KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University)
(Established Under Section 3 of UGC Act 1956)
Coimbatore - 641021.
DEPARTMENT OF CS, CA & ITSemester – VI

16ITU602B	**CLOUD COMPUTING**	**4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0   **Marks:** Int : **40** Ext : **60**   Total: **100**

SCOPE
The main objective of the course is to portray the recent trends in the field of cloud computing and providing exposures to some open source and commercial clouds.

OBJECTIVES
- Provide a good understanding of the concepts, standards and protocols in Cloud computing

UNIT-I
Overview of Computing Paradigm: Recent trends in Computing: Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing.**Introduction to Cloud Computing:** Introduction to Cloud Computing, History of Cloud Computing, Cloud service providers, Benefits and limitations of Cloud Computing.

UNIT-II
Cloud Computing Architecture: Comparison with traditional computing architecture (client/server), Services provided at various levels, Service Models- Infrastructure as a Service(IaaS), Platform as a Service(PaaS), Software as a Service(SaaS), How Cloud Computing Works, Deployment Models- Public cloud, Private cloud, Hybrid cloud, Community cloud, Case study of NIST architecture.

UNIT-III
Case Studies: Case study of Service model using Google App Engine, Microsoft Azure, Amazon EC2 , Eucalyptus.

UNIT-IV
Service Management in Cloud Computing: Service Level Agreements (SLAs), Billing & AITUounting, Comparing Scaling Hardware: Traditional vs. Cloud, Economics of scaling.

UNIT-V
Cloud Security: Infrastructure Security- Network level security, Host level security, Application level security, Data security and Storage- Data privacy and security Issues, Jurisdictional issues raised by Data location, Authentication in cloud computing.

Suggested Readings
1. Barrie Sosinsky. (2010). Cloud Computing Bible. New Delhi: Wiley-India,
2. Rajkumar Buyya., James Broberg., & Andrzej, M. Goscinski Wile. Cloud Computing: Principles and Paradigms.
3. Nikos Antonopoulos., & Lee Gillam. (2012). Cloud Computing: Principles, Systems and Applications. Springer.

4. Ronald, L. Krutz., & Russell Dean Vines. (2010). Cloud Security: A Comprehensive Guide to Secure Cloud Computing.New Delhi: Wiley-India.
5. Gautam Shroff. (2010). Enterprise Cloud Computing Technology Architecture Applications. Adobe Reader ebooks available from eBooks.com.
6. Toby Velte., Anthony Velte., & Robert Elsenpeter.(2010). Cloud Computing, A Practical Approach. McGraw Hills.
7. Dimitris, N. Chorafas. (2010). Cloud Computing Strategies. CRC Press.

WEB SITES
1. en.wikipedia.org/wiki/Cloud_computing
2. www.ibm.com/cloud-computing/in/en/
3. www.oracle.com/CloudComputing
4.   www.microsoft.com/en-us/cloud/default.aspx

16ITU603B   **SYSTEM PROGRAMMING**   **3H – 3C**

Instruction Hours / week: L: 4 T: 0 P: 0   Marks: Int : **40** Ext : **60**   Total: **100**

SCOPE

This course enables for good understanding of the role of system programming and the scope of duties and tasks of a system programmer. This course enables to learn the concepts and principles of developing system-level software (e.g., compiler, and networking software)

OBJECTIVES
- To introduce students the concepts and principles of system programming
- To provide students the knowledge about both theoretical and practical aspects of system programming, teaching them the methods and techniques for designing and implementing system-level programs.
- To train students in developing skills for writing system software with the aid of sophisticated OS services, programming languages and utility tools.

UNIT-I

Assemblers & Loaders, Linkers: One pass and two pass assembler design of an assembler, Absolute loader, relocation and linking concepts, relocating loader and Dynamic Linking., overview of compilation, Phases of a compiler.

UNIT-II

Lexical Analysis:

Role of a Lexical analyzer, Specification and recognition of tokens, Symbol table, lexical

UNIT-III

Parsing:

Bottom up parsing- LR parser, yaITU. **Intermediate representations: Three** address code generation, syntax directed translation, translation of types, control Statements.

UNIT-IV

Storage organization: Activation records stack allocation.

UNIT-V

Code Generation: Object code generation

Suggested Readings
1. Santanu Chattopadhyaya. (2011). Systems Programming. New Delhi: PHI.
2. Alfred, V. Aho., Monica, S. Lam., Ravi Sethi.,& Jeffrey, D. Ullman. (2006). Compilers: Principles, Techniques, and Tools (2nd ed.). New Delhi: Prentice Hall.
3. Dhamdhere, D. M. (2011). Systems Programming. New Delhi: Tata McGraw Hill.

4. Leland Beck., & Manjula, D. (2008). System Software: An Introduction to System Programming (3rd ed.). New Delhi: Pearson Education.

Grune, D., Van Reeuwijk, K., Bal, H. E., Jacobs, C. J. H., & Langendoen, K.(2012). Modern Compiler Design (2nd ed.). Springer.

**DEPARTMENT OF COMPUTER SCIENCE, COMPUTER APPLICATION
AND INFORMATION TECHNOLOGY**

SUBJECT NAME: CLOUD COMPUTING

SUBJECT CODE: 16ITU602B   SEMESTER: VI

STAFF: J.HEMAGOWRI   CLASS   : III B.Sc. IT

S.No	Lecture Duration Period	Topics to be Covered	Support Material/Page Nos
		UNIT-I	
1.	1	Overview of Computing Paradigm: Recent trends in computing: Grid Computing, Cluster computing	w1
2.	1	Distributed Computing	w1
3.	1	Utility Computing	w1
4.	1	Cloud Computing	w1
5.	1	**Introduction to Cloud Computing:** History of cloud Computing	SR1 :3-5
6.	1	Cloud service providers	SR1:9-13
7.	1	Benefits and limitations of Cloud Computing.	SR1:16-19
8.	1	Recapitulation and Discussion of Important Questions	
Total No Of Periods Planned For Unit 1 : 8			
		UNIT-II	
1.	1	Comparison with traditional computing architecture (client/server)	SR1 :65,w2
2.	1	Services provided at various levels, Service Models – Infrastructure as a Service (IaaS)	SR1:66 -69
3.	1	Platform as a Service (PaaS), Software as a Service (SaaS)	SR1:70 -75
4.	1	How Cloud Computing Works	w2
5.	1	Deployment Models - Public& Private cloud	R1:24-27
6.	1	Hybrid cloud, Community Cloud	R1:28-29
7.	1	Case Study of NIST architecture.	R2:121,167, W2
8.	1	Recapitulation and Discussion of Important Questions	
Total No Of Periods Planned For Unit II: 8			

		UNIT-III	
1.	1	Case Studies: Introduction	W3
2.	1	Case Study of Service model	SR1:151-161
3.	1	Case Study using Google App Engine	SR1:162-173
4.	1	Microsoft Azure	SR1:206-228
5.	1	Amazon EC2	SR1:185-195
6.	1	Amazon EC2- other IaaS	SR1:196-199
7.	1	Eucalyptus	R2:115-116
8.	1	Recapitulation and Discussion of Important Questions	
Total No Of Periods Planned For Unit III : 8			
		UNIT-IV	
1.	1	Service Management in Cloud computing	SR1:232-237 , w4
2.	1	Service Level Agreements	R1:11, 23
3.	1	Billing and Accounting	R2:234-235
4.	1	Billing and Accounting – Economic Model	R2: 248-251
5.	1	Comparing Scaling Hardware	R2:50-53
6.	1	Traditional versus Cloud	R2:54-56
7.		Traditional versus Economics of scaling	
8.	1	Recapitulation and Discussion of Important Questions	
Total No Of Periods Planned For Unit IV: 8			
		UNIT-V	
1.	1	Cloud security - Infrastructure Security, Network Level Security, Host Level Security, Application Level Security	SR1: 250-259
2.	1	Data Security and Storage	SR1:260-265
3.	1	Data Privacy and Security Issues	R1:85-90
4.	1	Jurisdictional issues raised by data location Authentication in Cloud computing	W4
5.	1	Recapitulation and Discussion of important Questions	
6.	1	Discussion of Previous ESE Question Papers.	
7.	1	Discussion of Previous ESE Question Papers.	
8.	1	Discussion of Previous ESE Question Papers.	
Total No of Periods planned for Unit V: 8			
Total Planned Hours: 40			

Suggested Readings

SR1: Barrie Sosinsky. (2010). Cloud Computing Bible. New Delhi: Wiley-India,
References Books

References Books

R1: Dr.Kumar Saurabh (2014), Cloud Computing, 2ed edition, Wiley Pvt.Ltd.New Delhi
R2: Judith Hurwitz, Robin Bloor, Marcia karfman, Fern Halper. (2015), Cloud Computing for
Dummies,Wiley Publication, New Delhi.

WEB SITES

W1: en.wikipedia.org/wiki/Cloud_computing
W2: www.ibm.com/cloud-computing/in/en/
W3: www.oracle.com/CloudComputing
W4: www.microsoft.com/en-us/cloud/default.aspx

S.NO	Questions	opt1	opt2	opt3	opt4	Answer
1	_____refers to applications and services that run on a distributed network using virtualized resources and accessed by common Internet protocols and networking standards.	Cloud Computing	Virtual Computing	Cloud Storage	Cloud Networking	Cloud Computing
2	The term Cloud refers to _____	data center	data storage	Internet	remote location	Internet
3	_____ is a complete operating environment with applications, management, and the user interface	CaaS	PaaS	IaaS	SaaS	SaaS
4	The _____is something that you can obtain under contract from your vendor.	QoS	QpS	QtS	QaS	QoS
5	_____refers to the components and subcomponents required for Cloud Computing	Cloud Computing	Cloud Computing	Cloud Computing	Cloud Based	Cloud Computing Stack
6	_____ computing connects geographically remote computer into a single network.	Grid	cluster	Utility	Parallel	Grid
7	_____ is one of the cloud applications in use.	Cloud backup	Cloud storage	Cloud service	Cloud Networking	Cloud backup
8	_____is the technique of linking two or more computers into a network	Grid	cluster	Utility	Parallel	cluster
9	_____ computing process which communicates with each other over a network	Grid	cluster	Utility	Distributed	Distributed
10	Google App Engine is an example of _____ services.	CaaS	PaaS	IaaS	SaaS	PaaS
11	SQL Azure is an example of _____ services.	CaaS	PaaS	IaaS	SaaS	SaaS
12	The Backend platforms are called as_____	Intercloud	Mobile device	Storage	Fat client	Storage
13	_____is taking the physical hardware and going completely virtual	IaaS	PaaS	Daas	SaaS	IaaS

14	Cloud networking is a_____ network	Non Agile	Agile	Latency	Low Latency	Agile
15	In which computing resources the customer can go pay-as-you-go for specific usage.	Grid	cluster	Utility	Distributed	Utility
16	Cloud Providers has _____ main component services in cloud computing	3	2	5	1	3
17	The abbreviation for SaaS is _____	Software as a Service	Software as a Server	Server as a Service	Structure as a Service	Software as a Service
18	The abbreviation for IaaS is _____	Infra as a Service	Independent as a Service	Infrastructure as a Service	Infrastructure service	Infrastructure as a Service
19	The abbreviation for PaaS is _____	Platform as a Service	Plat as a Service	Platform as a Server	Public as a Service	Platform as a Service
20	_____abstracts the details of system implementation from users and developers.	Cloud Computing	Virtual Computing	Cloud Storage	Cloud Networking	Cloud Computing
21	_____consists of the particular types of services that you can access on a cloud computing platform.	Development models	Deployment models	Service models	Business models	Service models
22	_____is an example of IaaS service providers	Oracle on Demand	GoogleApps	Force.com	Eucalyptus	Eucalyptus
23	In which year J.C.R. Licklider developed the ARPANET.	1969	1950s	1970s	1997	1969
24	All cloud computing applications suffer from the inherent latency that is intrinsic in their _____connectivity	MAN	WAN	LAN	LAN & MAN	WAN
25	Cloud computing is a _____system	stateful	stateup	stateless	statedown	stateless
26	A single area of concern in cloud computing is_____	privacy and network	security and storage	storage and network	privacy and security	privacy and security
27	The use of the word "cloud" makes reference to the____and___essential concepts.	Abstraction& Virtualization	Services & applications	Virtualization & Services	Abstraction & applications	Abstraction & Virtualization
28	_____provides virtual machines, operating systems, applications, services, development frameworks, transactions, and control structures.	IaaS	PaaS	Daas	SaaS	PaaS

29	Expand EC2	Elastic Cloud Compute	Extended Compute	Elastic Compute	Extended Cloud	Elastic Compute Cloud
30	_____can be rapidly and elastically provisioned.	Data	Network	Information	Resources	Resources
31	The abbreviation for AWS is _____	Amazon Web Server	Amazon Web Services	Application Web Services	Amazon Wide	Amazon Web Services
32	_____creates a single point of failure.	Fat Clients	The Zero Clients	Thick Clients	Cloud Clients	The Zero Clients
33	_____provides the equivalent of installed applications in the traditional delivery of applications.	IaaS	Daas	SaaS	PaaS	SaaS
34	In which year Amazon introduced the Elastic Compute Cloud (EC2) as a commercial web service.	1969	2006	2009	2010	2006
35	Google App Engine is an example of _____ services.	CaaS	PaaS	IaaS	SaaS	PaaS
36	The Backend platforms are called as_____.	Intercloud	Mobile device	Storage	Fat client	Storage
37	In which computing paradigm the job submission is non-interactive.	Grid	cluster	Utility	Parallel	Grid
38	. _____is an example of IaaS service providers	Oracle on Demand	GoogleApps	Force.com	Eucalyptus	Eucalyptus
39	In case of network failure, the entire system becomes unstable in _____computing	Grid	cluster	Utility	Distributed	Distributed
40	_____ is one of the large IaaS cloud service providers	Rackspace.com	Salesforce.com	GoGrid.com	Openstack.com	Rackspace.com
41	_____has the least levels of integrated functionality.	IaaS	PaaS	Daas	SaaS	IaaS
42	_____has the most levels of integrated functionality.	IaaS	SaaS	Daas	PaaS	SaaS
43	Expand SLA	Strorage Level Agreement	Service Level Agreement	Service Level Applications	Storage Level	Service Level Agreement
44	_____ is not a benefit of cloud computing.	Resource pooling	Rapid elasticity	Infinite data	Measured service	Infinite data

45	If your application needs large amounts of data transfer, _____ may not be the best model for you.	Distributed computing	Load balancing	Virtualization	Cloud computing	Cloud computing
46	_____ cloud is used for healthcare industry	Private cloud	Public cloud	Hybrid cloud	Community cloud	Community cloud
47	_____ is not an opertaion of Quality of Service.	Data replication	Queries	System monitoring	Disaster recovery	Queries
48	A _____ cloud combines multiple clouds are bound together as a unit.	Community cloud	Public cloud	Private cloud	Hybrid cloud	Hybrid cloud
49	Expand VM	virtual machine	vendor machine	virtual mechanisms	vendor mechanisms	virtual machine
50	One of the fundamental components of PaaS middleware is the mapping of _____ onto the cloud infrastructure	Dynamic applications	Standalone applications	Standard applications	Distributed applications	Distributed applications
51	Cloud computing represents a _____ in the way in which systems are deployed.	Real time applications	Real Paradigm shift	Infinitely Scalable	Measurable Service	Real Paradigm shift
52	The scale of cloud computing networks and their ability to provide_____ makes them highly reliable.	Lower costs	Ease of utilization	Load balancing and failover	Simplified maintenance and upgrade	Load balancing and failover
53	Cloud computing industry continues to address _____ concerns, if you have an application that works with sensitive data.	Security	Privacy	Storage	Bigdata	Security
54	_____is not an architectural standards in Cloud computing.	Grid computing	Distributed computing	Autonomic systems	Standardized Web services	Distributed computing
55	_____ is one of the large IaaS cloud service providers	Rackspace.com	Salesforce.com	GoGrid.com	Openstack.com	Rackspace.com
56	IDaaS Stands for_____	Infrastructure as a Service	Independent as a Service	Interdependent as a Service	Identity as a Service	Identity as a Service
57	_____ has a number of operating systems and some enterprise applications that they offer on a rental basis to customers in the form of a number of canned images.	Eucalyptus	Amazon	MS Azure	GoGrid	Amazon

58	The _____ providing applications and enabiling technology, infrastruc	vendors	partners	business leaders	GoGrid.com	vendors
59	Expand API .	Application Programming	App Programming	Application Program	Application Program	Application Programming
60	_____is a CPU emulator and virtual machinemonitor	Parallels	QEMU	Jumpbox	Vmachines	QEMU

UNIT-I

Overview of Computing Paradigm: Recent trends in Computing: Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing. **Introduction to Cloud Computing:** Introduction to Cloud Computing, History of Cloud Computing, Cloud service providers, Benefits and limitations of Cloud Computing.

Introduction

Cloud computing is an emerging technology and has many challenges in various aspects of information handling. Cloud Computing provides us means by which we can access the applications as utilities over the internet. It allows us to create, configure, and customize the business applications online. The term Cloud refers to a Network or Internet. In other words, we can say that Cloud is something, which is present at remote location. Cloud can provide services over public and private networks, i.e., WAN, LAN or VPN.

Applications such as e-mail, web conferencing, customer relationship management (CRM) execute on cloud.

Fig 1: Cloud Computing

Cloud computing offers platform independency, as the software is not required to be installed locally on the PC. Hence, the Cloud Computing is making our business applications mobile and collaborative.

OVERVIEW OF COMPUTING PARADIGM:
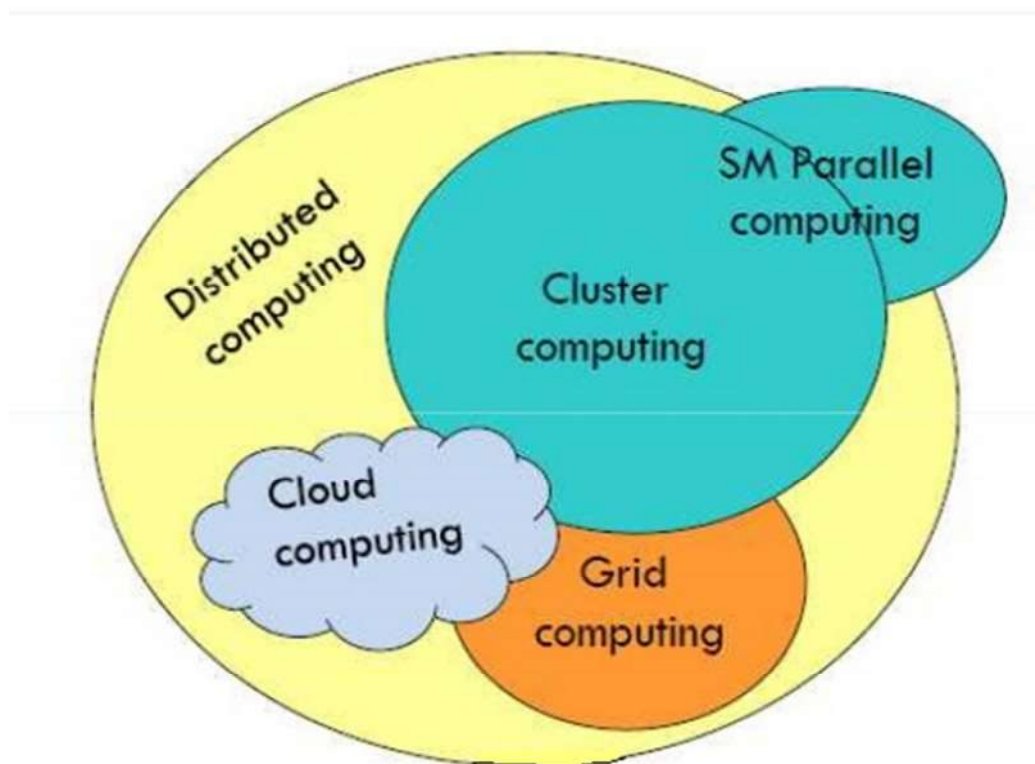
Fig 2: Overview of computing paradigm

What is computing?

- The process of utilizing computer technology to complete a task. Computing may involve computer hardware and/or software, but must involve some form of a computer system.

• **Computing includes -**

- ➢ designing,
- ➢ developing and building hardware and software systems;
- ➢ processing,
- ➢ structuring, and managing various kinds of information;
- ➢ doing scientific research on and with computers;
- ➢ Entertainment media.

1. Grid computing - Grid computing involves connecting geographically remote computers into a single network to create a virtual supercomputer by combining the computational power of all computers on grid.
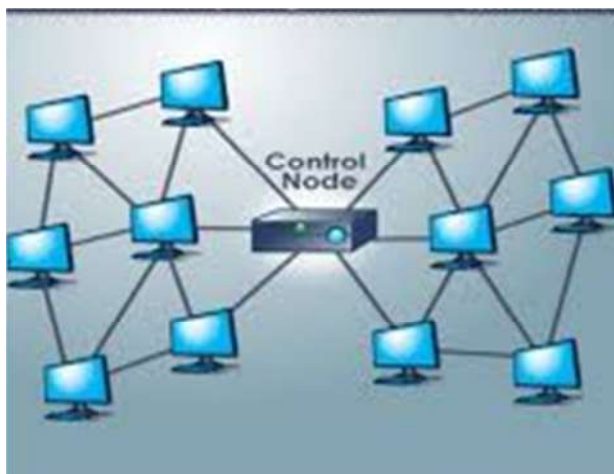
Fig 3: How Grid Computing works

- "the Grid" links together computing resources (PCs, workstations, servers, storage elements) and provides the mechanism needed to access them.
- By implementing our proposed Intranet Grid it is very easy to download multiple files very fast.
- No need to worry about the security as we are authenticating each and every step taking place in our Grid.
- In particular user to access the database. Further implementations could be carried out in the nearest future.

WHY GRID COMPUTING?
- 40% Mainframes are idle
- 90% Unix servers are idle
- 95% PC servers are idle
- 0-15% Mainframes are idle in peak-hour
- 70% PC servers are idle in peak-hour

Advantages

- Can solve larger, more complex problems in a shorter time
- Easier to collaborate with other organizations
- Make better use of existing hardware

Disadvantages

- Grid software and standards are still evolving
- Learning curve to get started
- Non-interactive job submission

Examples:

1. A Scientists studying scientific concepts has the ability to use an entire network of computers in order to analyze data
2. A Business man has the ability to access an entire network of computers in order to forecast the growth of particular stock.

2. Cluster computing

- It is a form of computing in which a group of computers are linked together so they can act like a single entity.
- It is the technique of linking two or more computers into a network (Usually through a local area network) in order to take advantage of the parallel processing power of those computers.
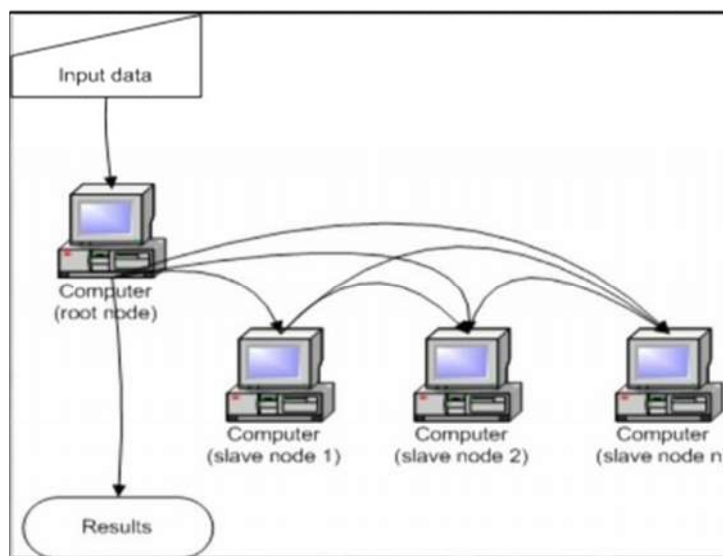
Fig 4: A Simple Cluster Layout

Cluster Application

- Google Search Engine
- Earthquake Simulation Software
- Image Rendering
- Weather Forecasting

Benefits

- High processing power
- Cost Efficient
- High Availability
- Fault Tolerance

Advantages

A computer cluster provides much faster processing speed, larger storage capacity, better data integrity, superior reliability and wider availability of resources.

Disadvantages

Cost is high. ... Since clustering needs more servers and hardware to establish one, monitoring and maintenance is hard.

3. Distributed Computing

Distributed computing is the method of processing in which different parts of a program are run simultaneously on two or more computers that are communicating with each other over a network.
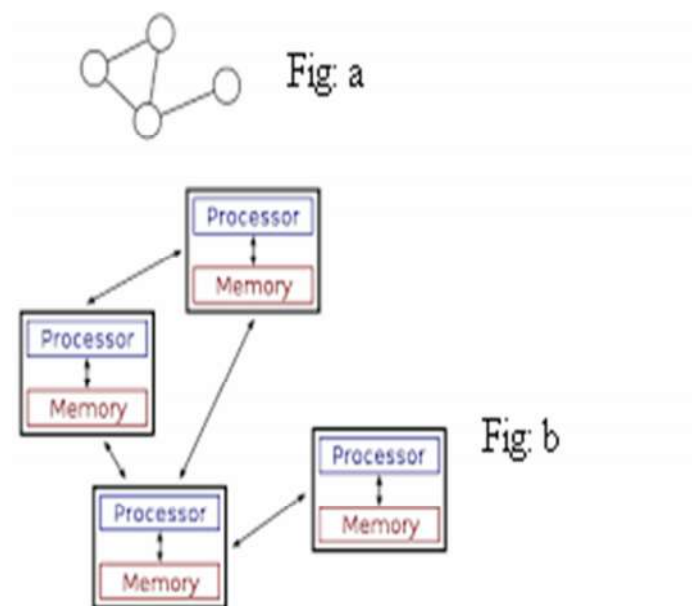
Fig 5: Distributed computing

The figure illustrates the distributed computing systems. Figure (a) is a schematic view of a typical distributed system; the system is represented as a network topology in which each node is a computer and each line connecting the nodes is a communication link. Figure (b) shows the same distributed system in more detail: each computer has its own local memory, and information can be exchanged only by passing messages from one node to another by using the available communication links.

Advantages

- **Inherently Distributed applications**: several applications are inherently distributed in nature and require distributed computing system for their realization

- **Information Sharing among Distributed Users:** In a distributed computing system, information generated by one of the users can be easily and efficiently shared by the users working at other nodes of the system .The use of distributed computing systems by a group of users to work cooperatively is known as computer-supported cooperative working (CSCW), or groupware .

- **Resource Sharing:** Information is not the only thing that can be shared in a distributed computing system. Sharing of software resources such as software libraries and databases as well as hardware resources such as printers, hard disks, and plotters can also be done in a very effective way among all the computers and the users of a single distributed computing system

Disadvantages

- **Complex**: Additional programming required to set up distributed systems
- **Security**: Information passed around the network may be tracked and used for illegal purposes
- **Network dependency**: In case of network failure, the entire system becomes unstable.

4. Utility computing

It is a service provisioning model in which a service provider makes computing resources and infrastructure management available to the customer as needed, and charges them for specific usage rather than a flat rate.

Like other types of on-demand computing (such as grid computing), the utility model seeks to maximize the efficient use of resources and/or minimize associated costs.
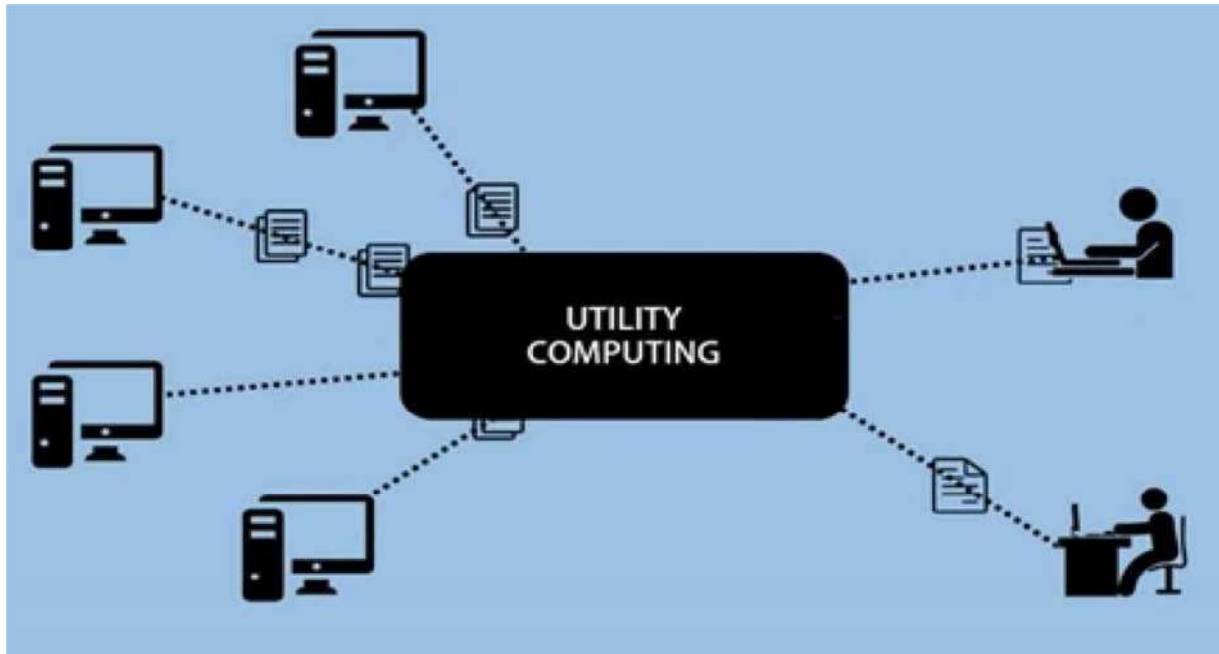
Fig 6: Utility Computing

The Evolution of cloud computing:

With Software as a Service (SaaS) becoming widely accepted, Cloud Computing is becoming increasingly important for small businesses because of its low cost (pay as you go and just for what you need) and agility (rapid ramp up and down).
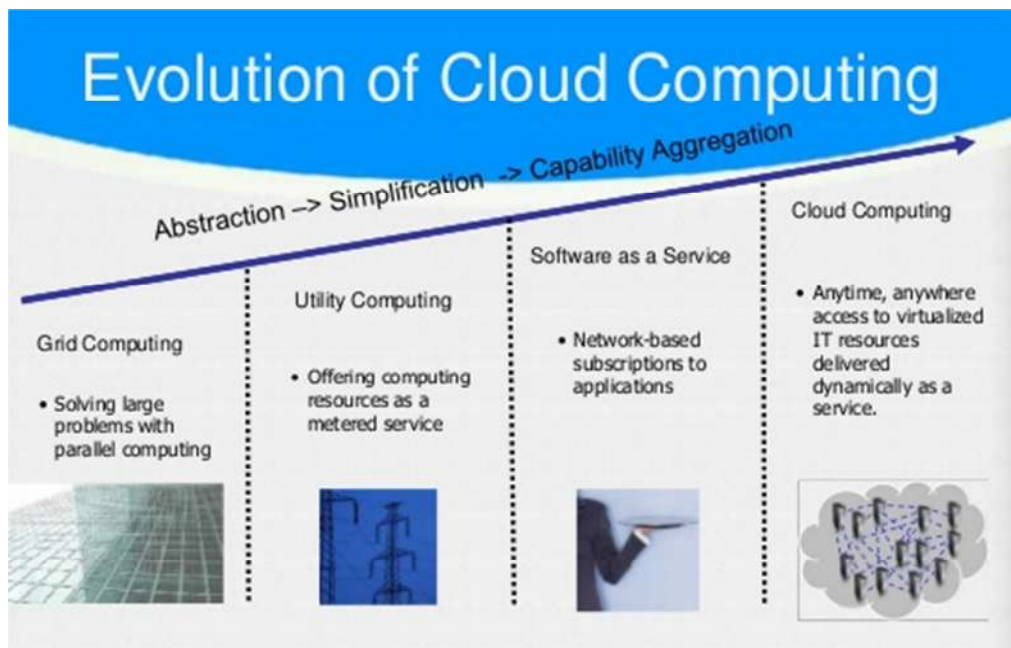
Fig 7: Evolution of Cloud Computing

Business Drivers for Cloud Business growth

1. **Business growth** - is one of the top benefits organisations realise as a result of cloud adoption, with 52% of enterprises reporting increased growth since going cloud (2015 Cloud Enterprise Report).

2. **Efficiency** - is an extremely common cloud driver, with 71% of organisations worldwide ranking it a top area they hope to approve through cloud technology (2015 Cloud Enterprise Report).

3. **Experience** - Next among the business drivers is improving the quality of the customer experience, which 45% of enterprises worldwide rank as a top cloud driver (although that number jumps to 61% looking at only organisations in the UK and Australia).

4. **Assurance** - Finally, there is assurance, which is the idea that data will be more secure in the cloud and the user will attain better uptime because its solutions are maintained by providers that have built their businesses around these competencies

Cloud Computing:

- **In the simplest terms**, cloud computing means storing and accessing data and programs over the Internet instead of your compufter's hard drive. The cloud is just a metaphor for the Internet.

- **Definition** - Cloud Computing is the use of hardware and software to deliver a service over a network (typically the Internet). With cloud computing, users can access files and use applications from any device that can access the Internet. An example of a Cloud Computing provider is Google's Gmail. That is Gmail users can access files and applications hosted by Google via the internet from any device.
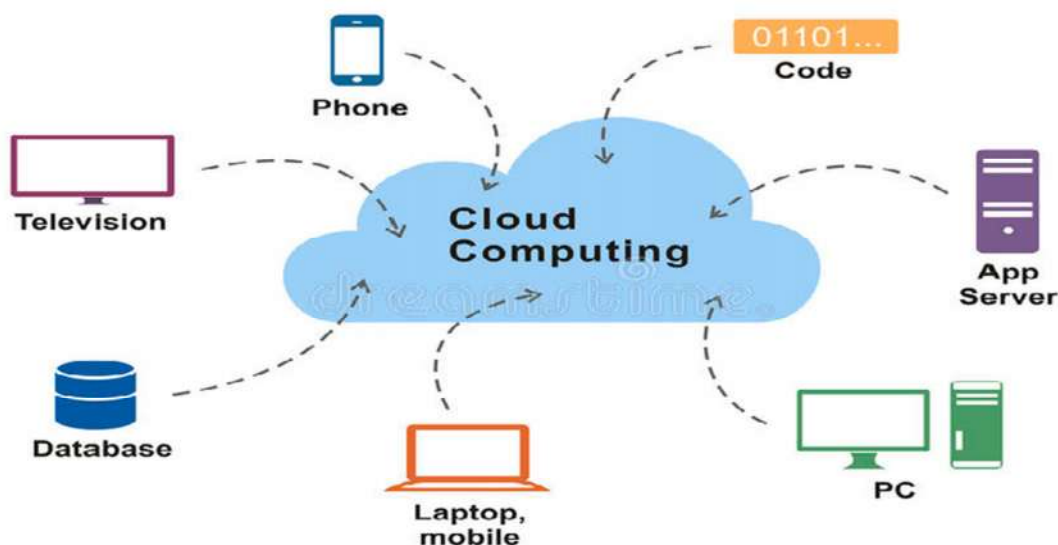

Fig 8: Cloud Computing - Devices

History of Cloud Computing

- **1950s** - In the 50s mainframe computers were huge, occupying entire rooms. Due to the cost of buying and maintaining mainframes, organisations couldn't afford to purchase

one for each user. The solution was "time sharing" in which multiple users shared access to data and CPU time. The term "time sharing" is the premise of cloud computing.

- **1969** - J.C.R. Licklider developed the ARPANET (Advanced Research Projects Agency Network) – the network that became the basis of the internet. His vision was for everyone on the globe to be interconnected and accessing programs and data at any site, from anywhere.

- **1970s** - IBM released an operating system called VM that allowed admins to have multiple virtual systems, or "Virtual Machines" (VMs) on a single physical node. The VM operating system took the 50s "time sharing" model to the next level and most of the basic functions of any virtualisation software that you see nowadays can be traced back to this early VM operating system.

- **1990s** - Telecommunications companies started offering virtualised private network connections, which meant it was possible to allow for more users through shared access to the same physical infrastructure. This change enabled traffic to be shifted as necessary to allow for better network balance and more control over bandwidth usage. Meanwhile, virtualisation for PC-based systems started in earnest, and as the Internet became more accessible, the next logical step was to take virtualisation online.

- **1997**- The term "cloud computing" is coined by University of Texas professor Ramnath Chellappa in a talk on a "new computing paradigm."

- **2002**- Amazon created Amazon Web Services (AWS), providing an advanced system of cloud services from storage to computation.

- **2006** - Amazon introduced the Elastic Compute Cloud (EC2) as a commercial web service. The EC2 let small companies rent computers on which they could run their own computer applications.

- **2009** - Google and Microsoft entered the playing field. The Google App Engine brought low-cost computing and storage services, and Microsoft followed suit with Windows Azure.

- **2010** - The Oneserve field service management software moves to the cloud
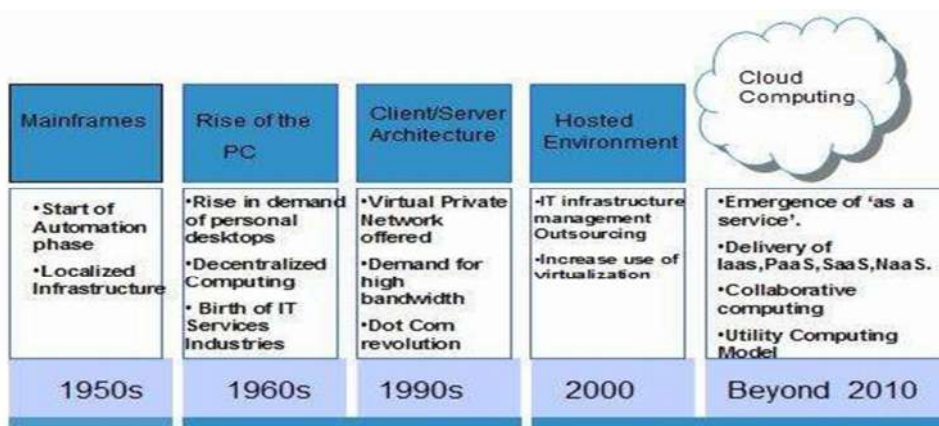
Fig 9: History of Cloud Computing

Challenges in Cloud Computing

Fig 10: Challenges in Cloud Computing

1. Security and Privacy

- Security and privacy are the main challenge in cloud computing.

- These challenges can reduce by using security applications, encrypted file systems, data loss software.

2. Interoperability

- The application on one platform should be able to incorporate services from the other platform. This is known as Interoperability.

- It is becoming possible through web services, but to develop such web services is complex.

3. Portability

- The applications running on one cloud platform can be moved to new cloud platform and it should operate correctly without making any changes in design, coding.
- The portability is not possible, because each of the cloud providers uses different standard languages for their platform.

4. Service Quality

- The Service-Level Agreements (SLAs) of the providers are not enough to guarantee the availability and scalability. The businesses disinclined to switch to cloud without a strong service quality guarantee.

5. Computing Performance

- High network bandwidth is needed for data intensive applications on cloud, this results in high cost.
- In cloud computing, low bandwidth does not meet the desired computing performance.

6. Reliability and Availability

- Most of the businesses are dependent on services provided by third-party, hence it is mandatory for the cloud systems to be reliable and robust.

Features of Cloud Computing

1. **High scalability** - It means on demand provisioning of resources on a large scale without requiring human interaction with each service provider.

2. **High availability and reliability** - Availability of servers is more reliable and high because it minimizes the chances of infrastructure failure.

3. **Agility** - It shares the resources between users and works very quickly.

4. **Multi-sharing** - Multiple user and applications work more efficiently with less cost by sharing common infrastructure using cloud computing.

5. **Maintenance** - Maintenance of cloud computing applications is easier as they are not required to be install on each computer and can also be accessed from various places,

ultimately   reducing   the   cost.
6. **Low cost** - It is cost effective because the company no more needs to set its own infrastructure.   It   pays   according   to   resources   it   has   consumed.
7. **Services in pay-per-use mode** - APIs(Application Programming Interfaces) are provided to the users for accessing the services on the cloud and pay according to use of the service.

Cloud Service Provider

A cloud service provider, or CSP, is a company that offers some component of cloud computing -- typically infrastructure as a service (IaaS), software as a service (SaaS) or platform as a service (PaaS) to other businesses or individuals.
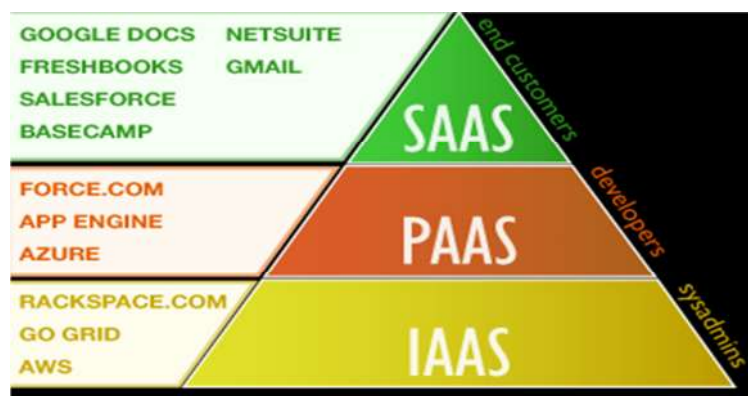

Fig 11: Cloud Service Provider

Examples of cloud service provides are:

1) Amazon Web Service (AWS)

2) Microsoft Azure.

3) Google Cloud Platform.

4) Adobe.

5) VMware.

6) IBM Cloud.

7) Rackspace.

8) Red Hat.

Fig 12: Example of Cloud Services

Cloud Computing Services:

The three major Cloud Computing Offerings are:

- **Software as a Service (SaaS)** - SaaS or software as a service is a software distribution model in which applications are hosted by a vendor or service provider and made available to customers over a network (internet). SaaS is becoming an increasingly prevalent delivery model as underlying technologies that supports Service Oriented Architecture (SOA) or Web Services. Through internet this service is available to users anywhere in the world.

    Traditionaly, software application needed to be purchased upfront &then installed it onto your computer. SaaS users on the other hand, instead of purchasing the software subscribes to it, usually on monthly basis via internet.

    Anyone who needs an access to a particular piece of software can be subscribing as a user, whether it is one or two people or every thousands of employees in a corporation. SaaS is compatible with all internet enabled devices.

    Many important tasks like accounting, sales, invoicing and planning all can be performed using SaaS.

- **Platform as a Service (PaaS)** - Platform as a service, is referred as PaaS, it provides a platform and environment to allow developers to build applications and services. This service is hosted in the cloud and accessed by the users via internet.

To understand in a simple terms, let compare this with painting a picture, where you are provided with paint colors, different paint brushes and paper by your school teacher and you just have to draw a beautiful picture using those tools.

PaaS services are constantly updated & new features added. Software developers, web developers and business can benefit from PaaS. It provides platform to support application development. It includes software support and management services, storage, networking, deploying, testing, collaborating, hosting and maintaining applications.

- **Infrastructure as a Service (IaaS)** - IaaS (Infrastructure As A Service) is one of the fundamental service model of cloud computing alongside PaaS(Platform as a Service). It provides access to computing resources in a virtualized environment "the cloud" on internet. It provides computing infrastructure like virtual server space, network connections, bandwidth, load balancers and IP addresses. The pool of hardware resource is extracted from multiple servers and networks usually distributed across numerous data centers. This provides redundancy and reliability to IaaS.

  IaaS(Infrastructure as a service) is a complete package for computing. For small scale businesses who are looking for cutting cost on IT infrastructure, IaaS is one of the solutions. Annually a lot of money is spent in maintenance and buying new components like hard-drives, network connections, and external storage device etc. which a business owner could have saved for other expenses by using IaaS.

Benefits and limitations of Cloud Computing:

Advantages:

- **Easy implementation** - Cloud hosting allows business to retain the same applications and business processes without having to deal with the backend technicalities. Readily manageable by the Internet, a cloud infrastructure can be accessed by enterprises easily and quickly.

- **Accessibility** - Access your data anywhere, anytime. An Internet cloud infrastructure maximizes enterprise productivity and efficiency by ensuring your application is always

accessible. This allows for easy collaboration and sharing among users in multiple locations. No hardware required. Since everything will be hosted in the cloud, a physical storage center is no longer needed. However, a backup could be worth looking into in the event of a disaster that could leave your company's productivity stagnant.

- **Cost per head** - Overhead technology costs are kept at a minimum with cloud hosting services, enabling businesses to use the extra time and resources for improving the company infrastructure.

- **Flexibility for growth** - The cloud is easily scalable so companies can add or subtract resources based on their needs. As companies grow, their system will grow with them.

- **Efficient recovery** - Cloud computing delivers faster and more accurate retrievals of applications and data. With less downtime, it is the most efficient recovery plan.

Disadvantages:

- **No longer in control** - When moving services to the cloud, you are handing over your data and information. For companies who have an in-house IT staff, they will be unable to handle issues on their own. However, Stratosphere Networks has a 24/7 live help desk that can rectify any problems immediately.

- **May not get all the features** - Not all cloud services are the same. Some cloud providers tend to offer limited versions and enable the most popular features only, so you may not receive every feature or customization you want. Before signing up, make sure you know what your cloud service provider offers.

- **No Redundancy** - A cloud server is not redundant nor is it backed up. As technology may fail here and there, avoid getting burned by purchasing a redundancy plan. Although it is an extra cost, in most cases it will be well worth it.

- **Bandwidth issues** - For ideal performance, clients have to plan accordingly and not pack large amounts of servers and storage devices into a small set of data centers.

Fig 13: Pros /Cons in Cloud Computing

POSSIBLE QUESTIONS

PART A

Q.NO 1 TO 20 (MULTIPLE CHOICE QUESTIONS)

PART B (2 MARKS)

1. Define Cloud Computing

2. Mention any two benefits and limitations in cloud computing.

3. Give few examples for cloud service providers?

4. List out any 5 cloud service providers.

5. Name any two advantages and disadvantage in Grid Computing.

6. List out any two differences between cluster computing and utility computing.

7. Mention any two prons and cons for cloud computing

8. Give a clear structure for overview of cloud computing paradigm

9. What is distributed computing

10. What is evolution of cloud computing.

PART C (6 MARKS)

1. Explain Overview of Computing Paradigm with neat sketch

2. Elucidate History of Computing..

3. Describe the challenges in cloud computing with neat diagram

4. Explain the features of cloud computing.

5. Explain some of the benefits and limitations of cloud computing.

IT Infrastructure

Traditional data centers consist of various pieces of hardware, such as a desktop computer, which are connected to a network via a remote server. This server is typically installed on the premises, and provides all employees using the hardware, access to the business's stored data and applications.

Businesses with this IT model must purchase additional hardware and upgrades in order to scale up their data storage and services to support more users. Mandatory software upgrades are also required with traditional IT infrastructure to ensure fail safe systems are in place to in case a hardware failure occurs. For many businesses with IT data centers, an in-house IT department is needed to install and maintain the hardware.

On the other hand, traditional IT infrastructure are considered to be one of the most secure data hosting solutions and allows you to maintain full control of your company's applications and data on the local server. They are a customized, dedicated system ideal for organizations that need to run many different types of applications.

Cloud Computing Architecture

Cloud Computing architecture comprises of many cloud components, which are loosely coupled. We can broadly divide the cloud architecture into two parts:

- Front End
- Back End

Each of the ends is connected through a network, usually Internet. The following diagram shows the graphical view of cloud computing architecture:
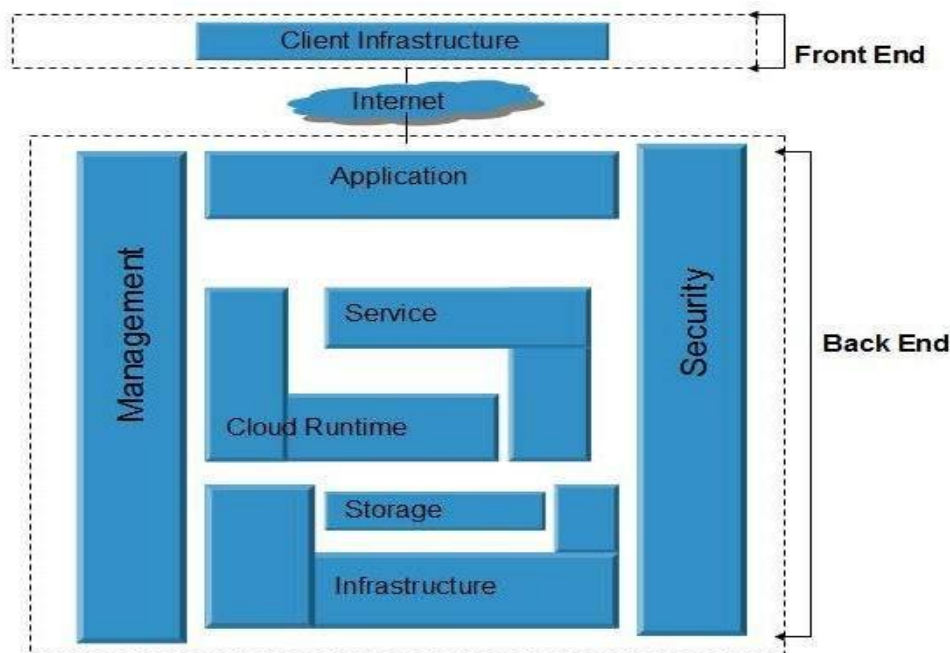
Front End

The front end refers to the client part of cloud computing system. It consists of interfaces and applications that are required to access the cloud computing platforms, Example - Web Browser.

Back End

The back End refers to the cloud itself. It consists of all the resources required to provide cloud computing services. It comprises of huge data storage, virtual machines, security mechanism, services, deployment models, servers, etc.

Cloud Computing vs Traditional IT infrastructure

Cloud computing is far more abstract as a virtual hosting solution. Instead of being accessible via physical hardware, all servers, software and networks are hosted in the cloud, off premises. It's a real-time virtual environment hosted between several different servers at the same time. So rather than investing money into purchasing physical servers in-house, you can rent the data storage space from cloud computing providers on a more cost effective pay-per-use basis.

The main differences between cloud hosting and traditional web hosting are:

Resilience and Elasticity

The information and applications hosted in the cloud are evenly distributed across all the servers, which are connected to work as one. Therefore, if one server fails, no data is lost and downtime is avoided. The cloud also offers more storage space and server resources, including better computing power. This means your software and applications will perform faster.

Traditional IT systems are not so resilient and cannot guarantee a consistently high level of server performance. They have limited capacity and are susceptible to downtime, which can greatly hinder workplace productivity.

Flexibility and Scalability

Cloud hosting offers an enhanced level of flexibility and scalability in comparison to traditional data centres. The on-demand virtual space of cloud computing has unlimited storage space and more server resources. Cloud servers can scale up or down depending on the level of traffic your website receives, and you will have full control to install any software as and when you need to. This provides more flexibility for your business to grow.

With traditional IT infrastructure, you can only use the resources that are already available to you. If you run out of storage space, the only solution is to purchase or rent another server.If you hire more employees, you will need to pay for additional software licences and have these manually uploaded on your office hardware. This can be a costly venture, especially if your business is growing quite rapidly.

Automation

A key difference between cloud computing and traditional IT infrastructure is how they are managed. Cloud hosting is managed by the storage provider who takes care of all the necessary hardware, ensures security measures are in place, and keeps it running smoothly. Traditional data centres require heavy administration in-house, which can be costly and time consuming for your business. Fully trained IT personnel may be needed to ensure regular

monitoring and maintenance of your servers – such as upgrades, configuration problems, threat protection and installations.

Running Costs

Cloud computing is more cost effective than traditional IT infrastructure due to methods of payment for the data storage services. With cloud based services, you only pay for what is used – similarly to how you pay for utilities such as electricity. Furthermore, the decreased likelihood of downtime means improved workplace performance and increased profits in the long run.

With traditional IT infrastructure, you will need to purchase equipment and additional server space upfront to adapt to business growth. If this slows, you will end up paying for resources you don't use. Furthermore, the value of physical servers decreases year on year, so the return on investment of investing money in traditional IT infrastructure is quite low.

Security

Cloud computing is an external form of data storage and software delivery, which can make it seem less secure than local data hosting. Anyone with access to the server can view and use the stored data and applications in the cloud, wherever internet connection is available. Choosing a cloud service provider that is completely transparent in its hosting of cloud platforms and ensures optimum security measures are in place is crucial when transitioning to the cloud.

Public Cloud allows systems and services to be easily accessible to general public. The IT giants such as **Google, Amazon** and **Microsoft** offer cloud services via Internet. The Public Cloud Model is shown in the diagram below.
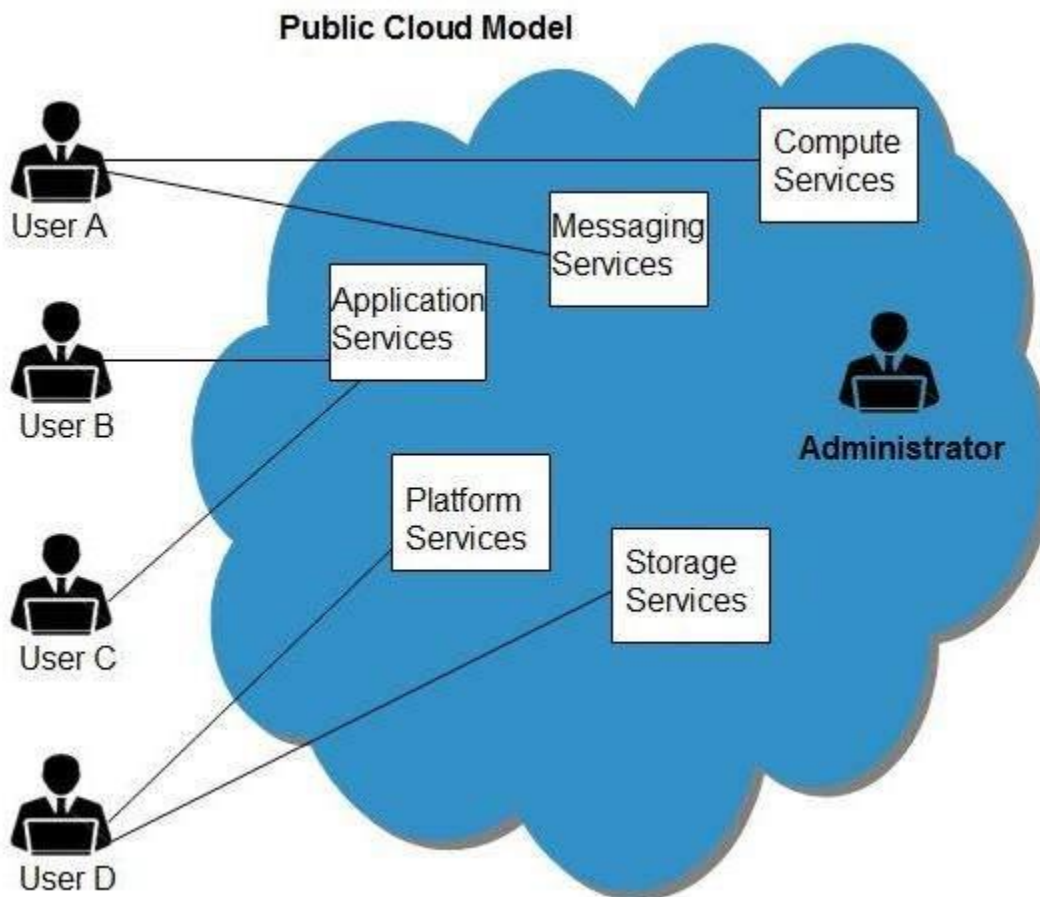
Benefits

There are many benefits of deploying cloud as public cloud model. The following diagram shows some of those benefits:
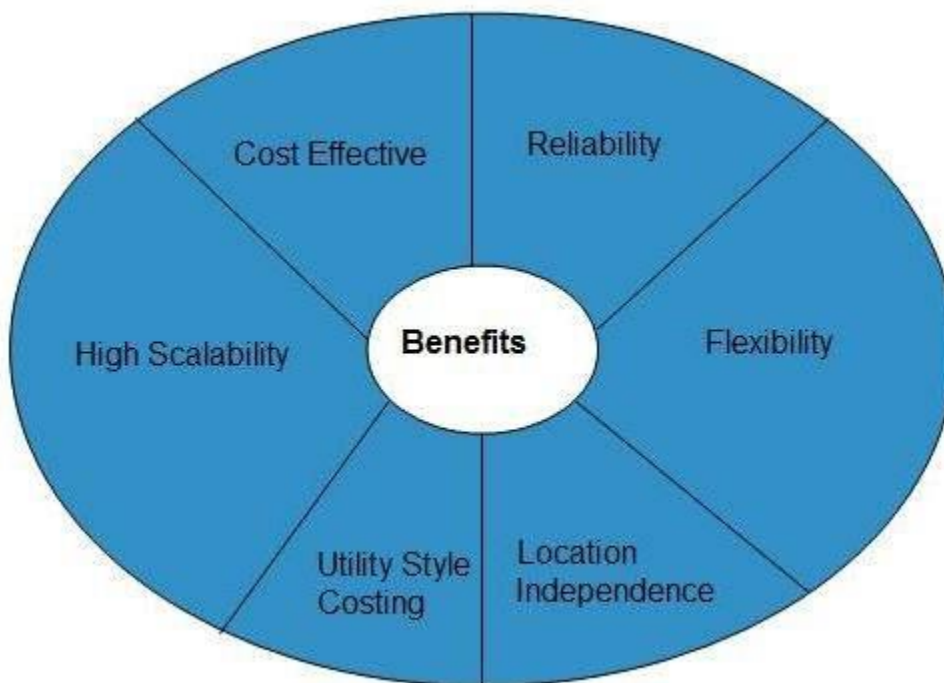
Cost Effective

Since **public cloud** shares same resources with large number of customers it turns out inexpensive.

Reliability

The **public cloud** employs large number of resources from different locations. If any of the resources fails, public cloud can employ another one.

Flexibility

The public cloud can smoothly integrate with private cloud, which gives customers a flexible approach.

Location Independence

Public cloud services are delivered through Internet, ensuring location independence.

Utility Style Costing

Public cloud is also based on **pay-per-use** model and resources are accessible whenever customer needs them.

High Scalability

Cloud resources are made available on demand from a pool of resources, i.e., they can be scaled up or down according the requirement.

Disadvantages

- Here are some disadvantages of public cloud model:

Low Security

- In **public cloud model,** data is hosted off-site and resources are shared publicly, therefore does not ensure higher level of security.

Less Customizable

- It is comparatively less customizable than private cloud.

Private Cloud allows systems and services to be accessible within an organization. The Private Cloud is operated only within a single organization. However, it may be managed internally by the organization itself or by third-party. The private cloud model is shown in the diagram below.
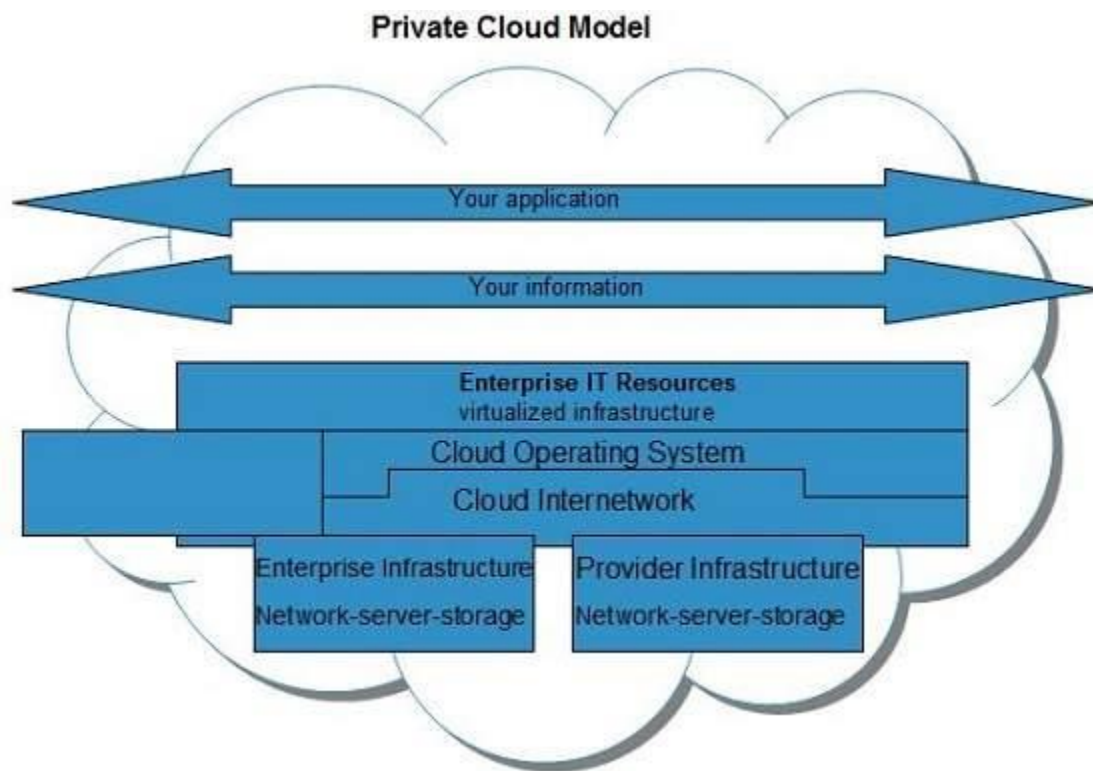
Benefits

There are many benefits of deploying cloud as private cloud model. The following diagram shows some of those benefits:
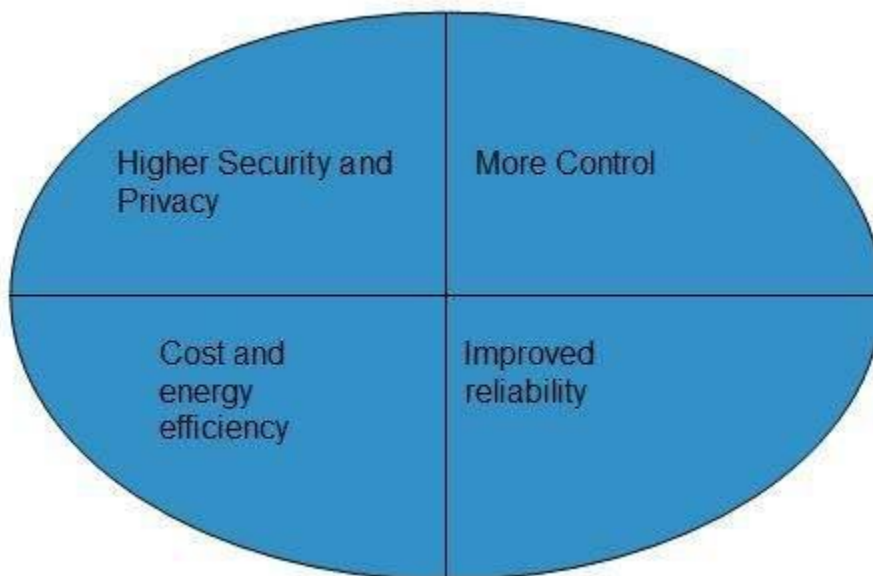
High Security and Privacy

Private cloud operations are not available to general public and resources are shared from distinct pool of resources. Therefore, it ensures high **security** and **privacy.**

More Control

The **private cloud** has more control on its resources and hardware than public cloud because it is accessed only within an organization.

Cost and Energy Efficiency

The **private cloud** resources are not as cost effective as resources in public clouds but they offer more efficiency than public cloud resources.

Disadvantages

Restricted Area of Operation

- The private cloud is only accessible locally and is very difficult to deploy globally.

High Priced

- Purchasing new hardware in order to fulfill the demand is a costly transaction.

Limited Scalability

- The private cloud can be scaled only within capacity of internal hosted resources.

Additional Skills

- In order to maintain cloud deployment, organization requires skilled expertise.

Hybrid Cloud is a mixture of **public** and **private** cloud. Non-critical activities are performed using public cloud while the critical activities are performed using private cloud. The Hybrid Cloud Model is shown in the diagram below.
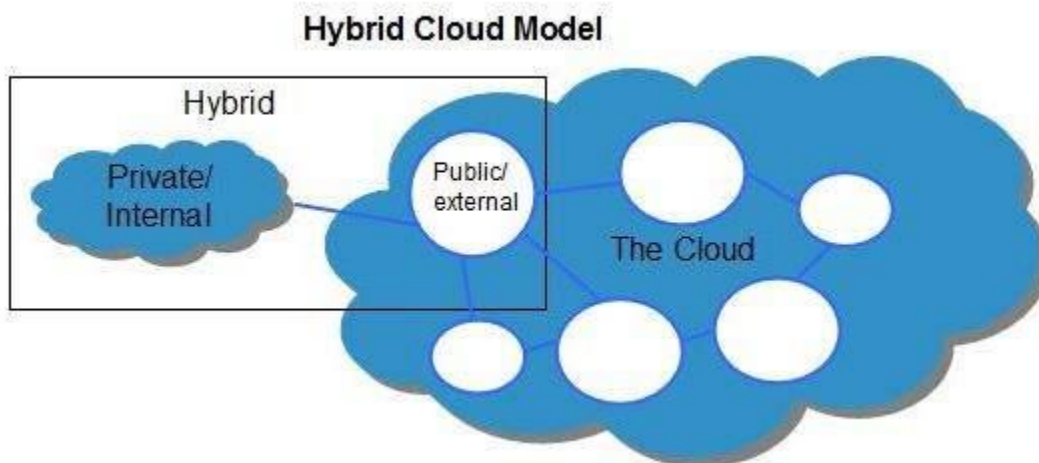
Benefits

There are many benefits of deploying cloud as hybrid cloud model. The following diagram shows some of those benefits:
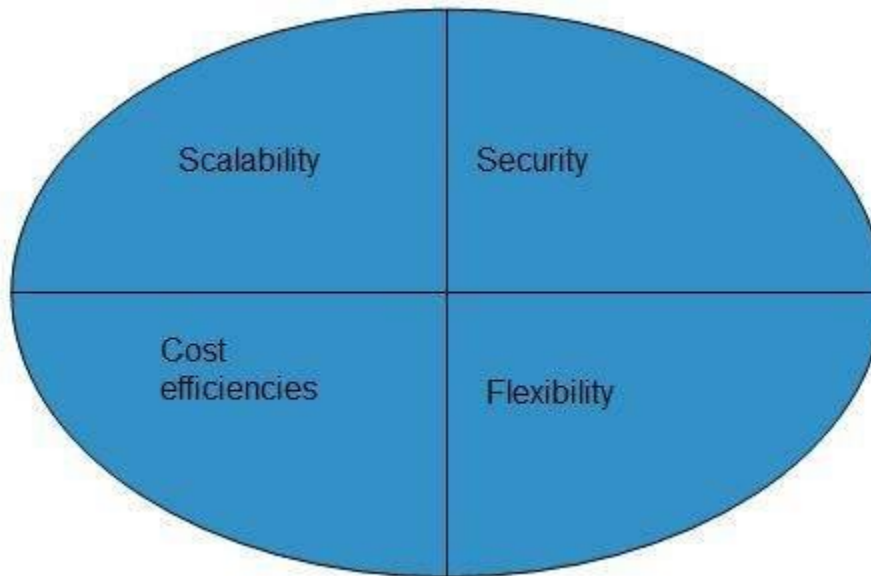
Scalability

- It offers features of both, the public cloud scalability and the private cloud scalability.

Flexibility

- It offers secure resources and scalable public resources.

Cost Efficiency

- Public clouds are more cost effective than private ones. Therefore, hybrid clouds can be cost saving.

Security

- The private cloud in hybrid cloud ensures higher degree of security.

Disadvantages

Networking Issues

- Networking becomes complex due to presence of private and public cloud.

Security Compliance

- It is necessary to ensure that cloud services are compliant with security policies of the organization.

Infrastructure Dependency

- The **hybrid cloud model** is dependent on internal IT infrastructure, therefore it is necessary to ensure redundancy across data centers.

Community Cloud allows system and services to be accessible by group of organizations. It shares the infrastructure between several organizations from a specific community. It may be managed internally by organizations or by the third-party. The Community Cloud Model is shown in the diagram below.
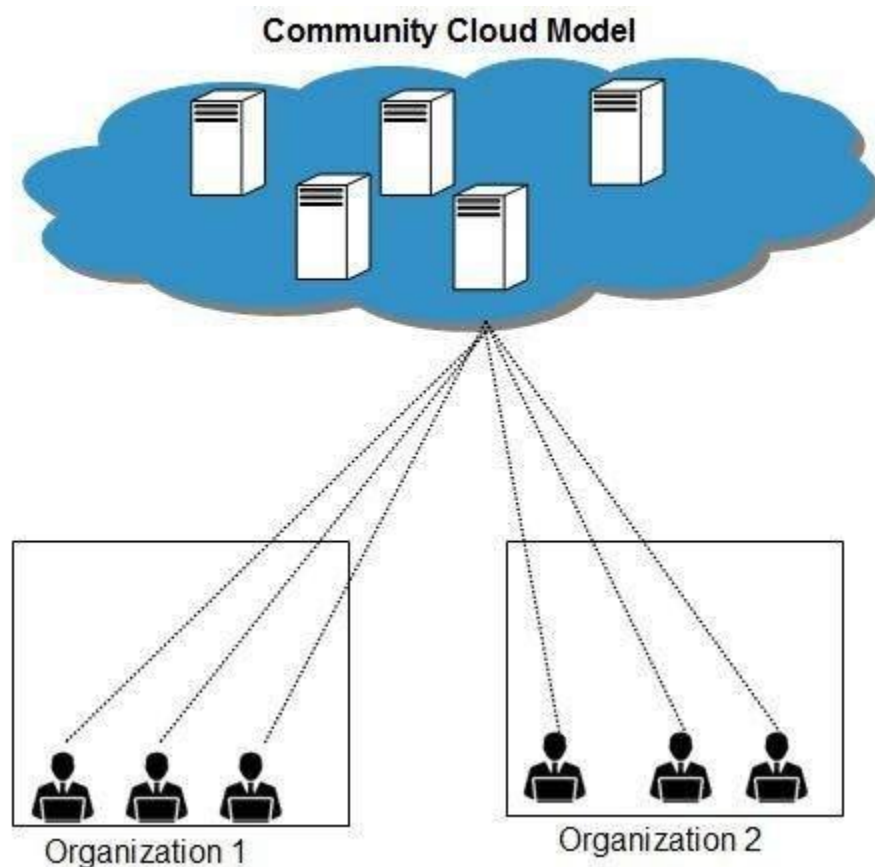
Benefits

There are many benefits of deploying cloud as **community cloud model.**

Cost Effective

- **Community cloud** offers same advantages as that of private cloud at low cost.
- Sharing Among Organizations
- Community cloud provides an infrastructure to share cloud resources and capabilities among several organizations.

Security

- The community cloud is comparatively more secure than the public cloud but less secured than the private cloud.

Issues

- Since all data is located at one place, one must be careful in storing data in community cloud because it might be accessible to others.
- It is also challenging to allocate responsibilities of governance, security and cost among organizations.

NIST ARCHITECTURE

The NIST cloud computing reference architecture is a generic high-level conceptual model that is a powerful tool for discussing the requirements, structures, and operations of cloud computing. The model is not tied to any specific vendor products, services, or reference implementation, nor does it define prescriptive solutions that inhibit innovation. It defines a set

of actors, activities, and functions that can be used in the process of developing cloud computing architectures, and relates to a companion cloud computing taxonomy. It contains a set of views and descriptions that are the basis for discussing the characteristics, uses, and standards for cloud computing.

The NIST cloud computing reference architecture focuses on the requirements of what cloud service provides, not on a design that defines a solution and its implementation. It is intended to facilitate the understanding of the operational intricacies in cloud computing. The reference architecture does not represent the system architecture of a specific cloud computing system; instead, it is a tool for describing, discussing, and developing the system-specific architecture using a common framework of reference..

NIST working group

- Cloud Computing Target Business Use Cases
- Cloud Computing Reference Architecture and Taxonomy
- Cloud Computing Standards Roadmap
- Cloud Computing SAJACC (Standards Acceleration to Jumpstart the Adoption of Cloud Computing)
- Cloud Computing Security

Objectives

The design of the NIST cloud computing reference architecture serves the objectives to: illustrate and understand various cloud services in the context of an overall cloud computing conceptual model; provide technical references to USG agencies and other consumers to understand, discuss, categorize, and compare cloud services; and communicate and analyze

security, interoperability, and portability candidate standards and reference implementations.
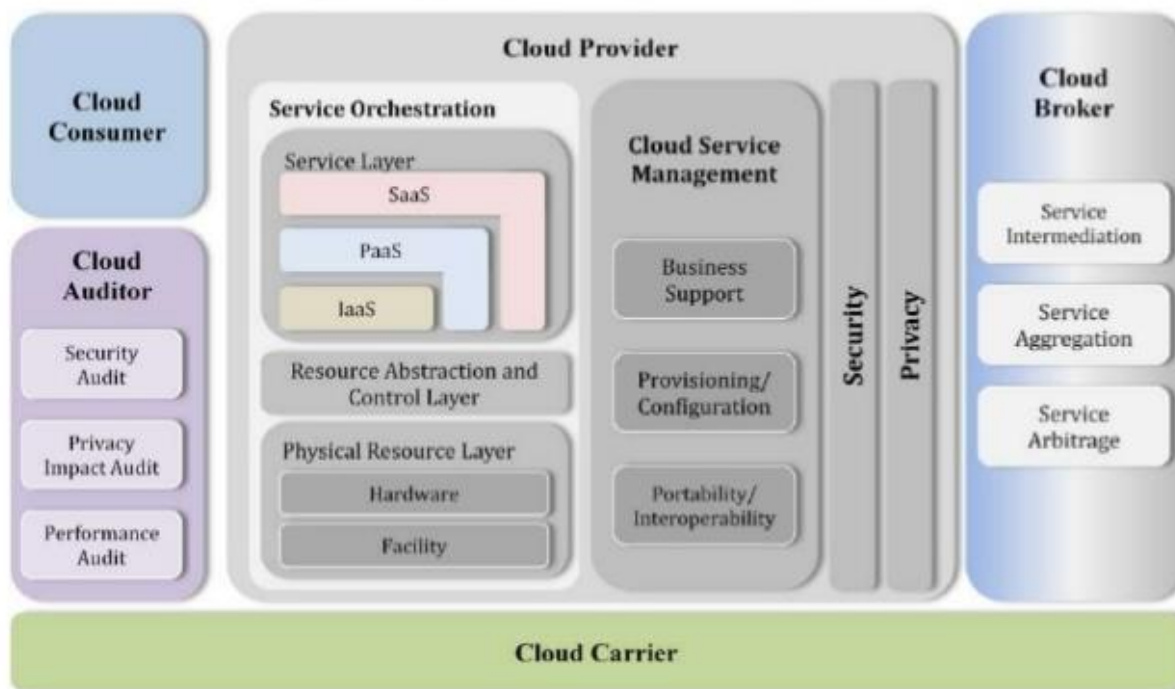
Cloud Computing Reference Architecture

Overview

The Overview of the Reference Architecture describes five major actors with their roles and responsibilities using the newly developing Cloud Computing Taxonomy. **The NIST cloud computing reference architecture defines five major actors: cloud consumer, cloud provider, cloud auditor, cloud broker, and cloud carrier (Cloud Actors).** These core individuals have key roles in the realm of cloud computing. Each actor is an entity (a person or an organization) that participates in a transaction or process and/or performs tasks in cloud computing.
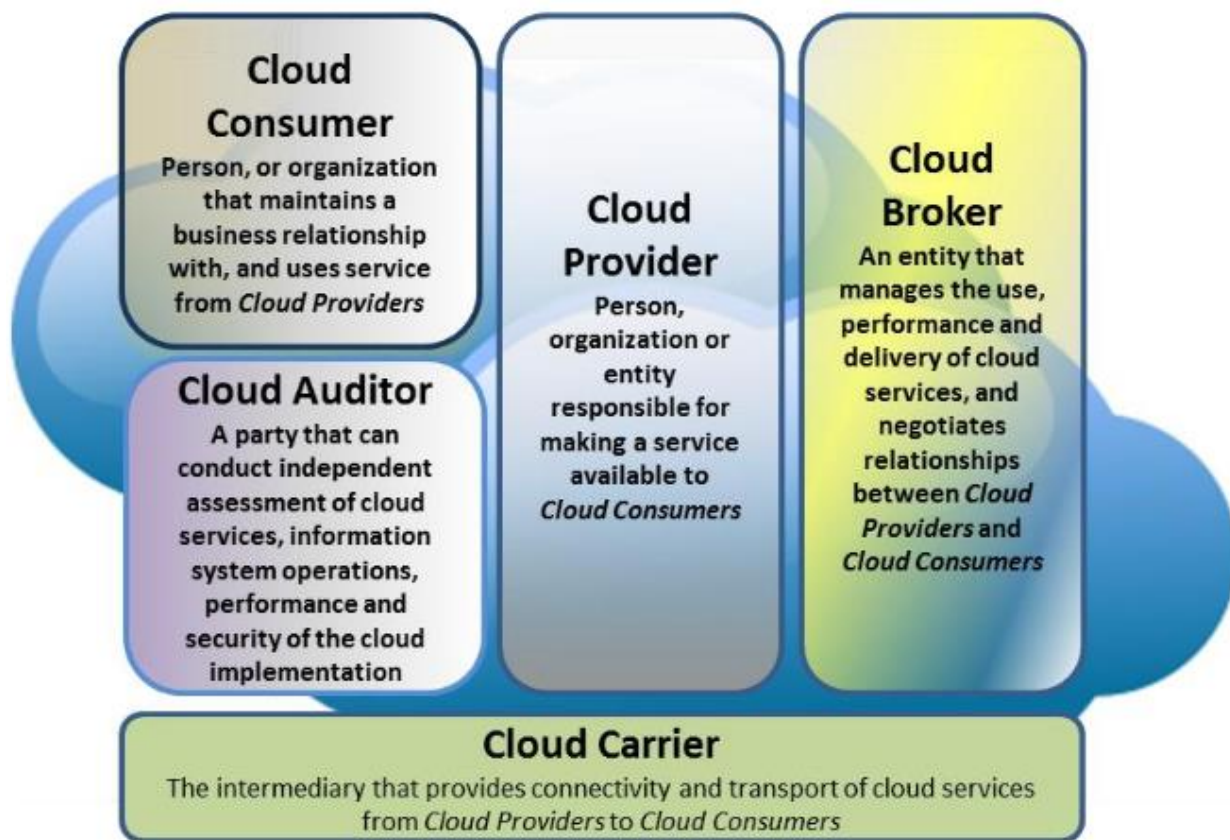
Cloud Actors

An interaction between the Actors in Cloud Computing shows the interactions among the actors in the NIST cloud computing reference architecture. A cloud consumer may request cloud services from a cloud provider directly or via a cloud broker. A cloud auditor conducts independent audits and may contact the others to collect necessary information. The details will be discussed in the following sections and be presented as successive diagrams in increasing levels of detail.

	The communication path between a cloud provider and a cloud consumer
	The communication paths for a cloud auditor to collect auditing information
	The communication paths for a cloud broker to provide service to a cloud consumer
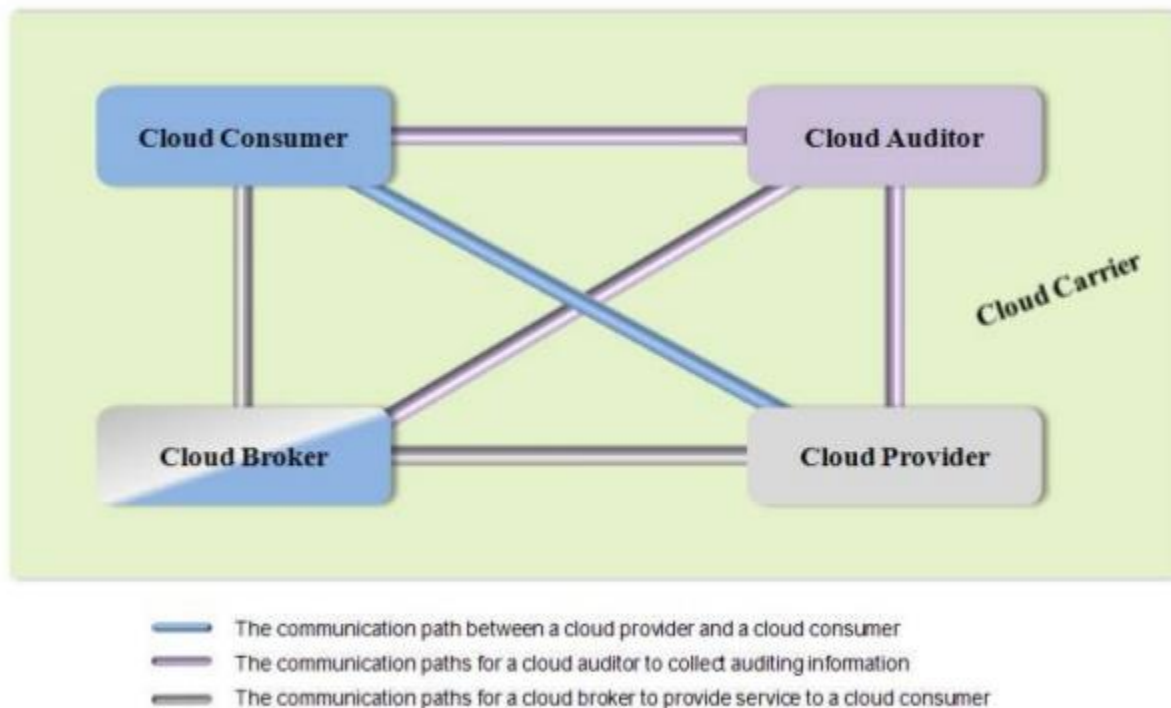
Interactions between the Actors in Cloud Computing

CLOUD CONSUMER

The cloud consumer is the ultimate stakeholder that the cloud computing service is created to support. A cloud consumer represents a person or organization that maintains a business relationship with, and uses the service from, a cloud provider. A cloud consumer browses the service catalog from a cloud provider, requests the appropriate service, sets up service contracts with the cloud provider, and uses the service. The cloud consumer may be billed for the service provisioned, and needs to arrange payments accordingly. Depending on the services requested, the activities and usage scenarios can be different among cloud consumers.

Service Models	Consumer Activities	Provider Activities
SaaS	Uses application/service for Business process operations.	Installs, manages, maintains, and supports the software application on a cloud Infrastructure.

PaaS	Develops, tests, deploys, and manages applications hosted in a Cloud system.	Provisions and manages cloud infrastructure and middleware for the platform consumers; provides development, deployment, and Administration tools to platform consumers.
IaaS	Creates/installs, manages, and monitors services for IT infrastructure operations	Provisions and manages the physical processing, storage, networking, and the hosting environment and cloud Infrastructure for IaaS consumers.

Cloud Consumer and Cloud Provider
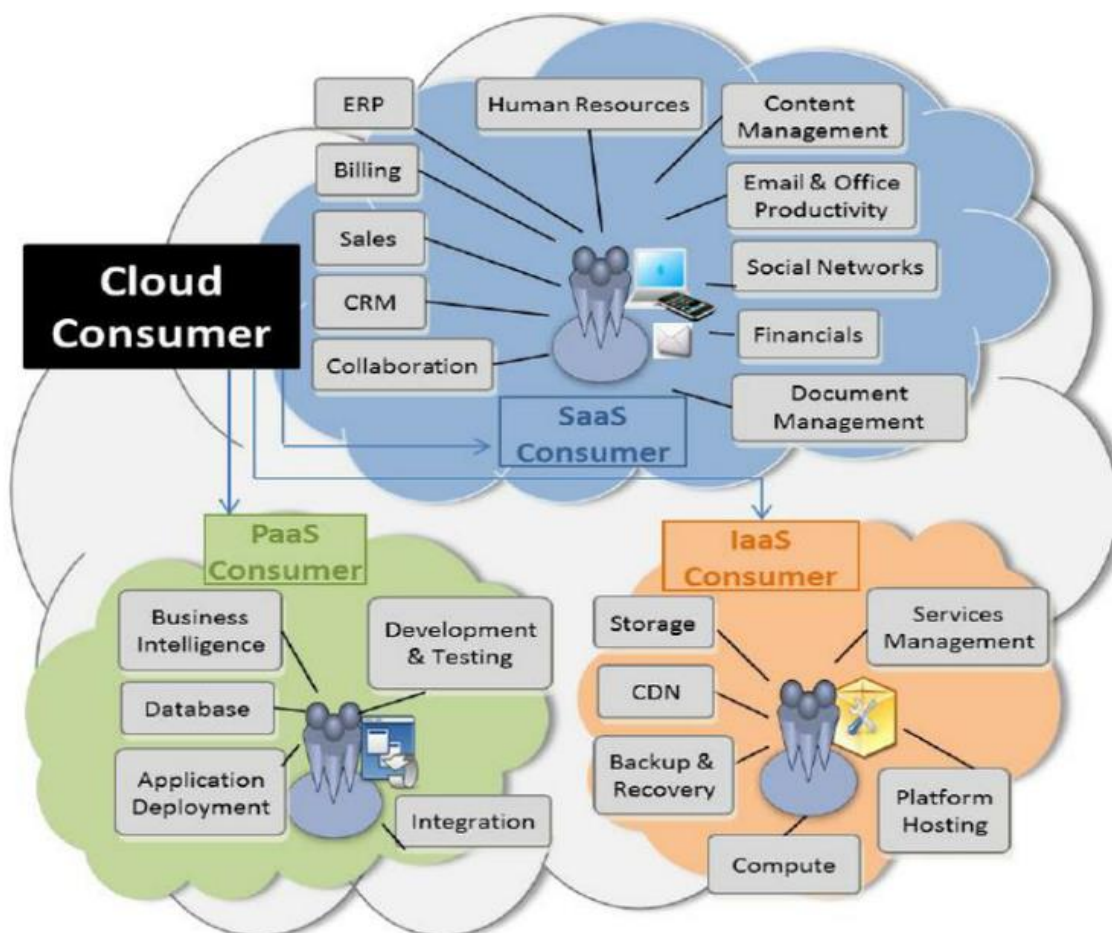
Examples of Services Available to a Cloud Consumer

SaaS applications are usually deployed as hosted services and are accessed via a network

connecting SaaS consumers and providers. The SaaS consumers can be organizations that provide their members with access to software applications, end users who directly use software applications, or software application administrators who configure applications for end users. SaaS consumers access and use applications on demand, and can be billed on the number of consumers or the amount of consumed services. The latter can be measured in terms of the time in use, the network bandwidth consumed, or the amount/duration of data stored.

For PaaS, cloud consumers employ the tools and execution resources provided by cloud providers for the purpose of developing, testing, deploying, and managing applications hosted in a cloud system. PaaS consumers can be application developers who design and implement application software, application testers who run and test applications in various cloud systems, application deployers who publish applications into a cloud system, and application administrators who configure and monitor application performance on a platform. PaaS consumers can be billed by the number of consumers, the type of resources consumed by the platform, or the duration of platform usage.

For IaaS, consumers are provisioned with the capabilities to access virtual computers, network accessible storage, network infrastructure components, and other fundamental computing resources,on which consumers can deploy and run arbitrary software. IaaS consumers can be system developers, system administrators, and information technology (IT) managers who are interested in creating, installing, managing and monitoring services for IT infrastructure operations. IaaS consumers are provisioned with the capabilities to access these computing resources, and are billed for the amount of resources consumed.

Cloud Provider
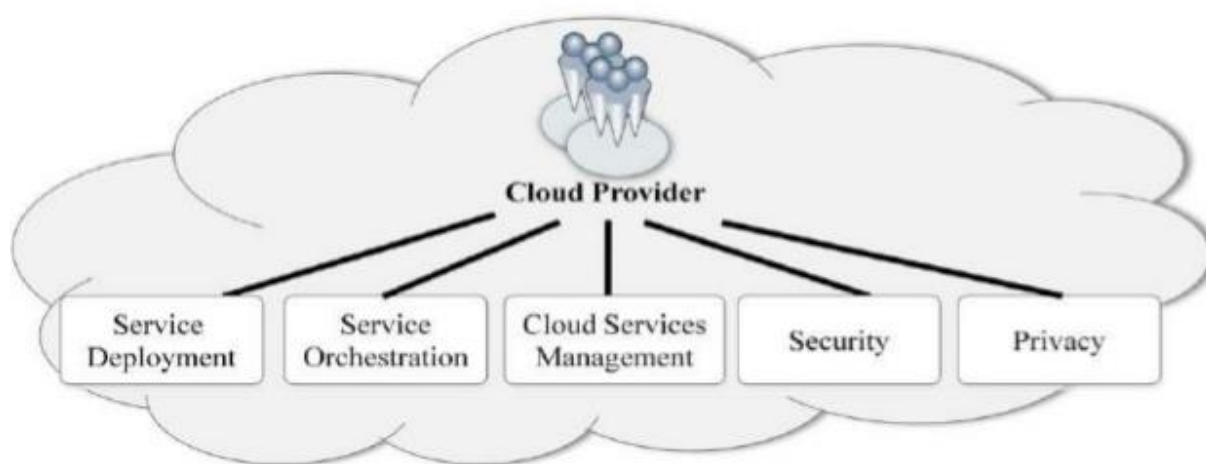
Cloud Provider - Major Activities

A cloud provider can be a person, an organization, or an entity responsible for making a service available to cloud consumers. A cloud provider builds the requested software/platform/ infrastructure services, manages the technical infrastructure required for providing the services, provisions the services at agreed-upon service levels, and protects the security and privacy of the services. Cloud Provider: Major Activities, cloud providers undertake different tasks for the provisioning of the various service models.

For SaaS, the cloud provider deploys, configures, maintains, and updates the operation of the software applications on a cloud infrastructure so that the services are provisioned at the expected service levels to cloud consumers. The provider of SaaS assumes most of the responsibilities in managing and controlling the applications and the infrastructure, while the cloud consumers have limited administrative control of the applications.

For PaaS, the cloud provider manages the cloud infrastructure for the platform, and provisions tools and execution resources for the platform consumers to develop, test, deploy, and administer applications. Consumers have control over the applications and possibly the hosting environment settings, but cannot access the infrastructure underlying the platform including network, servers, operating systems, or storage.

For IaaS, the cloud provider provisions the physical processing, storage, networking, and other fundamental computing resources, as well as manages the hosting environment and cloud infrastructure for IaaS consumers. Cloud consumers deploy and run applications, have more control over the hosting environment and operating systems, but do not manage or control the underlying cloud infrastructure (e.g., the physical servers, network, storage, hypervisors, etc.).

The activities of cloud providers can be discussed in greater detail from the perspectives of Service Deployment, Service Orchestration, Cloud Service Management, Security and Privacy.

As identified in the NIST cloud computing definition, a cloud infrastructure may be operated in one of the following deployment models: public cloud, private cloud, community cloud, or hybrid cloud.

A public cloud is one in which the cloud infrastructure and computing resources are made available to the general public over a public network. A public cloud is owned by an organization selling cloud services and serves a diverse pool of clients.

For private clouds, the cloud infrastructure is operated exclusively for a single organization. A private cloud gives the organization exclusive access to and usage of the infrastructure and computational resources. It may be managed either by the organization or by a third party, and may be implemented at the organization's premise (i.e., on-site private clouds) or outsourced to a hosting company (i.e., outsourced private clouds).

Similar to private clouds, a community cloud may be managed by the organizations or by a third party, and may be implemented at the customer's location (i.e., on-site community cloud) or outsourced to a hosting company (i.e., outsourced community cloud). However, a community cloud serves a set of organizations that have common security, privacy, and compliance considerations, rather than serving a single organization as does a private cloud.

A hybrid cloud is a composition of two or more cloud deployment models (private, community, or public) that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability. As discussed in this section, both private clouds and community clouds can be either implemented on-site or outsourced to a third party. Therefore, each constituent cloud of a hybrid cloud can be one of the five variants.

SERVICE ORCHESTRATION

Service orchestration refers to the arrangement, coordination, and management of cloud infrastructure to provide the optimizing capabilities of cloud services, as a cost-effective way of managing IT resources, as dictated by strategic business requirements.

The top layer is the service layer, where a cloud provider defines and provisions each of the three service models.

The middle layer is the resource abstraction and control layer. This layer contains the system components that a cloud provider uses to provide and manage access to the physical computing resources through software abstraction.

The lowest layer in the framework is the physical resource layer, which includes all the physical computing resources. This layer includes hardware resources, such as computers (CPU and memory), networks (routers, firewalls, switches, network links, and interfaces), storage components (hard disks), and other physical computing infrastructure elements
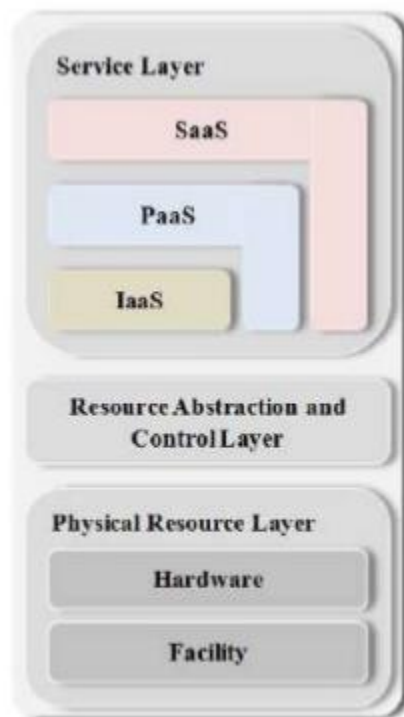
Cloud Provider - Service Orchestration

Cloud Service Management - includes all of the service-related functions that are necessary for the management and operation of those services required by or proposed to cloud consumers. cloud service management can be described from the perspective of business support, provisioning and configuration, and from the perspective of portability and interoperability requirements.

Cloud Provider - Cloud Service Management
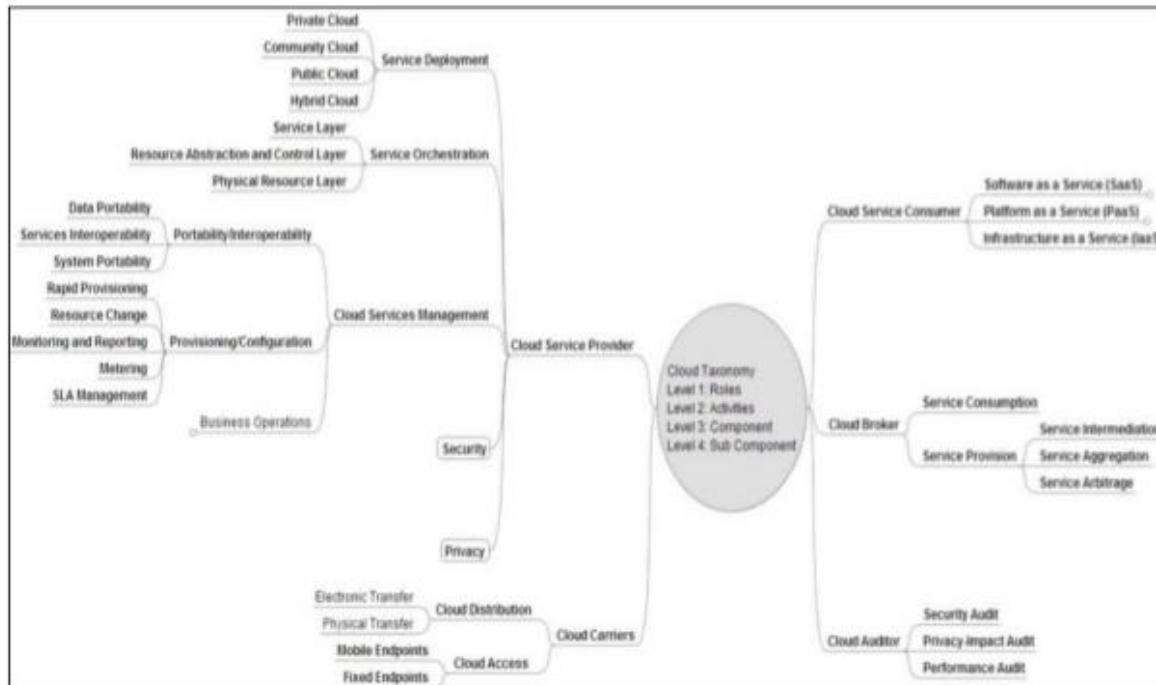
Cloud Taxonomy

Cloud Taxonomy

POSSIBLE QUESTIONS

PART A

Q.NO 1 TO 20 (MULTIPLE CHOICE QUESTIONS)

PART B (2 MARKS)

1. State the difference between a private cloud and public cloud

2. Compare the characteristics of PaaS and SaaS.

3. What do you mean by SaaS, IaaS, PaaS?

4. Define IaaS.

5. Generalize on PaaS and SaaS..

6. What is Cloud Taxonomy?

7. What is Cloud Service Management in NIST?

8. What does Service Orchestration refer in NIST?

9. List out Cloud Provider major activities.

10. Define NIST Architecture.

11. List out the interactions actors between in cloud computing.

PART C (6 MARKS)

1. Define cloud computing. Enlist and explain different service models.

2. Describe four cloud deployment models with neat diagram and example.

3. Explain the NIST cloud computing reference architecture?

4. Explain in detail software-as- a –service. What are different advantages and disadvantages of SAAS

5. Explain in detail, different implementation level of virtualization?

S.NO	Questions	opt1	opt2	opt3	opt4	Answer
1	The _____infrastructure is operated for the exclusive use of an organization.	Public Cloud	Private Cloud	Community Cloud	Hybrid Cloud	Private Cloud
2	_____refers to the location and management of the cloud's infrastructure.	Service models	Deployment models	Development models	Business models	Deployment models
3	A_____ cloud is one where the cloud has been organized to serve a common function or purpose.	Hybrid cloud	Community cloud	Private cloud	Public cloud	Community cloud
4	A _____ cloud combines multiple clouds are bound together as a unit.	Community cloud	Public cloud	Private cloud	Hybrid cloud	Hybrid cloud
5	_____constitute the first expression of cloud computing	Community Cloud	Private Cloud	Public Cloud	Hybrid Cloud	Public cloud
6	A fundamental characteristic of public clouds is _____	Security	High bandwidth	QoS	multi tenancy	multi tenancy
7	_____ is most commonly implemented in PaaS solutions that support hybrid clouds.	Dynamic provisioning	Provisioning	Distributed Mapping	Mapping	Dynamic provisioning
8	_____ are distributed systems created by integrating the services of different clouds to address the specific needs of an industry, a community, or a business sector	Community cloud	Private cloud	Public cloud	Hybrid cloud	Community cloud
9	From an architectural point of view, a _____ is most likely implemented over multiple administrative domains	Community cloud	Private cloud	Public cloud	Hybrid cloud	Community cloud
10	A cloud computing deployment lets someone else manage your computing infrastructure while you manage your business is called _____.	Outsourced IT Staffing	Outsourced IT management	QoS	Outsourced IT deployment	Outsourced IT management
11	_____ is one of the services that are heavily deployed on cloud computi	VoIP	IPoV	TCP	UDP	VoIP
12	_____ are open systems in which fair competition between different solutions can happen	Community cloud	Public cloud	Private cloud	Hybrid cloud	Community cloud

13	Science clouds are an interesting example of _____	Public cloud	Community cloud	Private cloud	Hybrid cloud	Community cloud
14	_____are appealing and provide a viable option to cut IT costs and reduce capital expenses.	Private cloud	Community cloud	Public cloud	Hybrid cloud	Public cloud
15	Customer information protection is an aspect of _____	Private cloud	Community cloud	Public cloud	Hybrid cloud	Private cloud
16	In most cases the _____ option prevails because of the existing IT infrastructure.	Public cloud	Community cloud	Private cloud	Hybrid cloud	Private cloud
17	From an architectural point of view, a_____ is most likely implemented over multiple administrative domains.	Community cloud	Public cloud	Hybrid cloud	Private cloud	Community cloud
18	_____ cloud is used for healthcare industry.	Private cloud	Public cloud	Hybrid cloud	Community cloud	Community cloud
19	Institutions such as government and military agencies will not consider _____ as an option for processing or storing their sensitive data.	Public cloud	Hybrid cloud	Private cloud	Community cloud	Public cloud
20	_____is the inability to scale on demand and to efficiently address peak loads	Public cloud	Hybrid cloud	Private cloud	Community cloud	Private cloud
21	_____address scalability issues by leveraging external resources for exceeding capacity demand	Public cloud	Hybrid cloud	Private cloud	Community cloud	Hybrid cloud
22	_____share common concerns such as their mission, policies, security, regulatory compliance needs, and so on.	Public cloud	Hybrid cloud	Community cloud	Private cloud	Community cloud
23	_____ are open systems in which fair competition between different solutions can happen.	Public cloud	Hybrid cloud	Community cloud	Private cloud	Community cloud
24	_____represents the ability for a cloud service to be widely accessible	Multitenancy	n-Demand Usag	Ubiquitous Access	Resiliency	Ubiquitous Access
25	We can broadly partition cloud computing into_____ layers that form a cloud computing ecosystem.	3	4	5	6	4
26	The _____ forms the basis for Software as a Service.	Application layer	Datalink layer	Platform layer	Network layer	Application layer
27	_____ is a cloud computing service model in which hardware is virtualized in the cloud.	Development as a Service	Platform as a Service	Infrastructure as a Service	Software as a Service	Infrastructure as a Service
28	The fundamental unit of virtualized client in an IaaS deployment is called a _____	Workload	Scheduling	Infrastructure	Operating System	Workload

29	A_____ would reserve a machine equivalent required to run each of these workloads.	Client	Server	Network	Host	Client
30	A group of users within a particular instance is called a _____	Aggregation	Silos	Pod	Network	Pod
31	_____ are the cloud computing equivalent of compute islands.	Aggregation	Silos	Pod	Network	Silos
32	The one example that is most quoted as a PaaS offering is _____	Force.com	Amazon Web Services	Google's App Engine platform	Quickbase	Google's App Engine platform
33	The ability to provide storage on demand from a storage pool is referred to as _____	Static provisioning	Dynamic provisioning	Thick provisioning	Thin provisioning	Thin provisioning
34	Open file backup systems are _____	Less Expensive	Expensive	Exchangable	Non Exchangable	Expensive
35	Continuous Data Protection (CDP) also known as_____	Porting	Imaging	Mirroring	Manipulating	Mirroring
36	An _____ allows a system to do what is referred to as a bare metal restore.	Image backup	Incremental backup	Differential backup	Point-in-time backup	Image backup
37	_____is an example of software that supplies Image backup.	Carbonite	Ghost	Apple's Time Machine	SQL Server	Ghost
38	_____is an example of software that supplies Point-in-time backup.	Carbonite	Ghost	Apple's Time Machine	SQL Server	Carbonite
39	_____ virtualizes storage into storage clouds.	SystemGRID	StorageGRID	DataGRID	GoGRID	SystemGRID
40	_____ is a direct competitor to Amazon's S3 service.	Nirvanix	Iron Mountain	Rackspace	EMC Atmos	Rackspace
41	Most of the user-based applications that work with cloud storage are of_____ type.	Unmanaged storage	Managed storage	Web storage	Rack storage	Unmanaged storage
42	_____ offer faster data transfers, but impose additional overhead on clients.	File storage devices	Block storage devices	Network Attached Storage device	Web storage devices	Block storage devices
43	FedCloud is used for_____	Banking industry	Medical industry	Government	Merchant transactions	Government
44	In IaaS, the virtualized resources are mapped to _____	Real systems	Virtual systems	Sophisticated systems	Dynamic systems	Real systems

45	The work done in IaaS can be measured by the number of _____	Data Per Minute	Process Per Minute	Transactions Per Minute	Clients Per Minute	Transactions Per Minute
46	In cloud computing, a provisioned server called an _____ is reserved by a customer.	Input	Instance	Application	Output	Instance
47	From an architectural standpoint, _____ in an IaaS infrastructure is assigned its own private network.	Server	Client	New User	Host	Client
48	_____ limits broadcast and multicast traffic because Data Link Layer in networking is not supported.	Amazon Web Service's routing	Google's App Engine routing	Quickbase routing	Rackspace routing	Amazon Web Service's routing
49	Consider a transactional eCommerce system, for which a typical stack contains____components.	4	3	5	6	5
50	Pods are managed by a _____	Google App Engine	Cloud Storage System	Amazon Web Services	Cloud Control System	Cloud Control System
51	____ are processing domains that are sealed off from the outside.	Silos	Aggregation	Pod	Network	Silos
52	_____ can be based on specific types of development languages, application frameworks, or other constructs.	Infrastructure	Softwares	Platforms	Compliance	Platforms
53	The ____ is responsible for all the operational aspects of the service, for maintenance, and for managing the product(s) lifecycle.	Hardware	Vendor	Software	Infrastructure	Vendor
54	A developer might write an application in a programming language like ____ using the Google API.	C++	C	Python	Pascal	Python
55	Gmail is an offering of _____	DaaS	SaaS	PaaS	CaaS	PaaS
56	The_____ is available over the Internet globally through a browser on demand.	Software	Hardware	Platform	Compliance	Software
57	_____applications feature automated upgrades, updates, and patch management and much faster rollout of changes.	SaaS	DaaS	PaaS	CaaS	SaaS
58	_____ supports multiple users and provides a shared data model through a single-instance, multi-tenancy model.	DaaS	PaaS	SaaS	IaaS	SaaS

59	_____is at the heart of the Internet as a service that provides identity authorization and lookup.	Distributed Name Service	Distributed Name System	Domain Name Service	Domain Name Solutions	Domain Name Service
60	_____ service currently in beta allows developers to store their data in Google's cloud storage infrastructure.	Atmos	Platypus	Eucalyptus	Nirvanix	Platypus

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UNIT -III

Case Study on Open Source and Commercial Clouds: Microsoft Azure- Amazon EC2-Google Web services – Open Nebula. - Eucalyptus

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Case Study on Open Source and Commercial Clouds:

Microsoft Azure

Microsoft Azure is an ever-expanding set of cloud services to help your organisation meet your business challenges. It is the freedom to build, manage and deploy applications on a massive, global network using your favorite tools and frameworks.

The Essentials

Amazon's AWS has a range of offerings that fall under IaaS, and each of these is categorized into four classes:

- content delivery and storage,
- compute,
- networking, and
- database.

No matter which IaaS offering you get, you will be using Amazon's identity and security services such as AWS CloudHSM's key storage service and Amazon's own Active Directory. Not only that, but AWS offerings also have a range of management tools that users can use, including AWS Config, AWS Cloudtrail, and Cloudwatch.

Azure, on the other hand, also has four classes of offerings:

- Data management and databases,
- compute,
- networking, and
- performance.

Security and management tools include Active Directory Federation Services, Azure Active Directory, Multi-Factor Auth, among others, as well as a range of integrations for Azure monitoring and performance tweaks.

Azure has multiple app deployment options for developers. Including App Services, Cloud Services, Service Fabric, Container Service, Functions, Batch, WebJobs and more. No matter what type of application you are developing, Microsoft has great tools in place to help deploy and scale it.

AWS offers similar solutions with Container Service, Elastic Beanstalk, Lambda, and Batch. AWS does not have as many options or features on the app hosting side. Microsoft has flexed their knowledge of developer tools to have a little bit of an advantage for hosting cloud apps.

Containers seem to be the preferred mechanism to deploy apps in the future, especially for open source applications. Look for more and more advancements in hosting containerized apps in the cloud. **Hybrid clouds are easier with Azure**, partly because Microsoft has foreseen the need for hybrid clouds early on. Azure offers substantial support for hybrid clouds, where you can use your onsite servers to run your applications on the Azure Stack. You can even set your computer resources to tap cloud-based resources when necessary.

Amazon EC2

Amazon Elastic Compute Cloud (Amazon EC2) provides scalable computing capacity in the Amazon Web Services (AWS) cloud. Using Amazon EC2 eliminates your need to invest in hardware up front, so you can develop and deploy applications faster. You can use Amazon EC2 to launch as many or as few virtual servers as you need, configure security and networking, and manage storage. Amazon EC2 enables you to scale up or down to handle changes in requirements or spikes in popularity, reducing your need to forecast traffic.

Features of Amazon EC2

Amazon EC2 provides the following features:

- Virtual computing environments, known as *instances*
- Preconfigured templates for your instances, known as *Amazon Machine Images (AMIs)*, that package the bits you need for your server (including the operating system and additional software)

- Various configurations of CPU, memory, storage, and networking capacity for your instances, known as *instance types*

- Secure login information for your instances using *key pairs* (AWS stores the public key, and you store the private key in a secure place)

- Storage volumes for temporary data that's deleted when you stop or terminate your instance, known as *instance store volumes*

- Persistent storage volumes for your data using Amazon Elastic Block Store (Amazon EBS), known as *Amazon EBS volumes*

- Multiple physical locations for your resources, such as instances and Amazon EBS volumes, known as *regions* and*Availability Zones*

- A firewall that enables you to specify the protocols, ports, and source IP ranges that can reach your instances using*security groups*

- Static IPv4 addresses for dynamic cloud computing, known as *Elastic IP addresses*

- Metadata, known as *tags*, that you can create and assign to your Amazon EC2 resources

- Virtual networks you can create that are logically isolated from the rest of the AWS cloud, and that you can optionally connect to your own network, known as *virtual private clouds* (VPCs)

Using Google Web Services

Google is the prototypical cloud computing services company, and it supports some of the largest Web sites and services in the world. Google uses automated technology to index the Web. It makes its search service available to users as a standard search engine and to developers as a collection of special search tools limited to various areas of content. The application of Google's searches to content aggregation has led to enormous societal changes and to a growing trend of disintermediation.

The most important commercial part of Google's activities is its targeting advertising business: AdWords and AdSense. Google has developed a range of services including Google

Analytics that supports its targeted advertising business.

Google applications are cloud-based applications. The range of application types offered by Google spans a variety of types: productivity applications, mobile applications, media delivery, social interactions, and many more.

Exploring Google Applications

The bulk of Google's income comes from the sales of target advertising based on information that Google gathers from your activities associated with your Google account or through cookies placed on your system using its AdWords system. The company is highly profitable, and that has allowed Google to create a huge infrastructure as well as launch many free cloud-based applications and services that this chapter details. These applications are offered mostly on a free usage model that represents Google's Software as a Service portfolio. A business model that offers cloud-based services for free that are ―good enough‖ is very compelling. While Google is slowly growing a subscription business selling these applications to enterprises, its revenue represents only a small but growing part of Google's current income.

Google's cloud computing services falls under two umbrellas. The first and best-known offerings are an extensive set of very popular applications that Google offers to the general public. These applications include Google Docs, Google Health, Picasa, Google Mail, Google Earth, and many more.

Google's cloud-based applications have put many other vendors' products—such as office suites, mapping applications, image-management programs, and many other categories of traditional shrink-wrapped software—under considerable pressure.

The second of Google's cloud offerings is its Platform as a Service developer tools. In April 2008, Google introduced a development platform for hosted Web applications using Google's

infrastructure called the Google App Engine (GAE). The goal of GAE is to allow developers to create and deploy Web applications without worrying about managing the infrastructure necessary to have their applications run. GAE applications may be written using many high-level programming languages (most prominently Java and Python) and the Google App Engine Framework, which lowers the amount of development effort required to get an application up and running. Goggle also allows a certain free level of service so that the application must exceed a certain level of processor load, storage usage, and network bandwidth (Input/Output) before charges are assessed.

More Google Products equals fewer commercial products.
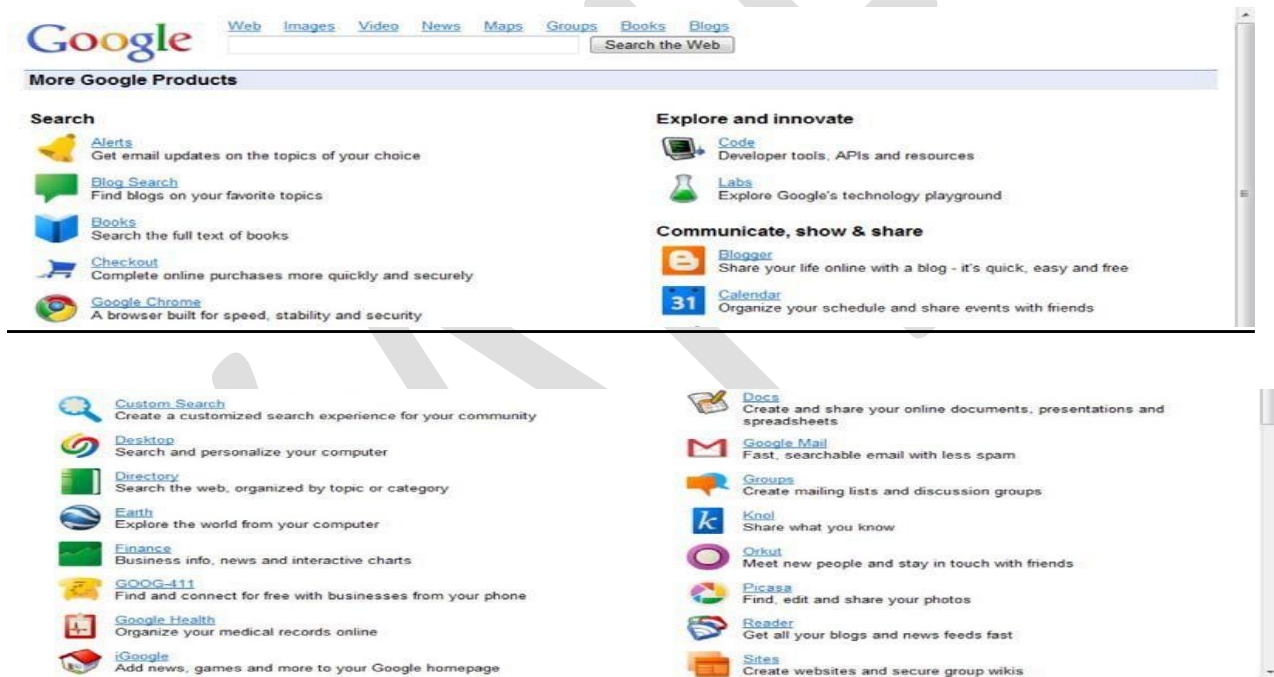
Surveying the Google Application Portfolio

It is fair to say that nearly all the products in Google's application and service portfolio are cloud computing services in that they all rely on systems staged worldwide on Google's one million plus servers in nearly 30 datacenters. Roughly 17 of the 48 services listed leverage Google's search engine in some specific way. Some of these search-related sites search through selected content such as Books, Images, Scholar, Trends, and more. Other sites such

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as Blog Search, Finance, News, and some others take the search results and format them into an Aggregation page. The below figure shows one of these aggregation pages: Google Finance.

Google's Finance page at http://www.google.com/finance/ is an example of an aggregation page provided by results from Google's search engine.
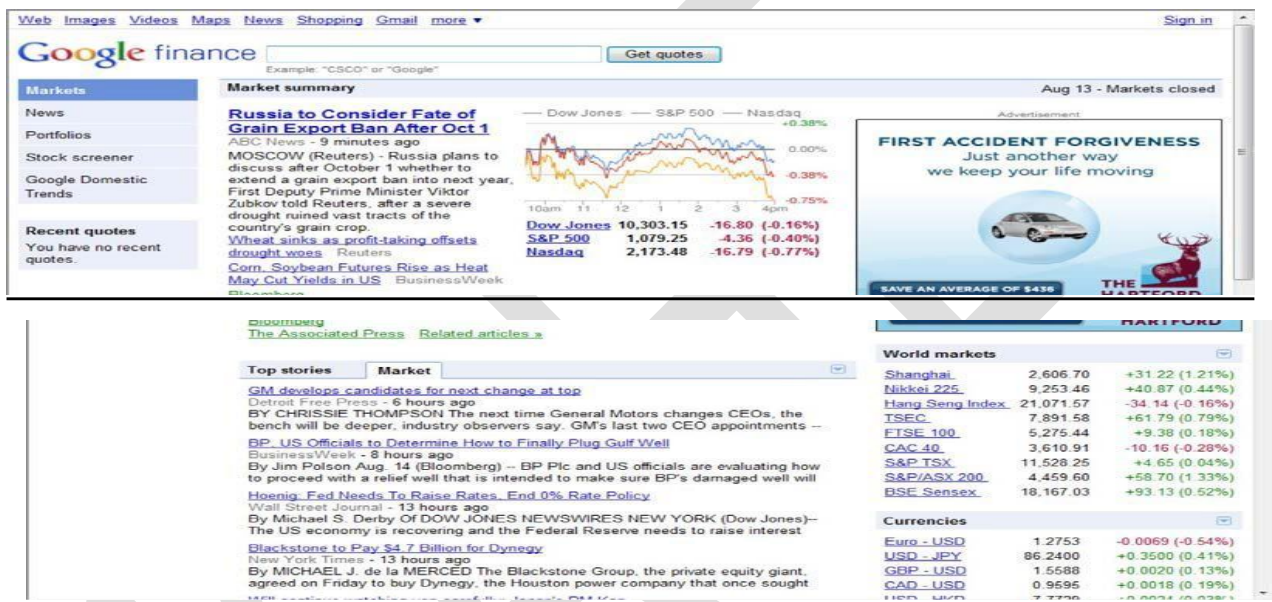
Enterprise offerings

As Google has built out its portfolio, it has released special versions of its products for the enterprise. The following are among Google's products aimed at the enterprise market:

• **Google Commerce Search** (http://www.google.com/commercesearch/): This is a search service for online retailers that markets their products in their site searches with a number of navigation, filtering, promotion, and analytical functions.

• **Google Site Search** (http://www.google.com/sitesearch/): Google sells its search engine customized for enterprises under the Google Site Search service banner. The user enters a search string in the site's search, and Google returns the results from that site.

• **Google Search Appliance** (http://www.google.com/enterprise/gsa): This server can be deployed within an organization to speed up both local (Intranet) and Internet searching. The three versions of the Google Search Appliance can store an index of up to 300,000 (GB-1001), 10 million (GB-5005), or 30 million (GB-8008) documents. Beyond indexing, these appliances have document management features, perform custom searches, cache content, and give local support to Google Analytics and Google Sitemaps.

• **Google Mini** (http://www.google.com/enterprise/mini/): The Mini is the smaller version of the GSA that stores 300,000 indexed documents.

Google Apps for Business is the commercial versions of the company's productivity suites.

Many of Google's productivity applications are quite capable, but none is a state-of-the-art client you might expect to find in a locally installed office suite. When compared one-on-one to Microsoft Office applications, Google's online offerings give users the essential features for a fraction of the Microsoft Office price.

AdWords

AdWords (http://www.google.com/AdWords) is a targeted ad service based on matching

advertisers and their keywords to users and their search profiles. This service transformed Google from a competent search engine into an industry giant and is responsible for the majority of Google's revenue stream. AdWords' two largest competitors are Microsoft adcenter (http://adcenter microsoft.com/) and Yahoo! Search Marketing (http://searchmarketing.yahoo.com/).

Ads are displayed as text, banners, or media and can be tailored based on geographical location, frequency, IP addresses, and other factors. AdWords ads can appear not only on Google.com, but on AOL search, Ask.com, and Netscape, along with other partners. Other partners belonging to the Google Display Network can also display AdSense ads. In all these cases, the AdWords system determines which ads to match to the user searches.

Using OpenNebula

OpenNebula is an open and flexible tool that fits into existing data center's environments to build any type of cloud deployment. OpenNebula can be primarily used as a virtualization tool to manage your virtual infrastructure, which is usually referred to as private cloud. OpenNebula supports a hybrid cloud to combine local infrastructure with public cloud-based infrastructure, enabling highly scalable hosting environments. OpenNebula also supports public clouds by providing cloud's interfaces to expose its functionality for virtual machine, storage, and network management. OpenNebula is one of the technologies being enhanced in the Reservoir Project , European research initiatives in virtualized infrastructures, and cloud computing.

OpenNebula architecture is shown in Figure which illustrates the existence of public and private clouds and also the resources being managed by its virtual manager.

OpenNebula is an open-source alternative to these commercial tools for the dynamic management of VMs on distributed resources. This tool is supporting several research lines in advance reservation of capacity, probabilistic admission control, placement

optimization, resource models for the efficient management of groups of virtual machines, elasticity support, and so on. These research lines address the requirements from both types of clouds namely, private and public.

OpenNebula and Haizea. Haizea is an open-source virtual machine-based lease management architecture developed by Sotomayor et al. ; it can be used as a scheduling backend for OpenNebula. Haizea uses leases as a fundamental resource provisioning abstraction and implements those leases as virtual machines, taking into account the overhead of using virtual machines when scheduling leases.
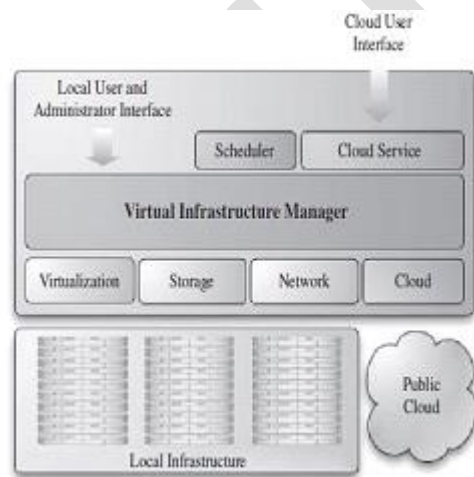
Haizea also provides advanced functionality such as:

- Advance reservation of capacity.
- Best-effort scheduling with backfilling.
- Resource preemption (using VM suspend/resume/migrate).
- Policy engine, allowing developers to write pluggable scheduling policies in Python.

Aneka

Manjrasoft Aneka is a .NET-based platform and framework designed for building and deploying distributed applications on clouds. It provides a set of APIs for transparently exploiting distributed resources and expressing the business logic of applications by using the preferred programming abstractions. Aneka is also a market-oriented cloud

platform since it allows users to build and schedule applications, provision resources, and monitor results using pricing, accounting, and QoS/SLA services in private and/or public cloud environments.

It allows end users to build an enterprise/private cloud setup by exploiting the power of computing resources in the enterprise data centers, public clouds such as Amazon EC2 , and hybrid clouds by combining enterprise private clouds managed by Aneka with resources from Amazon EC2 or other enterprise clouds built and managed using technologies such as XenServer.

Aneka also provides support for deploying and managing clouds. By using its Management Studio and a set ofWeb interfaces, it is possible to set up either public or private clouds, monitor their status, update their configuration, and perform the basic management operations.

Aneka Architecture.

Aneka platform, consists of a collection of physical and virtualized resources connected through a network. Each of these resources hosts an instance of the Aneka container representing the runtime environment where the distributed applications are executed. The container provides the basic management features of the single node and leverages all the other operations on the services that it is hosting. The services are broken up into fabric, foundation, and execution services. Fabric services directly interact with the node through the platform abstraction layer (PAL) and perform hardware profiling and dynamic resource provisioning. Foundation services identify the core system of the Aneka middleware, providing a set of basic features to enable Aneka containers to perform specialized and specific sets of tasks. Execution services directly deal with the scheduling and execution of applications in the cloud.

POSSIBLE QUESTIONS

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6 MARKS

1. Discuss about Google Web services with real-time environment.

2. Describe the role of Open Nebula in the cloud environment.

3. Discuss the features of Microsoft Azure in the cloud computing.

4. Elaborate the role of Amazon EC2 in the cloud.

S.No	Questions	opt1	opt2	opt3	opt4	Answer
1	_____ is a cloud operating system built on top of Microsoft datacenters infrastructure	Microsoft Windows	Oracle Azure	VB Azure	Java Azure	Microsoft Windows Azure
2	_____ are the core components of Microsoft Windows Azure,	Storage services	Compute services	Product services	Infrastructure services	Compute services
3	Expand BLOBs	Binary Large Objects	Blocking Large	Between Large	Blocking Last Objects	Binary Large Objects
4	_____ is a comprehensive middleware for developing, deploying, and managing applica tions on the cloud	Microsoft Windows	AppFabric	SQL Azure	Oracle Azure	AppFabric
5	_____is one of the most important and heavily trafficked Web sites in the world	Yahoo.com	Google.com	Amazon.com	MSN.com	Amazon.com
6	_____ is a Platform as a Service (PaaS) cloud-based Web hosting service on Google's infrastructure.	SQL Azure	Web Server Gateway	Amazon Web	Google App Engine	Google App Engine
7	_____is a service that allows developers to quickly access data persisted on Windows Azure storage.	Web Server Gateway	Azure Cache	Amazon Web	SQL Azure	Azure Cache
8	_____ supports databases with a maximum size of 1 GB or 5 GB.	Web Edition	Business Edition	Standard Edition	Special Edition	Web Edition
9	_____supports databases with a maximum size from 10 GB to 50 GB	Web Edition	Standard Edition	Business Edition	Special Edition	Business Edition
10	In Which Year did Amazon.com made its Web service platform available to	2006	2005	2007	2008	2006
11	_____ is the world's largest online retailer with net sales in $24.51 billion, according to their 2009 annual report.	Google.com	Amazon.com	Force.com	Rackspace.com	Amazon.com
12	_____ is the hourly rate with no long-term commitment.	On-Demand Instance	Reserved Instances	Spot Instance	Timing Instance	On-Demand Instance
13	There are currently _____different EC2 service zones or regions	Three	Four	Five	Six	Four
14	_____is the prototypical cloud computing Services Company.	Google	Yahoo	Amazon	IBM	Google

15	_____supports some of the largest Web sites and services in the world	Yahoo	Amazon	Google	IBM	Google
16	SEO stands for_____	Search Engine Optimization	Small Engine Optimization	Secret Engine	Sophisticated Engine	Search Engine Optimization
17	Online content that isn't indexed by search engines belongs to what has come to be called the_____	Crawl Web	Deep Web	Dark Web	Open Web	Deep Web
18	World's number two Web site, is called_____	Facebook	Google	Yahoo	MSN	Facebook
19	_____ is a prominent example of a site that isn't indexed in search engines	Facebook	Google	Yahoo	MSN	Facebook
20	The success of the ad is measured by what is called the_____	Money through Click	Click-through rate	Minimum Click	Maximum through Click	Click-through rate
21	_____ supports Dynamic Web services based on common standards.	SQL Azure	Azure Cloud	Google App Engine	Amazon EC2	Google App Engine
22	_____ can be used to run and scale PHP Web applications on Azure.	Worker Roles	Web Roles	Virtual machine	Storage Roles	Web Roles
23	_____ can be used to host Tomcat and serve JSP-based applications	Web Roles	Virtual machine	Worker roles	Storage Roles	Worker roles
24	A single block blob can reach ___ in dimension	100 GB	200 GB	150 GB	160 GB	200 GB
25	_____type of blob is optimized for random access and can be used to host data different from streaming	Page blobs	Block blobs	Storage blobs	Cluster blobs	Page blobs
26	Access to SQL Azure is based on the _____ protocol	User Datagram	Transmission Control	Tabular Data	Stream Oriented	Tabular Data Stream
27	_____ is foundation layer + set of developer services	Azure Platform	Google Platform	Amazon Platform	Azure Infrastructure	Azure Platform
28	_____provides access to e-mail and display names within your app	Amazon web services	App Engine	SQL Azure	Azure Cloud	App Engine
29	_____eliminates the need for an application to develop its own authentication system	Amazon web services	SQL Azure	App Engine	Azure Cloud	App Engine
30	_____has a distributed datastore system that supports queries and transactions.	Google App Engine	Azure Cloud	SQL Azure	Amazon EC2	Google App Engine
31	The Datastore in Google App Engine is _____	Non-relational	Relational	Schema based	Standard	Non-relational
32	The _____ uses an optimistic concurrency control and maintains strong consistency.	Entity Group	User API	Datastore	Attribute Group	Datastore

33	_____manage entities as a single group, and entity groups are stored together in the system so operations can be performed faster.	Queries	Datastore	Entity Group	Transactions	Transactions
34	Applications can use the_____ to determine whether a user belongs to a specific group	Admin API	User API	Third party API	API	User API
35	Applications running in GAE are isolated from the underlying operating system, which Google describes as running in a _____	Sandbox	Web pages	Well known ports	Protocols	Sandbox
36	The pricing scheme of Google in the Outgoing bandwidth measured in GB is _____ per GB.	$0.20	$0.22	$0.10	$0.12	$0.12
37	The pricing scheme of Google in the Incoming bandwidth measured in GB is ____ per GB	$0.20	$0.22	$0.10	$0.12	$0.10
38	The pricing scheme of Google in the Stored data measured in GB per month is ____ per GB/month	$0.20	$0.10	$0.12	$0.15	$0.15
39	The pricing scheme of Google in the CPU time measured in CPU hours is _____ per hour.	$0.10	$0.22	$0.20	$0.12	$0.10
40	WSGI stands for_____	Window Server Gateway Interface	Web Server Gateway Interface	Web Server Gateway Information	Window Server Gateway Information	Web Server Gateway Interface
41	_____ supports the feature Task queues and task scheduling	Google App Engine	Azure Cloud	SQL Azure	Amazon EC2	Google App Engine
42	_____ can appear not only on Google.com, but on AOL search, Ask.com, and Netscape, along with other partners	AdSense ads	AdDeep web ads	AdWords ads	AdServer ads	AdWords ads
43	The ____system determines which ads to match to the user searches	AdWords	AdSense	AdDeep web	AdServer	AdWords
44	Advertisers bid on _____that are used to match a user to their product or service	Exact words	Keywords	Retrieved words	Keys	Keywords
45	_____can be deployed within an organization to speed up both local (Intranet) and Internet searching	Google Site Search	Google Commerce Search	Google Search Appliance	Google Mini	Google Search Appliance

46	_____is the smaller version of the Google Search Appliance .	Google Mini	Google Commerce	Google Site	Google App	Google Mini
47	_____ includes Pages without links.	Crawl Web	Deep Web	Dark Web	Open Web	Deep Web
48	_____ includes Private or limited access Web pages and sites	Crawl Web	Dark Web	Deep Web	Open Web	Deep Web
49	_____ includes Information contained in sources available through executable code such as JavaScript	Deep Web	Crawl Web	Dark Web	Open Web	Deep Web
50	_____ can be useful in allowing content that isn't browsable to be crawled	Deep Web	Crawl Web	Dark Web	Sitemaps	Sitemaps
51	Web crawlers are also called as _____	Spiders or Robots	Dark Robots	Dark Spiders	Shadowers	Spiders or Robots
52	Content on pages is scanned up to a certain number of words and placed into an _____	Header	Index	Table	Database	Index
53	_____is an example of an aggregation page provided by results from Google's search engine	Google's app page	Google's Store page	Google's Finance page	Google's Box page	Google's Finance page
54	_____which lowers the amount of development effort required to get an application up and running.	Azure Cloud Framework	Google App Engine Framework	SQL Azure Framework	Amazon EC2 Framework	Google App Engine Framework
55	Google's cloud computing services falls under_____umbrellas	2	3	4	5	2
56	The bulk of Google's income comes from the sales of_____	Social Networking	Applications	Target advertising	Blogger	Target advertising
57	Google is always tweaking the algorithm to prevent _____strategies from gaming the system	Search Engine Results Page	Search Engine Data	Search Engine Algorithm	Search Engine Optimization	Search Engine Optimization
58	_____represent the units of deployment of Web applications within the Azure infrastructure	Web Roles	Virtual machine	Worker roles	Storage Roles	Web Roles
59	_____service is optimal to store large text or binary files.	Blocks	Blobs	Storage	Cluster	Blobs
60	A connection is the Service Bus element that is priced by Azure on a _____basis	Yearly	Weekly	Pay-as-you-go	Monthly	Pay-as-you-go

61	_____ is a .NET-based platform and framework designed for building and deploying distributed applications on clouds	Haizea	Manjrasoft Aneka	AdWords	google Analytics	Manjrasoft Aneka
62	_____clouds are easier with Azure	Private	Public	Community	Hybrid	Hybrid
63	_____ is a system for implementing on-premise private and hybrid clouds.	Eucalyptus	Amazon	Microsoft Azure	Google App Engine	Eucalyptus

S.No	Questions	opt1	opt2
1	The _____ type of scaling is referred to as upgrading with higher capacity IT resources.	scaling out	scaling in
2	The _____ type of scaling is referred to as downgrrading with lower capacity IT resources.	scaling out	scaling in
3	The horizontal allocation of resources is referred to as _____	scaling out	scaling in
4	The horizontal releasing of resources is referred to as	scaling out	scaling in
5	The _____ is a contract between service provider and customer.	server level agreement	service level agreement
6	Expand MTBF	mode time between failure	mode task between
7	The _____ is the amount of time services are running and availiable to the customer	benchmark	responsiveness
8	10. Which metric will perform the desired action promptly after the customer request for the service?	Reliability	Responsiveness
9	The _____ is a platform to make data and software accessible online anytime, anywhere from any device.	Cloud billing	Cloud accounting
10	Which software frees the business from having to install and maintain software on individual desktop computer?	Cloud billing	Cloud accounting
11	The bills are in the _____ for later use	Bill Repository	Bill Policy
12	The expansion of MTTR is _____.	Metric Time To Recover	Mean Time To Reach
13	The provider allocates resources when the customer needs them and decommisions them when they no	advanced provisioning	dynamic provisioning
14	The _____ is a way for hosting companies to put a large number of user on the same server	shared hosting	dedicated hosting
15	The _____ server can scale up or down depending on the level of traffic.	traditional	flexibility
16	A mobile computing infrastructure uses _____ networks	ad-hoc	LAN
17	Which cloud computing software frees the business from having to install and maintain on individual	Billing	Shared
18	Cloud computing accounting software may also referred to as_____	shared accounting	online accounting
19	Which is also a part of cloud accounting software?	data backup	data failure
20	The _____ is process of generating bills from the resource usage data using a set of predefined policies	cloud accounting	cloud service
21	The billing generation process is initiated by ___	accountant	Manager

22	SLA split into different levels each addressing different set of customer for the same service is	multiple SLA	many SLA
23	The _____ based SLA covers one service for all customers.	customer	sevice
24	The _____ based SLA is an agreement with one customer, covering all the services used by this	customer	sevice
25	Cloud Services have a_____ relationship with their customers.	many-to-many	one-to- many
26	Virtual Machine Ware (VMware) is an example of ____	Iaas	Paas
27	Amazon Web Services is which type of cloud computing distribution model?	Paas	Iaas
28	The term 'Cloud' in cloud-computing refers to _____.	The Internet	Cumulus Clouds
29	In order to participate in cloud-computing, you must be using which OS	Windows	Linux
30	Cloud billing is process of generating bills from the resource usage data using a set of predefined	policies	methods

opt3	opt4	opt5	opt6	Answer
scaling up	scaling down			scaling up
scaling up	scaling down			scaling down
scaling up	scaling down			scaling out
scaling up	scaling down			scaling in
Server level adjustment	Service level adjustment			service level agreement
mean time between	mean task between			mean time between failures
uptime	availiabilty			availiabilty
Accuracy	Quality			Responsiveness
Cloud fees	cloud resource			Cloud billing
Cloud software	cloud resource			Cloud accounting
Bill Records	Bill Accounts			Bill Repository
Metric Time To Reach	Mean Time To Recover			Mean Time To Recover
user self provisioning	static provisioning			dynamic provisioning
special hosting	cloud hosting			shared hosting
cloud	moblie			cloud
MAN	WAN			ad-hoc
Dedicated	Accounting			Accounting
dedicated accounting	Accounting			online accounting
data disaster	data			data backup
cloud management	cloud billing			cloud billing
web server	user			Manager

Multilevel SLA	hierarchy SLA			Multilevel SLA
corporate	multilevel			sevice
corporate	multilevel			customer
one-to- one	None			one-to- many
SaaS	None			Iaas
SaaS	None			Iaas
A Computer	Thin Clients			The Internet
Mac OS	All			All
schemes	service			policies

S.No	Questions	opt1
1	_____ is the process of recognizing a user's identity.	Security
2	___ level security ensures proper access control to resources in the public cloud.	Host
3	The attacker monitors the network traffic.	Sniffer
4	_____ is a security mechanism used to determine user privileges related to cloud resources.	Authentication
5	which type of attack can change or modify the content of the cookies?	Hypervisor
6	_____ is a set of policies to protect the cloud resources.	Cloud Security
7	_____ is a form of failover that distributes redundant	Security
8	_____ attack prevent the authorized user to access the services.	DNS
9	The expansion of MTTR is _____.	Metric Time To Recover
10	Which of the following service provider provides the least amount of built in security ?	Saas
11	Which of the following area of cloud computing is uniquely troublesome ?	Auditing
12	Which of the following is operational domain of CSA ?	Scalability
13	Which of the following is considered an essential element in cloud computing by CSA ?	Multi-tenancy
14	Which of the following is used for Web performance management and load testing ?	VMware Hyperic
15	Which of the following is application and infrastructure management software for hybrid multi-clouds ?	VMware Hyperic
16	CIA stands for_____	Confidential, Independent and Analysis
17	For the _____ model, the security boundary may be defined for the vendor to include the software framework and middleware layer.	Saas
18	Which of the following cloud does not require mapping	Public
19	Which of the following model type is not trusted in terms of security ?	Public

20	Which of the following is a compliance standard?	PCI-DSS
21	Which of the following is key mechanism for protecting data?	Access control
22	How many security accounts per client is provided by Microsoft?	lose the keys
23	_____ heps to interact with the public directly	Box.com
24	Which of the following is one of the most actively developing and important areas of cloud computing technology?	Logging
25	Which of the following is done by Identity management ?	controlling access to data in
26	Which of the following is required by Cloud Computing ?	That the authentication
27	_____ offers social networking service	Box.com
28	Which of the following is a complementary mechanism to OpenID and is used to create SSO systems ?	OpenSSL
29	Which of the following entity queries the OpenID identity provider to authenticate the veracity of the OpenID credentials ?	serving party
30	Which of the following provides a token service that can be used to present validated access to resources ?	OAuth
31	There are _____ types of cloud security services.	3
32	_____ allows users to authenticate their access to applications both locally and in the cloud with a claims-based identity.	AD FS
33	_____ is the testing or reconciliation of evidence of a user's identity.	Authentication
34	Which of the following is Virtual machine conversion cloud	BMC Cloud Computing Initiative
35	Which of the following area of cloud computing is uniquely troub	Auditing
36	Which of the following is a complimentary mechanism to OpenID and is used to create SSO systems ?	OpenSSL
37	_____ is a framework tool for managing cloud infrastructure.	IBM Tivoli Service Automation Manager
38	_____ is Microsoft's cloud-based management service for Windows systems.	Intune
39	_____ is security principles applied to protect data,applications and infrastructure associated within the CloudComputing technology.	cloud security

40	CSPs Stands for _____	Cloud Service Providers
41	_____ describes the technologies and protocols that enable a user to package security credentials across security domains	FIDM
42	Both the PaaS and SaaS hide the host operating system from end users in _____ level	Network
43	Host security responsibilities in SaaS and PaaS are transferred to CSP	Saas, PaaS
44	_____ is not responsibility for Application level Security	IaaS
45	Sensitive data cannot be stored in a _____	private cloud
46	Confidentiality, Integrity and Availability are objectives of _____ in the cloud	cloud security
47	_____Improves operational efficiency and regulatory compliance management	IAM
48	Industry standards for federated identity management is _____	SAML
49	The Abbreviation for OAuth is _____	Open Authentication
50	_____ in cloud should be stored in encrypted form	data
51	An alternative to using passwords for authentication in logical or technical access control is _____	Biometrics
52	Find the odd man man out in Data Security Key Mechanisms	Auditing
53	Which Application offers e-mail publishing platform?	MailChimp
54	_____ app helps the employee to share important information about organization in real time	MailChimp
55	_____ offers creating text documents, spreadsheets, presentations, etc	MailChimp
56	____ offers online accounting solutions for a business	MailChimp
57	Which one of the applications offering data storage and backup services in cloud ?	Box.com
58	_____ offers drag and drop service for files	Box.com
59	_____ offers online backup service for files to prevent data loss	Box.com
60	_____ is a web- based interface	Box.com

unit 4

1	Which of the following services that need to be negotiated in Service Level Agreements	Logging
2	Which of the following model allows vendor to provide security as part of the Service Level Agreement ?	Saas
3	How many security accounts per client is provided by Micros	1
4	Which of the following is the standard for interoperable cloud-based key management?	KMIP
5	Amazon Web Services supports _____ Type II Audits.	SAS70
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opt2	opt3	opt4	opt5	opt6	Answer
Hacking	Authentication	Authorization			**Authentication**
Network	infrastructure	application			**Network**
DoS	Eavesdropper	Hacker			Eavesdropper
Authorization	Security	Hacking			Authorization
Injection	Sniffer	Cookie Poisoning			Cookie Poisoning
Cloud Availability	Scalability	Cloud Privacy			Cloud Security
Availibility	Replicate	Resilient			Resilient
DoS	Evesdropping	Snifer			DoS
Mean Time To Reach	Metric Time To Reach	Mean Time To Recover			Mean Time To Recover
PaaS	IaaS	All the above			IaaS
Data integrity	e-Discovery for legal co	All the above			All the above
Portability and interoperability	Flexibility	Data integrity			Portability and interoperability
Identity and access	Virtualization	Scalability			Multi-tenancy
Webmetrics	Univa UD	Tapinsystems			Webmetrics
Webmetrics	Univa UD	Tapinsystems			Univa UD
Confidentiality, Integrity, and Availability	Cloud Integrity Assurance	Cloud Independent Analysis			Confidentiality, Integrity, and Availability
PaaS	IaaS	Cloud Privacy			PaaS
Private	Hybrid	VMware Hyperic			Public
Private	Hybrid	Cloud Privacy			Public

HIPPA	GLBA	All the above			All the above
Auditing	Authentication	All the above			All the above
lose the encryptio	lose the encryption sta	All the above			lose the keys
Mozy	facebook	Twitter			Twitter
Auditing	Regulatory compliance	Data integrity			Regulatory compliance
maintaining user roles	preventing unauthorized uses	All the above			All the above
That the identity be authenticated	That the authentication be	All the above			All the above
Mozy	facebook	Twitter			facebook
CHAP	SMAL	OpenID 2.0			SMAL
relieving party	relaying party	Authentication			relaying party
OCheck	SAML	CHAP			OAuth
2	4	5			**3**
AC	SAS	OAuth			AD FS
Authorization	Auditing	Accessibility			**Authentication**
Amazon CloudWa	AbiCloud	AWS			AbiCloud
Data integrity	e-Discovery for legal compliance	All the above			All the above
CHAP	SMAL	AD FS			SMAL
Microsoft Tivoli Service Automation Manager	Google Service Automation Manager	Windows Live Hotmail			IBM Tivoli Service Automation Manager
Utunes	Outtunes	Windows Live Hotmail			Intune
data security	Agility	Authentication			cloud security

Cloud Server Providers	Cloud Security Providers	Cloud Serive Privacy			Cloud Service Providers
FDM	FMID	FIM			FIDM
Host	Application	Network & Host			Host
SaaS,IaaS	IaaS, PaaS	PaaS,CSP			Saas, PaaS
PaaS	SaaS	RaaS			IaaS
public cloud	Hybrid cloud	commodity cloud			public cloud
Data integrity	data security	Authentication			data security
AMI	MAI	IMA			IAM
WS-Federation	Liberty Alliance	All the above			All the above
Authentication	Authorization	Open Authorization			Open Authentication
security	network	IMA			data
Passwords	Memory cards	Biometrics			Biometrics
Authentication	Authorization	service model			service model
Chatter	Google Apps for Business	Quickbooks			MailChimp
Chatter	Google Apps for Business	Quickbooks			Chatter
Chatter	Google Apps for Business	Quickbooks			Google Apps for Business
Outright	Google Apps for Business	Quickbooks			Quickbooks
Chatter	Google Apps for Business	Quickbooks			Box.com
Mozy	Joukuu	Moo			Box.com
Mozy	Joukuu	Audio box.fm			Mozy
Mozy	Joukuu	Twitter			Joukuu

Auditing	Regulatory complian	All the above		All the above
PaaS	IaaS			Saas
3	5	7		5

PMIK   AIMK   CAS   KMIP
SAS20   SAS702   SAS709   SAS70