



Vidya Vikas Education Trust's  
Universal College of Engineering, Kaman Road, Vasai-401212  
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## LAB MANUAL OF

**Skill Based Lab Code:**

**CSL605**

**(Cloud Computing Lab)**

Class: TE Computer Engineering

Semester: VI(CBCGS)

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Roll No: **37**

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Batch: **A2**

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Dr. Jitendra Saturwar  
**Head of Department**



## **Department of Computer Engineering**

**Vision:**

To be recognized globally as a department provides quality technical education that eventually caters to helping and serving the community

**Mission:**

To develop human resources with sound knowledge in theory and practice of computer science and engineering

To motivate the students to solve real-world problems to help the society grow

To provide a learning ambience to enhance innovations, team spirit and leadership qualities for students

### **Course Name and Code: Cloud Computing Lab-CSL803**

CO 1: Adapt different types of virtualization and increase resource utilization

CO 2: Build a private cloud using open-source technologies.

CO 3: Analyze security issues on cloud.

CO 4: Develop real world web applications and deploy on commercial cloud

CO 5: Demonstrate various service models



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Lab Code	Lab Name	Credits
<b>CSL605</b>	<b>Cloud Computing Lab</b>	<b>2</b>

**Term Work:**

- Term work should consist of at least 6 experiments and a mini project
- Journal must include at least 2 assignments.
- The final certification and acceptance of term work indicates that performance in laboratory work is
- Satisfactory and minimum passing marks may be given in term work. The distribution of marks for term work shall be as follows

1. Laboratory work (experiments)-----	(15) Marks.
2. Mini project.....	(15) Marks.
3. Mini Project presentation & Report-----	(10) Marks
4. Attendance.....	(05) Marks
5. Assignment.....	(05) Marks
<b>Total Marks -----</b>	<b>(50) Marks</b>

**Practical & Oral**

Examination will be based on Laboratory work, mini project and above syllabus.

**External Oral** **25 Marks**



### List of Experiments

Sr. No.	Title	Page No.
1	<b>Title: Study of NIST model of cloud computing.</b> Objective: Understand deployment models, service models, advantages of cloud computing	5
2	<b>Title: Virtualization.</b> A) Creating and Running Virtual machine On Hosted Hypervisor like virtual Box. B) Creating and Running Virtual machine On Linux kernel using KVM.	11
3	<b>Title: Virtualization.</b> Creating and Running Virtual machine On Bare metal Hypervisor like XEN SERVER.	26
4	<b>Title: Infrastructure as a Service.</b> To demonstrate installation of Open stack private cloud.	38
5	<b>Title: Storage as a Service</b> Explore storage as a service using Own cloud for remote file access Using web interfaces.	58
6	<b>Title: Software as a Service</b> Installation and configuration of Ulteo to demonstrate on demand application delivery Over web browser to explore SAAS Environment.	68
7	<b>Title: Amazon Web Service</b> To create and access VM instances and demonstrate EC2 using AWS.	77
8	<b>Title: Case Study on Fog Computing</b> To study implementation and application of Fog Computing.	92
9	<b>Title: Mini Project</b> Objective: Using the concepts studied throughout the semester students shall be able to 1. Create their private cloud for the institute using the available resources. 2. Apply security concepts to secure a private cloud. 3. Implement efficient load balancing. 4. Compare various virtualization technologies with given resource. 5. Create cloud applications such as messenger, photo editing website, your own social media etc. Note: Evaluators must check if students have used appropriate cloud computing tools for their projects.	



### Experiment No.: 1

**Aim:** Study of NIST model of cloud computing.

**Objective:** Understand deployment models, service models, advantages of cloud computing.

**Theory:**

**1) Cloud Computing:**

Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.

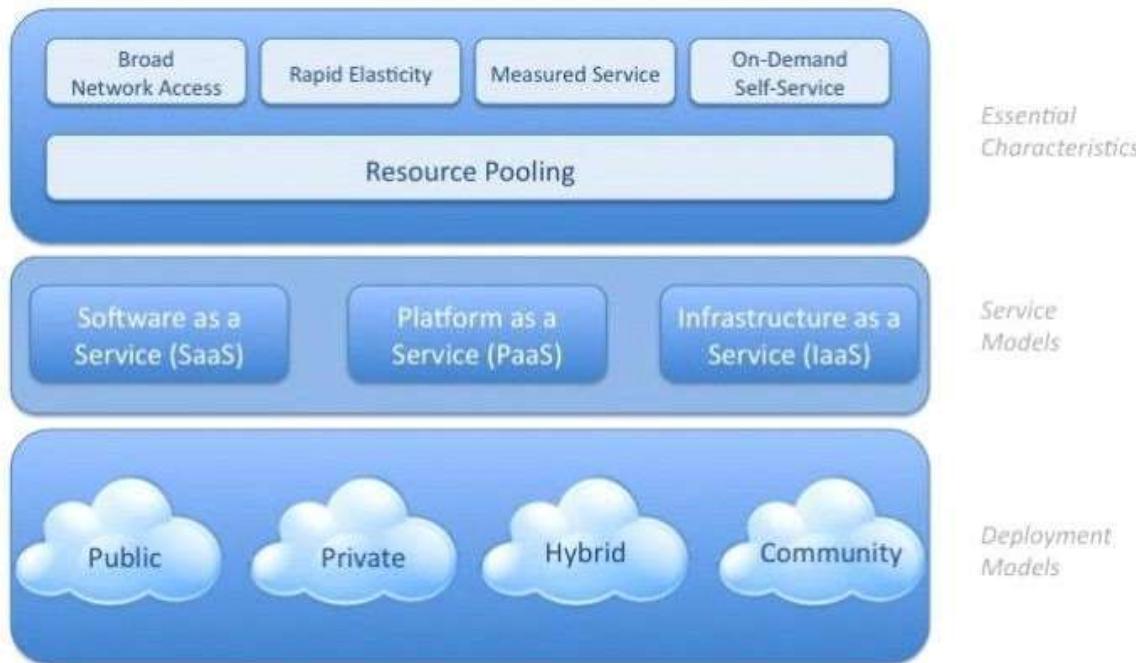
This cloud model is composed of five essential characteristics, three service models, and four deployment models.

**2) NIST cloud computing model**

From the NIST definition of cloud computing, “Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interactive.” NIST provides the following definitions of the essential characteristics and service and deployment models for cloud computing.

Essential Cloud Computing Characteristics:

- 1) On-demand self-service: consumers can unilaterally provision computing capabilities as needed automatically without requiring human interaction with each service provider.
- 2) Broad network access: capabilities are available over the network and accessed through standard mechanism that promote use by heterogeneous thin or thick client platforms.
- 3) Resources pooling: The provider’s computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand
- 4) Rapid elasticity: capabilities can be elastically provisioned and released to scale rapidly outward and inward commensurate with demand.
- 5) Measured service: cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service.



### 3) Why use cloud computing:

1. Cloud offers better insight. In a world awash in structured and, increasingly, unstructured data, 54% of leading organizations are using analytics to derive insights from big data, which helps them target customers and product opportunities more effectively.
2. Cloud helps collaboration. Cloud allows work to be accessed from multiple devices and from anywhere, which in turns makes it much easier for teams to collaborate on shared data.
3. Cloud drives better engagement. As we see the focus of business decision makers shift from cost efficiencies in their back-office systems to improvements in their systems of engagement, cloud is often seen as the most effective means of forging a tighter link with the customer.
4. Speed! Fifty-two percent of leading organizations are turning to the cloud to drive more rapid innovation in products and services.

For example, Kuma Games is a leading developer of episodic video games, serving up immersive 3-D experiences — with narratives ripped from news headlines and cable TV — to millions of users each week. Since 2007, Kuma has worked with IBM to achieve the flexibility, reliability and scalability required for such immersive and dynamic gaming. A cloud solution helps Kuma Games offer a consistent high-performance, graphically attractive and seamless experience to gamers all over the world, no matter how many users are playing simultaneously.



5. Cloud benefits are measurable and pay for themselves. From efficiency gains to improved employee mobility, leading organizations are able to measure significant benefits from their cloud investments, but equally importantly, can pace their investments so they avoid big up-front capital expenses and pay monthly as their business scales.

#### **4) Deployment Model and types**

Cloud technology provides many benefits to users, these benefits should be classified based on the needs of the users. The cloud deployment model represents the exact category of cloud environment based on proprietorship, size, and access and also describes the nature and purpose of the cloud. Most organizations implement cloud infrastructure to minimize capital expenditure & regulate operating costs.

##### **Types**

###### **a) Private Cloud**

It is a cloud-based infrastructure used by stand-alone organizations. It offers greater control over security. The data is backed up by a firewall and internally, and can be hosted internally or externally. Private clouds are perfect for organizations that have high-security requirements, high management demands, and availability requirements.

###### **b) Public Cloud**

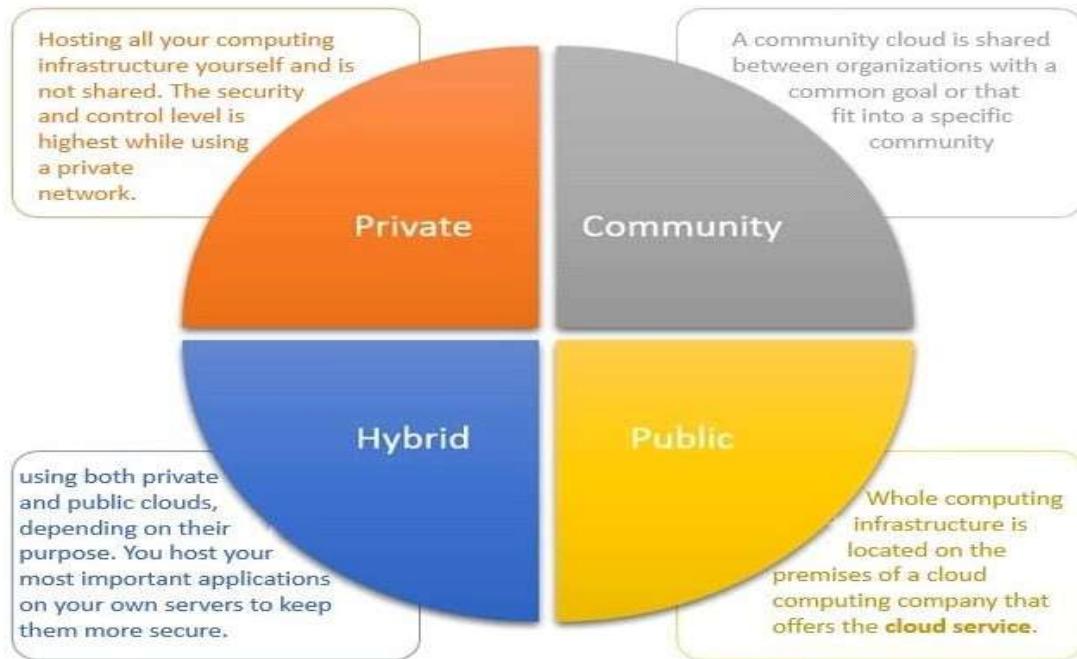
This type of cloud services is provided on a network for public use. Customers have no control over the location of the infrastructure. It is based on a shared cost model for all the users, or in the form of a licensing policy such as pay per user. Public deployment models in the cloud are perfect for organizations with growing and fluctuating demands. It is also popular among businesses of all sizes for their web applications, webmail, and storage of non-sensitive data.

###### **c) Community Cloud**

It is a mutually shared model between organizations that belong to a particular community such as banks, government organizations, or commercial enterprises. Community members generally share similar issues of privacy, performance, and security. This type of deployment model of cloud computing is managed and hosted internally or by a third-party vendor.

###### **d) Hybrid Cloud**

This model incorporates the best of both private and public clouds, but each can remain as separate entities. Further, as part of this deployment of cloud computing model, the internal, or external providers can provide resources. A hybrid cloud is ideal for scalability, flexibility, and security. A perfect example of this scenario would be that of an organization who uses the private cloud to secure their data and interacts with its customers using the public cloud.



## 5) Types of Cloud computing service models

### a) Cloud Software as a Service (SaaS).

The capability provided to the consumer is to use the provider's applications running on a cloud infrastructure. The applications are accessible from various client devices through a thin client interface such as a Web browser (e.g., Web-based email), or a program interface. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific application configuration settings.

### b) Cloud Platform as a Service (PaaS).

The capability provided to the consumer is to deploy onto the cloud infrastructure consumer-created or -acquired applications created using programming languages and tools supported by the provider. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly application hosting environment configurations.

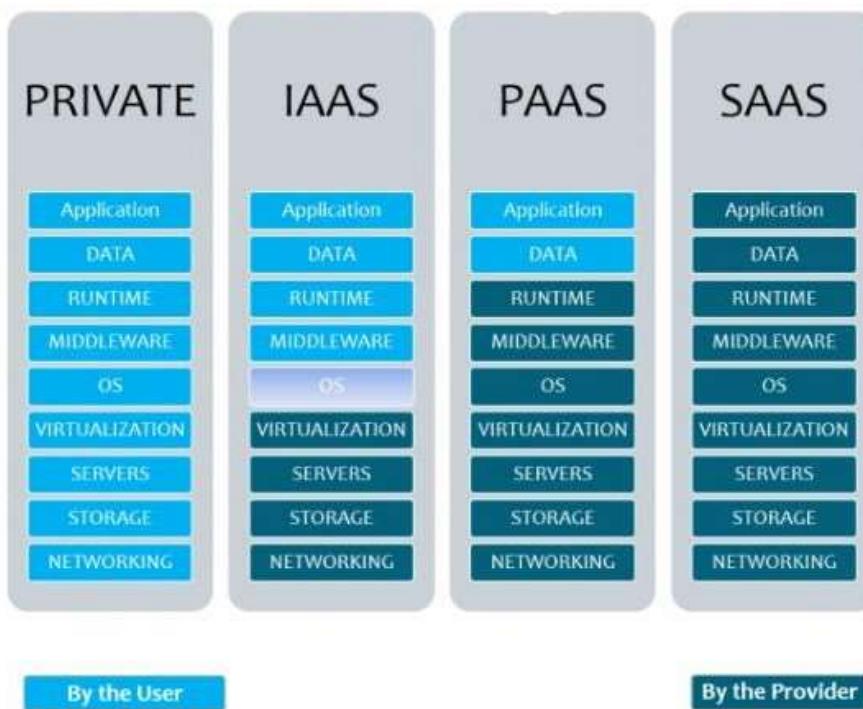
### c) Coud Infrastructure as a Service (IaaS).

The capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software,



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which can include operating systems and applications. The consumer does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, deployed applications; and possibly limited control of select networking components (e.g., host, firewalls).



Advantages:

- 1) Cloud Computing is low in cost and affordable because we get the bills as per the usage.
- 2) The storage and maintenance of a large amount of information or data are possible.
- 3) The cloud computing is very flexible.
- 4) It provides high security.
- 5) The option of data recovery is available.
- 6) Data can be managed easily.
- 7) It has automatic update option.

Disadvantages:

- 1) Requires Constant Internet Connection
- 2) Cloud might not work properly in low internet speed
- 3) Stored data can be lost
- 4) Stored data might not be secure



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- 5) Features available might be available

**Conclusion:**

The features of cloud, the services provided by it shows that the cloud computing is highly reliable computing paradigm where the consumer can use large amount of computing resources as per his/her demand without actually owning it.



### Experiment No.: 2

**Aim:** To study Virtualization

**Objective:** Understand different types of virtualizations, Host and bare metal hypervisors and implement horizontal scalability.

**Technology:** XEN/ VMware's ESXi

#### Theory:

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". With the help of Virtualization multiple operating systems and applications can run on same Machine at the same time increasing the utilization and flexibility of hardware

#### Why is virtualization useful?

The techniques and features that VirtualBox provides are useful for several scenarios:

- **Running multiple operating systems simultaneously.** VirtualBox allows you to run more than one operating system at a time. Since you can configure what kinds of "virtual" hardware should be presented to each such operating system, you can install an old operating system such as DOS or OS/2 even if your real computer's hardware is no longer supported by that operating system.
- **Easier software installations.** Software vendors can use virtual machines to ship entire software configurations. For example, installing a complete mail server solution on a real machine can be a tedious task. With VirtualBox, such a complex setup (then often called an "appliance") can be packed into a virtual machine. Installing and running a mail server becomes as easy as importing such an appliance into VirtualBox.
- **Testing and disaster recovery.** Once installed, a virtual machine and its virtual hard disks can be considered a "container" that can be arbitrarily frozen, woken up, copied, backed up, and transported between hosts. On top of that, with the use of another VirtualBox feature called "snapshots", one can save a particular state of a virtual machine and revert back to that state, if necessary. This way, one can freely experiment with a computing environment. If something goes wrong (e.g. after installing misbehaving software or infecting the guest with a virus), one can easily switch back to a previous snapshot and avoid the need of frequent backups and restores. Any number of snapshots can be created, allowing you to travel back and forward in virtual machine time. You can delete snapshots while a VM is running to reclaim disk space.
- **Infrastructure consolidation.** Virtualization can significantly reduce hardware and electricity costs. Most of the time, computers today only use a fraction of their potential



power and run with low average system loads. A lot of hardware resources as well as electricity is thereby wasted. So, instead of running many such physical computers that are only partially used, one can pack many virtual machines onto a few powerful hosts and balance the loads between them.

### **Types of Virtualization:**

- Hardware Virtualization:

When the virtual machine software or virtual machine manager (VMM) is directly installed on the hardware system is known as hardware virtualization.

- Operating System Virtualization:

When the virtual machine software or virtual machine manager (VMM) is installed on the Host operating system instead of directly on the hardware system is known as operating system virtualization.

- Server Virtualization:

When the virtual machine software or virtual machine manager (VMM) is directly installed on the Server system is known as server virtualization.

- Storage Virtualization:

Storage virtualization is the process of grouping the physical storage from multiple network storage devices so that it looks like a single storage device.

### **Terminology**

Host operating system (host OS).

This is the operating system of the physical computer on which VirtualBox was installed. There are versions of VirtualBox for Windows, Mac OS X, Linux and Solaris hosts.

Guest operating system (guest OS).

This is the operating system that is running inside the virtual machine. Theoretically, VirtualBox can run any operating system (DOS, Windows, OS/2, FreeBSD, OpenBSD).

Virtual machine (VM).

This is the special environment that VirtualBox creates for your guest operating system while it is



running. In other words, you run your guest operating system "in" a VM. Normally, a VM will be shown as a window on your computer's desktop, but depending on which of the various frontends of VirtualBox you use, it can be displayed in full screen mode or remotely on another computer. In a more abstract way, internally, VirtualBox thinks of a VM as a set of parameters that determine its behavior. They include hardware settings as well as state information. These settings are mirrored in the VirtualBox Manager window as well as the VBoxManage command line program.

#### Guest Additions.

This refers to special software packages which are shipped with VirtualBox but designed to be installed inside a VM to improve performance of the guest OS and to add extra features.

#### **Exp 2a) HYPERVISOR:**

A hypervisor, also known as a virtual machine monitor, is a process that creates and runs virtual machines (VMs). It is a small software layer that enables multiple operating systems to run alongside each other, sharing the same physical computing resources. The hypervisor, also known as a virtual machine monitor (VMM), manages these VMs as they run alongside each other.

- Type 2 Hypervisor: Hosted Hypervisor

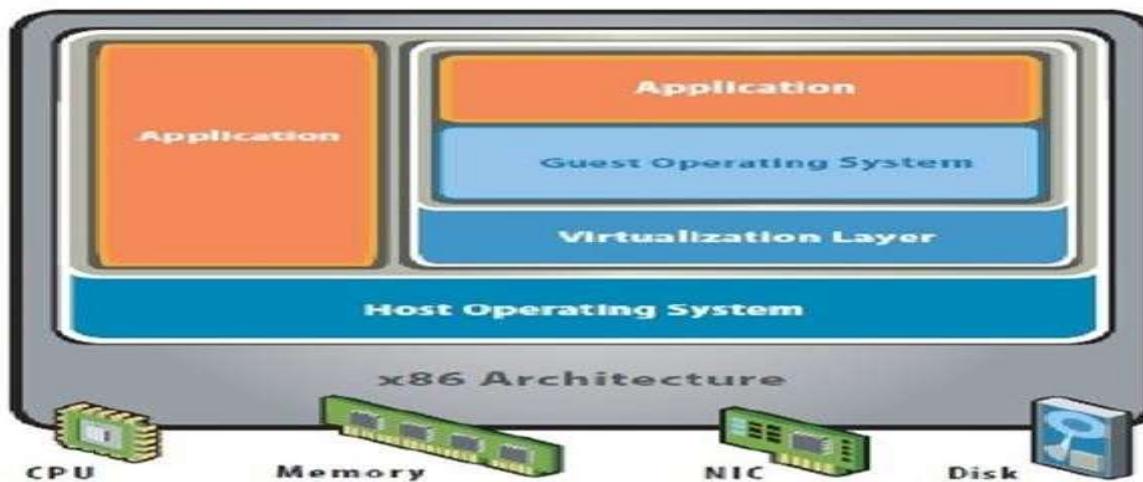
A Type 2 hypervisor doesn't run directly on the underlying hardware. Instead, it runs as an application in an OS. They're suitable for individual PC users needing to run multiple operating systems. The advantage of a hosted hypervisor is that it can be open or quit as needed, freeing up resources for the host computer. However, since it runs on top of an operating system, it may not offer the same performance as a native hypervisor. Examples of Type-2 hypervisors include VMware Workstation, Oracle VirtualBox, and Parallels Desktop for Mac.

Generally, hosted hypervisors are more common for personal and small business use, while native hypervisors are used for enterprise applications and cloud computing.

Example: VirtualBox, KVM etc



## HOSTED ARCHITECTURE



### TYPE 2 HYPERVISOR

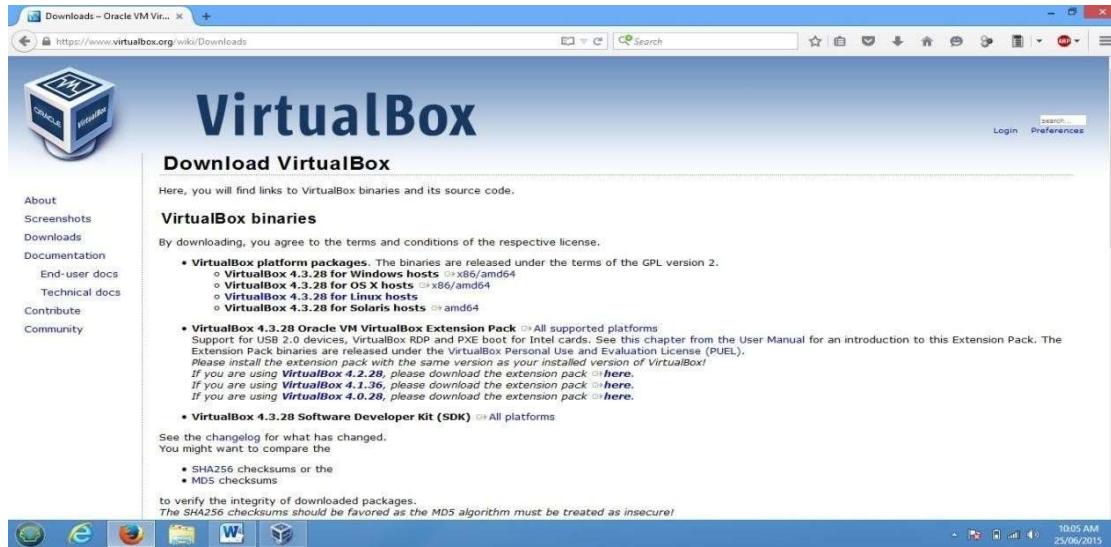
**Output:**  
**Hosted Hypervisor**

Virtual Box Installation and Installation of Ubuntu in Virtual Box



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Step 1: Download Oracle Virtual box from <https://www.virtualbox.org/wiki/Downloads>

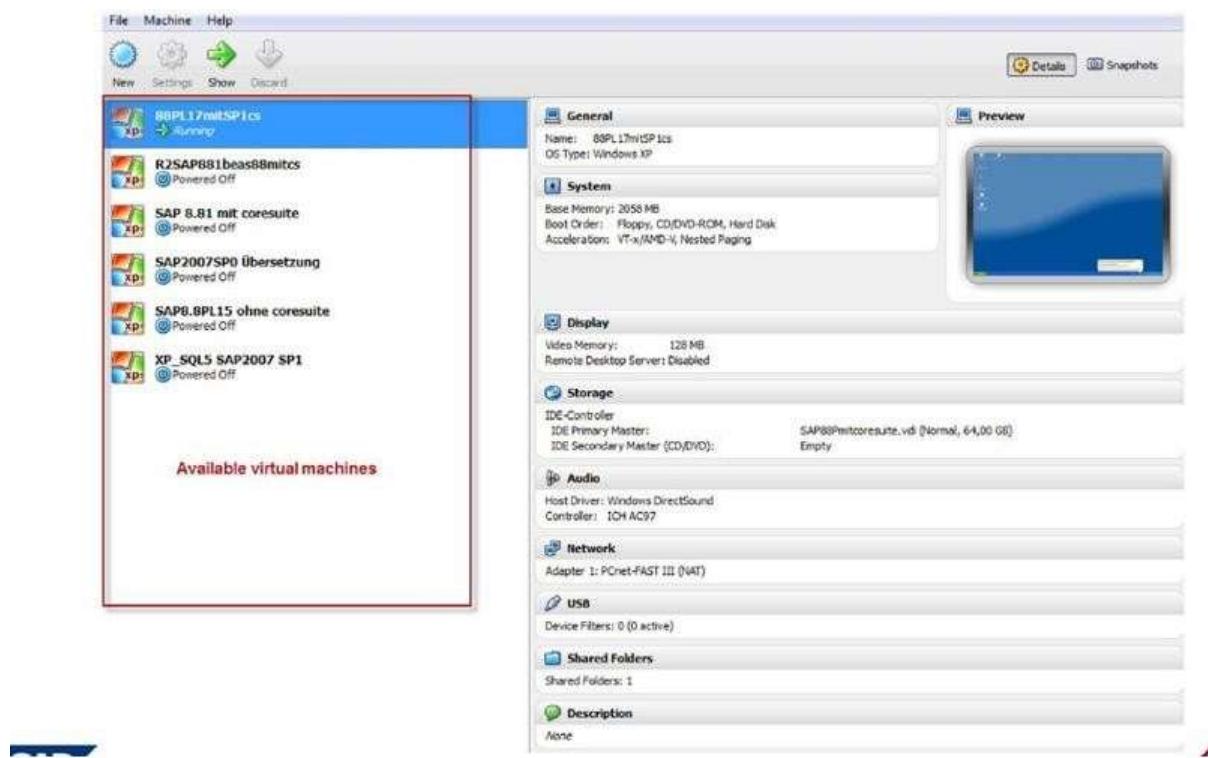


Step 2: Install it in Windows, Once the installation has done open it.





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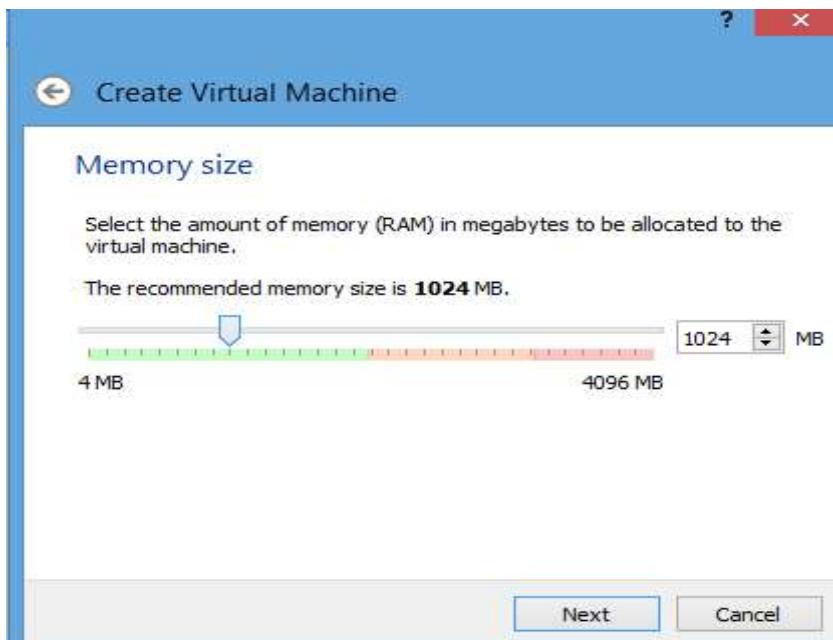
Step 3: Create new Virtual Machine by clicking on New and enter name and select OS and Version



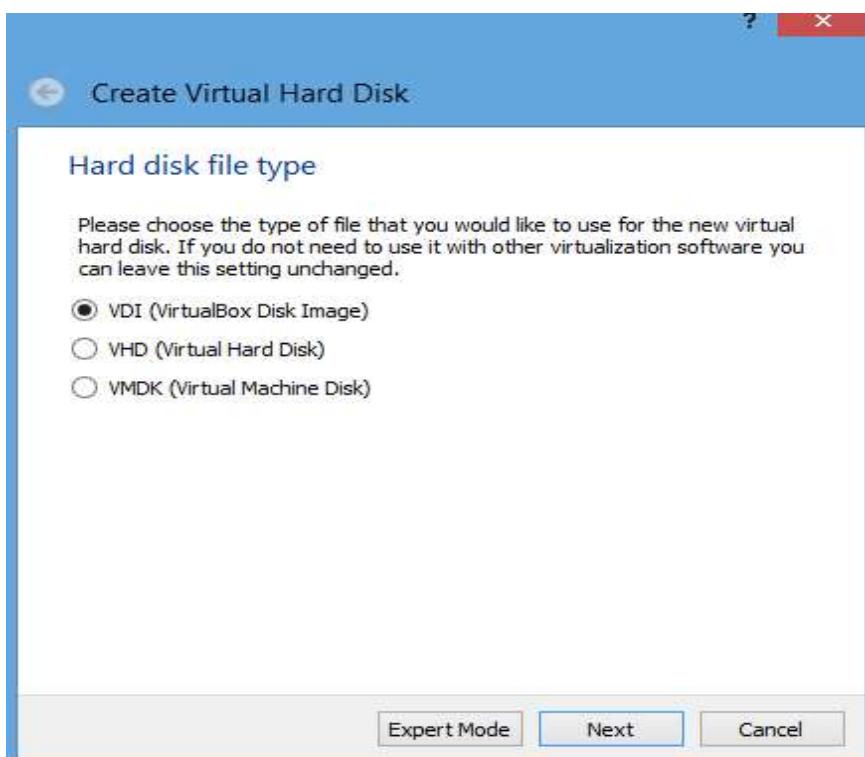


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Step 4: Select Memory Size



Step 5: Select Hard Disk File Type



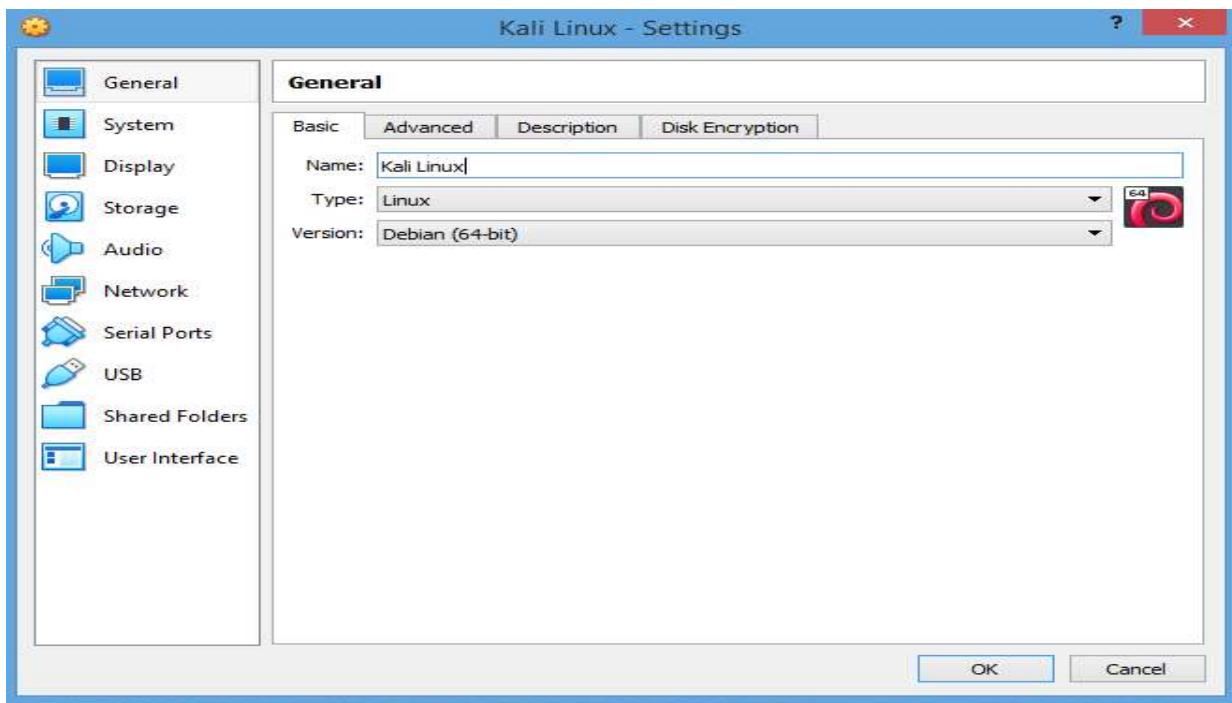


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Step 6: Select Storage on physical hard disk



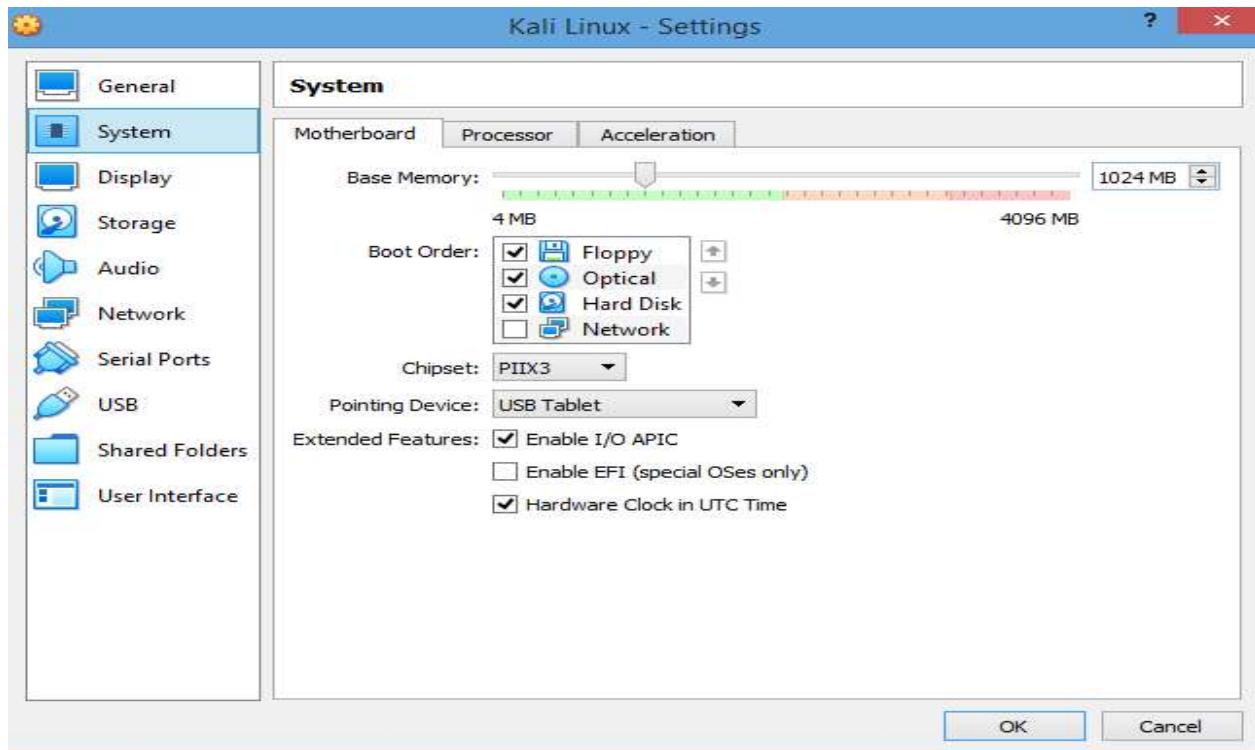
Step 7: Settings



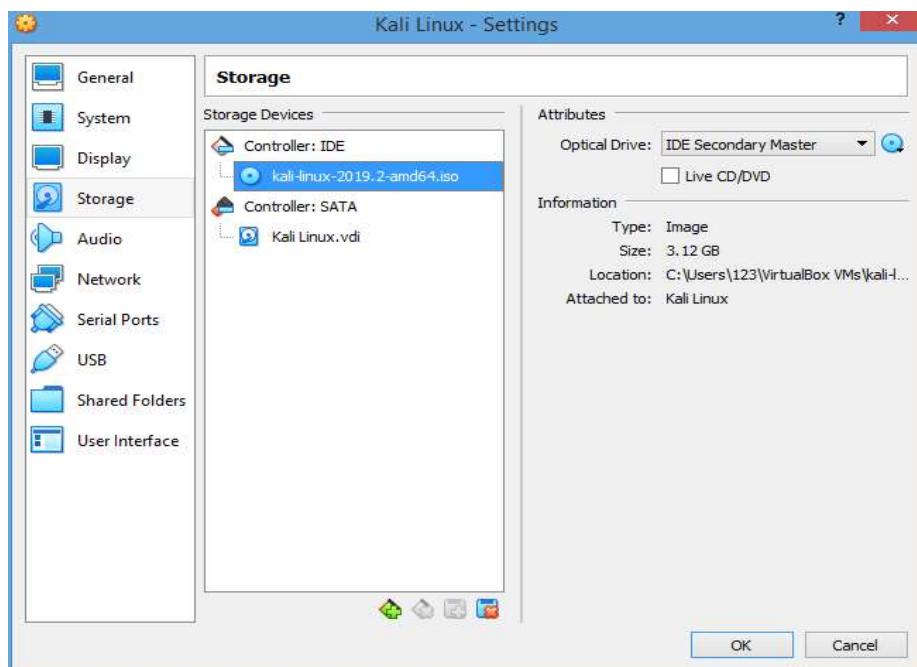


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Step 8: Specify RAM Size, HDD Size, change system and display as needed

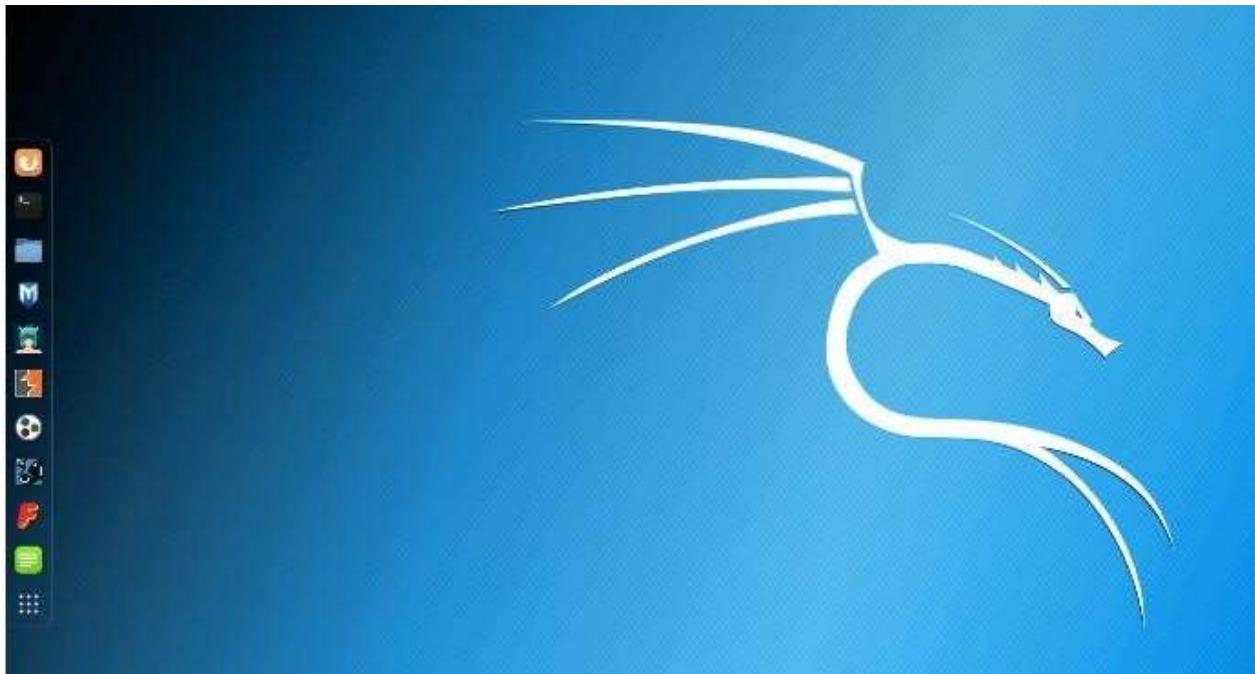


Step 9: To Select the media for installation Click on start and browse for iso file





Step 10: Complete the Installation and use it.



### **Exp 2b) Bare Metal Hypervisor:**

#### **HYPERVISOR:**

A hypervisor, also known as a virtual machine monitor, is a process that creates and runs virtual machines (VMs). It is a small software layer that enables multiple operating systems to run alongside each other, sharing the same physical computing resources. The hypervisor, also known as a virtual machine monitor (VMM), manages these VMs as they run alongside each other.

#### **Types of Hypervisor:**

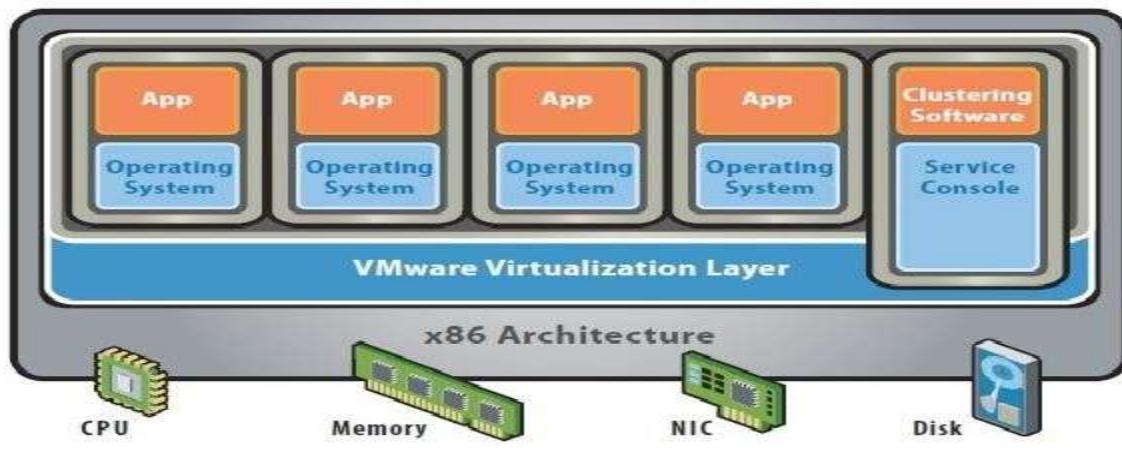
- Type 1 Hypervisor: Bare metal hypervisor

A Type 1 hypervisor runs directly on the underlying computer's physical hardware, interacting directly with its CPU, memory, and physical storage. For this reason, Type 1 hypervisors are also referred to as bare-metal hypervisors.

Example: XEN, VMware etc.



## BARE-METAL (HYPERVISOR) ARCHITECTURE



### TYPE 1 HYPERVISOR

A bare-metal hypervisor (Type 1) is a layer of software we install directly on top of a physical server and its underlying hardware.

There is no software or any operating system in between, hence the name *bare-metal hypervisor*. A Type 1 hypervisor is proven in providing excellent performance and stability since it does not run inside Windows or any other operating system.

Type 1 hypervisors are an OS themselves, a very basic one on top of which you can run virtual machines. The physical machine the hypervisor is running on serves virtualization purposes only. You cannot use it for anything else.

Type 1 hypervisors are mainly found in enterprise environments.

Installation of kvm and then installing Virtual Machine on it

**Output:**



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Step 1: Installing KVM on Ubuntu

```
$ sudo apt install qemu-kvm libvirt-bin bridge-utils virtinst virt-manager
```

The screenshot shows a terminal window titled "shah@shah-virtual-machine:~". The user has run the command \$ sudo apt-get update followed by \$ sudo apt install qemu-kvm libvirt-daemon-system libvirt-clients bridge-utils virt-manager. The terminal is dark-themed with light-colored text.

Step 2: KVM Virtual Machine Manager Installed on Ubuntu





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Step 3: Create New Virtual Machine



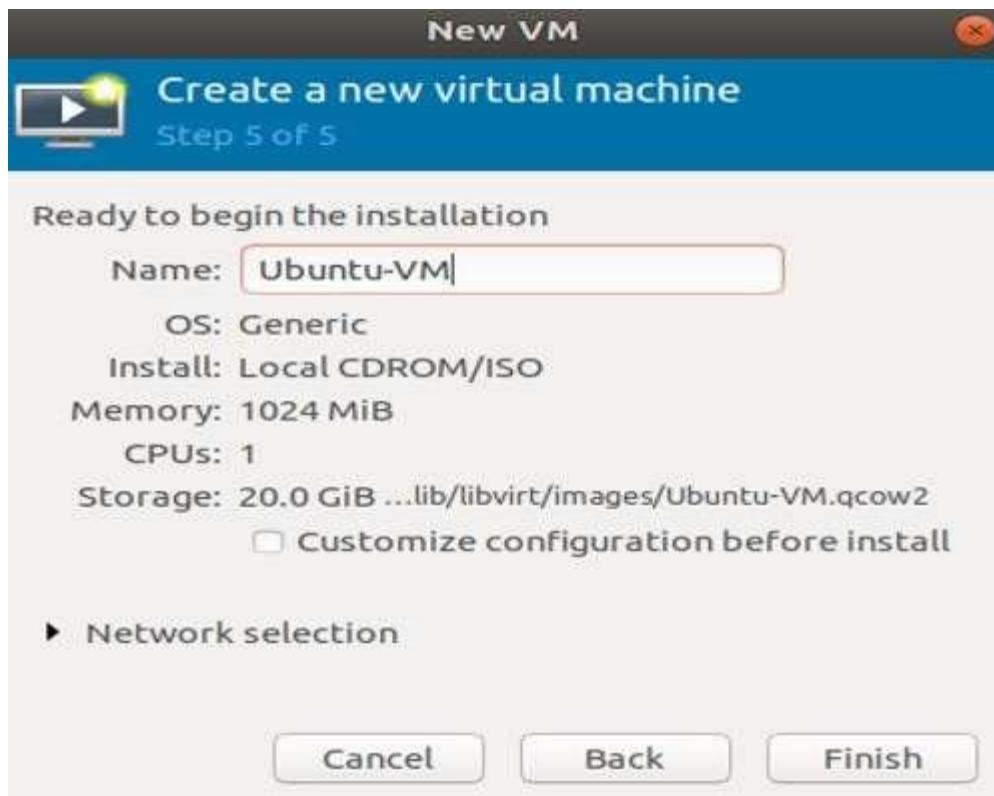
Step 4: Select Ram and No. of CPUs



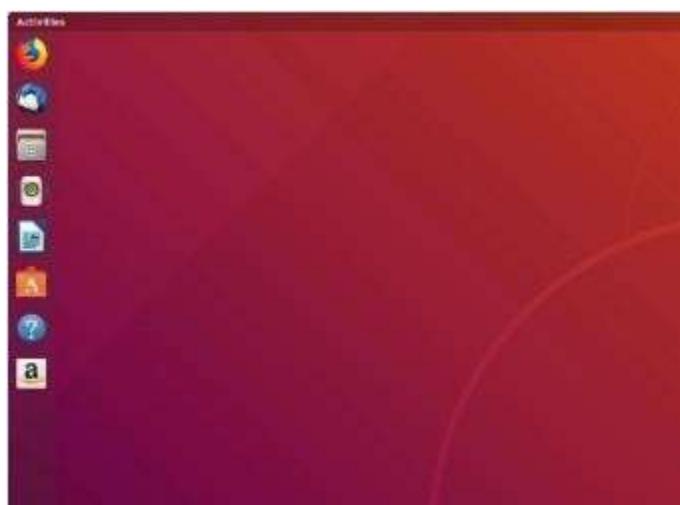


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Step 5: Give Name and start installation



Step 6: Installation Done





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**Conclusion:**

Type 1 hypervisor (also called a bare metal hypervisor) is installed directly on physical host server hardware just like an operating system. Type 1 hypervisors run on dedicated hardware. They require a management console and are used in data centers. Examples include Oracle OVM for SPARC, ESXi, Hyper-V and KVM. Type 2 hypervisors support guest virtual machines by coordinating calls for CPU, memory, disk, network and other resources through the physical host's operating system. This makes it easy for an end user to run a virtual machine on a personal computing device. Examples include VMware Fusion, Oracle Virtual Box etc.



### Experiment No.: 3

**Aim:** Creating and Running Virtual machine On Bare metal Hypervisor like XEN SERVER.

**Objective:** Understand bare metal hypervisors and implement horizontal scalability.

**Technology:** XEN Server

#### Theory:

Xen is an open-source hypervisor based on paravirtualization. It is the most popular application of paravirtualization. Xen has been extended to compatible with full virtualization using hardware-assisted virtualization. It enables high performance to execute guest operating system. This is probably done by removing the performance loss while executing the instructions requiring significant handling and by modifying portion of the guest operating system executed by Xen, with reference to the execution of such instructions. Hence this especially support x86, which is the most used architecture on commodity machines and servers.

Xen can run several guest operating systems each running in its own virtual machine or domain. When Xen is first installed, it automatically creates the first domain, Domain 0 (or dom0). Domain 0 is the management domain and is responsible for managing the system. It performs tasks like building additional domains (or virtual machines), managing the virtual devices for each virtual machine, suspending virtual machines, resuming virtual machines, and migrating virtual machines. Domain 0 runs a guest operating system and is responsible for the hardware devices.

#### Advantages:

- The Xen server is built on the open-source Xen hypervisor and uses a combination of paravirtualization and hardware-assisted virtualization. This collaboration between the OS and the virtualization platform enables the development of a simpler hypervisor that delivers highly optimized performance.
- Xen provides sophisticated workload balancing that captures CPU, memory, disk I/O, and network I/O data; it offers two optimization modes: one for performance and another for density.
- The Xen server takes advantage of a unique storage integration feature called the Citrix Storage Link. With it, the sysadmin can directly leverage features of arrays from such companies as HP, Dell Equal Logic, NetApp, EMC, and others.
- The Xen server includes multicore processor support, live migration, physical-server-to-virtual-machine conversion (P2V) and virtual-to-virtual conversion (V2V) tools, centralized multiserver management, real-time performance monitoring, and speedy performance for Windows and Linux.



Disadvantages:

- Xen has a relatively large footprint and relies on Linux in dom0.
- Xen relies on third-party solutions for hardware device drivers, storage, backup and recovery, and fault tolerance.
- Xen gets bogged down with anything with a high I/O rate or anything that sucks up resources and starves other VMs.
- Xen's integration can be problematic; it could become a burden on your Linux kernel over time.
- XenServer 5 is missing 802.1Q virtual local area network (VLAN) trunking; as for security, it doesn't offer directory services integration, role-based access controls, or security logging and auditing or administrative actions.

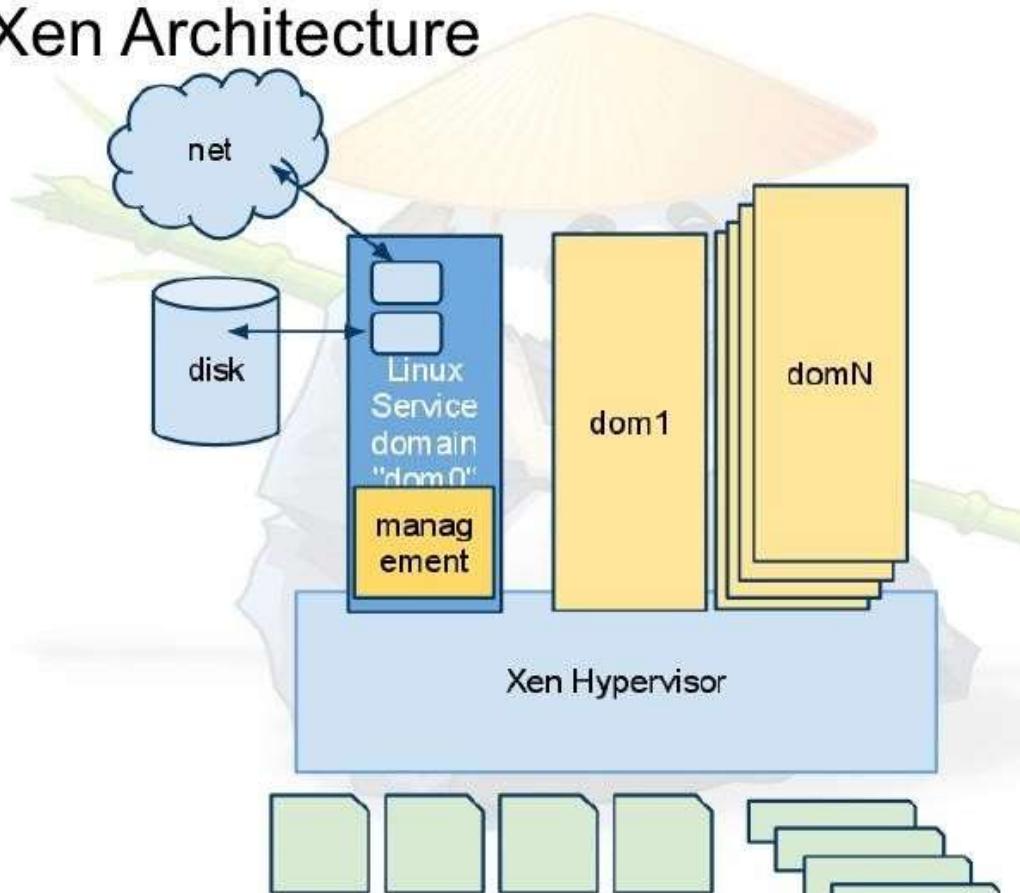
• Type 1 Hypervisor: Bare metal hypervisor

A Type 1 hypervisor runs directly on the underlying computer's physical hardware, interacting directly with its CPU, memory, and physical storage. For this reason, Type 1 hypervisors are also referred to as bare-metal hypervisors.

Example: XEN, VMware etc.



## Xen Architecture



### Output:

Step 1: Install and download the **XenServer ISO** file

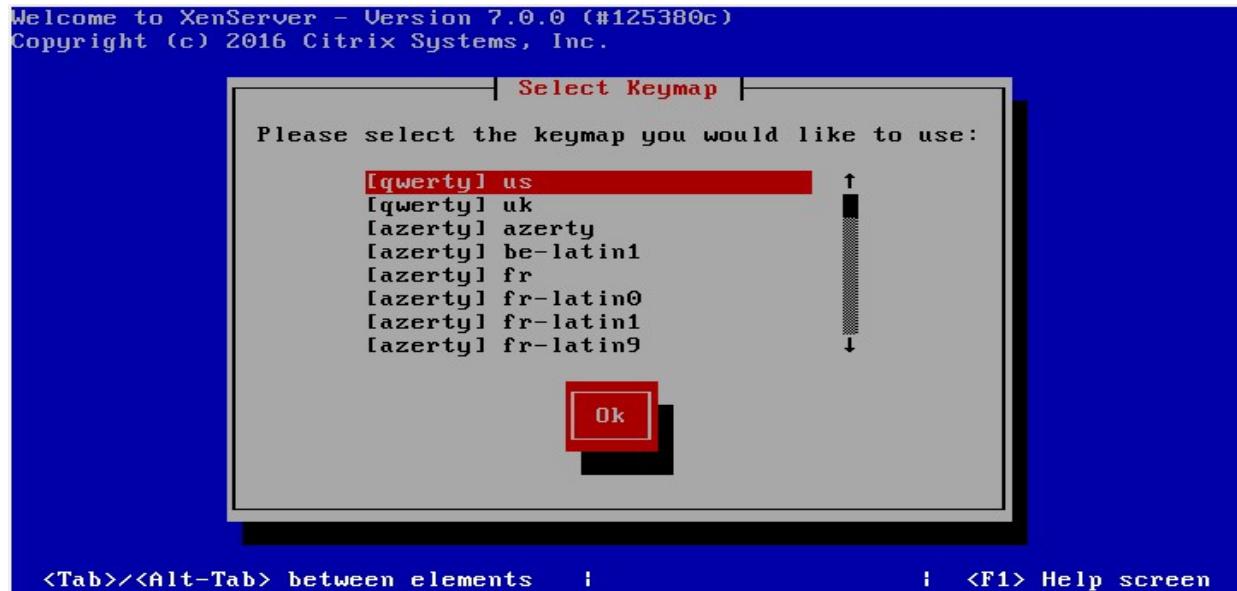
Step 2: Place the media into the system that XenServer will be installed and boot to that media. Upon successful boot the user should be greeted by the wonderful Citrix XenServer boot splash.



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Step 3: Press **enter** to begin the booting process. First screen is language selection



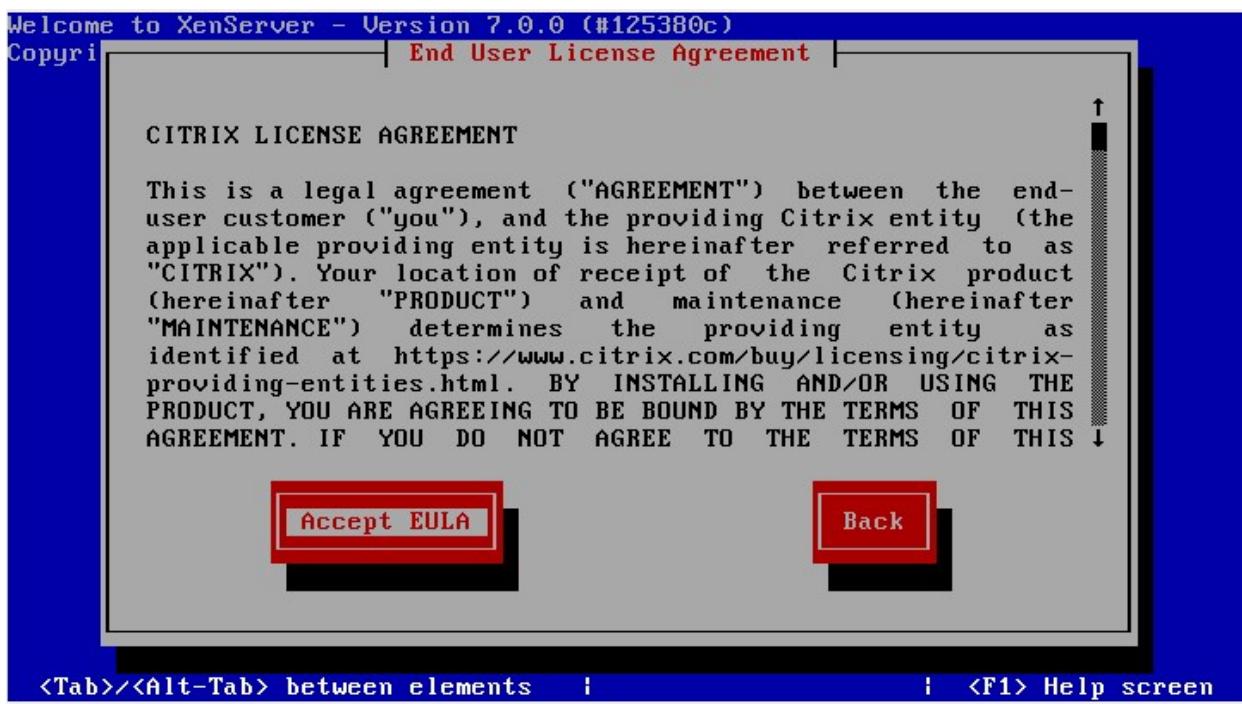
Step 4: This screen asks the user to confirm the reason for booting to this media as well as provide the option to load extra hardware drivers if needed. Press Ok to continue



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Step 5: Next prompt is the obligatory EULA (End User License Agreement). Accept the Agreement





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Step 6: Next screen requests the installation device. The RAID system is reflected as “sda – 556 GB [IBM ServeRAID-MR10k]” For this guide, thin provisioning is not necessary. Make sure the asterisk ( \* ) character is next to the hard drive selection to install XenServer and tab to the “OK” button.



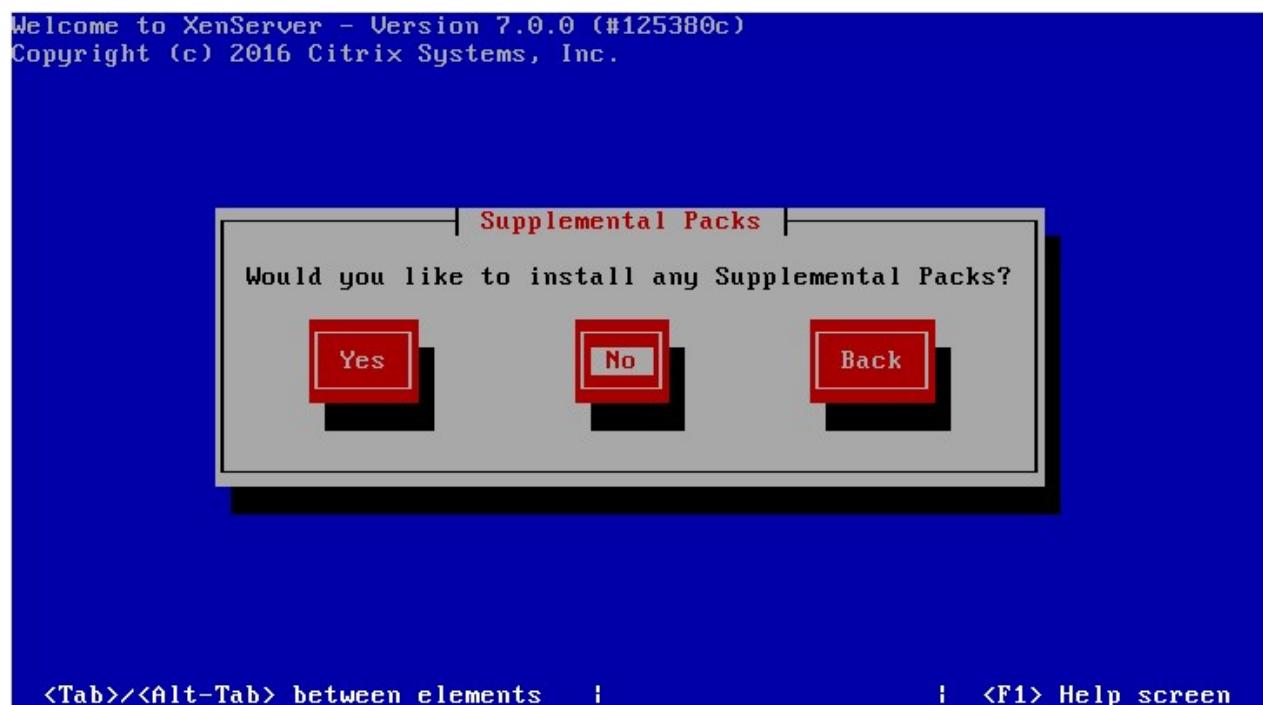
Step 7: The next screen will prompt the user for the location of the installation files. Since the installer was boot locally with a CD/DVD/USB, make sure to select the “**Local Media**” option.



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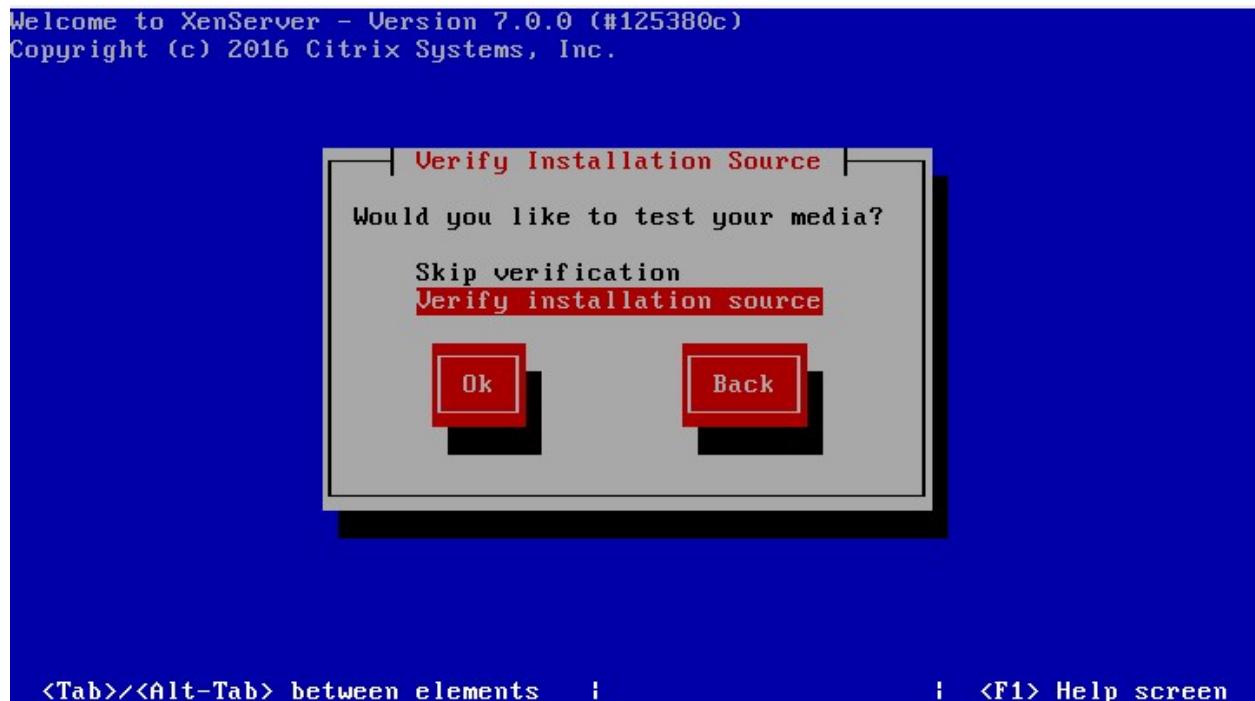
Step 8: Next step allows for the installation of **Supplemental Packs (SP)** at the time of install.



Step 9: The next screen will ask if the user wishes to verify that the installer media is not corrupt.



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Step 10: Installation of Base Pack Done





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Step 11: Virtual Machine Installation xe template list

```
[root@Tecmint ~]#xe template-list uuid=e9fc6cb0-bbc2-1da9-9c1d-952c4dc4d794
uuid ( RO) : e9fc6cb0-bbc2-1da9-9c1d-952c4dc4d794
    name-label ( RW): Debian Wheezy 7.0 (64-bit)
    name-description ( RW): Template that allows VM installation from Xen-aware Debian-based distros. To
use this template from the CLI, install your VM using vm-install, then set other-config-install-repository to the path to your network repository, e.g. http://<server>/<path>
```

Step 12: Selecting a particular UUID

```
[root@Tecmint ~]#xe sr-list name-label="Tecmint iSCSI Storage"
uuid ( RO) : bea6caa4-ecab-8509-33a4-2cda2599fb75
    name-label ( RW): Tecmint iSCSI Storage
    name-description ( RW):
    host ( RO): xenct-xen2
    type ( RO): lvmoiscsi
    content-type ( RO): user
```

Step 13: Descriptive name is desired to keep track of the purpose of this particular VDI. To rename this particular VDI, the UUID in the above output is needed and another ‘xe’ command needs to be created.



```
[root@Tecmint ~]#xe vm-disk-list vm=TecmintVM
Disk 0 VBD:
  uuid ( RO) : 2eac0d98-485a-7c22-216c-caa920b10ea9
    vm-name-label ( RO): TecmintVM
    userdevice ( RW): 0

Disk 0 VDI:
  uuid ( RO) : 90611915-fb7e-485b-a0a8-31c84a59b9d8
    name-label ( RW): 0
    sr-name-label ( RO): Tecmint iSCSI Storage
    virtual-size ( RO): 8589934592
```

Step 14: The Maximum memory utilized by a guest machine

```
[root@Tecmint ~]#xe vm-param-list uuid=6eab5bdd-c277-e55d-0363-dcf186c8e8e | grep -i memory | grep -v 'allowed\|recommendations'
  memory-actual ( RO): 0
  memory-target ( RO): 0
  memory-overhead ( RO): 4194304
  memory-static-max ( RW): 268435456
  memory-dynamic-max ( RW): 268435456
  memory-dynamic-min ( RW): 268435456
  memory-static-min ( RW): 134217728
  memory (MRO): <not in database>
```

Step 15: The above commands first list out the name for the Debian ISO. The next command will add a virtual CD-ROM device to the TecmintVM guest and assigns it the device ID of 3. The third command is used to determine the UUID for the newly added CD-ROM to continue setting up the device to boot the Debian ISO.



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```
[root@Tecmint ~]#xe vm-cd-add vm=TecmintVM cd-name=debian-8-netinst.iso device=3
[root@Tecmint ~]#xe vbd-list vm-name-label=TecmintVM userdevice=3
uuid ( R0) : 3836851f-928e-599f-dc3b-3d8d8879dd18
    [vm-uuid ( R0): 6eab5bdd-c277-e55d-0363-dcf186c8e8e]
    vm-name-label ( R0): TecmintVM
    vdi-uuid ( R0): 3f39b9c9-cc23-455d-87ac-5eb1a23617bc
        empty ( R0): false
    device ( R0):
```

Step 16: The next step is to make the CD-ROM bootable as well as instruct the guest to install an operating system from the CD-ROM.

```
[root@Tecmint ~]#xe vbd-param-set uuid=3836851f-928e-599f-dc3b-3d8d8879dd18 bootable=true
[root@Tecmint ~]#xe vm-param-set uuid=6eab5bdd-c277-e55d-0363-dcf186c8e8e other-config:install-repository=cdrom
[root@Tecmint ~]#
```

Step 17: The first command is used to obtain the **UUID** of the network created for this guest. The next command is used to create a network adapter for the guest and attach the network adapter to the proper network.

```
[root@Tecmint ~]#xe network-list name-description="Tecmint test VLAN 10"
uuid ( R0) : cfe987f0-b37c-dbd7-39be-36e7bfd94cef
    name-label ( RW): VLAN10
    name-description ( RW): Tecmint test VLAN 10
    bridge ( R0): xapi1

[root@Tecmint ~]#xe vif-create vm-uuid=6eab5bdd-c277-e55d-0363-dcf186c8e8e network-uuid=cf987f0-b37c-dbd7-39be-36e7bfd94cef device=0
677560b6-be0d-c236-b753-1313e2a0ce40
```

Step 18: The virtual machine is ready to boot and install! To start the guest, issue the following ‘xe’ command.



```
[root@Tecmint ~]#xe vm-start name-label=TecmintVM
[root@Tecmint ~]#xe vm-list name-label=TecmintVM
uuid ( RO) : 6eab5bdd-c277-e55d-0363-dcf186c8e8e
    name-label ( RW): TecmintVM
    power-state ( RO): running
```

### Conclusion:

A bare metal Hypervisor Xen server is created and installed directly on the hardware in which a guest machine is tried to be installed and has been successfully completed.



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**Experiment No.: 4**

**Aim:** To demonstrate installation of Open stack private cloud.

**Objective:** Implement IaaS using your resources.

**Technology:** Open Stack

**Theory:**

It is a free open standard cloud computing platform that first came into existence on July 21' 2010. It was a joint project of Rackspace Hosting and NASA to make cloud computing more ubiquitous in nature. It is deployed as Infrastructure-as-a-service(IaaS) in both public and private clouds where virtual resources are made available to the users. The software platform contains interrelated components that control multi-vendor hardware pools of processing, storage, networking resources through a data center.

In OpenStack, the tools which are used to build this platform are referred to as “projects”. These projects handle a large number of services including computing, networking, and storage services. Unlike virtualization, in which resources such as RAM, CPU, etc are abstracted from the hardware using hypervisors, OpenStack uses a number of APIs to abstract those resources so that users and the administrators are able to directly interact with the cloud services.

OpenStack is a free open standard cloud computing platform, mostly deployed as infrastructure-as-a-service (IaaS) in both public and private clouds where virtual servers and other resources are made available to users. The software platform consists of interrelated components that control diverse, multi-vendor hardware pools of processing, storage, and networking resources throughout a data center. Users either manage it through a web-based dashboard, through command-line tools, or through RESTful web services.

OpenStack includes the ability to provide on-demand networks, IP addresses, firewalls and routers. Basic capabilities for these are built-in and OpenStack can also be integrated with telco-oriented SDN offerings from network equipment providers such as Juniper, Cisco and Nokia. For a business, the ability to define networks through an API enables fast-paced infrastructure automation and cloud-style operations.

Similarly, OpenStack includes a framework for software-defined storage, including both block ('disk') and object storage mechanisms. There are pure software implementations of these that are built in to OpenStack, but it is also possible to integrate with third-party offerings from EMC, NetApp, Pure Storage and others.

**Benefits of Using OpenStack in Your Business**

Well, first of all, OpenStack comes with practically all of the benefits of cloud computing. That means it:

Enables rapid innovation

OpenStack's orchestration and self-service capabilities offers developers and IT staff with faster



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and better access to IT resources. Because developers can provision machines rapidly and on-demand, they can significantly reduce development and testing periods and have more freedom to experiment with new ideas.

**Cuts down time-to-market**

Faster deployment of IT resources also means end users and business units no longer have to wait days or weeks to start using the network services and applications they need. In turn, they would be more capable of rolling out and completing projects earlier than before.

**Boosts scalability and resource utilization**

Although not as scalable as public clouds, OpenStack private clouds still offer a significant degree of scalability. You can still spin up and spin down servers on-demand. So, for example, if one department encounters a surge in demand for computing resources, IT resources may be temporarily redirected from other departments to the one that currently needs it the most.

In addition, OpenStack also provides the following advantages over public clouds and proprietary cloud solutions:

**Eases regulatory compliance**

Because OpenStack enables the construction of private, on-premise clouds, it can help in regulatory compliance endeavors. If your cloud is in your own data center, you'll have more control of access privileges, security measures, and security policies. You can personally take charge of ensuring that policies for securing personal data, financial data, and other confidential and regulated information are actually enforced and not just printed on a piece of paper.

**Devoid of vendor lock-in**

One major problem with using a proprietary solution is vendor lock-in. If you're not happy with the vendor's services or the vendor closes shop, you cannot easily hop on to the next. OpenStack supports a variety of proprietary technologies and can operate in a smorgasbord of hypervisor and bare metal environments. Its ability to work with commodity hardware gives you more flexibility in choosing solutions based on a wider range of costs and competencies.

### **Challenges of Using OpenStack in Your Business**

In case you haven't noticed, we didn't include "cost savings" as one of the benefits of using OpenStack. That's because if you really compute for the total cost of ownership (TCO), the OpenStack route of building a private cloud won't be significantly cheaper than the proprietary route. In fact, in some cases, it could end up higher.

**Scarcity of talent**

Like many open source solutions, OpenStack initially appears to provide a much cheaper alternative to proprietary counterparts when, in reality, it's often not the case. Generally speaking, the talent pool for most open source solutions is quite limited.

As a result, the hourly rates of the experts in the field tend to be much higher. Thus, what ever you



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may save on license fees will usually be offset by professional fees, especially if you're a small business and don't have the required talent in-house.

May take longer to implement

Even assuming you have your own IT department and you decide to send out one or two staff members for training, that's still going to cost you. Besides, because OpenStack involves a rather steep learning curve, it might take some time before your staff can fully implement what they learn. That delay should be taken into consideration as well.

On the flip side, if available support for a particular proprietary solution starts to decrease or totally disappears (like if the developers go bankrupt), the pay scale of engineers of that solution and its associated technologies will naturally go up. An OpenStack environment won't be as exposed to this kind of risk because it's free from vendor lock-in.

### **OpenStack components**

Apart from various projects which constitute the OpenStack platform, there are nine major services namely Nova, Neutron, Swift, Cinder, Keystone, Horizon, Ceilometer, and Heat. Here is the basic definition of all the components which will give us a basic idea about these components.

**Nova (compute service):** It manages the compute resources like creating, deleting, and handling the scheduling. It can be seen as a program dedicated to the automation of resources that are responsible for the virtualization of services and high-performance computing.

**Neutron (networking service):** It is responsible for connecting all the networks across OpenStack. It is an API driven service that manages all networks and IP addresses.

**Swift (object storage):** It is an object storage service with high fault tolerance capabilities and it used to retrieve unstructured data objects with the help of Restful API. Being a distributed platform, it is also used to provide redundant storage within servers that are clustered together. It is able to successfully manage petabytes of data.

**Cinder (block storage):** It is responsible for providing persistent block storage that is made accessible using an API (self-service). Consequently, it allows users to define and manage the amount of cloud storage required.

**Keystone (identity service provider):** It is responsible for all types of authentications and authorizations in the OpenStack services. It is a directory-based service that uses a central repository to map the correct services with the correct user.

**Glance (image service provider):** It is responsible for registering, storing, and retrieving virtual disk images from the complete network. These images are stored in a wide range of back-end systems.

**Horizon (dashboard):** It is responsible for providing a web-based interface for OpenStack services. It is used to manage, provision, and monitor cloud resources.

**Ceilometer (telemetry):** It is responsible for metering and billing of services used. Also, it is used to generate alarms when a certain threshold is exceeded.

**Heat (orchestration):** It is used for on-demand service provisioning with auto-scaling of cloud resources. It works in coordination with the ceilometer.



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**DevStack Minimum Requirements**

- Fresh installation of Ubuntu 18.04
- Minimum memory of 4 GB
- At least 2 vCPU
- The storage capacity of 10 GB should be sufficient.
- Internet connection
- User with sudo

**Output:**

1) sudo su – To enter the root of the linux

```
root@shah-VirtualBox: /home/shah
File Edit View Search Terminal Help
To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

shah@shah-VirtualBox:~$ sudo su
[sudo] password for shah:
root@shah-VirtualBox:/home/shah#
```

2) apt update -y && apt upgrade -y – Updated the ubuntu repository

```
root@shah-VirtualBox:/home/shah# apt update -y && apt upgrade -y
Hit:1 http://in.archive.ubuntu.com/ubuntu bionic InRelease
Get:2 http://in.archive.ubuntu.com/ubuntu bionic-updates InRelease [88.7 kB]
Get:3 http://security.ubuntu.com/ubuntu bionic-security InRelease [88.7 kB]
Get:4 http://in.archive.ubuntu.com/ubuntu bionic-backports InRelease [74.6 kB]
Get:5 http://in.archive.ubuntu.com/ubuntu bionic-updates/main amd64 Packages [1,913 kB]
Get:6 http://in.archive.ubuntu.com/ubuntu bionic-updates/main i386 Packages [1,228 kB]
Get:7 http://in.archive.ubuntu.com/ubuntu bionic-updates/main Translation-en [394 kB]
Get:8 http://in.archive.ubuntu.com/ubuntu bionic-updates/main amd64 DEP-11 Metadata [295 kB]
Get:9 http://security.ubuntu.com/ubuntu bionic-security/main i386 Packages [925 kB]
Get:10 http://in.archive.ubuntu.com/ubuntu bionic-updates/restricted amd64 Packages [256 kB]
Get:11 http://in.archive.ubuntu.com/ubuntu bionic-updates/restricted Translation-en [34.3 kB]
```

3) sudo reboot

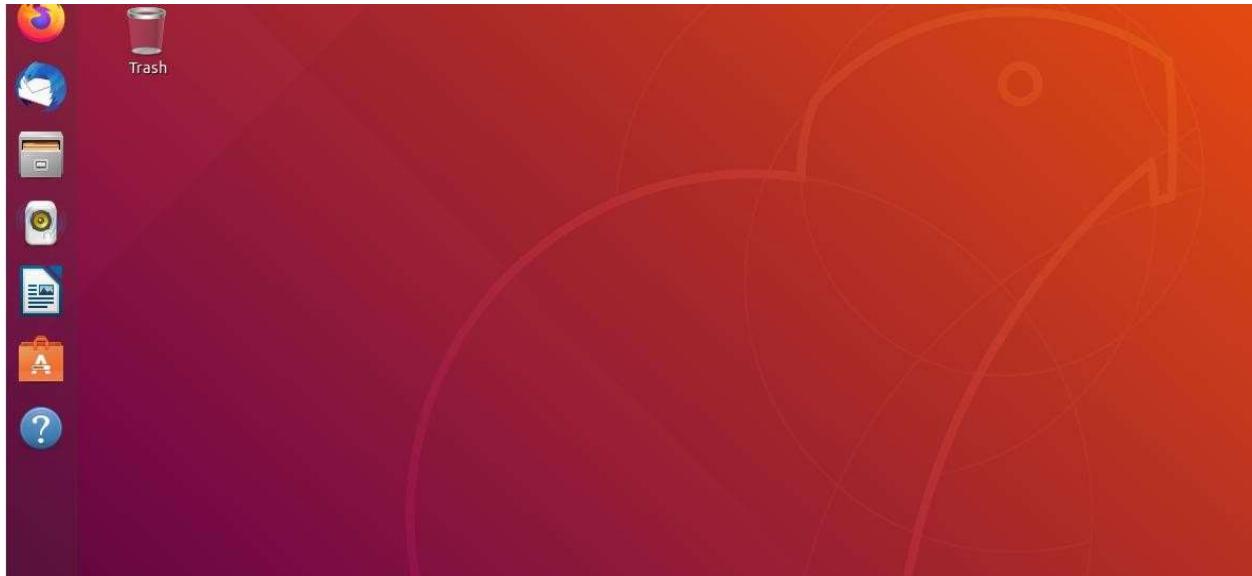


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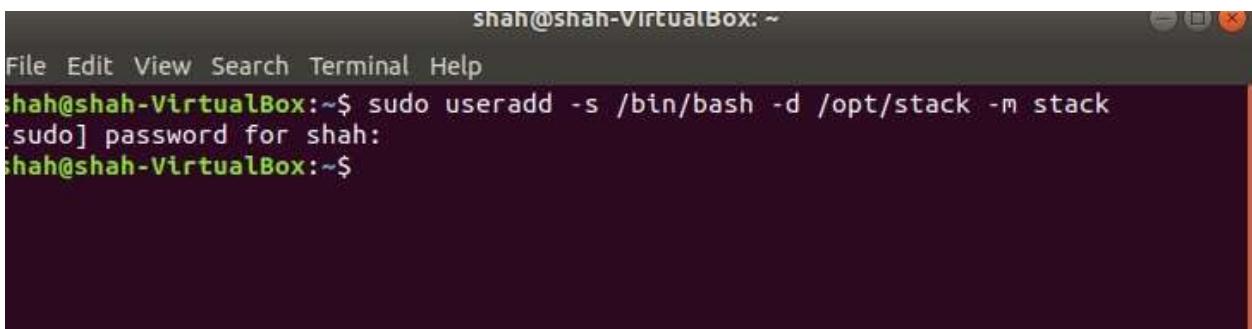
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```
Found cpio image: /boot/vmlinuz-5.4.0-66-generic
Found initrd image: /boot/initrd.img-5.4.0-66-generic
Found linux image: /boot/vmlinuz-5.0.0-23-generic
Found initrd image: /boot/initrd.img-5.0.0-23-generic
Found memtest86+ image: /boot/memtest86+.elf
Found memtest86+ image: /boot/memtest86+.bin
done
Processing triggers for systemd (237-3ubuntu10.44) ...
root@shah-VirtualBox:/home/shah# sudo reboot
```



4) sudo useradd -s /bin/bash -d /opt/stack -m stack



```
5) echo "stack ALL=(ALL) NOPASSWD: ALL" | sudo tee /etc/sudoers.d/stack
```



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```
shah@shah-VirtualBox:~$ echo "stack ALL=(ALL) NOPASSWD: ALL" | sudo tee /etc/sudoers.d/stack
stack ALL=(ALL) NOPASSWD: ALL
shah@shah-VirtualBox:~$ █
```

6) sudo apt install git -y – Installed git on Ubuntu

```
stack@shah-VirtualBox:~$ sudo apt install git -y
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following packages were automatically installed and are no longer required:
  efibootmgr gir1.2-geocodeglib-1.0 libegl1-mesa libfwupd liblvm8
  libwayland-egl1-mesa ubuntu-web-launchers
Use 'sudo apt autoremove' to remove them.
The following additional packages will be installed:
  git-man liberror-perl
Suggested packages:
  git-daemon-run | git-daemon-sysvinit git-doc git-el git-email git-gui gitk
  gitweb git-cvs git-mediawiki git-svn
The following NEW packages will be installed:
  git git-man liberror-perl
0 upgraded, 3 newly installed, 0 to remove and 0 not upgraded.
Need to get 4,741 kB of archives.
After this operation, 34.0 MB of additional disk space will be used.
```

7) sudo su – stack

```
shah@shah-VirtualBox:~$ sudo su - stack
stack@shah-VirtualBox:~$ █
```

8) git clone <https://github.com/openstack-dev/devs... -b stable/pike devstack/> -

Downloaded the latest git repository for openstack



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```
stack@shah-VirtualBox:~$ git clone https://github.com/openstack-dev/devstack.git  
-b stable/pike devstack/  
Cloning into 'devstack'...  
remote: Enumerating objects: 236, done.  
remote: Counting objects: 100% (236/236), done.  
remote: Compressing objects: 100% (166/166), done.  
remote: Total 46650 (delta 142), reused 132 (delta 68), pack-reused 46414  
Receiving objects: 100% (46650/46650), 14.91 MiB | 3.24 MiB/s, done.  
Resolving deltas: 100% (32485/32485), done.  
stack@shah-VirtualBox:~$
```

9) cd devstack/ - opened the devstack directory

```
stack@shah-VirtualBox:~/devstack$  
stack@shah-VirtualBox:~/devstack$
```

10) sudo apt install net-tools

```
stack@shah-VirtualBox:~/devstack$ sudo apt install net-tools  
Reading package lists... Done  
Building dependency tree  
Reading state information... Done  
The following packages were automatically installed and are no longer required:  
  efibootmgr gir1.2-geocodeglib-1.0 libegl1-mesa libfwupd liblvm8  
  libwayland-egl1-mesa ubuntu-web-launchers  
Use 'sudo apt autoremove' to remove them.  
The following NEW packages will be installed:
```

11) ifconfig – The Ip address to access the dashboard of openstack after installation is done

```
stack@shah-VirtualBox:~/devstack$ ifconfig  
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500  
      inet 10.0.2.15 netmask 255.255.255.0 broadcast 10.0.2.255  
        inet6 fe80::83a3:36ea:60ce:58f7 prefixlen 64 scopeid 0x20<link>  
          ether 08:00:27:5c:0f:ab txqueuelen 1000 (Ethernet)  
            RX packets 19747 bytes 25768117 (25.7 MB)  
            RX errors 0 dropped 0 overruns 0 frame 0  
            TX packets 2743 bytes 190835 (190.8 KB)  
            TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0  
  
lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536  
      inet 127.0.0.1 netmask 255.0.0.0  
        inet6 ::1 prefixlen 128 scopeid 0x10<host>  
          loop txqueuelen 1000 (Local Loopback)  
            RX packets 205 bytes 17150 (17.1 KB)  
            RX errors 0 dropped 0 overruns 0 frame 0  
            TX packets 205 bytes 17150 (17.1 KB)  
            TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```



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12) [[local|localrc]] ADMIN\_PASSWORD=secret  
DATABASE\_PASSWORD=\\$ADMIN\_PASSWORD  
RABBIT\_PASSWORD=\\$ADMIN\_PASSWORD  
SERVICE\_PASSWORD=\\$ADMIN\_PASSWORD HOST\_IP=10.0.2.15 RECLONE=yes EOF  
Set the password, rabbit, service authentication, horizon, keystone

```
stack@shah-VirtualBox:~/devstack$ cat > local.conf <<EOF
> [[local|localrc]]
> ADMIN_PASSWORD=secret
> DATABASE_PASSWORD=\$ADMIN_PASSWORD
> RABBIT_PASSWORD=\$ADMIN_PASSWORD
> SERVICE_PASSWORD=\$ADMIN_PASSWORD
> HOST_IP=10.0.2.15
> RECLONE=yes
> EOF
stack@shah-VirtualBox:~/devstack$
```

13) FORCE=yes ./stack.sh – started the installation by executing stack.sh shell script

```
Setting up erlang-tools (1:20.2.2+dfsg-1ubuntu2) ...
Setting up erlang-tools (1:20.2.2+dfsg-1ubuntu2) ...
Setting up erlang-diameter (1:20.2.2+dfsg-1ubuntu2) ...
Setting up erlang-ssh (1:20.2.2+dfsg-1ubuntu2) ...
Setting up erlang-os-mon (1:20.2.2+dfsg-1ubuntu2) ...
Setting up erlang-eldap (1:20.2.2+dfsg-1ubuntu2) ...
Setting up erlang-edoc (1:20.2.2+dfsg-1ubuntu2) ...
Setting up erlang-corba (1:20.2.2+dfsg-1ubuntu2) ...
Setting up erlang-erl-docgen (1:20.2.2+dfsg-1ubuntu2) ...
Setting up erlang-nox (1:20.2.2+dfsg-1ubuntu2) ...
Setting up rabbitmq-server (3.6.10-1ubuntu0.4) ...
Adding group `rabbitmq' (GID 132) ...
Done.
Adding system user `rabbitmq' (UID 127) ...
Adding new user `rabbitmq' (UID 127) with group `rabbitmq' ...
Not creating home directory `/var/lib/rabbitmq'.
Created symlink /etc/systemd/system/multi-user.target.wants/rabbitmq-server.service → /lib/systemd/system/rabbitmq-server.service.
Processing triggers for systemd (237-3ubuntu10.44) ...
Processing triggers for man-db (2.8.3-2ubuntu0.1) ...
Processing triggers for ureadahead (0.100.0-21) ...
Processing triggers for libc-bin (2.27-3ubuntu1.4) ...
```

14) Openstack access the Horizon dashboard with below URL: <http://10.0.2.15/dashboard> - a new user created can be used for login where the username is admin and password is secret



15) Creation of a project to run on cloud in openstack  
Create a Project and add a member to the Project

Login to the dashboard using Admin credentials and Go to **Identity Tab** → **Projects and Click on Create Project**

**To create Users , Go to Identity Tab-> Users-> Click on ‘Create User’ Button then specify User Name, email, password, Primary Project and Role and click on create user to add in to OpenStack workspace.**



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The screenshot shows the OpenStack Identity / Projects interface. The top navigation bar includes 'openstack' and 'alt\_demo'. The left sidebar has 'Project', 'Admin', and 'Identity' tabs, with 'Identity' being the active tab. The main content area is titled 'Projects' and displays a table of project details. The columns are: Name, Description, Project ID, Domain Name, Enabled, and Actions. The table contains five entries:

Name	Description	Project ID	Domain Name	Enabled	Actions
service		658a0f563a7b4a978734531968c859ec	Default	Yes	Manage Members
alt_demo		b9fb25d580c844fabb3001d61182385e	Default	Yes	Manage Members
demo		c0f5b140bfee447ea2030a78d8996a72	Default	Yes	Manage Members
Invisible_to_admin		c9609da33fdc45fe9d30b195a143a3e8	Default	Yes	Manage Members
admin	Bootstrap project for initializing the cloud.	fa715732d0cf441381194d7521f1eec2	Default	Yes	Manage Members

At the bottom of the table, it says 'Displaying 5 items'.

**16) Create Image and Flavor**

**a)** create flavor - To create a flavor login in dashboard using admin credentials, Go to **Admin Tab** **> Flavors > Click on create Flavor.**

Specify the Flavor Name (fedora.small) , VCPU , Root Disk , Ephemeral Disk & Swap disk.



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Flavor Name	VCPUs	RAM	Root Disk	Ephemeral Disk	Swap Disk	ID	Public	Metadata	Actions
m1.tiny	1	512MB	1GB	0GB	0MB	1	Yes	No	Edit Flavor
m1.small	1	2GB	20GB	0GB	0MB	2	Yes	No	Edit Flavor
m1.medium	2	4GB	40GB	0GB	0MB	3	Yes	No	Edit Flavor
m1.large	4	8GB	80GB	0GB	0MB	4	Yes	No	Edit Flavor
m1.xlarge	8	16GB	160GB	0GB	0MB	5	Yes	No	Edit Flavor

Flavor Information \*      Flavor Access

Name \*: tedora.small  
ID \*: auto  
VCPUs \*: 1  
RAM (MB) \*: 1024  
Root Disk (GB) \*: 10  
Ephemeral Disk (GB): 2  
Swap Disk (MB): 512

Flavors define the sizes for RAM, disk, number of cores, and other resources and can be selected when users deploy instances.

Public	Metadata	Actions
Yes	No	Edit Flavor



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b) create Image

To Create Image, **Go to Admin Tab → Images→ Click on Create Image.**

Specify the Image Name , Description, Image Source (here using Fedora Image File which have already been downloaded from fedora website with Format QCOW2)

The screenshot shows the 'Images' section of the OpenStack Dashboard. On the left, there is a sidebar with 'Project', 'Admin', and 'System' sections. Under 'System', 'Images' is selected. The main area has a title 'Images' and a sub-section 'Image'. The 'Create Image' form is displayed:

- Name \***: fedora-image
- Description**: fedora-image
- Description** (info): Specify an image to upload to the Image Service.  
Currently only Images available via an HTTP URL are supported. The Image location must be accessible to the Image Service. Compressed image binaries are supported (.zip and .tar.gz.)
- Image Source**: Image File
- Image File**:  (The file path 'Fedora-Cloud-Base-23-20151030.x86\_64.qcow2' is highlighted with a red oval)
- Please note:** The Image Location field MUST be a valid and direct URL to the image binary. URLs that redirect or serve error pages will result in unusable images.
- Format \***: QCOW2 - QEMU Emulator
- Architecture**: (empty input field)
- Minimum Disk (GB) \***: (empty input field)
- Minimum RAM (MB) \***: (empty input field)
- Public**:



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**17) Create Network for Project**

To create Network and router for Innovation project sign out of admin user and login as local user in dashboard.

Internal Network = 10.10.10.0/24

External Network or Floating IP Network = 192.168.1.0/24

Create Network

Subnet

Subnet Name: sub-internal

Network Address: 10.10.0.0/24

IP Version: IPv4

Gateway IP:

Disable Gateway

Create a subnet associated with the network. Advanced configuration is available by clicking on the "Subnet Details" tab.

Cancel Back Next

Subnet Details

Enable DHCP:

Allocation Pools:

DNS Name Servers:

Host Routes:

Specify additional attributes for the subnet.

Cancel Back Create

Network

Network Name: external

Admin State: UP

Create Subnet

Create a new network. In addition, a subnet associated with the network can be created in the next panel.

Cancel Back Next

Gateway of External Network = 192.168.1.1

Now, go to the **Network Tab** —> **Click on Networks** —> **then Click on Create Network**

Specify the Network Name as Internal

Click on Next.

Then Specify the Subnet name (sub-internal) and Network Address (10.10.0.0/24)



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Click on Next.

VMs will be getting internal IP from DHCP Server as enabled DHCP option for internal network.

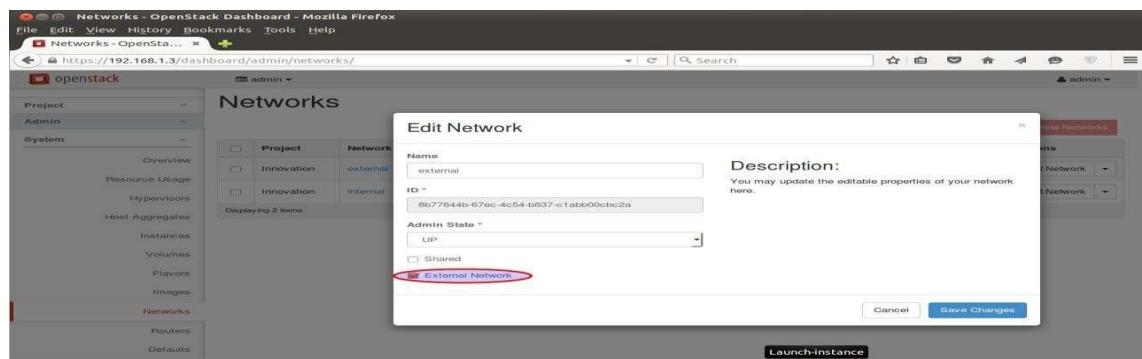
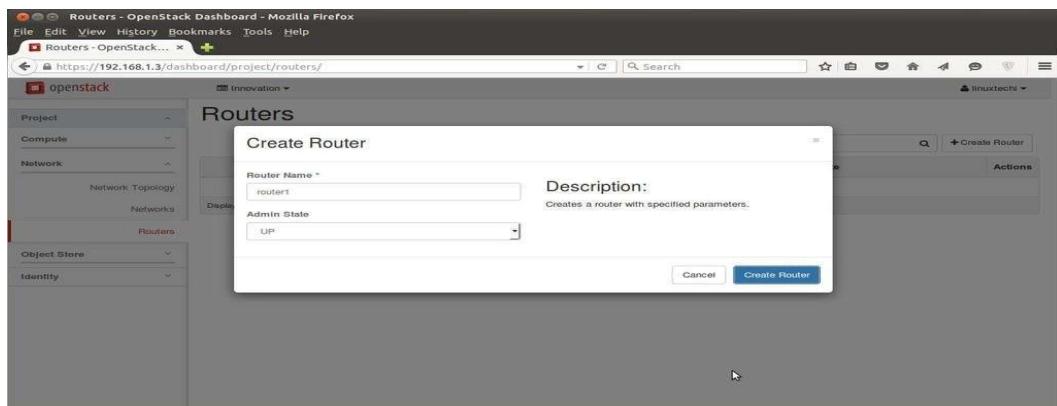
18) Create External Network.

Click on “**Create Network**” again, Specify Network Name as “**external**”

Click on Next. Specify subnet Name as “**sub-external**” & Network Address as “**192.168.1.0/24**”

19) Create Router for the Project

To create router, Go to **Network Tab** → **Routers** → Click on ‘+ Create Router’



Click on Save Changes. Now Logout from admin user and login as local user. Go to Network



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## 20) Set Gateway

**Tab —> Routers —> for Router1 click on “Set Gateway”**

Click on “**Set Gateway**”, this will add an interface on router and will assign the first ip of external subnet (192.168.1.0/24).

The screenshot shows the OpenStack Dashboard with the 'Routers' tab selected. A modal dialog titled 'Set Gateway' is open for Router1. The 'External Network' dropdown is set to 'external'. The 'Router Name' field contains 'router1'. The 'Router ID' field shows the UUID '43836923-bfce-4e1e-b401-62cc568c15e7'. The 'Description' text area provides information about connecting an external network to the router. At the bottom right of the dialog are 'Cancel' and 'Set Gateway' buttons, with 'Set Gateway' being highlighted.

The screenshot shows the OpenStack Dashboard with the 'Router Details' tab selected for Router1. A modal dialog titled 'Add Interface' is open. The 'Subnet' dropdown is set to 'internal: 10.10.0.0/24 (sub-internal)'. The 'IP Address (optional)' field is empty. The 'Router Name' field contains 'router1'. The 'Router ID' field shows the UUID '43836923-bfce-4e1e-b401-62cc568c15e7'. The 'Description' text area provides information about connecting a subnet to the router. At the bottom right of the dialog are 'Cancel' and 'Add Interface' buttons, with 'Add Interface' being highlighted.



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**Access & Security - OpenStack Dashboard - Mozilla Firefox**

[https://192.168.1.3/dashboard/project/access\\_and\\_security/](https://192.168.1.3/dashboard/project/access_and_security/)

**Create Security Group**

Name \*: fedora-rules  
Description: fedora-rules

Description:  
Security groups are sets of IP filter rules that are applied to the network settings for the VM. After the security group is created, you can add rules to the security group.

Cancel Create Security Group

Project: Compute  
Compute: Overview, Instances, Volumes, Images  
Access & Security: Network, Object Store, Identity

**Manage Security Group Rules - OpenStack Dashboard - Mozilla Firefox**

[https://192.168.1.3/dashboard/project/access\\_and\\_security/security\\_groups/db214103-ac5f-45ce-a4](https://192.168.1.3/dashboard/project/access_and_security/security_groups/db214103-ac5f-45ce-a4)

**Add Rule**

Rule \*: SSH  
Remote \*: CIDR  
CIDR \*: 0.0.0.0/0

Description:  
Rules define which traffic is allowed to instances assigned to the security group. A security group rule consists of three main parts:  
**Rule:** You can specify the desired rule template or use custom rules, the options are Custom TCP Rule, Custom UDP Rule, or Custom ICMP Rule.  
**Open Port/Port Range:** For TCP and UDP rules you may choose to open either a single port or a range of ports. Selecting the "Port Range" option will provide you with space to provide both the starting and ending ports for the range. For ICMP rules you instead specify an ICMP type and code in the spaces provided.  
**Remote:** You must specify the source of the traffic to be allowed via this rule. You may do so either in the form of an IP address block (CIDR) or via a source group (Security Group). Selecting a security group as the source will allow any other instance in that security group access to any other instance via this rule.

Cancel Add

Project: Compute  
Compute: Overview, Instances, Volumes, Images  
Access & Security: Network, Object Store, Identity

## 21) Launch Instance

Go to **Compute Tab** → **Click on Instances** → then click on '**Launch Instance**'  
Specify the Instance Name, Flavor that we created in above steps and '**Boot from image**' from Instance Boot Source option and Select Image Name '**fedora-image**'.



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The image consists of three vertically stacked screenshots of the OpenStack Dashboard, specifically the Instances section. Each screenshot shows the 'Launch Instance' dialog box over a list of existing instances.

- Screenshot 1:** Shows the 'Details' tab of the 'Launch Instance' dialog. Fields include:
  - Availability Zone: nova
  - Instance Name: fedora23
  - Flavor: fedora.small
  - Instance Count: 1
  - Instance Boot Source: Boot from Image
  - Image Name: fedora-image (223.5 MB)Below the form, a 'Flavor Details' table shows:

Name	fedora.small
VCPUs	1
Root Disk	10 GB
Ephemeral Disk	2 GB
Total Disk	12 GB
RAM	1,024 MB

A 'Project Limits' section indicates 0 of 10 allowed instances and 0 of 20 allowed VCPUs.
- Screenshot 2:** Shows the 'Access & Security' tab of the 'Launch Instance' dialog. It includes fields for 'Key Pair' (myssh-keys) and 'Security Groups' (default, fedora-rules). The 'Launch' button is at the bottom right.
- Screenshot 3:** Shows the 'Networking' tab of the 'Launch Instance' dialog. It displays 'Selected networks' (NIC 1: Internal) and 'Available networks' (external). The 'Launch' button is at the bottom right.

**22) Click on ‘Access & Security’ and Select the Security Group ‘fedora-rules’ & Key Pair “myssh- keys”**



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23) After VM is launched , Associate a floating ip so that we can access the VM.

The image consists of three vertically stacked screenshots of the OpenStack Dashboard, specifically the Instances page.

- Screenshot 1:** Shows the "Allocate Floating IP" dialog box. The "Pool" dropdown is set to "external". The "Description" field contains the placeholder "Allocate a floating IP from a given floating IP pool." Below it, "Project Quotas" are listed, showing "Floating IP (0)" and "0 Available". At the bottom are "Cancel" and "Allocate IP" buttons.
- Screenshot 2:** Shows the "Manage Floating IP Associations" dialog box. It has fields for "IP Address" (set to "192.168.1.20") and "Port to be associated" (set to "fedora23: 10.10.0.3"). A message at the top says "Success: Allocated Floating IP 192.168.1.20." At the bottom are "Cancel" and "Associate" buttons.
- Screenshot 3:** Shows the main Instances table. It lists one item: "fedora23" (Instance Name), "fedora-image" (Image Name), "10.10.0.3" (IP Address). To the right of the table is a context menu with various options, including "Associate Floating IP" which is highlighted with a red box.

24) Click on 'Associate Floating IP' to get public IP addresses



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The image consists of three vertically stacked screenshots of the OpenStack Dashboard, specifically the Instances page.

**Screenshot 1: Instances - OpenStack Dashboard**  
This screenshot shows a table of instances. One instance, "fedora23", is listed with the details: Instance Name: fedora23, Image Name: fedora-image, IP Address: 10.10.0.3, Size: fedora.small, Key Pair: myssh-keys, Status: Active, Availability Zone: nova, Task: None, Power State: Running, and Time since created: 0 minutes. To the right of the table is a context menu with various actions, one of which is "Associate Floating IP".

Instance Name	Image Name	IP Address	Size	Key Pair	Status	Availability Zone	Task	Power State	Time since created	Actions
fedora23	fedora-image	10.10.0.3	fedora.small	myssh-keys	Active	nova	None	Running	0 minutes	Create Snapshot Associate Floating IP Attach Interface Detach Interface Edit Instance Edit Security Groups Console View Log Pause Instance Suspend Instance Shelve Instance Resize Instance Lock Instance Unlock Instance

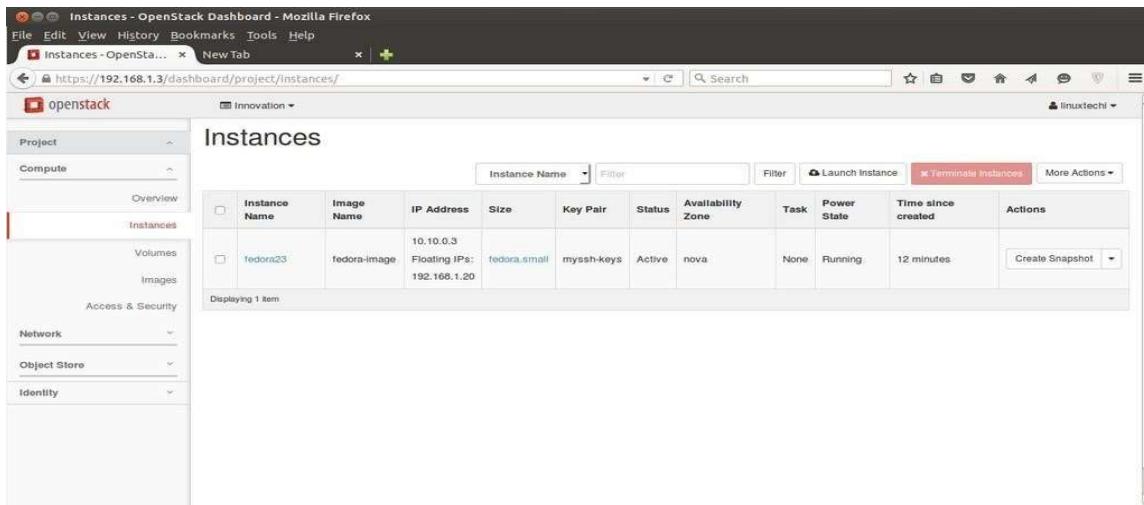
**Screenshot 2: Instances - OpenStack Dashboard**  
This screenshot shows the "Allocate Floating IP" dialog box. It has a dropdown menu for "Pool" set to "external". The "Description" field contains the placeholder "Allocate a floating IP from a given floating IP pool.". Below it, "Project Quotas" show "Floating IP (0)" available. At the bottom are "Cancel" and "Allocate IP" buttons.

**Screenshot 3: Instances - OpenStack Dashboard**  
This screenshot shows the "Manage Floating IP Associations" dialog box. It lists an association: IP Address: 192.168.1.20, Port to be associated: fedora23: 10.10.0.3. A success message box is overlaid on the main dashboard, stating "Success: Allocated Floating IP 192.168.1.20." The status bar at the bottom right says "Current workspace: 'Workspace 1'".

25) access the VM with floating IP ( 192.168.1.20) using keys



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Instance Name	Image Name	IP Address	Size	Key Pair	Status	Availability Zone	Task	Power State	Time since created	Actions
fedora23	Fedora-Image	10.10.0.3 Floating IPs: 192.168.1.20	tedora.small	myssh-keys	Active	nova	None	Running	12 minutes	<button>Create Snapshot</button>

```
[root@openstack ~]# ls -l myssh-keys.pem
-rw-r--r--. 1 root root 1683 Jan  2 12:30 myssh-keys.pem
[root@openstack ~]# chmod 600 myssh-keys.pem

[root@openstack ~]# ssh -i myssh-keys.pem 192.168.1.20 -l fedora
The authenticity of host '192.168.1.20 (192.168.1.20)' can't be established.
RSA key fingerprint is 99:d0:da:3d:d2:41:89:fc:df:97:d3:25:b9:29:9b:22.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '192.168.1.20' (RSA) to the list of known hosts.
[fedora@fedora23 ~]$ sudo su -
[root@fedora23 ~]# cat /etc/redhat-release
Fedora release 23 (Twenty Three)
[root@fedora23 ~]#
```

### Conclusion:

OpenStack is a cloud operating system that controls large pools of compute, storage, and networking resources throughout a datacenter, all managed and provisioned through APIs with common authentication mechanisms.



**Aim:** Explore storage as a service using Own cloud for remote file access using web interfaces.

**Technology:** ownCloud

**Theory:**

An incredibly versatile tool, ownCloud is a free, open-source application that lets you build more than a Dropbox replacement to dump your data. Along with data storage, the app comes with a number of other features such as a way to manage your calendar, to-do lists, a document editing tool and many more.

OwnCloud is a file sharing server that permits you to store your personal content, like documents and pictures, in a centralized location, much like Dropbox. The difference with ownCloud is that it is free and open-source, which allows anyone to use and examine it. It also returns the control and security of your sensitive data back to you, thus eliminating the utilization of a third-party cloud hosting service.

OwnCloud is an open-source file sync and share software for everyone from individuals operating the free ownCloud Server edition, to large enterprises and service providers operating the ownCloud Enterprise Subscription. ownCloud provides a safe, secure, and compliant file synchronization and sharing solution on servers that you control.

You can share one or more files and folders on your computer, and synchronize them with your ownCloud server. Place files in your local shared directories, and those files are immediately synchronized to the server and to other devices using the ownCloud Desktop Sync Client, Android app, or iOS app

ownCloud is a suite of client-server software for creating and using file hosting services. ownCloud functionally has similarities to the widely used Dropbox. The primary functional difference between ownCloud and Dropbox is that ownCloud does not offer data center capacity to host stored files. The Server Edition of ownCloud is free and open-source, thereby allowing anyone to install and operate it without charge on their own private server.

ownCloud supports extensions that allow it to work like Google Drive, with online document editing, calendar and contact synchronization, and more. Its openness avoids enforced quotas on storage space or the number of connected clients, instead of having hard limits (for example on storage space or number of users) limits are determined by the physical capabilities of the server.

**Prerequisite to install ownCloud**

- 1) A sudo user on your server: You can create a user with sudo privileges by following the Ubuntu initial server setup guide.
- 2) A LAMP stack: ownCloud requires a web server, a database, and PHP to function properly. Setting up a LAMP stack (Linux, Apache, MySQL, and PHP) server fulfills all of these requirements.



- To take full advantage of all the features that ownCloud has to offer, make sure to install the following PHP modules: php-bz2, php-curl, php-gd, php-imagick, php-intl, php-mbstring, php-xml, and php-zip.
- 3) An SSL certificate: How you set this up depends on whether or not you have a domain name that resolves to your server.
  - If you have a domain name... the easiest way to secure your site is with Let's Encrypt, which provides free, trusted certificates. Follow the Let's Encrypt guide for Apache to set this up.
  - If you do not have a domain... and you are just using this configuration for testing or personal use, you can use a self-signed certificate instead. This provides the same type of encryption, but without the domain validation. Follow the self-signed SSL guide for Apache to get set up.

### **Output:**

Installation of ownCloud:

- 1) Installation of LAMP – php, mysql, apache, ssl
  - Install Apache
  - Commands - sudo apt install apache2
  - a2dismod autoindex
  - \$ sudo a2enmod rewrite
  - \$ sudo a2enmod headers
  - \$ sudo a2enmod env
  - \$ sudo a2enmod dir
  - \$ sudo a2enmod mime
  - \$ sudo systemctl restart apache2



```
shah@shah-VirtualBox:~$ sudo apt install apache2
[sudo] password for shah:
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
  apache2-bin apache2-data apache2-utils libapr1 libaprutil1
    libaprutil1-dbd-sqlite3 libaprutil1-ldap liblua5.2-0
Suggested packages:
  apache2-doc apache2-suexec-pristine | apache2-suexec-custom
The following NEW packages will be installed:
  apache2 apache2-bin apache2-data apache2-utils libapr1 libaprutil1
    libaprutil1-dbd-sqlite3 libaprutil1-ldap liblua5.2-0
0 upgraded, 9 newly installed, 0 to remove and 0 not upgraded.
Need to get 1,710 kB of archives.
After this operation, 6,932 kB of additional disk space will be used.
Do you want to continue? [Y/n] y
Get:1 http://in.archive.ubuntu.com/ubuntu bionic/main amd64 libapr1 amd64 1.6.3-2 [90.9 kB]
Get:2 http://in.archive.ubuntu.com/ubuntu bionic/main amd64 libaprutil1 amd64 1.
shah@shah-VirtualBox:~$ sudo a2enmod rewrite
Enabling module rewrite.
To activate the new configuration, you need to run:
  systemctl restart apache2
shah@shah-VirtualBox:~$ sudo a2enmod headers
Enabling module headers.
To activate the new configuration, you need to run:
  systemctl restart apache2
shah@shah-VirtualBox:~$ sudo a2enmod env
Module env already enabled
shah@shah-VirtualBox:~$ sudo a2enmod dir
Module dir already enabled
shah@shah-VirtualBox:~$ sudo a2enmod mime
Module mime already enabled
shah@shah-VirtualBox:~$ █
```

2) Installing MariaDB Server

```
$ sudo apt-get install mariadb-server mariadb-client
```



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```
shah@shah-VirtualBox:~$ sudo apt-get install mariadb-server mariadb-client
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
galera-3 gawk libaio1 libconfig-inifiles-perl libdbd-mysql-perl libdbi-perl
libhtml-template-perl libjemalloc1 libmysqlclient20 libreadline5 libsigsegv2
libterm-readkey-perl mariadb-client-10.1 mariadb-client-core-10.1
mariadb-common mariadb-server-10.1 mariadb-server-core-10.1 mysql-common
socat
Suggested packages:
gawk-doc liblmbm-perl libnet-daemon-perl libsql-statement-perl
libipc-sharedcache-perl mailx tinyca
The following NEW packages will be installed:
galera-3 gawk libaio1 libconfig-inifiles-perl libdbd-mysql-perl libdbi-perl
libhtml-template-perl libjemalloc1 libmysqlclient20 libreadline5 libsigsegv2
libterm-readkey-perl mariadb-client mariadb-client-10.1
mariadb-client-core-10.1 mariadb-common mariadb-server mariadb-server-10.1
```

\$ sudo mysql\_secure\_installation

```
shah@shah-VirtualBox:~$ sudo mysql_secure_installation
```

```
NOTE: RUNNING ALL PARTS OF THIS SCRIPT IS RECOMMENDED FOR ALL MariaDB
      SERVERS IN PRODUCTION USE! PLEASE READ EACH STEP CAREFULLY!
```

```
In order to log into MariaDB to secure it, we'll need the current
password for the root user. If you've just installed MariaDB, and
you haven't set the root password yet, the password will be blank,
so you should just press enter here.
```

```
Enter current password for root (enter for none):
OK, successfully used password, moving on...
```

```
Setting the root password ensures that nobody can log into the MariaDB
```

```
$ sudo mysql -u root -p
CREATE DATABASE owncloud;
CREATE USER 'oc_user'@'localhost' IDENTIFIED BY 'PASSWORD';
GRANT ALL ON owncloud.* TO 'oc_user'@'localhost' IDENTIFIED BY 'PASSWORD' WITH
GRANT OPTION;
FLUSH PRIVILEGES;
EXIT;
```



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```
MariaDB [(none)]> CREATE DATABASE owncloud;
Query OK, 1 row affected (0.02 sec)

MariaDB [(none)]> CREATE USER 'oc_user'@'localhost' IDENTIFIED BY 'PASSWORD';
Query OK, 0 rows affected (0.00 sec)

MariaDB [(none)]> GRANT ALL ON owncloud.* TO 'oc_user'@'localhost' IDENTIFIED BY
  'PASSWORD' WITH
    -> GRANT OPTION;
Query OK, 0 rows affected (0.02 sec)

MariaDB [(none)]> FLUSH PRIVILEGES;
Query OK, 0 rows affected (0.00 sec)

MariaDB [(none)]> EXIT;
Bye
shah@shah-VirtualBox:~$
```

3) Install PHP

```
$ sudo apt-get install software-properties-common
$ sudo add-apt-repository ppa:ondrej/php
$ sudo apt update
$ sudo apt install php7.1
```

```
or ppa:ondrej/nginx

PLEASE READ: If you like my work and want to give me a little motivation, please
consider donating regularly: https://donate.sury.org/

WARNING: add-apt-repository is broken with non-UTF-8 locales, see
https://github.com/oerdnj/deb.sury.org/issues/56 for workaround:

# LC_ALL=C.UTF-8 add-apt-repository ppa:ondrej/php
More info: https://launchpad.net/~ondrej/+archive/ubuntu/php
Press [ENTER] to continue or Ctrl-c to cancel adding it.

Hit:1 http://in.archive.ubuntu.com/ubuntu bionic InRelease
Get:2 http://ppa.launchpad.net/ondrej/php/ubuntu bionic InRelease [20.8 kB]
Get:3 http://ppa.launchpad.net/ondrej/php/ubuntu bionic/main i386 Packages [89.4
kB]
Get:4 http://ppa.launchpad.net/ondrej/php/ubuntu bionic/main amd64 Packages [89.
2 kB]
Get:5 http://ppa.launchpad.net/ondrej/php/ubuntu bionic/main Translation-en [32.
6 kB]
Fetched 232 kB in 2s (115 kB/s)
```

```
$ sudo apt-get install php7.1-cli php7.1-common php7.1-mbstring php7.1-gd php7.1-intl php7.1-
xml php7.1-mysql php7.1-zip php7.1-curl php7.1-xmlrpc
```



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```
php7.1-cli set to manually installed.
php7.1-common is already the newest version (7.1.33-34+ubuntu18.04.1+deb.sury.org+1).
php7.1-common set to manually installed.
The following additional packages will be installed:
  libcurl4 libicu65 libxmlrpc-epi0 libzip4
The following NEW packages will be installed:
  libcurl4 libicu65 libxmlrpc-epi0 libzip4 php7.1-curl php7.1-gd php7.1-intl
    php7.1-mbstring php7.1-mysql php7.1-xml php7.1-xmlrpc php7.1-zip
0 upgraded, 12 newly installed, 0 to remove and 8 not upgraded.
Need to get 9,690 kB of archives.
After this operation, 37.6 MB of additional disk space will be used.
Do you want to continue? [Y/n] y
Get:1 http://ppa.launchpad.net/ondrej/php/ubuntu bionic/main amd64 libicu65 amd64 4.65.1-1+ubuntu18.04.1+deb.sury.org+1 [8,467 kB]
Get:2 http://in.archive.ubuntu.com/ubuntu bionic/main amd64 libcurl4 amd64 7.58.0-2ubuntu3 [214 kB]
Get:3 http://in.archive.ubuntu.com/ubuntu bionic/main amd64 libxmlrpc-epi0 amd64
```

4) Installing of own cloud zip file by changing directory to temp

```
$ cd /tmp
$ wget https://download.owncloud.org/community/owncloud-10.0.3.zip
```

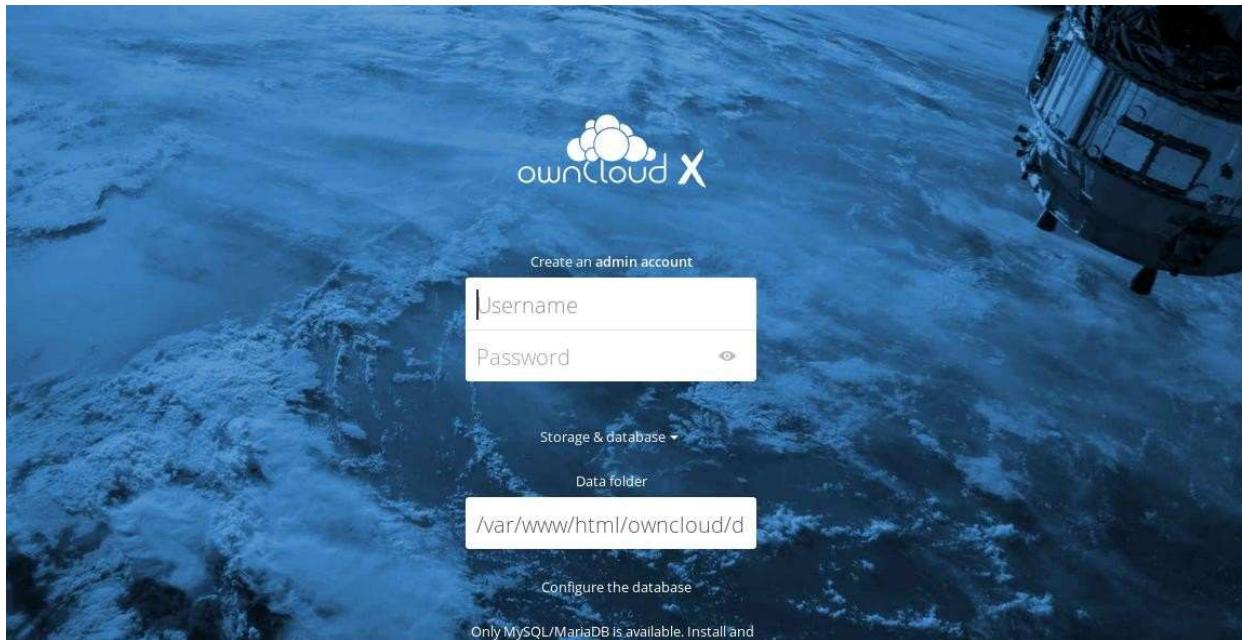
```
shah@shah-VirtualBox:/tmp$ wget https://download.owncloud.org/community/owncloud-10.0.3.zip
--2021-02-28 22:56:52--  https://download.owncloud.org/community/owncloud-10.0.3.zip
Resolving download.owncloud.org (download.owncloud.org)... 167.233.14.167, 2a01:4f8:1c1d:3d1::1
Connecting to download.owncloud.org (download.owncloud.org)|167.233.14.167|:443...
.. connected.
HTTP request sent, awaiting response... 301 Moved Permanently
Location: https://attic.owncloud.org/community/owncloud-10.0.3.zip [following]
--2021-02-28 22:56:53--  https://attic.owncloud.org/community/owncloud-10.0.3.zip
Resolving attic.owncloud.org (attic.owncloud.org)... 195.201.36.192, 2a01:4f8:c2:c5c1d::1
Connecting to attic.owncloud.org (attic.owncloud.org)|195.201.36.192|:443...
HTTP request sent, awaiting response... 200 OK
Length: 46697498 (45M) [application/zip]
Saving to: 'owncloud-10.0.3.zip'

owncloud-10.0.3.zip 22%[==>] 10.12M 3.69MB/s
```

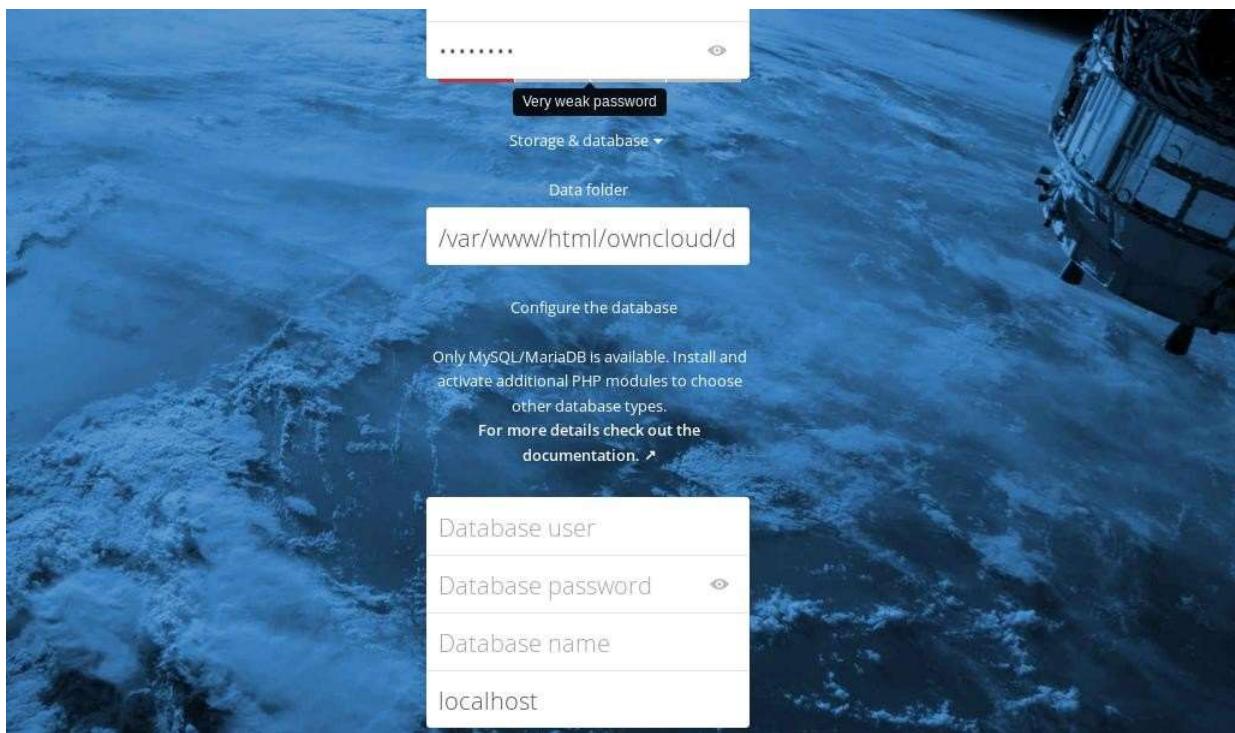
5) Own Cloud Installed



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- 6) Create an admin account by choosing a username and a password.  
Here as set User is francis and password is PASSWORD

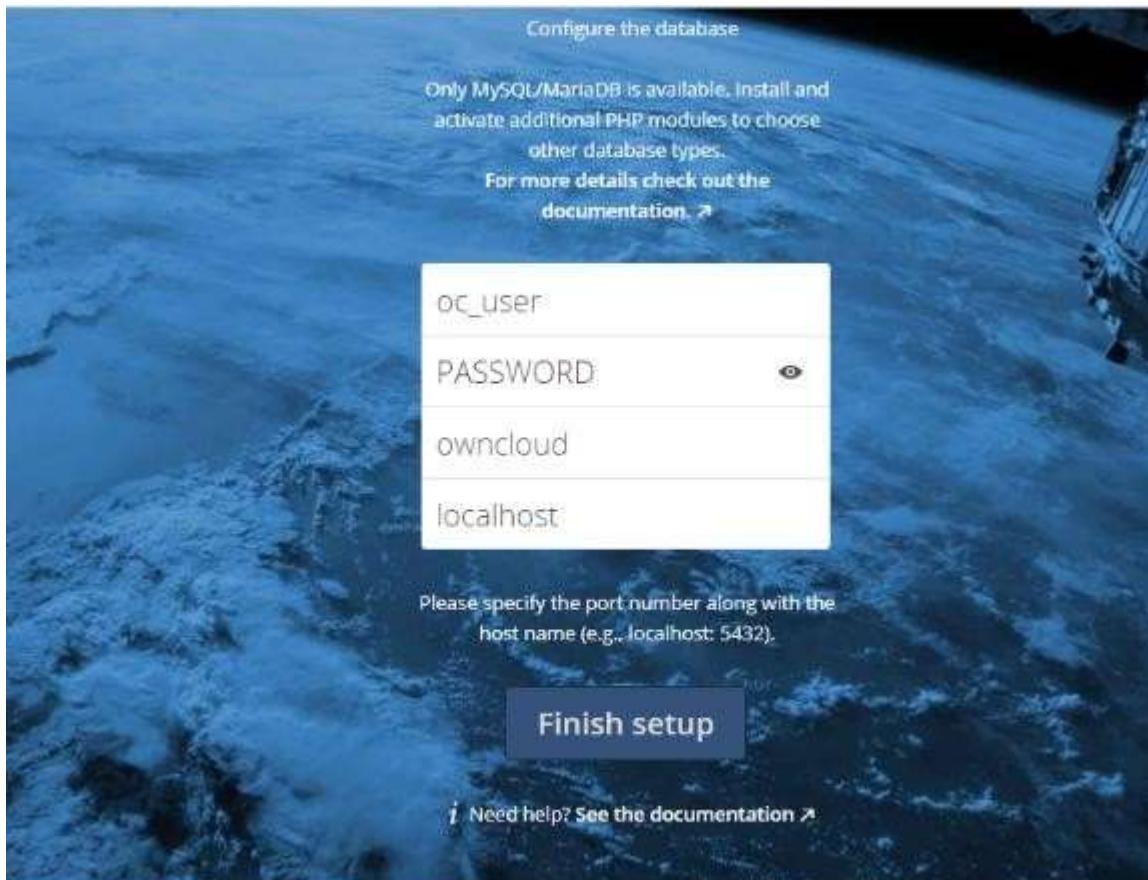




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7)

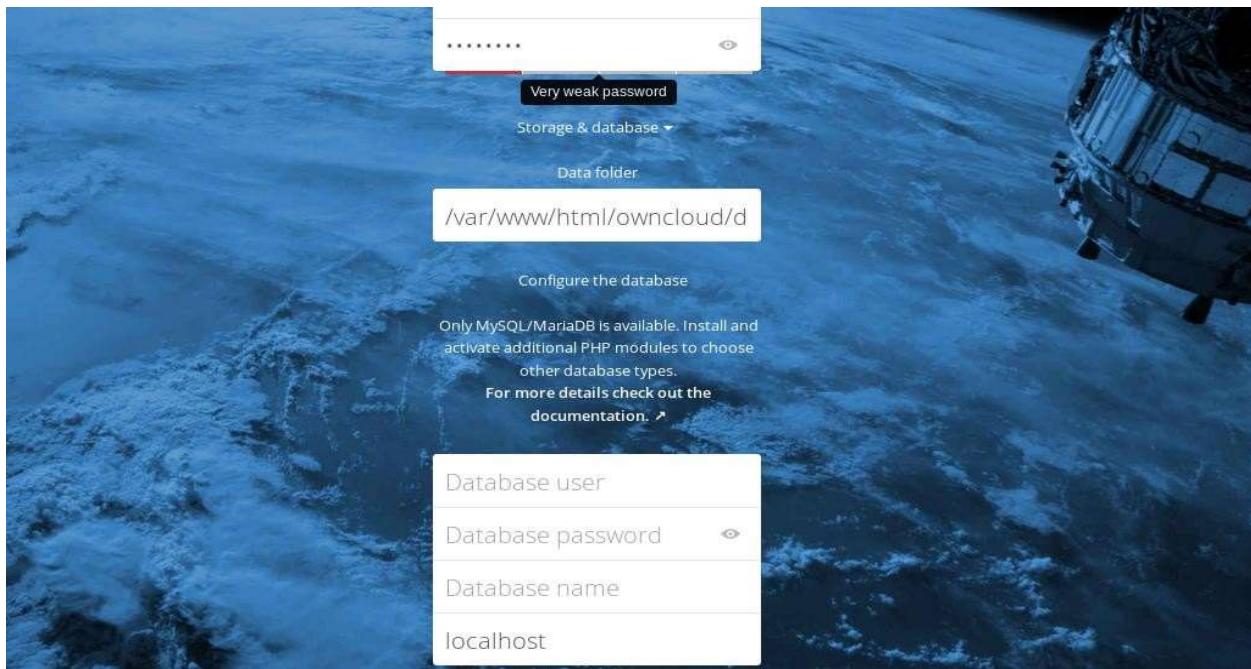
Database user : oc\_user  
Database password: PASSWORD  
Database name: owncloud



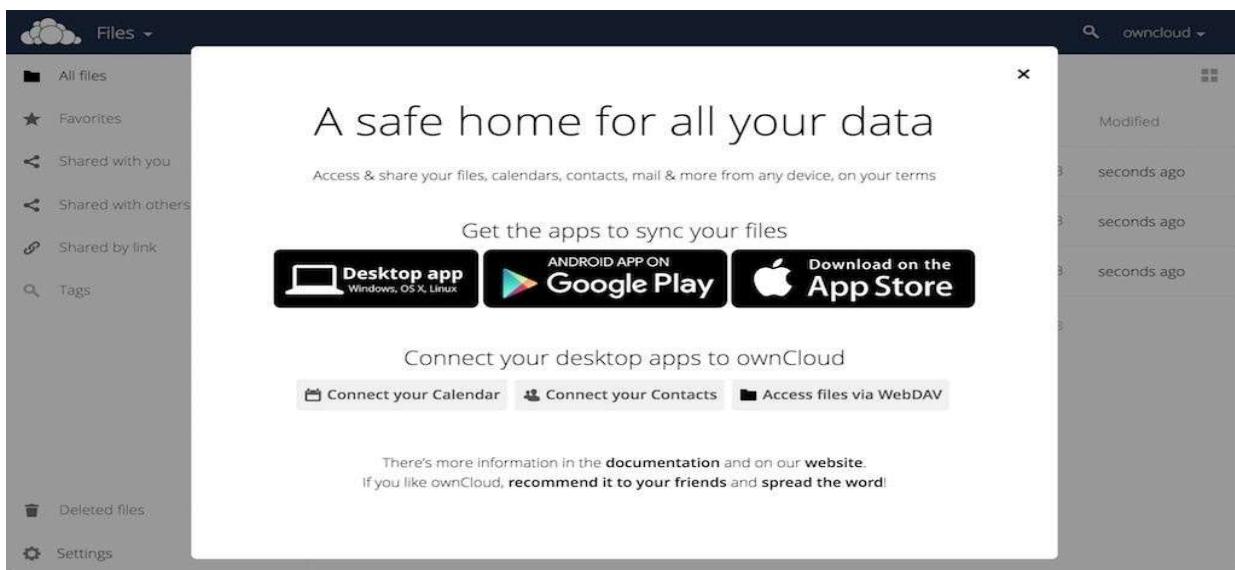
8) Before clicking the **Finish setup** button, click on the **Storage & database** link:  
Keep **Data folder** setting as-is and click the **MySQL/MariaDB** button in the **Configure the database** section. Here By Default **MySQL/MariaDB**



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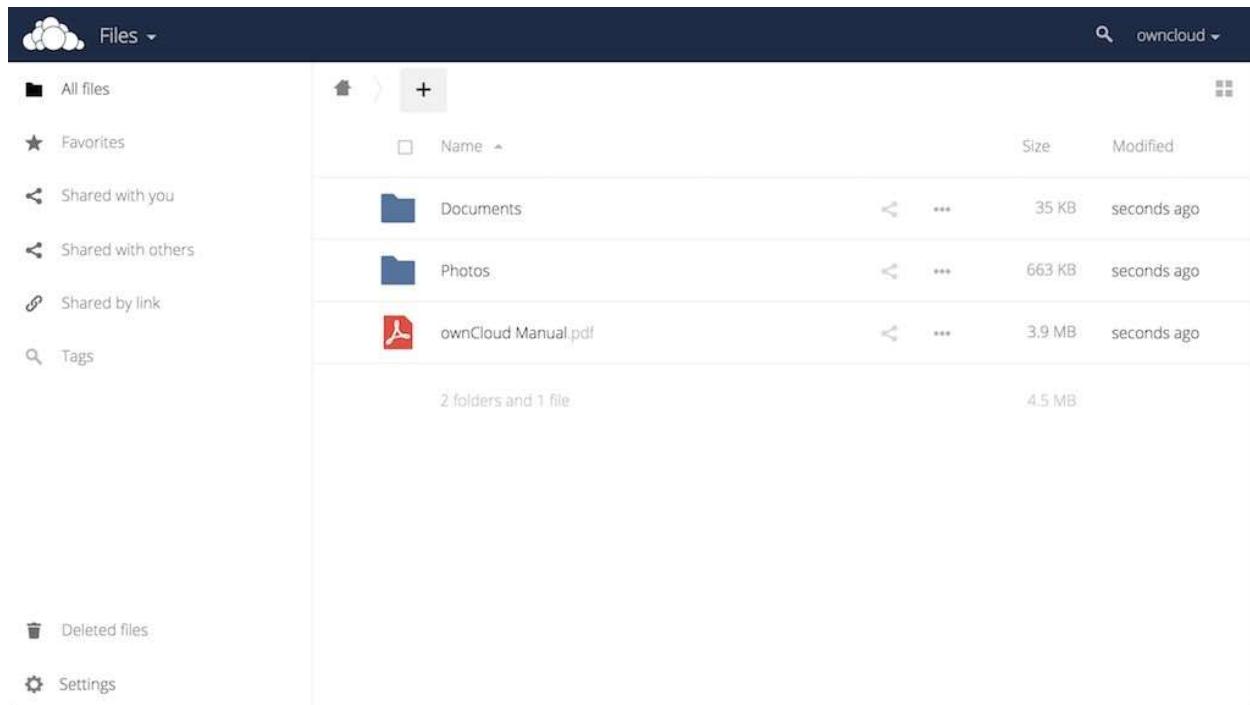
- 9) Enter the database information that you configured in the previous step.  
Click **Finish setup** button to sign into ownCloud. A **safe home for all your data** splash screen should appear close that.



- 10) Own Cloud Instance created.



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The screenshot shows the ownCloud web interface. At the top, there is a navigation bar with icons for cloud storage, files, search, and user account. Below the navigation bar is a sidebar containing links for 'All files', 'Favorites', 'Shared with you', 'Shared with others', 'Shared by link', and 'Tags'. On the right side, the main area displays a file list with three items: 'Documents' (35 KB, modified seconds ago), 'Photos' (663 KB, modified seconds ago), and 'ownCloud Manual.pdf' (3.9 MB, modified seconds ago). The total count is 2 folders and 1 file, with a total size of 4.5 MB.

Name	Size	Modified
Documents	35 KB	seconds ago
Photos	663 KB	seconds ago
ownCloud Manual.pdf	3.9 MB	seconds ago

### Conclusion:

OwnCloud gives universal access to all your files, contacts, calendars and bookmarks across all of your devices. Unlike many of the shared repository services out there, with ownCloud, you have your own, private repo. It can replicate the capabilities of popular third-party cloud storage services. Content can be shared between users or externally with public URLs. The advantage of ownCloud is that the information is stored securely in a place that you control.



### Experiment No.: 6

**Aim:** To Install and configure of Ulteo to demonstrate on demand application delivery Over web browser to explore SaaS Environment.

**Technology:** Ulteo

#### Theory:

Ulteo Open Virtual Desktop (OVD) is a delivery platform that provides on-demand access to private and public cloud hosted virtual desktops and supports Windows Remote Desktop Services and Linux hosted desktop and application sessions. OVD enables organizations to integrate and seamlessly deliver them as a secure service to clients based on Windows, Linux, MacOS, Android and IOS platforms. The challenge for IT is to deliver solutions that satisfy the increasing newly technological demands within their existing budget. Ulteo helps organizations respond to these challenges by providing a scalable and powerful infrastructure that enables IT to transform the way it delivers and manages desktops and applications helping the business to reduce the complexity and overheads associated with traditional delivery methods. Ulteo is an open-source Virtual Desktop infrastructure project that can deliver various operating systems desktops - including Windows and Linux desktops or applications - to end users. The Open Virtual Desktop allows corporates to deploy virtualized GNU/Linux and/or Windows desktops. Parts of Ulteo products are based on Debian and Ubuntu. Ulteo Open Virtual Desktop is an open-source alternative to Citrix and VMWare solutions.

#### Key Benefits

- **Transform IT Delivery:**  
Deliver hosted virtual desktops and applications on-demand.
- **Reduce Complexity:**  
Simplify the process of desktop and application management and delivery.
- **Lower Costs:**  
Reduced complexity leads to lower infrastructure costs. In addition, Ulteo provides perpetual license free affordable software subscription plans.

#### Platform Features

- **Open Architecture** - Open source, open architecture, cross platform with Windows and Linux support, open to integration and perpetual license free!
- **Simplicity** - Feature rich and flexible platform with an easy-to-use seamless user experience
- **Scalability** - The OVD architecture has been designed for performance and scalability incorporating advanced server load balancing. Performance tuning and comprehensive



testing of Windows and Linux application servers ensures efficient load handling and directory management.

- **Hi-Def Delivery** - The UxDA display protocol has been developed to deliver a rich user experience that parallels that of a local PC and supports the use of local peripherals such as printers and storage while being Microsoft RDP compatible.

**Output:**

Step 1: Install Ulteo through DVD or Open Ulteo OVF file in Vmware player by selecting import VM button. If you haven't an Ulteo OVD DVD-ROM yet, please download the corresponding ISO file from this place at [www.ulteo.com](http://www.ulteo.com) and burn it to a fresh DVD.

Step 2:

- Insert the Ulteo OVD DVD-ROM into your computer and restart it. If you selected the DVD- ROM as first boot device you'll see the boot loader Screen.
- Select Install Ulteo Option
- The first step is used to select the system language. Choose your language from the list and click on Forward.
- In the second step, the system asks you to define your location. Either select a point on the map or choose one from the Selected city form and click on Forward.
- The third step is used to define the keyboard layout. Select yours and click on Forward.
- Then, you have to select the partitioning method. We suggest the automatic method: Erase and use the entire disk.
- These questions are about the installed operating system itself, user login and password used to access the OS, along with the hostname of the machine.
- Type a password and confirm it. Useful address is displayed to you for a near future use of OVD.
- Then read carefully the installation summary, then click on Install and wait til installation completes
- Finally, click on Restart now to finish installation process.

Step 3: Open a web browser and access URL provided by ulteo-appliance. Here it is:

- <https://Ulteo-Server-ipaddress/ovd> for Client access
- <https://Ulteo-Server-ipaddress/admin> for Admin access



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The screenshot shows the Ulteo OVD Virtual appliance 4.0.0 landing page. At the top is the Ulteo logo, followed by the text "Ulteo OVD Virtual appliance 4.0.0". Below this, a message says: "You can now connect to the [User login page](#) to open an OVD session. By default the demo users have the same password as their login." Further down, it says: "To configure, open the [Administration console](#). Default login : admin Default password: admin". It also provides links for "To install a windows application server, download the setup [here](#) and install it on a windows server." and "The documentation is [here](#)". The "About Ulteo" section describes Ulteo Open Virtual Desktop (OVD) as a virtual desktop and application delivery platform supporting Windows Remote Desktop Services and Linux hosted desktop and application sessions. It mentions secure delivery to clients on Windows, Linux, MacOS, Android, and IOS platforms. A link to "More informations here : [www.ulteo.com](http://www.ulteo.com)" is provided.

Login on Admin portal specify Username and Password as Admin

The screenshot shows the "Open Virtual Desktop - Administration" log in page. The title bar says "Open Virtual Desktop - Administration". The main area has a "Log in" heading with a key icon. There are two input fields: "Login" containing "admin" and "Password" containing "\*\*\*\*\*". Below the fields is a "Log in" button. At the bottom right, it says "powered by Ulteo". The browser tab shows the URL "192.168.237.129/ovd/admin/login.php".

The screenshot shows a web browser window with a download progress bar for "ultra-ovd-native-client.exe". The progress bar is at 0% and says "Cancelled". The browser toolbar includes icons for Back, Forward, Stop, Refresh, Home, and others. The status bar at the bottom right shows "ENG 14:55 INTL 26-02-2016".

Step 4: Figure shows Home page of the Administration console. Edit the General configuration here.

Under server tab Register server, Click on manage to add ip address of Ulteo Server



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The screenshot shows the Ulteo Open Virtual Desktop Administration interface at the URL [192.168.0.101/ovd/admin/](http://192.168.0.101/ovd/admin/). The top navigation bar includes links for Index, Servers, Users, Applications, Configuration, Status, and Logout. The Ulteo logo is in the top right corner. The main content area is divided into several sections: 'Index' (with 'Users and Users groups' and 'Applications and applications groups' lists), 'Servers' (with 'Servers list' and 'Unregistered servers list'), 'Configuration' (with 'General configuration'), 'System' (showing 'The system is on production mode' and a link to 'Switch the system to maintenance mode'), and 'Status' (listing 0 active session, 0 online server, 0 offline server, and 3 broken servers). A note at the bottom right says 'powered by Ulteo OVD v3.0.4'.

The screenshot shows the 'General Configuration' page of the Ulteo Open Virtual Desktop Administration interface at the URL [192.168.237.129/ovd/admin/configuration-partial.php?mode=general](http://192.168.237.129/ovd/admin/configuration-partial.php?mode=general). The left sidebar lists various settings categories: Summary, Database Settings, System Settings, Server Settings, Domain Integration Settings, Authentication Settings, Session Settings, Event Settings, Web Interface Settings, Change Administrator Password, and Liaisons. The main panel displays the 'General Configuration' settings, including: 'System in maintenance mode' set to 'no', 'Administration Console language' set to 'Autodetect', 'Debug options list' (checkboxes for debug, info, warning, error, critical), 'Cached logs update interval' set to '30 seconds', 'Cached logs expiry time' set to '1 year', 'Default user group' set to 'static\_1', 'Domain integration' set to 'Internal', 'Maximum items per page' set to '15', 'Default browser' (checkboxes for Linux and Windows), 'Liaisons' (checkboxes for various modules like ApplicationDB, AuthMethod, ProfileDB, SessionManagement, SharedFolderDB, and UserDB), and 'Maximum number of running sessions' set to '30'. The status bar at the bottom shows the file 'ulteo-ovd-native-clie...e...' is being downloaded.

Step 5: To add user using Administration Console.

Go to user tab to add multiple users

Note: Only 15 users are displayed by default. To view newly created user, we can delete few names from the existing list.



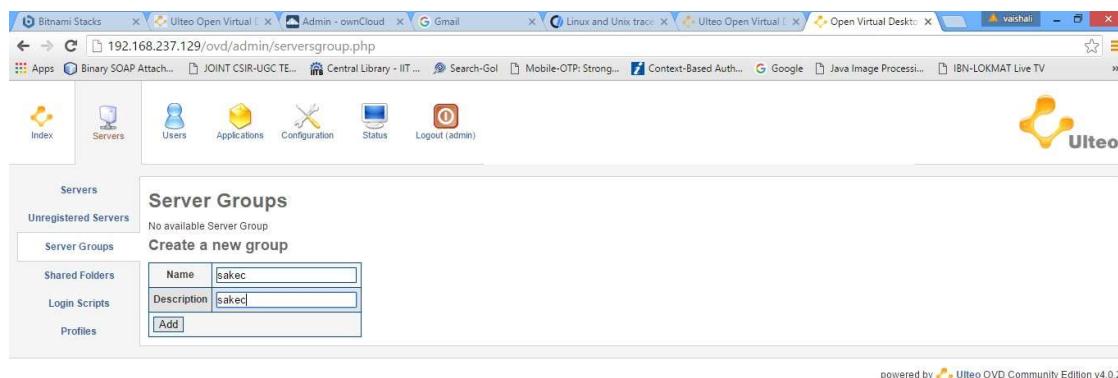
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Publications			
Publication Wizard			
<input type="checkbox"/> cholland	Charlotte Holland	<input type="button" value="Delete"/>	
<input type="checkbox"/> cthompson	Chris Thompson	<input type="button" value="Delete"/>	
<input type="checkbox"/> dpaul	Derrick Paul	<input type="button" value="Delete"/>	
<input type="checkbox"/> hcarpenter	Harriet Carpenter	<input type="button" value="Delete"/>	
<input type="checkbox"/> jdoten	John Doten	<input type="button" value="Delete"/>	
<input type="checkbox"/> jeshelman	Joanie Eshelman	<input type="button" value="Delete"/>	
<input type="checkbox"/> jkang	Jesse Kang	<input type="button" value="Delete"/>	
<input type="checkbox"/> mwhiddon	Marcia Whiddon	<input type="button" value="Delete"/>	
<input type="checkbox"/> mwilson	Marvin Wilson	<input type="button" value="Delete"/>	
<input type="checkbox"/> rbrady	Rosemary Brady	<input type="button" value="Delete"/>	
<input type="checkbox"/> rdavis	Ricardo Davis	<input type="button" value="Delete"/>	
<input type="checkbox"/> rfukasawa	Ryuji Fukasawa	<input type="button" value="Delete"/>	
<input type="checkbox"/> scates	Sandra Cates	<input type="button" value="Delete"/>	
<input type="checkbox"/> vkoch	Victor Koch	<input type="button" value="Delete"/>	
<input type="button" value="Mark all / Unmark all"/>			<input type="button" value="Delete"/>

#### Step 6: Create User group.

Go to User tab then select user group then create a new user group and add users in to them



The screenshot shows the Ulteo Open Virtual Desktop Admin interface. In the top navigation bar, there are several tabs: Bitnami Stacks, Ulteo Open Virtual, Admin - ownCloud, Gmail, Linux and Unix trace, Ulteo Open Virtual, Open Virtual Desktop, and vashali. Below the tabs, there is a toolbar with icons for Index, Servers, Users, Applications, Configuration, Status, and Logout (admin). On the left side, there is a sidebar with sections for Servers, Unregistered Servers, Server Groups, Shared Folders, Login Scripts, and Profiles. Under the Server Groups section, it says "No available Server Group" and "Create a new group". A form is displayed with fields for Name (saked) and Description (saked), and a "Add" button. At the bottom right of the page, it says "powered by Ulteo OVD Community Edition v4.0.2".





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Go to Application Tab to Create Application Group

The screenshot shows a web-based application management interface for Ulteo Open Virtual Desktop. The left sidebar has links for Index, Servers, Users, Applications (which is selected), Configuration, Status, and Logout. The main content area is titled 'Applications' and lists various software packages:

Name	Description	Type	Action
Adobe Reader 9	PDF Viewer	linux	Manage
Bulk Rename	Rename Multiple Files	linux	Manage
Firefox Web Browser	Browse the World Wide Web	linux	Manage
GIMP Image Editor	Create images and edit photographs	linux	Manage
Mousepad	Simple text editor	linux	Manage
OpenOffice.org Database	Manage databases, create queries and reports to track and manage your information.	linux	Manage
OpenOffice.org Drawing	Create and edit drawings, flow charts, and logos.	linux	Manage
OpenOffice.org Formula	Create and edit scientific formulas and equations.	linux	Manage
OpenOffice.org Impress	Create and edit presentations for slideshows, meeting and Web pages.	linux	Manage

Step 7: Add users to the newly created groups.

Note: Use the "Add to this server" button to add the groups to the server.

The screenshot shows the 'Server Group management - sakec' page. The left sidebar has links for Servers, Unregistered Servers, Server Groups (which is selected), Shared Folders, Login Scripts, and Profiles. A green success message at the top says 'Server group 'sakec' successfully added'. The main content area shows the settings for the 'sakec' server group:

Description	Status
sakec	Enabled

Under 'Settings':

- Delete this group** button
- Block** button
- Input fields for **sakec** (name) and **sakec** (description)

Under 'List of servers including this group':

No server has this group defined  
192.168.237.129 **Add to this server**

Under 'List of published User Groups for this group':

All users **Add this publication**

Step 8: Create Shared folder and assign the folder to the particular group or the application group



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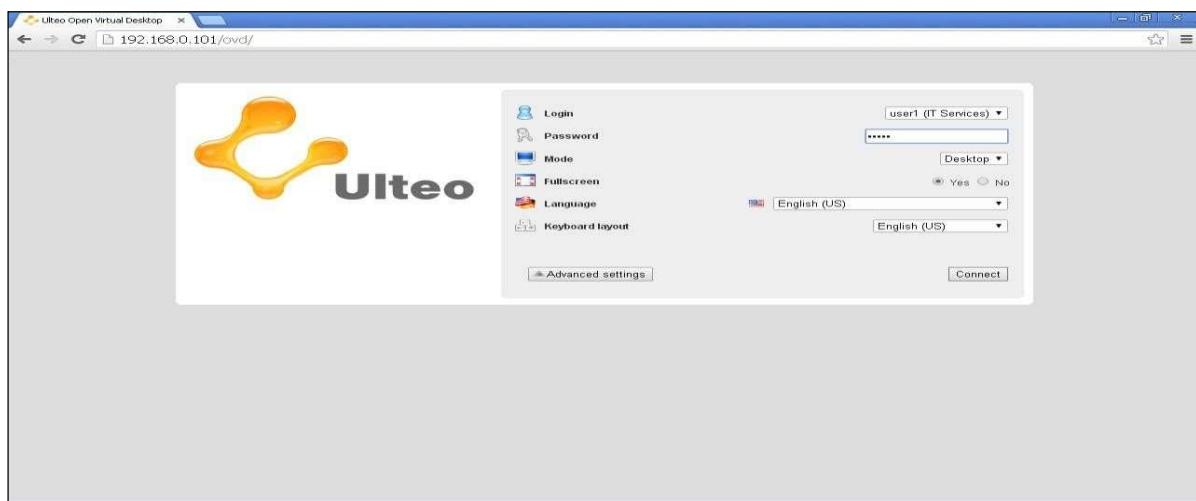
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- Map User group with Application group and use the services at client side
- The Administrator panel is limited to Administrator who can manage Applications, users and groups. Once admin logged in to this portal, he can create users, user groups, Application groups maps users to User group and Application group, manages applications or installs software's based on users requirement.

Step 9: At client side open <https://Ulteo-Server-ipaddress/ovd> for Client access, Specify Username and Password and Access the softwares added in Application group

Once user selects Access Ulteo option it shows login page of Ulteo session manager shown below. The user can get login name and password by filling Registration form through main page of cloud portal Shown below.



Step 10: Once user is validated, he can access the services using portal mode or Desktop mode. Both the modes give access to software applications which are installed on Linux Application Server and Windows Application Server. In portal mode the user get applications in vertical pane Shown in



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The screenshot shows the Ulteo Open Virtual Desktop interface. At the top, there is a browser-like header with the URL [192.168.0.101/ovd/](http://192.168.0.101/ovd/). Below the header, the title "IT Services" is displayed next to the Ulteo logo. On the right side, there is a "Logout" button. The main area is divided into two panes. The left pane, titled "Profile", lists various software icons: Adobe Reader 9, Bulk Rename, Firefox Web Browser, GIMP Image Editor, Mousepad, OpenOffice.org Database, OpenOffice.org Drawing, OpenOffice.org Presentation, OpenOffice.org Spreadsheet, OpenOffice.org Word Processor, and Thunderbird Mail. The right pane shows a file management interface with a toolbar at the top containing icons for Parent, Refresh, Thumbs, Upload, New Dir, New File, Download, Rename, Copy, Move, and Delete. A table below the toolbar lists folders under the "Profile" section:

Filename	Size	Type	Modified
Desktop	-	Directory	2014/03/31 14:22
Documents	-	Directory	2014/03/31 14:22

At the bottom of the right pane, there are statistics: Folders : 2, Files : 0, Total size : 0 B.

Ulteo Portal mode



Ulteo Desktop mode



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**Conclusion:**

Ulteo Open Virtual Desktop (OVD) is a delivery platform that provides on-demand access to private and public cloud hosted virtual desktops.



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### Experiment No. 7

**Aim:** To create and access VM instances and demonstrate EC2 using AWS.

**Technology:** AWS

#### Theory:

AWS (Amazon Web Services) is a comprehensive, evolving cloud computing platform provided by Amazon that includes a mixture of infrastructure as a service (IaaS), platform as a service (PaaS) and packaged software as a service (SaaS) offerings. AWS services can offer an organization tools such as compute power, database storage and content delivery services.

AWS launched in 2006 from the internal infrastructure that Amazon.com built to handle its online retail operations. AWS was one of the first companies to introduce a pay-as-you-go cloud computing model that scales to provide users with compute, storage or throughput as needed.

Amazon web service is a platform that offers flexible, reliable, scalable, easy-to-use and cost-effective cloud computing solutions.

AWS is a comprehensive, easy to use computing platform offered Amazon. The platform is developed with a combination of infrastructure as a service (IaaS), platform as a service (PaaS) and packaged software as a service (SaaS) offering.



Amazon Elastic Compute Cloud (Amazon EC2) provides scalable computing capacity in the Amazon Web Services (AWS) Cloud. Using Amazon EC2 eliminates your need to invest in hardware up front, so you can develop and deploy applications faster. You can use Amazon EC2 to launch as many or as few virtual servers as you need, configure security and networking, and



manage storage. Amazon EC2 enables you to scale up or down to handle changes in requirements or spikes in popularity, reducing your need to forecast traffic. Amazon Machine Images (**AMIs**) are the basic building blocks of Amazon EC2. An AMI is a template that contains a software configuration (operating system, application server and applications) that can run on Amazon's computing environment. AMIs can be used to launch an *instance*, which is a copy of the AMI running as a virtual server in the cloud.

Amazon EC2 provides the following features:

- 1) Virtual computing environments, known as instances
- 2) Preconfigured templates for your instances, known as Amazon Machine Images (AMIs), that package the bits you need for your server (including the operating system and additional software)
- 3) Various configurations of CPU, memory, storage, and networking capacity for your instances, known as instance types
- 4) Secure login information for your instances using key pairs (AWS stores the public key, and you store the private key in a secure place)
- 5) Storage volumes for temporary data that's deleted when you stop, hibernate, or terminate your instance, known as instance store volumes
- 6) Persistent storage volumes for your data using Amazon Elastic Block Store (Amazon EBS), known as Amazon EBS volumes
- 7) Multiple physical locations for your resources, such as instances and Amazon EBS volumes, known as Regions and Availability Zones
- 8) A firewall that enables you to specify the protocols, ports, and source IP ranges that can reach your instances using security groups

### Output:

Step 1 - Login to AWS portal and Select EC2 service from admin console  
Create an AWS Account and Sign into AWS. On the Amazon Web Services site. click on "Sign in to the Console". Sign in if you have account. If you don't, you will need to make one.



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CONTACT SALES Get help from our sales experts

Explore Our Products

Secure | https://console.aws.amazon.com/console/home?region=us-east-1

aws Services Resource Groups Michael Galarnyk N. Virginia Support

AWS services

Find a service by name or feature (for example, EC2, S3 or VM, storage).

Recently visited services

EC2

All services

Compute

EC2

EC2 Container Service

Lightsail

Elastic Beanstalk

Lambda

Batch

Developer Tools

CodeStar

CodeCommit

CodeBuild

CodeDeploy

CodePipeline

X-Ray

Internet of Things

AWS IoT

AWS Greengrass

Contact Center

Amazon Connect

Storage

S3

EFS

Glacier

Storage Gateway

Management Tools

CloudWatch

CloudFormation

Config

OpsWorks

Service Catalog

Trusted Advisor

Managed Services

Game Development

Amazon GameLift

Mobile Services

Mobile Hub

Cognito

Device Farm

Mobile Analytics

Pinpoint

Database

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Security, Identity & Compliance

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Application Services

Helpful tips

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Get real-time billing alerts based on your cost and usage budgets. Start now

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Use AWS Organizations for policy-based management of multiple AWS accounts. Start now

Explore AWS

Amazon Relational Database Service (RDS)

RDS manages and scales your database for you. RDS supports Aurora, MySQL, PostgreSQL, MariaDB, Oracle, and SQL Server. Learn more.

Real-Time Analytics with Amazon Kinesis

Stream and analyze real-time data, so you can get timely insights and react quickly. Learn more.

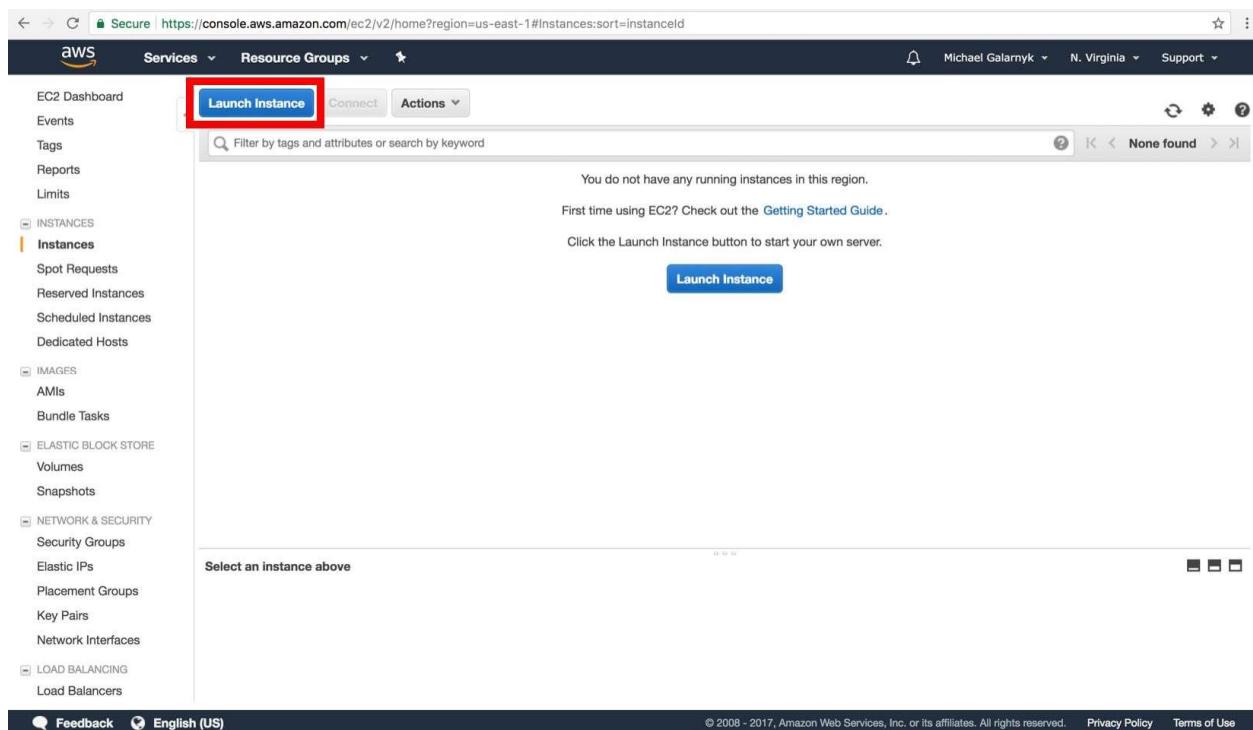
Get Started with Containers on AWS

Amazon ECS helps you build and scale containers for any size application. Learn more.

Step 2 - The EC2 resource page will appear which will show you the summary of instances. Now click on launch instance to select the VM instance type

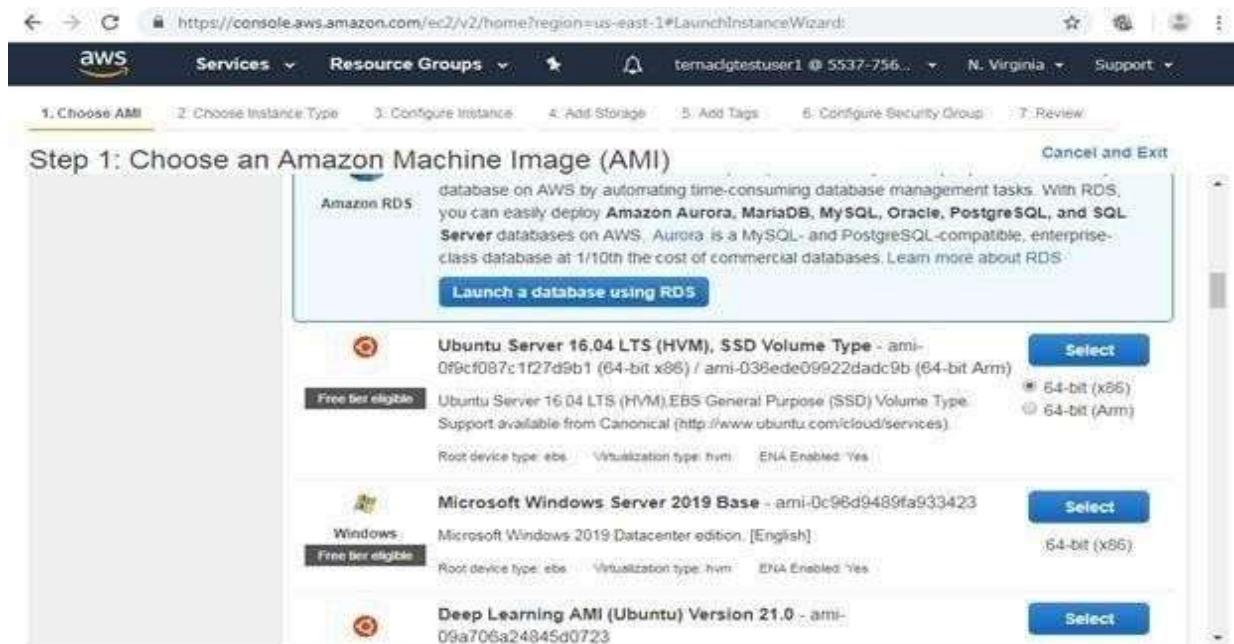


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The screenshot shows the AWS EC2 Dashboard. On the left, there is a sidebar with various navigation links: EC2 Dashboard, Events, Tags, Reports, Limits, INSTANCES (with Instances selected), SPOT REQUESTS, Reserved Instances, Scheduled Instances, Dedicated Hosts, IMAGES (with AMIs selected), ELASTIC BLOCK STORE (with Volumes and Snapshots), NETWORK & SECURITY (with Security Groups, Elastic IPs, Placement Groups, Key Pairs, Network Interfaces), and LOAD BALANCING (with Load Balancers). At the top, there is a search bar with the placeholder "Filter by tags and attributes or search by keyword" and a "Launch Instance" button. Below the search bar, it says "You do not have any running instances in this region." and "First time using EC2? Check out the Getting Started Guide." There is also a "Launch Instance" button at the bottom of the main content area. At the bottom of the page, there are links for Feedback, English (US), and copyright information: "© 2008 - 2017, Amazon Web Services, Inc. or its affiliates. All rights reserved. Privacy Policy Terms of Use".

Step 3 - Select the operating system type in AMI format. In this example we have selected Windows server instance which is eligible for free tier and click on Next.



The screenshot shows the "Step 1: Choose an Amazon Machine Image (AMI)" screen of the AWS Launch Instance Wizard. The top navigation bar includes tabs for 1: Choose AMI, 2: Choose Instance Type, 3: Configure Instance, 4: Add Storage, 5: Add Tags, 6: Configure Security Group, and 7: Review. A "Cancel and Exit" link is also present. The main content area is titled "Step 1: Choose an Amazon Machine Image (AMI)". It features a section for "Amazon RDS" with a "Launch a database using RDS" button. Below this, there are three options listed:

Image Type	Description	Action
Ubuntu Server 16.04 LTS (HVM), SSD Volume Type - ami-0f9cf087c1f27d9b1 (64-bit x86)	Support available from Canonical ( <a href="http://www.ubuntu.com/cloud/services">http://www.ubuntu.com/cloud/services</a> ) Root device type: ebs Virtualization type: hvm ENA Enabled: Yes	<input checked="" type="radio"/> 64-bit (x86) <input type="radio"/> 64-bit (Arm)
Microsoft Windows Server 2019 Base - ami-0c98d9489fa933423	Microsoft Windows 2019 Datacenter edition, [English] Root device type: ebs Virtualization type: hvm ENA Enabled: Yes	<input type="radio"/> 64-bit (x86)
Deep Learning AMI (Ubuntu) Version 21.0 - ami-09a706a24845d0723		<input type="radio"/> Select



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Step 4 - Now select the hardware type for Virtual machine. In this example we have selected free tier eligible General-purpose hardware and click on Next.

The screenshot shows the AWS EC2 console during the instance creation process, specifically Step 2: Choose an Instance Type. The 'Free tier eligible' status is highlighted for the t2.micro instance type. The table lists various instance types with their details like Family, Type, vCPUs, Memory, Instance Storage, EBS-Optimized Available, Network Performance, and IPv6 Support. The t2.micro row is selected.

Family	Type	vCPUs	Memory (GiB)	Instance Storage (GB)	EBS-Optimized Available	Network Performance	IPv6 Support
General purpose	t2.nano	1	0.5	EBS only	-	Low to Moderate	Yes
General purpose	<b>t2.micro</b> Free tier eligible	<b>1</b>	<b>1</b>	EBS only	-	Low to Moderate	Yes
General purpose	t2.small	1	2	EBS only	-	Low to Moderate	Yes
General purpose	t2.medium	2	4	EBS only	-	Low to Moderate	Yes
General purpose	t2.large	2	8	EBS only	-	Low to Moderate	Yes

Make sure t2 micro (free instance type) is selected.

The screenshot shows the same step in the AWS EC2 instance creation process. The t2.micro instance type is now explicitly highlighted with a red box. The rest of the interface is identical to the previous screenshot, showing the list of instance types and their details.

Step 5 - Now specify the instance details like Number of instances, networking options like



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VPC, Subnet of dhcp public IP etc. and click on Next

Step 3: Configure Instance Details

lower pricing, assign an access management role to the instance, and more.

Number of instances 1 Launch into Auto Scaling Group

Purchasing option Request Spot instances

Network vpc-7e5bed04 (default) Create new VPC

Subnet No preference (default subnet in any Availability Zone) Create new subnet

Auto-assign Public IP Use subnet setting (Enable)

Placement group Add instance to placement group

Capacity Reservation Open Create new Capacity Reservation

Domain join directory No directory Create new directory

Cancel Previous Review and Launch Next: Add Storage

Step 6 - click on "Review and Launch"

Step 4: Add Storage

Your instance will be launched with the following storage device settings. You can attach additional EBS volumes and instance store volumes to your instance, or edit the settings of the root volume. You can also attach additional EBS volumes after launching an instance, but not instance store volumes. Learn more about storage options in Amazon EC2.

Volume Type	Device	Snapshot	Size (GiB)	Volume Type	IOPS	Throughput (MB/s)	Delete on Termination	Encrypted
Root	/dev/sda1	snap-00b26152071002108	30	General Purpose SSD	100 / 3000	N/A	<input checked="" type="checkbox"/>	Not Encrypted

Add New Volume

Free tier eligible customers can get up to 30 GB of EBS General Purpose (SSD) or Magnetic storage. Learn more about free usage tier eligibility and usage restrictions.

Cancel Previous Review and Launch Next: Add Tags

Step 7 - Click on Launch



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Secure | https://console.aws.amazon.com/ec2/v2/home?region=us-east-1#LaunchInstanceWizard:

1. Choose AMI   2. Choose Instance Type   3. Configure Instance   4. Add Storage   5. Add Tags   6. Configure Security Group   7. Review

**Step 7: Review Instance Launch**

Please review your instance launch details. You can go back to edit changes for each section. Click **Launch** to assign a key pair to your instance and complete the launch process.

**AMI Details**

Microsoft Windows Server 2016 Base - ami-e3bb7399  
Free tier eligible Microsoft Windows 2016 Datacenter edition. [English]  
Root Device Type: ebs Virtualization type: hvm

If you plan to use this AMI for an application that benefits from Microsoft License Mobility, fill out the [License Mobility Form](#). Don't show me this again

**Instance Type**

Instance Type	ECUs	vCPUs	Memory (GiB)	Instance Storage (GB)	EBS-Optimized Available	Network Performance
t2.micro	Variable	1	1	EBS only	-	Low to Moderate

**Security Groups**

Security group name: launch-wizard-4  
Description: launch-wizard-4 created 2017-11-09T12:13:45.100-08:00

**Launch**

Step 8 - Now to secure VM instance, encrypt it using public key and create a private key pair to decrypt that. Here specify key pair name and download key pair.

Secure | https://console.aws.amazon.com/ec2/v2/home?region=us-east-1#LaunchInstanceWizard:

1. Choose AMI   2. Choose Instance Type   3. Configure Instance   4. Add Storage   5. Add Tags   6. Configure Security Group   7. Review

**Step 7: Review**

Please review your instance launch details. You can go back to edit changes for each section. Click **Launch** to assign a key pair to your instance and complete the launch process.

**Select an existing key pair or create a new key pair**

A key pair consists of a **public key** that AWS stores, and a **private key file** that you store. Together, they allow you to connect to your instance securely. For Windows AMIs, the private key file is required to obtain the password used to log into your instance. For Linux AMIs, the private key file allows you to securely SSH into your instance.

Note: The selected key pair will be added to the set of keys authorized for this instance. Learn more about removing existing key pairs from a public AMI.

Create a new key pair  
Key pair name: cloud

You have to download the **private key file** (\*.pem file) before you can continue. **Store it in a secure and accessible location**. You will not be able to download the file again after it's created.

**Launch Instances**



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Step 9 - Finally Click on launch instance to Launch VM



Step 10 - The instance is now launched. Go back to the Amazon EC2 console. I would recommend that you click on what is enclosed in the red rectangle as it will bring you back to the console.

Wait till you see that "Instance State" is running before you proceed to the next step. This can take a few minutes.



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The screenshot shows the AWS Launch Status page. At the top, there is a navigation bar with the AWS logo, Services, Resource Groups, a star icon, a bell icon, the user name 'termidigitestuser1 @ 5537-756...', N. Virginia, and Support. Below the navigation bar, the title 'Launch Status' is displayed. In the center, there is a blue circular progress indicator. Below it, the text 'Initiating Instance Launches' is shown, followed by the instruction 'Please do not close your browser while this is loading'. Below that, two status messages are displayed: 'Creating security groups... Successful' and 'Authorizing inbound rules...'. The overall background is white with black text and blue highlights.

The screenshot shows the AWS Launch Status page after the instance has been successfully launched. The navigation bar at the top is identical to the previous screenshot. The main content area now displays a green success message: 'Your instances are now launching' with a checkmark icon. Below this message, it says 'The following instance launches have been initiated: i-08fba093071089f1d' and a 'View launch log' link. Below this, there is another section with a blue information icon and the text 'Get notified of estimated charges.' It explains that users can create billing alerts to get email notifications when estimated charges exceed a defined amount. The background is white with green highlights for the success message.

The screenshot shows the AWS Launch Status page with a focus on connecting to instances. The navigation bar is at the top. Below it, a section titled 'How to connect to your instances' is shown. It contains a paragraph explaining that instances are launching and may take a few minutes to reach the 'running' state. It also provides instructions on how to monitor instances using the 'View Instances' link and how to connect to them once they are running. At the bottom of this section, there is a list of helpful resources: 'Here are some helpful resources to get you started' with a plus sign, followed by a bullet point 'Amazon EC2 User Guide'. The background is white with grey sections for the main content and a light grey sidebar on the right.

Step 11 - Now from summary page click on View instance to see the instance state. After some time, you will see the running instance of your VM.



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**aws** Services Resource Groups Support

### Launch Status

Your instances are launching, and it may take a few minutes until they are in the **running** state, when they will be ready for you to use. Usage hours on your new instances will start immediately and continue to accrue until you stop or terminate your instances.

Click [View Instances](#) to monitor your instances' status. Once your instances are in the **running** state, you can [connect](#) to them from the Instances screen. Find out how to connect to your instances.

▼ Here are some helpful resources to get you started:

- [How to connect to your Windows instance](#)
- [Learn about AWS Free Usage Tier](#)
- [Amazon EC2: User Guide](#)
- [Amazon EC2: Microsoft Windows Guide](#)
- [Amazon EC2: Discussion Forum](#)

While your instances are launching you can also:

- Create status check alarms to be notified when these instances fail status checks. (Additional charges may apply)
- Create and attach additional EBS volumes. (Additional charges may apply)
- Manage security groups.

[View Instances](#)

**aws** Services Resource Groups Support

**EC2 Dashboard**

Events

Tags

Reports

Limits

**INSTANCES**

**Instances**

Launch Templates

Spot Requests

Reserved Instances

Dedicated Hosts

Scheduled Instances

Capacity Reservations

**IMAGES**

AMIs

Bundle Tasks

**ELASTIC BLOCK STORE**

**Launch Instance** Connect Actions

Filter by tags and attributes or search by keyword

Name	Instance ID	Instance Type	Availability Zone	Instance State	Status Checks
WindowsInst...	i-01d5635a2c710ec34	t2.micro	us-east-1a	terminated	
WindowsSer...	i-08fba093071089f1d	t2.micro	us-east-1a	running	Initializing

Instance: i-08fba093071089f1d (Windows Server) Public DNS: ec2-52-23-167-230.compute-1.amazonaws.com

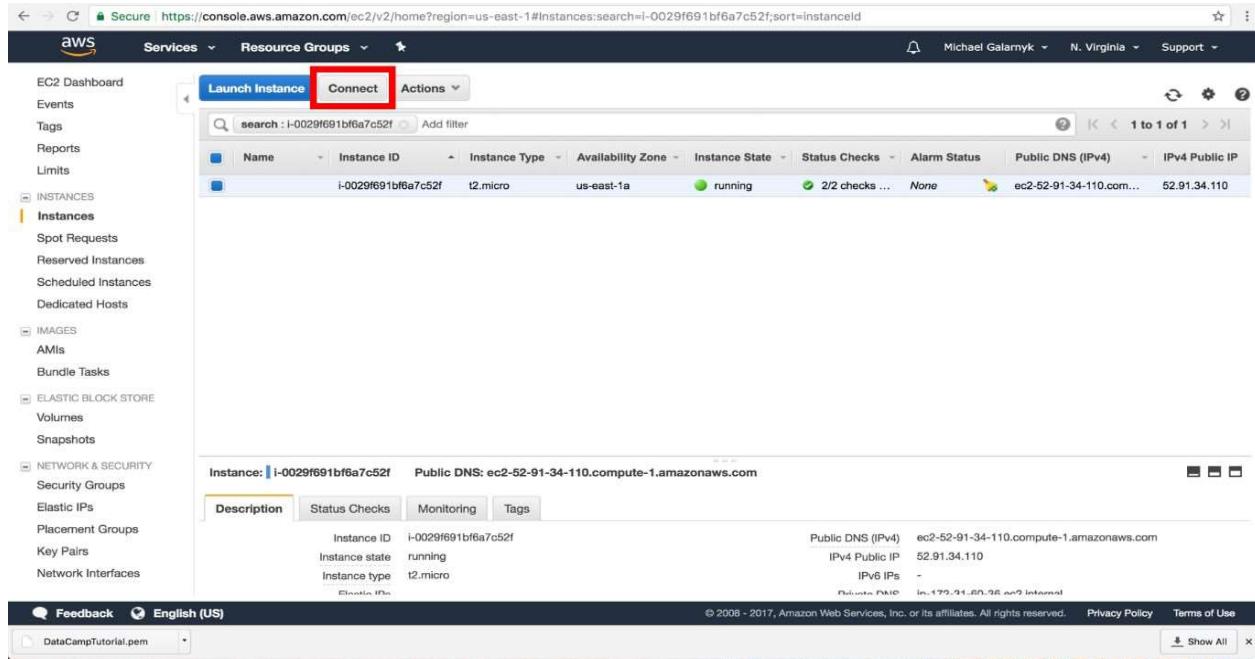
Description Status Checks Monitoring Tags

Instance ID: i-08fba093071089f1d Public DNS (IPv4): ec2-52-23-167-230.compute-1.amazonaws.com



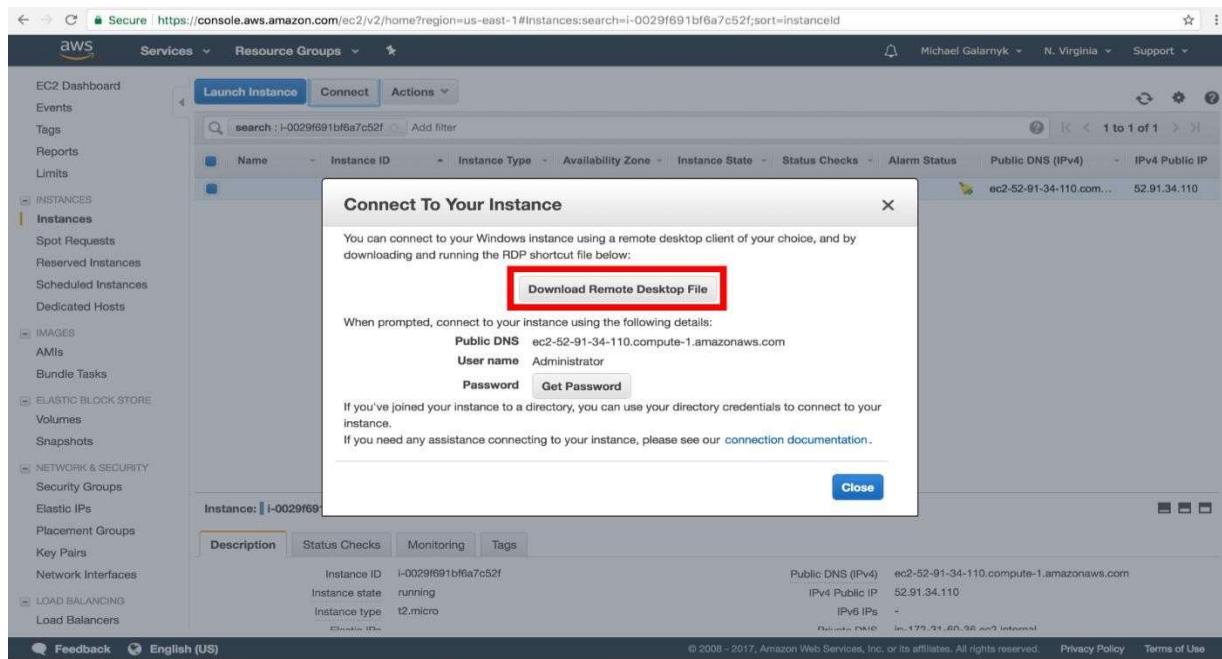
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Step 12 - Click on connect



The screenshot shows the AWS EC2 Instances page. On the left sidebar, under the 'INSTANCES' section, the 'Instances' option is selected. In the main content area, there is a table of instances. The first instance listed has its 'Name' column value 'i-0029f691bf6a7c52f'. To the right of this name, there is a 'Connect' button, which is highlighted with a red box. Below the table, there is a detailed view of the selected instance 'i-0029f691bf6a7c52f'. This view includes tabs for 'Description', 'Status Checks', 'Monitoring', and 'Tags'. The 'Description' tab is active, showing details like Instance ID, Instance state, and Instance type. The 'Status Checks' tab shows 2/2 checks passing. The 'Monitoring' tab indicates no monitoring is enabled. The 'Tags' tab shows no tags assigned.

Step 13 - Click on "Download Remote Desktop File". Save the remote desktop file (rdp) file somewhere safe

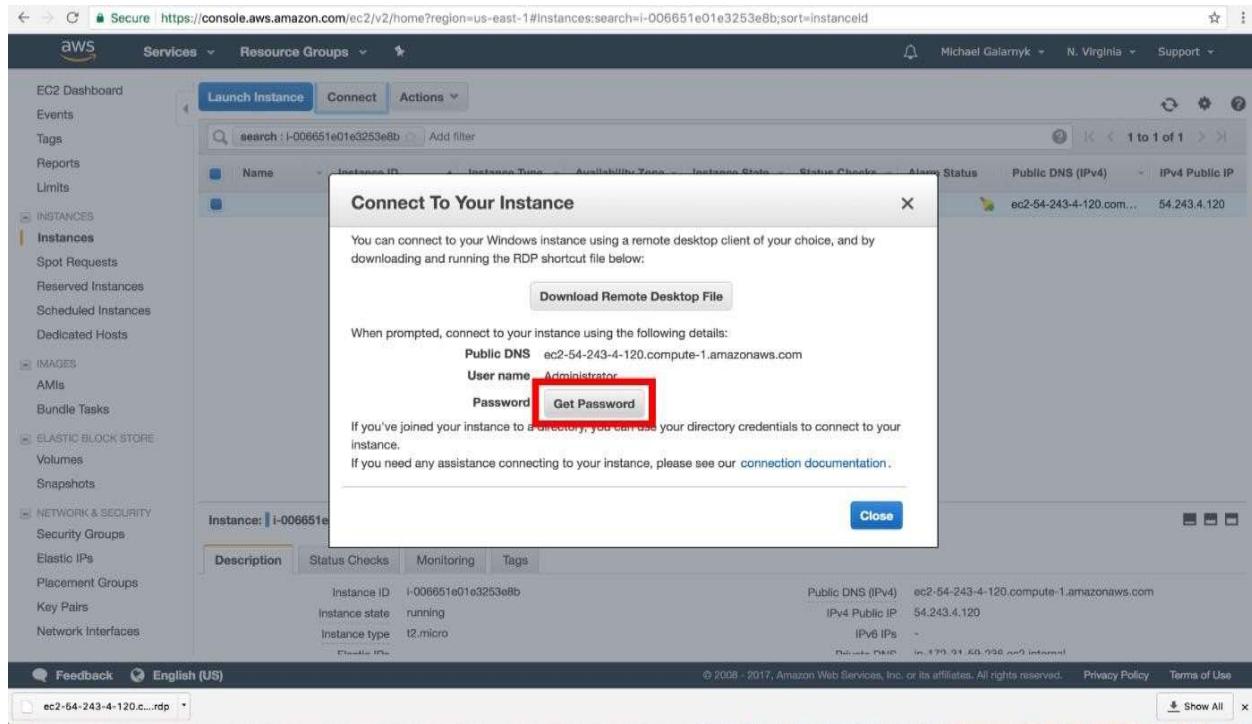


The screenshot shows the same AWS EC2 Instances page as the previous step. A modal dialog box titled 'Connect To Your Instance' is displayed over the instance list. Inside the dialog, there is a paragraph explaining how to connect using a remote desktop client, followed by a large red box highlighting the 'Download Remote Desktop File' button. Below this button, there is a section for entering connection details, including 'Public DNS' (set to 'ec2-82-91-34-110.compute-1.amazonaws.com'), 'User name' (set to 'Administrator'), and a 'Password' field. There is also a 'Get Password' link. At the bottom of the dialog, there is a 'Close' button. The background of the page shows the same instance details as before, including its Public DNS, Instance ID, and Instance type.



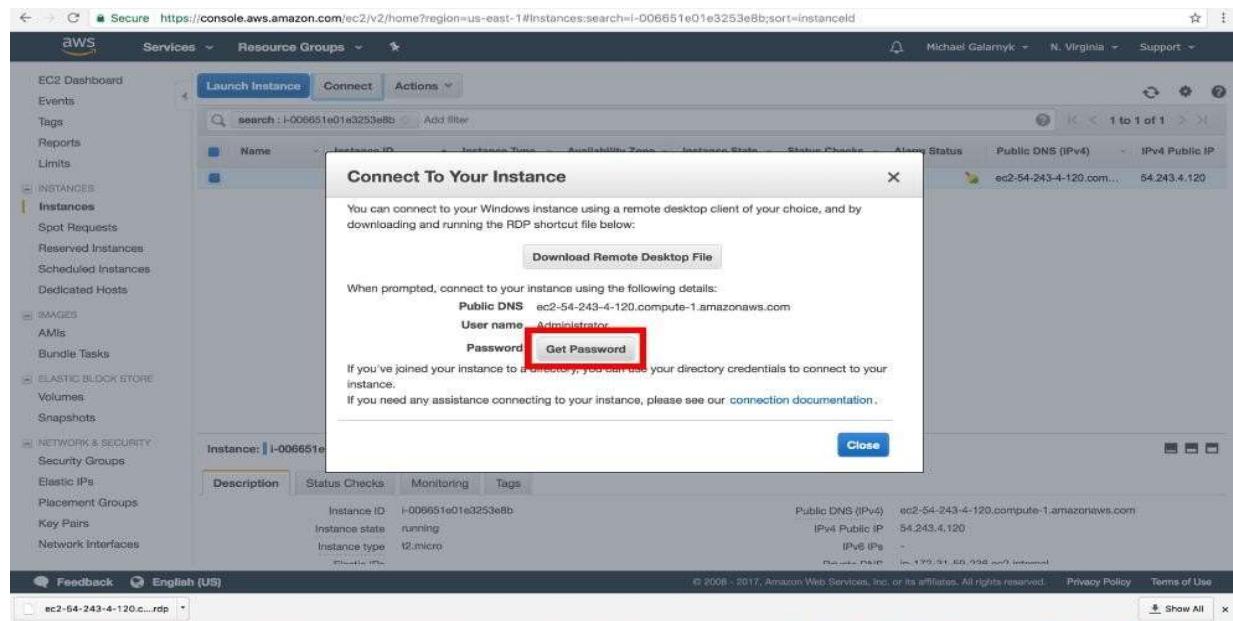
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Step 14 - Click on "Get Password". Keep in mind that you have to wait at least 4 minutes after you launch an instance before trying to retrieve your password



The screenshot shows the AWS EC2 console with a search bar for instance ID 'i-006651e01e3253e8b'. A modal window titled 'Connect To Your Instance' is open. It contains instructions for connecting via RDP and provides fields for 'Public DNS' (ec2-54-243-4-120.compute-1.amazonaws.com), 'User name' (Administrator), and 'Password'. The 'Get Password' button is highlighted with a red box. Below the fields, there are notes about using directory credentials or connection documentation. At the bottom of the modal is a 'Close' button.

Step 15 - Choose the pem file you downloaded and then click "Decrypt Password"



This screenshot is identical to the one above, showing the 'Connect To Your Instance' dialog box with the 'Get Password' button highlighted in red. The rest of the interface, including the sidebar menu and the main EC2 dashboard, remains the same.



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Step 16 - After you decrypt your password, save it somewhere safe. Need it to log into your instance

The screenshot shows the AWS EC2 Dashboard with the 'Instances' section selected. A modal window titled 'Connect To Your Instance' is open, displaying connection details for an instance with ID i-0029f691bf6a7c52f. The modal includes fields for Public DNS (ec2-54-175-183-69.compute-1.amazonaws.com), User name (Administrator), and Password (-45Z3&&G)Dl&YSa@?{tDu9oklnvF5vm). A 'Download Remote Desktop File' button is also present. Below the modal, the main EC2 Instances page shows the same instance details.

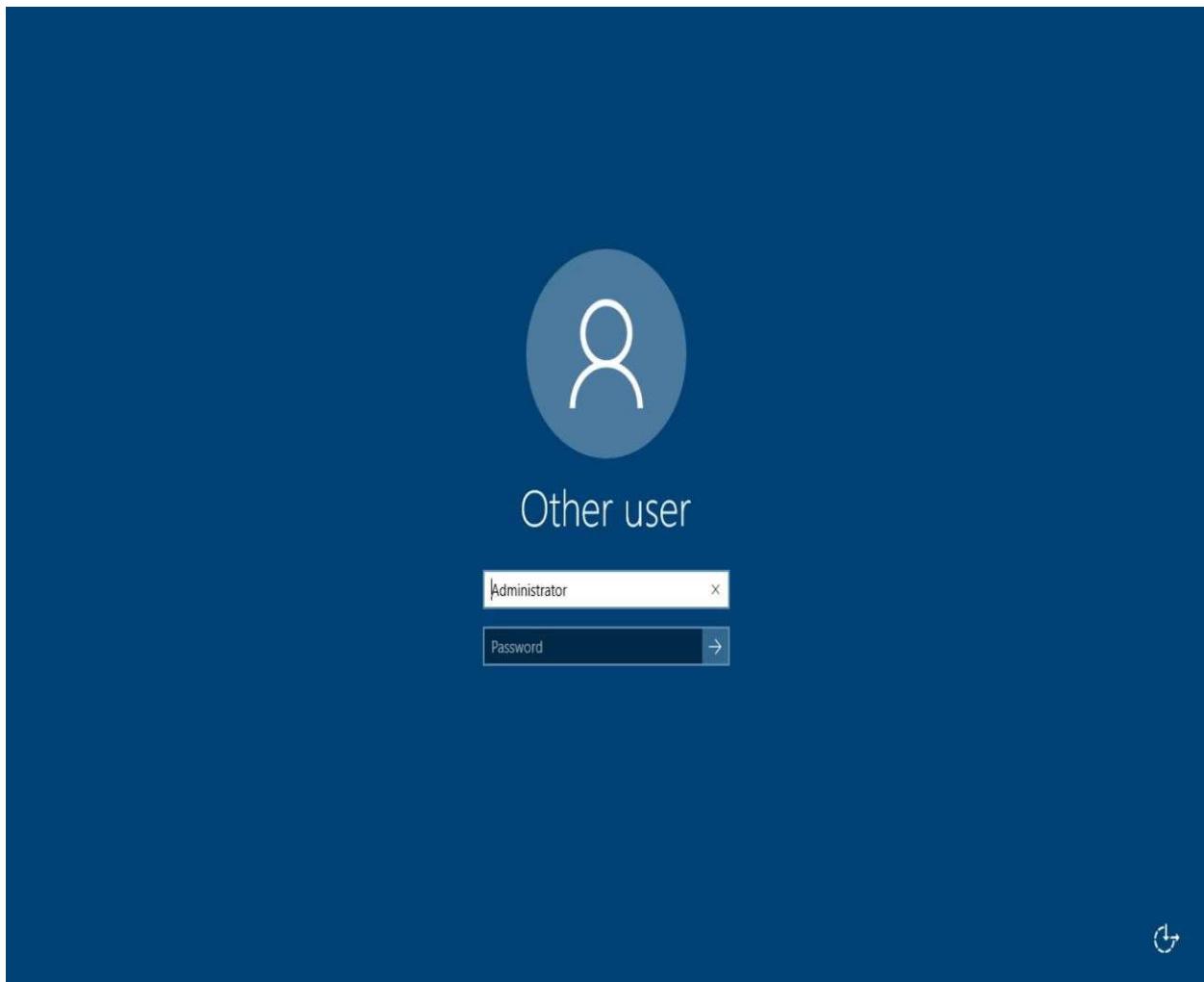
Step 17 - Open your rdp file. Click on continue.

The screenshot shows a Windows Remote Desktop Connection dialog box. It displays a warning message about the certificate being untrusted and asks if the user wants to continue. The 'Continue' button is highlighted with a red box. Below the dialog, the text 'Negotiating Credentials ...' is visible, indicating the connection is in progress.



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Step 18 - Enter your decrypted password





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Step 19 - You can delete the instance permanently by selecting instance state followed by Terminate

The screenshot shows the AWS EC2 Instances page. On the left, there's a sidebar with options like EC2 Dashboard, Events, Tags, Reports, Limits, INSTANCES (with Instances selected), Spot Requests, and Reserved Instances. The main area shows a table of instances. One instance, with ID i-02b590068cc087f1, is selected. A context menu is open over this instance, with 'Actions' expanded. The 'Instance State' option is highlighted. Under 'Instance State', the 'Terminate' option is shown and has a red box drawn around it, indicating it's the target of the step.

### Conclusion:

Amazon Web Services (AWS) is a subsidiary of Amazon that provides on-demand cloud computing platforms and APIs to individuals, companies, and governments, on a metered pay-as-you-go basis. Subscribers can pay for a single virtual AWS computer, a dedicated physical computer, or clusters of either.



### Experiment No.: 8

**Aim:** To study implementation and application of Fog Computing.

**Objective:** To have a basic understanding of implementation/applications of fog computing.

#### Theory:

Fog computing is a promising computing paradigm that extends cloud computing to the edge of networks. Similar to cloud computing but with distinct characteristics, fog computing faces new security and privacy challenges besides those inherited from cloud computing. Fog computing is introduced as an intermediate layer between the clients and the Cloud. It brings computing, storage, management, and network services among others, closer to the sensor/actuator nodes.

The Internet-of-Things (IoT) is a self-configuring and adaptive network which connects real-world things to the Internet enabling them to communicate with other connected objects leading to the realization of a new range of ubiquitous services. The IoT is already around us connecting wearable devices, smart cars and smart home systems. It is expected that more than 50 billion devices will be connected to the Internet by 2020

The introduction of such a huge number of connected devices requires a scalable architecture to accommodate them without any degradation of the quality of service demanded by applications. In addition, the majority of the devices that make up the Internet of Things are resource-constrained; resources, such as computing power, energy, bandwidth and storage are scarce. These constraints limit the deployment scenarios of applications using such IoT devices. Fog computing layer brings computing, network and storage services closer to the end-nodes in IoT. Compared to Cloud computing, this computing layer is highly distributed and introduces additional services to end-devices located in the perception layer.

Fog computing is a decentralized computing infrastructure in which data, compute, storage and applications are located somewhere between the data source and the cloud. Like edge computing, fog computing brings the advantages and power of the cloud closer to where data is created and acted upon. Many people use the terms *fog computing* and *edge computing* interchangeably because both involve bringing intelligence and processing closer to where the data is created.

#### Difference between Cloud Computing and Fog Computing

Parameters	Cloud Computing	Fog Computing
Data Integration	Multiple data sources can be integrated.	Multiple Data sources and devices can be integrated.
Mobility	In cloud computing mobility is Limited.	Mobility is supported in fog computing.
Location Awareness	Partially Supported in Cloud computing.	Supported in fog computing.



Number of Server Nodes	Cloud computing has Few numbers of server nodes.	Fog computing has Large number of server nodes.
Geographical Distribution	It is centralized.	It is decentralized and distributed.
Location of service	Services provided within the internet.	Services provided at the edge of the local network.
Working environment	Specific data center building with air conditioning systems	Outdoor (streets, base stations, etc.) or indoor (houses, cafes, etc.)
Latency	Cloud computing has high latency compared to fog computing	Fog computing has low latency
Capacity	Cloud Computing does not provide any reduction in data while sending or transforming data	Fog Computing reduces the amount of data sent to cloud computing.
Responsiveness	Response time of the system is low.	Response time of the system is high.
Security	Cloud computing has less security compared to Fog Computing	Fog computing has high Security.
Speed	Access speed is high depending on the VM connectivity.	High even more compared to Cloud Computing.

### The fog computing is used because

Fog computing addresses following three requirements of today's networks.

- Data Volume
- Latency
- Bandwidth

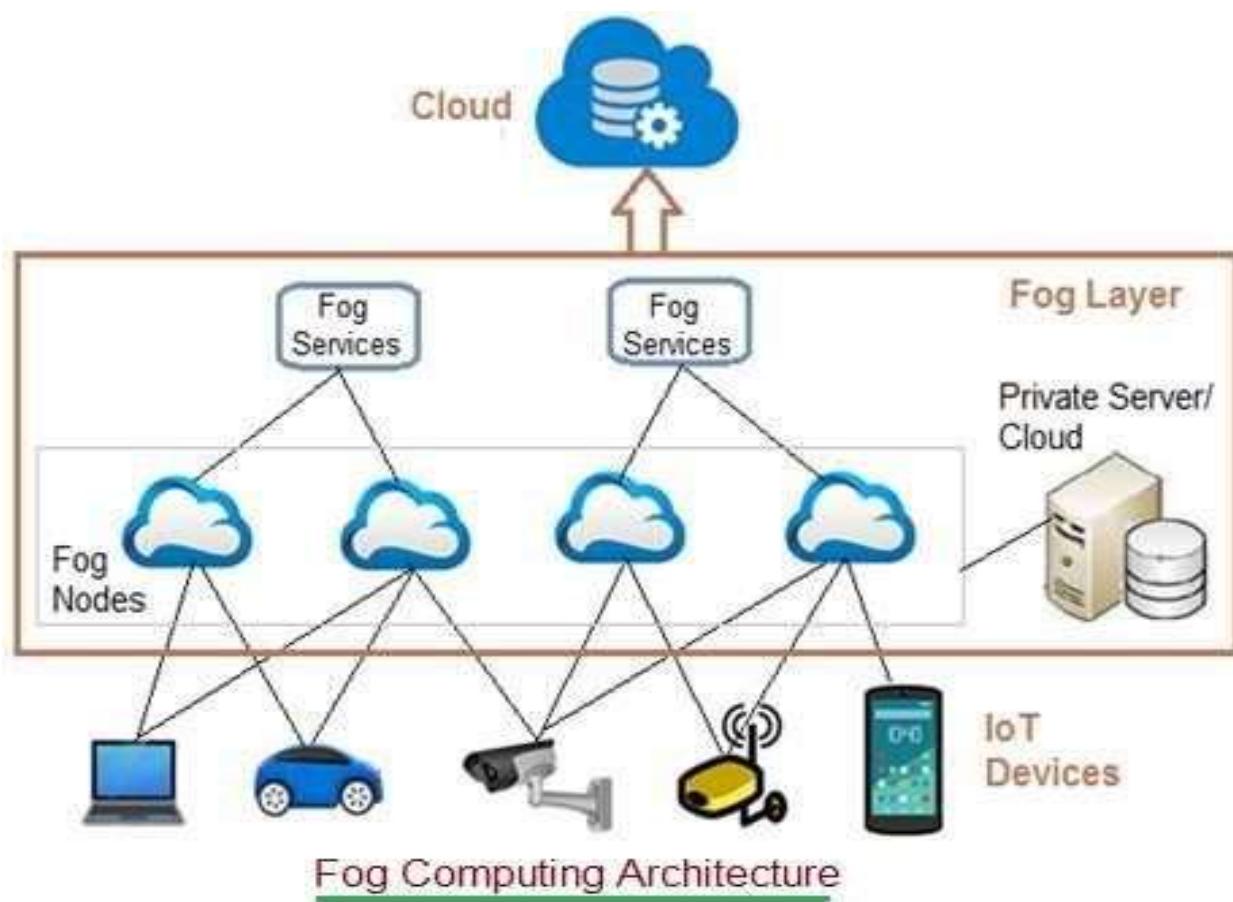
Moreover, use of IoT devices is increasing due to wide availability of low-cost sensors. As per one study, huge amount of data are generated from various sensors. Following requirements of IoT should be met for its successful implementation.

- Reduction in latency of data
- High data security
- Data reliability
- Processing of data at respective suitable place based on type of data
- Monitoring of data across large geographical area



### Architecture and its Working:

The Fog computing architecture consists of physical and logical elements in the form of hardware and software to implement IoT (Internet of Things) network. It is composed of IoT devices, fog nodes, fog aggregation nodes with the help of fog data services, remote cloud storage and local data storage server/cloud.



**IoT devices:** These are devices connected on IoT network using various wired and wireless technologies. These devices produce data regularly in huge amount. There are numerous wireless technologies used in IoT which include Zigbee, Zwave, RFID, 6LoWPAN, HART, NFC, Bluetooth, BLE, NFC, ISA-100.11A etc. IoT protocols used include IPv4, IPv6, MQTT, CoAP, XMPP, AMQP etc.

**Fog Nodes:** Any device with computing, storage and network connectivity is known as fog node. Multiple fog nodes are spread across larger region to provide support to end devices. Fog nodes are connected using different topologies. The fog nodes are installed at various locations as per



different applications such as on floor of a factory, on top of power pole, along side of railway track, in vehicles, on oil rig and so on. Examples of fog nodes are switches, embedded servers, controllers, routers, cameras etc. High sensitive data are processed at these fog nodes.

**Fog aggregate nodes:** Each fog nodes have their aggregate fog node. It analyzes data in seconds to minutes. IoT data storage at these nodes can be of duration in hours or days. Its geographical coverage is wider. Fog data services are implemented to implement such aggregate node points. They are used to address average sensitive data.

**Remote Cloud:** All the aggregate fog nodes are connected with the cloud. Time insensitive data or less sensitive data are processed, analyzed and stored at the cloud.

**Local server and cloud:** Often fog computing architecture uses private server/cloud to store the confidential data of the firm. These local storage is also useful to provide data security and data privacy.

### **Characteristics of the Fog layer**

In contrast to the Cloud layer, the Fog layer is closer to the perception layer and this proximity provides a range of advantages that characterize the layer. One of the immediate benefits over the Cloud is its location-awareness. Such awareness comes due to the largescale geographical distribution of the devices that make up the Fog layer. The location-awareness of the Fog layer can be utilized to address multiple functional and non-functional requirements of IoT applications, such as mobility and security. Another closely related characteristics of the Fog layer is its large-scale distribution in contrast to the centralized Cloud layer. Centralization in this context is relative; the Cloud layer is centralized as seen from the client side. Looking from the organization of the servers in the cloud, however, it is geographically distributed but not at the scale expected from the Fog layer. For instance, Cloud service providers such as Amazon have multiple data centers in different regions. The IoT in general is dominated by wireless networks. There are many wireless protocols, mostly tailored for low-power operation, coverage or bandwidth.

### **Design and Organization of the Fog layer**

Based on the characteristics of the Fog layer presented in the previous section and the possible set of services highlighted in the following section, the Fog layer can Chapter 1 Fog Computing Fundamentals in The Internet-of-Things 7 be organized in an efficient way to address the requirements. This section is by no means comprehensive and detailed enough for build a usable intermediate layer, but instead gives an introductory information that will be dealt in more details in later chapters. To begin with, consider a network gateway or a wireless hot-spot serving clients in its vicinity. The role of such a gateway is to pass network packets to the back-end infrastructure which is connected to the Internet

### **Fog Computing Services**



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This layer takes advantage of its proximity to the sensor layer and provides services that are extensions of the cloud layer and also unique ones that are feasible only at this layer. This section gives an overview of a subset of possible services at the fog layer and the related advantages that enable IoT. These services are organized into Compute, Storage and Network services.

### **Computing services**

The limitations of computing power of the devices in the perception layer have led to the introduction of remote processing approaches. Processing at the Fog layer is not only motivated by the constraint of processing power at sensor nodes, but also by the desired location of computing to better meet system requirements and maintain energy efficiency.

### **Storage Services**

A huge amount of data can be generated by the sensor nodes and there are billions of these sensor devices around. The storage available in the devices at the perception layer is not often sufficient to store even a one-day data considering the rate of data generation. Combined with the computing service, the stored data can be filtered, analyzed, and compressed for efficient transmission or for learning local information regarding the system behaviour. In cases where the communication may not be robust, the storage services help enhance the reliability of the system by maintaining proper system behavior for client nodes.

### **Communication Services**

The communication in the Internet-of-Things is dominated by wireless nodes. Due to the resource constraints in the perception layer, these wireless protocols are optimized for low power operation, narrow-band transmission or longer range of coverage. Currently, a long list of alternative protocols is available in the market. This helps in managing sub-networks of sensors and actuators providing security, channeling messages among devices and enhancing the reliability of the system. In addition, this layer can provide interoperability of disparate protocols by listing and interpreting the representation format. Moreover, the Fog layer provides visibility of devices that are non-IP-based to be accessible through the Internet.

### **Fog Computing Applications**

**Smart Homes:** Fog computing addresses home security applications with use of smart sensors, cameras, wireless technologies and so on.

**Smart Cities:** Large cities face more challenges in public safety, traffic handling, sanitation, energy utility etc. Single IoT network with network of fog nodes can address these challenges.

**Smart Vehicle:** Fog computing can be integrated into vehicular networks. It is categorized into two types viz. infrastructure based and autonomous. Fog nodes are responsible for sending and



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receiving information to/from vehicles.

**Rail Monitoring:** Fog nodes are installed along side of the railway track. These nodes help in real time monitoring of track conditions. Moreover, sending data to cloud from high speed train is difficult and complex task which can be easily addressed by fog computing architecture based network.

**Visual Security:** Video cameras are installed at public places, residential plots, parking lots, gardens, shopping malls etc. Bandwidth of visual data generated from these cameras make it impossible to send them to cloud for storage and analysis. Fog computing takes care of this situation to provide safety and security to the people by fast analyzing data near to the video camera end itself.

**Health Data Management:** Using fog computing patients can have their health-related data available locally. Moreover, these data are analyzed locally to provide fast treatment by doctors and health experts.

### **Conclusion:**

Fog computing is a promising computing paradigm that extends cloud computing to the edge of networks. Similar to cloud computing but with distinct characteristics, fog computing faces new security and privacy challenges besides those inherited from cloud computing.