

1. During the Ubuntu 20.04 Server installation, for the "Guided storage configuration" part, make sure "Use an entire disk", "Set up this disk as an LVM group", and "Encrypt the LVM group with LUKS" are selected, and enter a "Passphrase" for the LUKS Encryption.



- a.
2. Go through the rest of the Ubuntu Server 20.04 setup as normal.
 - a. After the Ubuntu Server 20.04 setup has completed, select "Reboot Now" and hit the "Enter" key.
 - b. After restarting the virtual machine, unlock the disk.
 - c. Log-in to the virtual machine when prompted.
 - d. When you can see the input terminal screen type "shutdown", and press the "Enter" key to shutdown the virtual machine.

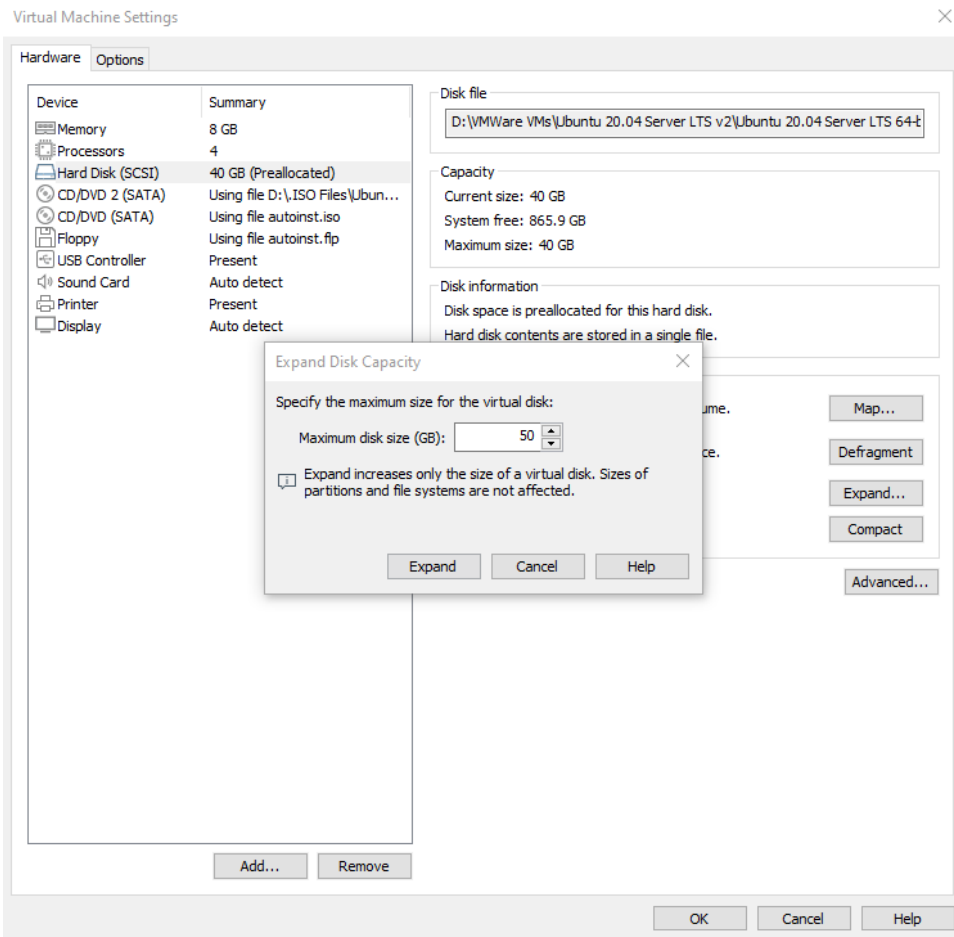
```
on, 30 Oct 2023 20:05:02 +0000. Up 71.35 seconds.
[ 73.540313] cloud-init[1969]: 2023-10-30 20:05:04,210 - cc_set_passwords.py[WARNING]: Ignoring co
nfig 'ssh_pwauth: None'. SSH service 'ssh' is not installed.
ci-info: no authorized SSH keys fingerprints found for user sandbox.
<14>Oct 30 20:05:05 cloud-init: #####
<14>Oct 30 20:05:05 cloud-init: -----BEGIN SSH HOST KEY FINGERPRINTS-----
<14>Oct 30 20:05:05 cloud-init: 1024 SHA256:8bSW4mHzMkjsHTrCfK2FnucVC1u+Iaakh24ivyE22vg root@sandbox
server (DSA)
<14>Oct 30 20:05:05 cloud-init: 256 SHA256:Mdo9TsvZVzag8KX/CU3d5resKhFALSAopFd8/a0X/C0 root@sandbox
server (ECDSA)
<14>Oct 30 20:05:05 cloud-init: 256 SHA256:YReeT6X/CeevHhBKQywu6eT4eKkT1UsEaJ6jaNmZDg9E root@sandbox
server (ED25519)
<14>Oct 30 20:05:05 cloud-init: 3072 SHA256:fQxjplfhL/SX1m5HqbtuXiPqVpCgwigpa6qdBLb6rjI root@sandbox
server (RSA)
<14>Oct 30 20:05:05 cloud-init: -----END SSH HOST KEY FINGERPRINTS-----
<14>Oct 30 20:05:05 cloud-init: #####
-----BEGIN SSH HOST KEY KEYS-----
ecdsa-sha2-nistp256 AAAAE2VjZHNhLXNoYTItbmlzdHAuNTYAAAAIbmlzdHAuNTYAAABBAWNNKkig1WbYcqeJFyikX0VGCvsp
nry8Ra2Rk8zQZRHhJnPVjBakmK2JfG92f0VoSw01B76B/dF0QWicbRCOI8c= root@sandboxserver
ssh-ed25519 AAAAC3NzaC1l2D1lINTE5AAAAIN16uYLudAaJu0kBVcmo7/tlyN07G8/2VfVM71z5RhoK root@sandboxserver
ssh-rsa AAAAB3NzaC1yc2EAAAADAQABAAQgQDA/7R3FnArvx6ur6MazgJpJ5Phd52x3zP/rNr+t3wHHB0o26Q48h+wB2ap71Fw
1eTyn1fBPEC19vKk7e0TpAMUj869559S3INQJC57HfnAQahMr+bbuvGClaijmgS7d0+wHmxKsMG/XQtX1x0NeDOK6/nPHSw1yeo
Ge5mVkm6sR1Qg17Kx4kmT3aTck40zXF2HvLdtCuKRotDNKLmGkt+Y5g3EaxmUdaYH05D1REf0Xxme20no9UoLncn1j0vJS0pc6b
f+B1QZ1w/eGCHH80HpR0JvEyLs0wka3LmAUKE+0155Jkt3GURAYe3s9TG80GtXDU0bJFCtapEYX4q29i+Xjr8hALZY9W/6yiTLqQ
wS66xy2tn1AqUT8QKkRIQMxJu6GkEaPuTvr2IHdnWf9nnnck3NQ1BwUxkdeRt7AJ0WkhvBzCkktCM/SanIg+4W5EhBdh1wIAxnWn
RN1+3UDpi2uicni+XEIU0Eth8svz6/i1M77HuUcKvYf0DcUwG8= root@sandboxserver
-----END SSH HOST KEY KEYS-----
[ 74.664127] cloud-init[2014]: Cloud-init v. 22.4.2-0ubuntu0~20.04.2 running 'modules:final' at Mo
n, 30 Oct 2023 20:05:05 +0000. Up 74.39 seconds.
[ 74.666179] cloud-init[2014]: Cloud-init v. 22.4.2-0ubuntu0~20.04.2 finished at Mon, 30 Oct 2023
20:05:05 +0000. DataSource DataSourceNone. Up 74.65 seconds
[ 74.668052] cloud-init[2014]: 2023-10-30 20:05:05,335 - cc_final_message.py[WARNING]: Used fallba
ck datasource
sandbox@sandboxserver:~$ shutdown
Shutdown scheduled for Mon 2023-10-30 20:06:19 UTC, use 'shutdown -c' to cancel.
sandbox@sandboxserver:~$ _
```

e.

How to Increase/Extend the Ubuntu Server LVM Volume with LUKS (VMWare)

Follow this section after you have created, and setup, the Ubuntu Server Virtual Machine.

1. While the virtual machine is shutdown, right-click the virtual machine's name on the left-hand side, and click "Settings..."
 - a. Click on "Hard Disk"
 - b. Under "Disk utilities", click "Expand..."
 - c. Type your new desired maximum disk side, and click "Expand".
 - i. Example (Part 1): If the VM was created with a 40 GB disk, you would enter in 40 + # GB
 - ii. Example (Part 2): 50.0 GB would extend the drive by 10.0 GB



- d.
2. After the disk has finished expanding, click "OK", click "OK", and click "Power on this virtual machine".
 - a. After powering on the virtual machine, unlock the disk.
 - b. Log-in to the virtual machine when prompted.
3. When you can see the input terminal screen type **lsblk**, and press the "Enter" key to view all of the drive partitions, and their mountpoints.
 - a. Make note of the "NAME"s of the parent drives, for the root "/" drive.
 - b. Example: **sda sda3 dm_crypt-0 ubuntu--vg-ubuntu--lv**

```
sandbox@sandboxserver:~$ lsblk
NAME                                MAJ:MIN RM  SIZE RO TYPE  MOUNTPOINT
fd0                                  2:0    1  1.4M  0 disk
loop0                               7:0    0 63.3M  1 loop  /snap/core20/1828
loop1                               7:1    0 91.9M  1 loop  /snap/lxd/24061
loop2                               7:2    0 49.9M  1 loop  /snap/snapd/18357
sda                                  8:0    0   50G  0 disk
├─sda1                              8:1    0    1M  0 part
├─sda2                              8:2    0    2G  0 part  /boot
├─sda3                              8:3    0   38G  0 part
│   └─dm_crypt-0                    253:0    0   38G  0 crypt
│       └─ubuntu--vg-ubuntu--lv    253:1    0   19G  0 lvm   /
sr0                                  11:0    1 99.4M  0 rom
sr1                                  11:1    1  1.4G  0 rom
sandbox@sandboxserver:~$ _
```

- c.
4. Type in the command, "sudo growpart /dev/sda <sda #>", and press the "Enter" key.
 - a. Example: **sudo growpart /dev/sda 3**
 - b. Type in the **lsblk** command again, and press enter to make sure that the corresponding "sda#" has actually increased in size.

```
sandbox@sandboxserver:~$ sudo growpart /dev/sda 3
[sudo] password for sandbox:
CHANGED: partition=3 start=4198400 old: size=79685632 end=83884032 new: size=100659167 end=104857567
sandbox@sandboxserver:~$ lsblk
NAME                                MAJ:MIN RM  SIZE RO TYPE  MOUNTPOINT
fd0                                  2:0      1  1.4M  0 disk
loop0                               7:0      0 63.3M  1 loop  /snap/core20/1828
loop1                               7:1      0 91.9M  1 loop  /snap/lxd/24061
loop2                               7:2      0 49.9M  1 loop  /snap/snapd/18357
sda                                  8:0      0   50G  0 disk
├─sda1                              8:1      0    1M  0 part
├─sda2                              8:2      0    2G  0 part  /boot
├─sda3                              8:3      0   48G  0 part
│   └─dm_crypt-0                    253:0    0   38G  0 crypt
│       └─ubuntu--vg-ubuntu--lv    253:1    0   19G  0 lvm    /
sr0                                  11:0     1 99.4M  0 rom
sr1                                  11:1     1  1.4G  0 rom
```

c. sandbox@sandboxserver:~\$ _

5. Type in the command, "sudo cryptsetup resize dm_crypt-<crypt #>", press the "Enter" key, input the password for the drive, and press the "Enter" key again.

a. Example: **sudo cryptsetup resize dm_crypt-0**

- b. Type in the **lsblk** command again, and press enter to make sure that the corresponding "dm_crypt-<crypt #>" has actually increased in size.

```
sandbox@sandboxserver:~$ sudo cryptsetup resize dm_crypt-0
Enter passphrase for /dev/sda3:
sandbox@sandboxserver:~$ lsblk
NAME                                MAJ:MIN RM  SIZE RO TYPE  MOUNTPOINT
fd0                                  2:0      1  1.4M  0 disk
loop0                               7:0      0 63.3M  1 loop  /snap/core20/1828
loop1                               7:1      0 91.9M  1 loop  /snap/lxd/24061
loop2                               7:2      0 49.9M  1 loop  /snap/snapd/18357
sda                                  8:0      0   50G  0 disk
├─sda1                              8:1      0    1M  0 part
├─sda2                              8:2      0    2G  0 part  /boot
├─sda3                              8:3      0   48G  0 part
│   └─dm_crypt-0                    253:0    0   48G  0 crypt
│       └─ubuntu--vg-ubuntu--lv    253:1    0   19G  0 lvm    /
sr0                                  11:0     1 99.4M  0 rom
sr1                                  11:1     1  1.4G  0 rom
```

c. sandbox@sandboxserver:~\$

6. Type in the command, **sudo pvs**, press the "Enter" key, and make note of the "PV" path for the root, "/", partition, and the "PFree" size value.

a. PV Path - **/dev/mapper/dm_crypt-0**

b. PFree - **18.99G**

```
sandbox@ubuntu2004server:~$ sudo pvs
PV                                VG      Fmt Attr PSize PFree
/dev/mapper/dm_crypt-0          ubuntu-vg lvm2 a-- 37.98g 18.99g
```

c.

7. Type in the command, "sudo pvresize /<PV path>", press the "Enter" key, and make sure that the terminal says 1 (or more) "physical volume(s) resized or updated".

a. Example: **sudo pvresize /dev/mapper/dm_crypt-0**

```
sandbox@ubuntu2004server:~$ sudo pvresize /dev/mapper/dm_crypt-0
Physical volume "/dev/mapper/dm_crypt-0" changed
1 physical volume(s) resized or updated / 0 physical volume(s) not resized
```

b.

8. Type in the command, "sudo lvextend -L +<PFree Size>G /<PV path (except dm_crypt)>/<root drive name>", and press the "Enter" key.

a. Example: **sudo lvextend -L +18.99G /dev/mapper/ubuntu--vg-ubuntu--lv**

- b. Type in the **lsblk** command again, and press enter to make sure that the corresponding root, "/", partition has actually increased in size, in the "lsblk" view.

```
sandbox@ubuntu2004server:~$ sudo lvextend -L +18.9G /dev/mapper/ubuntu--vg-ubuntu--lv
Rounding size to boundary between physical extents: 18.90 GiB.
Size of logical volume ubuntu-vg/ubuntu-lv changed from 37.99 GiB (4861 extents) to 56.89 GiB (7200 extents).
Logical volume ubuntu-vg/ubuntu-lv successfully resized.
sandbox@ubuntu2004server:~$ lsblk
NAME                                MAJ:MIN RM  SIZE RO TYPE  MOUNTPOINT
fd0                                  2:0      1  1.4M  0 disk
loop0                               7:0      0 63.3M  1 loop  /snap/core20/1828
loop1                               7:1      0 91.9M  1 loop  /snap/lxd/24061
loop2                               7:2      0 49.9M  1 loop  /snap/snapd/18357
sda                                  8:0      0   50G  0 disk
├─sda1                              8:1      0    1M  0 part
├─sda2                              8:2      0    2G  0 part  /boot
├─sda3                              8:3      0   48G  0 part
│   └─dm_crypt-0                    253:0    0   48G  0 crypt
│       └─ubuntu--vg-ubuntu--lv    253:1    0  56.9G  0 lvm    /
sr0                                  11:0     1 99.4M  0 rom
sr1                                  11:1     1  1.4G  0 rom
```

c.

9. Type in the command, "sudo resize2fs /<PV path (except dm_crypt)>/<root drive name>", and press the "Enter" key.

a. Example: **sudo resize2fs /dev/mapper/ubuntu--vg-ubuntu--lv**

```
sandbox@sandboxserver:/$ sudo resize2fs /dev/mapper/ubuntu--vg-ubuntu--lv
[sudo] password for sandbox:
resize2fs 1.45.5 (07-Jan-2020)
Filesystem at /dev/mapper/ubuntu--vg-ubuntu--lv is mounted on /; on-line resizing required
old_desc_blocks = 3, new_desc_blocks = 5
The filesystem on /dev/mapper/ubuntu--vg-ubuntu--lv is now 9937920 (4k) blocks long.
```

b.

10. Type in the command, **df -h**, to make sure that the corresponding root, "/", partition has actually increased in size, in the eyes of the ext4 file system.

a. Here, you are looking for the "Avail" value corresponding to the "Mounted on" "/" row.

```
sandbox@sandboxserver:/$ df -h
Filesystem      Size  Used Avail Use% Mounted on
udev            3.9G   0    3.9G   0% /dev
tmpfs           793M   1.6M 792M   1% /run
/dev/mapper/ubuntu--vg-ubuntu--lv 38G  6.3G   30G  18% /
tmpfs           3.9G   0    3.9G   0% /dev/shm
tmpfs           5.0M   0    5.0M   0% /run/lock
tmpfs           3.9G   0    3.9G   0% /sys/fs/cgroup
/dev/loop0       50M   50M    0 100% /snap/snapd/18357
/dev/loop1       92M   92M    0 100% /snap/lxd/24061
/dev/loop2       64M   64M    0 100% /snap/core20/1828
/dev/sda2        2.0G  108M   1.7G   6% /boot
tmpfs            793M   0    793M   0% /run/user/1000
```

b.

11. Type in the **lsblk** command again, and press enter to make sure that the corresponding root, "/", partition still has its increased size value.

```
sandbox@sandboxserver:/$ lsblk
NAME                MAJ:MIN RM  SIZE RO TYPE  MOUNTPOINT
fd0                  2:0    1   1.4M  0 disk
loop0                7:0    0  49.9M  1 loop  /snap/snapd/18357
loop1                7:1    0  91.9M  1 loop  /snap/lxd/24061
loop2                7:2    0  63.3M  1 loop  /snap/core20/1828
sda                  8:0    0   50G   0 disk
├─sda1                8:1    0    1M   0 part
├─sda2                8:2    0    2G   0 part  /boot
├─sda3                8:3    0   48G   0 part
│   └─dm_crypt-0      253:0    0   48G   0 crypt
│       └─ubuntu--vg-ubuntu--lv 253:1    0  37.9G   0 lvm    /
sr0                  11:0    1  99.4M  0 rom
sr1                  11:1    1   1.4G  0 rom
```

a.

12. You have successfully extended an LVM partition, with LUKS encryption! 😊