How to extend the size of Logical Volume in Ubuntu

1. Get the information about existing disk partitions, volume groups and logical volumes.

```
root@w4-vcqe-r0404:~# lsblk
NAME                      MAJ:MIN RM   SIZE RO TYPE MOUNTPOINT
sda                         8:0    0 223.6G  0 disk
sda1                      8:1    0     1M  0 part
sda2                      8:2    0     1G  0 part /boot
sda3                      8:3    0 222.6G  0 part
  ubuntu--vg-ubuntu--lv 253:0    0 111.3G  0 lvm  /
nvme0n1                   259:0    0   3.5T  0 disk
nvme1n1                   259:1    0   1.8T  0 disk
nvme2n1                   259:2    0   1.5T  0 disk
root@w4-vcqe-r0404:~#
root@w4-vcqe-r0404:~#

root@w4-vcqe-r0404:~# df -h
Filesystem                         Size  Used Avail Use% Mounted on
udev                               189G     0  189G   0% /dev
tmpfs                               38G  2.3M   38G   1% /run
/dev/mapper/ubuntu--vg-ubuntu--lv  110G  9.6G   94G  10% /
tmpfs                              189G     0  189G   0% /dev/shm
tmpfs                              5.0M     0  5.0M   0% /run/lock
tmpfs                              189G     0  189G   0% /sys/fs/cgroup
/dev/sda2                          976M   80M  830M   9% /boot
tmpfs                               38G     0   38G   0% /run/user/0
root@w4-vcqe-r0404:~#
```

From the above output, we can see that there are 4 disks - sda, nvme0n1, nvme1n1 and nvme2n1.

It can be seen that disk sda is partitioned into 3 partitions sda1, sda2 and sda3 and sda3 has a logical volume configured.

The "/" directory is mounted on the logical volume and "/boot" is mounted on the sda2 partition.

2. There are commands which give more information about the disks such as:

```
root@w4-vcqe-r0404:~#
root@w4-vcqe-r0404:~# fdisk -l
Disk /dev/sda: 223.6 GiB, 240057409536 bytes, 468862128 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 4096 bytes
I/O size (minimum/optimal): 4096 bytes / 4096 bytes
Disklabel type: gpt
Disk identifier: 06C1A743-9468-415A-B41B-46E1A68050D7

Device       Start       End   Sectors   Size Type
/dev/sda1     2048      4095      2048     1M BIOS boot
/dev/sda2     4096   2101247   2097152     1G Linux filesystem
/dev/sda3  2101248 468858879 466757632 222.6G Linux filesystem


Disk /dev/mapper/ubuntu--vg-ubuntu--lv: 111.3 GiB, 119491526656 bytes, 233381888 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 4096 bytes
I/O size (minimum/optimal): 4096 bytes / 4096 bytes


Disk /dev/nvme0n1: 3.5 TiB, 3840755982336 bytes, 7501476528 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes


Disk /dev/nvme1n1: 1.8 TiB, 1920383410176 bytes, 3750748848 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes


Disk /dev/nvme2n1: 1.5 TiB, 1600321314816 bytes, 3125627568 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
root@w4-vcqe-r0404:~#
```

```
root@w4-vcqe-r0404:~# parted -l
Model: ATA SSDSCKKB240G8R (scsi)
Disk /dev/sda: 240GB
Sector size (logical/physical): 512B/4096B
Partition Table: gpt
Disk Flags:

Number  Start   End     Size    File system  Name  Flags
 1      1049kB  2097kB  1049kB                     bios_grub
 2      2097kB  1076MB  1074MB  ext4
 3      1076MB  240GB   239GB


Model: Linux device-mapper (linear) (dm)
Disk /dev/mapper/ubuntu--vg-ubuntu--lv: 119GB
Sector size (logical/physical): 512B/4096B
Partition Table: loop
Disk Flags:

Number  Start  End    Size   File system  Flags
 1      0.00B  119GB  119GB  ext4


Error: /dev/nvme0n1: unrecognised disk label
Model: Dell Ent NVMe P5500 RI U.2 3.84TB (nvme)
Disk /dev/nvme0n1: 3841GB
Sector size (logical/physical): 512B/512B
Partition Table: unknown
Disk Flags:

Error: /dev/nvme2n1: unrecognised disk label
Model: Dell Ent NVMe P5600 MU U.2 1.6TB (nvme)
Disk /dev/nvme2n1: 1600GB
Sector size (logical/physical): 512B/512B
Partition Table: unknown
Disk Flags:

Error: /dev/nvme1n1: unrecognised disk label
Model: Dell Ent NVMe P5500 RI U.2 1.92TB (nvme)
Disk /dev/nvme1n1: 1920GB
Sector size (logical/physical): 512B/512B
Partition Table: unknown
Disk Flags:

root@w4-vcqe-r0404:~#
root@w4-vcqe-r0404:~#
```

3. Use the following commands to get the mapping of the physical partitions to the volume groups to the logical volumes.

```
root@w4-vcqe-r0404:~# lvscan
  ACTIVE            '/dev/ubuntu-vg/ubuntu-lv' [<111.29 GiB] inherit

root@w4-vcqe-r0404:~# pvscan
  PV /dev/sda3   VG ubuntu-vg       lvm2 [<222.57 GiB / 111.28 GiB free]
  Total: 1 [<222.57 GiB] / in use: 1 [<222.57 GiB] / in no VG: 0 [0   ]

root@w4-vcqe-r0404:~# vgscan
  Reading volume groups from cache.
  Found volume group "ubuntu-vg" using metadata type lvm2

root@w4-vcqe-r0404:~# lvs
  LV        VG        Attr       LSize    Pool Origin Data%  Meta%  Move Log Cpy%Sync Convert
  ubuntu-lv ubuntu-vg -wi-ao---- <111.29g

root@w4-vcqe-r0404:~# pvs
  PV         VG        Fmt  Attr PSize    PFree
  /dev/sda3  ubuntu-vg lvm2 a--  <222.57g 111.28g
root@w4-vcqe-r0404:~#

root@w4-vcqe-r0404:~# vgs
  VG        #PV #LV #SN Attr   VSize    VFree
  ubuntu-vg   1   1   0 wz--n- <222.57g 111.28g
root@w4-vcqe-r0404:~#
```

4. As you can see from the previous commands, the only disk partition in use by the volume group and logical volume is sda3. We see that the 3 physical disks nvme0n1, nvme1n1 and nvme2n1 are not partitioned or in use.

5. Create the volumes for the physical disks which do not have volumes created yet.

```
root@w4-vcqe-r0404:~# pvcreate /dev/nvme0n1 /dev/nvme1n1 /dev/nvme2n1
  Physical volume "/dev/nvme0n1" successfully created.
  Physical volume "/dev/nvme1n1" successfully created.
  Physical volume "/dev/nvme2n1" successfully created.
root@w4-vcqe-r0404:~# pvs
  PV           VG        Fmt  Attr PSize    PFree
  /dev/nvme0n1           lvm2 ---     3.49t   3.49t
  /dev/nvme1n1           lvm2 ---    <1.75t  <1.75t
  /dev/nvme2n1           lvm2 ---    <1.46t  <1.46t
  /dev/sda3    ubuntu-vg lvm2 a--  <222.57g 111.28g
root@w4-vcqe-r0404:~# lvs
  LV        VG        Attr       LSize    Pool Origin Data%  Meta%  Move Log Cpy%Sync Convert
  ubuntu-lv ubuntu-vg -wi-ao---- <111.29g
root@w4-vcqe-r0404:~# vgs
  VG        #PV #LV #SN Attr   VSize    VFree
  ubuntu-vg   1   1   0 wz--n- <222.57g 111.28g
root@w4-vcqe-r0404:~# lsblk
NAME                      MAJ:MIN RM   SIZE RO TYPE MOUNTPOINT
sda                         8:0    0 223.6G  0 disk
sda1                        8:1    0     1M  0 part
sda2                        8:2    0     1G  0 part /boot
sda3                        8:3    0 222.6G  0 part
  ubuntu--vg-ubuntu--lv 253:0    0 111.3G  0 lvm  /
nvme0n1                   259:0    0   3.5T  0 disk
nvme1n1                   259:1    0   1.8T  0 disk
nvme2n1                   259:2    0   1.5T  0 disk
root@w4-vcqe-r0404:~#
```

6. Until this point, only the /dev/sda3 volume is part of the volume group ubuntu-vg. So we need to extend the volume group to include the newly created volumes.

```
root@w4-vcqe-r0404:~# pvscan
  PV /dev/sda3      VG ubuntu-vg       lvm2 [<222.57 GiB / 111.28 GiB free]
  PV /dev/nvme2n1                      lvm2 [<1.46 TiB]
  PV /dev/nvme1n1                      lvm2 [<1.75 TiB]
  PV /dev/nvme0n1                      lvm2 [3.49 TiB]
  Total: 4 [6.91 TiB] / in use: 1 [<222.57 GiB] / in no VG: 3 [<6.70 TiB]
root@w4-vcqe-r0404:~# lsblk
NAME                      MAJ:MIN RM   SIZE RO TYPE MOUNTPOINT
sda                         8:0    0 223.6G  0 disk
sda1                      8:1    0     1M  0 part
sda2                      8:2    0     1G  0 part /boot
sda3                      8:3    0 222.6G  0 part
  ubuntu--vg-ubuntu--lv 253:0    0 111.3G  0 lvm  /
nvme0n1                   259:0    0   3.5T  0 disk
nvme1n1                   259:1    0   1.8T  0 disk
nvme2n1                   259:2    0   1.5T  0 disk
root@w4-vcqe-r0404:~# vgextend /dev/ubuntu-vg /dev/nvme0n1 /dev/nvme1n1 /dev/nvme2n1
  Volume group "ubuntu-vg" successfully extended
root@w4-vcqe-r0404:~#
root@w4-vcqe-r0404:~# pvscan
  PV /dev/sda3      VG ubuntu-vg       lvm2 [<222.57 GiB / 111.28 GiB free]
  PV /dev/nvme0n1   VG ubuntu-vg       lvm2 [3.49 TiB / 3.49 TiB free]
  PV /dev/nvme1n1   VG ubuntu-vg       lvm2 [<1.75 TiB / <1.75 TiB free]
  PV /dev/nvme2n1   VG ubuntu-vg       lvm2 [<1.46 TiB / <1.46 TiB free]
  Total: 4 [6.91 TiB] / in use: 4 [6.91 TiB] / in no VG: 0 [0   ]
root@w4-vcqe-r0404:~#
root@w4-vcqe-r0404:~# lvs
  LV        VG        Attr       LSize    Pool Origin Data%  Meta%  Move Log Cpy%Sync Convert
  ubuntu-lv ubuntu-vg -wi-ao---- <111.29g
root@w4-vcqe-r0404:~# pvs
  PV           VG        Fmt  Attr PSize    PFree
  /dev/nvme0n1 ubuntu-vg lvm2 a--     3.49t   3.49t
  /dev/nvme1n1 ubuntu-vg lvm2 a--    <1.75t  <1.75t
  /dev/nvme2n1 ubuntu-vg lvm2 a--    <1.46t  <1.46t
  /dev/sda3    ubuntu-vg lvm2 a--  <222.57g 111.28g
root@w4-vcqe-r0404:~# vgs
  VG        #PV #LV #SN Attr   VSize VFree
  ubuntu-vg   4   1   0 wz--n- 6.91t 6.80t
root@w4-vcqe-r0404:~#
```

7. Once the volume group is extended, we need to extend the logical volume

```
root@w4-vcqe-r0404:~# lvextend -l 100%VG /dev/ubuntu-vg/ubuntu-lv
  Size of logical volume ubuntu-vg/ubuntu-lv changed from <111.29 GiB (28489 extents) to 6.91 TiB (1812084
extents).
  Logical volume ubuntu-vg/ubuntu-lv successfully resized.
root@w4-vcqe-r0404:~#
root@w4-vcqe-r0404:~# lvs
  LV        VG        Attr       LSize Pool Origin Data%  Meta%  Move Log Cpy%Sync Convert
  ubuntu-lv ubuntu-vg -wi-ao---- 6.91t
root@w4-vcqe-r0404:~# pvs
  PV           VG        Fmt  Attr PSize    PFree
  /dev/nvme0n1 ubuntu-vg lvm2 a--     3.49t    0
  /dev/nvme1n1 ubuntu-vg lvm2 a--    <1.75t    0
  /dev/nvme2n1 ubuntu-vg lvm2 a--    <1.46t    0
  /dev/sda3    ubuntu-vg lvm2 a--  <222.57g    0
root@w4-vcqe-r0404:~# vgs
  VG        #PV #LV #SN Attr   VSize VFree
  ubuntu-vg   4   1   0 wz--n- 6.91t    0
root@w4-vcqe-r0404:~# df -h
Filesystem                         Size  Used Avail Use% Mounted on
udev                               189G     0  189G   0% /dev
tmpfs                               38G  2.3M   38G   1% /run
/dev/mapper/ubuntu--vg-ubuntu--lv  110G  9.6G   94G  10% /
tmpfs                              189G     0  189G   0% /dev/shm
tmpfs                              5.0M     0  5.0M   0% /run/lock
tmpfs                              189G     0  189G   0% /sys/fs/cgroup
/dev/sda2                          976M   80M  830M   9% /boot
tmpfs                               38G     0   38G   0% /run/user/0
root@w4-vcqe-r0404:~#
```

8. The final step is to resize the file system for the filesystem to start using the logical volume that was extended.

```
root@w4-vcqe-r0404:~# resize2fs /dev/ubuntu-vg/ubuntu-lv
resize2fs 1.44.1 (24-Mar-2018)
Filesystem at /dev/ubuntu-vg/ubuntu-lv is mounted on /; on-line resizing required
old_desc_blocks = 14, new_desc_blocks = 885

The filesystem on /dev/ubuntu-vg/ubuntu-lv is now 1855574016 (4k) blocks long.

root@w4-vcqe-r0404:~#
root@w4-vcqe-r0404:~#
root@w4-vcqe-r0404:~# lsblk
NAME                      MAJ:MIN RM   SIZE RO TYPE MOUNTPOINT
sda                         8:0    0 223.6G  0 disk
sda1                        8:1    0     1M  0 part
sda2                        8:2    0     1G  0 part /boot
sda3                        8:3    0 222.6G  0 part
  ubuntu--vg-ubuntu--lv 253:0    0   6.9T  0 lvm  /
nvme0n1                   259:0    0   3.5T  0 disk
ubuntu--vg-ubuntu--lv   253:0    0   6.9T  0 lvm  /
nvme1n1                   259:1    0   1.8T  0 disk
ubuntu--vg-ubuntu--lv   253:0    0   6.9T  0 lvm  /
nvme2n1                   259:2    0   1.5T  0 disk
ubuntu--vg-ubuntu--lv   253:0    0   6.9T  0 lvm  /
root@w4-vcqe-r0404:~#
root@w4-vcqe-r0404:~# df -h
Filesystem                         Size  Used Avail Use% Mounted on
udev                               189G     0  189G   0% /dev
tmpfs                               38G  2.3M   38G   1% /run
/dev/mapper/ubuntu--vg-ubuntu--lv  6.9T  9.6G  6.6T   1% /
tmpfs                              189G     0  189G   0% /dev/shm
tmpfs                              5.0M     0  5.0M   0% /run/lock
tmpfs                              189G     0  189G   0% /sys/fs/cgroup
/dev/sda2                          976M   80M  830M   9% /boot
tmpfs                               38G     0   38G   0% /run/user/0
root@w4-vcqe-r0404:~#
```

Important Links

Please use the following links to read about the details of the volume groups and logical volumes.

https://opensource.com/business/16/9/linux-users-guide-lvm

https://www.digitalocean.com/community/tutorials/an-introduction-to-lvm-concepts-terminology-and-operations