



LVM

Logical Volume Management

**DE HOGESCHOOL
MET HET NETWERK**

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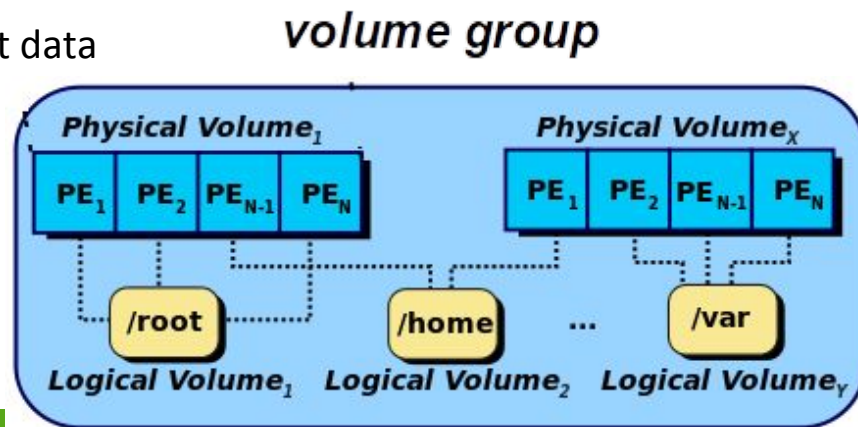
Beheer van devices en partities

- Klassieke partities zijn niet flexibel om mee te werken.
Partitie vol: backup nemen, unmounten, herpartitioneren, 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

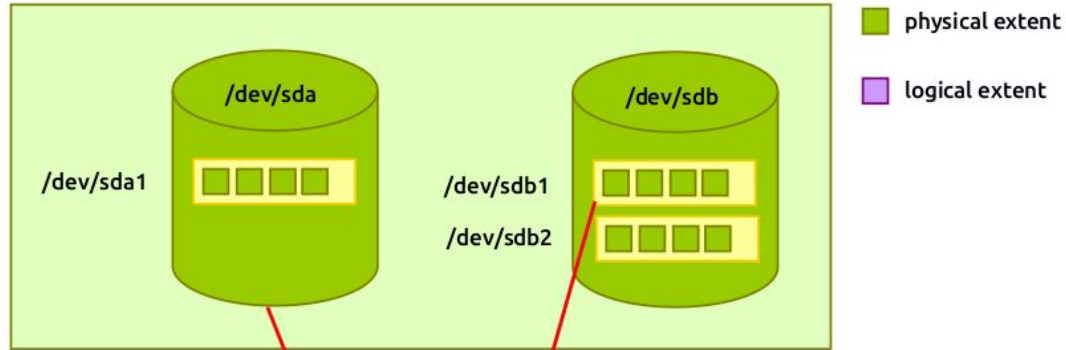
Eigenlijke data op LV's
(mounten, FS installeren)

LV resizen on the fly.

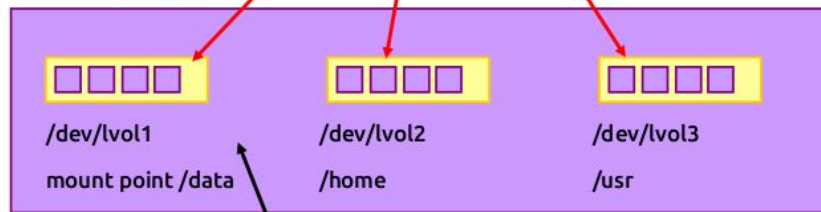
⇒ **Pure Magie**



physical volumes



logical volumes

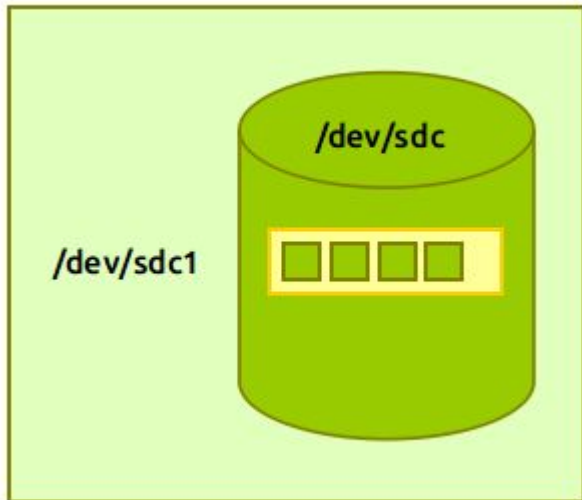


```
student@server1:~$ cat /data/testfile
```



Physical Volumes

physical volumes



0. Maak eerst een partitie `/dev/sdc1` aan via `fdisk`
1. Een device toevoegen aan LVM

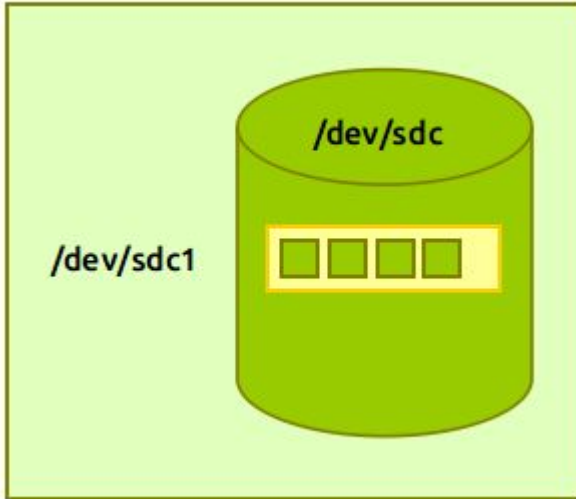
```
student@server1:~$ sudo pvcreate /dev/sdc1  
Physical volume "/dev/sdc1" successfully created
```

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

physical volumes



1.

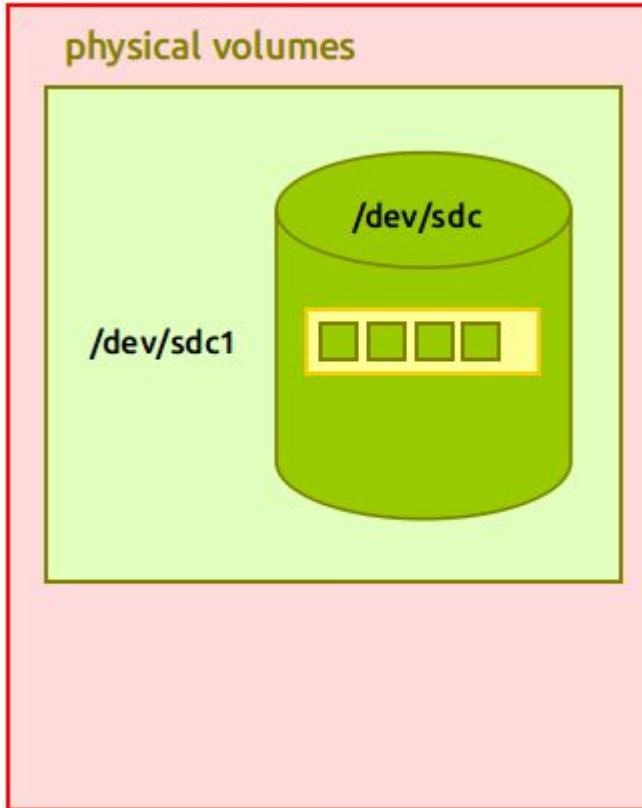
```
student@server1:~$ sudo pvcreate /dev/sdc1
Physical volume "/dev/sdc1" successfully created
```

Lijst van block devices die gebruikt kunnen worden met LVM:

```
student@server1:~$ sudo lvm diskscan | 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

Volume group vg



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   1   0 wz--n- 10.00g 9.51g  
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 vgdisk display
--- 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                1
Open LV               1
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       125 / 500.00 MiB
Free PE / Size        2434 / 9.51 GiB
VG UUID               WqWYS8-FLas-ZUwF-w0eh-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 9.51g
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 9.51g
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 / 9.51 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      2434
Allocated PE 125
PV UUID      toqT6x-Db3S-Ppov-W7lt-zfK8-77Wr-1KIv0i
```

```
student@server1:~$ sudo pvdisplay /dev/sdb1
```

```
"/dev/sdb1" is a new physical volume of "10.00 GiB"
```

```
--- NEW Physical volume ---
```

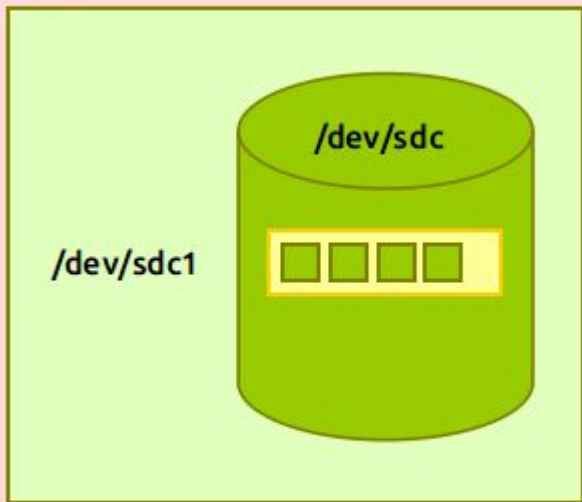
```
PV Name      /dev/sdb1
VG Name
PV Size      10.00 GiB
Allocatable  NO
PE Size      0
Total PE     0
Free PE      0
Allocated PE 0
PV UUID      pNC0Gf-BP3d-k3oN-gkqb-afKp-UcG9-YHtwpy
```



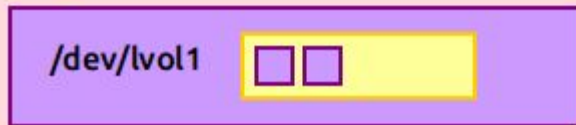
Logical Volumes

Volume group vg

physical volumes



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
```

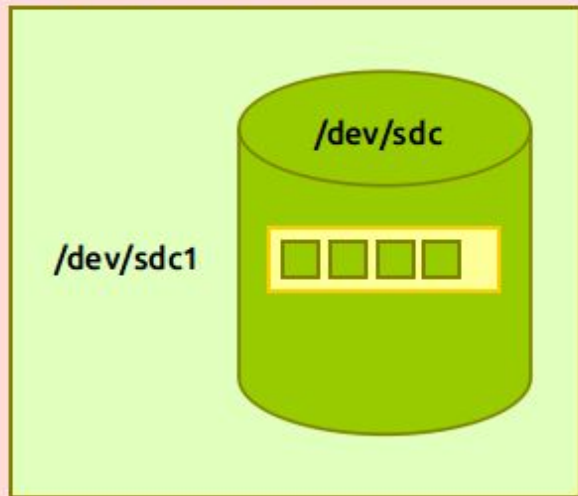
Dit is een logical volume van 500MB groot.

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

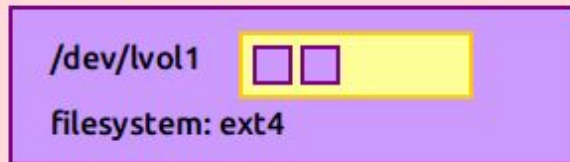
Logical Volumes

Volume group vg

physical volumes



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.

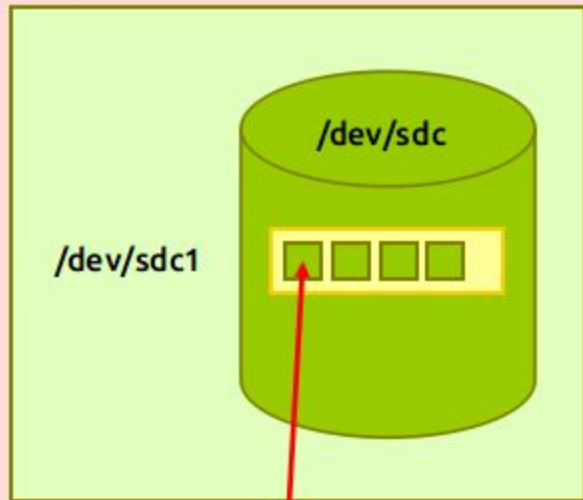
```
student@server1:~$ sudo lvcreate --size 500m vg  
Logical volume "lvol0" created
```
4.

```
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  
0 blocks (0.00%) reserved for the super user  
First data block=1  
Maximum filesystem blocks=67633152  
63 block groups  
8192 blocks per group, 8192 fragments per group
```

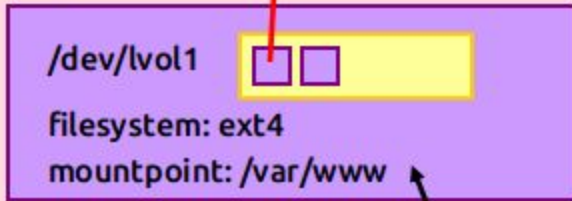
Volume group vg

Logical Volumes

physical volumes



logical volumes



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

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
lv100  vg      -wi-ao--- 500.00m
```

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/lv100' [500.00 MiB] inherit
student@server1:~$
```



Logical Volumes

Meer gedetailleerde informatie over een logical volume:

```
student@server1:~$ sudo lvs vg/lvol0
--- Logical volume ---
LV Path                /dev/vg/lvol0
LV Name                 lvol0
VG Name                 vg
LV UUID                 HbMDob-RB3n-5Gyl-SyYf-p7at-4QaN-Y0qKNq
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:

```
student@server1:~$ sudo vgscan --mknodes -v
  Wiping cache of LVM-capable devices
  Wiping internal VG cache
  Reading all physical volumes. This may take a while...
  Finding all volume groups
  Finding volume group "vg"
  Found volume group "vg" using metadata type lvm2
  Finding all logical volumes
student@server1:~$
```

--mknodes

controleert de LVM special files in /dev die nodig zijn voor actieve logical volumes en creëert de vermiste en verwijdert de ongebruikte.

-v

verbose

→ sudo vim /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
```

Resize een logical volume

```
student@server2:~$ sudo lvsdisplay /dev/vg/littlelv | grep Size
LV Size
littlelv 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 lvsdisplay /dev/vg/littlelv | grep Size
LV Size
littlelv 300.00 MiB
```

-L of --size

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`)

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 op /dev/sdd2

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

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   vg      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) extension/reduction
van physical volumes voor deze volume group

```
student@server2:~$ sudo vgsdisplay 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 vgsdisplay 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   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
```



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 lumir -m 1 vgmir
```

```
Logical volume "lumir" 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/lumir
```

LV	VG	Attr	LSize	Pool	Origin	Data%	Move	Log	Copy%	Convert
lumir	vgmir	mwi-a-m	200.00m					lumir_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.tutronics.com/html>

