

SUBJECT CODE : CS714PE

JNTUH - R18

B.Tech., IV-I (CSE / IT) Professional Elective - IV

CLOUD COMPUTING

Iresh A. Dhotre

M.E. (Information Technology)

Ex-Faculty,

Sinhgad College of Engineering, Pune

FEATURES

- Written by Popular Authors of Text Books of Technical Publications
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 - Fill in the Blanks with Answers for Mid Term Exam
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A Guide For Engineering Students

CLOUD COMPUTING

SUBJECT CODE : CS714PE

B.Tech., IV-I [CSE / IT] Professional Elective - IV

- Unit - I**
Cloud Computing Paradigms : High-Performance Computing, Parallel Computing, Distributed Computing, Cluster Computing, Grid Computing, Cloud Computing, Bio Computing, Mobile Computing, Quantum Computing, Optical Computing, Nano Computing. (**Chapter - 1**)

- Unit - II**
Cloud Computing Fundamentals : Motivation for Cloud Computing, The need for Cloud Computing, Defining Cloud Computing, Definition of Cloud Computing, Cloud Computing is a Service, Cloud Computing is a platform, Principles of Cloud Computing, Five essential characteristics, Four cloud deployment models. (**Chapter - 2**)

- Unit - III**
Cloud Computing Architecture and Management : Cloud Architecture, Layer, Anatomy of the Cloud, Network Connectivity in Cloud Computing, Applications on the Cloud, Managing the Cloud, Infrastructure, Managing the Cloud application, Migrating Application to Cloud, Phases of Cloud Migration Approaches for Cloud Migration. (**Chapter - 3**)

- Unit - IV**
Cloud Service Models : Infrastructure as a Service, Characteristics of IaaS, Suitability of IaaS, Pros and Cons of IaaS, Summary of IaaS Providers, Platform as a Service, Characteristics of PaaS, Suitability of PaaS, Pros and Cons of PaaS, Summary of PaaS Providers, Software as a Service, Characteristics of SaaS, Suitability of SaaS, Pros and Cons of SaaS, Summary of SaaS Providers, Other Cloud Service Models. (**Chapter - 4**)

- Unit - V**

- Cloud Service Providers :** EMC, EMC IT, Captiva Cloud Toolkit, Google, Cloud Platform, Cloud Storage, Google Cloud Connect, Google Cloud Print, Google App Engine, Amazon Web Services, Amazon Elastic Compute Cloud, Amazon Simple Storage Service, Amazon Simple Queue Service, Microsoft, Windows Azure, Microsoft Assessment and Planning Toolkit, SharePoint, IBM, Cloud Models, IBM Smart Cloud, SAP Labs, SAP HANA Cloud Platform, Virtualization Services Provided by SAP, Sales force, Sales Cloud, Service Cloud : Knowledge as a Service, Rack space, VMware, Majora Soft, Aneka Platform. (**Chapter - 5**)

SYLLABUS

Cloud Computing - (CS714PE)

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Unit - V

- Cloud Service Providers :** EMC, EMC IT, Captiva Cloud Toolkit, Google, Cloud Platform, Cloud Storage, Google Cloud Connect, Google Cloud Print, Google App Engine, Amazon Web Services, Amazon Elastic Compute Cloud, Amazon Simple Storage Service, Amazon Simple Queue Service, Microsoft, Windows Azure, Microsoft Assessment and Planning Toolkit, SharePoint, IBM, Cloud Models, IBM Smart Cloud, SAP Labs, SAP HANA Cloud Platform, Virtualization Services Provided by SAP, Sales force, Sales Cloud, Service Cloud : Knowledge as a Service, Rack space, VMware, Majora Soft, Aneka Platform. (**Chapter - 5**)



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Fill in the Blanks with answers for Mid Term Exam

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Solved JNTU Question Papers (S - 1) to (S - 14)

1**COMPUTING PARADIGMS****1.1 : High Performance Computing & Parallel Computing****Q.1 Explain about parallel computing.**

[JNTU : May-18, Marks-2]

OR What is parallel computing ?

[JNTU : March-17, Marks-2]

Ans. : Parallel computing is the simultaneous use of multiple compute resources to solve a computational problem. To be run using multiple CPUs. A problem is broken into discrete parts that can be solved concurrently. Each part is further broken down to a series of instructions. Instructions from each part execute simultaneously on different CPUs.

Q.2 Describe computational grids.

[JNTU : Dec-17, Marks-2]

Ans. : • Computational grid is a hardware and software infrastructure that provides dependable, consistent, pervasive, and inexpensive access to high-end computational capabilities.

- A computational grid is a loose network of computers linked to perform grid computing. In a computational grid, a large computational task is divided up among individual machines, which run calculations in parallel and then return results to the original computer.
- These individual machines are nodes in a network, which may span multiple administrative domains and may be geographically distant.

Q.3 Why Use Parallel Computing ?

Ans. : 1. Save time and money : In theory, throwing more resources at a task will shorten its time to completion, with potential cost savings. Parallel clusters can be built from cheap, commodity components.

2. Solve larger problems : Many problems are so large and complex that it is impractical or impossible to solve them on a single computer, especially given limited computer memory.
 3. Provide concurrency : A single compute resource can only do one thing at a time. Multiple computing resources can be doing many things simultaneously.
 4. Use of non-local resources : Using computer resources on a wide area network, or even the Internet when local computer resources are scarce.
- Parallel computing allows one to solve problems that don't fit on a single CPU and solve problems that can't be solved in a reasonable time. All computers are parallel these days, even your iPhone 4S has two cores.

Q.4 What is high-performance computing ?

Ans. : In high-performance computing systems, a pool of processors connected with other resources like memory, storage, and input and output devices, and the deployed software is enabled to run in the entire system of connected components.

1.2 : Distributed Computing & Cluster computing**Q.5 Discuss about computer clusters.**

[JNTU : May-19, Marks-3]

Ans. : • A computer cluster is a set of connected computers (nodes) that work together as if they are a single machine.

- All processor machines share resources such as a common home directory and have a software such as a message passing interface (MPI) implementation installed to allow programs to be run across all nodes simultaneously.

- Computer clusters are often used for cost-effective high performance computing (HPC) and high availability (HA) by businesses of all sizes.
- A computer cluster help to solve complex operations more efficiently with much faster processing speed, better data integrity than a single computer and they only used for mission-critical applications.

Q.6 Differentiate between parallel and distributed computing paradigms.

☞ [JNTU : Dec-16, Marks-2]

Ans. : • In distributed computing, each processor has its own private memory (distributed memory). Information is exchanged by passing messages between the processors.

- In parallel computing, all processors may have access to a shared memory to exchange information between processors.
- Distributed computing is the process of aggregating the power of several computing entities, which are logically distributed and may even be geologically distributed, to collaboratively run a single computational task in a transparent and coherent way, so that they appear as a single, centralized system.
- Parallel computing is the simultaneous execution of the same task on multiple processors in order to obtain faster results.

Q.7 Define distributed system. What are the major milestones to lead cloud computing ?

- Ans. :** • A distributed system is a collection of independent computers that appears to its users a single coherent system.
- A distributed system can consist of any number of possible configurations, such as mainframes, personal computers, workstations, minicomputers, and so on.
 - The major milestones have led to cloud computing are mainframes computing, cluster computing, and grid computing.

Q.8 Differentiate between distributed computing and cloud computing.

Ans. : • Cloud computing is a technology that delivers many kinds of resources as services, mainly over the internet, while distributed computing is the concept of using a distributed system consisting of many self-governed nodes to solve a very large problem.

- Cloud computing is basically a sales and distribution model for various types of resources over the internet, while distributed computing can be identified as a type of computing, which uses a group of machines to work as a single unit to solve a large scale problem.
- Distributed computing achieves this by breaking the problem up to simpler tasks, and assigning these tasks to individual nodes.

Q.9 Discuss in detailed about distributed system models.

☞ [JNTU : May-2019, Marks-10]

OR How distributed system models are useful for enabling technologies ? Discuss.

☞ [JNTU : May-18, Marks-10]

OR Explain system models for distributed and cloud computing.

☞ [JNTU : Dec-17, Marks-5]

OR Explain the distributed system models.

☞ [JNTU : March-17, Marks-10]

Ans. : • Distributed systems are built over a large number of autonomous computer nodes. These node machines are interconnected by SANs, LANs, or WANs in a hierarchical manner.

- With today's networking technology, a few LAN switches can easily connect hundreds of machines as a working cluster.
- A WAN can connect many local clusters to form a very large cluster of clusters. In this sense, one can build a massive system with millions of computers connected to edge networks.
- System Models for Distributed Computing are Clusters of Cooperative Computers, Grid Computing Infrastructures, Peer-to-Peer Network Families and Cloud Computing over the Internet.
- Clusters of Cooperative Computers : A computing cluster consists of interconnected stand-alone

- computers which work cooperatively as a single integrated computing resource.
- A cluster of servers interconnected by a high-bandwidth SAN or LAN with shared I/O devices and disk arrays; the cluster acts as a single computer attached to the Internet.
 - Grid technology demands new distributed computing models, software/middleware support, network protocols, and hardware infrastructures.
 - Grid systems are classified in essentially two categories: computational or data grids and P2P grids.
 - Computational grid or data grid providing computing utility, data, and information services through resource sharing and cooperation among participating organizations.
 - The P2P architecture offers a distributed model of networked systems. First, a P2P network is client-oriented instead of server-oriented.
 - In a P2P system, every node acts as both a client and a server, providing part of the system resources. Peer machines are simply client computers connected to the Internet. All client machines act autonomously to join or leave the system freely.
 - Overlay Networks : Data items or files are distributed in the participating peers. Based on communication or file-sharing needs, the peer IDs form an overlay network at the logical level.
 - Fig. Q.9.1 shows overlay network.

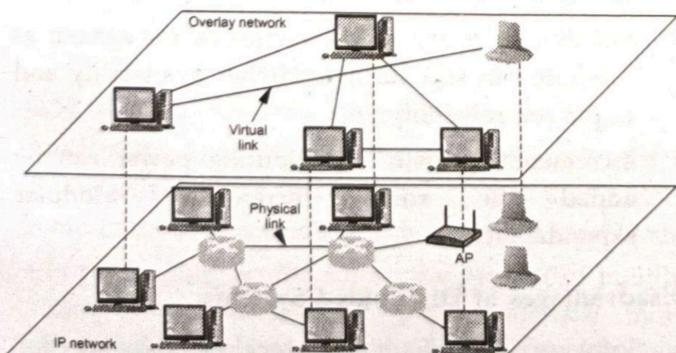


Fig.Q.9.1

- This overlay is a virtual network formed by mapping each physical machine with its ID, logically, through a virtual mapping.
- There are two types of overlay networks: unstructured and structured.
- An unstructured overlay network is characterized by a random graph. There is no fixed route to send messages or files among the nodes. Structured overlay networks follow certain connectivity topology and rules for inserting and removing nodes (peer IDs) from the overlay graph. Routing mechanisms are developed to take advantage of the structured overlays.
- Cloud computing has been defined differently by many users and designers.
- The cloud supports redundant, self-recovering, highly scalable programming models that allow workloads to recover from many unavoidable hardware/software failures.
- Finally, the cloud system should be able to monitor resource use in real time to enable rebalancing of allocations when needed.

Q.10 How computer clusters are useful for scalable parallel computing? Explain.

[JNTU : May-18, Marks-10]

- Ans. :**
- Clustering of computers enables scalable parallel and distributed computing in both science and business applications.
 - A computer cluster is a collection of interconnected stand-alone computers which can work together collectively and cooperatively as a single integrated computing resource pool.
 - Clustering explores massive parallelism at the job level and achieves high availability (HA) through stand-alone operations.
 - The benefits of computer clusters and massively parallel processors (MPPs) include scalable performance, HA, fault tolerance, modular growth, and use of commodity components.
 - These features can sustain the generation changes experienced in hardware, software, and network components.

Q.11 Briefly explain the design principles of computer clusters.  [JNTU : Dec-17, Marks-5]

- Ans. :**
- Single-System Image Features: SSI does not mean a single copy of an operating system image residing in memory, as in an SMP or a workstation.
 - Single system : The entire cluster is viewed by users as one system that has multiple processors.
 - Single-system image (SSI) consisting of single entry point, single file hierarchy, single I/O space, single networking scheme, single control point, single job management system, single memory space, and single process space.
 - The ultimate goal of SSI is for a cluster to be as easy to use as a desktop computer.
 - Single job management system: All cluster jobs can be submitted from any node to a single job management system.
 - Single user interface: The users use the cluster through a single graphical interface. Such an interface is available for workstations and PCs.
 - When designing robust, highly available systems three terms are often used together: reliability, availability, and serviceability (RAS).
 - Reliability measures how long a system can operate without a breakdown.
 - Availability indicates the percentage of time that a system is available to the user, that is, the percentage of system uptime.
 - Serviceability refers to how easy it is to service the system, including hardware and software maintenance, repair, upgrades, and so on.

Q.12 What are the design objectives of computer clusters ?  [RGPV : Dec-17, Marks-5]

- Ans. :**
- Design Objectives of Computer Clusters are scalability, packaging, control, homogeneity, programmability, and security.

1. Scalability: Clustering of computers is based on the concept of modular growth. The scalability could be limited by a number of factors, such as the multi-core chip technology, cluster topology, packaging method, power consumption, and cooling scheme applied.

2. Packaging : Cluster nodes can be packaged in a compact or a slack fashion.
3. Control : A cluster can be either controlled or managed in a centralized or decentralized fashion. A compact cluster normally has centralized control, while a slack cluster can be controlled either way. In a centralized cluster, all the nodes are owned, controlled, managed, and administered by a central operator. In a decentralized cluster, the nodes have individual owners.
4. Homogeneity : A homogeneous cluster uses nodes from the same platform, that is, the same processor architecture and the same operating system; often, the nodes are from the same vendors.
5. Security : Intracluster communication can be either exposed or enclosed. In an exposed cluster, the communication paths among the nodes are exposed to the outside world.

Q.13 Explain advantages and disadvantages of distributed systems ?

Ans. : Advantages of Distributed Systems over Centralized Systems

1. Economics : A collection of microprocessors offer a better price/performance than mainframes. Low price/performance ratio : Cost effective way to increase computing power.
2. Speed : A distributed system may have more total computing power than a mainframe.
3. Inherent distribution : Some applications are inherently distributed e.g. a supermarket chain.
4. Reliability : If one machine crashes, the system as a whole can still survive. Higher availability and improved reliability.
5. Incremental growth : Computing power can be added in small increments. Modular expandability.

Disadvantages of Distributed Systems:

1. Software : Difficult to develop software for distributed systems.
2. Network : Saturation, lossy transmissions.
3. Security : Easy access also applies to secret data.

1.3 : Grid Computing & Cloud computing

Q.14 Explain any three services offered by cloud.

[JNTU : Dec-17, Marks-3]

Ans. : • Software as a Service : SaaS provider dispose the applied software unified on their server, the user can subscribe applied software service from the manufacturer through Internet.

- Platform As A Service (PaaS) : PaaS takes development environment as a service to supply. This layer provides a platform for creating applications.
- Infrastructure As A Service (IaaS) : In this layer, servers, network devices, and storage disks are made available to organizations as services on a need-to basis.

Q.15 Explain cluster computing and grid computing.

Ans. : • Cluster computing is a group of linked computers, working together closely thus in many respects forming a single computer.

- Clusters are usually deployed to improve performance and availability over that of a single computer, while typically being much more cost-effective than single computers of comparable speed or availability. Clustering allows us to run applications on several parallel servers.
- Grid computing is a distributed computing system where a group of computers are connected to create and work as one large virtual computing power, storage, database, application, and service.

1.4 : Bio computing & Mobile Computing

Q.16 What is bio-computing ?

Ans. : • Bio-computing systems use the concepts of biologically derived or simulated models that perform computational processes in order to solve a problem.

- Bio-computing is defined as the process of building computers that use biological materials, mimic biological organisms or are used to study biological organisms.
- Two of the terms used in biological computing are "genetic algorithms" and "neural networks." Both of

these refer to the ability of computing systems to learn and to make decisions based on the information they are given.

1.7 What is Mobile Computing ?

Ans. : • Mobile computing can be defined as a human-computer interaction that enables transmission of voice, video and data. It comprises of mobile communication, mobile hardware, and mobile software.

- In mobile computing, the processing (or computing) elements are small and the communication between various resources is taking place using wireless media.

1.5 : Quantum Computing, Optical computing, Nano Computing

Q.18 What is Quantum Computers ?

Ans. : • A quantum computer is a machine that performs calculations based on the laws of quantum mechanics, which is the behavior of particles at the sub-atomic level.

- In classical computation, the unit of information is a bit, which can be 0 or 1. In quantum computation, this unit is a quantum bit (qubit), which is a superposition of 0 and 1. A bit of data is represented by a single atom that is in one of two states denoted by $|0\rangle$ and $|1\rangle$.
- In a quantum computer, one quantum bit could be both 0 and 1 at the same time. So with three qubits of data, a quantum computer could store all eight combinations of 0 and 1 simultaneously. That means a three-qubit quantum computer could calculate eight times faster than a three-bit digital computer.
- Typical personal computers today calculate 64 bits of data at a time. A quantum computer with 64 qubits would be 2 to the 64th power faster, or about 18 billion times faster.

Q.19 Describe briefly Nano computing.

Ans. : • Nanocomputing refers to computing systems that are constructed from nanoscale components. The silicon transistors in traditional computers may be replaced by transistors based on carbon nanotubes.

- Generally nanotechnology deals with sizes between 1 to 100 nanometer and involves developing or modifying materials or devices within that size.
- Nanotechnology is the production technology to get the extra high accuracy and ultra fine dimensions, i.e. the precision and fineness on the order of 1 nm (nanometer), 10⁻⁹ meter in length.
- Nanotechnology continues to be touted as the "next big thing" that will transform a wide range of economic sectors, ranging from medicine to electronics to advanced materials.
- In the diagnostics area, nanosensors that can detect, identify, and quantify biological substances in body fluids are leading to early disease detection and earlier treatments as well as the ability to detect environmental contaminants in the body.
- The next generation of graphene and carbon nanotube-based devices will lead to even lighter but stronger structures than has been made possible by carbon fiber and will become increasingly obvious in cars, bicycles, and sporting equipment.
- One of the challenges faced in computational nanotechnology is the immense computational power needed to simulate systems at atomic and molecular level. Even a small sample of materials few nanometers thick contain many thousand atoms.
- So calculation of the properties and simulation of matter at such a scale require developing novel computational techniques to enhance the efficiency and allow for larger systems to be simulated for longer time spans.

Q.20 Define Optical Computing.

Ans. : Optical computing system uses the photons in visible light or infrared beams, rather than electric current, to perform digital computation.

Fill in the Blanks for Mid Term Exam

- Q.1** The goal of distributed computing is to make such a network work as a _____.
- Q.2** In _____ computing, the processing elements are small and the communication between various resources is taking place using wireless media.

- Q.3** Optical computing system uses the photons in visible light or infrared beams, rather than electric current, to perform _____.
- Q.4** _____ measures the reliability and self management from the chip to the system and application levels.
- Q.5** System availability (in terms of MTTF and MTTR) = _____.
- Q.6** _____ the users use the cluster through a single graphical interface.
- Q.7** Virtualization ranging from hardware to applications has _____ abstraction levels.
- Q.8** _____ converts data from a source data format into destination data format.
- Q.9** The _____ started as an open source project and has served as a base to other virtualization products both commercial and open source.
- Q.10** An _____ Brokerage service combines multiple services into one or more new services.
- Q.11** _____ cloud has a designated service provider for general public under a utility based pay per use consumption model.
- Q.12** _____ interact with cloud computing infrastructure on an ad hoc basis.
- Q.13** _____ refer to any storage medium, local or remote, that holds the base images of the VMs.

Multiple Choice Questions for Mid Term Exam

- Q.1** A _____ is typically installed in a desk side rack in a central computer room.
- | | |
|---|--|
| <input type="checkbox"/> a Enterprise cluster | <input type="checkbox"/> b Cluster |
| <input type="checkbox"/> c Dedicated cluster | <input type="checkbox"/> d Virtual cluster |

Answer keys for Fill in the Blanks

Q.1	Single computer	Q.2	mobile
Q.3	digital computations	Q.4	Dependability
Q.5	MTTF/(MTTF+MTTR)	Q.6	Single user interface
Q.7	five	Q.8	Data transformation
Q.9	Xen	Q.10	cloud

Q.11	Public	Q.12	Iaas
Q.13	Open Nebula		

Answer keys for Multiple Choice Questions

Q.1	c
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END... ↵

2

CLOUD COMPUTING FUNDAMENTALS

2.1 : Motivation for Cloud Computing

Q.1 Discuss brief history of cloud computing.

Ans. : • The idea of cloud computing was introduced by computer scientist John McCarthy publicly in 1961.

- Then in 1969, Leonard Kleinrock, a chief scientist of the ARPANET project comments about Internet.
- The general public has been leveraging forms of Internet-based computer utilities since the mid-1990s through various incarnations of search engines, e-mail services, open publishing platforms and other types of social media.
- Though consumer-centric, these services popularized and validated core concepts that form the basis of modern-day cloud computing.
- The Salesforce.com provides remote service from 1990 to organization. Amazon launched its web services in 2002 and it provides services to organization for storage and remote computing.
- Cloud computing definition as per Gartner "a style of computing in which scalable and elastic IT-enabled capabilities are delivered as a service to external customers using Internet technologies".
- In 2008, Gartner's original definition of cloud was changed. In the definition, "massively scalable" was used instead of "scalable and elastic."
- **NIST definition of cloud :** Cloud computing is a pay-per-use model for enabling available, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, services) that can be rapidly provisioned and released with minimal management effort or service-provider interaction.

- The above cloud definition was published by NIST in 2009, followed by a revised version after further review and industry input that was published in September of 2011.

- Cloud computing refer to a variety of services available over the Internet that deliver compute functionality on the service provider's infrastructure.
- Its environment (infrastructure) may actually be hosted on either a grid or utility computing environment, but that doesn't matter to a service user.

Q.2 What are the reasons for motivation of cloud computing ?

Ans. : • It is easy and handy to get the required computing power and resources from some provider as and when it is needed and pay only for that usage.

- Cloud computing is very economical and saves a lot of money.
- The cloud represents the Internet-based computing resources.
- Cloud computing encompasses the subscription-based or pay-per-use service model of offering computing to end users.

Q.3 List the different cloud application available in the market. Briefly explain the scenario/situations of "when to not use clouds".

Ans. : Different cloud application available in the market :

1. Healthcare
2. Data center for storage
3. Social networking
4. Media application
5. Image processing

Scenario/situations of "when to not use clouds" :

- In some cases cloud providers are more expensive than on-premise systems.
- Using the Internet can cause network latency with some cloud applications.
- Security is largely immature, and currently requires specialized expertise.
- Much of the technology is proprietary, and thus can cause lock-in.
- Compliance issues could raise the risks of using cloud computing.
- Data privacy issues could arise, if your cloud provider seeks to monetize the data in their system.

2.2 : Defining Cloud Computing**Q.4 What is cloud computing ? Explain it.**

 [JNTU : May-18, 19, Marks-2]

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

Q.5 What is cloud ecosystem ?

Ans. : Cloud computing ecosystems are business process, application services, platform services and Infrastructure services.

- A cloud ecosystem is a complex system of interdependent components that all work together to enable cloud services.
- In cloud computing, the ecosystem consists of hardware and software as well as cloud customers, cloud engineers, consultants, integrators and partners.

Q.6 What is cloud service ?

Ans. : • Cloud service is any service made available to users on demand via the Internet from a cloud computing provider's servers as opposed to being provided from a company's own on-premises servers.

- Cloud services are designed to provide easy, scalable access to applications, resources and services, and are fully managed by a cloud services provider.

Q.7 Discuss the advantages and disadvantages of cloud computing. Also write down the limitation of cloud computing.

Ans. : Advantages of cloud computing

1. **Lower computer costs :** Since applications run in the cloud, not on the desktop PC, your desktop PC does not need the processing power or hard disk space demanded by traditional desktop software.
2. **Improved performance :** Computers in a cloud computing system boot and run faster because they have fewer programs and processes loaded into memory.
3. **Reduced software costs :** Instead of purchasing expensive software applications, you can get most of what you need for free.
4. **Instant software updates :** When you access a web-based application, you get the latest version - without needing to pay for or download an upgrade.
5. **Improved document format compatibility :** You do not have to worry about the documents you create on your machine being compatible with other user's applications or operating systems.
6. **Unlimited storage capacity :** Cloud computing offers virtually limitless storage.
7. **Increased data reliability :** Unlike desktop computing, in which if a hard disk crashes and destroy all your valuable data, a computer crashing in the cloud should not affect the storage of your data.
8. **Universal document access :** All your documents are instantly available from wherever you are.
9. **Latest version availability :** The cloud always hosts the latest version of your documents; as long as you are connected, you are not in danger of having an outdated version.
10. **Easier group collaboration :** Sharing documents leads directly to better collaboration.

11. Device independence : Move to a portable device and your applications and documents are still available.

Disadvantages of cloud computing :

1. It requires a constant Internet connection : Cloud computing is impossible if you cannot connect to the Internet.
2. Features might be limited.
3. Stored data might not be secure : With cloud computing, all your data is stored on the cloud.
4. Does not work well with low-speed connections.

Limitation of cloud computing :

1. Peripherals : Peripheral devices like printers or scanners might not work with cloud. Many of them require software to be installed locally. Networked peripherals have lesser problems.
2. Integration : Integrating internal applications with those on cloud can be complex and in some cases not viable.
3. Generic : Public cloud offerings are very generic and offer multi-tenancy service which all organizations might not be comfortable with.

2.3 : Principles of Cloud Computing

Q.8 List and explain cloud deployment models.

Ans. : Cloud deployment models are refers to the location and management of the cloud's infrastructure. Deployment models are defined by the ownership and control of architectural design and the degree of available customization. Cloud deployment models are private, public and community clouds.

Q.9 What is public cloud ?

Ans. : Public cloud is built over the Internet and can be accessed by any user who has paid for the service. Public clouds are owned by service providers and are accessible through a subscription.

Q.10 What is private clouds ?

Ans. : A private cloud is built within the domain of an intranet owned by a single organization. Therefore, it is client owned and managed, and its access is limited to the owning clients and their partners.

Q.11 What is community cloud ?

Ans. : The cloud infrastructure is shared by several organizations and supports a specific community that has shared concerns (e.g. mission, security requirements, policy, or compliance considerations). It may be managed by the organizations or a third party and may exist on-premises or off-premises.

Q.12 Explain difference between public and private cloud.

Ans. :

Public Cloud	Private Cloud
Public cloud infrastructure is offered via web applications and also as web services over Internet to the public.	Private cloud infrastructure is dedicated to a single organization.
Support multiple customer.	Support dedicated customer.
Full utilized of infrastructure.	Does not utilize shared infrastructure.
Security is low as compared to private cloud.	High level of security.
Low cost.	High cost.
Azure, Amazon Web Services, Google App Engine and Force.com are a few examples of public clouds.	An example of the Private Cloud is NIRIX's one Server with dedicated servers.

Q.13 Write a short note on desired features of a cloud.

[JNTU : Dec.-16, Marks-3]

OR Explain the feature of cloud computing ?

[JNTU : March-17, Marks-3]

Ans. : 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 without requiring human interaction with each service's provider.

2. **Ubiquitous network access** : Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms.
3. **Location-independent resource pooling** : The provider's computing resources are pooled to serve all consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand.
4. **Rapid elasticity** : Capabilities can be rapidly and elastically provisioned to quickly scale up, and rapidly released to quickly scale down.
5. **Pay per use** : Capabilities are charged using a metered, fee-for-service, or advertising-based billing model to promote optimization of resource use.

Q.14 Explain about virtual machines.

[JNTU : May-19, Marks-2]

- Ans. :**
- A Virtual Machine is a software construct that mimics the characteristics of a physical server.
 - A Virtual Machine (VM) is a software program or operating system that not only exhibits the behavior of a separate computer, but is also capable of performing tasks such as running applications and programs like a separate computer.

Q.15 Describe various deployment models in cloud.

[JNTU : Dec.-17, Marks-5]

- Ans. :**
- Deployment models (shared or dedicated, and whether internally hosted or externally hosted) are defined by the ownership and control of architectural design and the degree of available customization
 - Cloud deployment models are private, public and community clouds. Fig. Q.15.1 shows these cloud models.

- 1) **Public cloud** : The cloud infrastructure is made available to the general public or a large industry group and is owned by an organization selling cloud services.

Public cloud benefits :

1. Low investment hurdle : Pay for what you use.
2. Good test/development environment for applications that scale to many servers.

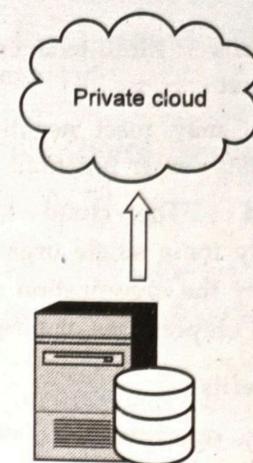


Fig. Q.15.1(a) : Private cloud

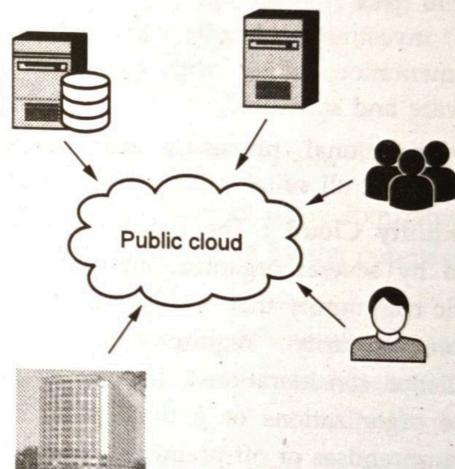


Fig. Q.15.1(b) : Public cloud

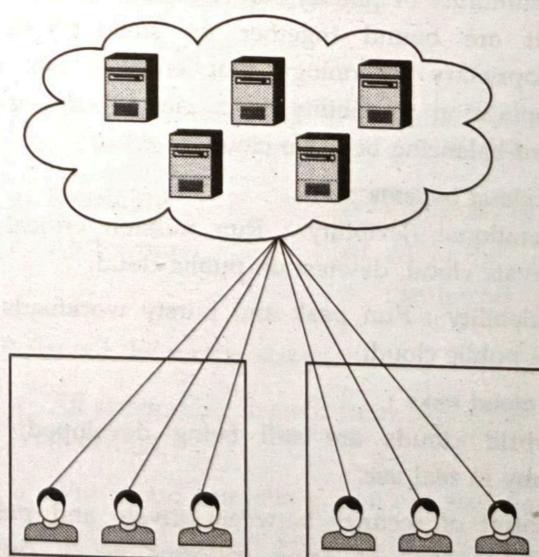


Fig. Q.15.1(c) : Community cloud

Public cloud risks :

1. Security concerns : Multi-tenancy and transfers over the internet.
2. IT organization may react negatively to loss of control over data center function.
- 2) **Private cloud :** The cloud infrastructure is operated solely for a single organization. It may be managed by the organization or a third party and may exist on-premises or off-premises.

Private cloud benefits :

1. Fewer security concerns as existing data center security stays in place.
2. IT organization retains control over data center.

Private cloud risks :

1. High investment hurdle in private cloud implementation, along with purchases of new hardware and software.
2. New operational processes are required; old processes not all suitable for private cloud.
- 3) **Community Cloud :** The cloud infrastructure is shared by several organizations and supports a specific community that has shared concerns (e.g. mission, security requirements, policy, or compliance considerations). It may be managed by the organizations or a third party and may exist on-premises or off-premises.
- 4) **Hybrid Cloud :** The cloud infrastructure is a composition of two or more clouds (private, community or public) that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load-balancing between clouds).

Hybrid cloud benefits :

1. Operational flexibility : Run mission critical on private cloud, dev/test on public cloud.
2. Scalability : Run peak and bursty workloads on the public cloud.

Hybrid cloud risks :

1. Hybrid clouds are still being developed; not many in real use.
2. Control of security between private and public clouds, some of same concerns as in public cloud.

Q.16 What is multitenant technology ? What is role of tenants ? Explain benefit of multitenant technology.

Ans. : • A multi-tenant cloud is a cloud computing architecture that allows customers to share computing resources in a public or private cloud. Each tenant's data is isolated and remains invisible to other tenants.

- It allows multiple users to work in a software environment at the same time, each with their own separate user interface, resources and services.

- The multitenant application design was created to enable multiple users (tenants) to access the same application logic simultaneously.

- Tenants can individually customize features of the application, such as :

1. **User Interface :** Tenants can define a specialized look for their application interface.
2. **Business Process :** Tenants can customize the rules, logic, and workflows of the business processes that are implemented in the application.
3. **Data Model :** Tenants can extend the data schema of the application to include, exclude, or rename fields in the application data structures.
4. **Access Control :** Tenants can independently control the access rights for users and groups.

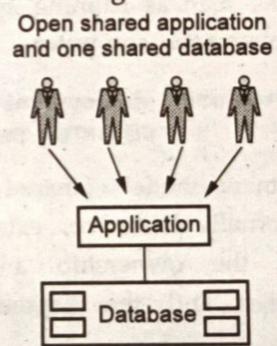


Fig. Q.16.1 Multi-tenant technology

• Benefits of a Multitenancy technology :

1. **Costs savings :** It yields tremendous economy of scale for the provider so he can offer the service at a lower cost to customers.
2. **Improved quality, user satisfaction, and customer retention :** a multitenant application is one large community hosted by the provider which can gather operational information from the collective user population and make frequent, incremental improvements to the service that benefit the entire user community at once.

3. Improved security : Most current enterprise security models are perimeter-based, making them vulnerable to inside attacks.

Q.17 List the important features of cloud platforms.

- Ans. :**
- Physical computing platform : Cloud environment support physical or virtual platforms. Virtual platforms have unique identifies to provide isolated environment.
 - Distributed file system and huge data storage service : DFS provides similar interface as local file system. It support massive data storage service. Cloud data storage service provide large disk capacity.
 - Runtime support : Runtime support is transparent to users and their applications.
 - Support services : It includes data and computing services.
 - Workflow and data query language support : Programming model offers abstraction for the cloud infrastructure.
 - Programming interface and service deployment : Special API are required for cloud applications.

Fill in the Blanks

- Q.1** _____ measures the utilization rate of resources in an execution model by exploiting massive parallelism in HPC.
- Q.2** Information exchange in a distributed system is accomplished through _____.
- Q.3** A cluster can be either controlled or managed in _____ fashion.
- Q.4** The virtualization layer is known as _____.
- Q.5** _____ enables aggregation of distributed resources and transparently access to them.
- Q.6** _____ is software that separates physical infrastructures to create various dedicated resources.
- Q.7** The _____ is the largest Digital information superhighway.
- Q.8** The primary target of OpenNebula is to mange _____.

- Q.9** In a _____ cloud scenario, capital expense is virtually eliminated.

Multiple Choice Questions

- Q.1** Point out the wrong statement :
- a Abstraction enables the key benefit of cloud computing : shared, ubiquitous access.
 - b Virtualization assigns a logical name for a physical resource and then provides a pointer to that physical resource when a request is made.
 - c All cloud computing applications combine their resources into pools that can be assigned on demand to users.
 - d All of the mentioned.
- Q.2** Point out the wrong statement :
- a The massive scale of cloud computing systems was enabled by the popularization of the Internet.
 - b Soft computing represents a real paradigm shift in the way in which systems are deployed.
 - c Cloud computing makes the long-held dream of utility computing possible with a pay-as-you-go, infinitely scalable, universally available system.
 - d All of the mentioned.
- Q.3** Which of the following is essential concept related to Cloud ?
- | | |
|--|--|
| <input type="checkbox"/> a Reliability | <input type="checkbox"/> b Productivity |
| <input type="checkbox"/> c Abstraction | <input type="checkbox"/> d All of the mentioned. |
- Q.4** Point out the wrong statement :
- a All applications benefit from deployment in the cloud.
 - b With cloud computing, you can start very small and become big very fast.
 - c Cloud computing is revolutionary, even if the technology it is built on is evolutionary.

d None of the mentioned.

Q.5 Which of the following cloud concept is related to pooling and sharing of resources?

- a Polymorphism b Abstraction
- c Virtualization
- d None of the mentioned

Q.6 CDC Stands for _____.

- a Cloud Data Computing
- b Cloud Data Cluster
- c Cloud Data Center
- d Computing Data on Cloud

Q.7 In which year IoT was introduced?

- | | |
|---------------------------------|---------------------------------|
| <input type="checkbox"/> a 1999 | <input type="checkbox"/> b 1998 |
| <input type="checkbox"/> c 1996 | <input type="checkbox"/> d 1997 |

Q.8 _____ is mainly used to utilize idle resources in the nodes.

- a Dedicated cluster b Enterprise cluster
- c Distributed Cluster
- d Centralized cluster

Q.9 _____ is the entry point into the cloud for user and administrators.

- a Cloud Manager b Group Manager
- c Instance Manager d VM Manager

Q.10 The services that provides utility may directly correlate with their _____?

- a expectations b profit
- c time d satisfaction

Q.11 The promise of _____ has raised the IT expectations of small and medium enterprises beyond measures.

- a cloud computing b cloud computing
- c Cluster computing d Client-Server computing

Q.12 Cloud supports applications _____ and resources elasticity.

- a performance
- b reliability
- c scalability
- d None of the above

Q.13 _____ cloud is shared by several organizations and supports a specific community that has shared concerns.

- a Private
- b Public
- c Managed
- d Community

Q.14 _____ of grids/clouds to offer standard interfaces for dynamically scalable services delivery in their products.

- a Vendors
- b Consumers
- c Integrators
- d providers

Q.15 VAN Stands for _____.

- a Virtual Application Network
- b Virtual Acceptable Network
- c Virtual Admission Network
- d Virtual Area Network

Q.16 In what type of cluster, the nodes are closely packaged in one or more racks Sitting in a room, and the nodes are not attached to peripherals.

- a Compact
- b Slack
- c loosely coupled
- d Tightly coupled

Q.17 Virtualization is a computer architecture technology by which multiple _____ are multiplexed in the same hardware machine.

- a Virtual Memory
- b Virtual Machines
- c Physical Machines
- d Virtual Machine Monitor

Q.18 Which of the following is not VI manager ?

- | | |
|---------------------------------------|--------------------------------------|
| <input type="checkbox"/> a Apache VCL | <input type="checkbox"/> b App Logic |
| <input type="checkbox"/> c Google VI | <input type="checkbox"/> d Nimbuz 3 |

Q.19 According to Infosys how many steps are there in the migration model ?

- | | |
|------------------------------|------------------------------|
| <input type="checkbox"/> a 4 | <input type="checkbox"/> b 5 |
| <input type="checkbox"/> c 6 | <input type="checkbox"/> d 7 |

Q.20 _____ is the process of transferring data between storage types, formats or systems.

- a Data Mediation
- b Data integrity
- c Data Modification
- d Data Migration

Q.21 Which of the following is not principle of the cloud ?

- a Federation
- b Non independent
- c Trust
- d Isolation

Q.22 _____ is a directory on the cluster node where a VM is running.

- a Virtualization
- b KVM
- c Virtual Machine Directory
- d VMware

Answer keys for Fill in the Blanks

Q.1	Efficiency	Q.2	Message passing
Q.3	Centralized or decentralized	Q.4	hypervisor
Q.5	Grid computing	Q.6	Virtualization
Q.7	Web	Q.8	Virtual machine
Q.9	Public		

Answer keys for Multiple Choice Questions

Q.1	c	Q.2	b	Q.3	c	Q.4	a
Q.5	c	Q.6	c	Q.7	a	Q.8	b
Q.9	a	Q.10	a	Q.11	b	Q.12	c
Q.13	d	Q.14	a	Q.15	d	Q.16	a
Q.17	b	Q.18	b	Q.19	d	Q.20	d
Q.21	a	Q.22	b				

END... ↗

3

Cloud Computing Architecture and Management

3.1 : Cloud Architecture

Q.1 List layer name of Cloud Computing Architecture.

Ans. : Layers are User/client layer, network layer, cloud management layer and Hardware resource layer.

Q.2 What are functions of Cloud Management Layer ?

Ans. : • This layer manages the cloud.

- It acts as an interface between the data center and the user.
- These software's usually allow resource management (scheduling, provisioning, etc.), optimization (server consolidation, storage workload consolidation), and internal cloud governance.

Q.3 What is data center ?

Ans. : Data centers are buildings where multiple servers and communication gear are co-located because of their common environmental requirements and physical security needs, and for ease of maintenance. Data Centers are specialized environments that safeguard company's most valuable equipment and intellectual property.

Q.4 Draw and explain cloud architecture.

Ans. : • Fig. Q.4.1 shows cloud architecture.

- It consists of four layers: User/client layer, network layer, cloud management layer and Hardware resource layer.

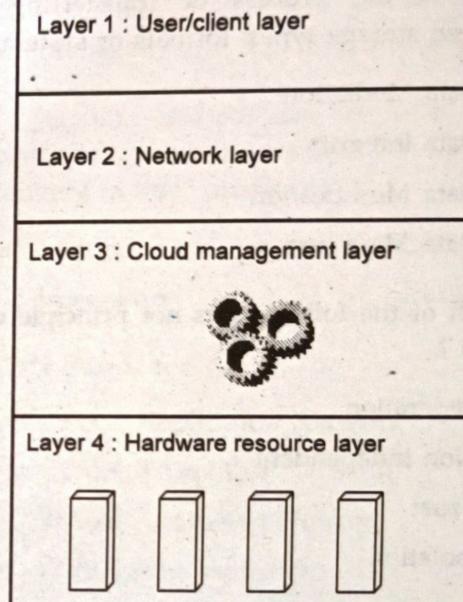


Fig. Q.4.1

Layer 1 (User/Client Layer) :

- This layer is the bottom layer in the cloud architecture. All the users or client belong to this layer.
- User/client send request for connection. Client includes mobile device, thin and thick client.
- Cloud application can be accessed in the same way as a web application.

Layer 2 (network layer) :

- This layer allows the users to connect to the cloud. Here services are offered to the customers.
- If client is using private cloud, the connectivity may be provided by a local area network.
- When accessing the public or private cloud, the users require minimum bandwidth.

Layer 3 (Cloud Management Layer) :

- In this layer, software's are used in managing the cloud.
- It acts as an interface between the data center and the user.
- These software's usually allow resource management (scheduling, provisioning, etc.), optimization (server consolidation, storage workload consolidation), and internal cloud governance.

Layer 4 (Hardware Resource Layer) :

- It consists of data center in the back end for public cloud.
- Data center in a private cloud, contains a huge collection of hardware resources interconnected to each other.
- This layer comes under the purview of SLAs.
- Whenever a user accesses the cloud, it should be available to the users as quickly as possible and should be within the time that is defined by the SLAs.
- As mentioned, if there is any discrepancy in provisioning the resources or application, the service provider has to pay the penalty.

3.2 : Anatomy of the Cloud**Q.5 What is Anatomy of the Cloud ?**

Ans. : • Cloud anatomy can be simply defined as the structure of the cloud. Anatomy can be considered as a part of architecture. Fig Q.5.1 shows cloud anatomy.

1. Application : The upper layer is the application layer. In this layer, any applications are executed.

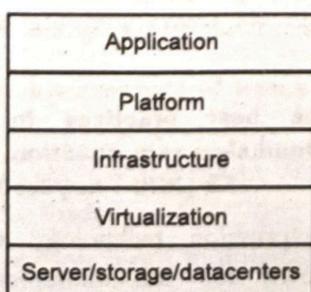


Fig. Q.5.1

2. **Platform :** This component consists of platforms that are responsible for the execution of the application. This platform is between the infrastructure and the application.
3. **Infrastructure :** The infrastructure consists of resources over which the other components work. This provides computational capability to the user.
4. **Virtualization :** Virtualization is the process of making logical components of resources over the existing physical resources. The logical components are isolated and independent, which form the infrastructure.
5. **Physical hardware :** The physical hardware is provided by server and storage units.

3.3 : Network Connectivity in Cloud Computing

Q.6 Discuss Public Cloud Access Networking.

Ans. : In public cloud access, Internet is used for accessing the cloud. Some organization uses virtual private networks (VPNs) and they provide services using VPN to customer.

- Accessing public cloud services will always create issues related to security, which in turn is related to performance.
- Security is major issue, so the information may be sent via secure pipes on the Internet.
- This procedure will be an overhead in the connectivity, and using it will certainly increase delay and may impact performance.
- To reduce the delay without compromising security, then suitable routing method is selected so one reducing the delay by minimizing transit hops in the end-to-end connectivity between the cloud provider and cloud consumer.
- Since the end-to-end connectivity support is via the Internet, which is a complex federation of interconnected providers, one has to look at the options of selecting the path.

Q.7 What is Private Intra-cloud Networking ?

- Ans. :** • Private intra-cloud networking is usually supported over connectivity between the major data center sites owned by the company.
- All cloud computing implementations will rely on intra-cloud networking to link users with the resource to which their application was assigned.
 - If the principle of service-oriented architecture (SOA) is followed, then traffic may move between components of the application, as well as between the application and the user.
 - The impact of cloud computing performance is the differences that exist between the current application and the network relationships with the application.

3.4 : Applications on the Cloud**Q.8 What is difference between cloud application and web application ?****Ans. :**

Sr. No	Cloud application	Web application
1	All cloud applications are web applications.	Not all web applications are cloud applications.
2	Inherently scalable.	Limited by scalability.
3	Very high uptime.	Limited by availability.
4	Multi-tenancy solution.	Isolated - tenancy solution.
5	The provided application is standardized for all customers.	Each customer uses its own instance of the application.
6	User data and business process store in a multiple replicated data centers.	User data and business process store in single data center.
7	The cloud applications can be installed on a public cloud or a private cloud and accessed there.	The web applications can be installed on Internet or intranet and accessed there.

Q.9 List and explain common characteristics of multitenant applications.

- Ans. :** • Common characteristics of multitenant applications are as follows :

1. Usage Isolation - The usage behavior of one tenant does not affect the application availability and performance of other tenants.
2. Data Security - Tenants cannot access data that belongs to other tenants.
3. Recovery - Backup and restore procedures are separately executed for the data of each tenant.
4. Application Upgrade - Tenants are not negatively affected by the synchronous upgrading of shared software artifacts.
5. Scalability - The application can scale to accommodate increases in usage by existing tenants and/or increases in the number of tenants.
6. Metered Usage - Tenants are charged only for the application processing and features that are actually consumed.
7. Data Tier Isolation - Tenants can have individual databases, tables, and schemas isolated from other tenants.

Q.10 What is difference between multitenancy and virtualization.

Ans. : • **With multitenancy :** A physical or virtual server hosting an application is designed to allow usage by multiple different users. Each user feels as though they have exclusive usage of the application.

• **With virtualization :** Multiple virtual copies of the server environment can be hosted by a single physical server. Each copy can be provided to different users, can be configured independently, and can contain its own operating systems and applications.

Q.11 Explain the best practices to build an application on cloud.slew rate equation.

[JNTU : Nov/Dec-17, Marks-5]

Ans. : • Gene expression technology using DNA microarrays, allows for the monitoring of the expression levels of thousands of genes at once. As a direct result of recent advances in DNA microarray technology, it is now feasible to obtain gene

expression profiles of tissue samples at relatively low costs.

- Gene expression profiles provide important insights into, and further our understanding of, biological processes. As such, they are key tools used in medical diagnosis, treatment and drug design.
- Cloud-CoXCS is a machine learning classification system for gene expression datasets on the Cloud infrastructure.
- It is composed of three components: CoXCS, Aneka, and Offspring.
- 1. **CoXCS** : CoXCS is a coevolutionary learning classifier based on feature space partitioning. It extends the XCS model by introducing a co-evolutionary approach. The CoXCS architecture is based on a collection of independent populations of classifiers that are trained using different partitions of the feature space within the training dataset.
- The model uses a modified covering operator and crossover operators, which improves the generation of new classifiers during the evolutionary process.
- After a fixed number of iterations, selected classifiers from each of the independent populations are transferred to a different population. The evolutionary cycle is then repeated.
- 2. **Aneka** : Aneka is a platform for developing applications and deploying them on Clouds. It provides a runtime environment and a set of APIs that allow developers to build .NET applications that offload their computation on both public and private clouds.
- 3. **Offspring** : Offspring is a software tool that allows scientists and developers to quickly prototype distributed applications.

Q.12 Explain shortcomings of web application.

Ans. : Shortcomings are as follows:

1. Web application is not elastic and cannot handle very heavy loads.
2. Web application is not multitenant.
3. Web applications are not provided on a pay-as-you-go basis.

4. Web applications are usually in one particular platform.

Q.13 Explain features of Cloud application.

Ans. : features are as follows :

1. **Multitenancy** : Multi-tenancy means that a single instance of the software and its supporting infrastructure serves multiple customers. Each customer shares the software application and also shares a single database.
2. **Heterogeneous cloud platform** : The cloud platform supports heterogeneity, wherein any type of application can be deployed in the cloud.
3. **On-demand service** : The cloud applications offer service to the user, on demand, that is, whenever the user requires it.
4. **Quantitative measurement** : The services provided can be quantitatively measured.

3.5 : Managing the Cloud

Q.14 What is cloud infrastructure ?

 [JNTU : March-17, Marks-2]

Ans. : The infrastructure of the cloud is considered to be the backbone of the cloud. Infrastructure platform is a system that provides computing resources, particularly servers, storage and networking, in a way that they can be programmatically allocated and managed.

Q.15 List two functions of Cloud management.

Ans. : Functions of cloud management are:

1. Managing the infrastructure of the cloud.
2. Managing the cloud application.

Q.16 What is Service-Level Agreements? Why is Service Level Agreement important in Cloud Computing ?

Ans. : Service level agreement (SLA) is a contract between a service provider (either internal or external) and the end user that defines the level of service expected from the service provider.

- SLAs are output-based in that their purpose is specifically to define what the customer will receive. SLAs do not define how the service itself is provided or delivered.

- The SLA an Internet Service Provider (ISP) will provide its customers is a basic example of an SLA from an external service provider.
- Because of the dynamic nature of the cloud environment, uninterrupted controlling on Quality of Service (QoS) characteristics is essential to apply SLAs.
- An SLA cannot guarantee that you will get the service it describes, any more than a warranty can guarantee that your car will never break down.
- In particular, an SLA cannot make a good service out of a bad one. At the same time, an SLA can avoid the risk of choosing a bad service.
- There are three major SLA categories :
 1. Basic - An SLA with well-organized metrics that are calculated and/or confirmed. The gathering of these metrics is usually completed physically.
 2. Medium - A multi-stage superiority depending on the cost of the service. The goal is to equalize the stages of superiority and cost.
 3. Advanced - Dynamic distribution of resources to achieve requirements.
- Many cloud providers are vague on the specifics of the underlying hardware and software stack they use to deliver a virtual server to the end customer, which allows for over commitment.
- Techniques for over committing hardware include (but are not limited to) :
 1. Specify memory allocation and leave CPU allocation unspecified, allowing total hardware memory to dictate the number of customers the hardware can support.
 2. Quote shared resource maximums instead of private allocations.
 3. Offer a range of performance for a particular instance, such as a range of GHz.
 4. Overallocate resources on a physical server, or thin provisioning. Commercial virtualization management software such as VMware offer the ability to over allocate resources on the underlying hardware, resulting in reduced performance during peak loads.

Q.17 What are the requirements of SLA ?

Ans. : A signed agreement with each customer.

- Transactions by hour and jobs by day for each application.
- A method of reporting SLA results.
- Priority of services in case of insufficient availability.
- Agreed methods of penalty in case customer exceeds his limits.
- Agreed methods of penalty in case cloud provider fails to meet contract specifications.
- Schedule of virtual or actual meeting between the customer and the cloud provider if necessary.

3.6 : Migrating Application to Cloud

Q.18 What are the benefits of migration into cloud? Explain.

[April/May-18, Marks-3]

Ans. : Cloud migration presents an opportunity to significantly reduce costs incurred on applications.

- Operational Flexibility - A cloud solution allows you to be more flexible when testing and deploying applications.
- It provides better Storage and reduced cost.
- Extremely Scalable - The highlight feature of cloud migration is beyond doubt its inherent scalability and flexibility.

Q.19 List the phases of cloud migration.

Ans. : Phases of cloud migration are evaluation, migration strategy, prototyping, provisioning, and testing.

Q.20 Explain the seven-step model of migration into a cloud.

[JNTU : March-17, Marks-5]

Ans. : Seven-step model of migration.

- Fig Q.20.1 shows seven step model of migration.

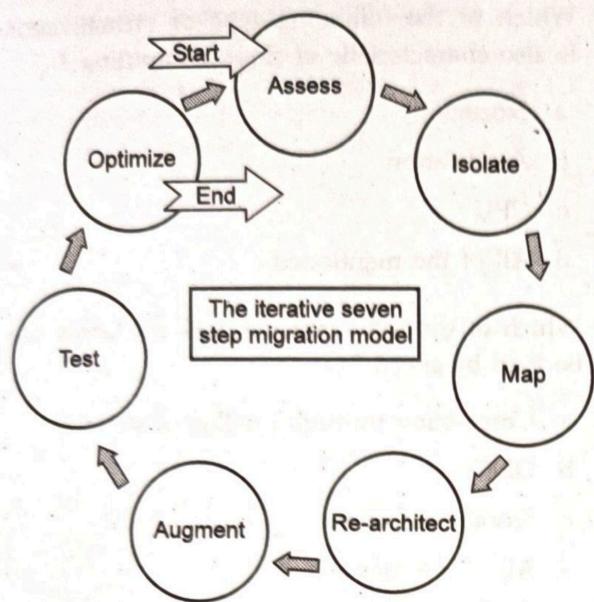


Fig. Q.20.1

1. Conduct cloud migration assessment.

- Understand the migration issues at the application level or the code, the design, the architecture, or usage levels.
- Consider the cost of migration : ROI (Return of investment).

2. Isolate the dependencies.

- Isolate all systematic and environmental dependencies of the enterprise application components within the captive data center.

3. Map the messaging and environment.

- Message map: displaying detailed, hierarchically organized responses to anticipated questions or concerns.
- Generate the mapping constructs between what shall remain in the local captive data center and what goes onto the cloud.

4. Re-architect and implement the lost functionalities.

- Perhaps some functionality may be lost due to migration.
- Some part of the enterprise application may need to be re-architect, redesigned, and re-implemented on the cloud.

- Leverage cloud function and features : Leverage the intrinsic features of the cloud computing service to augment the enterprise application.

5. Test the migration : Test the new form of the enterprise application.
6. Iterate and optimize : Iterate and optimize the process.

Q.21 Describe approaches for Cloud Migration.

Ans. : • The following are the four broad approaches for cloud migration:

1. Migrate existing applications : Rebuild or re-architect some or all the applications, taking advantage of some of the virtualization technologies around to accelerate the work.
2. Start from scratch.
3. Separate company : One may want to create a whole new company with separate brand, management, R&D, and sales.
4. Buy an existing cloud vendor.

Fill in the Blanks for Mid Term Exam

Q.1 Cloud anatomy cannot be considered the same as cloud _____.

Q.2 Cloud architecture consists of a _____ set of components that collectively describe the way the cloud works.

Q.3 _____ is the process of making logical components of resources over the existing physical resources.

Q.4 Public cloud computing networks are internal to the _____ and thus not visible to the user/customer.

Q.5 SOA stands for _____.

Q.6 The web application is not _____.

Q.7 Cloud application in general refers to a _____ application.

Q.8 A stand-alone application is developed to be run on a _____ system that does not use network for its functioning.

Q.9 SLAs are the set of rules that are defined between the _____ and _____ provider that decide upon the QoS factor.

Multiple Choice Questions for Mid Term Exam

Q.1 Which of the following is NOT Cloud application features ?

- a Multitenancy
- b Elasticity
- c Homogeneous cloud platform
- d On-demand service

Q.2 Usually, when accessing the public or private cloud, the users require minimum _____ which is sometimes defined by the cloud providers ?

- a Frequency
- b bandwidth
- c Internet
- d all of these

Q.3 Cloud architecture consists of a _____ set of components that collectively describe the way the cloud works.

- a Horizontal
- b vertical
- c hierarchical
- d all of these

Q.4 Which of the following is NOT phases of cloud migration ?

- a migration strategy
- b prototyping
- c provisioning
- d debugging

Q.5 _____ are a set of agreements that are signed between the user and service providers.

- a Service level agreement
- b Service oriented architecture
- c service layer agreement
- d software level agreement

Q.6 Which of the following type of virtualization is also characteristic of cloud computing ?

- a Storage
- b Application
- c CPU
- d All of the mentioned

Q.7 Which of the following network resources can be load balanced ?

- a Connection through intelligent switches
- b DNS
- c Storage resources
- d All of the mentioned

Q.8 How many types of virtual private server instances are partitioned in an IaaS stack ?

- a One
- b Two
- c Three
- d All of the mentioned

Q.9 Which of the following is associated with considerable vendor lock-in ?

- | | |
|---------------------------------|---------------------------------|
| <input type="checkbox"/> a PaaS | <input type="checkbox"/> b IaaS |
| <input type="checkbox"/> c CaaS | <input type="checkbox"/> d SaaS |

Q.10 _____ for both hosted on premises applications and data sources.

- | | |
|---------------------------------|---------------------------------|
| <input type="checkbox"/> a IaaS | <input type="checkbox"/> b PaaS |
| <input type="checkbox"/> c SaaS | <input type="checkbox"/> d DaaS |

Answer keys for Fill in the Blanks

Q.1	architecture	Q.2	hierarchical
Q.3	Virtualization	Q.4	service provider
Q.5	service-oriented architecture	Q.6	multitenant
Q.7	SaaS	Q.8	single
Q.9	user, cloud service		

Answer keys for Multiple Choice Questions

Q.1	c	Q.2	b
Q.3	c	Q.4	d
Q.5	a	Q.6	c
Q.7	d	Q.8	c
Q.9	a	Q.10	a

END... ↵

4

CLOUD SERVICE MODELS

4.1 : Infrastructure as a Service

Q.1 What is NIST definition of IaaS ?

Ans. : The ability given to the infrastructure architects to deploy or run any software on the computing resources provided by the service provider. The end users are responsible for managing applications that are running on top of the service provider cloud infrastructure.

Q.2 Draw basic cloud service models diagram.

Ans. : The National Institute of Standards and Technology (NIST) defines three basic service models, namely, IaaS, PaaS, and SaaS, as shown in Fig. Q.2.1

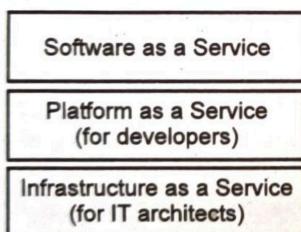


Fig. Q.2.1

Q.3 How cloud provides Infrastructure as a service (IaaS) ? Explain. [JNTU : May/June 19, Marks 10]

Ans. : • IaaS gives the storage room likeness to the in-house datacenter stood out from various organizations sorts.

- Center datacenter framework segments are capacity, servers (registering units), the system itself, and administration apparatuses for foundation upkeep and checking.

- Each of these parts has made a different market specialty. While some little organizations have practical experience in just a single of these IaaS cloud specialties, vast cloud suppliers like Amazon or Right Scale have offerings over all IaaS territories. Fig. Q.3.1 shows IaaS.

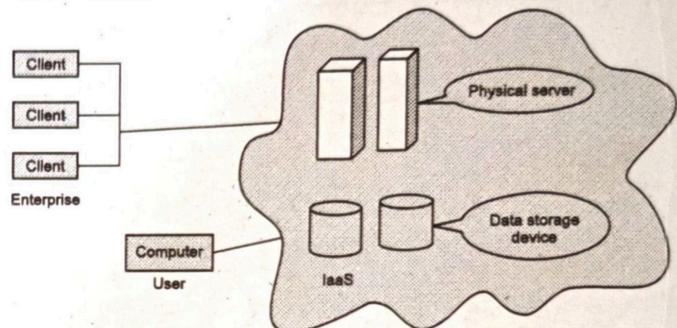


Fig. Q.3.1

- It offers the hardware so that your organization can put whatever they want onto it. Rather than purchase servers, software, racks, and having to pay for the datacenter space for them, the service provider rents those resources :

- Server space
- Network equipment
- Memory
- CPU cycles
- Storage space

- Again, the customer is not managing cloud infrastructure, but in this case, the customer does control operating systems, deployed applications, storage, and sometimes certain networking components.
- IaaS changes the computing from a physical infrastructure to a virtual infrastructure. IaaS provides virtual computing, storage, and network resources by abstracting the physical resources.
- The end users or IT architects will use the infrastructure resources in the form of VMs.
- The IT architect can design virtual infrastructure, network, load balancers, etc., based on their needs.
- IaaS quickly scales up and down with demand, letting you pay only for what you use. It helps you avoid the expense and complexity of buying and

managing your own physical servers and other datacenter infrastructure.

- Each resource is offered as a separate service component, and you only need to rent a particular one for as long as you need it.
- Examples : Amazon EC2, Rackspace Mosso, GoGrid

Q.4 Discuss the services provided by typical IaaS provider.

Ans. : Typical IaaS provider provides following services:

- **Compute -** Computing as a Service includes virtual CPUs and virtual main memory for the VMs that are provisioned to the end users.
- **Storage -** Storage as a Service provides back-end storage for the VM images. Some of the IaaS providers also provide the back end for storing files.
- **Network -** Network as a Service provides virtual networking components such as virtual router, switch, and bridge for the VMs.
- **Load balancers -** Load balancing as a service may provide load balancing capability at the infrastructure layer.

Q.5 List and explain advantages and disadvantages of IaaS.

Ans. : Advantages:

1. Elimination of an expensive and staff-intensive data center
2. Ease of hardware scalability
3. Reduced hardware cost
4. On-demand, pay as you go scalability
5. Reduction of IT staff
6. Suitability for ad hoc test environments
7. Allows complete system administration and management
8. Support multiple tenants

Disadvantages:

1. Interoperability issues : There are no common standards followed among the different IaaS providers.

2. Security issue : Most of the IaaS providers are not able to provide 100% security to the VMs and the data stored on the VMs.
3. Performance : Latency of the network plays an important role in deciding the performance.

Q.6 Explain characteristics of IaaS.

Ans. : Characteristics of IaaS

1. Resources are provided as a service
2. Allows for dynamic scaling and elasticity
3. It has a variable cost, usage based pricing model (pay per go and pay per use).
4. It has multi-tenant architecture, includes multiple users on a single piece of hardware.
5. IaaS typically has enterprise grade infrastructure
6. Preconfigured VMs : IaaS providers offer preconfigured VMs with operating systems, network configuration, etc.

4.2 : Platform as a Service

Q.7 Discuss about Platform as a service (PaaS) in cloud.

 [April/May.-18, Marks 3]

- Ans. :**
- Platform as a Service (PaaS) is an abstracted and integrated cloud-based computing environment that supports the development, running, and management of applications.
 - Application components may exist in a cloud environment or may integrate with applications managed in private clouds or in data centers.
 - The ability given to developers to develop and deploy an application on the development platform provided by the service provider.
 - Generally, PaaS services are provided by the service provider on an on-premise or dedicated or hosted cloud infrastructure.
 - In PaaS cloud computing platform, back end scalability is handled by the cloud service provider and the end user does not have to worry about to manage the infrastructure.
 - All the infrastructure to run the applications will be over the internet.

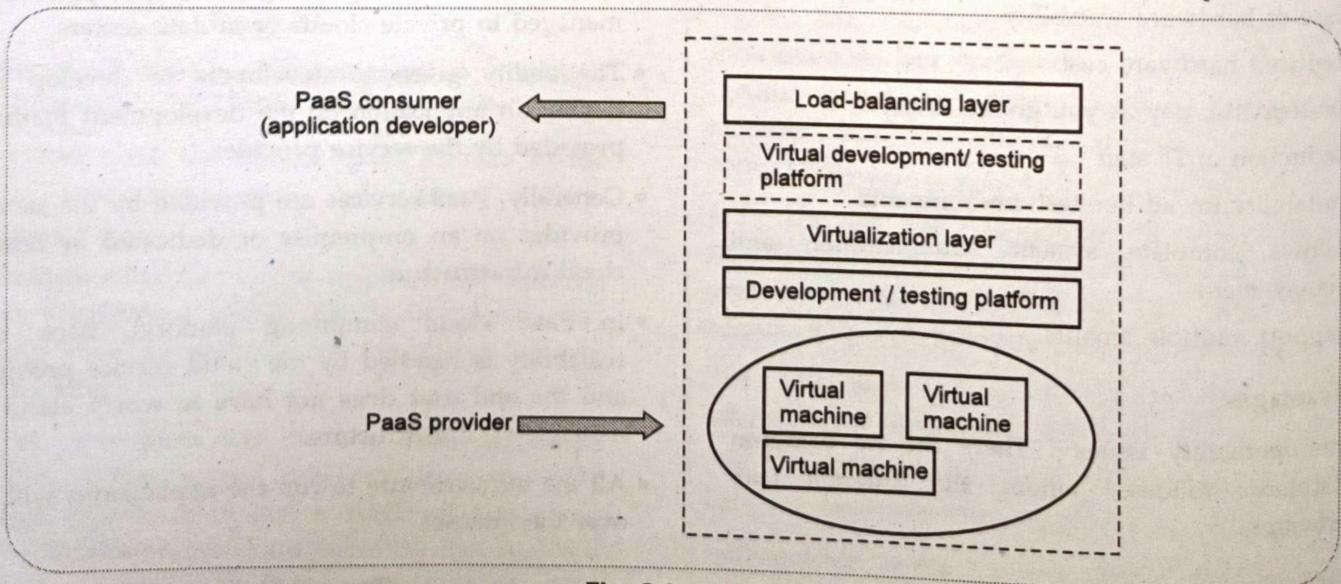
Q.8 List the characteristics of PaaS.**Ans. : Characteristics of PaaS :**

1. It supports multi-tenant architecture.
2. It supports for development of group collaboration.
3. PaaS systems can be deployed as public cloud services or as private cloud services.
4. Provision of runtime environments. Typically each runtime environment supports either one or a small set of programming languages and frameworks
5. It supports for custom applications. Support for the development, deployment and operation of custom applications.
6. Preconfigured capabilities - Many PaaS systems are characterized by capabilities that are preconfigured by the provider, with a minimum of configuration available to developers and customer operations staff.
7. It supports for porting existing applications. While many PaaS systems are primarily designed to support "born on the cloud" applications.
8. It supports is an important characteristic in PaaS. It needs to provide authentication and authorization to differentiate the access rights of different users.

Q.9 Explain PaaS with suitable diagram.

Ans. : • Platform as a service is another application delivery model and also known as cloud-ware. Supplies all the resources required to build applications and services completely from the Internet, without having to download or install software.

- Services include : Application design, development, testing, deployment, and hosting, team collaboration, web service integration, database integration, security, scalability, storage, state management, and versioning. Fig. Q.9.1 shows PaaS.
- PaaS is closely related to SaaS but delivers a platform from which to work rather than an application to work with.
- This model involves software encapsulated and offered as a service, from which higher levels of service may then be built. The user, customer, or client in this model is the one building applications which then run on the provider's infrastructure.
- This in turn provides customers and clients with the capability to deploy applications onto the cloud infrastructure using programming tools and languages, which the provider supports.
- The customer still does not manage the framework, network, servers or operating system, but has control over deployed applications and sometimes over the hosting environment itself.

**Fig. Q.9.1 PaaS**

- Some examples of Platform as a Service include Google's App Engine or Force.com
- PaaS consists of following components:
 1. Browser based development studio
 2. Pay contrary to billing
 3. Management and supervising tools
 4. Seamless deployment to host run time environment.
- PaaS providers provide all the tools that are required to develop, test, and deploy an application.
- PaaS providers provide a wide variety of programming languages for the developers to develop applications

Q.10 Explain pros and cons of PaaS.

Ans. : Pros of PaaS :

1. Scalability including rapid allocation and deallocation of resources with a pay-as-you-use model
2. Reduced capital expenditure
3. Reduced lead times with on-demand availability of resources
4. Self-service with reduced administration costs
5. Reduced skill requirements
6. Different teams can work together
7. Ability to add new users quickly

Cons of PaaS :

1. Vendor lock-in : One have to write the applications according to the platform provided by PaaS vendor so migration of an application to another PaaS vendor would be a problem.
2. Data Privacy : Corporate data, whether it can be critical or not, will be private so if it is not located within the walls of the company there can be a risk in terms of privacy of data.
3. Integration with the rest of the systems applications : It may happen that some applications are local and some are in cloud. So there will be chances of increased complexity when we want to use data which in the cloud with the local data.

Q.11 List the situations where PaaS may not be the best option ?

- Ans. :**
- Integration with on-premise application
 - Flexibility at the platform level
 - Customization at the infrastructure level
 - Frequent application migration

4.3 : Software as a Service

Q.12 Briefly describe software as a service.

Ans. :

- SaaS is a software distribution model in which applications are hosted by a cloud service provider and made available to customers over internet. SaaS is also known as "On-Demand Software".

- In SaaS, software and associated data are centrally hosted on the cloud server. SaaS is accessed by users using a thin client via a web browser.
 - Model in which an application is hosted as a service to customers who access it via the Internet.
 - The provider does all the patching and upgrades as well as keeping the infrastructure running.
 - The traditional model of software distribution, in which software is purchased for and installed on personal computers, is referred to as product.
- Fig. Q.12.1 shows SaaS.

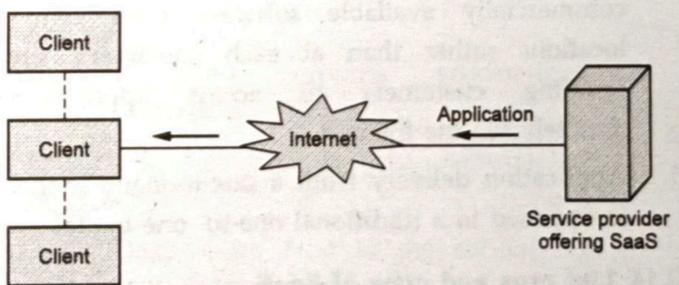


Fig Q.12.1 SaaS

- In this model, the user, client or consumer runs an application from a cloud infrastructure. Through an interface such as a web browser, the client or user may access this application from a variety of devices.
- The complete application is offered as on demand service. This saves the client from having to invest in any software licenses or servers up front, and

can save the provider money since they are maintaining and providing only a single application.

- In this model, the client does not manage cloud infrastructure, networks or servers, storage, or operating systems. Even, Microsoft, Google, and Zoho offer SaaS.
- The SaaS concept can be defined as providing robust "web-based, on-demand software, storage and various applications" to organizations.
- The SaaS model has emerged as an alternative to traditional one-time licensing for providing and maintaining the software needed by knowledge workers within organizations.

Q.13 Explain characteristics of SaaS.

Ans. : Characteristics of SaaS -

1. Software applications or services are stored remotely.
2. A user can then access these services or software applications via the Internet.
3. In most cases, a user does not have to install anything onto their host machine, all they require is a web browser to access these services and in some cases, a browser may require additional plug-in/add-on for certain services.
4. Network-based management and access to commercially available software from central locations rather than at each customer's site, enabling customers to access applications remotely via the Internet.
5. Application delivery from a one-to-many model, as opposed to a traditional one-to-one model.

Q.14 List pros and cons of SaaS.

Ans. : Pros of SaaS :

1. You only pay for what you use.
2. Easier administration and invoicing.
3. Automatic updates and patch management
4. Compatibility : All users have access to the same version of software
5. Easier collaboration
6. It supports automated update and patch management services.

Cons of SaaS :

1. Loss of control : Since the data are stored in a third-party and off-premise location, the end user does not have any control over the data.
2. Connectivity requirements : SaaS applications require Internet connectivity for accessing it

Q.15 Explain difference between IaaS, PaaS and SaaS.

Ans. :

IaaS	PaaS	SaaS
IaaS gives users automated and scalable environments	PaaS provides a framework for quickly developing and deploying applications	SaaS makes applications available through the internet.
Amazon Web Services, for example, offers IaaS through the Elastic Compute Cloud, or EC2	Google Cloud Platform provides another PaaS option in App Engine	SaaS applications such as Gmail, Dropbox, Salesforce, or Netflix
In IaaS, infrastructure as a service.	In Paas, platform as a service	In SaaS, software as a service
Virtual platform on which required operating environment and application deployed	Operating environment included	Operating environment largely irrelevant, fully functional application provided
IaaS is a cloud service that provides basic computing infrastructure: servers, storage, and networking resources. In other words, IaaS is a virtual data center	PaaS refers to cloud platforms that provide runtime environments for developing, testing, and managing applications	SaaS allows people to use cloud-based web applications.

Major IaaS providers include Amazon Web Services, Microsoft Azure, and Google Compute Engine.	Examples of PaaS services are Heroku and Google App Engine.	email services such as Gmail and Hotmail are examples of cloud-based SaaS services.
IaaS services are available on a pay-for-what-you-use model	PaaS solutions are available with a pay-as-you-go pricing model.	SaaS services are usually available with a pay-as-you-go pricing model
Used by IT administrator	Used by software developers	Used by end user

4.4 : Other Cloud Service Models

Q.16 What is Desktop as a Service ?

Ans. : Desktop as a Service (DaaS) is a cloud computing offering that enables businesses to deliver cloud-hosted virtual desktops to any device, from anywhere. DaaS solutions provide complete hosted desktops for applications and email securely delivered over the web. They're simple to buy and easy to manage, with no software for IT to maintain.

Q.17 What is Data as a Service ?

Ans. : Data as a Service (DaaS) is an ability given to the end users to access the data that are provided by the service provider over the Internet. DaaS provides data on demand.

Q.18 Write short note on Identity as a Service.

Ans. : Identity as a Service (IDaaS) :

- Identity as a Service (IDaaS) is cloud-based authentication operated by a third-party provider.
- Identity as a service (IDaaS) are SaaS-based identity and access management (IAM) offerings that allow organizations to use single sign-on (SSO using SAML or OAuth), authentication and access controls to provide secure access to their growing number of software and SaaS applications.
- Five key capabilities are required to make enterprise IDaaS solutions possible:

1. **Single Sign-on (SSO)** : With single sign-on employees, partners and customers obtain easy, fast and secure access to all SaaS, mobile and enterprise applications with a single authentication using corporate credentials.
2. **Multi-factor Authentication (MFA)** : MFA typically includes adaptive authentication methods-options to step up as risk increases based on situational changes, user behavior or application sensitivity.
3. **Access Security** : Access security is policy-based access management for applications and APIs to enhance security beyond SSO.
4. **Directory** : While most enterprises prefer to integrate IDaaS with their existing user stores, they may use a cloud directory, especially to support customers and/or partners.
5. **Provisioning** : Through SCIM support and integration with on-premises provisioning, user data is synced with web and enterprise applications.

- IDaaS supplies cloud-based authentication or identity management to enterprises who subscribe. The goal is to ensure users are who they claim to be, and to give them the right kinds of access to software applications, files, or other resources at the right times. If the infrastructure to make this happen is built on site, then the company has to figure out what to do every time a problem comes up.

Advantages of IDaaS :

1. Deliver access services efficiently and cost-effectively.
2. Protect against internal and external security threats
3. With IDaaS, costs drop to the subscription fee and the administration work
4. Your team has to keep up servers; purchase, upgrade, and install software; back up data regularly; pay hosting fees.

Fill in the Blanks for Mid Term Exam

- Q.1 Generally, the IaaS services are provided from the service provider cloud _____.

Cloud Computing

- Q.2** Generally, _____ services are provided by the service provider on an on-premise or dedicated or hosted cloud infrastructure.
- Q.3** In IaaS, the end users are responsible for maintaining the development platform and the application running on top of the underlying _____.
- Q.4** IaaS follows a _____ delivery model and allows multiple IT users to share the same physical infrastructure.
- Q.5** _____ services are delivered as a one-to-many model where a single instance of the application can be shared by multiple tenants or customers.

Multiple Choice Questions for Mid Term Exam

- Q.1** STaaS stands for _____
 a Storage as a service
 b software storage as a service
 c storage as a standard
 d software as a service
- Q.2** Which of the following is a service models?
 a private b public
 c PaaS d hybrid
- Q.3** _____ is a pay-per-use cloud service delivery model in which the service provider manages the back-end responsibilities of data storage, backup, security, and upgrades.
 a STaaS b DEaaS
 c NaaS d DBaaS
- Q.4** _____ describes a distribution model in which applications are hosted by a service provider and made available to users.
 a Cloud Service
 b Infrastructure-as-a-Service
 c Platform-as-a-Service
 d Software-as-a-Service

Q.5 _____ model consists of the particular types of services that you can access on a cloud computing platform.

- | | |
|--|---|
| <input type="checkbox"/> a Service | <input type="checkbox"/> b Deployment |
| <input type="checkbox"/> c Application | <input type="checkbox"/> d None of this |

Answer keys for Fill in the Blanks

Q.1	data center	Q.2	PaaS
Q.3	infrastructure	Q.4	one-to-many
Q.5	PaaS		

Answer keys for Multiple Choice Questions

Q.1	a	Q.2	c
Q.3	b	Q.4	d
Q.5	a		

END... ↗

5

CLOUD SERVICE PROVIDERS

5.1 : EMC

Q.1 Which are the services offered by EMC ?

Ans. : EMC offer following services :

1. SaaS provides applications and tools in a service model for business enablement.
2. PaaS provides the secure application and information frameworks on top of application server, web server, database, unstructured content management.
3. User Interface as a Service (UIaaS) provisions user and interface experience.
4. IaaS offers EMC business units the ability to provision infrastructure components such as network, storage, computing, and operating systems individually or as integrated services.

Q.2 Discuss about Captiva Cloud Toolkit.

Ans. : • Captiva Cloud Toolkit was introduced by EMC for developing software.

- It helps web application developers to quickly add scanning and imaging functionality directly to their web-based business applications.
- Captiva Cloud Capture Toolkit offers web services application programming interfaces (APIs) for accessing and controlling the document scanner features to include image enhancement and barcode recognition capabilities.
- With Captiva Cloud Toolkit, developers can quickly create working, scan-enabled, web-based business applications compatible with existing corporate web browsers and development environments, including HTML5, Microsoft Silverlight, JavaScript, and Adobe Flash.
- Scanning is importing activity of documents into Captiva from a scanner. Scanning is the entry point to Captiva where one can import any kind of document like pdf, tiff, and jpg.

5.2 : Google

Q.3 What Is Google Cloud Connect ?

Ans. : • Google Cloud Connect is a feature provided by Google Cloud by integrating cloud and the API for Microsoft Office.

- Google Cloud Connect assigns each file a unique URL that can be shared to let others view the document.
- When the user uploads a document to Google Cloud Connect, the service inserts some metadata into the file.
- If changes are made to the document, those changes will show up for everyone else viewing it. When multiple people make changes to the same section of a document, Cloud Connect gives chance to the user to choose which set of changes to keep.

Q.4 List the important features of cloud platforms.

Ans. : • Physical computing platform : Cloud environment support physical or virtual platforms. Virtual platforms have unique identifies to provide isolated environment.

- Distributed file system and huge data storage service : DFS provides similar interface as local file system. It support massive data storage service. Cloud data storage service provide large disk capacity.
- Runtime support : Runtime support is transparent to users and their applications
- Support services : It includes data and computing services.
- Workflow and data query language support : Programming model offers abstraction for the cloud infrastructure.
- Programming interface and service deployment : Special API are required for cloud applications.

Q.5 What is Google App Engine ?

Ans. : • Google App Engine is a way to write your own web applications and have them hosted on Google servers. It enables developers to build their web applications on the same scalable system that power Google applications.

- An app is a piece of software which can run on the computer, internet, phone or any other electronic device. Google refers to their online services as Apps. They also sell a specific suite of services known as Google Apps.
- Google's providing both SaaS and PaaS solutions in cloud computing. Some of the example for SaaS solutions including Google Apps which including Gmail, Doc, etc., and PaaS includes Google App Engine.

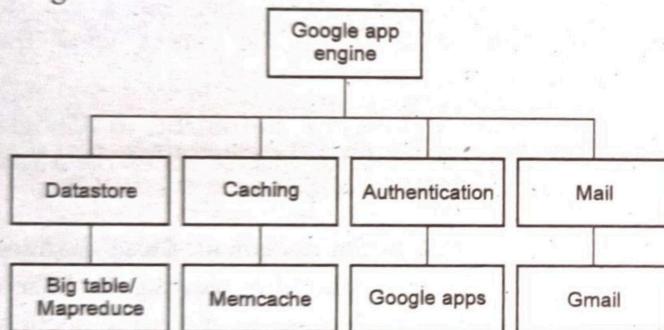


Fig. Q.5.1

- The App Engine offers a number of services that enable you to perform several common operations when managing your application. The following APIs are available to access these services :

1. Mail : Using the mail API, the developers can send email messages.
2. Memcache : The Memcache service gives the users the benefit of working efficiently by providing high retrieval speed, even when multiple users access the same application at the same instance of time.
3. Image Manipulation : The Image service allows you to manipulate images of your application. With the use of this API, you can resize, crop, rotate and flip images in JPEG and PNG formats.
- In the PaaS space Google is a key player. App Engine is a platform to create, store and run applications on Google's servers using development languages as java and python.
- App Engine includes tools for managing the data store, monitoring the site and its resource consumption, and debugging and logging. A user

can serve the app from his own domain name using Google Apps.

Q.6 List the major feature of Google App Engine. Which kind of problems can be solved using Google App Engine ?

Ans. : Major feature of Google App Engine :

1. Automatic scaling and load balancing.
 2. Authentication using Google Accounts API.
 3. Provides dynamic web services based on common standards.
 4. Integration with other Google cloud services and API.
 5. Support persistent storage, with query access sorting and transaction management features.
- Google App Engine offers users the ability to build and host web applications on Google's infrastructure.

Q.7 What is Google Cloud Print ?

Ans. : • Google Cloud Print is a Google service that lets users print from any Cloud - Print - aware application on any device in the network cloud to any printer.

- To use Google Cloud Print, the user needs to have a free Google profile, an app, a program, or a website that incorporates the Google Cloud Print feature, a cloud - ready printer or printer connected to a computer logged on to the Internet.
- Google Cloud Print uses Google's OAuth based system for identifying users and printers.
- If one has a cloud - ready printer, one can connect the printer to the Internet directly without the need for a dedicated computer. The cloud printer has to be registered with Google Cloud Print to take advantage of its capabilities.

5.3 : Amazon Web Services

Q.8 What is Amazon Web Services ? List its advantages and disadvantages.

Ans. : • Amazon Web Services (AWS) is a collection of remote computing services (web services) that together make up a cloud computing platform, offered over the Internet by Amazon.com.

- AWS is a cloud computing platform from Amazon that provides customers with a wide array of cloud services.
- The AWS Cloud infrastructure is built around Regions and Availability Zones (AZs). A Region is a physical location in the world where we have multiple AZs. AZs consist of one or more discrete data centers, each with redundant power, networking, and connectivity, housed in separate facilities.
- These AZs offer you the ability to operate production applications and databases that are more highly available, fault tolerant, and scalable than would be possible from a single data center.

AWS Services

- AWS consists of many cloud services that you can use in combinations tailored to your business or organizational needs.
- With Amazon Web Services you will find a complete cloud platform ready to use for virtually any workload.
- The user requests to the server by the method such as E-mail either to register or to transfer the domain.
- Your request which includes all information will be sent to Amazon API Gateway restful service.
- API Gateway will transfer the collected user information to an AWS lambda function.
- AWS Lambda function will generate an e-mail and forward it to the 3rd party mail server using Amazon SES.
- Components of Amazon Web Service Architecture are Amazon API Gateway, AWS Lambda, Amazon Simple Email Service.
- API Gateway is a front-door to access data, business logic and functionality. API Gateway will provide a restful API endpoint for our AWS Lambda function.

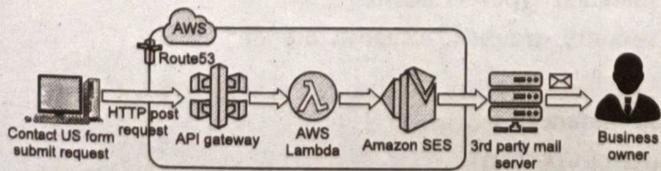


Fig. Q.8.1 AWS

- API works at small as well as large-scale and helps developers to manage, spectate, create and provide security to the API's.
- AWS Lambda is a compute service that runs your back-end code and responds to events such as object uploads to Amazon S3 bucket, Dynamo DB or in-app activity. The Lambda function will get all the information from a user through API Gateway.
- Amazon Simple Email Service helps us to send E-mail with minimal setup and maximum deliverability. It is integrated with AWS management console so that you can monitor your sending activity. Amazon Simple Email Service helps us by monitoring insecurity.

Advantages and Disadvantages of AWS

Advantages :

1. Easy to Use.
2. No Capacity Limits : Organizations launch different projects and the guess what capacity they will need.
3. Provides Speed and Agility.
4. Secure and reliable : AWS provides security and also helps to protect the privacy as it is stored in AWS data centers.

Disadvantages :

1. Limitations OF Amazon EC2 : AWS sets default limits on resources which vary from region to region. These resources consist of images, volumes, and snapshots.
2. Technical Support Fee : AWS charges you for immediate support.
3. Security Limitations.

Q.9 Write short note on AWS Ecosystem.

Ans. : • AWS ecosystem is made up of three subsystems :

1. AWS computing services provided by Amazon.
2. Computing services provided by third parties that operate on AWS.
3. Complete applications offered by third parties that run on AWS.

- **AWS computing services provided by Amazon :** Amazon provided more than 25 services and launching more all the time. AWS also provides large range of cloud computing services.

- Computing services provided by third parties that operate on AWS :** For building applications, these services are used. For example, AWS offers some billing capability to enable users to build applications and charge people to use them, but the AWS service doesn't support many billing use cases, user-specific discounts based on the size of the company.
- Complete applications offered by third parties that run on AWS :** User can use software as a service without installing software on his machine.

Q.10 What is Amazon EC2 ? How it provides programming environment ? Explain EC2 function and advantages.

Ans. : • Amazon Elastic Compute Cloud (Amazon EC2) is a web service that provides resizable compute capacity in the cloud. It is designed to make web-scale computing easier for developers and system administrators.

- The Amazon EC2 simple web service interface allows you to obtain and configure capacity with minimal friction. It provides you with complete control of your computing resources and lets you run on Amazon's proven computing environment.
- Amazon EC2 reduces the time required to obtain and boot new server instances (called Amazon EC2 instances) to minutes, allowing you to quickly scale capacity, both up and down, as your computing requirements change.
- Amazon EC2 changes the economics of computing by allowing you to pay only for capacity that you actually use. Amazon EC2 provides developers and system administrators the tools to build failure resilient applications and isolate themselves from common failure scenarios.
- EC2 allows creating Virtual Machines (VM) on-demand. Pre-configured template Amazon Machine Image (AMI) can be used get running immediately. Creating and sharing your own AMI is also possible via the AWS Marketplace.
- Amazon Machine Image (AMI) is a template for software configuration (Operating System, Application Server, and Applications). Fig. Q.10.1 shows AMI and instance.

- Instance is a AMI running on virtual servers in the cloud. Each instance type offers different compute and memory facilities. Create an Amazon Machine Image (AMI) containing your applications, libraries, data and associated configuration settings. Or use pre-configured, templated images to get up and running immediately.

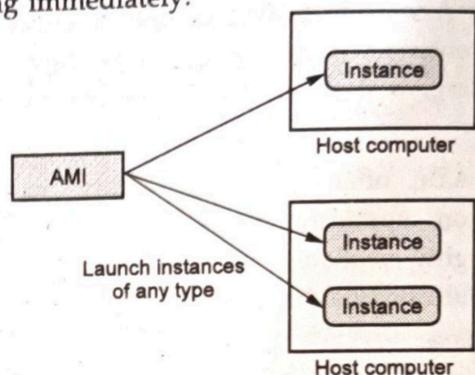


Fig. Q.10.1 AMI and instance

- Auto scaling allows automatically scale of the capacity up seamlessly during demand spikes to maintain performance and scales down during demand lulls to minimize costs.
- Elastic load balancing automatically distributes incoming application traffic across multiple Amazon EC2 instances. It provide tools to build failure resilient applications by launching application instances in separate availability zones.
- Pay only for resources actually consume, instance-hours. VM Import/Export enables you to easily import virtual machine images from your existing environment to Amazon EC2 instances and export them back at any time.
- Boto is a Python package that provides programmatic connectivity to Amazon Web Services.

launching an EC2 instance :

```

#!/usr/bin/python
import boto.ec2
conn = boto.ec2.connect_to_region("us-west-2")
conn.run_instances(
    'ami-6ac2a85a',
    key_name='nitheesh_oregon',
    instance_type='t1.micro',
    security_groups=['nitheesh_oregon']
)
  
```

Stop instances :

```

#!/usr/bin/python
import boto.ec2
  
```

```
conn = boto.ec2.connect_to_region("us-west-2")
conn.stop_instances(instance_ids=['instance-id-1',
'instance-id-2'])
```

- Boto supports more than fifty Amazon services, running the whole range from compute, database, application and payments and billing.

- EC2 functions :

1. Load variety of operating system.
2. Install custom applications.
3. Manage network access permission.
4. Run image using as many/few systems as you desire.

- EC2 advantages :

1. Amazon EC2 enables you to increase or decrease capacity within minutes.
2. User have complete control of your Amazon EC2 instances.
3. Support flexible cloud hosting services
4. Secure : Amazon EC2 works in conjunction with Amazon VPC to provide security and robust networking functionality.
5. Reliable : Amazon EC2 offers a highly reliable environment where replacement instances can be rapidly and predictably commissioned.

Q.11 What is Amazon S3 ? Explain working of S3 and also list its feature.

Ans. : • Amazon S3 has a simple web services interface that you can use to store and retrieve any amount of data, at any time, from anywhere on the web. S3 can serve as a raw data store for IoT systems for storing raw data, such as sensor data, log data, audio and video data.

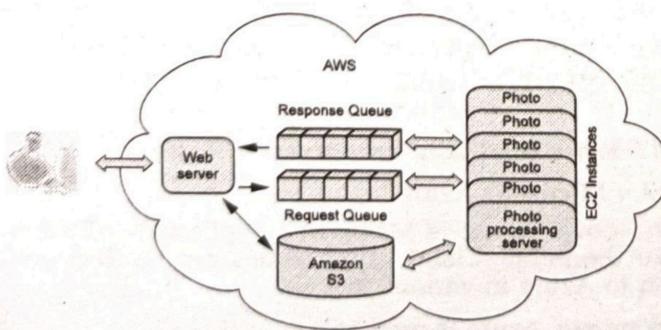


Fig. Q.11.1 Amazon S3 working

- Features :

1. Unlimited storage.

2. Highly scalable : In terms of storage, request rate and concurrent users.
3. Reliable : Store redundant data in multiple facilities and on multiple devices.
4. Secure : Flexibility to control who / how / when / where to access the data.
5. Performance : Choose region to optimize for latency / minimize costs.

- Example : Online photo processing service.

Procedure :

1. Web server receive request.
2. Put request message in the queue.
3. Pictures stored in S3.
4. Multiple EC2 instances run photo processing.
5. Put back in the queue.
6. Return.

- Store data on Amazon's distributed system containing multiple servers within Amazon's data center locations. Amazon doesn't offer you a GUI based tool to access your data. You can use one of the several tools online or build one through APIs.

- Amazon EC2 provides three type of storage option : Amazon EBS, Amazon S3 and Instance Storage. Amazon EBS (Elastic Block Store) provides persistent, block-level storage. Basically additional hard disk that you can attach to instance. It suitable for apps which require database, filesystem, block level storage.

- A bucket is a container for objects stored in Amazon S3. Every object is contained in a bucket. For example, if the object named "photos/puppy.jpg" is stored in the rakshita bucket, then it is addressable using the URL

<http://rakshita.s3.amazonaws.com/photos/puppy.jpg>

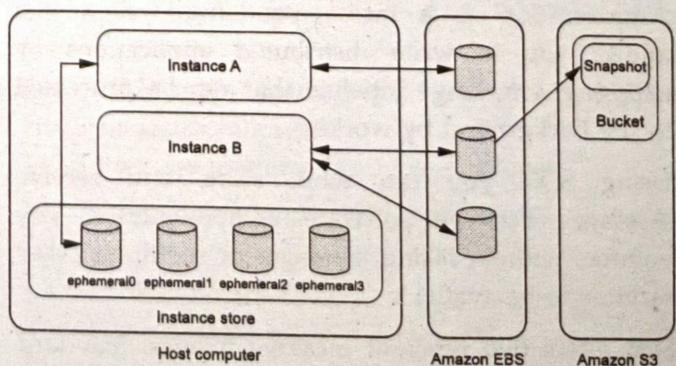


Fig. Q.11.2 Amazon EBS and S3

- Buckets serve several purposes : They organize the Amazon S3 namespace at the highest level, they identify the account responsible for storage and data transfer charges, they play a role in access control and they serve as the unit of aggregation for usage reporting.
- Objects are the fundamental entities stored in Amazon S3. Objects consist of object data and metadata. The data portion is opaque to Amazon S3. The metadata is a set of name-value pairs that describe the object. These include some default metadata, such as the date last modified and standard HTTP metadata, such as content-type. You can also specify custom metadata at the time the object is stored.
- A key is the unique identifier for an object within a bucket. Every object in a bucket has exactly one key. Because the combination of a bucket, key and version ID uniquely identify each object, Amazon S3 can be thought of as a basic data map between "bucket + key + version" and the object itself. Every object in Amazon S3 can be uniquely addressed through the combination of the web service endpoint, bucket name, key and optionally, a version.
- Regions : You can choose the geographical region where Amazon S3 will store the buckets you create. Objects stored in a region never leave the region unless you explicitly transfer them to another region.

Q.12 What is Amazon Simple Queue Service ?

- Ans. :
- Amazon Simple Queue Service (SQS) is a fully managed message queuing service that enables you to decouple and scale microservices, distributed systems, and serverless applications
 - Amazon SQS is a message-queuing system that allows you to write distributed applications by exposing a message pipeline that can be processed in the background by workers
 - Using SQS, you can send, store, and receive messages between software components at any volume, without losing messages or requiring other services to be available
 - SQS offers two types of message queues. Standard queues offer maximum throughput, best-effort ordering, and at-least-once delivery.

- SQS FIFO queues are designed to guarantee that messages are processed exactly once, in the exact order that they are sent.

5.4 : Microsoft

Q.13 What is Azure ?

Ans. : Windows Azure is a cloud computing platform and infrastructure, created by Microsoft, for building, deploying and managing applications and services through a global network of Microsoft-managed data centers.

Q.14 What is Microsoft sharepoint ?

Ans. : Microsoft offers its own online collaboration tool called SharePoint. Microsoft SharePoint is a web application platform that comprises a multipurpose set of web technologies backed by a common technical infrastructure.

Q.15 What is Azure queues ?

Ans. : Azure Queue storage is a service for storing large numbers of messages that can be accessed from anywhere in the world via authenticated calls using HTTP or HTTPS. A single queue message can be up to 64 KB in size, and a queue can contain millions of messages, up to the total capacity limit of a storage account.

Q.16 How virtualization employed in Azure ?

Ans. : Azure is a virtualized infrastructure to which a set of additional enterprise services has been layered on top, including, a virtualization service called Azure AppFabric that creates an application hosting environment. AppFabric is a cloud-enabled version of the .NET Framework.

Q.17 Write brief note on Microsoft Azure

Ans. : Microsoft Azure :

- Windows Azure is Microsoft's application platform for the public Cloud. Applications can be deployed on to Azure in various models
- Windows Azure is used to :
 - Build a web application that runs and stores its data in Microsoft datacenters.
 - Store data while the applications that consume this data run on premise (outside the public Cloud).

- 3. Create virtual machines to develop and test, or run SharePoint and other out-of-the-box applications.
- 4. Develop massively scalable applications with many users.
- 5. Offer a wide range of services.
- Microsoft Azure is a cloud computing service created by Microsoft for building, testing, deploying, and managing applications and services through a global network of Microsoft-managed data centers.
- It provides software as a service (SaaS), platform as a service and infrastructure as a service and supports many different programming languages, tools and frameworks, including both Microsoft-specific and third-party software and systems.
- Fig. Q.17.1 shows Windows Azure platform architecture

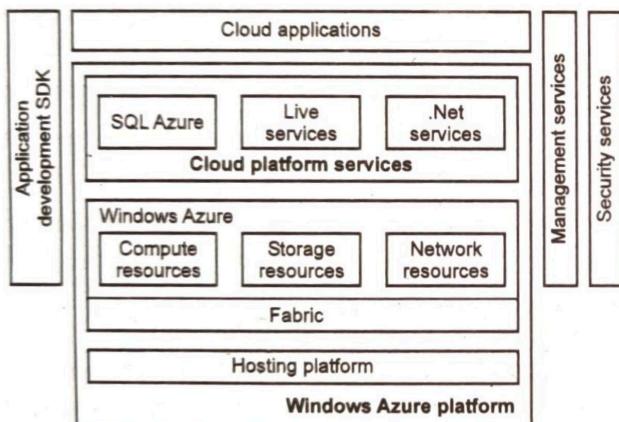


Fig. Q.17.1 Windows Azure platform architecture

- Windows Azure provides resources and services for consumers. For example, hardware is abstracted and exposed as compute resources.
- Physical storage is abstracted as storage resources and exposed through very well defined interfaces. A common Windows Fabric abstracts the hardware and the software and exposes virtual compute and storage resources.
- Each instance of an application is automatically managed and monitored for availability and scalability.
- If an application goes down, the Fabric is notified and a new instance of the application is created.
- Because virtualization is a key element in cloud computing, no assumption must be made on the state of the underlying hardware hosting the application.
- Azure has three components : compute, storage and fabric

5.5 : IBM

Q.18 Explain cloud provision models of IBM.

Ans. : IBM offers five different cloud provision models :

1. Private cloud, owned and operated by the customer.
2. Private cloud, owned by the customer but operated by IBM (or another provider).
3. Private cloud, owned and operated by IBM (or another provider).
4. Virtual private cloud services, based on multitenant support for individual enterprises.
5. Public cloud services, based on the provision of functions to individuals.

Q.19 What is IBM SmartCloud ?

Ans. : IBM SmartCloud is a line of enterprise - class cloud computing technologies and services for building and using private, public and hybrid clouds. SmartCloud offerings can be purchased as self-service or managed services.

5.6 : SAP Labs

Q.20 What is SAP HANA Cloud Platform ?

Ans. : SAP HANA Cloud Platform is an open - standard, Eclipse - based, modular PaaS. In SAP HANA Cloud Platform, applications are deployed via command - line tools to the cloud as web application archive (WAR) files or OSGi bundles.

Q.21 List the features of SAP HANA cloud platform.

Ans. : The main features of SAP HANA Cloud Platform are as follows :

1. Enterprise platform built for developers
2. Native integration with SAP and non - SAP software
3. In - memory persistence
4. Secure data platform
5. Lightweight, modular runtime container for applications.

5.7 : Salesforce

Q.22 What is service cloud ?

Ans. : Service Cloud refers to the service module in Salesforce.com. It includes Accounts, Contacts, Cases, and Solutions. It also encompasses features such as the public knowledge base, web-to-case, call center, and self-service portal, as well as customer service automation.

Q.23 What is Customer relationship management ?

Ans. : Customer Relationship Management (CRM) is a strategy for managing all your company's relationships and interactions with your customers and potential customers. It helps you improve your profitability.

Q.24 Explain Sales Cloud.

Ans. : • Salesforce Sales Cloud is a customer relationship management (CRM) platform designed to support sales, marketing and customer support in both business-to-business (B2B) and business-to-customer (B2C) contexts.

- Sales Cloud is a fully customizable product that brings all the customer information together in an integrated platform that incorporates marketing, lead generation, sales, customer service and business analytics and provides access to thousands of applications through the AppExchange.
- The Sales Cloud gives a platform to connect with customers from complete, up-to-date account information to social insights, all in one place and available anytime, anywhere.
- The platform is provided as Software as a Service (SaaS) for browser-based access; a mobile app is also available.
- A real-time social feed for collaboration allows users to share information or ask questions of the user community.
- Salesforce.com offers five versions of Sales Cloud on a per-user, per month basis, from lowest to highest: Group, Professional, Enterprise, Unlimited and Performance.
- The company offers three levels of support contracts : Standard Success Plan, Premier Success Plan and Premier + Success Plan.

5.8 : Rackspace and VMware

Q.25 List the name of cloud computing solutions offered by Rackspace.

Ans. : Rackspace Cloud offers three cloud computing solutions : Cloud Servers, Cloud Files, and Cloud Sites.

Q.26 What is use of cloud server in Rackspace ?

Ans. : • Cloud Servers provide computational power on demand in minutes

- The Cloud Servers systems are virtualized using the Xen Hypervisor for Linux and Xen Server for Windows
- Cloud Servers scale automatically to balance load
- Cloud Servers are provided persistent storage through RAID10 disk storage

Q.27 What is Open Virtualization format (OVF) ?

Ans. : • OVF is an open standard, specified by the Distributed Management Task Force (DMTF), for packaging and distributing a virtual appliance consisting of one or more virtual machines (VMs).

- An OVF Package is composed of metadata and file elements that describe virtual machines, plus additional information that is important to the deployment and operation of the applications in the OVF package. Its file extension is .ovf.

5.9 : Manjrasoft

Q.28 Discuss in brief Aneka for cloud computing.

Ans. : • Aneka is a software platform for developing cloud computing applications.

- Aneka is a platform and a framework for developing distributed applications on the Cloud. It harnesses the spare CPU cycles of a heterogeneous network of desktop PCs and servers or datacenters on demand.
- Aneka provides developers with a rich set of APIs for transparently exploiting such resources and expressing the business logic of applications by using the preferred programming abstractions.

Q.29 Discuss the cloud features of Aneka.

Ans. : • One of the key features of Aneka is the ability of providing different ways for expressing

distributed applications by offering different programming models; execution services are mostly concerned with providing the middleware with an implementation for these models.

- Additional services such as persistence and security are transversal to the entire stack of services that are hosted by the Container.
- At the application level, a set of different components and tools are provided to :
 - 1) simplify the development of applications (SDK);
 - 2) porting existing applications to the Cloud; and
 - 3) monitoring and managing the Aneka Cloud.
- Aneka provides APIs and tools that enable applications to be virtualized over a heterogeneous network.

Q.30 List the key advantages of Aneka over other GRID or Cluster based workload distribution.

Ans. : Key advantages are as follows :

- Rapid deployment tools and framework.
- Ability to harness multiple virtual and/or physical machines for accelerating application result.
- Provisioning based on QoS/SLA.
- Support of multiple programming and application environments.
- Simultaneous support of multiple run-time environments.
- Built on-top of Microsoft .NET framework, with support for Linux environments through Mono.

Q.31 Write brief note on Aneka.

Ans. : • Aneka is a software platform and a framework for developing distributed applications on the cloud.

- Aneka is a market oriented Cloud development and management platform with rapid application development and workload distribution capabilities.
- Fig. Q.31.1 shows Aneka framework architecture.
- The container is the building block of the middleware and represents the runtime environment for executing applications; it contains the core functionalities of the system and is built up from an extensible collection of services that allow administrators to customize the Aneka cloud.

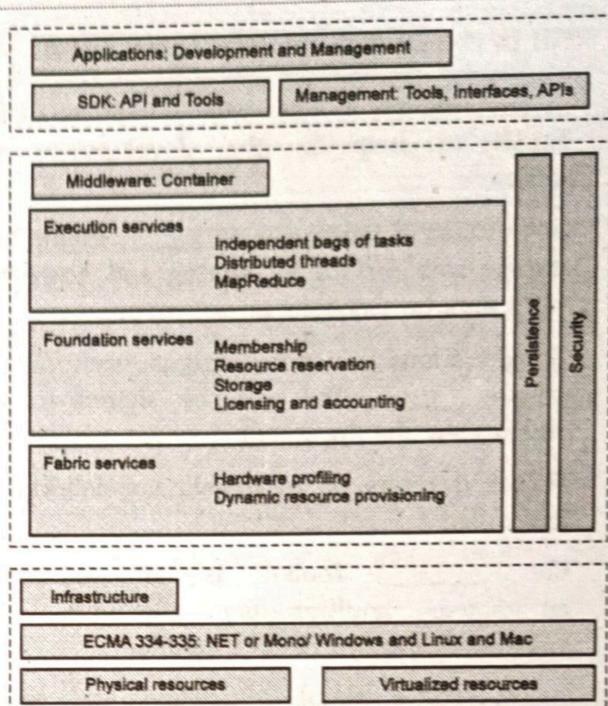


Fig. Q.31.1 : Aneka framework architecture

- There are three classes of services that characterize the container:
 1. **Execution Services**: They are responsible for scheduling and executing applications. Each of the programming models supported by Aneka defines specialized implementations of these services for managing the execution of a unit of work defined in the model.
 2. **Foundation Services**. These are the core management services of the Aneka container. They are in charge of metering applications, allocating resources for execution, managing the collection of available nodes, and keeping the services registry updated.
 3. **Fabric Services** : They constitute the lowest level of the services stack of Aneka and provide access to the resources managed by the cloud
- Aneka also provides a tool for managing the cloud, allowing administrators to easily start, stop, and deploy instances of the Aneka container on new resources and then reconfigure them dynamically to alter the behavior of the cloud.
- Applications managed by the Aneka container can be dynamically mapped to heterogeneous resources, which can grow or shrink according to the application's needs. This elasticity is achieved by means of the resource provisioning framework, which is composed primarily of services built into the Aneka fabric layer.

Fill in the Blanks for Mid Term Exam

- Q.1** _____ offers a tool called *Captiva Cloud Toolkit* to help in the development of softwares.
- Q.2** Google Cloud Storage is a _____ online file storage web service for storing and accessing one's data on Google's infrastructure.
- Q.3** Google Cloud Connect assigns each file a unique _____ that can be shared to let others view the document.
- Q.4** Microsoft offers its own online collaboration tool called _____.
- Q.5** The _____ Toolkit is an agentless, automated, multiproduct planning and assessment tool for cloud migration.
- Q.6** _____ is a cloud computing and social enterprise SaaS provider based in San Francisco.

Multiple Choice Questions for Mid Term Exam

- Q.1** Manjrasoft has come up with a platform called _____.
- | | |
|-----------------------------------|--------------------------------------|
| <input type="checkbox"/> a Aneka | <input type="checkbox"/> b Rackspace |
| <input type="checkbox"/> c VMware | <input type="checkbox"/> d sales.com |
- Q.2** Rackspace Cloud offers cloud computing solutions: _____, _____, _____.
- | | |
|--|---|
| <input type="checkbox"/> a Cloud Servers | <input type="checkbox"/> b Cloud Files |
| <input type="checkbox"/> c Cloud Sites | <input type="checkbox"/> d All of these |
- Q.3** Amazon EC2 is a computing service, whereas Amazon SQS and Amazon S3 are _____ services.
- | | |
|------------------------------------|-------------------------------------|
| <input type="checkbox"/> a Cloud | <input type="checkbox"/> b support |
| <input type="checkbox"/> c storage | <input type="checkbox"/> d platform |
- Q.4** In Rackspace, Cloud Servers are provided persistent storage through _____ disk storage.
- | | |
|----------------------------------|-----------------------------------|
| <input type="checkbox"/> a RAID1 | <input type="checkbox"/> b RAID5 |
| <input type="checkbox"/> c RAID6 | <input type="checkbox"/> d RAID10 |

Q.5 Google Cloud Print is a service that extends the printer's function to any device that can connect to the _____.

- | | |
|-------------------------------------|-------------------------------------|
| <input type="checkbox"/> a Intranet | <input type="checkbox"/> b Internet |
| <input type="checkbox"/> c WAN | <input type="checkbox"/> d LAN |

Q.6 Google Cloud Storage is a RESTful online _____ storage web service for storing and accessing one's data on Google's infrastructure.

- | | |
|----------------------------------|--|
| <input type="checkbox"/> a Data | <input type="checkbox"/> b information |
| <input type="checkbox"/> c block | <input type="checkbox"/> d file |

Answer keys for Fill in the Blanks

Q.1	EMC	Q.2	RESTful
Q.3	URL	Q.4	SharePoint
Q.5	Microsoft Assessment and Planning	Q.6	Salesforce.com

Answer keys for Multiple Choice Questions

Q.1	a	Q.2	d	Q.3	b	Q.4	d
Q.5	b	Q.6	d				

END... ↗

DECEMBER - 2019 [R16]

Cloud Computing (137 BC)

Solved Paper
B. Tech., IV - I
[Common to CSE, IT]

Time : 3 Hours

[Maximum Marks : 75]

Note : This question paper contains two parts A and B.

Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b as sub questions.

PART - A

(Marks 25)

Q.1 a) Define the terms, Grid Computing and Quantum Computing. [2]

Ans. : **Grid Computing** : Grid computing is a network of computing or processor machines managed with a middleware software, in order to access and use the resources remotely. The managing activity of grid resources through the middleware is called grid services.

Quantum Computing : Refer Q.18 of Chapter - 1.

b) Compare Distributed Computing with Parallel Computing and Network Computing. [3]

Ans. :

- In parallel computing multiple processors performs multiple tasks assigned to them simultaneously. Memory in parallel systems can either be shared or distributed. Parallel computing provides concurrency and saves time and money.
- In distributed computing we have multiple autonomous computers which seems to the user as single system. In distributed systems there is no shared memory and computers communicate with each other through message passing. In distributed computing a single task is divided among different computers.
- Network computing refers to the use of computers and other devices in a linked network, rather than as unconnected, stand-alone devices

c) What is Cloud Computing ? Give a formal definition as per NIST. (Refer Q.4 of Chapter - 2) [2]

d) List out and brief the principles of Cloud Computing. [3]

Ans. : The cloud computing, 5-4-3 principles is described by NIST describe

- i) The five essential characteristic features that promote cloud computing,
- ii) The four deployment models that are used to narrate the cloud computing opportunities for customers while looking at architectural models.
- iii) The three important and basic service offering models of cloud computing

Also refer Q.13 of Chapter - 2.

e) What is meant by Elasticity and Multitenancy ? [2]

Ans. :

- **Elasticity** can be defined as the degree to which a system is able to adapt to workload changes by provisioning and deprovisioning resources in an autonomic manner such that at each point in time, the available resources match the current demand as closely as possible.
- **Multitenancy** means that multiple customers of a cloud vendor are using the same computing resources.

f) What is SLA ? What is its role in Cloud Computing ? (Refer Q.16 of Chapter - 3) [3]

- g) As per NIST give the definition of Infrastructure as a Service. (Refer Q.1 of Chapter - 4) [2]
- h) Write short notes on the deployment and delivery of Cloud Service models with a neat diagram. (Refer Q.2 of Chapter - 4) [3]
- i) Write a brief note on Google's Cloud storage. [2]

Ans. : Google Cloud Storage is a RESTful online file storage web service for storing and accessing data on Google Cloud Platform infrastructure. The service combines the performance and scalability of Google's cloud with advanced security and sharing capabilities.

- j) What are the basic modules of EMC's Captiva Cloud Toolkit ? (Refer Q.2 of Chapter - 5) [3]

PART - B

(Marks 50)

- Q.2** "Quantum Computers are millions of times faster than most powerful supercomputer today". Justify your answer. [10]

Ans. :

- Quantum computers work differently from the classical computers we work on today
- Conventional computers process information in 'bits' or 1s and 0s, following classical physics under which our computers can process a '1' or a '0' at a time.
- The world's most powerful super computer today can juggle 148,000 trillion operations in a second and requires about 9000 IBM CPUs connected in a particular combination to achieve this feat.
- Quantum computers compute in 'qubits' (or quantum bits). They exploit the properties of quantum mechanics, the science that governs how matter behaves on the atomic scale.
- In this scheme of things, processors can be a 1 and a 0 simultaneously, a state called quantum superposition.
- While this accelerates the speed of computation, a machine with less than a 100 qubits can solve problems with a lot of data that are even theoretically beyond the capabilities of the most powerful supercomputers.
- The speed and capability of classical supercomputers are limited by energy requirements. Along with these they also need more physical space.
- Looking for really useful information by processing huge amounts of data quickly is a real-world problem and one that can be tackled faster by quantum computers.
- For example, if we have a database of a million social media profiles and had to look for a particular individual, a classical computer would have to scan each one of those profiles which would amount to a million steps.
- Prof Lov K. Grover from Bell Labs discovered that a quantum computer would be able to do the same task with one thousand steps instead of a million. That translates into reduced processors and reduced energy.
- In theory, a quantum computer can solve this problem rapidly because it can attack complex problems that are beyond the scope of a classical computer.
- The basic advantage is speed as it is able to simulate several classical computers working in parallel.
- Several encryption systems used in banking and security applications are premised on computers being unable to handle mathematical problems that are computationally demanding beyond a limit. Quantum computers, in theory, can surpass those limits.

OR

Q.3 a) Discuss in detail about Nano Computing and Optical Computing.

Ans. : Refer Q.19 of Chapter - 1.

Optical Computing :

- The main Optical components required for computing in an Optical Computer are VCSEL (Vertical Cavity Surface Emitting Micro Laser), Spatial Light Modulators, Optical Logical Gates and Smart Pixels
- VCSEL is a semiconductor Micro Laser Diode that emits light vertically from the surface. It basically converts the Electrical Signal to Optical Signal. It is the best example of one dimensional Photonic Crystal.
- Spatial Light Modulators are responsible for modulating the intensity and the phase of the Optical beam. They are used in Holographic Data Storage systems as they encode the information into a laser beam.
- An Optical Logic Gate is nothing but an Optical Switch that controls the light beams. It is said to be "ON" when the device transmits light and "OFF" when the device blocks the light.
- Smart Pixels help Optical Systems with high levels of Electronic Signal Processing.

b) Why is it necessary to understand the various Computing Paradigms ?

[5+5]

Ans. :

- Initially computers were constructed with the goal to reduce the computation time of rather complex but sequential mathematical tasks.
- Today a computer is deployed for radically different goals, where the mathematical computation in most cases is just a very small part of the task.
- The majority of the non-computational activities are reduced to or imitated by some kind of computations, because this is the only activity that the computer can do.
- The future of computing is heading toward using shared heterogeneous resources and is concerned about Big Data. These requirements result in emerging new distributed computing paradigms.
- In Cloud computing, resources are moving away from end-users towards centralized systems that possess huge processing power and storage capacities. In this model, problems arise for latency-sensitive applications, which require nodes in the vicinity to meet their delay requirements and users have no control over the manner in which they can access their data.
- Fog computing, in contrast, at a really distributed level, provides computing services between end points and traditional Cloud computing data centres, away from centralized nodes to the edge of a network.
- On the other hand, distributed computing infrastructures such as Cloud, Cluster or Grid currently are undergoing revolutionary change and becoming more heterogeneous and hierarchical. This leads scientists to use a simultaneous combination of heterogeneous, hierarchical, and distributed computing resources as a Jungle computing system, to access more computing power.

Q.4 Describe the five essential characteristics of Cloud Computing. (Refer Q.13 of Chapter - 2)

[10]

OR

Q.5 a) Elaborate the term "Software as a Service" related to cloud computing. (Refer Q.12 of Chapter - 4)

b) Give the drawbacks to Cloud Computing paradigm. (Refer Q.7 of Chapter - 2)

[6+4]

Q.6 Describe the role of Network Connectivity in Cloud Computing.

[10]

Ans. :

- Cloud computing is a technique of resource sharing where servers, storage, and other computing infrastructure in multiple locations are connected by networks.
- In the cloud, when an application is submitted for its execution, needy and suitable resources are allocated from this collection of resources; as these resources are connected via the Internet, the users get their required results.
- Also refer Q.6 and Q.7 of Chapter - 3.

OR

Q.7 Explain how to attain QoS by managing by managing cloud.

[10]

Ans. : • To attain QoS by managing by managing cloud is as follows :

1. Managing the Cloud Infrastructure :

- The infrastructure of the cloud is considered to be the backbone of the cloud. If the infrastructure is not properly managed, then the whole cloud can fail and QoS would be adversely affected.
- The main purpose of cloud infrastructure management is to provide business scalability while consolidating IT resources and enabling a variety of users to share the same infrastructure without compromising each other's data.
- Cloud computing infrastructure is the collection of hardware and software elements needed to enable cloud computing. It includes computing power, networking, and storage, as well as an interface for users to access their virtualized resources.
- Resource management is main core of cloud management. Resource management involves several internal tasks such as resource scheduling, provisioning, and load balancing.
- Poor resource management may lead to several inefficiencies in terms of performance, functionality, and cost. Service management is a measured package of applications and services that end users can easily deploy and manage via a public and/or private cloud vendor.

2. Managing the Cloud Application :

- Business companies are increasingly looking to move or build their corporate applications on cloud platforms to improve the performance and to meet dynamic requirements that exist in the globalization of businesses and responsiveness to market demands.
- But, this shift or moving the applications to the cloud environment brings new complexities.
 - a. If your application stores and retrieves very sensitive data, you might not be able to maintain it in the cloud. Similarly, compliance requirements could also limit your choices.
 - b. If your existing setup is meeting your needs, doesn't demand much maintenance, scaling, and availability, and your customers are all happy, why mess with it ?
 - c. If some of the technology you currently rely on is proprietary, you may not be legally able to deploy it to the cloud.
 - d. Some operations might suffer from added latency when using cloud applications over the internet.
 - e. If your hardware is controlled by someone else, you might lose some transparency and control when debugging performance issues
- Understanding the availability of an application requires inspecting the infrastructure, the services it consumes, and the upkeep of the application.

- Cloud application management is to address these issues and propose solutions to make it possible to have insight into the application that runs in the cloud.
- Cloud-based monitoring and management services can collect a multitude of events, analyze them, and identify critical information that requires additional remedial actions like adjusting capacity or provisioning new services.

Q.8 a) What are the pros and cons of SaaS ? (Refer Q.14 of Chapter - 4)

b) What are the suitable conditions of PaaS ? Discuss briefly.

[5+5]

Ans. : Suitable conditions of PaaS :

1. **Collaborative development** : To increase the time to market and development efficiency, there is a need for a common place where the development team and other stakeholders of the application can collaborate with each other.
2. **Automated testing and deployment** : Automated testing and building of an application are very useful while developing applications at a very short time frame.
3. **Time to market** : The PaaS services follow the iterative and incremental development methodologies that ensure that the application is in the market as per the time frame given.

OR

Q.9 a) What are the Service provided by PaaS ? Discuss in detail.

Ans. : Services provided by PaaS :

- PaaS solutions can offer middleware for developing applications together with the infrastructure or simply provide users with the software that is installed on the user premises.
- Programming languages : It provides a wide variety of programming languages for the developers to develop applications. Java, Perl, PHP, Python are programming languages provided by PaaS vendors.
- Application frameworks : It provided by PaaS venders for simplifying the application development. Node.js, Rails, Drupal, Joomla, Django are examples of application framework.
- Database : PaaS providers are providing databases also with their PaaS platforms. The popular databases provided by the popular PaaS vendors are ClearDB, PostgreSQL, etc.
- Tools : PaaS providers provide all the tools that are required to develop, test, and deploy an application.

b) Mention the characteristics of SaaS. (Refer Q.13 of Chapter - 4)

[5+5]

Q.10 a) List out and brief the features of Amazon Simple Queue Service.

Ans. : Features of amazon simple queue service :

1. SQS allows multiple readers and writers at the same time.
2. It also gives provision for having variable length messages as well as configurable settings for each queue.
3. It sends server-side encrypted messages.
4. The Amazon Simple Queue Service (SQS) is a fast, reliable, scalable, fully managed message queuing service.
5. The queue acts as a buffer between the component producing and saving data, and the component receives the data for processing.
6. Amazon SQS is a web service that gives you access to a message queue that can be used to store messages while waiting for a computer to process them.
7. SQS can be used to transmit any volume of data.

b) Explain the cloud services provided by Windows Azure. (Refer Q.17 of Chapter - 5)

[5+5]

OR

Q.11 a) Briefly explains the architecture of IBM SmartCloud with a neat architectural diagram.

Ans. : IBM SmartCloud :

- Fig. 1 shows architecture of IBM Smartcloud.

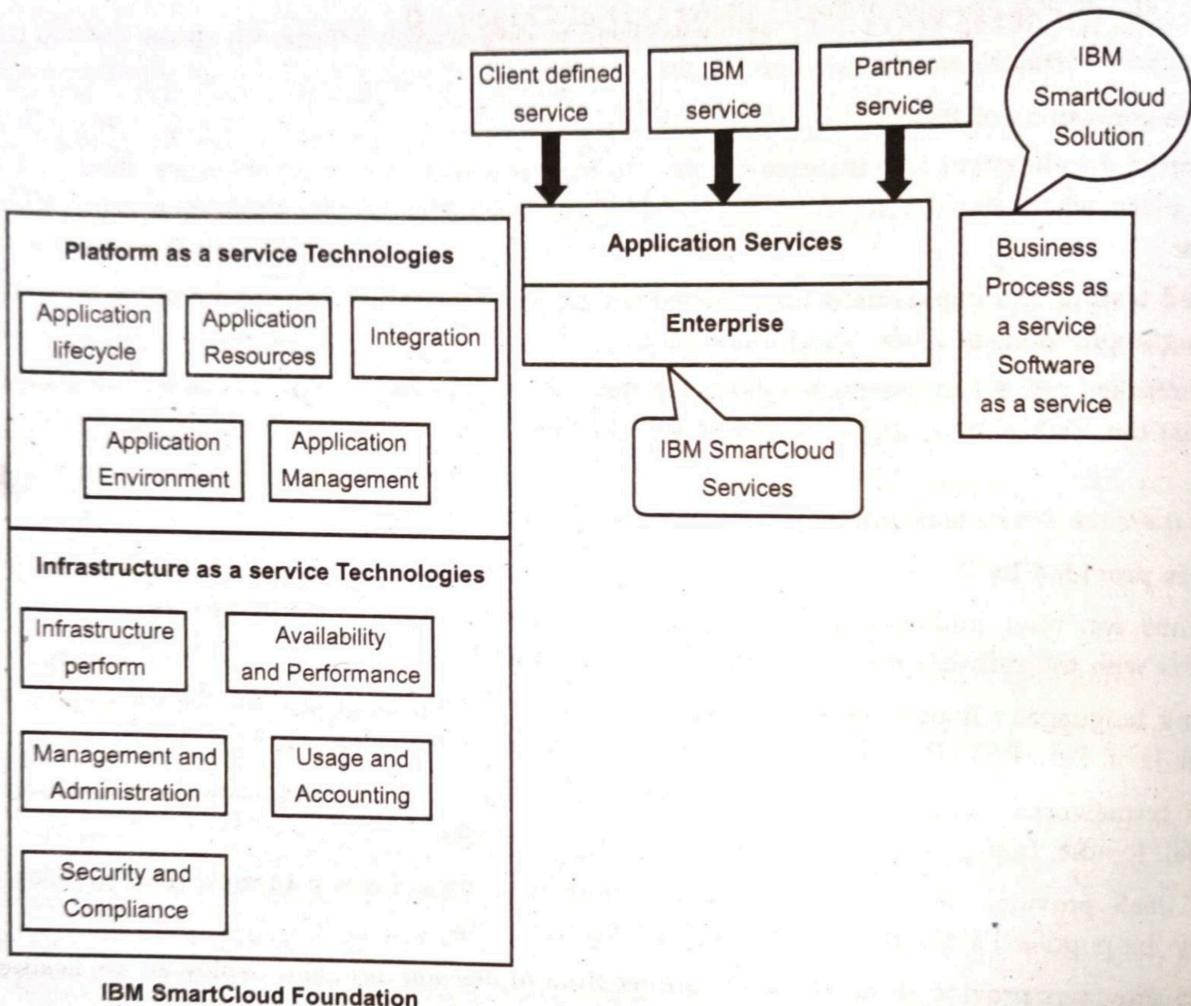


Fig. 1 Architecture of IBM Smartcloud

- IBM SmartCloud is a branded ecosystem of cloud computing products and solutions from IBM.
- The IBM SmartCloud brand includes infrastructure as a service, software as a service and platform as a service offered through public, private and hybrid cloud delivery models.
- IBM places these offerings under three umbrellas: SmartCloud Foundation, SmartCloud Services and SmartCloud Solutions
- SmartCloud Foundation consists of the infrastructure, hardware, provisioning, management, integration, and security that serve as the underpinnings of a private or hybrid cloud.
- Infrastructure cloud services provide the consumer the provision of processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications

b) Give a brief summary on various Cloud Services offered by salesforce.

(Refer Q.22 and Q.24 of Chapter - 5)

[5+5]

END... ☺

NOVEMBER - 2020 [R16]

Cloud Computing (137BC)

Solved Paper
B. Tech., IV - I
[CSE / IT]

Time : 2 Hours

[Maximum Marks : 75]

Answer any Five Questions
All Questions Carry Equal Marks

- Q.1 a) What is cloud computing ? What are the advantages and disadvantages of cloud computing ?**
 (Refer Q.4 and Q.7 of Chapter 2)
- b) Define the terms : Distributed computing and parallel computing. Mention the differences between them.**
 (Refer Q.1, Q.6 and Q.7 of Chapter 1) [7+8]
- Q.2 Outline the similarities and differences between distributed computing, grid computing and cloud computing. [15]**

Ans. :

- Distributed computing normally refers to managing or pooling the hundreds or thousands of computer systems which individually are more limited in their memory and processing power. On the other hand, grid computing has some extra characteristics. It is concerned to efficient utilization of a pool of heterogeneous systems with optimal workload management utilizing an enterprise's entire computational resources acting together to create one or more large pools of computing resources. There is no limitation of users, departments or originations in grid computing.
- Grid computing is focused on the ability to support computation across multiple administrative domains that sets it apart from traditional distributed computing. Grids offer a way of using the information technology resources optimally inside an organization involving virtualization of computing resources. Its concept of support for multiple administrative policies and security authentication and authorization mechanisms enables it to be distributed over a local, metropolitan, or wide-area network.
- Cloud computing uses a client-server architecture to deliver computing resources such as servers, storage, databases and software over the cloud (Internet) with pay-as-you-go pricing.

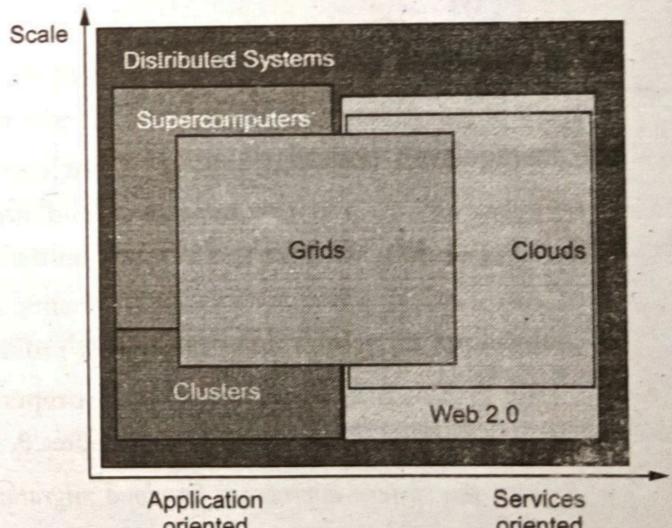


Fig. 1

Distributed Computing	Grid Computing	Cloud Computing
Small to medium size	Large size	Small to large size
Low security requirement	high security requirement	Low security requirement
It is homogeneous	It is heterogeneous	It is heterogeneous

Network type is private	Network type is private	Network type is public
It is based on Ethernet	It is based on Ethernet	It is based on Ethernet
SLA requirement is strict	SLA requirement is high	SLA requirement is low

Q.3 List out and discuss the essential characteristics of cloud computing. (Refer Q.13 of Chapter 2) [15]

Q.4 State and explain the principles of cloud computing. [15]

Ans. : Principles of cloud computing is defined as NIST are as follows :

- a. Five essential characteristic features : Refer Q.13 of Chapter 2.
- b. The four deployment models : Refer Q.15 of Chapter 2.
- c. The three important and basic service offering models of cloud computing
- Three kinds of services with which the cloud-based computing resources are available to end customers are as follows : Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS).

Q.5 How does cloud architecture overcome the difficulties faced by traditional architecture ? [15]

Ans. :

- Cloud architecture is a software application that uses on demand services and access pool of resources from the cloud. Cloud architecture act as a platform on which the applications are built. It provides the complete computing infrastructure and provides the resources only when it is required.
- Cloud architecture provide large pool of dynamic resources that can be accessed any time whenever there is a requirement, which is not being given by the traditional architecture.
- In traditional architecture it is not possible to dynamically associate a machine with the rising demand of infrastructure and the services. Cloud architecture provides scalable properties to meet the high demand of infrastructure and provide on-demand access to the user.
- Cloud platform provides a pool of dynamic resources that can be accessed any time when there is a business requirement, which can not be provided by traditional models.
- Cloud architecture provides scalable properties to meet high business demands and provides on demand access. Also refer Q.16 of Chapter 3.

Q.6 Explain the various approaches for cloud migration. (Refer Q.21 of Chapter 3) [15]

Q.7 Describe in detail about various services provided and used by IaaS with example. (Refer Q.3 and Q.4 of Chapter 4) [15]

Q.8 Explain in detail about the virtualization services provided by SAP. [15]

Ans. :

- SAP HANA cloud combines the power and performance of SAP HANA with the scale and elasticity of the cloud. With multi-model support and integrated petabyte scale data lake, SAP HANA cloud provides a single gateway to access all data sources and types.
- SAP HANA cloud platform is an open platform as a service that provides unique in-memory database and application services.
- Many large enterprises run SAP to manage their operations. SAP itself is experimenting with running its suite of products : SAP Business One as well as SAP Netweaver on Amazon cloud offerings.

- Virtualization doesn't mean an end to IT management tasks. A virtualized environment involves the constant provisioning and deprovisioning of new virtualized servers as capacity demand ebbs and flows. To maintain control over your SAP environment, your IT group needs to monitor all this activity in real time.
- SAP NetWeaver Landscape Virtualization Management software, combined with the VMware Adapter for SAP LVM, gives you this control providing a single console to manage both your SAP software and the infrastructure on which it runs.
- By automating and simplifying common administrative tasks, the software helps reduce the time, effort, and cost of operating your SAP systems while improving IT agility. For example, you can use automated workflow to ease the burden of cloning, copying and refreshing systems.
- And with automatic capacity management, the software can add or remove application servers from systems as needed according to application response times that you specify based on service level agreements.
- SAP NetWeaver Landscape Virtualization Management also supports centralized visualization and monitoring, dependency analysis and automated management reporting.
- Also refer Q.20 and Q.21 of Chapter 5.

JULY - 2021 [R16]
Cloud Computing (137BC)

Solved Paper
B. Tech., IV - I
[CSE / IT]

Time : 3 Hours]

[Maximum Marks : 75]

Q.1 a) List and explain the characteristics of grid computing.

Ans. : Characteristics of grid computing :

- Grid services provide access control, security, access to data including digital libraries and databases.
- Grids are usually heterogeneous networks.
- Grid provides robust communication infrastructure to handle and resolve communication failures in the network.
- Grid computing is a distributed computing system.
- Resource sharing : Resources in a grid belong to many different organizations that allow other organizations.
- Heterogeneity : A grid hosts both software and hardware resources that can be very varied ranging from data, files, software components or programs to sensors, scientific instruments.
- Geographic distribution : The services of a grid can be found in remote locations.
- Coordination of resources : Grid resources must be organized to provide distributed processing abilities.
- Transparent access : A single digital processor must be treated as a grid.

- Various administrations : Each company should set up specific safety and operational procedures to control and use its private services.
 - Scalability : The grid must be flexible with no efficiency failure to treat a huge number of networks.
- b) Compare and contrast the bio computing and mobile computing. (Refer Q.16 and Q.17 of Chapter 1) [7+8]

Q.2 a) Explain the need for cloud computing.

Ans. :

- The main reasons for the need and use of cloud computing are convenience and reliability.
- We can remotely run all our workload data of applications and processes online over the Internet instead of using physical hardware and software.
- Cloud not only handles data storage remotely but it also protects and recovers all crashed or loss data, so we don't have to worry about crashed or loss of data, it gives you high security.
- With the help of cloud, we can access any data, applications whenever and wherever we want to, over the internet.
- Scalability : Another major benefit of cloud computing is its scalability. Cloud-based services are ideal for organizations with growing or fluctuating bandwidth demands.
- Collaboration efficiency : Cloud computing model enables your business to communicate and share more easily outside of the traditional methods. It allows better collaboration between employees, enabling multiple users to share and work on data and files at the same time.
- Communication : Cloud computing allows people to access cloud-based communication tools such as calendars and emails. Also, messaging and calling apps such as WhatsApp and skype are all built on cloud infrastructure.

b) List and explain the essential characteristics of cloud computing. (Refer Q.13 of Chapter 2) [7+8]

Q.3 a) Discuss the approaches for cloud migration. (Refer Q.21 of Chapter 3)

b) Explain the phases of migrating an application to the cloud. (Refer Q.20 of Chapter 3) [7+8]

Q.4 Make a comparison between the IaaS, PaaS and SaaS. (Refer Q.4 and Q.15 of Chapter 4) [15]

Q.5 a) Explain the microsoft assessment and planning toolkit.

Ans. :

- Microsoft Assessment and Planning Toolkit (MAP) is an agentless, automated, multiproduct planning and assessment tool for cloud migration. It helps you understand your organization's IT infrastructures and assets.
- Microsoft assessment and planning toolkit is made up of four main components :
 - a) MAPSetup.exe contains MAP as well as the files IT administrators need to set up a local SQL Server Database Engine.
 - b) readme_en.htm file details what administrators need to run MAP Toolkit and known issues.
 - c) MAP_Sample_Documents.zip provides examples of the types of reports and proposals MAP Toolkit creates.
 - d) MAP_Training_Kit.zip explains how to use MAP Toolkit and provides a sample database of the information MAP Toolkit can provide.

- MAP provides detailed readiness assessment reports and executive proposals with extensive hardware and software information. MAP Toolkit does not require an agent. It automatically inventories the devices, software, users and infrastructure in a Window.
- MAP analyses server utilization data for server virtualization and also server consolidation with Hyper-V. In addition to the information it provides, MAP Toolkit delivers recommendations on how IT should proceed with its migration plan.

b) Give a brief note on IBM smart cloud and SAP labs. (Refer Q.11 (a) of Dec.-19 and Q.8 of Nov.-2020) [7+8]

Q.6 a) What is meant by parallel computing ? Also, mention its advantages and applications.

(Refer Q.1 and Q.3 of Chapter - 1)

b) List and explain the benefits of cloud computing. (Refer Q.7 of Chapter 2) [7+8]

Q.7 a) Discuss how to manage the cloud infrastructure.

Ans. :

- Cloud infrastructure refers to the servers, software, network devices and storage devices that make up the cloud. It is no different from typical data center infrastructure except that it's virtualized and consumed over the Internet.
 - Cloud infrastructure falls into three categories : computing, networking, and storage
 - The infrastructure of the cloud is considered to be the backbone of the cloud. This component is mainly responsible for the QoS factor.
 - Cloud infrastructure management is the setup, configuration, monitoring, and optimization of the components of cloud infrastructure. It happens through a web-based interface.
 - Cloud infrastructure management gives enterprises some level of scalability and consolidates IT resources. Users can share the same infrastructure without compromising each other's data.
 - Cloud infrastructure management comprises the processes and tools needed to effectively allocate and deliver key resources when and where they are required. The UI, or dashboard, is a good example of such a tool; it acts as a control panel for provisioning, configuring and managing cloud infrastructure. Cloud infrastructure management is useful in delivering cloud services to both :
 - a) Internal users, such as developers or any other roles that consume cloud resources.
 - b) External users, such as customers and business partners.
 - Cloud infrastructure management is a must for achieving the significant promise of cloud computing overall. Properly managed and optimized, the cloud offers enterprises greater flexibility and scalability for their applications and infrastructure, while keeping costs under control.
 - The core of cloud management is resource management. Resource management involves several internal tasks such as resource scheduling, provisioning and load balancing.
 - Poor resource management may lead to several inefficiencies in terms of performance, functionality, and cost. If a resource is not efficiently managed, the performance of the whole system is affected.
 - Also refer Q.16 of Chapter 3.
- b)** Explain the role of service oriented architecture in cloud computing. [7+8]

Ans. :

- Service-Oriented Architecture (SOA) is a type of software design that makes software components reusable using service interfaces that use a common communication language over a network.

- Cloud computing is a service delivery model in which shared services and resources are consumed by the users across the Internet just like a public utility on an on-demand basis.
- SOA is used by enterprise applications and cloud computing is used for availing the various Internet-based services. Different companies or service providers may offer various services such as financial services, health-care services, manufacturing services and HR services.
- Incorporating SOA allows companies the option of deploying a software-as-a-service in their cloud platform. Meanwhile, the cloud pumps out processing power as demanded. This relationship allows for greater flexibility and robustness, providing ample time to meet your operational needs.
- SOA lays down a framework that simplifies the management of Information Technology (IT) systems. SOA employs mechanisms that allow IT systems to work together cohesively within one enterprise cloud platform.
- While SOA's main function is to provide structure to the cloud business model. Additionally, SOA can be helpful for :
 - i. Code reuse : Due to high cohesion and low coupling, SOA services can be used in different systems without the need to put much effort into a rework or bringing in a large team.
 - ii. Simple construction and maintenance : Time can be saved through SOA by recycling services. Additionally, this means future maintenance and/or errors can be dealt with quickly and efficiently.
 - iii. Low coupling : SOA programs exist as a series of well-defined parts allowing them to operate independently, which helps to keep the cohesion level high.
 - iv. Platform integration : XML messages make it possible to integrate systems across platforms and ease data exchange.

Q.8 Write a short note on the following : a) VMware b) Manjra soft c) EMC.

[5+5+5]

Ans. : a) VMware :

- VMware is a virtualization and cloud computing software provider. It supports private and public cloud.
- Private clouds enable the better usage and management of internal IT infrastructure than the traditional methods.
- VMware Inc. developed ESX and ESXi as bare metal embedded hypervisors, which means that they run directly on server hardware and do not require the installation of an additional underlying operating system.
- This virtualization software creates and runs its own kernel, which is run after a Linux kernel bootstraps the hardware. The resulting service is a microkernel, which has three interfaces : Hardware, Guest system and Console operating system.
- VMware ESXi server is computer virtualization software developed by VMware Inc. The ESXi server is an advanced, smaller-footprint version of the VMware ESX server.
- Fig. 1 shows architecture of ESXi. (See Fig. 1 on next page.)
- The VMware ESXi architecture comprises the underlying operating system, called VMkernel and processes that run on top of it.
- VMkernel provides means for running all processes on the system, including management applications and agents as well as virtual machines.

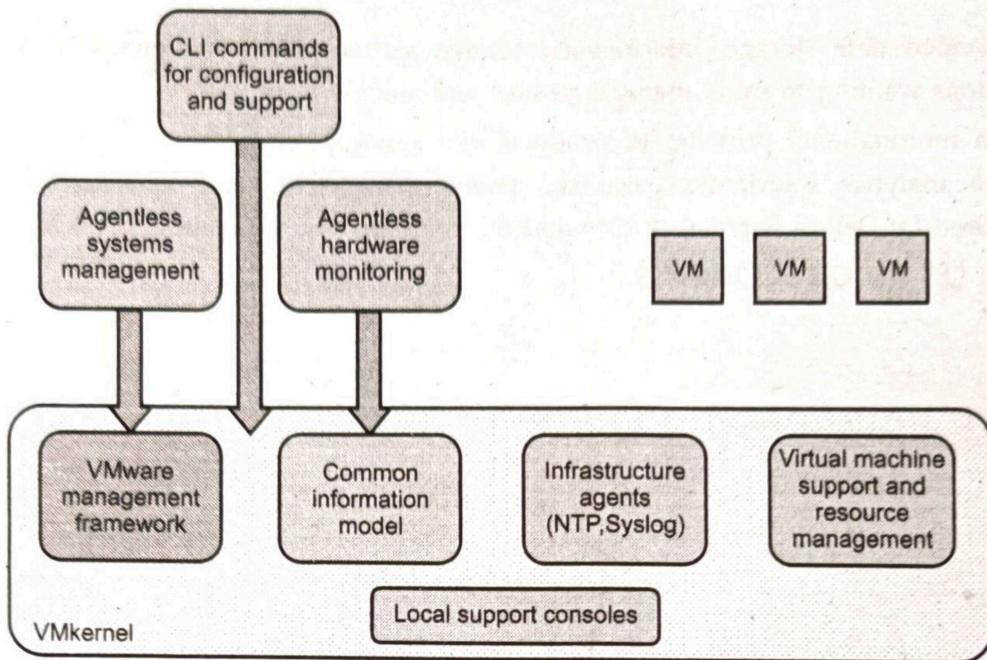


Fig. 1 ESXi architecture

- It has control of all hardware devices on the server and manages resources for the applications. The main processes that run on top of VMkernel are :
 1. Direct Console User Interface (DCUI) : The low-level configuration and management interface, accessible through the console of the server, used primarily for initial basic configuration.
 2. The virtual machine monitor, which is the process that provides the execution environment for a virtual machine, as well as a helper process known as VMX. Each running virtual machine has its own VMM and VMX process.
 3. Various agents used to enable high-level VMware infrastructure management from remote applications.
 4. The Common Information Model (CIM) system : CIM is the interface that enables hardware-level management from remote applications via a set of standard APIs.
- Implemented within the VMware infrastructure, ESXi can be used to facilitate centralized management for enterprise desktops and data centre applications.
- A commercially available hypervisor from VMware that provides users a Type-1 or bare-metal, hypervisor to host virtual machines on their servers.
- VMware developed their initial x86-based solutions in the late 1990s and were the first to deliver a commercial product to the marketplace.

b) Manjra soft

- Manjra soft develops Market-Oriented Cloud Computing platforms that allow you to build, accelerate and manage your applications ultimately saving you time and money, leading to enhanced business productivity and profit.
- It has come up with a platform called Aneka that provides a set of services that help the development of applications in an easier way.
- Also refer Q.28, Q.29 and Q.31 of Chapter 5.

c) EMC

- EMC provided data storage, information security, virtualisation, analytics and cloud computing to organisations wanting to store, manage, protect and analyse data.
- EMC is a multinational provider of products and services related to cloud computing, storage, big data, data analytics, information security, content management and converged infrastructure. EMC was acquired by Dell in September 2016 and the company was renamed to Dell EMC.
- Also refer Q.1 and Q.2 of Chapter 5.

END...