



**School of Computer Science and  
Engineering**

**CSE-2005-Operating System**

**Winter Semester 2020-21**

**Slot – C1**

**REPORT**

**Under the guidance of**  
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SCOPE

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Sam Methuselah (19BCE1698)

Arjun Arora (19BCE1808)

# **Virtualization using VMware Hypervisor-ESXi**

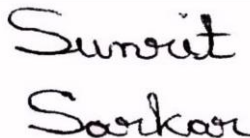
## **DECLARATION**

We hereby declare that the project entitled “Virtualization using VMware Hypervisor-ESXi” submitted by 19BCE1679-Sunrit Sarkar, 19BCE1698-Sam Methuselah and 19BCE1808-Arjun Arora, for the project component of the Operating System to VIT is a record of bonafide carried out by us under the supervision of Prof. J V Thomas Abraham, Assistant Professor (SG), SCOPE, Vellore Institute of Technology, Chennai.

We further declare that the project report submitted has not been submitted and will not be submitted, either in a part or full for the award of any other degree or diploma in this institute or any other Institute or University.

**PLACE: CHENNAI**

**SIGNATURE:**



**DATE: 05 June, 2021**

## **CERTIFICATE**

This is to certify that the project entitled “**Virtualization using VMware Hypervisor-ESXi**”, submitted by Student Name and Register Number for the project component of the Operating System to VIT is a record of bona-fide work carried out by them under my supervision during the period, 01.02.2021 to 08.06.2020 as per the VIT code of academic and research ethics.

The contents of this report have not been submitted and will not be submitted either in part or in full, for the award of any other degree or diploma in this institute or any other institute or university. The project fulfils the requirements and regulations of the university and in my opinion meets the necessary standards for submission.

PLACE: CHENNAI

Signature of the guide

DATE: 05 June, 2021

## **ABSTRACT**

Virtualization is the process of creating a software-based (virtual) representation of virtual applications, servers, storage and networks. It is the single most effective way to reduce IT expenses while boosting efficiency and agility for all size businesses due to benefits like availability of resources, increased performance, reduced capital and operating costs.

The aim of this project is to understand the concept of Virtualization by implementing the VMware ESXi in a hardware and create multiple virtual machines on the hardware. Virtualize the hardware resource like CPU, Memory, Storage and Network and allocate them to the multiple virtual machines that is created. These multiple virtual machines will be allocated resources as per the requirement for running the applications hosted on these virtual machines.

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## **INTRODUCTION**

The virtualization technology simply means moving a physical system in a virtual environment. It has become the most important factor, today in the IT sector. The number of organizations and institutions adopting virtual technology are increasing rapidly. Today, virtualization is being used by numerous growing organizations to scientific organization. The idea of virtualization technology was brought to the field due to the limited resources and growing industry in the IT sector. The use of virtualization technology benefits an organization by reducing use of network resources, increasing security measures, manpower and hence providing economic benefits to organizations.

Virtualization technology allows running multiple operating systems at an instance within a single computer. Virtualization separates a layer between hardware and software. The operating system uses the resources from the hypervisor not from the host hardware. Basically virtualization technology provides an ability to stimulate a hardware platform in the software which is installed in the hypervisor. Virtualization technology separates the connection of the software application from the host hardware component. Of course, there is a host hardware resource supporting the virtual instance (hypervisor). With virtualization technology, multiple servers can be consolidated into more powerful servers. Also, the virtual machines can be grouped together to form a network within a single physical machine.

Virtualization has mainly three areas in the field of IT which is growing rapidly-network virtualization, storage virtualization and server virtualization. In this project, server virtualization is the main focus. The virtualization technology that was used in this project is VMware. VMware ESXi (6.5) server is used to virtualize the server.



# **THEORETICAL BACKGROUND**

## **What is Virtualization?**

Virtualization is the process of creating a software-based, or virtual, representation of something, such as virtual applications, servers, storage and networks. It is the single most effective way to reduce IT expenses while boosting efficiency and agility for all size businesses. Additionally, Virtualization can increase IT agility, flexibility and scalability while creating significant cost savings.

Some benefits of Virtualization are:

- Greater workload mobility.
- Increased performance and availability of resources.
- Reduced capital and operating costs.
- Minimized or eliminated downtime.
- Increased IT productivity, efficiency, agility and responsiveness.
- Greater business continuity and disaster recovery.
- Simplified data center management.

These are some benefits of Virtualization which makes Information Technology (IT) simpler to manage and less costly to own and operate.

## **What are Virtual Machines (VMs)?**

A virtual computer system is known as a “virtual machine” (VM): a tightly isolated software container with an operating system and application inside.

Each self-contained VM is completely independent. Putting multiple VMs on a single computer enables several operating systems and applications to run on just one physical server, or “host.”

A thin layer of software called a “hypervisor” decouples the virtual machines from the host and dynamically allocates computing resources to each virtual machine as needed.

## **Key Properties of Virtual Machines**

VMs have the following characteristics, which offer several benefits-

### Partitioning

- Run multiple operating systems on one physical machine.
- Divide system resources between virtual machines.

### Isolation

- Provide fault and security isolation at the hardware level.
- Preserve performance with advanced resource controls.

### Encapsulation

- Save the entire state of a virtual machine to files.
- Move and copy virtual machines as easily as moving and copying files.

### Hardware Independence

- Provision or migrate any virtual machine to any physical server.

## **Different types of Virtualization**

### **1. Server Virtualization-**

Server virtualization enables multiple operating systems to run on a single physical server as highly efficient virtual machines. Key benefits include:

- Greater IT efficiencies
- Reduced operating costs
- Faster workload deployment
- Increased application performance
- Higher server availability
- Eliminated server sprawl and complexity

### **2. Network Virtualization-**

By completely reproducing a physical network, network virtualization allows applications to run on a virtual network as if they were running on a physical network — but with greater operational benefits and all the hardware

independencies of virtualization. (Network virtualization presents logical networking devices and services — logical ports, switches, routers, firewall, load balancers, VPNs and more — to connected workloads.)

### **3. Desktop Virtualization-**

Deploying desktops as a managed service enables IT organizations to respond faster to changing workplace needs and emerging opportunities. Virtualized desktops and applications can also be quickly and easily delivered to branch offices, outsourced and offshore employees, and mobile workers using iPad and Android tablets.

## **Hypervisor**

Hypervisor, also called a virtual machine monitor (vmm) is a computer application software, firmware or hardware that offers a platform to create and run virtual machines. The physical machine (computer) on which a hypervisor runs one or more virtual machines is called a host machine. Each virtual machine is called a guest machine.

There are two types of hypervisors (Type-1, Type-2) as described below.

**Type-1 hypervisor** runs directly on the computer's hardware. For this reason they are called metal hypervisors. A guest operating system runs as a process on the host. VMware ESX/ESXi, Citrix XenServer are the examples of type-1 hypervisor.

**Type-2 hypervisor** runs on the top of computers operating system. It abstract guest operating system from the host operating system. VMware workstation and VirtualBox are examples of type-2 hypervisors.

## **VMware ESXi Server**

VMware ESXi is a type-1 hypervisor which runs directly on the top of physical server. VMware developed ESX and ESXi server as a bare metal which means it does not require operating system for installation. It runs only on the server with 64 bit with x86 CPU and at least 2 cores with minimum of 2GB of internal memory. It is an advanced smaller-footprint version of VMware ESX server. This virtualization software creates and runs its own Kernel, which runs after the Linux kernel bootstraps the hardware. It is the most important part of vSphere. ESXi is the component used for the virtualization server. It is used to deploy the multiple virtual machines on it. Each VM shares the same physical resources and can run instantly at the same time. This management functionality of the virtual machines can be done remotely.

VMware ESXi server has many features. Because of its features and high performance in the field of server virtualization, it has become the most used software for the server virtualization.

The key features of ESXi server are:

1. The ESXi architecture uses service console for the management tasks including the script execution and third-party agent installation.
2. When compared to the ESX server, it has simple security profile configuration.
3. It uses a small direct console user interface rather than a full server console.
4. VMware Virtual Symmetric Multiprocessing (SMP) enhances virtual machine performance by allowing the single virtual machine to use up to eight physical processors, simultaneously.

# **PROJECT**

## **Aim**

In this project we will demonstrate accessing a Server where one Windows Virtual Machine and one Ubuntu (Linux) Virtual Machine is created, from a Client. Two laptops are used for this project, one acting as the Client and the other laptop as the Server / Host to connect the Hypervisor for creating the Virtual Machine.

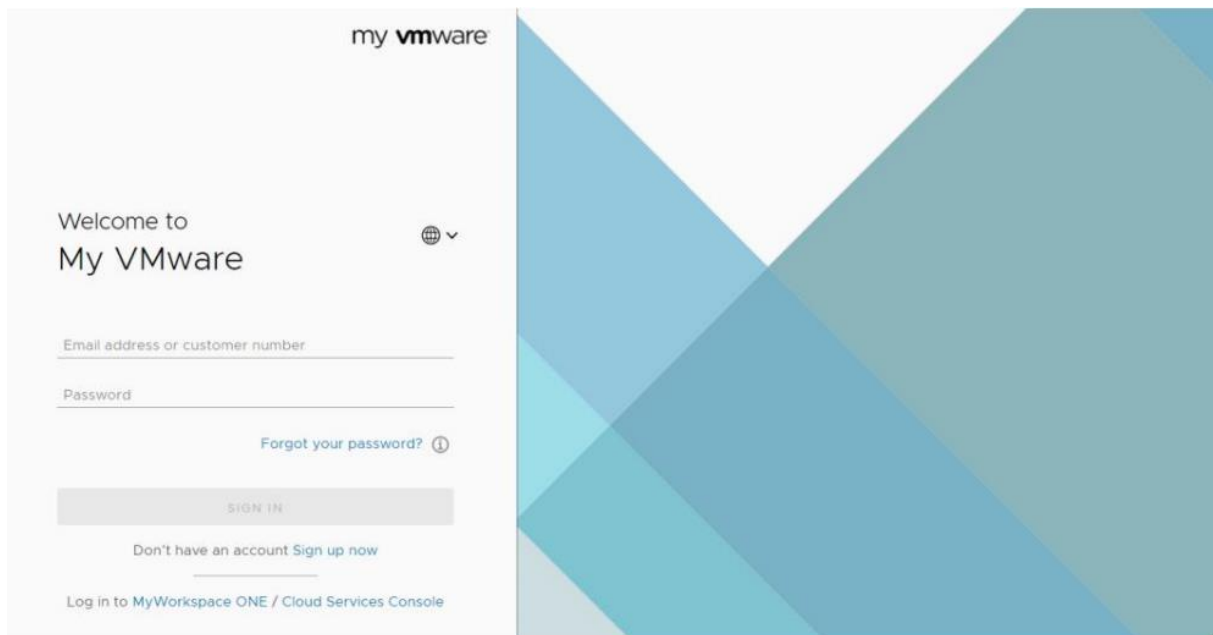
## **Project Requirements -**

- 2 hardwares – Server/Host(1) and Client(1)
- Hardware - 500 HDD and 8 GB RAM (Server) and 500 HDD and 8 GB RAM (Client)
- OS platform – VMware Hypervisor (ESXi)
- ISO image for the VMware Hypervisor-ESXi (6.5)
- ISO image for Windows 10 for the Windows desktop
- ISO image for Ubuntu 16.04 for the Ubuntu (Linux) desktop
- Ethernet Hub and Ethernet LAN cable(2 nos.)

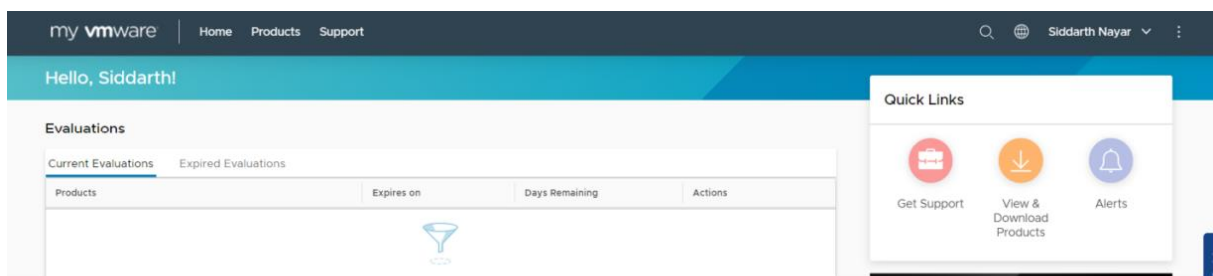
# IMPLEMENTATION

**1. Download the VMware EXSi 6.5 from the VMware site onto a pen drive.**

- Create an account in VMware and login-

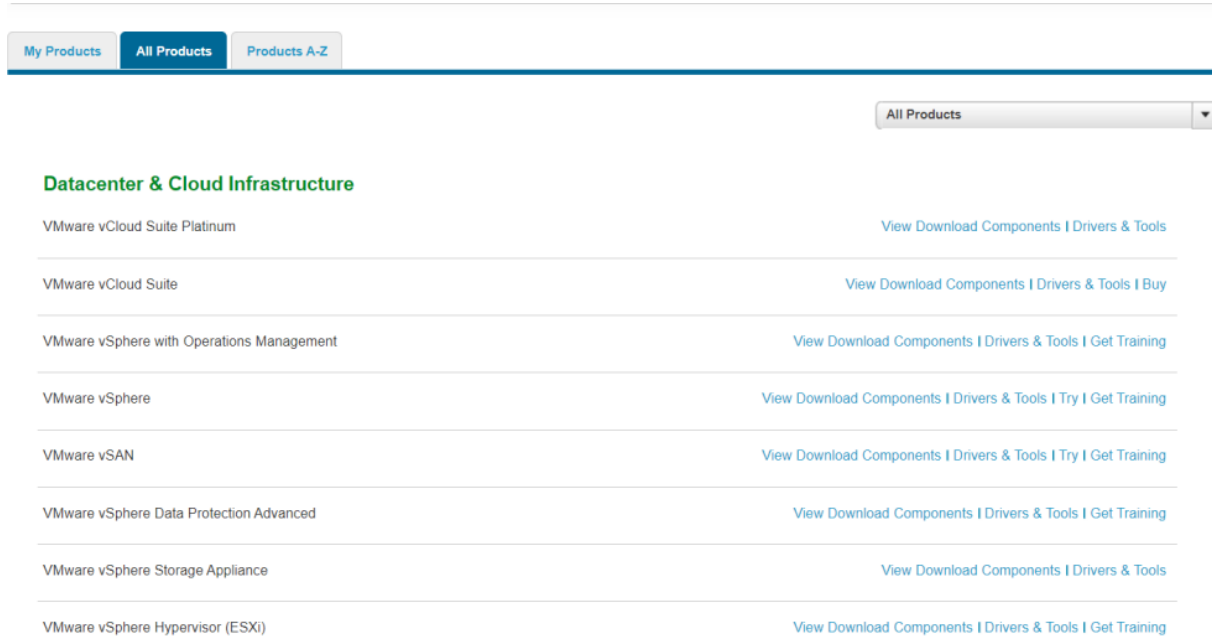


- Click ‘view and download products.’

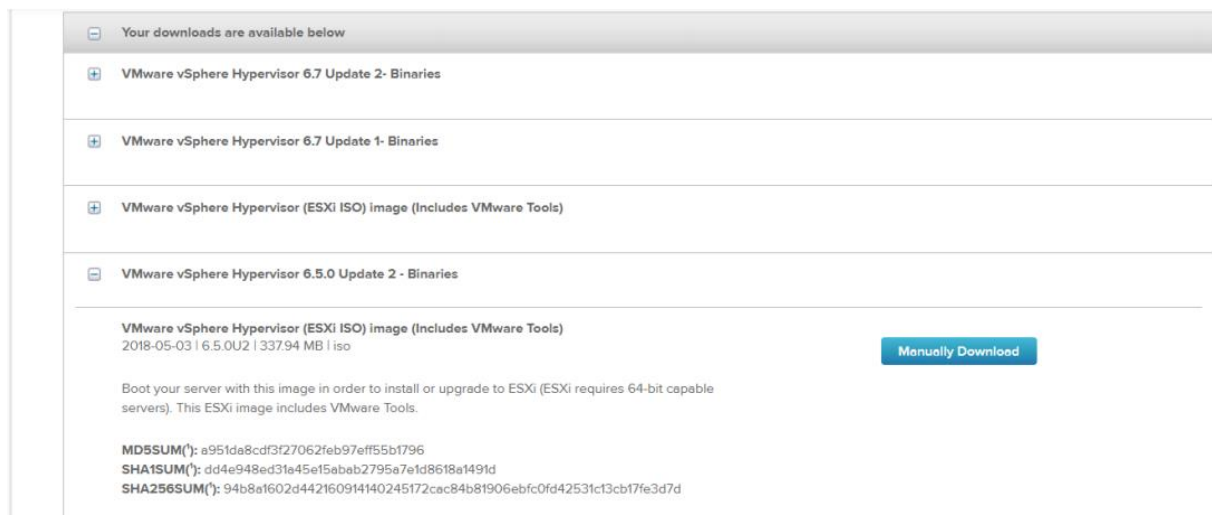




- Choose ‘VMware vSphere Hypervisor (ESXi)’, Click ‘Download components’, Click ‘download.’



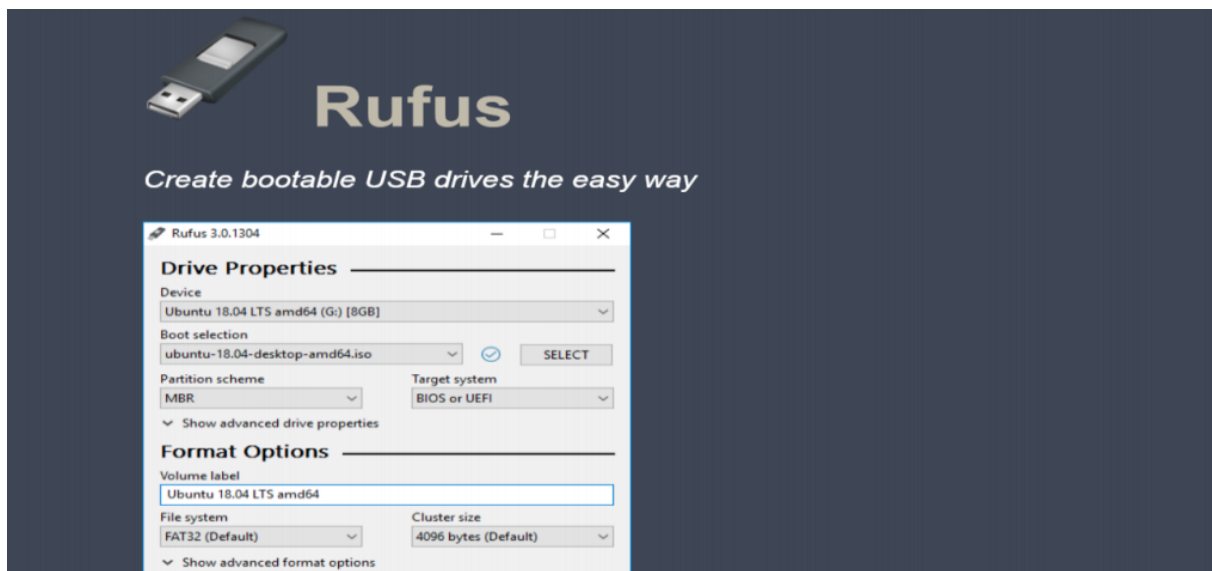
- Click ‘Manually download’



- Save the ISO image in a pen drive.

## 2. Download the VMware EXSi 6.5 from the VMware site onto a pen drive.

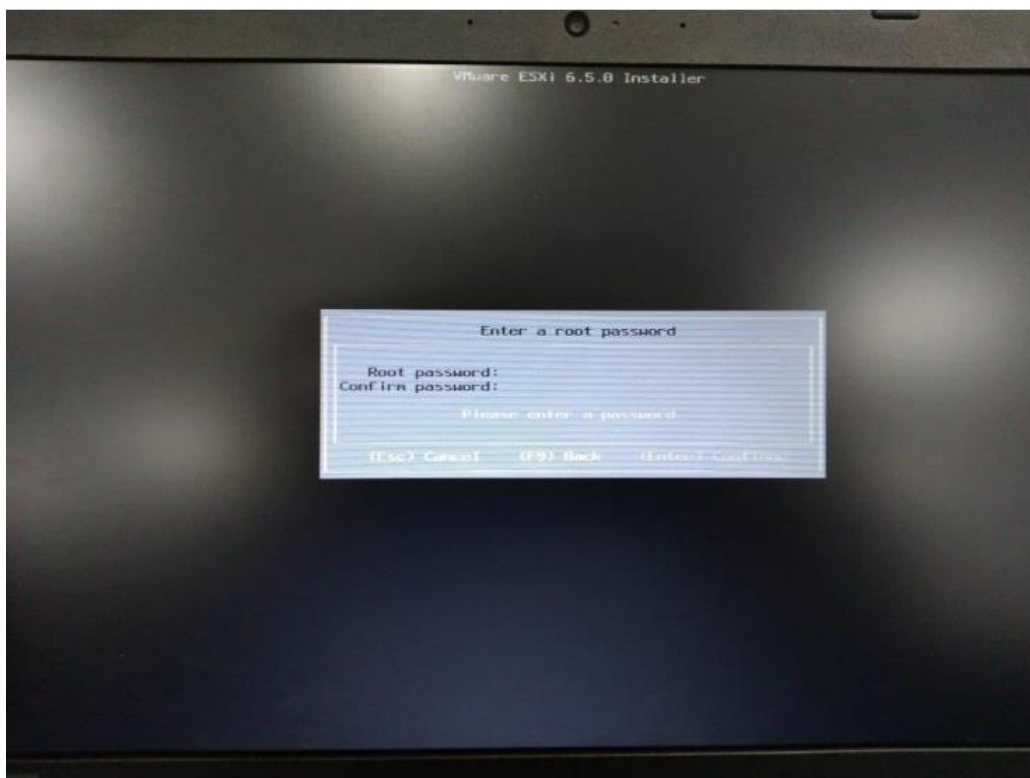
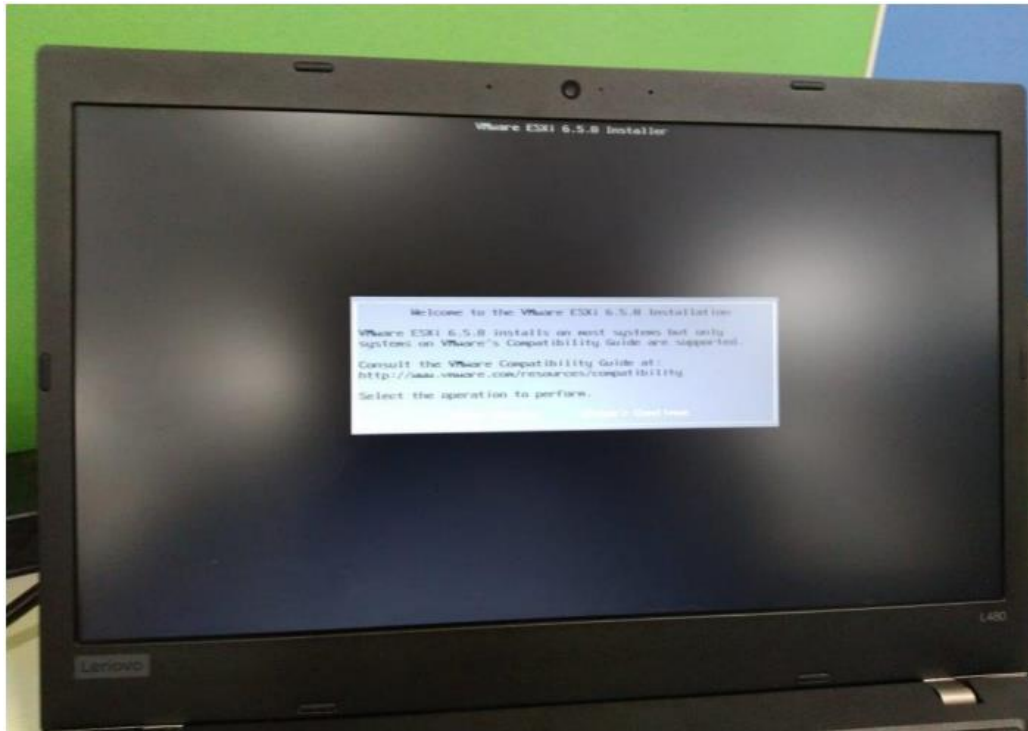
- Using open source software Rufus software, download Rufus. Connect the pen drive to the hardware that is used as the Server. Open Rufus. Select the pen drive, select the ISO image, select MBR partition scheme for BIOS or UEFI computers and press Start.

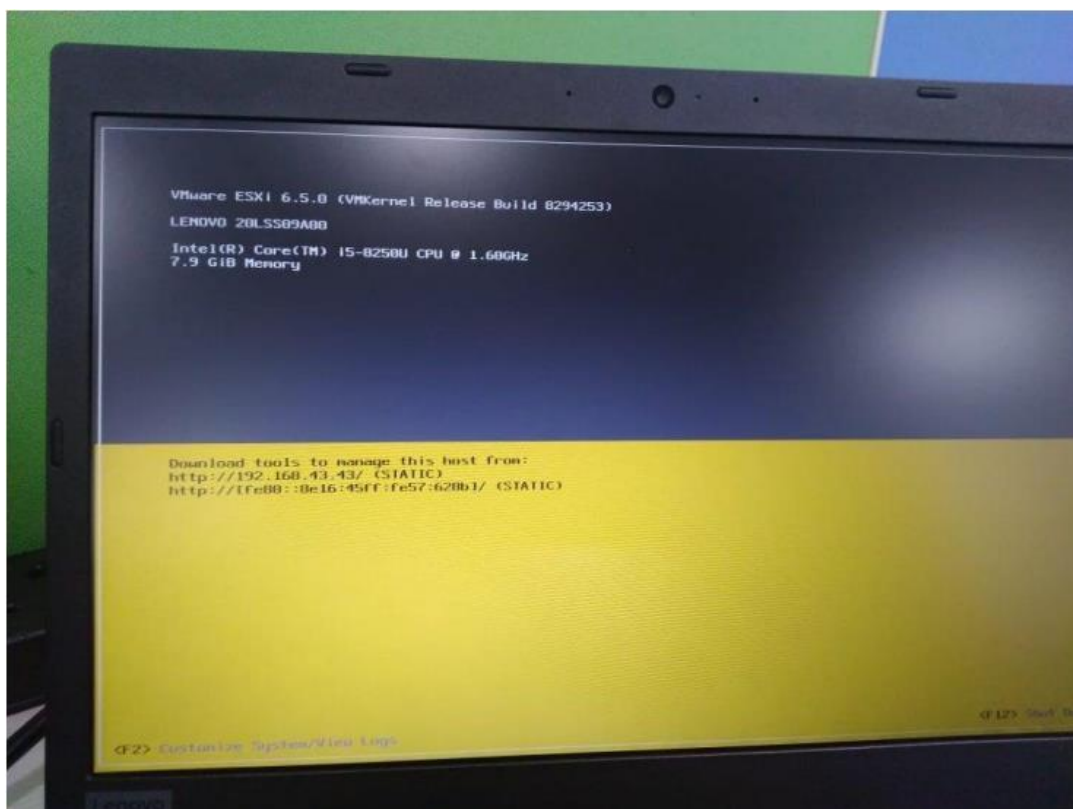
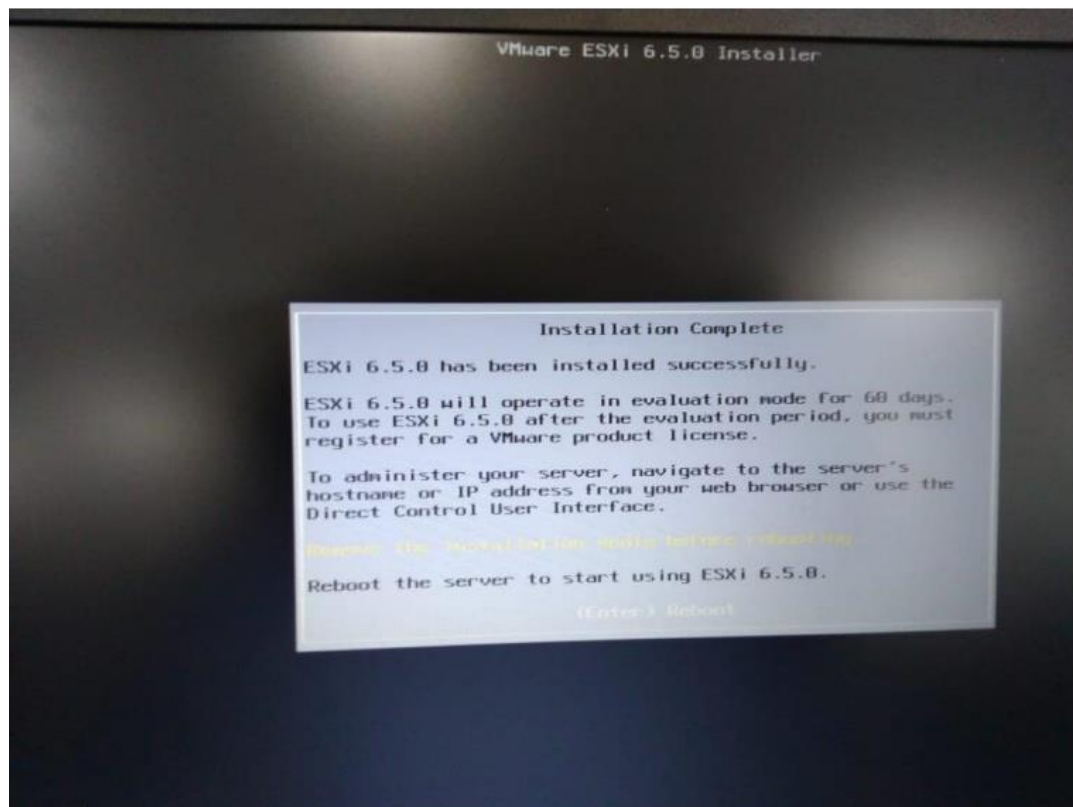


## 3. Connecting the bootable device to the Server and starting the hardware.

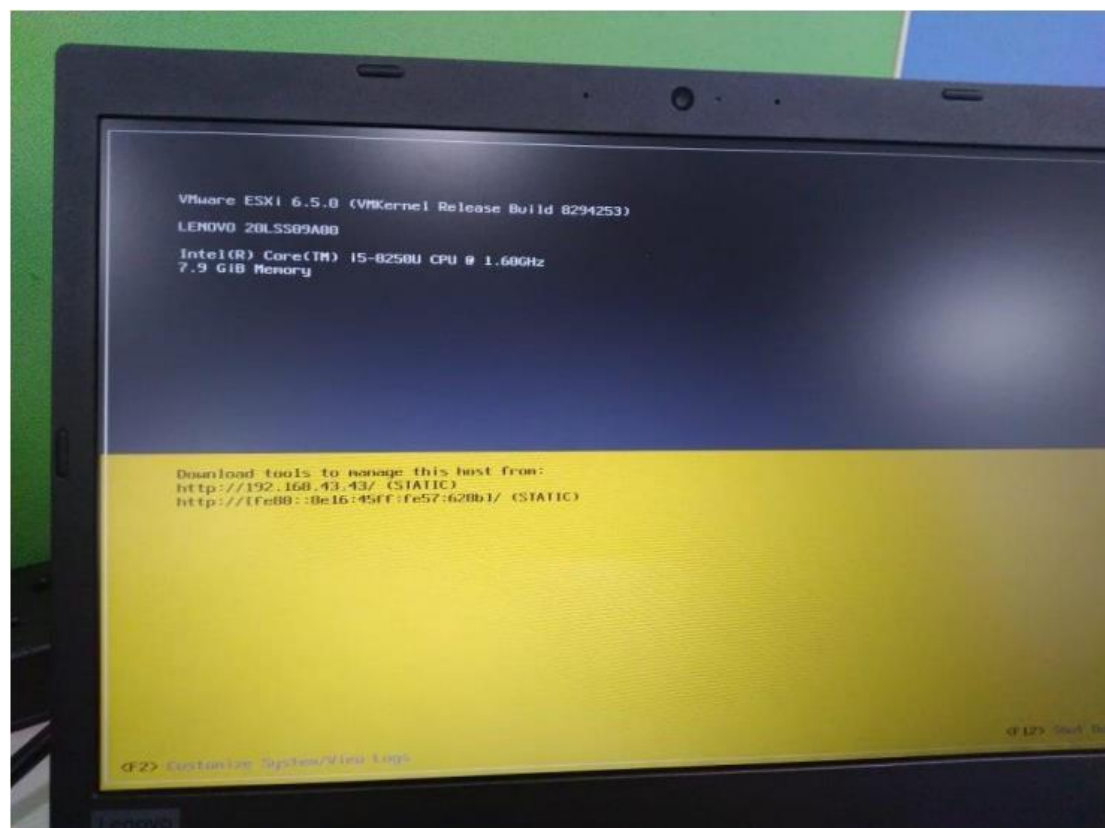
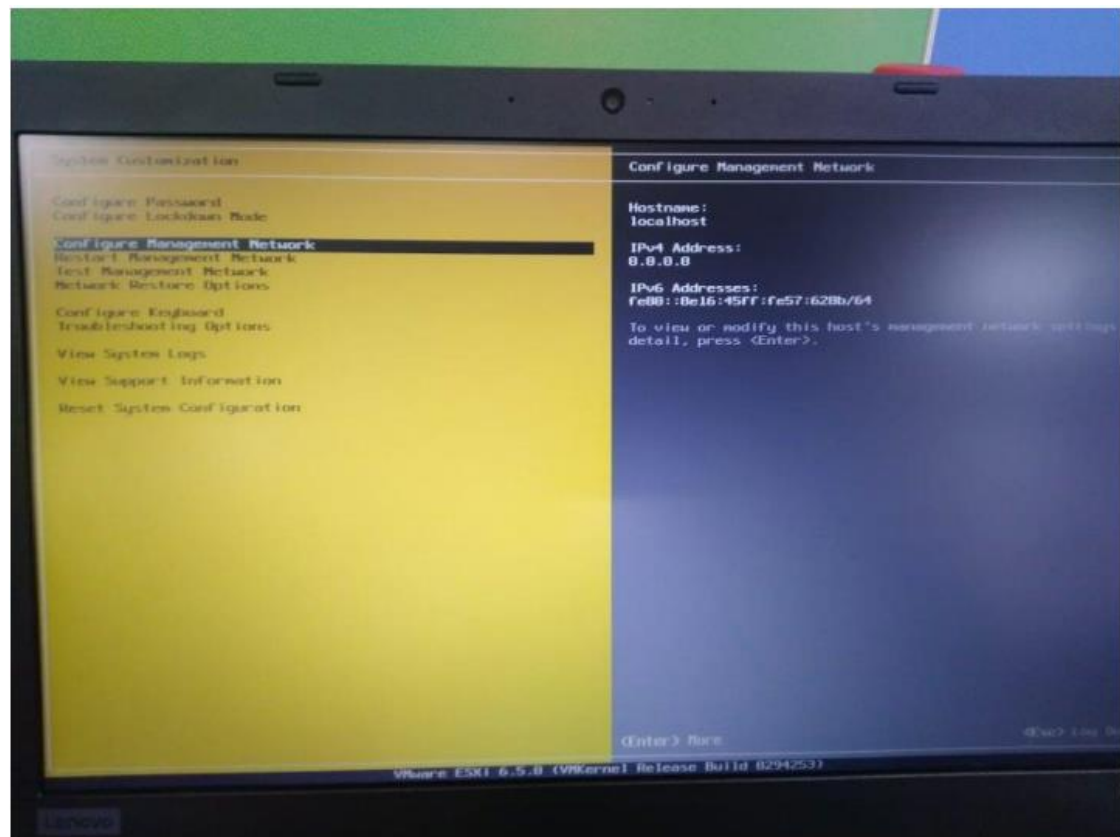
- Connect the bootable pen drive to the hardware that is used as the server (host).

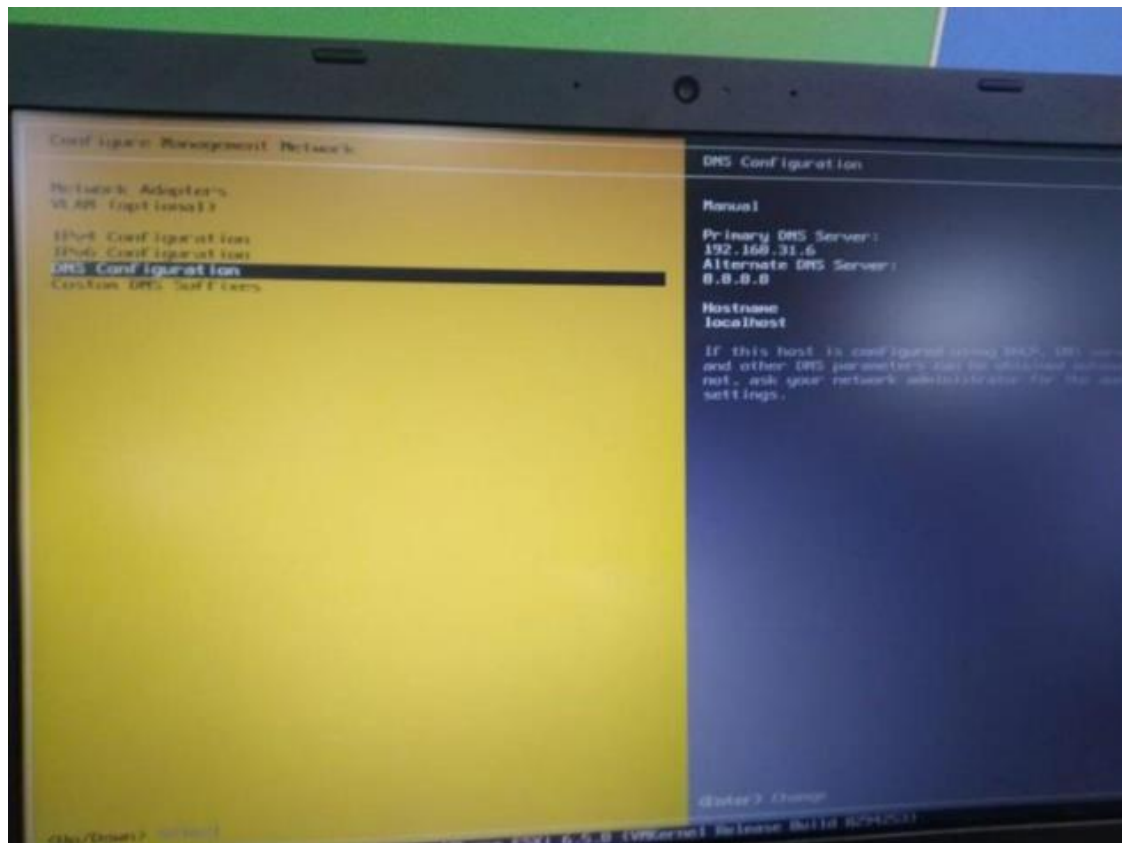
- Choose the pen drive as the first bootable device. Now the Server is booting to EXSi OS.





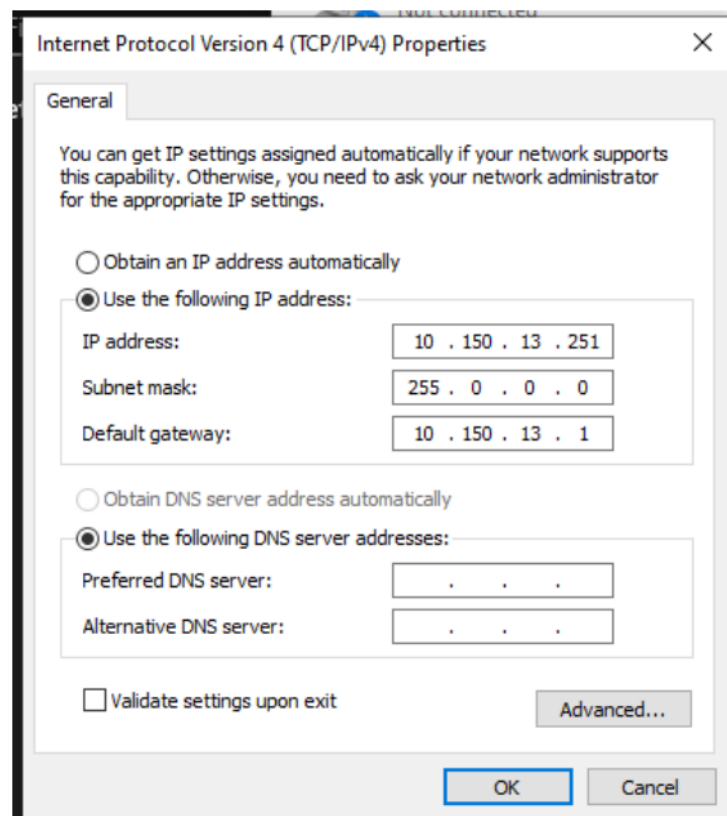
#### 4. Configure the Management Network.





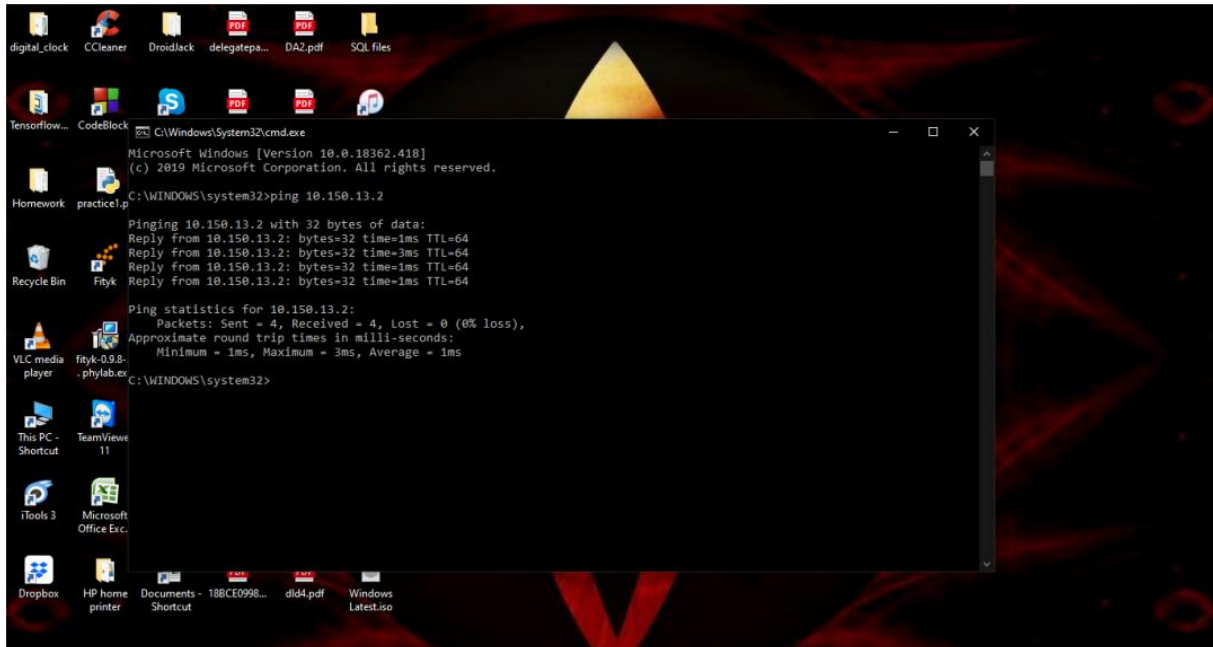
## 5. Assigning an IP address to the Client laptop

- We assign the host an IP address





## 6. Connecting the Server and the Client laptops via a hub and then pinging the two together.

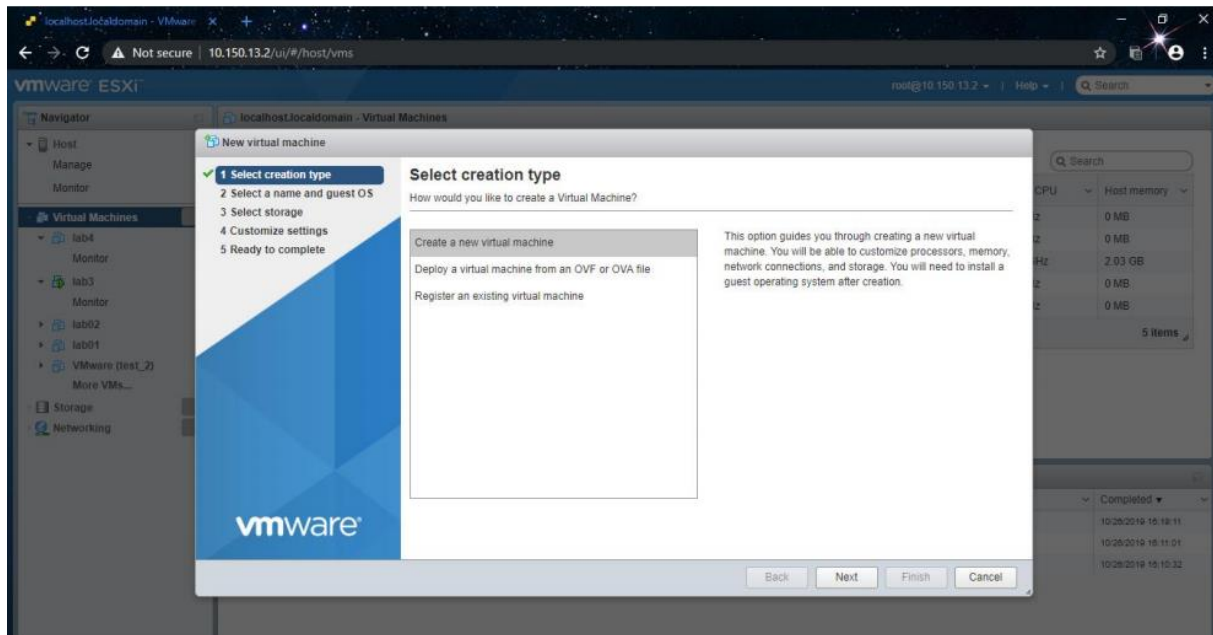


Once the Client and the Server laptops are linked, we can create the virtual machine using the VMware account.

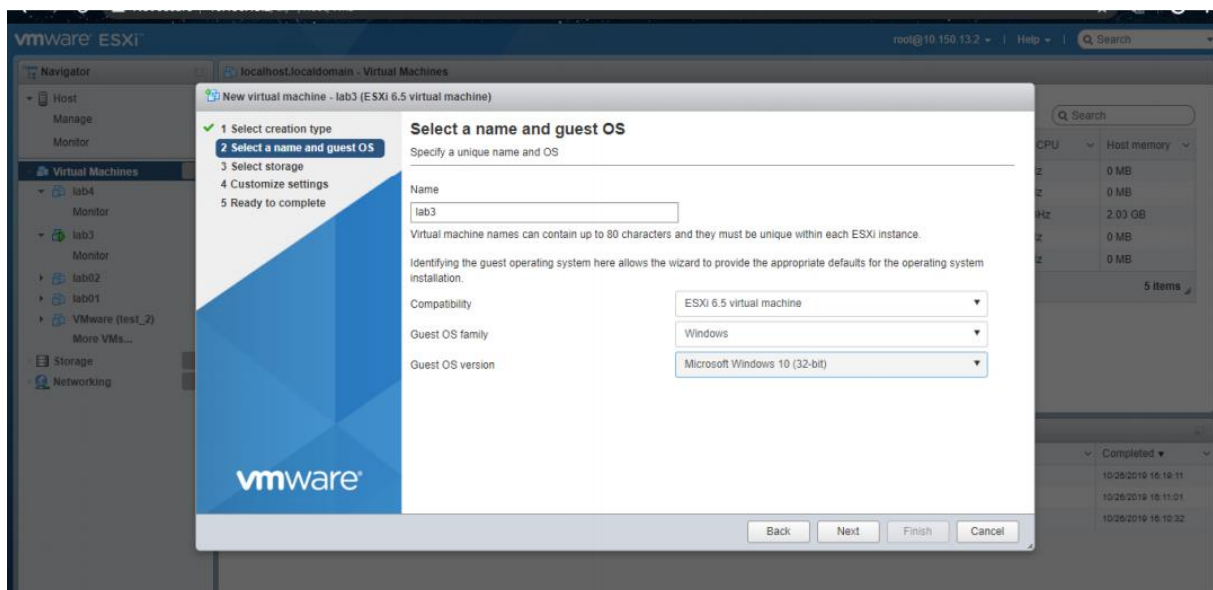
## 7. Creating the virtual machines:

- Step-1

...



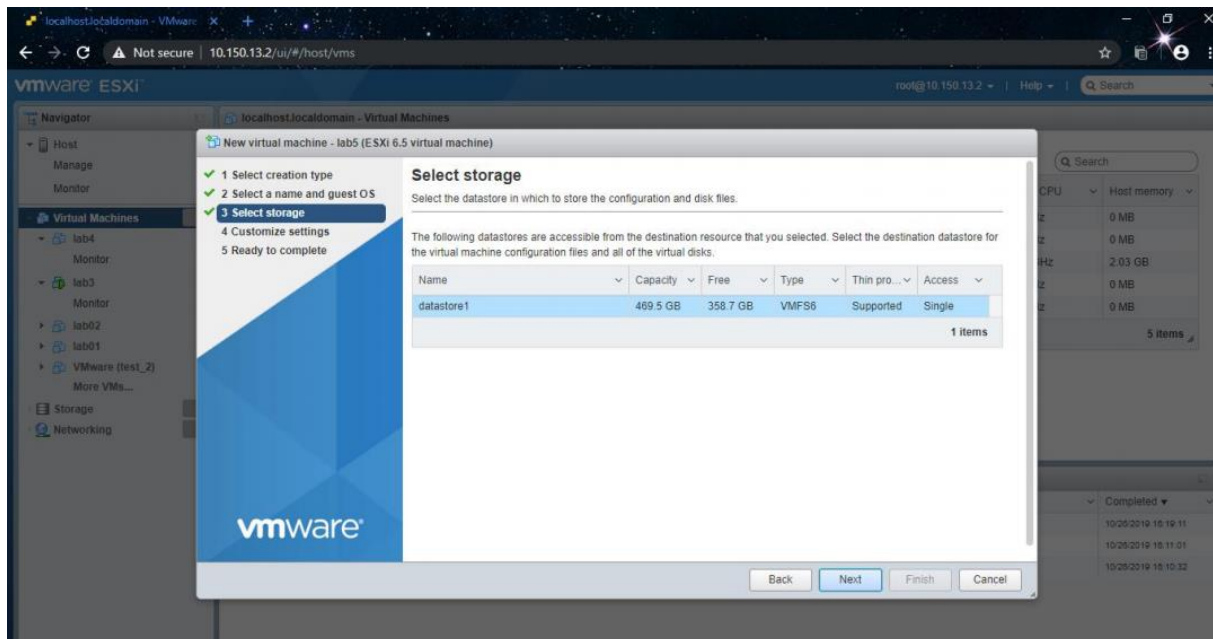
## - Step-2



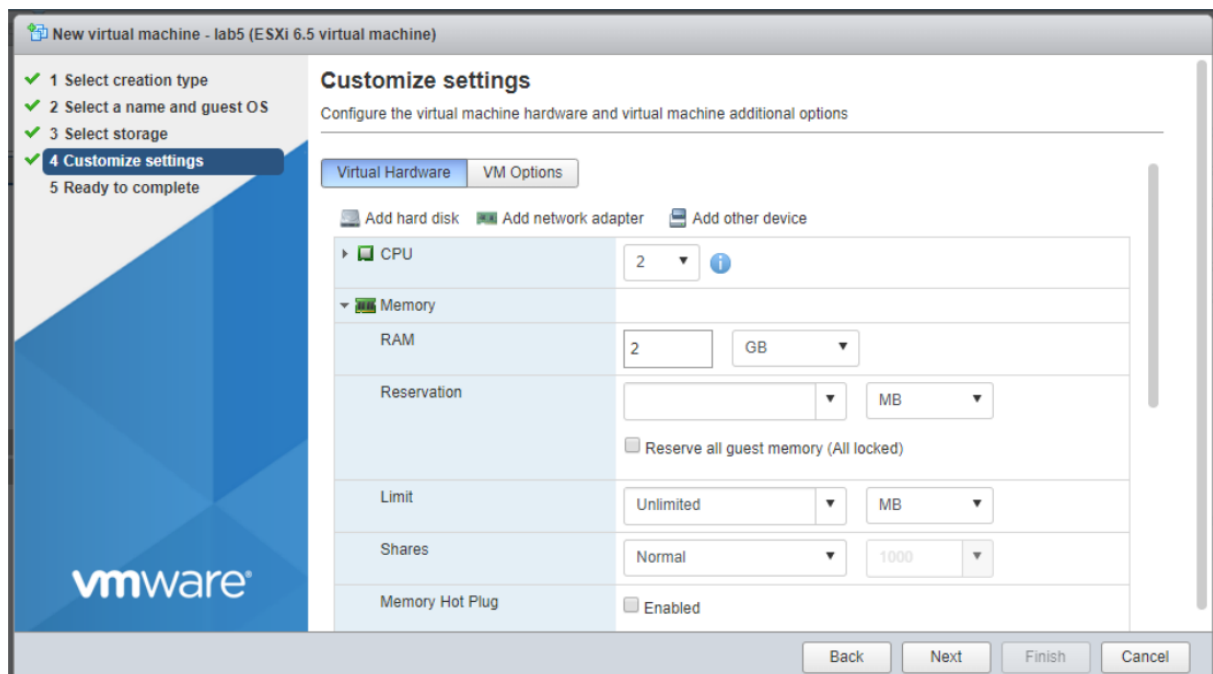
Select the required Compatibility, Guest OS family and Guest OS version for creating the virtual machine.

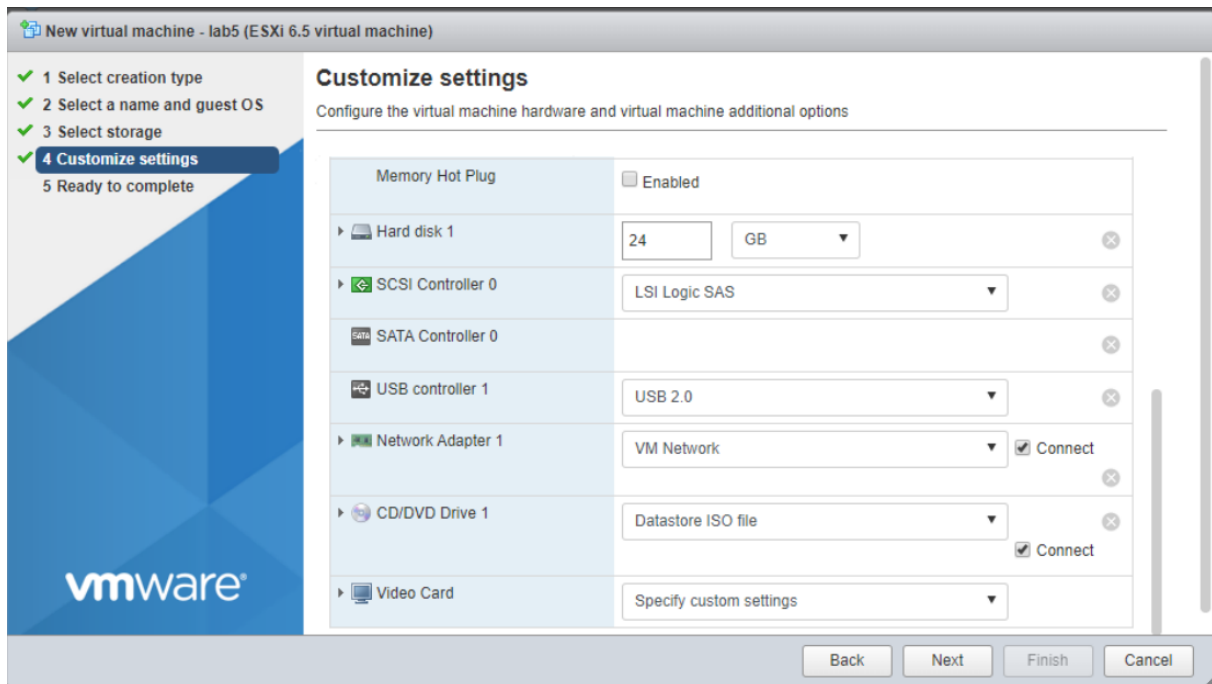


### • Step-3



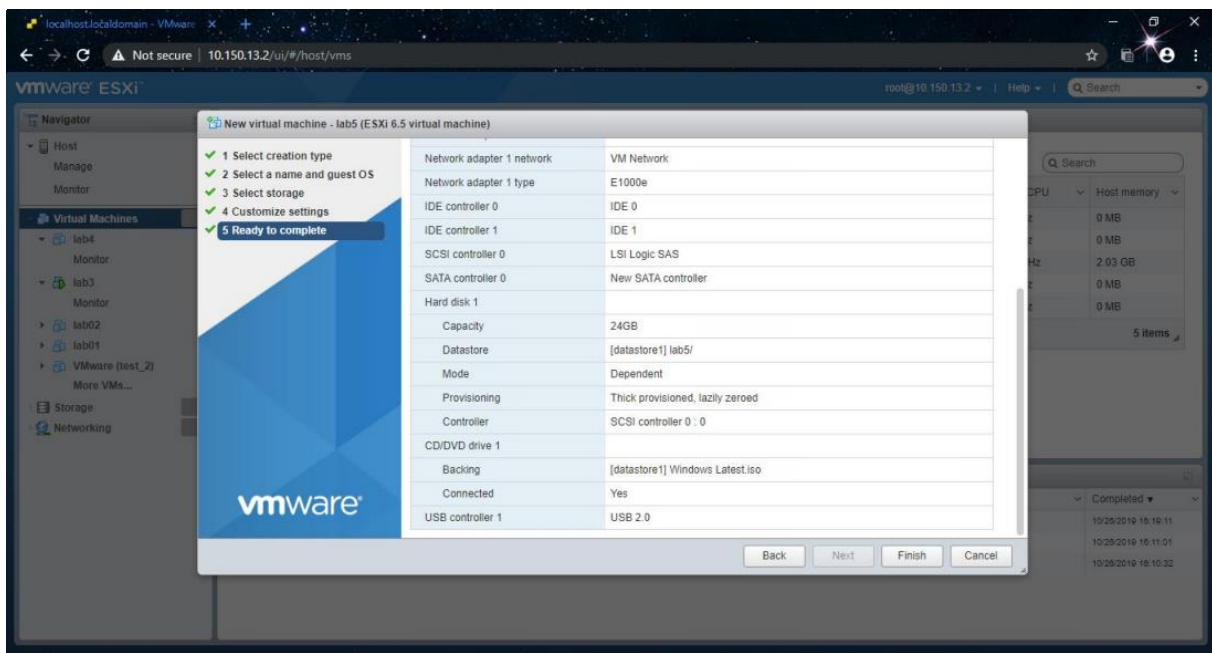
### • Step-4



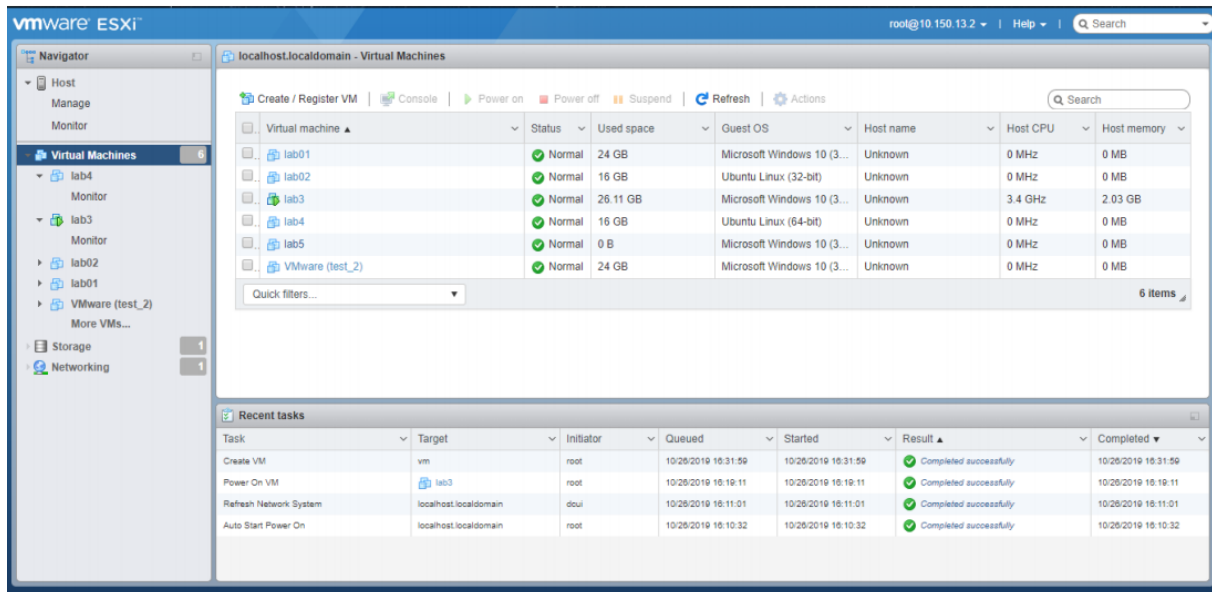


Change the CD/DVD Drive 1 to 'Datastore ISO file' and select the required ISO file for the virtual machine you want to create.

- **Step-5**



After clicking on 'Finish' we can see that the virtual machine will be created and stored in the library along with the other virtual machines.



# **BUSINESS BENEFITS OF SERVER**

## **VIRTUALIZATION**

### **1) Reduced Hardware Costs-**

It is said that humans theoretically only use 10% of their brain command; most of the servers in a strictly physical environment are heavily under-utilized, using an estimated 5-15% of their capacity. When you implement a virtualized server / cloud computing approach, hardware utilization is increased because one physical server can now hold multiple virtual machines. Applications no longer need their own server because each virtual machine on the physical server now runs them. In 2011, IDC reported a 40% reduction in hardware and software costs for IT departments that adopted a server virtualization strategy.

### **2) Faster Server Provisioning and Deployment-**

Server virtualization enables system provisioning and deployment within minutes, allowing you to clone an existing virtual machine without the hours and costs normally spent installing a new physical server. Companies with virtual environments already look back and cringe at the gruelling process of filling out a purchase order, waiting for the server to arrive and then waiting

hours for the operating system and applications to finish installing.

### **3) Greatly Improved Disaster Recovery-**

Perhaps the greatest benefit of server virtualization is the capability to move a virtual machine from one server to another quickly and safely. Backing up critical data is done quickly and effectively because your company can effortlessly create a replication site. Most enterprise virtualization platforms contain software that helps automate the failover during a disaster. The software also allows you to test a disaster recovery failover—think of it as your data center’s own fire escape plan. If a data center disaster occurs, your infrastructure is already set up to take appropriate measures for a swift and safe recovery.

### **4) Significant Energy Cost Savings-**

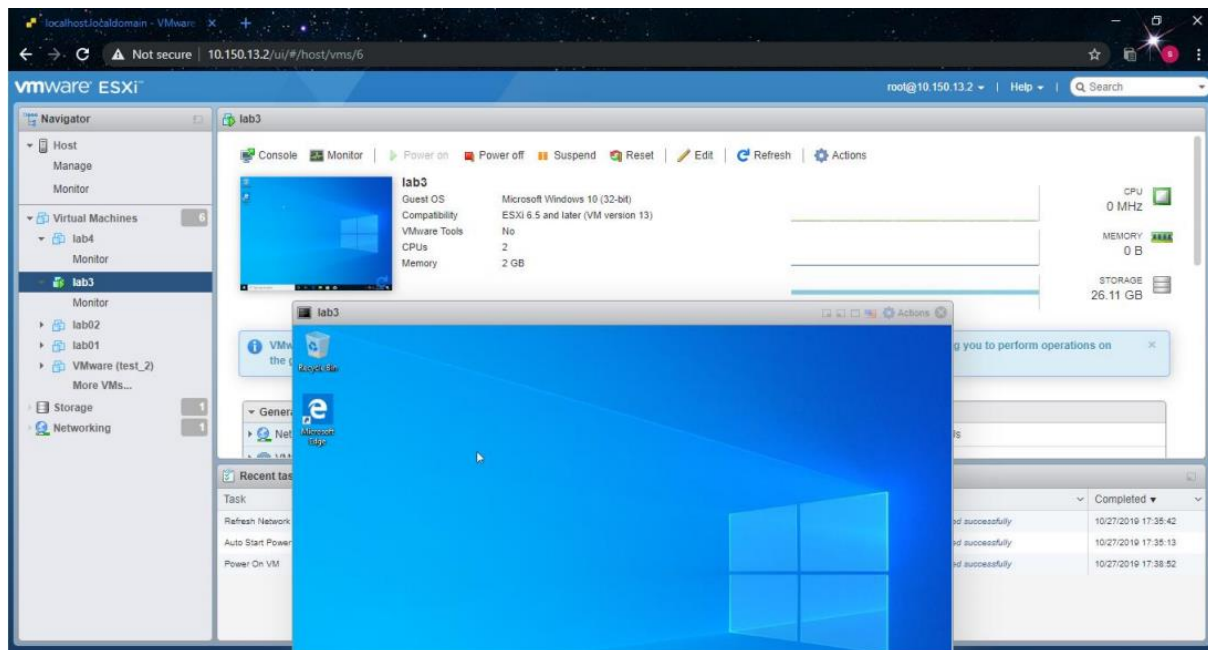
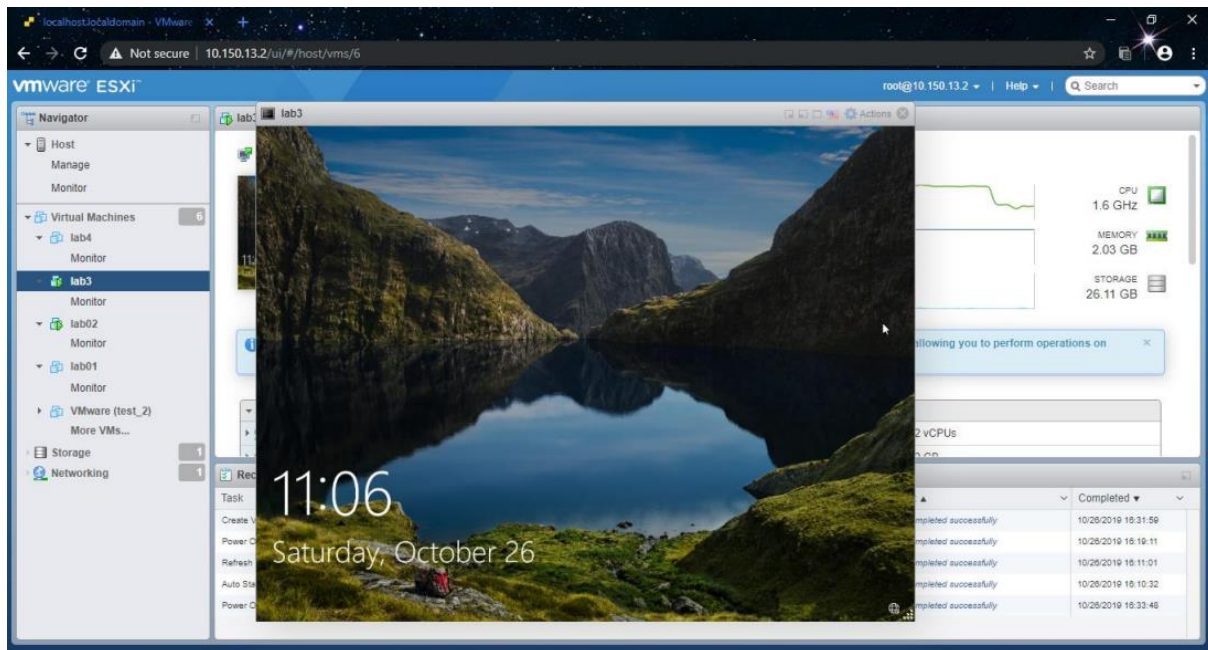
Among other server virtualization benefits, the migration of physical servers to virtual machines allows you to consolidate them onto fewer physical servers. Cooling and power costs are significantly reduced, which means not only will you be “going green,” but you will also have more green to spend elsewhere. According to VMware, server consolidation reduces energy costs by up to 80%. Another major plus is the ability to power down servers without affecting applications or users.

## **5) Increased Productivity-**

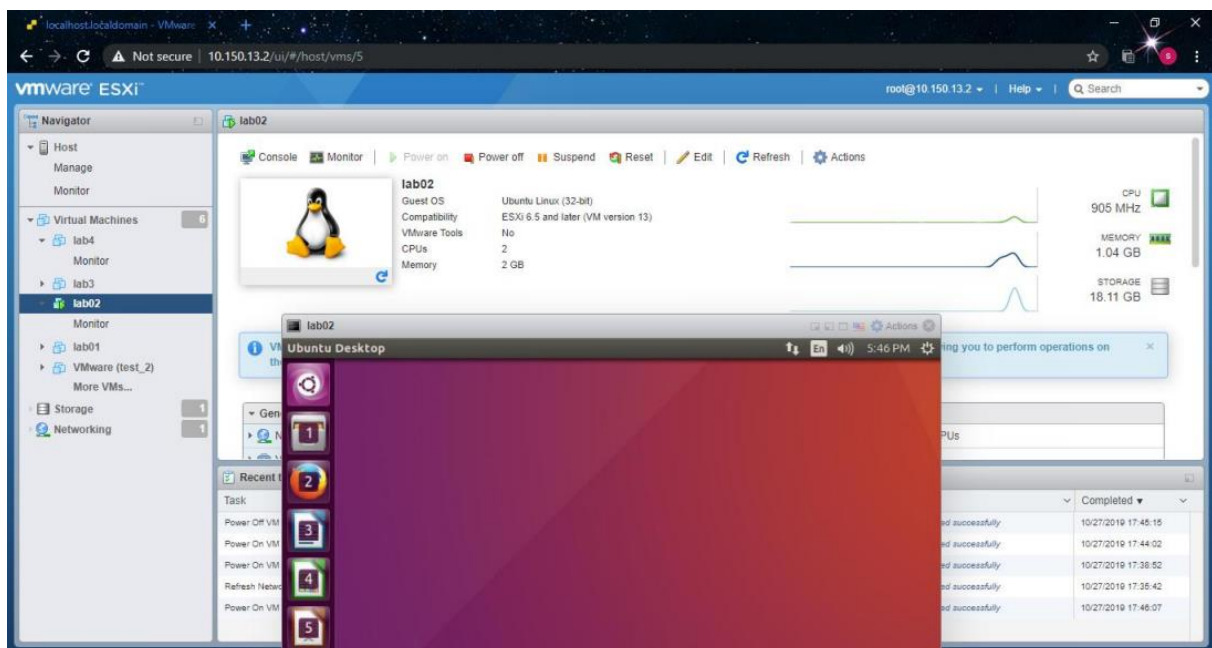
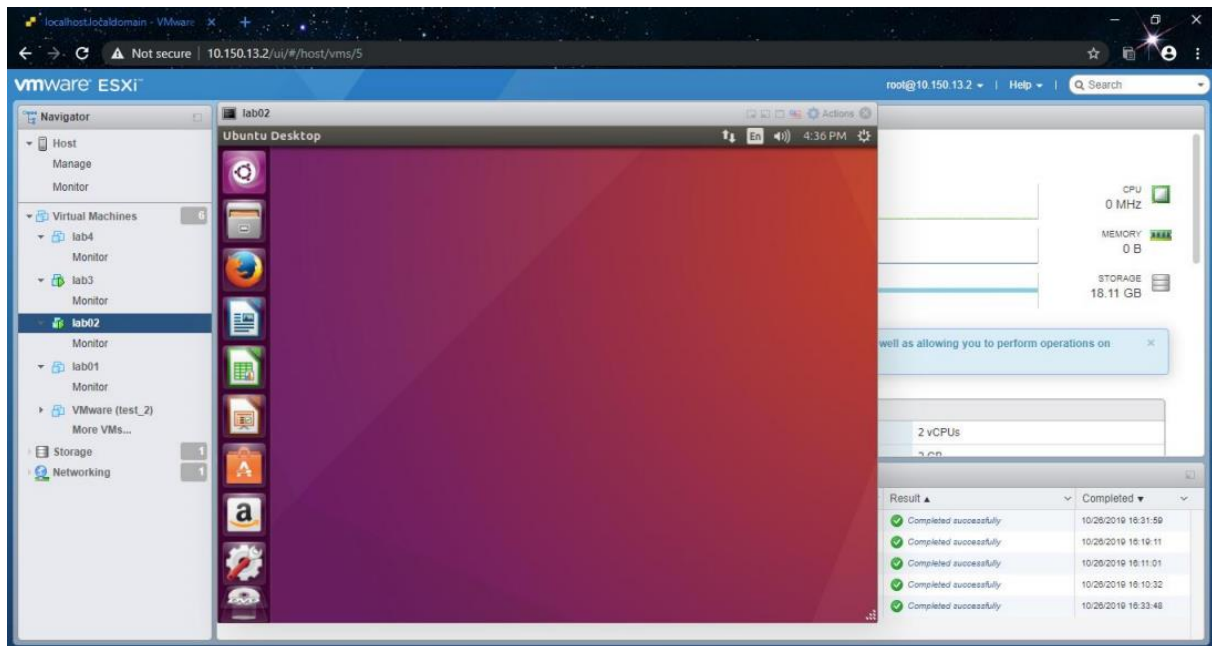
Having fewer physical servers means there are less of them to maintain and manage. This leaves your IT staff more time to spend on more productive tasks such as driving new business initiatives, cutting expenses and raising revenue.

# FINAL RESULT

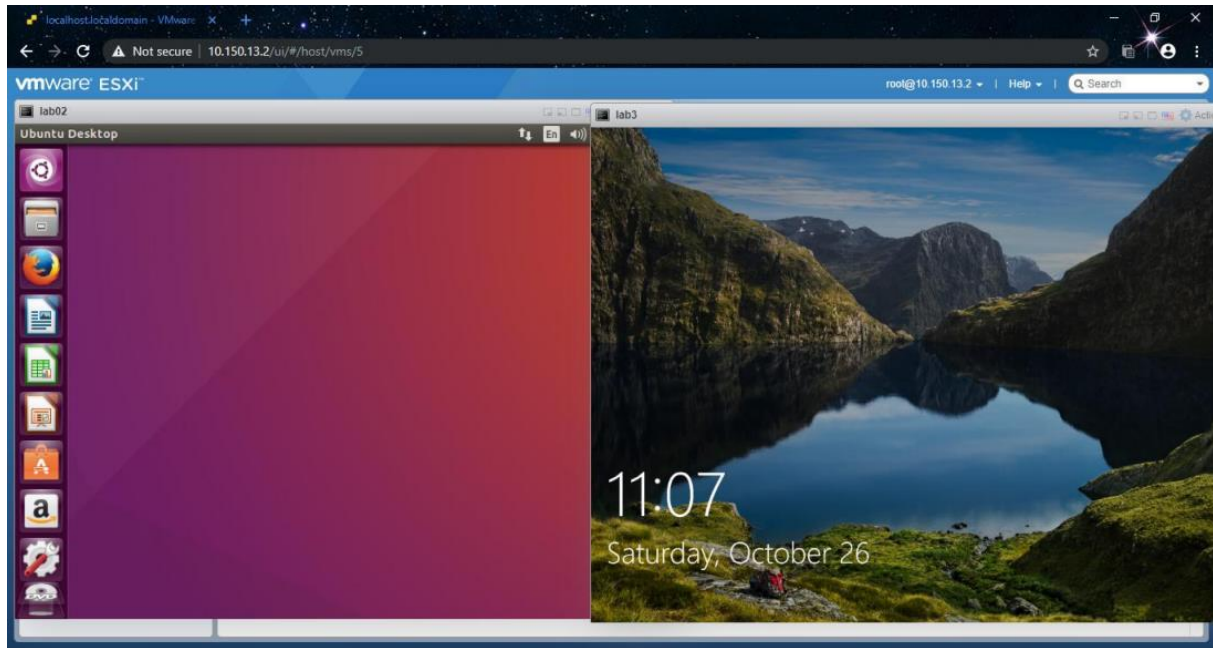
## Windows 10 virtual machine



## Ubuntu 16.04 virtual machine







The above picture shows that both the virtual machines which is, the Windows 10 virtual machine as well as the Ubuntu 16.04 virtual machine both are running successfully simultaneously.

## **REFERENCES:**

- 1) <https://www.udacity.com/course/introduction-to-operating-systems--ud923>
- 2) <https://www.udemy.com/course/virtualization-one-hour-crash-course/>
- 3) <https://cloudacademy.com/course/introduction-to-virtualization-technologies/introduction-11/>
- 4) <https://searchnetworking.techtarget.com/tip/How-to-achieve-server-virtualization-in-your-network>
- 5) **Book-** Virtualization Essentials by Matthew Portnoy