CSL803 Cloud Computing Lab
Question-Answer for Oral Examination

Q.1. Define Cloud computing as per National Institute of Standards and Technology.

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 (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.

Q.2. Enlist/Explain Essential Characteristics of Cloud Computing.

1) **On-demand self-service.** A consumer can unilaterally provision computing capabilities, such as server time and network storage, 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 mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops, and workstations).

3) **Resource 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. There is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or datacenter). Examples of resources include storage, processing, memory, and network bandwidth.

4) **Rapid elasticity.** Capabilities can be elastically provisioned and released, in some cases automatically, to scale rapidly outward and inward commensurate with demand. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be appropriated in any quantity at any time.

5) **Measured service.** Cloud systems automatically control and optimize resource use by leveraging a metering capability1 at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts). Resource usage can be monitored, controlled, and reported, providing transparency for both the provider and consumer of the utilized service.

The base of Cloud computing is made of these characteristics. But to get better understanding and a more details of the Cloud, then we need to know the four traits of Cloud computing.

- **Abstraction of Resources:** Cloud consist of different types of hardware, systems, networking resources along with bunch of software for provision, control and to provide services. User need not want to concern about these all data center IT infrastructure. From this mixture of resources customer is getting resources according their requirement without worry about its locations and control management. This type of concept known as abstraction of resources means only focusing what our needs.

- **Virtualization of Resources:** Through software, we can simulate the resources. A virtual machine is the best example of virtualization, which is a simulation of a computer and it can have its own operating system and running applications. Not only

virtual machines are servers in the Cloud but other resources like storage and networking infrastructure are also virtualized. Thus there is no need to purchase a millions of computers. Virtualization is offering the great "rapid elasticity" of the Cloud, because of a quick and easy provision and updating of the resources.

- **Automation:** the concept of Cloud automation includes computing capabilities like server time and network storage can be obtained easily without personal interaction with service's provider.
  Apart from that the Cloud applications themselves whenever needed can make a provision or de-provision of the new Cloud resources.

- **Service-Based:** The Cloud is virtual rather than physical so it is offering services and not the physical objects. It has its own virtual characteristics to be provisioned and configured easily and rapidly.

Q.3. What is the purpose of a cloud taxonomy?

The **cloud** computing **taxonomy** was initially developed by the United States National Institute of Standards and Technology (NIST) as a tool for standardizing conversations around **cloud** architectures. Since then, this basic model has been enhanced by the community and broadly adopted to discuss basic concepts.

Cloud Taxonomy
The Cloud Taxonomy is one concept which is providing information on the Cloud computing services and developing a link between Cloud computing services providers and developers. It is shown in figure 2.
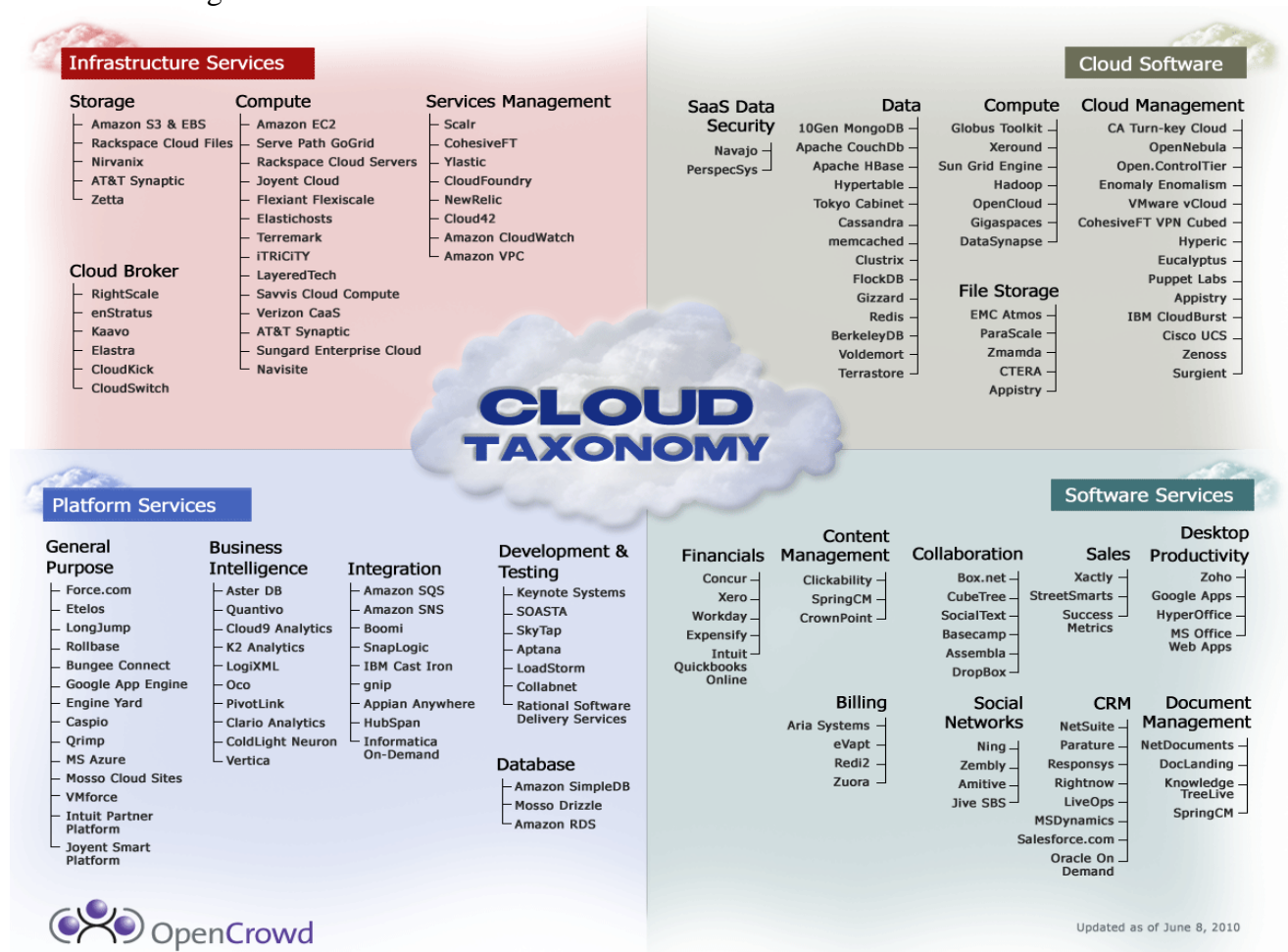
Q.4. What is cloud computing reference architecture? Or What is NIST in cloud computing? Or What is Cloud Computing Reference Model?

NIST reference architecture of Cloud Computing

The NIST Cloud computing reference architecture and its major actors, their activities, and their functions in Cloud computing which is depicted in below diagram. The diagram focuses a systematic architecture to facilitate the understanding of the features and standards of Cloud computing and its requirements and uses.

The reference architecture displayed in Figure 3 is updated model and it has been verified and approved by the RA/TAX Public Working Group process members. The main change among the original reference architecture found in NIST 500-292 and this one is the change in the position of the "Privacy" and "Security" components.

It was identified that Security and Privacy are cross-cutting concerns and items that are shared responsibilities for each Cloud computing actor, therefore the placement of Security and Privacy as a backplane to the Cloud computing reference architecture is an appropriate change to the model (Badger, et al., 2011).

There are five major actors in the NIST Cloud computing reference architecture like Cloud consumer, Cloud provider, Cloud carrier, Cloud auditor, and Cloud broker. Being an entity (a person or an organization), each actor contributes an important role in a transaction or process or performs tasks in Cloud computing.
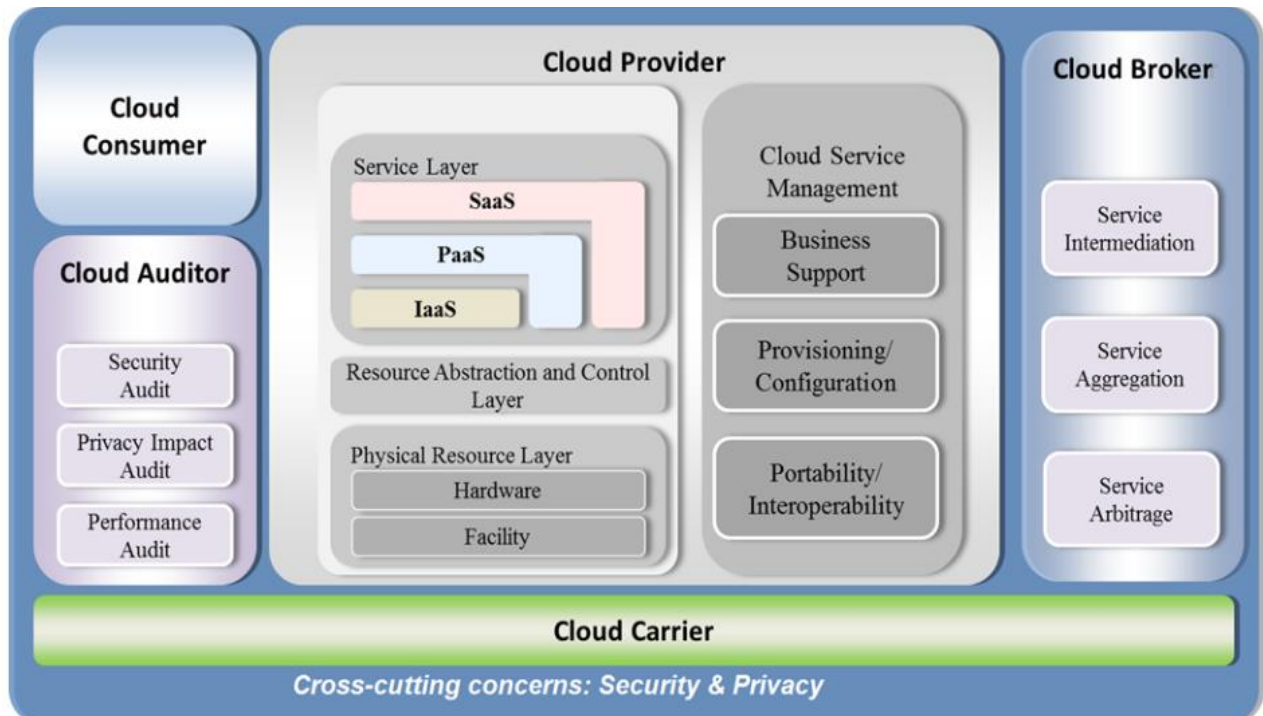

Figure 3 The Conceptual reference Model of Cloud Computing

This reference architecture is very helpful in guiding the development of various real architectures through different viewpoints of operational and technical environments of organisations like application architecture, middleware architecture, data architecture, and

network architecture etc. The reference architecture has also great impact on the Cloud consumer. A Cloud consumer understands and compares Cloud service offerings and make informed decisions with the help of the reference architecture. The reference architecture also helps to creates the issues and provide a collective standard model for research to the academician and Standards Development Organizations (SDOs) who are the stakeholders of Cloud.

Q.5. Enlist and explain various stakeholders of the cloud computing reference architecture.

The various stakeholders are given below:
- **Cloud consumer:** The primary stakeholder for the Cloud computing service is the Cloud-consumer. A Cloud-consumer can be a person or organization that preserves a corporate goodwill. A Cloud-consumer can select the appropriate service contracts with the Cloud-provider.
- **Cloud Provider:** A Cloud provider is the one who are responsible to make a service available to intended consumers. The main function of the Cloud provider is to obtain and arrange the computing infrastructure of the services.
- **Cloud Auditor:** A Cloud auditor is third party who examines and controls the Cloud services. Cloud Auditor are verifying the performances and the standards on the basis of objective evidence like security controls, privacy, and performance of the services.
- **Cloud Broker:** a Cloud broker is the one who is providing Cloud services to a Cloud consumer as a mediator to deliver the Cloud services and maintains the relationships between Cloud providers and Cloud consumers. It is very difficult to the consumer to manage the various Cloud services directly with a Cloud provider.
- **Cloud Carrier:** A Cloud carrier is as a link that provides the Cloud consumers and Cloud providers a connectivity and transport of Cloud services through network, telecommunication, and other access devices.

Q.6. Explain various service models supported by cloud computing.

Service Models of cloud computing

The many paradigms of cloud computing can be broken down into three unique service model classifications: Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). NIST defines each of these three service models in a highly technical sense that we will deconstruct into layman's terms for you to easily digest in the below subheadings.

Software As A Service (SaaS)

NIST defines SaaS as a service model where a *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.* SaaS applications offer extensive configuration options and development environments that enable customers to code their own modifications and additions. Users access the service via a web browser or app buying the service on a per-seat or per-user basis. The beauty of SaaS is in its simplicity as local installation of SaaS software is unnecessary. It is for this reason that most consumers gravitate towards using this service model over other service models.
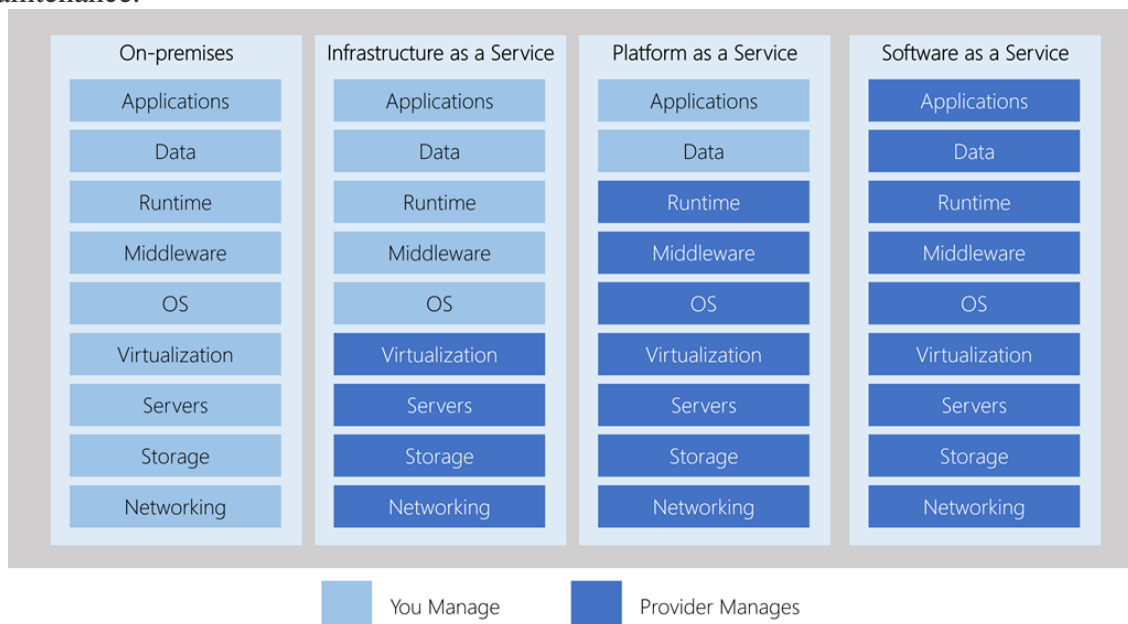
Platform As A Service (PaaS)

NIST defines PaaS as a service model that allows consumers to deploy onto the consumer-created cloud infrastructure or acquired applications created using shared programming tools,

processes, and APIs to accelerate the development, test, and deployment of applications. This service model provides users with application platforms and databases that is similar in function to middleware services. PaaS can automatically configure infrastructure resources across consumer-created environments, making them a platform for hybrid cloud. Due to its complexity and need for consumers to be technically proficient in software development technologies, such as Ruby on Rails, .NET, Python, or Java, it is the smallest part of the Cloud Computing market to date. Once the consumers final code is complete, the cloud service provider will begin to host the application, thus making it available to other internet users.

Infrastructure As A Service (IaaS)

NIST tells us that IaaS gives *the consumer [the ability to] provision processing, storage, networks, and other fundamental computing resources where the consumer deploys and runs arbitrary software which can include operating systems and applications.* IaaS provides consumers with rented physical or virtual servers and networking along with storage in a cloud environment on a pay per usage basis. In essence, IaaS is the most basic service model tech companies use to access raw computing power without the responsibilities of installation or maintenance.
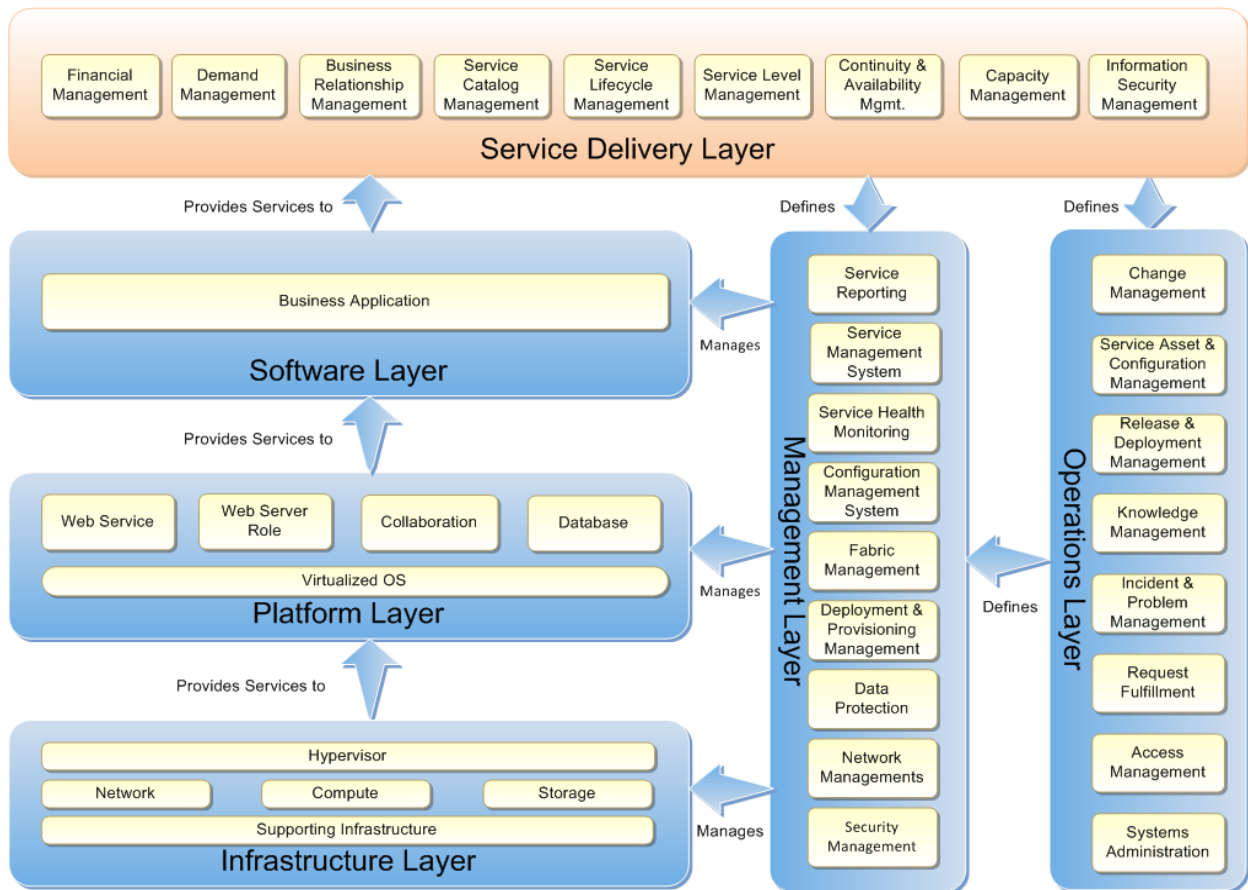
On-premises	Infrastructure as a Service	Platform as a Service	Software as a Service
Applications	Applications	Applications	Applications
Data	Data	Data	Data
Runtime	Runtime	Runtime	Runtime
Middleware	Middleware	Middleware	Middleware
OS	OS	OS	OS
Virtualization	Virtualization	Virtualization	Virtualization
Servers	Servers	Servers	Servers
Storage	Storage	Storage	Storage
Networking	Networking	Networking	Networking

You Manage   Provider Manages

Figure 5 Advanced Reference Model describes services of Cloud

Type	Consumer	Service Provided By Cloud	Service Level Coverage	Customization
SaaS	End user	• Finished application	• Application uptime • Application Performance	• Minimal to no customization • Capabilities dictated by market or provider
PaaS	Application owner	• Runtime environment for application code • Cloud storage • Other Cloud services such as integration	• Environment availability • Environment performance • No application coverage	• High degree of application level customization available within constraints of the service offered • Many applications will need to be rewritten
IaaS	Application owner or IT provides OS, middleware and application support	• Virtual server • Cloud storage	• Virtual server availability • Time to provision • No platform or application coverage	• Minimal constraints on applications installed on standardized virtual OS builds

Figure 6: Comparisons of service models of Cloud

Common Examples of SaaS, PaaS, & IaaS

Platform	Common Examples

SaaS	Google Apps, Dropbox, Salesforce, Cisco WebEx, Concur, GoToMeeting
PaaS	AWS Elastic Beanstalk, Windows Azure, Heroku, Force.com, Google App Engine, Apache Stratos, OpenShift
IaaS	DigitalOcean, Linode, Rackspace, Amazon Web Services (AWS), Cisco Metapod, Microsoft Azure, Google Compute Engine (GCE)

Q.7. Enlist and explain various cloud computing deployment models.

Cloud Computing Deployment Models

There are three different cloud deployment models. A cloud deployment model defines where your data is stored and how your customers interact with it – how do they get to it, and where do the applications run? It also depends on how much of your own infrastructure you want or need to manage.

Public cloud

This is the most common deployment model. In this case, you have no local hardware to manage or keep up-to-date – everything runs on your cloud provider's hardware. In some cases, you can save additional costs by sharing computing resources with other cloud users.

Businesses can use multiple public cloud providers of varying scale. Microsoft Azure is an example of a public cloud provider.

Advantages

- High scalability/agility – you don't have to buy a new server in order to scale
- Pay-as-you-go pricing – you pay only for what you use, no CapEx costs
- You're not responsible for maintenance or updates of the hardware
- Minimal technical knowledge to set up and use - you can leverage the skills and expertise of the cloud provider to ensure workloads are secure, safe, and highly available

A common use case scenario is deploying a web application or a blog site on hardware and resources that are owned by a cloud provider. Using a public cloud in this scenario allows cloud users to get their website or blog up quickly, and then focus on maintaining the site without having to worry about purchasing, managing or maintaining the hardware on which it runs.

Disadvantages

- Not all scenarios fit the public cloud. Here are some disadvantages to think about:
  - There may be specific security requirements that cannot be met by using public cloud
  - There may be government policies, industry standards, or legal requirements which public clouds cannot meet
  - You don't own the hardware or services and cannot manage them as you may want to
  - Unique business requirements, such as having to maintain a legacy application might be hard to meet

Private cloud

In a private cloud, you create a cloud environment in your own datacenter and provide self-service access to compute resources to users in your organization. This offers a simulation of

a public cloud to your users, but you remain completely responsible for the purchase and maintenance of the hardware and software services you provide.

Advantages: This approach has several advantages:

- You can ensure the configuration can support any scenario or legacy application
- You have control (and responsibility) over security
- Private clouds can meet strict security, compliance, or legal requirements

Disadvantages: Some reasons teams move away from the private cloud are:

- You have some initial CapEx costs and must purchase the hardware for startup and maintenance
- Owning the equipment limits the agility - to scale you must buy, install, and setup new hardware

Private clouds require IT skills and expertise that's hard to come by

- A use case scenario for a private cloud would be when an organization has data that cannot be put in the public cloud, perhaps for legal reasons. An example scenario may be where government policy requires specific data to be kept in-country or privately.
- A private cloud can provide cloud functionality to external customers as well, or to specific internal departments such as Accounting or Human Resources.

Hybrid cloud

A hybrid cloud combines public and private clouds, allowing you to run your applications in the most appropriate location. For example, you could host a website in the public cloud and link it to a highly secure database hosted in your private cloud (or on-premises datacentre).

This is helpful when you have some things that cannot be put in the cloud, maybe for legal reasons. For example, you may have some specific pieces of data that cannot be exposed publicly (such as medical data) which needs to be held in your private datacentre. Another example is one or more applications that run on old hardware that can't be updated. In this case, you can keep the old system running locally, and connect it to the public cloud for authorization or storage.

Advantages: Some advantages of a hybrid cloud are:

- You can keep any systems running and accessible that use out-of-date hardware or an out-of-date operating system
- You have flexibility with what you run locally versus in the cloud
- You can take advantage of economies of scale from public cloud providers for services and resources where it's cheaper, and then supplement with your own equipment when it's not
- You can use your own equipment to meet security, compliance, or legacy scenarios where you need to completely control the environment

Disadvantages: Some concerns you'll need to watch out for are:

- It can be more expensive than selecting one deployment model since it involves some CapEx cost up front
- It can be more complicated to set up and manage

Q.8. Enlist and explain benefits of cloud computing.

Benefits/Advantages of Cloud Computing

1) **Cost Savings:** If you are worried about the price tag that would come with making the switch to cloud computing, you aren't alone 20% of organizations are concerned about the initial cost of implementing a cloud-based server. But those who are attempting to weigh the advantages and disadvantages of using the cloud need to consider more factors than just initial price they need to consider ROI.

   Once you're on the cloud, easy access to your company's data will save time and money in project startups. And, for those who are worried that they'll end up paying for features that they neither need nor want, most cloud-computing services are pay as you go. This means that if you don't take advantage of what the cloud has to offer, then at least you won't have to be dropping money on it.

   The pay-as-you-go system also applies to the data storage space needed to service your stakeholders and clients, which means that you'll get exactly as much space as you need, and not be charged for any space that you don't. Taken together, these factors result in lower costs and higher returns. Half of all CIOs and IT leaders surveyed by Bitglass reported cost savings in 2015 as a result of using cloud-based applications.

2) **Security:** Many organizations have security concerns when it comes to adopting a cloud-computing solution. After all, when files, programs, and other data aren't kept securely onsite, how can you know that they are being protected? If you can remotely access your data, then what's stopping a cybercriminal from doing the same thing? Well, quite a bit, actually.

   For one thing, a cloud host's full-time job is to carefully monitor security, which is significantly more efficient than a conventional in-house system, where an organization must divide its efforts between a myriad of IT concerns, with security being only one of them. And while most businesses don't like to openly consider the possibility of internal data theft, the truth is that a staggeringly high percentage of data thefts occur internally and are perpetrated by employees. When this is the case, it can actually be much safer to keep sensitive information offsite. Of course, this is all very abstract, so let's consider some solid statistics.

   Rapid Scale claims that 94% of businesses saw an improvement in security after switching to the cloud, and 91% said the cloud makes it easier to meet government compliance requirements. The key to this amped-up security is the encryption of data being transmitted over networks and stored in databases. By using encryption, information is less accessible by hackers or anyone not authorized to view your data. As an added security measure, with most cloud-based services, different security settings can be set based on the user. While 20% of cloud user claim disaster recovery in four hours or less, only 9% of cloud users could claim the same.

3) **Flexibility:** Your business has only a finite amount of focus to divide between all of its responsibilities. If your current IT solutions are forcing you to commit too much of your attention to computer and data-storage issues, then you aren't going to be able to concentrate on reaching business goals and satisfying customers. On the other hand, by relying on an outside organization to take care of all IT hosting and infrastructure, you'll have more time to devote toward the aspects of your business that directly affect your bottom line.

   The cloud offers businesses more flexibility overall versus hosting on a local server. And, if you need extra bandwidth, a cloud-based service can meet that demand instantly, rather than undergoing a complex (and expensive) update to your IT infrastructure. This improved freedom and flexibility can make a significant difference to the overall efficiency of your organization. A 65% majority of respondents to an

InformationWeek survey said "the ability to quickly meet business demands" was one of the most important reasons a business should move to a cloud environment.

4) **Mobility:** Cloud computing allows mobile access to corporate data via smartphones and devices, which, considering over 2.6 billion smartphones are being used globally today, is a great way to ensure that no one is ever left out of the loop. Staff with busy schedules, or who live a long way away from the corporate office, can use this feature to keep instantly up to date with clients and co-worker.

Through the cloud, you can offer conveniently accessible information to sales staff who travel, freelance employees, or remote employees, for better work-life balance. Therefore, it's not surprising to see that organizations with employee satisfaction listed as a priority are up to 24% more likely to expand cloud usage.

5) **Insight:** As we move ever further into the digital age, it's becoming clearer and clearer that the old adage "knowledge is power" has taken on the more modern and accurate form: "Data is money." Hidden within the millions of bits of data that surround your customer transactions and business process are nuggets of invaluable, actionable information just waiting to be identified and acted upon. Of course, sifting through that data to find these kernels can be very difficult, unless you have access to the right cloud-computing solution.

Many cloud-based storage solutions offer integrated cloud analytics for a bird's-eye view of your data. With your information stored in the cloud, you can easily implement tracking mechanisms and build customized reports to analyze information organization wide. From those insights, you can increase efficiencies and build action plans to meet organizational goals. For example, the beverage company Sunny Delight was able to increase profits by about $2 million a year and cut $195,000 in staffing costs through cloud-based business insights.

6) **Increased Collaboration:** If your business has two employees or more, then you should be making collaboration a top priority. After all, there isn't much point to having a team if it is unable to work like a team. Cloud computing makes collaboration a simple process. Team members can view and share information easily and securely across a cloud-based platform. Some cloud-based services even provide collaborative social spaces to connect employees across your organization, therefore increasing interest and engagement. Collaboration may be possible without a cloud-computing solution, but it will never be as easy, nor as effective.

7) **Quality Control:** There are few things as detrimental to the success of a business as poor quality and inconsistent reporting. In a cloud-based system, all documents are stored in one place and in a single format. With everyone accessing the same information, you can maintain consistency in data, avoid human error, and have a clear record of any revisions or updates. Conversely, managing information in silos can lead to employees accidentally saving different versions of documents, which leads to confusion and diluted data.

8) **Disaster Recovery:** One of the factors that contributes to the success of a business is control. Unfortunately, no matter how in control your organization may be when it comes to its own processes, there will always be things that are completely out of your control, and in today's market, even a small amount of unproductive downtime can have a resoundingly negative effect. Downtime in your services leads to lost productivity, revenue, and brand reputation.

But while there may be no way for you to prevent or even anticipate the disasters that could potentially harm your organization, there is something you can do to help speed your recovery. Cloud-based services provide quick data recovery for all kinds of emergency scenarios, from natural disasters to power outages. While 20% of cloud

users claim disaster recovery in four hours or less, only 9% of non-cloud users could claim the same. In a recent survey, 43% of IT executives said they plan to invest in or improve cloud-based disaster recovery solutions.

9) **Loss Prevention:** If your organization isn't investing in a cloud-computing solution, then all of your valuable data is inseparably tied to the office computers it resides in. This may not seem like a problem, but the reality is that if your local hardware experiences a problem, you might end up permanently losing your data. This is a more common problem than you might realize computers can malfunction for many reasons, from viral infections, to age-related hardware deterioration, to simple user error. Or, despite the best of intentions, they can be misplaced or stolen (over 10,000 laptops are reported lost every week at major airports).

If you aren't on the cloud, you're at risk of losing all the information you had saved locally. With a cloud-based server, however, all the information you've uploaded to the cloud remains safe and easily accessible from any computer with an internet connection, even if the computer you regularly use isn't working.

10) **Automatic Software Updates:** For those who have a lot to get done, there isn't anything more irritating than having to wait for system updates to be installed. Cloud-based applications automatically refresh and update themselves, instead of forcing an IT department to perform a manual organizationwide update. This saves valuable IT staff time and money spent on outside IT consultation. PCWorld lists that 50% of cloud adopters cited requiring fewer internal IT resources as a cloud benefit.

11) **Competitive Edge:** While cloud computing is increasing in popularity, there are still those who prefer to keep everything local. That's their choice, but doing so places them at a distinct disadvantage when competing with those who have the benefits of the cloud at their fingertips. If you implement a cloud-based solution before your competitors, you'll be further along the learning curve by the time they catch up. A recent Verizon study showed that 77% of businesses feel cloud technology gives them a competitive advantage, and 16% believe this advantage is significant.

12) **Sustainability:** Given the current state of the environment, it's no longer enough for organizations to place a recycling bin in the breakroom and claim that they're doing their part to help the planet. Real sustainability requires solutions that address wastefulness at every level of a business. Hosting on the cloud is more environmentally friendly and results in less of a carbon footprint.

Cloud infrastructures support environmental proactivity, powering virtual services rather than physical products and hardware, and cutting down on paper waste, improving energy efficiency, and (given that it allows employees access from anywhere with an internet connection) reducing commuter-related emissions. A Pike Research report predicted data center energy consumption will drop by 31% from 2010 to 2020 based on the adoption of cloud computing and other virtual data options.
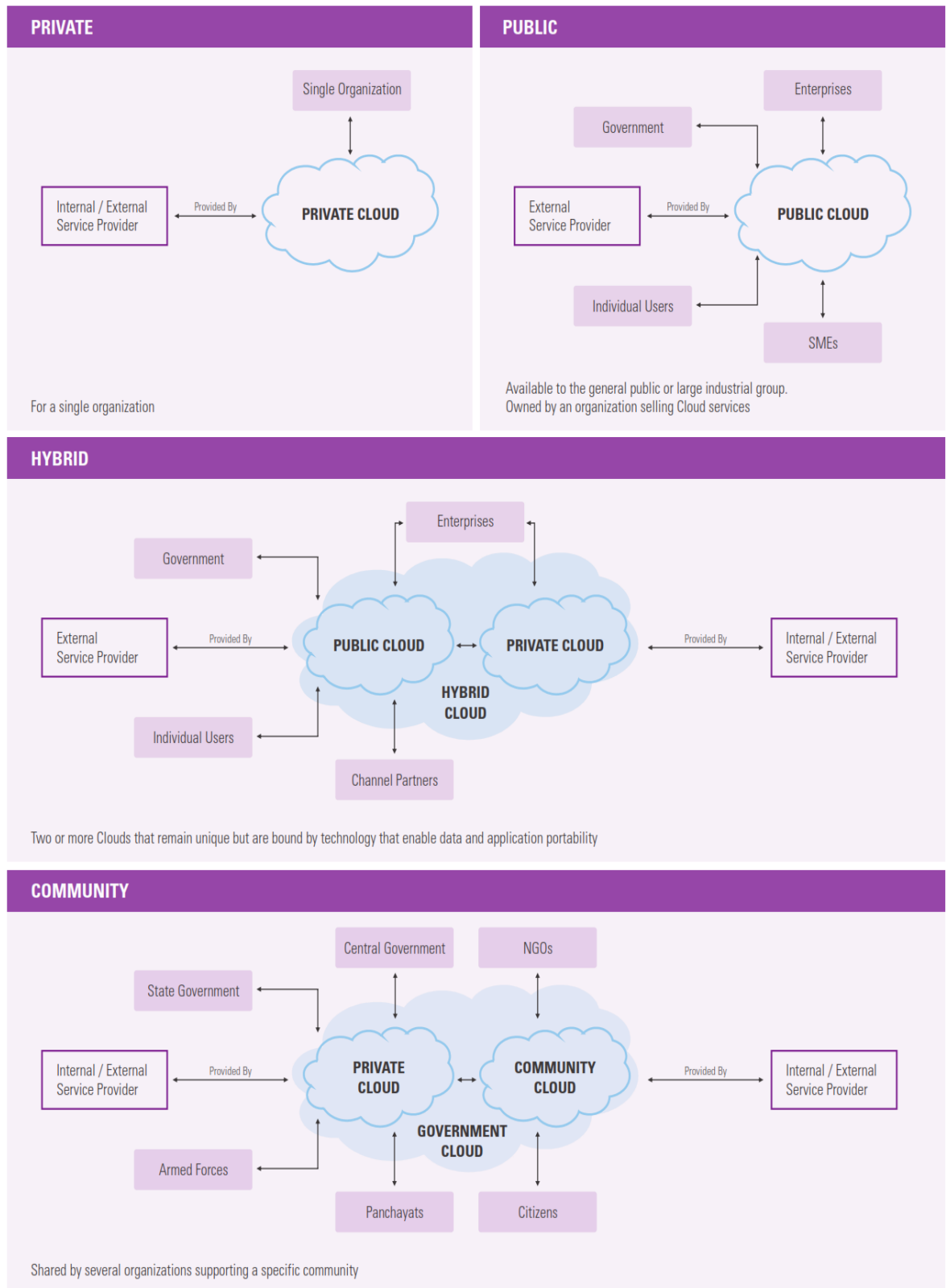
Q.9. Enlist and explain disadvantages of cloud computing.

Disadvantages of Cloud Computing

Here, are significant challenges of using Cloud Computing:

1) **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.

2) **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.

3) **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.

4) **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.

5) **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.

6) **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

7) **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.

PRIVATE — For a single organization

PUBLIC — Available to the general public or large industrial group. Owned by an organization selling Cloud services

HYBRID — Two or more Clouds that remain unique but are bound by technology that enable data and application portability

COMMUNITY — Shared by several organizations supporting a specific community

Source: KPMG's The Cloud: Changing the Business Ecosystem, 2011

Q.10. What Services Should Be Moved to the Cloud?

A Cloud provides online data backup at different physical location to protect the data against any threat. The Cloud also avoids huge investments in physical hardware and software and enables the user to secure from a destructive accident. Cloud computing offers

the business endurance and any retrieval through the use of accessible and virtualized resources.

The following additional points are useful in evaluating the applications for Cloud organisation:

➢ Speed and response-time requirements of an application
➢ any application to be written in a certain language and has restrictions such as no VPNs
➢ Any regulations such as HIPAA need that delicate data be managed and organized in-house.
➢ To advance a product or service which requires many months, and time to market is a concern.
➢ to run the application more effectively on a physical system or in a virtualized environment,
➢ Integrating the application multi-tenancy.
➢ Very complex applications and highly complex data that are essential to the persistence of an organization.
➢ Selected applications consist of serious liability issues should ensure with an organization's IT system.

Q.11. What Questions Should You Ask Your Cloud Provider?

There are multiple questions that we should asked to the Cloud provider regarding security, performance, charges, control, availability, and privacy. Some of the serious questions are as follows:

➢ Do I have any control or choice over where my information will be stored? Where will my data reside and what are the security and privacy laws in effect in those locations?
➢ Are the Cloud operations available for physical inspection?
➢ Can you provide an estimate of historical downtimes at your operation?
➢ Are there any extra exit fees or fine for migrating from your Cloud to another vendor's Cloud operation? Do you delete all my data from your systems if I move to another vendor? How do you prove to me that you have completely removed all my data from your Cloud system?
➢ Can you provide documentation about your disaster recovery policies and procedures and how they are implemented?
➢ What are your organization's privacy policies and policies addressing ownership of client data?
➢ Will you provide a sample of your log files so that the types of data being recorded are available for review?
➢ What are your policies concerning my sensitive information when a law enforcement agency presents a subpoena for that data? What protections for my information can you provide in this event?
➢ Will you provide models of your SLA?

Q.12. When Should You Use a Public, Private, or Hybrid Cloud?

Remember that, the single party owned and controlled the private Cloud whose services are channelled on a private network. The private organization purchases the hardware and software on or off the organization's premises, and monitored by the organization or a third party. The principal advantages of a private Cloud are as follow:

➢ An organization gets the benefit of economic and flexibility.

➢ Resource to progress and restore new applications and then ultimately share with a public Cloud
➢ Resource to achieve controlling and lawful requirements without interaction with a Cloud provider
➢ Deployment of other existing resources in vicinity to the private Cloud
➢ Make able to direct control security, sensitive applications, and data
➢ Ability to develop and implement preferred privacy policies
➢ Resource of controlling the hardware characteristics and provisioning
➢ reduce operational costs and enhance server deployment
➢ chance to enhance use of automation and standards

A public Cloud is the one in which common computing environment is used through the Internet and it is more efficient due to shared resources, but there are more risk about security. A public Cloud is a good option if there are:

➢ Low budget capital expenditures on the resources.
➢ Developed and tested application code.
➢ Preference for a pay-per-use model.
➢ Deduction in IT operational and maintenance personnel.
➢ Added computing resources are offered on seasonal workloads.
➢ Obtainability of high Internet bandwidth.
➢ Applications are broadly used and applied off-site, such as e-mail.

In short, a private Cloud offers more control and secure environment for critical applications and data and a public Cloud is more reasonable and offers high flexibility and accessibility. The collaboration of these features move towards the hybrid Cloud and it is a combination of both a public and private Cloud. A hybrid Cloud consists of numerous providers and a wide range of platforms to monitor and secure. A hybrid Cloud is beneficial in the following conditions:

➢ An organization wants to communicate and share information with clients and partners, but protects critical data.
➢ An organizations' policies and means to manage and control activities of work projects in and out of the Cloud.
➢ An organization is able to make policies regarding where to run applications based on cost structures and services.
➢ An organization wants to ensure that governing and lawful requirements are achieved.
➢ An organization seeking secure SaaS applications and uses a private Cloud.

Q.13. What is meaning of SLAs in Cloud Computing.

- SLAs have evolved over the years to cater to different types of IT services. The evolution of shared infrastructure services such as clouds have necessitated the use of strong service-level agreements. SLAs by definition can define any level of service, but a well-structured SLA will ideally:
- Codify the specific parameters and minimum levels required for each element of the service, as well as remedies for failure to meet those requirements.
- Affirm the client's ownership of its data stored in the service provider's system and specify the client's rights to get it back.
- Detail the system infrastructure and security standards to be maintained by the service provider, along with the client's rights to audit their compliance.
- Specify the client's rights and cost to continue and discontinue using the cloud service provider's service.

- For cloud users, the most important element of an SLA is typically the guaranteed up-time, which varies by service and by provider. Up-time is usually measured in "nines," where three 9s, for example, means 99.9%, four 9s means 99.99%, and so on. Providers frequently offer service credits when SLAs are not met. Amazon, for example, provides customers with a 10% service credit if the monthly up-time for an Elastic Beanstalk instance falls below 99.99%, and a 30% credit if it falls below 99%. A figure such as 99% sounds high, but it means that a service could be unavailable for about 3.5 days per year. That's a long time for a company like Amazon or Expedia whose primary interface to its customers (and means of generating revenue) is via the web.
- Up-time guarantees can also vary by configuration and by service tier. Microsoft, for example, guarantees that you will have connectivity to an Azure virtual machine at least 99.99% of the time, but only if two or more instances of the virtual machine are deployed across two or more availability zones in the same Azure region. In addition, some cloud services allow you to select from several service tiers, with higher tiers offering higher guaranteed up-times. In general, the higher the guaranteed up-time, the higher the cost.

Q.14. What is meaning of Virtualization?

- Virtualization is a technology that helps us to install different Operating Systems on a hardware. They are completely separated and independent from each other. In Wikipedia, you can find the definition as – "In computing, virtualization is a broad term that refers to the abstraction of computer resources.
- Virtualization hides the physical characteristics of computing resources from their users, their applications or end users. This includes making a single physical resource (such as a server, an operating system, an application or a storage device) appear to function as multiple virtual resources. It can also include making multiple physical resources (such as storage devices or servers) appear as a single virtual resource..."
- Virtualization is often:
    - The creation of many virtual resources from one physical resource.
    - The creation of one virtual resource from one or more physical resource

Q.15. Enlist and explain different type of Virtualization which are applied in IT.

Today the term virtualization is widely applied to a number of concepts, some of which are described below:

- ☐ Server Virtualization
- ☐ Client & Desktop Virtualization
- ☐ Services and Applications Virtualization
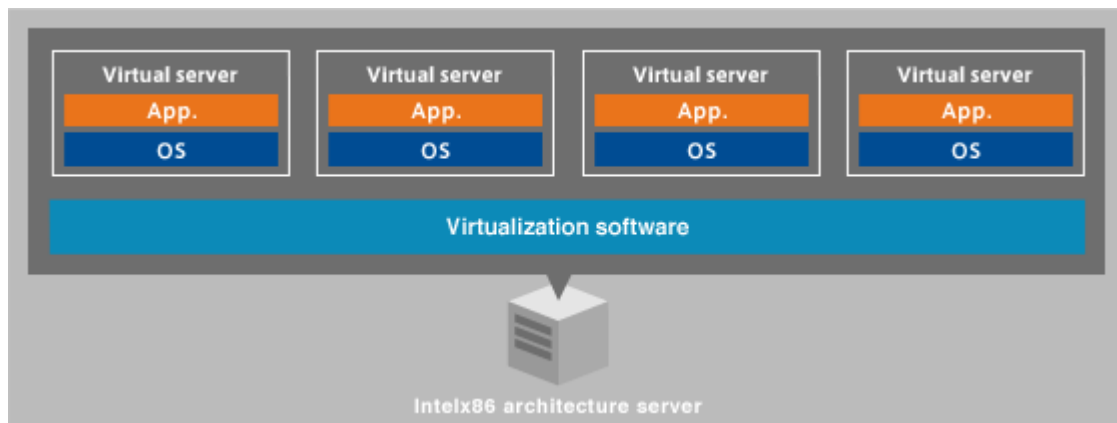- ☐ Network Virtualization
- ☐ Storage Virtualization

Let us now discuss each of these in detail.
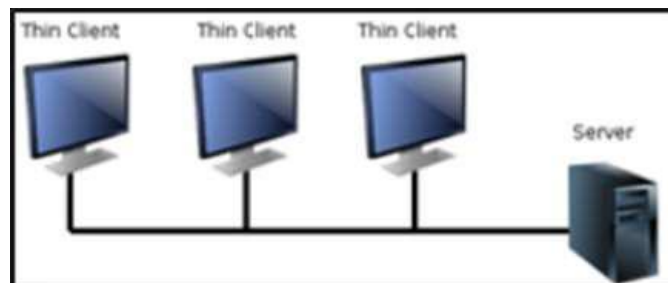
Server Virtualization

It is virtualizing your server infrastructure where you do not have to use any more physical servers for different purposes.

Client & Desktop Virtualization

This is similar to server virtualization, but this time is on the user's site where you virtualize

their desktops. We change their desktops with thin clients and by utilizing the datacenter resources.


Services and Applications Virtualization

The virtualization technology isolates applications from the underlying operating system and from other applications, in order to increase compatibility and manageability. For example – Docker can be used for that purpose.
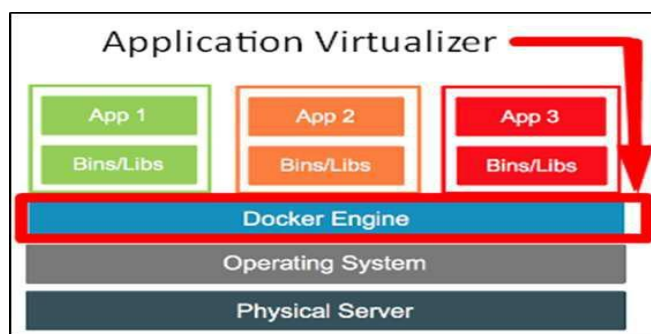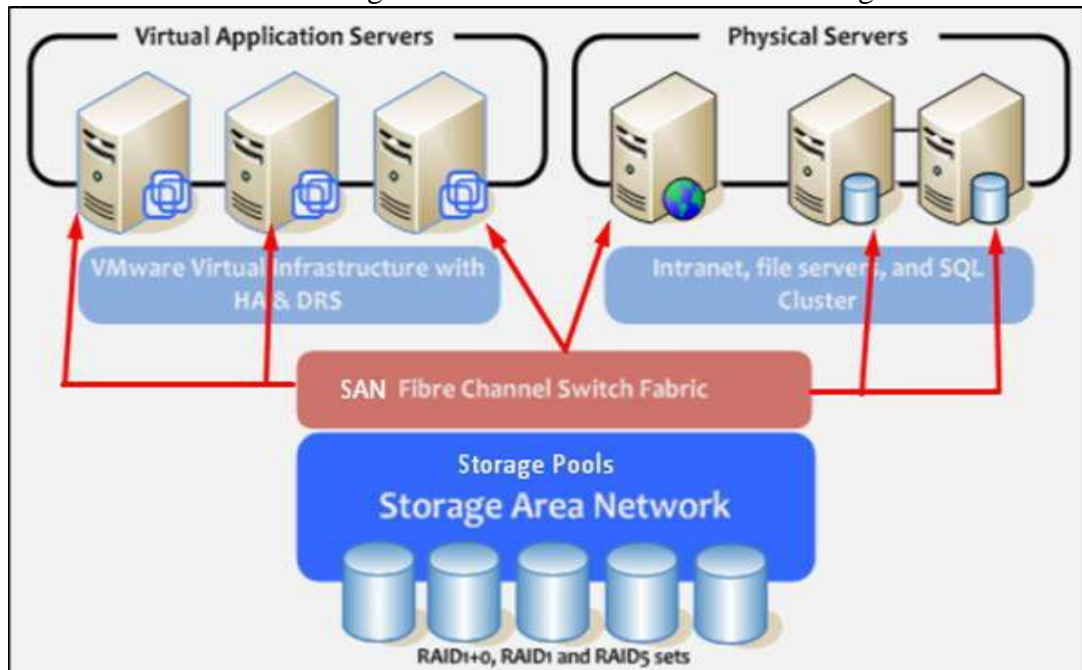

Network Virtualization

It is a part of virtualization infrastructure, which is used especially if you are going to visualize your servers. It helps you in creating multiple switching, Vlans, NAT-ing, etc.

The following illustration shows the VMware schema:
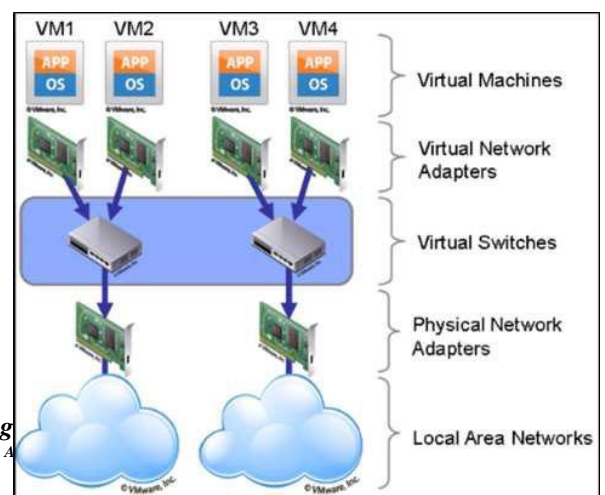
Storage Virtualization

This is widely used in datacentres where you have a big storage and it helps you to create, delete, allocated storage to different hardware. This allocation is done through network connection. The leader on storage is SAN. A schematic illustration is given below:

Q.16. Explain type of Hypervisors used in Virtualization?

Understanding Different Types of Hypervisors

A hypervisor is a thin software layer that intercepts operating system calls to the hardware. It is also called as the **Virtual Machine Monitor** (VMM). It creates a virtual platform on the host computer, on top of which multiple guest operating systems are executed and monitored.

Hypervisors are two types:

☐ Native of Bare Metal Hypervisor and
☐ Hosted Hypervisor

Let us now discuss both of these in detail.

Native or Bare Metal Hypervisor : Native hypervisors are software systems that run directly on the host's hardware to control the hardware and to monitor the **Guest Operating Systems**. The guest operating system runs on a separate level above the hypervisor. All of them have a Virtual Machine Manager.

Examples of this virtual machine architecture are **Oracle VM**, **Microsoft Hyper-V**, **VMWare ESX** and **Xen**.

Hosted Hypervisor: Hosted hypervisors are designed to run within a traditional operating system. In other words, a hosted hypervisor adds a distinct software layer on top of the host operating system. While, the guest operating system becomes a third software level above the hardware. A well-known example of a hosted hypervisor is **Oracle VM VirtualBox**. Others include **VMWare Server and Workstation**, **Microsoft Virtual PC**, **KVM**, **QEMU** and **Parallels**.
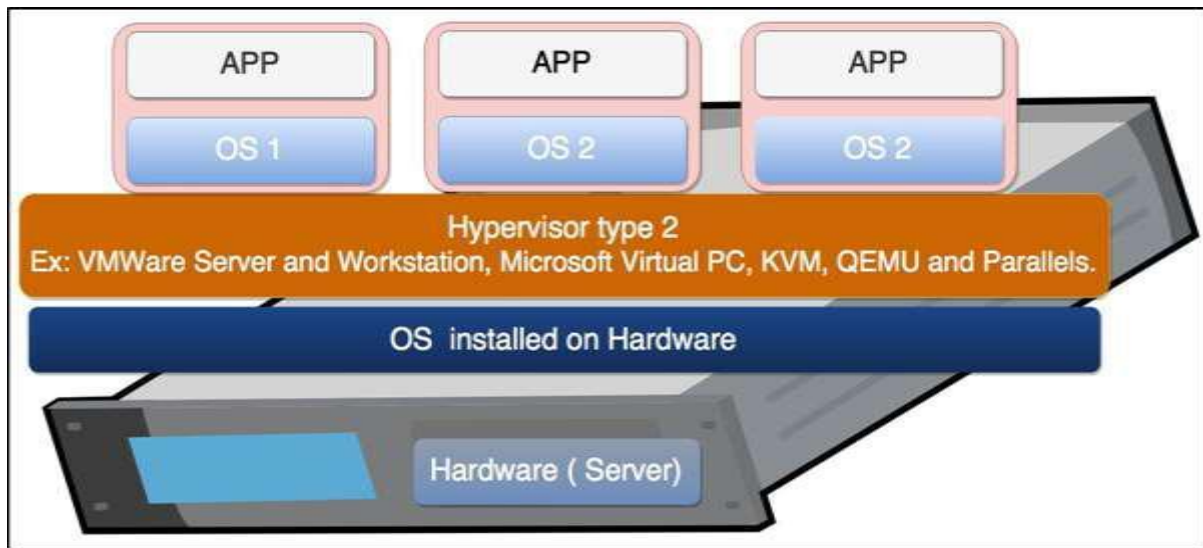
Q.17. Enlist and explain advantages of Virtualization?

Advantages of Virtualization

Following are some of the most recognized advantages of Virtualization, which are explained in detail.

Using Virtualization for Efficient Hardware Utilization

Virtualization decreases costs by reducing the need for physical hardware systems. Virtual machines use efficient hardware, which lowers the quantities of hardware, associated maintenance costs and reduces the power along with cooling the demand. You can allocate memory, space and CPU in just a second, making you more self-independent from hardware vendors.

Using Virtualization to Increase Availability

Virtualization platforms offer a number of advanced features that are not found on physical servers, which increase uptime and availability. Although the vendor feature names may be different, they usually offer capabilities such as live migration, storage migration, fault tolerance, high availability and distributed resource scheduling. These technologies keep virtual machines chugging along or give them the ability to recover from unplanned outages.

The ability to move a virtual machine from one server to another is perhaps one of the greatest single benefits of virtualization with far reaching uses. As the technology continues to mature to the point where it can do long-distance migrations, such as being able to move a virtual machine from one data center to another no matter the network latency involved.

Disaster Recovery

Disaster recovery is very easy when your servers are virtualized. With up-to-date snapshots of your virtual machines, you can quickly get back up and running. An organization can more easily create an affordable replication site. If a disaster strikes in the data center or server room itself, you can always move those virtual machines elsewhere into a cloud provider. Having that level of flexibility means your disaster recovery plan will be easier to enact and will have a 99% success rate.

Save Energy

Moving physical servers to virtual machines and consolidating them onto far fewer physical servers' means lowering monthly power and cooling costs in the data center. It reduces carbon

footprint and helps to clean up the air we breathe. Consumers want to see companies reducing their output of pollution and taking responsibility.

Deploying Servers too fast

You can quickly clone an image, master template or existing virtual machine to get a server up and running within minutes. You do not have to fill out purchase orders, wait for shipping and receiving and then rack, stack, and cable a physical machine only to spend additional hours waiting for the operating system and applications to complete their installations. With virtual backup tools like Veeam, redeploying images will be so fast that your end users will hardly notice there was an issue.

Save Space in your Server Room or Datacenter

Imagine a simple example: you have two racks with 30 physical servers and 4 switches. By virtualizing your servers, it will help you to reduce half the space used by the physical servers. The result can be two physical servers in a rack with one switch, where each physical server holds 15 virtualized servers.

Testing and setting up Lab Environment

While you are testing or installing something on your servers and it crashes, do not panic, as there is no data loss. Just revert to a previous snapshot and you can move forward as if the mistake did not even happen. You can also isolate these testing environments from end users while still keeping them online. When you have completely done your work, deploy it in live.

Shifting all your Local Infrastructure to Cloud in a day

If you decide to shift your entire virtualized infrastructure into a cloud provider, you can do it in a day. All the hypervisors offer you tools to export your virtual servers.

Possibility to Divide Services

If you have a single server, holding different applications this can increase the possibility of the services to crash with each other and increasing the fail rate of the server. If you virtualize this server, you can put applications in separated environments from each other as we have discussed previously.

Q.18. What are the Disadvantages of Virtualization.

Although you cannot find many disadvantages for virtualization, we will discuss a few prominent ones as follows:

Extra Costs

Maybe you have to invest in the virtualization software and possibly additional hardware might be required to make the virtualization possible. This depends on your existing network. Many businesses have sufficient capacity to accommodate the virtualization without requiring much cash. If you have an infrastructure that is more than five years old, you have to consider an initial renewal budget.

Software Licensing

This is becoming less of a problem as more software vendors adapt to the increased adoption of virtualization. However, it is important to check with your vendors to understand how they view software use in a virtualized environment.

Learn the new Infrastructure

Implementing and managing a virtualized environment will require IT staff with expertise in virtualization. On the user side, a typical virtual environment will operate similarly to the non-virtual environment. There are some applications that do not adapt well to the virtualized environment.

Q.19. What is meaning of Virtual CPU?

When we install a hypervisor, each physical CPU is abstracted into virtual CPUs. This divides the available CPU cycles for each core and allows multiple VMs to "time share" a given physical processor core. Generally talking, the hypervisor typically assigns one workload per vCPU (per core) . If the workloads on a server need more CPU cycles, it is better to deploy fewer VMs on a particular virtual CPU.

Let us consider the following example to understand the logic of virtual CPU.

I have a physical server with two processors (CPU 1 and CPU 2) and each of them has four physical cores. In total, we have 2*4 = 8 physical cores.

Based on some calculations our hypervisor provided for each physical core, we can get 5-10 vCPUs.

In total, we will have [8 physical cores * (5 to 10 vCPUs)] 40 -80 vCPUs, which means that we can assign a maximum of 80 vCPUs to virtual machines.

## Q.20. What is meaning off Virtual memeory.

Understanding Virtual Memory

Virtual Memory in simple words is the RAM of the machine. The memory resource settings for a virtual machine determines how much of the host's memory is allocated to the virtual machine. The virtual hardware memory size determines how much memory is available to applications that run in the virtual machine.

A virtual machine cannot benefit from more memory resources than its configured virtual hardware memory size. The **ESXi hosts** limit the memory resource use to the maximum amount useful for the virtual machine, so that you can accept the default of unlimited memory resources.

You can add, change, and configure virtual machine memory resources or options to enhance virtual machine performance. You can set most of the memory parameters while creating the virtual machine or it can also be done after the **Guest Operating System** is installed. Most of the hypervisors require to power off the virtual machine before changing the settings.

In the following schematic illustration, you can see that the total physical memory is divided between two virtual machines.
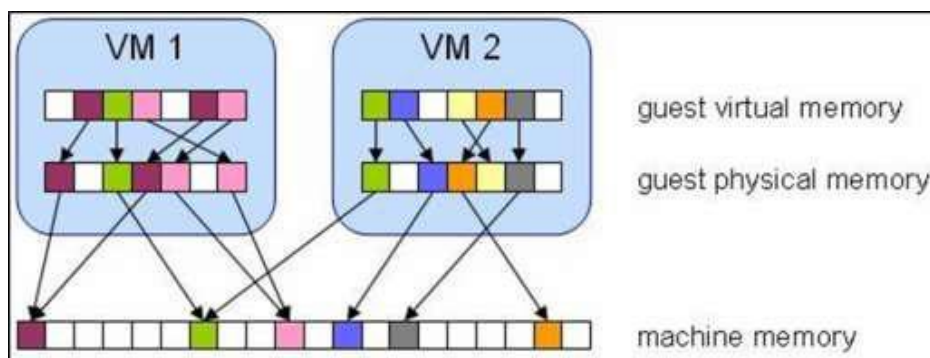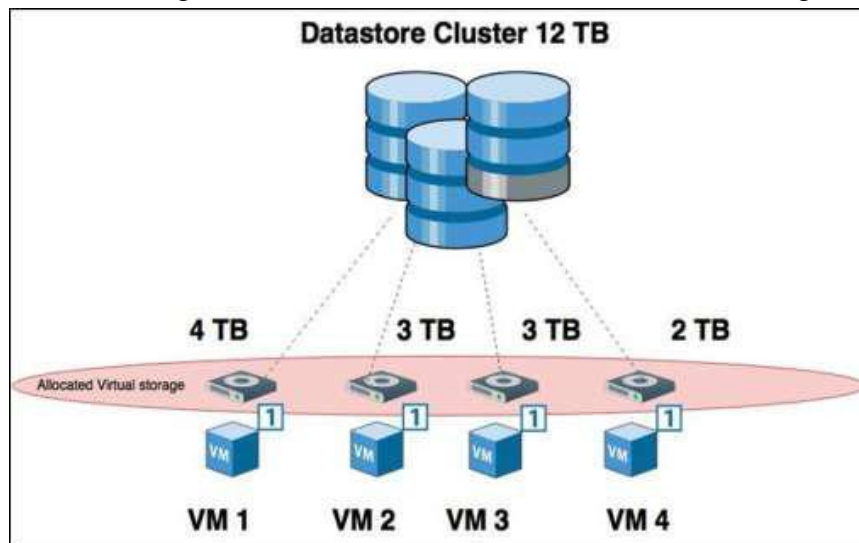
Q.21. What is meaning of Virtual Storage?

Understanding Virtual Storage

Storage virtualization is the pooling of physical storage (Data cluster) from multiple network storage devices into what appears to be a single storage device that is managed from a central console. We cannot assign more storage to virtual machines that data cluster offers physically.

You will see these extensions on the end of a file. Of all the files used as part of a virtual machine, different hypervisors like to use different file types. Some of the more common are **VDI**, **VHDX**, **VMDK** and **HDD**.

In the following example, we have a data cluster of 12 TB in total and four virtual machines to which we have allocated storage to each of them. In total, the maximum storage allocated to them is 12 TB.


Q.22. What is meaning of Virtual Networking?

Understanding Virtual Networking

We will discuss this with a simple example as to how virtual networking done.

We have Virtual Machine 1, 2, 3 and 4 running on the same host. They would like to send the network traffic back and forth. This is done by virtual networking cards as shown in the following illustration (vNIC), which connects virtually with a virtual switch (vSwitch) that is created by the hypervisor.

This virtual switch communicates with a physical card of the server (pNIC), which is connected with a physical switch (pSwitch) and then communicates with the rest of the network equipment. Please see the following schematically done up scenario.
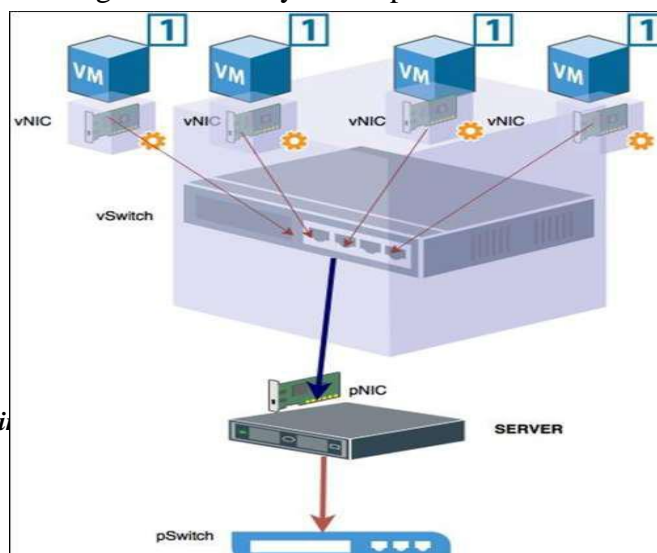
Q.23. Compare and contrast vSphere vs XenServer vs Hyper-V vs KVM.

Feature	Windows Hyper-V 2019	VMware ESXi vSphere 6.7	XenServer 7.6	KVM
Hypervisor	type-1	type-1	type-1	type-2
RAM/Host	24TB	12 TB	5TB	12TB
RAM/VM	12 TB for generation 2; 1 TB for generation 1	6 TB	1.5TB	6 TB
CPUs/VM	240 for generation 2; 64 for generation 1;	128	32	240
VM Disk	64 TB for VHDX format; 2040 GB for VHD format	62TB	2TB	10TB
VM Live Migration	Yes	Yes	Yes	Yes
VM Replication supports	Yes	Yes	Yes	Yes
Overcommit resources	No	Yes	No	Yes
Disk I/O Throttling	Yes	Yes	Yes	Yes
Hot plug of virtual resources	Yes	Yes	Yes	Yes

## Q.24. What is meant by OpenStack?

- 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.
- A dashboard is also available, giving administrators control while empowering their users to provision resources through a web interface.
- Beyond standard infrastructure-as-a-service functionality, additional components provide orchestration, fault management and service management amongst other services to ensure high availability of user applications.

Q.25. What are the components of OpenStack?

- OpenStack is made up of many different moving parts. Because of its open nature, anyone can add additional components to OpenStack to help it to meet their needs. But the OpenStack community has collaboratively identified nine key components that are a part of the "core" of OpenStack, which are distributed as a part of any OpenStack system and officially maintained by the OpenStack community.

- **Nova** is the primary computing engine behind OpenStack. It is used for deploying and managing large numbers of virtual machines and other instances to handle computing tasks.

- **Swift** is a storage system for objects and files. Rather than the traditional idea of a referring to files by their location on a disk drive, developers can instead refer to a unique identifier referring to the file or piece of information and let OpenStack decide where to store this information. This makes scaling easy, as developers don't have the worry about the capacity on a single system behind the software. It also allows the system, rather than the developer, to worry about how best to make sure that data is backed up in case of the failure of a machine or network connection.

- **Cinder** is a block storage component, which is more analogous to the traditional notion of a computer being able to access specific locations on a disk drive. This more traditional way of accessing files might be important in scenarios in which data access speed is the most important consideration.

- **Neutron** provides the networking capability for OpenStack. It helps to ensure that each of the components of an OpenStack deployment can communicate with one another quickly and efficiently.

- **Horizon** is the dashboard behind OpenStack. It is the only graphical interface to OpenStack, so for users wanting to give OpenStack a try, this may be the first component they actually "see." Developers can access all of the components of OpenStack individually through an application programming interface (API), but the dashboard provides system administrators a look at what is going on in the cloud, and to manage it as needed.

- **Keystone** provides identity services for OpenStack. It is essentially a central list of all of the users of the OpenStack cloud, mapped against all of the services provided by the cloud, which they have permission to use. It provides multiple means of access, meaning developers can easily map their existing user access methods against Keystone.

- **Glance** provides image services to OpenStack. In this case, "images" refers to images (or virtual copies) of hard disks. Glance allows these images to be used as templates when deploying new virtual machine instances.

- **Ceilometer** provides telemetry services, which allow the cloud to provide billing services to individual users of the cloud. It also keeps a verifiable count of each user's system usage of each of the various components of an OpenStack cloud. Think metering and usage reporting.

- **Heat** is the orchestration component of OpenStack, which allows developers to store the requirements of a cloud application in a file that defines what resources are necessary for that application. In this way, it helps to manage the infrastructure needed for a cloud service to run.
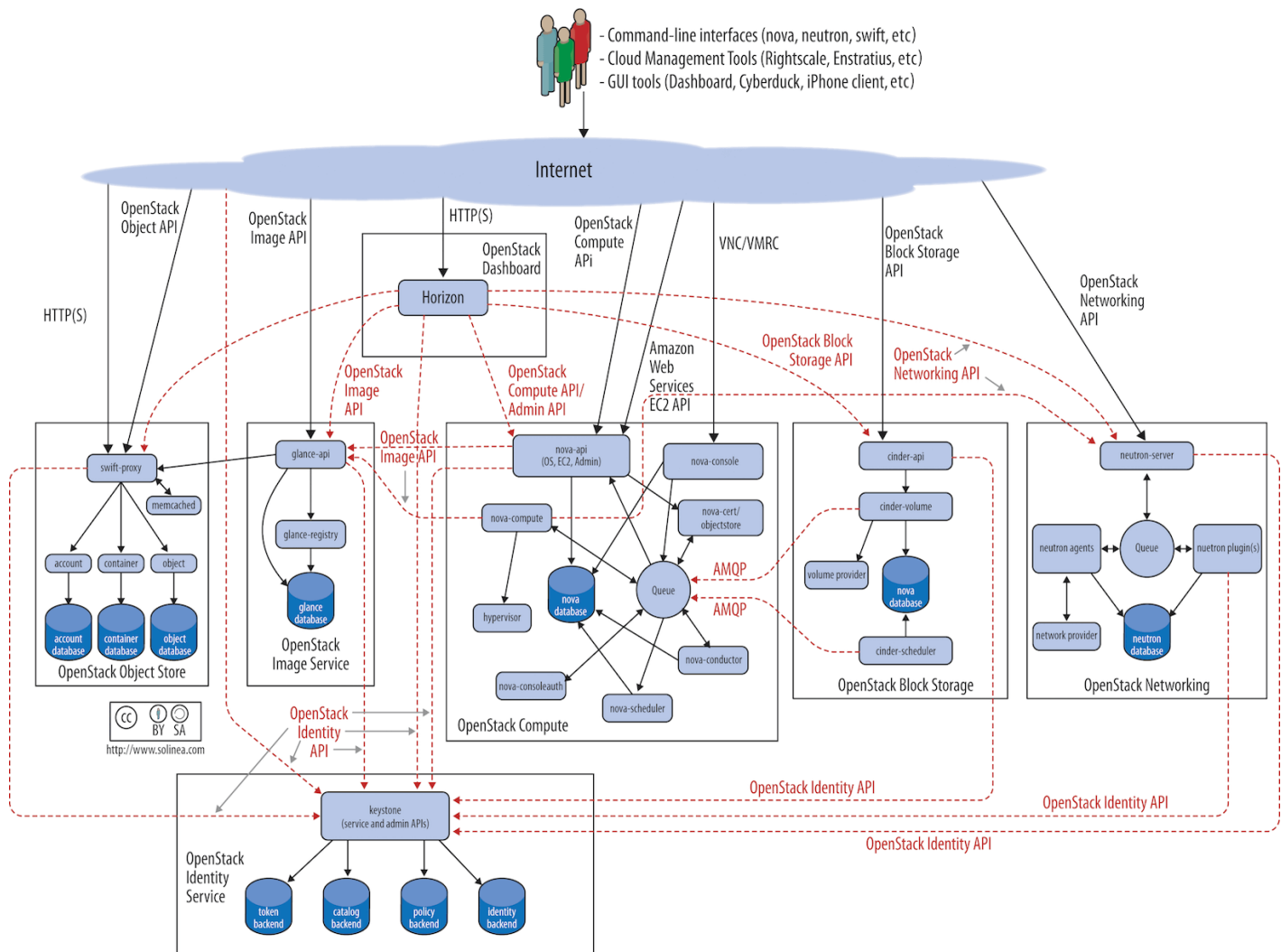
Q.26. List down the type of Hypervisors supported by OpenStack.

The following hypervisors are supported:

- KVM - Kernel-based Virtual Machine. The virtual disk formats that it supports is inherited from QEMU since it uses a modified QEMU program to launch the virtual machine. The supported formats include raw images, the qcow2, and VMware formats.
- LXC - Linux Containers (through libvirt), used to run Linux-based virtual machines.
- QEMU - Quick EMUlator, generally only used for development purposes.
- UML - User Mode Linux, generally only used for development purposes.
- VMware vSphere 5.1.0 and newer, runs VMware-based Linux and Windows images through a connection with a vCenter server.
- Xen (using libvirt) - Xen Project Hypervisor using libvirt as management interface into nova-compute to run Linux, Windows, FreeBSD and NetBSD virtual machines.

- XenServer - XenServer, Xen Cloud Platform (XCP) and other XAPI based Xen variants runs Linux or Windows virtual machines. You must install the nova-compute service in a para-virtualized VM.
- Hyper-V - Server virtualization with Microsoft Hyper-V, use to run Windows, Linux, and FreeBSD virtual machines. Runs nova-compute natively on the Windows virtualization platform.
- Virtuozzo 7.0.0 and newer - OS Containers and Kernel-based Virtual Machines supported via libvirt virt_type=parallels. The supported formats include ploop and qcow2 images.

Q.27. What are services generally run on a controller node?

Following services run on a controller node:

- Identity Service (KeyStone)
- Image Service (Glance)
- Nova Services like Nova API, Nova Scheduler & Nova DB
- Block & Object Service
- Ceilometer Service
- MariaDB / MySQL and RabbitMQ Service
- Management services of Networking (Neutron) and Networking agents
- Orchestration Service (Heat)

Q.28. What is ownCloud and why would I use it?

ownCloud is a file server that enables secure storage, collaboration and sharing.

- It is convenient to store files in the cloud, so they are available on any device and can be shared with a few clicks. There are a lot of popular providers like Google, Apple, Facebook, Twitter and Dropbox. With a lot of these vendors, files are stored and processed beyond users control. With U.S. firms, files are subject to the Cloud Act and thus to government snooping.
- ownCloud helps users regain their digital sovereignty. It provides lots of convenient features, too, but also stores files securly and efficiently. There are no backdoors, you can check, it's open source. Users can install ownCloud themselves or rent a managed instance.
- You want to use ownCloud to benefit from the upsides of the public clouds while being in control of your data.

Q.29. Can I use ownCloud as a backup solution?

- No. ownCloud is absolutely not a backup solution.
- Changes you make in one place are synchronized to other places which means that if you accidentally remove or overwrite a file on your local system, ownCloud will remove it from the server.
- If a file gets corrupted at one place the corrupted file gets distributed to other places.
- The 'previous files' and 'undelete' functionality of ownCloud is merely meant as a convenience and should never be relied upon as a backup function. Algorithms are in place that clean up 'old files' and thus, changes will get lost over time.

- External Storage connects ownCloud to an external storage like FTP, SMB another ownCloud Server or third-party providers like Google Drive, Amazon S3 or Dropbox. Files will show up in your web interface and can be synced with the client. However, they are not replicated on your ownCloud server!

Q.30. What is AWS cloud platform

- Amazon Web Services (AWS) is a subsidiary of Amazon providing on-demand cloud computing platforms and APIs to individuals, companies, and governments, on a metered pay-as-you-go basis.
- Amazon Web Services offers cloud-based products that allow you to compute, access storage, create databases, run analytics, develop networking, incorporate mobile, access developer tools, utilize management tools, avail of the IoT, implement security and utilize enterprise applications. That means your company can grow faster, lower its IT costs, and scale up at exponential rates.
- AWS is trusted by the largest enterprises and the hottest start-ups to power a wide variety of workloads including web and mobile applications, game development, data processing and warehousing, storage, archive, and a whole lot more. That means your company can grow faster, lower its IT costs, and scale up at exponential rates. What are the most used of Top AWS Services?
- Amazon S3: Amazon S3 Amazon S3 is listed top in the AWS services list - because, storing and retrieving the data plays a prominent role in cloud computing. So, AWS offers a wonderful service called Amazon Simple Storage Service or Amazon S3 to store and retrieve data from the cloud. S3 allows the user to store, upload, retrieve large files up to 5 TB from the cloud. It is a scalable, low-cost and high-speed web-based service designed for archival and online backup of application programs and data. Using S3, the user can access the same system that Amazon uses to run its website. Users have control over the public or private accessibility of the data.
- Amazon EC2 [Elastic Compute Cloud]: Amazon EC2 provides scalable computing capacity in the AWS cloud. Using Amazon EC2, you can develop and deploy applications quickly and effectively for a low cost. And also you can use Amazon EC2 to launch virtual servers according to your requirements.
- AWS Lambda: Amazon Lambda is a service that allows the user to run code without any server. Amazon Lambda executes the code only when the user needed and scales automatically. Users pay only for the compute time, no need to charge when your code is not running. This service supports the code written in Node.js, Java, Python, and languages supported by Amazon Linux.
- Amazon Glacier: Amazon Glacier is one of the most important services provided by AWS. The Glacier is an online web storage service that provides you with low cost and effective storage with security features for archival and data backup. With Glacier, you can store the information effectively for months, years, or even decades.
- Amazon SNS: Amazon SNS is a web service provided by the AWS. SNS stands for Simple Notification Service, and it manages and delivers the messages or notifications to the users and clients from any cloud platform. In SNS, there are two types of clients, subscribers, and publishers. Publishers produce and send a message to the subscriber instance through the communication channels.
- Subscribers receive notification from the publisher over one of the supported protocols such as Amazon SQS, HTTP, and Lambda, etc. Amazon SNS automatically triggers the service and sends an email with a message that " your EC2 instance is growing"

when you are using Auto Scaling. Amazon SNS automatically triggers the service and sends an email with a message that " your EC2 instance is growing" when you are using Auto Scaling.

- Amazon CloudFront: To Know how fast your website is working, you can use the CloudFront service. It speeds up the sharing of your dynamic and static web content such as .css, .html and image files to your users. It securely delivers your images, videos, data and applications to users and clients with high transfer speed and low latency, all within a developer-friendly environment.

- Amazon EBS [Elastic Block Store]:EBS is an Amazon service, which is used to store persistent data, and it is block-level storage to use EC2 instances. You can use EBS service, to move the data from one instance to another instance without losing the stored data at EBS. You can mount multiple volumes on the same instance, but each volume can be attached to a single instance at a time.

- Amazon Kinesis: Are you worried about how to deal with the large volume of data? AWS is offering Amazon Kinesis service to handle big data in real-time. It allows developers to take any large volume of data from any source that can run on EC2 instance. It stores, capture and processes the data from large distributed streams like social media feeds and log events. After completion of processing the data, it distributes the data to the consumers simultaneously.

- Amazon Virtual Private Cloud (Amazon VPC): lets you provision a logically isolated section of the AWS Cloud where you can launch AWS resources in a virtual network that you define. You have complete control over your virtual networking environment, including selection of your own IP address range, creation of subnets, and configuration of route tables and network gateways. You can use both IPv4 and IPv6 in your VPC for secure and easy access to resources and applications.

- Amazon SQS: Amazon SQS stands for Simple Queue Service, and it manages the message queue service. Using this service, you can move the data or message from one application to another even though it is not in the running or active state. SQS sends messages between multiple services, including S3, DynamoDB, EC2 Instance, and also it uses the Java message queue service to deliver the information. The maximum visibility timeout of a message is 12 hours in the SQS queue.

- Amazon Elastic Beanstalk: Developers can easily deploy the services and web applications developed with .NET, Java, PHP, Python and more without providing any infrastructure. A number of cloud clients, including Amazon Web Services, Microsoft Azure, offer development tools to make the process easy and simple.

- DynamoDB: It is a fully managed NoSQL database service that supports document data structures and key values that are offered by Amazon.com. DynamoBD allows you to create the database tables so that you can retrieve and store any format of data. It controls the data traffic over multiple servers and maintains the performance of the tables.

- Amazon RDS [Relational Database Service]: It is a fully SQL database cloud service that allows users to operate and create relational databases. RDS can manage from any AWS Management Console. Using RDS, you can access files and databases from anywhere in a highly scalable and cost-effective way.

Q.31. What is Microsoft Azure?

- Microsoft Azure is a growing collection of integrated public cloud services including analytics, Virtual Machines, databases, mobile, networking, storage, and web—ideal for hosting your solutions. Microsoft Azure provides a scalable computing platform

that allows you to only pay for what you use, when you want it - without having to invest in on-premises hardware. Azure is ready when you are to scale your solutions up and out to whatever scale you require to service the needs of your clients.

- Microsoft Azure is an integrated suite of tools, templates, and managed services to significantly improve the productivity of any developer or IT professional. With its massive set of features and functionalities, and build for the Microsoft platform, Azure makes it easier for IT professionals to build and manage enterprise, mobile, Web and Internet of Things (IoT) apps.

- The advantages of Microsoft Azure are compatibility with Windows, Linux, and container as well as an excellent frontend management interface. Microsoft has been investing heavily in the Microsoft Azure public cloud architecture and the efforts are paying off in the Infrastructure-as-a-Service (IaaS) field. Microsoft Azure was once an also-ran, but now it is competing fiercely with market leaders Amazon Web Services and Google Cloud Platform.

- Microsoft Azure is an ideal app for businesses that have standardized on Windows as well as for Linux users. The Linux compatibility extends to virtual infrastructure guest operating systems (OSes) as well as the Linux-based container architecture Docker. While the app is designed on top of a Windows Hyper-V framework, you can run different Linux distributions (such as CentOS, OpenSUSE, SUSE, and Ubuntu as well as Windows Server 2008 and 2012).