

DATA CENTER TECHNOLOGIES

A PRACTICAL REPORT
ON
Data Center Technologies

SUBMITTED BY
Mr. BHAVISHAY MANKANI
Roll No: 22009

UNDER THE GUIDANCE OF
PROF. DINAAZ SHAIKH

Submitted in fulfilment of the requirements for qualifying
MSc. IT Part II Semester - III Examination 2023-2024

University of Mumbai
Department of Information Technology

R.D. & S.H National College of Arts, Commerce & S.W.A.
Science College Bandra (West), Mumbai – 400 050



R. D. & S. H. National & S. W. A. Science College

Bandra (W), Mumbai - 400050

Department of Information Technology M.Sc. (IT – SEMESTER III)

Certificate

This is to certify that Data Center Technologies Practical's performed at R.D & S.H National & S.W.A. Science College by Mr. Bhavishay Mankani holding Seat No. 22009 studying Master of Science in Information Technology Semester – III has been satisfactorily completed as prescribed by the University of Mumbai, during the year 2023 – 2024.

Subject In-Charge

Coordinator In-Charge

External Examiner

College Stamp

INDEX

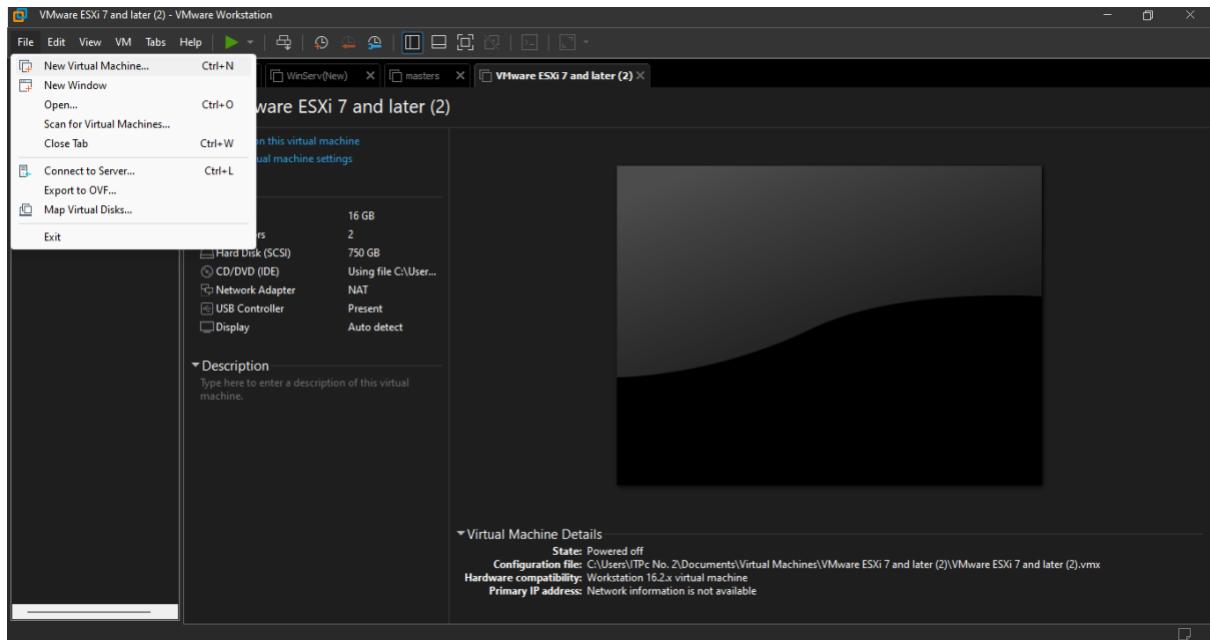
Sr. No	Date	Practical	Page No	Sign
1.	14/10/2023	Configuring ESXi Hosts a. Install ESXi on a VM using Student desktop b. Install ESXi	1	
2.	16/10/2023	Configuring ESXi Hosts a. Examine the Options in the DCUI b. Configure the Management Network c. Enable SSH	13	
3.	30/10/2023	Deploying and Configuring a Virtual Machine a. Create a virtual machine b. Install a guest operating system and disable windows updates c. Install VMware Tools/install files	27	
4.	3/11/2023	Working with vCenter Server	51	
5.	11/12/2023	Navigating the vSphere Clients	79	
6.	19/12/2023	Creating Folders in vCenter Server Application	83	
7.	23/12/2023	Using Standard Switches	88	
8.	16/1/2023	Accessing iSCSI Storage a. Managing VMFS Datastores b. Accessing NFS Storage	105	

Practical: 1

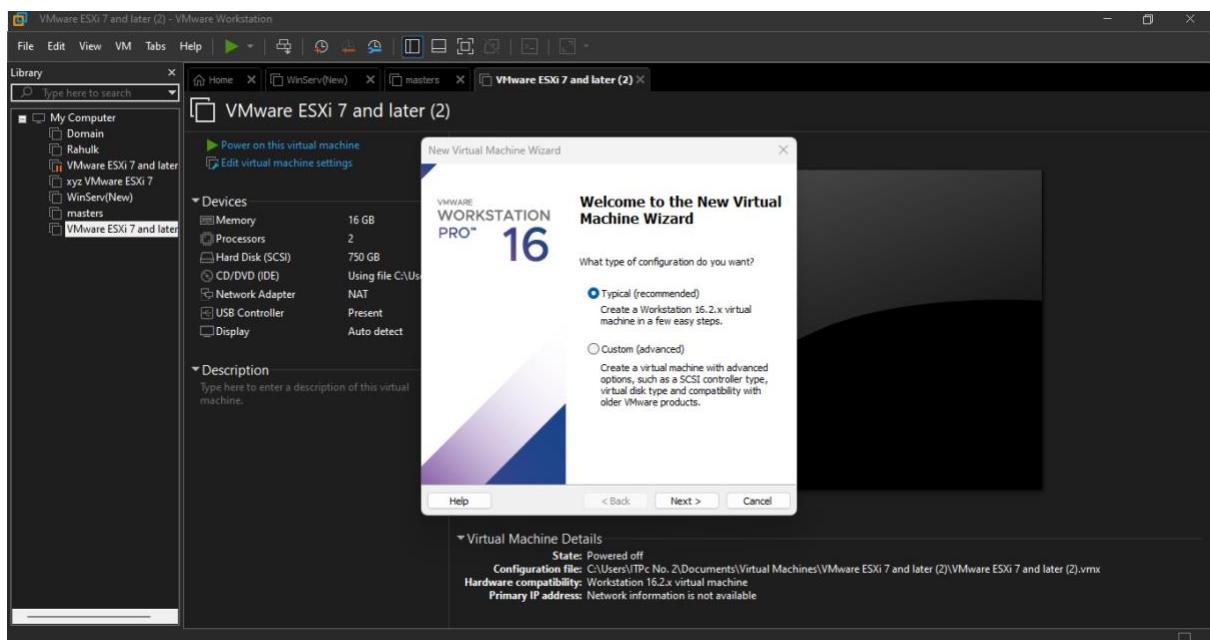
Aim: Installing VMware ESXi on VMware workstation.

Writeup:

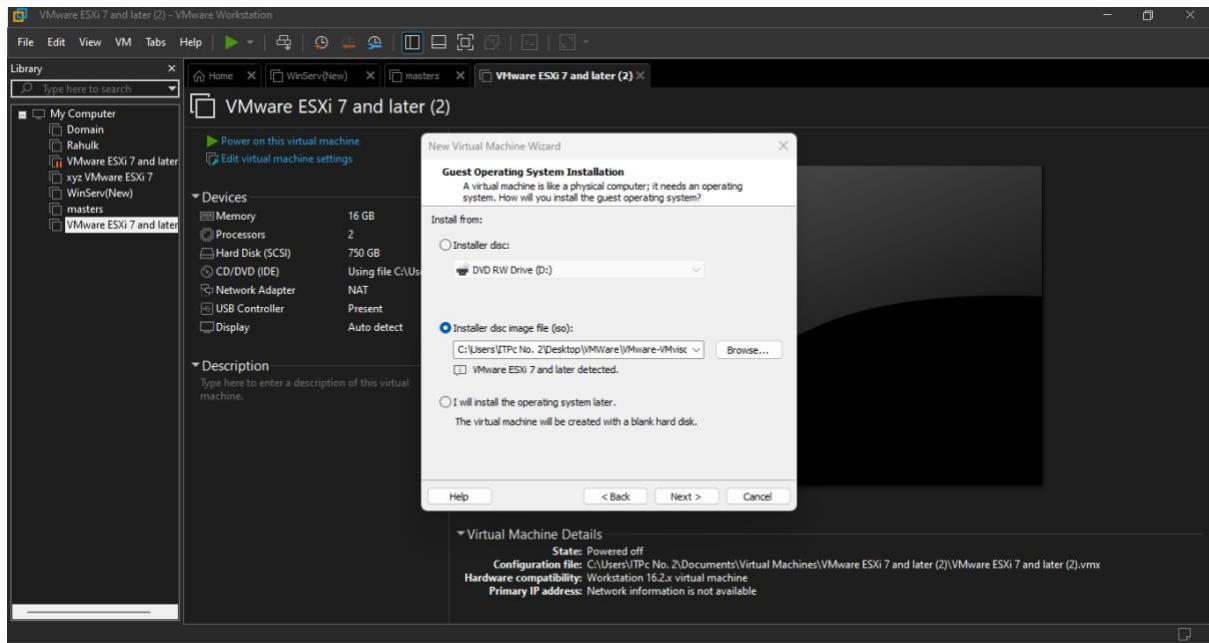
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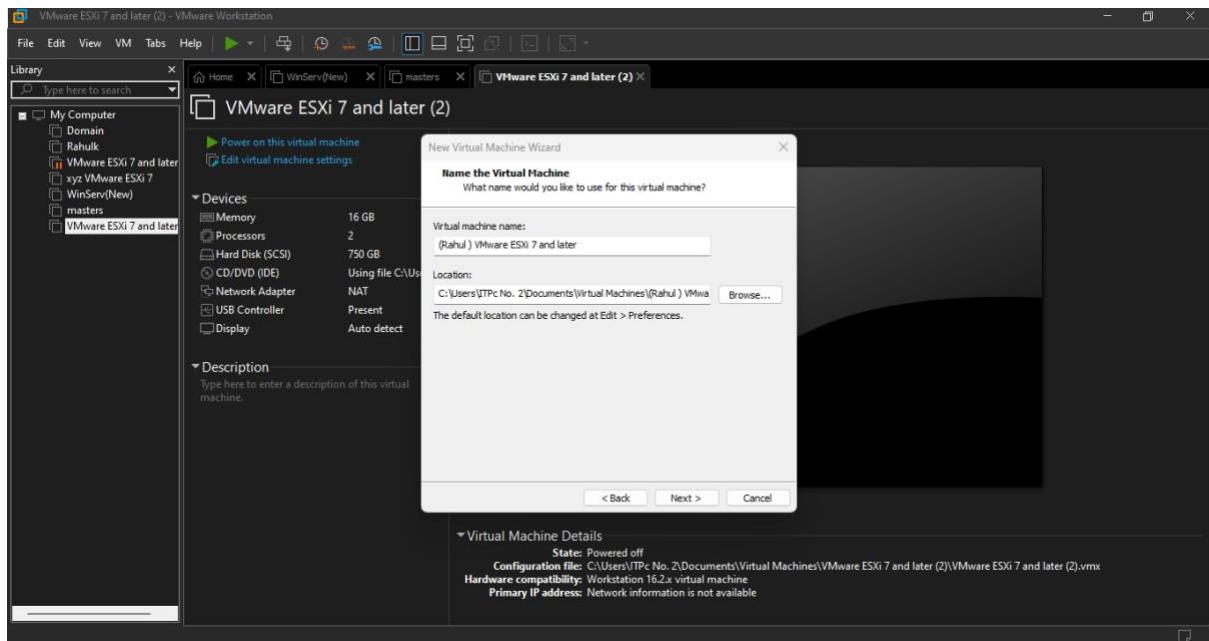
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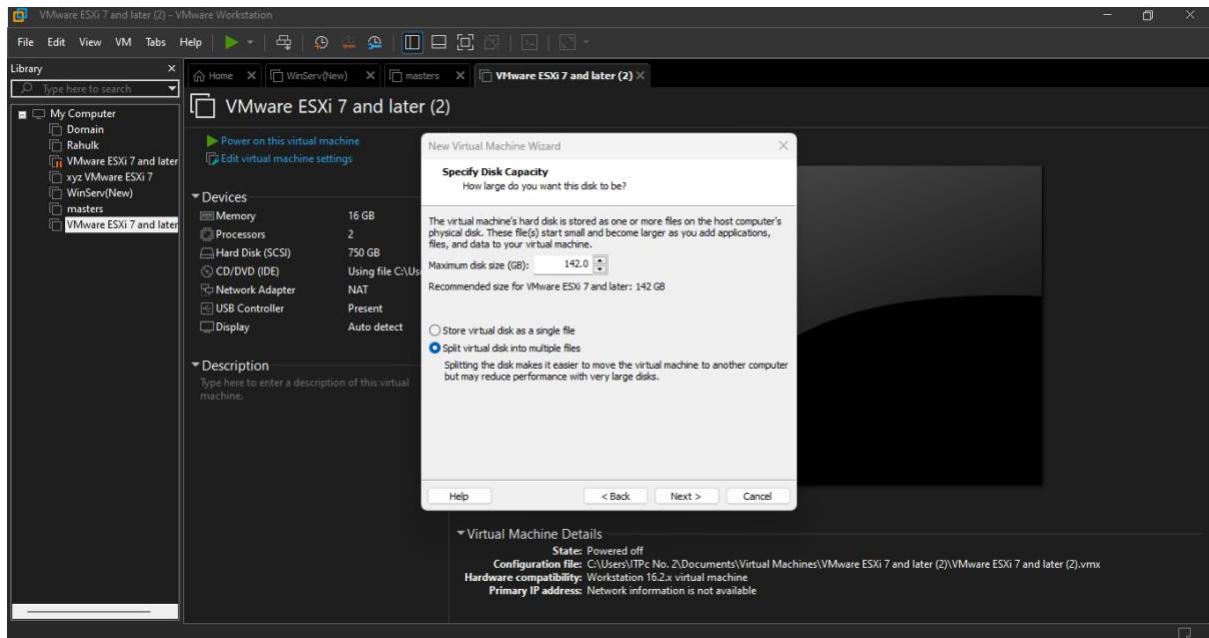
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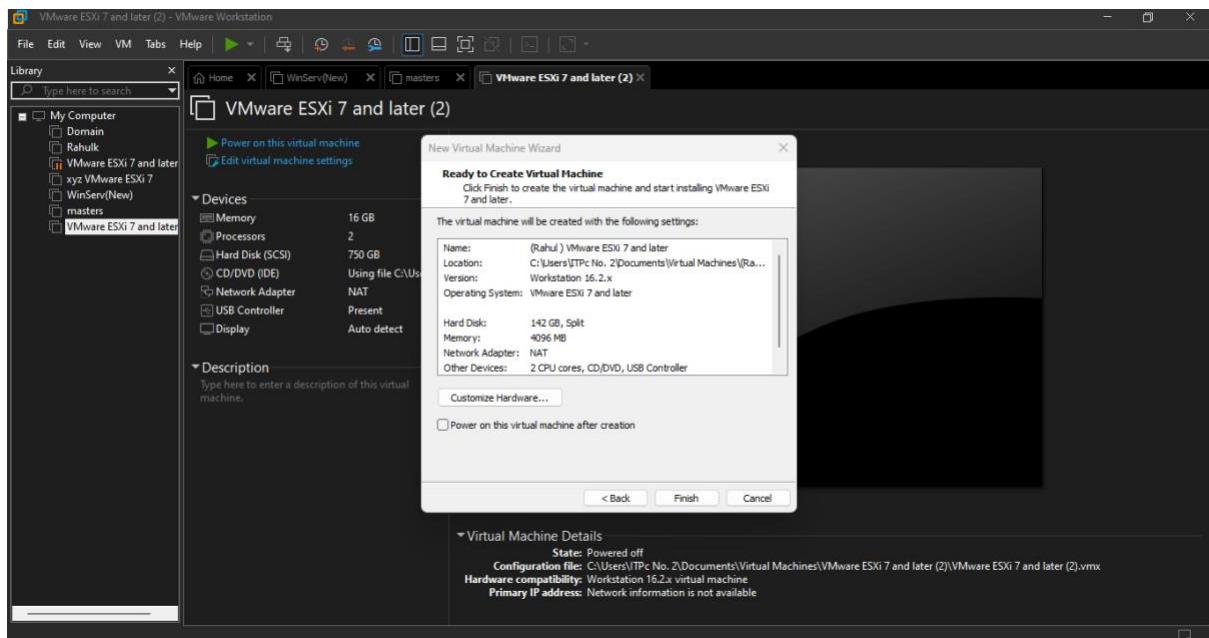
Step 4: Give Name the Virtual Machine : **Rahul** and click on Next.



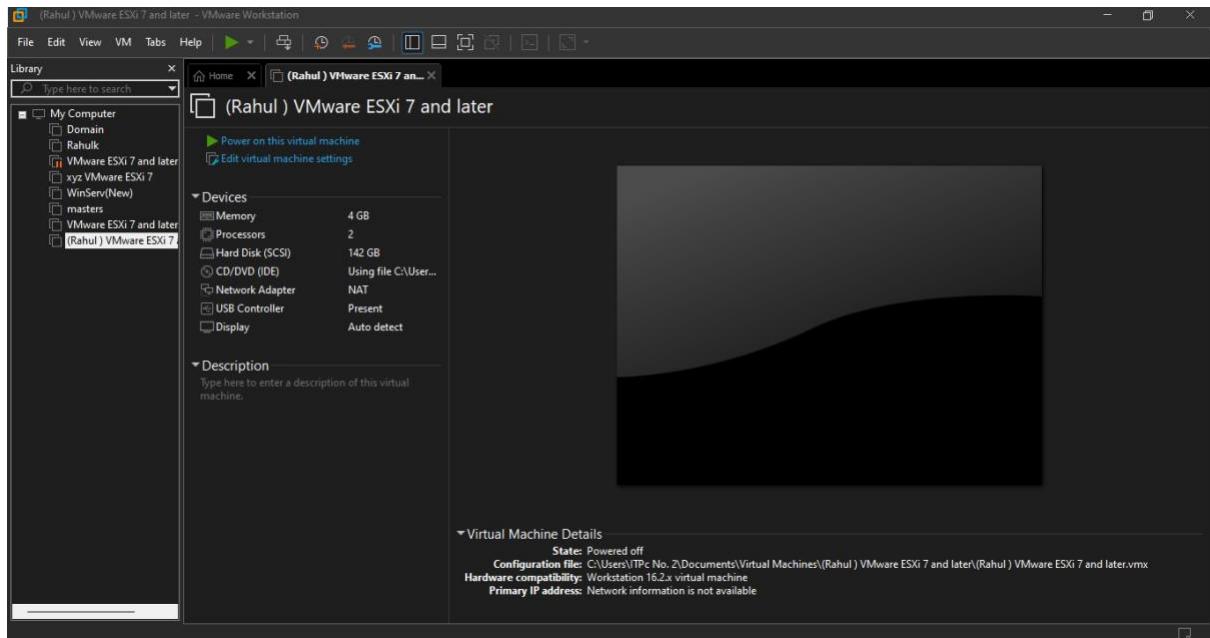
Step 5: Keep the default setting and Click on Next



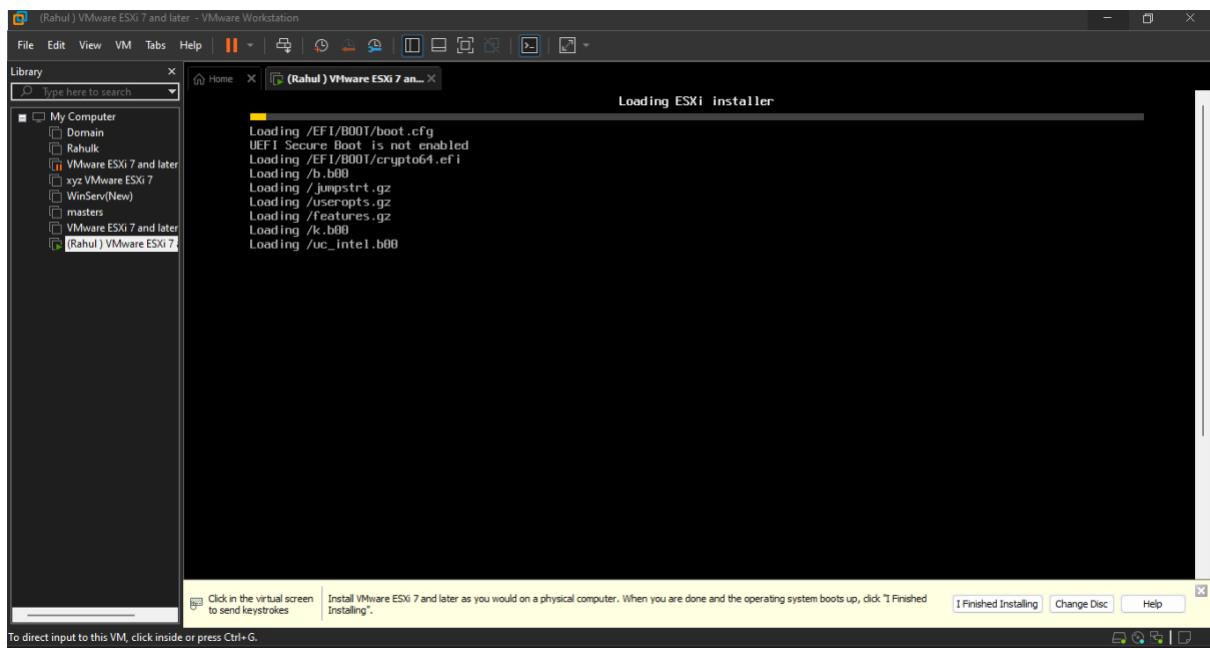
Step 6: Click on Finish



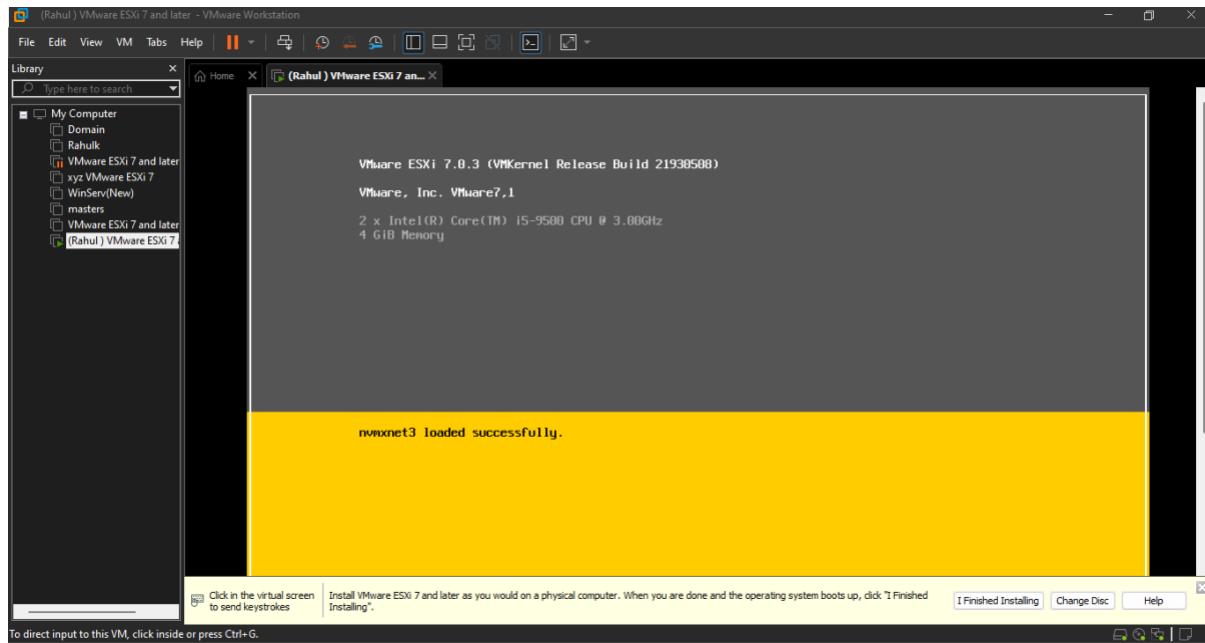
Step 7: Click on Power on this virtual machine



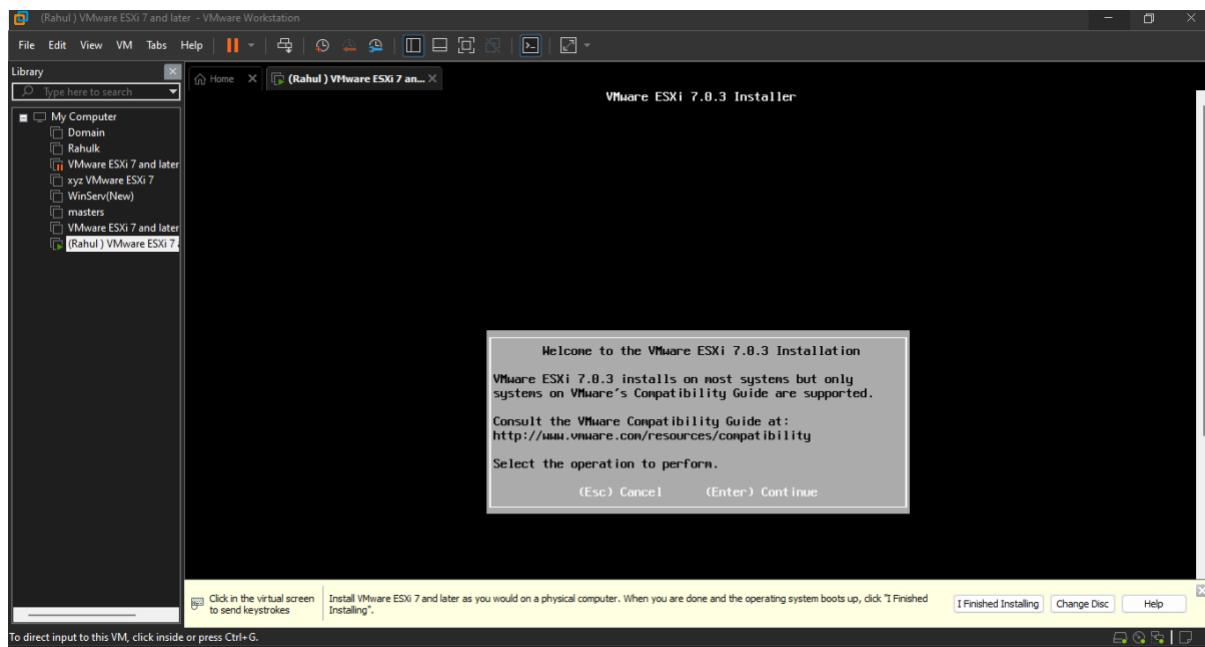
Step 8: It will start installation



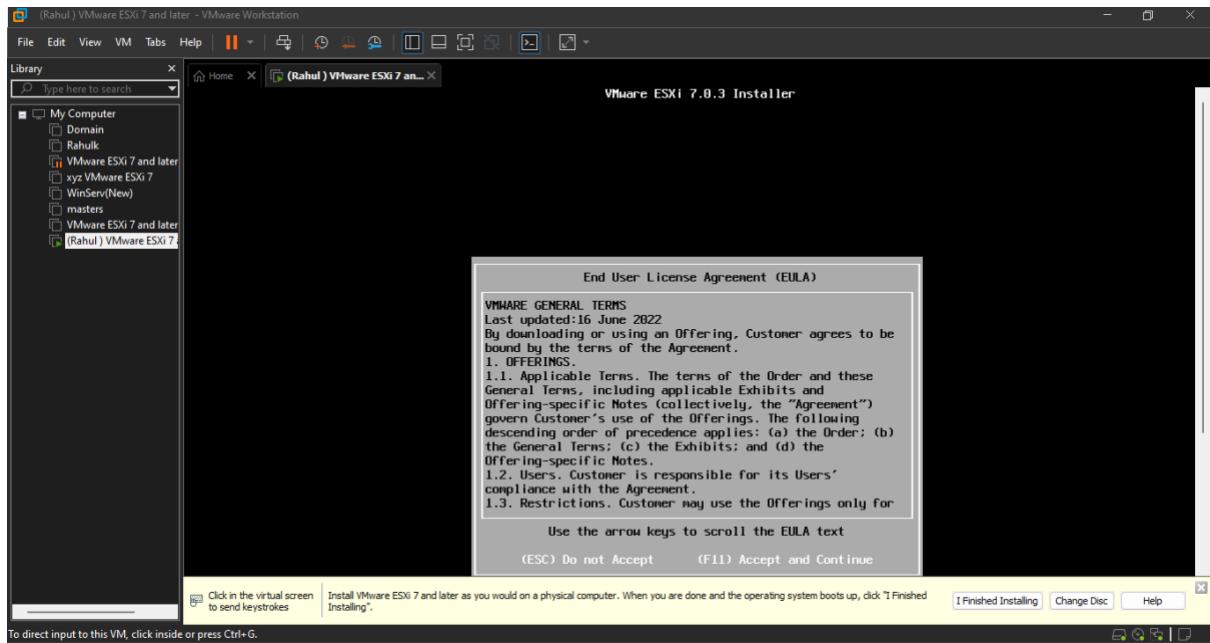
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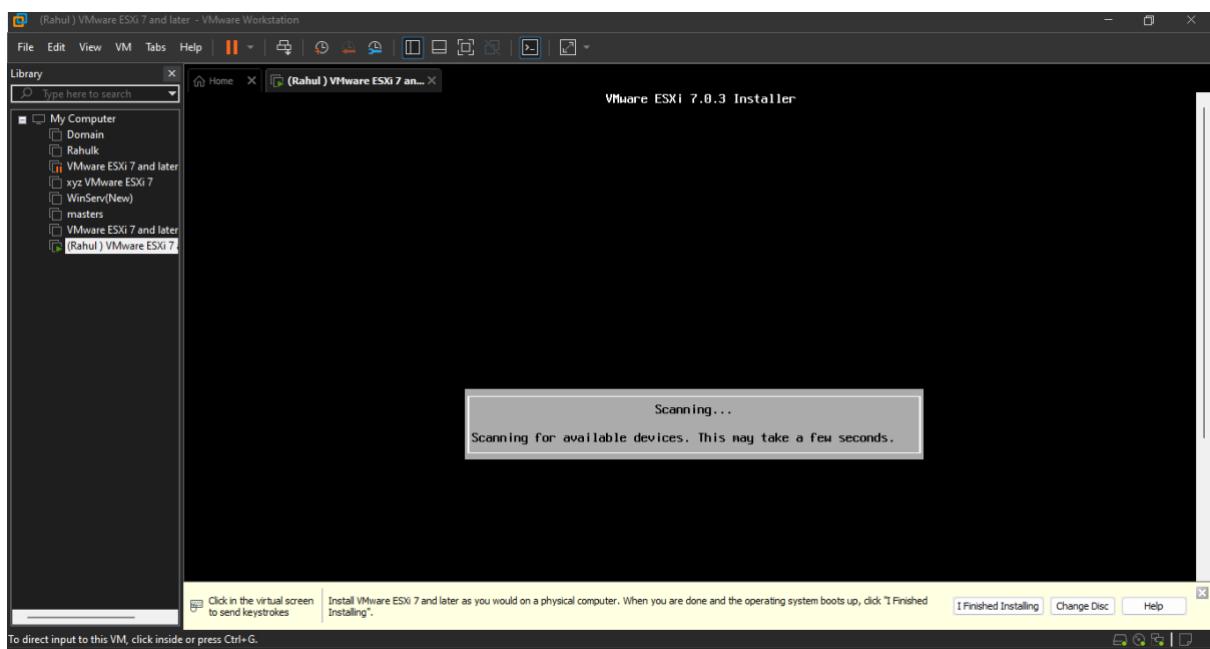
Step 10: Click on Enter



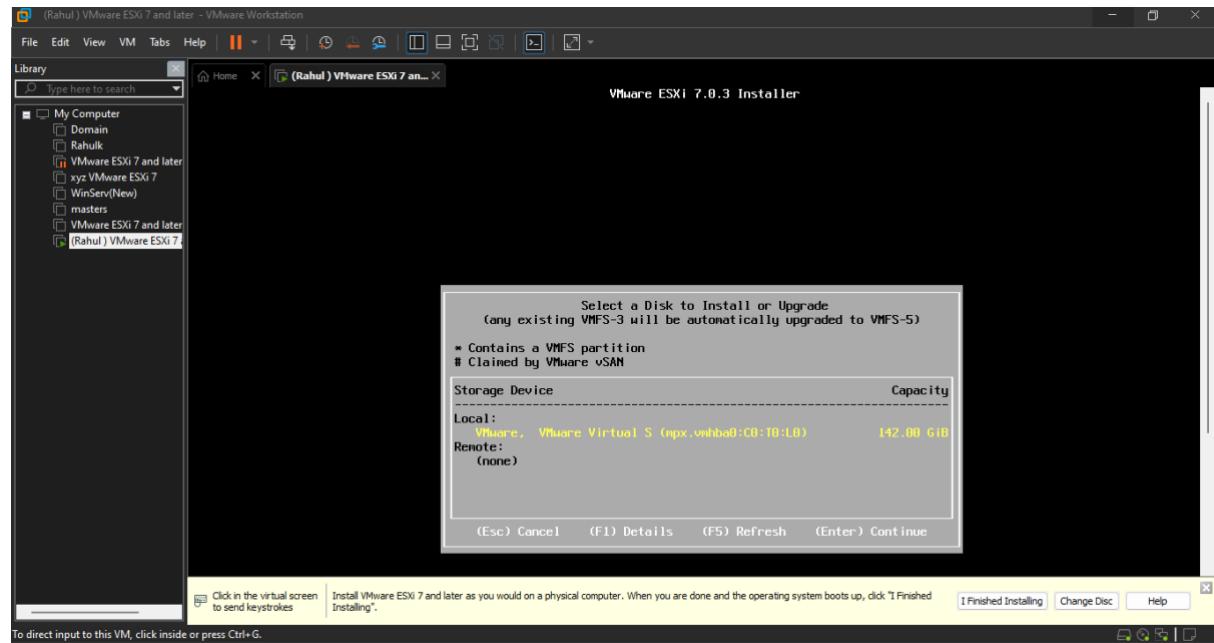
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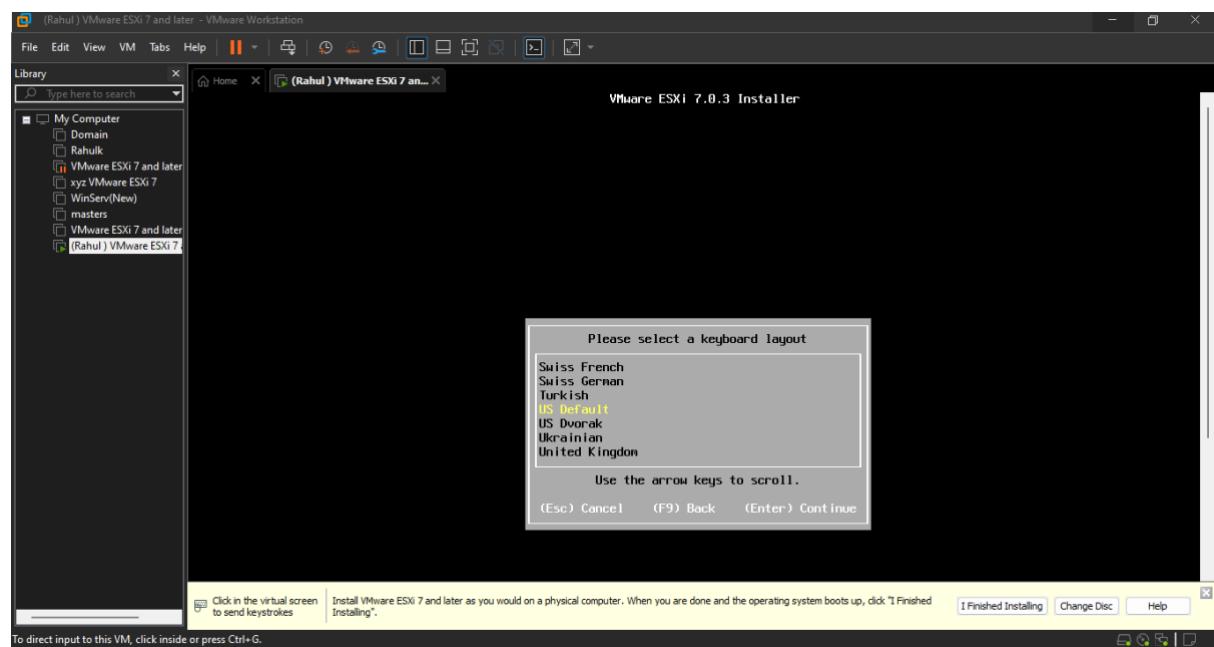
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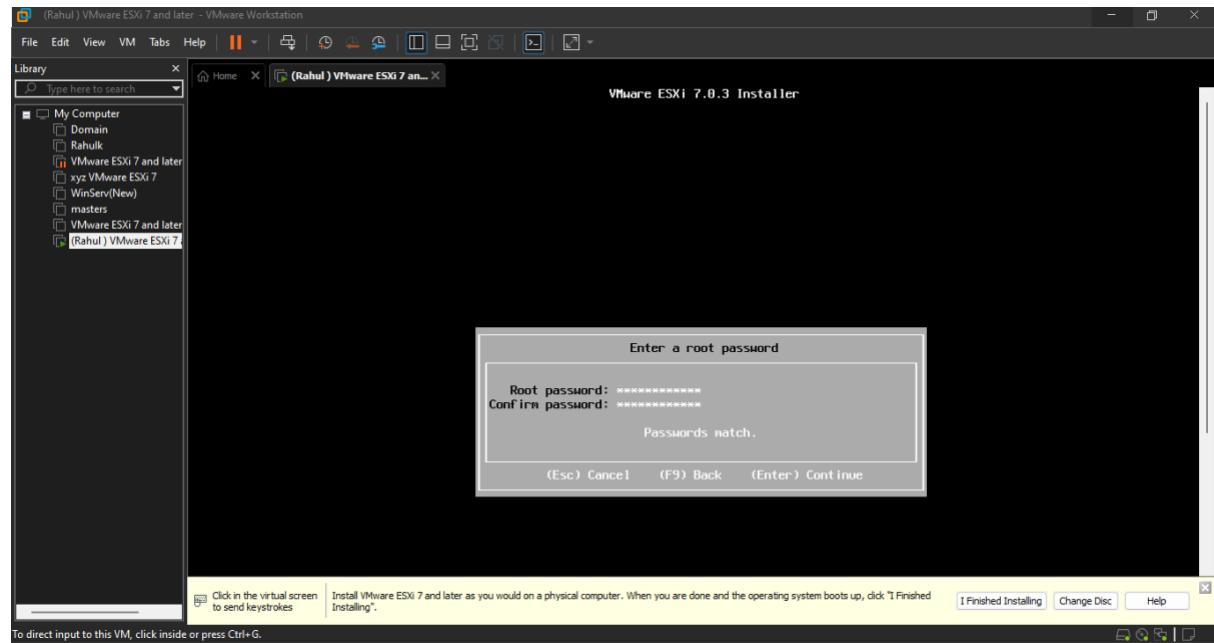
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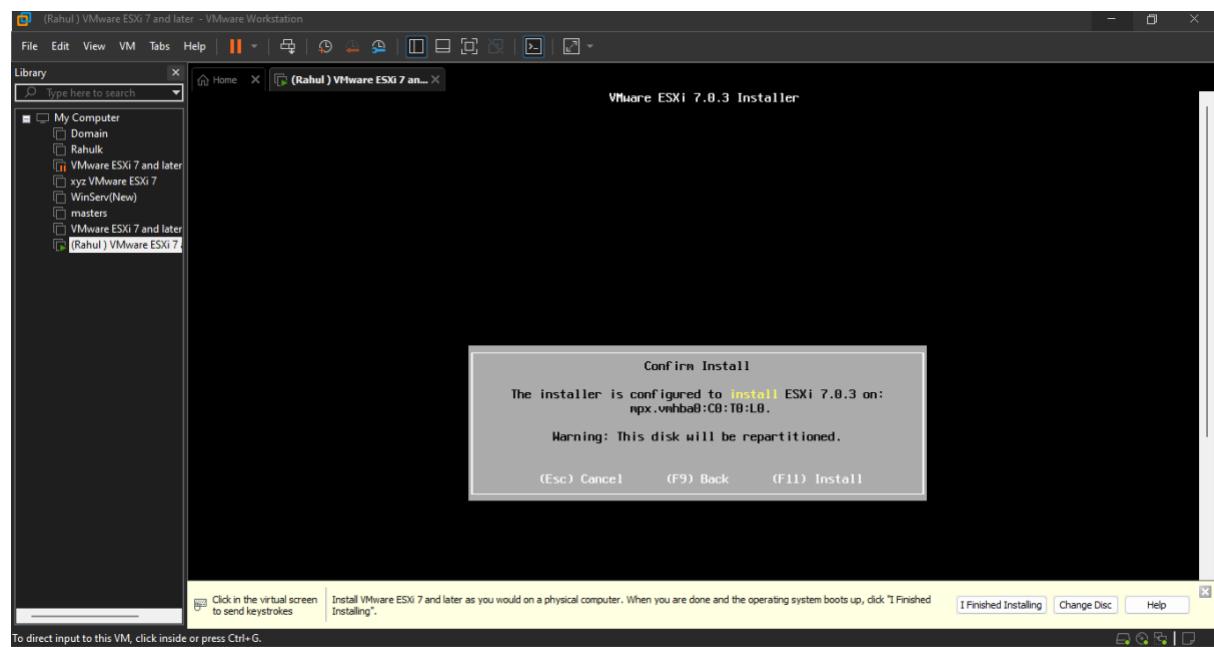
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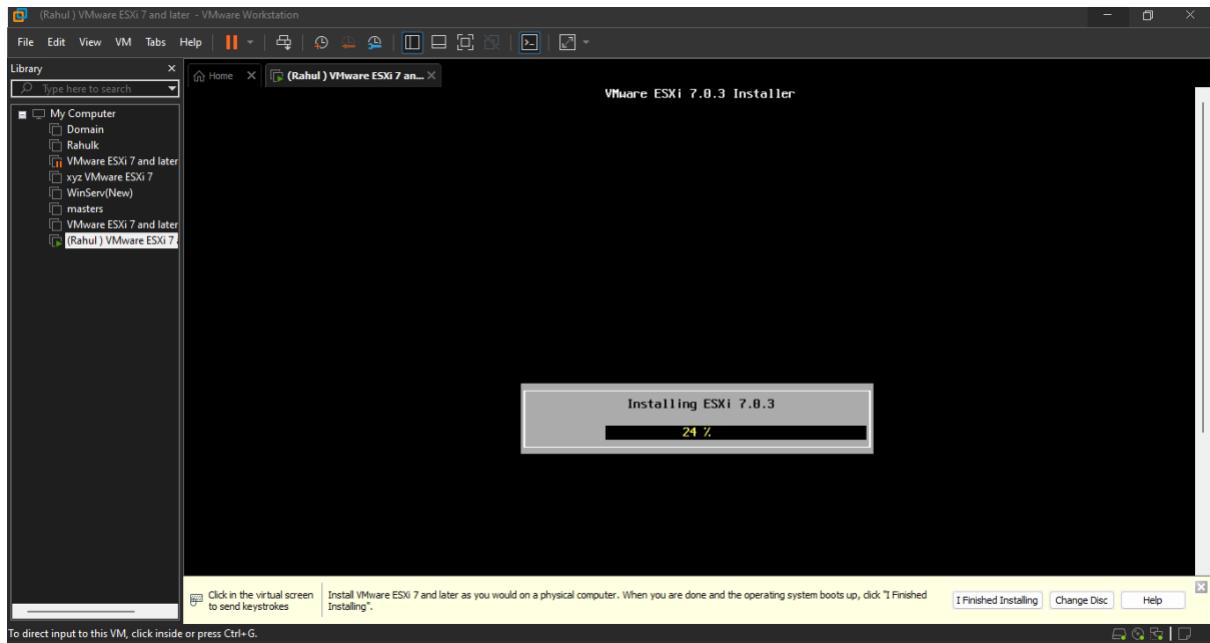
Step 15: Enter a root password (Here it is: NATIONAL@4034) and Click on Enter.



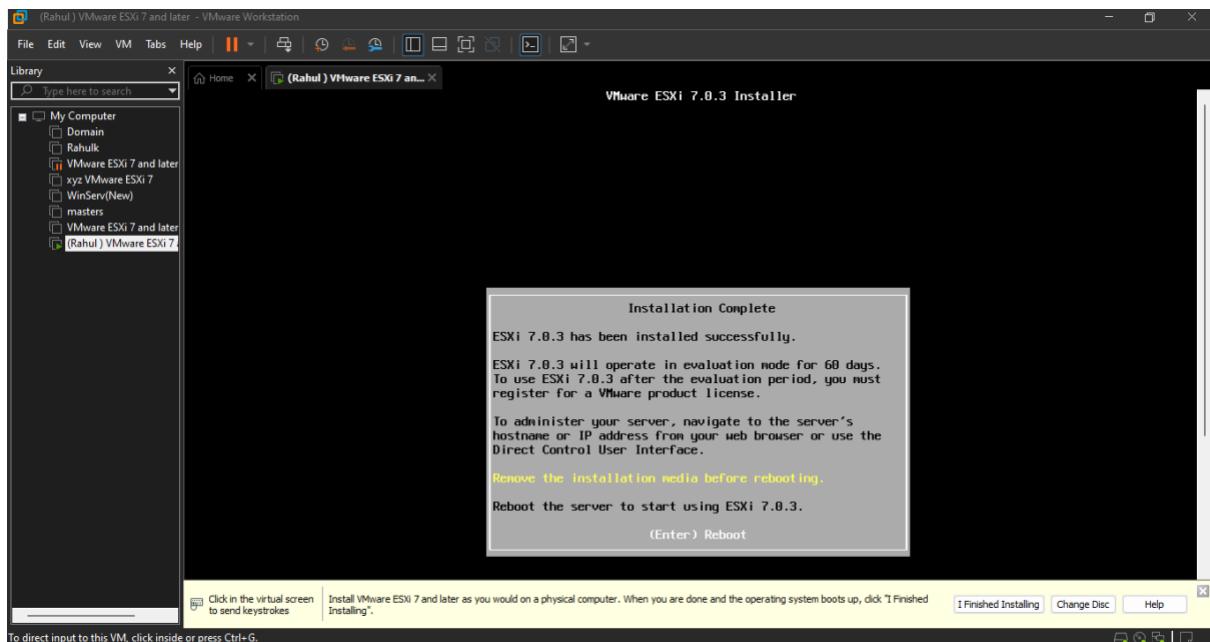
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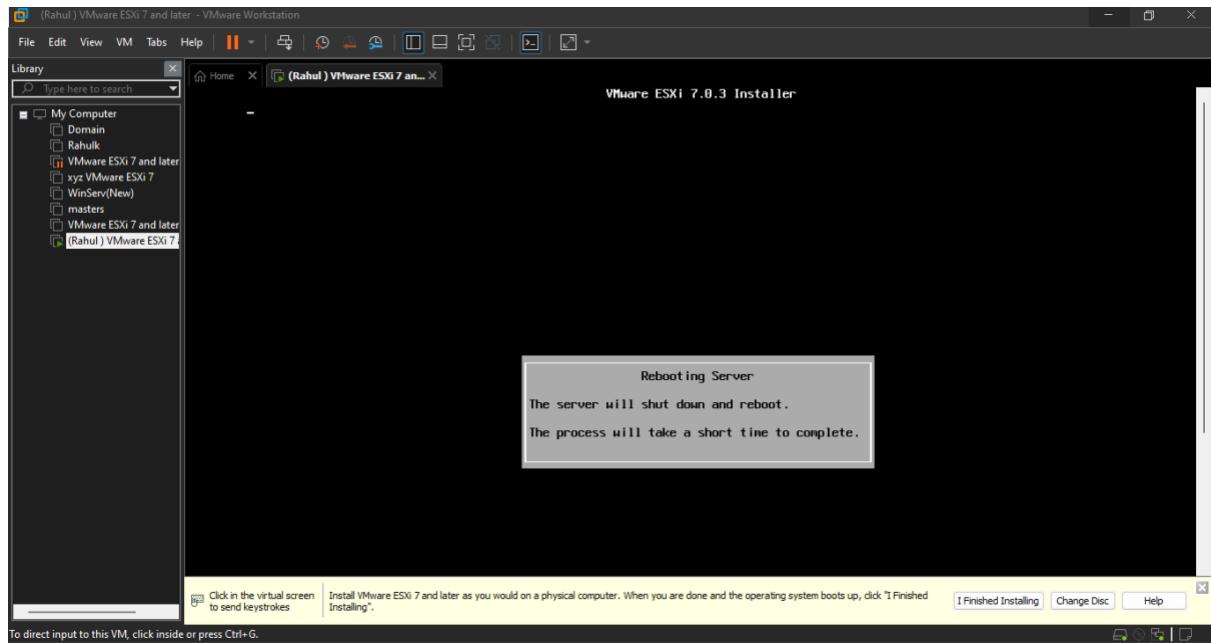
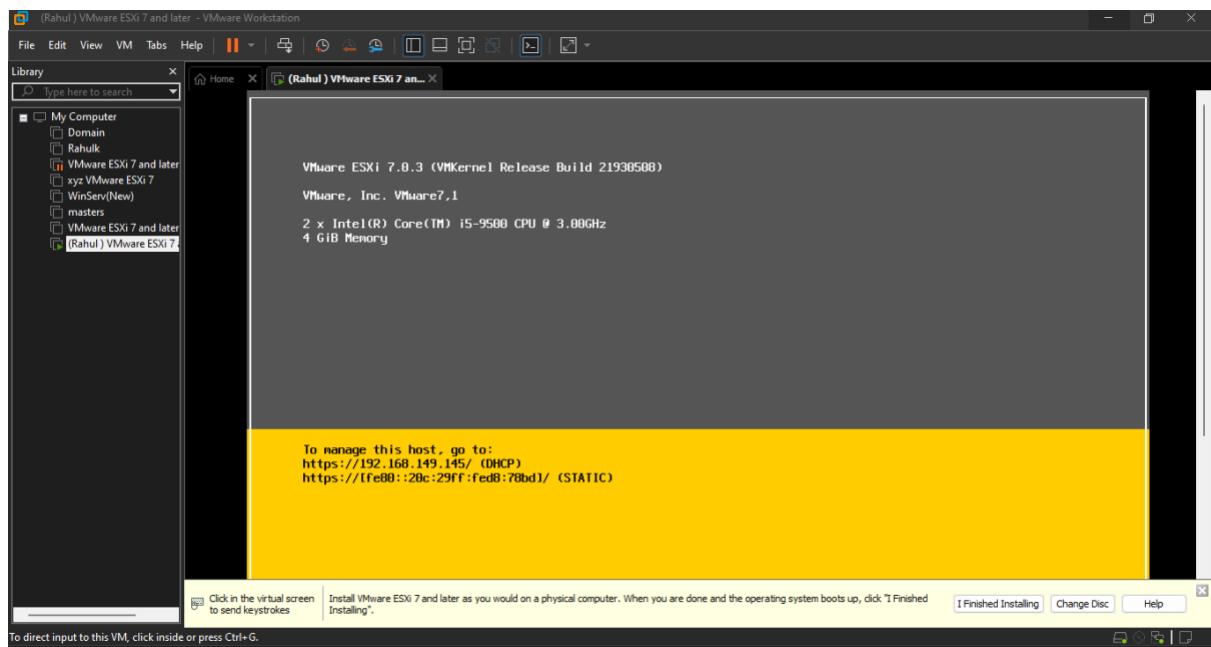


Step 17: Installation Processes start

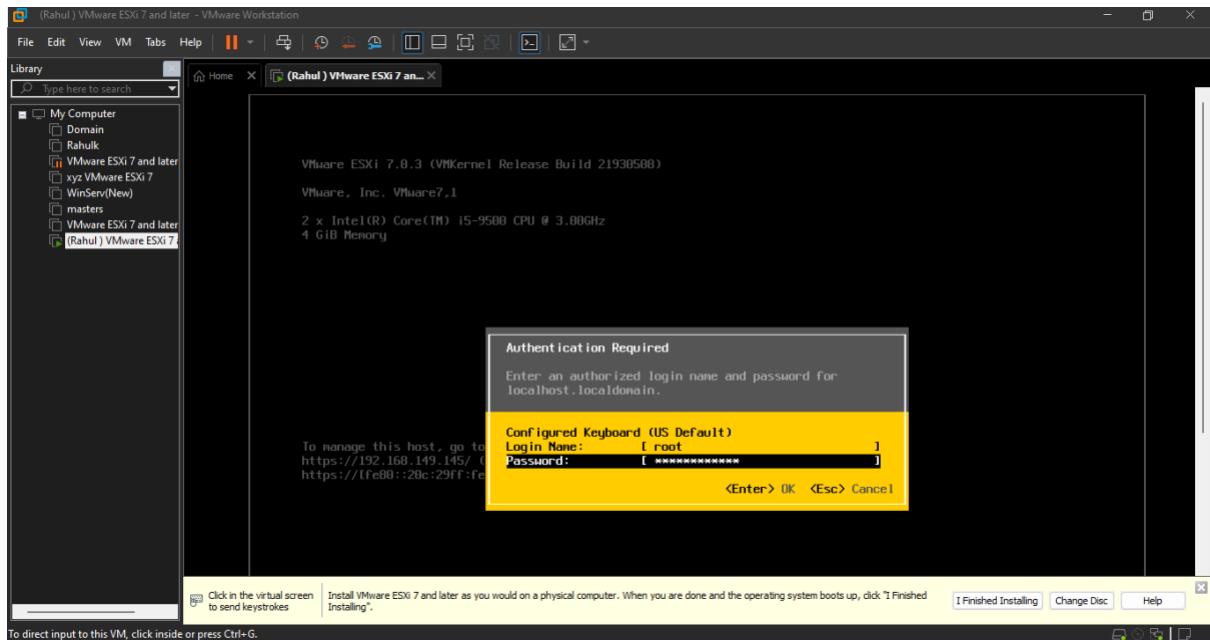


Step 18: After the installation we need to Reboot the Server

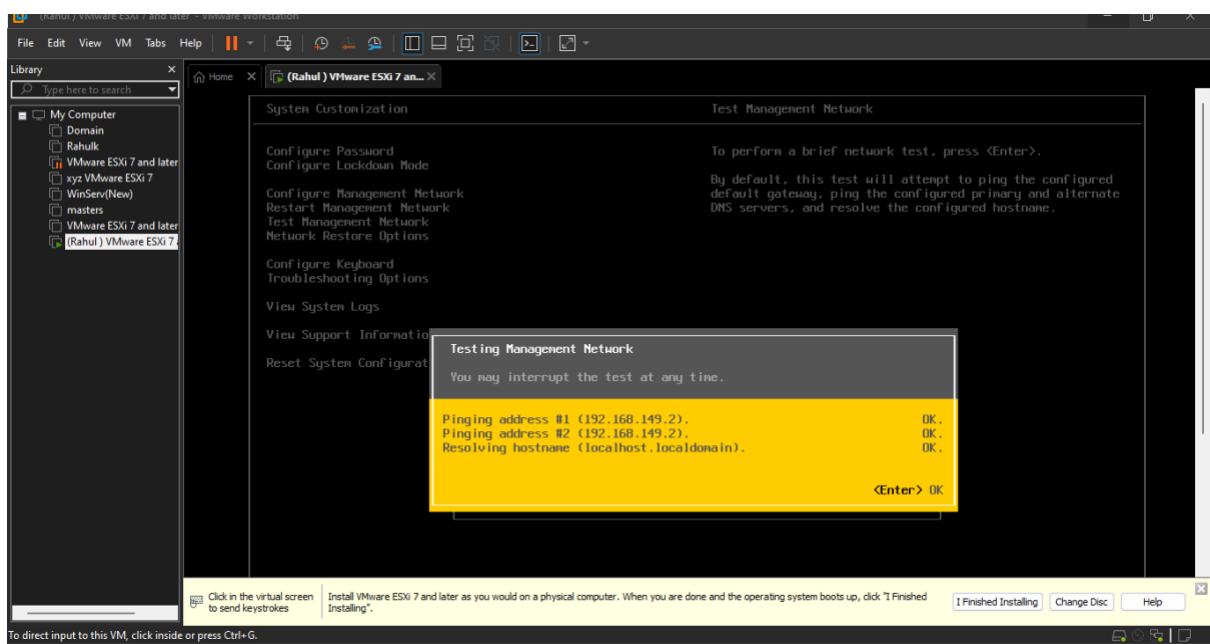


Step 20: It will start the Rebooting Server**Step 21:** To configure the network/new user/etc press F2

Step 22: Before configuring anything we need to enter password to confirm user



Step 23: After configuring we need to test the network if config is working or not.

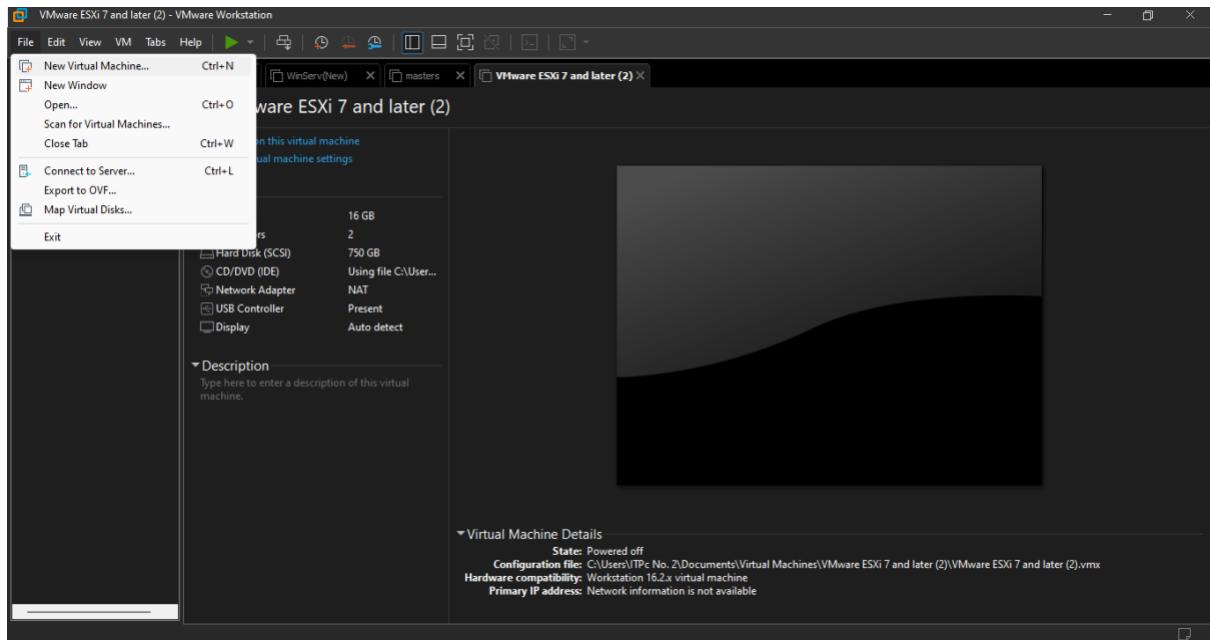


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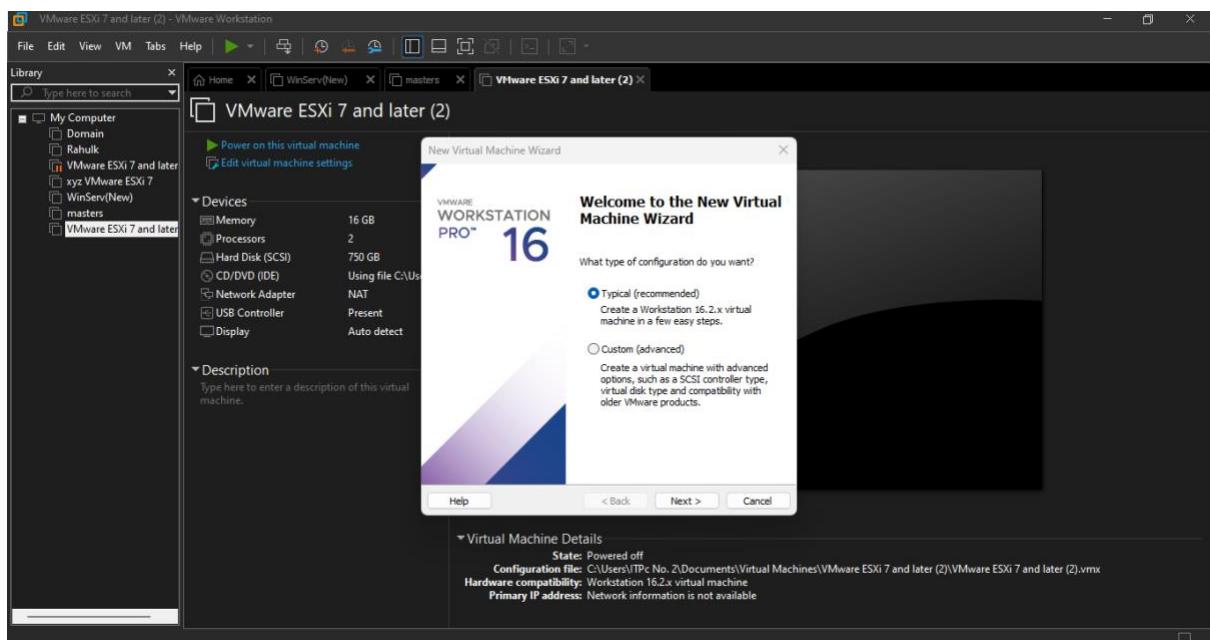
Aim: - Enabling SSH setting in VMWare ESXi.

Writeup:

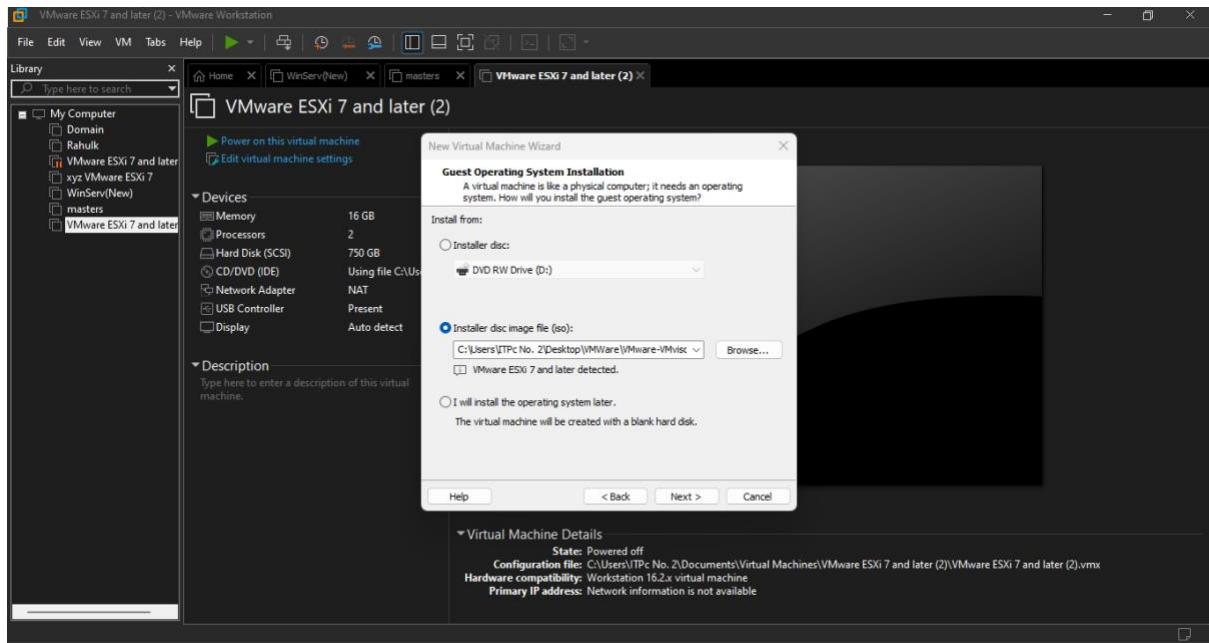
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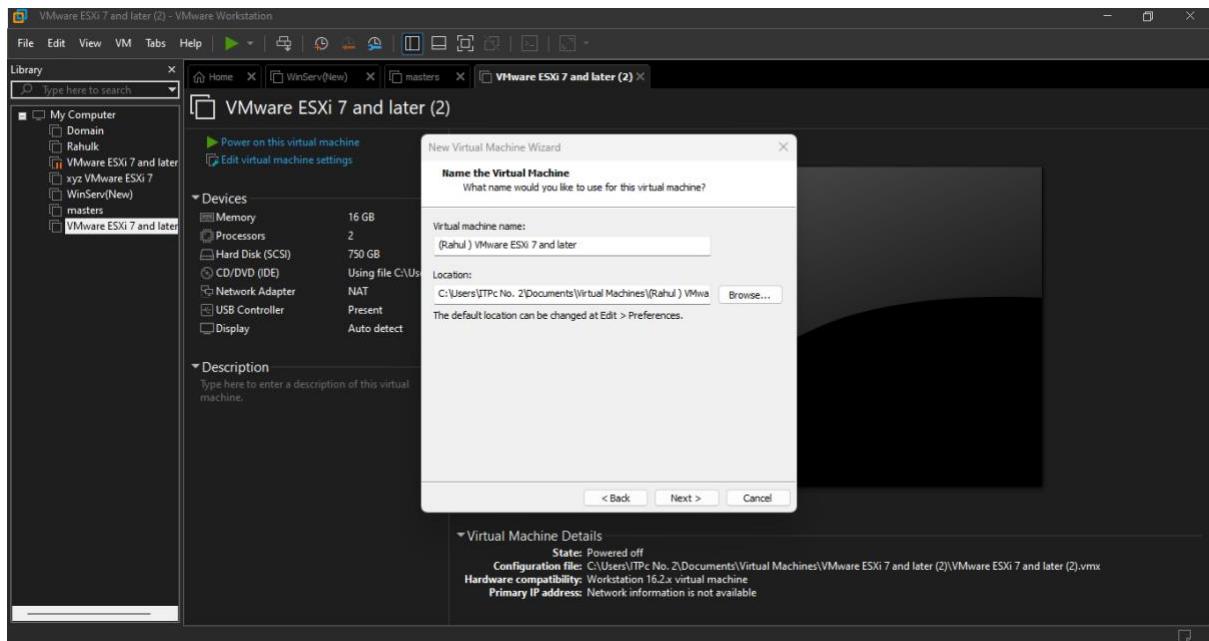
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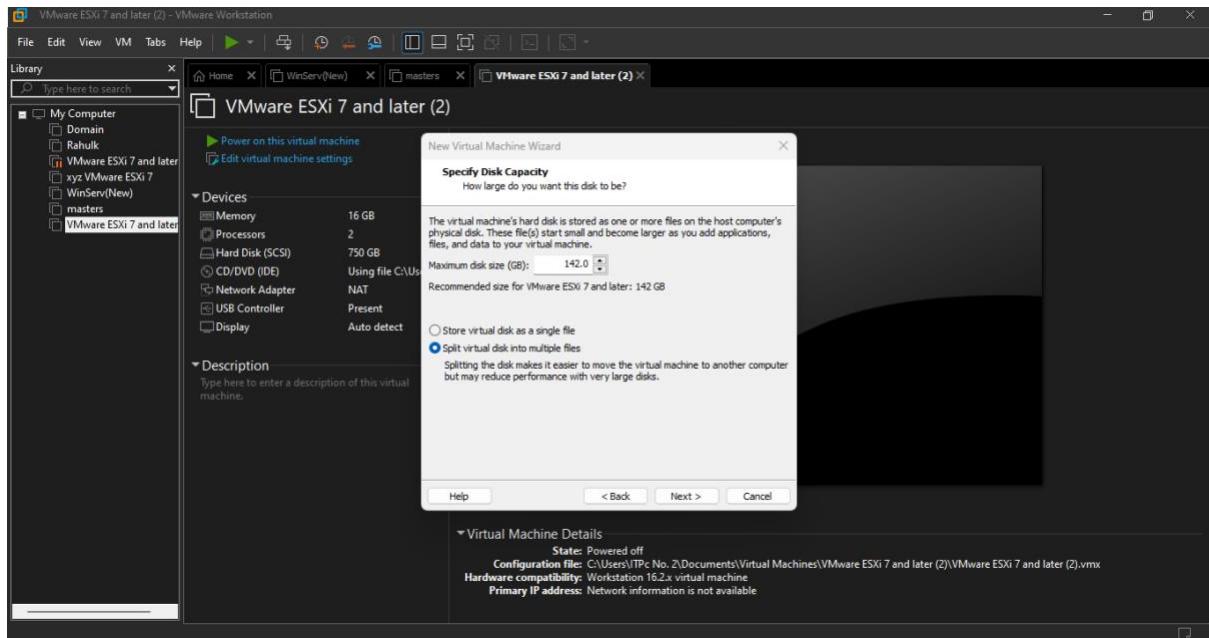
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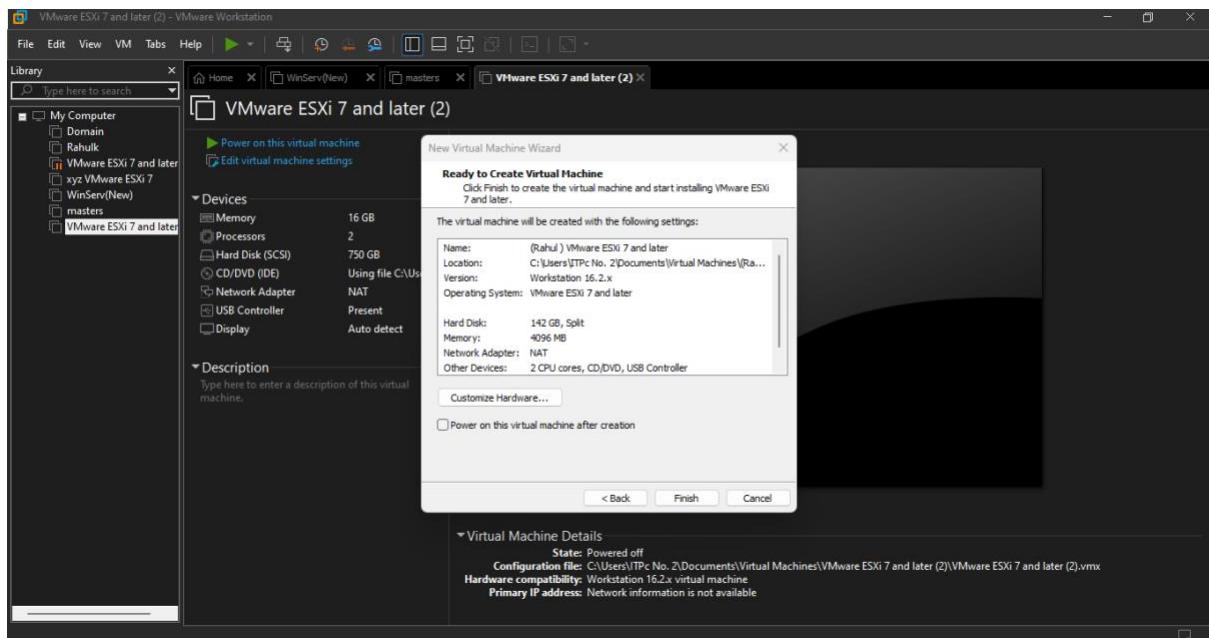
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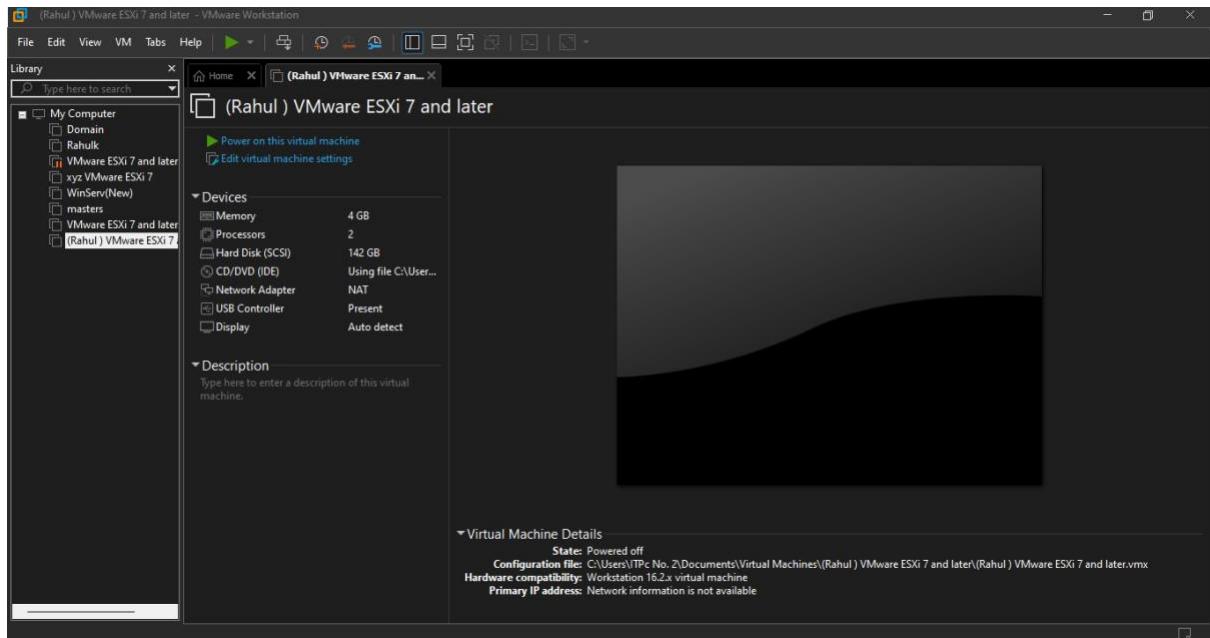
Step 5: Keep the default setting and Click on Next



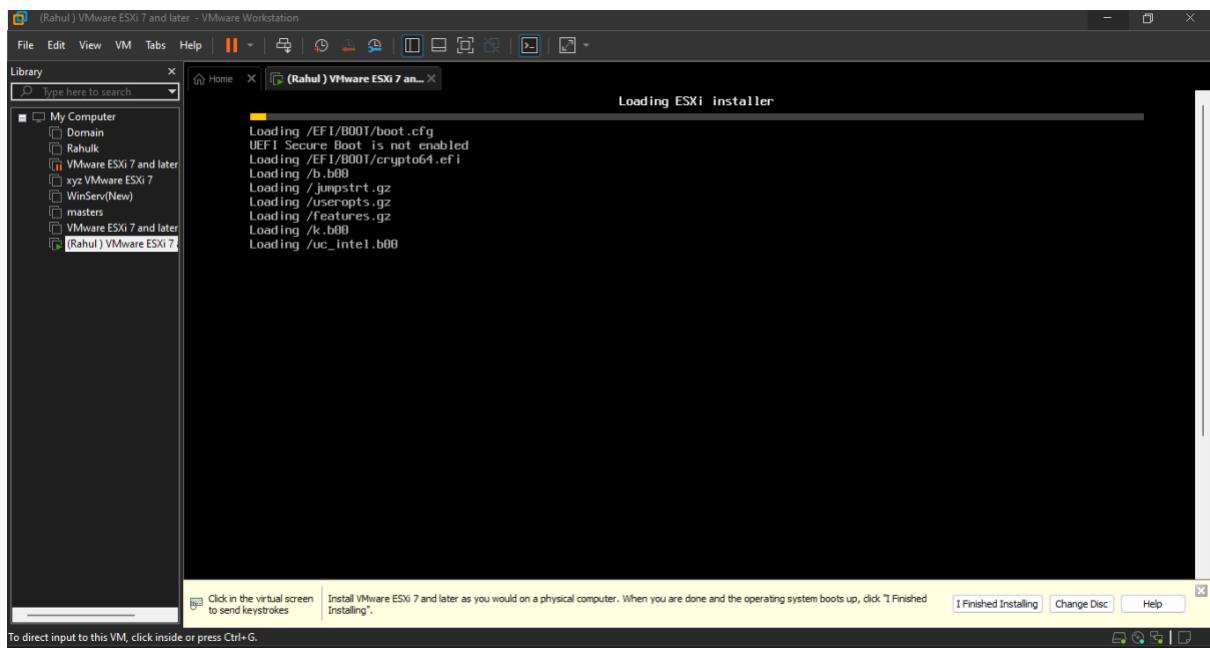
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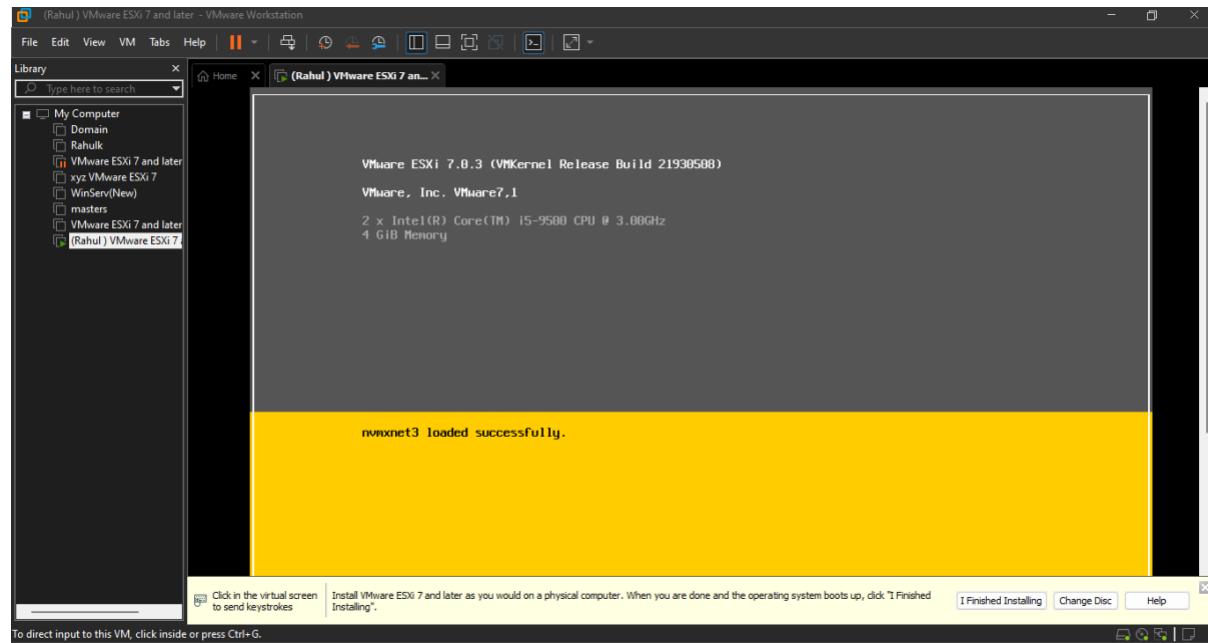
Step 7: Click on Power on this virtual machine



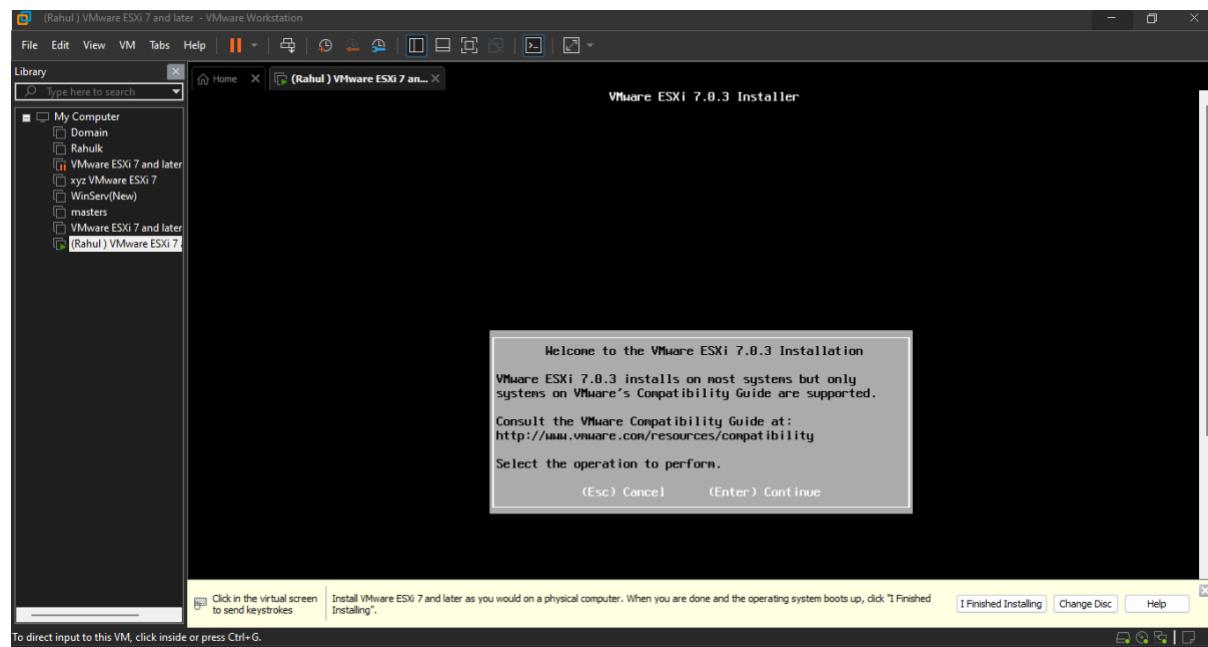
Step 8: It will start installation



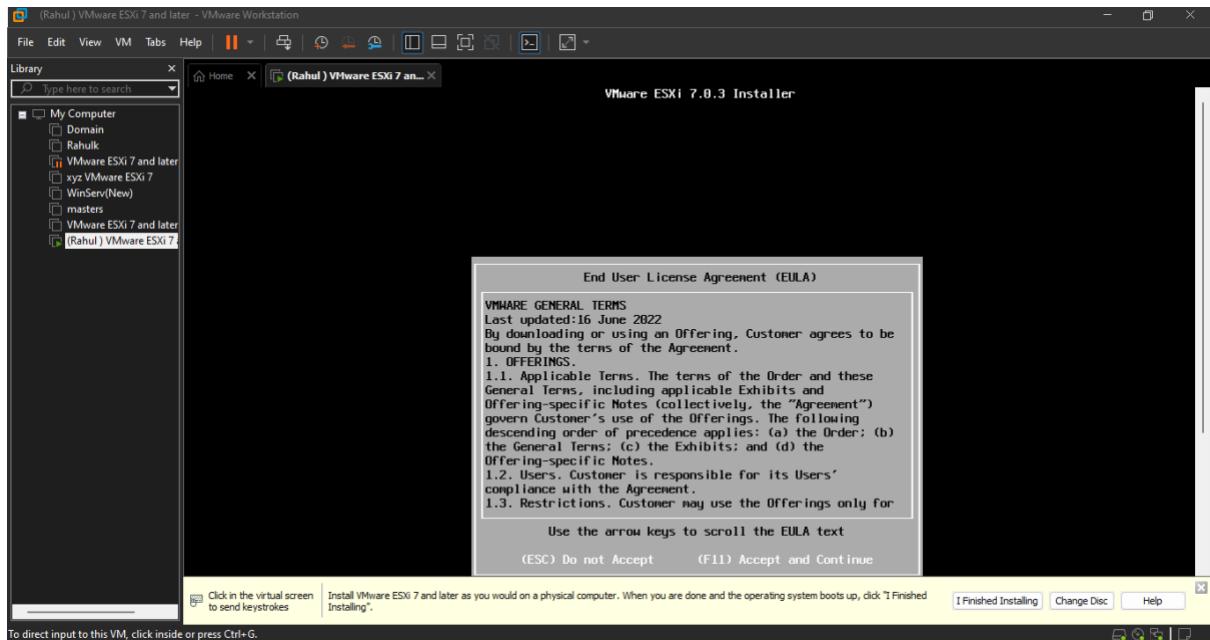
Step 9: Installation Processes start.



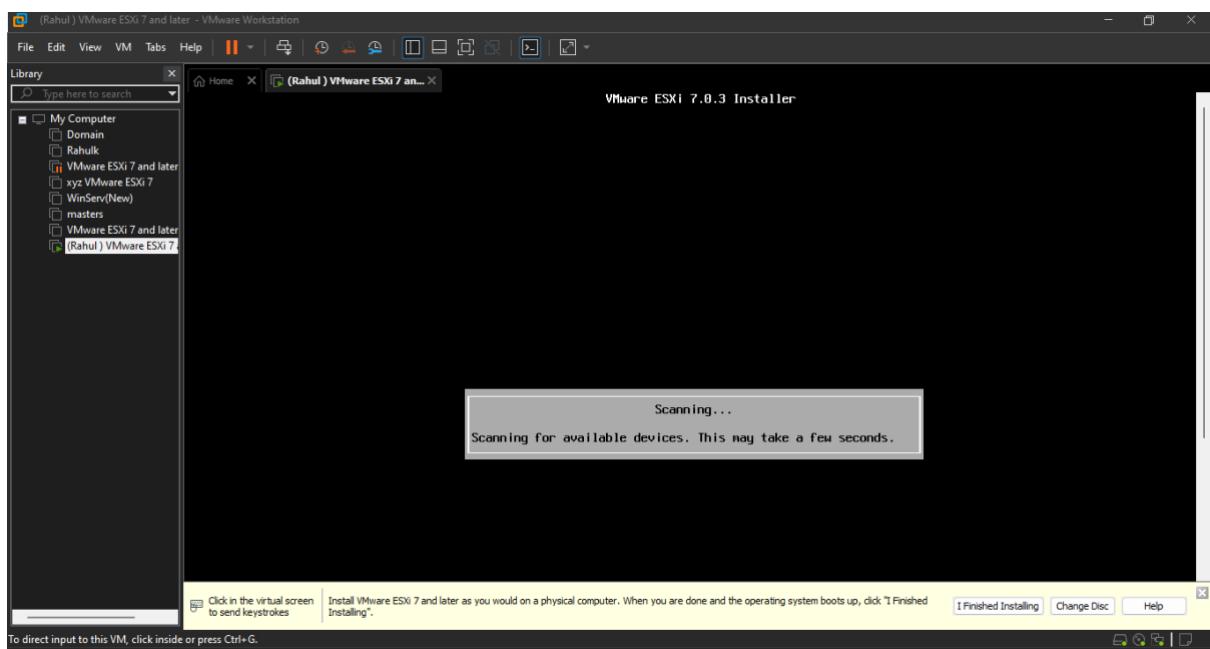
Step 10: Click on Enter



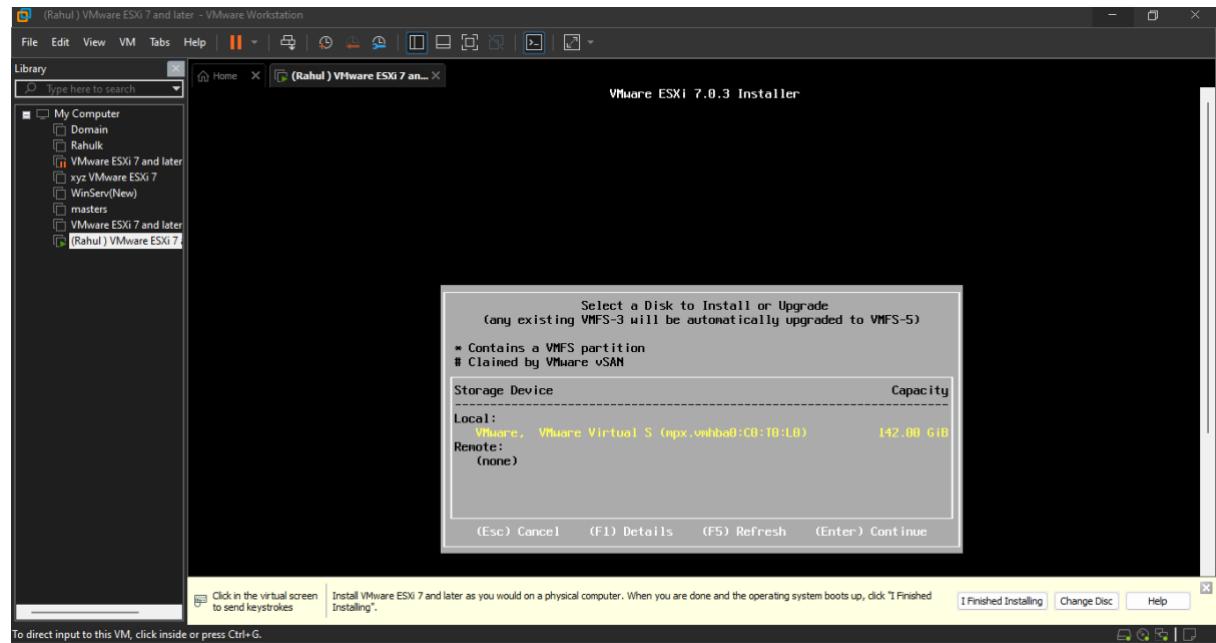
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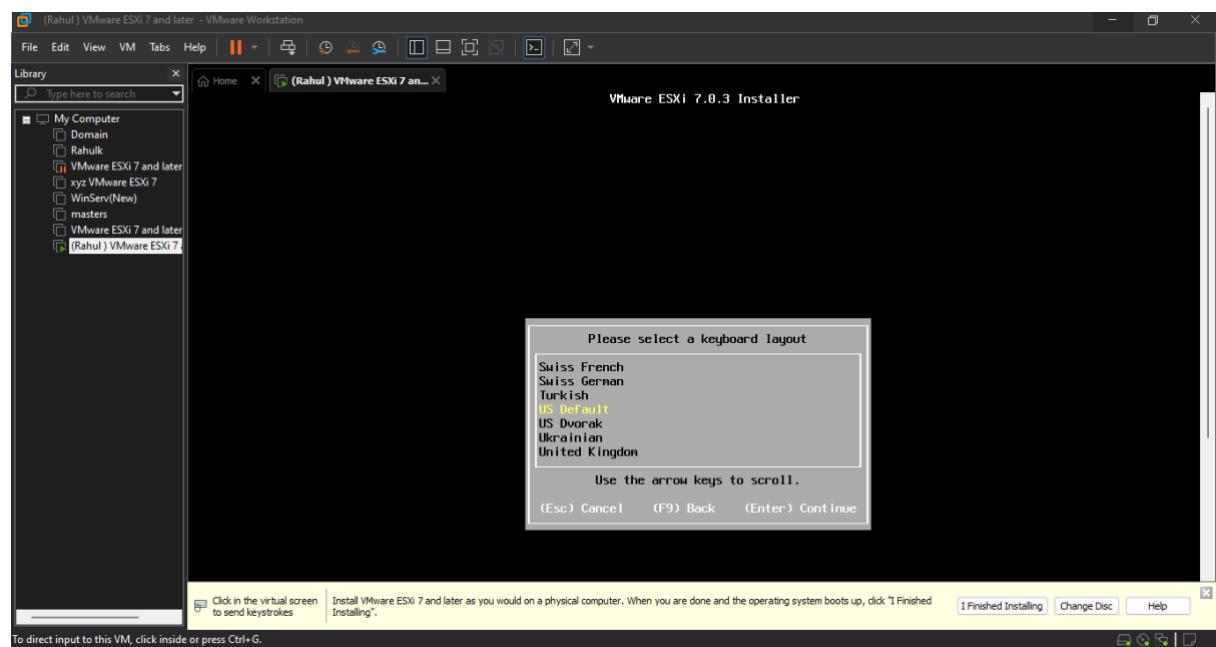
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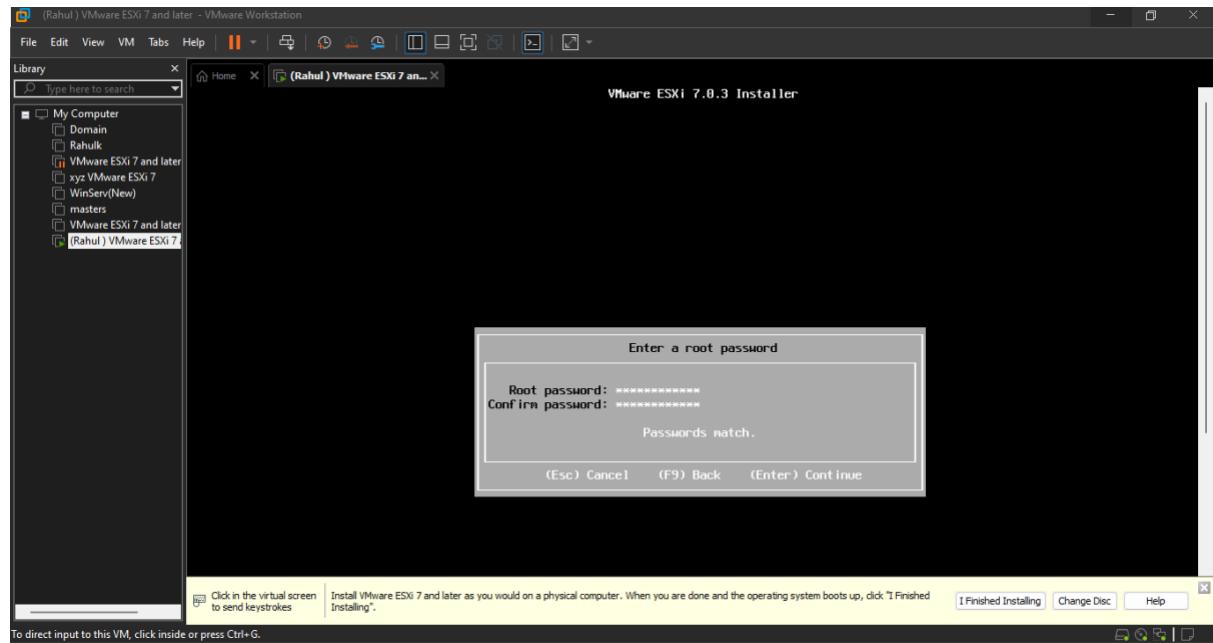
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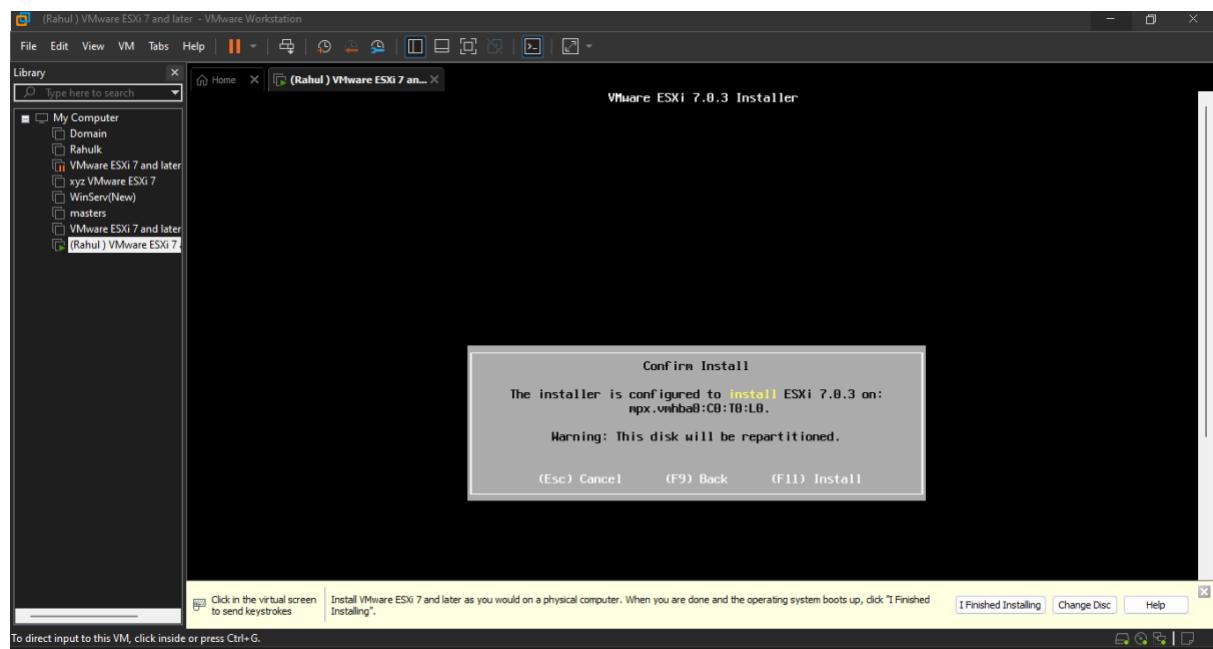
Step 14: Keep the default value and **Click on Enter**



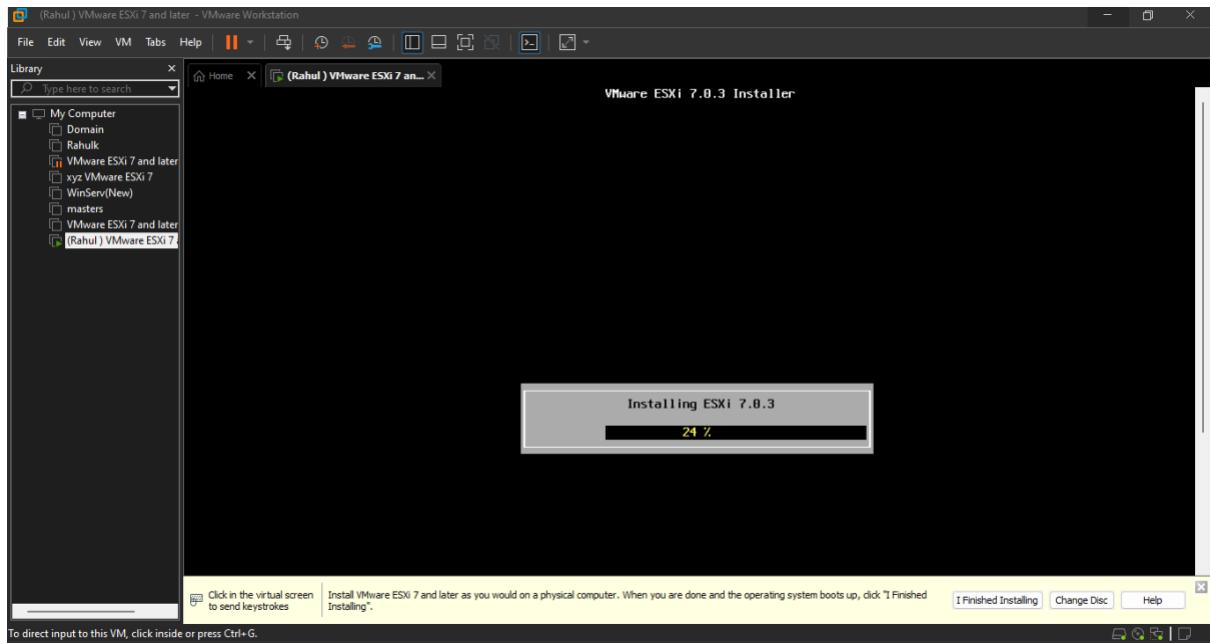
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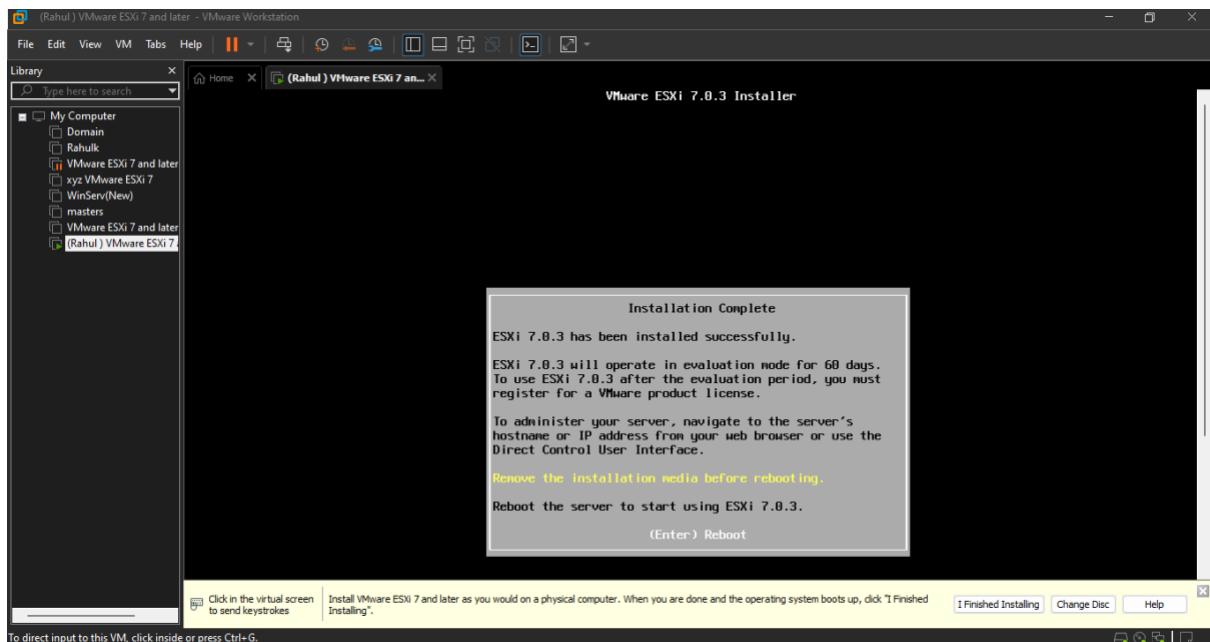
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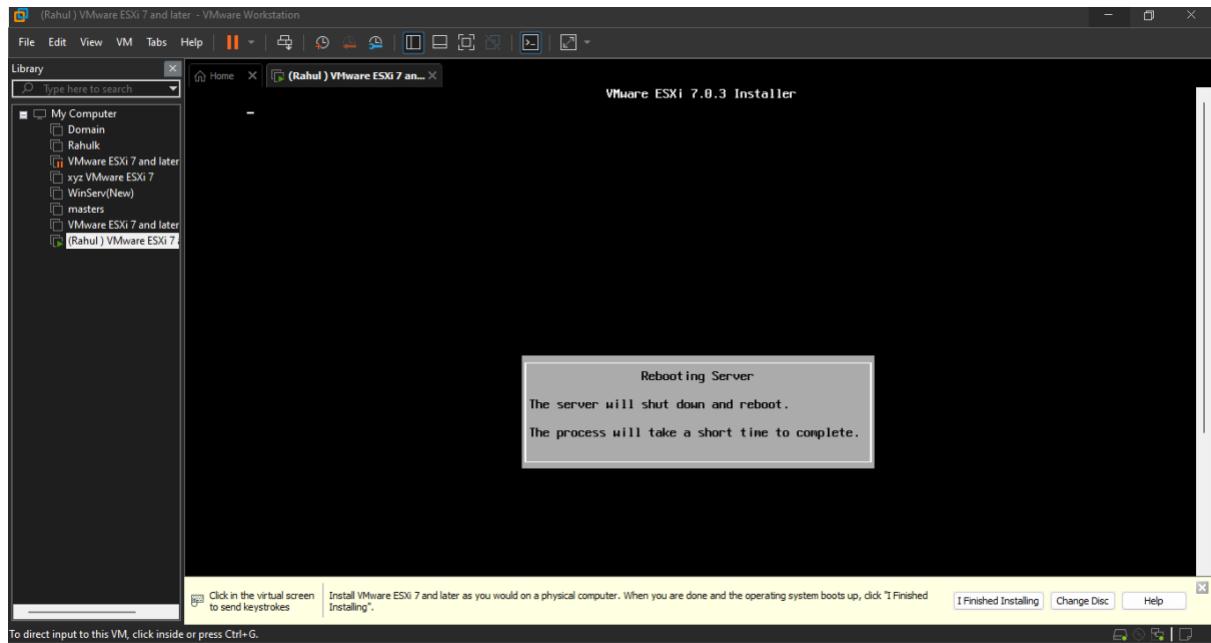
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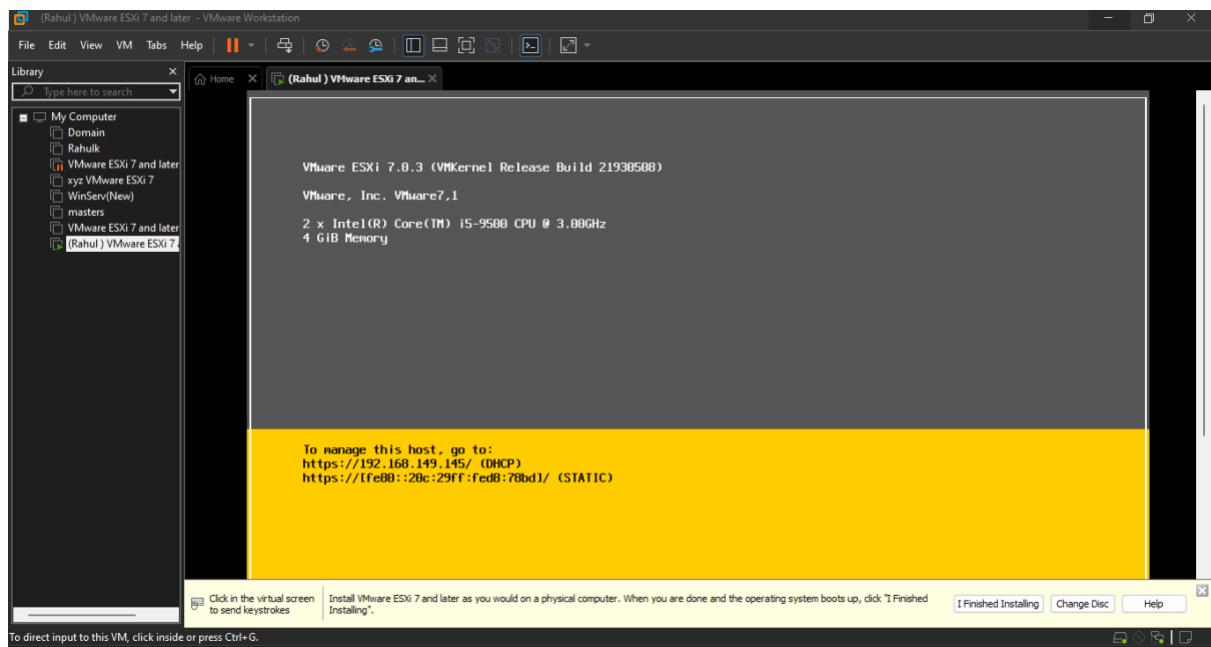
Step 18: After the installation we need to Reboot the Server



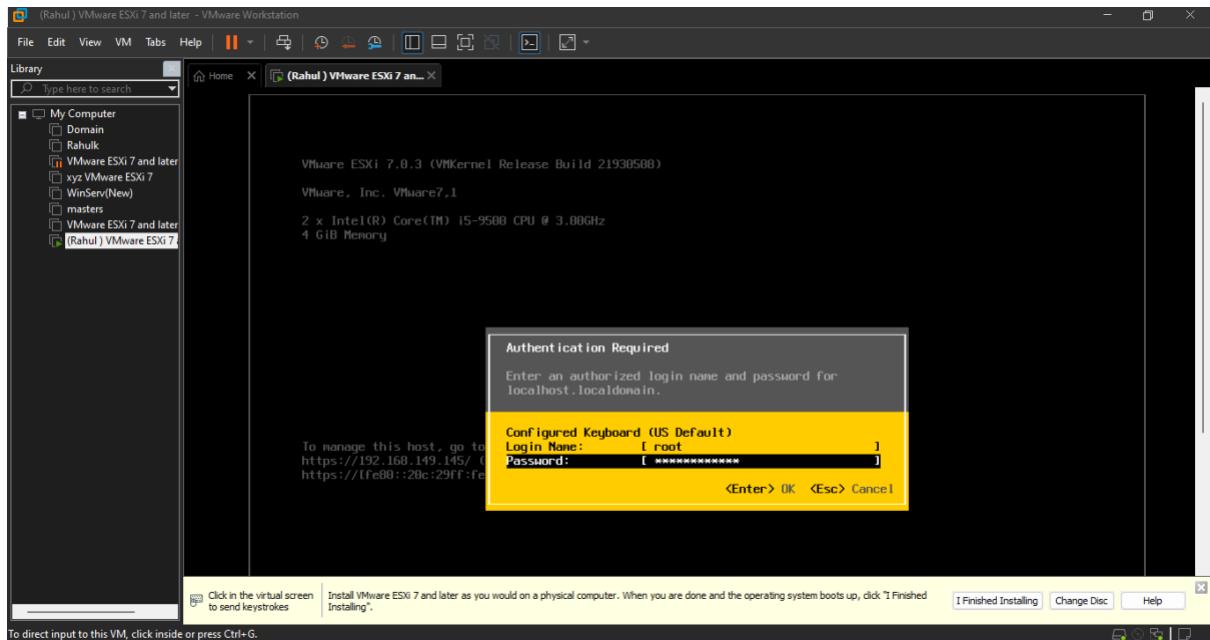
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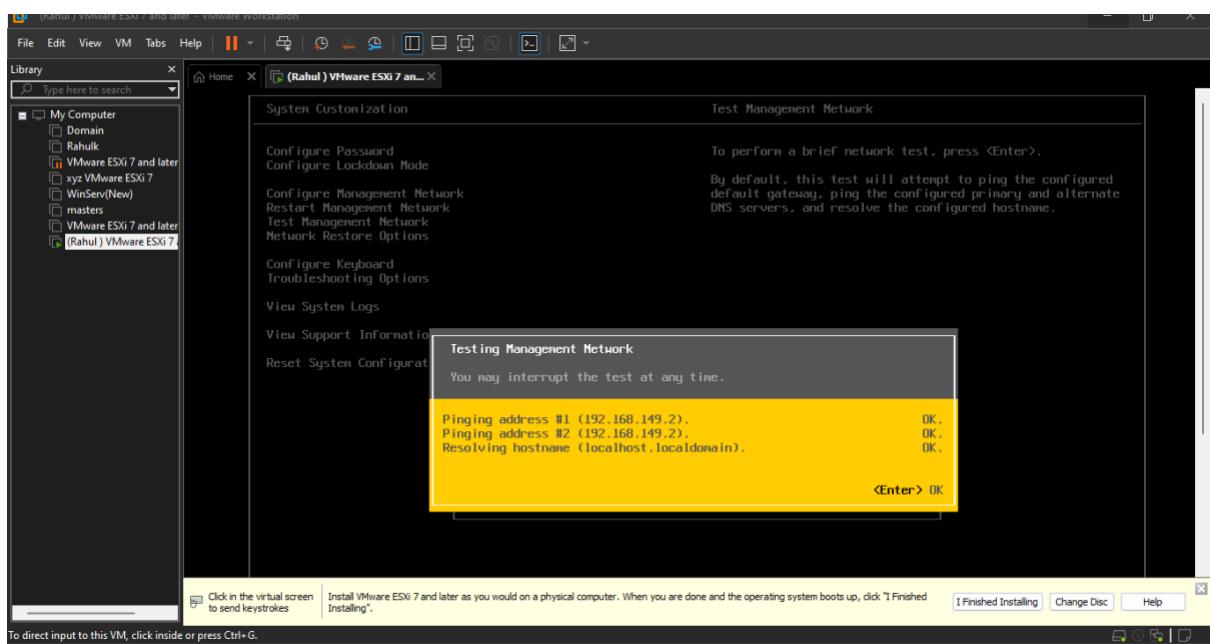
Step 21: To configure the network/new user/etc press F2



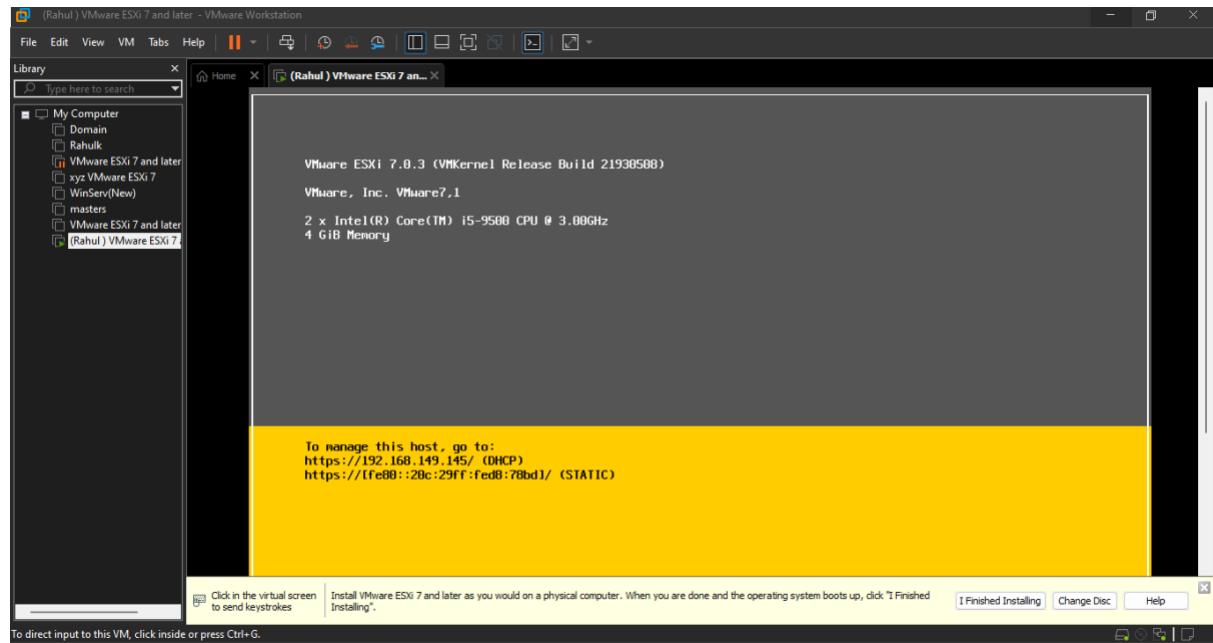
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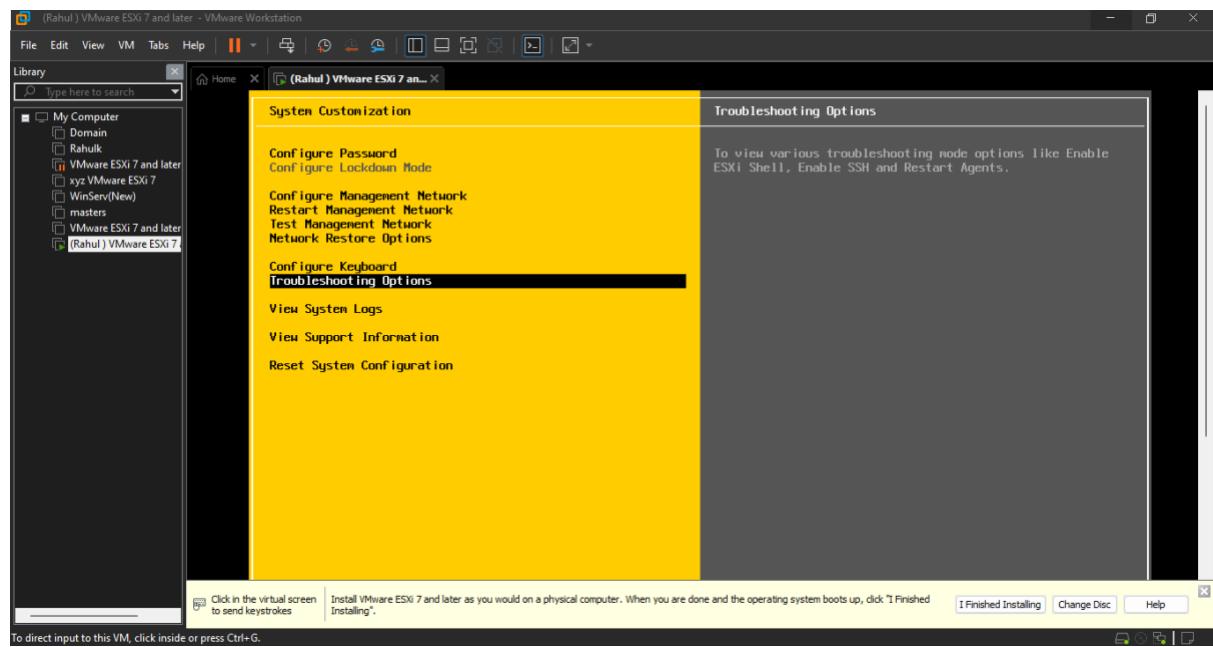
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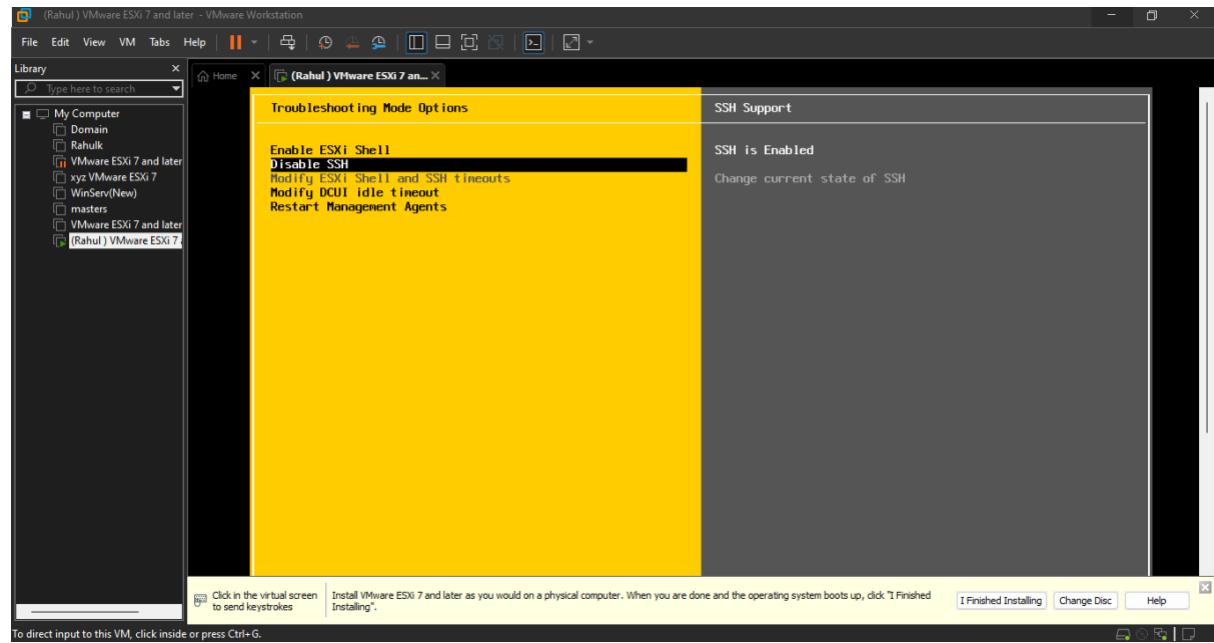
Step 24: To configure the SSH press F2



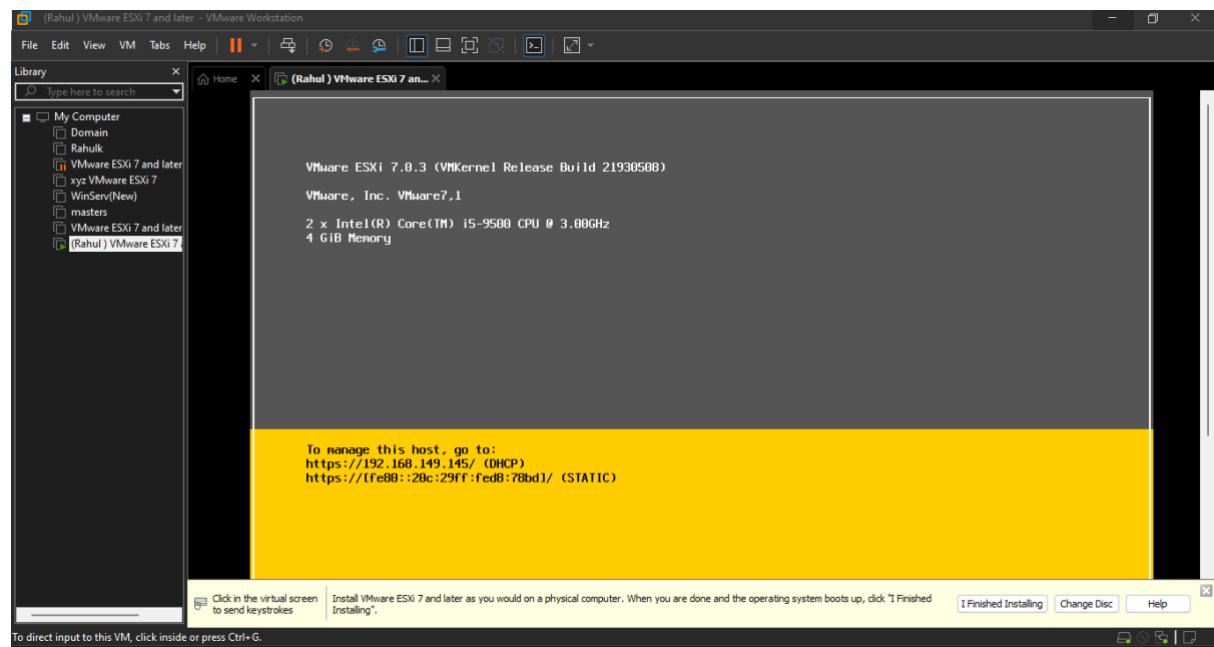
Step 23: Select “Troubleshooting Option” click Enter



Step 24: Select “Disable SSH” and Enter to Enable SSH



Step 25: Press Esc button to go back and save the setting

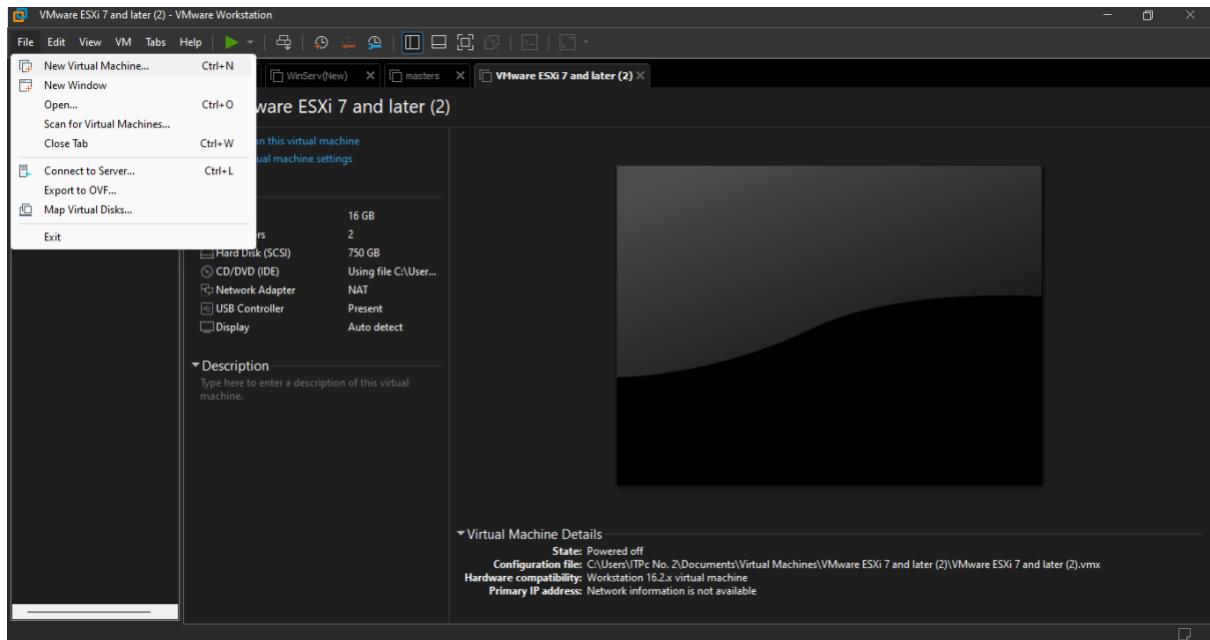


Practical: 3

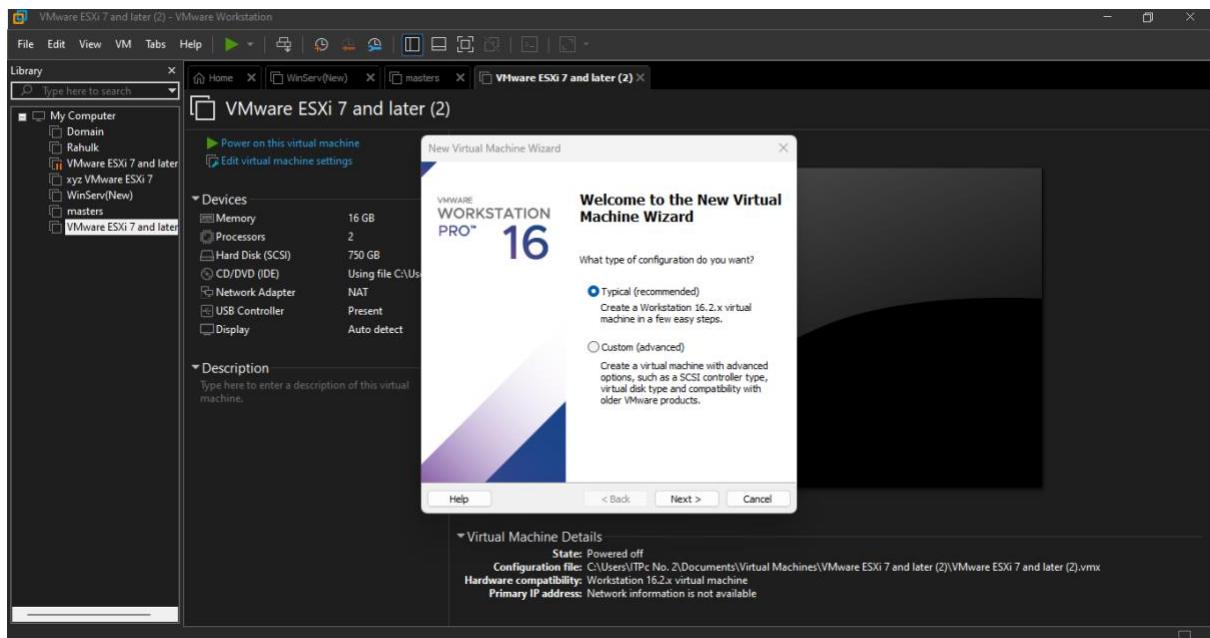
Aim: Deploying and configuring a virtual machine.

Writeup:

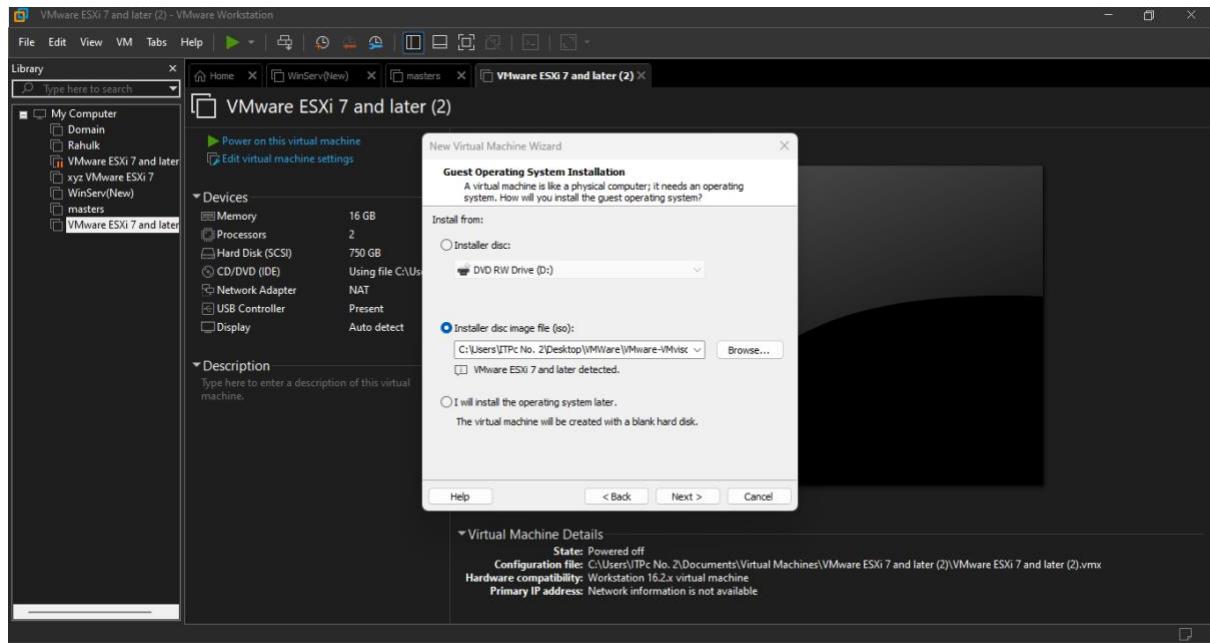
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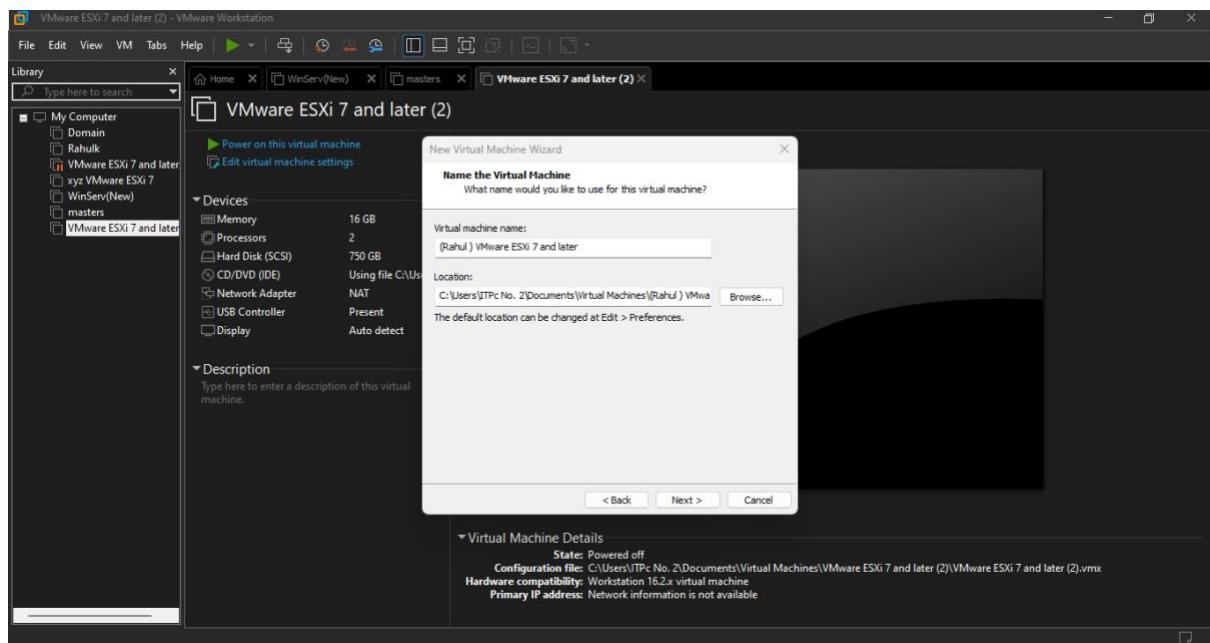
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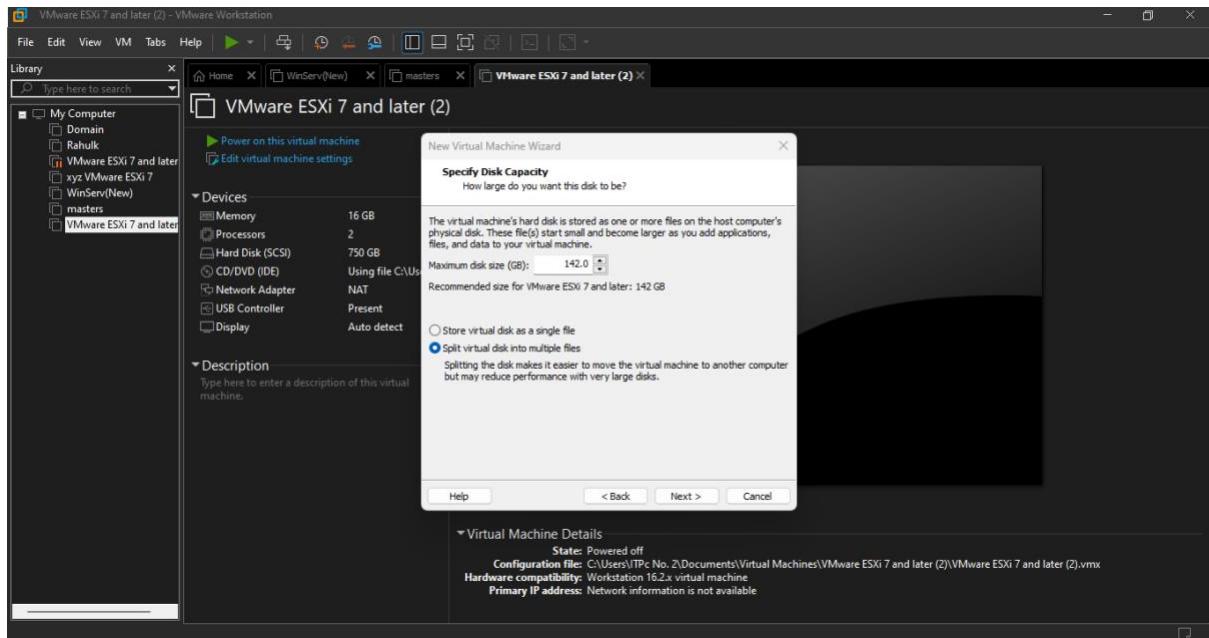
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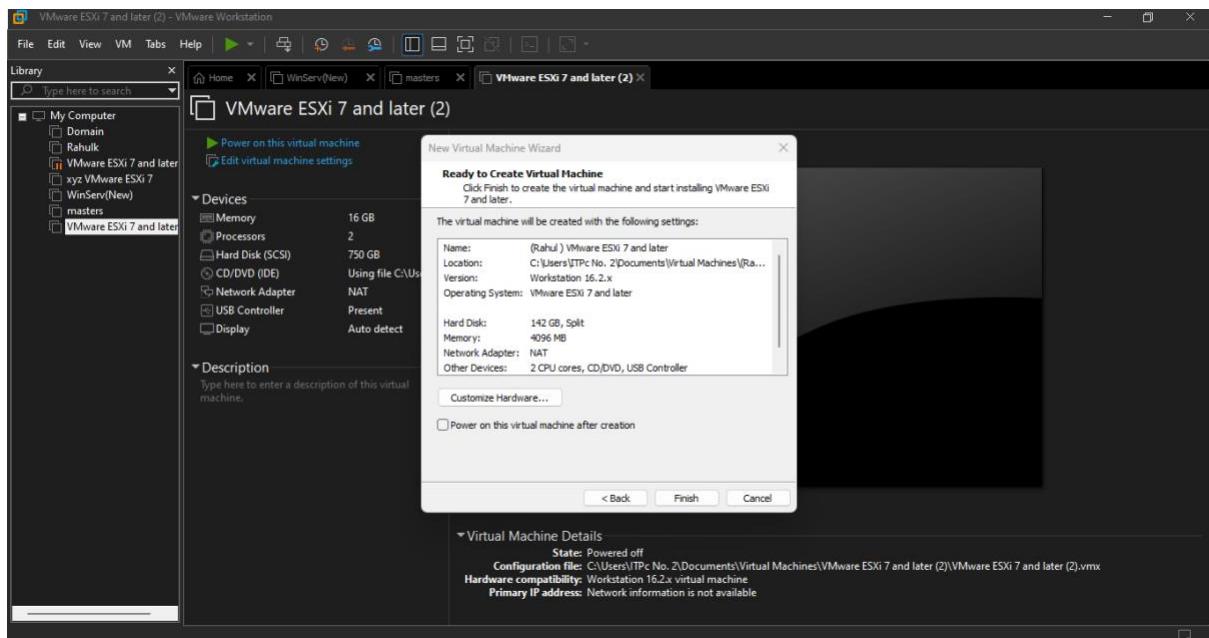
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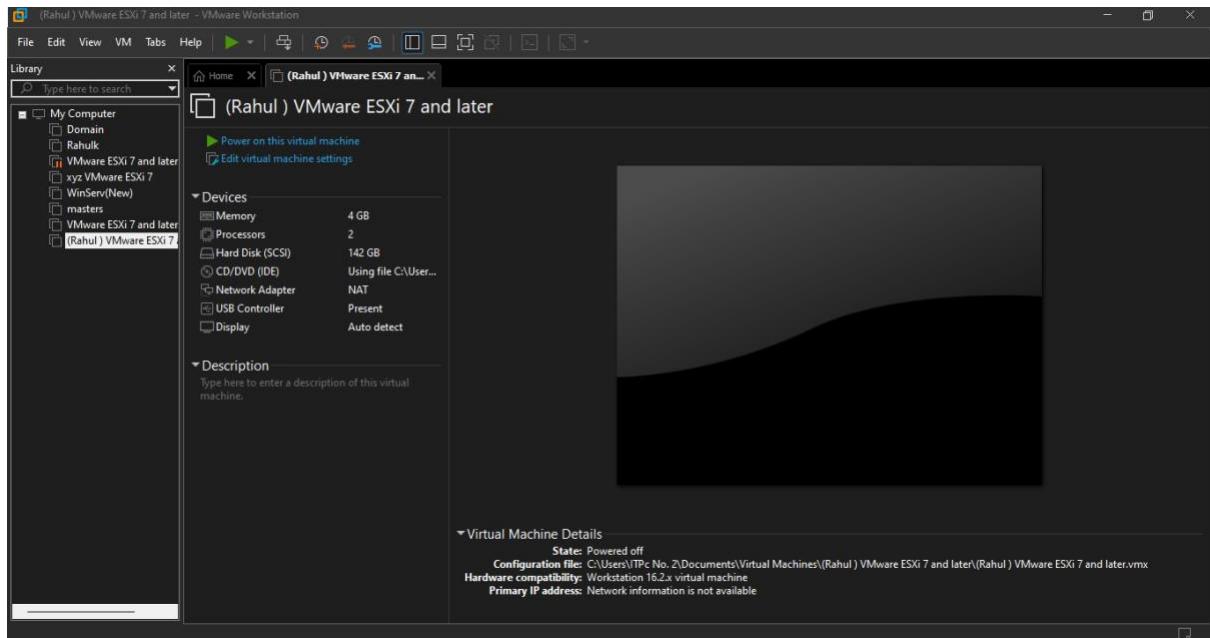
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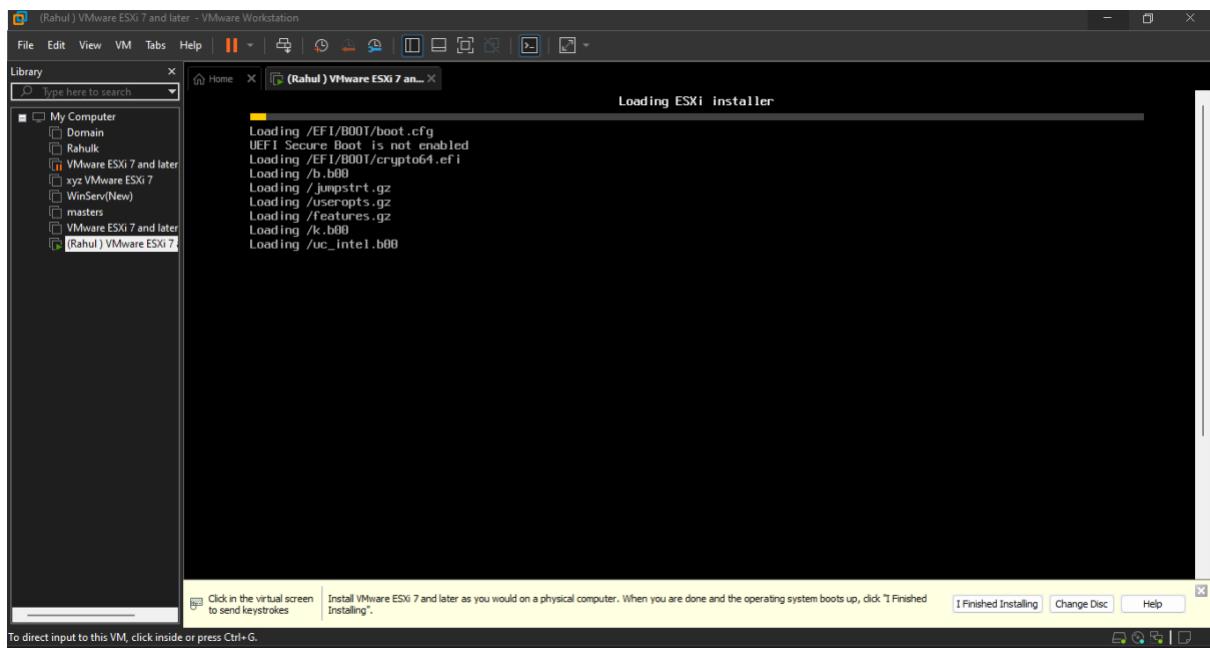
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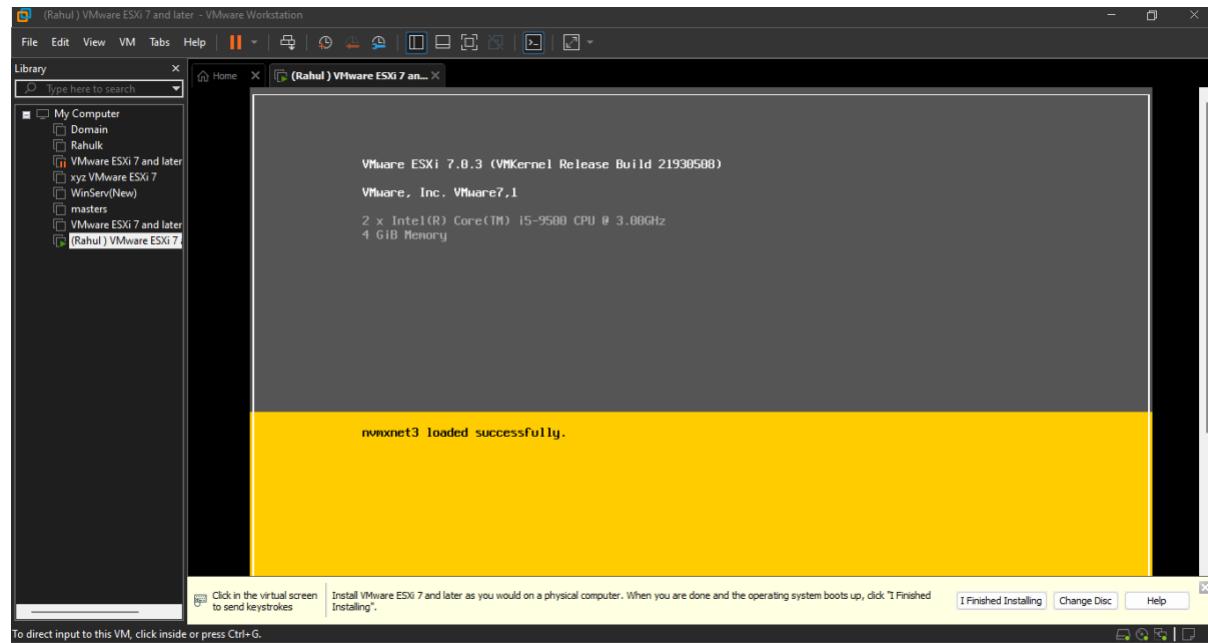
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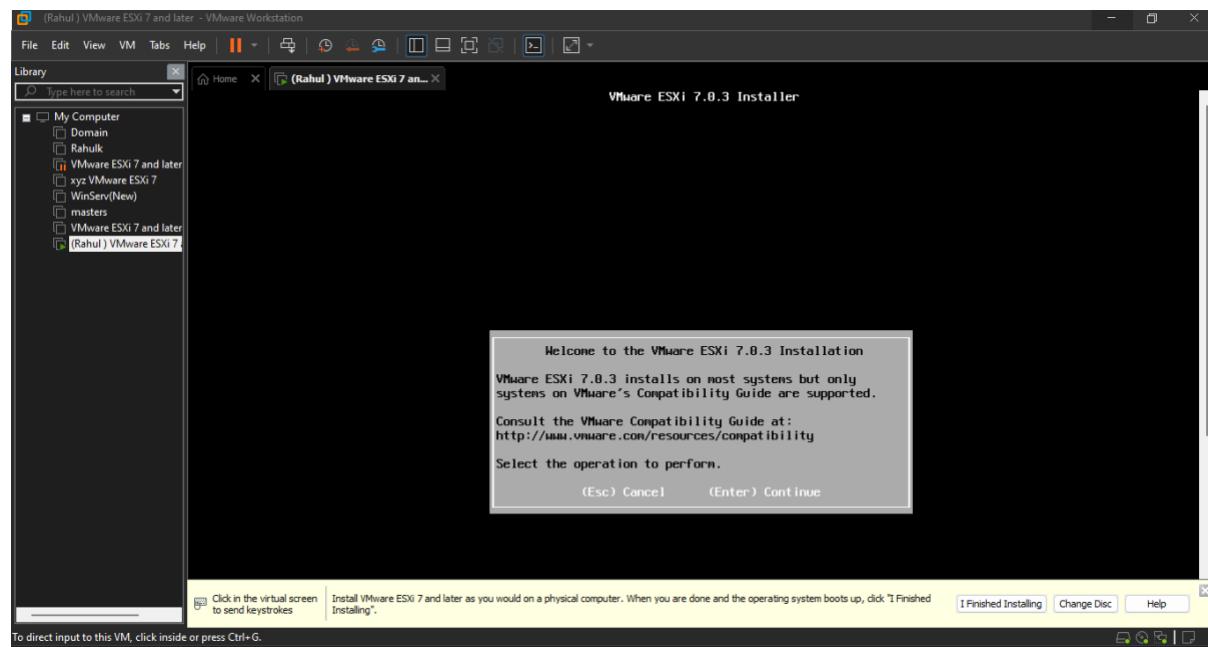
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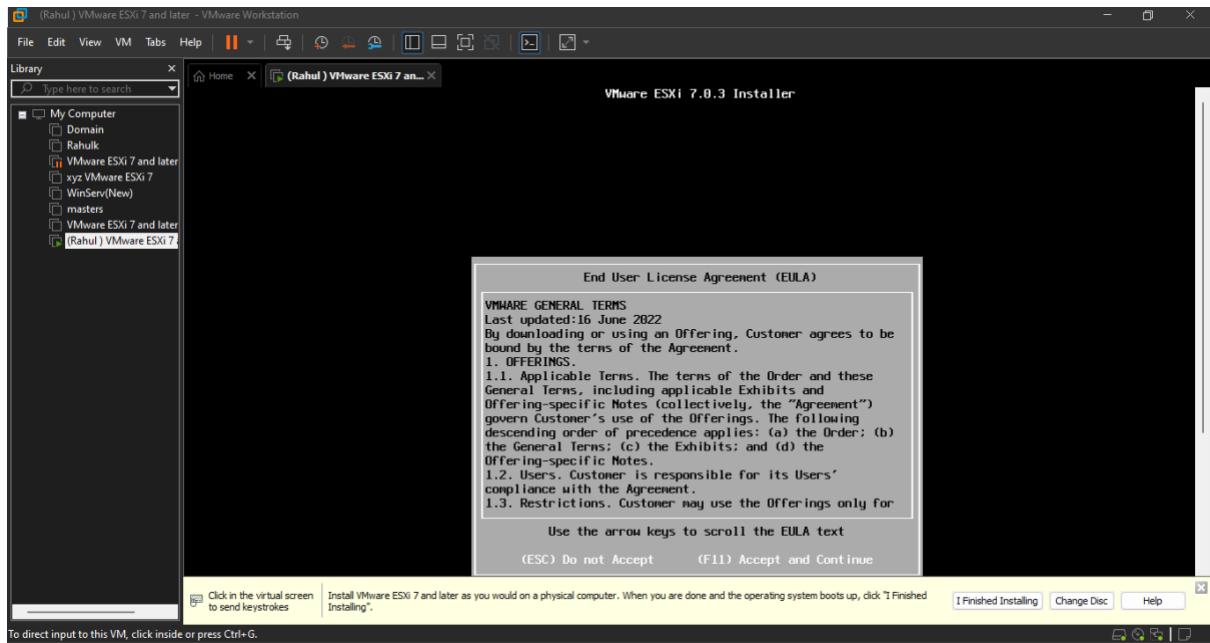
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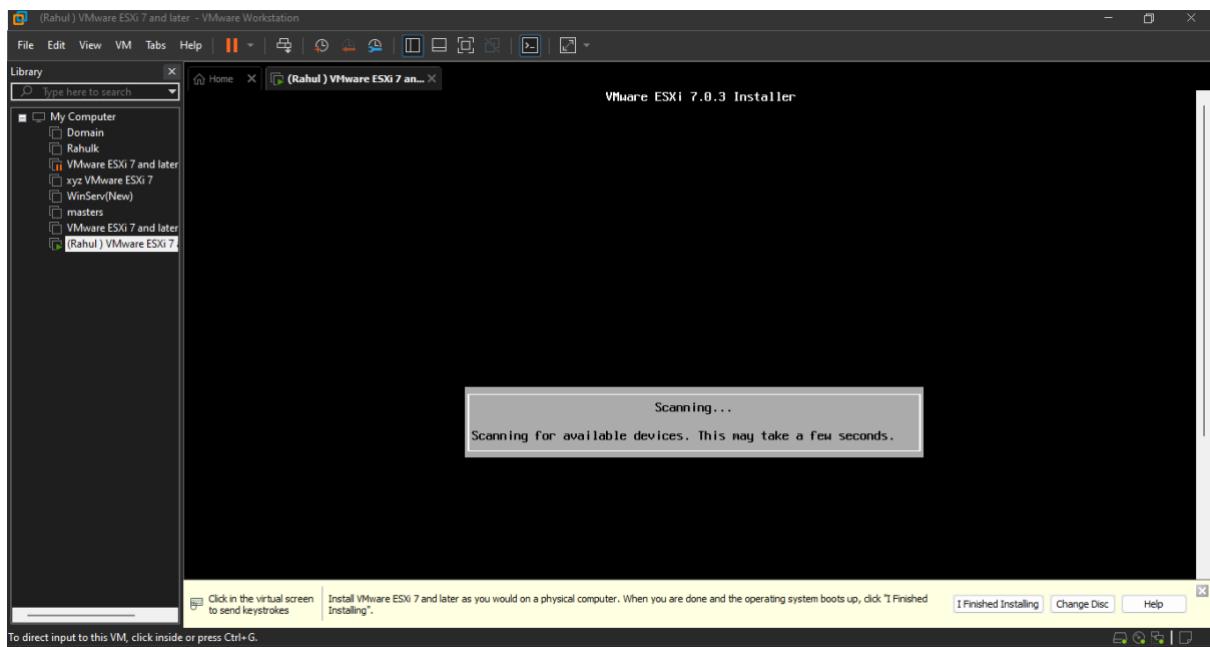
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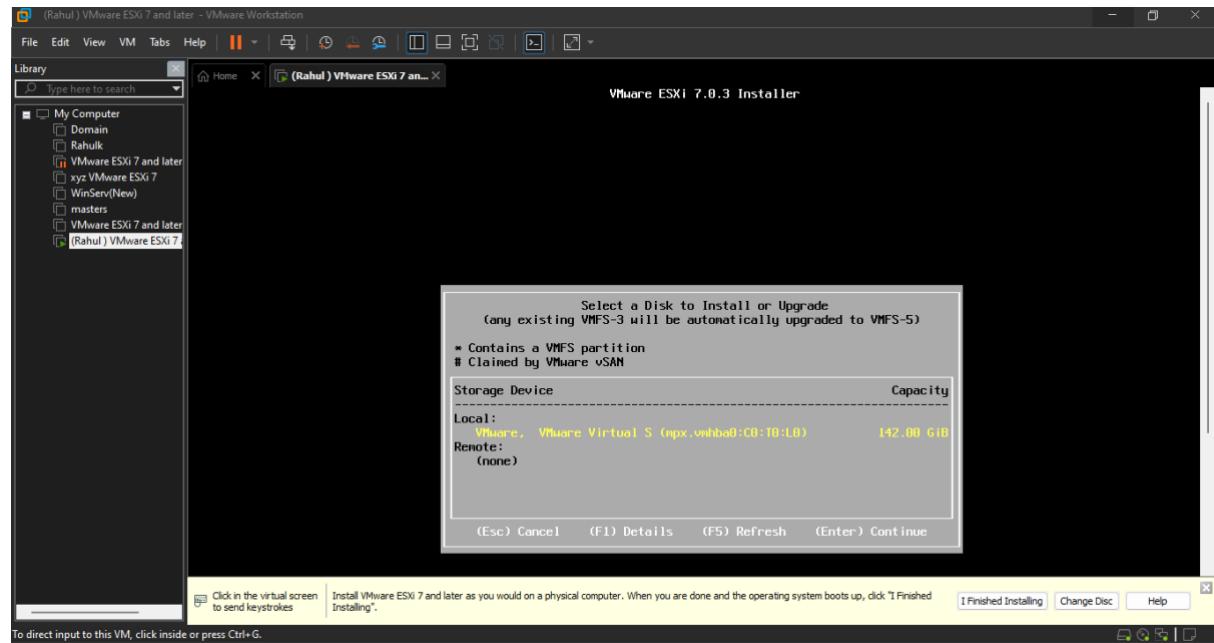
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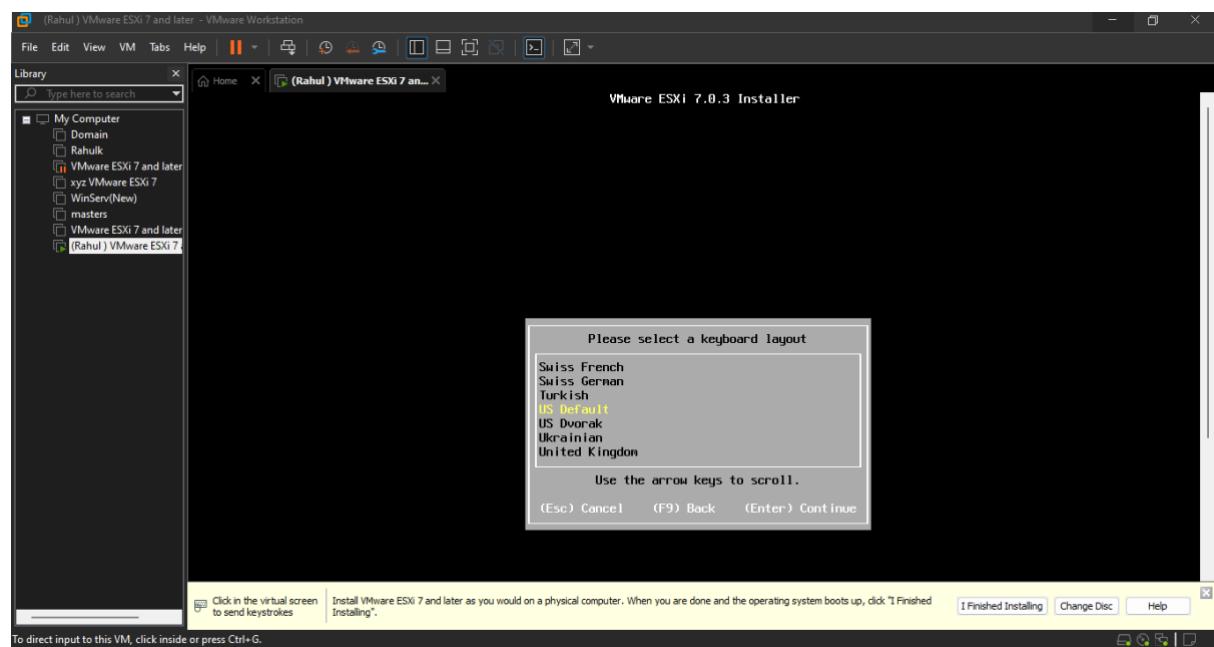
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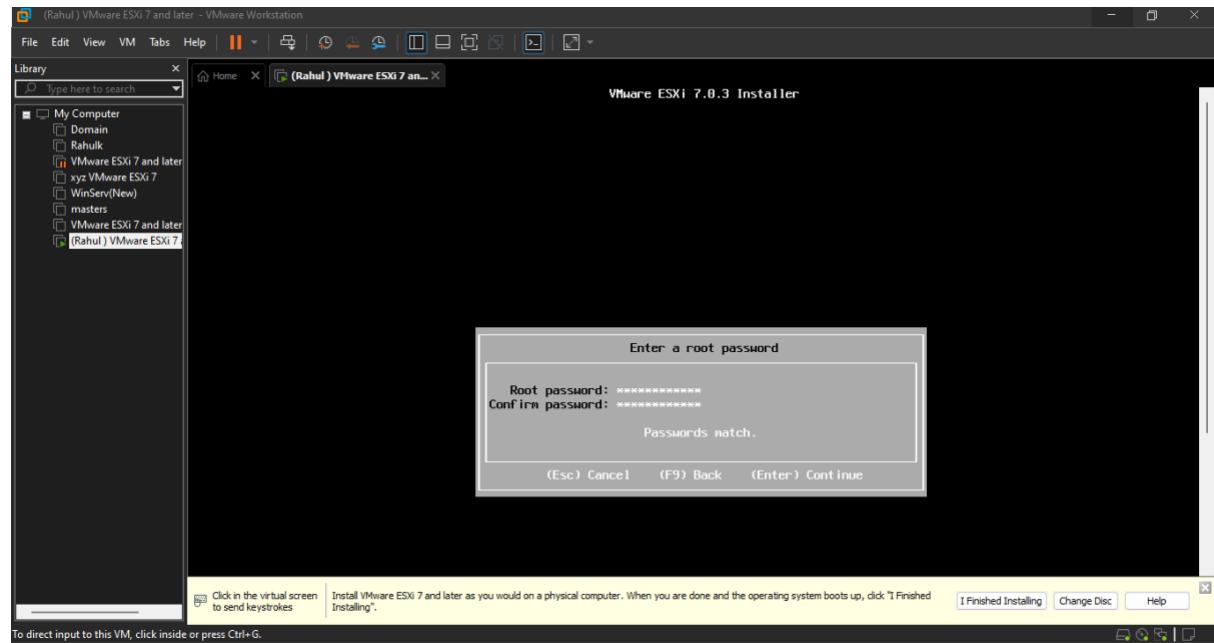
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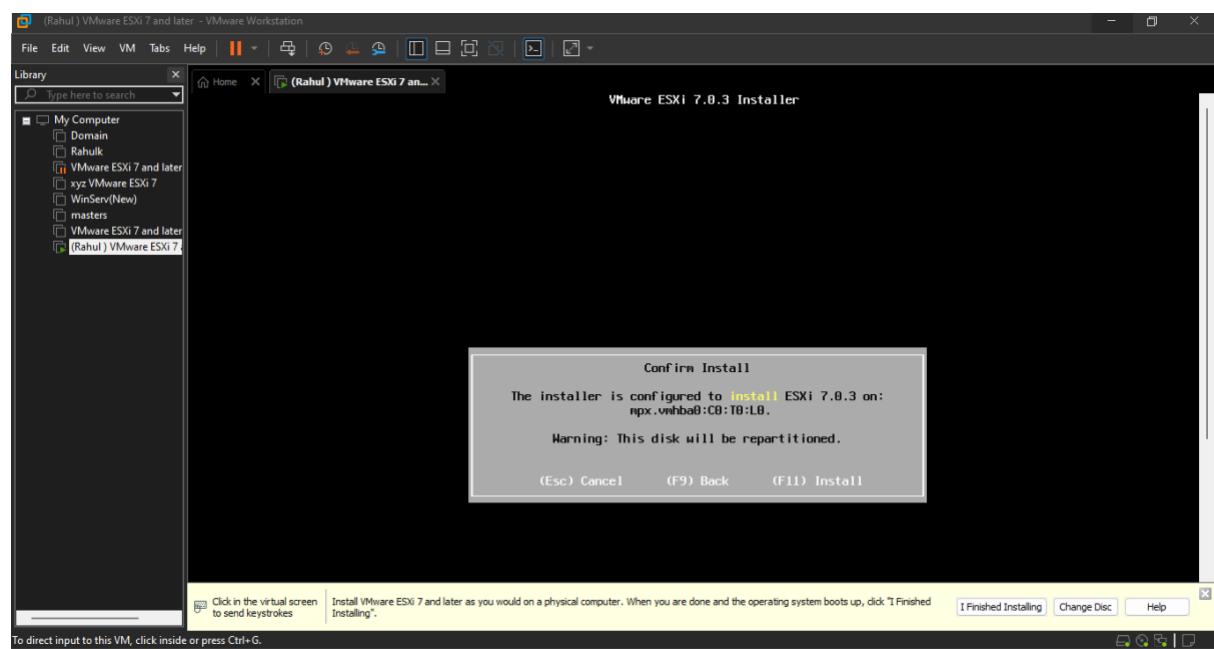
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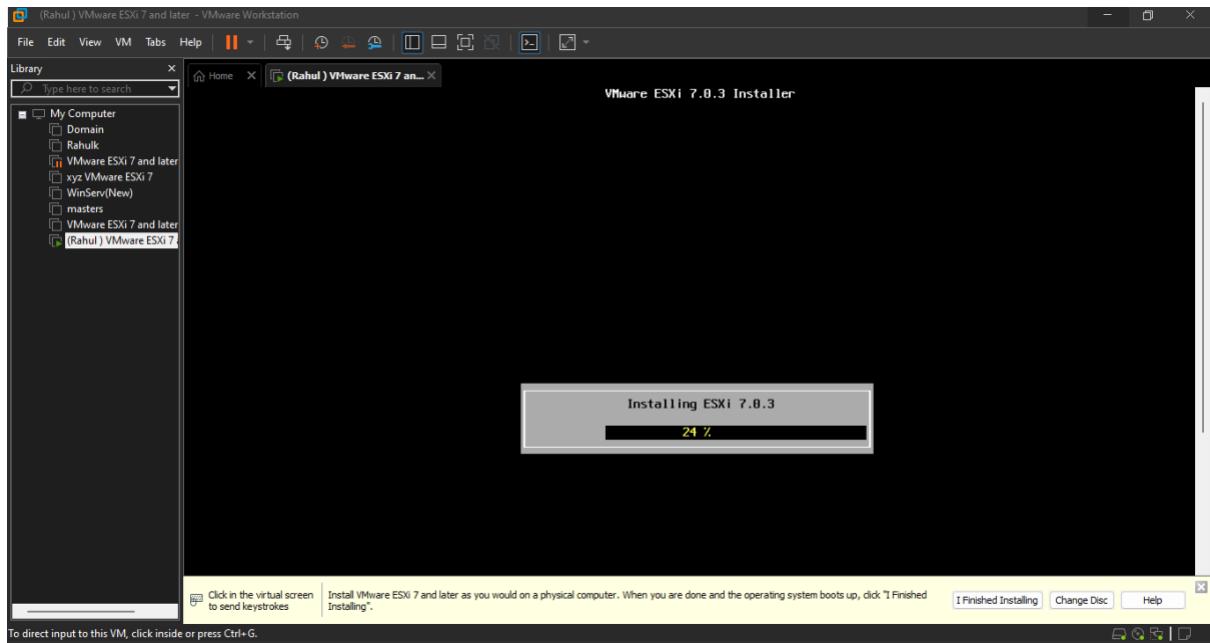
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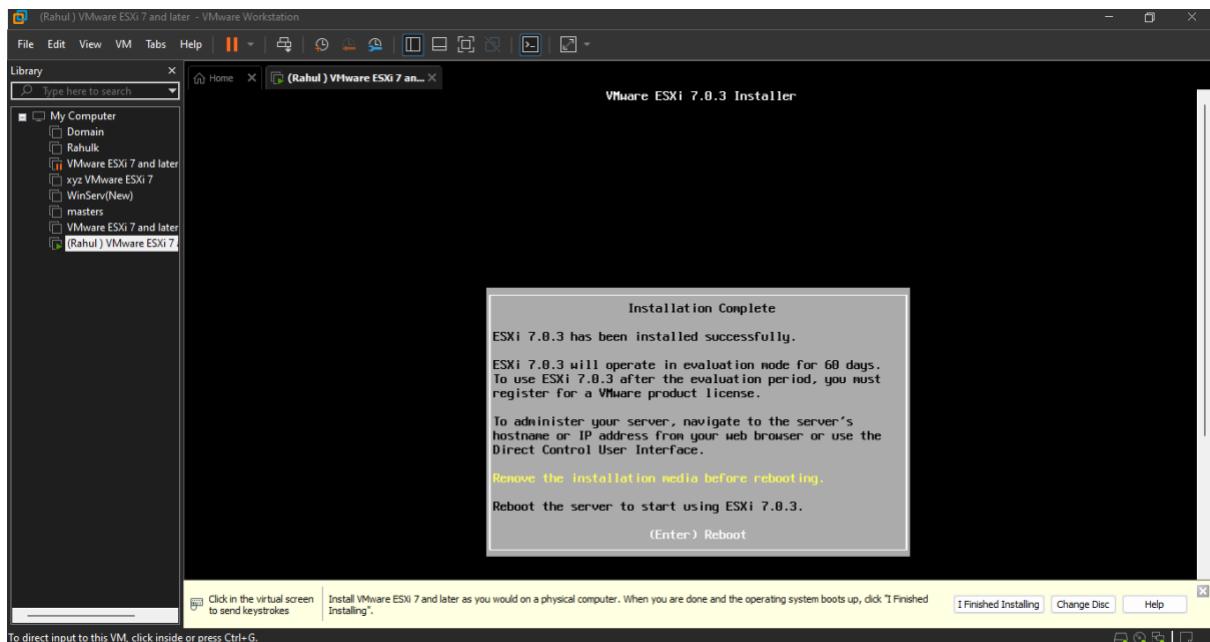
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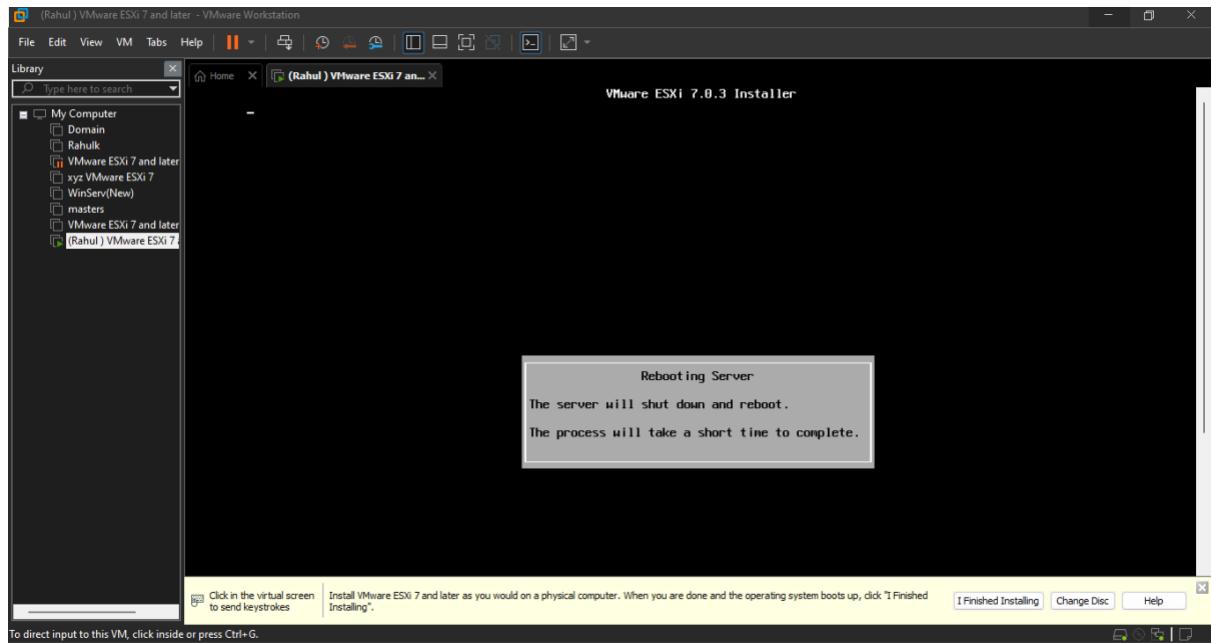
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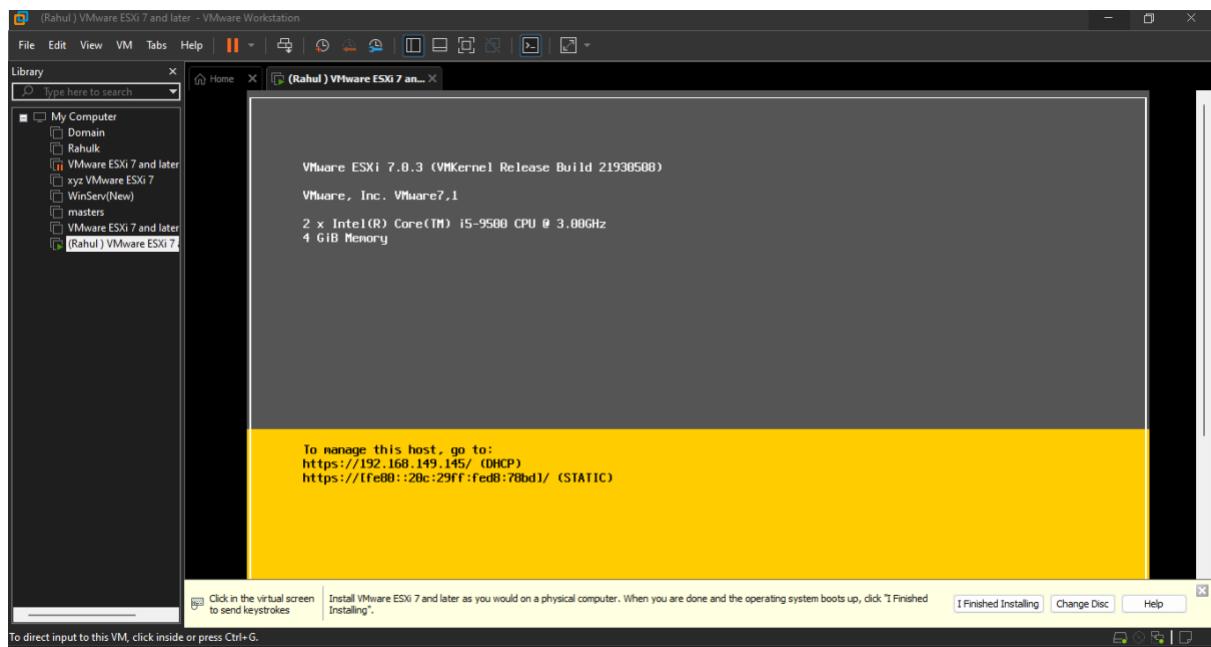
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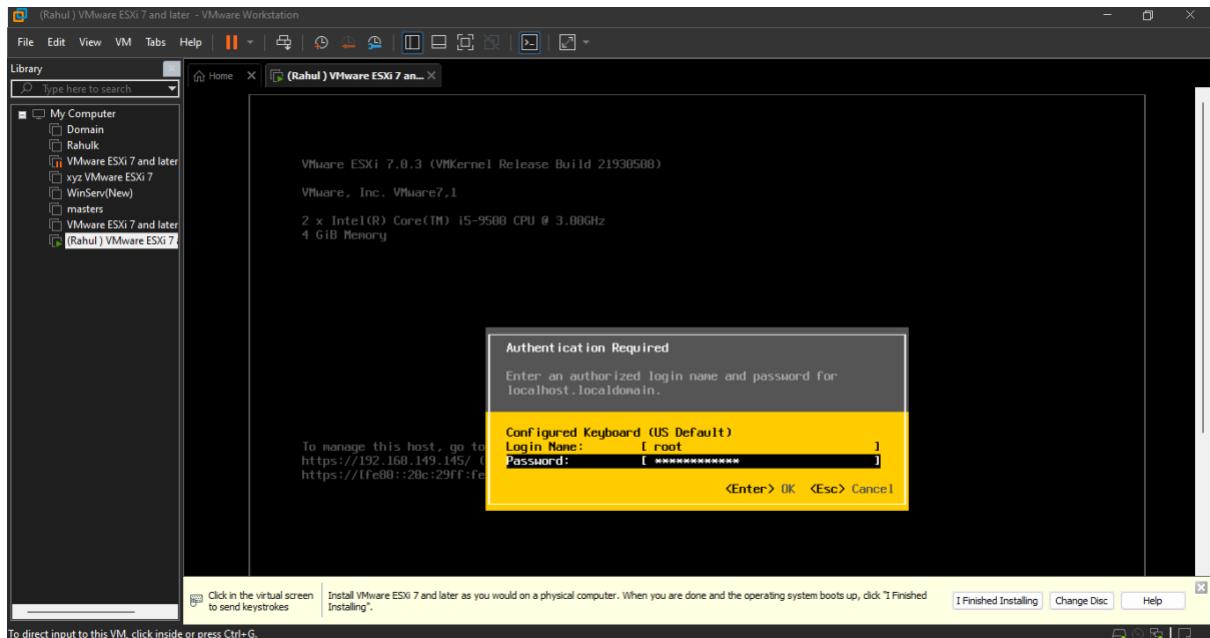
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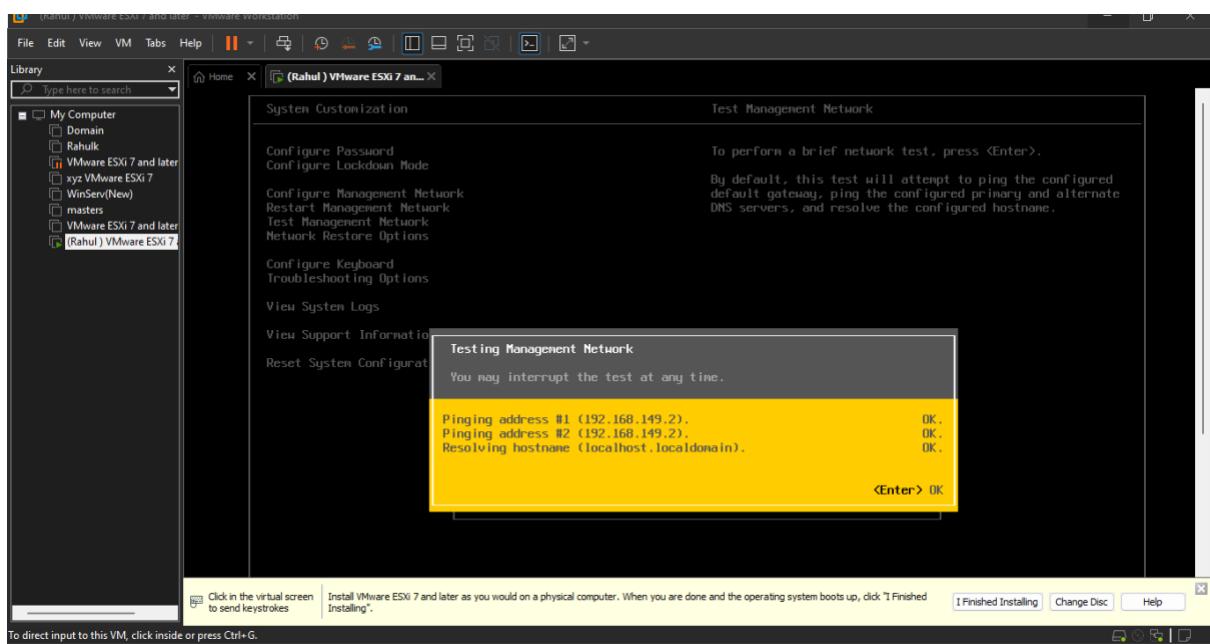
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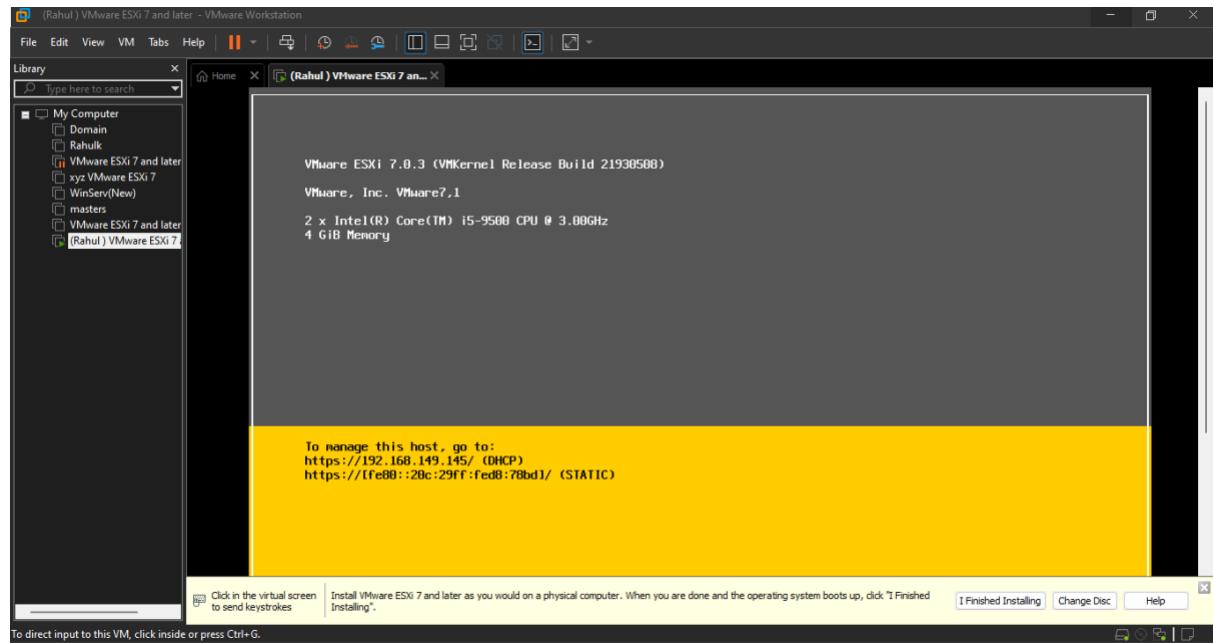
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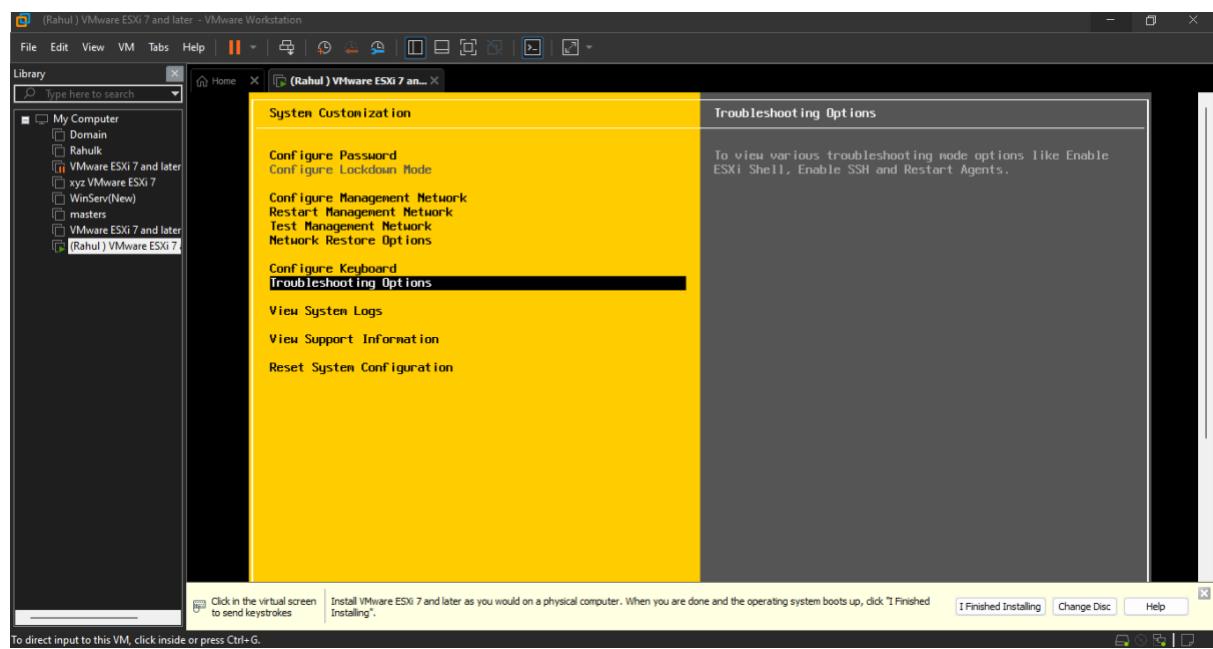
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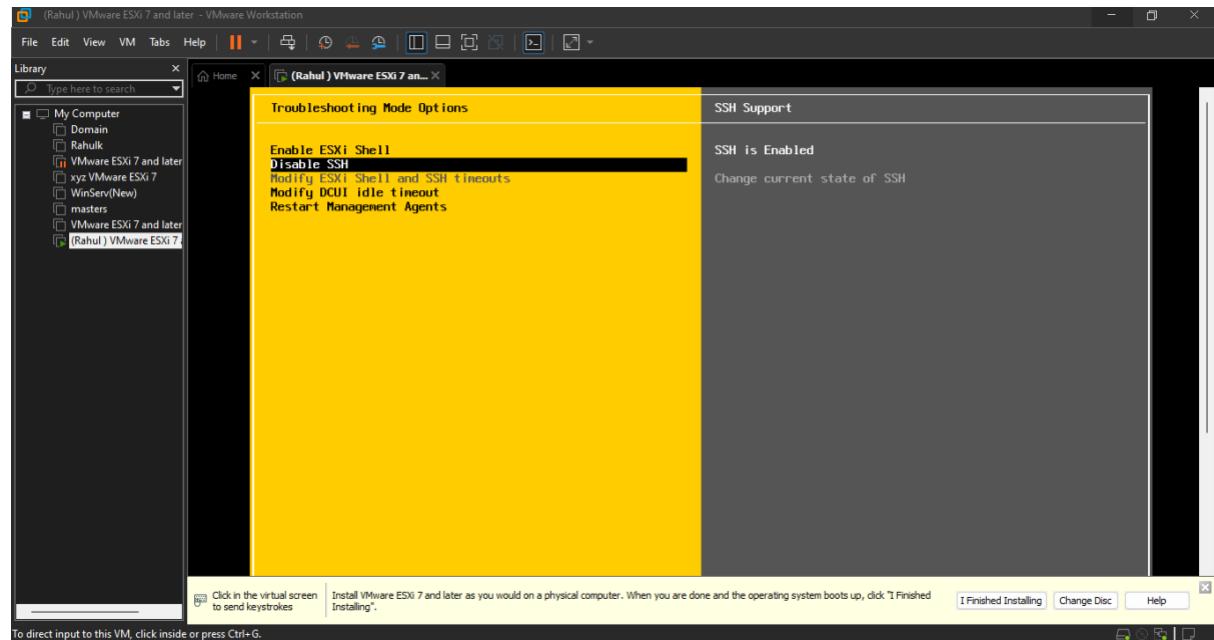
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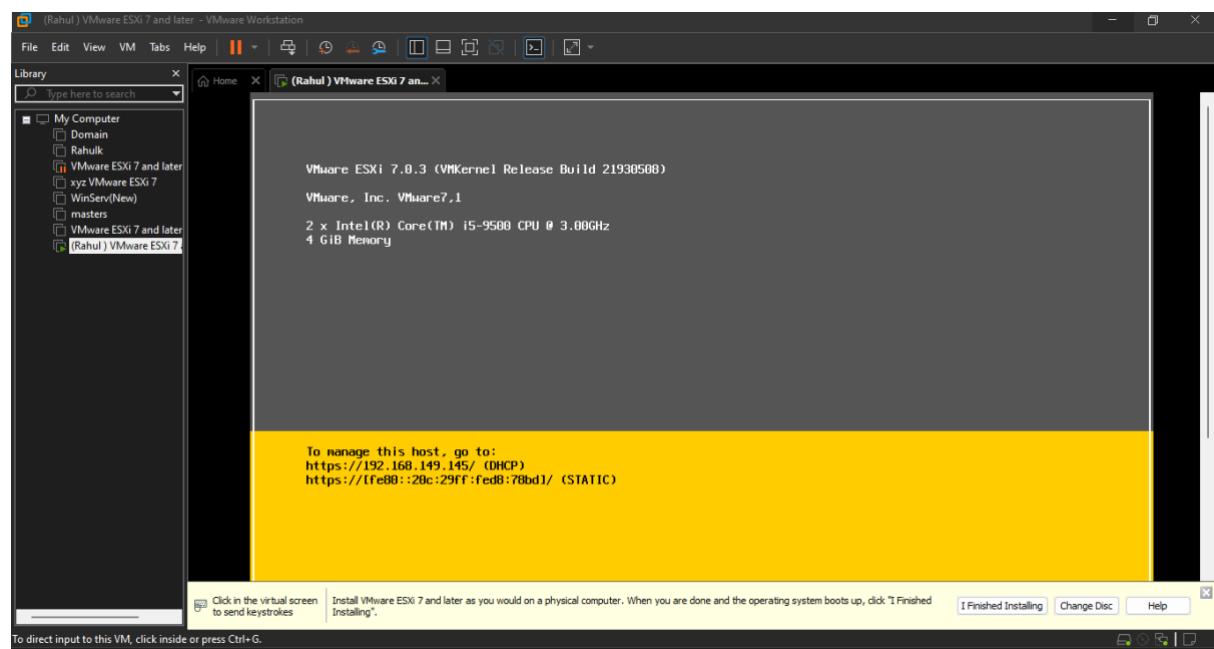
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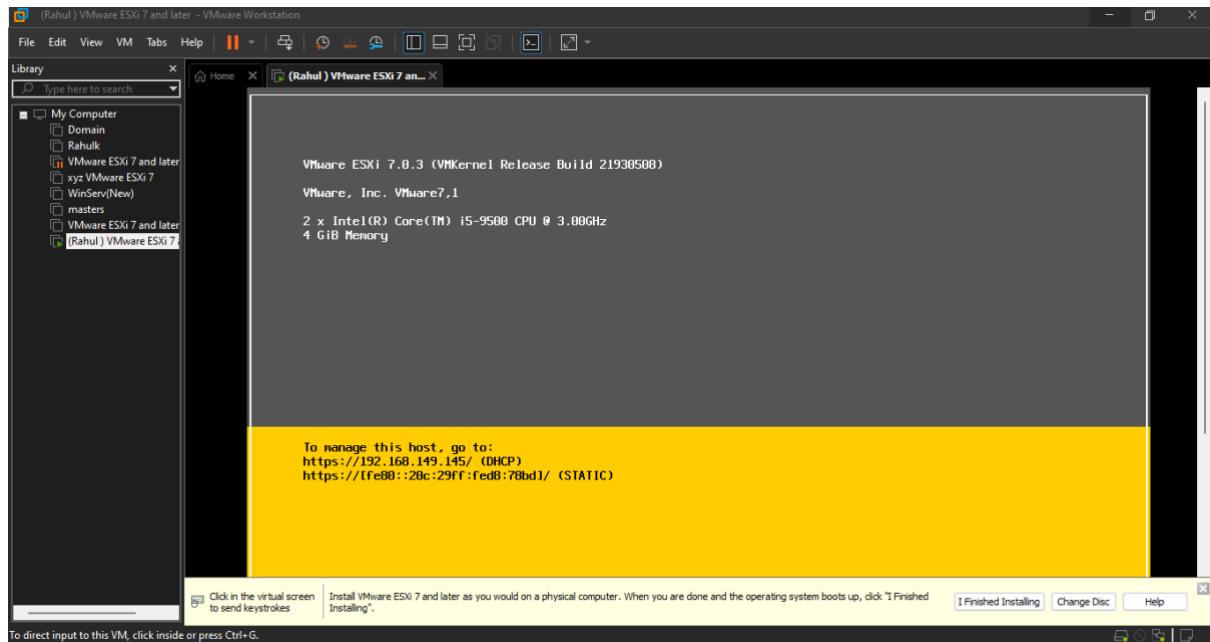


Step 24: Select “Disable SSH” and Enter to Enable SSH

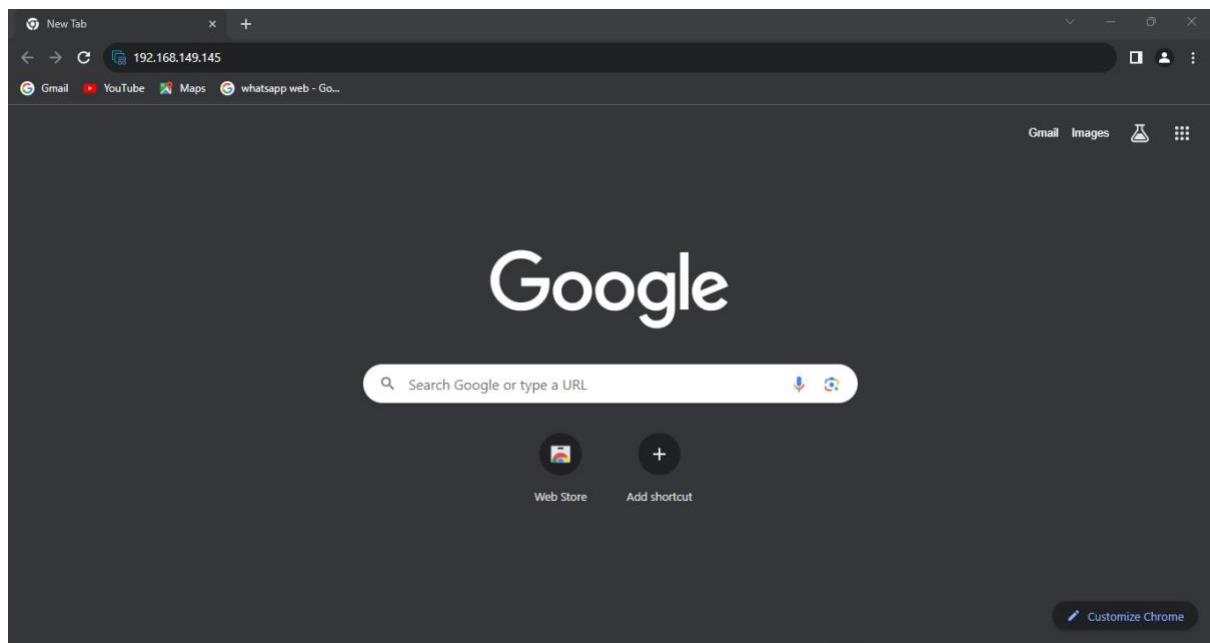


Step 25: Press Esc button to go back and save the setting

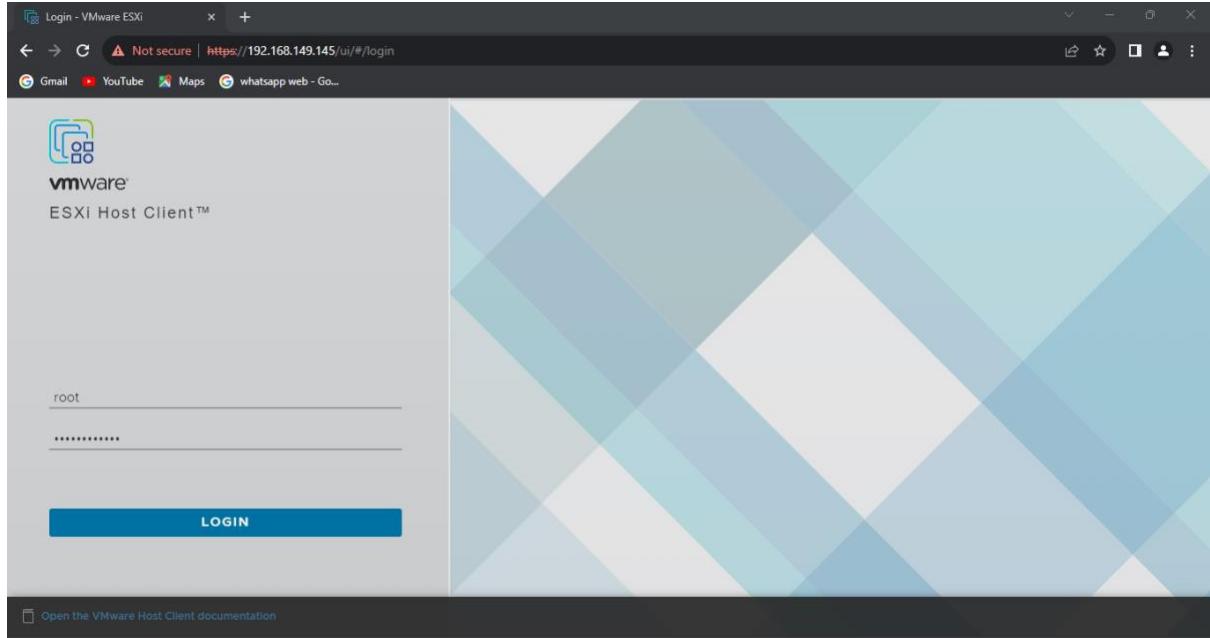


Step 26: Start VMWare ESXi

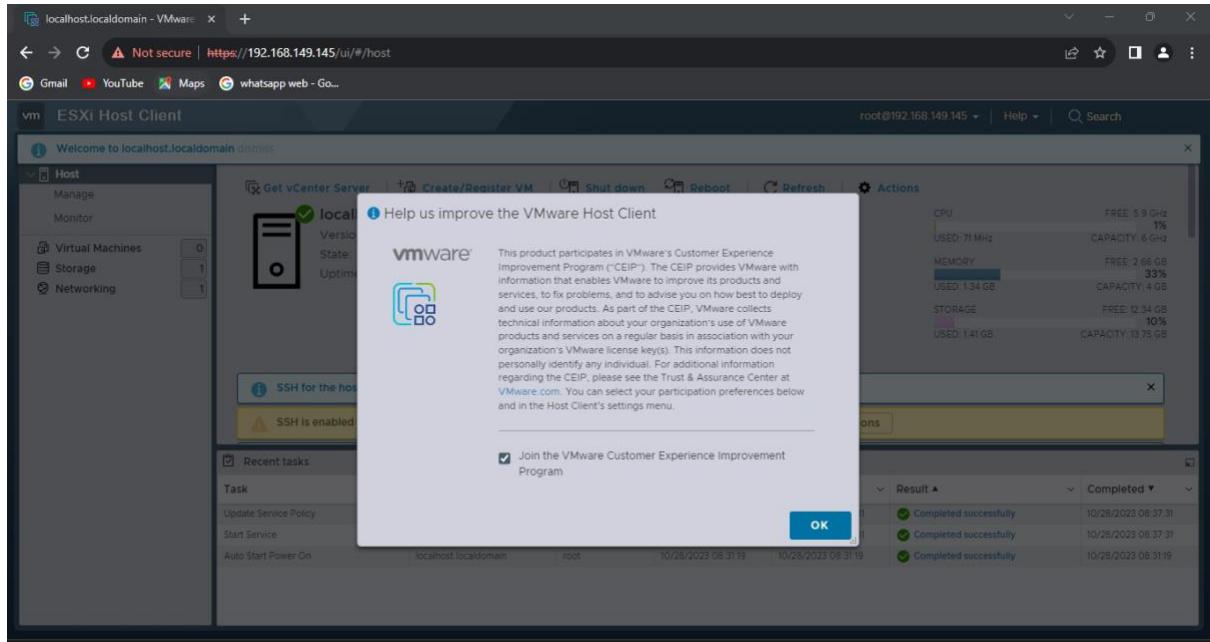
Step 27: Enter the ESXi IP (**192.168.149.145**) to web browser to access VMWare ESXi host to create and manage VMs.



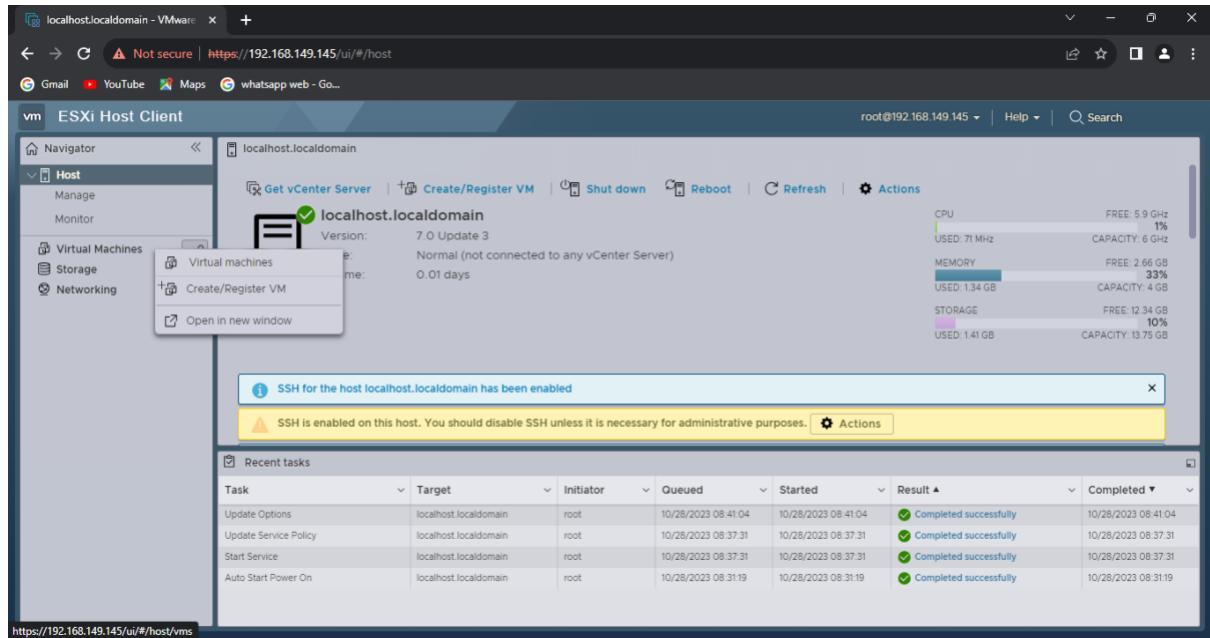
Step 28: Enter username and password same as used in configuring ESXi Machine



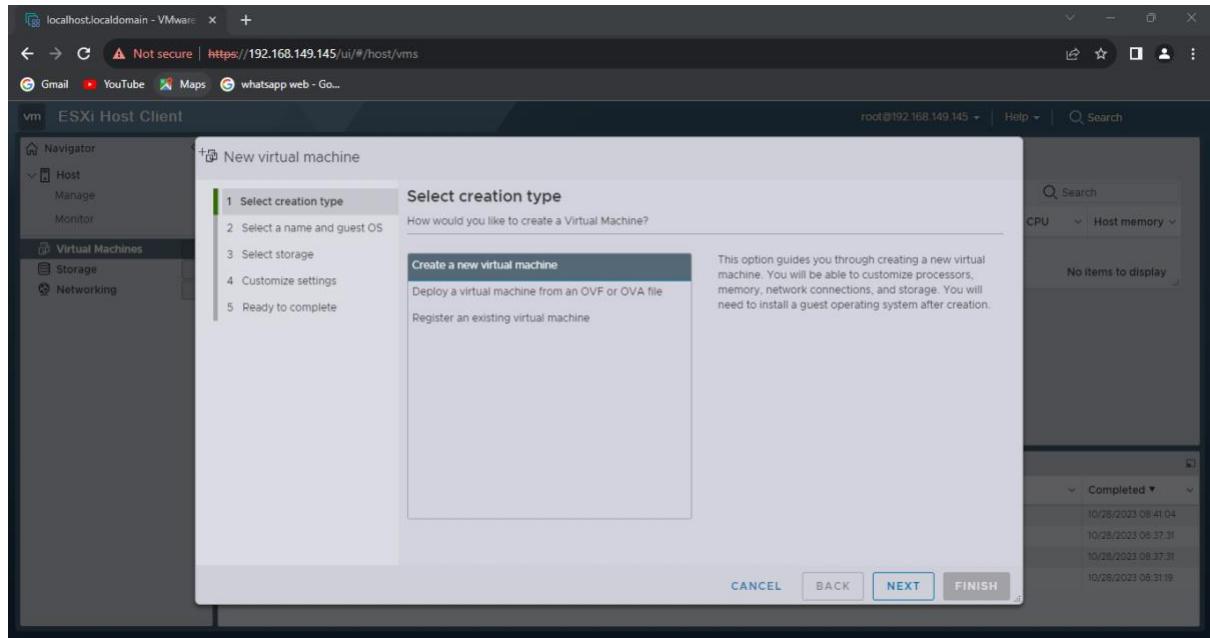
Step 29: ESXi Host Client Windows open And Pop-up open and Click on OK



Step 30: Click on virtual machines->create/Register VM (to start creating VMs)



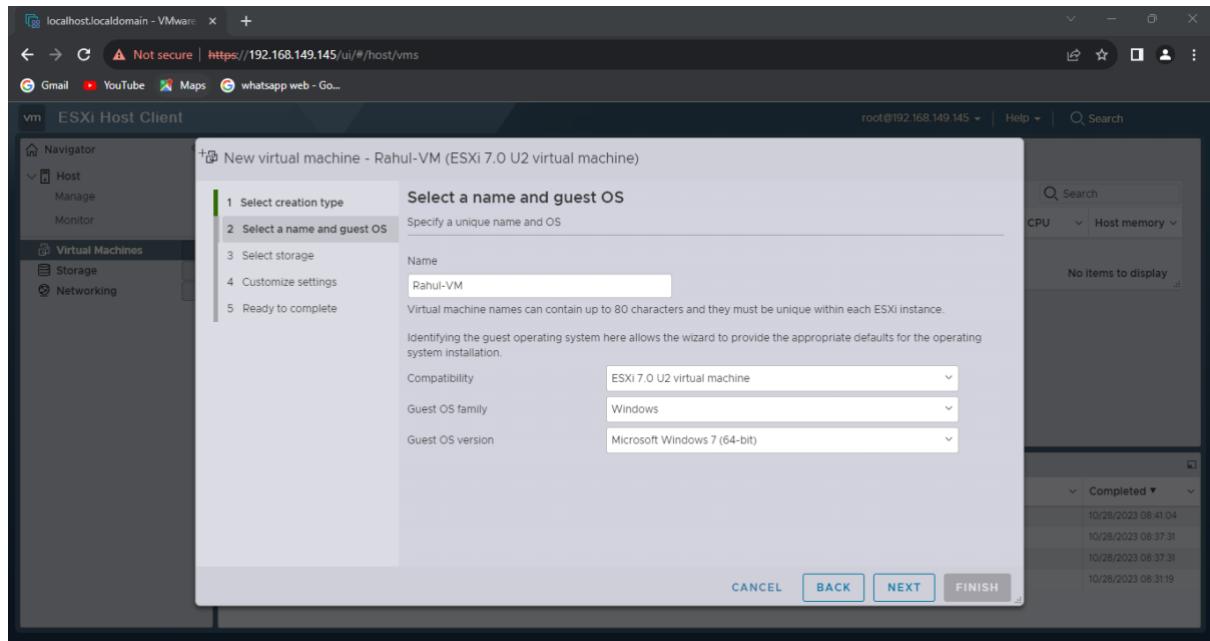
Step 31: Select Create a new virtual machine and Click on Next



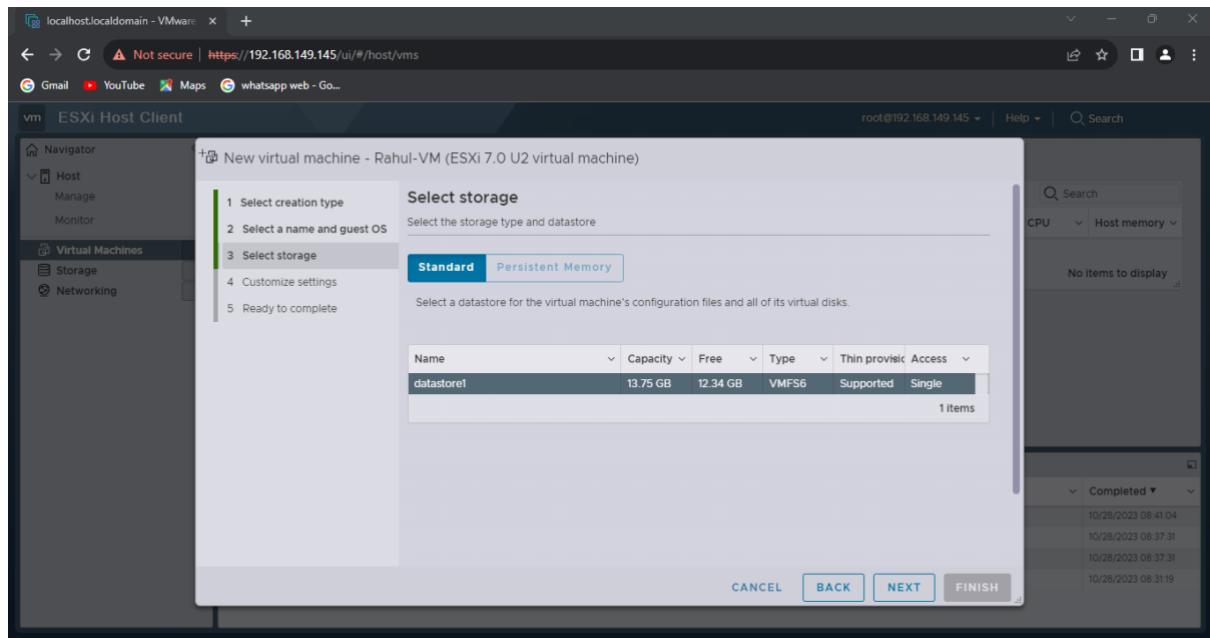
Step 32: Give Name to your virtual machine (Here it is Rahul-VM)

- Compatibility: Select ESXi 7.0 U2 virtual machine
- Guest OS family: Windows
- Guest OS version: Microsoft Windows 7 (64-bit)

Click on Next

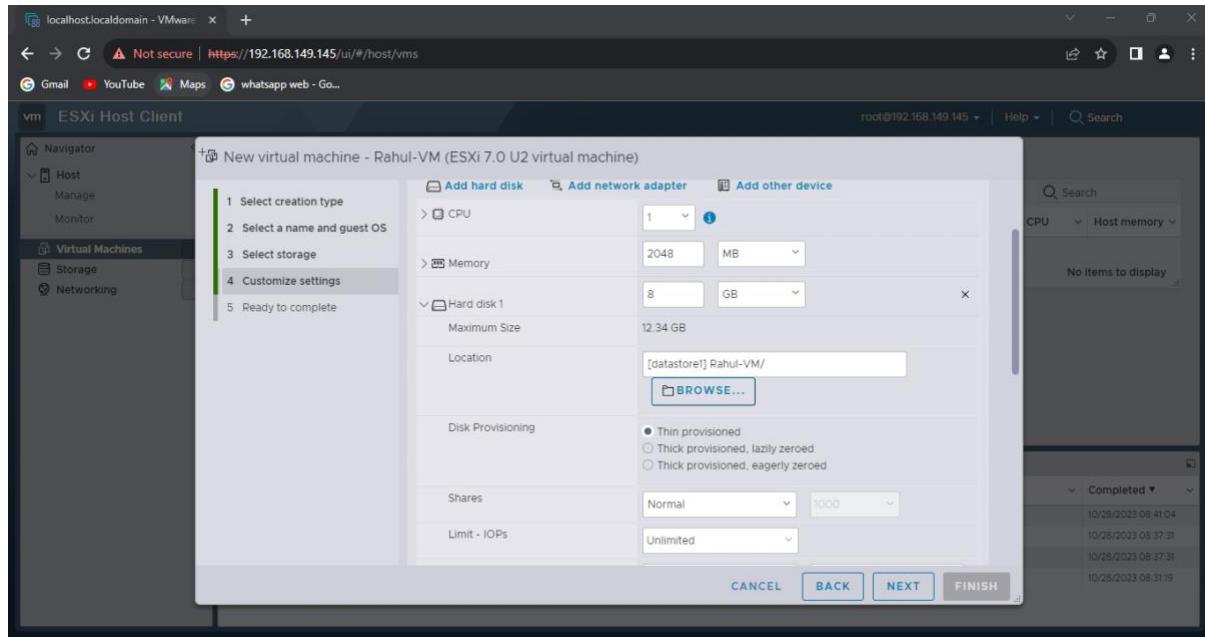


Step 33: Keep the default value and Click on Next

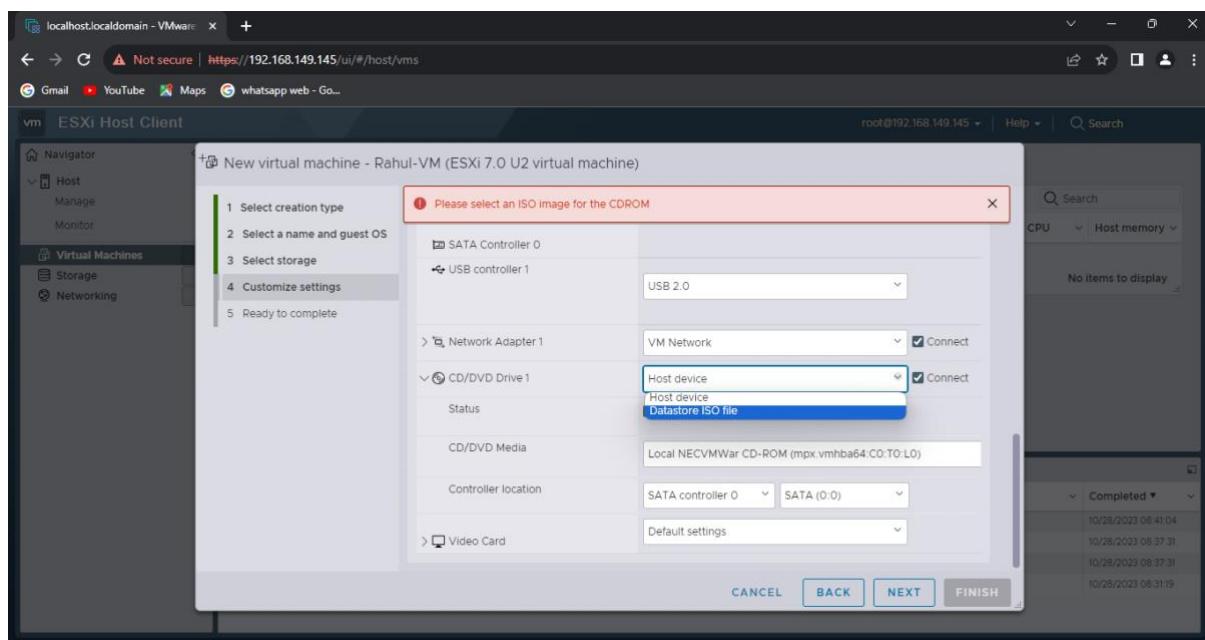


Step 34: Under Customize setting

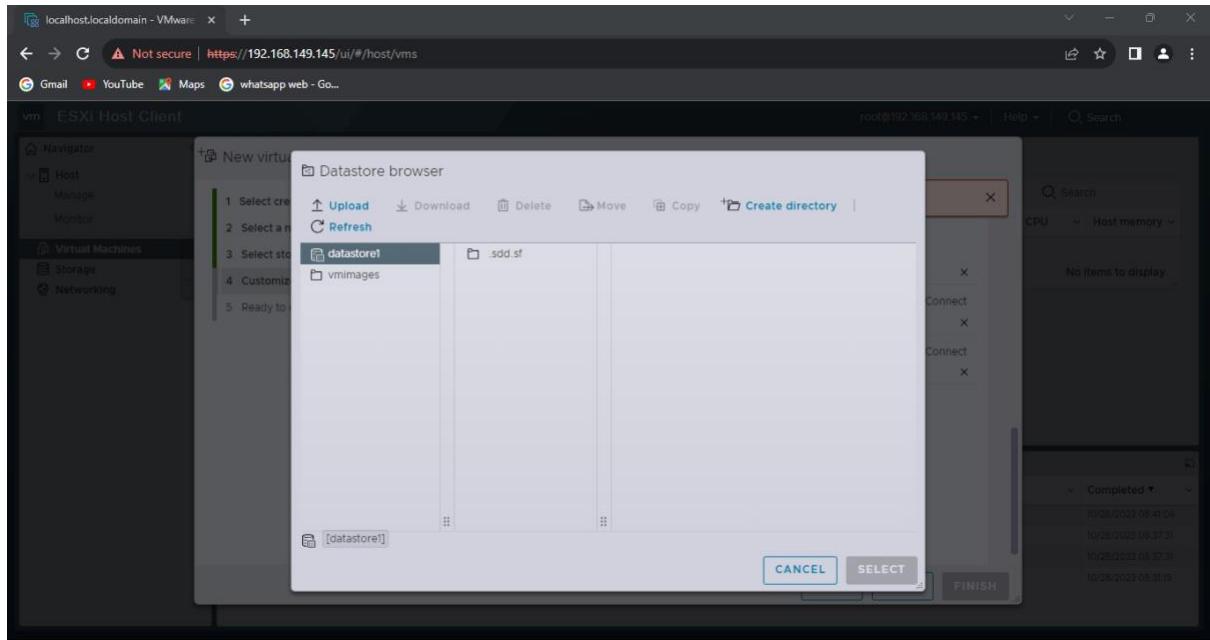
- Give Hard disk size : 8GB
- Disk Provisioning: Select Thin provisioned



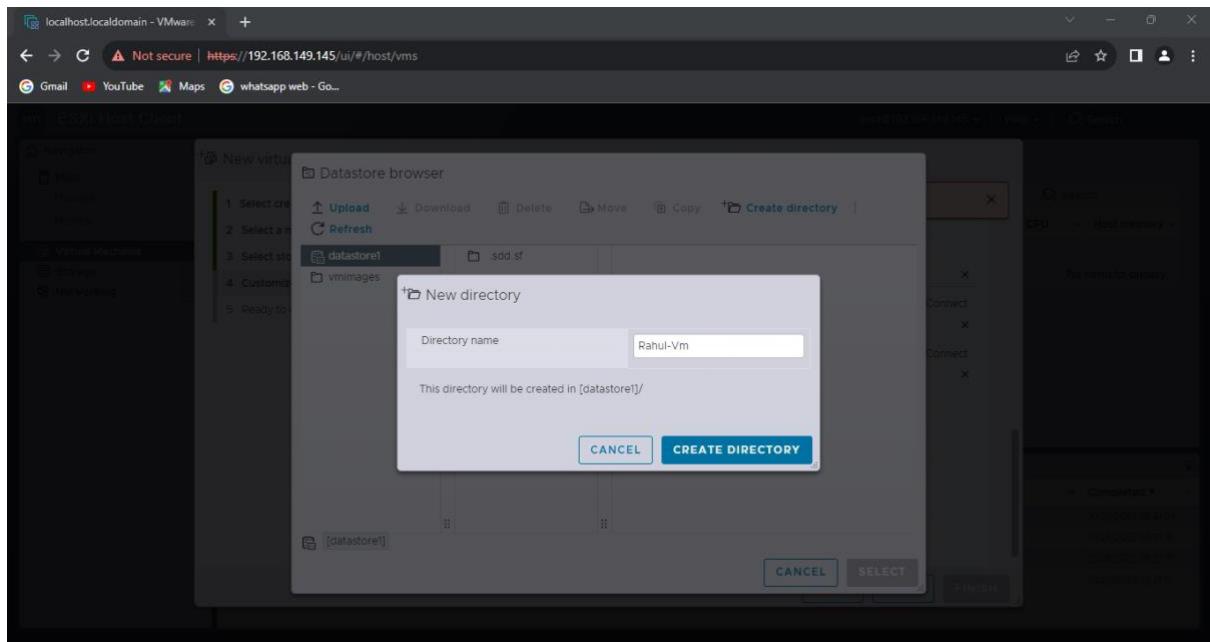
- Under Customize Setting
- CD/DVD Drive 1: Select Datastore ISO
- Note: make sure Network Adapter and CD/DVD Drive both are Connect



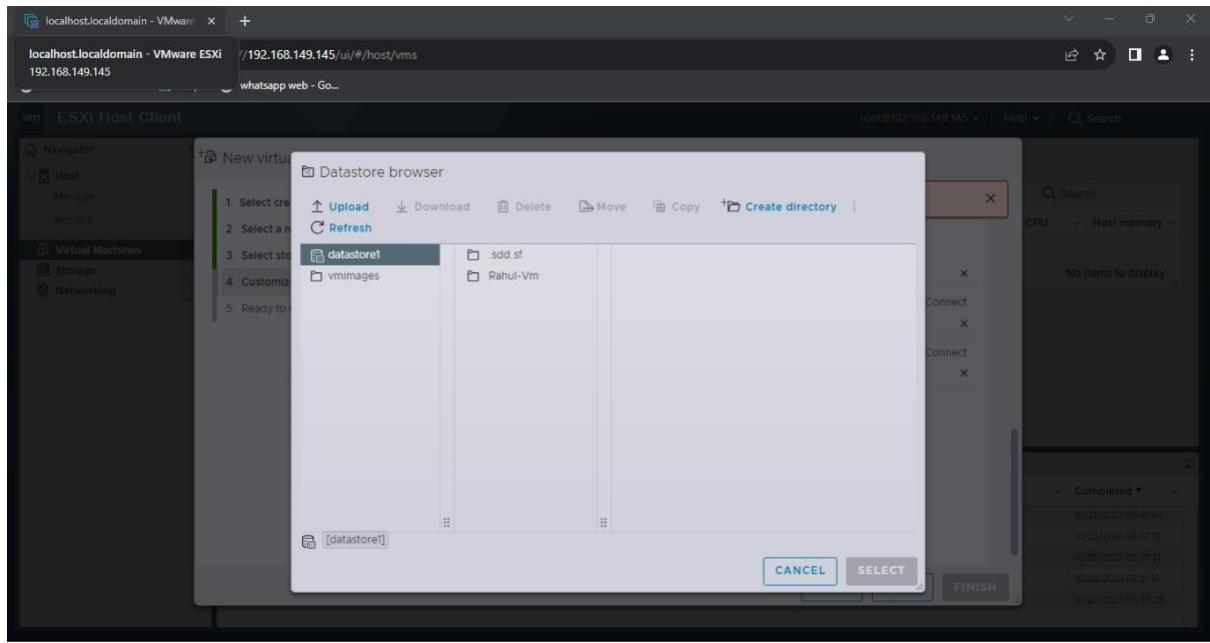
- Under Customize Setting → CD/DVD Drive 1
- Click on Create directory



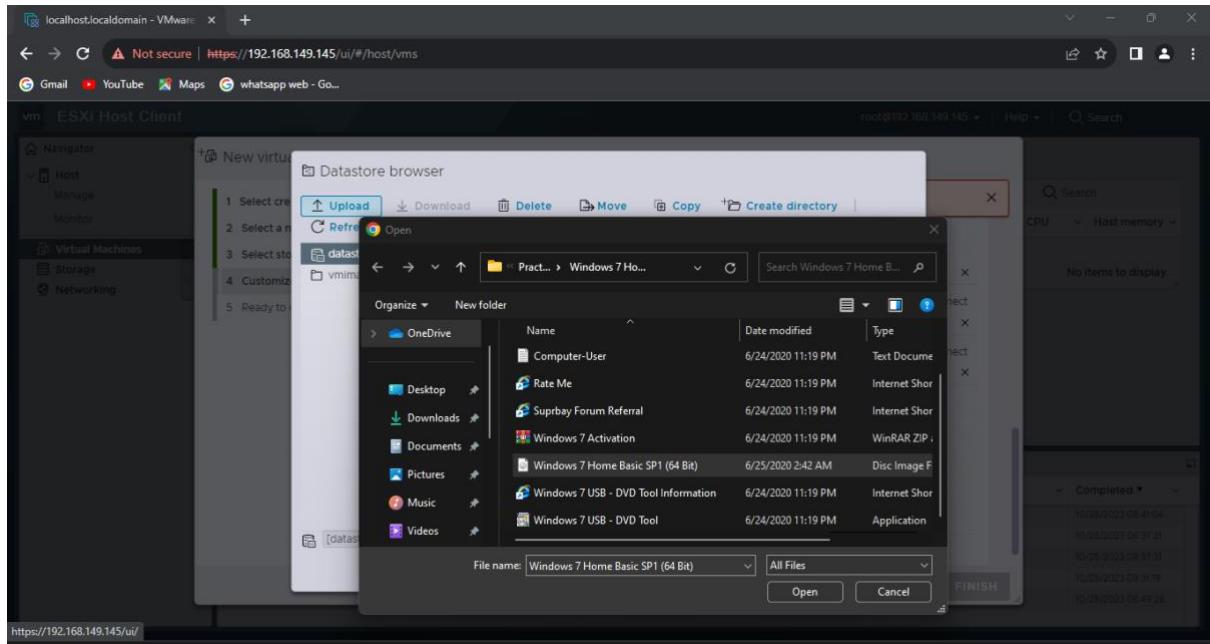
- Give Name to New directory (**Here it is Rahul-Vm**) and Click on Create Directory



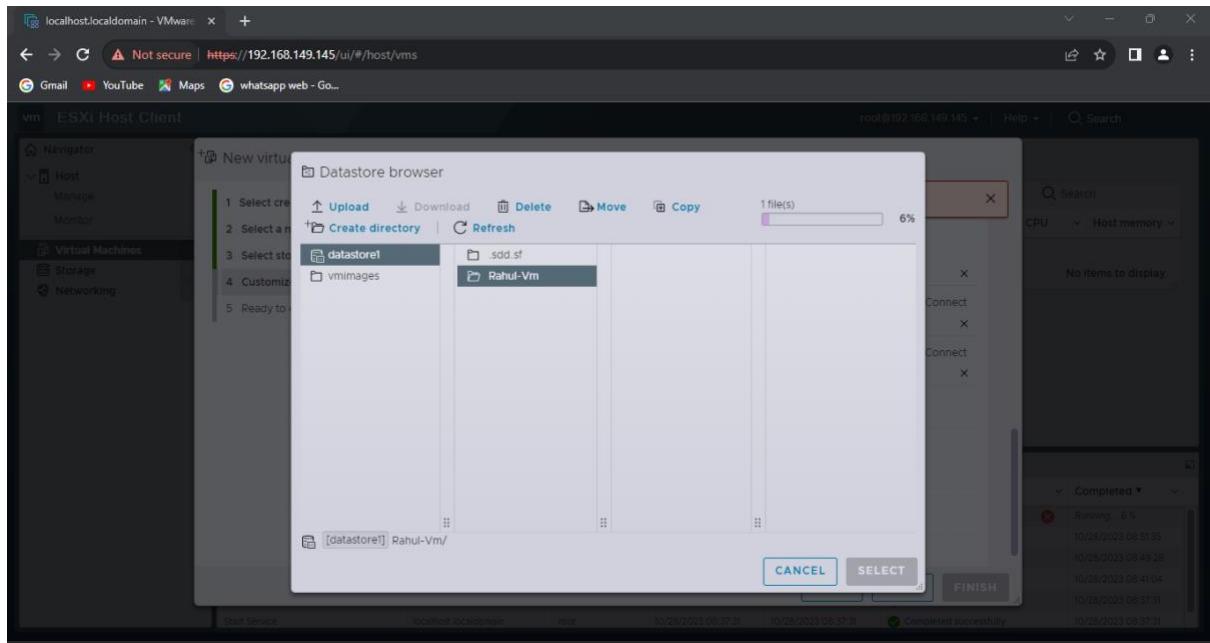
- Select **Rahul-Vm** and Click on **Upload**



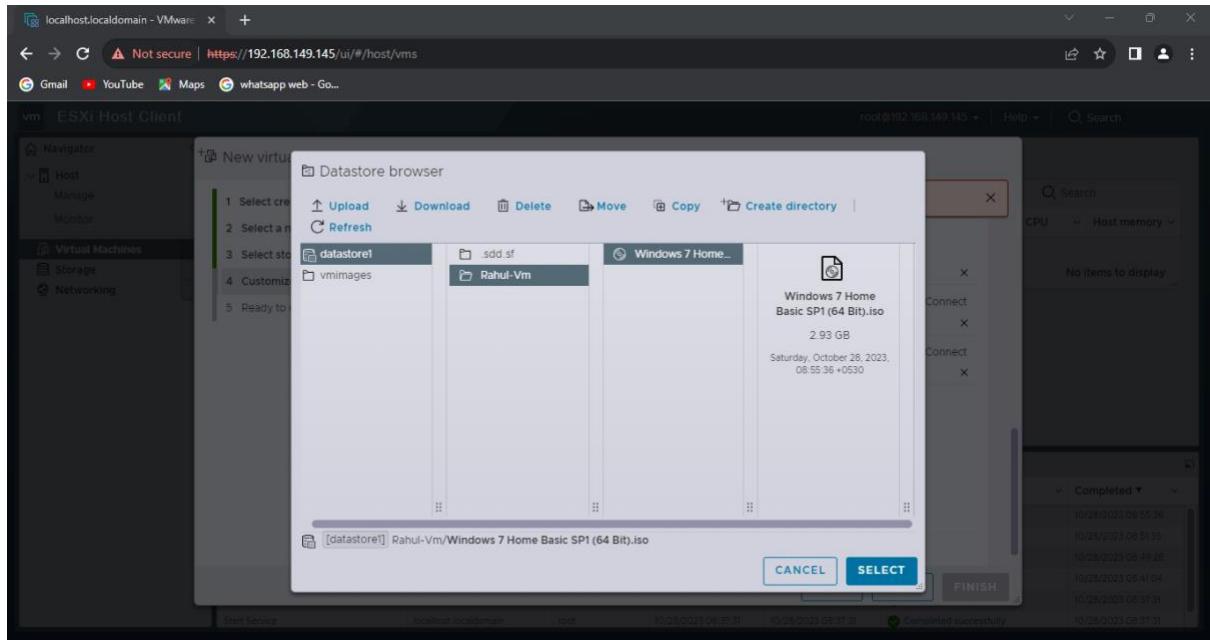
- Select Windows 7 Home Basic SP1 (64 Bit) and Click on Open



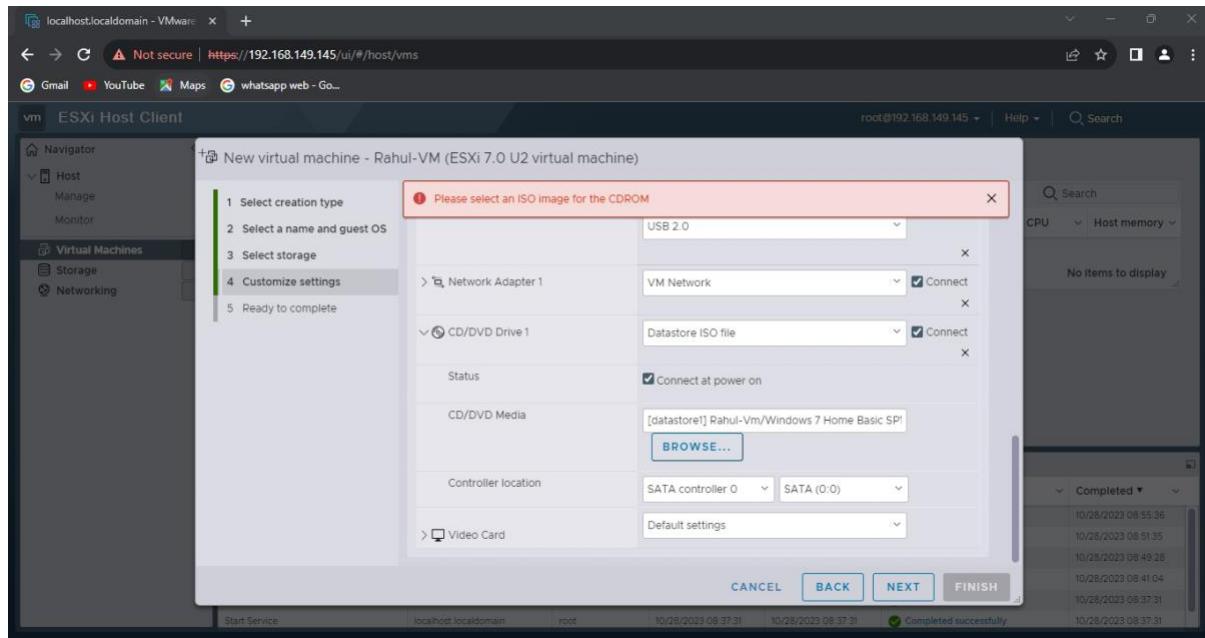
- ISO File Start Uploading



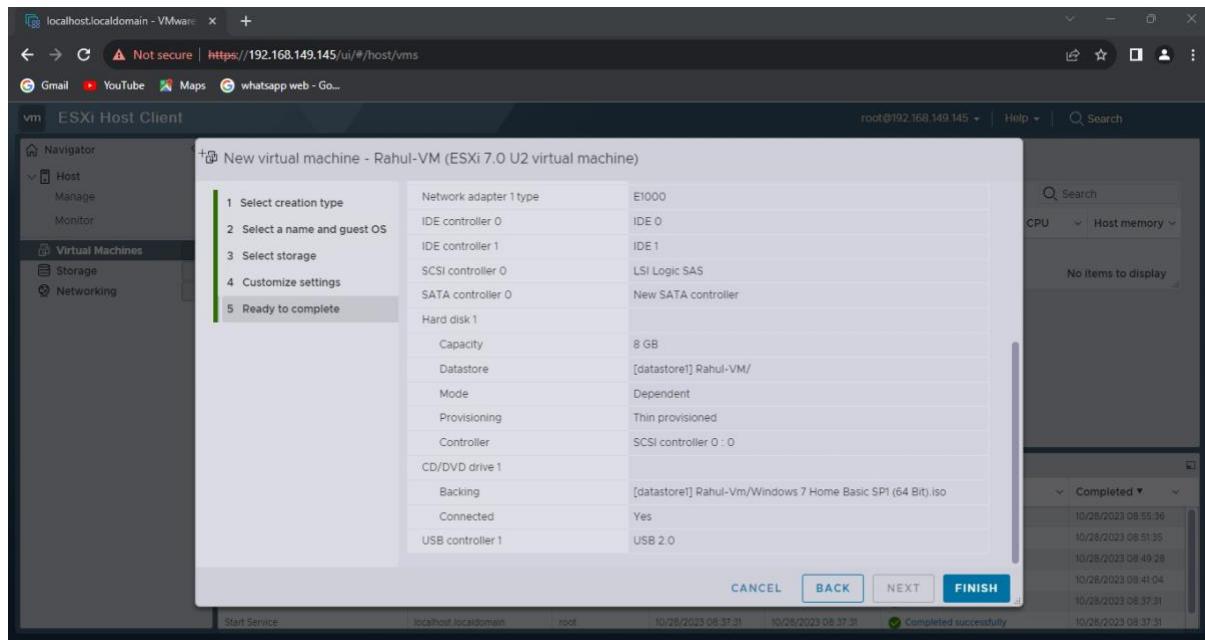
- After Installation of ISO File Select Windows 7 Home



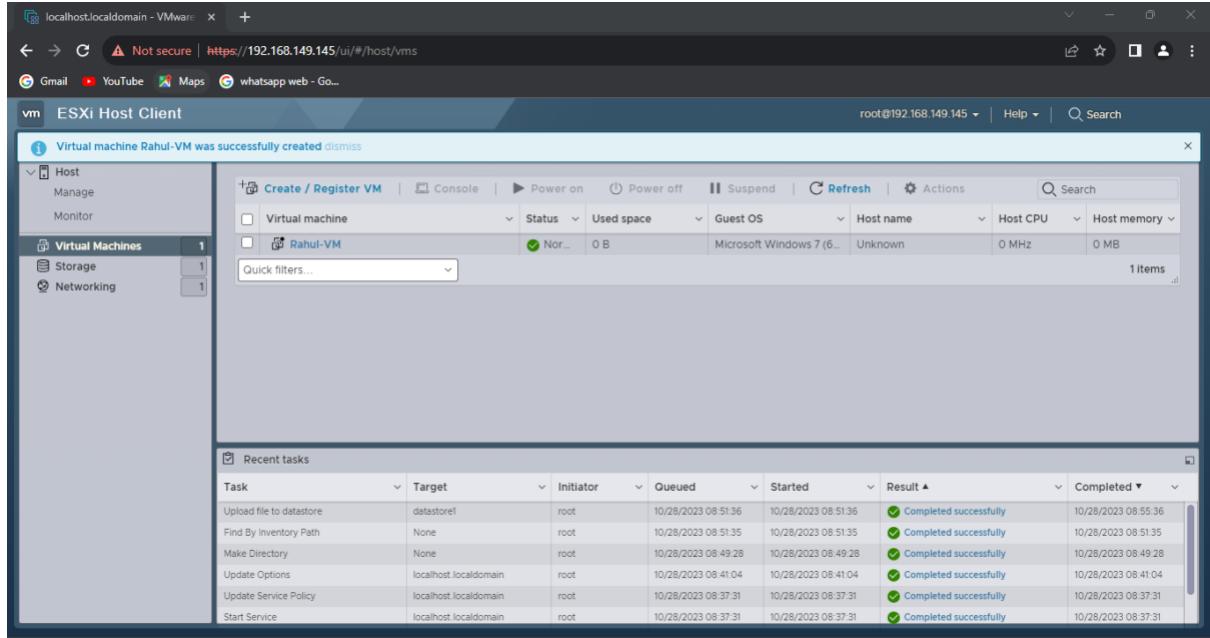
- Click on Next



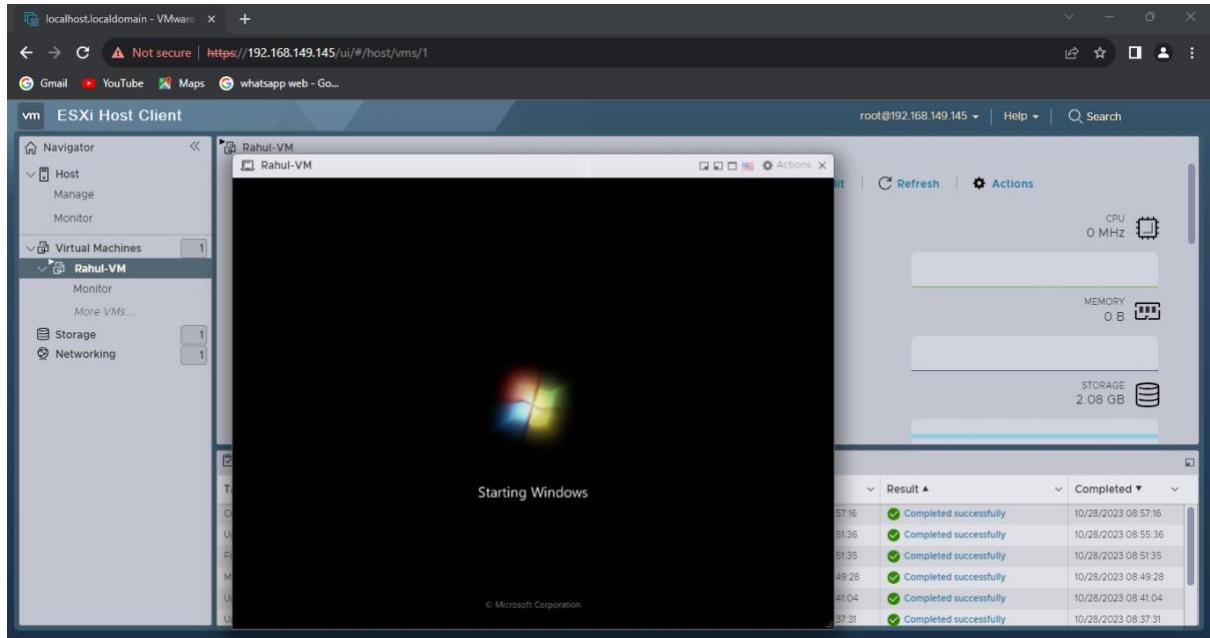
- Review the summary and Click on Finish



Step 35: New Virtual Machine Created



- Click on Rahul-VM

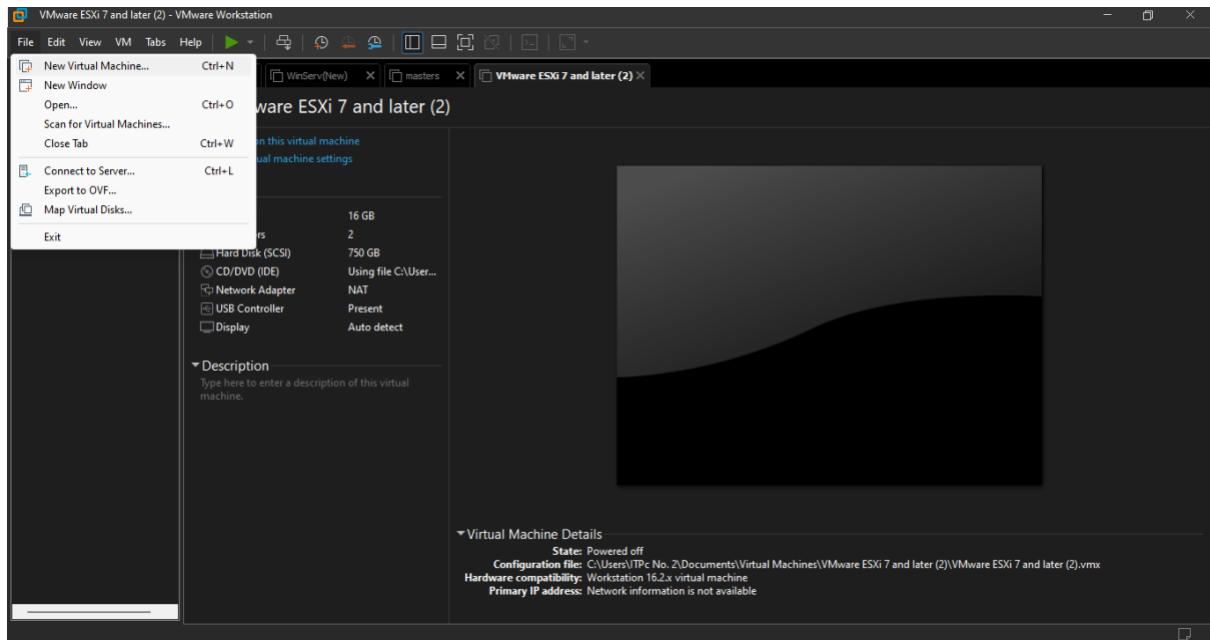


Practical: 4

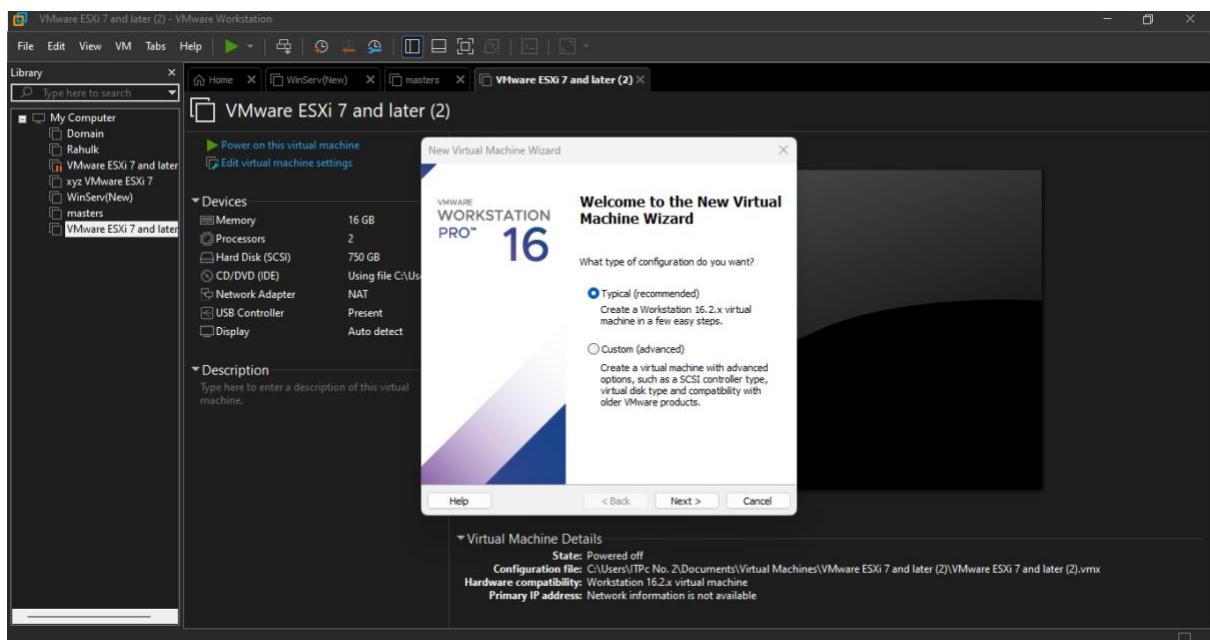
Aim: Installing vCenter server.

Writeup:

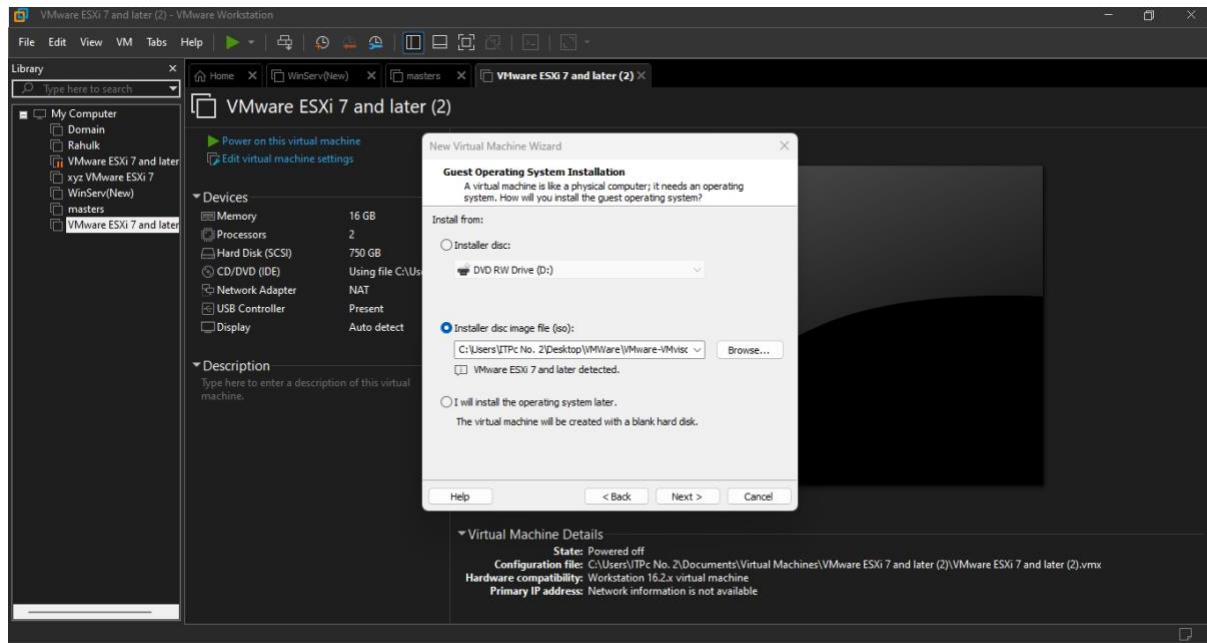
Step 1: Creating a new virtual machine wizard with VMware workstation



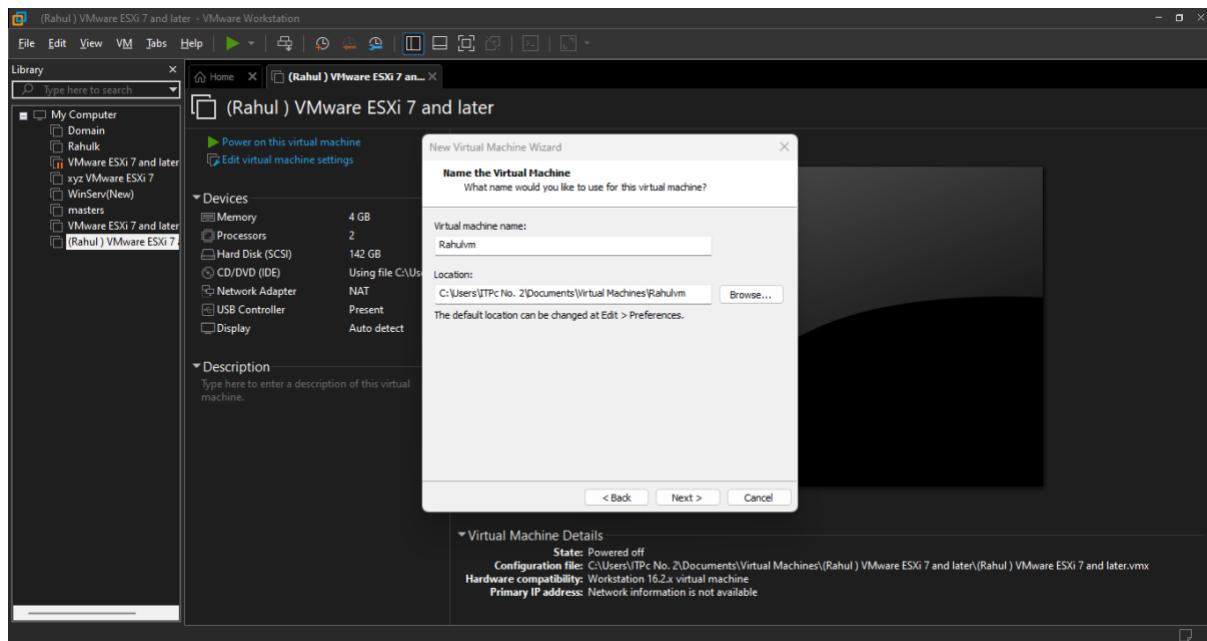
Step 2: Select Typical and Click on Next



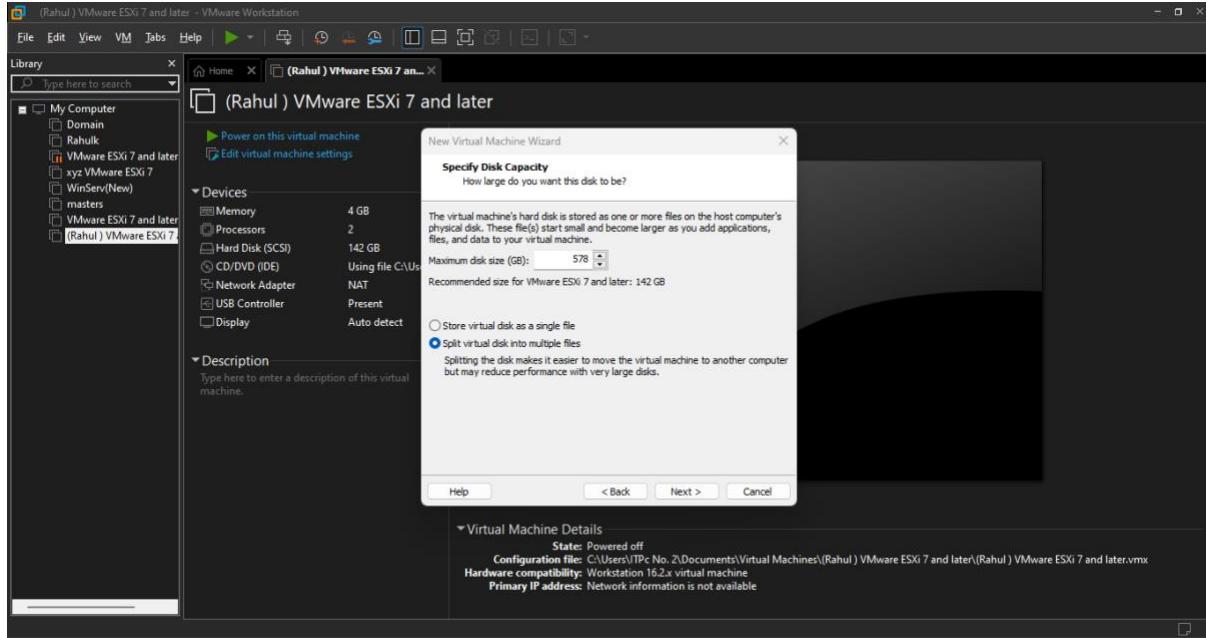
Step 3: Click on Browser and Select the IOS file of VMware ESXi from the directory



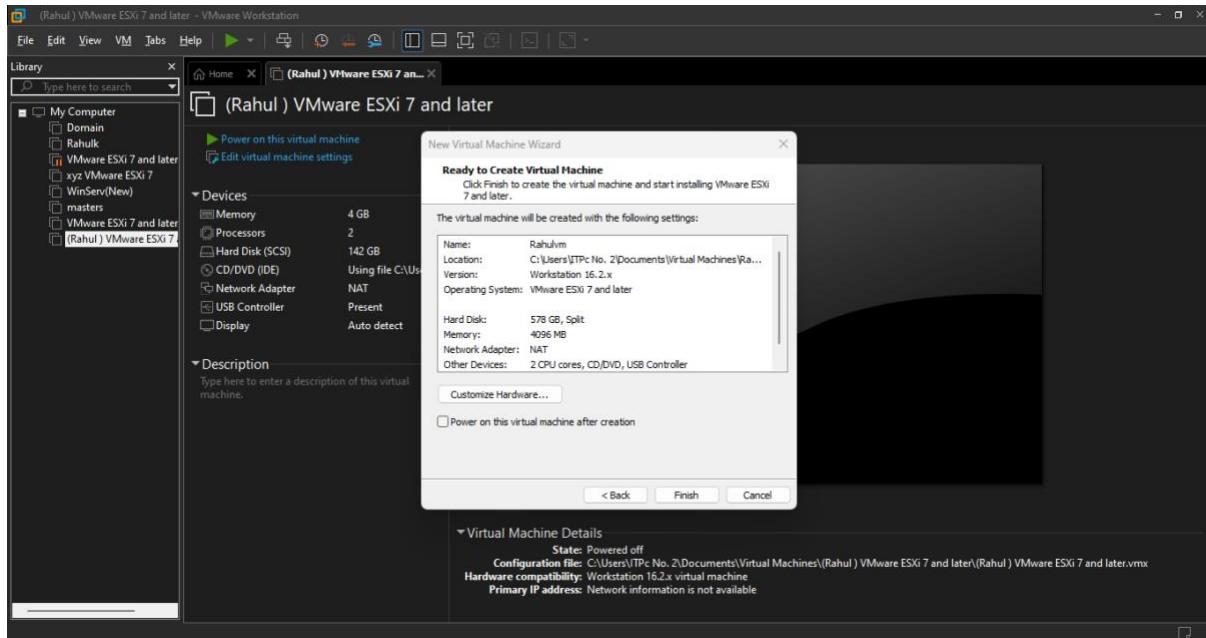
Step 4: Give Name the Virtual Machine: **Rahulvm** and click on Next.



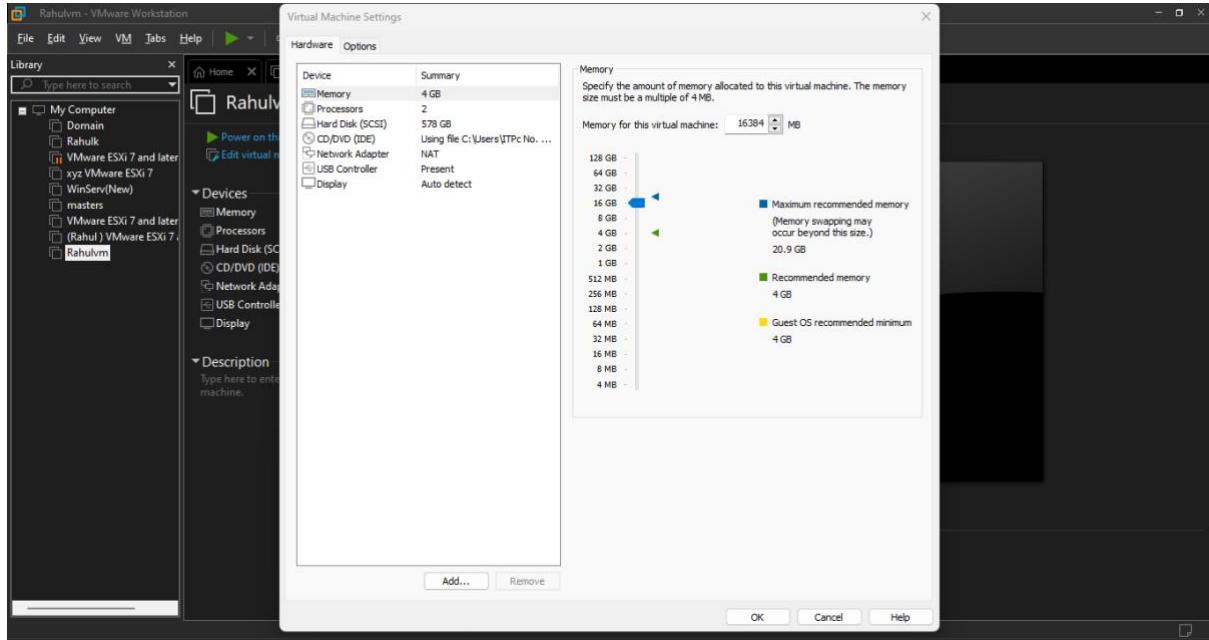
Step 5: Expand Disk size (Here Maximum disk size (GB): 578) and Click on Next



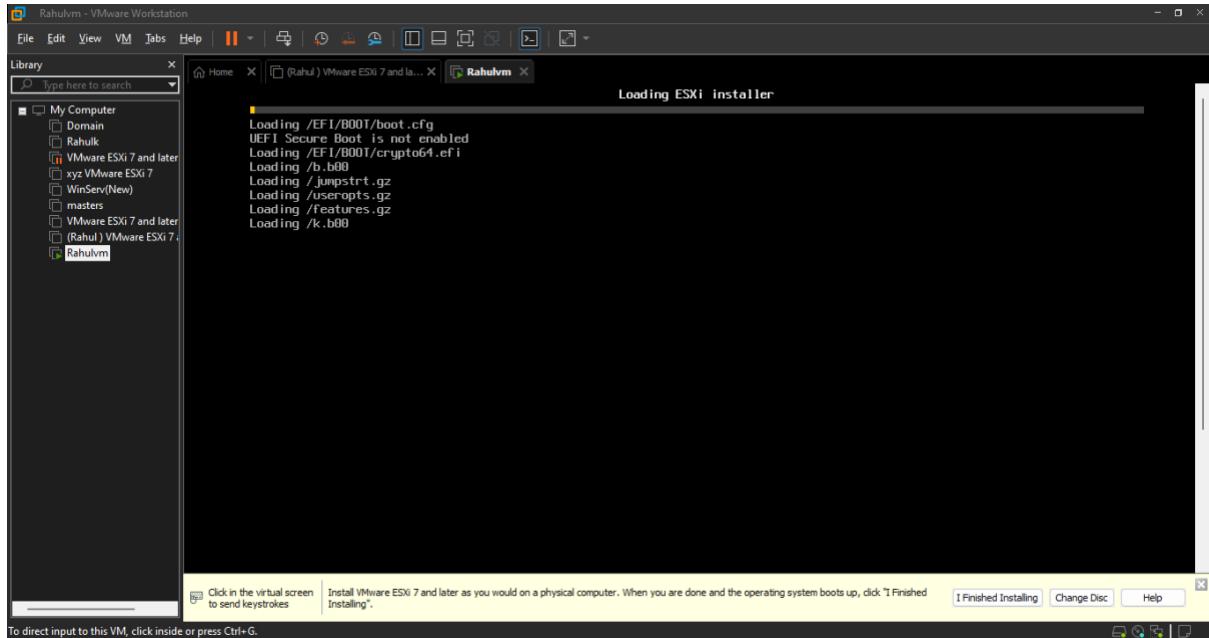
Step 6: Click on Finish



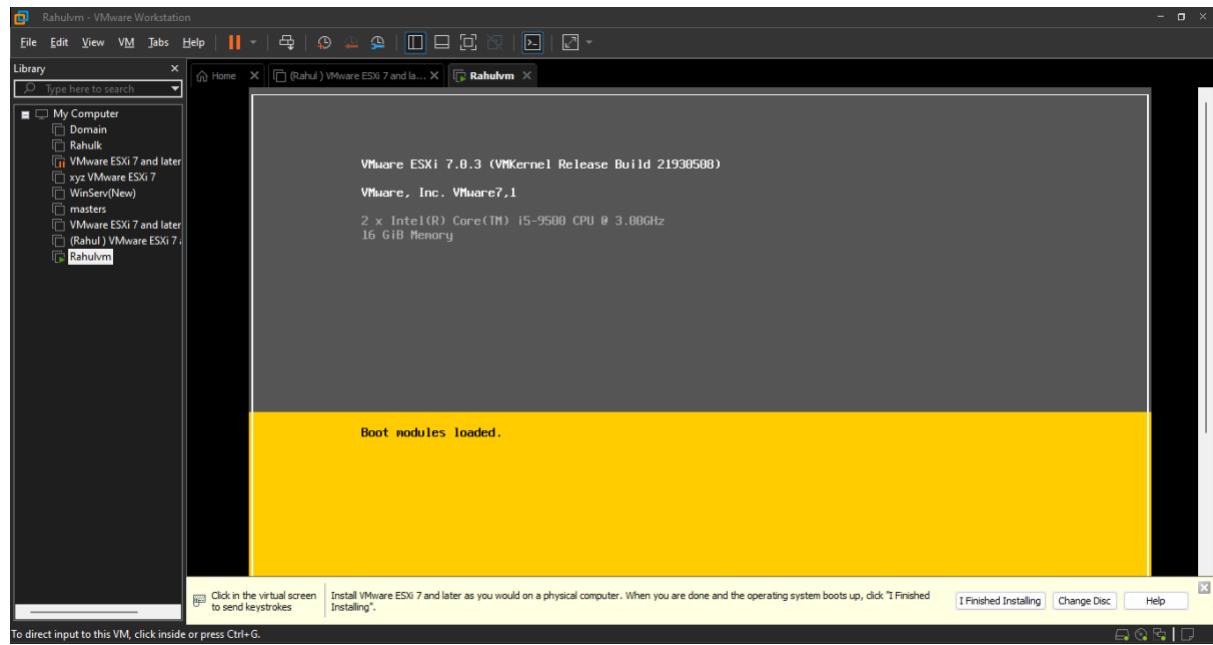
Step 7: Before Click on Power on this virtual machine **Click on Edit virtual machine settings** In Memory Specify the amount of memory allocated to this virtual machine (**Here Size of Memory for this virtual machine is :16GB**) and **Click on OK**



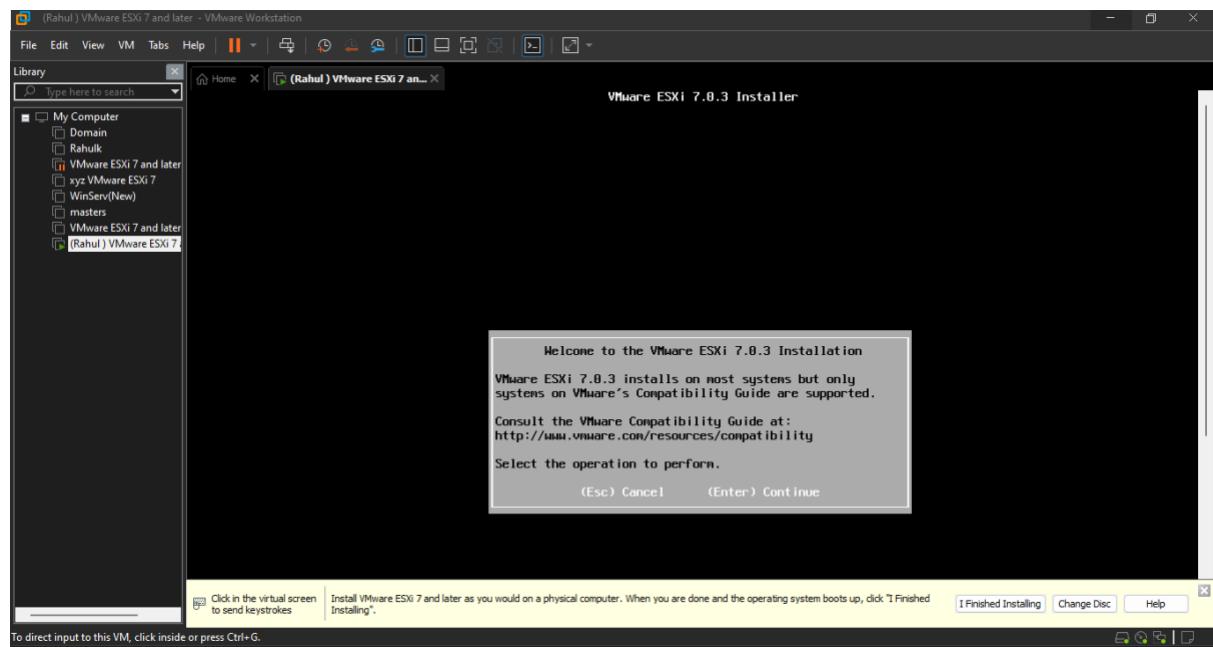
Step 8: It will start installation



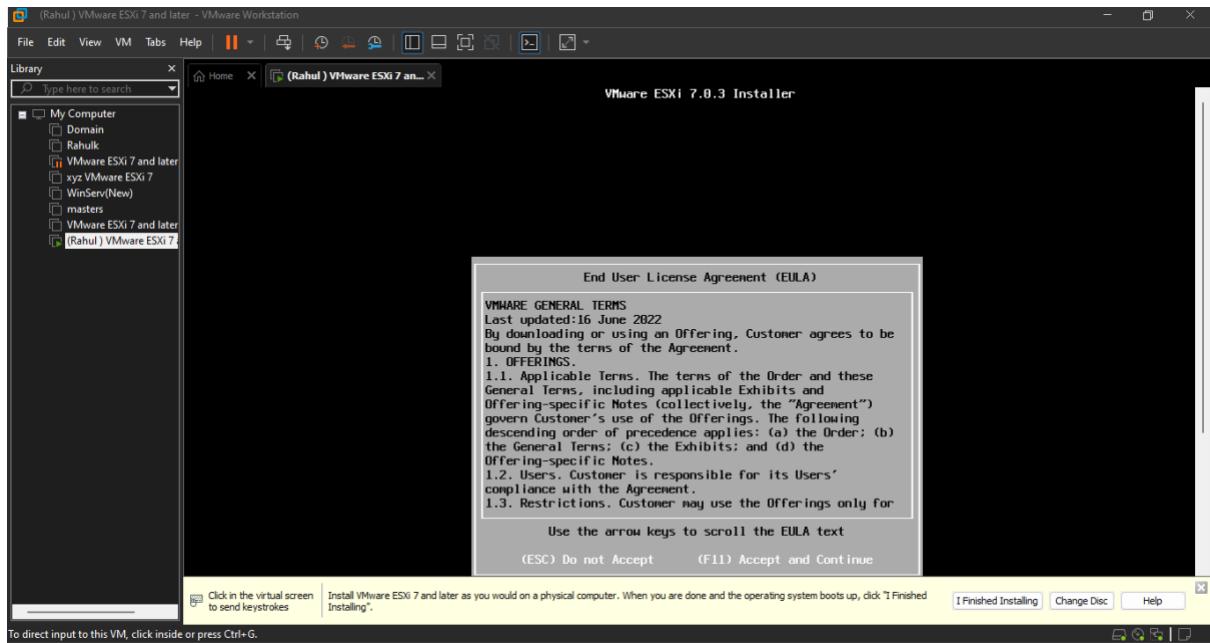
Step 9: Installation Processes start.



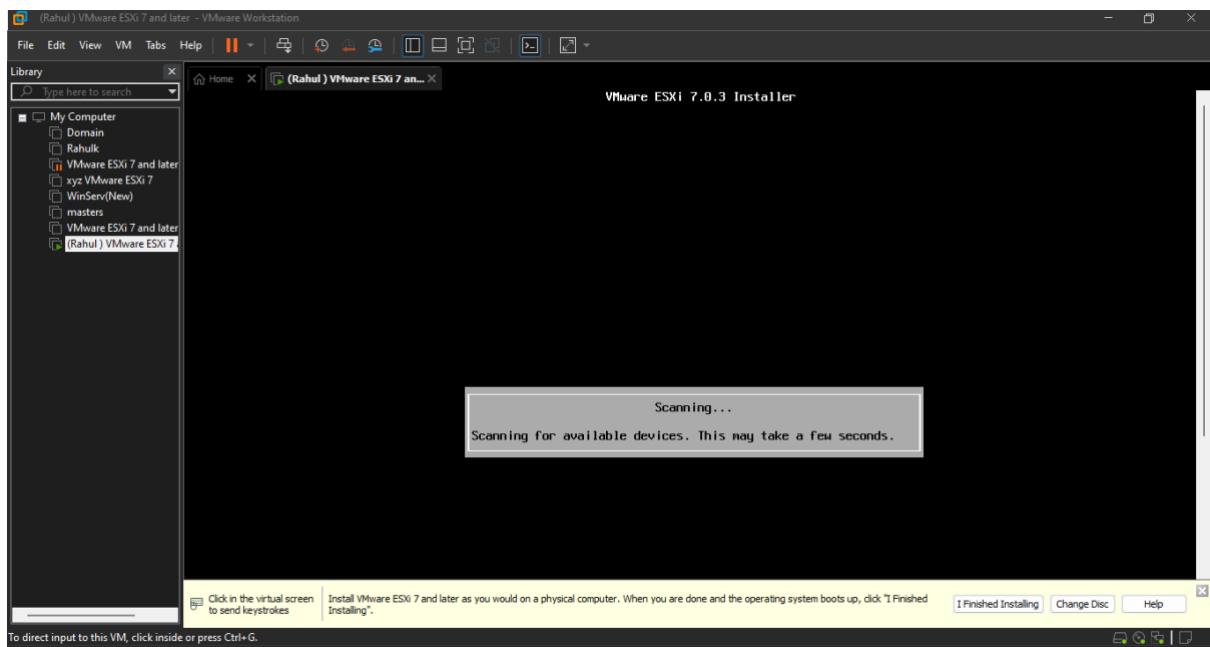
Step 10: Click on Enter



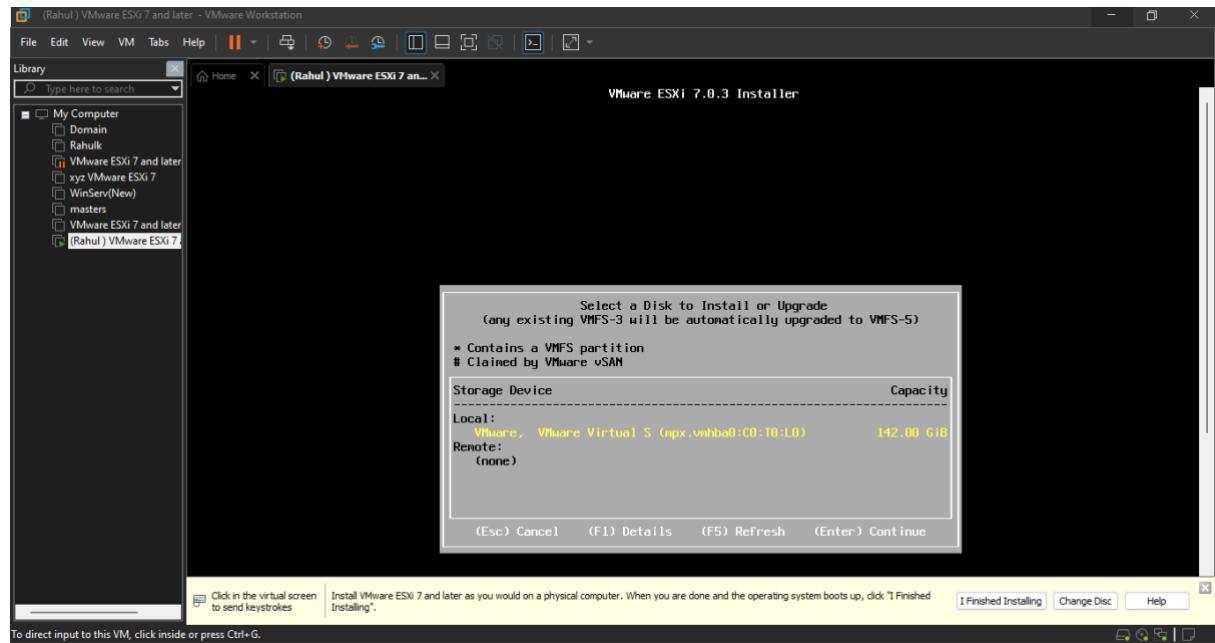
Step 11: Accept the EULA and Press F11



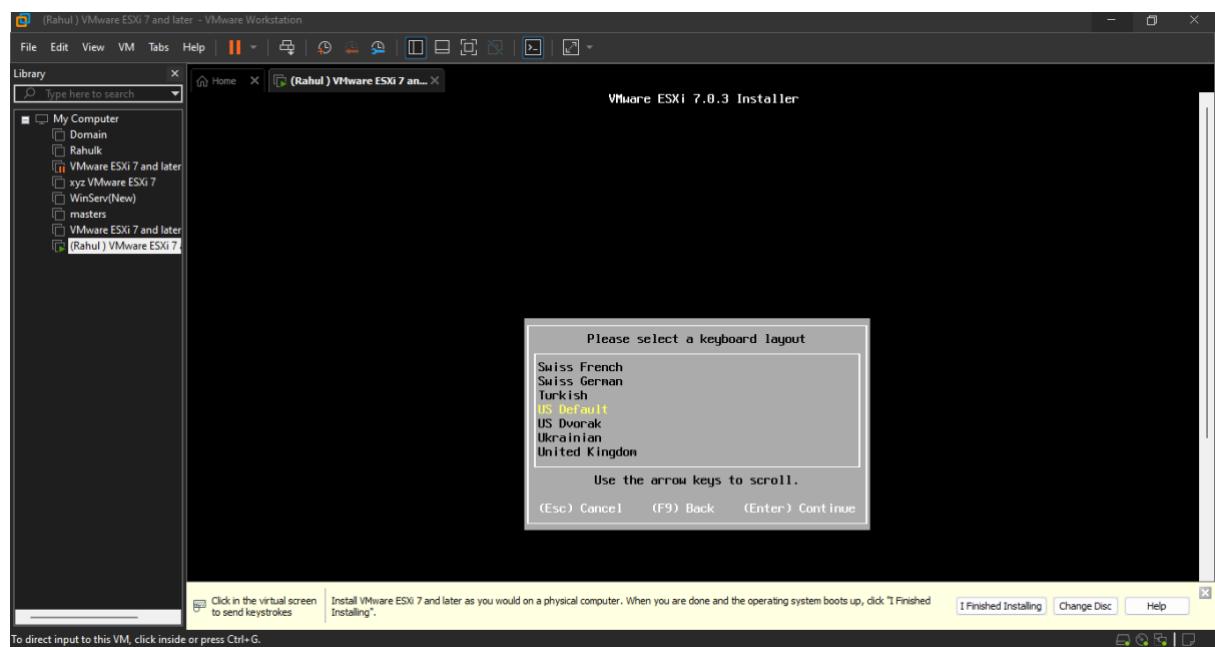
Step 12: Scanning processes start for available devices.



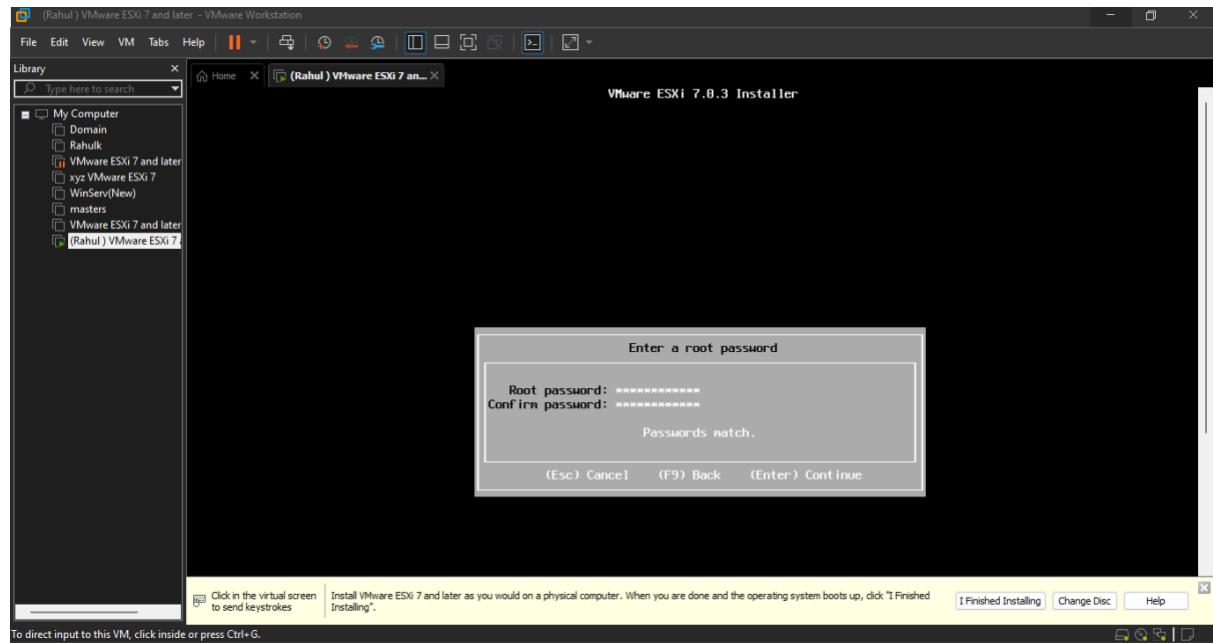
Step 13: Keep the default value and **Click on Enter**



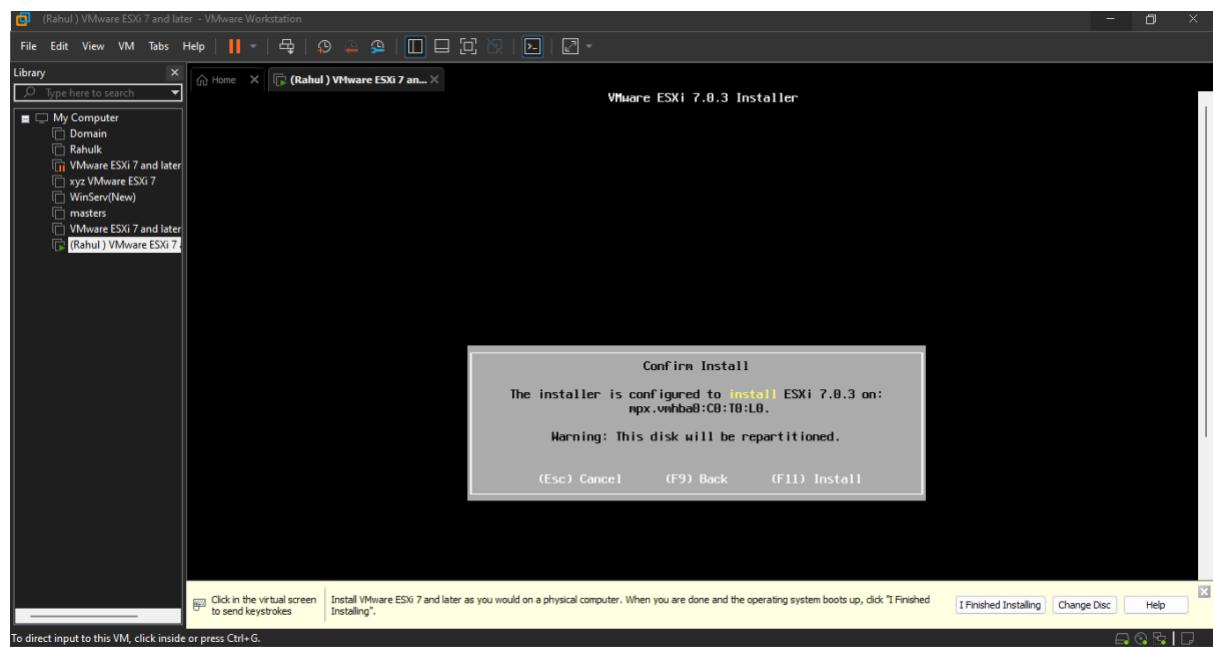
Step 14: Keep the default value and **Click on Enter**



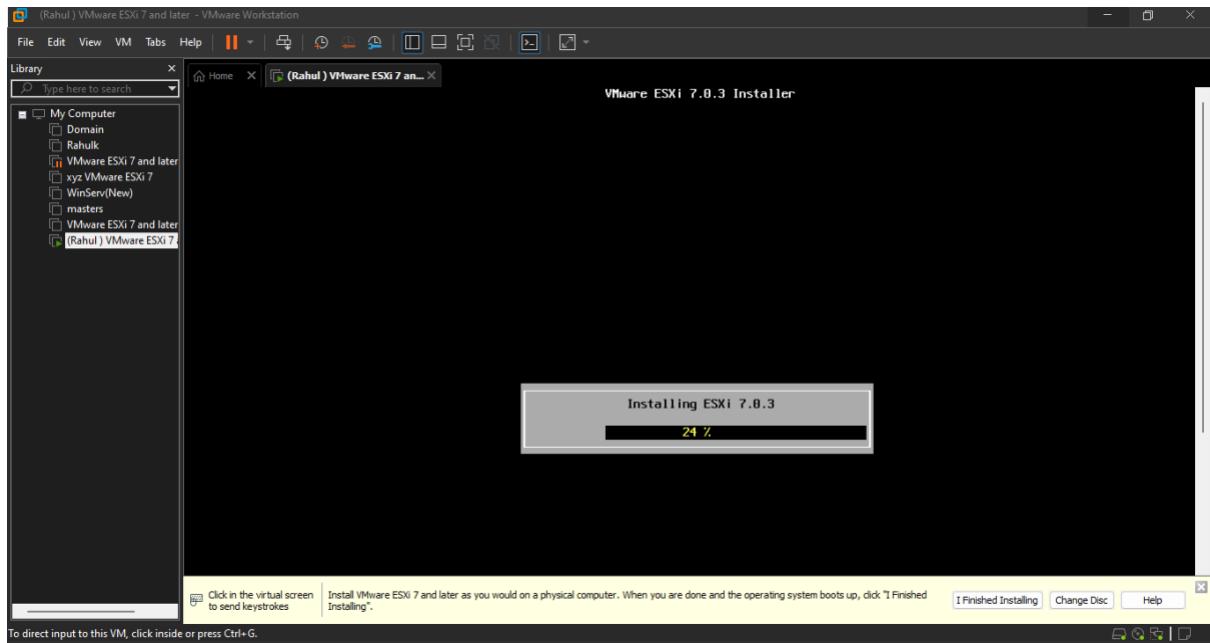
Step 15: Enter a root password (Here it is: NATIONAL@4034) and Click on Enter.



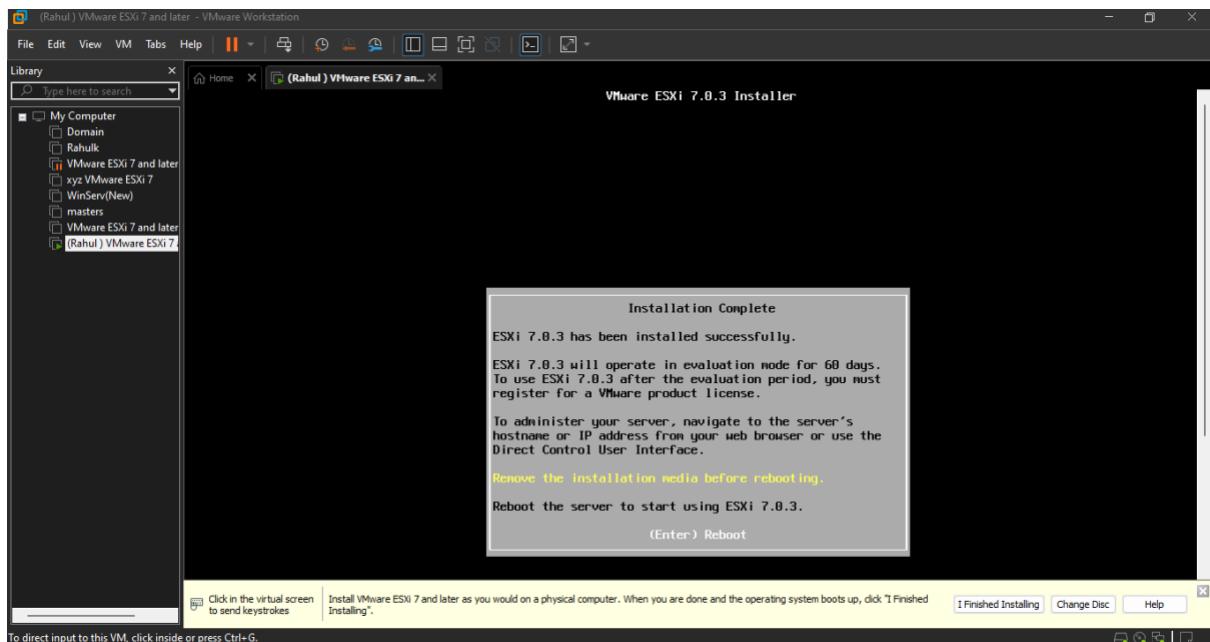
Step 16: Press F11 to Install the VMware ESXi



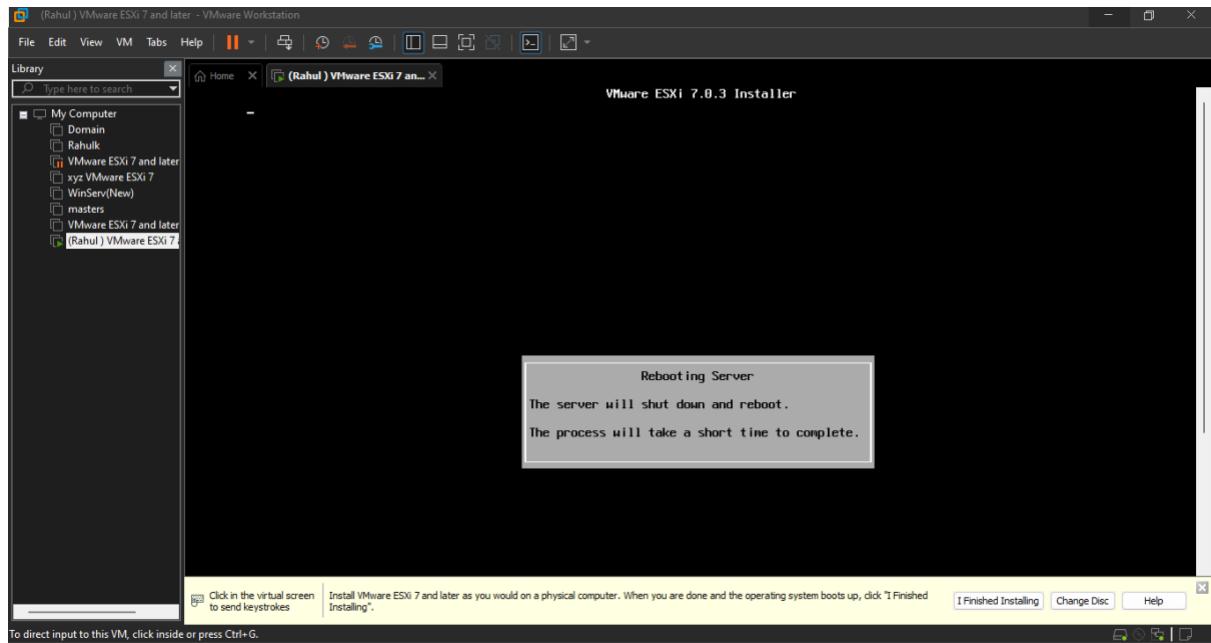
Step 17: Installation Processes start



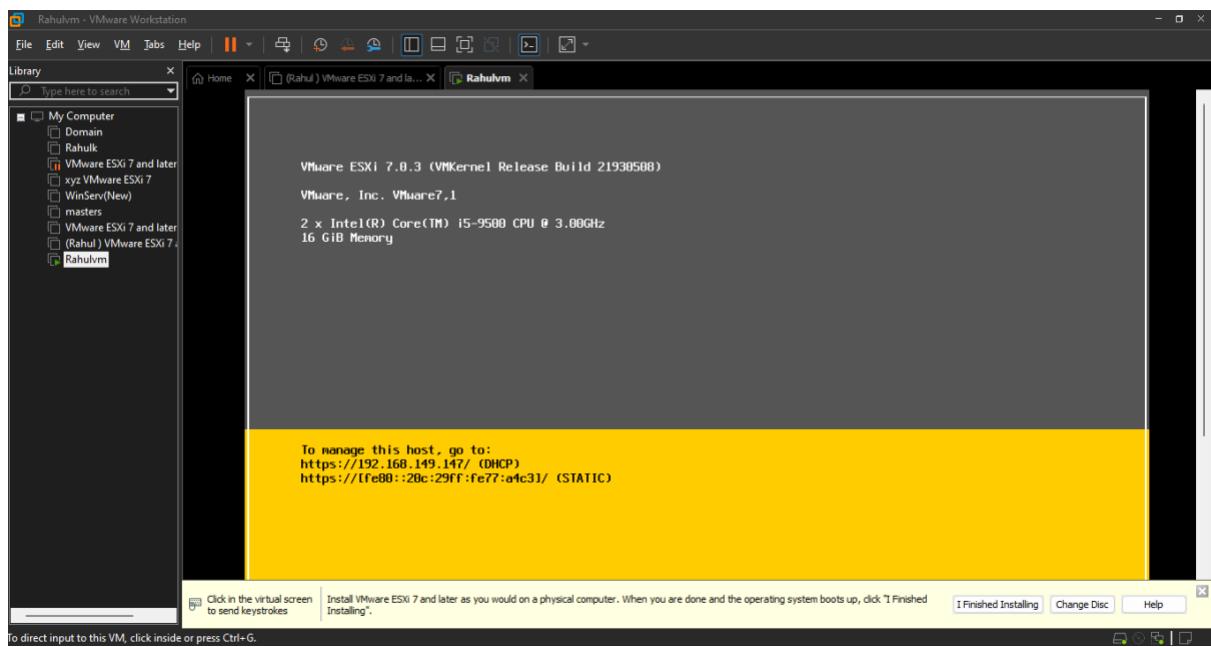
Step 18: After the installation we need to Reboot the Server



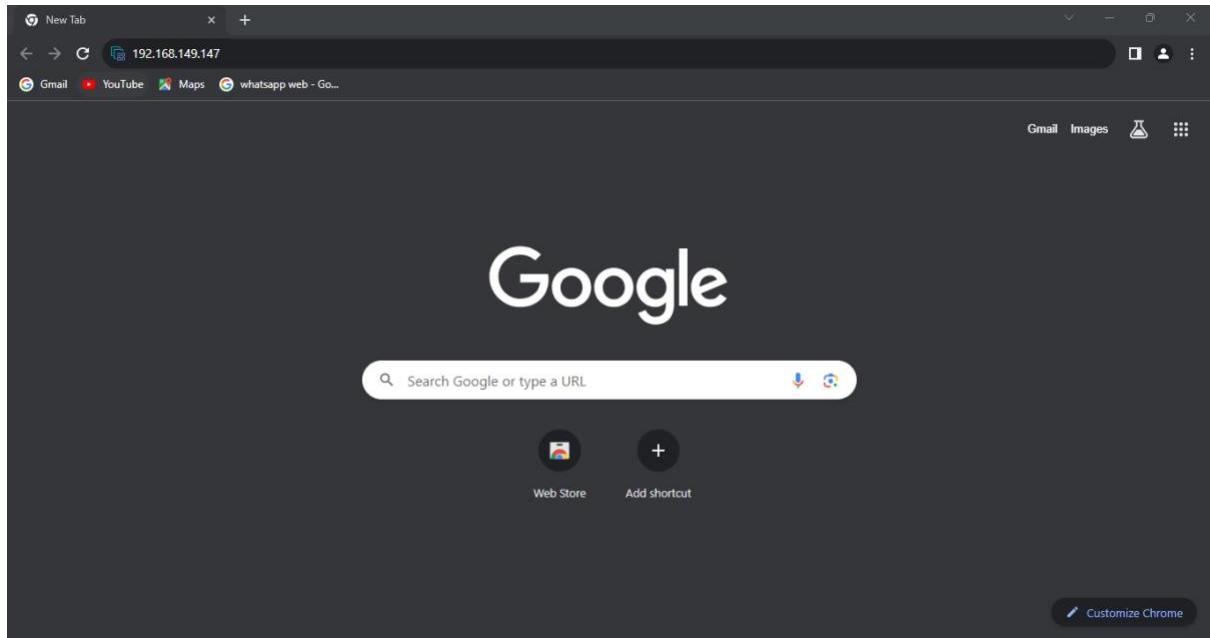
Step 20: It will start the Rebooting Server



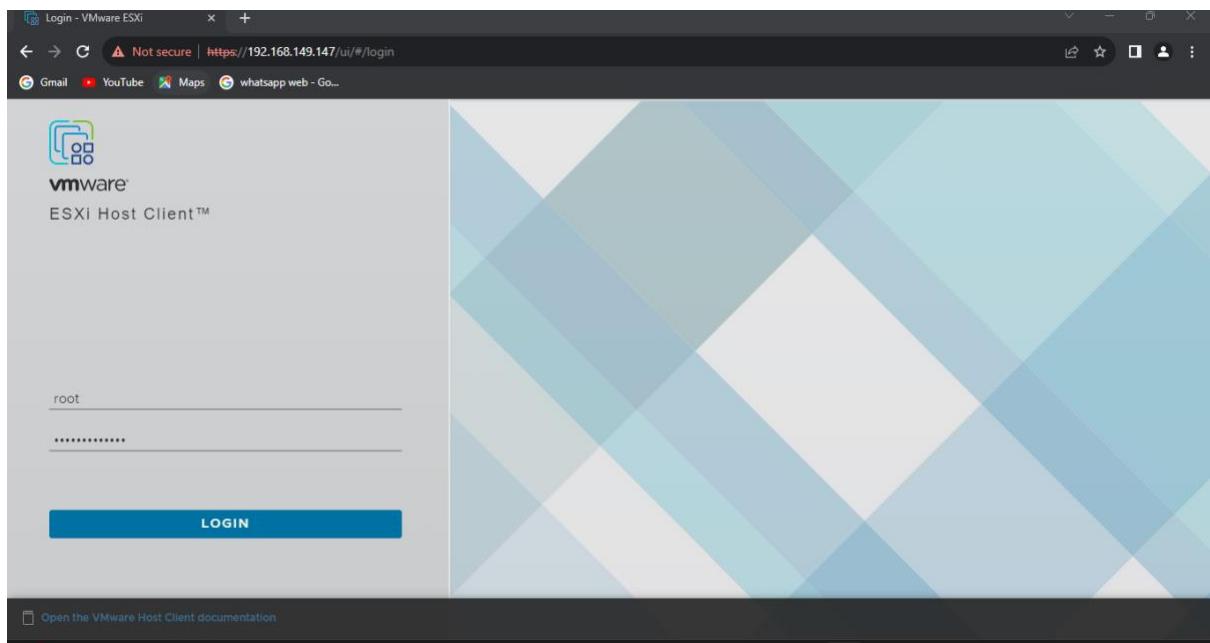
Step 21: Start VMWare ESXi



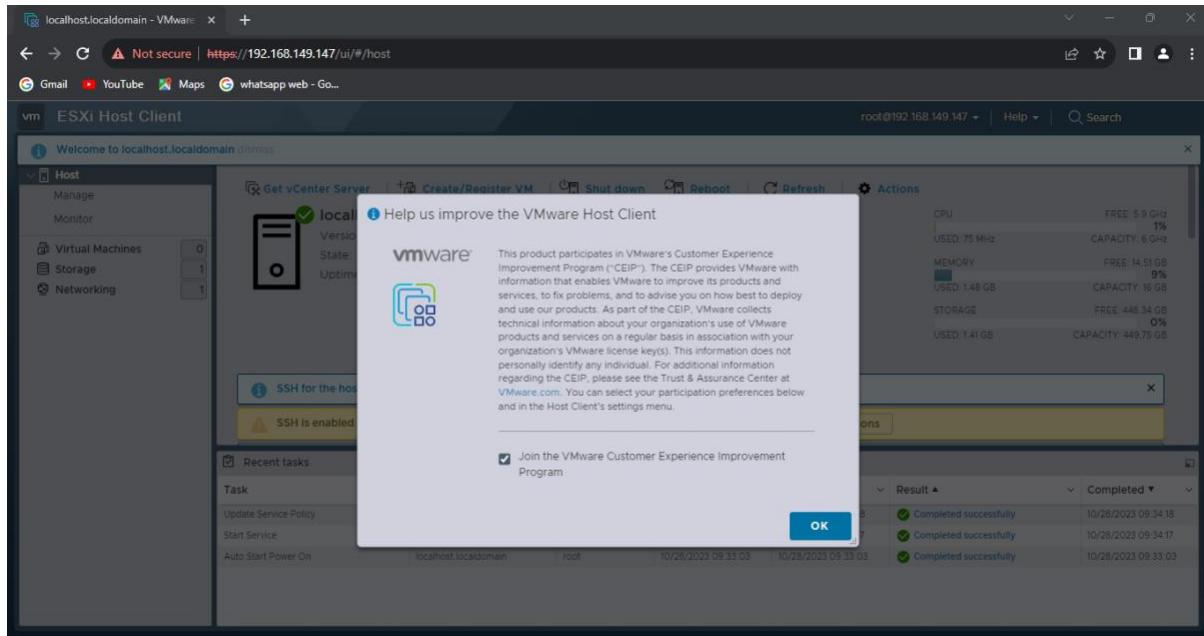
Step 22: Enter the ESXi IP (**192.168.149.147**) to web browser to access **VMWare ESXi host**



Step 23: Enter username and password same as used in configuring ESXi Machine

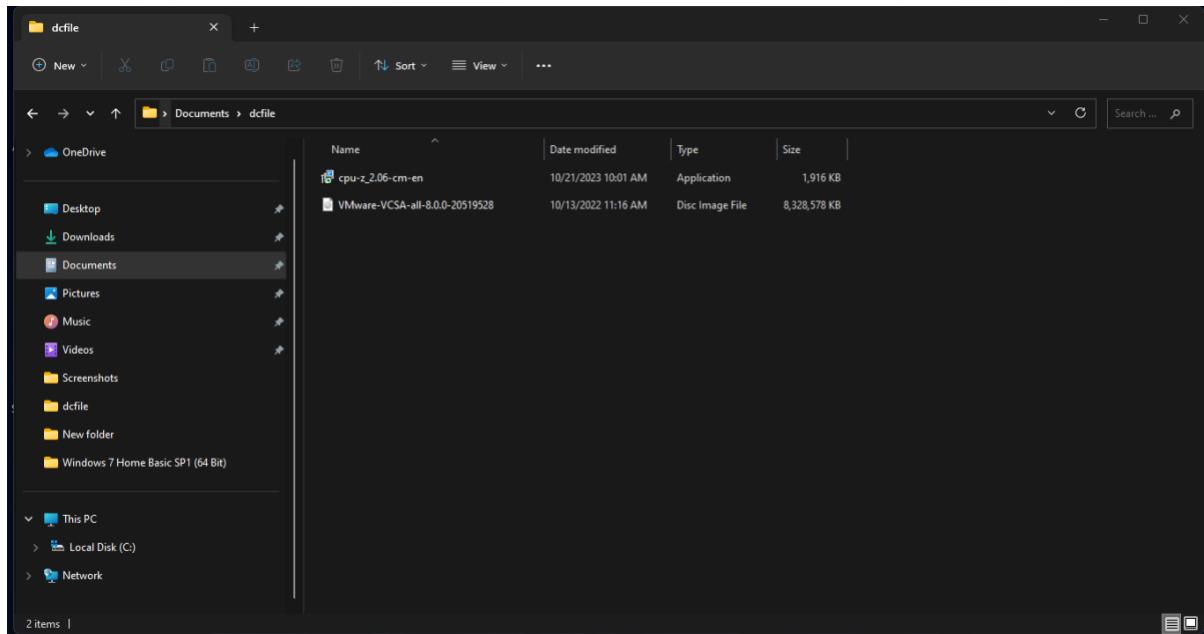


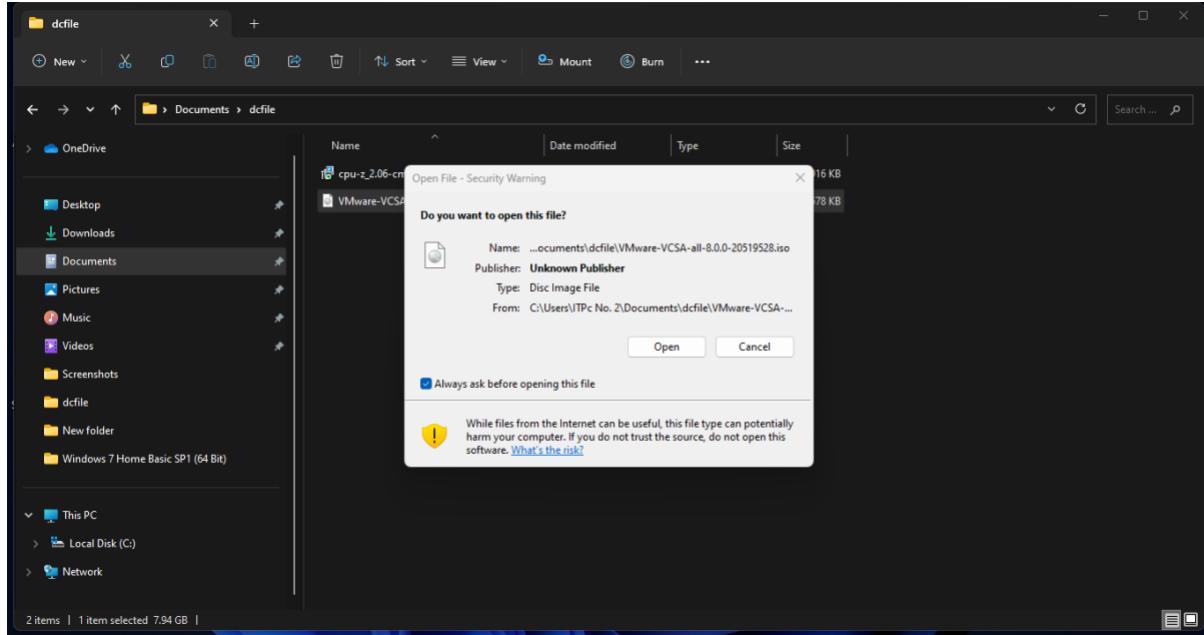
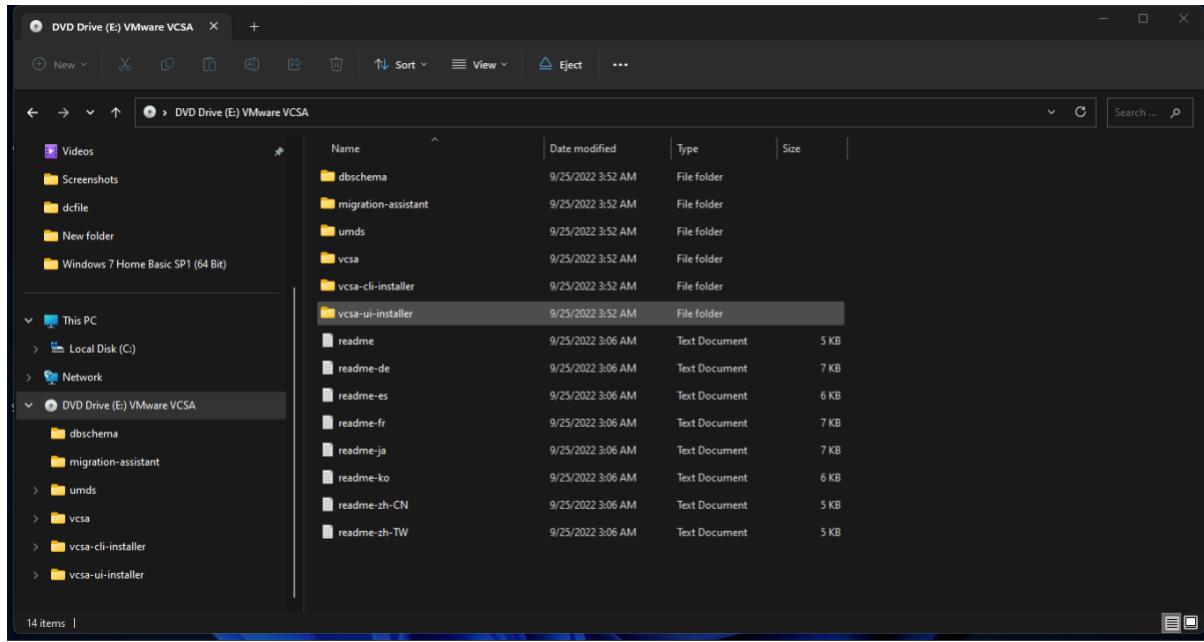
Step 24: ESXi Host Client Windows open And Pop-up open and Click on OK



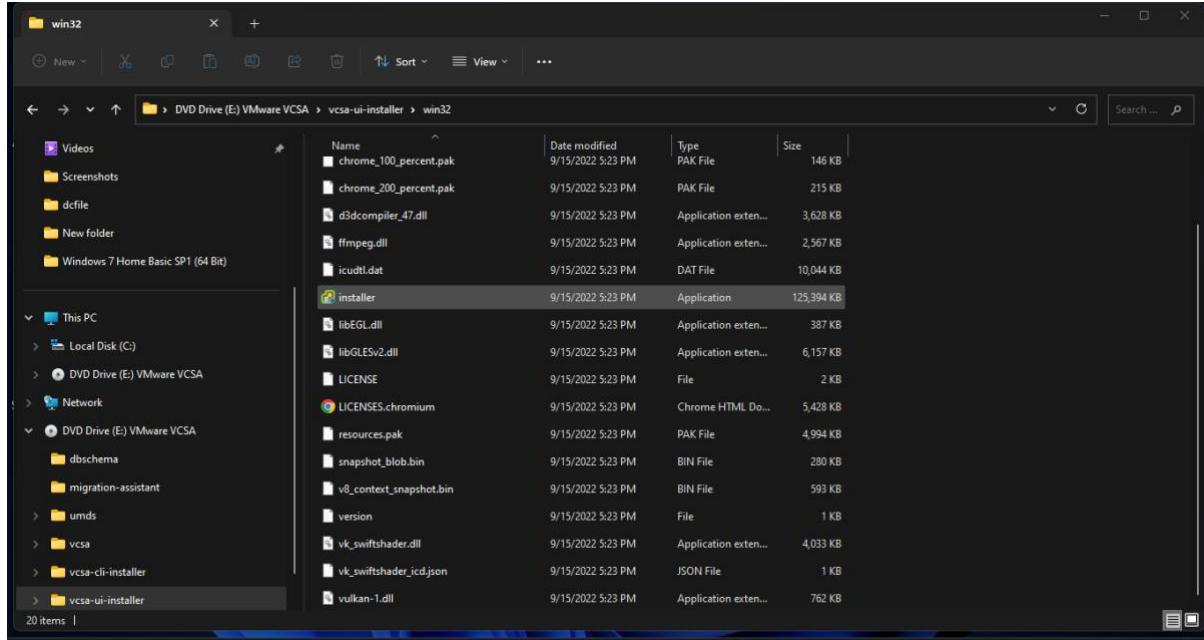
Step 25: Now Install vCenter Server

- Double Click on VMware-VCSA-all-8.0.0-20519528

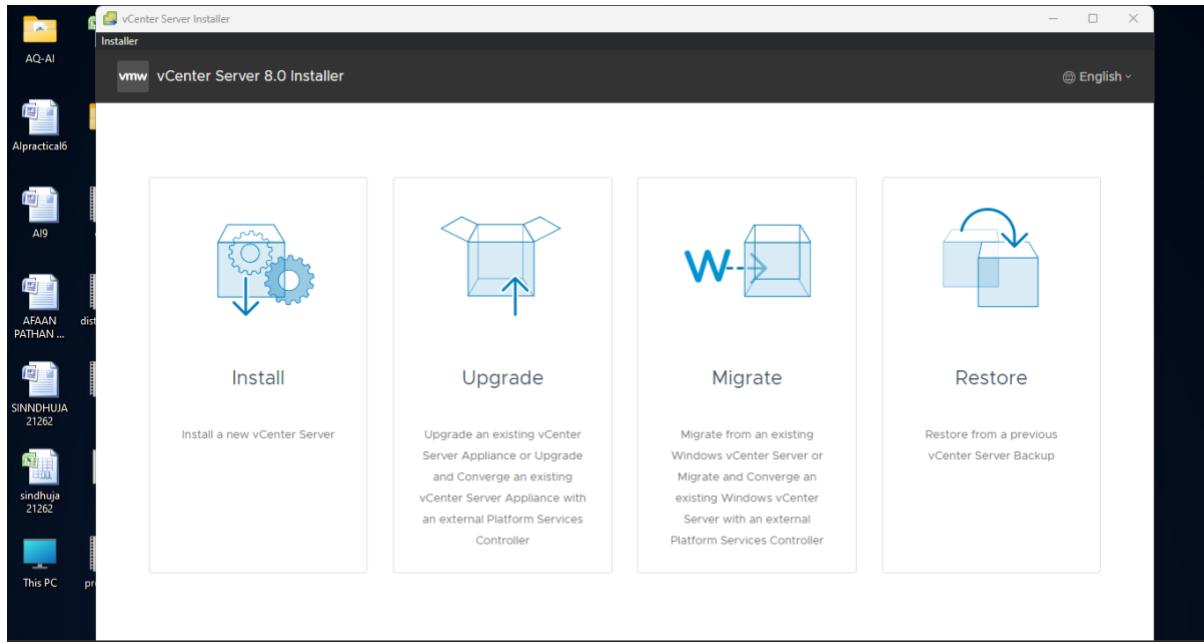


Step 26: Click on Open**Step 27: Click on vcsa-ui-installer**

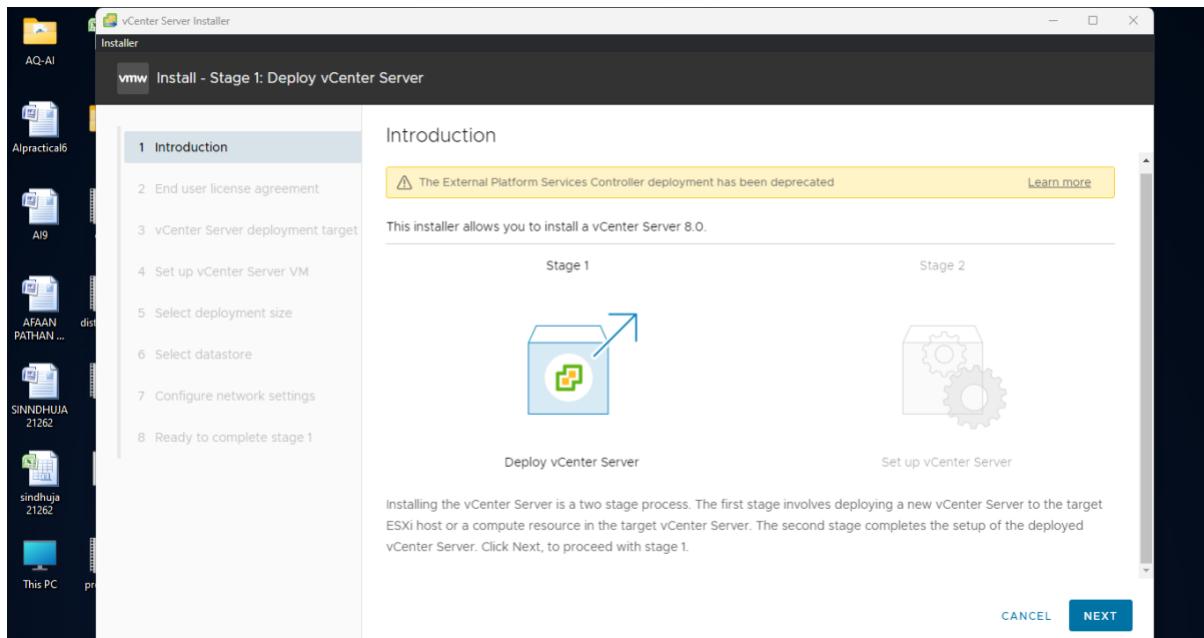
Step 27: Under win32 Click on installer



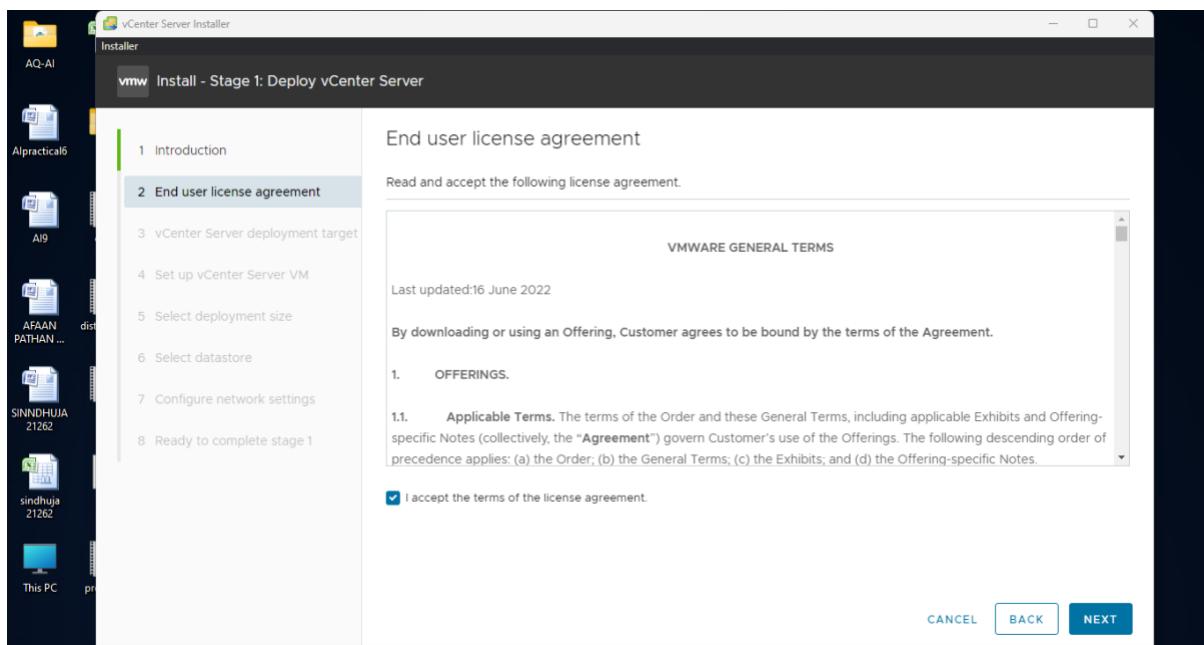
Step 28: Now vCenter Server Installer Window Click on install



Step 29: Click on Next

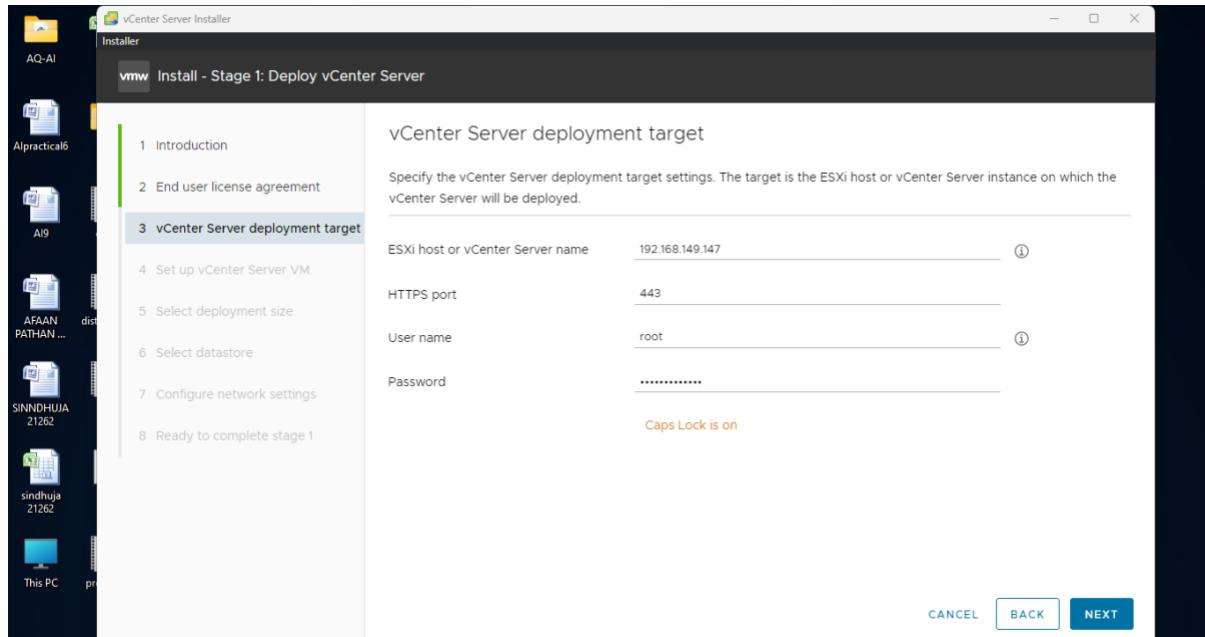


Step 30: Select I accept the terms of the license agreement and Click on Next

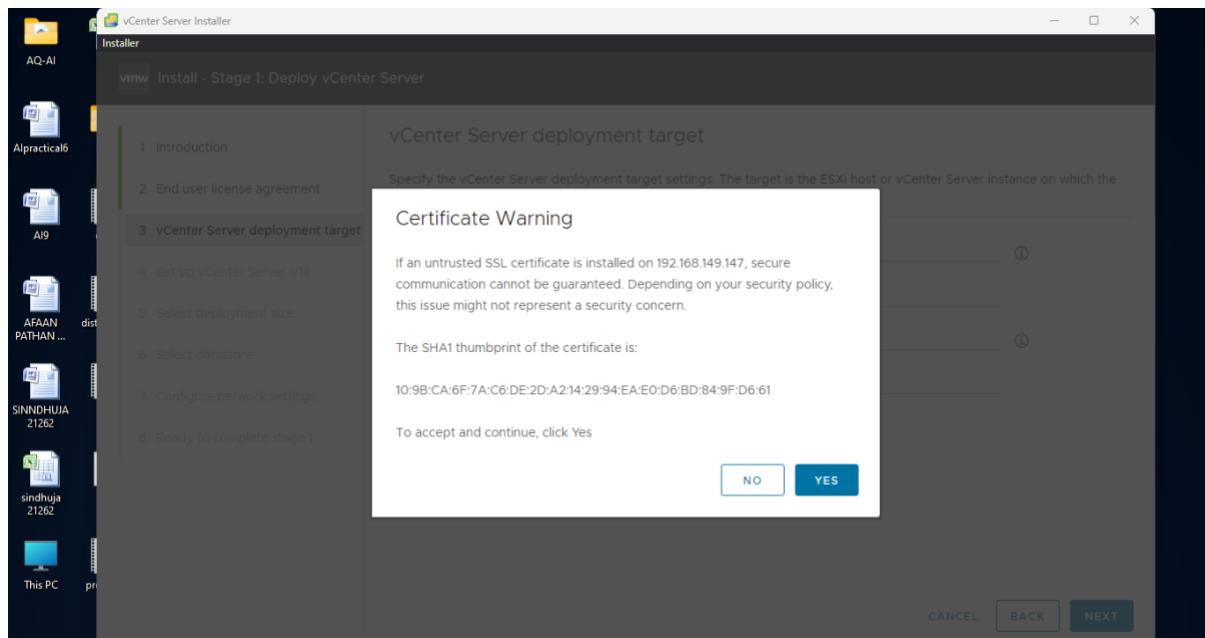


Step 31: Here Enter ESXi host ip address (192.168.149.147)

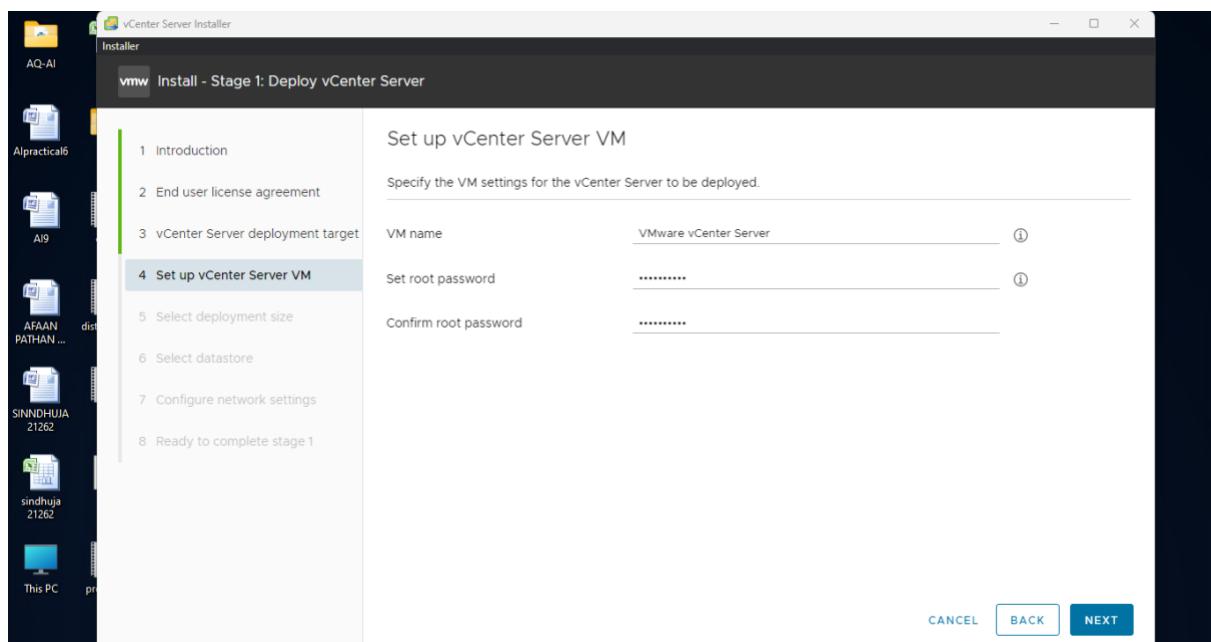
- Type User name (Here it is root) and password (Here it is National@4034)
- Click on Next



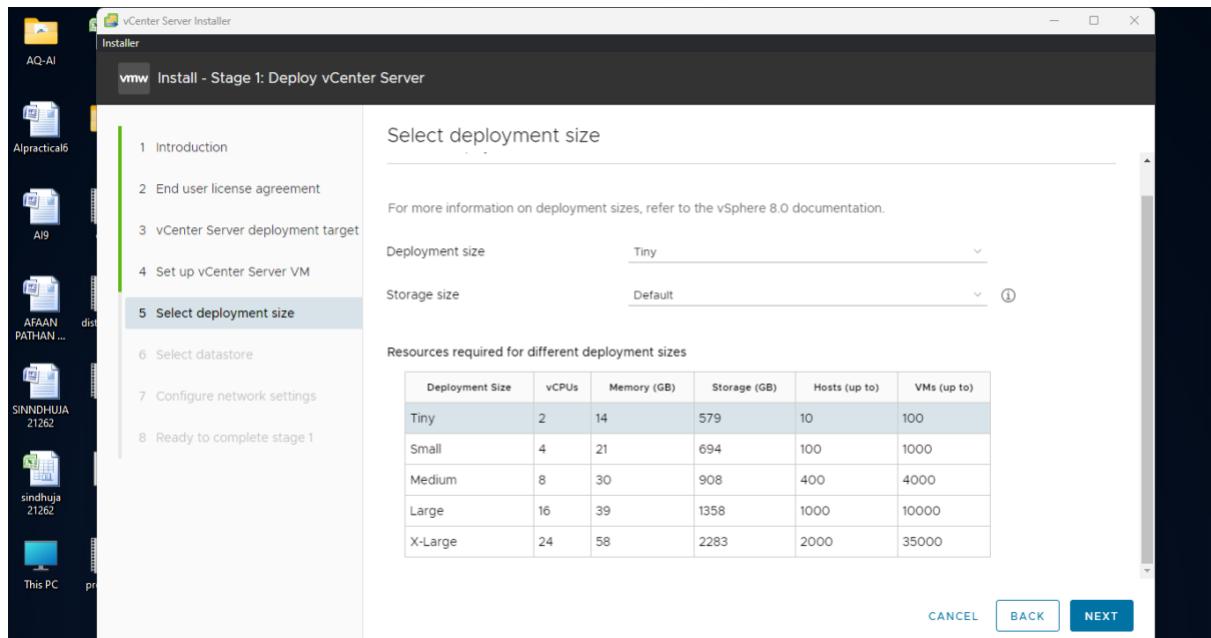
Step 32: Certificate Warning pop-up open Click on Yes



Step 33: Give name your VM (Here it is VMware vCenter Server) and Set root password (Here it is National1@) and Confirm the root password and Click on Next

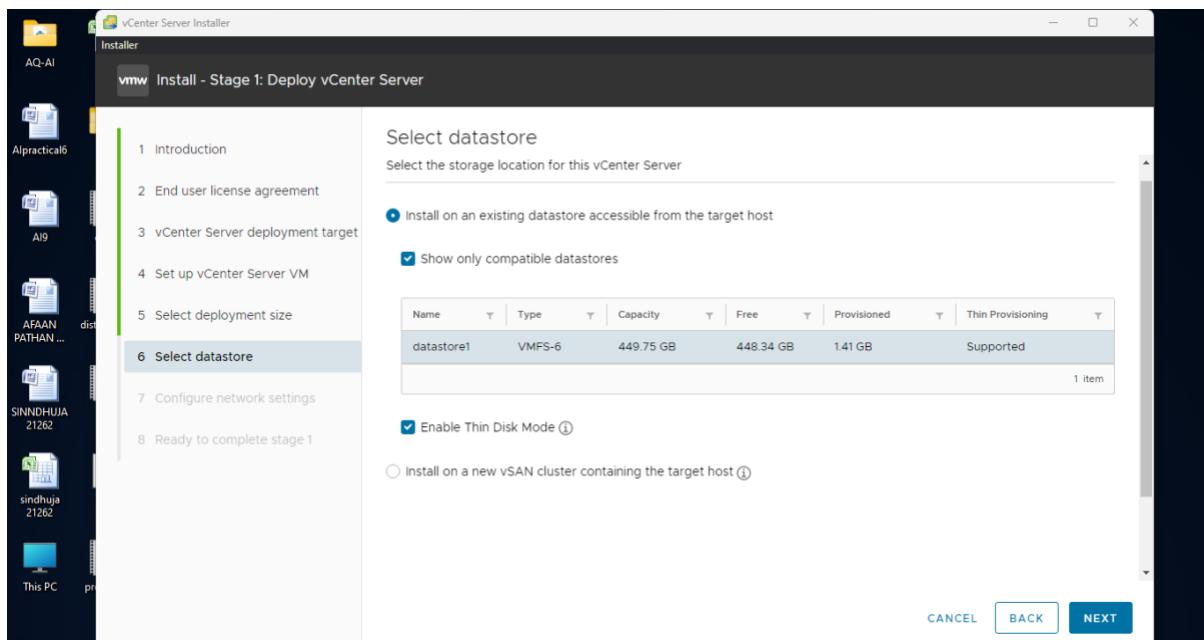


Step 34: Select deployment size (Here it is Tiny) and Select Storage size Default and Click on Next



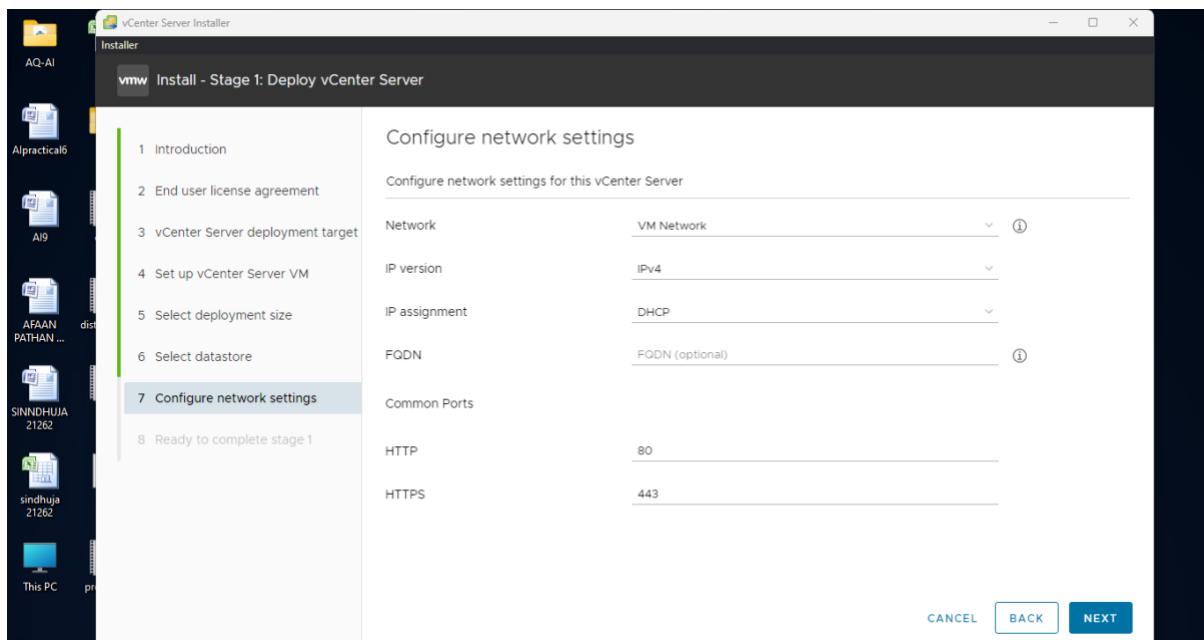
Step 35: Select the storage location for this vCenter Server

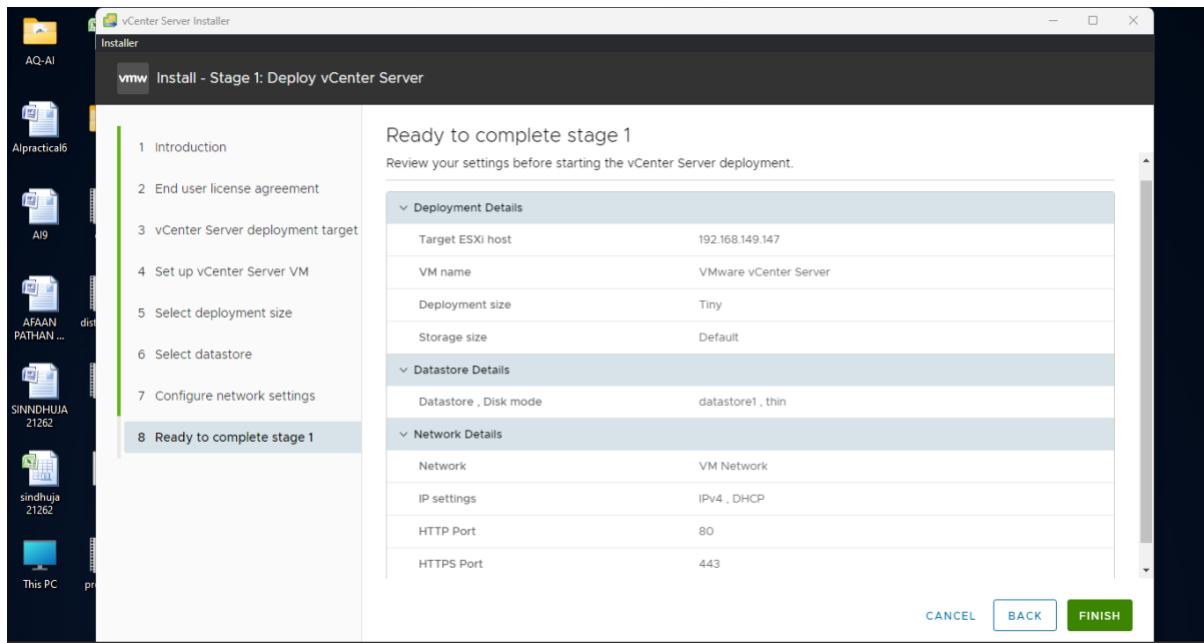
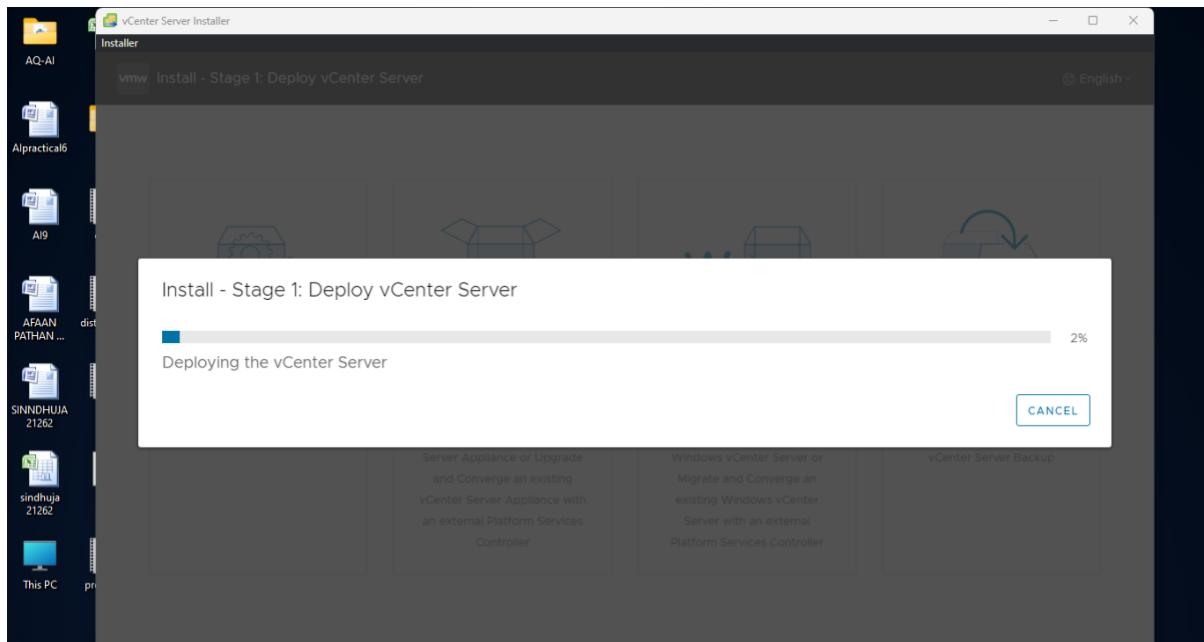
- **Install on an existing datastore accessible from the target host**
- **Show only compatible datastores**
- **Enable Thin Disk Mode**
- **Click on Next**



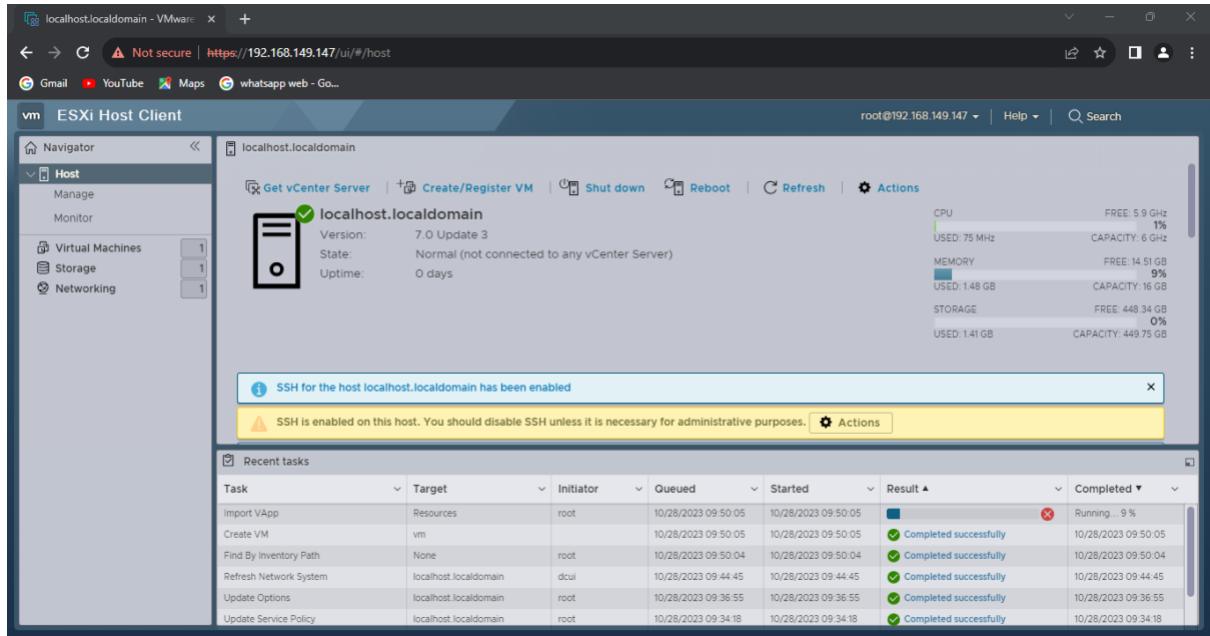
Step 36: In network settings Select:

- **IP version: IPv4**
- **IP assignment: DHCP**
- **Click on Next**

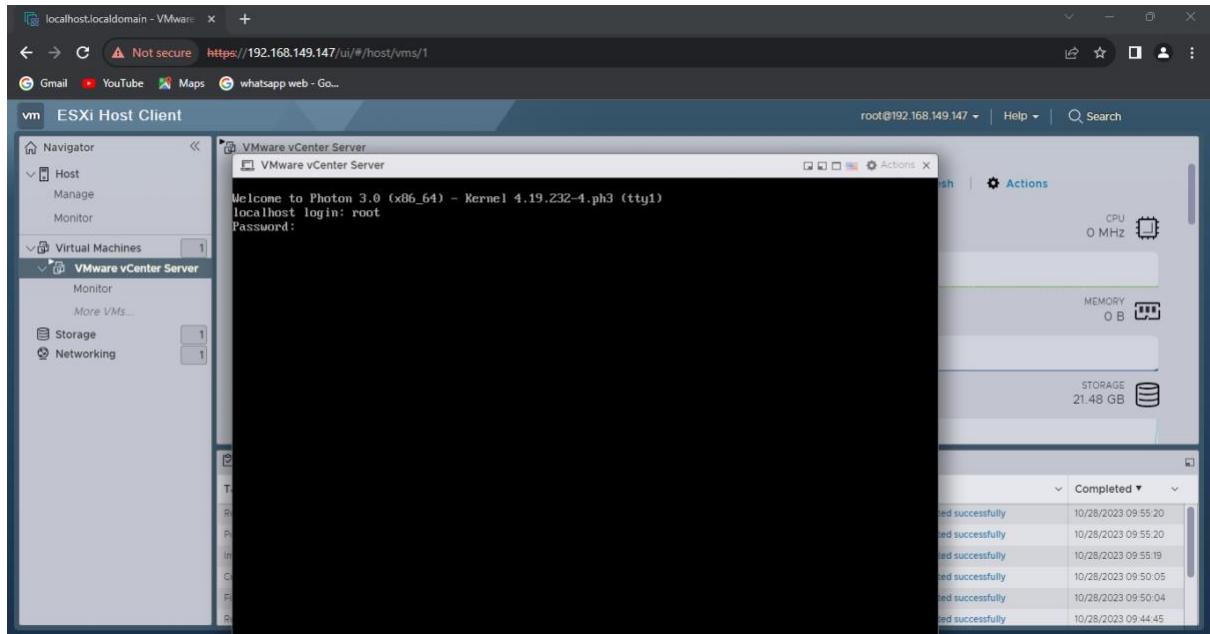


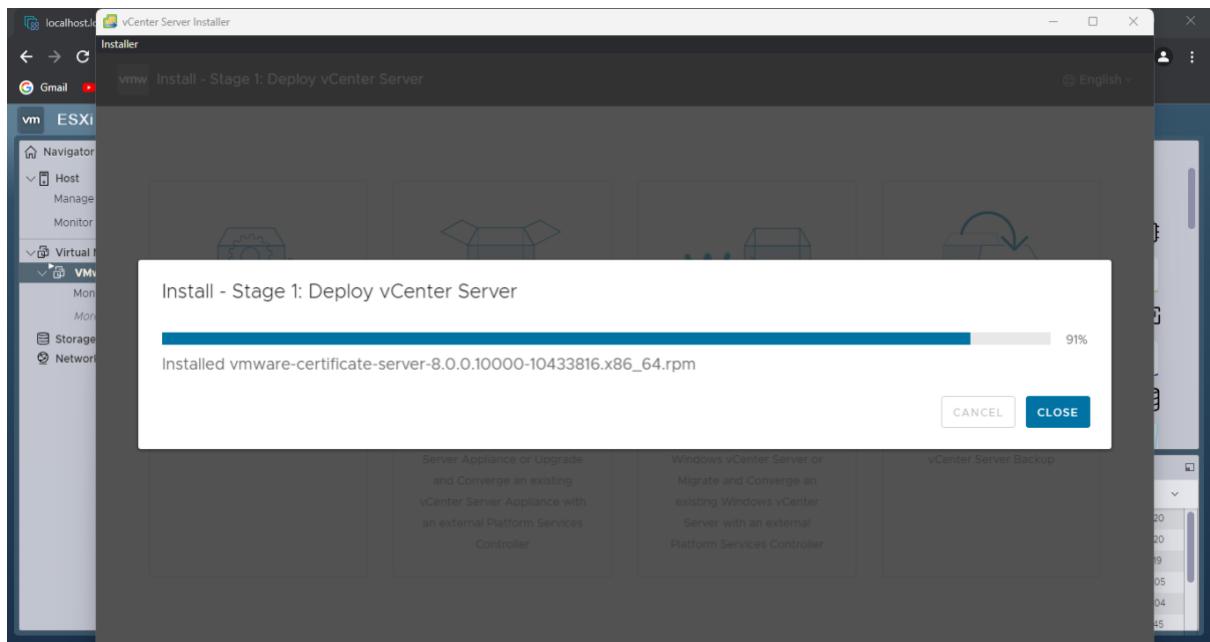
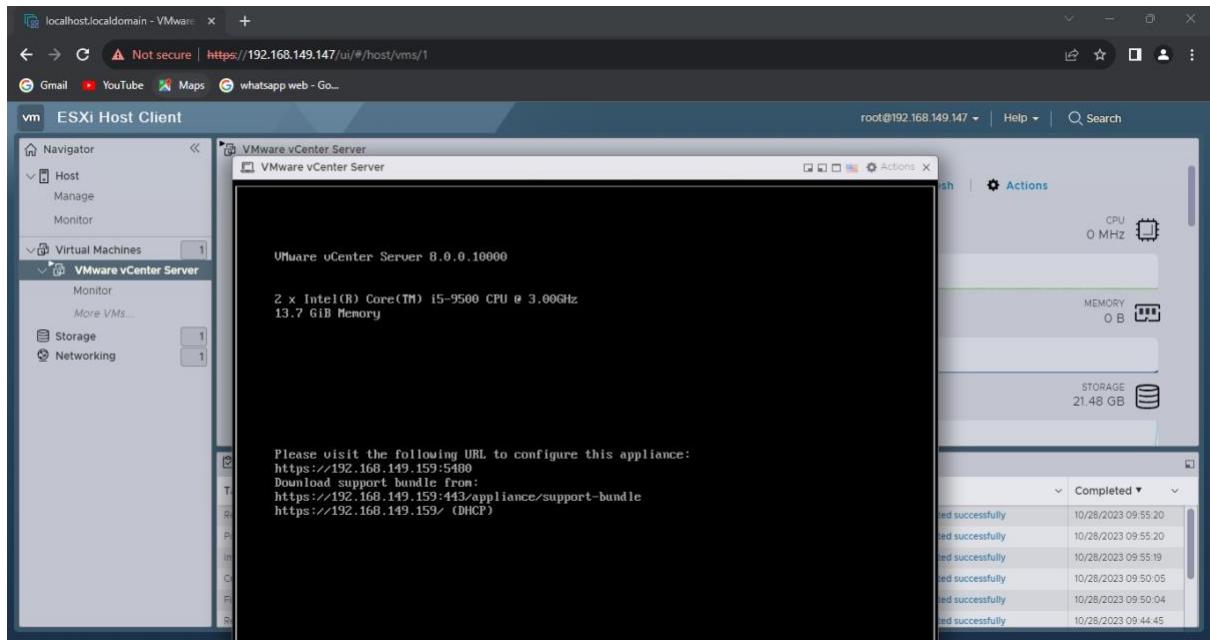
Step 37: Review your settings and Click on Finish**Step 38: Installation of Stage 1 start**

- In ESXi Host Client Window you can also view the installation processes of stage 1

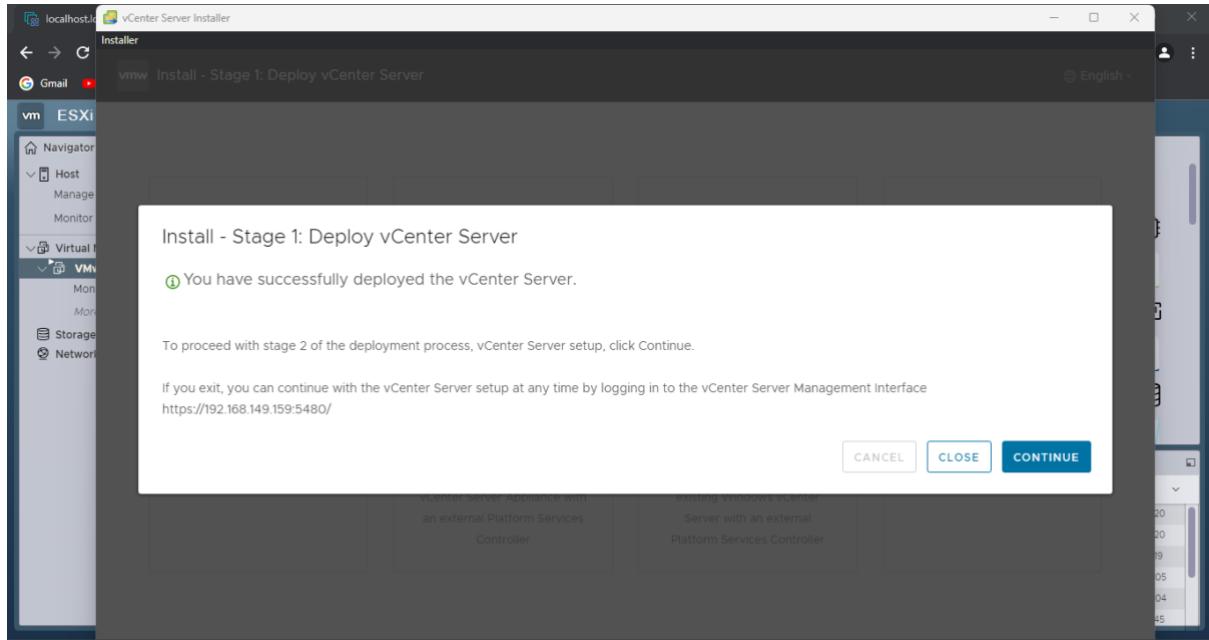


- At 80 percent of the installation, open the ESXi Host Client and Enter the password for your ESXi Server in the vCenter Server VM

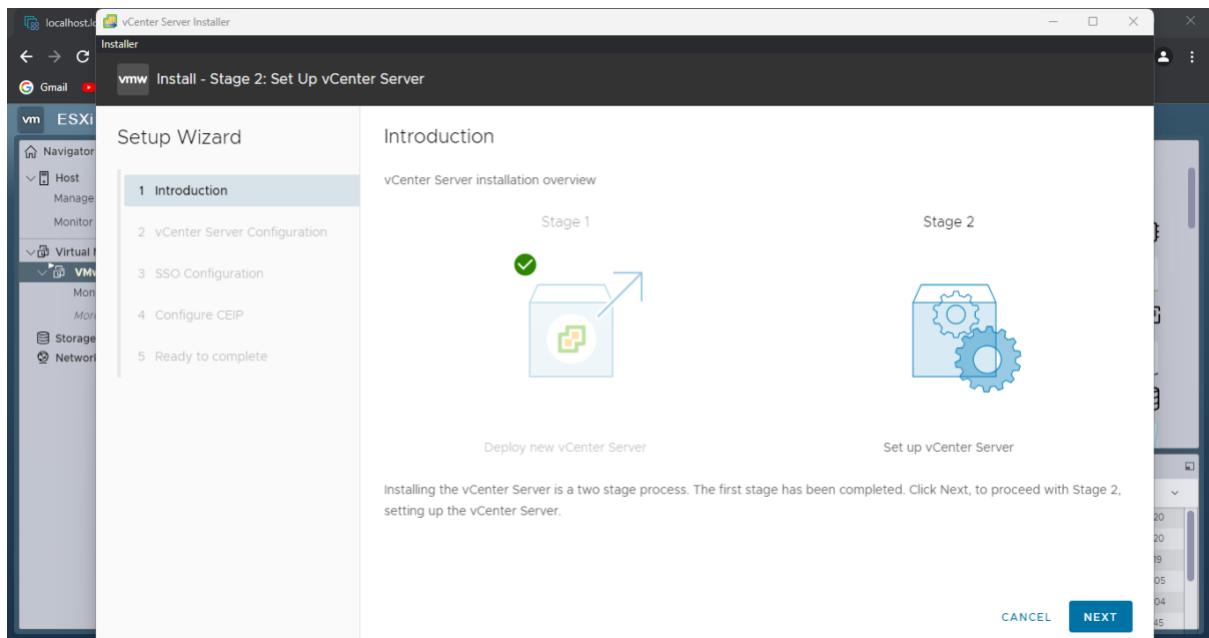




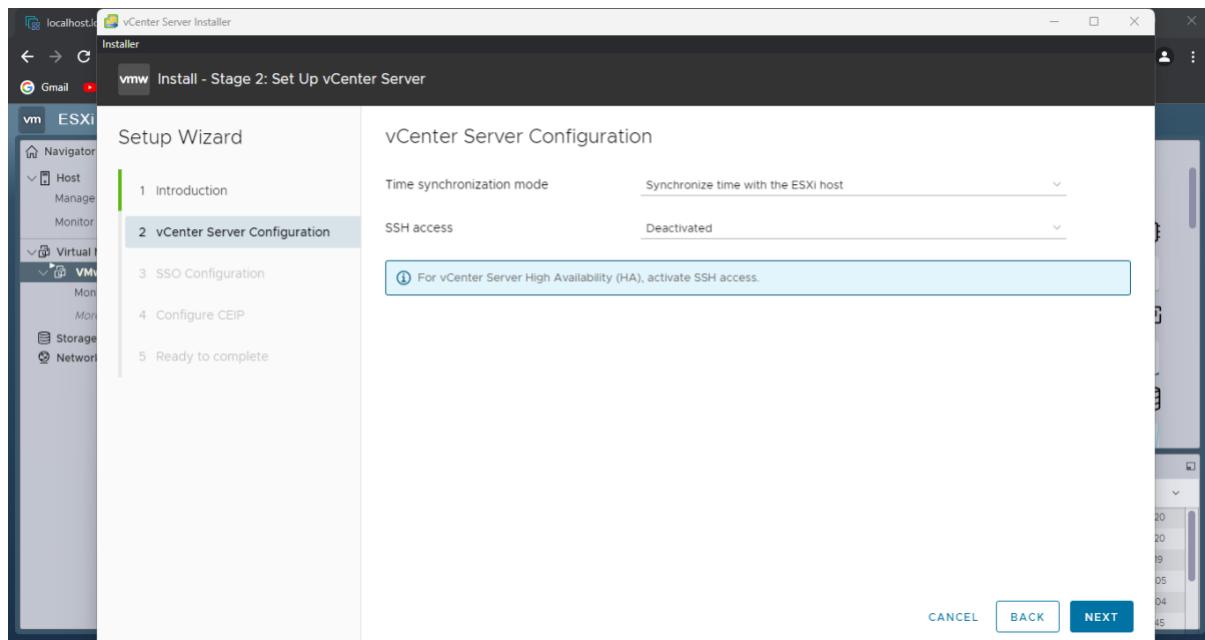
- After the setup is completed **Click Continue**



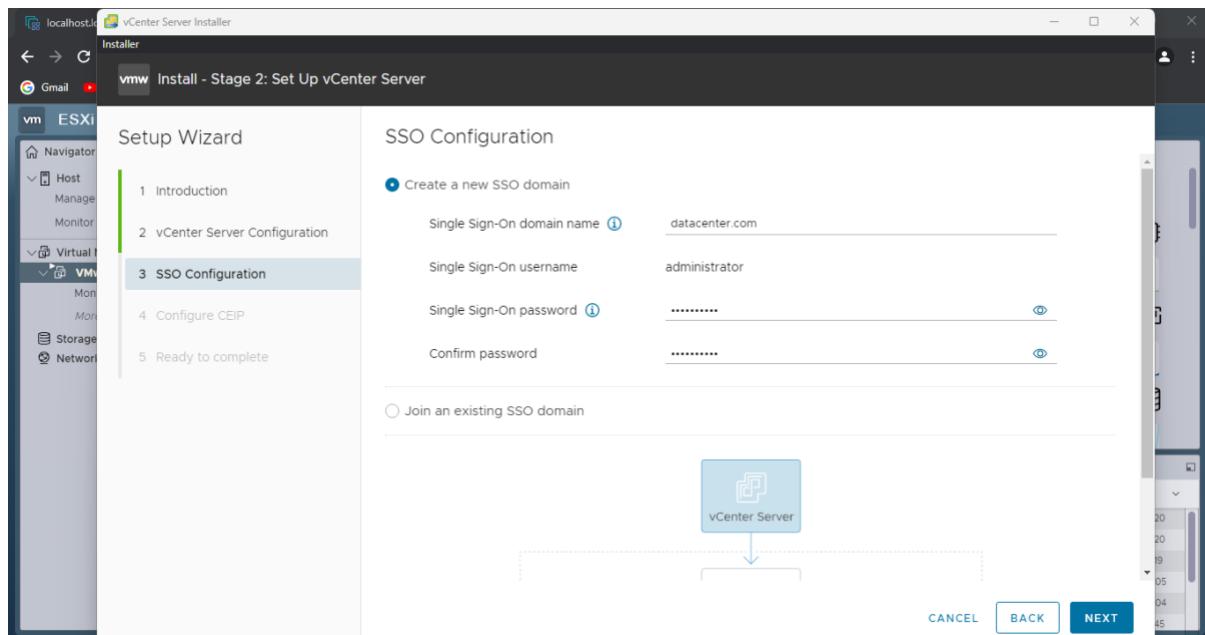
- This will Load Stage 2 which involves setting up the vCenter Server, Click Next



- In Time Synchronization Mode Select **Synchronize time with ESXi host** and Click **Next**

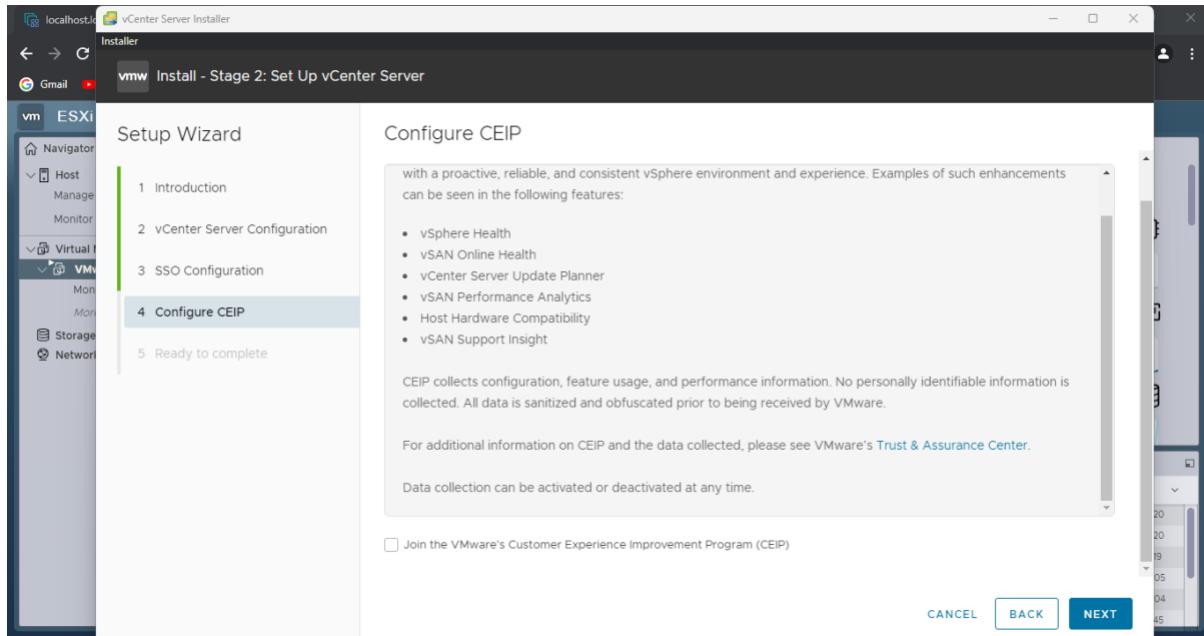


- Enter a Single Sign on domain name (**Here it is datacenter.com**) and enter a password (**Here it is National1@**) and Click **Next**

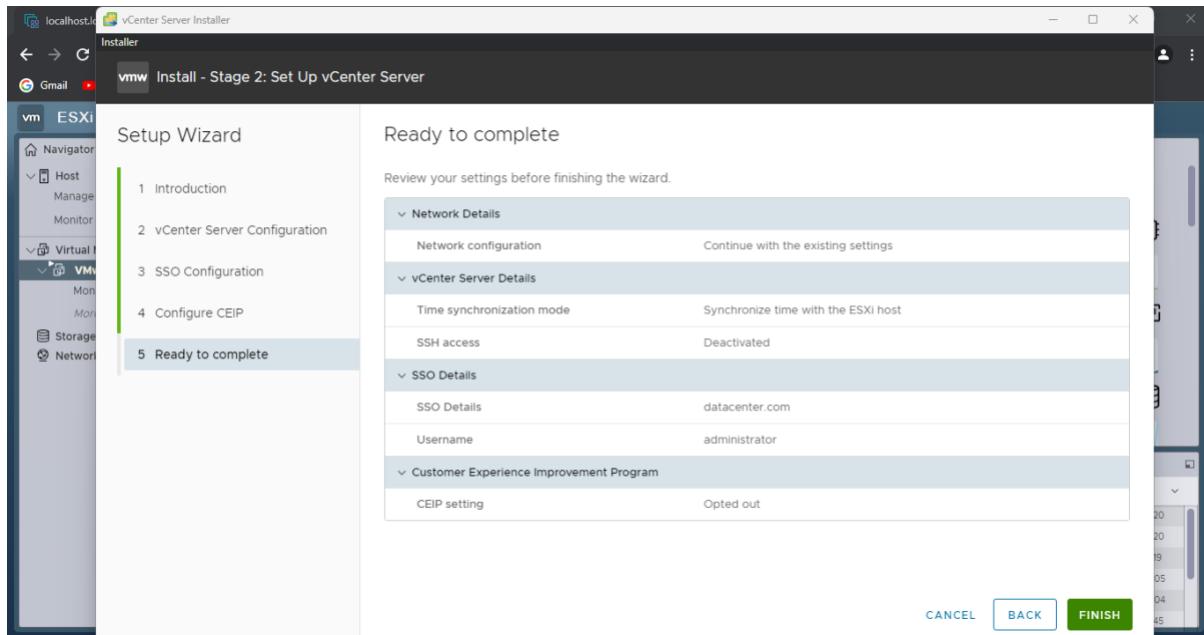


- Keep the default value and Click on Next

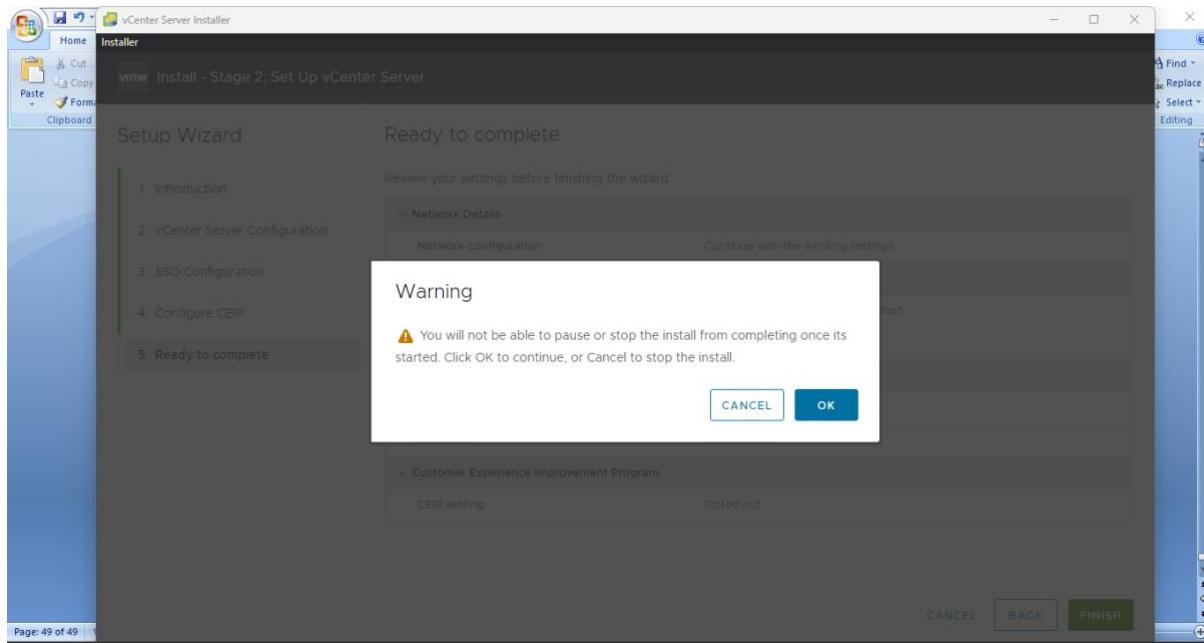
Note: Un-check the Join the VMware's customers Experience improvement Program



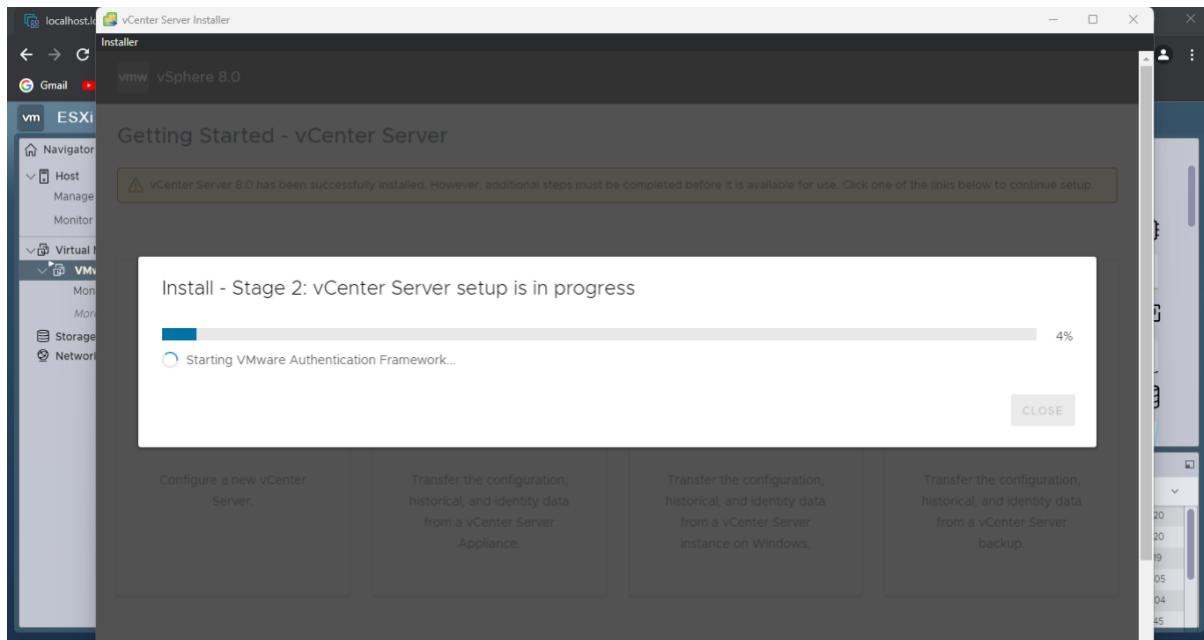
- View the Summary and Click on Finish



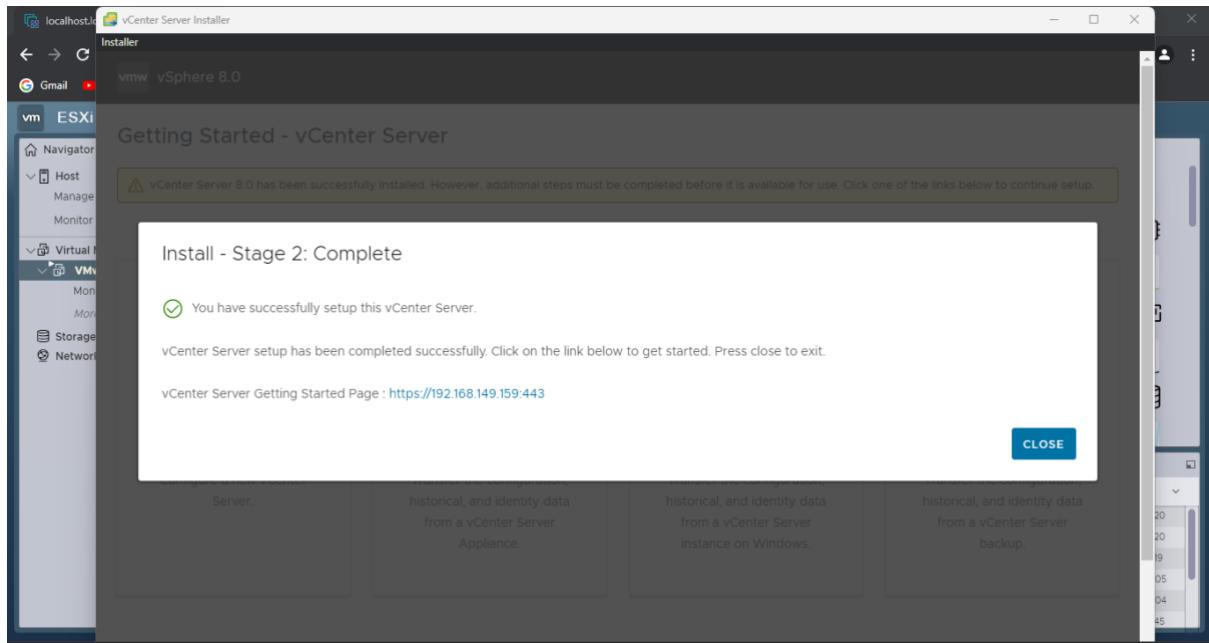
- Warning pop-up open and **Click on OK**



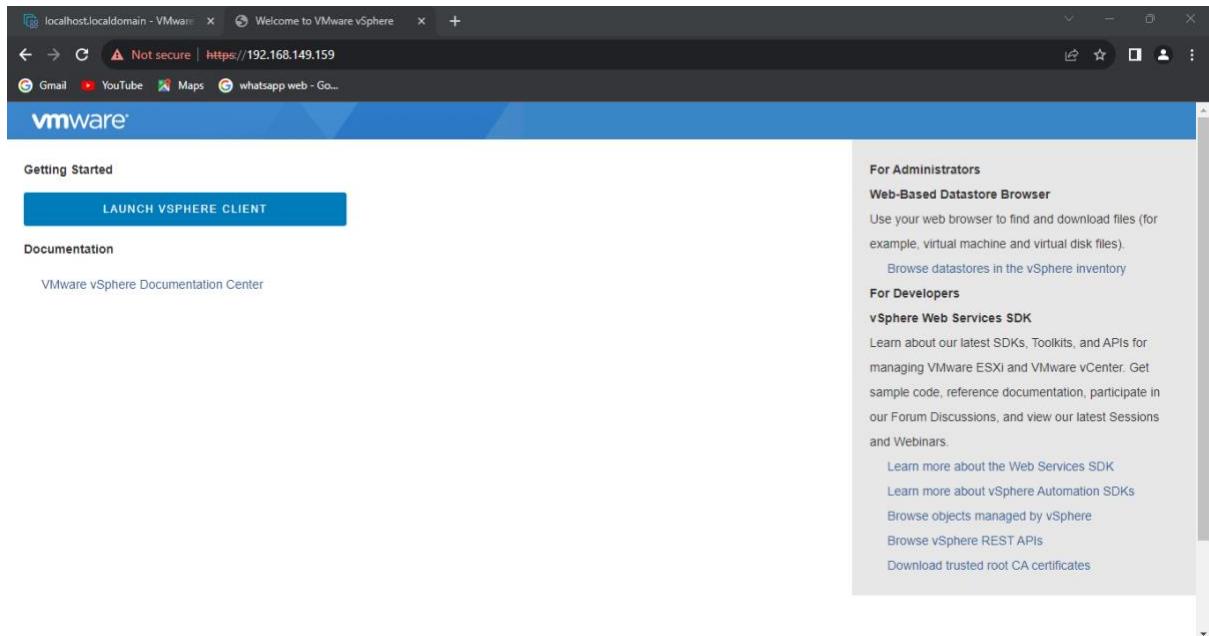
- **Installation of Stage 2 start**



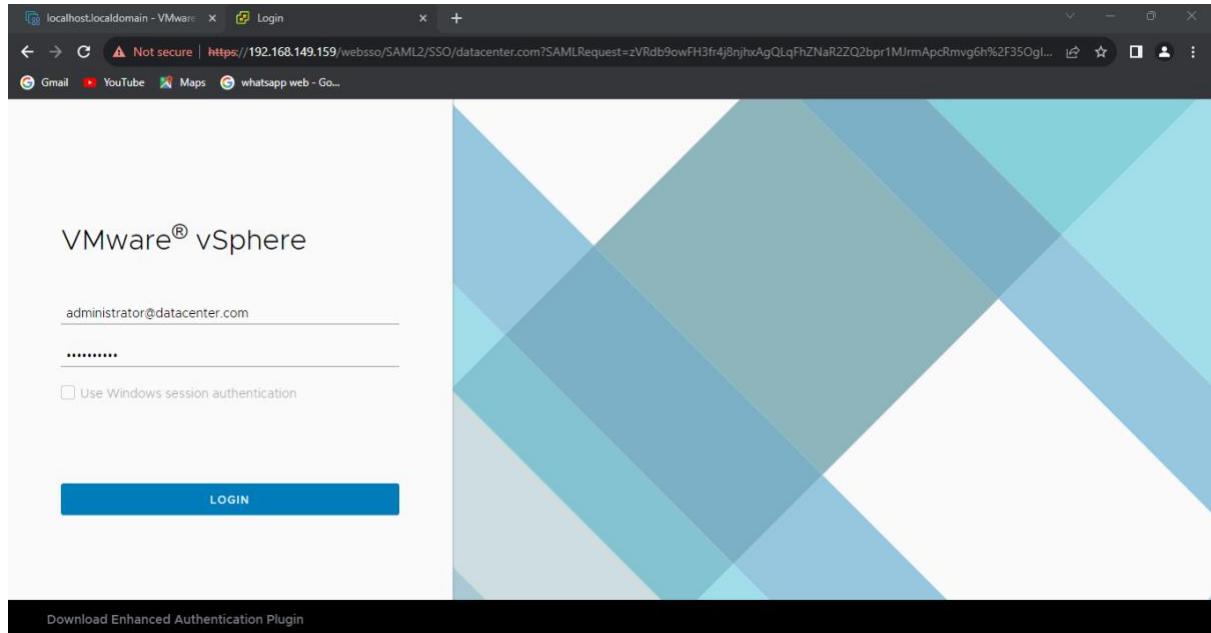
- Installation of stage 2 Complete



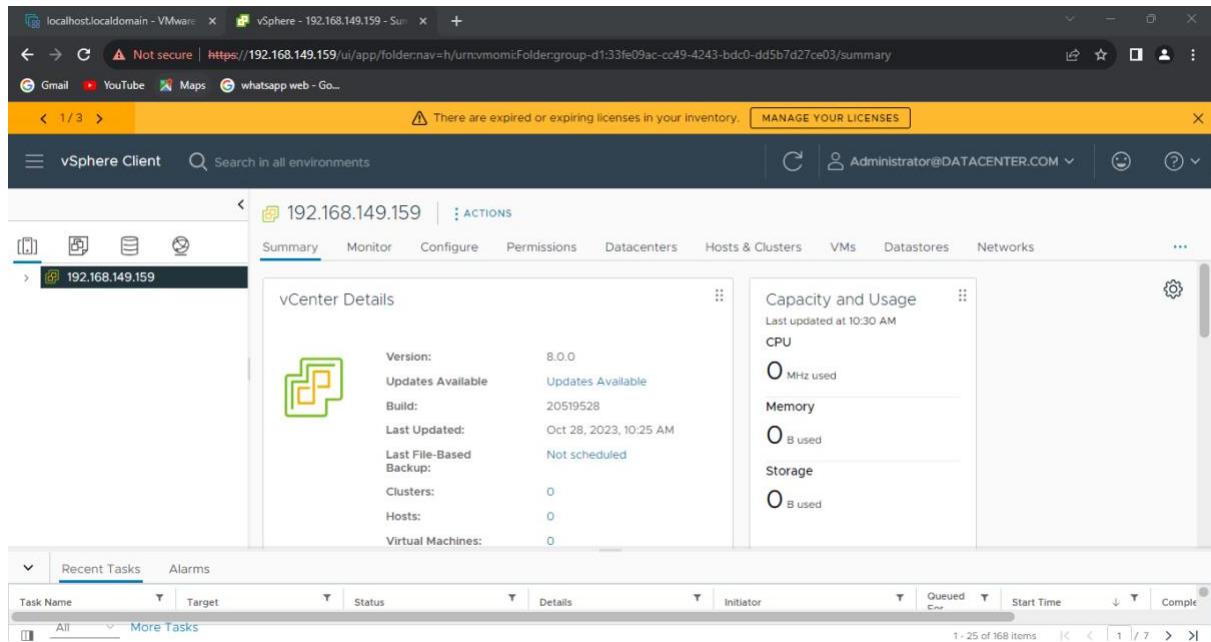
- After installation you will have to type the vCenter Server's IP Address (192.168.149.159) onto the browser and Click on Launch vSphere Client



- Enter your credentials and login



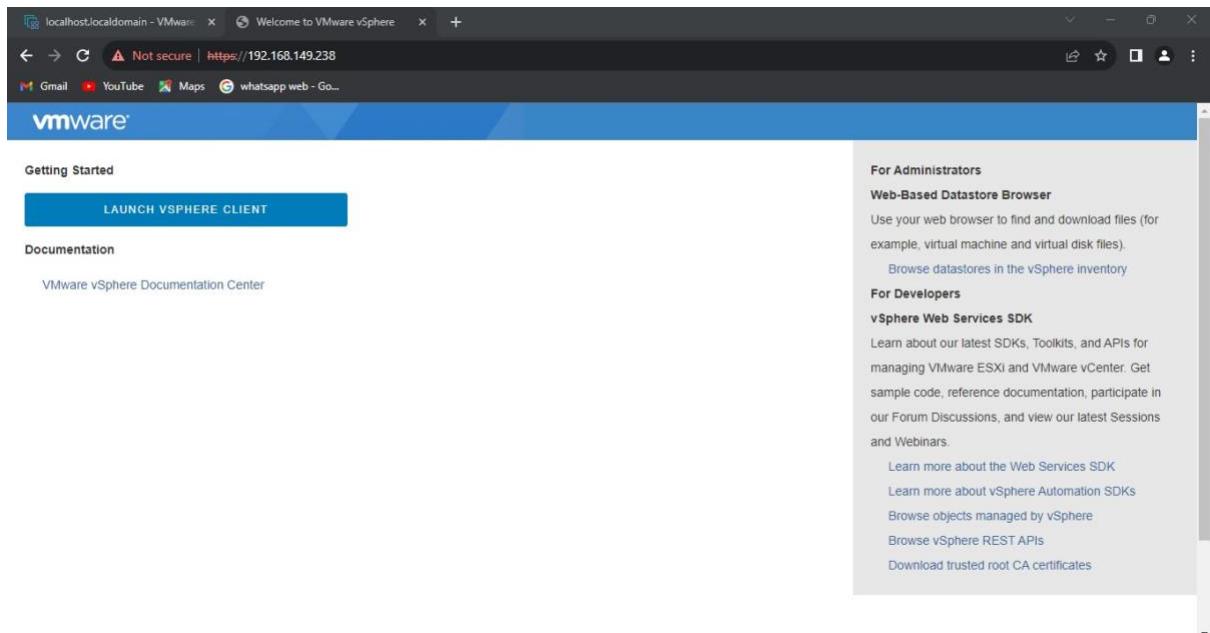
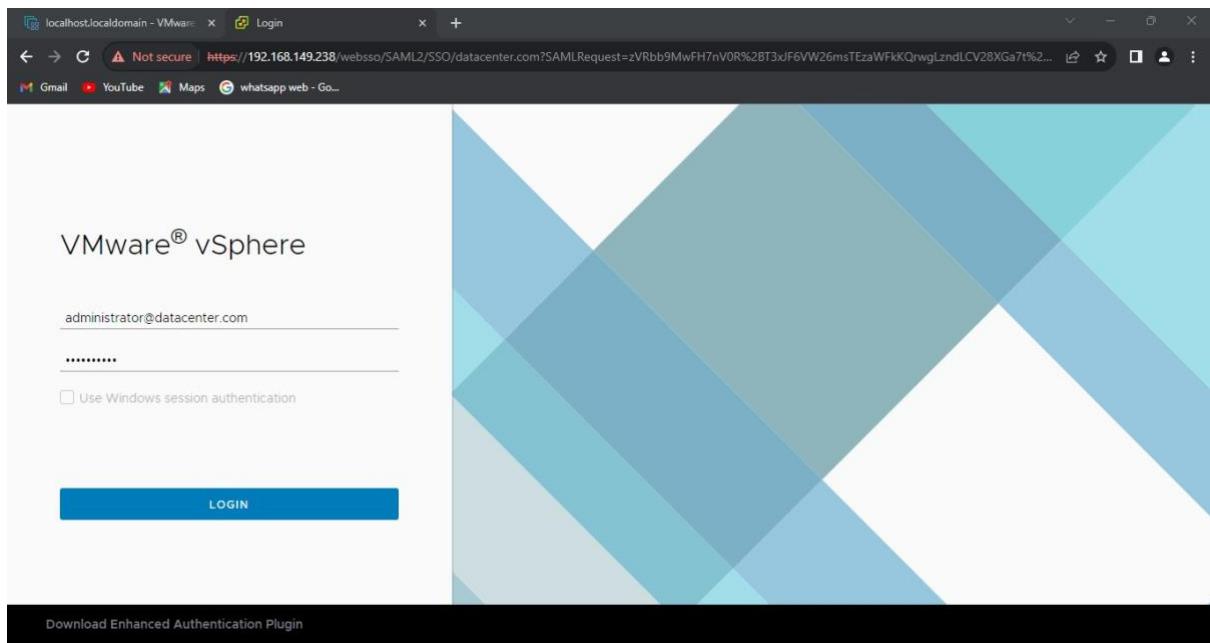
- Here it is vSphere Client Window Open



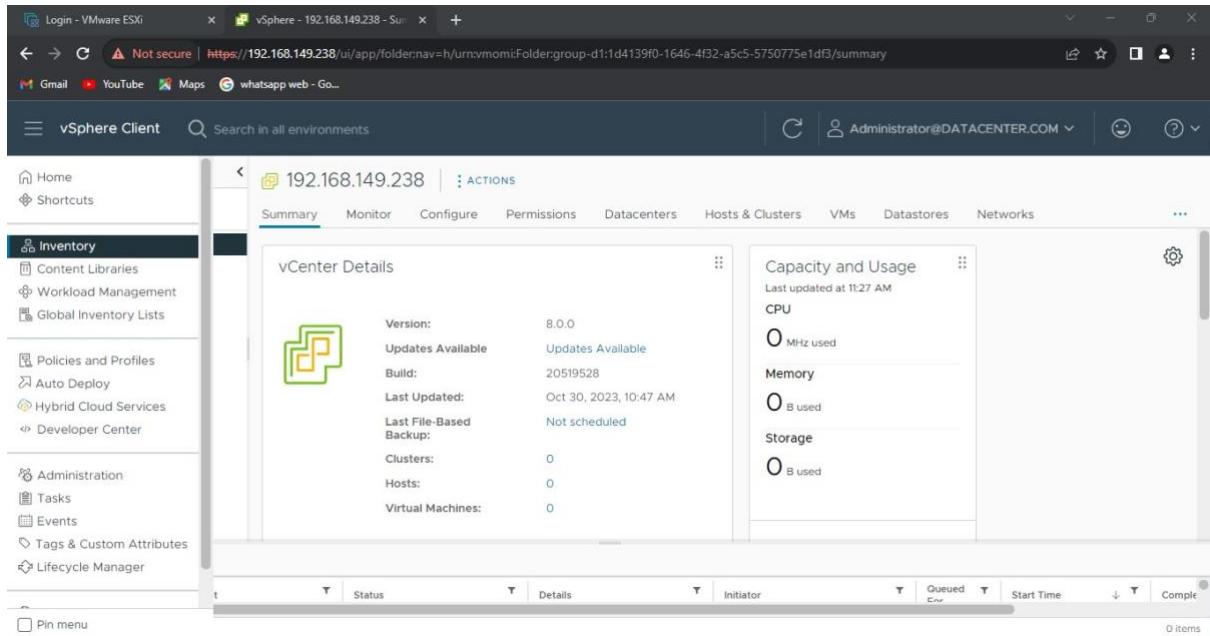
Practical: 5

Aim: Navigating the vSphere Clients.

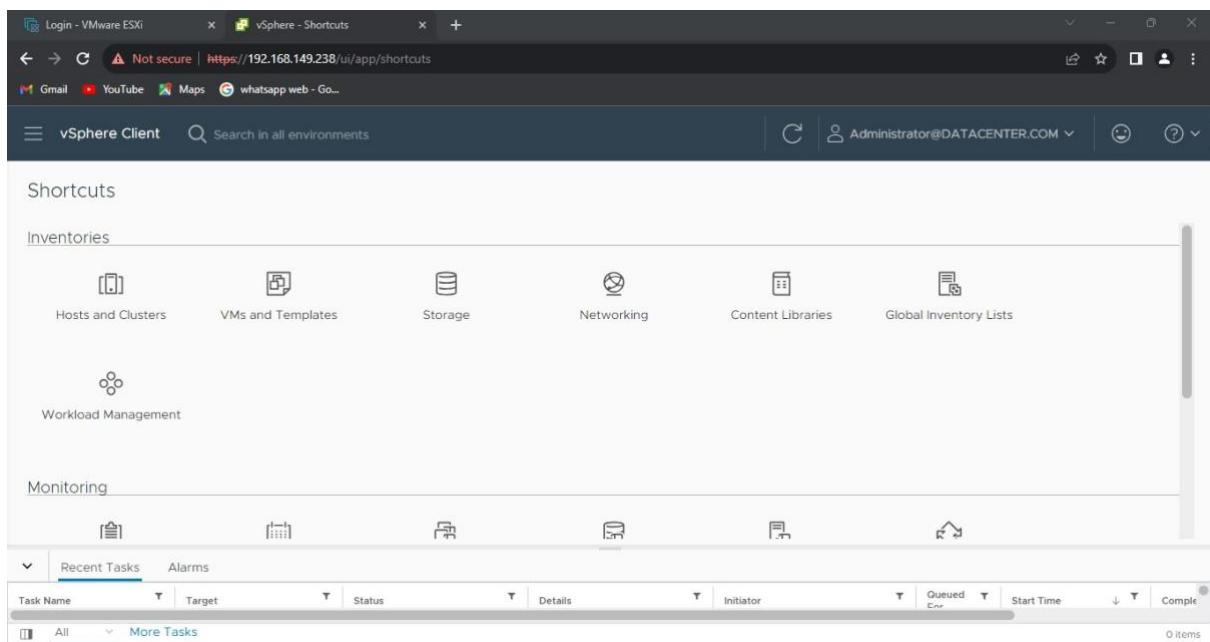
Writeup:

Step 1: Click on Launch Vsphere Client.**Step 2:** Enter Credential for your VMware vSphere

Step 3: Click on Home icon and Click on Inventory



Step 4: Here you can see many different options, that can be used in vSphere Web Client (Flash)



Step 5: Click on Data center and Select Actions here you can many task you can perform on your data center using vSphere Client

The screenshot shows the vSphere Client interface running in a web browser. The URL is https://192.168.149.238/ui/app/folder:nav=h/urn:vmomi:Folder:group-d1:d4139f0-1646-4f32-a5c5-5750775e1df3/summary. The main navigation bar includes links for Gmail, YouTube, Maps, and WhatsApp Web. The top right shows the user is logged in as Administrator@DATACENTER.COM.

The left sidebar shows a tree view with '192.168.149.238' selected. The 'vCenter Details' panel displays the following information:

- Version: [version number]
- Updates Available: [number]
- Build: [build number]
- Last Update: [date]
- Last File Backup: [date]
- Clusters: [number]
- Hosts: 0
- Virtual Machines: 0

A context menu is open over the 'Actions' button in the top right of the main pane, listing options such as 'New Datacenter...', 'New Folder', 'Export System Logs...', 'Assign License...', 'Tags & Custom Attributes...', 'Add Permission...', and 'Alarms'.

The main pane displays 'Capacity and Usage' statistics:

- CPU: 0 MHz used
- Memory: 0 B used
- Storage: 0 B used

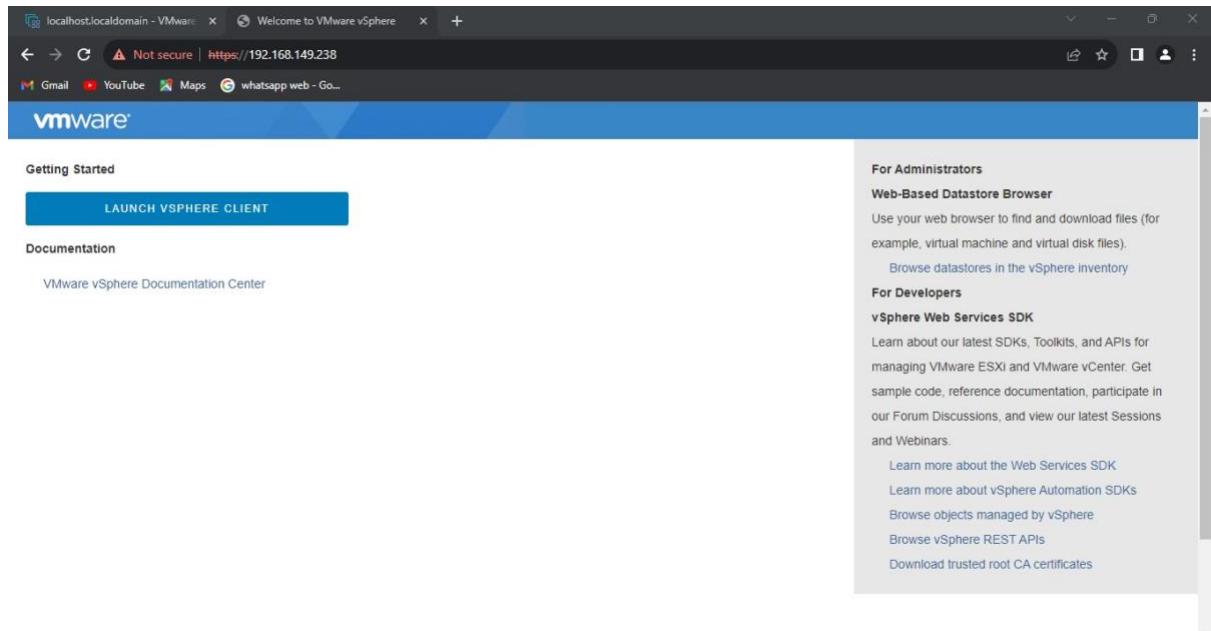
Below the main pane, there is a 'Recent Tasks' section and a 'More Tasks' button.

Practical: 6

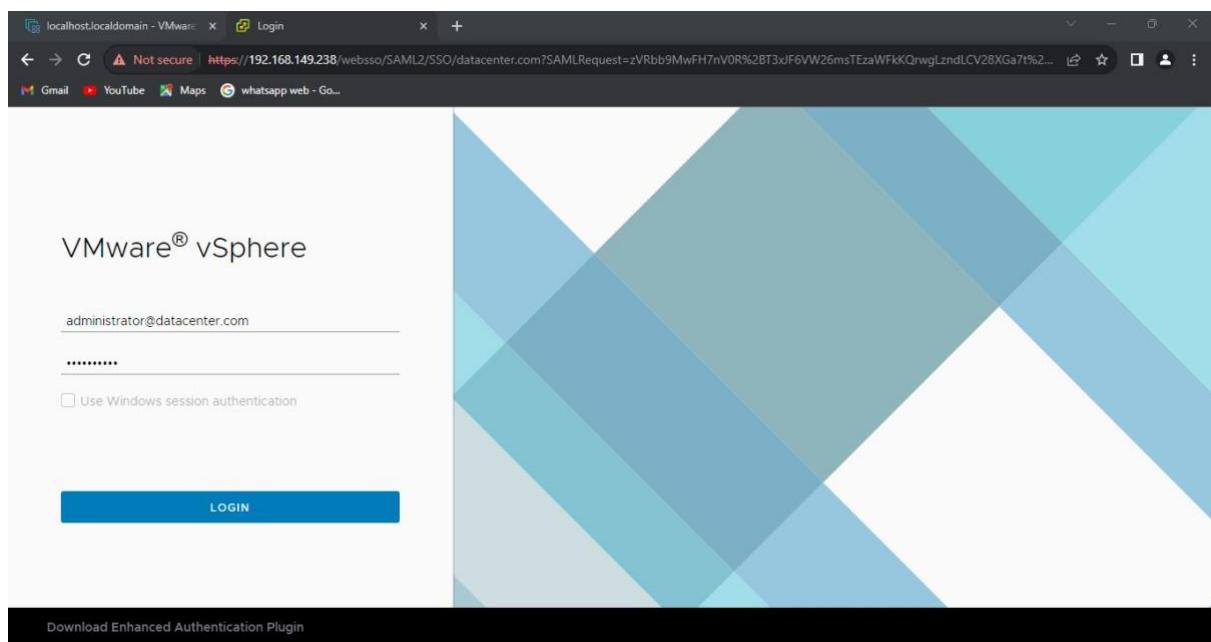
Aim: Creating Folders in vCenter Server Application.

Writeup:

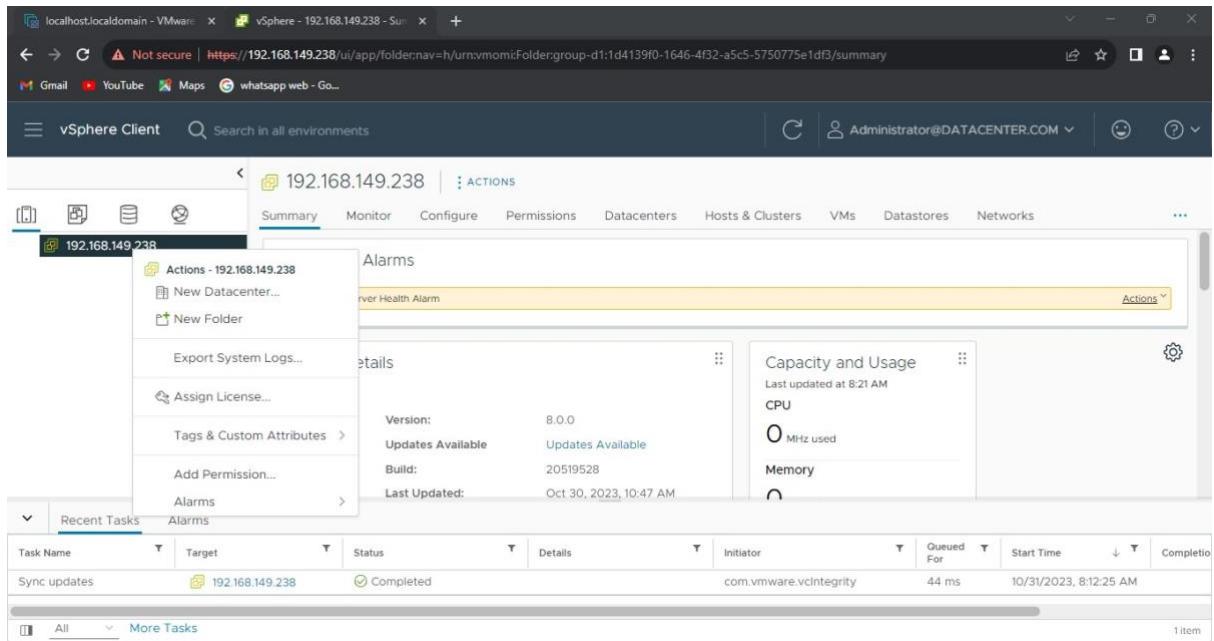
Step 1: Click on LAUNCH VSPHERE CLIENT



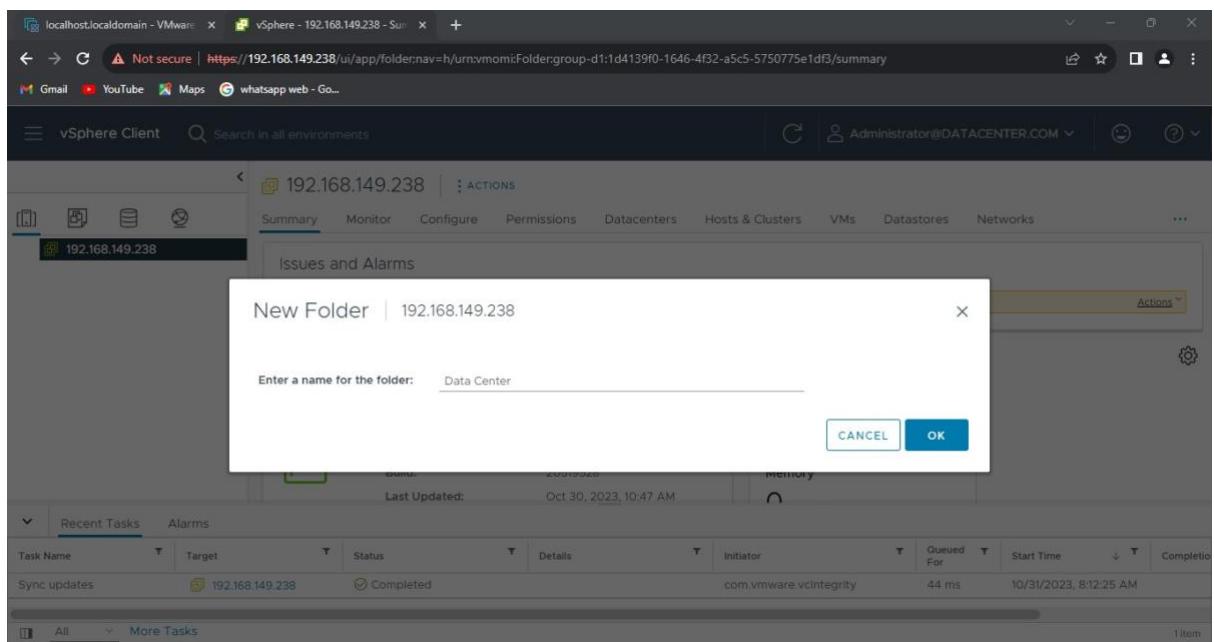
Step 2: Enter Credential for your vSphere Client



Step 3: Right-click on IP address and select New Datacenter



Step 4: Enter a name for the folder (Here it is: Data Center) and then Click on Ok



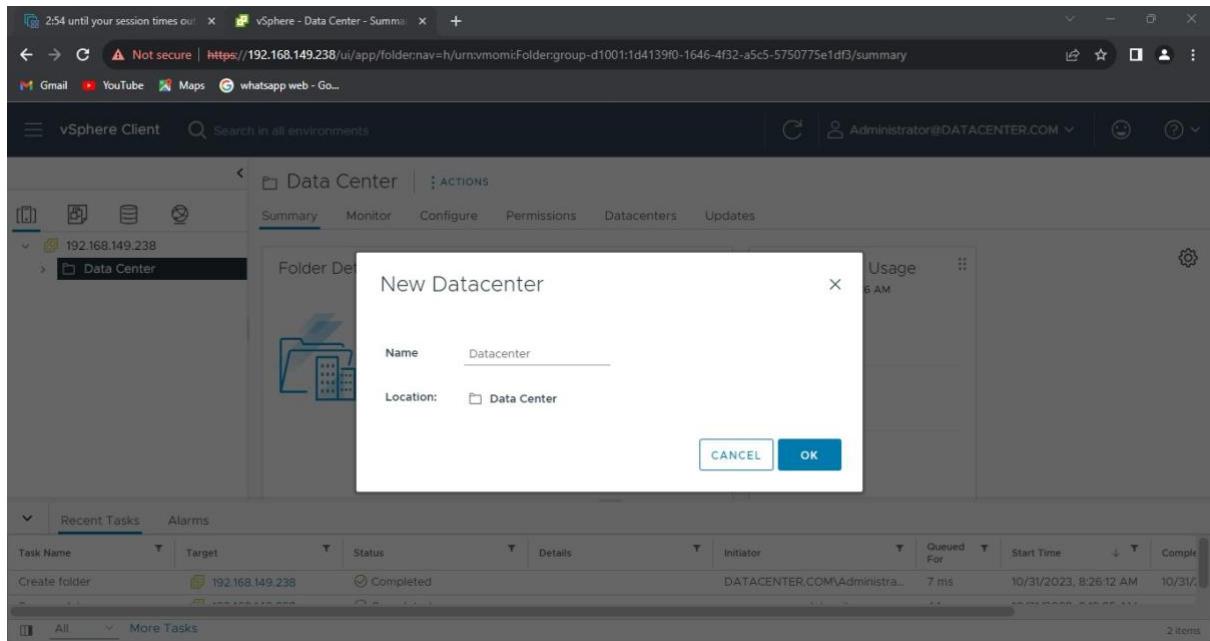
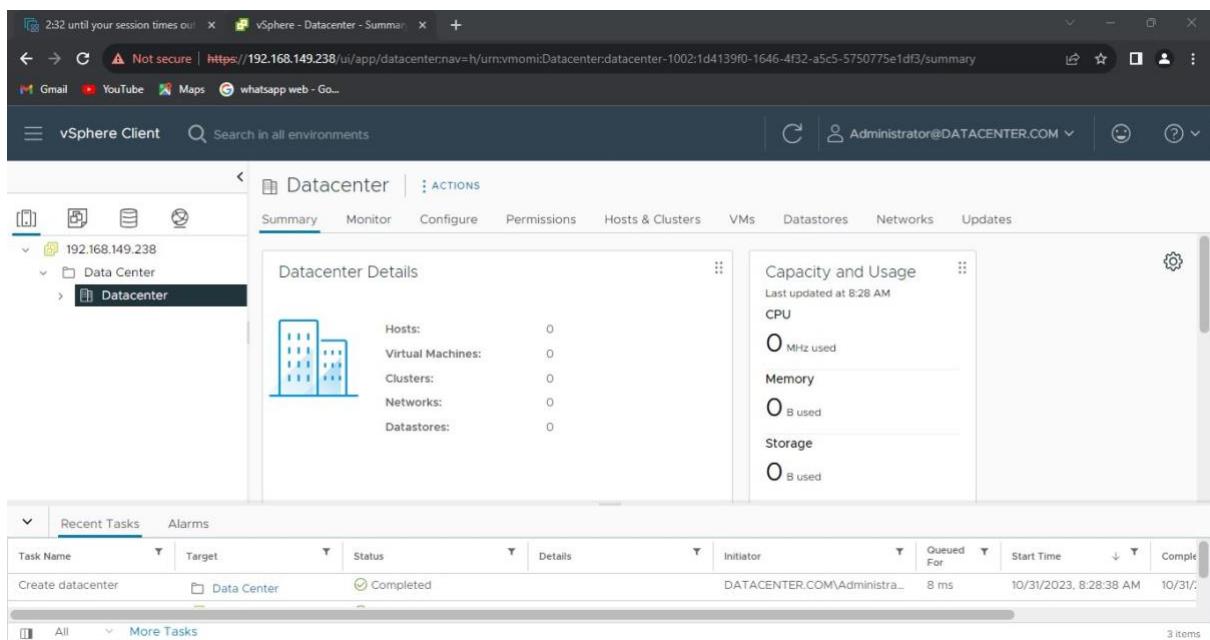
Step 5: you can see the folder created

The screenshot shows the vSphere Client interface. In the left sidebar, under 'Data Center' > '192.168.149.238', there is a new folder icon labeled 'Data Center'. The main pane displays 'Folder Details' with counts for Clusters (0), Hosts (0), and Virtual Machines (0). To the right is a 'Capacity and Usage' summary. Below these are sections for CPU, Memory, and Storage, each showing 0 used. At the bottom, a task list shows a completed task named 'Create folder'.

Task Name	Target	Status	Details	Initiator	Queued For	Start Time	Completed
Create folder	192.168.149.238	Completed		DATACENTER.COM\Administr...	7 ms	10/31/2023, 8:26:12 AM	10/31/...

Step 6: Right-Click on New Datacenter

This screenshot is similar to the previous one but shows a context menu open over the 'Data Center' folder. The menu options include 'Actions - Data Center', 'New Datacenter...', 'New Folder', 'Move To...', 'Rename...', 'Tags & Custom Attributes', 'Alarms', and 'Remove from Inventory'. The rest of the interface is identical to the first screenshot, showing the folder details and capacity usage.

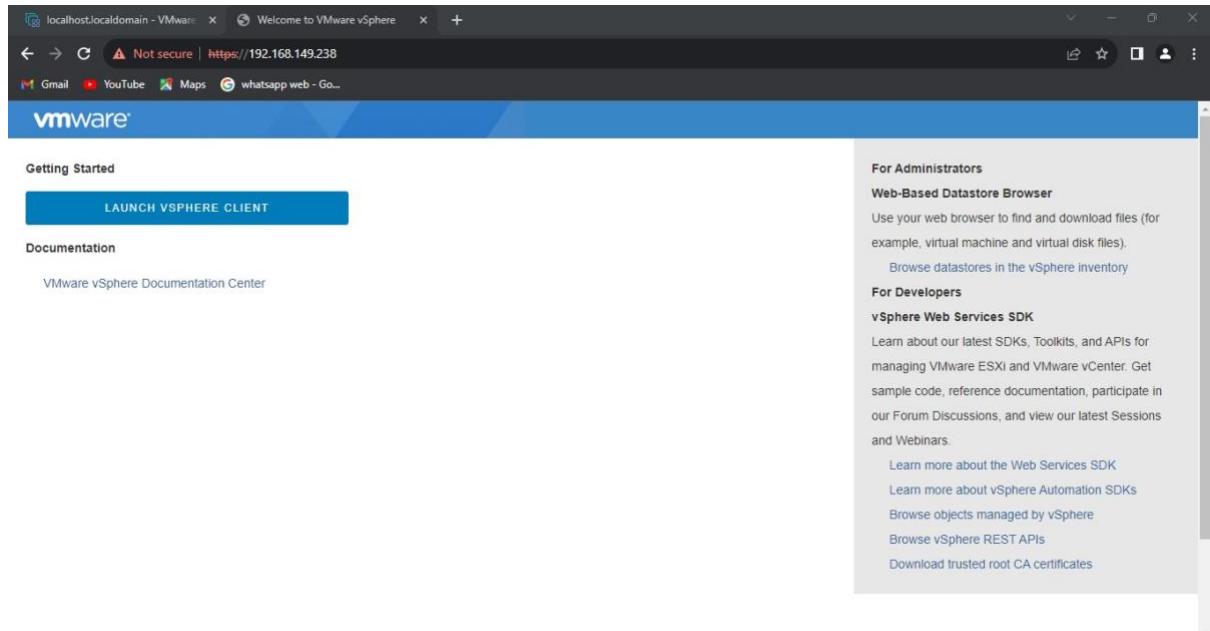
Step 7: Enter a folder name and then click on Ok**Step 7: Here we Can See New Folder Created**

Practical: 7

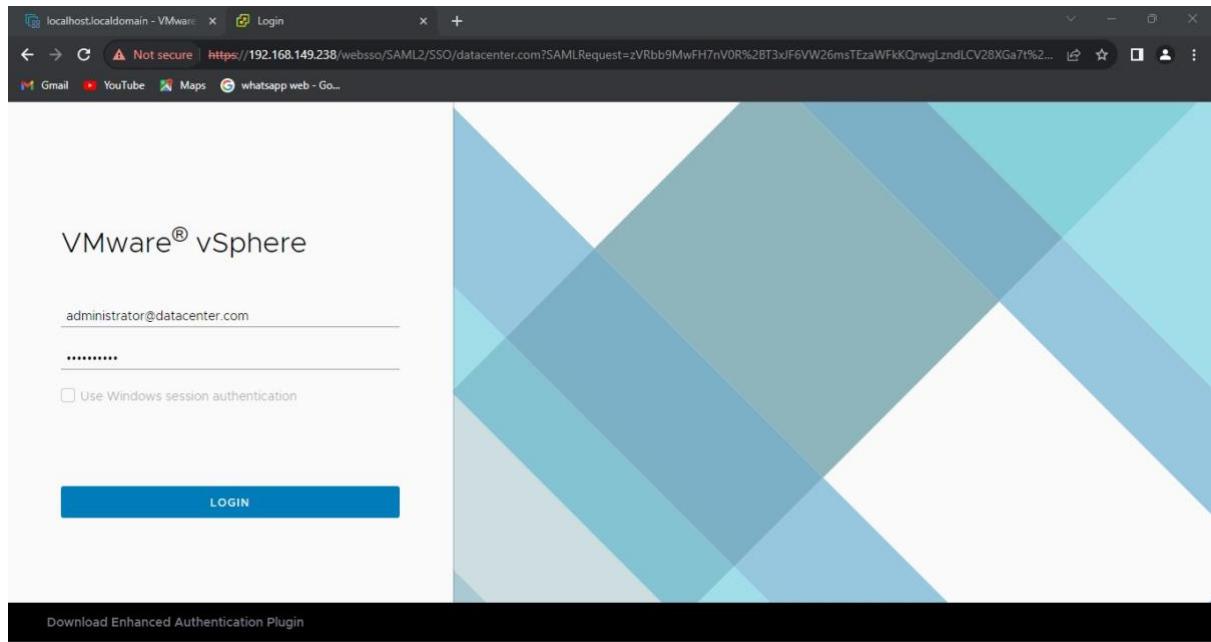
Aim: Using Standard Switches.

Writeup:

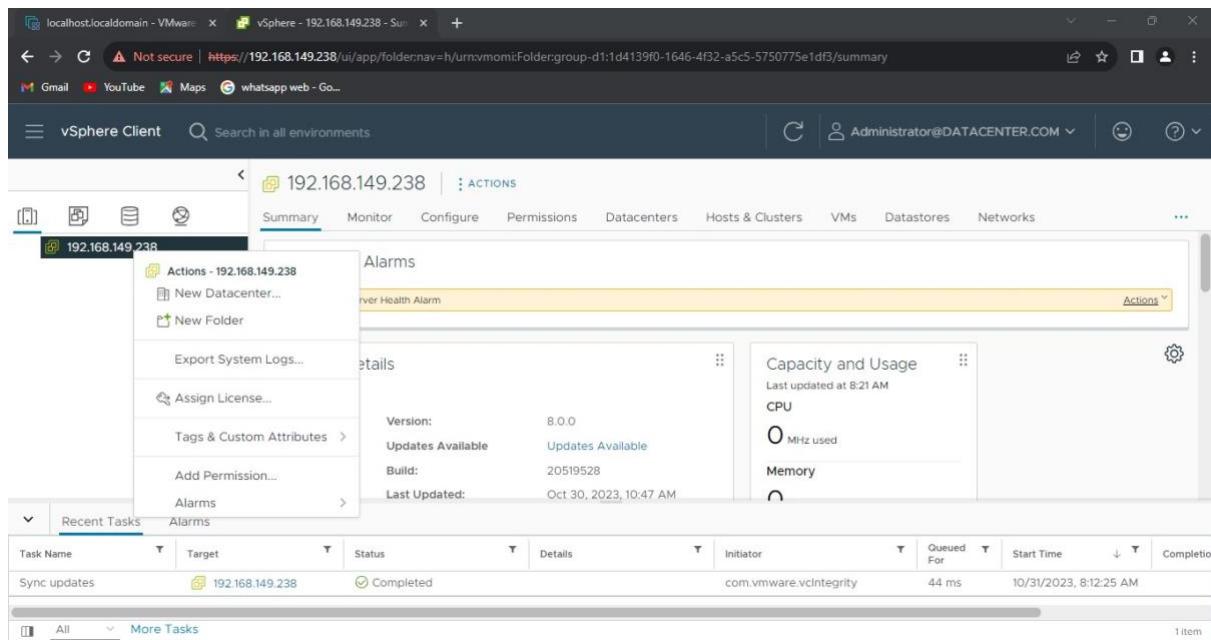
Step 1: Click on LAUNCH VSPHERE CLIENT



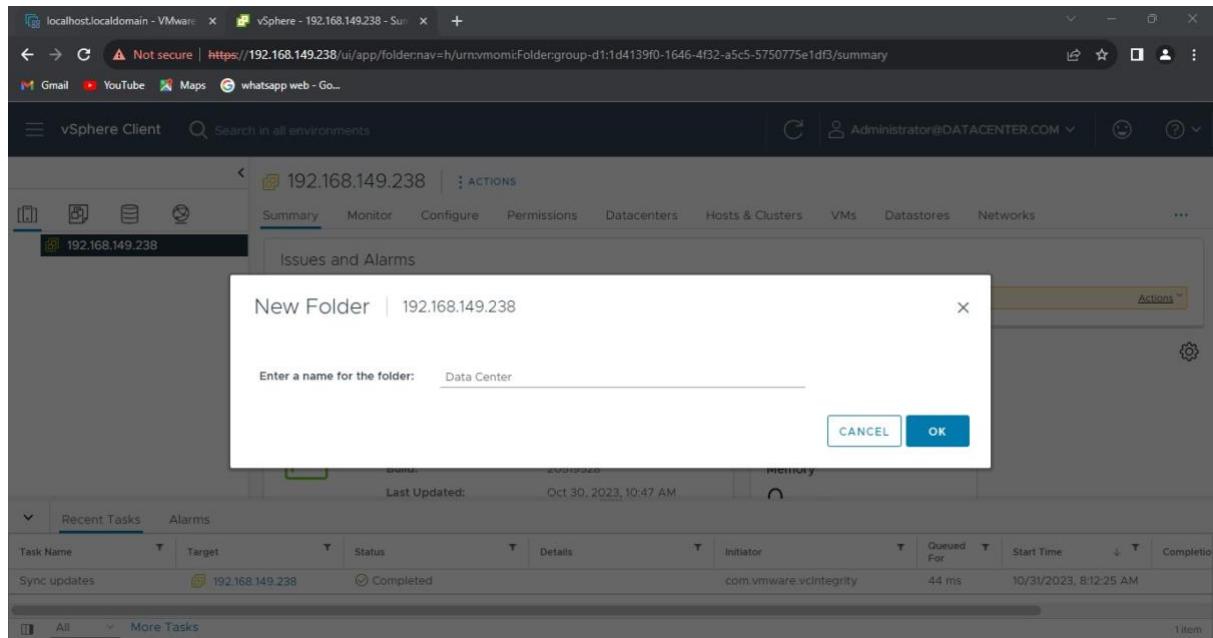
Step 2: Enter Credential for your vSphere Client



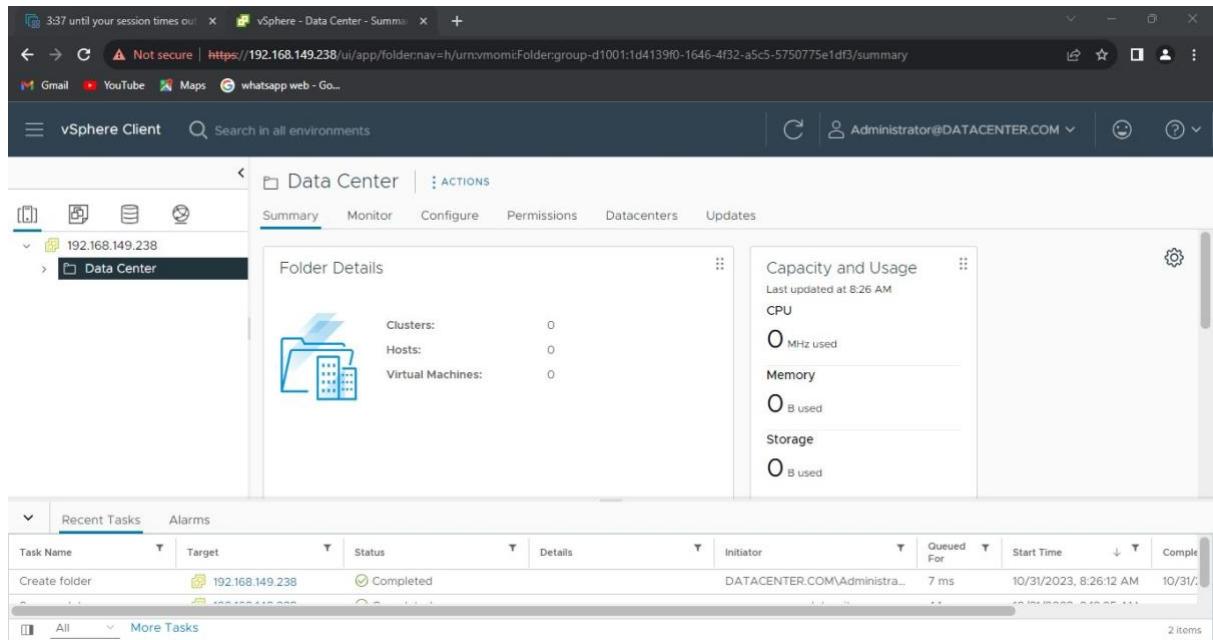
Step 3: Right-click on IP address and select New Datacenter



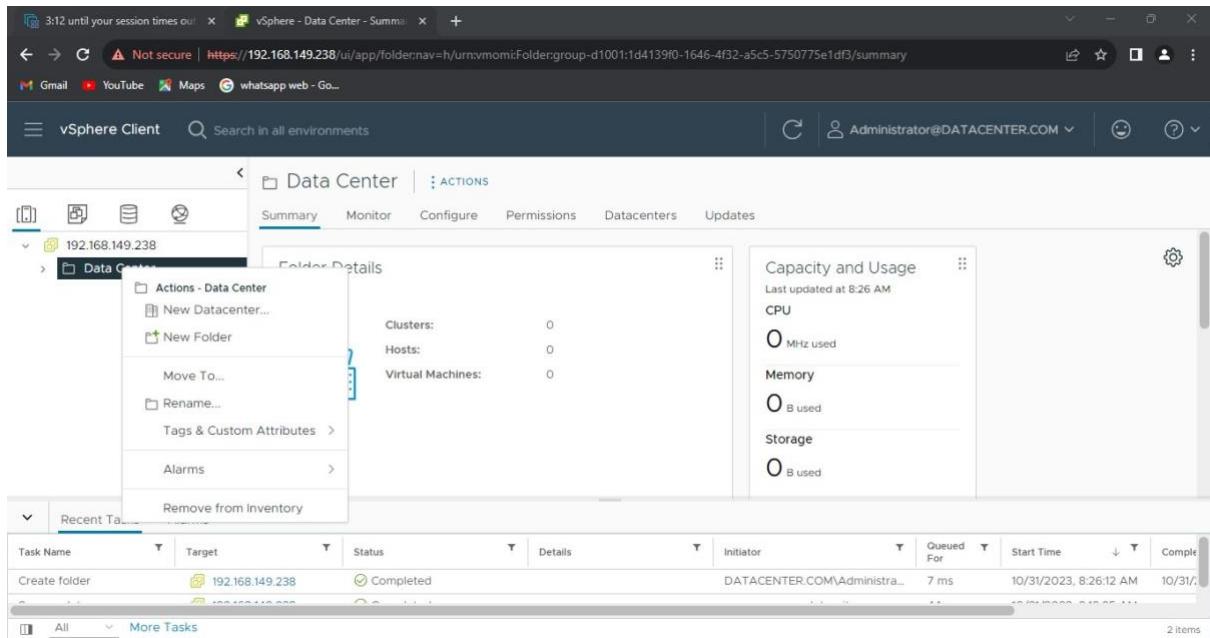
Step 4: Enter a name for the folder (Here it is: Data Center) and then Click on Ok



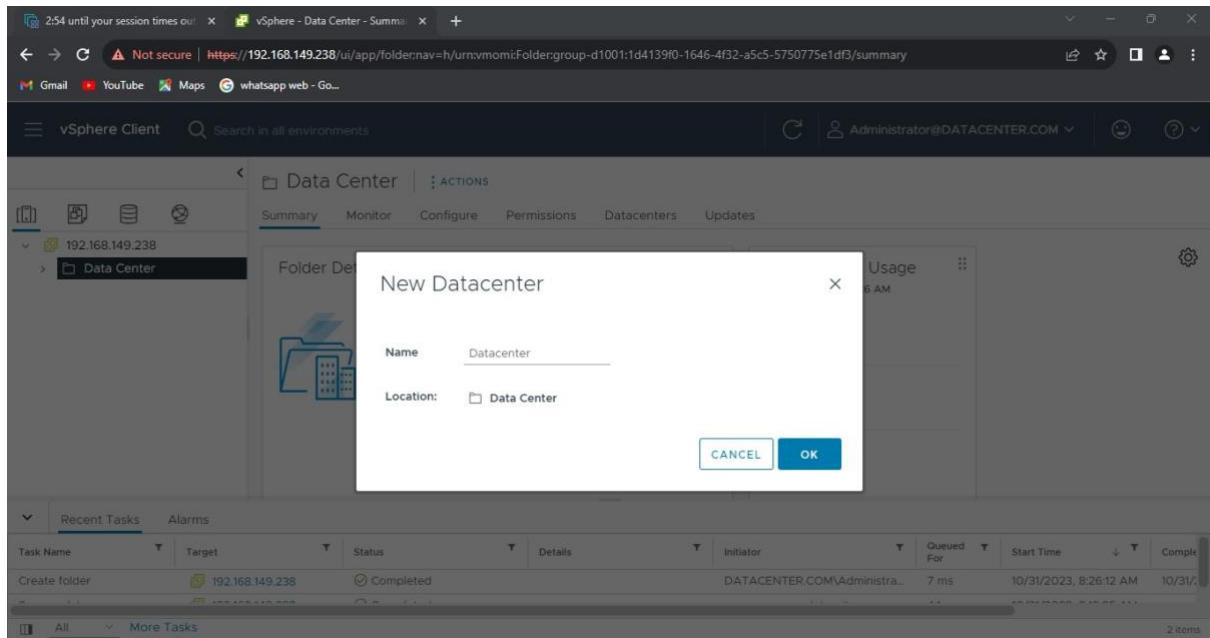
Step 5: you can see the folder created



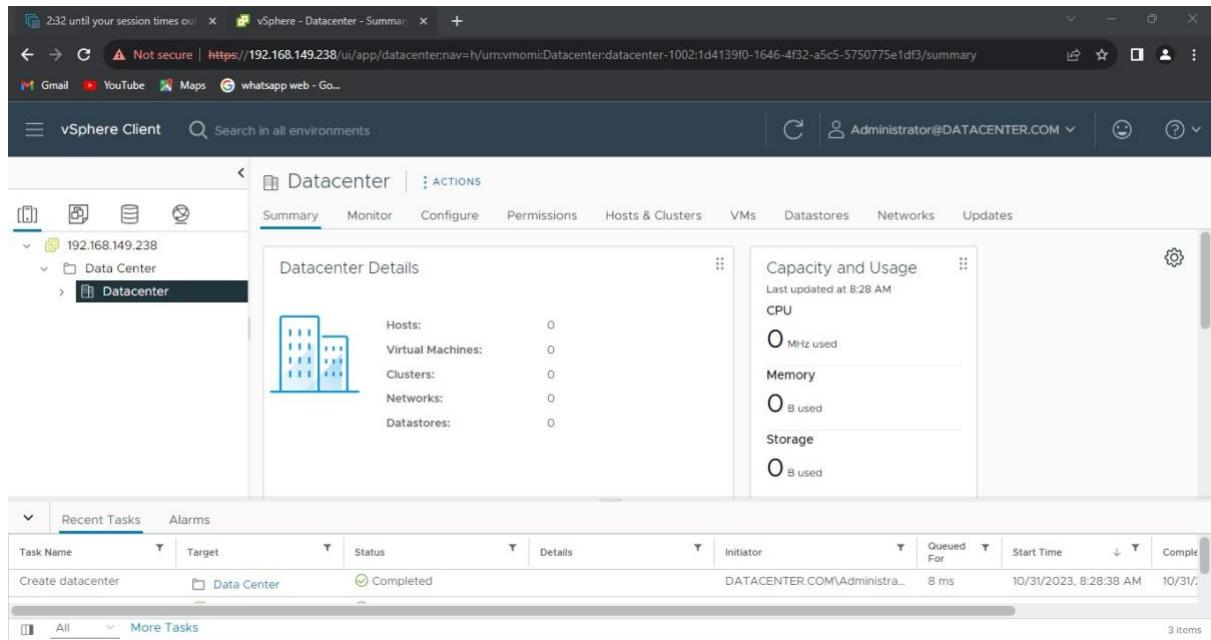
Step 6: Right-Click on New Datacenter



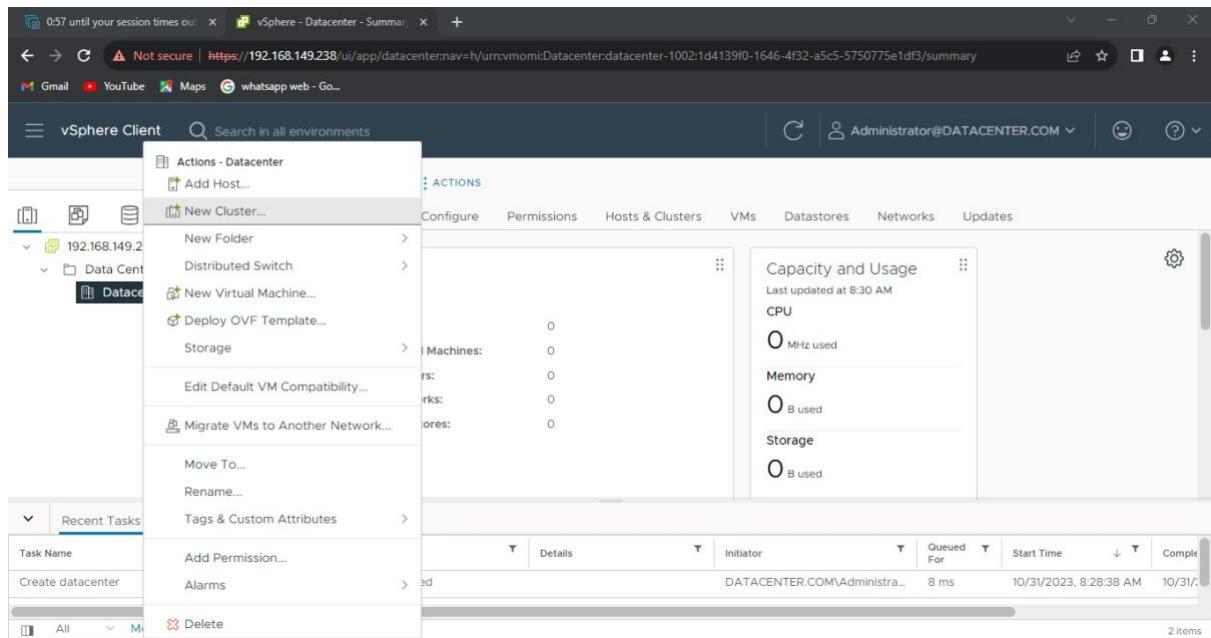
Step 7: Enter a folder name and then click on Ok



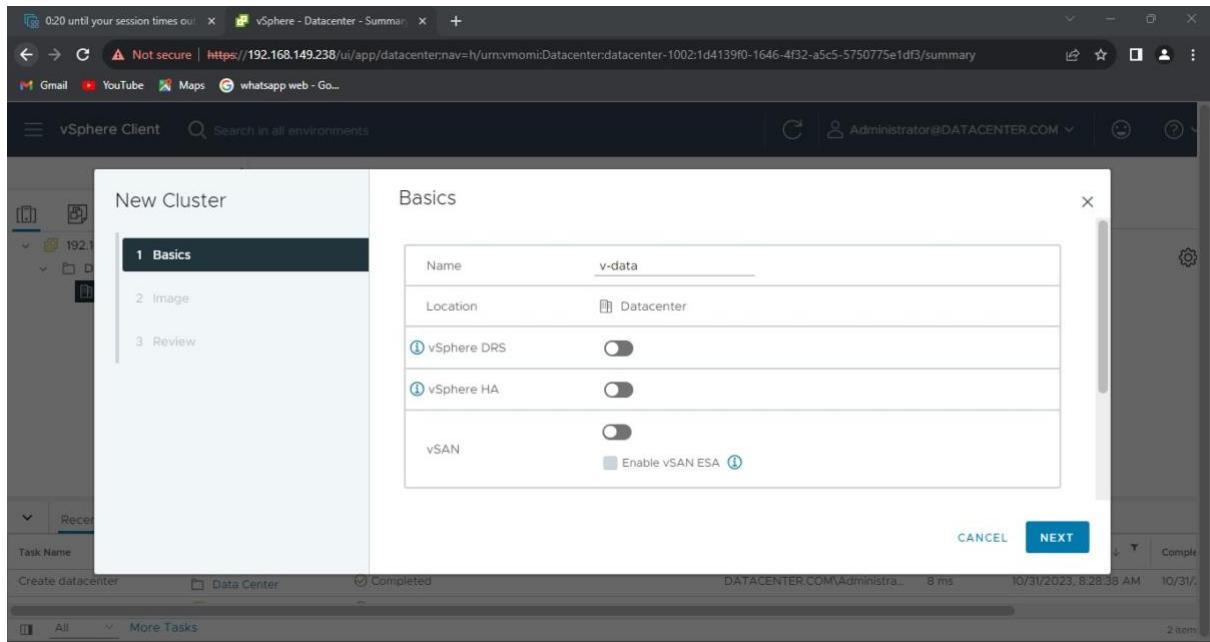
Step 7: Here we Can See New Folder Created



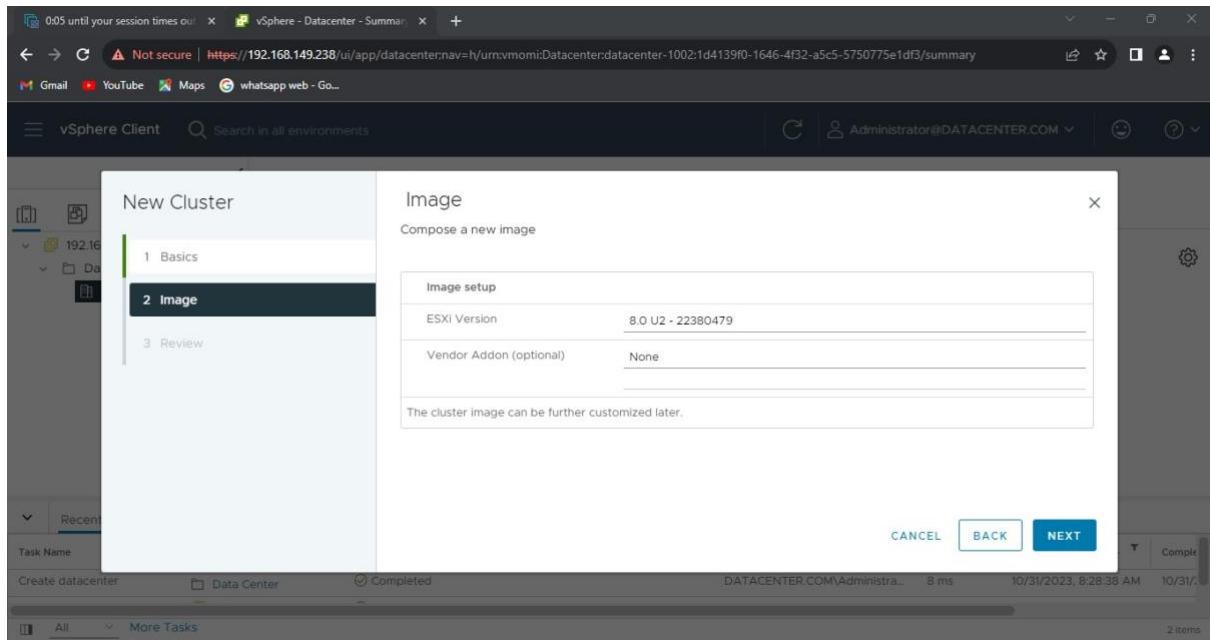
Step 8: Right-Click on Data Center And then Select New Cluster



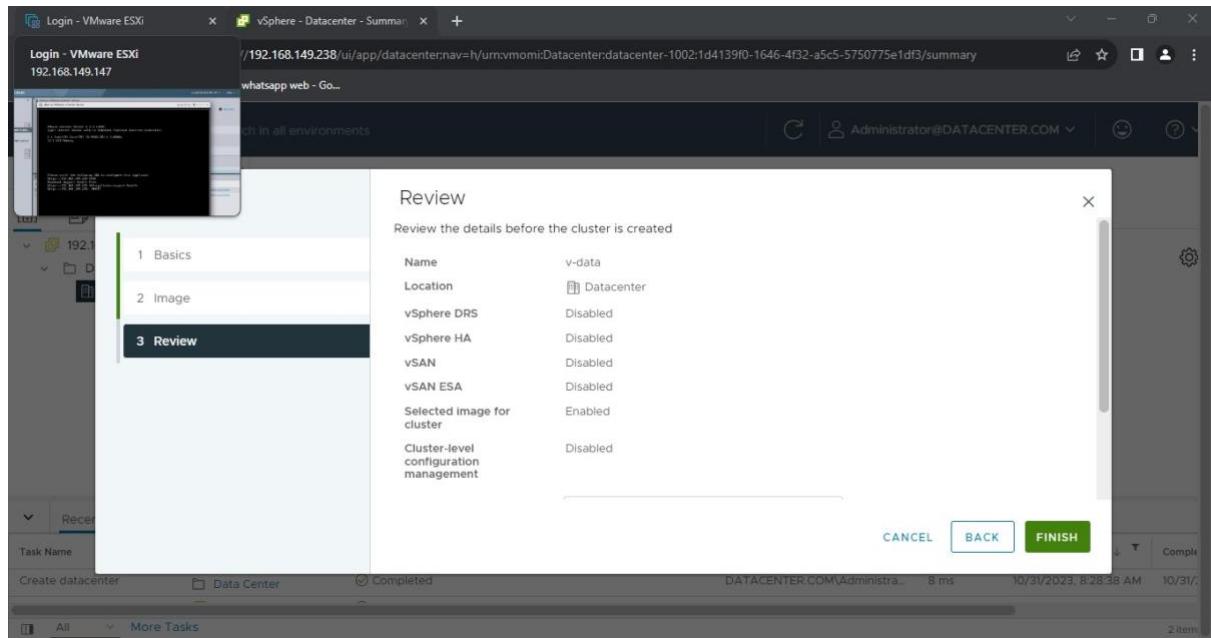
Step 9: Enter a Name for your New Cluster (Here it is: v-data) and then Click on Next



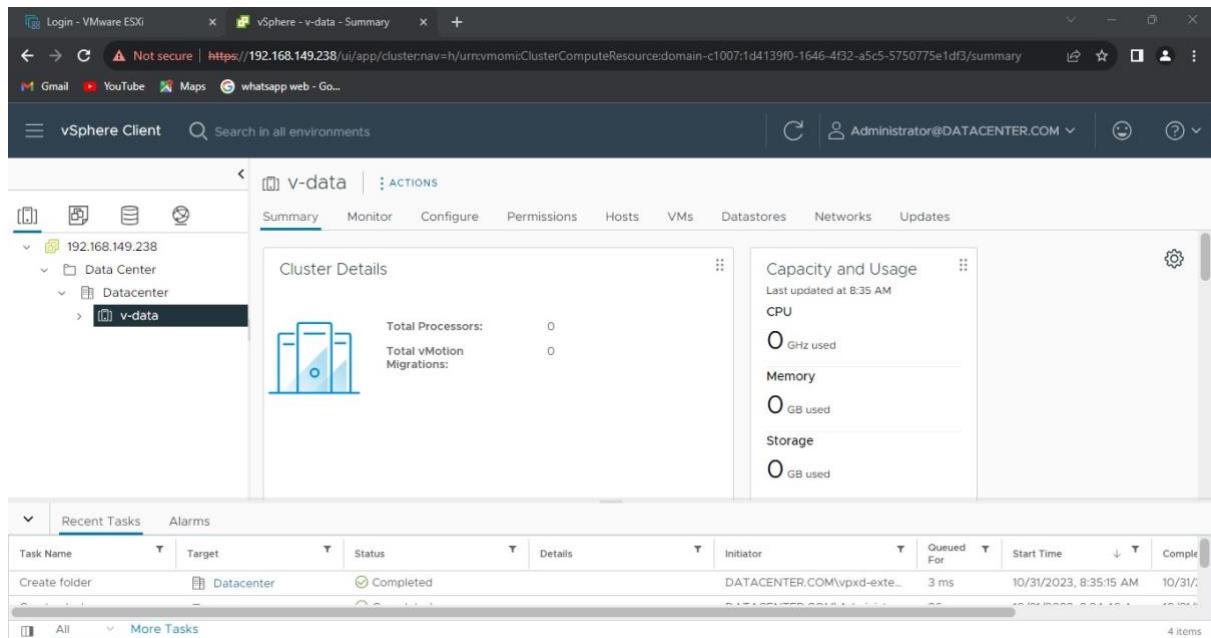
Step 10: Keep the default values and then click on Next



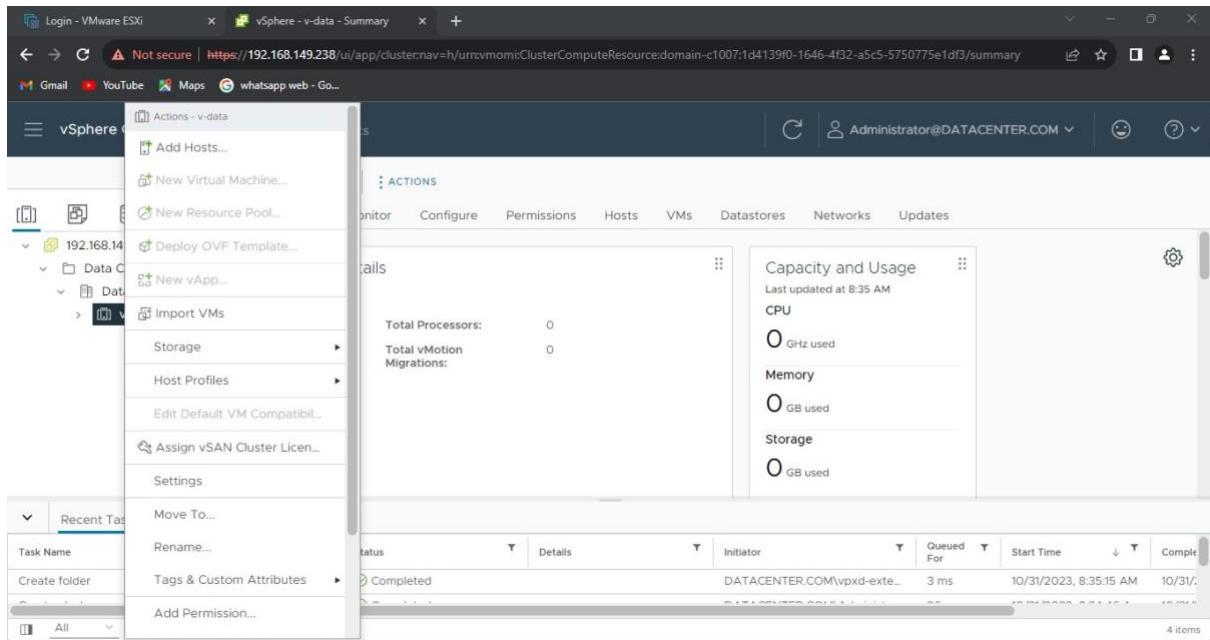
Step 12: Review the summary and Click on Finish



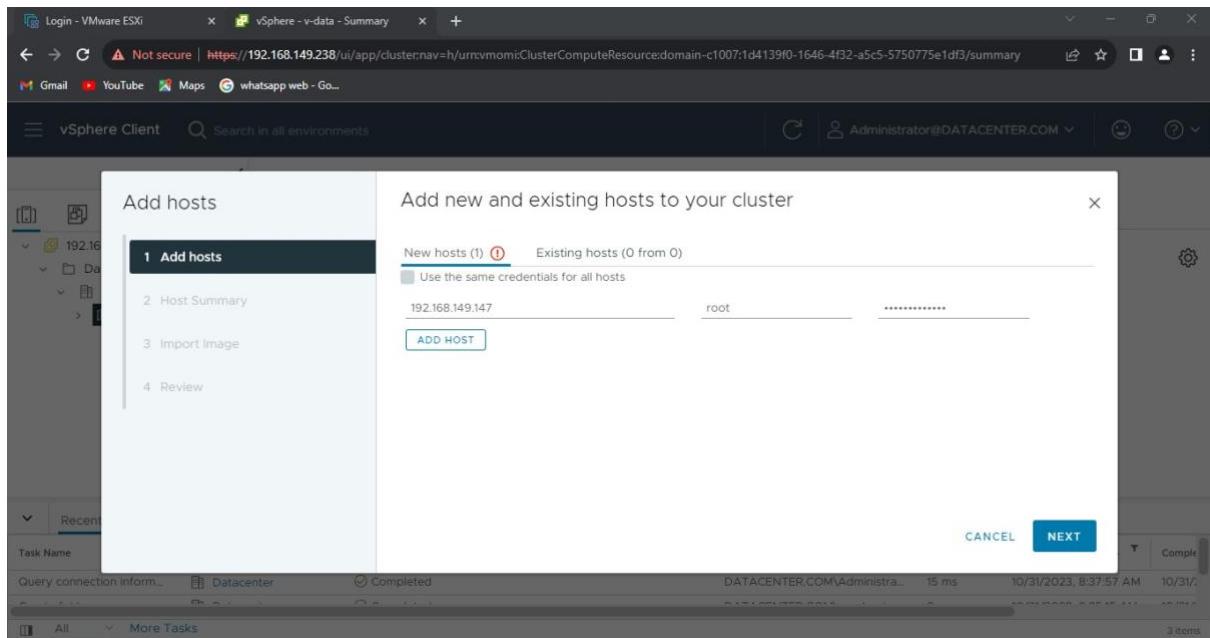
- Here we can see v-data cluster folder created



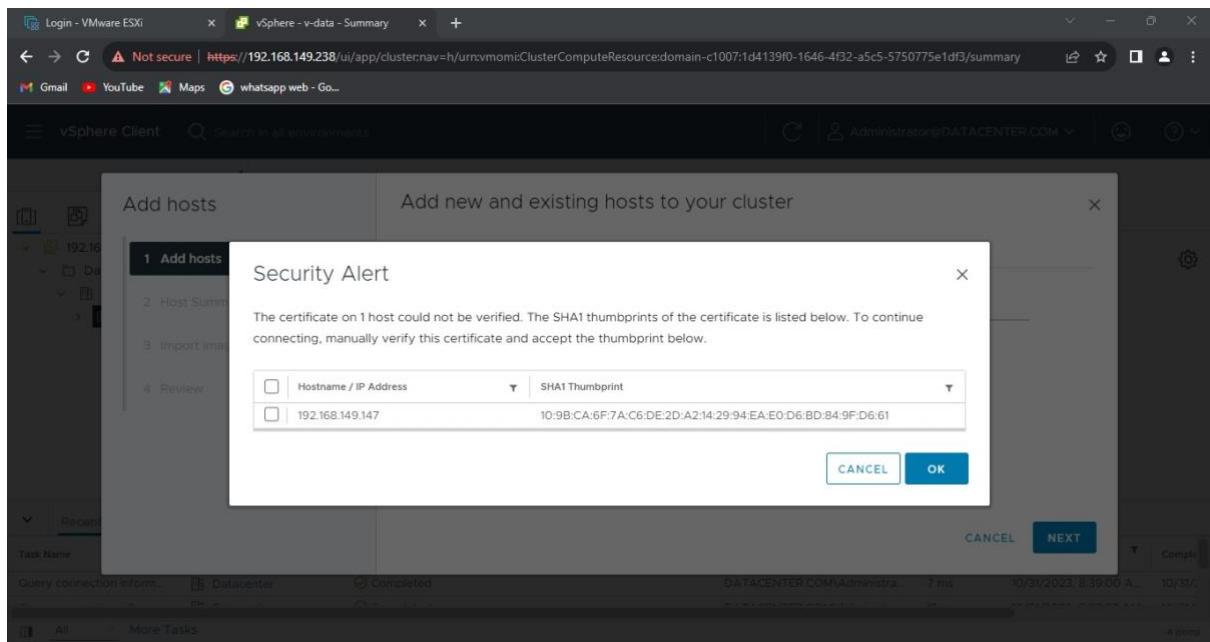
Step 13: Right-Click on v-data and then Select Add Hosts



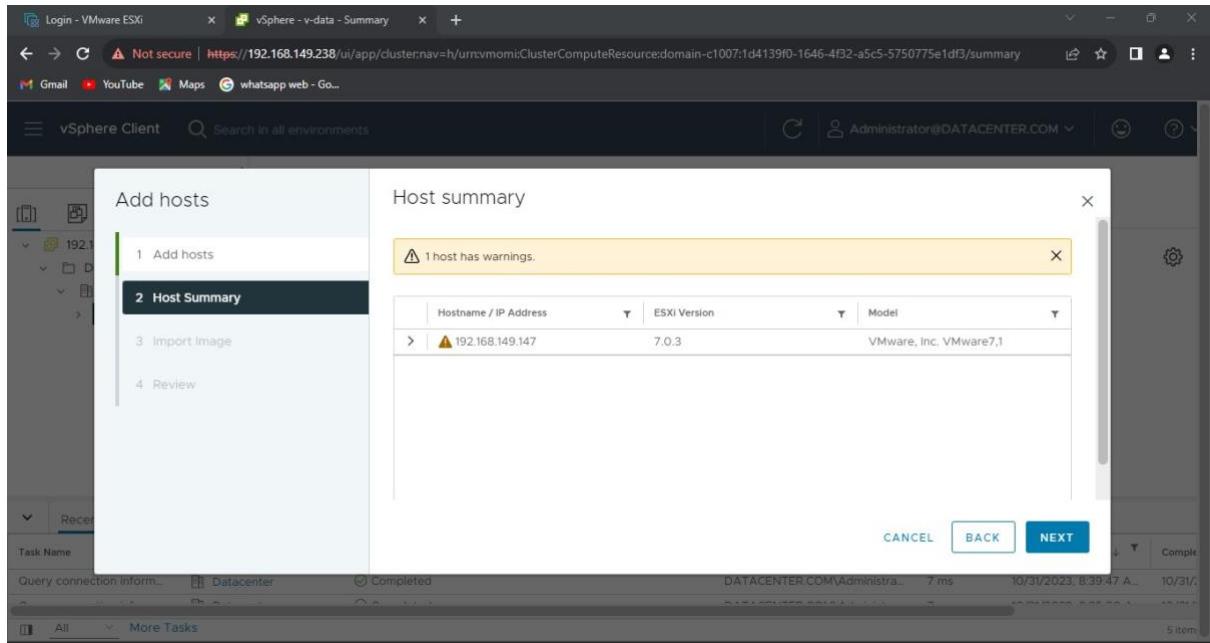
Step 14: Add hosts IP address Here You Enter VMware ESXi Hosts IP address and then Enter Credential for VMware ESXi hosts and then **Click on Next**



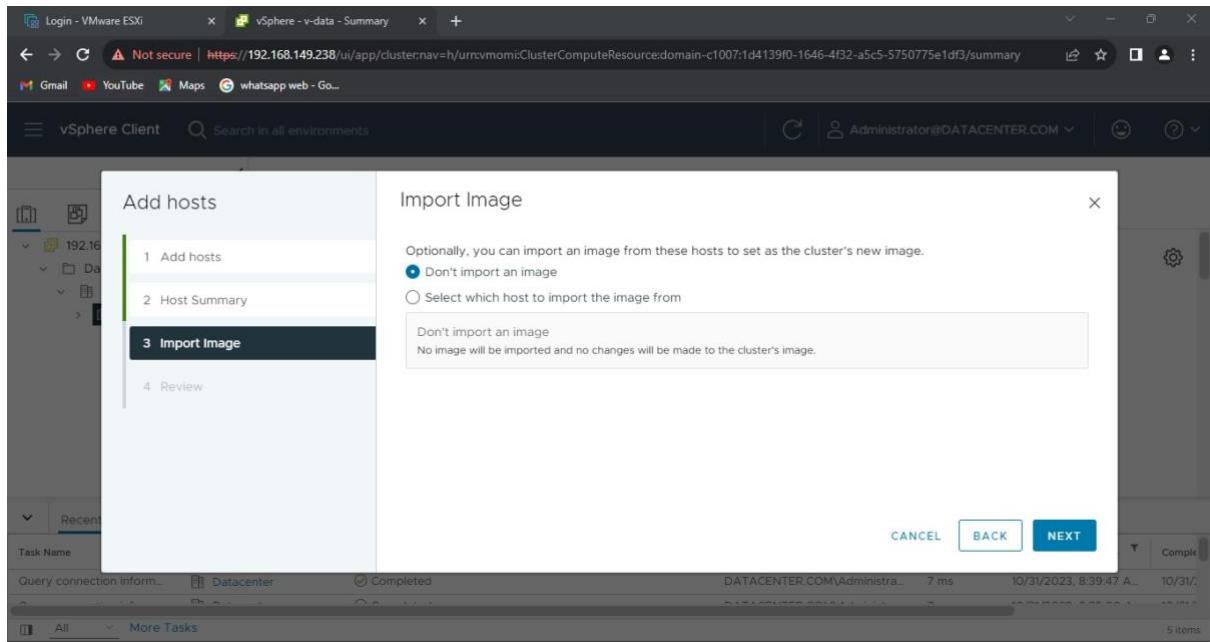
Step 15: Click Ok



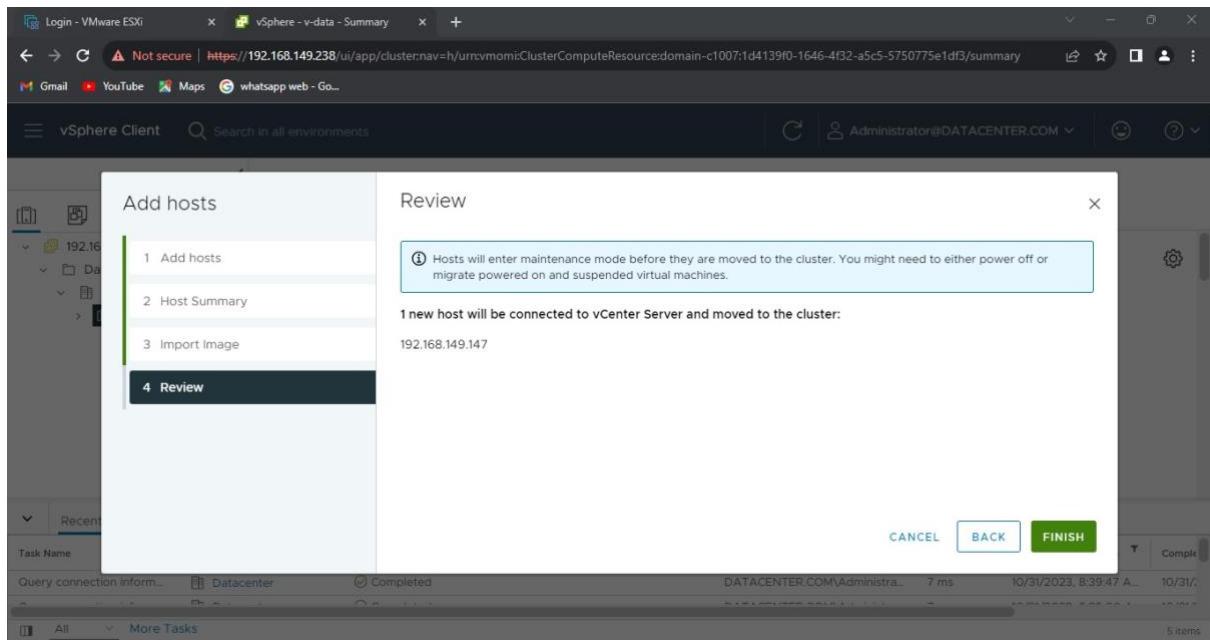
Step 16: Click Next



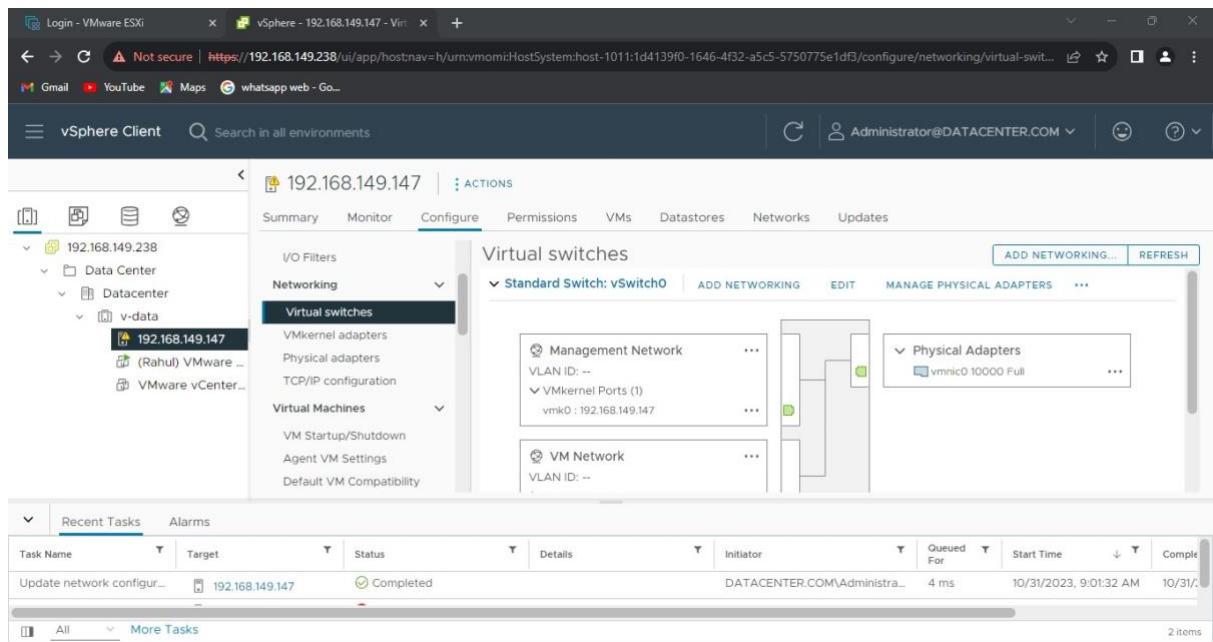
Step 17: Select Don't import an image and then Click on Next



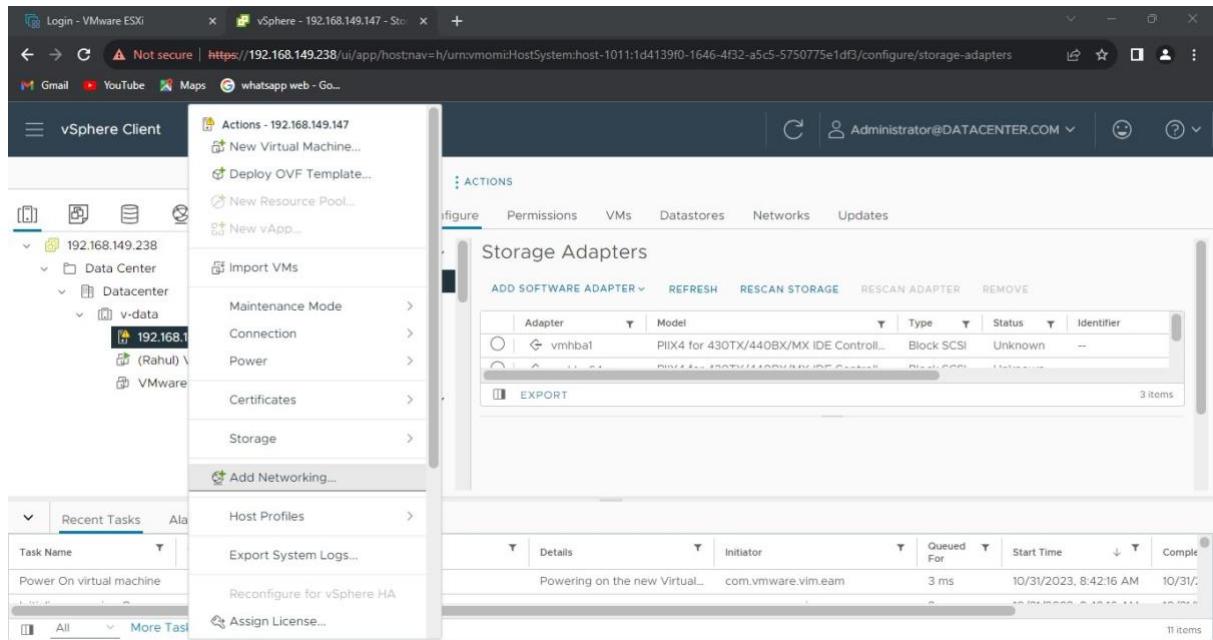
Step 18: Click on Finish



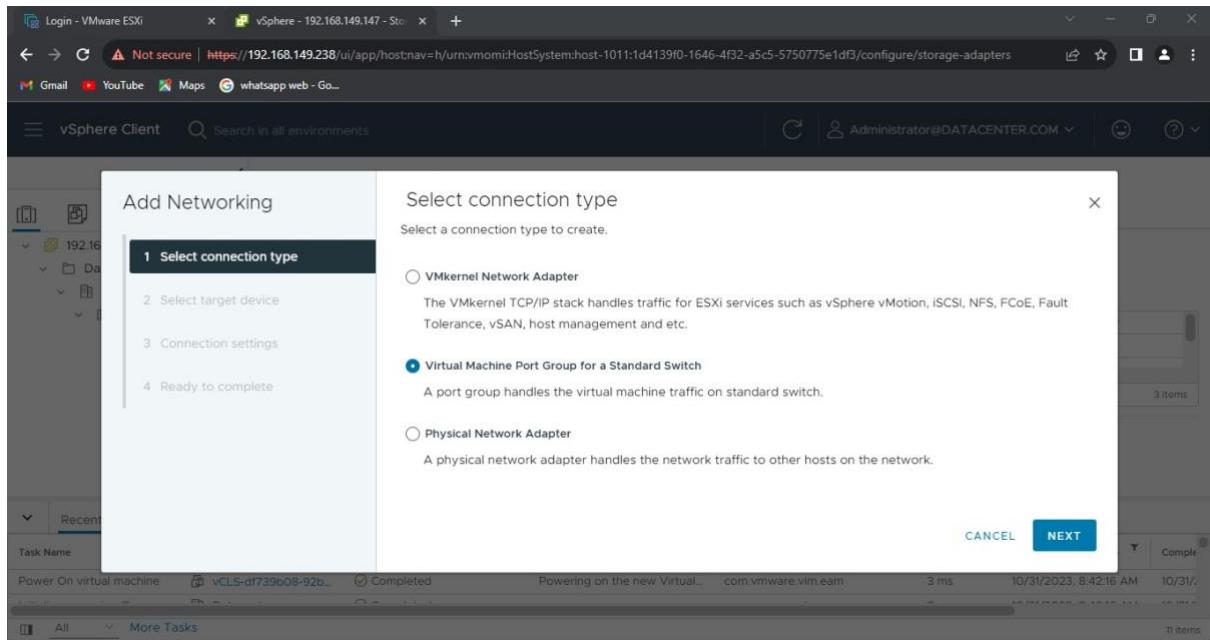
Step 19: Select 192.168.163.132, click the Configure tab, and select Virtual switches in the middle pane.



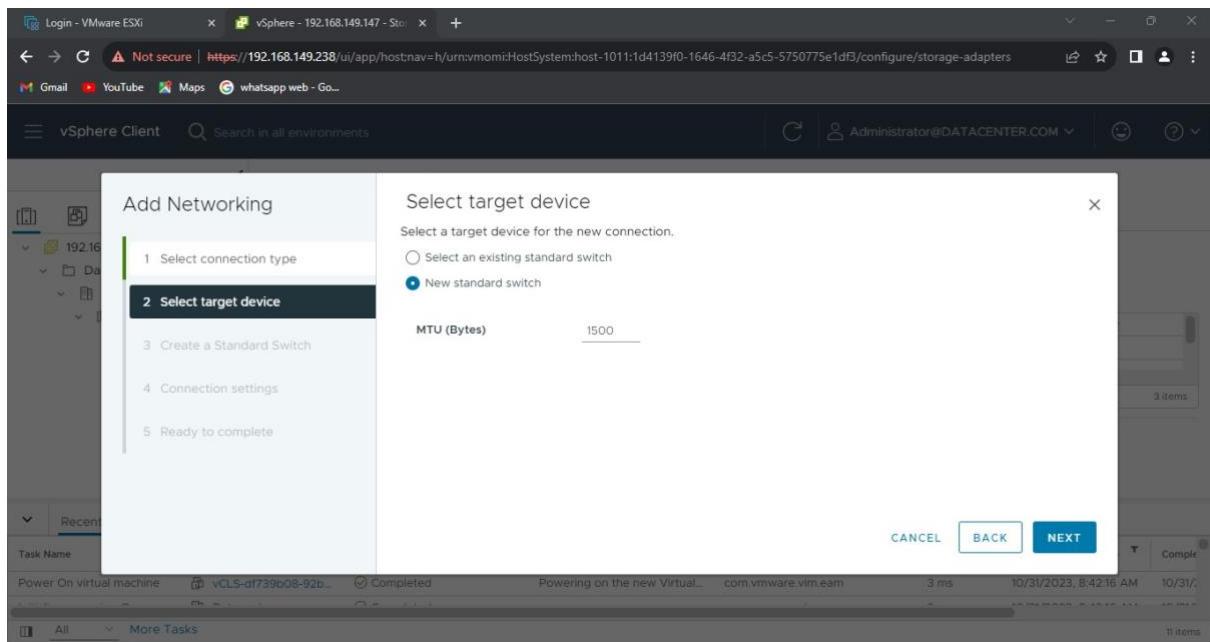
Step 20: Right-Click on 192.168.149.147 and then Select Add Networking



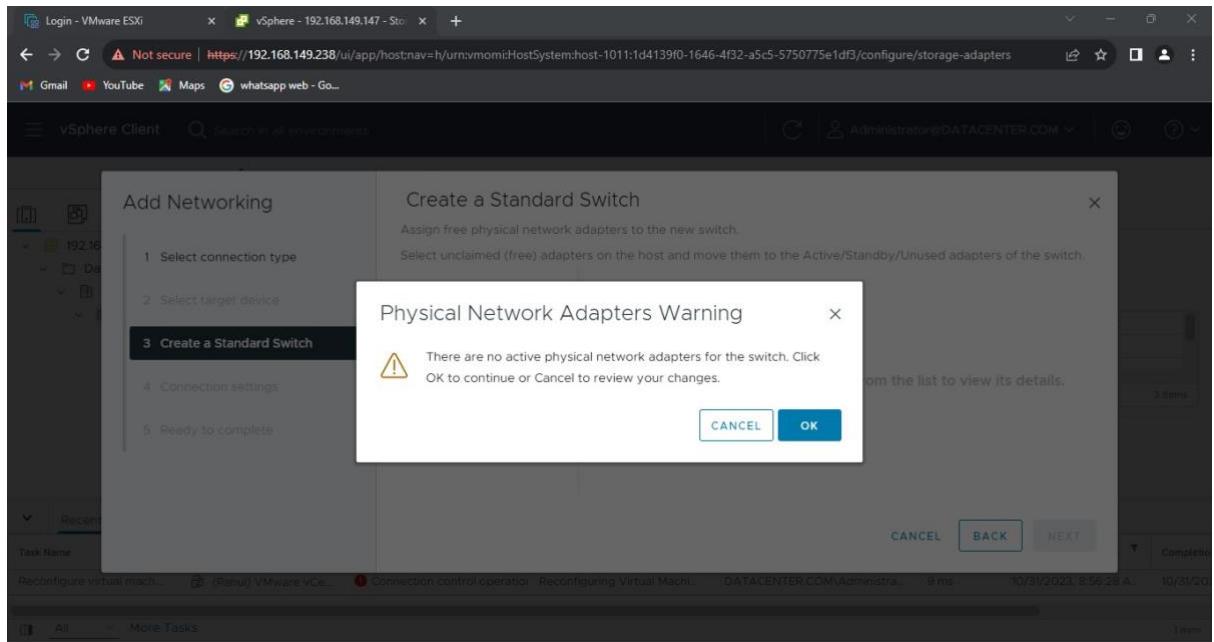
Step 21: Select Virtual Machine Port Group for a Standard Switch and then Click Next



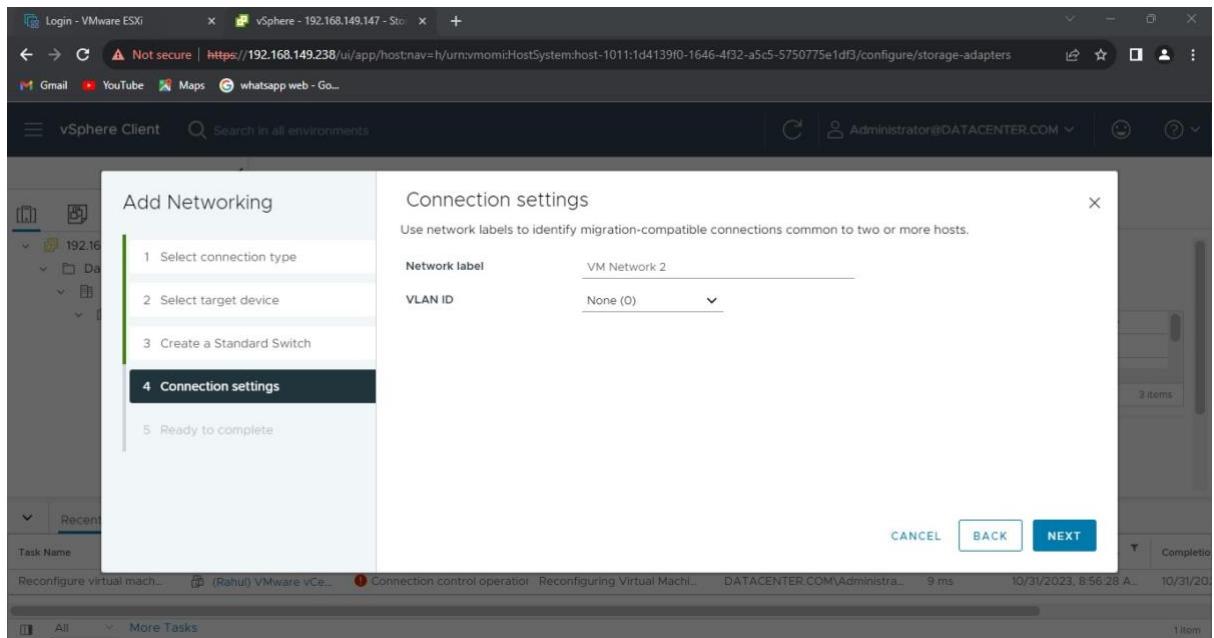
Step 22: Select New Standard Switch and Set MTU 1500, then Click Next.



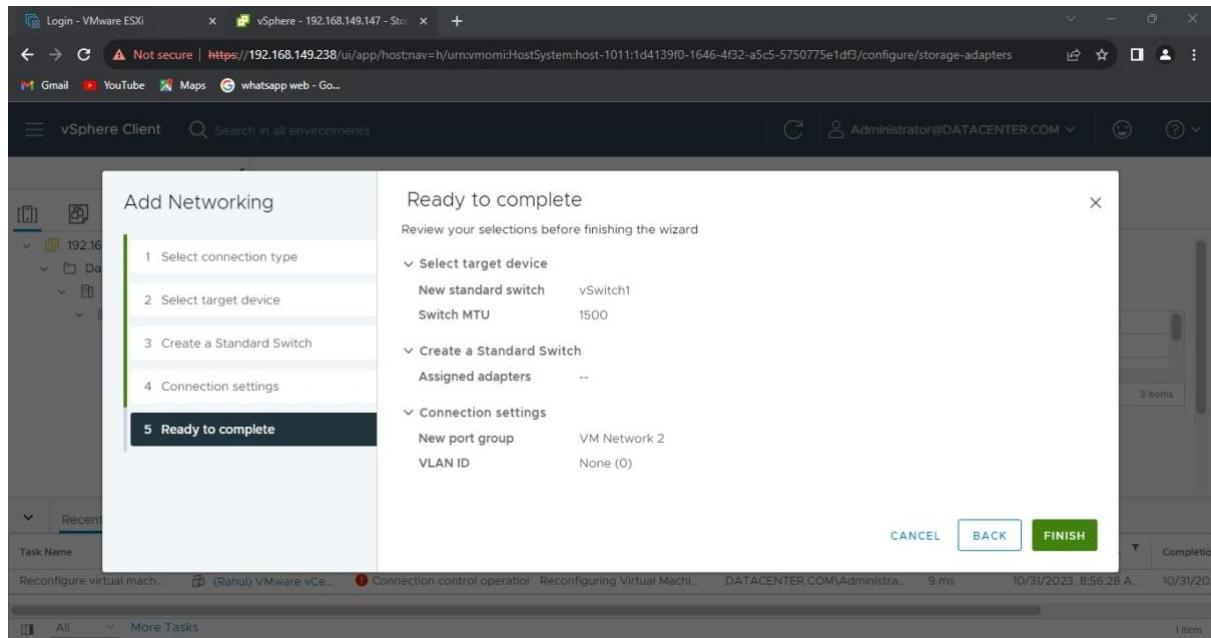
Step 23: Click on OK



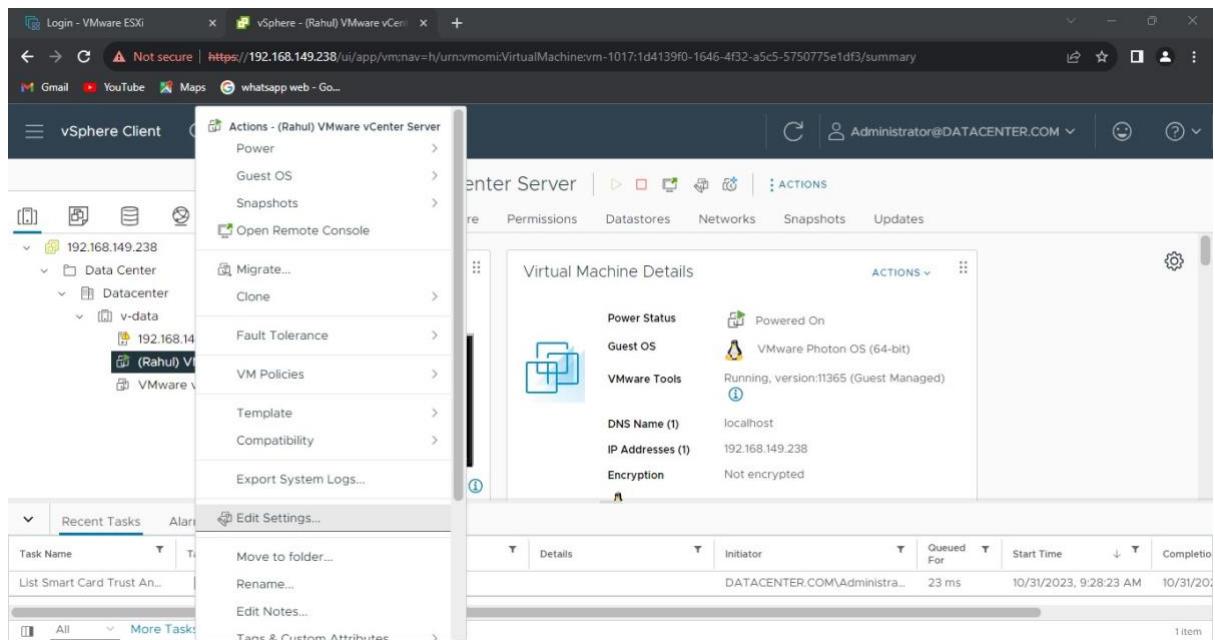
Step 24: Give your Network Label (Here it is Network Label is: VM Network 2) and Vlan Id and Click Next



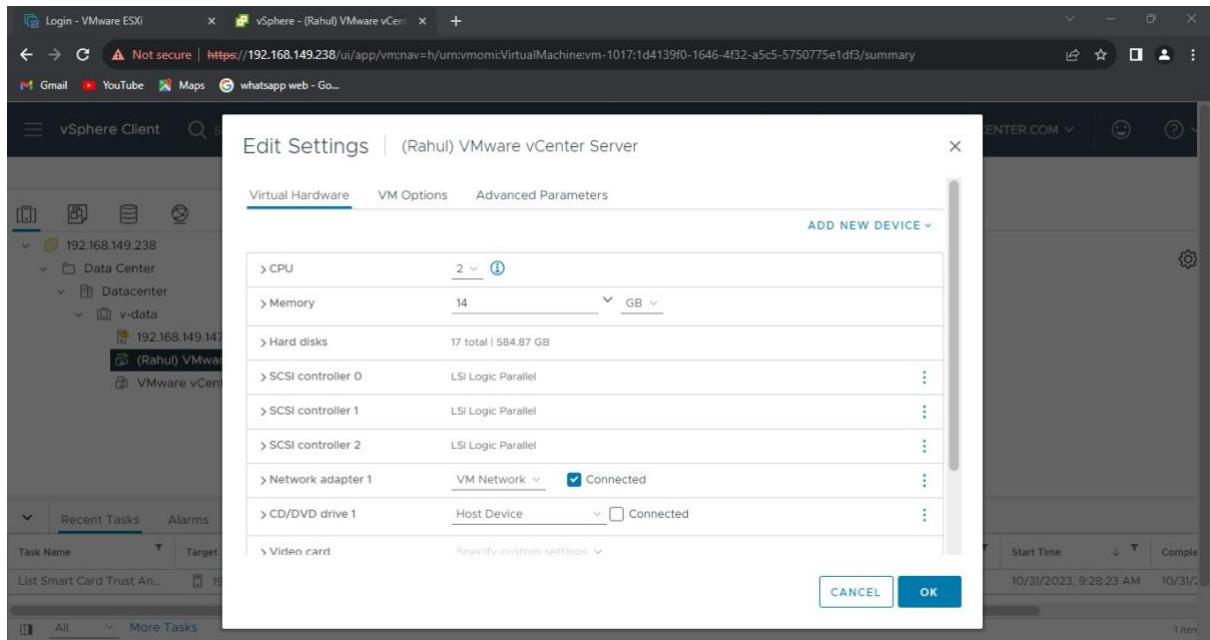
Step 25: Click on Finish



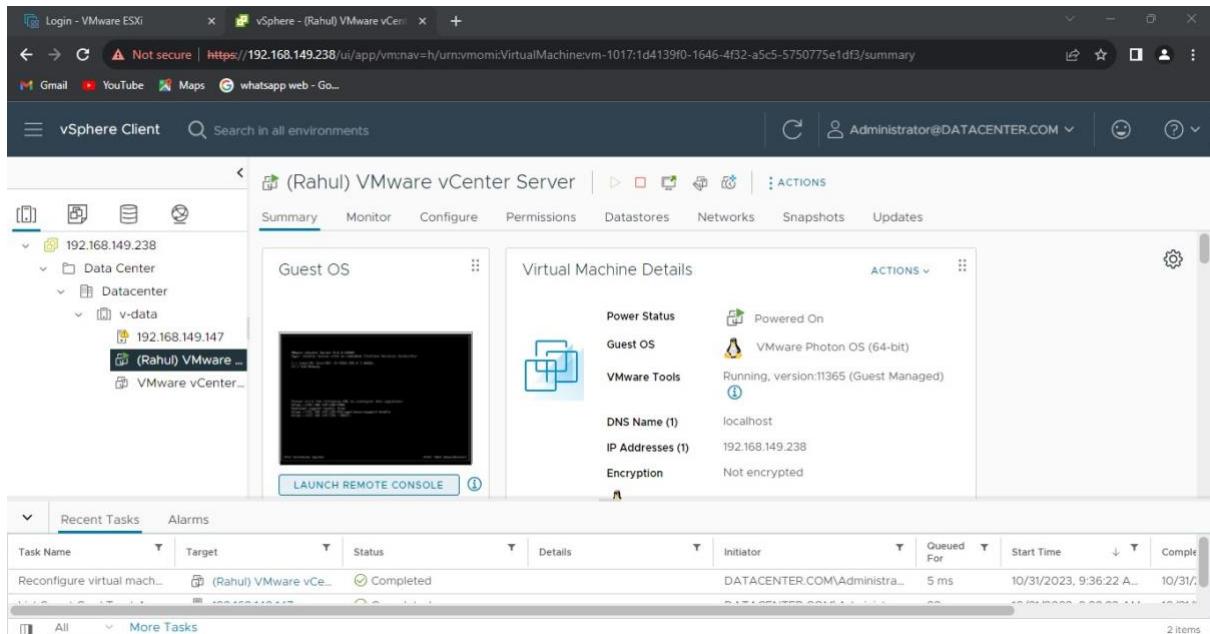
Step 26: Click on Rahul VM and Click on Edit Settings

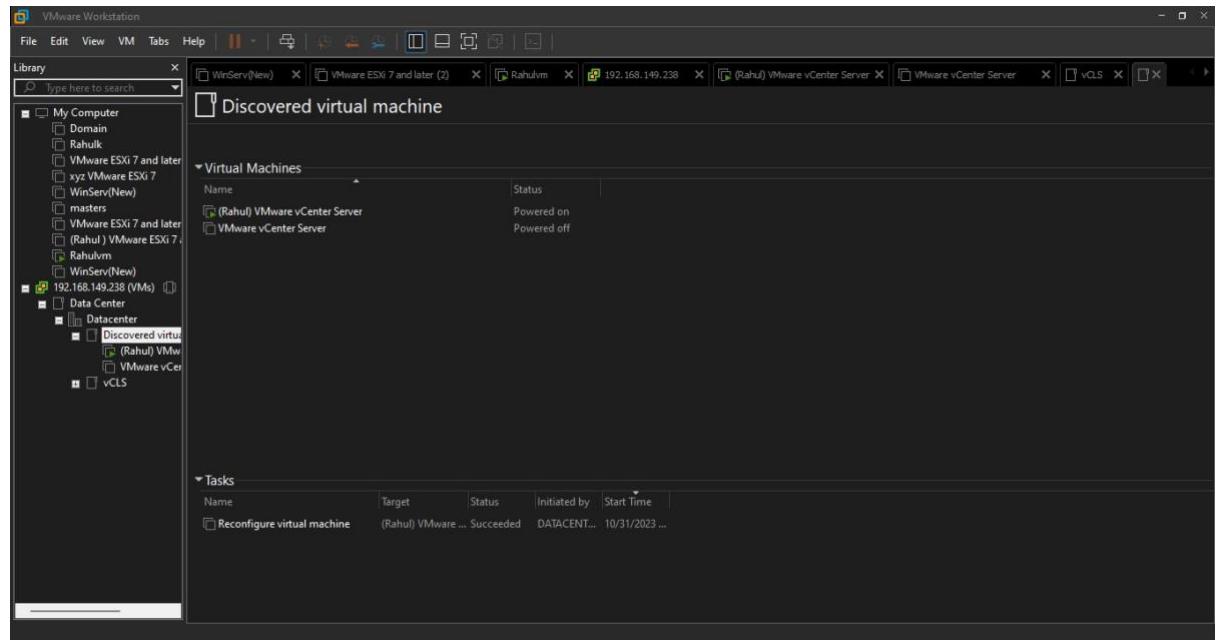
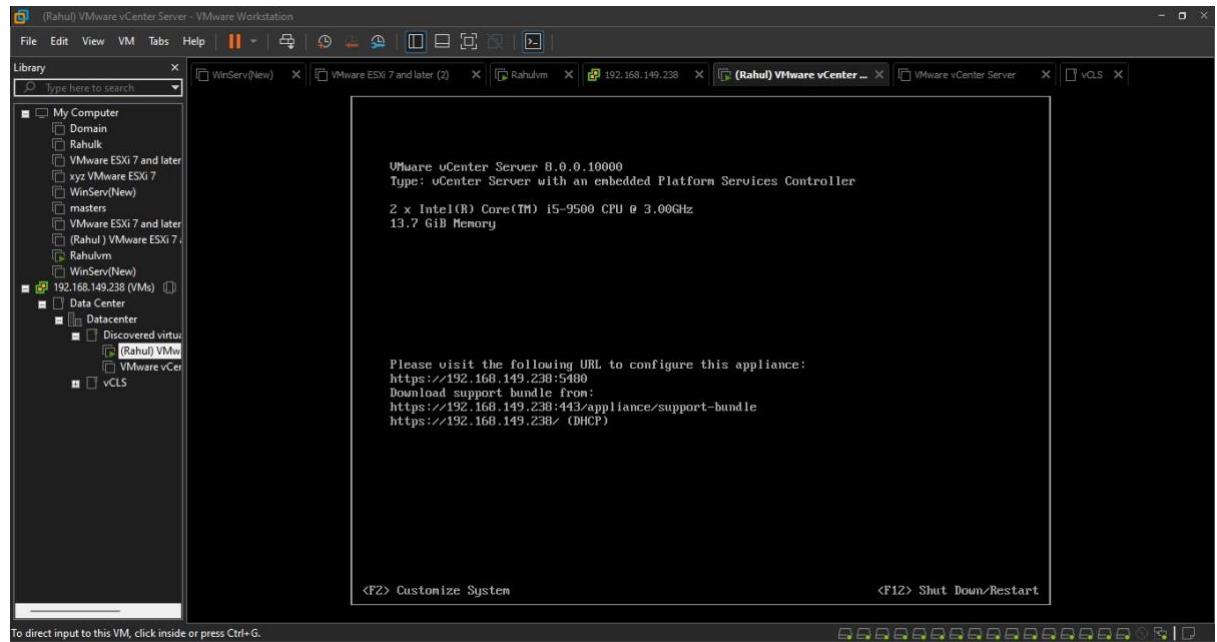


Step 27: In Network adapter 1 Click on Connect and then Click on Ok



Step 28: Click on Launch Remote Console





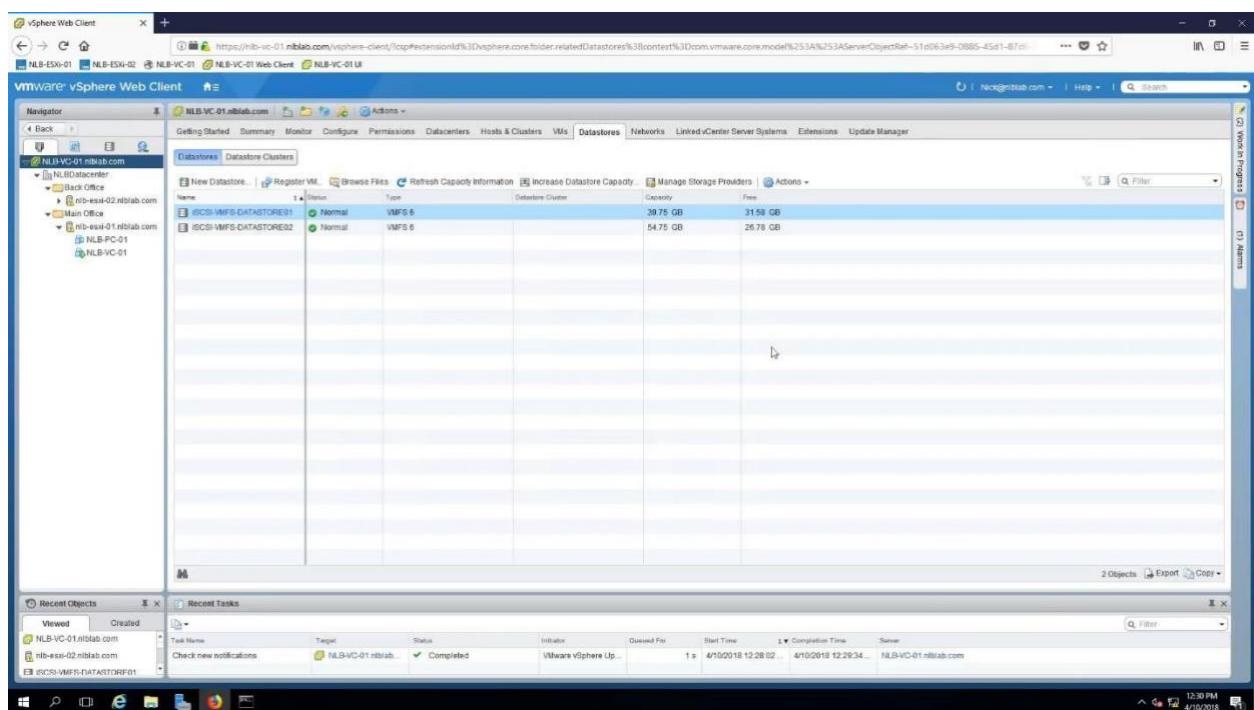
Practical: 8

Aim: Accessing iSCSI Storage.

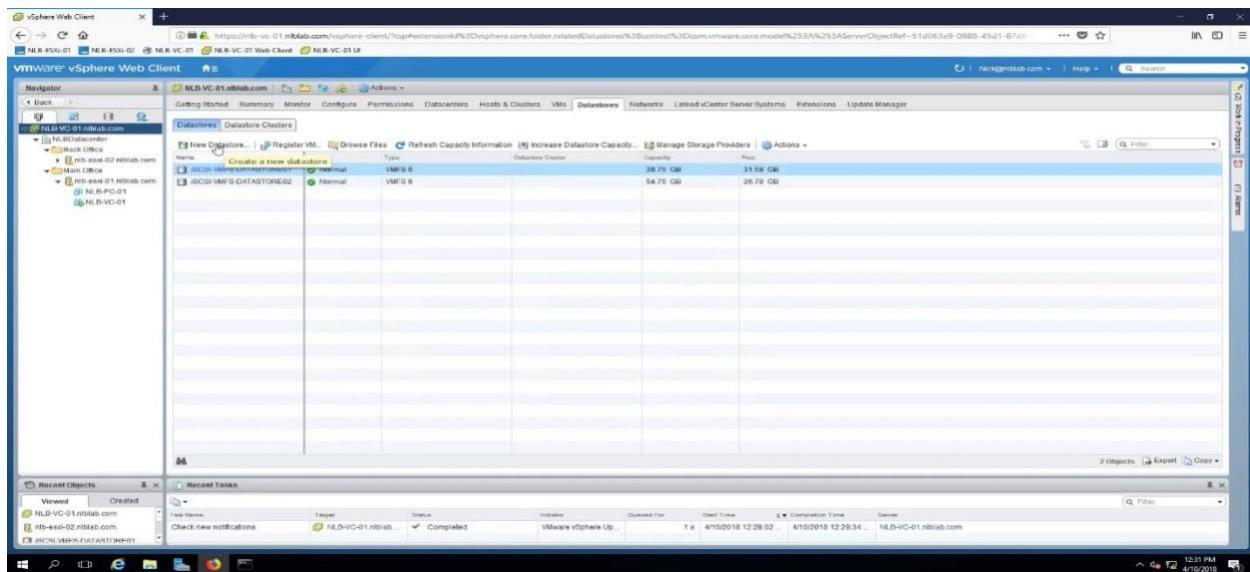
Writeup:

A) Managing VMFS Datastores

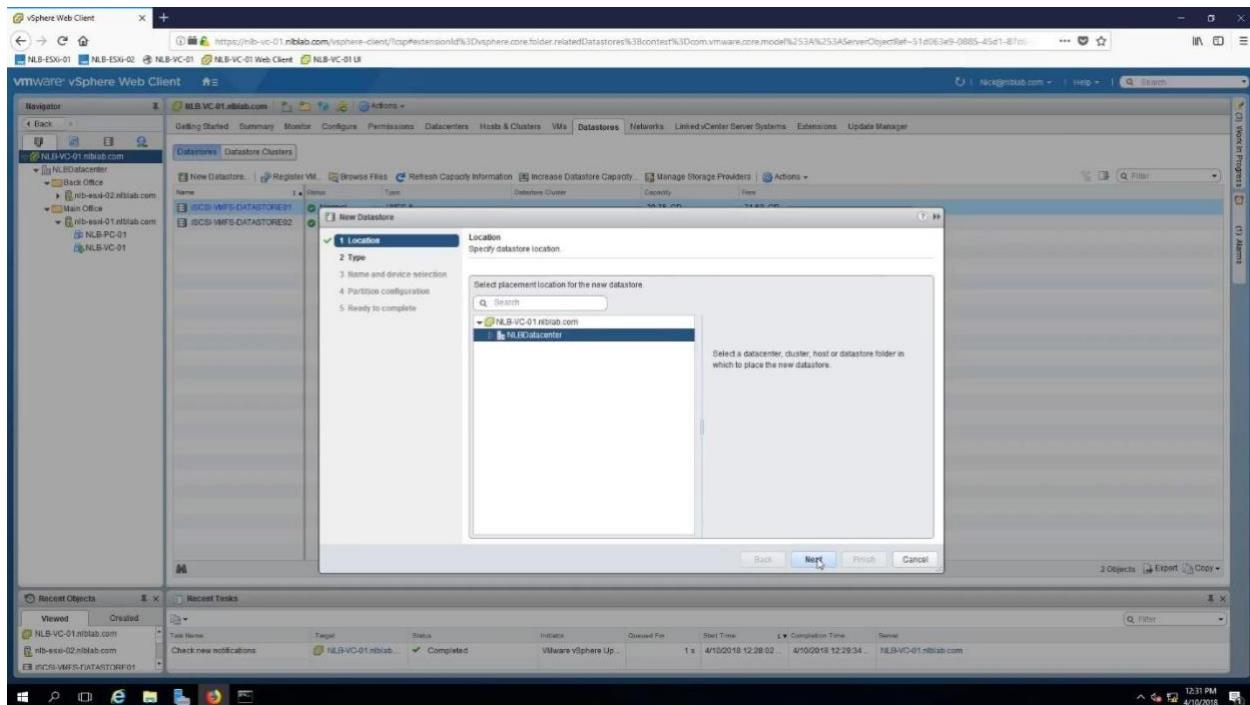
- Select your vCenter Server and Click on Datastores



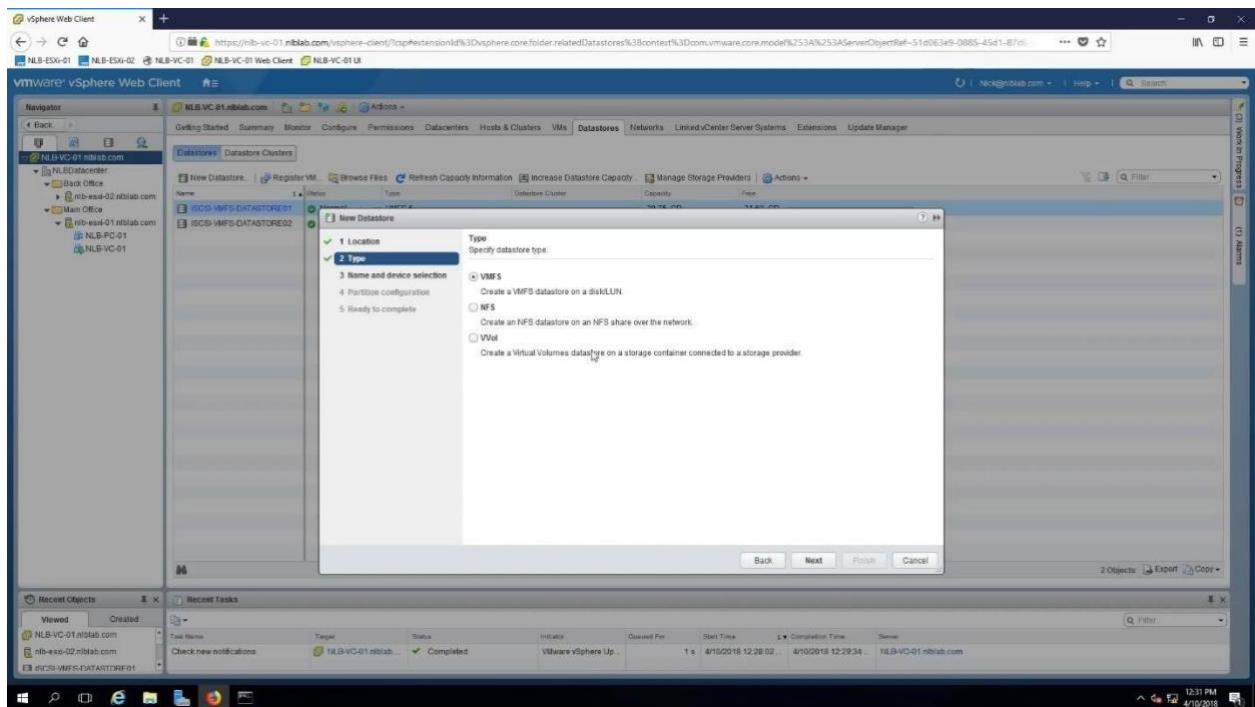
- Click on New Datastore to Create New Data Store



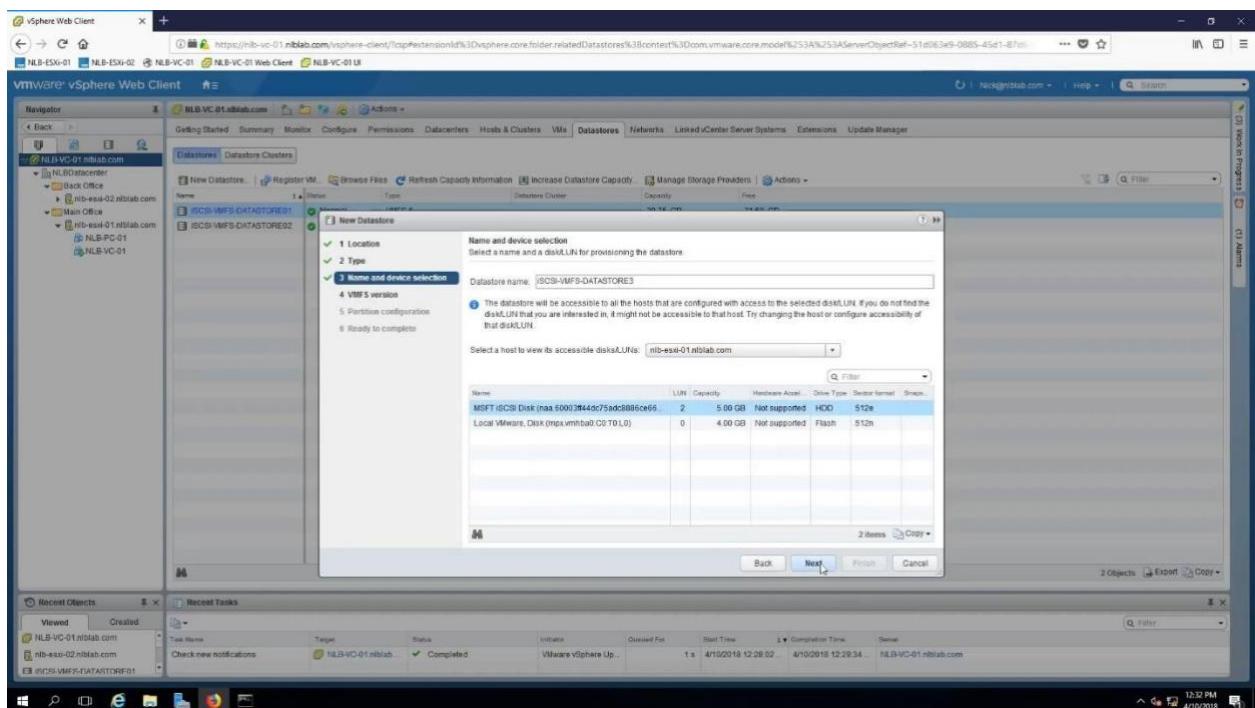
- Click Placement Location for this new datastore.



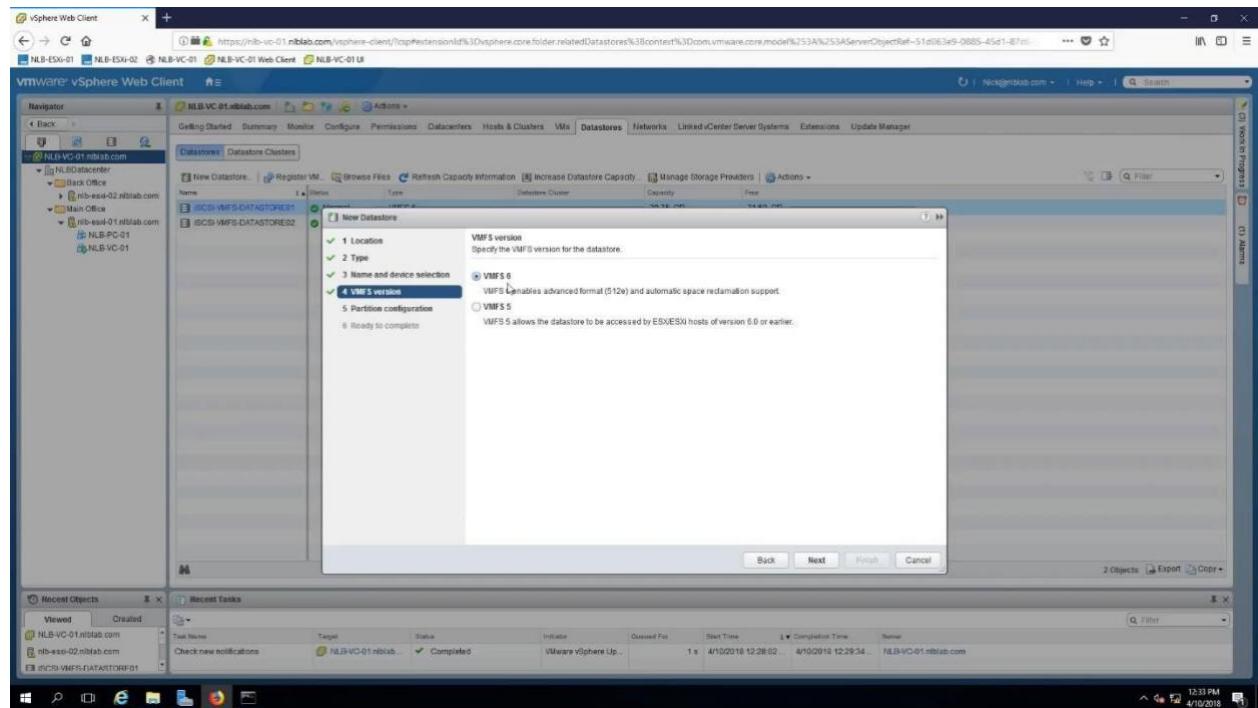
- Specify Datastore type, select VMFS and Click Next.



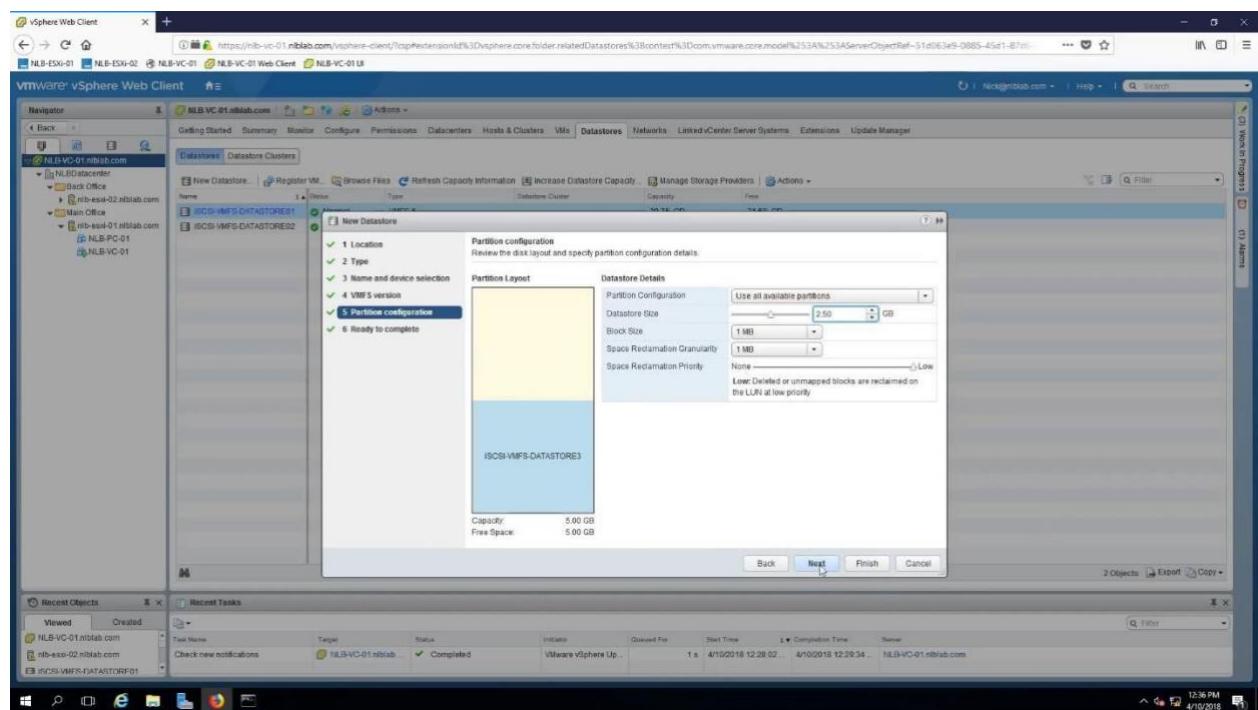
- Give Name to your Datastore and Select a host to view its accessible disk and select disk, Click Next.



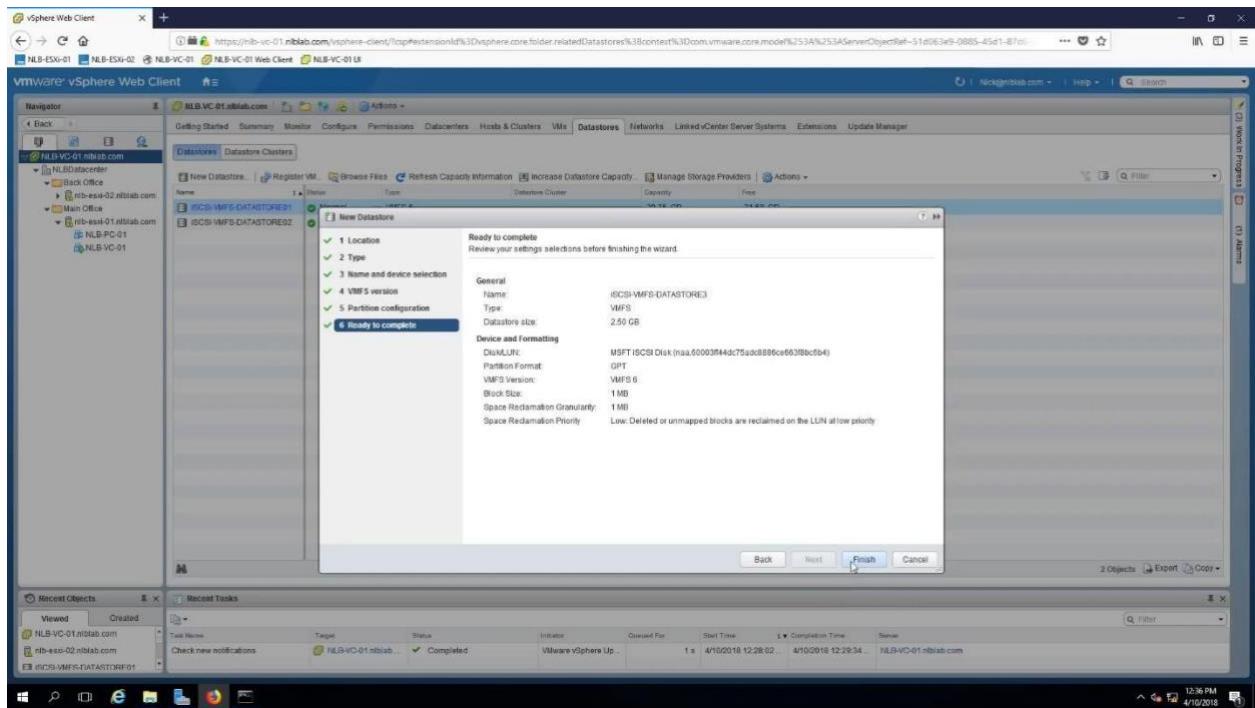
- Specify the VMFS version for the datastore and Click Next.



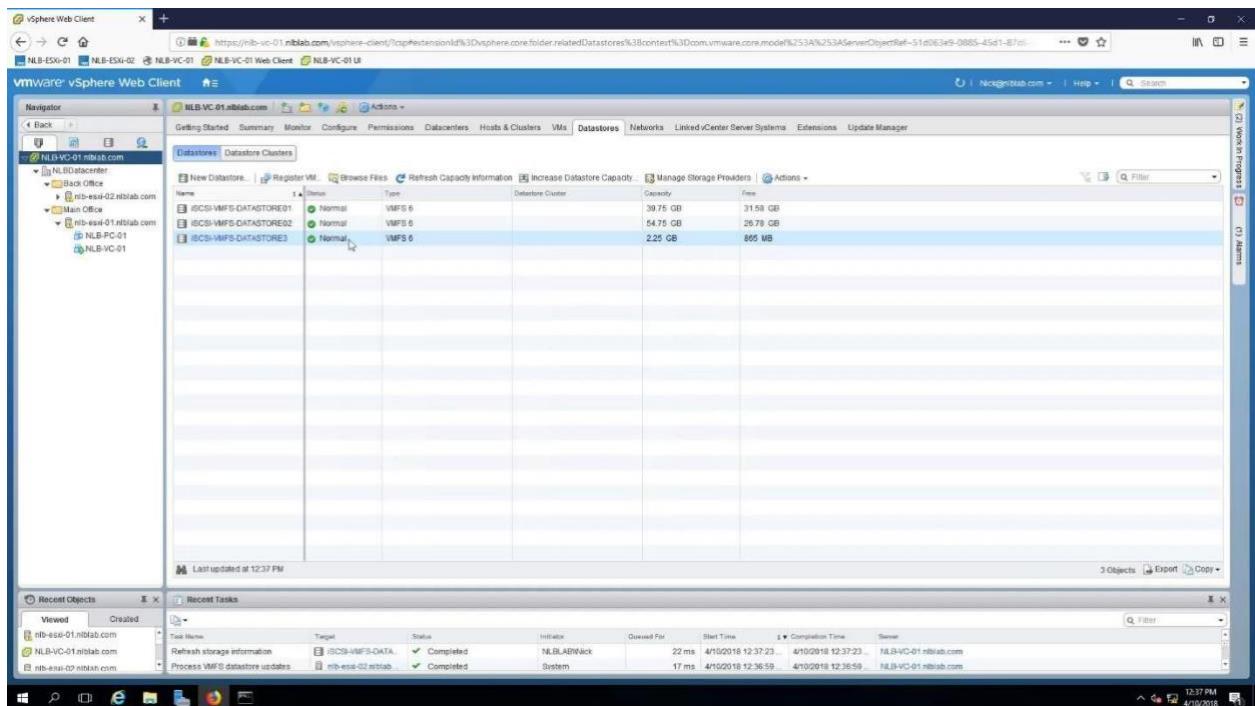
- Review the disk Layout and Specify disk partition configuration details, Click Next.



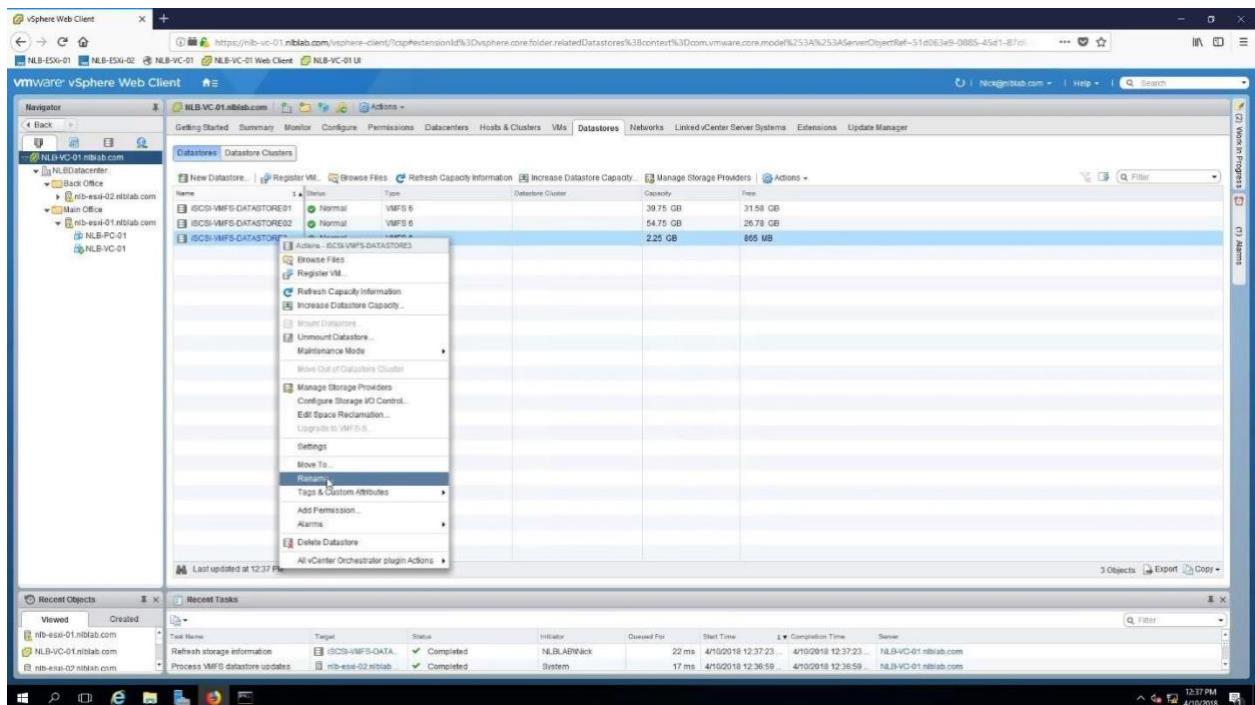
- Review your Settings Selections before finishing the wizard.



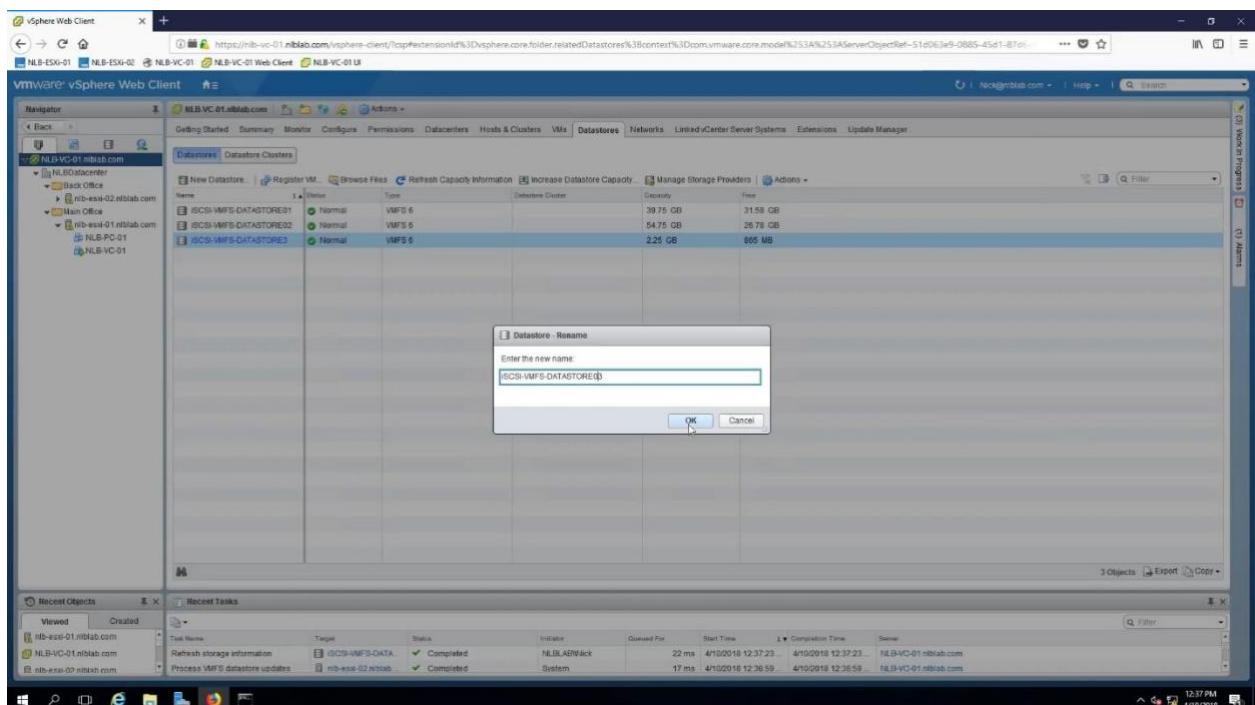
- Hence New Data Store is Created and you can see that in Data store list.



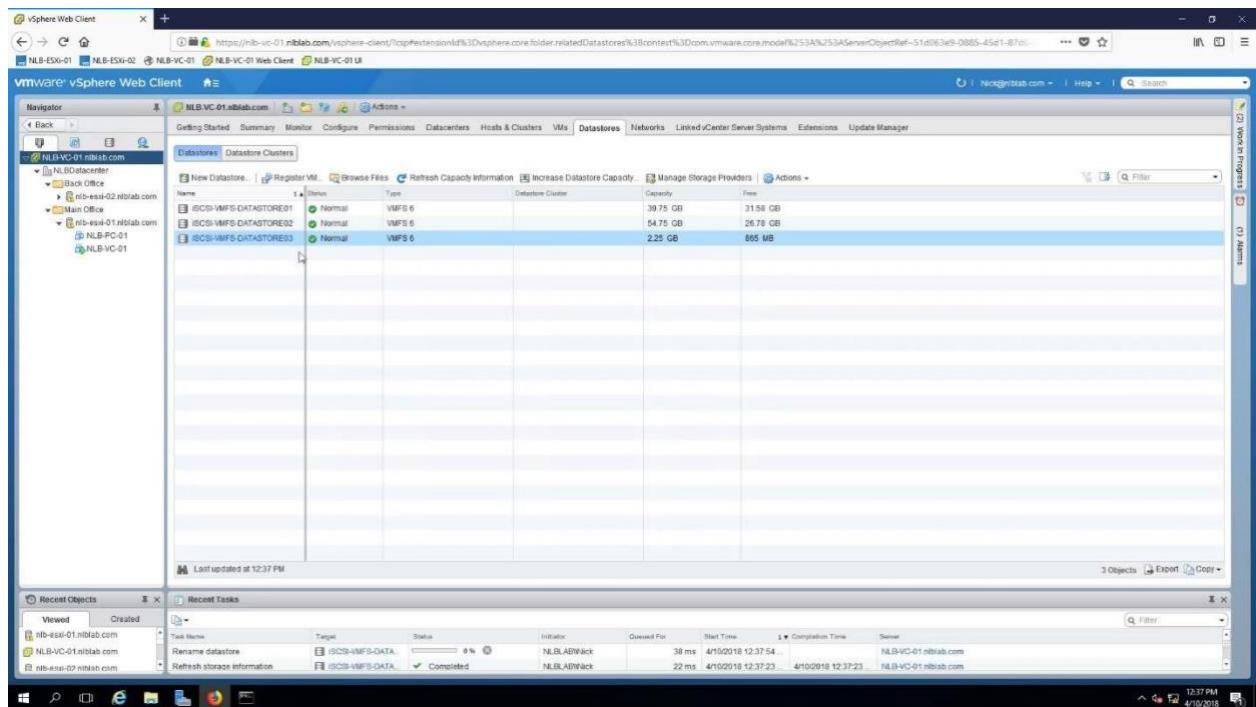
- Click on your new data store and Right Click and Rename it.



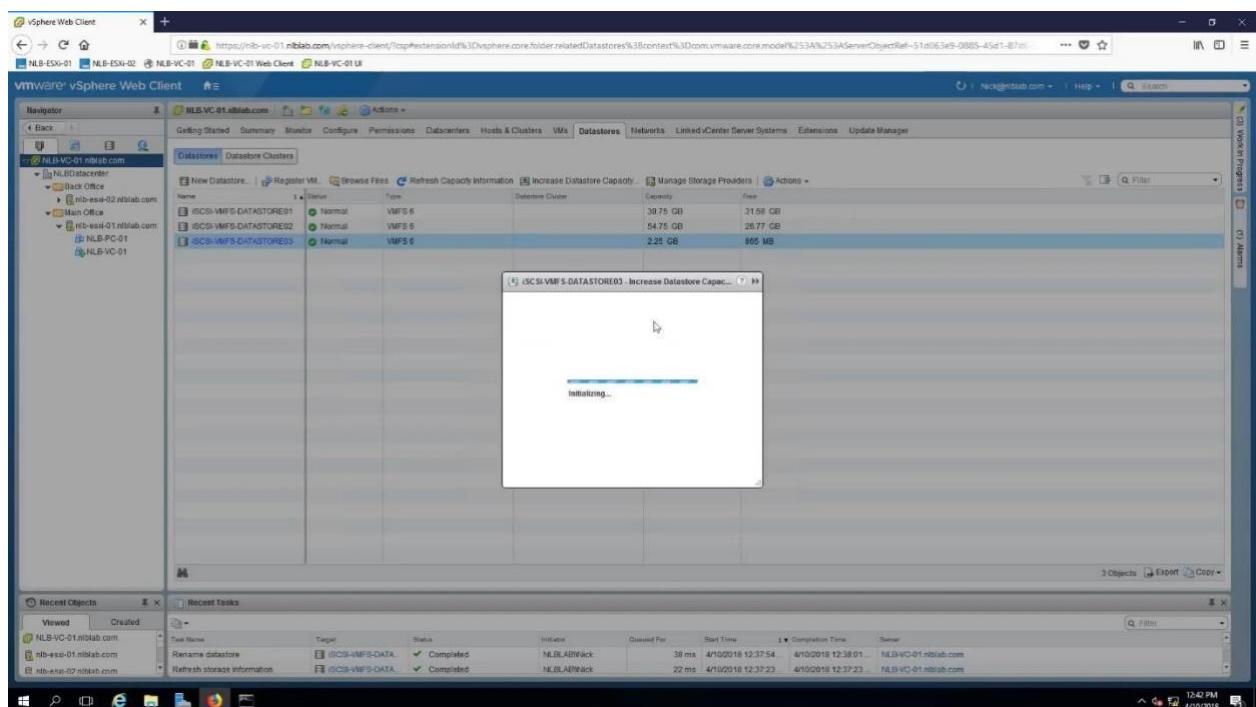
- Give Name and Click Ok.



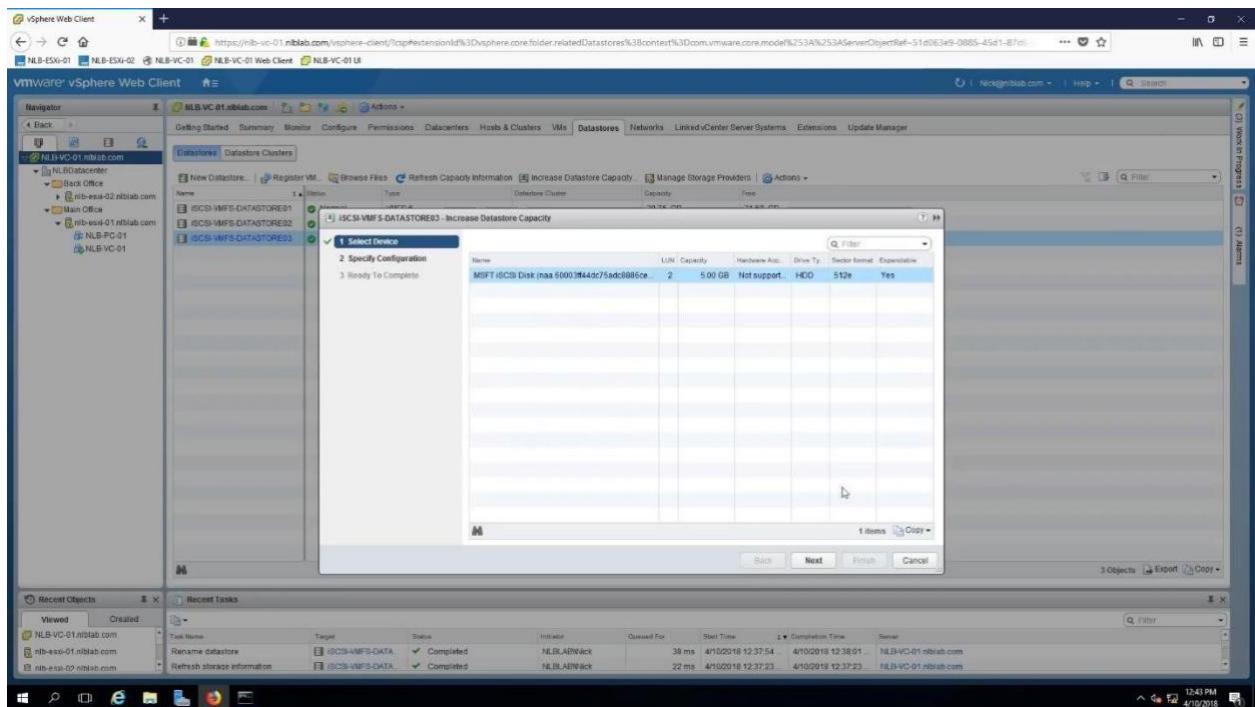
- Here you can see the datastore name change in data store list.



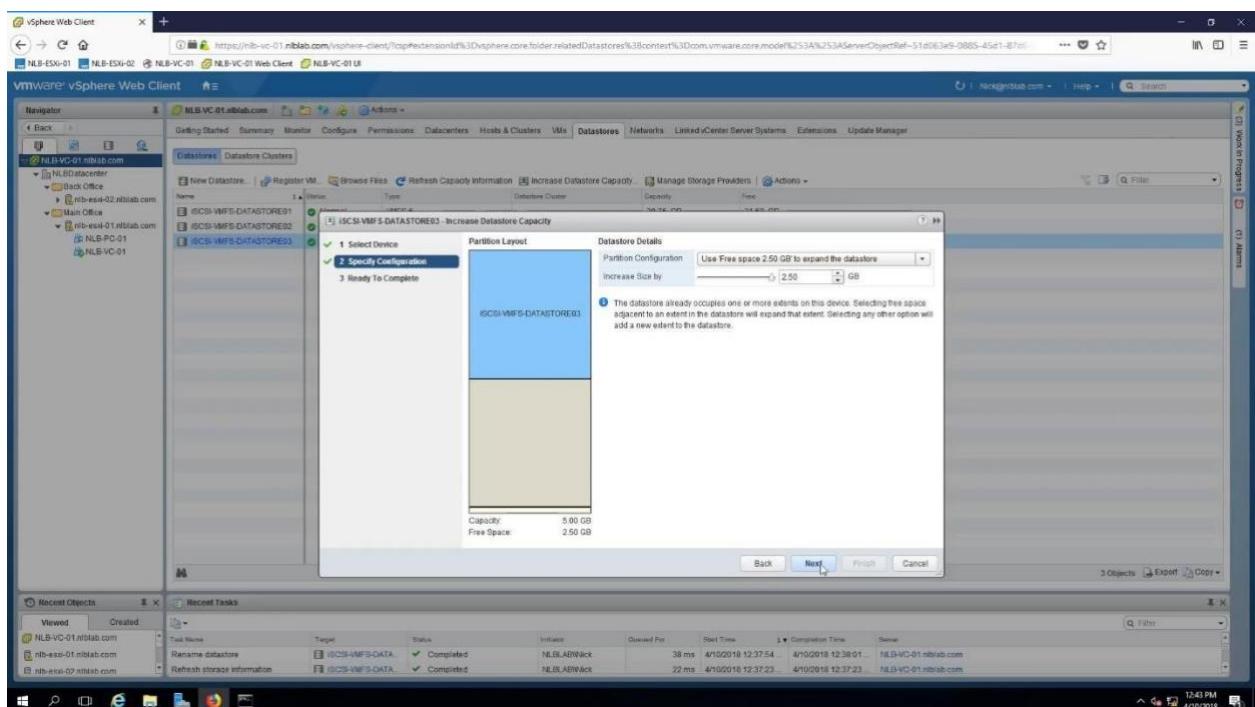
- Go to Datastores and Select Datastore, Click Increase Datastore Capacity.



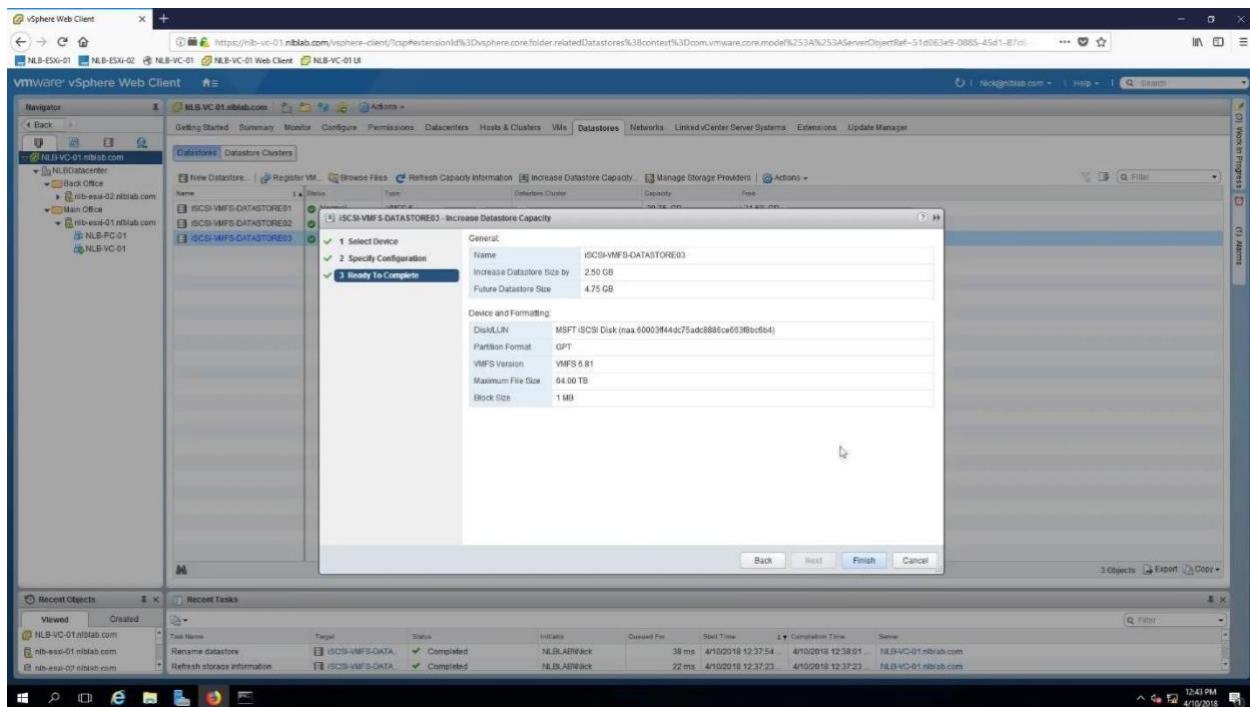
- Select your device disk and Click Next.



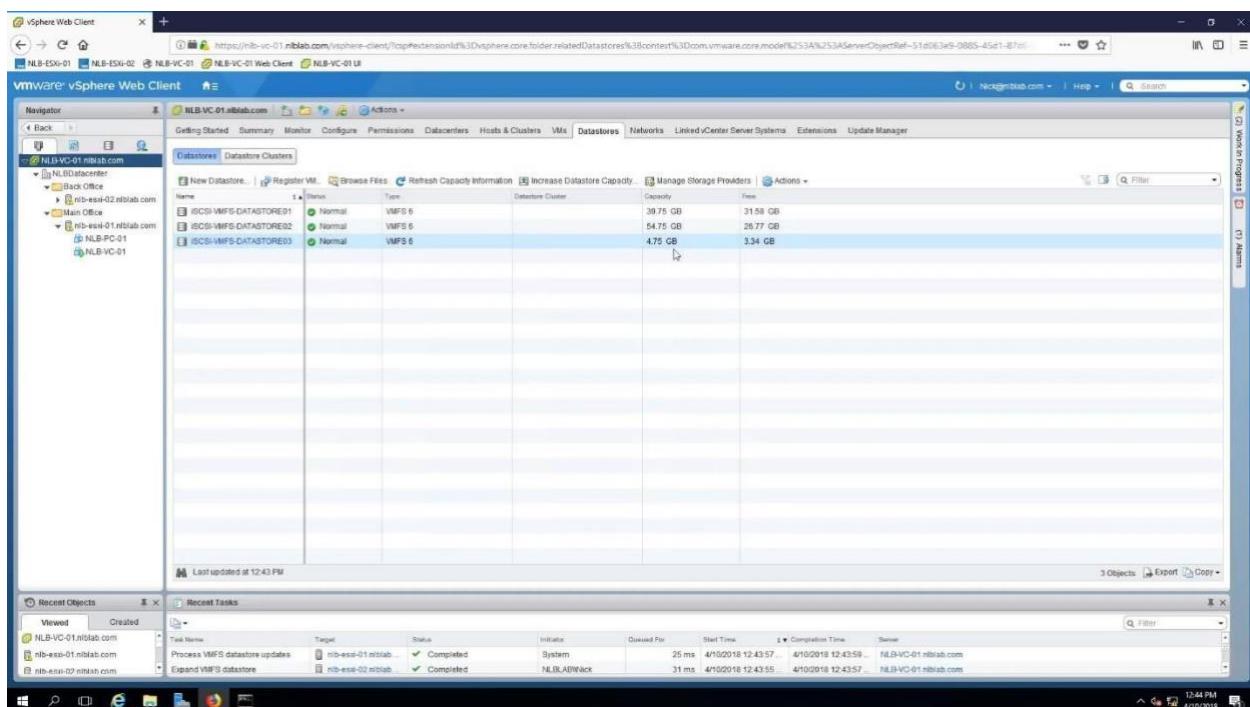
- Specify the Configuration and Click Next.



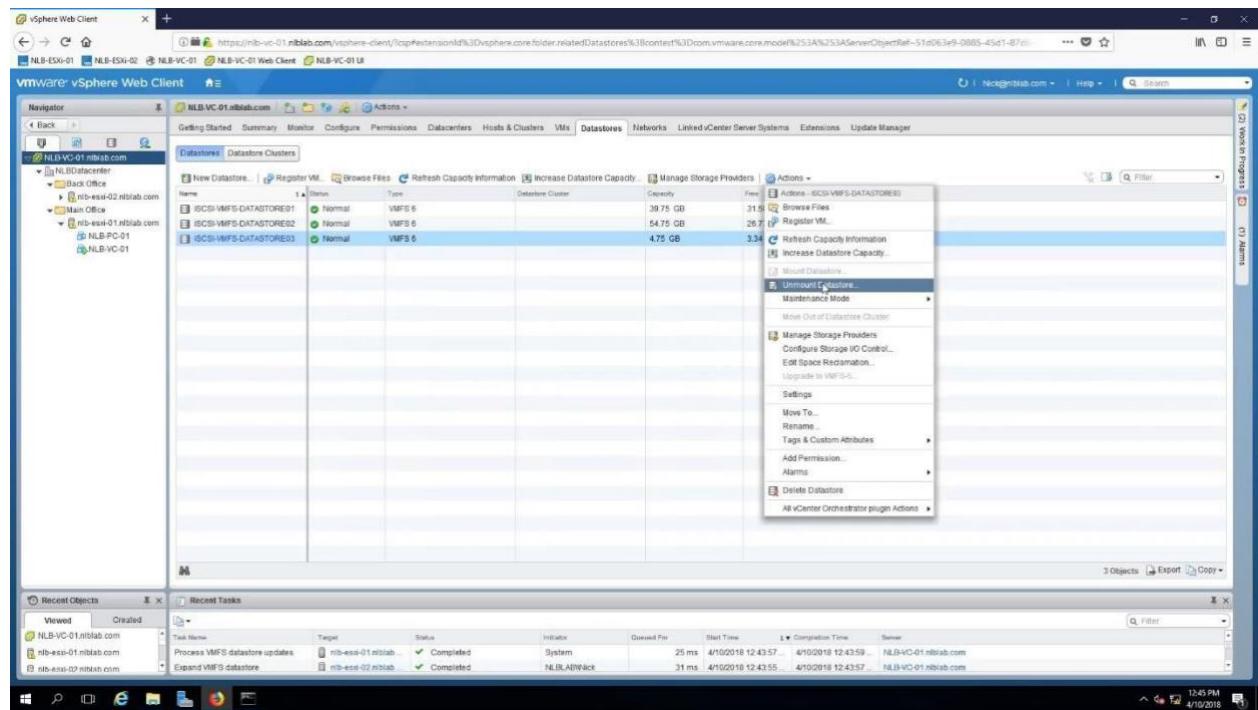
- View your Configuration Settings and Click Finish.



- After few seconds, you can see the updated Capacity of Datastore.

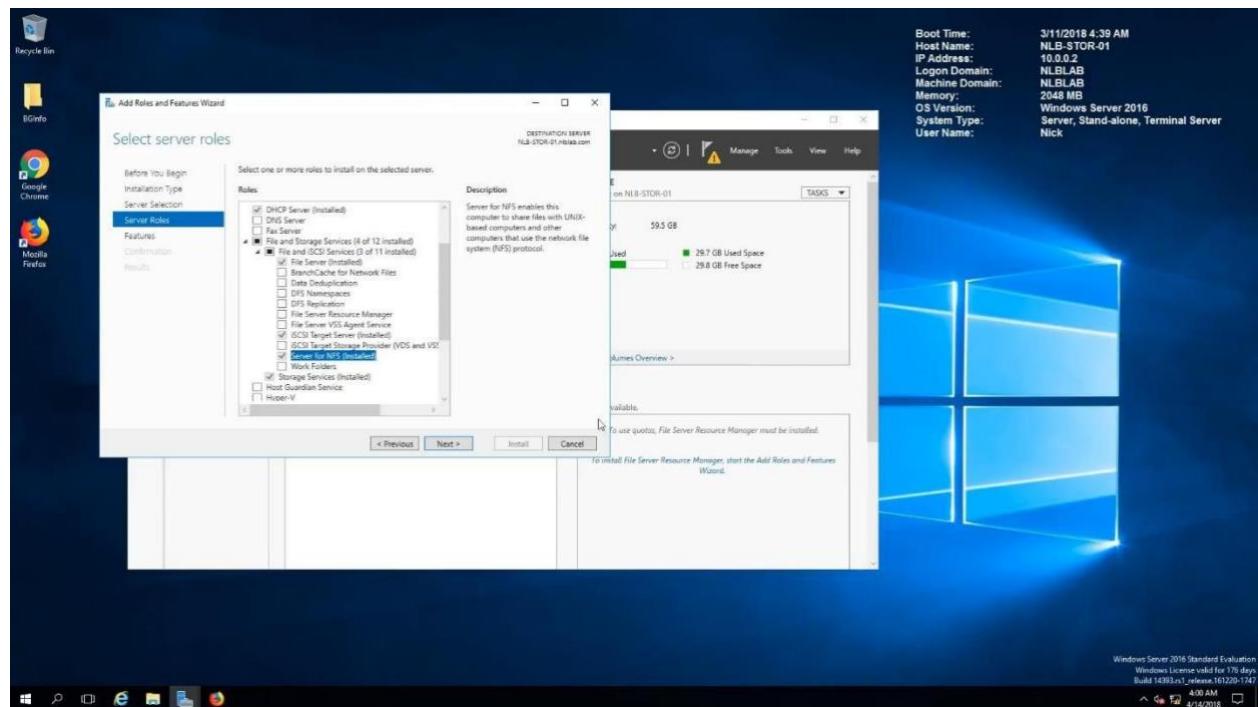


- Click on Actions here you can perform different operation on your data store like Rename, Unmount, Expand and Delete etc.

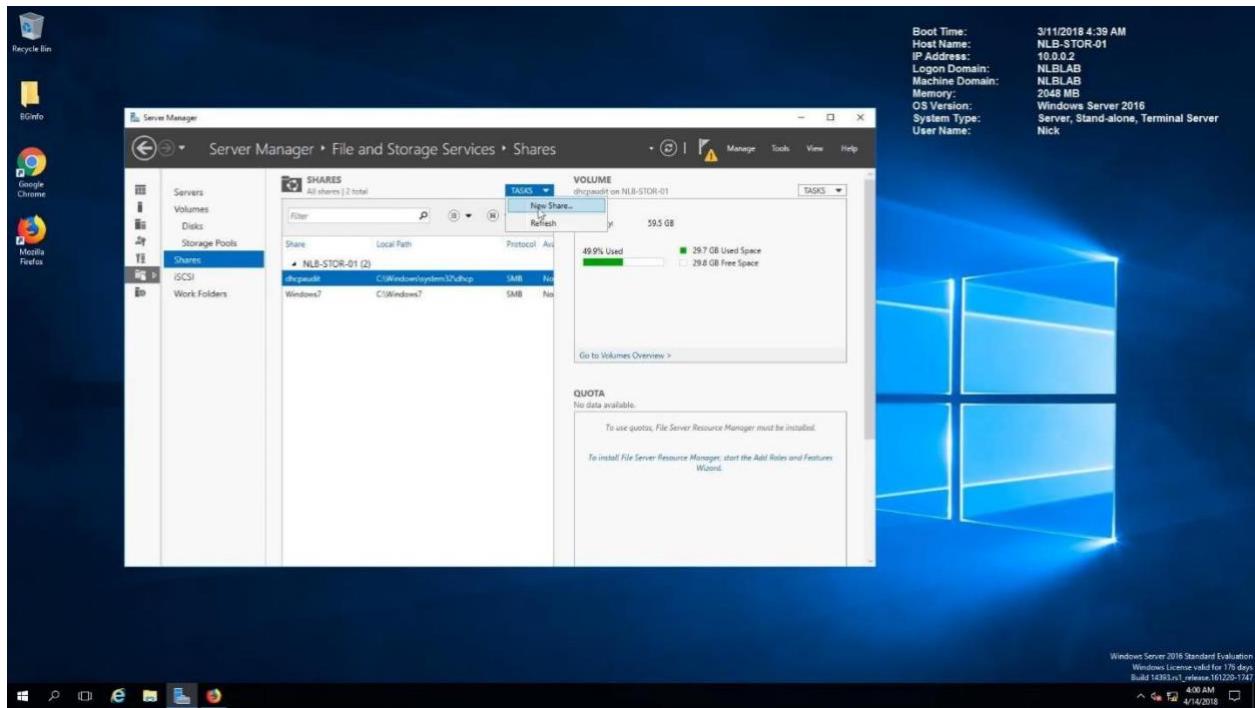


8 b) Accessing NFS Storage

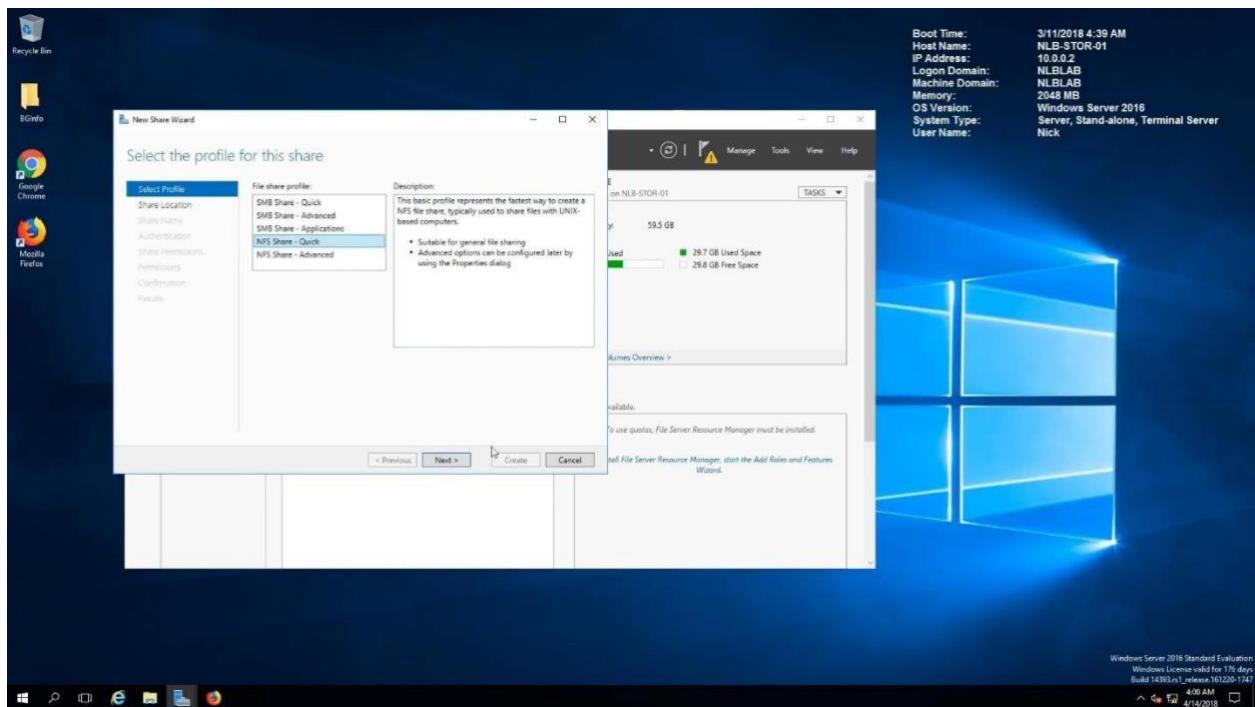
- First Enable the Server of NFS



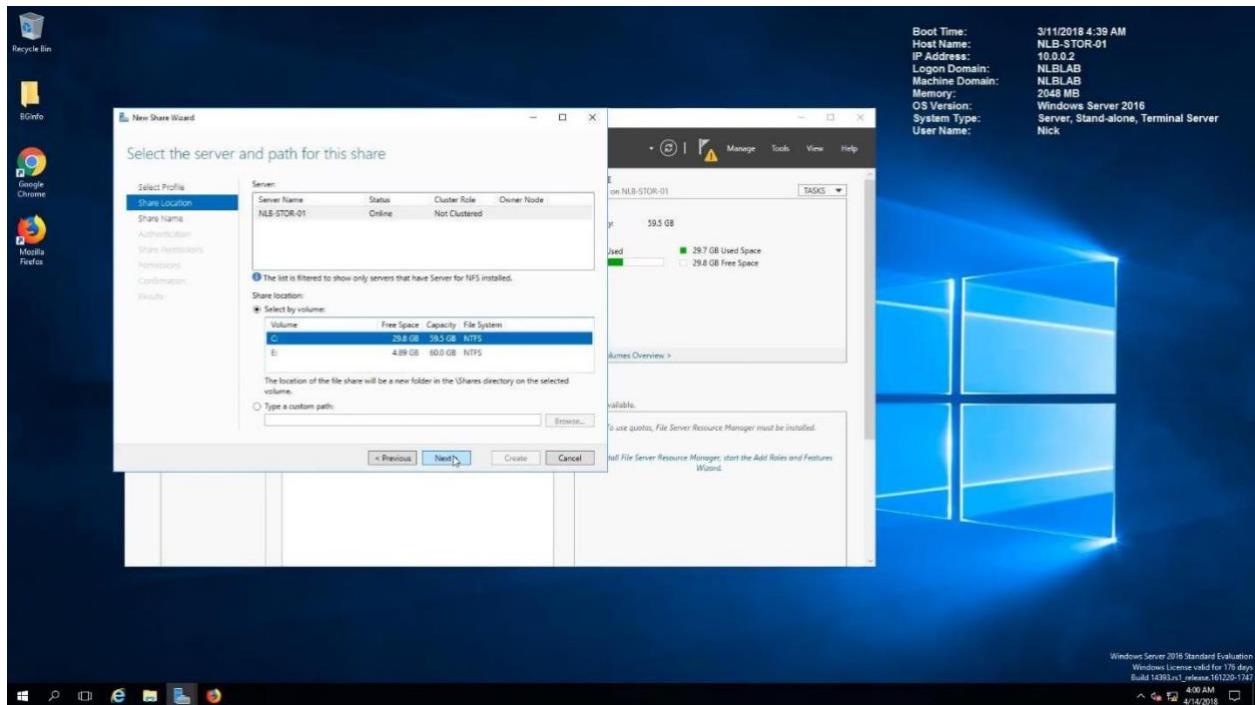
- Under Shares > Tasks > New Shares.



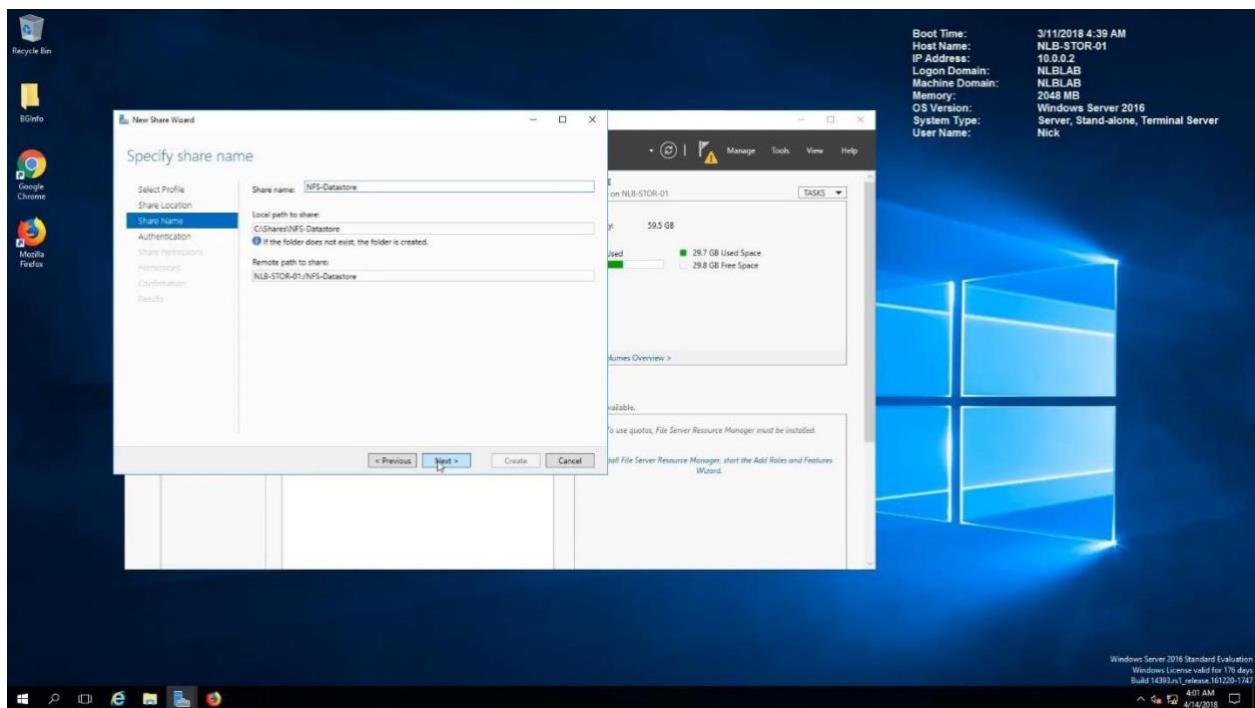
- Select NFS Share - Quick and Click Next.



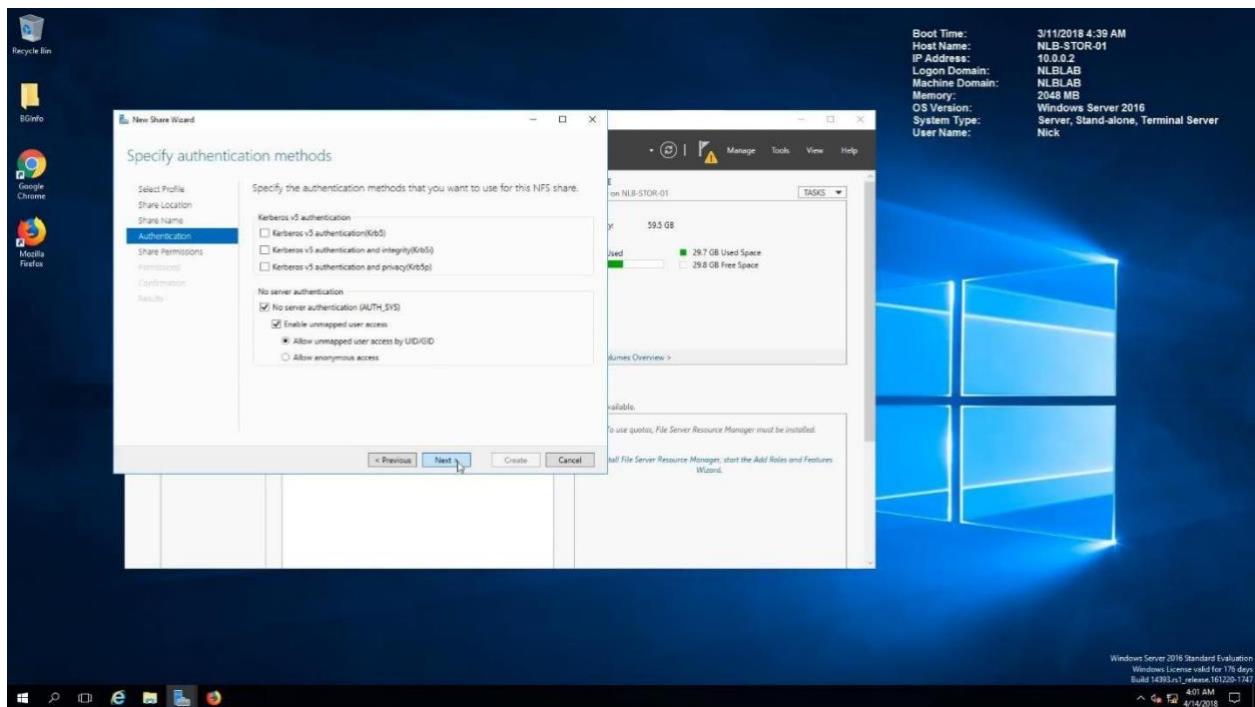
- Select the Volume and Click Next.



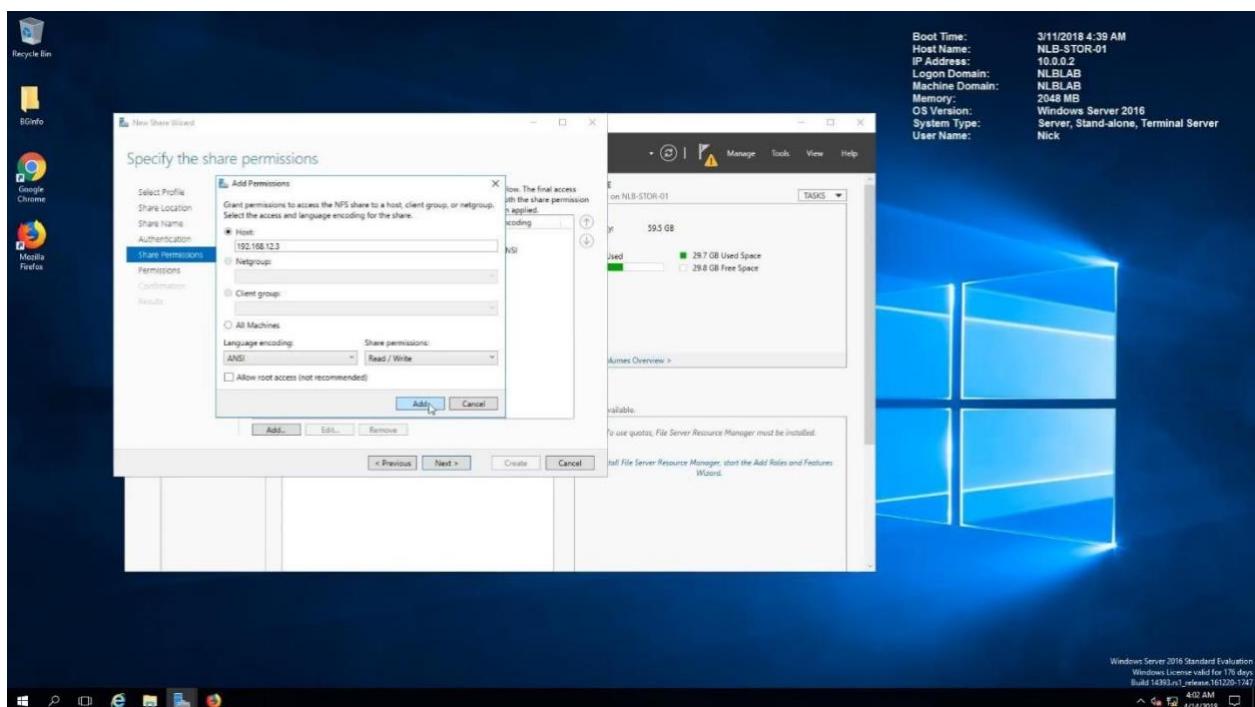
- Give Share Name and Click Next.



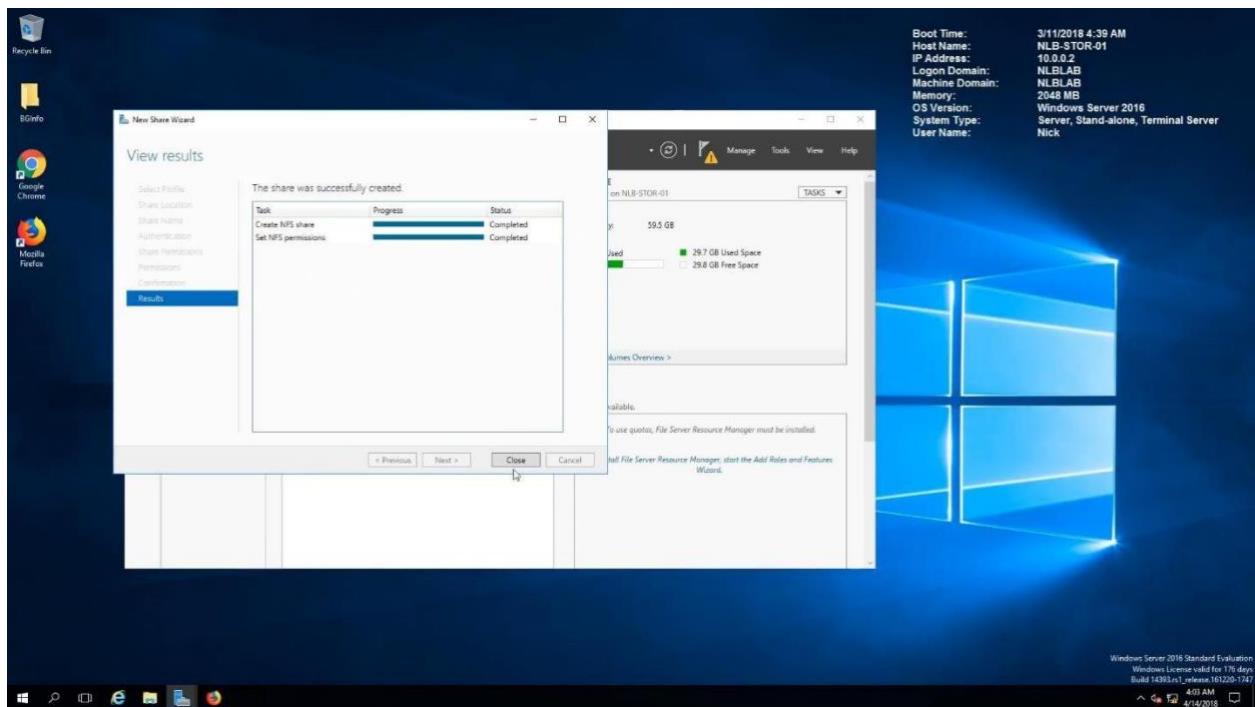
- Specify the Authentication Methods.



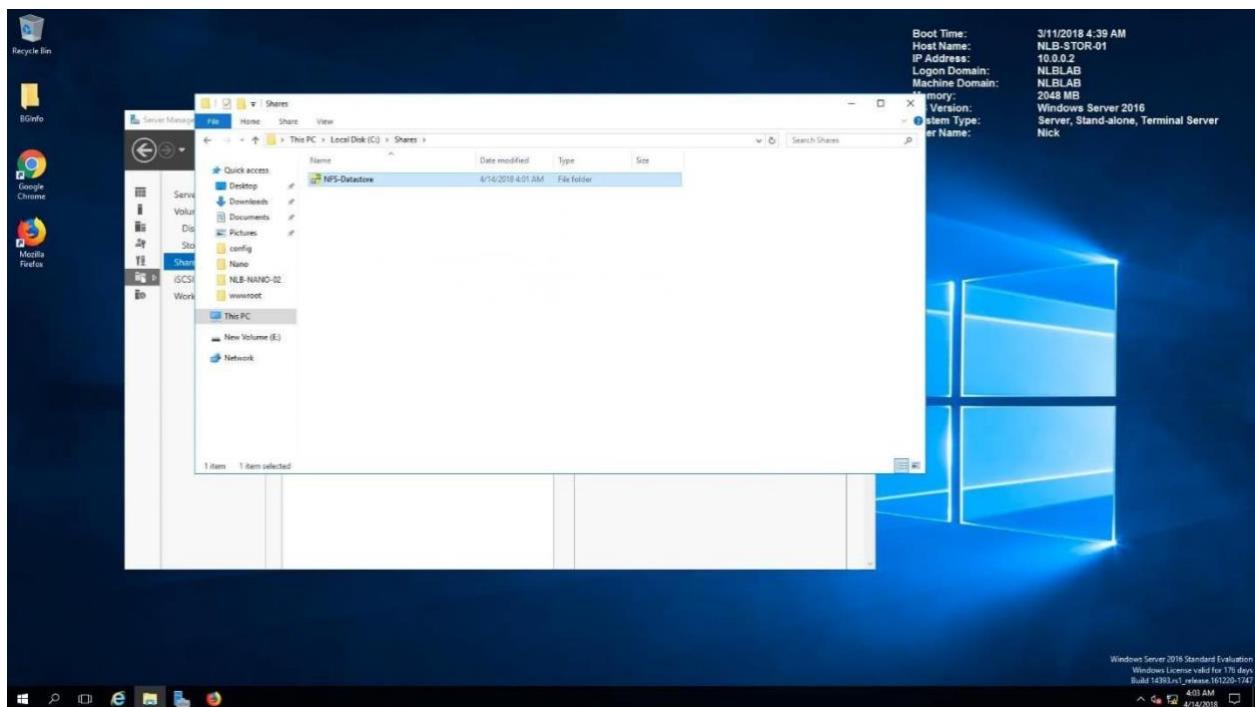
- Specify the Share Permissions Give Host IP and Read/Write Access.



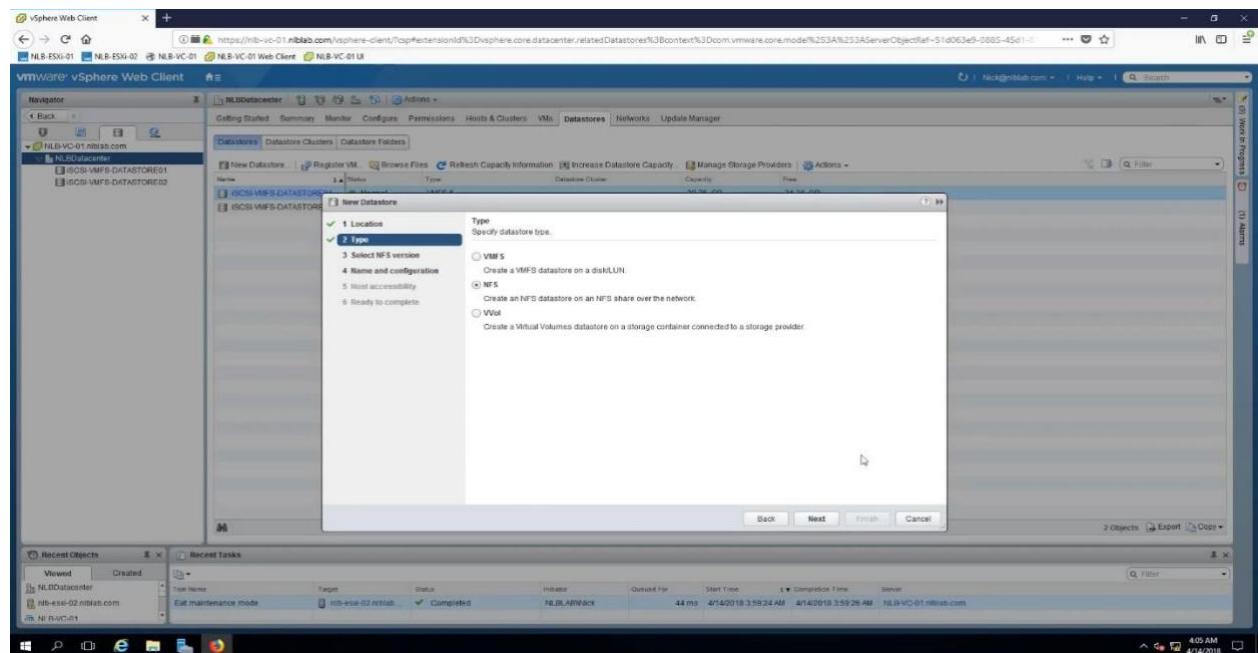
- Click Next and Leave other settings default and Click Close.



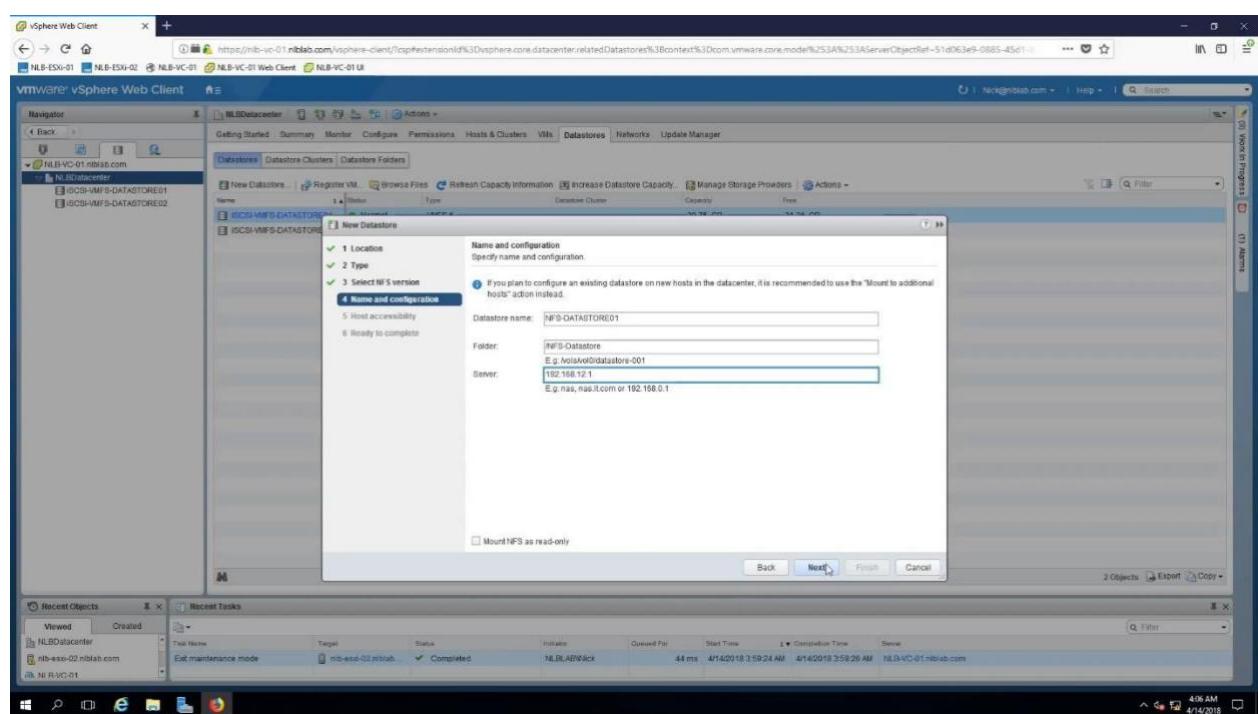
- In your C Partition Under Share Folder here you can see your created NFS Data Store.



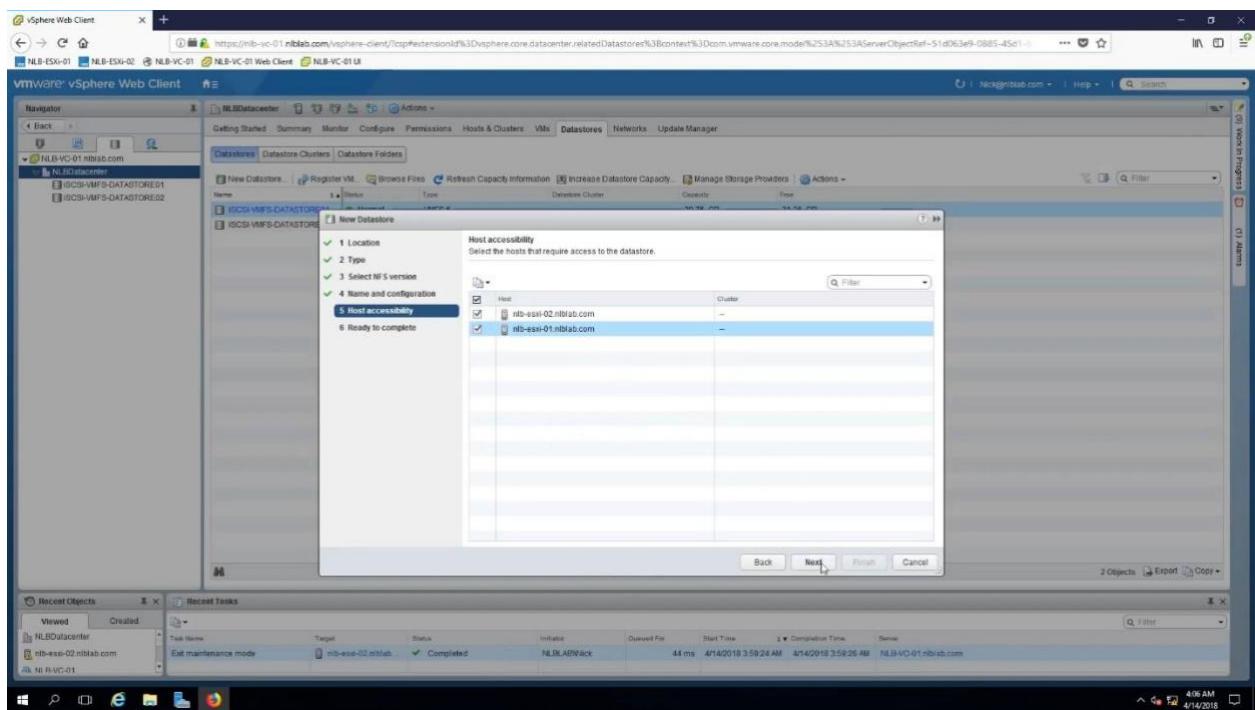
- Go to vSphere Client > Datastore > select your datastore > New Datastore > Type of Data Store > Click Next.



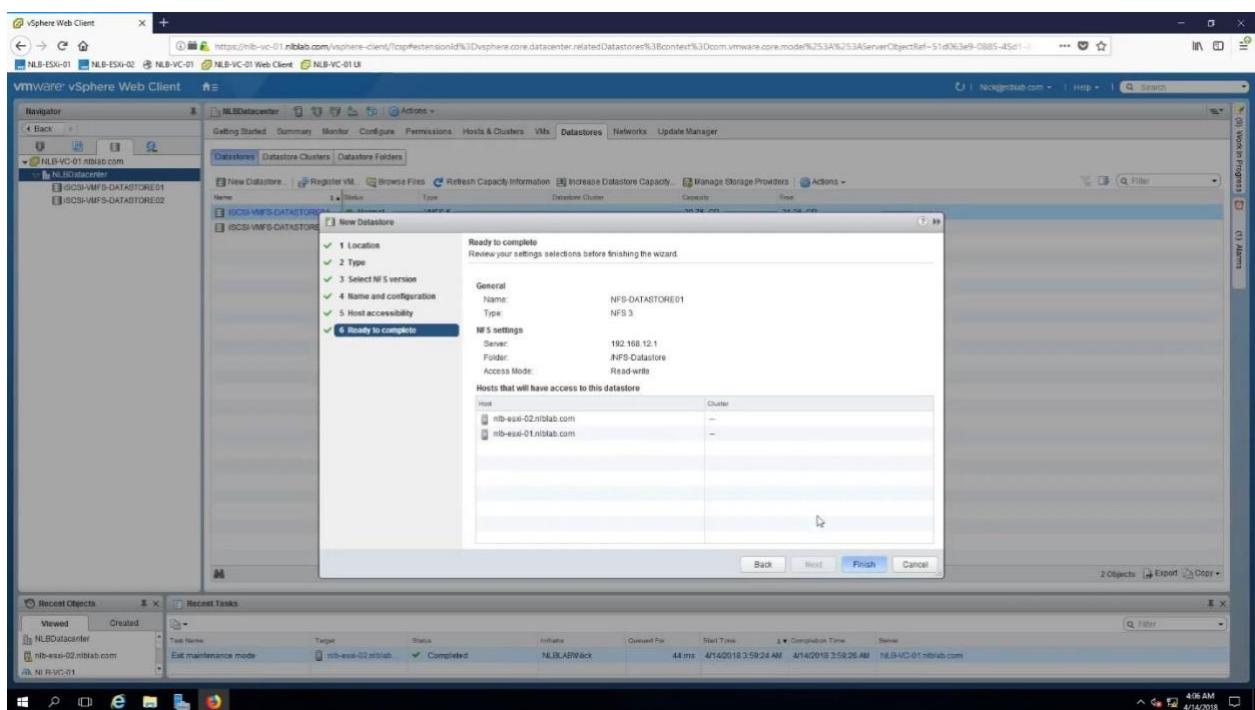
- Specify the NFS Version > Click Next > Here Give Datastore Name, Folder Name and Server IP > Click Next.



- Select the hosts that require access to the datastore.

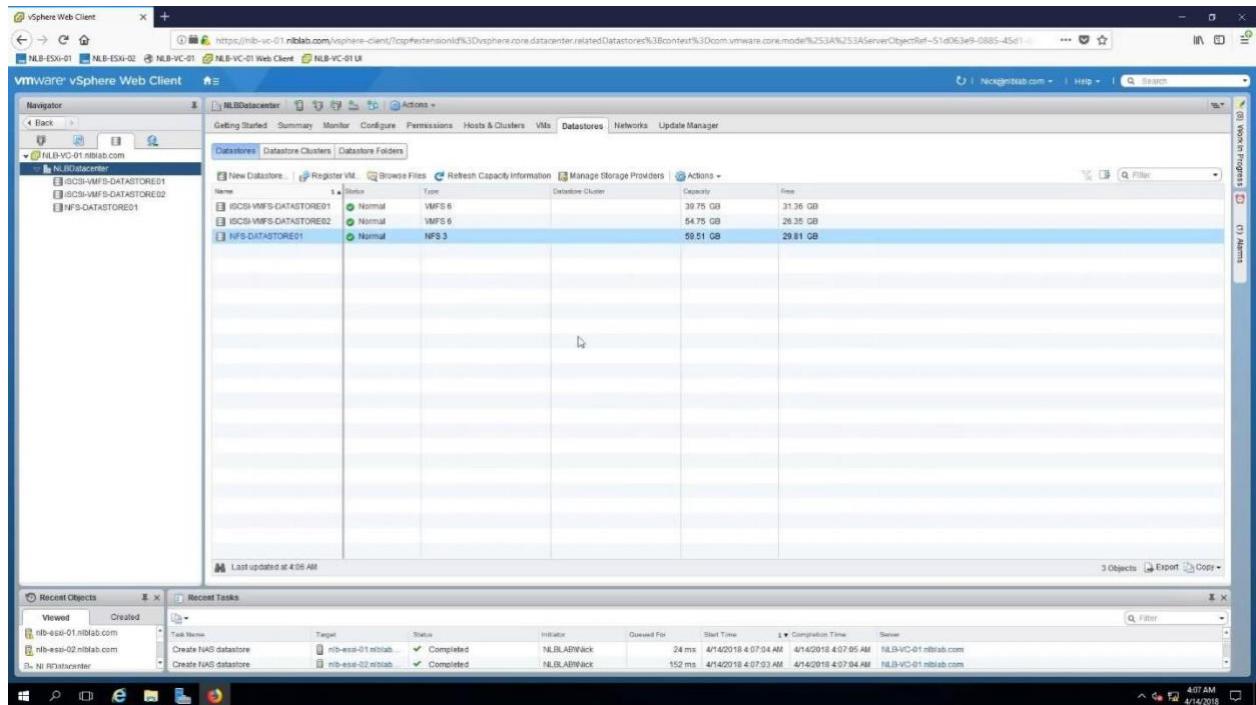


- Click Finish.

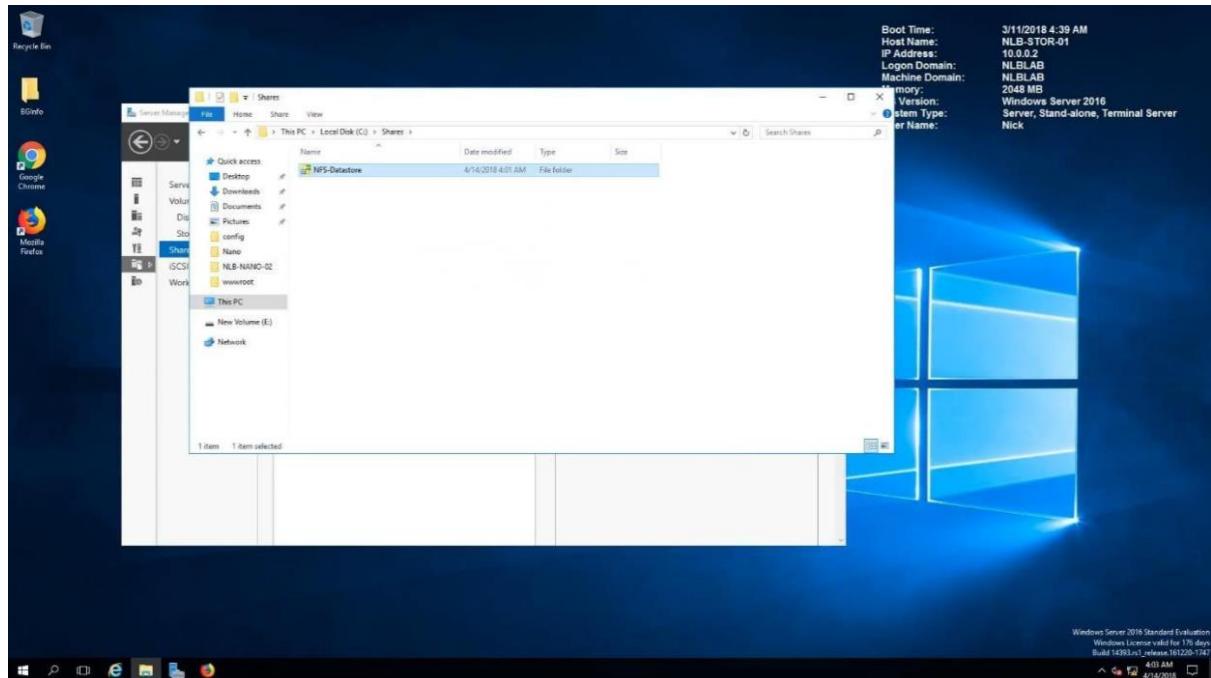


Here you can see the Successful mount of NFS datastore

- From here you can migrate the NFS data store to virtual machine etc.



Presentation



Virtualized Chassis with Fabric Extenders

- Server Access Models
- Understanding Fabric Extenders
- Connecting a Fabric Extender to a Parent Switch
- Fabric Extender Topologies

Virtualized Chassis with Fabric Extenders

A virtualized chassis with fabric extenders is a data center architecture that uses fabric extender switches to connect multiple blade server enclosures to a unified fabric.

Cisco introduced the concept of Fabric Extenders with the Nexus 2000 series.

Fabric extenders with the Nexus 2000 series refer to the use of Cisco Nexus 2000 series fabric extenders to create a virtualized chassis architecture. A virtualized chassis architecture is a network architecture that allows multiple blade server enclosures to be connected to a unified fabric through fabric extender switches. This provides a number of benefits, including reduced complexity, increased scalability, and improved performance.

The Nexus 2000 series fabric extenders are a family of modular switches that provide high - performance connectivity for blade servers and other data center devices. They are designed to be used with Cisco Nexus fabric interconnects to create a virtualized chassis architecture.

Server Access Models

In 2005, the Electronic Industries Alliance (EIA) and the Telecommunications Industry Association (TIA) published the first formal specification for data center infrastructure: ANSI/TIA - 942.

This standard was intended to provide requirements and guidelines for the design and installation of a data center and includes the facility, network, and cabling design.

This specification defines horizontal cabling as the extension from the mechanical termination of the equipment distribution area (servers) to the horizontal distribution area (switches).

ANSI/TIA-942 specification supports the most popular server connectivity models: Top -of-Rack (ToR) and End-of-Row (EoR).

These models define where the access layer switches are positioned in relation to the server localization, and consequently, how the horizontal cabling is designed.

Top-of-Rack access network (ToR):

Top of rack (ToR) which is also known as In -Rack design. In this approach, the network access switch is placed on the top position inside the server cabinets; hence, servers are directly connected to the network access switch.

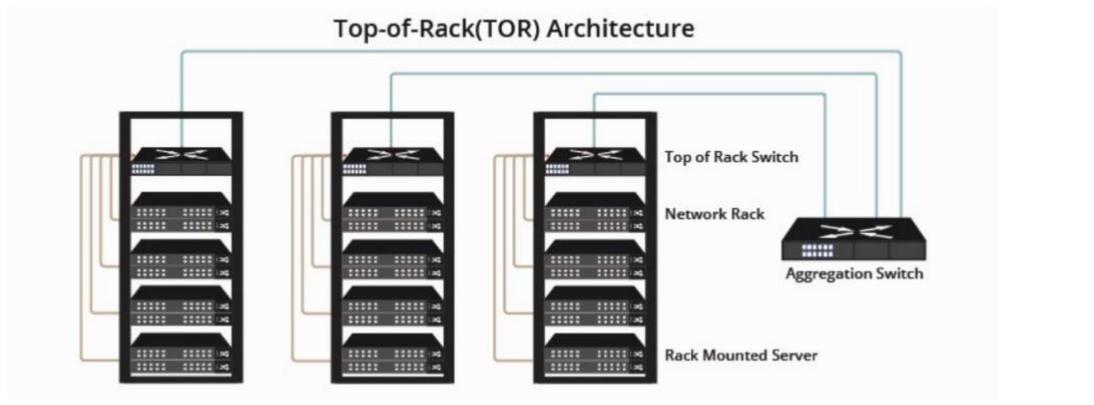
This means that 1 or 2 Ethernet switches are directly installed inside the rack, therefore copper cables stay inside the rack.

It is cost-effective because it reduces the number of copper cables between racks.

The rack is linked to the data center network by an Ethernet switch, often through a fiber cable. This fiber cable is a direct link from the common aggregation area to the rack.

In the ToR approach, every rack in the data center network is a separate entity that eases its management. Any change, upgrade, or malfunction in the rack usually affects that rack only. Fewer cables mean that one can opt for better quality and higher bandwidth cables in the same budget.

Top-of-Rack access network (ToR):



key characteristics and advantages of the Top-of-Rack (ToR) access network model:

Scalability: ToR switches can be easily scaled as data center capacity grows. When more servers are added to a rack or additional racks are deployed, new ToR switches can be installed to accommodate the increased demand.

Redundancy: To ensure high availability, redundant ToR switches can be used within each rack. This redundancy ensures that a network failure in one switch does not disrupt server connectivity, and traffic can be rerouted through the redundant switch.

Flexibility: The ToR model allows for flexibility in network architecture and design. It enables the use of a variety of networking technologies, including Ethernet and Fiber Channel, to meet specific application and performance requirements.

Maintenance and Upgrades: With switches located at the top of racks, maintenance and upgrades are more accessible and less disruptive to the overall network. If a switch needs servicing or replacement, it can be done without affecting the entire data center.

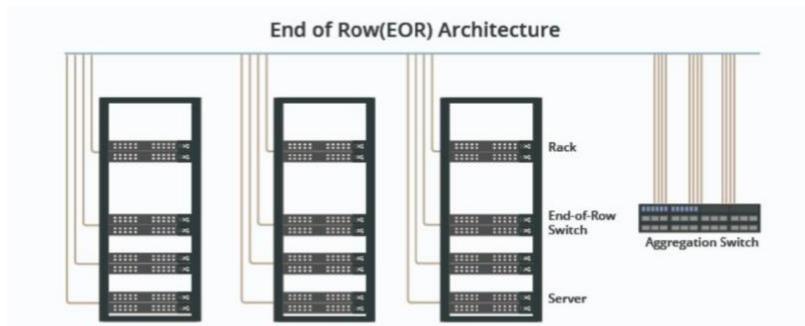
End of Row Architecture(EoR):

In EoR network design, there is a direct connection of each server in the rack with the end of row aggregation switch. This eliminates the need to connect servers directly with the in -rack switch.

Racks are normally arranged in such a way that they form a row, a cabinet or rack is positioned at the end of this row. This rack has the row aggregation switch, which provides network connectivity to servers mounted in individual racks. This switch, a modular chassis -based platform, sometimes supports hundreds of server connections. A large amount of cabling is required to support this architecture.

In ToR each rack is an independent unit whereas in EoR the whole row of servers acts as a group within the data center. Any issue with the row aggregation switch impacts the complete row of servers.

End of Row Architecture(EoR):



features and benefits of the End-of-Row architecture:

Reduced Cable Complexity: With switches placed at the end of each row, the cabling within the racks tends to be simpler and cleaner. Server racks connect to the End -of-Row switches via shorter cables, reducing cable clutter and making it easier to manage and maintain the network.

Enhanced Redundancy: EoR architecture often provides robust redundancy options. Multiple switches can be used within each row, and if one switch fails, traffic can be rerouted through a redundant switch, minimizing downtime.

Ease of Maintenance: Maintenance tasks and switch upgrades are typically less disruptive to the overall data center network in the EoR model. Since switches are located at the end of rows, they are more accessible and can be serviced without affecting the entire network.

Understanding Fabric Extenders

In 2009, Cisco launched the Nexus 2000 Fabric Extender series.

Ethernet switches, these devices are remote linecards that are managed by a parent switch, such as a Nexus 5000, Nexus 6000, UCS Fabric Interconnect, or Nexus 7000 (with appropriate modules).

Fabric Extenders (or FEX) enable a data center to leverage the advantages from both ToR and EoR models because

- Multiple Fabric Extenders can be managed from a single parent switch (similar to EoR).
- A Fabric Extender can be installed inside a server cabinet and decrease cabling costs (similar to ToR).

Understanding Fabric Extenders

[Figure 7-5](#) illustrates an example of a server access topology that uses Fabric Extenders.

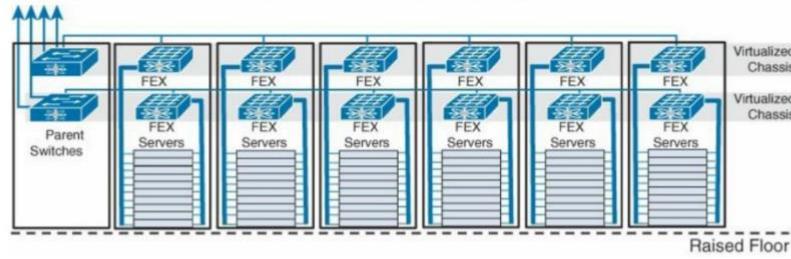


Figure 7-5 Fabric Extender Topology

Understanding Fabric Extenders

As the figure suggests, a parent switch and multiple Fabric Extenders are elements of a virtualized modular chassis. Inside this virtual structure, every management operation is performed on the parent switch (which performs the role of a supervisor module of such chassis), and Ethernet frames are exchanged on the Fabric Extender interfaces (which represent the chassis interface modules).

The main endeavor of Fabric Extenders is to keep the configuration complexity within the parent switches and drive simplicity toward the server interfaces.

The Fabric Extender architecture introduces new types of ports to the network, including physical and virtual interfaces.

Fabric Extender Topologies

In the previous section, you were presented with simple scenarios that demonstrated basic functionalities of a Fabric Extender connected to one parent switch. Nevertheless, it is paramount that you understand the principles behind highly available FEX topologies.

There are basically two classes of topologies that provide fault tolerance in Fabric Extender designs:

- Straight-through: Where a Fabric Extender is connected to a single parent switch
- Dual-homed: Where a Fabric Extender is connected to a pair of parent switches

Fabric Extender Topologies

An example of each of these topologies is presented in [Figure 7-10](#).

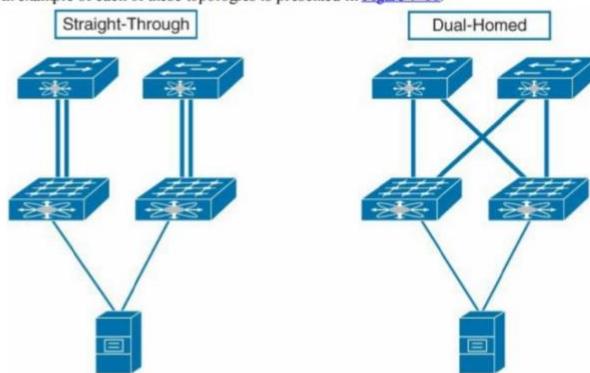


Figure 7-10 Fabric Extender Topology Types

Fabric Extender Topologies

Straight-Through Topologies

In straight-through topologies, it is recommended that each host has interfaces connected to Fabric Extenders that are managed by distinct parent switches.

This practice avoids the total loss of connectivity for a server in case of a switch failure. Straight-through designs create a pair of NX-OS virtualized chassis with a single supervisor module in each. Likewise, IEEE 802.3ad – compatible servers can leverage active-active connections using virtual PortChannels (vPCs).

Fabric Extender Topologies

Dual-Homed Topologies

In a dual-homed fabric extender topology, each fabric extender is connected to two parent switches simultaneously. This design offers fault tolerance by providing redundancy and ensuring that if one parent switch or link fails, the other can take over seamlessly.

Benefit

▪ **High availability:** Dual-homed fabric extenders ensure that server connectivity remains available even if one parent switch or link experiences a failure.

▪ **Load balancing:** With dual-homed connections, traffic can be load-balanced between the two parent switches, distributing the load evenly and improving network performance