Logical Volume Management (LVM)

Unit objectives

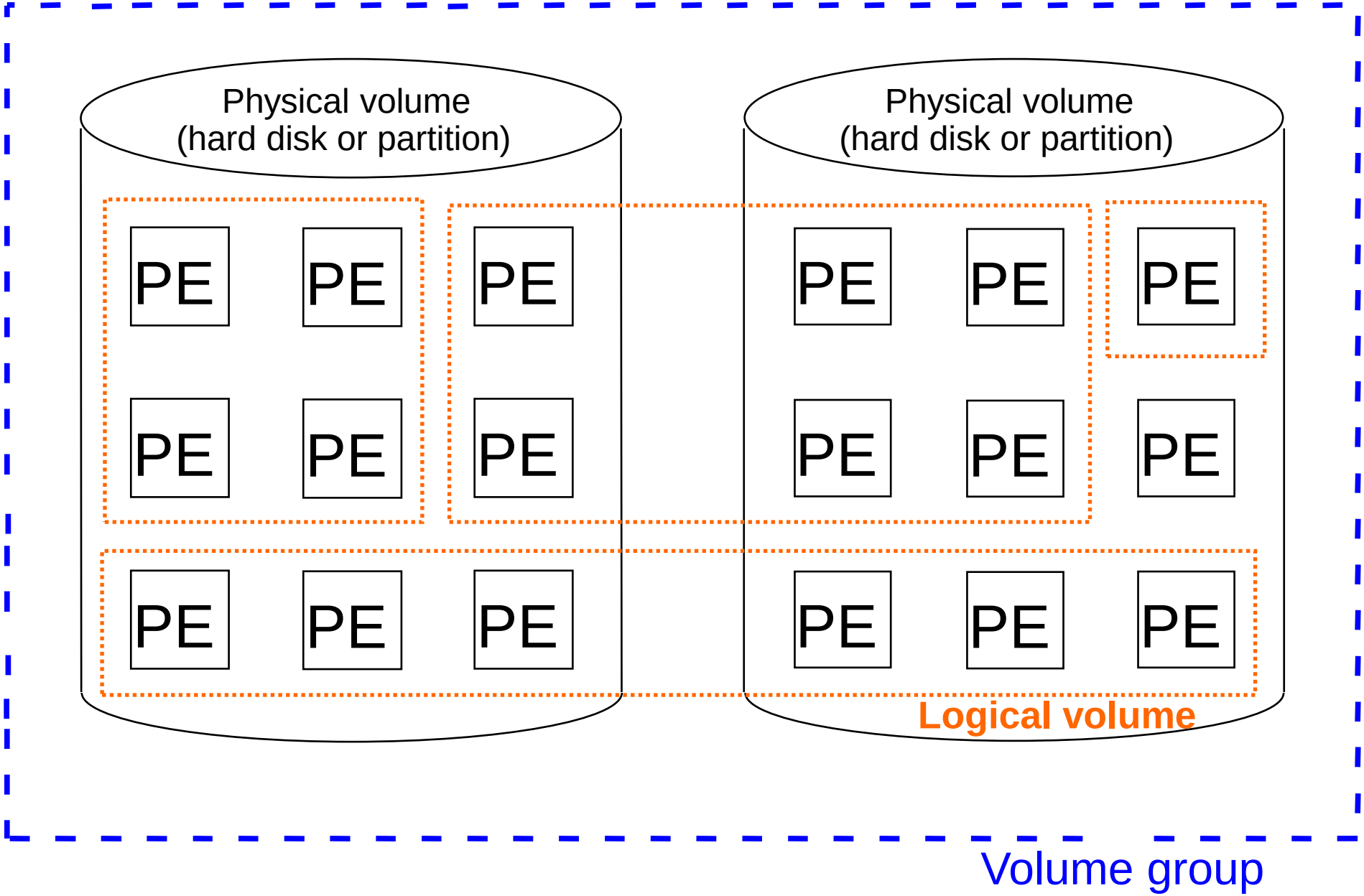
After completing this unit, you should be able to:

- Understand LVM
- LVM Implementation
- Basic LVM Commands
- Extend or Reduce VG
- Extend or Reduce LV
- Review additional LVM considerations

Logical volume management (1 of 3)

- Traditional disk partitioning scheme has several disadvantages:
  - Virtually impossible to resize or move a partition
  - Partition size is limited by disk size
- Logical volume management solves these disadvantages:
  - One or more physical volumes (hard disks, partitions) are assigned to a volume group (VG).
  - All physical volumes (PV) are split into physical extents (PE) of identical size (default 4 MB).
  - PEs in a VG can be combined into logical volumes (LV), which can be used like any block device.
- An LV can span multiple disks.
- To increase the size of an LV, add PEs.
- To increase the size of a VG, add PVs.

Logical volume management (2 of 3)



Logical volume management (3 of 3)

- Raw disks : sd | hd | nvme | san luns
- PV : pvcreate | pvremove | pvmove
- VG : vgcreate | vgextend | vgreduce
- LV : lvcreate | lvremove | lvresize
- FS : mkfs | mkfs.xfs | mkfs.ext4
- Mount : mount /dev/vg/lv /mnt
- User : cd | touch | mkdir | more | vi | cat ...

LVM implementation overview

- Add hard disks and/or create partitions (type 0x8e) on existing hard disks
- Initialize physical volumes (disks or partitions)

```
# pvcreate /dev/sda3
# pvcreate /dev/sdb
```

- Create volume group **datavg** with physical volumes

```
# vgcreate datavg /dev/sda3 /dev/sdb
```

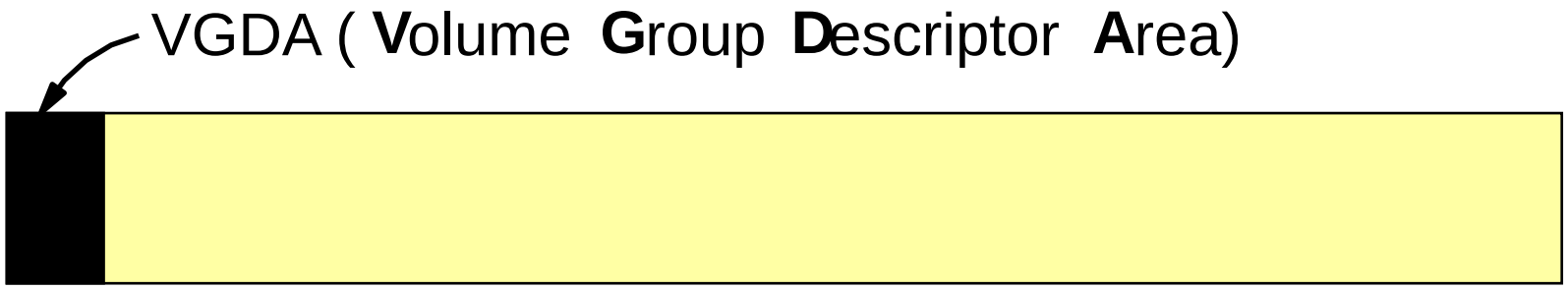
- Create logical volume **dblv01** in volume group

```
# lvcreate -L 50M -n dblv01 datavg
```

- Can now use /dev/datavg/dblv01 as block device

Physical volume commands

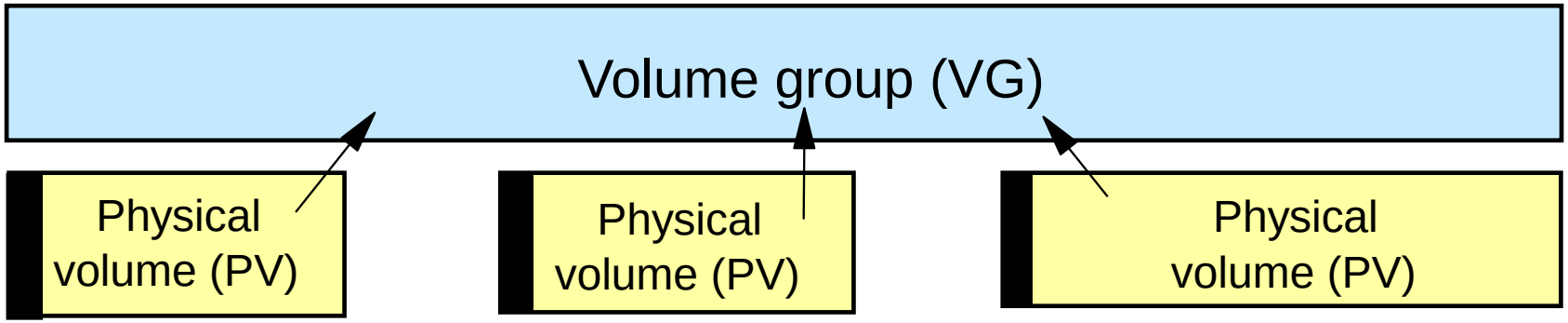
- **`pvcreate <pv>`**
  - Initializes a physical volume by putting an (empty) volume group descriptor area at the start of the PV



- **`pvmove [-n <lv>] <source pv> [<destination pv>]`**
  - Move PEs from one PV to another PV in the volume group
- **`pvdisplay <pv>`**
  - List information about a PV

Volume group commands

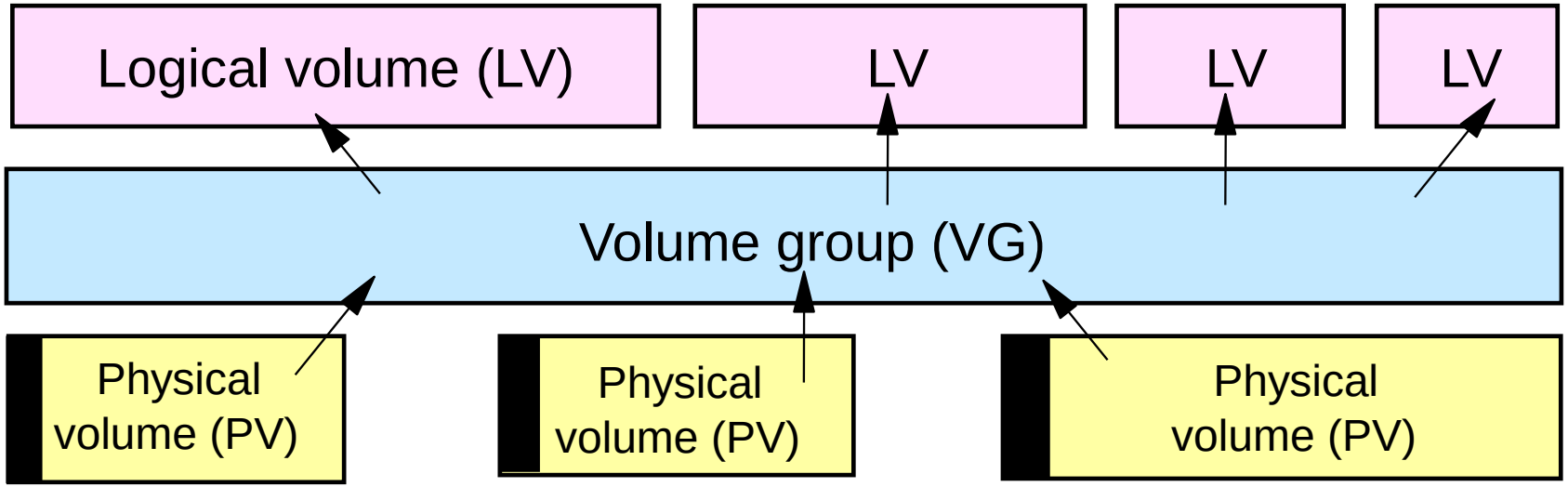
- **`vgcreate [-s <pe size>] <vg name> <pv> [<pv>...]`**
  - Create a volume group



- **`vgdisplay [<vg>]`**
  - Display information about a volume group
- **`vgremove <vg>`**
  - Delete a volume group

Logical volume commands

- **`lvcreate -L <size> [-n <lv name>] <vg> [<pv>...]`**
  - Create a logical volume in a volume group
  - Use -m option to enable mirroring



- **`lvdisplay <lv> [<lv>...]`**
  - Display information about a logical volume
- **`lvremove <lv> [<lv>...]`**
  - Remove a logical volume

Extending or reducing a volume group

- To add or remove a physical volume to or from a volume group, use the **vgextend** and **vgreduce** commands.
- To move physical extents from one physical volume to another, use **pvmove**.

```
# vgextend vg00 /dev/sdb6
# vgreduce vg00 /dev/sda5
ERROR: can't reduce volume group "vg00" by used
physical volume "/dev/sda5"
# pvmove /dev/sda5 /dev/sdb6
# vgreduce vg00 /dev/sda5
```

Extending or reducing a logical volume

- To extend/shrink a logical volume use the **`lvextend`**/**`lvreduce`** commands.
  - Use -L option to specify size in bytes
  - Use -l option to specify size in PEs
- **`lvextend`**/**`lvreduce`** do *not* extend/shrink a file system in the LV automatically!

  (Extending/shrinking a file system will be covered later.)

Command	Results
`lvextend -l 128`	Resize the logical volume to *exactly* 128 extents in size.
`lvextend -l +128`	Add 128 extents to the current size of the logical volume.
`lvextend -L 128M`	Resize the logical volume to *exactly* 128 MiB.
`lvextend -L +128M`	Add 128 MiB to the current size of the logical volume.
`lvextend -l +50%FREE`	Add 50 percent of the current free space in the VG to the LV.

Resize LV with ext4 file system

- Can do on the fly even users are **connected**
- Can only increase file system
- Use lvresize and resize2fs command

```
# lvresize -L +100m /dev/datavg/ext4
# lvs datavg/ext4
# resize2fs /dev/datavg/ext4
# df -m
```

- Can do on the fly when users **not connected**
- Use lvresize and --resizefs parameter
- Can increase & decrease file system

```
# lvresize -L +100m --resizefs /dev/datavg/ext4
Answer Y ← will unmount, adjust, then remount
# lvs datavg/ext4
# df -m
```

Resize LV with xfs file system

- Can do on the fly even users are **connected**
- Can only increase file system
- Use lvresize and xfs_growfs command

```
# lvresize -L +100m /dev/datavg/xfs
# lvs datavg/xfs
# xfs_growfs /dev/datavg/xfs
# df -m

# lvresize -L 500m /dev/datavg/xfs
# lvresize -L -50m /dev/datavg/xfs
# xfs_growfs /dev/datavg/xfs
# df -m
```

Create swap space using logical volume

- Improve flexibility
- Improve speed when combined with striping
- Improve reliability when combined with RAID

```
# swapon
NAME      TYPE      SIZE      USED    PRIO
/dev/dm-1 partition   2G      128.4M  -2
# lvcreate -L 100m -n swap1 datavg
# mkswap /dev/datavg/swap1
# swapon /dev/datavg/swap1
```

Extend swap space in logical volume

- Must deactive first. All data will be moved out to remaining active swap device
- Extend / Reduce size
- Re-activate

```
# swapon
NAME      TYPE      SIZE      USED    PRIO
/dev/dm-1 partition   2G      128.4M  -2
/dev/dm-4 partition 100M          0B  -3
# swapoff /dev/dm-4
# lvextend -L +100m /dev/datavg/swap1
# mkswap /dev/datavg/swap1
# swapon /dev/datavg/swap1
```

Additional LVM considerations

- Do not put /boot on LVM.
- Advanced LVM features:
  - Stripe logical volumes across disks
  - Creating Snapshots
  - Splitting volume groups
  - Migrating volume groups to other system
  - Extending PVs (useful on LUNs)
  - Combine with RAIDs
- Cluster LVM (CLVM) allows for concurrent access.
  - Useful in clusters with data on SAN

Checkpoint

1. Which are components in LVM? [choose two]
   a) Group Extend
   b) Logical Volume
   c) Physical Extend
   d) Logical Group

2. Which is correct sequence?
   a) lvcreate > pvcreate > vgcreate > mkfs > mount
   b) vgcreate > lvcreate > pvcreate > mkfs > mount
   c) pvcreate > vgcreate > lvcreate > mkfs > mount
   d) vgcreate > pvcreate > > lvcreate > mkfs > mount

3. Which command moves all extends from /dev/sda to /dev/sdg in vgA?
   a) mv /dev/sda /dev/sdg
   b) mv –ar /dev/sda /dev/sdg
   c) pvmove /dev/sda /dev/sdg
   d) pvmove –ar /dev/sda /dev/sdg

4. True or False: LV with XFS can resize on the fly

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Unit summary

Having completed this unit, you should be able to:

- Understand LVM
- Implementation of LVM
- Perform basic LVM Commands
- Extend or Reduce VG
- Extend or Reduce LV
- Review additional LVM considerations