THADOMAL SHAHANI TSEC ENGINEERING COLLEGE

EXPERIMENT NO. 3

Aim :- To study and implement Bare-metal visualization using Xen.

Theory :-

Functions performed by Bare-metal hypervisors

(A) Hardware Abstraction:
A bare-metal hypervisor's main function is to abstract the underlying physical h/w. It creates a virtualization layer that allows multiple virtual machines to run independently on the same server.

(B) Resource Allocation:
The hypervisor manages and allocates physical resources such as CPU, memory, storage and N/w bandwidth among the virtual machines. It ensures fair and efficient allocation.

(C) Isolation:
They provide strong isolation b/w virtual machines. It enhances the security and stability, thus preventing one VM from affecting others.

(D) Live Migration:

Bare-metal hypervisors often support live migration, allowing VMs to be moved from one physical

host to another w/o disrupting their operation. This functionality is useful for load balancing, maintenance, and ensuring high availability.

(E) Snapshot and Cloning:
Bare-metal hypervisor supports above feature, enabling administrators to capture current state of a VM and create identical copies.

(F) Centralized Management:
They typically come with centralized management tools that allow adminstrators to monitor and manage multiple VMs and hosts from a single interface.

Comparisons between Hosted and Bare-metal hypervisors.

Hosted	Bare-metal
Installed on top of a OS.	Installed on physical hardware.
It may experience slightly lower performance due to additional layer of host OS.	Generally offers better performance because it run directly on h/w, w/o overhead of OS.
May not offer same level of isolation as bare-metal hypervisors.	Provides a robust isolation b/w VMs since it operates directly on hardware.

Easier to set up and manage, with a proper GUI and configuration options.	Requires more expertise in server and virtualization management.
VMware WorkStations, Oracle VirtualBox, Hyper-V, etc.	VMware ESXi, Xen

- Explain the following terms:

i) Horizontal and Vertical Scaling:
Horizontal Scaling means you add more machines into your pool of resources to an existing machine. This allows you to distribute your workload across a larger pool of resources. Scalability is achieved.
Vertical Scaling means increasing the capacity of a single machine by adding more resources, application continues to run on a single, more powerful machine. Vertical Scaling is not easy but also cheaper than Horizontal scaling. It also requires less time to be fixed.

ii) Auto-Scaling:
Auto-Scaling is a cloud computing feature that enables the automatic adjustment of computing resources based on the actual demand or workload of an application. The goal is to perform optimal operation, cost efficiency and resource utilization

by automatically adding or removing resources as needed.

iii) Load-Balancing :-
It is an essential technique used in cloud computing to optimize resource allocation and utilization and ensure that no single resource is over-burdened with traffic. It is a process of distributing workloads across multiple computing resources.

Advantages :-
1) It helps to distribute workload across multiple resources, which reduces the load on each resource, increasing performance.

2) High Availability : It ensures that there is no single point of failure in the system.

3) Scalability is performed rapidly.

4) Efficient Resource Utilization.

Steps of installation for above mentioned experiment :-

Step 1 : Install XenServer

i) Install Bootable CD into CDROM or Bootable Pendrive and make first boot device from BIOS.

ii) Press F2 for advance options and make enabled virtualization technology from BIOS. Save and Reboot.

iii) Begin by choosing keymap, i.e, keyboard Layout
iv) Press enter to load Device Drivers.
v) Press enter to accept end user license agreement.
vi) Select appropriate disk for installation.
vii) Select appropriate installation media.
viii) Press yes to select additional packages, else no.
ix) Pick a root password and ethernet ports.
x) Press enter for installation.

Step 2: Connect XenCenter to XenServer

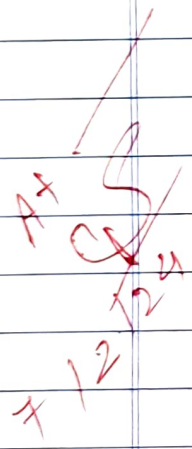
i) Download XenCenter, install and open it from start Menu of windows on Machine 2.
ii) To connect to XenServer Host which is configured earlier, click ADD a server.
iii) Enter IP address of XenServer and enter user login credentials.

Step 3: Create local ~~ISO~~ storage

Before creating VM, we have to create storage repository which is nothing but shared directory on Xen Center which holds all ISO files and which is required to install OS on XenServer.

i) Right click on XenServer icon on Xen Center and select New VM.
ii) Select VM template.
iii) Name the virtual machine.
iv) Locate OS installation media to select appropriate OS ISO file.
v) Allocate CPU + Memory to VM.
vi) Select N/wing.
vii) Finish.

Conclusion :- Thus, we have successfully created a VM on XenServer using Xen Center tool.



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Experiment 3

Aim: To study and Implement Bare-metal Virtualization using Xen.

Objective: To understand the concept of hypervisors, its types and functions in CloudComputing.

Theory:

Virtualization in Cloud Computing

Virtualization is the "creation of a virtual (rather than actual) version of something, such as a server, a desktop, a storage device, an operating system or network resources".

In other words, Virtualization is a technique, which allows to share a single physical instance of a resource or an application among multiple customers and organizations. It does by assigning a logical name to a physical storage and providing a pointer to that physical resource when demanded.

What is the concept behind the Virtualization?

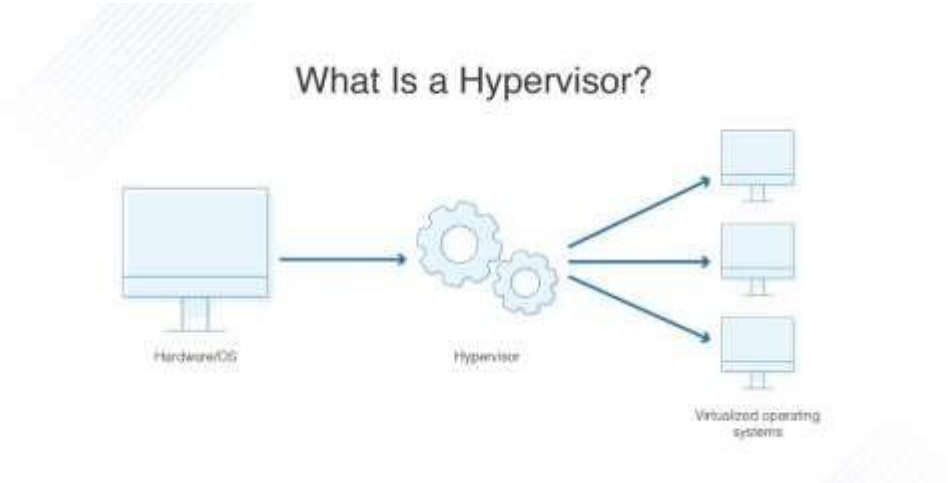
Creation of a virtual machine over existing operating system and hardware is known asHardware Virtualization. A Virtual machine provides an environment that is logically separated from the underlying hardware.

The machine on which the virtual machine is going to create is known as Host Machine andthat virtual machine is referred as a Guest Machine.

What is a hypervisor?

A hypervisor, also known as a virtual machine monitor or VMM. The hypervisor is a piece of software that allows us to build and run virtual machines which are abbreviated as VMs.

A hypervisor allows a single host computer to support multiple virtual machines (VMs) by sharing resources including memory and processing.



What is the use of a hypervisor?

Hypervisors allow the use of more of a system's available resources and provide greater ITversatility because the guest VMs are independent of the host hardware which is one of themajor benefits of the Hypervisor.

In other words, this implies that they can be quickly switched between servers. Since a hypervisor with the help of its special feature, it allows several virtual machines to operate ona single physical server. So, it helps us to reduce:

- The Space efficiency
- The Energy uses
- The Maintenance requirements of the server.

Kinds of hypervisors

There are two types of hypervisors: "Type 1" (also known as "bare metal") and "Type 2" (also known as "hosted"). A type 1 hypervisor functions as a light operating system that operates directly on the host's hardware, while a type 2 hypervisor functions as a softwarelayer on top of an operating system, similar to other computer programs.

Since they are isolated from the attack-prone operating system, bare-metal hypervisors areextremely stable.

Furthermore, they are usually faster and more powerful than hosted hypervisors. For these purposes, the majority of enterprise businesses opt for bare-metal hypervisors for their datacenter computing requirements.

While hosted hypervisors run inside the OS, they can be topped with additional (anddifferent) operating systems.

The hosted hypervisors have longer latency than bare-metal hypervisors which is a very major disadvantage of the it. This is due to the fact that contact between the hardware and thehypervisor must go through the OS's extra layer.

The Type 1 hypervisor

The native or bare metal hypervisor, the Type 1 hypervisor is known by both names.

It replaces the host operating system, and the hypervisor schedules VM services directly tothe hardware.

The type 1 hypervisor is very much commonly used in the enterprise data center or otherserver-based environments.

It includes KVM, Microsoft Hyper-V, and VMware vSphere. If we are running the updated version of the hypervisor then we must have already got the KVM integrated into the Linux kernel in 2007.

The Type 2 hypervisor

It is also known as a hosted hypervisor, The type 2 hypervisor is a software layer orframework that runs on a traditional operating system.

It operates by separating the guest and host operating systems. The host operating systemschedules VM services, which are then executed on the hardware.

Individual users who wish to operate multiple operating systems on a personal computershould use a form 2 hypervisor.

This type of hypervisor also includes the virtual machines with it.

Hardware acceleration technology improves the processing speed of both bare-metal andhosted hypervisors, allowing them to build and handle virtual resources more quickly.

On a single physical computer, all types of hypervisors will operate multiple virtual servers for multiple tenants. Different businesses rent data space on various virtual servers from public cloud service providers. One server can host multiple virtual servers, each of which isrunning different workloads for different businesses.

Benefits of hypervisors

Using a hypervisor to host several virtual machines has many advantages:

- Speed: The hypervisors allow virtual machines to be built instantly unlike bare-metal servers. This makes provisioning resources for complex workloads much simpler.
- Efficiency: Hypervisors that run multiple virtual machines on the resources of a single physical machine often allow for more effective use of a single physical server.
- Flexibility: Since the hypervisor distinguishes the OS from the underlying hardware, the program no longer relies on particular hardware devices or drivers, bare-metal hypervisors enable operating systems and their related applications to operate on a variety of hardware types.
- Portability: Multiple operating systems can run on the same physical server thanks tohypervisors (host machine). The hypervisor's virtual machines are portable because they are separate from the physical computer.

As an application requires more computing power, virtualization software allows it to access additional machines without interruption.

Difference between Type-1 and Type-2 Hypervisors:

Criteria	Type 1 hypervisor	Type 2 hypervisor
AKA	Bare-metal or Native	Hosted
Definition	Runs directly on the system with VMs running on them	Runs on a conventional Operating System
Virtualization	Hardware Virtualization	OS Virtualization
Operation	Guest OS and applications run on the hypervisor	Runs as an application on the host OS
Scalability	Better Scalability	Not so much, because of its reliance on the underlying OS.
Setup/Installation	Simple, as long as you have the necessary hardware support	Lot simpler setup, as you already have an Operating System.

System Independence	Has direct access to hardware along with virtual machines it hosts	Are not allowed to directly access the host hardware and its resources
Speed	Faster	Slower because of the system's dependency
Performance	Higher-performance as there's no middle layer	Comparatively has reduced performance rate as it runs with extra overhead
Security	More Secure	Less Secure, as any problem in the base operating system affects the entire system including the protected Hypervisor
Examples	• VMware ESXi • Microsoft Hyper-V • Citrix XenServer	• VMware Workstation Player • Microsoft Virtual PC • Sun's VirtualBox

What is Cloud Scaling?

In cloud computing, scaling is the process of adding or removing compute, storage, and network services to meet the demands a workload makes for resources in order to maintainavailability and performance as utilization increases. Scaling generally refers to adding or reducing the number of active servers (instances) being leveraged against your workload'sresource demands. Scaling up and scaling out refer to two dimensions across which resources—and therefore, capacity—can be added.

What Factors Impact Cloud Resource Demands?

The demands of your cloud workloads for computational resources are usually determinedby:

- The number of incoming requests (front-end traffic)
- The number of jobs in the server queue (back-end, load-based)
- The length of time jobs have waited in the server queue (back-end, time-based)

Scaling Up & Scaling Out

Scaling up refers to making an infrastructure component more powerful—larger or faster—soit can handle more load, while scaling out means spreading a load out by adding additional components in parallel.

Scale Up (Vertical Scaling)

Scaling up is the process of resizing a server (or replacing it with another server) to give itsupplemental or fewer CPUs, memory, or network capacity.

Benefits of Scaling Up

- Vertical scaling minimizes operational overhead because there is only one server to manage. There is no need to distribute the workload and coordinate among multiple servers.
- Vertical scaling is best used for applications that are difficult to distribute. For example, when a relational database is distributed, the system must accommodate

transactions that can change data across multiple servers. Major relational databasescan be configured to run on multiple servers, but it's often easier to vertically scale.

Vertical Scaling Limitations

- There are upper boundaries for the amount of memory and CPU that can allocated to a single instance, and there are connectivity ceilings for each underlying physical host
- Even if an instance has sufficient CPU and memory, some of those resources may sitidle at times, and you will continue pay for those unused resources

Scale Out (Horizontal Scaling)

Instead of resizing an application to a bigger server, scaling out splits the workload acrossmultiple servers that work in parallel.

Benefits of Scaling Out

- Applications that can sit within a single machine—like many websites—are well-suited to horizontal scaling because there is little need to coordinate tasks between servers. For example, a retail website might have peak periods, such as around the end-of-year holidays. During those times, additional servers can be easily committedto handle the additional traffic.
- Many front-end applications and microservices can leverage horizontal scaling. Horizontally-scaled applications can adjust the number of servers in use according tothe workload demand patterns.

Horizontal Scaling Limitations

- The main limitation of horizontal scaling is that it often requires the application to be architected with scale out in mind in order to support the distribution of workloads across multiple servers.

What is Cloud Autoscaling?

Autoscaling (sometimes spelled auto scaling or auto-scaling) is the process of automatically increasing or decreasing the computational resources delivered to a cloud workload based on need. The primary benefit of autoscaling, when configured and managed properly, is that your workload gets exactly the cloud computational resources it requires (and no more or less) at any given time. You pay only for the server resources you need, when you need them.

Load balancing in Cloud Computing

Cloud load balancing is defined as the method of splitting workloads and computing properties in a cloud computing. It enables enterprise to manage workload demands or application demands by distributing resources among numerous computers, networks orservers. Cloud load balancing includes holding the circulation of workload traffic and demands that exist over the Internet.

As the traffic on the internet growing rapidly, which is about 100% annually of the present traffic. Hence, the workload on the server growing so fast which leads to the overloading of servers mainly for popular web server. There are two elementary solutions to overcome theproblem of overloading on the servers-

- First is a single-server solution in which the server is upgraded to a higherperformance server. However, the new server may also be overloaded soon, demanding another upgrade. Moreover, the upgrading process is arduous and expensive.
- Second is a multiple-server solution in which a scalable service system on a cluster of servers is built. That's why it is more cost effective as well as more scalableto build a server cluster system for network services.

Load balancing is beneficial with almost any type of service, like HTTP, SMTP, DNS, FTP, and POP/IMAP. It also rises reliability through redundancy. The balancing service is provided by a dedicated hardware device or program. Cloud-based servers farms can attain more precise scalability and availability using server load balancing.

Load balancing solutions can be categorized into two types –

- Software-based load balancers: Software-based load balancers run on standardhardware (desktop, PCs) and standard operating systems.
- Hardware-based load balancer: Hardware-based load balancers are dedicated boxeswhich include Application Specific Integrated Circuits (ASICs) adapted for a particular use. ASICs allows high speed promoting of network traffic and are frequently used for transport-level load balancing because hardware-based load balancing is faster in comparison to software solution.

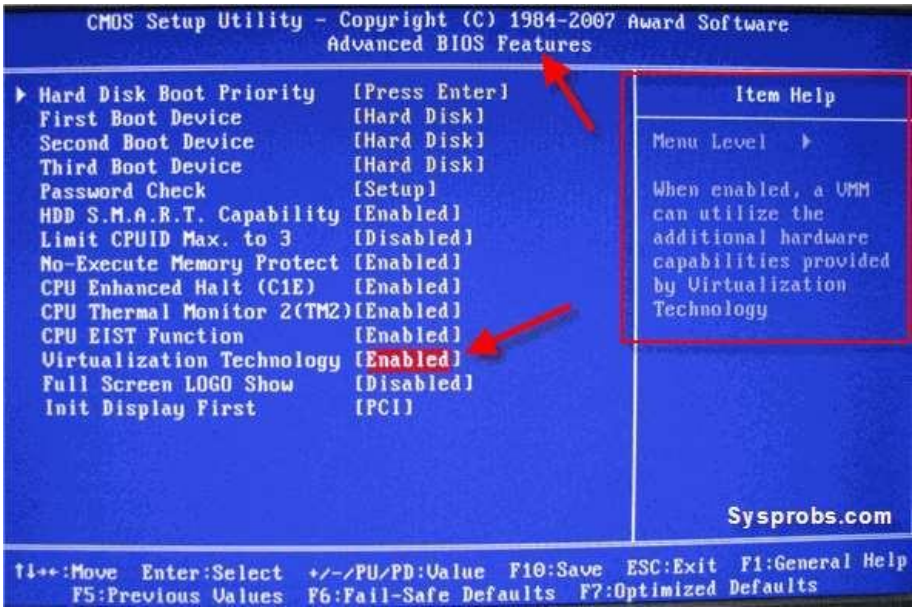
Major Examples of Load Balancers –

- Direct Routing Requesting Dispatching Technique: This approach of request dispatching is like to the one implemented in IBM's Net Dispatcher. A real server and load balancer share the virtual IP address. In this, load balancer takes an interface constructed with the virtual IP address that accepts request packets and it directly routes the packet to the selected servers.
- Dispatcher-Based Load Balancing Cluster: A dispatcher does smart load balancing byutilizing server availability, workload, capability and other user-defined criteria to regulate where to send a TCP/IP request. The dispatcher module of a load balancer can split HTTP requests among various nodes in a cluster. The dispatcher splits the load among many servers in a cluster so the services of various nodes seem like a virtual service on an only IP address; consumers interrelate as if it were a solo server,without having an information about the back-end infrastructure.
- Linux Virtual Load Balancer: It is an opensource enhanced load balancing solution used to build extremely scalable and extremely available network services such as HTTP, POP3, FTP, SMTP, media and caching and Voice Over Internet Protocol (VoIP). It is simple and powerful product made for load balancing and fail-over. The load balancer itself is the primary entry point of server cluster systems and can execute Internet Protocol Virtual Server (IPVS), which implements transport-layer load balancing in the Linux kernel also known as Layer-4 switching.

Output:

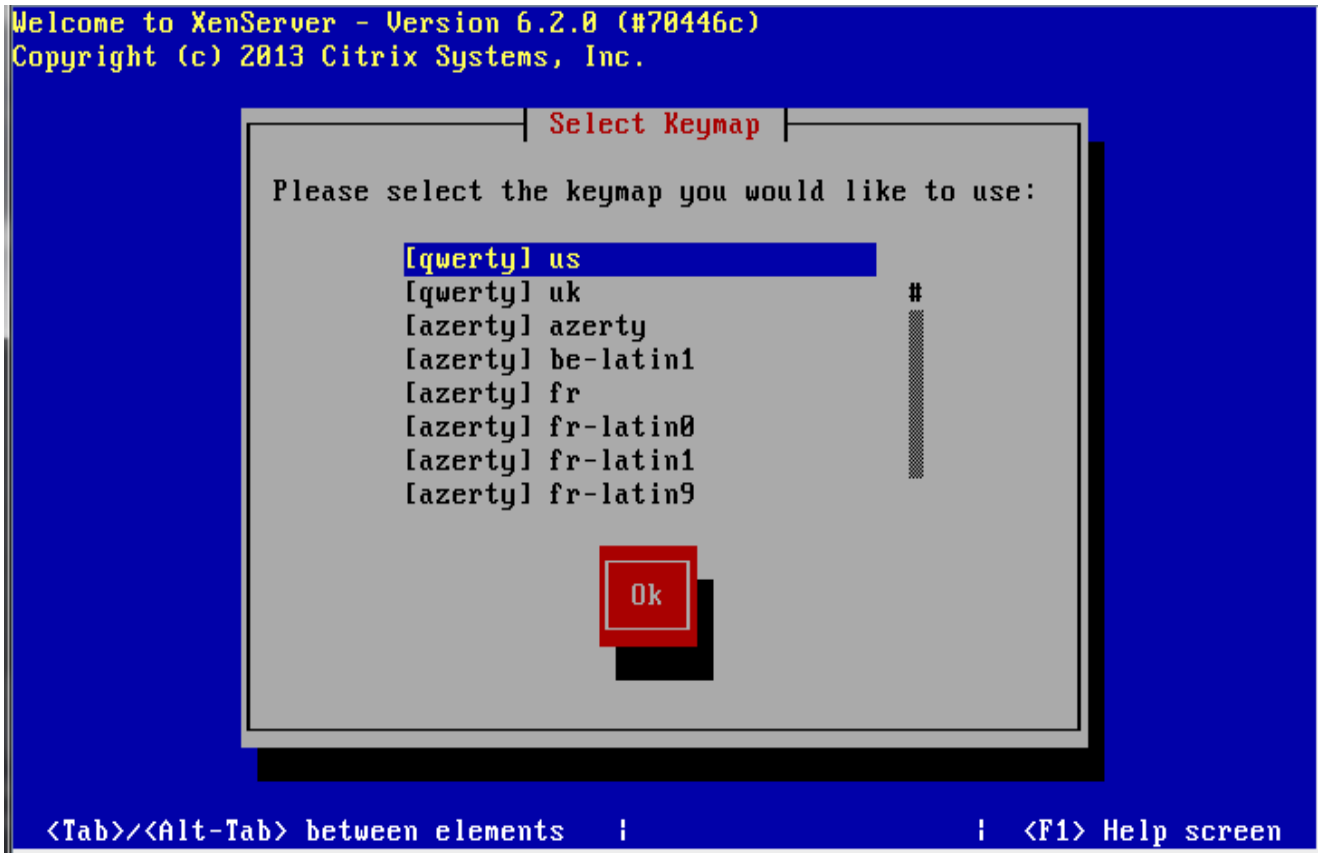
1. Install XenServer: Insert Bootable CD into CDROM or Bootable Pen drive and make first boot device from BIOS.

2. Press F2 for advance options and Make Enabled Virtualization Technology fromBIOS

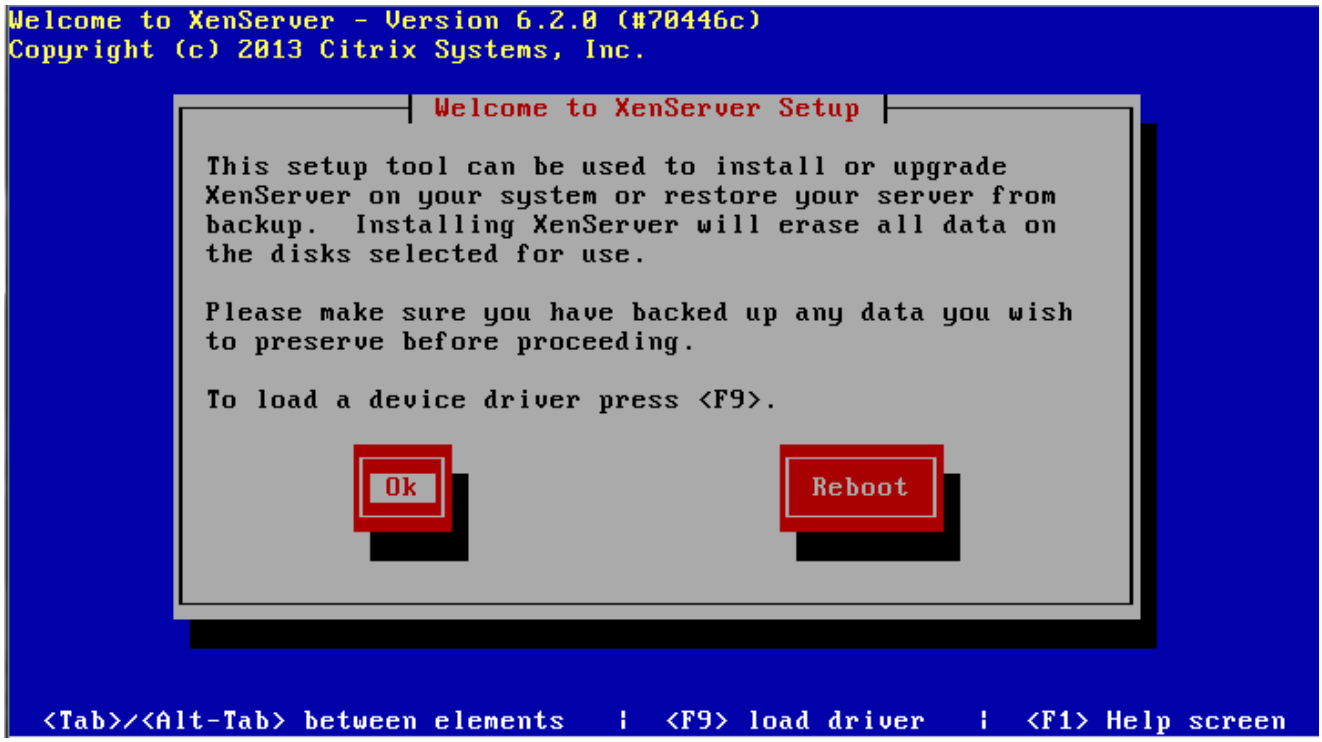


3. Save and reboot

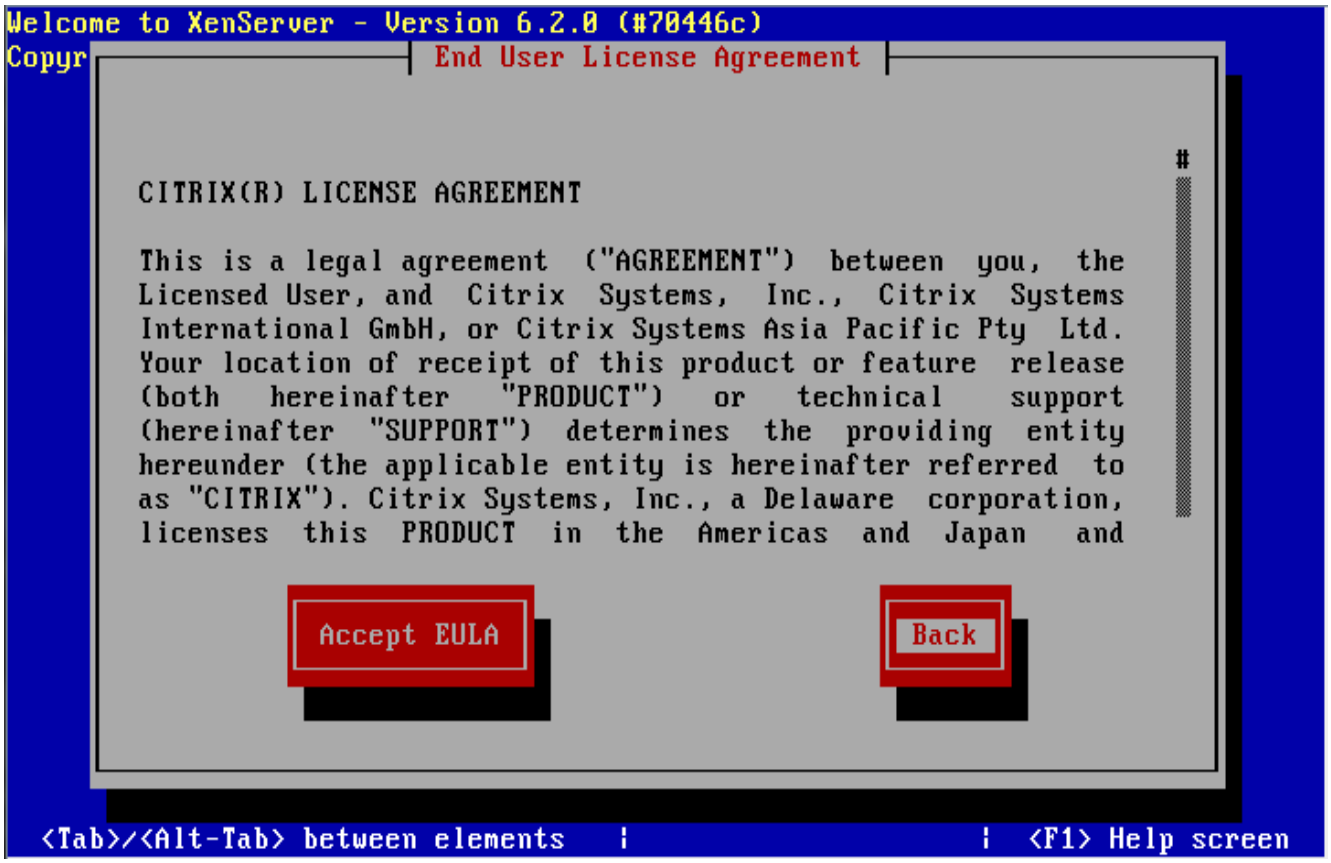
4. We begin by choosing the keymap i.e. Keyboard Layout



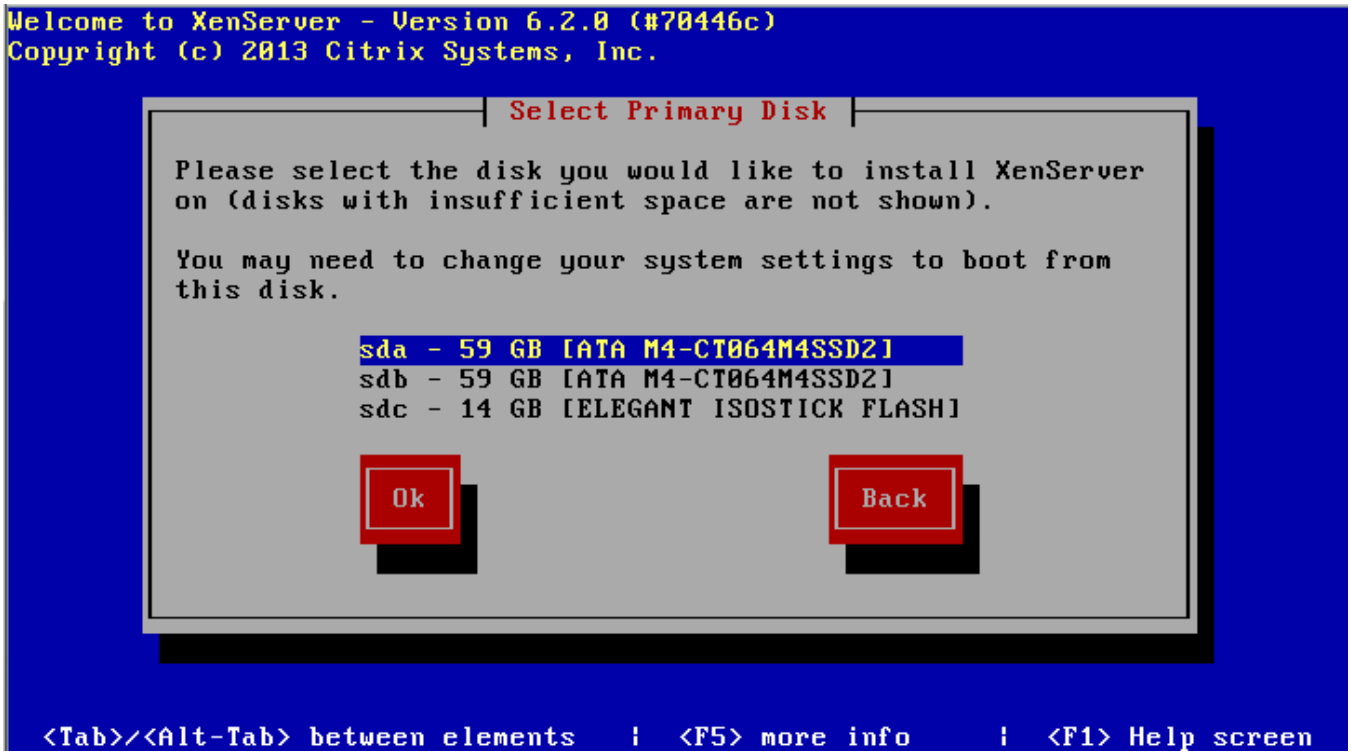
5. Press Enter to load Device Drivers



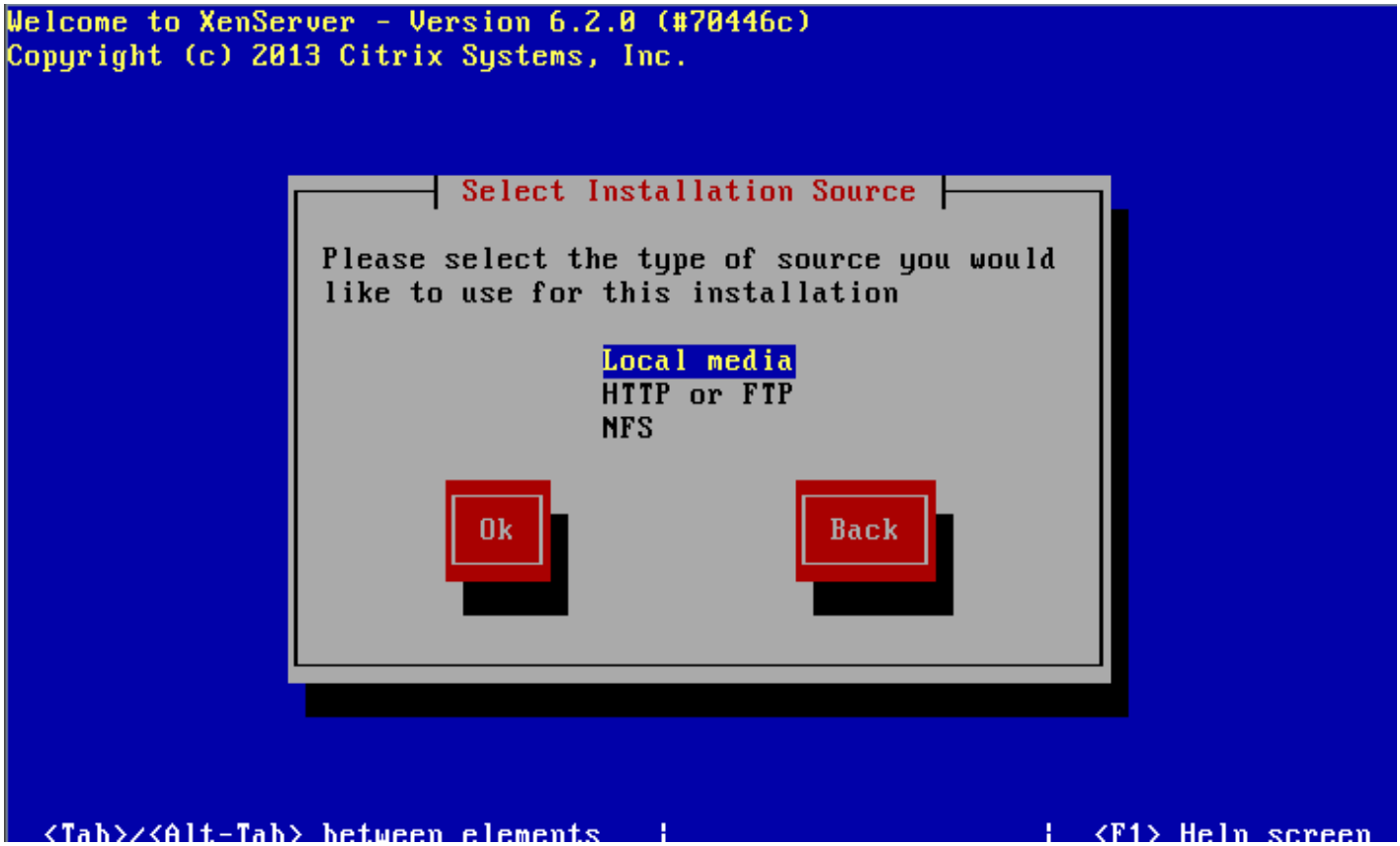
6. Press Enter to accept End User License Agreement



7. Select Appropriate disk on which you want to install Xenserver

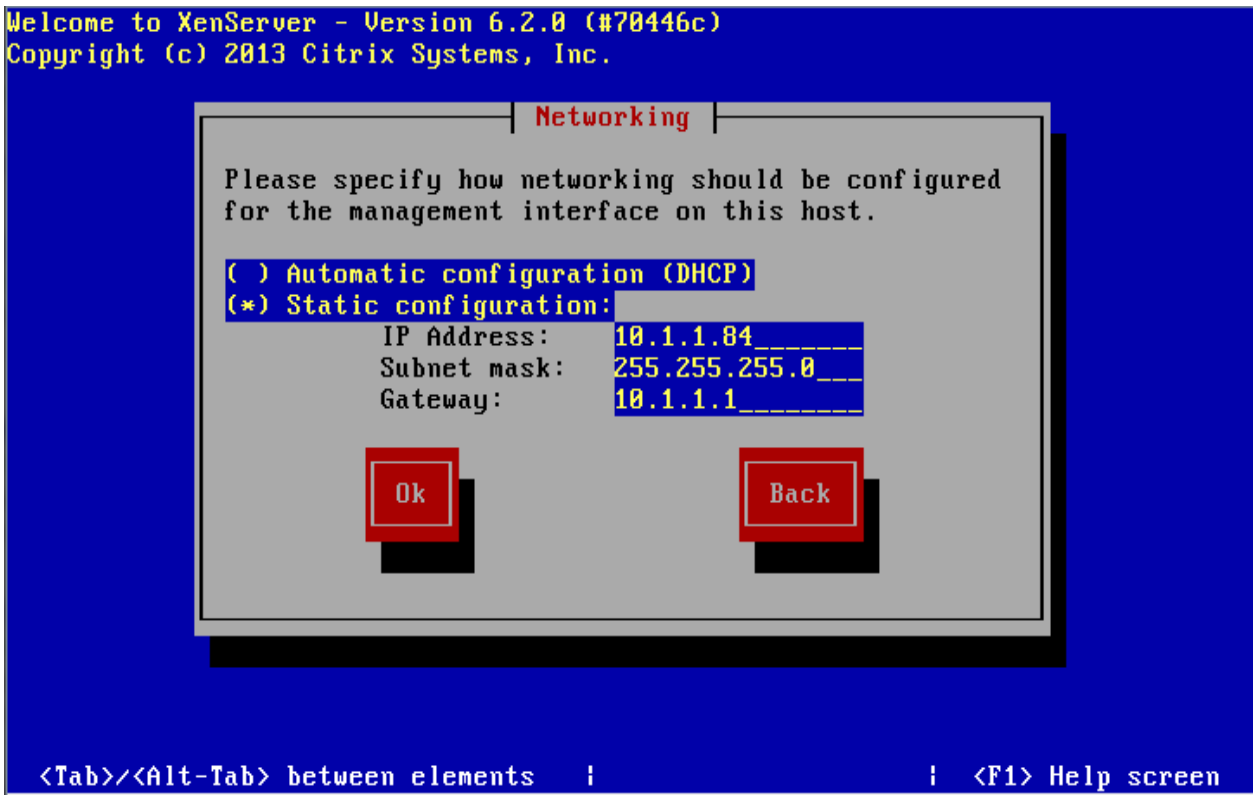


8. Select appropriate Installation Media



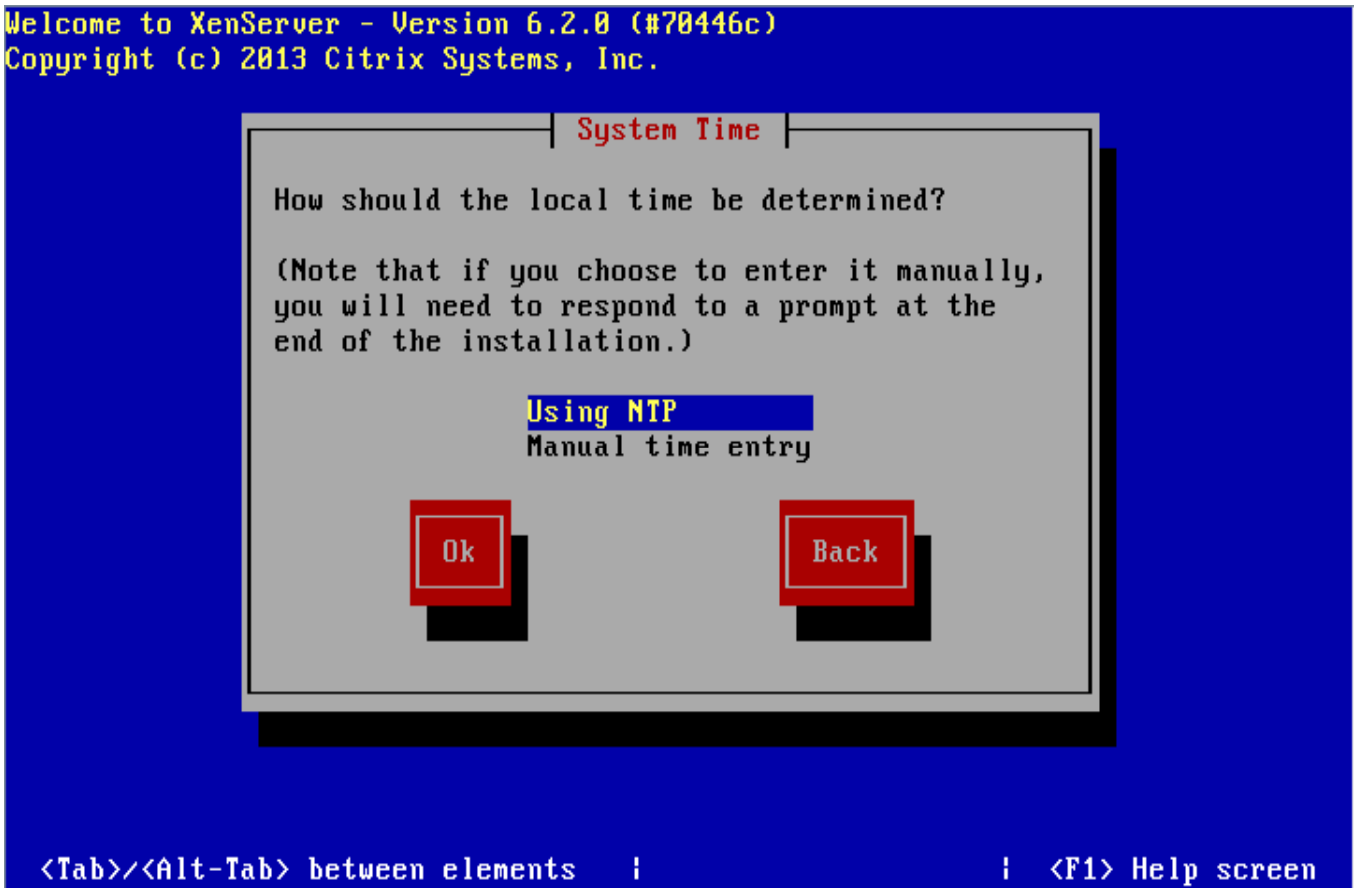
9. Press yes to Select additional packages for installation , Otherwise Press No

10. The motherboard we are installing have two Ethernet ports, both of which are supported by XenServer Choose the one you wish to use for the management network
– you can change this later. Here we get to choose the networking settings for ourmanagement network.

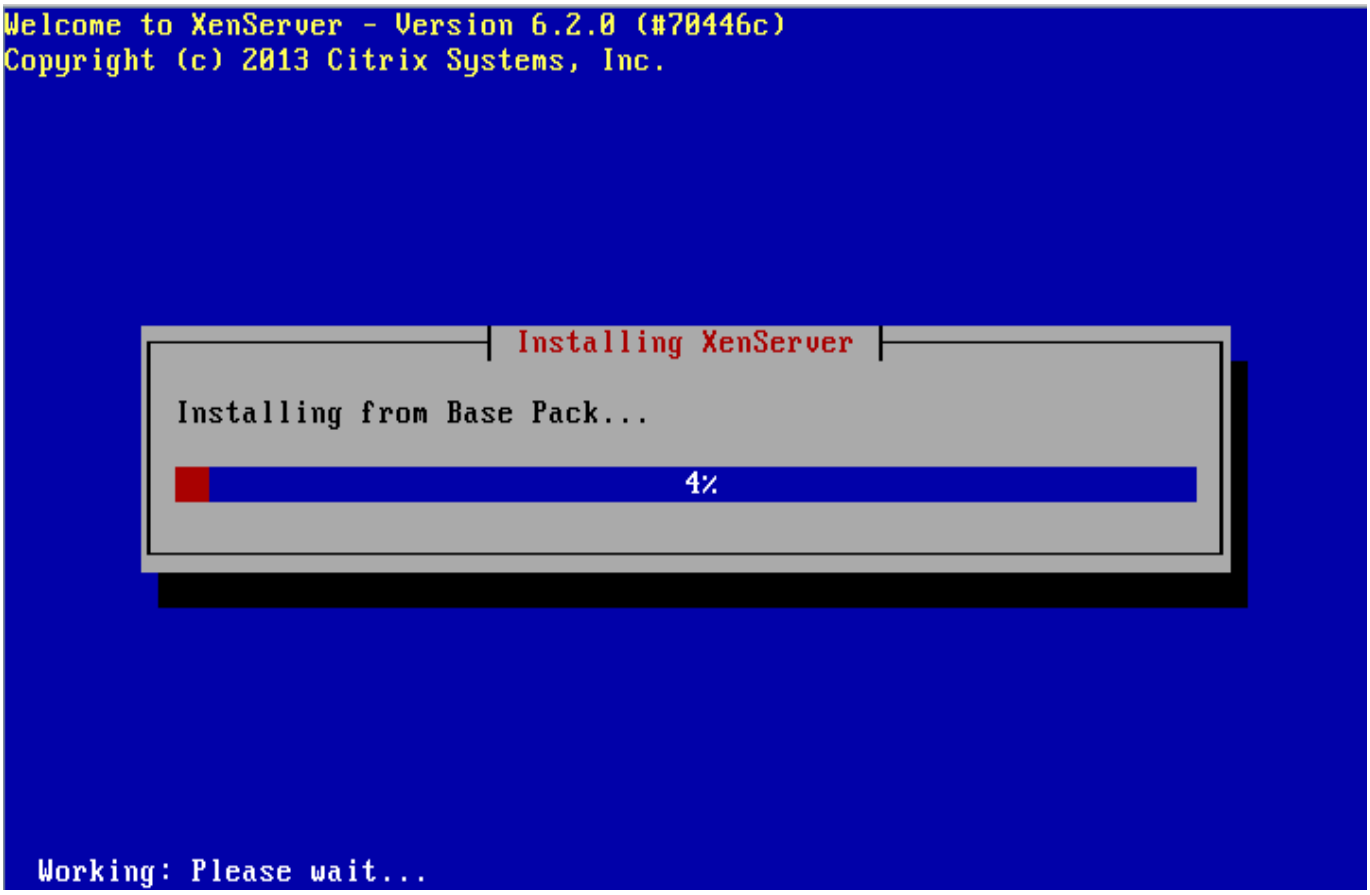


11. Select Time zone

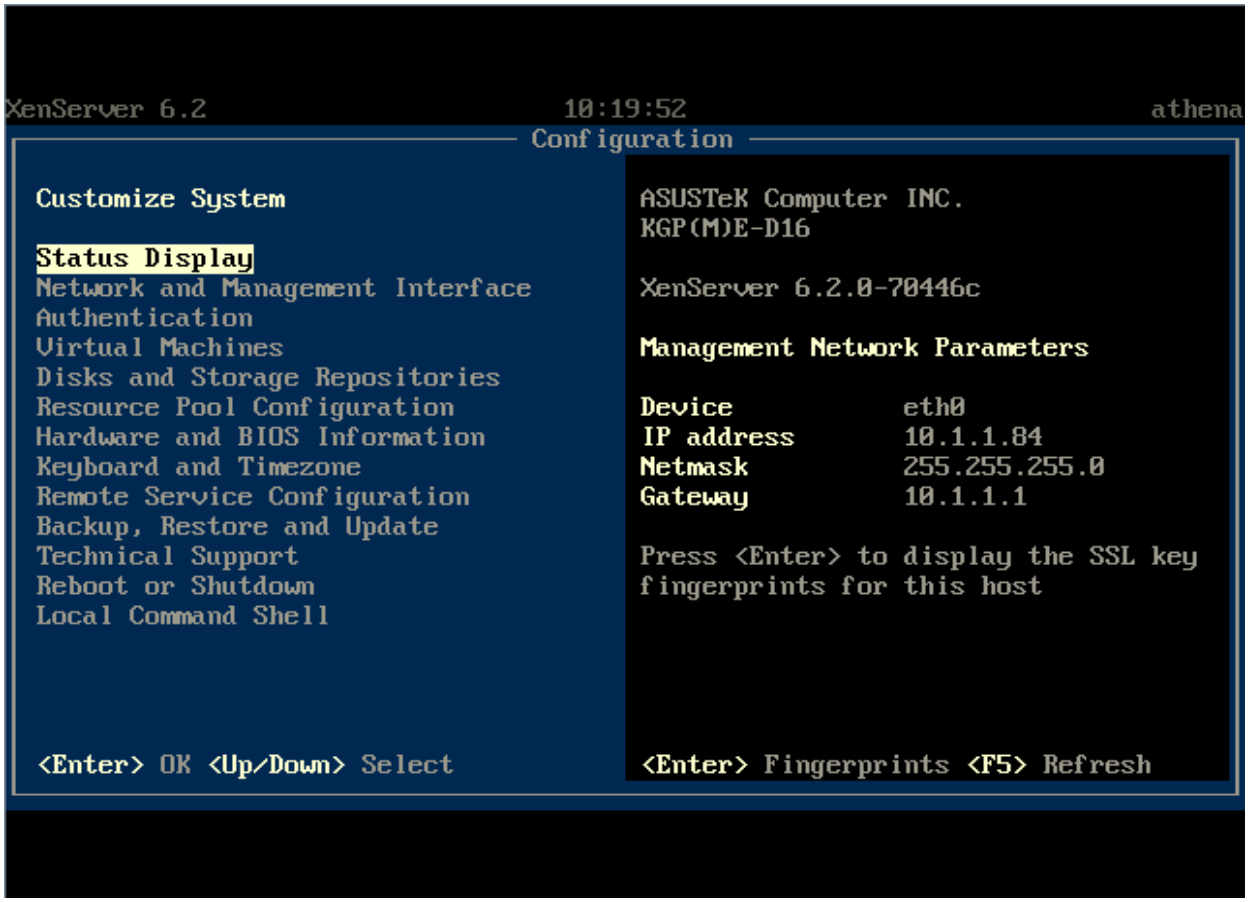
12. Specify NTP Server address and start installation to set your time



13. Press Enter to start installation of XenServer

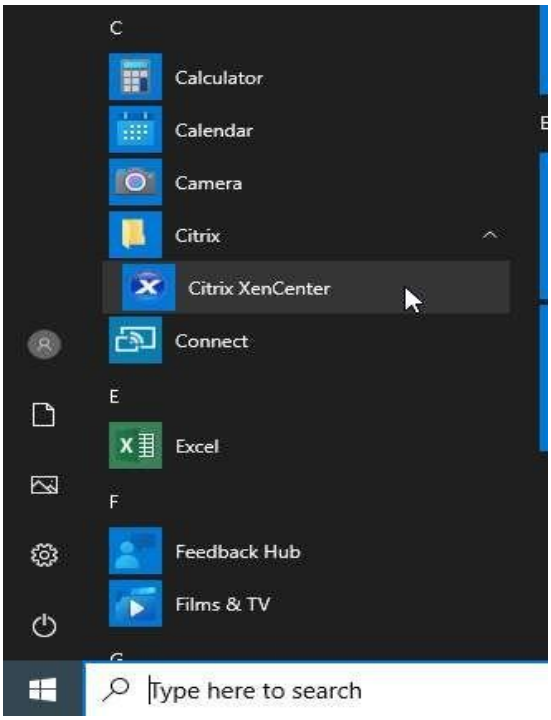


14. This is the loading screen and console for installed new XenServer



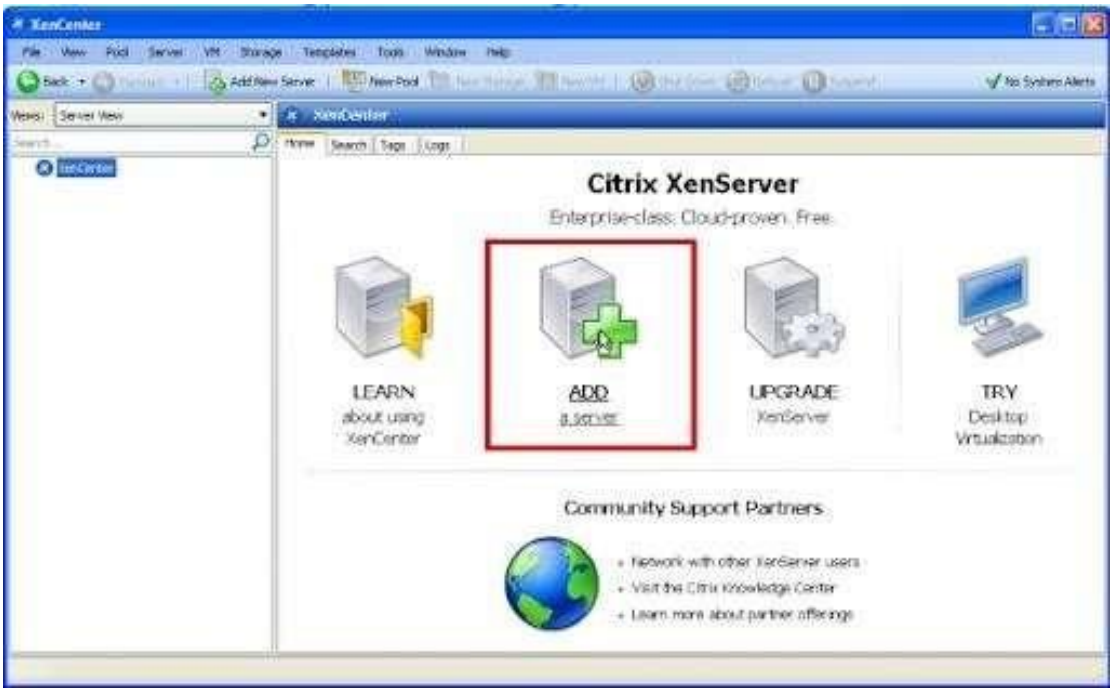
Step 2: Connect XenCenter to XenServer

1. Download the XenCenter a management utility from XenServer IP address as a URL on browser. Install XenCenter and open it from start Menu of Windows on Machine 2

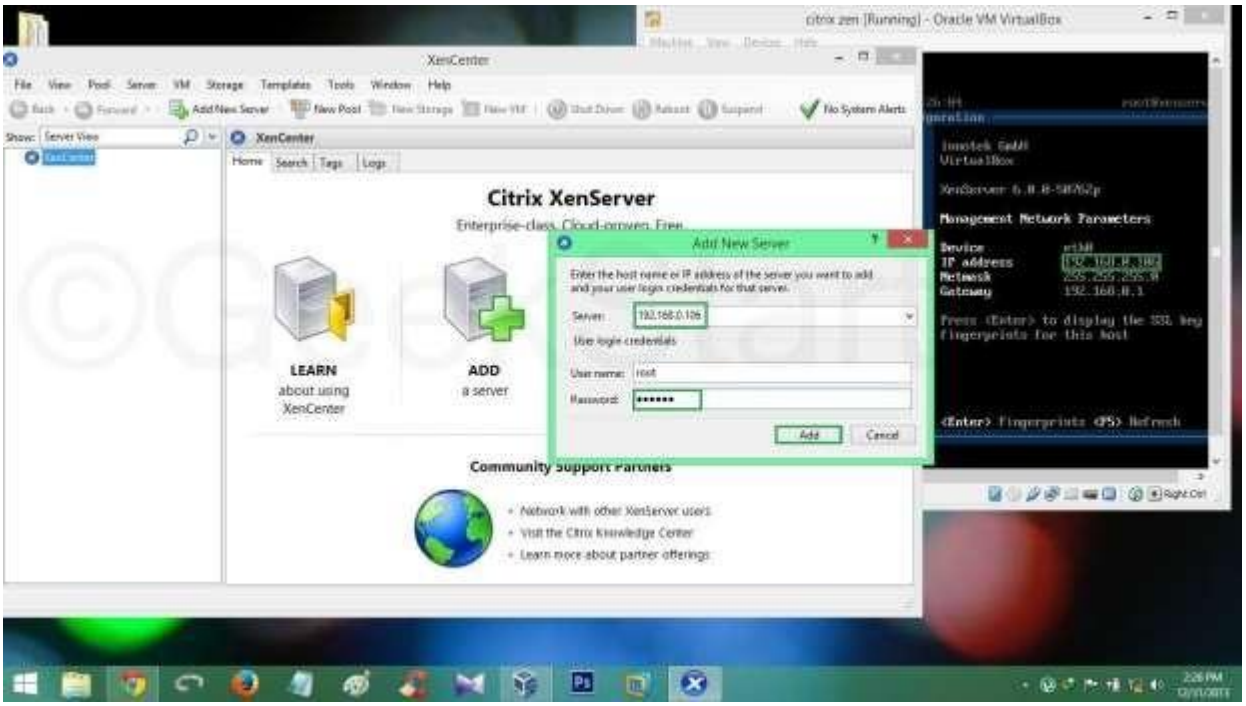


2. Once you click on Citrix XenCenter ..It Looks like as below:

3. To Connect to the XenServer host which is configured earlier, click ADD a Server

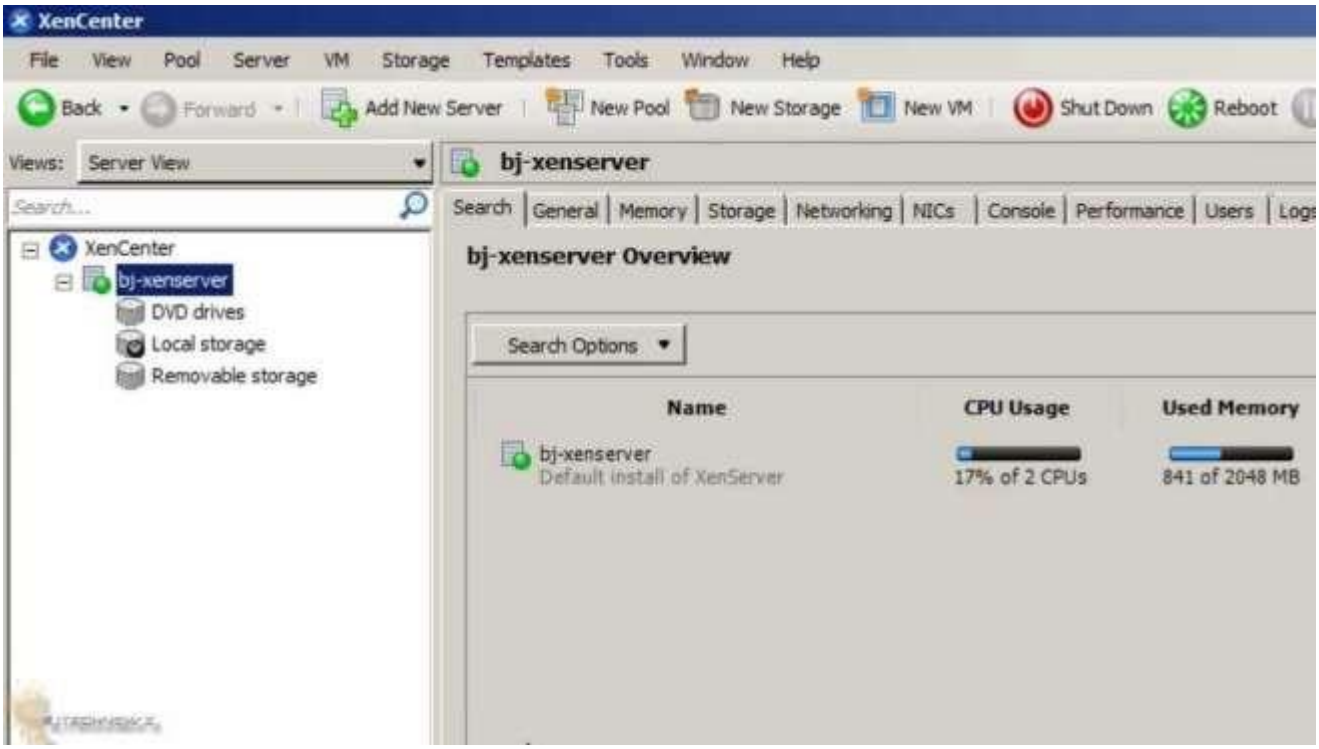


4. Enter IP address of XenServer and Enter User login credentials and click Add



5. Once you clicked on Add , it will ask to configure a master password for all the XenServers.

6. Xenserver is added now to XenCenter



Step 3: Create Local ISO Storage .

Now before creating Virtual Machine we have to Create storage repository which is nothing but shared directory on XenCenter which holds all iso files and which is required to install Operating system on XenServer .

Using Local command Shell

i. First View Xen Directory Structrure # df – h
ii. Now make folder to store ISO images # mkdir /var/ISO_images
iii. Using wget command download iso files . for example:
#wget http:// releases.ubuntu.com/16.04/ubuntu-16.04.6-desktop-

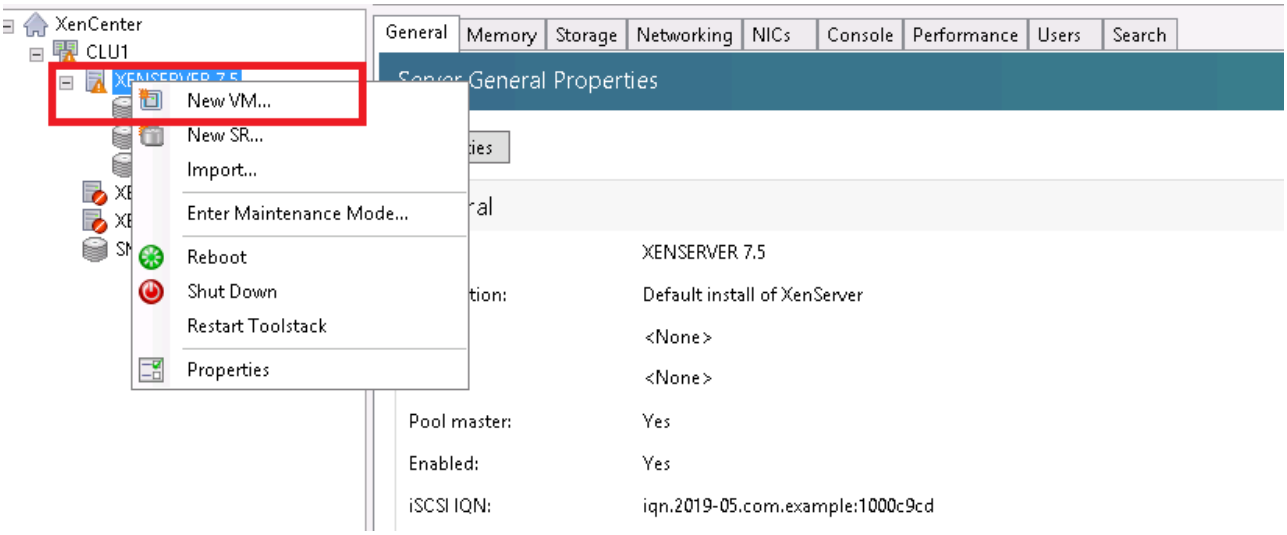
amd64.isoOR

USING PENDRIVE (need to Mount Pendrive)

a) #mkdir /mnt/myusb
b) #ls – l /dev/sdb1 to check drive for removable disk.
c) #mount –t vfat –o rw,users /dev/sdb1 /mnt/ myusb
d) #cd / mnt/myusb
e) # ls (content of pendrive)
f) # cp Ubuntu -16.04.5-desktop-i386.iso /var/ISO_images
g) Reboot or shutdown Xenserver from Xencenter or from console of Xenserver

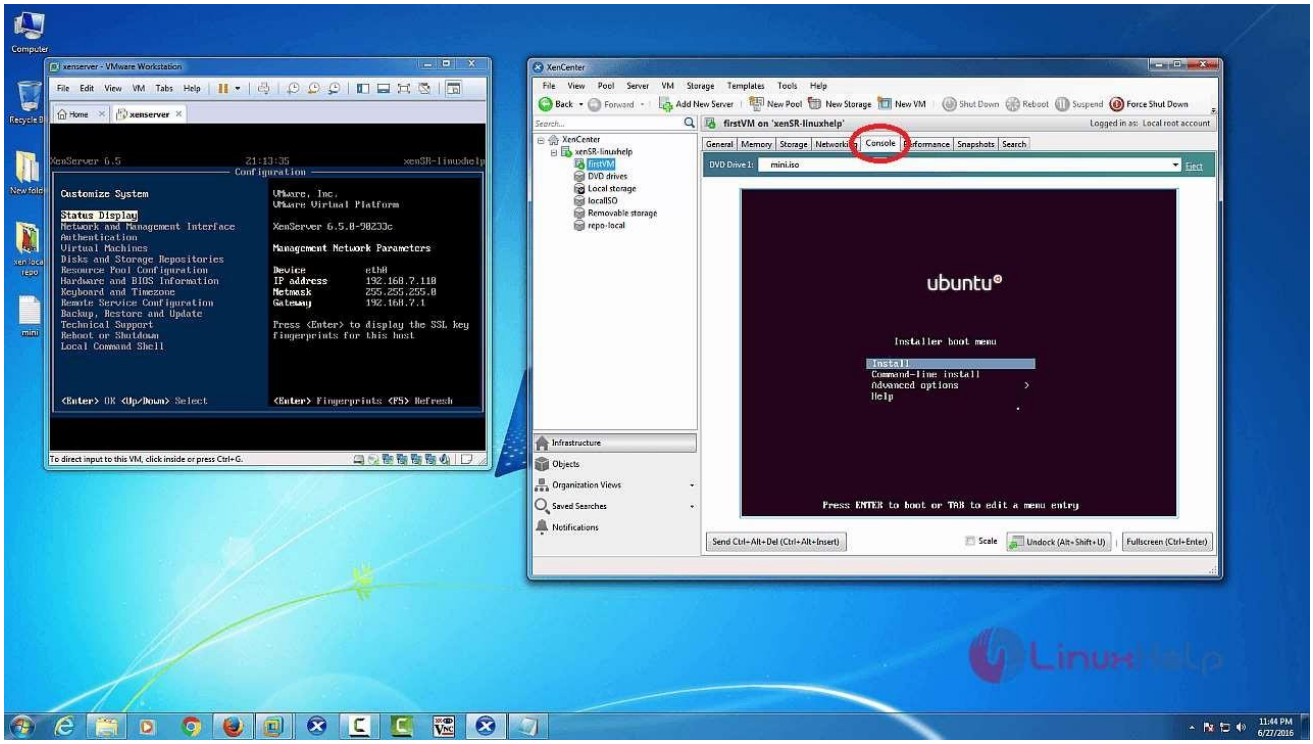
Step 4: Installation of Virtual Machine from Xencenter

i. Right click on Xenserver icon on Xen center and select New VM.



ii. Select VM template

iii. Name the virtual machine
iv. Locate the operating system installation media To select appropriate OS iso file.
v. Allocate CPU and memory to VM
vi. Select networking
vii. finish



Conclusion: Thus we have successfully created a virtual machine in xenserver usingXenCenter tool.