Aim: Study of NIST model of Cloud Computing.

Theory:

1. **What is Cloud Computing?**

   Answer Source: [1]

   a. *Cloud computing* is the on-demand availability of computer system resources, especially data storage and computing power, without direct active management by the user.
   b. The term is generally used to describe data centers available to many users over the Internet.
   c. Large clouds, predominant today, often have functions distributed over multiple locations from central servers. If the connection to the user is relatively close, it may be designated an edge server .
   d. An *edge server* is a computer that exists at the edge of the network. It serves as connection between networks and often used to cache content close to the requesting client machine to improve page load time and to reduce latency. [3]

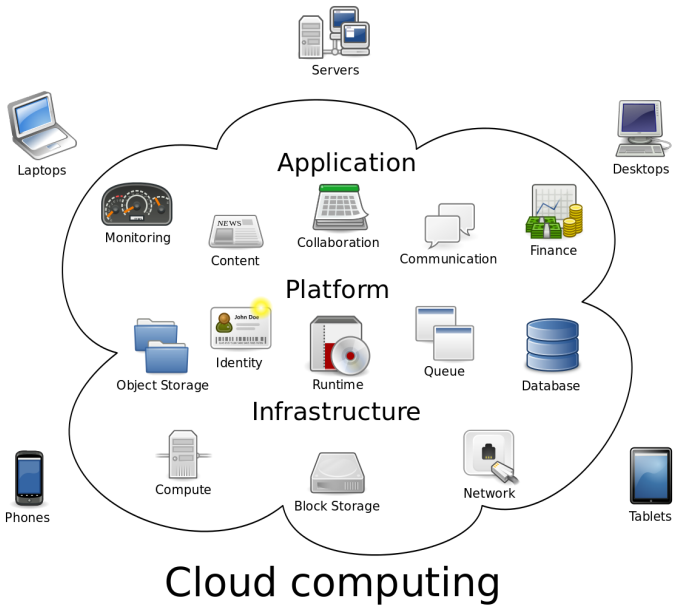


Fig 1. Cloud Computing conceptual model [2]

2. **Explain the Architecture of Cloud Computing.**

   Answer Source: [4]

a. Cloud computing architecture refers to the components and subcomponents required for cloud computing.
b. These components typically consist of a front end platform (fat client, thin client, mobile device), back end platforms (servers, storage), a cloud based delivery, and a network (Internet, Intranet, Intercloud).
c. Combined, these components make up cloud computing architecture.

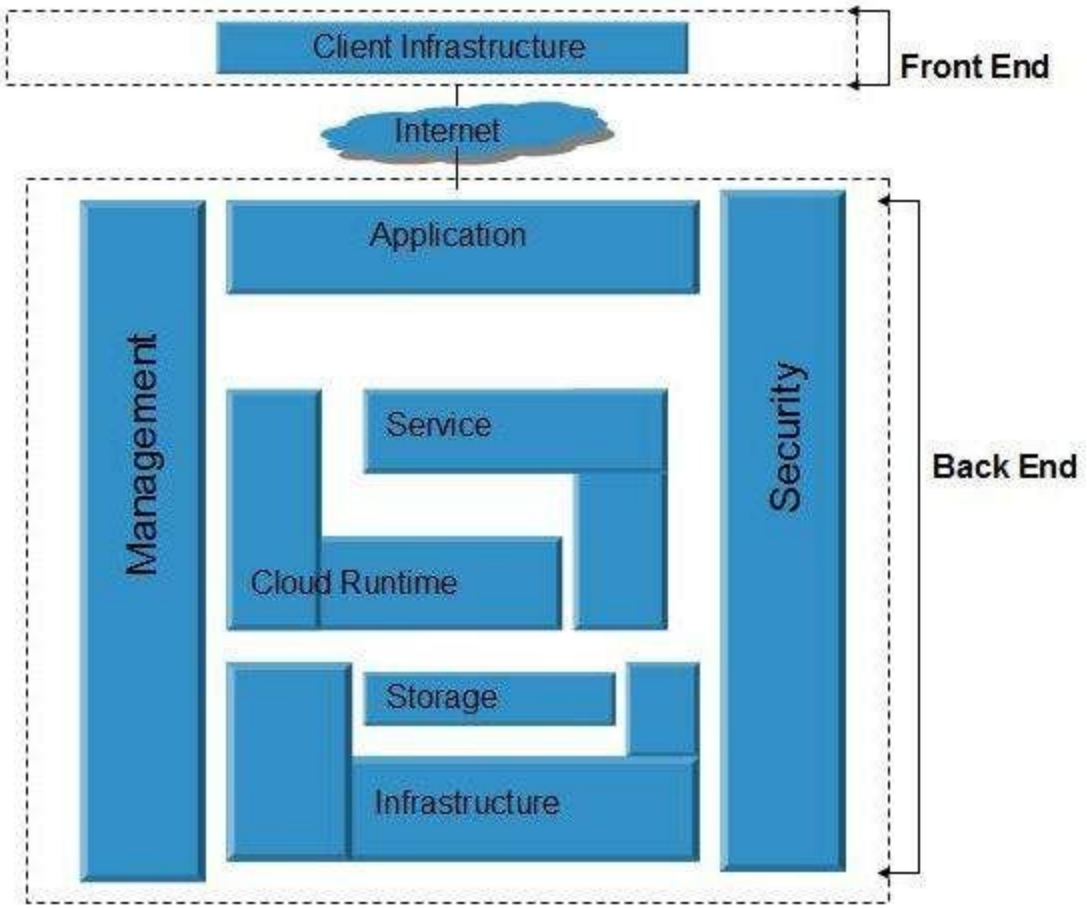


Fig 2. Cloud Computing Architecture [5]

d. Front End [6]:
    i. The front end refers to the client part of cloud computing system.
    ii. It consists of interfaces and applications that are required to access the cloud computing platforms, Example - Web Browser.
e. Back End [6]:
    i. The back End refers to the cloud itself.
    ii. It consists of all the resources required to provide cloud computing services.
    iii. It comprises of huge data storage, virtual machines, security mechanism, services, deployment models, servers, etc.

3. **Explain the Different types of Cloud.**

Answer Source: [7]

NIST defines four cloud deployment models: public clouds, private clouds, community clouds, and hybrid clouds. A cloud deployment model is defined according to where the infrastructure for the deployment resides and who has control over that infrastructure

a. Public Clouds:
    i. Public clouds are environments that are entirely managed and serviced by an external service provider.
    ii. When most people think about computer clouds, it is public clouds they are thinking about.
    iii. In fact, most of the articles and material you find regarding clouds are in fact referring to public clouds.
    iv. This is because the first cloud environments were public clouds.
    v. The idea of there being other types of cloud deployments took a little while to develop.
    vi. Public clouds are still the most deployed cloud environments.
b. PRIVATE CLOUDS
    i. Private clouds are completely managed and maintained by your organization.
    ii. Generally all the infrastructure for the environment will be housed in a data-center that you control.
    iii. So, you are responsible for purchase, maintenance, and support.
    iv. Many people have an understanding of the cloud such that they do not believe that private clouds are actually clouds.
    v. They feel only public clouds are true clouds.
    vi. But if you look at the characteristics of clouds, you can see that it doesn't matter where the cloud is hosted.
    vii. The value proposition of the cloud changes when you talk about private clouds as opposed to public clouds; but the value proposition doesn't determine whether it's a cloud a not.
c. COMMUNITY CLOUDS
    i. Community clouds aren't used as much as public or private clouds; in fact, they are the least known and least used cloud deployment model.
    ii. In a community cloud, the cloud is shared by a group of organizations that have a common purpose or goal.
    iii. The cloud environment is generally built to help them achieve that purpose or goal.
d. HYBRID CLOUDS
    i. As the cloud computing era matures, hybrid clouds will most likely become the most common cloud implementation.
    ii. There is a slight misconception about what a hybrid cloud actually is.
    iii. Many people think a hybrid cloud is a cloud environment in which some components are public and some are private. This is not that case.
    iv. Hybrid clouds can offer the best of both worlds as well as the worst of both worlds.
    v. Hybrid clouds offer the freedom to implement whatever is necessary to meet your organization's needs, but hybrid clouds can also be complex and expensive to implement.

4. Services of cloud.

Answer Source: [12]

Infrastructure as a Service, or IaaS, gives business access to vital web architecture, such as storage space, servers, and connections, without the business need of purchasing and managing this internet infrastructure themselves. Because of the economies of scale and specialization involved, this can be to the benefit of both the business providing the infrastructure and the one using it. In particular, IaaS allows an internet business a way to develop and grow on demand. Both PaaS and SaaS clouds are grounded in IaaS clouds, as the company providing the software as service is also providing the infrastructure to run the software. Choosing to use an IaaS cloud demands a willingness to put up with complexity, but with that complexity comes flexibility. Amazon EC2 and Rackspace Cloud are examples of IaaS.

Platform as a Service (PaaS) clouds are created, many times inside IaaS Clouds by specialists to render the scalability and deployment of any application trivial and to help make your expenses scalable and predictable. Some examples of a PaaS system include: Mosso, Google App Engine, and Force.com. The chief benefit of a service like this is that for as little as no money you can initiate your application with no stress more than basic development and maybe a little porting if you are dealing with an existing app. Furthermore, PaaS allows a lot of scalability by design because it is based on cloud computing as defined earlier in the article. If you want a lean operations staff, a PaaS can be very useful if your app will capitulate. The most important negative of using a PaaS Cloud provider is that these services may implement some restrictions or trade-offs that will not work with your product under any circumstances.

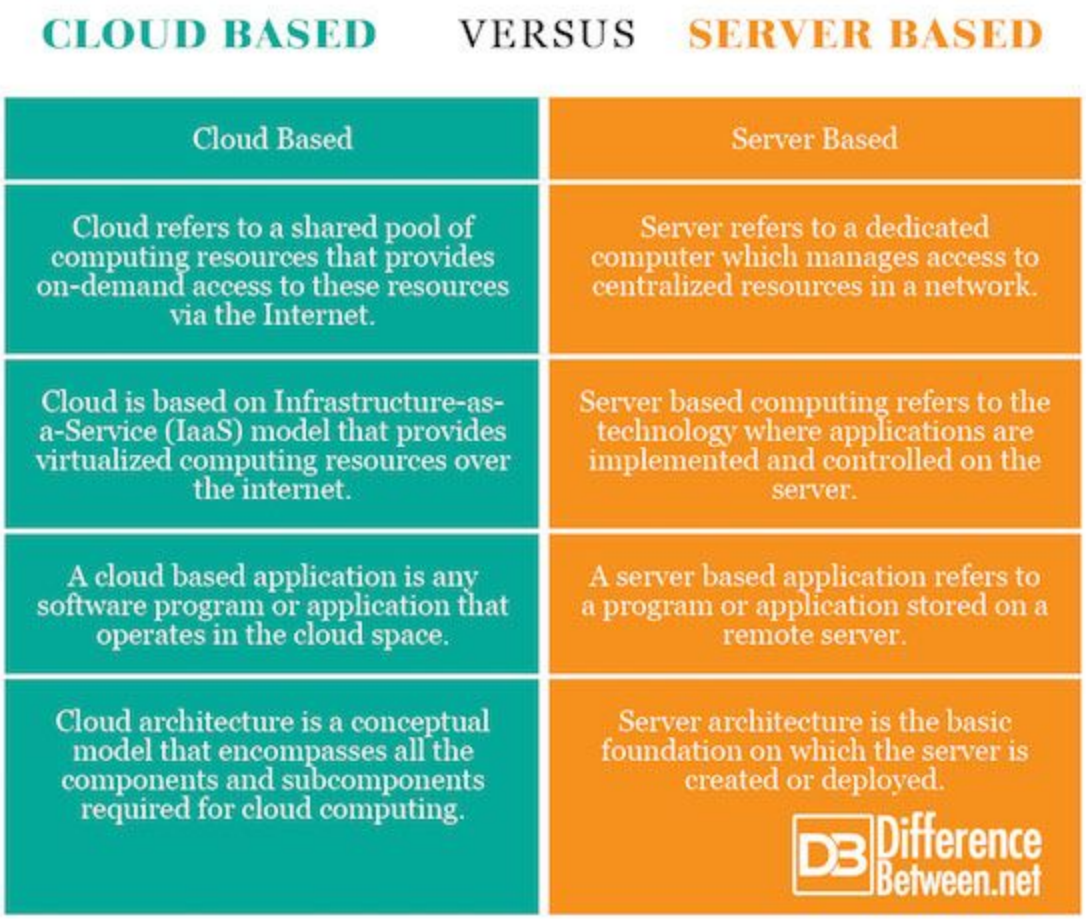
Software as a Service (SaaS) is relatively mature, and the phrase's use predates that of cloud computing. Cloud applications allow the cloud to be leveraged for software architecture, reducing the burdens of maintenance, support, and operations by having the application run on computers belonging to the vendor. GMail and Salesforce are among examples of SaaS run as clouds, but not all SaaS has to be based in cloud computing.

5. Explain the characteristics of Cloud Computing.
    a. **On-demand self-service**
        i. Cloud computing resources can be provisioned without human interaction from the service provider. In other words, a manufacturing organization can provision additional computing resources as needed without going through the cloud service provider. This can be a storage space, virtual machine instances, database instances, and so on.
        ii. Manufacturing organizations can use a web self-service portal as an interface to access their cloud accounts to see their cloud services, their usage, and also to provision and de-provision services as they need to.

b. **Broad network access**
    i. Cloud computing resources are available over the network and can be accessed by diverse customer platforms. It other words, cloud services are available over a network—ideally high broadband communication link—such as the internet, or in the case of a private clouds it could be a local area network (LAN).
    ii. Network bandwidth and latency are very important aspects of cloud computing and broad network access, because they relate to the quality of service (QoS) on the network. This is particularly important for serving time sensitive manufacturing applications.
c. **Multi-tenancy and resource pooling**
    i. Cloud computing resources are designed to support a multi-tenant model. Multi-tenancy allows multiple customers to share the same applications or the same physical infrastructure while retaining privacy and security over their information. It's similar to people living in an apartment building, sharing the same building infrastructure but they still have their own apartments and privacy within that infrastructure. That is how cloud multi-tenancy works.
    ii. Resource pooling means that multiple customers are serviced from the same physical resources. Providers' resource pool should be very large and flexible enough to service multiple client requirements and to provide for economy of scale. When it comes to resource pooling, resource allocation must not impact performances of critical manufacturing applications.
d. **Rapid elasticity and scalability**
    i. One of the great things about cloud computing is the ability to quickly provision resources in the cloud as manufacturing organizations need them. And then to remove them when they don't need them. Cloud computing resources can scale up or down rapidly and, in some cases, automatically, in response to business demands. It is a key feature of cloud computing. The usage, capacity, and therefore cost, can be scaled up or down with no additional contract or penalties.
    ii. Elasticity is a landmark of cloud computing and it implies that manufacturing organizations can rapidly provision and de-provision any of the cloud computing resources. Rapid provisioning and de-provisioning might apply to storage or virtual machines or customer applications.
e. **Measured service**
    i. Cloud computing resources usage is metered and manufacturing organizations pay accordingly for what they have used. Resource utilization can be optimized by leveraging charge-per-use capabilities. This means that cloud resource usage—whether virtual server instances that are running or storage in the cloud—gets monitored, measured and reported by the cloud service provider. The cost model is based on "pay

for what you use"—the payment is variable based on the actual consumption by the manufacturing organization.

6. How does Cloud Computing differs from client server model?



7. **Cloud service providers:**

   Answer Source: [11]

   a. Amazon Web Services
      i. AWS is Amazon's cloud web hosting platform which offers fast, flexible, reliable and cost-effective solutions. It offers a service in the form of building block which can be used to create and deploy any kind of application in the cloud. It is the most popular as it was the first to enter the cloud computing space.
      ii. Features:
         1. Easy sign-up process
         2. Fast Deployments
         3. Allows easy management of add or remove capacity
         4. Access to effectively limitless capacity
         5. Centralized Billing and management
         6. Offers Hybrid Capabilities and per hour billing

   b. Kamatera
      i. A cloud server tool developed by Kamatera is very much similar to a physical server. It operated in a virtual infrastructure cloud, making it

highly flexible and cost-effective. This cloud server pricing is based on pay as you use model a standard in the industry.

ii. Features:

1. 13 Data Centers across four continents for ultimate performance and availability
2. Customized and Tailored Made VPS Hosting to fit your needs
3. Scalability: Allows you to quickly add load balancers, firewalls, private networks and apps such as: pfSense, Docker, CPanel, Drupal, Jenkins, WordPress, Magento, node.JS and many more.
4. All SSDs with UNLIMITED TRAFFIC. 99.95% Up-Time Guaranteed
5. Scale across hundreds of servers in seconds
6. Billing options – Per Month or Per Day
7. 24/7/365 Tech Human Support

c. DigitalOcean

i. Digitalocean's droplet is a scalable computer service. It is more than just virtual machines. This cloud platform offers add-on storage, security, and monitoring capabilities to run production applications easily.

ii. Features:

1. Allows you to deploy your custom image, one-click app, or standard distribution
2. You can deploy Droplets and get a reliable connection and flat pricing across 8 data center regions
3. Option to select Standard Plans or Performance Plans according to your business needs

d. Rackspace

i. Rackspace is another useful cloud computer service tool. It offers services like hosting web applications, cloud files, cloud backup, database, and cloud server, etc.

ii. Features:

1. Fast-migrating to the Cloud
2. Helps you to prepare your business for the worst-case scenario
3. Work on pay as you go model, so you are charged base on your usage
4. It helps you to use a combination of solid-state drives and hard drives to deliver high performance

8. How can security be maintained in Cloud Computing.

Answer Source: [10]

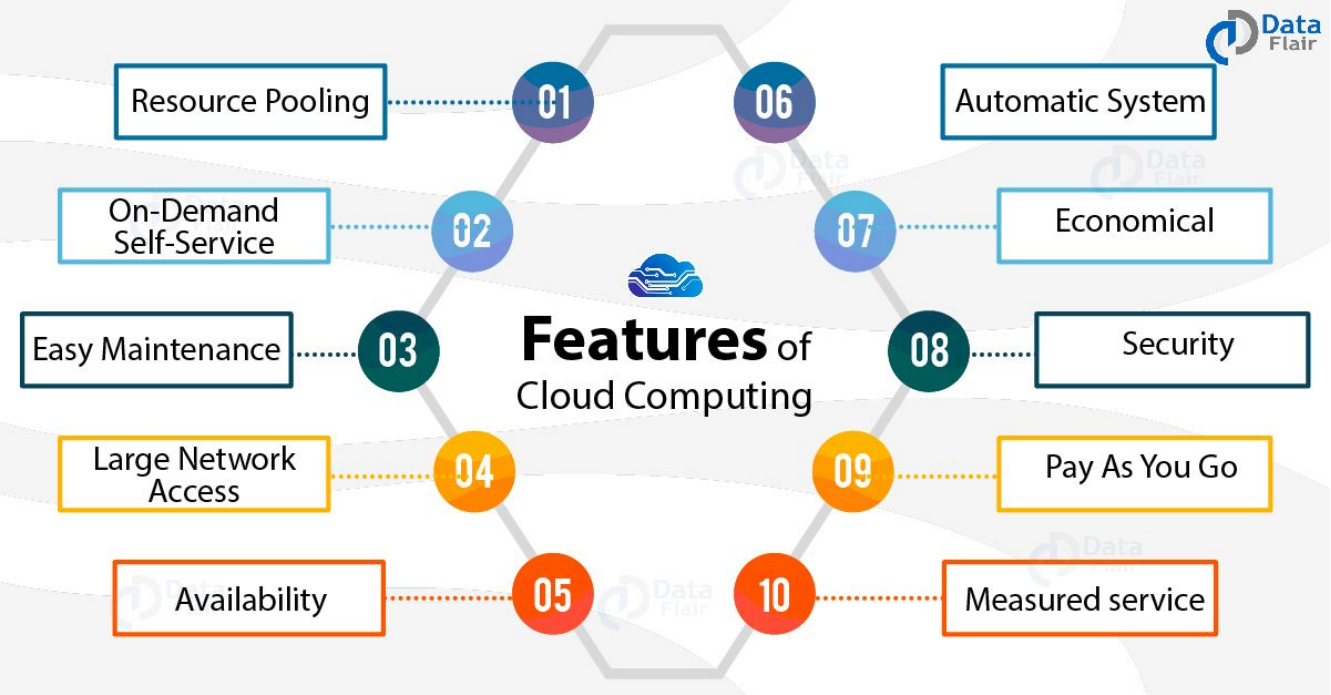
a. A number of security threats are associated with cloud data services: not only traditional security threats, such as network eavesdropping, illegal invasion, and denial of service attacks, but also specific cloud computing threats, such as side

channel attacks, virtualization vulnerabilities, and abuse of cloud services. The following security requirements limit the threats.

b. Confidentiality:
    i. Data confidentiality is the property that data contents are not made available or disclosed to illegal users.
    ii. Outsourced data is stored in a cloud and out of the owners' direct control.
    iii. Only authorized users can access the sensitive data while others, including CSPs, should not gain any information of the data.
    iv. Meanwhile, data owners expect to fully utilize cloud data services, e.g., data search, data computation, and data sharing, without the leakage of the data contents to CSPs or other adversaries.
c. Access controllability
    i. Access controllability means that a data owner can perform the selective restriction of access to their data outsourced to the cloud.
    ii. Legal users can be authorized by the owner to access the data, while others can not access it without permissions.
    iii. Further, it is desirable to enforce fine-grained access control to the outsourced data, i.e., different users should be granted different access privileges with regard to different data pieces.
    iv. The access authorization must be controlled only by the owner in untrusted cloud environments.
d. Integrity
    i. Data integrity demands maintaining and assuring the accuracy and completeness of data.
    ii. A data owner always expects that her or his data in a cloud can be stored correctly and trustworthily.
    iii. It means that the data should not be illegally tampered, improperly modified, deliberately deleted, or maliciously fabricated.
    iv. If any undesirable operations corrupt or delete the data, the owner should be able to detect the corruption or loss.
    v. Further, when a portion of the outsourced data is corrupted or lost, it can still be retrieved by the data users.

9. Features of Cloud Computing.

Answer Source: [8]



Features of Cloud Computing [9]

a. Resources Pooling:
    i. It means that the Cloud provider pulled the computing resources to provide services to multiple customers with the help of a multi-tenant model.
    ii. There are different physical and virtual resources assigned and reassigned which depends on the demand of the customer.
    iii. The customer generally has no control or information over the location of the provided resources but is able to specify location at a higher level of abstraction
b. On-Demand Self-Service:
    i. It is one of the important and valuable features of Cloud Computing as the user can continuously monitor the server uptime, capabilities, and allotted network storage.
    ii. With this feature, the user can also monitor the computing capabilities.
c. Easy Maintenance
    i. The servers are easily maintained and the downtime is very low and even in some cases, there is no downtime.
    ii. Cloud Computing comes up with an update every time by gradually making it better.
    iii. The updates are more compatible with the devices and perform faster than older ones along with the bugs which are fixed.
d. Large Network Access
    i. The user can access the data of the cloud or upload the data to the cloud from anywhere just with the help of a device and an internet connection.
    ii. These capabilities are available all over the network and accessed with the help of internet.
e. Availability:

i. The capabilities of the Cloud can be modified as per the use and can be extended a lot.
ii. It analyzes the storage usage and allows the user to buy extra Cloud storage if needed for a very small amount.

f. Automatic System:
i. Cloud computing automatically analyzes the data needed and supports a metering capability at some level of services.
ii. We can monitor, control, and report the usage. It will provide transparency for the host as well as the customer.

g. Economical:
i. It is the one-time investment as the company (host) has to buy the storage and a small part of it can be provided to the many companies which save the host from monthly or yearly costs.
ii. Only the amount which is spent is on the basic maintenance and a few more expenses which are very less.

h. Data Security:
i. It creates a snapshot of the data stored so that the data may not get lost even if one of the servers gets damaged.
ii. The data is stored within the storage devices, which cannot be hacked and utilized by any other person. The storage service is quick and reliable.

i. Pay as you go
i. In cloud computing, the user has to pay only for the service or the space they have utilized.
ii. There is no hidden or extra charge which is to be paid.
iii. The service is economical and most of the time some space is allotted for free.

j. Measured Service
i. Cloud Computing resources used to monitor and the company uses it for recording.
ii. This resource utilization is analyzed by supporting charge-per-use capabilities.
iii. This means that the resource usages which can be either virtual server instances that are running in the cloud are getting monitored measured and reported by the service provider.
iv. The model pay as you go is variable based on actual consumption of the manufacturing organization.

10. Advantages, Limitations, Applications.

a. Advantages of Cloud Computing:

Cost Savings: It helps you to save substantial capital cost as it does not need any physical hardware investments. Also, you do not need trained personnel to maintain the hardware. The buying and managing of equipment is done by the cloud service provider.

Strategic edge: Cloud computing offers a competitive edge over your competitors. It helps you to access the latest and applications any time without spending your time and money on installations.

High Speed: Cloud computing allows you to deploy your service quickly in fewer clicks. This faster deployment allows you to get the resources required for your system within fewer minutes.

Back-up and restore data: Once the data is stored in a Cloud, it is easier to get the back-up and recovery of that, which is otherwise very time taking process on-premise.

Automatic Software Integration: In the cloud, software integration is something that occurs automatically. Therefore, you don't need to take additional efforts to customize and integrate your applications as per your preferences.

Reliability: Reliability is one of the biggest pluses of cloud computing. You can always get instantly updated about the changes.

Mobility: Employees who are working on the premises or at the remote locations can easily access all the could services. All they need is an Internet connectivity.

Unlimited storage capacity: The cloud offers almost limitless storage capacity. At any time you can quickly expand your storage capacity with very nominal monthly fees.

Collaboration: The cloud computing platform helps employees who are located in different geographies to collaborate in a highly convenient and secure manner.

Quick Deployment: Last but not least, cloud computing gives you the advantage of rapid deployment. So, when you decide to use the cloud, your entire system can be fully functional in very few minutes. Although, the amount of time taken depends on what kind of technologies are used in your business.

b. Limitations of Cloud Computing:

Performance Can Vary: When you are working in a cloud environment, your application is running on the server which simultaneously provides resources to other businesses. Any greedy behavior or DDOS attack on your tenant could affect the performance of your shared resource.

Technical Issues: Cloud technology is always prone to an outage and other technical issues. Even, the best cloud service provider companies may face this type of trouble despite maintaining high standards of maintenance.

Security Threat in the Cloud: Another drawback while working with cloud computing services is security risk. Before adopting cloud technology, you should be well aware of the fact that you will be sharing all your company's sensitive information to a third-party cloud computing service provider. Hackers might access this information.

Downtime: Downtime should also be considered while working with cloud computing. That's because your cloud provider may face power loss, low internet connectivity, service maintenance, etc.

Internet Connectivity: Good Internet connectivity is a must in cloud computing. You can't access cloud without an internet connection. Moreover, you don't have any other way to gather data from the cloud.

Lower Bandwidth: Many cloud storage service providers limit bandwidth usage of their users. So, in case if your organization surpasses the given allowance, the additional charges could be significantly costly

Lacks of Support: Cloud Computing companies fail to provide proper support to the customers. Moreover, they want their user to depend on FAQs or online help, which can be a tedious job for non-technical persons.

c. **Applications of Cloud Computing:**

Storing File Online: Cloud Computing provides a benefit to store and access the software with the help of internet connection to the Cloud. The interface provided is very easy to operate and is economical too.

Video Making and Editing Software: There are many software available which can access with the help of the cloud. This software helps to create and modify the videos. The videos create or modify are stored in the cloud itself and we can access anytime.

Anti-Virus Applications: There is software which is stored in the cloud and from there they fix the system. All the viruses and the malware are detected and analyzed by the software and the system is fixed. They also come up with a feature of downloading the software.

E-commerce Application: With the help of e-commerce application in the cloud, user and e-business allow responding quickly to the opportunities which are emerging. It also allows the user to respond quickly to the market opportunities and the challenges. Business tycoons focuse on the usage of cloud computing without keeping time in the mind.

Business Process: Business management applications are based on the cloud service provider. The business utilizes the cloud computing to store the necessary data and all the relevant information. This information can be anything such as the personal data of the customer, analyzed records, and many more.

Backup and Recovery: The cloud computing can be used as a backup option in which we can store the files, information, and the data. This data is stored will be protected and provided much security. When the data is lost the user can recover the data which he/she has stored in the cloud.

File Converters: There are many applications which utilize to change to format of the file such that from HTML to pdf and so on. This software is available at cloud and access from anywhere with the help of internet connection.

Conclusion:

1. Learnt what is cloud computing and the areas where it can be used.
2. Found out the applications where traditional client-server approach of using service provider’s servers fails which can be replaced by cloud based services.

3. Explored various aspects of the cloud computing in terms of architecture, security, types of deployment models, etc.
4. Read about the factors affecting decision of a company to switch over cloud computing.

References:

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AIM: Virtualization in Cloud Computing.

Theory:

1. **What is Virtualization?**
    a. Virtualization is the process of running a virtual instance of a computer system in a layer abstracted from the actual hardware.
    b. Most commonly, it refers to running multiple operating systems on a computer system simultaneously.
    c. To the applications running on top of the virtualized machine, it can appear as if they are on their own dedicated machine, where the operating system, libraries, and other programs are unique to the guest virtualized system and unconnected to the host operating system which sits below it.
    d. Virtualization uses software that simulates hardware functionality in order to create a virtual system.
    e. This practice allows IT organizations to operate multiple operating systems, more than one virtual system and various applications on a single server.
    f. The benefits of virtualization include greater efficiencies and economies of scale.

2. **Role of Virtualization in Cloud Computing.**
    a. Looking at the advantages of Cloud Computing like the ease of scaling up, security, fluid or flexible resources, etc. all these are achieved by virtualization. If another server is required, a virtual server will rapidly be created and we will have a fresh server prepared. When we need an additional amount of memory, we expand the configurations of the virtual server which we are already using and now we have that extra memory we needed.
    b. Thus, virtualization forms the core technology of the Cloud Computing business model.

3. **Types of Virtualization:**
    Answer Source: https://www.javatpoint.com/virtualization-in-cloud-computing
    a. Hardware Virtualization:
        i. When the virtual machine software or virtual machine manager (VMM) is directly installed on the hardware system is known as hardware virtualization.
        ii. The main job of hypervisor is to control and monitoring the processor, memory and other hardware resources.
        iii. After virtualization of hardware system we can install different operating system on it and run different applications on those OS.
        iv. Usage:
            1. Hardware virtualization is mainly done for the server platforms, because controlling virtual machines is much easier than controlling a physical server.
    b. Operating System Virtualization:
        i. 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.

ii. Usage:
    1. Operating System Virtualization is mainly used for testing the applications on different platforms of OS.

c. Server Virtualization:
    i. When the virtual machine software or virtual machine manager (VMM) is directly installed on the Server system is known as server virtualization.
    ii. Usage:
        1. Server virtualization is done because a single physical server can be divided into multiple servers on the demand basis and for balancing the load.

d. Storage Virtualization:
    i. Storage virtualization is the process of grouping the physical storage from multiple network storage devices so that it looks like a single storage device.
    ii. Storage virtualization is also implemented by using software applications.
    iii. Usage:
        1. Storage virtualization is mainly done for back-up and recovery purposes.

4. Explain "Hypervisor"

Answer Source: https://en.wikipedia.org/wiki/Hypervisor

a. A hypervisor (or virtual machine monitor, VMM) is a computer software, firmware or hardware that creates and runs virtual machines.
b. A computer on which a hypervisor runs one or more virtual machines is called a host machine, and each virtual machine is called a guest machine.
c. The hypervisor presents the guest operating systems with a virtual operating platform and manages the execution of the guest operating systems.
d. Multiple instances of a variety of operating systems may share the virtualized hardware resources: for example, Linux, Windows, and macOS instances can all run on a single physical x86 machine.
e. This contrasts with operating-system-level virtualization, where all instances (usually called containers) must share a single kernel, though the guest operating systems can differ in user space, such as different Linux distributions with the same kernel.

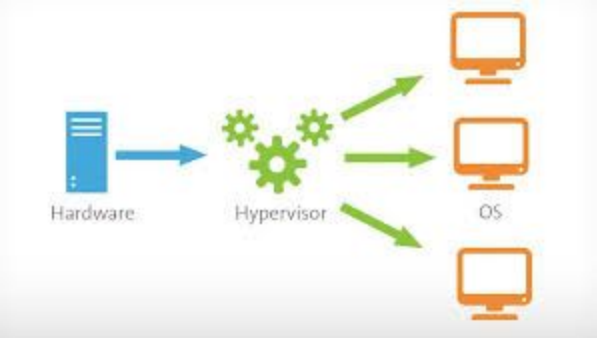


Fig 1. Hypervisor in Virtualization(https://www.google.com/url?sa=i&source=images&cd=&ved=2ahUKEwiY3cmq44LnAhWB9XMBHdmuB5sQjRx6BAgBEAQ&url=https%3A%2F%2Fwww.vmware.com%2Ftopics%2Fglossary%2Fcontent%2Fhypervisor&psig=AOvVaw0A7RldgTy5lt-hQMIDwtCF&ust=1579080475924283)

5. Types of Hypervisors

Answer Source: https://en.wikipedia.org/wiki/Hypervisor

There are two types of Hypervisors namely (Type 1 and Type 2)

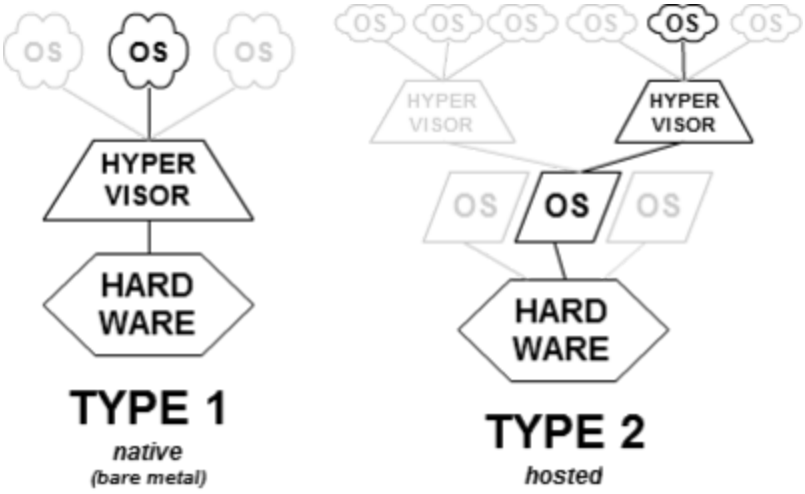


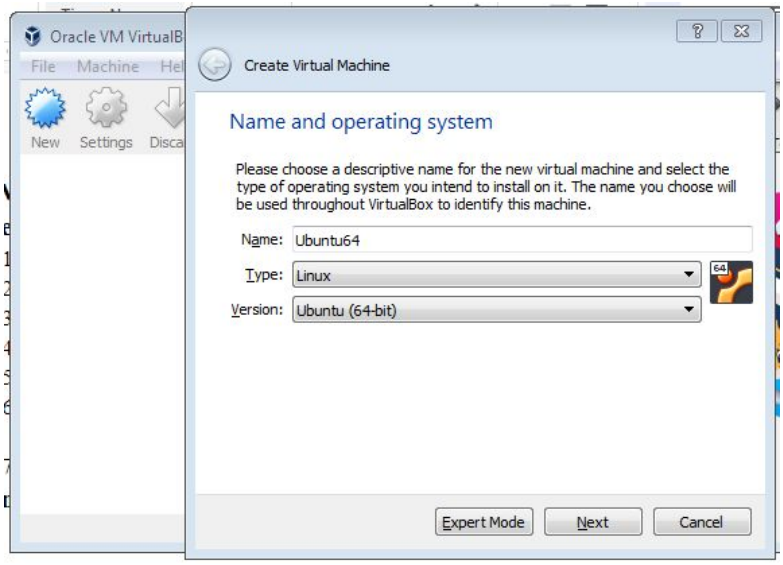
Fig 2. Types of hypervisors(type1 and type2)

a. Type-1 / native / bare-metal hypervisors
    i. These hypervisors run directly on the host's hardware to control the hardware and to manage guest operating systems.
    ii. For this reason, they are sometimes called bare metal hypervisors. The first hypervisors, which IBM developed in the 1960s, were native hypervisors.
    iii. These included the test software SIMMON and the CP/CMS operating system (the predecessor of IBM's z/VM).
    iv. Modern equivalents include Nutanix AHV, AntsleOs, Xen, XCP-ng, Oracle VM Server for SPARC, Oracle VM Server for x86, Microsoft Hyper-V, Xbox One system software, and VMware ESXi (formerly ESX).
b. Type-2 / hosted hypervisors
    i. These hypervisors run on a conventional operating system (OS) just as other computer programs do.
    ii. A guest operating system runs as a process on the host. Type-2 hypervisors abstract guest operating systems from the host operating system.
    iii. VMware Workstation, VMware Player, VirtualBox, Parallels Desktop for Mac and QEMU are examples of type-2 hypervisors.

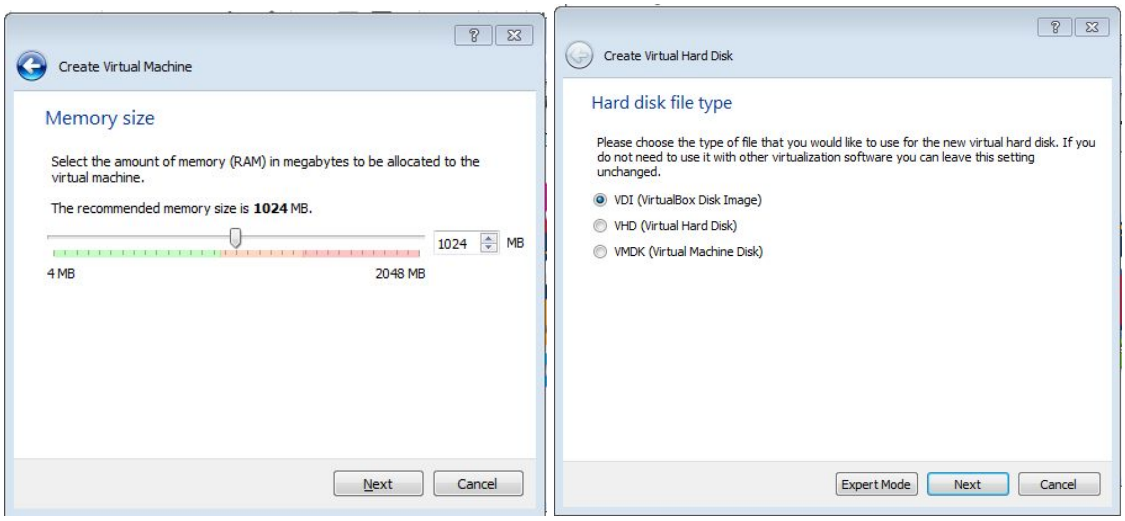
	Type 1 Hypervisor	Type 2 Hypervisor
Definition	A hypervisor that runs directly on the host's hardware to control the hardware and to manage guest Operating Systems.	A hypervisor that runs on a conventional Operating System just as other computer programs do.
Alternate names	Called as a native or Bare Metal Hypervisor	Called as a host OS hypervisor
Runs on	Runs directly on the host hardware	Runs on an operating system similar to any other computer programs.

Support	Hardware Virtualization	OS Virtualization
Performance	Very High. Resources are not being consumed by a bloated parent Operating System.	Steep Resource Overhead penalties reduce performance.

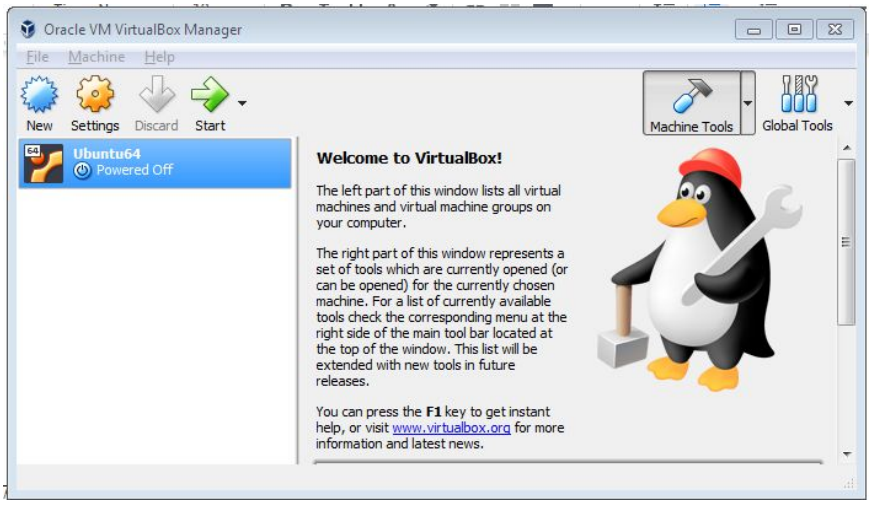
6. Installation steps in Windows.
    a. Click on new to start creation of a new virtual OS and enter the relevant information.



    b. Some other configurations for virtual OS.



    c. A new machine is created.

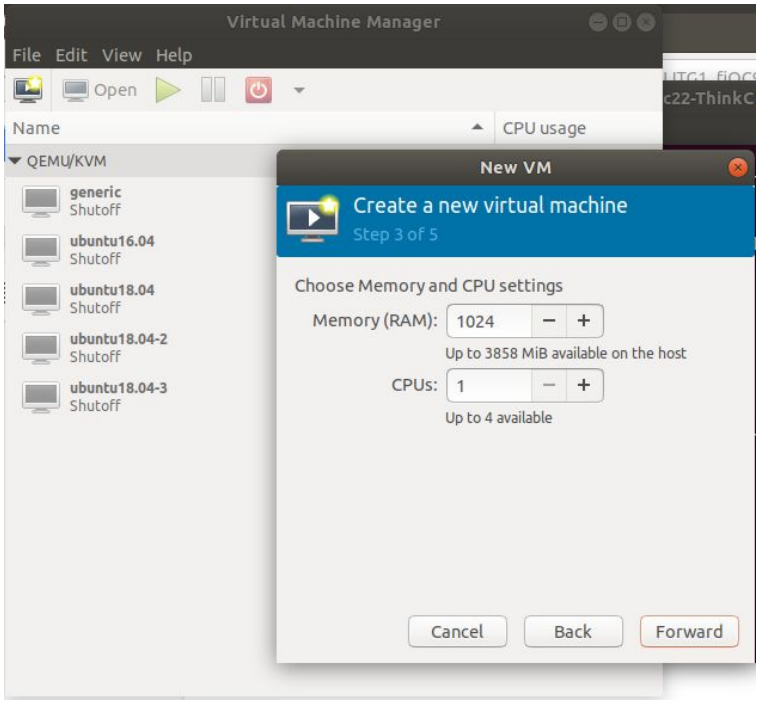


d. Boot the newly created virtual OS.

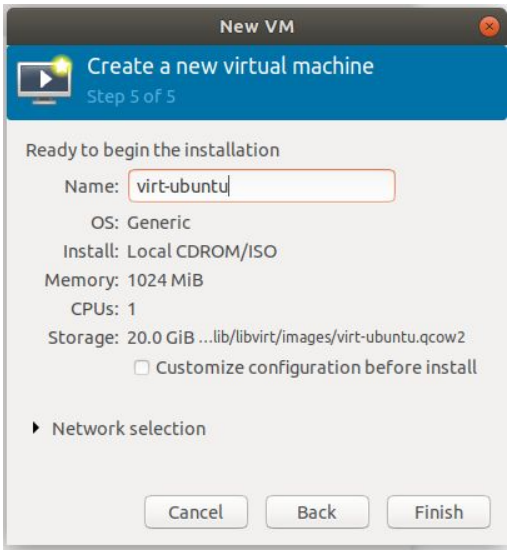
7. Installation steps in Linux.
   a. Run the following commands:
      i. sudo apt-get update
      ii. sudo apt-get install qemu-kvm libvirt-bin bridge-utils
      iii. sudo apt-get virt-manager
      iv. sudo virt-manager

```
rishabh@bhatnagar:~$ cat commands.sh
sudo apt-get update
sudo apt-get install qemu-kvm libvirt-bin bridge-utils
sudo apt-get virt-manager
sudo virt-manager
rishabh@bhatnagar:~$
rishabh@bhatnagar:~$ bash commands.sh
```

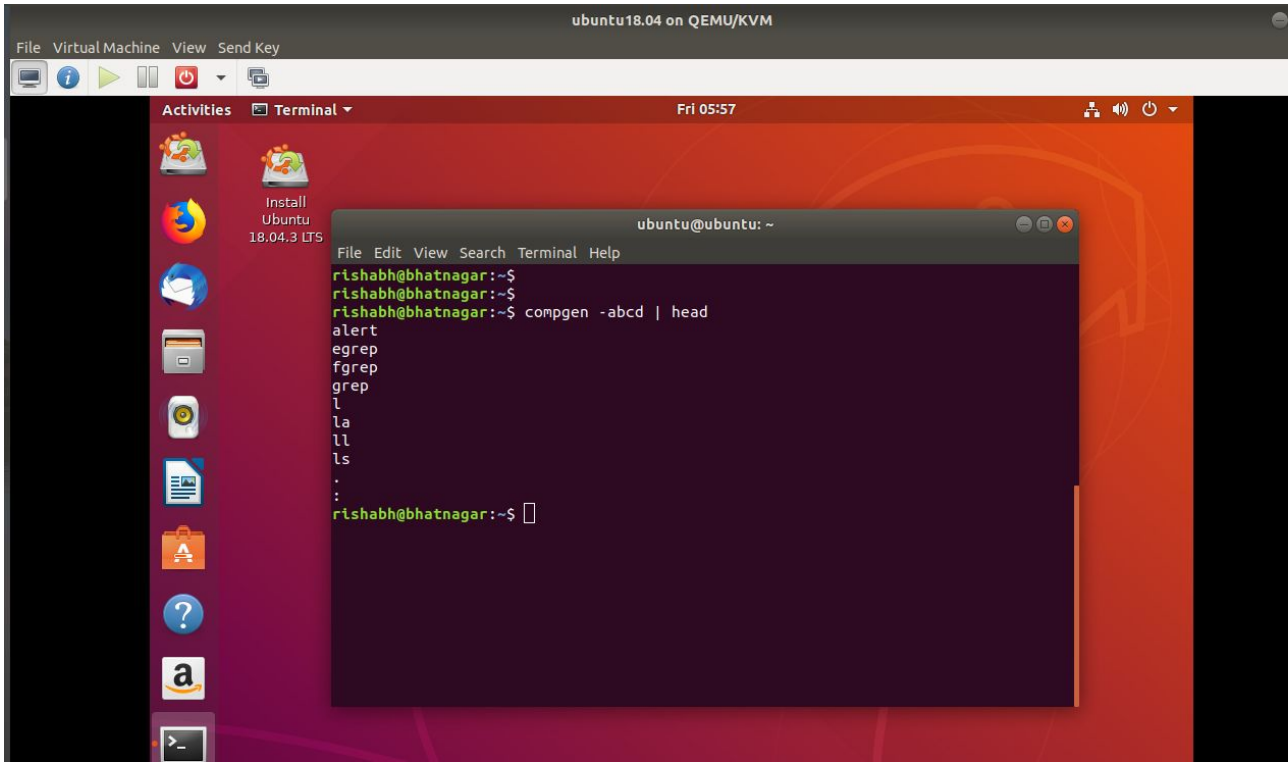
   b. Create a new virtual machine via the downloaded disk image:



c. Confirm other options.



d. Boot the new virtual OS:



Conclusion:

1. Found the need of Virtual Operating System.
2. Learnt how to install virtual OS on two different Operating System.
3. https://www.linuxtechi.com/install-lxd-lxc-containers-from-scratch/

1. **Explain Different Types of services.**

   Answer Source: [1]

   a. **Infrastructure as a Service, or IaaS**, gives business access to vital web architecture, such as storage space, servers, and connections, without the business need of purchasing and managing this internet infrastructure themselves. Because of the economies of scale and specialization involved, this can be to the benefit of both the business providing the
   b. infrastructure and the one using it. In particular, IaaS allows an internet business a way to develop and grow on demand. Both PaaS and SaaS clouds are grounded in IaaS clouds, as the company providing the software as service is also providing the infrastructure to run the software. Choosing to use an IaaS cloud demands a willingness to put up with complexity, but with that complexity comes flexibility. Amazon EC2 and Rackspace Cloud are examples of IaaS.

   c. **Platform as a Service (PaaS)** clouds are created, many times inside IaaS Clouds by specialists to render the scalability and deployment of any application trivial and to help make your expenses scalable and predictable. Some examples of a PaaS system include: Mosso, Google App Engine, and Force.com. The chief benefit of a service like this is that for as little as no money you can initiate your application with no stress more than basic development and maybe a little porting if you are dealing with an existing app. Furthermore, PaaS allows a lot of scalability by design because it is based on cloud computing as defined earlier in the article. If you want a lean operations staff, a PaaS can be very useful if your app will capitulate. The most important negative of using a PaaS Cloud provider is that these services may implement some restrictions or trade-offs that will not work with your product under any circumstances.

   d. **Software as a Service (SaaS)** is relatively mature, and the phrase's use predates that of cloud computing. Cloud applications allow the cloud to be leveraged for software architecture, reducing the burdens of maintenance, support, and operations by having the application run on computers belonging to the vendor. GMail and Salesforce are among examples of SaaS run as clouds, but not all SaaS has to be based in cloud computing.

2. **Explain what is OwnCloud.**

   Answer Source: [4]

   a. 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 centre 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.
   b. 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 having hard limits (like on storage space or number of users) defined only by the physical capabilities of the server.

3. Features of OwnCloud.

4. Sync and Share Your Data, with Ease
    i. ownCloud is the most straightforward way to file sync and share data. You don't need to worry about where or how to access your files. With ownCloud all your data is where ever you are; accessible on all devices, any time.
    b. A Safe Home for All Your Data
        i. ownCloud is hosted exclusively on your own private server/cloud so you can rest assured that your data is under your control. ownCloud is all about your privacy and works to protect your files. It ensures that access is controlled only by the one who should have control: You.
    c. Your Data is Where You Are
        i. When traveling, access ownCloud through your Android or iOS devices. Automatically upload pictures after taking them. Sync files at home or work with the desktop client keeping one or more local folders synchronized between devices. And wherever you are, the web interface lets you view, share and edit your files alone or with others. Want to integrate third-party storage providers? With its open and flexible architecture, ownCloud offers implementations of Dropbox, Microsoft OneDrive and many more. Wherever you are, your data is with you.
    d. Community Driven
        i. With over 50 million users and a very active developing community of over 1,100 contributors, ownCloud is one of the biggest open source projects worldwide. Start reaping in the benefits by joining the ownCloud community: Get help, contribute to our development team or sign up for exclusive beta versions.

5. Advantages OwnCloud.

Answer Source: [3]

a. Access, Share and Sync Your Data with OwnCloud
    i. OwnCloud provides you with access to your data through a web interface, sync clients or WebDAV while providing a platform to view, sync and share across devices. It is a self-hosted file sync and share server that is all under your control. Its open architecture is extensible through simple but powerful API for plugins and applications that works with any storage.
b. Access to Everything Important
    i. With ownCloud you are able to store all of your private pictures, documents, calendars and contacts on your server at home. You can access your existing data on an FTP drive at work, shared images with Dropbox through your ownCloud server. It should be run in a place that you trust and access all the data you want in one location. ownCloud also gives you the capability to access your data through your IOS and Android devices from anywhere in the world. You can automatically upload pictures after taking them, sync files at home or work and access the web interface to view, share or edit your files alone or with others.

c. Ability to Share ownCloud with Anyone
    i. You are also able to send password protected links for others to upload files. You will receive notifications on your phone when you receive a share from another or your own ownCloud server. A place where you can edit documents together, have video calls and comment on photos that are shared by or with you. You can easily share and collaborate with whomever you choose.

6. Disadvantages of OwnCloud

a. Upgrading ownCloud to two or more versions above is not possible.
b. ownCloud was removed from debian package.
c. Arch Packages doesn't have signatures to verify the installation of ownCloud instance.
d. Integrity Check in Arch is not possible.
e. Altered permissions cause the software to render in an inconsistent state causing installation problem forcing user to reinstall the package.
f. OwnCloud uses it's own set of versions which are not easily backward compatible with libraries like apache.

7. Limitations of OwnCloud

Answer Source: [2]

a. Extremely large files eg. individual files that are larger than 16GB.
b. Data or files that are to be directly accessed by systems undertaking intensive analysis and modelling.
c. Synchronising folders to a desktop where the total folders/files synchronised exceeds 200GB
d. Interactive and simultaneous document authoring with multiple people.

8. Installation Steps.

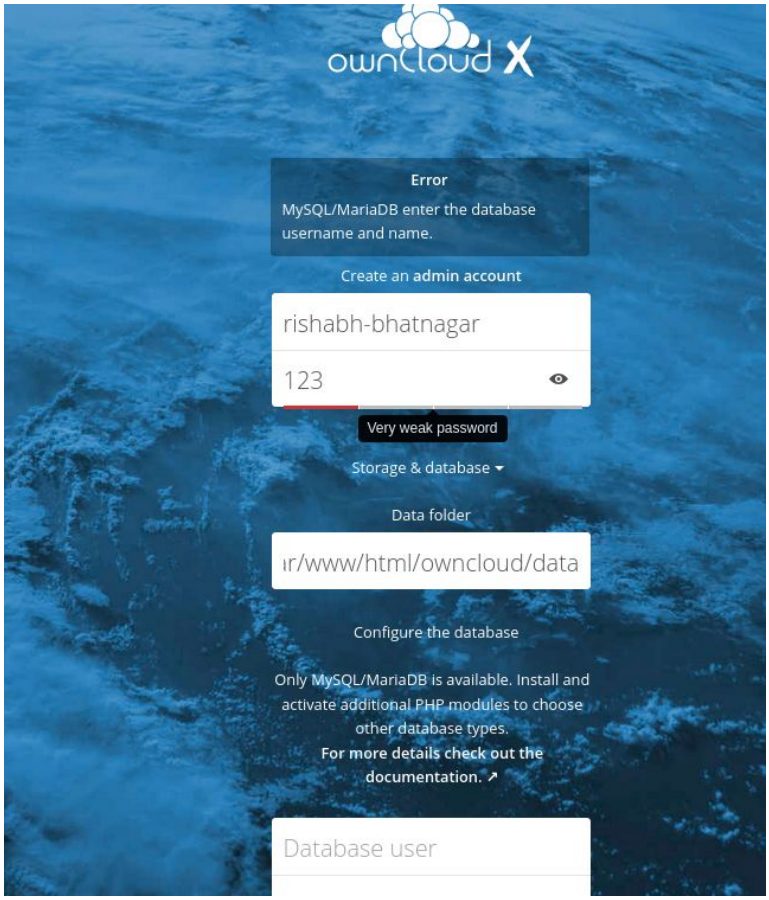
Save folowing commands in a bash file and run sh file.sh.

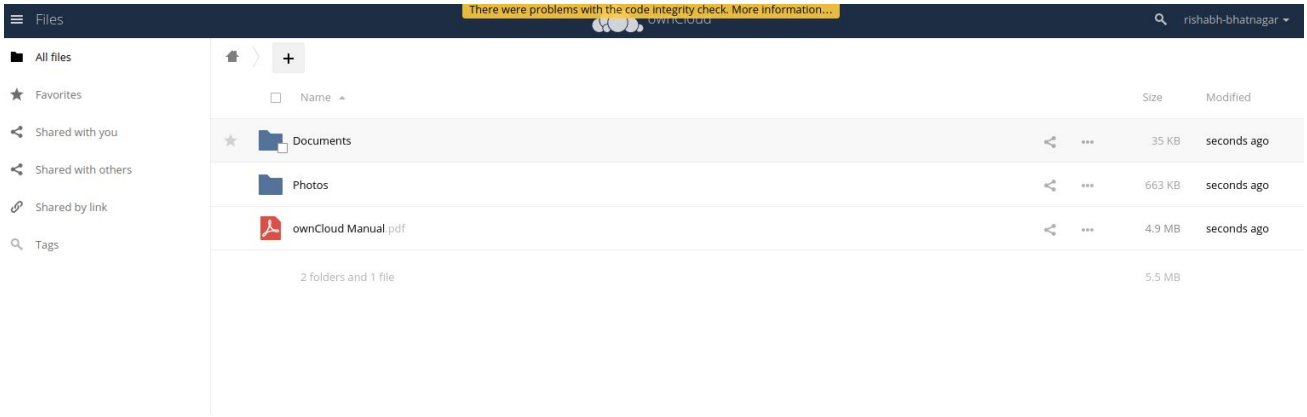
```
sudo apt install apache2
sudo sed -i "s/Options Indexes FollowSymLinks/Options FollowSymLinks/" /etc/apache2/apache2.conf
sudo systemctl stop apache2.service
sudo systemctl start apache2.service
sudo systemctl enable apache2.service
sudo apt-get install mariadb-server mariadb-client
sudo systemctl stop mysql.service
sudo systemctl start mysql.service
sudo systemctl enable mysql.service
sudo mysql_secure_installation

sudo systemctl restart mysql.service
sudo apt-get install software-properties-common
sudo add-apt-repository ppa:ondrej/php
sudo apt update
```

Creating new database for owncloud launching a new instance.

```
pc-11@pc11-Vostro-3670:~$ sudo mysql -u root -p
Enter password:
Welcome to the MariaDB monitor.  Commands end with ; or \g.
Your MariaDB connection id is 30
Server version: 10.1.43-MariaDB-0ubuntu0.18.04.1 Ubuntu 18.04

Copyright (c) 2000, 2018, Oracle, MariaDB Corporation Ab and others.

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

MariaDB [(none)]> CREATE DATABASE owncloud;
Query OK, 1 row affected (0.00 sec)

MariaDB [(none)]> CREATE USER 'rishabh-bhatnagar'@'localhost' IDENTIFIED BY '123';
Query OK, 0 rows affected (0.00 sec)

MariaDB [(none)]> GRANT ALL ON owncloud.* TO 'rishabh-bhatnagar'@'localhost' IDENTIFIED BY '123' WITH GRANT OPTION;
Query OK, 0 rows affected (0.00 sec)
```

Launching the new owncloud instance:





References:

[1] https://www.monitis.com/blog/3-types-of-cloud-computing-services/

[2] https://www.newcastle.edu.au/current-staff/working-here/it-and-computing/information-management/owncloud/accordion-owncloud/limitations-of-owncloud

[3] https://www.tristartechsolutions.co.uk/owncloud-the-features-and-benefits/

[4] https://en.wikipedia.org/wiki/OwnCloud

Conclusion:

1. Installed a new owncloud instance on a linux-based-distro.
2. Made some local transactions to share some files across different users in the same connection.
3. Being an Open-Source-System, saw some part of the gigantic repository code based on networking.
4. Some of the various platforms that owncloud seem to work flawlessly after installation includes linux-based-OSs and Android platform.

Experiment No. 5 Marks: 13/15

Checked by SD'souza

Aim: Demonstration of cloud services using Amazon web services.

Theory
:

1. Explain AWS

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. In aggregate, these cloud computing web services provide a set of primitive abstract technical infrastructure and distributed computing building blocks and tools. One of these services is Amazon Elastic Compute Cloud, which allows users to have at their disposal a virtual cluster of computers, available all the time, through the Internet. AWS's version of virtual computers emulate most of the attributes of a real computer, including hardware central processing units (CPUs) and graphics processing units (GPUs) for processing; local/RAM memory.

2. List the different services provided by AWS

➢ Amazon Elastic Cloud Compute (EC2) ➢ Amazon S3 (Simple Storage Service) ➢ Amazon Virtual Private Cloud (VPC) ➢ Amazon Cloud Front. ➢ Amazon Relational Database Services (RDS)

3. Explain EC2 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.

Steps for
EC2

Step 1 -: Login to AWS portal and Select EC2 service from admin console

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

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.
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.

Step 5-: Now specify the instance details like Number of instances, networking options like VPC, Subnet ot dhcp public IP etc. and click on Next

Step 6-: Specify the storage space for VM and click on Next

Step 6-: Click on Add tag to specify VM Name and click on Next

Step 6-: Configure security group to provide access to VM using different protocols. In this example we have selected default RDP protocol.

Step 7-: Now Review the instance and click on Launch
button
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.

Step 8-: Finally Click on launch instance to Launch
VM

Step 9-: 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.
Step 10-:Now Click on Connect to get the password for VM to access it over RDP protocol.

Step 11 -: Select the downloaded key pair file to decrypt the password.

Step 12 -: Now connect the instance using RDP tool by using Ipaddress/DNS, username and Password decrypted in last step

Step 13-: Once you click on connect, you will see the running Windows virtual machine as shown below.

Step 14-: You can shut down instance by selecting instance state followed by stop

Step 15-: You can delete the instance permanently by selecting instance state followed by stop

4. Explain S3 Amazon S3 or Amazon Simple Storage Service is a service offered by

Amazon Web Services (AWS) that provides object storage through a web service interface. Amazon S3 uses the same scalable storage infrastructure that Amazon.com uses to run its global e-commerce network. Amazon S3 can be employed to store any type of object which allows for uses like storage for Internet applications, backup and recovery, disaster recovery, data archives, data lakes for analytics, and hybrid cloud storage

Steps for S3

Step 1: Select S3 service and click on create bucket, enter a name for the bucket and region.
Step 2: Set properties give owner the read and write access to objects and object permissions. For public permissions select do not grant public read access to this bucket.
Step 3: After setting permission the page will be denied access, then we need to reload the page. After reloading the image of the sheep will appear as shown below.

5. Importance of AWS

Amazon Web Services (abbreviated AWS) is a collection of remote computing services (also called web services) that together make up a cloud computing platform, offered

over the Internet
by Amazon.com. The most central and well-known of these services are Amazon EC2 and Amazon S3.AWS is a suite of hosting products that aims to take the headache out of traditional hosting solutions. Services like Dropbox and websites such as Reddit all use AWS. In Fact we feel that we are in a good neighborhood by being on AWS.AWS isn't just for the Dropboxes and Reddits of the world, though. We recently have been using AWS to host the web backend for an enterprise web application we built for the mortgage servicing industry, which usually runs on high traffic during the office hours and a bit of less traffic in the off hours

6.

Advantages:

➢ Easy to use ➢ No capacity limit ➢ Provides speed and agility ➢ Secure and reliable

Disadvantages:

➢ Limitations of amazon EC2
➢ Security limitations ➢ Technical support fee ➢ General cloud computing issues

Applications:

1. AWS Application in Business Stream

AWS helps the business to build the app and generate new revenue streams quickly. Through this, you can easily develop applications for your business purpose. Amazon EC2 has a number of different performance levels to support your application’s requirement.

• Pay as you go

• Easy and Scalable

• Accessible and fast

2. AWS Application in content Management System

AWS provides quality work which makes their customers a permanent one. The content provided by the user is confidential and secure. AWS uses high-speed servers which helps the user to easily complete their task.

Conclusion

In this experiment we studied Applications of Amazon Web Services. Amazon cloud is the secure and reliable platform which saves your money and time. The applications of AWS are only for business and private (small-scale) purpose.

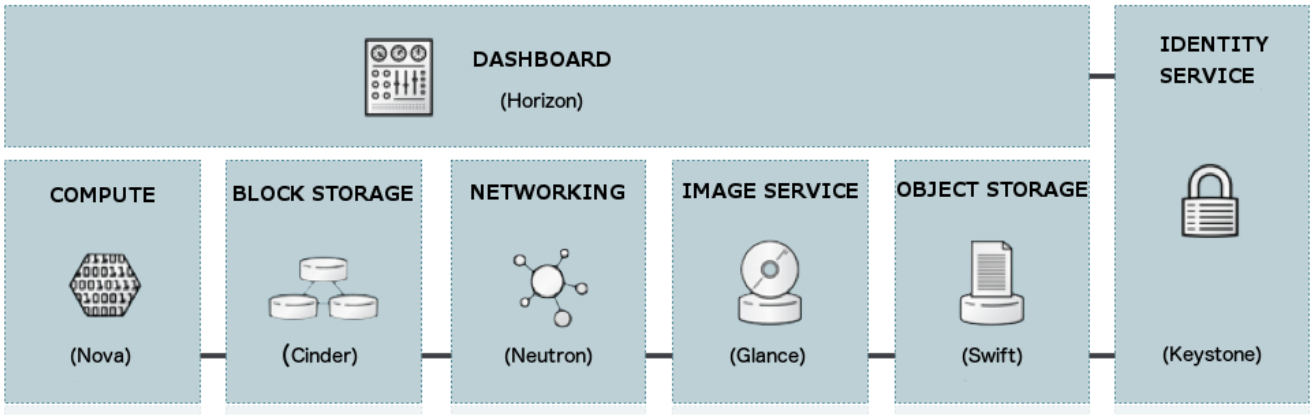
AIM: Case Study on IaaS: Openstack.

Compiled By: RishabhBhatnagar

Roll No: 54.

Theory:

1. **Introduction to OpenStack.**
    a. OpenStack embraces a modular architecture to provide a set of core services that facilitates scalability and elasticity as core design tenets. This chapter briefly reviews OpenStack components, their use cases and security considerations.



    b. Compute::
        i. OpenStack Compute service (nova) provides services to support the management of virtual machine instances at scale, instances that host multi-tiered applications, dev or test environments, “Big Data” crunching Hadoop clusters, or high-performance computing.
        ii. The Compute service facilitates this management through an abstraction layer that interfaces with supported hypervisors (we address this later on in more detail).
    c. Object Storage:
        i. The OpenStack Object Storage service (swift) provides support for storing and retrieving arbitrary data in the cloud. The Object Storage service provides both a native API and an Amazon Web Services S3-compatible API. The service provides a high degree of resiliency through data replication and can handle petabytes of data.
        ii. It is important to understand that object storage differs from traditional file system storage. Object storage is best used for static data such as media files (MP3s, images, or videos), virtual machine images, and backup files.
    d. Block Storage:
        i. The OpenStack Block Storage service (cinder) provides persistent block storage for compute instances. The Block Storage service is responsible for managing the life-cycle of block devices, from the creation and attachment of volumes to instances, to their release.
        ii. Security considerations for block storage are similar to that of object storage.
    e. Shared File Systems:
        i. The Shared File Systems service (manila) provides a set of services for managing shared file systems in a multi-tenant cloud environment, similar to

how OpenStack provides for block-based storage management through the OpenStack Block Storage service project. With the Shared File Systems service, you can create a remote file system, mount the file system on your instances, and then read and write data from your instances to and from your file system.

f. Networking:
    i. The OpenStack Networking service (neutron, previously called quantum) provides various networking services to cloud users (tenants) such as IP address management, DNS, DHCP, load balancing, and security groups (network access rules, like firewall policies). OpenStack Networking allows cloud tenants to manage their guest network configurations. Security concerns with the networking service include network traffic isolation, availability, integrity, and confidentiality.

g. Dashboard:
    i. The OpenStack Dashboard (horizon) provides a web-based interface for both cloud administrators and cloud tenants. Using this interface, administrators and tenants can provision, manage, and monitor cloud resources. The dashboard is commonly deployed in a public-facing manner with all the usual security concerns of public web portals.

h. Identity service:
    i. The OpenStack Identity service (keystone) is a shared service that provides authentication and authorization services throughout the entire cloud infrastructure. The Identity service has pluggable support for multiple forms of authentication.
    ii. Security concerns with the Identity service include trust in authentication, the management of authorization tokens, and secure communication.

i. Image service:
    i. The OpenStack Image service (glance) provides disk-image management services, including image discovery, registration, and delivery services to the Compute service, as needed.
    ii. Trusted processes for managing the life cycle of disk images are required, as are all the previously mentioned issues with respect to data security.

2. Features of OpenStack.

a. Compatibility and portability. Aside from its open source nature, OpenStack has a number of advantages for cloud users. For starters, OpenStack is agile and easy to deploy; it supports both private and public clouds, but often companies choose it to build the former. OpenStack APIs are compatible with Amazon Web Services, so users don't need to rewrite applications for AWS. This compatibility also allows applications and storage to transit between private clouds and public cloud providers.

b. Security. One of the biggest roadblocks for cloud adoption -- no matter the service provider -- remains security concerns. To calm those companies' worries, OpenStack's robust security system supports multiple forms of identification.

c. Management and visibility. The open source cloud's Horizon dashboard gives administrators an overview of their cloud environment -- including resources and instance pools.

d. Cloud storage. OpenStack offers unlimited storage pools and supports block-IO from a variety of vendors, as well as object file storage. Its built-in storage management automatically recovers failed drives or nodes. Replication and erasure coding with Ceph provides strong data integrity. To avoid the effects of drive failures, users can take advantage of pre-emptive drive checking. Additionally, OpenStack's scaling capabilities enable users to add servers and storage elastically.
e. As the need to tackle big data in the cloud rises, OpenStack's flexibility is an added bonus. Users can run Hadoop apps and Web pages for big data analytics, media files and standard block-IO.
f. Quality control. Because its code base is evolving, OpenStack's release process is broken down into blocks -- roughly four to six months apart. This ensures quality control and release stabilization. The current stable release is Icehouse, but a recent Juno release is a likely replacement.

3. Advantages of OpenStack.

a. Enables rapid innovation
    i. OpenStack’s orchestration and self-service capabilities offers developers and IT staff with faster 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.
b. Cuts down time-to-market
    i. 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.
c. Boosts scalability and resource utilization
    i. 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.
    ii. In addition, OpenStack also provides the following advantages over public clouds and proprietary cloud solutions:
d. Eases regulatory compliance
    i. 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.

4. Components of OpenStack.

a. Compute (Nova)
    i. OpenStack Compute is a cloud computing fabric controller, which manages pools of computer resources and work with virtualization technologies, bare

metals, and high-performance computing configurations. Nova's architecture provides flexibility to design the cloud with no proprietary software or hardware requirements and also delivers the ability to integrate the legacy systems and third-party products.

ii. Nova can be deployed using hypervisor technologies such as KVM, VMware, LXC, XenServer, etc. It is used to manage numerous virtual machines and other instances that handle various computing tasks.

b. Image Service (Glance)
   i. OpenStack image service offers discovering, registering, and restoring virtual machine images. Glance has client-server architecture and delivers a user REST API, which allows querying of virtual machine image metadata and also retrieval of the actual image. While deploying new virtual machine instances, Glance uses the stored images as templates.
   ii. OpenStack Glance supports Raw, VirtualBox (VDI), VMWare (VMDK, OVF), Hyper-V (VHD), and Qemu/KVM (qcow2) virtual machine images.
c. Object Storage (Swift)
   i. OpenStack Swift creates redundant, scalable data storage to store petabytes of accessible data. The stored data can be leveraged, retrieved and updated. It has a distributed architecture, providing greater redundancy, scalability, and performance, with no central point of control.
   ii. Swift is a profoundly available, shared, eventually consistent object store. It helps organizations to store lots of data safely, cheaply and efficiently. Swift ensures data replication and distribution over various devices, which makes it ideal for cost-effective, scale-out storage.
d. Dashboard (Horizon)
   i. Horizon is the authorized implementation of OpenStack's Dashboard, which is the only graphical interface to automate cloud-based resources. To service providers and other commercial vendors, it supports with third party services such as monitoring, billing, and other management tools. Developers can automate tools to manage OpenStack resources using EC2 compatibility API or the native OpenStack API.
e. Identity Service (Keystone)
   i. Keystone provides a central list of users, mapped against all the OpenStack services, which they can access. It integrates with existing backend services such as LDAP while acting as a common authentication system across the cloud computing system.
   ii. Keystone supports various forms of authentication like standard username & password credentials, AWS-style (Amazon Web Services) logins and token-based systems. Additionally, the catalog provides an endpoint registry with a queryable list of the services deployed in an OpenStack cloud.
f. Networking (Neutron)
   i. Neutron provides networking capability like managing networks and IP addresses for OpenStack. It ensures that the network is not a limiting factor in a cloud deployment and offers users with self-service ability over network

configurations. OpenStack networking allows users to create their own networks and connect devices and servers to one or more networks. Developers can use SDN technology to support great levels of multi-tenancy and massive scale.

ii. Neutron also offers an extension framework, which supports deploying and managing of other network services such as virtual private networks (VPN), firewalls, load balancing, and intrusion detection system (IDS).

5. Architecture.

a. OpenStack Glance has a client-server architecture that provides a REST API to the user through which requests to the server can be performed.

b. A Glance Domain Controller manages the internal server operations that is divided into layers. Specific tasks are implemented by each layer.

c. All the file (Image data) operations are performed using glance_store library, which is responsible for interaction with external storage back ends and (or) local filesystem(s). The glance_store library provides a uniform interface to access the backend stores.

d. Glance uses a central database (Glance DB) that is shared amongst all the components in the system and is sql-based by default. Other types of database backends are somewhat supported and used by operators but are not extensively tested upstream.

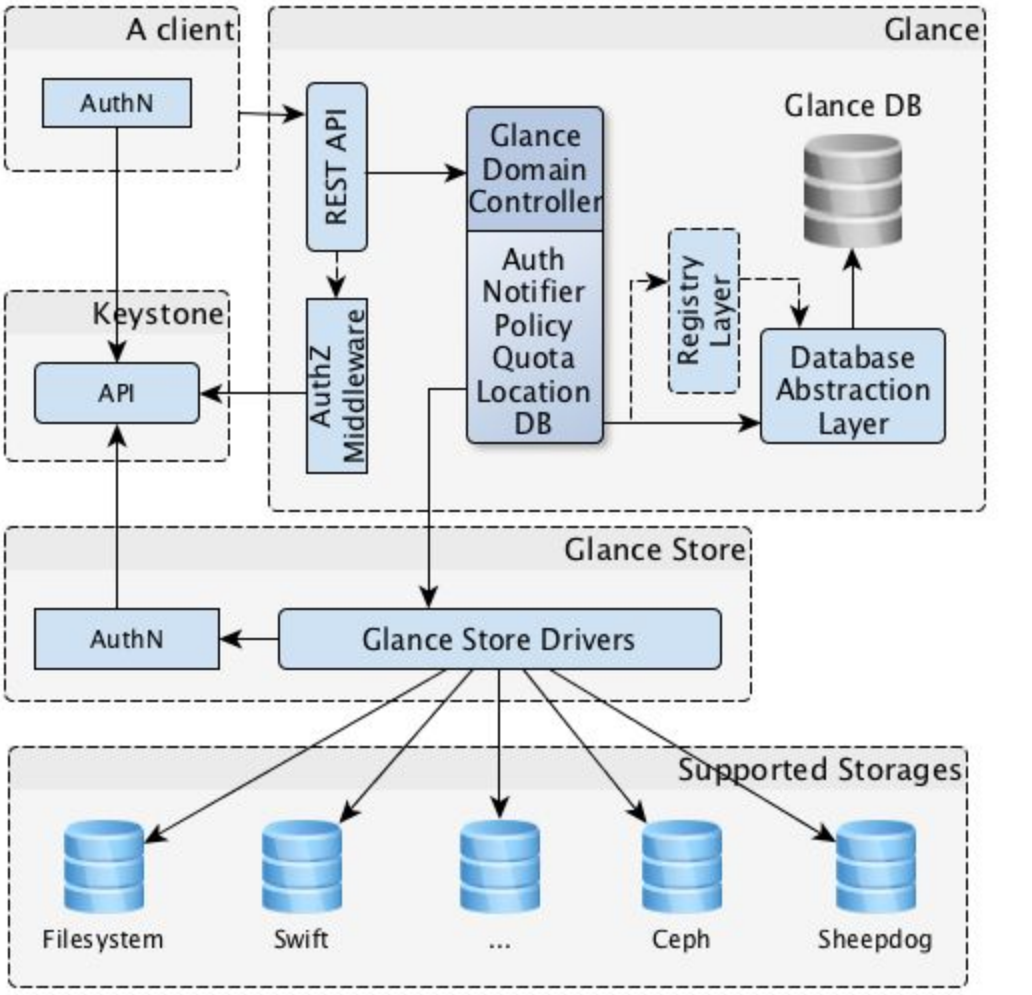


Image 1. OpenStack Glance Architecture

e. Following components are present in the Glance architecture:

i. A client - any application that makes use of a Glance server.
ii. REST API - Glance functionalities are exposed via REST.
iii. Database Abstraction Layer (DAL) - an application programming interface
iv. (API) that unifies the communication between Glance and databases.
v. Glance Domain Controller - middleware that implements the main
vi. Glance functionalities such as authorization, notifications, policies, database connections.
vii. Glance Store - used to organize interactions between Glance and various data stores.
viii. Registry Layer - optional layer that is used to organise secure communication between the domain and the DAL by using a separate service.

Conclusion:

Though OpenStack is made up of several other components because of its open nature, the OpenStack community has recognized these nine components as the core components.

OpenStack will help any business in accelerating the time-to-market, integrating with a variety of key businesses, and delivering the most value from the cloud. So, enterprises need to consider building their cloud platform with OpenStack.

Experiment 7

AIM: Study and Implementation of Software as a Service (Ulteo)

Theory:

Software as a Service:
Software as a service (SaaS) is a software distribution model in which a third-party provider hosts applications and makes them available to customers over the Internet. SaaS is one of three main categories of cloud computing, alongside infrastructure as a service (IaaS) and platform as a service (PaaS).

SaaS is closely related to the application service provider (ASP) and on-demand computing software delivery models. The hosted application management model of SaaS is similar to ASP, where the provider hosts the customer's software and delivers it to approved end-users over the internet. In the software on-demand SaaS model, the provider gives customers network-based access to a single copy of an application that the provider created specifically for SaaS distribution. The application's source code is the same for all customers and when new features or functionalities are rolled out, they are rolled out to all customers. Depending upon the service level agreement (SLA), the customer's data for each model may be stored locally, in the cloud or both locally and in the cloud.Organizations can integrate SaaS applications with other software using application programming interfaces (APIs). For example, a business can write its own software tools and use the SaaS provider's APIs to integrate those tools with the SaaS offering.

Ulteo
Ulteo Open Virtual Desktop (OVD) was an open-source Application Delivery and Virtual Desktop infrastructure project that could deliver applications or a desktop hosted on a Linux or Windows server to end-users. It was an open-source alternative to Citrix and VMware solutions and was, as of June 2012, the only presentation virtualization solution supporting both Linux and Windows applications. It was created by Gaël Duval, who previously created Mandriva Linux. The software seems to be withdrawn, the website is unavailable.

Features
Ulteo OVD provides access to applications or an entire desktop session hosted on a Linux or Windows (2003 or later) server. These are executed in a virtual session on the server (as opposed to simple display mirroring). Version 3 introduced RDP as the protocol used for both Linux and Windows applications. Sessions can be accessed through a web portal, using any Java or HTML5-capable browser, or integrated into the local desktop environment and launched like local applications. Remote applications can access local file systems (including network and USB), print to local printers, play

sound locally and copy to or paste from the local clipboard. Starting with OVD 4, local PC/SC smartcard readers can also be accessed from a remote application, though this feature is supported only in the Premium edition and only for applications running on Windows servers.

Users can authenticate through Microsoft Active Directory or any LDAP or CAS server. Support for additional authentication mechanisms, including single sign-on, can be implemented using an open API. Ulteo includes a dedicated file server into which other file servers (such as CIFS/Samba/Windows file servers) can be integrated as backends.

The environment can be configured and monitored through a web-based administration interface. A farm can include multiple application servers, running a mix of Linux, Windows and Web servers, and the administrator can configure load balancing between them based on criteria such as processor load, memory usage, number of open sessions or random distribution. Ulteo states that a single farm can serve up to 50,000 users and more.

An SSL gateway is available to deploy applications over the Internet.

Besides the classic application delivery scenario, OVD can also be integrated into web-based document management platforms such as Microsoft SharePoint. Clicking a file in the portal will then open it with an application published on the OVD farm rather than downloading it and opening it with a locally installed application.

Ulteo is distributed as a set of application packages that can be installed on a standard Linux distribution (Ubuntu, Debian, SUSE Linux Enterprise Server, Redhat Enterprise Linux), with Windows installers also available for some components.

A live DVD (Demo) and a virtual appliance image are available for testing purposes. They contain a full Linux distribution (based on Ubuntu), all Ulteo components and some applications, allowing an Ulteo OVD farm to be quickly installed on a single server. The DVD additionally contains the full documentation and installation sources for all supported operating systems.

Working of ULTEO: Source
Ulteo OVD uses several modules with different roles. The Session Manager, at least one Application Server and the client component are required, while the others are optional. Each module comes with a binary installation package for Linux and, in most cases, also for Windows.
Session Manager

This server is the central piece of an Ulteo OVD architecture. It manages the session launching and hosts the administration console. It is the first module to install. Servers controlled by the Session Manager are known as slave servers.

A binary installation package is only available for Linux at the moment[when?], although it can be installed from source on Windows. The Session Manager may be installed on an Application Server, but this setup is not recommended for production environments.

High Availability

This add-on in Ulteo OVD 3 allowed setting up two physical Session Managers and databases in a cold-standby cluster. Data was replicated between the two databases using DRBD, and failover was handled by the Heartbeat cluster manager. High Availability was a Gold module. It is no longer included in the source code for OVD 4, nor available from the Premium repository.

Application Server

These are slave servers that run the published applications or desktops. They can be running Linux or Windows, depending on the type of applications or desktop to be delivered. Mixing Linux and Windows servers in an Ulteo OVD farm is supported.

Linux Application servers can be set up in two modes: either as regular Linux installations with desktop environment, applications and the Application Server package, or using the Ulteo Subsystem. The Ulteo Subsystem can be installed on a Linux server with no desktop environment and no applications. It consists of a chroot jail with a modified Xfce desktop environment and some standard applications, including LibreOffice, Adobe Reader, Mozilla Firefox and Thunderbird. Additional applications can be installed within the chroot jail.

Web Gateway

This slave server module, introduced in OVD 4, allows publishing of Web applications alongside Linux and Windows application.

Hypervisor

The OVD 4 source code includes code for another new type of slave server called Hypervisor, allowing Ulteo to act as a front end for a VDI. No installation package is provided as of April 2014.

Client

In order to start an Ulteo OVD session, an Ulteo OVD Client is required. Clients generally support two modes, application mode (or portal mode) and desktop mode. In application mode, the user can launch individual applications. In desktop mode the user is presented a full desktop, which can be either Linux or Windows and may contain applications from the respective other platform.

Web Client

All editions of OVD include a Java client. In desktop mode, the desktop is displayed inside the browser. The portal mode includes a web-based file browser based on AjaXplorer, from which users can download files, upload files or launch files in a published application. The Web Client can be installed on the Session Manager or, beginning with OVD 4, on a dedicated server.

HTML5 Client

OVD 4 introduced an HTML5 client, which is based on Guacamole and available in both editions of OVD. It does not require Java but can run in any browser which supports HTML5 (which most modern browsers do, the only notable exception being Internet Explorer). It does not support some features of the other clients, such as client drive mapping and sound. Apart from this, the look-and-feel is similar to the Java client, including the file browser in portal mode.

The HTML5 client can be installed on the Session Manager or a separate web server. The server translates all RDP traffic into HTML5 and vice versa, effectively acting as a gateway. This makes it a suitable solution for deployment across firewalls, as the only traffic channel between the client and the HTML5 gateway is a HTTP or HTTPS connection.

Native Client

Native clients are available as Premium modules for Linux, Windows, Android and iOS.

The desktop OS clients support desktop mode or application mode. In application mode, users can either launch remote applications from the client's main window, or configure the client to place icons into their start menu, from where they can be launched like local applications.

The tablet clients support only desktop mode. They are available from the respective app stores.

File Server

Ulteo OVD includes an optional file server to host user profiles or shared folders, ensuring user access to the same files when using applications from different servers. As of version 4.0, only a Linux version is available. The File Server may be installed on an Application Server. Without a file server, shares can still be mounted using the mechanisms of the operating system, but these shares may not be available on all application servers or application server platforms, and cannot be accessed from the Web Client's AjaXplorer component.

Gateway

This slave server module facilitates deployment of Ulteo OVD applications over the Internet by tunneling connections to application servers through an SSL (443) connection. This eliminates the requirement to expose individual application servers with a public IP address. It also eases access for clients which are behind firewalls, as many firewall environments allow outgoing SSL traffic on port 443 with no further restrictions. The Gateway is a Premium module.

Installation:

I. The first step is used to select the system language. Choose your language from the list and click on Forward.

II. In the second step, the system asks you to define your location. Either select a point on the map or choose one from theSelected cityform and click on Forward.

III. The third step is used to define the keyboard layout. Select yours and click on Forward.

IV. Then, you have to select the partitioning method. We suggest the automatic method:Erase And use the entire disk.

V. 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.

VI. Type a password and confirm it. Useful address is displayed to you for a near future use of OVD.

VII. Now read carefully the installation summary, then click onInstall. Now, you just have to wait during the system installation.

VIII. Finally, click onRestart now.

IX. Wait for the new OVD system to be rebooted. It displays again the same boot splash screen as seen before.Once the OVD has rebooted, it shows up the login prompt system and waits. Useful OVD URLinformation is recalled to you.Logging in to the OVD system is recommended to experienced users. Login id and password are the same as used during the fifth step of installation.

X. Once you can access the Ulteo system from your browser, go to the administration console: http://10.42.1.242/ovd/adminand and authenticate yourself. The administrator login and password are both those filled at the sixth step of installation. Then you arrive at the main administrator menu in the Web interface.

XI. Then you arrive at the main administrator menu in the Web interface.

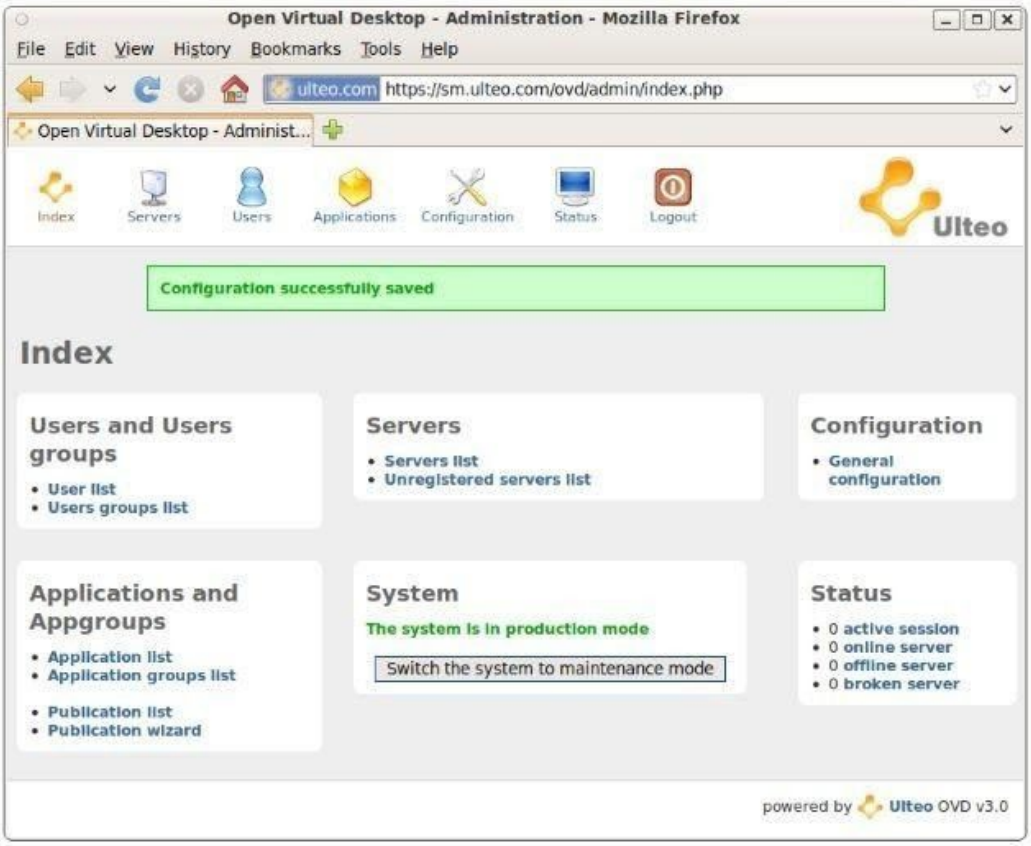


Fig 2 - Administration Panel (Ulteo)

XII. To start a session, we are going to use the Ulteo OVD Web client. You just have to use your web browser to connect to.

Note:

Prerequisites are -

- Java JDK version 1.6 or greater
- Any web browser compatible with Java Runtime (Firefox, Safari, etc.)

If a user can't start a web browser from the same machine as its Ulteo OVD install, replace localhost by the IP of the remote machine.

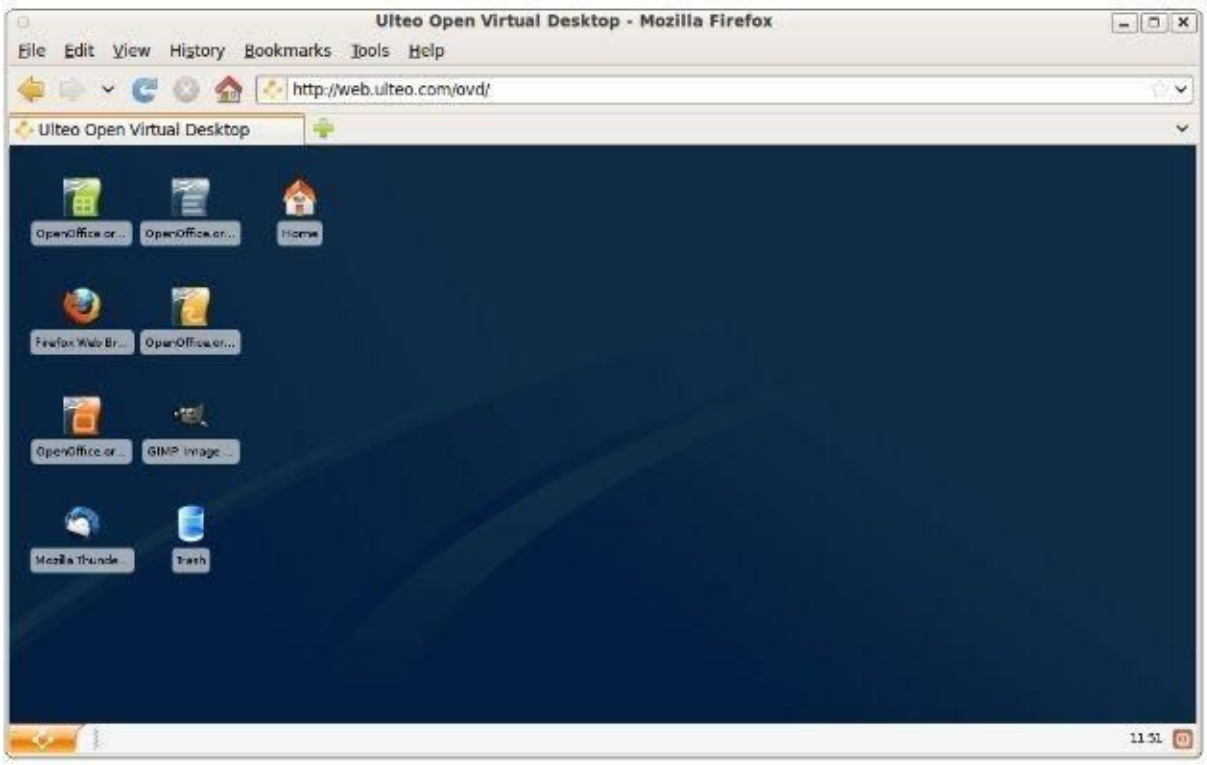


Fig 3 - Ulteo Screen

Conclusion: -

Thus, we've implemented the software-as-a-service platform: Ulteo Open Virtual Desktop. It is an open-source Application Delivery and Virtual Desktop infrastructure project that could deliver applications or a desktop hosted on a Linux or Windows server to end users. We've installed it on a VM instance of our host PC, configured its administration panel and initiated the operation.

AIM: Case Study on Fog Computing and Security Issues in Cloud Computing.

Theory:

1. Introduction to Fog Computing:

a. Fog computing can be perceived both in large cloud systems and big data structures, making reference to the growing difficulties in accessing information objectively.
b. This results in a lack of quality of the obtained content.
c. The effects of fog computing on cloud computing and big data systems may vary.
d. However, a common aspect is a limitation in accurate content distribution, an issue that has been tackled with the creation of metrics that attempt to improve accuracy
e. Both cloud computing and fog computing provide storage, applications, and data to end-users. However, fog computing is closer to end-users and has wider geographical distribution.
f. The term 'Fog Computing' was defined by Prof. Jonathan Bar-Magen Numhauser in the year 2011 as part of his PhD dissertation project proposal. In January 2012 he presented the concept in the Third International Congress of Silenced Writings in the University of Alcala and published in an official source
g. Also known as edge computing or fogging, fog computing facilitates the operation of compute, storage, and networking services between end devices and cloud computing data centers..

2. Architecture of Fog Computing:

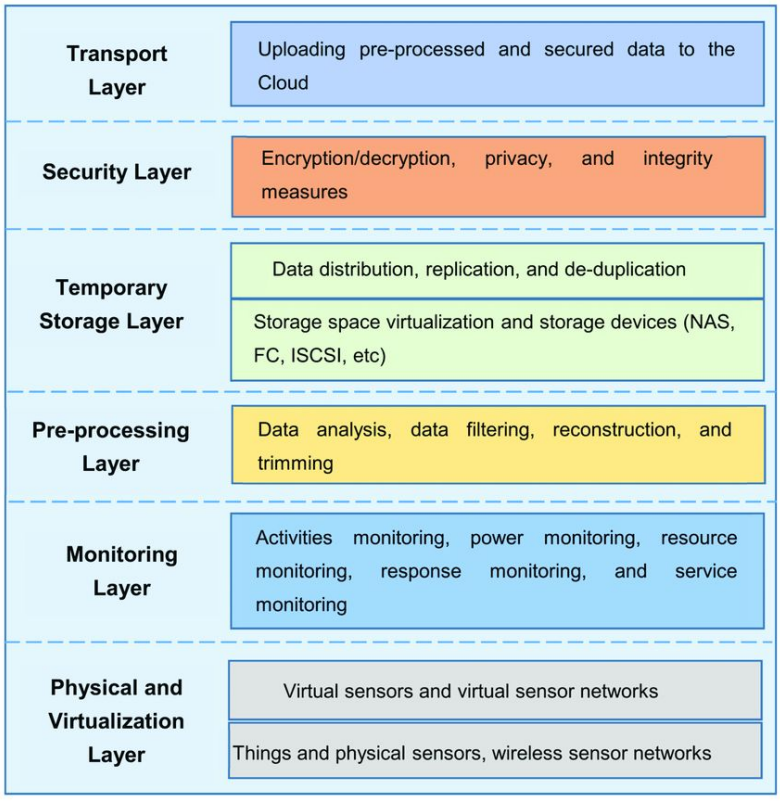


Fig 1. Architecture of Fog Computing.

a. **IoT endpoints:** which include end devices like sensors, gateways, edge devices, and other physical computing objects that perform the required functions and provide apps that are installed on the end devices.
    i. These devices are generally 2 Fog Computing in the IoT Environment connected to a data storage. The IoT endpoints collect the data from other different devices; process some data in real-time in the IP network data processing units. The rest of the data is stored in a Cloud environment for further processing.
b. **IP (Internet Protocol) Network**: that provides distributed intelligence and is linked to IoT End-point devices (e.g. sensors) to receive data from and also to the Cloud environment to send required data for storage purposes and future analysis. Purpose is mainly to provide communication links. the IP network utilises distributed intelligence for supporting intelligence representation e.g. big data mining etc. Distributed Intelligence is considered as a collective intelligence that provides an effective theoretical framework for understanding what humans can achieve and how artefacts, tools, and socio-technical environments can be designed and evaluated to empower human beings.
c. **Centralised Control and Mediation Unit**: which is a cloud-based unit in the Cloud environment where the remaining data, which was not processed in the data processing unit, is stored and analysed, as required. This unit is used for storage, queries, and business analytics.

3. **Features of Fog Computing:**
    a. Low Latency/Edge Computing: Fog computing ropes end-points with premium services at the boundary of the network.
    b. Large Number of Nodes/Scalability: Even with close-to immeasurable resources, the cloud may have obstacles if all the raw data achieved by end devices is persistent to be sent to it. Since fog computing aims to rectify arriving data closer to the data source itself .
    c. Support For Mobility: Fog applications commence exactly with mobile devices, thereby upholding mobility techniques, including the LISP protocol, this decouples host to location individually, and requires allocated directory system. Using LISP protocol, fog devices provide mobility systems like decouple host to location identity.
    d. Real Time Interactions Important Fog applications engage real-time interplay rather than group processing. Fog computing compels real time interactions for early services.
4. **Components:**
    a. The Fog Infrastructure:
        i. That includes networking equip-ment with particular Fog capabilities and provides forend-to-end communication services.•
        ii. The Operational Support System (OSS):

1. That leverage the Fog Infrastructure to provide the customary asset man-agement and business support functions (e.g., inventory,maintenance, provisioning, etc.).

5. **Pros and Cons:**
    a. **Pros:**
        i. **Reduced network load**: In the fog computing structure, the amount of data flowing into a network is reduced because computation is conducted at a network edge near IoT devices.
        ii. **Mobility support as a default function**: The Mobility according to reliability is a fundamental requirement to many IoT applications. The device resources like smart phones and laptops may provide physical or virtual mobility to support a mobile IoT application.
        iii. **Context awareness**: In the fog computing structure, resources provide context awareness relating to data created by a sensor. The device resources play roles in combining data at a sensor, using position or application context.
        iv. **No single defective point**: As calculation is completed in a distributed way in fog computing, the model does not have a single defective point. Several snapshots of an application can be allocated at a cloud to improve reliability
    b. **Cons:**
        i. **Physical location** – Perhaps the most significant limitation of fog computing is that it is much more geographically restrictive than a cloud service. A cloud service can be accessed from anywhere whereas fog computing is used to interact with devices on a local level. It doesn't have any centralized access.
        ii. **Security** – Another key concern is that of security. Fog computing relies on trusting those close to the edge of the network and the fog nodes to maintain them and protect them against malicious entities. The lack of visibility of these systems due to their physical location can leave enterprises open to external threats.
        iii. **Complexity** – If you're using a network with traditional infrastructure, cloud services, and fog computing, things can get very complex very quickly. All of this architecture needs to be maintained, and adding a patchwork of these complex technologies together makes this a very difficult task.

6. **Importance / Need:**
    a. In a fog environment, intelligence is at the local area network. Data is transmitted from endpoints to a gateway where it is then transmitted to sources for processing and return transmission. In edge computing, intelligence and power of the edge gateway or appliance are in devices such as programmable automation controllers.
    b. Proponents of edge computing tout its reduction of points of failure, as each device independently operates and determines which data to store locally and which data to send to the cloud for further analysis. Proponents of fog computing over edge computing

say it is more scalable and gives a better big-picture view of the network as multiple data points feed data into it.

c. Fog Computing and Internet of Things (IoT)
d. The group has identified numerous IoT use cases that require edge computing including smart buildings, drone-based delivery services, real-time subsurface imaging, traffic congestion management and video surveillance. The group released a fog computing reference architecture in February 2017. Because cloud computing is not viable for many internet-of-things applications, fog computing is often used. Its distributed approach addresses the needs of IoT and industrial IoT, as well as the immense amount of data smart sensors and IoT devices generate, which would be costly and time-consuming to send to the cloud for processing and analysis. Fog computing reduces the bandwidth needed and reduces the back-and-forth communication between sensors and the cloud, which can negatively affect IoT performance.

7. How is Fog computing different from Cloud Computing?

	Cloud	Fog
Architecture	Centralized	Distributed
Communication with devices	From a distance	Directly from the edge
Data processing	Far from the source of information	Close to the source of information
Computing capabilities	Higher	Lower
Number of nodes	Few	Very large
Analysis	Long-term	Short-term
Latency	High	Low
Connectivity	Internet	Various protocols and standards
Security	Lower	Higher

8. What are the security issues in Cloud Computing and how will you overcome it.

a. Challenge 1: Optimizing Cloud Expenses:

i. This has been one of the most challenging tasks for cloud users. A tad more than security issues, managing cloud spending is a tough task. With multiple reasons involved, organizations tend to waste quite a lot of their budget in unnecessary activities involved through the cloud. Be it carelessness, lack of knowledge,

hurried operations, unskilled resources – what happens is that the costs associated with cloud computing go beyond limits.

ii. Overcome the Challenge by:
    1. Seeking assistance from various technological solutions for cloud cost management.
    2. Involving a cloud computing partner who is skilled and experience at cloud solution management.
    3. Creating a centralized cloud team to look at the budget details

b. Challenge 2: Working with Poly Cloud Environments:

i. With increasing options in cloud solutions, most enterprises are moving towards the multi-cloud model of working. This strategy brings along with it, multiple cloud types as well as multiple cloud vendors involved. That itself poses as a challenge to manage the synchronization, security, and robustness of operations within the organization as well as with multiple cloud service providers.

ii. You can Overcome the Challenge by:
    1. Adapting best practices such as performing research and training
    2. Dynamically managing vendor relationships
    3. Redesigning processes to involve all stakeholders and cloud patterns
    4. Integrating cloud solutions by various service providers into one
    5. Managing and maintaining a proper infrastructure to encompass the entire functioning

c. Challenge 3: Migrating Existing Applications onto the Cloud:

i. You compare developing a totally new cloud application as against migrating an existing application onto the cloud – the answer is straight and simple. Migrating an existing one has its own set of hurdles, drawbacks, and challenges to face. Time has proven that cloud migration has faced troubles like security configuration, time consumption, budget overflow, unmatched requirements, downtime, etc.

ii. You can Overcome the Challenge by:
    1. Performing pre-migration testing that focuses primarily on migration-related needs
    2. Setting a realistic project deadline and budget keeping in mind migration hassles.
    3. Hiring cloud service providers who are experts at migration projects

d. Challenge 4: Adapting the Cloud-first Model:

i. There are many enterprises who aren't yet prepared to embrace the cloud culture but are still rushing onto doing it, because of peer competition in the market. It strikes as an awkward position for such organizations who do not understand the complete significance of the cloud and have half knowledge of how exactly the cloud would help their business. They are not able to understand the changes in

operations, infrastructure, and environment that would be present with cloud computing solutions.

ii. You can Overcome the Challenge by:
    1. Training organizations with much-needed knowledge about the cloud
    2. Appraising teams about what is in store for them, after cloud implementation

Conclusion:

Fog Computing aims to reduce processing burden of cloud computing. Fog computing is bringing data processing, networking, storage and analytics closer to devices and applications that are working at the network's edge. that's why Fog Computing today's trending technology mostly for IoT Devices.