Linux System Administration – Practice Exercises

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Introduction

The plan is to create own **Virtual Machine**, then to install **Operating System** on it (Ubuntu Server in our case) and then on top of it some **Application Software** like SSH Server, Web Server, Firewall, FTP Server, Database Management System (DBMS), etc.

You will learn:

- How to install Linux
- Basic Linux commands
- User rights and file permissions
- Network Settings
- How to install and set up application software on Linux

Development Environment

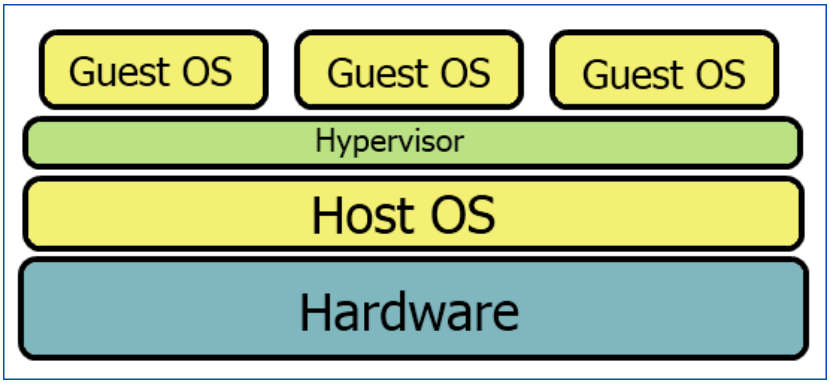
In this exercise, we use Virualbox **Virtualization Software** to create our own development environment. Any other virtualization software could work as well.

Download and install Virtualbox

https://www.virtualbox.org/wiki/Downloads

If your PC runs on Windows (most of the cases) download Virtualbox for windows host.

NOTE: Host is the machine that hosts the virtual machines. Therefore the virtual machine itself is called guest or just virtual machines.



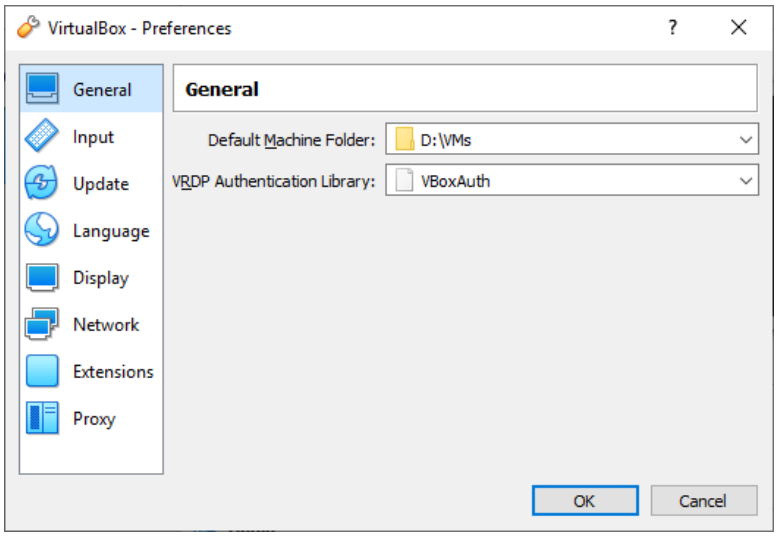
https://www.howtogeek.com/66734/htg-explains-what-is-a-hypervisor/

Virtualbox Settings

"Default Machine Folder" is where the virtual machine files are located.

By default it is in system drive C. It is recommended to set this Folder location to drive with enough free space, for example D:\VMs.

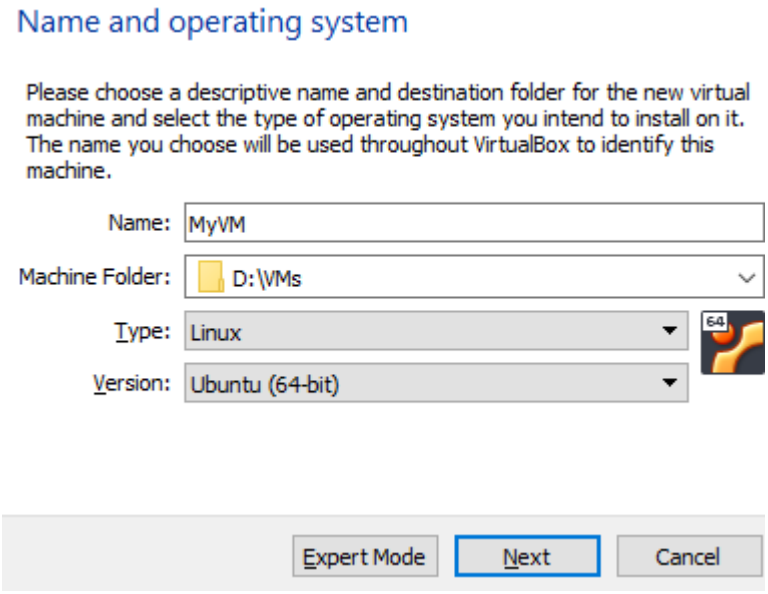
File->Preferences->General->Default Machine Folder



Create new virtual machine

Use the wizard to create new virtual machine.

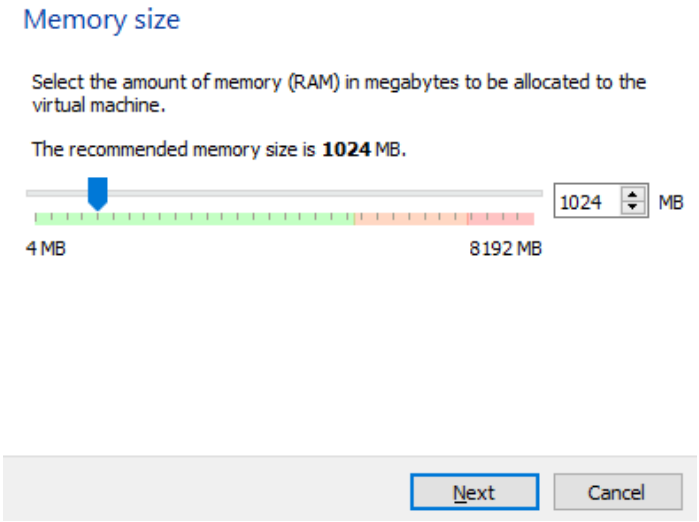
Type a name and choose Type: Linux and Version: Ubuntu (64-bit)



NOTE: If 64-bit option is unavailable, you should allow Virtualization in BIOS setting. Restart of the host machine is required.

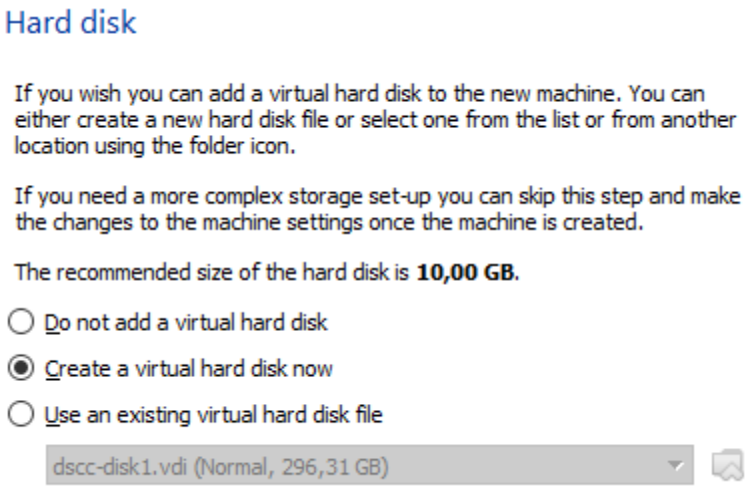
512 MB of RAM is enough. You can add or remove extra RAM is needed at any time.

NOTE: Ubuntu installation wizard creates swap file with the size of the available RAM by default.



Create new dynamic VDI disk.

Dynamic mean that the virtualization software will dynamically allocate more space, so the initial disk size will be small and will increase during the operation.



Create Virtual Hard Disk

Hard disk file type

Please choose the type of file that you would like to use for the new virtual hard disk. If you do not need to use it with other virtualization software you can leave this setting unchanged.

- (•) VDI (VirtualBox Disk Image)
- ( ) VHD (Virtual Hard Disk)
- ( ) VMDK (Virtual Machine Disk)

Create Virtual Hard Disk

Storage on physical hard disk

Please choose whether the new virtual hard disk file should grow as it is used (dynamically allocated) or if it should be created at its maximum size (fixed size).

A **dynamically allocated** hard disk file will only use space on your physical hard disk as it fills up (up to a maximum **fixed size**), although it will not shrink again automatically when space on it is freed.

A **fixed size** hard disk file may take longer to create on some systems but is often faster to use.

- (•) Dynamically allocated
- ( ) Fixed size

Create Virtual Hard Disk

File location and size

Please type the name of the new virtual hard disk file into the box below or click on the folder icon to select a different folder to create the file in.

MyVM

Select the size of the virtual hard disk in megabytes. This size is the limit on the amount of file data that a virtual machine will be able to store on the hard disk.

483,56 GB

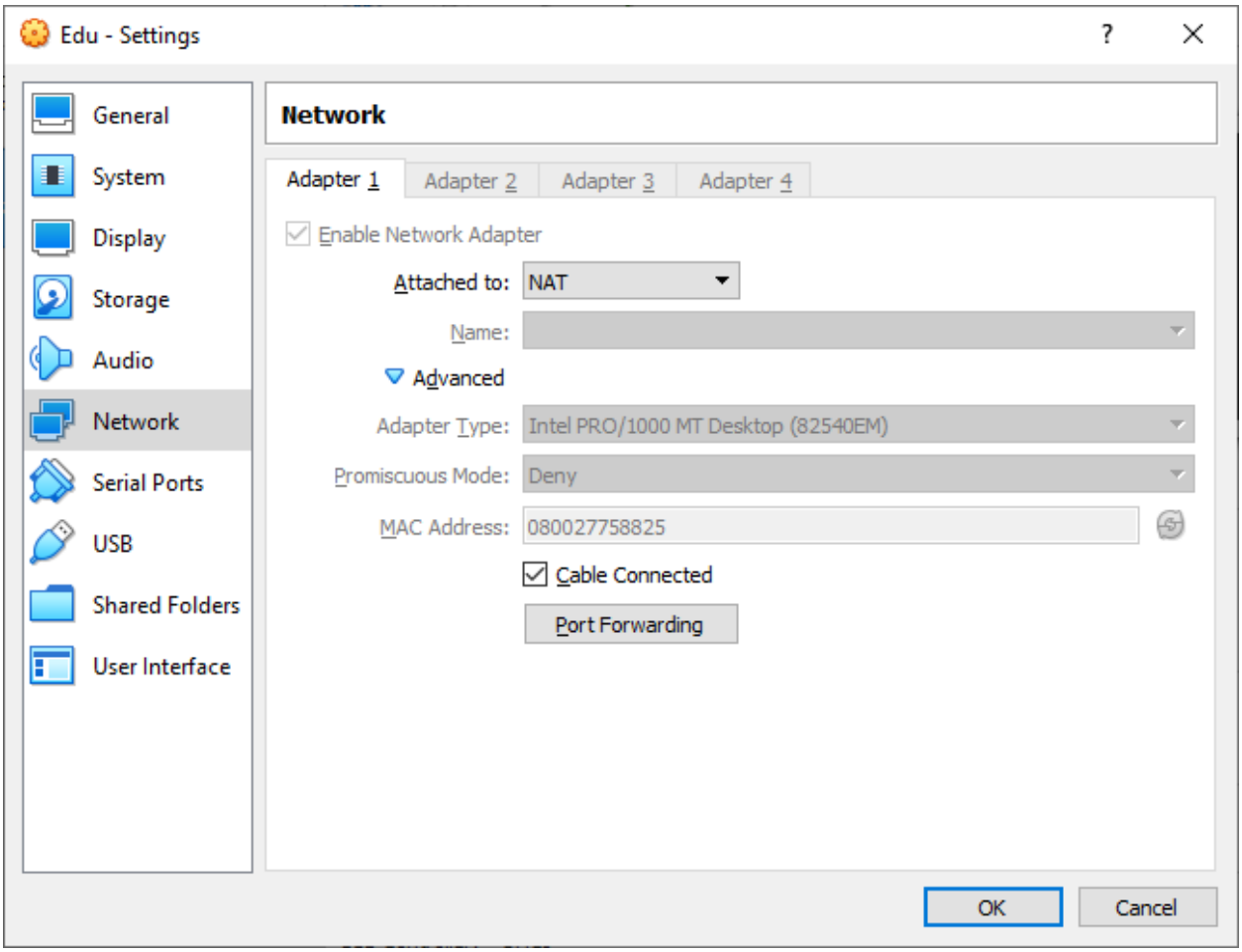
4,00 MB 2,00 TB

The virtual machine is ready, but if you just run it, you will see an error message “No bootable medium found” or something similar. Now it’s time to install the operating system.

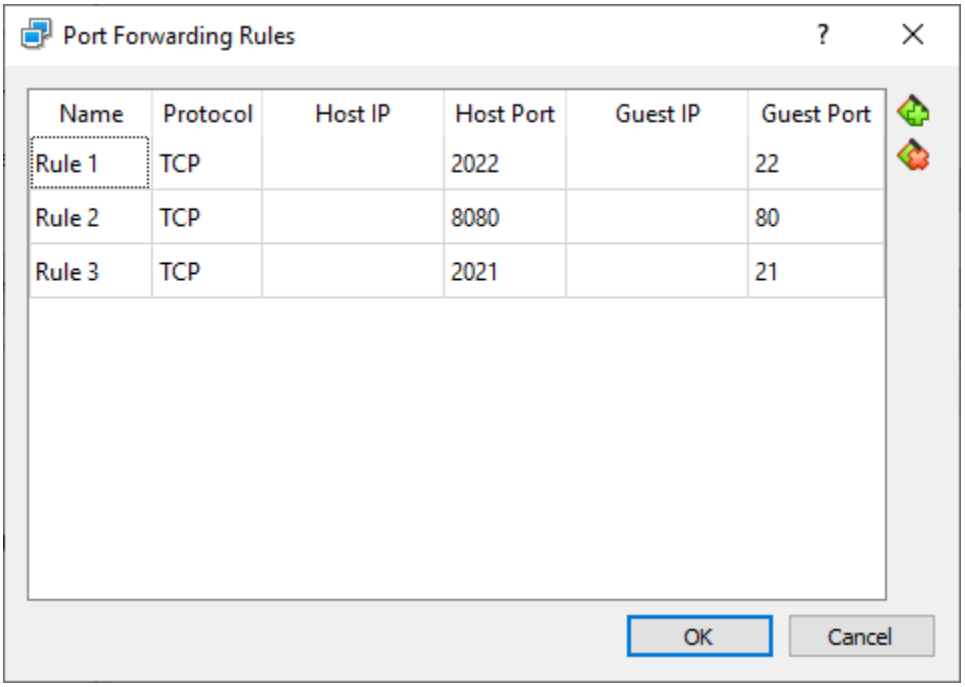
Port Forwarding

In order to access the host’s resource like SSH Server, Web Server, FTP Server, etc., from the host one can use **Port Forwarding**.

Go to Setting->Network->Port Forwarding.



Up to now, we need to forward ports 21, 22, 80, respectively for FTP, SSH and HTTP.

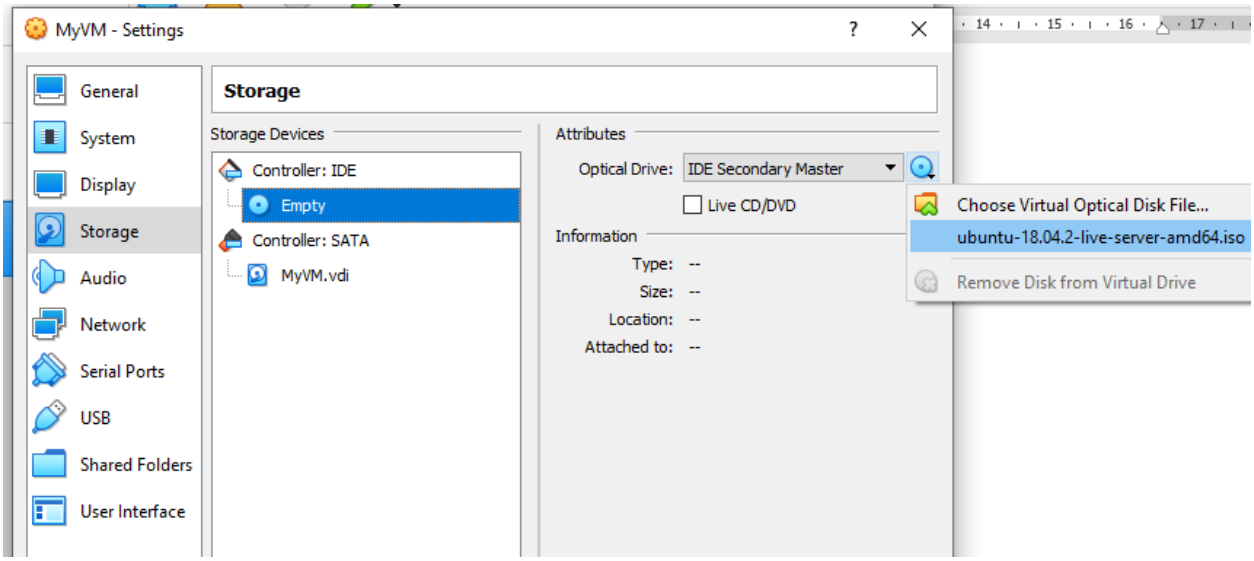


Install Ubuntu Server (Operating System)

From the newly created virtual machine go to Setting and choose the installation media.

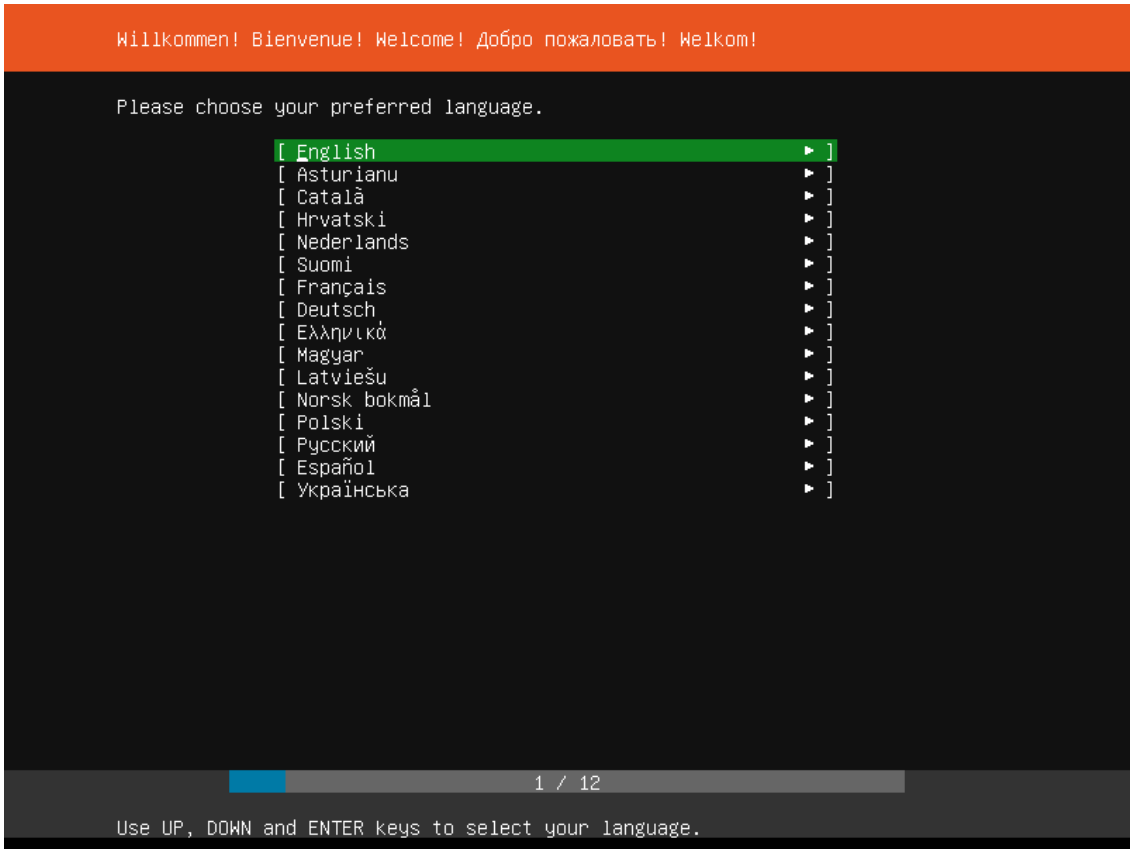
The installation media is the Ubuntu Server 18.4

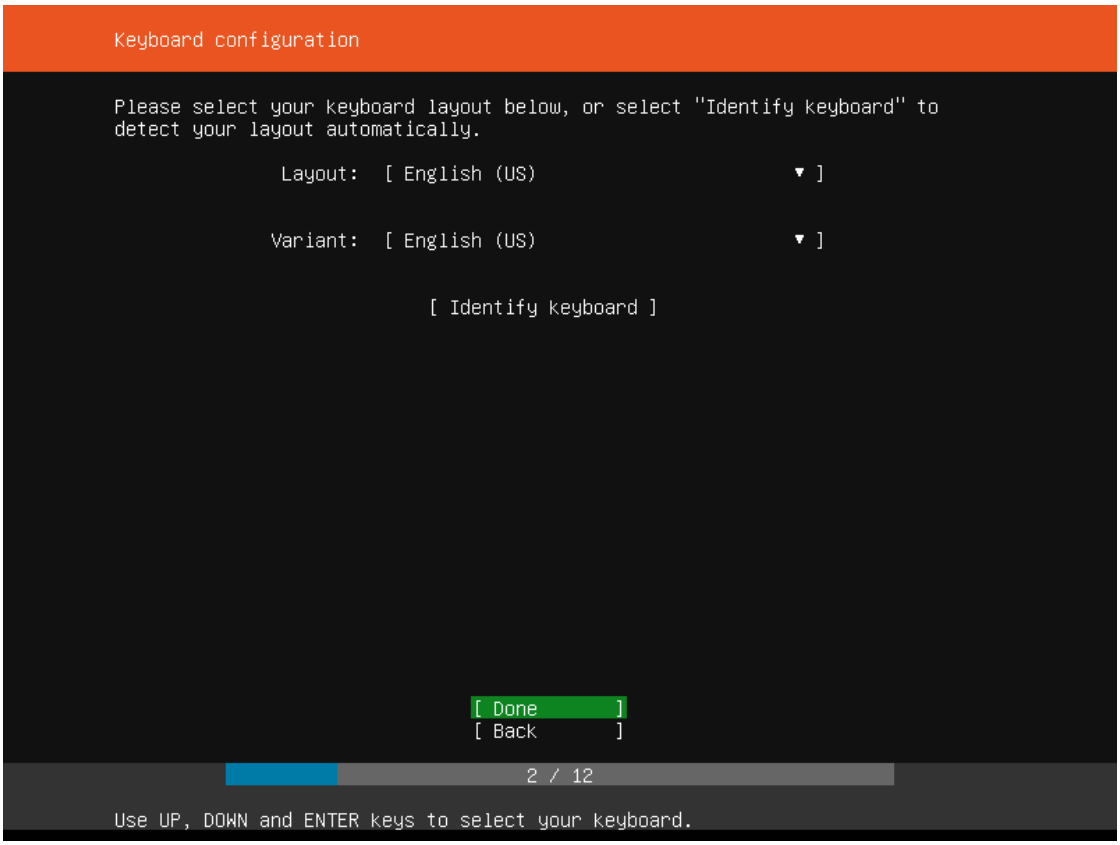
You can download it from https://www.ubuntu.com/download/server

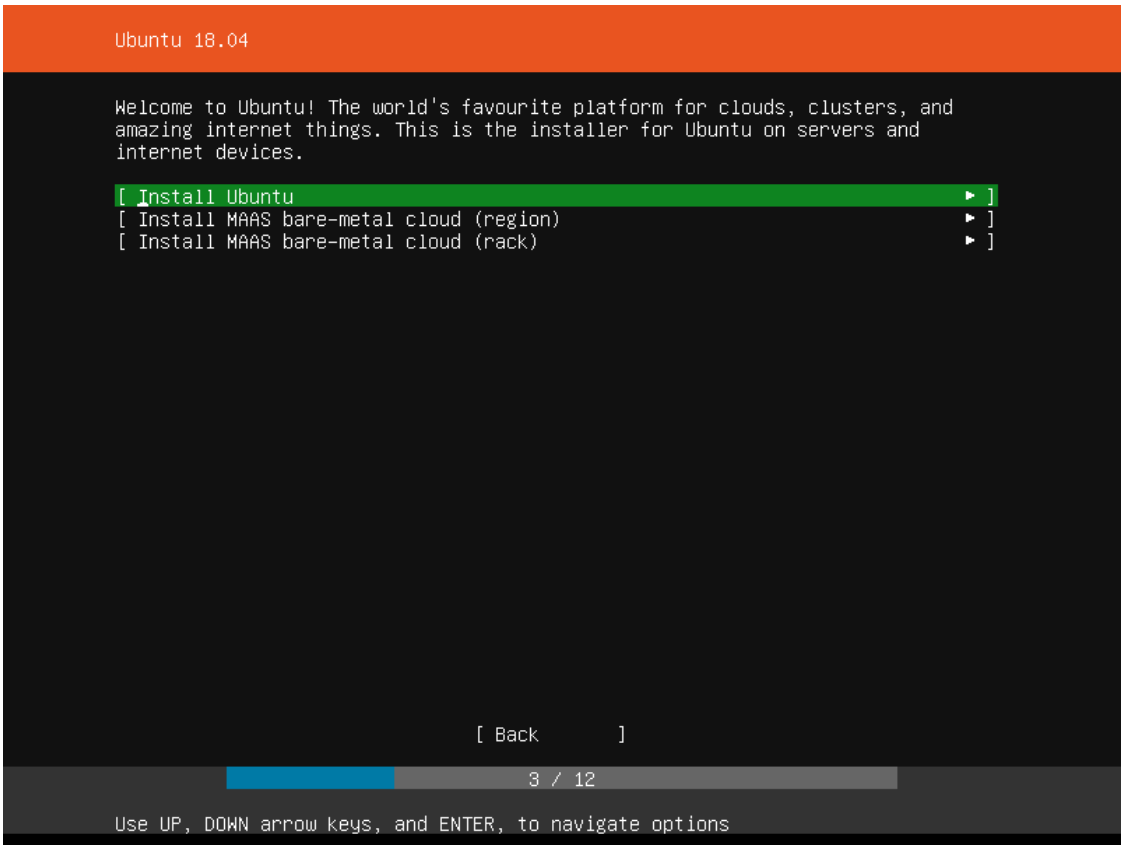


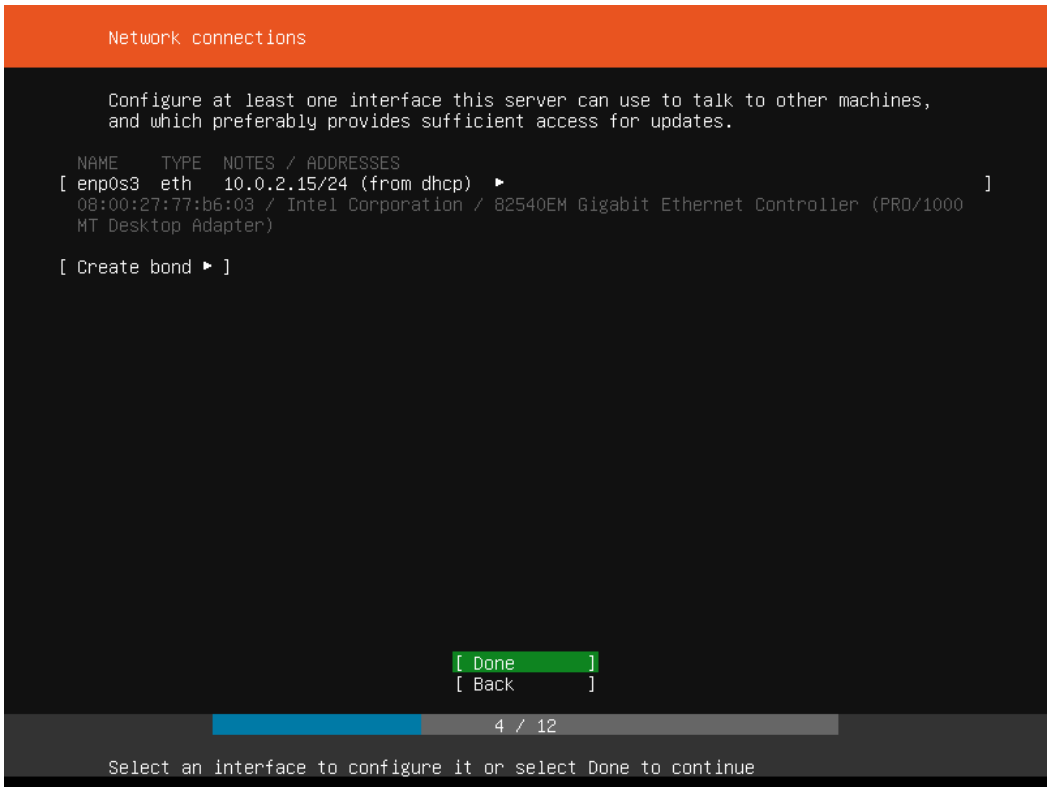
Now, start the machine and follow the wizard to install Ubuntu Server.

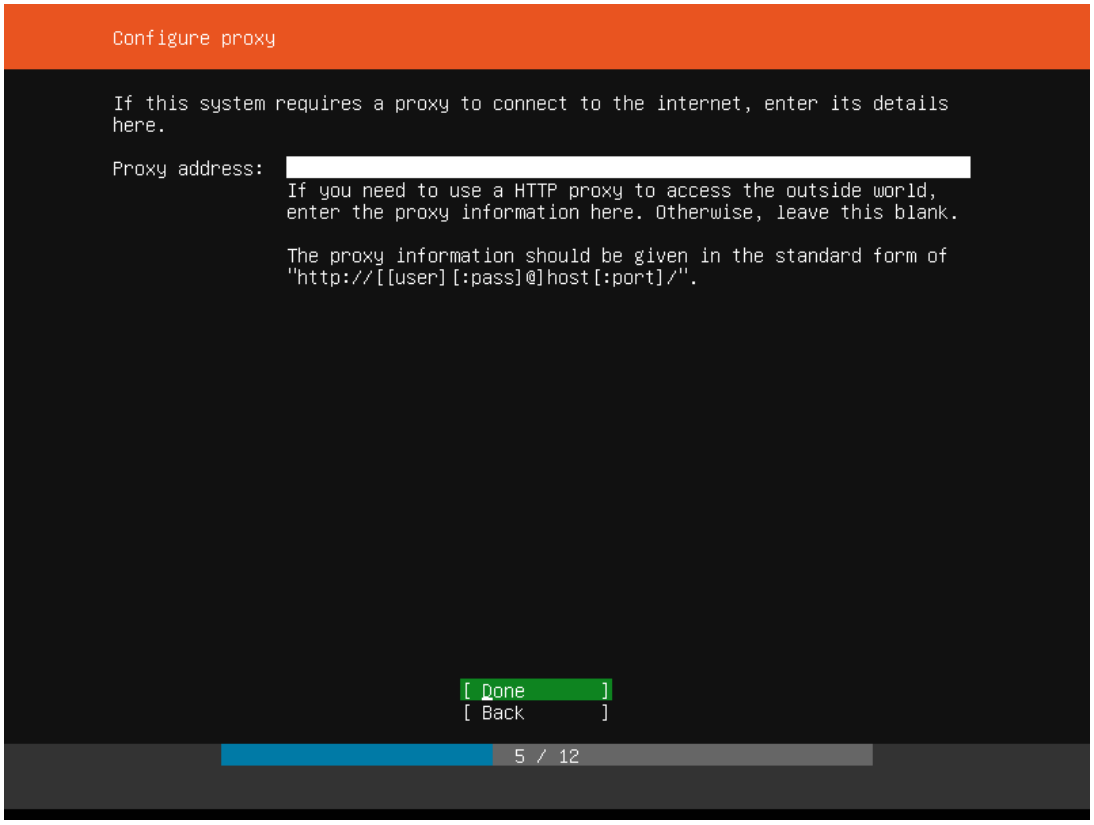
At first, choose the language and keyboard

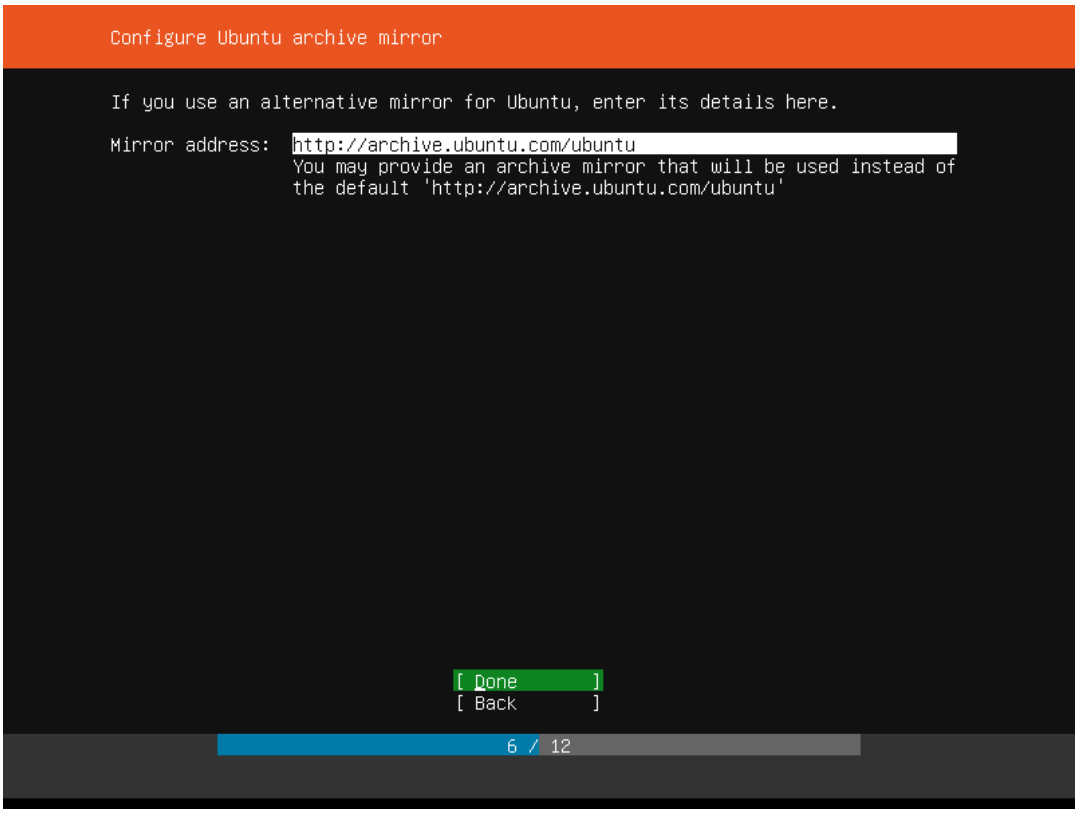



Keyboard configuration
Please select your keyboard layout below, or select "Identify keyboard" to detect your layout automatically.
Layout: [English (US) ▾]
Variant: [English (US) ▾]
[Identify keyboard]
[Done]
[Back]
2 / 12
Use UP, DOWN and ENTER keys to select your keyboard.


Ubuntu 18.04
Welcome to Ubuntu! The world's favourite platform for clouds, clusters, and amazing internet things. This is the installer for Ubuntu on servers and internet devices.
[Install Ubuntu ▸]
[Install MAAS bare-metal cloud (region) ▸]
[Install MAAS bare-metal cloud (rack) ▸]
[Back]
3 / 12
Use UP, DOWN arrow keys, and ENTER, to navigate options


Network connections
Configure at least one interface this server can use to talk to other machines,
and which preferably provides sufficient access for updates.
NAME TYPE NOTES / ADDRESSES
[enp0s3 eth 10.0.2.15/24 (from dhcp) ▸]
08:00:27:77:b6:03 / Intel Corporation / 82540EM Gigabit Ethernet Controller (PRO/1000
MT Desktop Adapter)
[Create bond ▸]
[Done]
[Back]
4 / 12
Select an interface to configure it or select Done to continue


Configure proxy
If this system requires a proxy to connect to the internet, enter its details
here.
Proxy address:
If you need to use a HTTP proxy to access the outside world,
enter the proxy information here. Otherwise, leave this blank.
The proxy information should be given in the standard form of
"http://[[user][:pass]@]host[:port]/".
[Done]
[Back]
5 / 12


Configure Ubuntu archive mirror
If you use an alternative mirror for Ubuntu, enter its details here.
Mirror address: http://archive.ubuntu.com/ubuntu
You may provide an archive mirror that will be used instead of the default 'http://archive.ubuntu.com/ubuntu'
[Done]
[Back]
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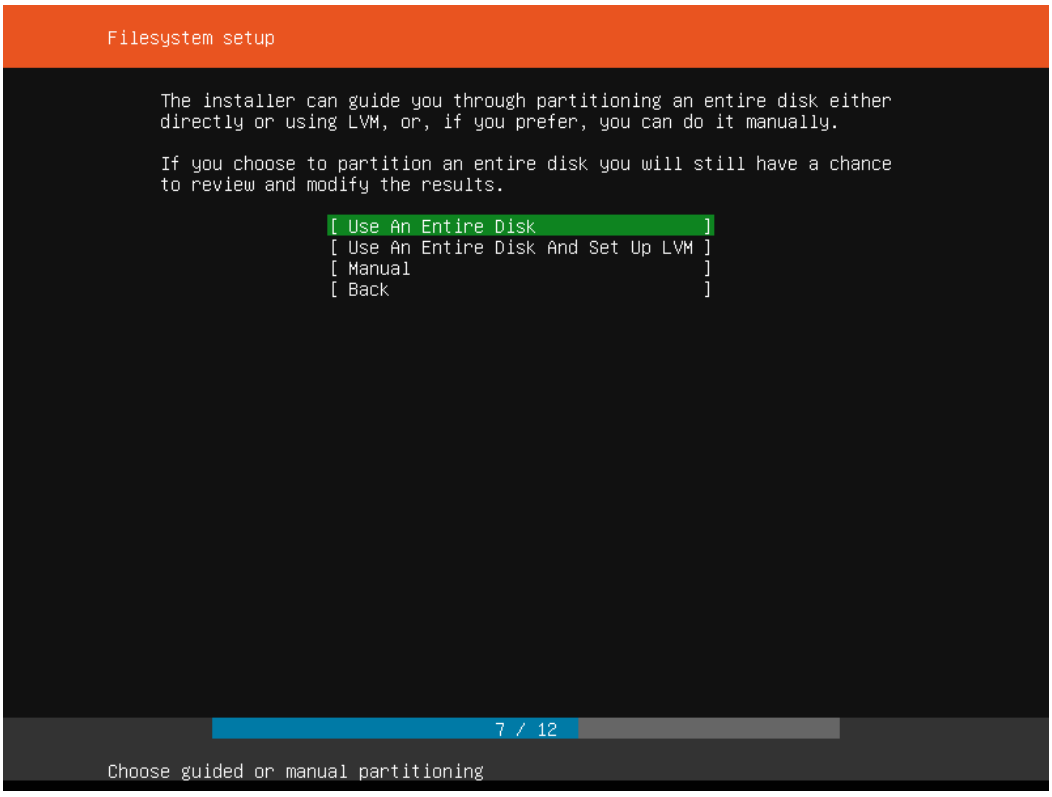
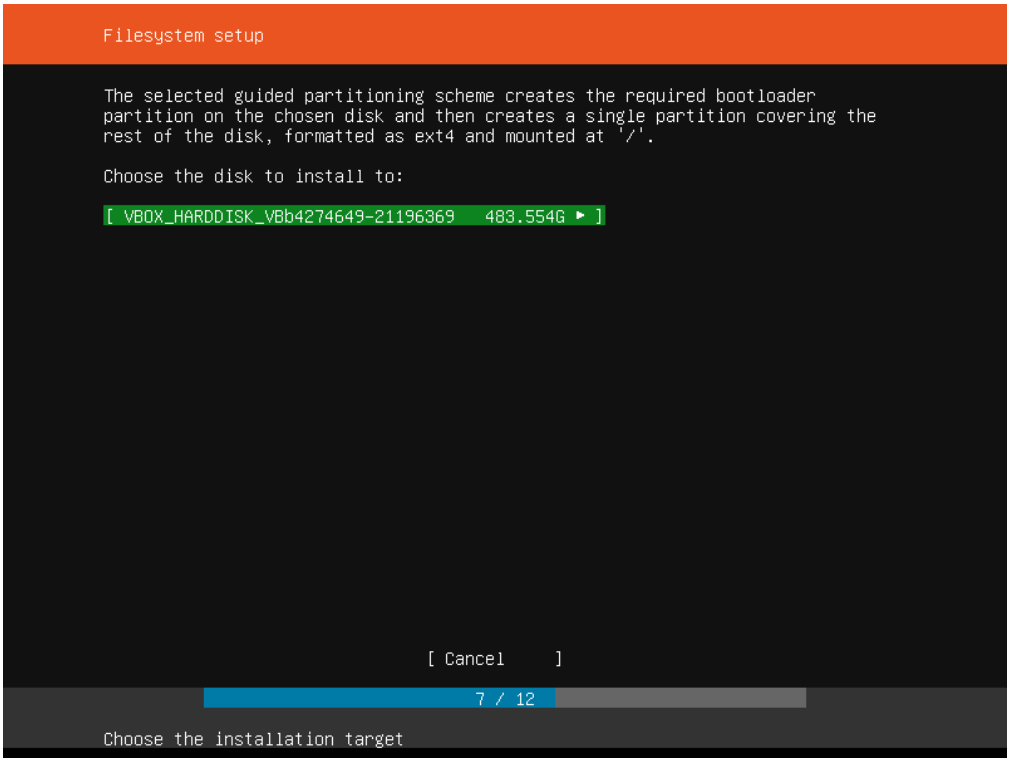
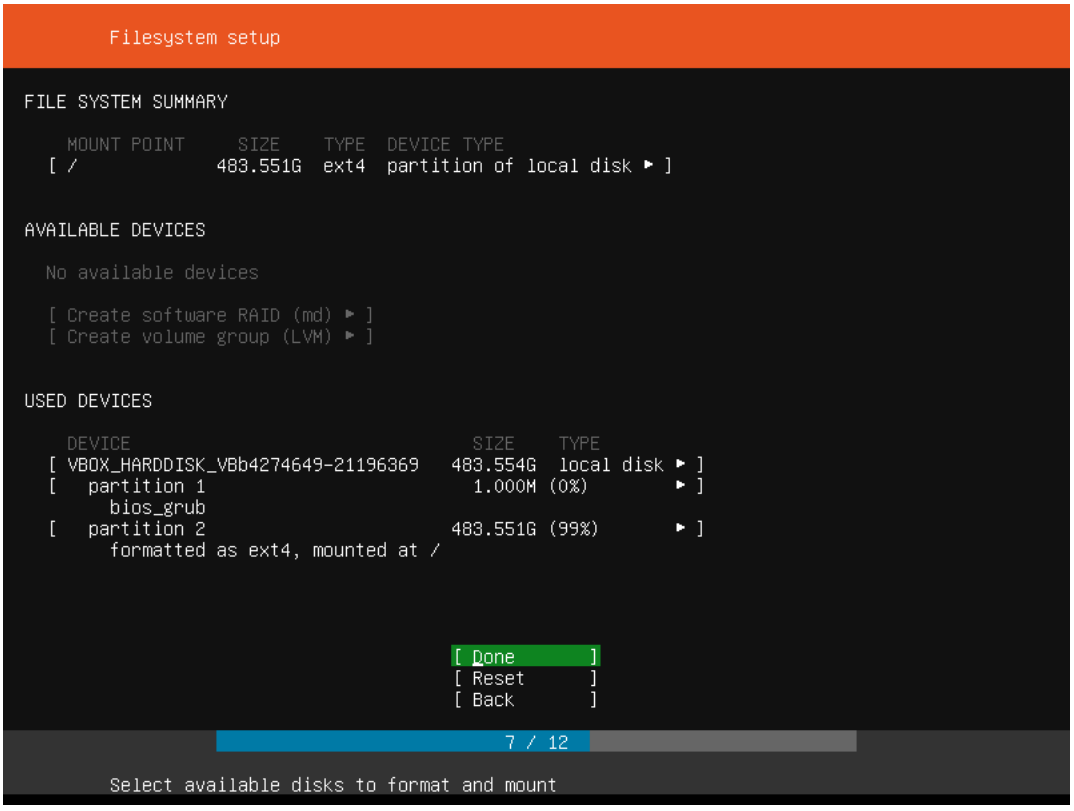
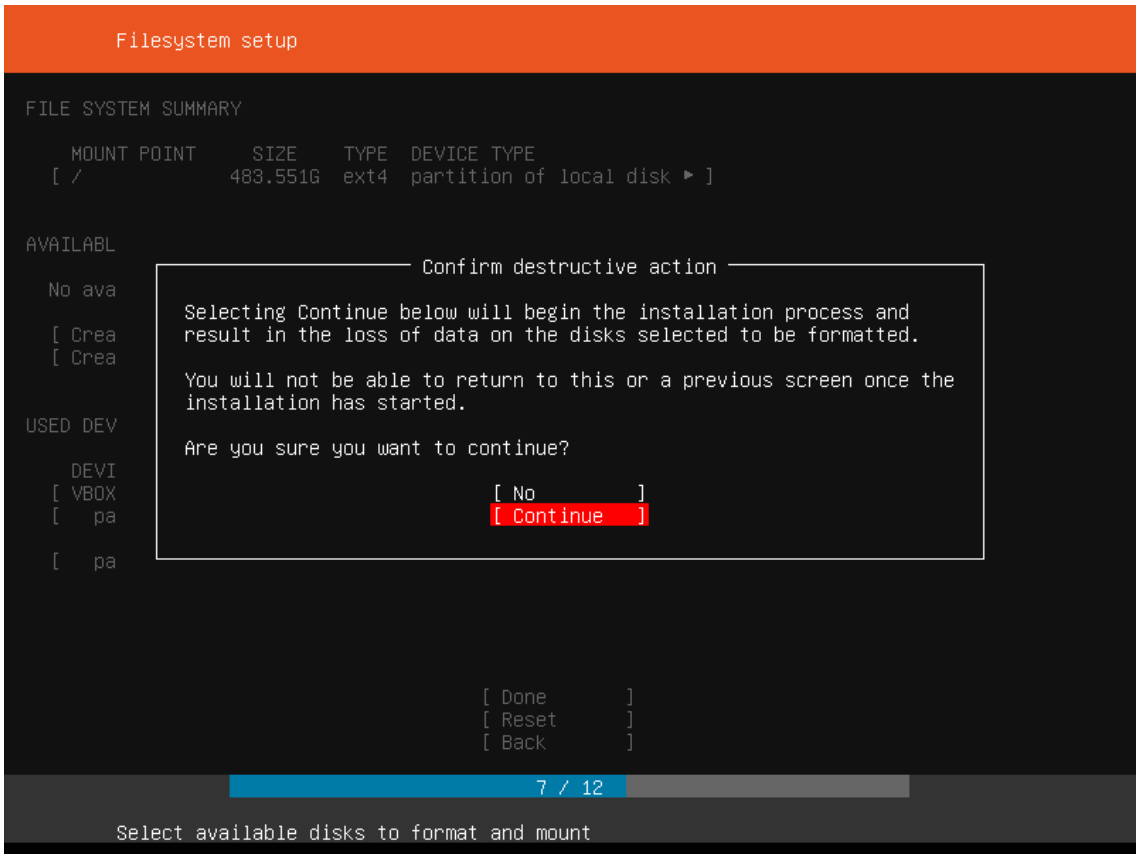
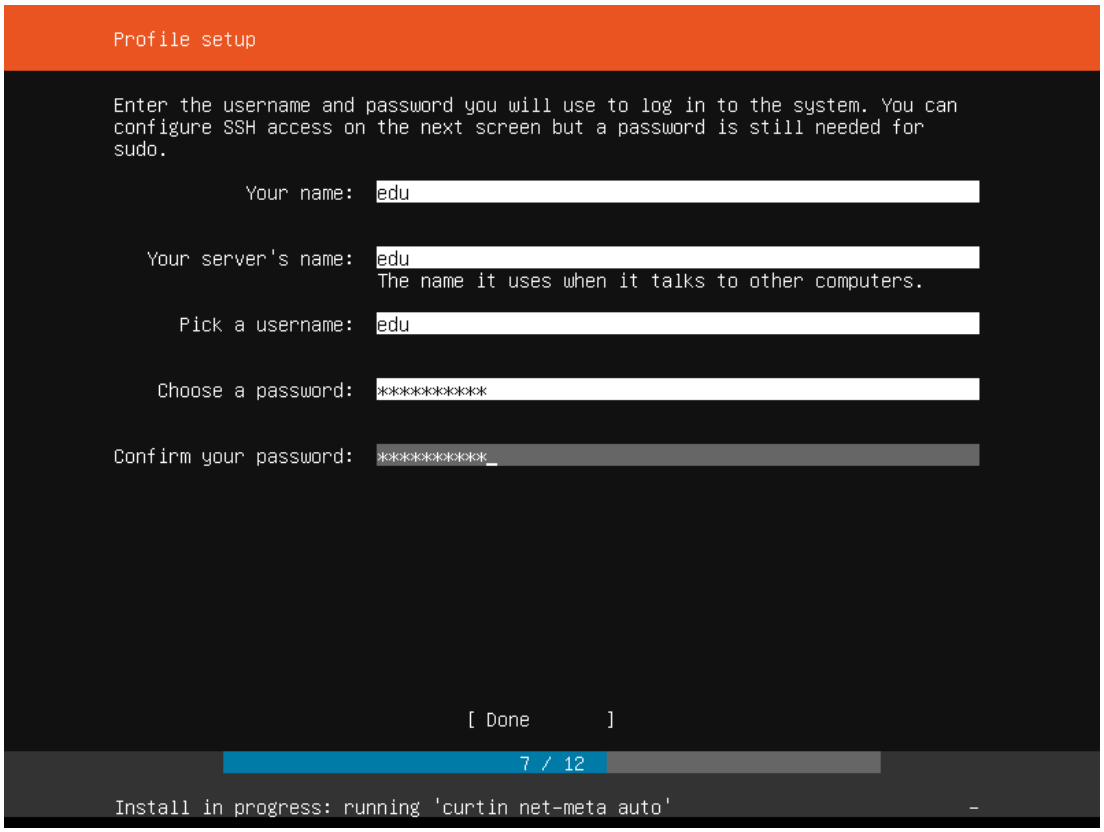
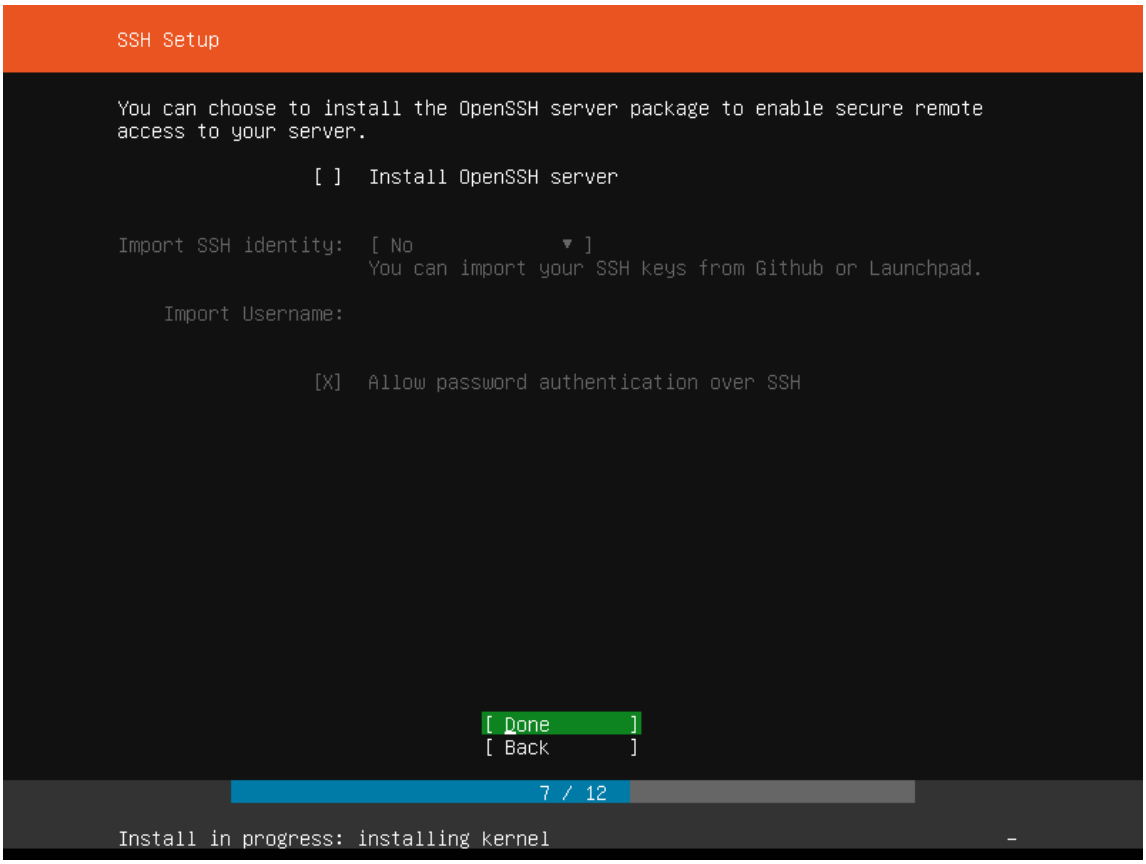

Filesystem setup
The installer can guide you through partitioning an entire disk either directly or using LVM, or, if you prefer, you can do it manually.
If you choose to partition an entire disk you will still have a chance to review and modify the results.
[Use An Entire Disk]
[Use An Entire Disk And Set Up LVM]
[Manual]
[Back]
7 / 12
Choose guided or manual partitioning

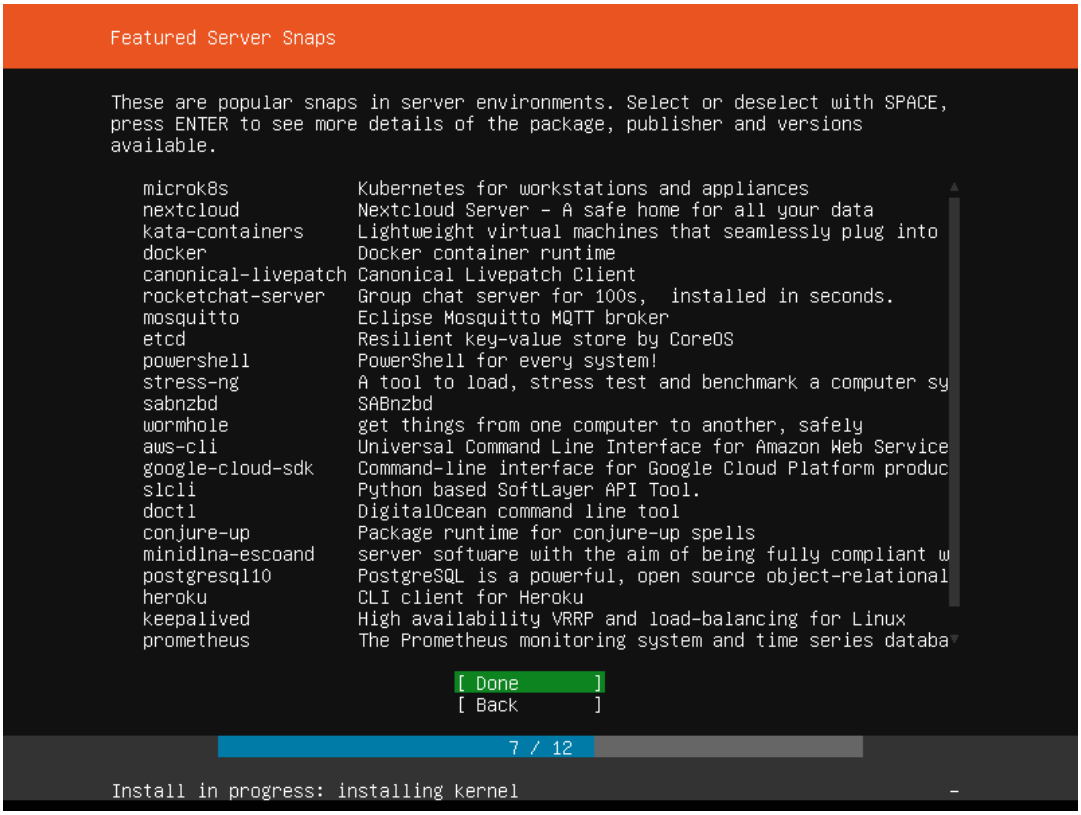

Filesystem setup
The selected guided partitioning scheme creates the required bootloader
partition on the chosen disk and then creates a single partition covering the
rest of the disk, formatted as ext4 and mounted at '/'.
Choose the disk to install to:
[VBOX_HARDDISK_VBb4274649-21196369 483.554G ▸]
[Cancel]
7 / 12
Choose the installation target

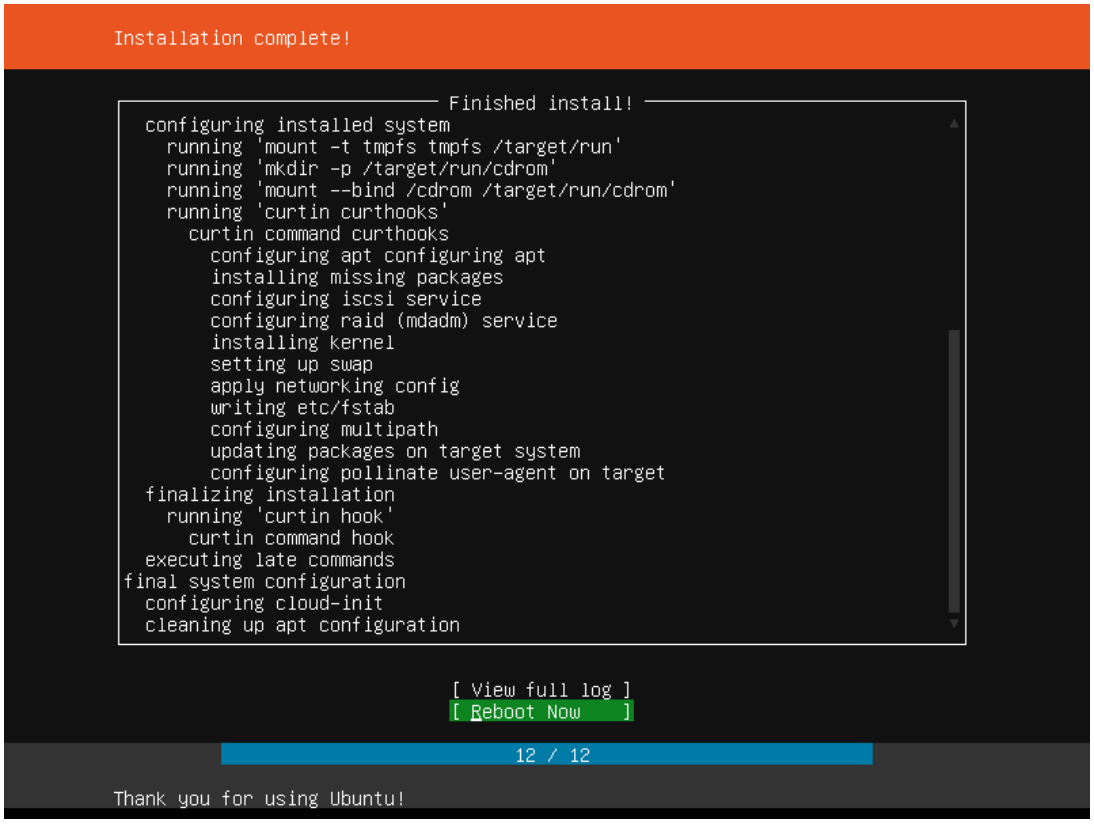

Filesystem setup
FILE SYSTEM SUMMARY
MOUNT POINT SIZE TYPE DEVICE TYPE
[/ 483.551G ext4 partition of local disk ▸]
AVAILABLE DEVICES
No available devices
[Create software RAID (md) ▸]
[Create volume group (LVM) ▸]
USED DEVICES
DEVICE SIZE TYPE
[VBOX_HARDDISK_VBb4274649-21196369 483.554G local disk ▸]
[partition 1 1.000M (0%) ▸]
bios_grub
[partition 2 483.551G (99%) ▸]
formatted as ext4, mounted at /
[Done]
[Reset]
[Back]
7 / 12
Select available disks to format and mount


Filesystem setup
FILE SYSTEM SUMMARY
MOUNT POINT SIZE TYPE DEVICE TYPE
[/ 483.551G ext4 partition of local disk ▸]
AVAILABL
No ava
[Crea
[Crea
USED DEV
DEVI
[VBOX
[pa
[pa
Confirm destructive action
Selecting Continue below will begin the installation process and result in the loss of data on the disks selected to be formatted.
You will not be able to return to this or a previous screen once the installation has started.
Are you sure you want to continue?
[No]
[Continue]
[Done]
[Reset]
[Back]
7 / 12
Select available disks to format and mount


Profile setup
Enter the username and password you will use to log in to the system. You can configure SSH access on the next screen but a password is still needed for sudo.
Your name: edu
Your server's name: edu
The name it uses when it talks to other computers.
Pick a username: edu
Choose a password: **********
Confirm your password: **********
[Done]
7 / 12
Install in progress: running 'curtin net-meta auto'


SSH Setup
You can choose to install the OpenSSH server package to enable secure remote access to your server.
[ ] Install OpenSSH server
Import SSH identity: [No ▾]
You can import your SSH keys from Github or Launchpad.
Import Username:
[X] Allow password authentication over SSH
[Done]
[Back]
7 / 12
Install in progress: installing kernel


Featured Server Snaps
These are popular snaps in server environments. Select or deselect with SPACE, press ENTER to see more details of the package, publisher and versions available.
microk8s Kubernetes for workstations and appliances
nextcloud Nextcloud Server - A safe home for all your data
kata-containers Lightweight virtual machines that seamlessly plug into
docker Docker container runtime
canonical-livepatch Canonical Livepatch Client
rocketchat-server Group chat server for 100s, installed in seconds.
mosquitto Eclipse Mosquitto MQTT broker
etcd Resilient key-value store by CoreOS
powershell PowerShell for every system!
stress-ng A tool to load, stress test and benchmark a computer sy
sabnzbd SABnzbd
wormhole get things from one computer to another, safely
aws-cli Universal Command Line Interface for Amazon Web Service
google-cloud-sdk Command-line interface for Google Cloud Platform produc
slcli Python based SoftLayer API Tool.
doctl DigitalOcean command line tool
conjure-up Package runtime for conjure-up spells
minidlna-escoand server software with the aim of being fully compliant w
postgresql10 PostgreSQL is a powerful, open source object-relational
heroku CLI client for Heroku
keepalived High availability VRRP and load-balancing for Linux
prometheus The Prometheus monitoring system and time series databa
[Done]
[Back]
7 / 12
Install in progress: installing kernel



Now you can login with your credentials and see the prompt.

Using SSH to access the Server

In order to access the Linux server resource via SSH, you can use open SSH application server.

sudo apt install openssh-server

You can use any SSH client to access the server.

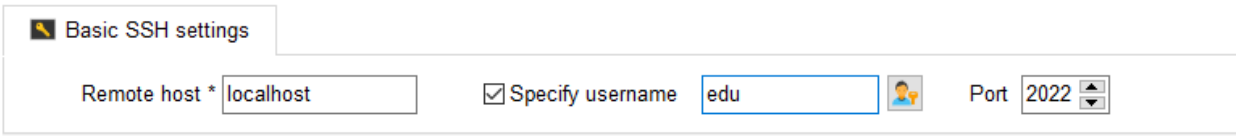
MobaXterm client is highly recommended.

To download and install MobaXterm, go to

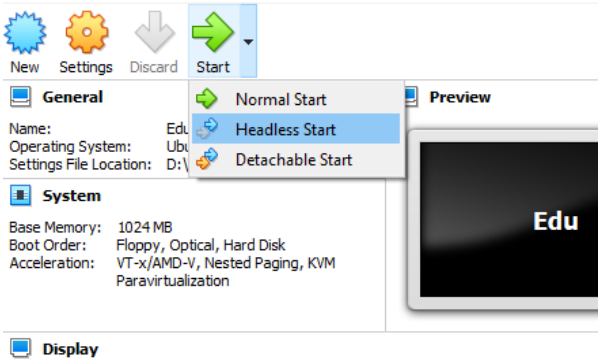
https://mobaxterm.mobatek.net/download-home-edition.html

Connect to your virtual machine using SSH.

NOTE: Use the forwarded host port.



After having access via SSH, you can use the machine in Headless mode. It's very useful when you run several virtual machines, because there is no open windows for them.



Network Settings

sudo nano /etc/netplan/50-cloud-init.yaml

Useful Resources

Ubuntu Network settings

https://www.ostechnix.com/how-to-configure-ip-address-in-ubuntu-18-04-lts/

https://www.tecmint.com/configure-network-static-ip-address-in-ubuntu/

https://linuxconfig.org/how-to-configure-static-ip-address-on-ubuntu-18-04-bionic-beaver-linux

Install Build

In order to use fully featured compiler tools you need to install build-essential

sudo apt update

sudo apt install build-essential

To compile hello.c to executable hello

gcc hello.c -o hello

To run the executable hello

./hello

Firewall

Ping

Search for Windows Firewall, and click to open it.

Click Advanced Settings on the left.

From the left pane of the resulting window, click Inbound Rules.

In the right pane, find the rules titled File and Printer Sharing (Echo Request - ICMPv4-In).

Right-click each rule and choose Enable Rule.

Windows Firewall setting to allow ICMP (Ping)

https://kb.iu.edu/d/aopy

https://tsvetanov.bg/basic-firewall-configuration-for-ubuntu/

OS Basics

https://en.wikipedia.org/wiki/Unix-like

ufw is the default firewall configuration tool for Ubuntu.

To check the ufw status

sudo ufw status verbose

To open a port (ssh in this example):

sudo ufw allow 22

To close a port

sudo ufw deny 53

To add add service by name

sudo ufw allow ssh

to disable/enable ufw

sudo ufw disable

sudo ufw enable

Log files are also interesting

less /var/log/auth.log

Note: If you are connected to remote machine (through ssh for example) and enable the firewall, before allowing port 22, probably the connection will be closed and you won't be able to connect again

Useful resources

https://tsvetanov.bg/basic-firewall-configuration-for-ubuntu/

Nginx

To install Nginx run the command

sudo apt install nginx

Useful resources

https://mediatemple.net/community/products/developer/204405534/install-nginx-on-ubuntu

sudo service nginx stop

Install LAMP Server

To install LAMP server use the following command

sudo apt install lamp-server^

Create new folder in **document root**.

cd /var/www/html

ls -alt

mkdir dir-name

mkdir: cannot create directory ‘share’: Permission denied

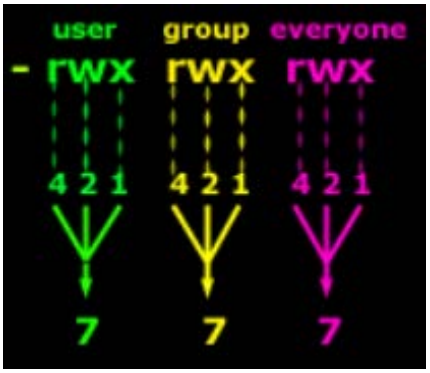
sudo mkdir dir-name

sudo chmod 777 html

mkdir

Useful resources

Linux Permissions



http://www.firewall.cx/linux-knowledgebase-tutorials/introduction-to-linux.html/299-linux-file-folder-permissions.html

LAMP Server

https://www.linode.com/docs/web-servers/lamp/install-lamp-stack-on-ubuntu-18-04/

https://linuxconfig.org/how-to-install-lamp-ubuntu-18-04-bionic-beaver-linux-apache-mysql-php

https://www.linode.com/docs/web-servers/lamp/install-lamp-stack-on-ubuntu-18-04/

https://www.wikihow.com/Set-up-an-FTP-Server-in-Ubuntu-Linux

Basic Linux Commands

https://docs.google.com/document/d/1xs-ZtRCoybv4xVjF8QsSEKLooOlZVTqj_Rog0dFFmy8/edit

Linux permissions

http://www.linuxandubuntu.com/home/the-linux-permissions-an-introduction

FTP Server

sudo apt install vsftpd

sudo nano /etc/vsftpd.conf

Uncomment write_enable=YES

sudo service vsftpd restart

sudo tail -f /var/log/vsftpd.log

FTP Client

ftp user@ftpdomain.com

https://www.howtoforge.com/tutorial/how-to-use-ftp-on-the-linux-shell/

Some issues with NAT connection. Passive mode is recommended

https://enterprisedt.com/products/edtftpjssl/doc/manual/html/howtoftpthroughafilewall.html

https://superuser.com/questions/1091593/port-forwarding-for-ftp-server

FTP GUI Client

sudo apt install filezilla

Useful resources

https://linuxconfig.org/how-to-setup-ftp-server-on-ubuntu-18-04-bionic-beaver-with-vsftpd

FTP over TLS

https://websiteforstudents.com/install-vsftpd-on-ubuntu-18-04-lts-beta-server-with-ssl-tls-certificates/

https://linuxize.com/post/how-to-setup-ftp-server-with-vsftpd-on-ubuntu-18-04/

Install and configure Samba

To install Samba use the following command

sudo apt install samba

To check if the installation was successful

whereis samba

Create a directory for to be shared

mkdir ~/sambashare

Samba client

sudo apt install smbclient

smbclient -L host -U host

https://help.ubuntu.com/community/Samba/SambaClientGuide

https://www.tldp.org/HOWTO/SMB-HOWTO-8.html

Web programming

HTML

Introduction

https://www.w3schools.com/html/default.asp

https://www.w3schools.com/html/html_basic.asp

Elements

https://www.w3schools.com/html/html_elements.asp

Attributes

https://www.w3schools.com/html/html_attributes.asp

Links

https://www.w3schools.com/html/html_links.asp

CSS

https://www.w3schools.com/html/html_css.asp

Create new stylesheet in styles.css file.

Create two web pages (copy the one created in previous exercise) and add reference to the slyles.css

CSS

https://www.w3schools.com/css/default.asp

Java Script

https://www.w3schools.com/js/default.asp

Application Form example

https://www.w3schools.com/php/default.asp

cd /var/www/

sudo chmod 777 html

mkdir php-forms

Databases

SQL

https://www.w3schools.com/sql/default.asp

MySQL

Phpmyadmin

https://www.hostingadvice.com/how-to/install-phpmyadmin-on-ubuntu/

sudo apt install phpmyadmin

Content Management Systems

Wordpress

Useful resources

Install and configure

https://tutorials.ubuntu.com/tutorial/install-and-configure-samba#0

https://websiteforstudents.com/samba-setup-on-ubuntu-16-04-17-10-18-04-with-windows-systems/

https://www.computerbeginnersguides.com/blog/2018/04/27/install-and-configure-samba-in-ubuntu-18-04-bionic-beaver/

https://linuxize.com/post/how-to-install-and-configure-samba-on-ubuntu-18-04/

https://linuxconfig.org/how-to-configure-samba-server-share-on-ubuntu-18-04-bionic-beaver-linux

Theory

https://unix.stackexchange.com/questions/34742/cifs-vs-samba-what-are-the-differences

https://en.wikipedia.org/wiki/Server_Message_Block