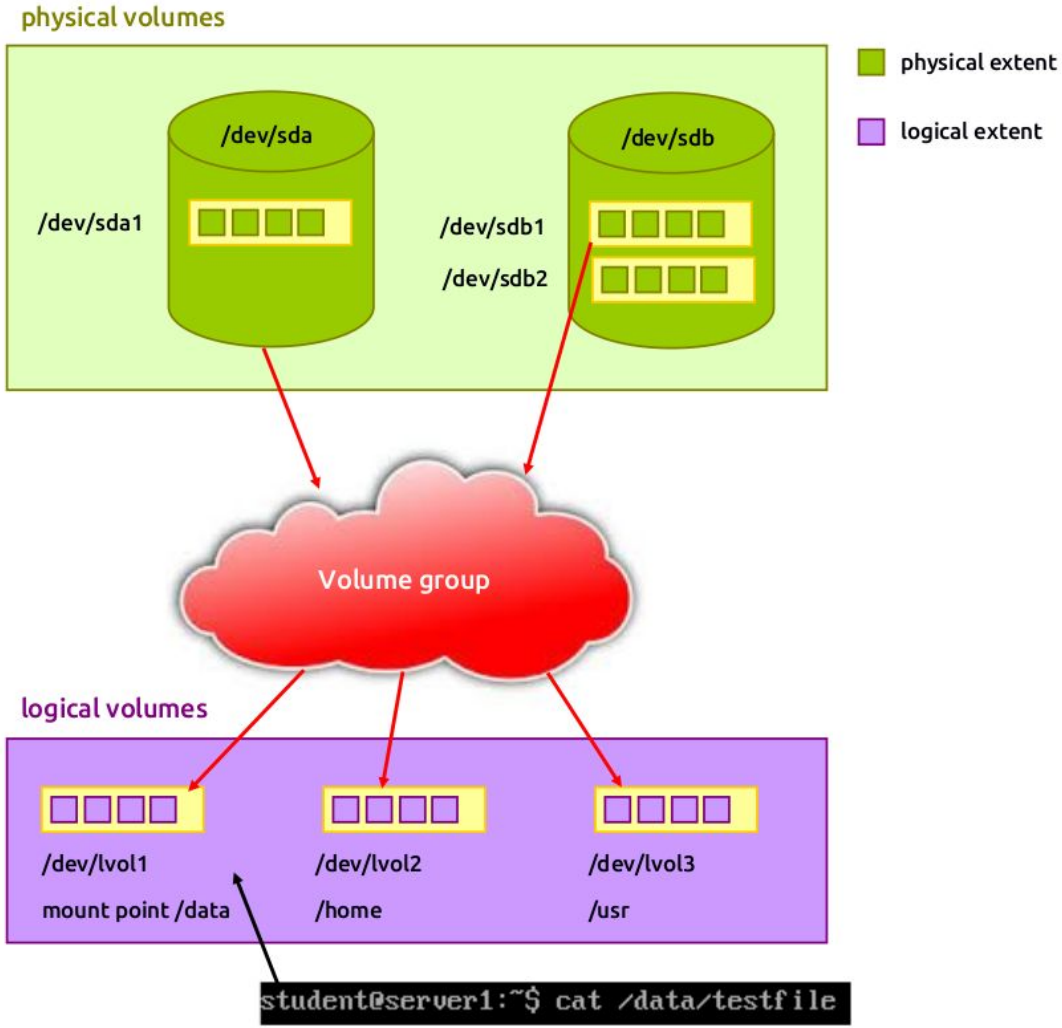
- Klassieke partities zijn niet flexibel om mee te werken.
  Partitie vol: backup nemen, unmounten, herpartioneren, mounten, backup terugzetten
  ⇒ **Zeer veel werk!**
- LVM: Logical Volume Management
  - Volume Group (VG) beheert PV en LV
    (= abstractie laag tussen block devices en logical volumes)
  - Physical Volumes (PV) = devices, MD's, partities
  - Logical Volumes (LV) ~ 'block device' met data

    Eigenlijke data op LV's
    (mounten, FS installeren)

    LV resizen on the fly.

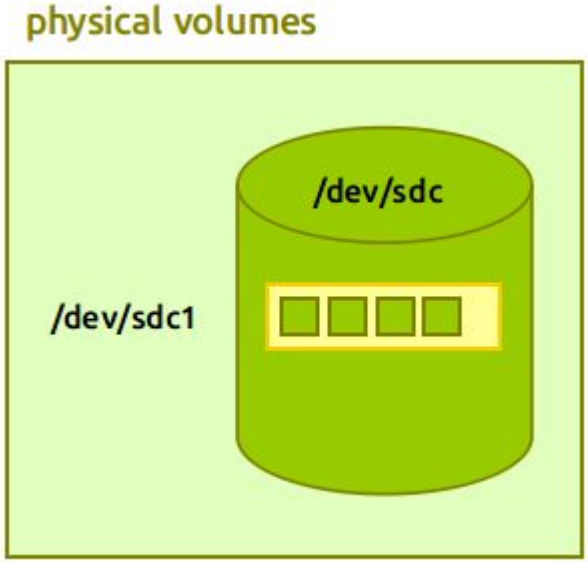
    ⇒ **Pure Magie**




physical volumes
physical extent
logical extent
/dev/sda
/dev/sdb
/dev/sda1
/dev/sdb1
/dev/sdb2
Volume group
logical volumes
/dev/lvol1
mount point /data
/dev/lvol2
/home
/dev/lvol3
/usr
student@server1:~$ cat /data/testfile

```
student@server1:~$ sudo apt-get install lvm2
```

Physical Volumes



0. Maak eerst een partitie /dev/sdc1 aan via fdisk

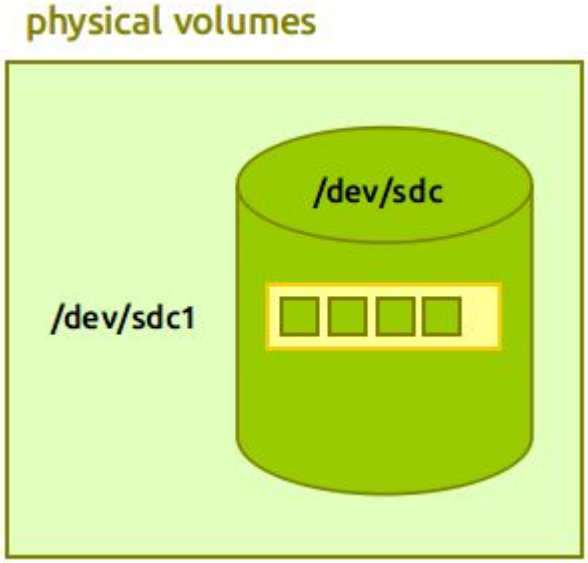
1. Een device toevoegen aan LVM

```
student@server1:~$ sudo pvcreate /dev/sdc1
  Physical volume "/dev/sdc1" successfully created
```

LVM werkt goed als het volledig device gebruikt wordt. Een ander besturingssysteem op dezelfde computer zal LVM niet herkennen en beschouwt dit als een leeg block device.

Je kan dit voorkomen door **eerst** een partitie aan te maken die je volledig device overspant. Maak **dan** een physical volume van deze partitie.

Physical Volumes



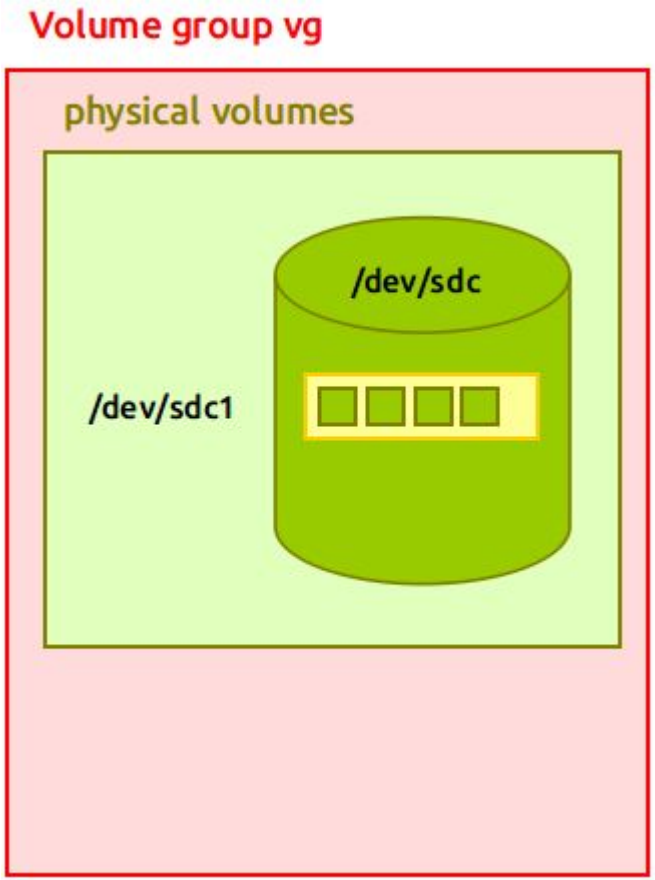
1.

```
student@server1:~$ sudo pvcreate /dev/sdc1
  Physical volume "/dev/sdc1" successfully created
```

Lijst van block devices die gebruikt kunnen worden met LVM:

```
student@server1:~$ sudo lvmdiskscan | grep sd
  /dev/sda1     [      19.00 GiB]
  /dev/sda5     [    1022.00 MiB]
  /dev/sdb1     [      10.00 GiB]
  /dev/sdc1     [      10.00 GiB] LVM physical volume
student@server1:~$
```

Volume Groups



1.
```
student@server1:~$ sudo pvcreate /dev/sdc1
  Physical volume "/dev/sdc1" successfully created
```

2. Creëer een VG

```
student@server1:~$ sudo vgcreate vg /dev/sdc1
  Volume group "vg" successfully created
```

- Overzicht van alle VG's:

```
student@server1:~$ sudo vgs
  VG   #PV #LV #SN Attr   VSize  VFree
  vg     1   0   0 wz--n- 10.00g 10.00g
student@server1:~$
```

- Scan alle schijven voor bestaande volume groups én update het bestand /etc/lvm/.cache:

```
student@server1:~$ sudo vgscan
  Reading all physical volumes.  This may take a while...
  Found volume group "vg" using metadata type lvm2
student@server1:~$
```

Volume Groups

Meer gedetailleerde informatie over een VG:

```
student@server1:~$ sudo vgdisplay
  --- Volume group ---
  VG Name               vg
  System ID
  Format                lvm2
  Metadata Areas        1
  Metadata Sequence No  2
  VG Access             read/write
  VG Status             resizable
  MAX LV                0
  Cur LV                0
  Open LV               0
  Max PV                0
  Cur PV                1
  Act PV                1
  VG Size               10.00 GiB
  PE Size               4.00 MiB
  Total PE              2559
  Alloc PE / Size       0 / 0 MiB
  Free  PE / Size       2559 / 10.00 GiB
  VG UUID               WqWYS8-FLas-ZUwF-wOeh-T3Wp-K7Ak-1mpE3D
```

Physical Volumes → Volume Groups

Welke devices zijn gekend bij LVM ?

```
student@server1:~$ sudo pvs
  PV         VG   Fmt  Attr PSize  PFree
  /dev/sdc1  vg   lvm2 a--  10.00g 10.00g
student@server1:~$
```

/dev/sdc1 is onderdeel van de volume group vg

```
student@server1:~$ sudo pvcreate /dev/sdb1
  Physical volume "/dev/sdb1" successfully created
student@server1:~$ sudo pvs
  PV         VG   Fmt  Attr PSize  PFree
  /dev/sdb1       lvm2 a--  10.00g 10.00g
  /dev/sdc1  vg   lvm2 a--  10.00g 10.00g
student@server1:~$
```

/dev/sdb1 is gekend bij LVM, maar niet gelinkt aan een volume group

Scan alle schijven voor bestaande PV's:

```
student@server1:~$ sudo pvscan
  PV /dev/sdc1   VG vg              lvm2 [10.00 GiB / 10.00 GiB free]
  PV /dev/sdb1                      lvm2 [10.00 GiB]
  Total: 2 [20.00 GiB] / in use: 1 [10.00 GiB] / in no VG: 1 [10.00 GiB]
student@server1:~$
```

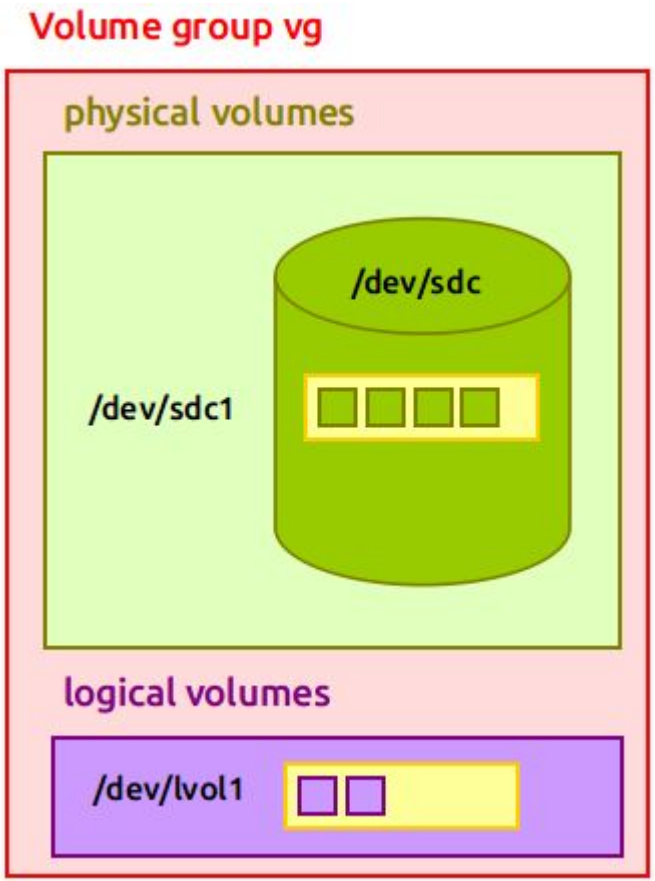
Physical Volumes → Volume Groups

Meer gedetailleerde informatie over een PV:

```
student@server1:~$ sudo pvdisplay /dev/sdc1
  --- Physical volume ---
  PV Name               /dev/sdc1
  VG Name               vg
  PV Size               10.00 GiB / not usable 3.00 MiB
  Allocatable           yes
  PE Size               4.00 MiB
  Total PE              2559
  Free PE               2559
  Allocated PE          125
  PV UUID               toqT6x-Db3S-Ppov-W7lt-zfK8-77Wr-1KIvOi
```

```
student@server1:~$ sudo pvdisplay /dev/sdb1
  "/dev/sdb1" is a new physical volume of "10.00 GiB"
  --- NEW Physical volume ---
  PV Name               /dev/sdb1
  VG Name
  PV Size               10.00 GiB
  Allocatable           NO
  PE Size               0
  Total PE              0
  Free PE               0
  Allocated PE          0
  PV UUID               pNC0Gf-BP3d-k3oN-gkqb-afKp-UcG9-YHtwpy
```

Logical Volumes



1.
```
student@server1:~$ sudo pvcreate /dev/sdc1
  Physical volume "/dev/sdc1" successfully created
```

2.
```
student@server1:~$ sudo vgcreate vg /dev/sdc1
  Volume group "vg" successfully created
```

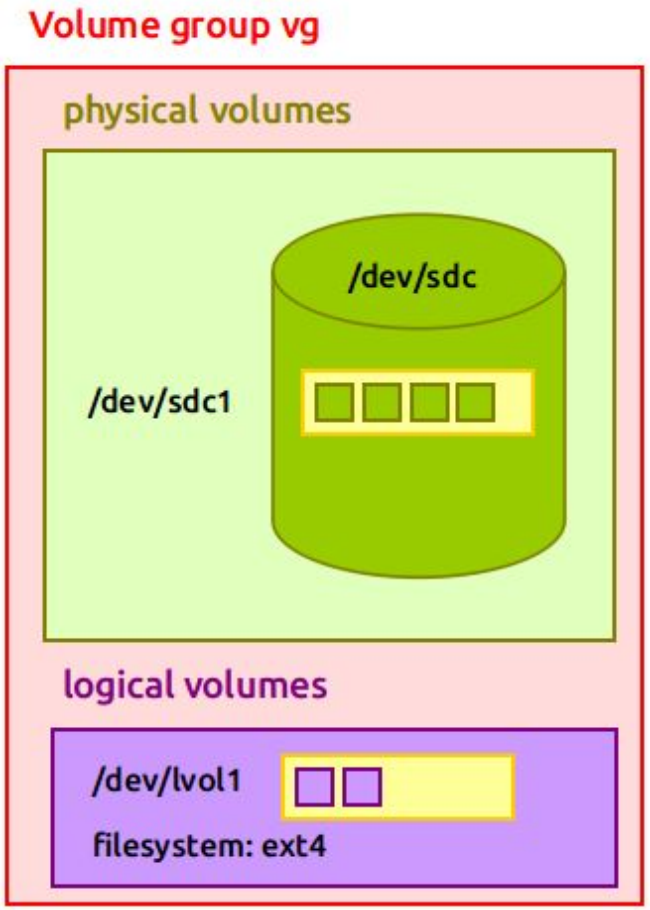
3. Creëer een logical volume in een volume group

```
student@server1:~$ sudo lvcreate --size 500m vg
  Logical volume "lvol0" created
```

Dit is een logical volume van 500MB groot.

De **naam** van dit logical volume is `lvol0`
(met de optie -n kan je zelf de naam bepalen van een logical volume).

Logical Volumes



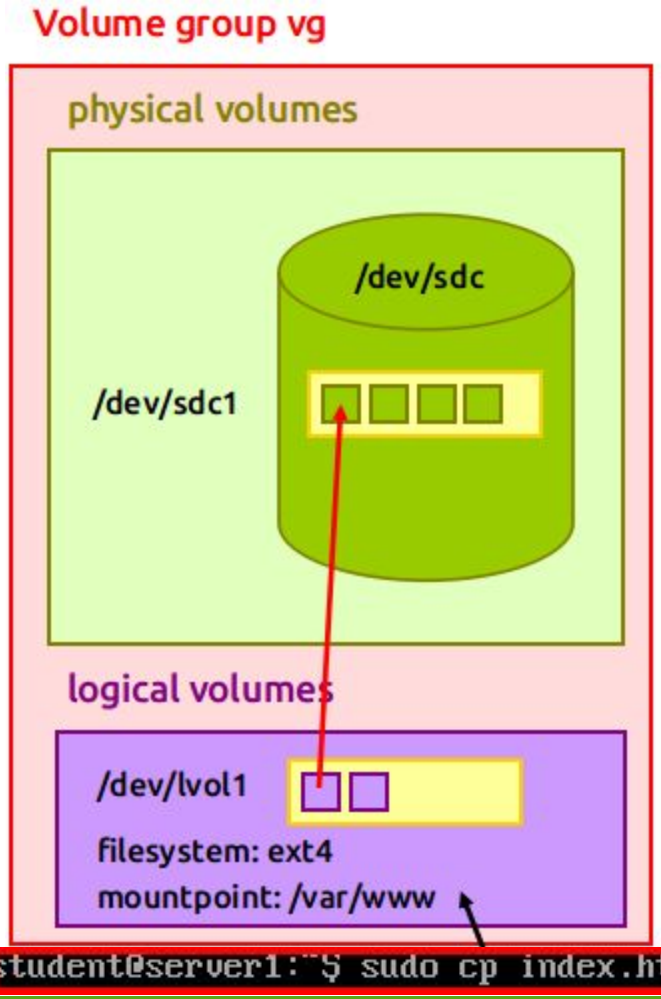
1.
```
student@server1:~$ sudo pvcreate /dev/sdc1
  Physical volume "/dev/sdc1" successfully created
```

2.
```
student@server1:~$ sudo vgcreate vg /dev/sdc1
  Volume group "vg" successfully created
```

3.
```
student@server1:~$ sudo lvcreate --size 500m vg
  Logical volume "lvol0" created
```

4.
```
student@server1:~$ sudo mkfs.ext4 /dev/vg/lvol0
mke2fs 1.42.9 (4-Feb-2014)
Filesystem label=
OS type: Linux
Block size=1024 (log=0)
Fragment size=1024 (log=0)
Stride=0 blocks, Stripe width=0 blocks
128016 inodes, 512000 blocks
```

Logical Volumes



1.
```
student@server1:~$ sudo pvcreate /dev/sdc1
  Physical volume "/dev/sdc1" successfully created
```

2.
```
student@server1:~$ sudo vgcreate vg /dev/sdc1
  Volume group "vg" successfully created
```

3.
```
student@server1:~$ sudo lvcreate --size 500m vg
  Logical volume "lvol0" created
```

4.
```
student@server1:~$ sudo mkfs.ext4 /dev/vg/lvol0
mke2fs 1.42.9 (4-Feb-2014)
Filesystem label=
```

5.
```
student@server1:~$ sudo mkdir /var/www
student@server1:~$ sudo mount /dev/vg/lvol0 /var/www/
student@server1:~$
```

6.
```
student@server1:~$ sudo cp index.html /var/www/
```

Met een logical volume kan je op dezelfde manier werken als met een partitie.

Logical Volumes

Alle bestaande logical volumes:

```
student@server1:~$ sudo lvs
  LV    VG   Attr       LSize   Pool Origin Data%  Move Log Copy%  Convert
  lvol0 vg   -wi-ao---- 500.00m
student@server1:~$
```

```
Attr:       zie man lvs (en man lvm)
            w     writeable
            i     inherit (default allocation policy)
            a     active
            o     open (device is gemount)
```

Scan alle schijven voor bestaande logical volumes:

```
student@server1:~$ sudo lvscan
  ACTIVE            '/dev/vg/lvol0' [500.00 MiB] inherit
student@server1:~$
```

Logical Volumes

Meer gedetailleerde informatie over een logical volume:

```
student@server1:~$ sudo lvdisplay vg/lvol0
  --- Logical volume ---
  LV Path                /dev/vg/lvol0
  LV Name                lvol0
  VG Name                vg
  LV UUID                HbMDob-RB3n-5Gyl-SyYf-p7at-4QaN-YOqKNq
  LV Write Access        read/write
  LV Creation host, time server1, 2014-11-07 18:30:30 +0100
  LV Status              available
  # open                 1
  LV Size                500.00 MiB
  Current LE             125
  Segments               1
  Allocation             inherit
  Read ahead sectors     auto
  - currently set to     256
  Block device           252:0
```

Logical Volumes

Mount behouden na reboot:

→ sudo vi /etc/fstab

```
/dev/vg/lvol0   /var/www        ext4    defaults        0       0
```

Manage logical volumes

Creëer een logical volume

```
student@server2:~$ sudo vgs
  VG   #PV #LV #SN Attr   VSize  VFree
  vg     1   1   0 wz--n- 10.00g 9.51g
student@server2:~$ sudo lvs
  LV    VG   Attr       LSize   Pool Origin Data%  Move Log Copy%  Convert
  lvol0 vg   -wi-ao---- 500.00m
student@server2:~$ sudo lvcreate --size 200m -n littlelv vg
  Logical volume "littlelv" created
student@server2:~$ sudo lvs
  LV       VG   Attr       LSize   Pool Origin Data%  Move Log Copy%  Convert
  littlelv vg   -wi-a----- 200.00m
  lvol0    vg   -wi-ao---- 500.00m
```

-L of --size

Resize een logical volume

```
student@server2:~$ sudo lvdisplay /dev/vg/littlelv | grep Size
  LV Size                200.00 MiB
student@server2:~$ sudo lvextend -L +100 /dev/vg/littlelv
  Extending logical volume littlelv to 300.00 MiB
  Logical volume littlelv successfully resized
student@server2:~$ sudo lvdisplay /dev/vg/littlelv | grep Size
  LV Size                300.00 MiB
```

Nadien nog gevolgd door:
`sudo resize2fs /dev/vg/littlelv`
zodat het filesystem de volledige grootte van de logical volume overspant.
(te controleren met: `df -h`)

Je kan ook de optie -r of --resizefs meegeven aan het lvextend-commando

Manage Logical Volumes

Hernoemen van een logical volume:

```
student@server2:~$ sudo lvrename vg/littlelv vg/newnamelv
  Renamed "littlelv" to "newnamelv" in volume group "vg"
student@server2:~$
```

Verwijderen van een logical volume:

```
student@server2:~$ sudo lvremove vg/newnamelv
Do you really want to remove and DISCARD active logical volume newnamelv? [y/n]: y
  Logical volume "newnamelv" successfully removed
```

Er kunnen ook meerdere LV's gelijktijdig verwijderd worden.

Manage Physical Volumes

```
student@server2:~$ sudo pvcreate /dev/sdd
  Physical volume "/dev/sdd" successfully created
student@server2:~$
```

```
student@server2:~$ sudo pvremove /dev/sdd
  Labels on physical volume "/dev/sdd" successfully wiped
student@server2:~$
```

Zorg via fdisk voor volgende partities:

```
   Device Boot      Start         End      Blocks   Id  System
/dev/sdd1            2048     2050047     1024000   83  Linux
/dev/sdd2         2050048     4098047     1024000   83  Linux
```

Creëer een PV van /dev/sdd2

```
student@server2:~$ sudo pvcreate /dev/sdd2
  Physical volume "/dev/sdd2" successfully created
```

Via fdisk: delete de partitie /dev/sdd2 en maak deze opnieuw, maar dan een andere size

```
   Device Boot      Start         End      Blocks   Id  System
/dev/sdd1            2048     2050047     1024000   83  Linux
/dev/sdd2         2050048     6146047     2048000   83  Linux
```

Resize je PV

```
student@server2:~$ sudo pvresize /dev/sdd2
  Physical volume "/dev/sdd2" changed
  1 physical volume(s) resized / 0 physical volume(s) not resized
student@server2:~$ sudo pvs
  PV         VG   Fmt  Attr PSize  PFree
  /dev/sdc1  vg   lvm2 a--  10.00g 9.51g
  /dev/sdd2       lvm2 a--   1.95g 1.95g
```

Manage Volume Groups

Startsituatie: 2 PV's, waarvan 1 gelinkt aan VG, de andere niet.

```
student@server2:~$ sudo pvs
  PV         VG   Fmt  Attr PSize  PFree
  /dev/sdc1  vg   lvm2 a--  10.00g  9.51g
  /dev/sdd        lvm2 a--  10.00g 10.00g
```

PV toevoegen aan volume group vg

```
student@server2:~$ sudo vgextend vg /dev/sdd
  Volume group "vg" successfully extended
```

```
student@server2:~$ sudo pvdisplay | grep -B1 vg
  PV Name               /dev/sdc1
  VG Name               vg
--
  PV Name               /dev/sdd
  VG Name               vg
```

LV aanmaken

```
student@server2:~$ sudo lvcreate --size 200m vg
  Logical volume "lvol1" created
student@server2:~$ sudo mkfs.ext4 /dev/vg/lvol1
mke2fs 1.42.9 (4-Feb-2014)
Filesystem label=
```

```
student@server2:~$ sudo mkdir /home/resizetest
student@server2:~$ sudo mount /dev/vg/lvol1 /home/resizetest/
```

Manage Volume Groups

Verwijder een PV uit een VG:

```
student@server2:~$ sudo pvs
  PV         VG   Fmt  Attr PSize  PFree
  /dev/sdb1       lvm2 a--  10.00g 10.00g
  /dev/sdc1  vg   lvm2 a--  10.00g  9.31g
  /dev/sdd   vg   lvm2 a--  10.00g 10.00g
student@server2:~$ sudo vgextend vg /dev/sdb1
  Volume group "vg" successfully extended
student@server2:~$ sudo pvs
  PV         VG   Fmt  Attr PSize  PFree
  /dev/sdb1  vg   lvm2 a--  10.00g 10.00g
  /dev/sdc1  vg   lvm2 a--  10.00g  9.31g
  /dev/sdd   vg   lvm2 a--  10.00g 10.00g
student@server2:~$ sudo vgreduce vg /dev/sdb1
  Removed "/dev/sdb1" from volume group "vg"
student@server2:~$ sudo pvs
  PV         VG   Fmt  Attr PSize  PFree
  /dev/sdb1       lvm2 a--  10.00g 10.00g
  /dev/sdc1  vg   lvm2 a--  10.00g  9.31g
  /dev/sdd   vg   lvm2 a--  10.00g 10.00g
```

Manage Volume Groups

Wijzig properties van een volume group

```
student@server2:~$ sudo pvs
  PV         VG   Fmt  Attr PSize  PFree
  /dev/sdb1  vg1  lvm2 a--  10.00g 10.00g
  /dev/sdc1  vg   lvm2 a--  10.00g  9.31g
  /dev/sdd        lvm2 a--  10.00g 10.00g
student@server2:~$ sudo vgchange -xn vg1
  Volume group "vg1" successfully changed
student@server2:~$ sudo vgextend vg1 /dev/sdd
  Volume group vg1 is not resizeable.
student@server2:~$
```

-x of --resizeable
enable (-xy) of disable (-xn) extention/reduction van physical volumes voor deze volume group

```
student@server2:~$ sudo vgdisplay vg1 | grep -i max
  MAX LV                0
  Max PV                0
student@server2:~$ sudo vgchange -l16 vg1
  Volume group "vg1" successfully changed
student@server2:~$ sudo vgchange -p8 vg1
  Volume group "vg1" successfully changed
student@server2:~$ sudo vgdisplay vg1 | grep -i max
  MAX LV                16
  Max PV                8
```

-l of --logicalvolume
maximum aantal logical volumes
-p of --maxphysicalvolumes
maximum aantal physical volumes
(0 → geen limiet)

Manage Volume Groups

Voeg 2 volume groups samen

```
student@server2:~$ sudo pvs
  PV         VG   Fmt  Attr PSize  PFree
  /dev/sdb1  vg1  lvm2 a--  10.00g 10.00g
  /dev/sdc1  vg   lvm2 a--  10.00g  9.31g
  /dev/sdd   vg2  lvm2 a--  10.00g 10.00g
student@server2:~$ sudo vgmerge vg1 vg2
  Volume group "vg2" successfully merged into "vg1"
student@server2:~$ sudo pvs
  PV         VG   Fmt  Attr PSize  PFree
  /dev/sdb1  vg1  lvm2 a--  10.00g 10.00g
  /dev/sdc1  vg   lvm2 a--  10.00g  9.31g
  /dev/sdd   vg1  lvm2 a--  10.00g 10.00g
```

Verwijder een volume group

```
student@server2:~$ sudo vgremove vg1
  Volume group "vg1" successfully removed
student@server2:~$ sudo pvs
  PV         VG   Fmt  Attr PSize  PFree
  /dev/sdb1       lvm2 a--  10.00g 10.00g
  /dev/sdc1  vg   lvm2 a--  10.00g  9.31g
  /dev/sdd        lvm2 a--  10.00g 10.00g
```

Mirror a Logical Volume

3 PV’s nodig:

- De 3 PV’s moeten even groot zijn
- 2 PV’s worden gebruikt als mirror
- De 3e physical volume wordt gebruikt al mirrorlog
- Mirror log:
  - Wat bij crash?
  - Data geschreven op Disk1 maar nog niet op Disk2?
  - Mirror log houdt het verschil tussen Disk1 en Disk2 bij
  - Mirror log niet leeg na crash: synchronisatie

```
student@server2:~$ sudo fdisk -l /dev/sdd | grep sdd
Disk /dev/sdd: 10.7 GB, 10737418240 bytes
/dev/sdd1            2048      587985      292969   83  Linux
/dev/sdd2          587986     1173923      292969   83  Linux
/dev/sdd3         1173924     1759861      292969   83  Linux
student@server2:~$ sudo pvcreate /dev/sdd1 /dev/sdd2 /dev/sdd3
  Physical volume "/dev/sdd1" successfully created
  Physical volume "/dev/sdd2" successfully created
  Physical volume "/dev/sdd3" successfully created
```

Mirror a Logical Volume

```
student@server2:~$ sudo vgcreate vgmir /dev/sdd1 /dev/sdd2 /dev/sdd3
  Volume group "vgmir" successfully created
student@server2:~$ sudo pvs
  PV         VG    Fmt  Attr PSize   PFree
  /dev/sdb1        lvm2 a--   10.00g  10.00g
  /dev/sdc1  vg    lvm2 a--   10.00g   9.31g
  /dev/sdd1  vgmir lvm2 a--  284.00m 284.00m
  /dev/sdd2  vgmir lvm2 a--  284.00m 284.00m
  /dev/sdd3  vgmir lvm2 a--  284.00m 284.00m
student@server2:~$ sudo lvcreate --size 200m -n lvmir -m 1 vgmir
  Logical volume "lvmir" created
student@server2:~$ sudo pvs
  PV         VG    Fmt  Attr PSize   PFree
  /dev/sdb1        lvm2 a--   10.00g  10.00g
  /dev/sdc1  vg    lvm2 a--   10.00g   9.31g
  /dev/sdd1  vgmir lvm2 a--  284.00m  84.00m
  /dev/sdd2  vgmir lvm2 a--  284.00m  84.00m
  /dev/sdd3  vgmir lvm2 a--  284.00m 280.00m
student@server2:~$ sudo lvs vgmir/lvmir
  LV    VG    Attr       LSize   Pool Origin Data%  Move Log        Copy%  Convert
  lvmir vgmir mwi-a-m--- 200.00m                                lvmir_mlog 100.00
```

-m 1
disk wordt 1x gemirrored

Attr	1e veld m	volume type: mirrored
	7e veld m	target type: mirror

Snapshot a Logical Volume

Snapshot: virtuele copy van alle data op een logical volume op een bepaald tijdstip.

```
student@server2:~$ sudo lvs
  LV    VG    Attr      LSize   Pool Origin Data%  Move Log        Copy%  Convert
  lvol0 vg    -wi-ao--- 500.00m
  lvol1 vg    -wi-ao--- 200.00m
  lvmir vgmir mwi-a-m-- 200.00m                      lvmir_mlog 100.00
student@server2:~$ sudo lvcreate -L100M -s -n snaplv vg/lvol1
  Logical volume "snaplv" created
student@server2:~$ sudo lvs
  LV     VG    Attr      LSize   Pool Origin Data%  Move Log        Copy%  Convert
  lvol0  vg    -wi-ao--- 500.00m
  lvol1  vg    owi-aos-- 200.00m
  snaplv vg    swi-a-s-- 100.00m      lvol1    0.01
  lvmir  vgmir mwi-a-m-- 200.00m
```

Data% 0.01
percentage van veranderingen in data vanaf het moment dat de snapshot werd gemaakt

Meer uitleg:
http://www.tutonics.com/2012/12/lvm-guide-part-2-snapshots.html