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Rasipuram - 637 408, Namakkal Dist., Tamil Nadu

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L 01

LECTURE HANDOUTS

MCA

II / III

Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **I - Distributed Systems**

Date of Lecture: 18.08.2021

Topic of Lecture : Introduction to Distributed Systems

Introduction :

- A distributed system contains multiple nodes that are physically separate but linked together using the network.
- All the nodes in this system communicate with each other and handle processes in tandem.

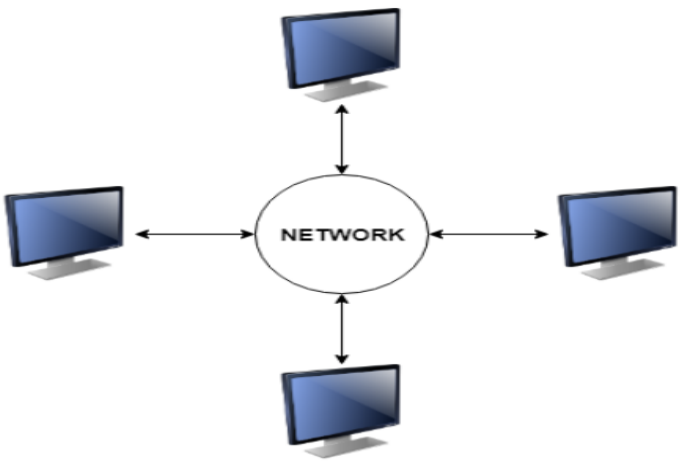
Prerequisite knowledge for Complete understanding and learning of Topic:

- Nodes
- Data Communication
- Data Transmission

Detailed content of the Lecture:

Distributed Systems:

- A distributed system contains multiple nodes that are physically separate but linked together using the network.
- All the nodes in this system communicate with each other and handle processes in tandem.
- Each of these nodes contains a small part of the distributed operating system software.



DISTRIBUTED OPERATING SYSTEM

Advantages of Distributed Systems:

- All the nodes in the distributed system are connected to each other. So nodes can easily share data with other nodes.
- More nodes can easily be added to the distributed system i.e. it can be scaled as required.
- Failure of one node does not lead to the failure of the entire distributed system. Other nodes can still communicate with each other.
- Resources like printers can be shared with multiple nodes rather than being restricted to just one.

Disadvantages of Distributed Systems:

- It is difficult to provide adequate security in distributed systems because the nodes as well as the connections need to be secured.
- Some messages and data can be lost in the network while moving from one node to another.
- The database connected to the distributed systems is quite complicated and difficult to handle as compared to a single user system.
- Overloading may occur in the network if all the nodes of the distributed system try to send data at once.

Types of Distributed Systems:

- The nodes in the distributed systems can be arranged in the form of client/server systems or peer to peer systems. Details about these are as follows −

Client/Server Systems:

- In client server systems, the client requests a resource and the server provides that resource.
- A server may serve multiple clients at the same time while a client is in contact with only one server.
- Both the client and server usually communicate via a computer network and so they are a part of distributed systems.

Peer to Peer Systems:

- The peer to peer systems contains nodes that are equal participants in data sharing. All the tasks are equally divided between all the nodes.
- The nodes interact with each other as required as share resources.
- This is done with the help of a network.

Video Content / Details of website for further learning (if any):
https://www.youtube.com/watch?v=dX2PSA0si5g

Important Books/Journals for further learning including the page nos.:
Distributed and Cloud computing,From Parallel Processing to the Internet of Things-Kai Hwang, Geoffrey C. Fox & Jack G. Dongarra,Morgan Kaufmann Publishers,First Edition, 2012.
(Page No : 36 - 40)

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LECTURE HANDOUTS

MCA

II / III

Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **I - Distributed Systems**

Date of Lecture: 19.08.2021

Topic of Lecture: Characterization of Distributed Systems

Introduction :

- A distributed system is one in which components located at networked computers communicate and coordinate their actions only by passing messages.
- A distributed system consists of a collection of autonomous computers linked by a computer network and equipped with distributed system software.
- This software enables computers to coordinate their activities and to share the resources of the system hardware, software, and data.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Distributed Data.
- Distributed Computing.
- Data Communications.

Detailed content of the Lecture:

Characterization of Distributed Systems:

- A distributed system is one in which components located at networked computers communicate and coordinate their actions only by passing messages.
- A distributed system consists of a collection of autonomous computers linked by a computer network and equipped with distributed system software.
- This software enables computers to coordinate their activities and to share the resources of the system hardware, software, and data.
- Cluster - "A type of parallel or distributed processing system, which consists of a collection of interconnected stand-alone computers cooperatively working together as a single, integrated computing resource" .
- Cloud - "A type of parallel and distributed system consisting of a collection of interconnected and virtualised computers that are dynamically provisioned and presented as one or more unified computing resources based on service level agreements established through negotiation between the service provider and consumers".

Characterization of a Distributed System

- There are three significant characteristics on how distributed systems are dfiferent from centralized systems:

1. **Concurrency of components** - different system components do work at once and handle communication (ex. retrieving results or sending data) by passing messages.
2. **Lack of global clock** - in distributed systems each system has its own clock. Systems might somewhat synchronize their clocks sometimes but they most likely will not have the same time.
3. **Independent failures of components** - in a distributed system one component might fail due to some unforeseen (or foreseen) circumstances. Dependant on how the distributed system is managed, the other components may keep on running or fail as well.

Types of Distributed Operating System

- Client-Server Systems.
- Peer-to-Peer Systems.
- Middleware.
- Three-tier.
- N-tier.

Distributed system concepts

- Availability
- Consistency
- Idempotency
- Data durability
- Message Persistence

Key characteristics of distributed systems

- Resource sharing.
- Openess.
- Concurrency.
- Scalability.
- Fault Tolerance.
- Transparency.

Video Content / Details of website for further learning (if any):
https://www.youtube.com/watch?v=wLzIhhLQlqk

Important Books/Journals for further learning including the page nos.:
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II / III

Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **I - Distributed Systems**

Date of Lecture: 21.08.2021

Topic of Lecture: Distributed Architectural Models

Introduction :

- There are several technology frameworks to support distributed architectures, including . NET, J2EE, CORBA, . NET Web services, AXIS Java Web services, and Globus Grid services.
- Middleware is an infrastructure that appropriately supports the development and execution of distributed

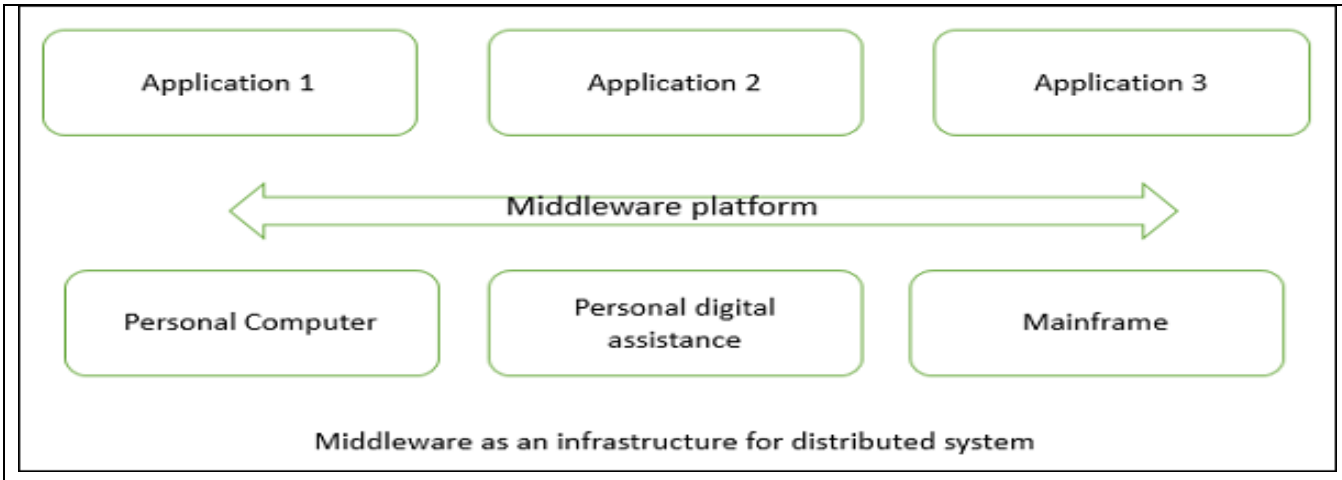
Prerequisite knowledge for Complete understanding and learning of Topic:

- Distributed Computing.
- Distributed Architectural.
- Grids Services.

Detailed content of the Lecture:

Distributed Architectural Models:

- In this architecture, information processing is not confined to a single machine rather it is distributed over several independent computers.
- A distributed system can be demonstrated by the client-server architecture which forms the base for multi-tier architectures; alternatives are the broker architecture such as CORBA, and the Service-Oriented Architecture (SOA).
- There are several technology frameworks to support distributed architectures, including .NET, J2EE, CORBA, .NET Web services, AXIS Java Web services, and Globus Grid services.
- Middleware is an infrastructure that appropriately supports the development and execution of distributed applications. It provides a buffer between the applications and the network.
- It sits in the middle of system and manages or supports the different components of a distributed system. Examples are transaction processing monitors, data convertors and communication controllers etc.
- The basis of a distributed architecture is its transparency, reliability, and availability.



Middleware as an infrastructure for distributed system

Advantages

- **Resource sharing** − Sharing of hardware and software resources.
- **Openness** − Flexibility of using hardware and software of different vendors.
- **Concurrency** − Concurrent processing to enhance performance.
- **Scalability** − Increased throughput by adding new resources.
- **Fault tolerance** − The ability to continue in operation after a fault has occurred.

Disadvantages

- **Complexity** − They are more complex than centralized systems.
- **Security** − More susceptible to external attack.
- **Manageability** − More effort required for system management.
- **Unpredictability** − Unpredictable responses depending on the system organization and network load.

Video Content / Details of website for further learning (if any):
https://www.youtube.com/watch?v=qTU375J5F9s

Important Books/Journals for further learning including the page nos.:
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II / III

Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **I - Distributed Systems**

Date of Lecture:23.08.2021

Topic of Lecture : Remote Invocation

Introduction :

- Remote Method Invocation (RMI) is an API which allows an object to invoke a method on an object that exists in another address space, which could be on the same machine or on a remote machine.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Distributed Architectural.
- Grids Services.
- Object.

Detailed content of the Lecture:

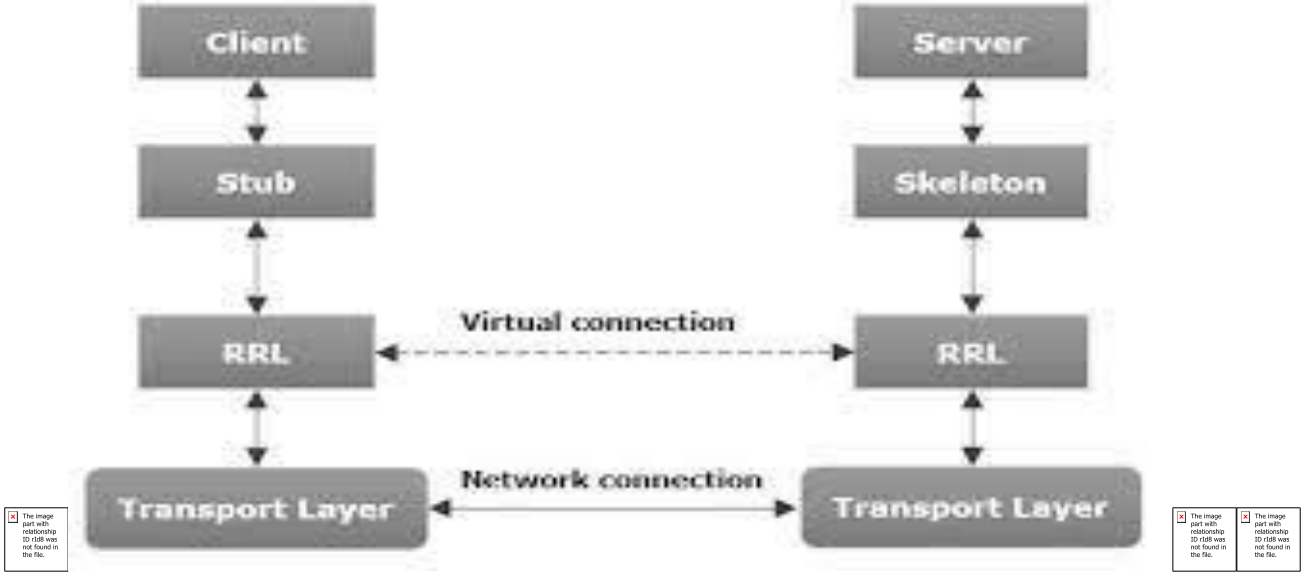
Remote Invocation :

RMI:

- RMI stands for Remote Method Invocation.
- It is a mechanism that allows an object residing in one system (JVM) to access/invoke an object running on another JVM.
- RMI is used to build distributed applications; it provides remote communication between Java programs. It is provided in the package java.

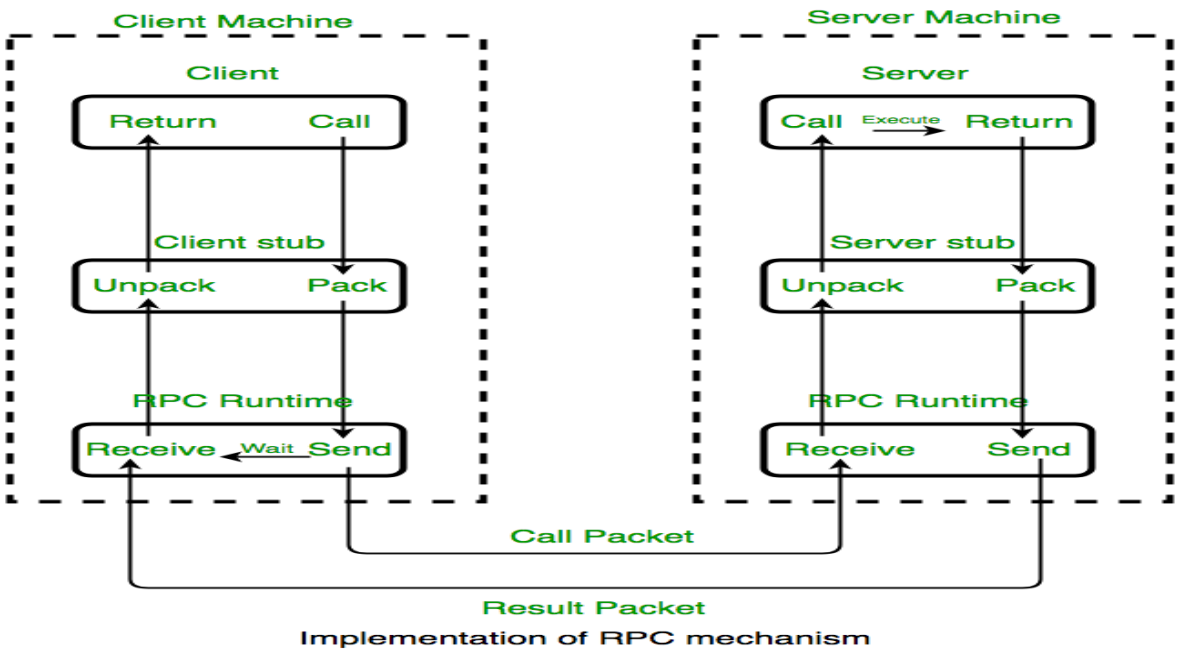
Architecture of an RMI Application

- In an RMI application, we write two programs, a server program (resides on the server) and a client program (resides on the client).
- Inside the server program, a remote object is created and reference of that object is made available for the client (using the registry).
- The client program requests the remote objects on the server and tries to invoke its methods.
- The following diagram shows the architecture of an RMI application.



RPC:

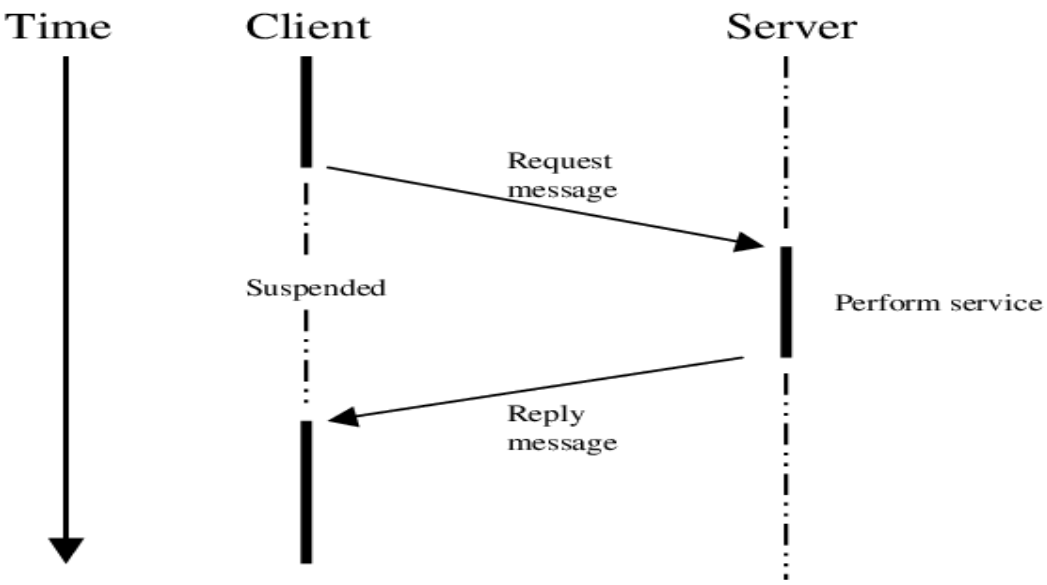
- Remote Procedure Call is a software communication protocol that one program can use to request a service from a program located in another computer on a network without having to understand the network's details.
- RPC is used to call other processes on the remote systems like a local system.



Implementation of RPC mechanism

RRP:

- In computer science, request–response or request–reply is one of the basic methods computers use to communicate with each other in a network, in which the first computer sends a request for some data and the second responds to the request.



- To implement request/reply communication, the BEA Tuxedo system uses IPC message queues. Queues are the key to connection less communication.
- Each server is assigned an Inter-Process Communication (IPC) message queue called a request queue and each client is assigned a reply queue.

Video Content / Details of website for further learning (if any):
https://www.youtube.com/watch?v=kBw7c5Kwf00

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II / III

Course Name with Code :**CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **I - Distributed Systems**

Date of Lecture: 25.08.2021

Topic of Lecture : Group Communication

Introduction :

- Communication between two processes in a distributed system is required to exchange various data, such as code or a file, between the processes.
- When one source process tries to communicate with multiple processes at once, it is called Group Communication.

Prerequisite knowledge for Complete understanding and learning of Topic:

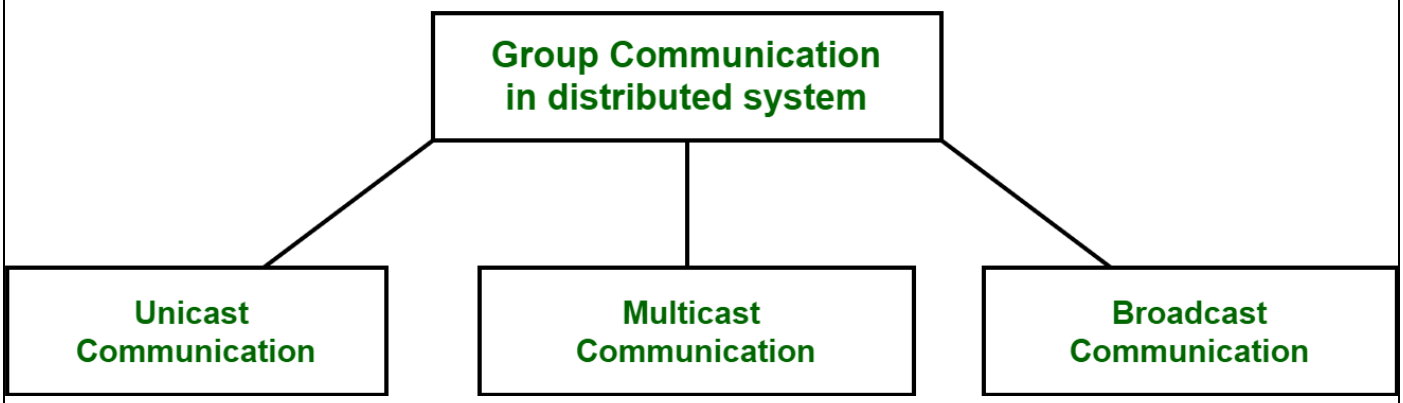
- Object.
- Group Communication.
- Distributed Systems.

Detailed content of the Lecture:

Group Communication :

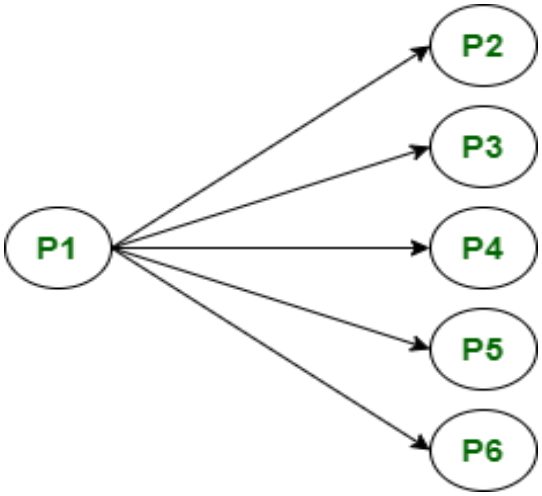
- A group is a collection of interconnected processes with abstraction. This abstraction is to hide the message passing so that the communication looks like a normal procedure call.
- Group communication also helps the processes from different hosts to work together and perform operations in a synchronized manner, therefore increases the overall performance of the system.

Types of Group Communication in a Distributed System :



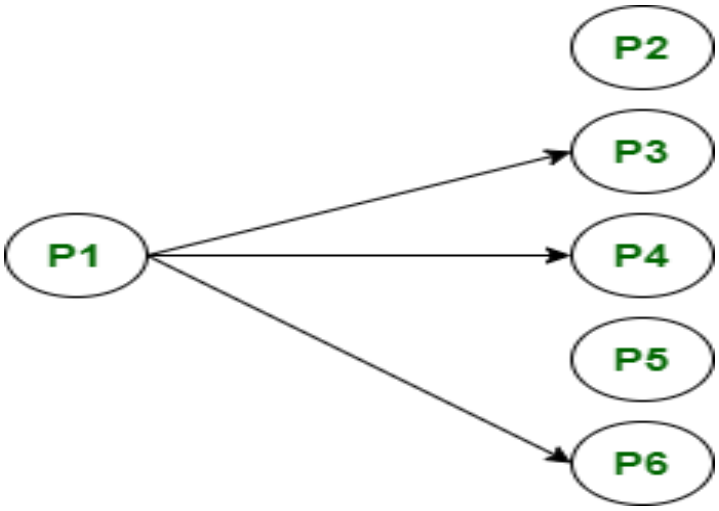
Broadcast Communication :

- When the host process tries to communicate with every process in a distributed system at same time.
- Broadcast communication comes in handy when a common stream of information is to be delivered to each and every process in most efficient manner possible.



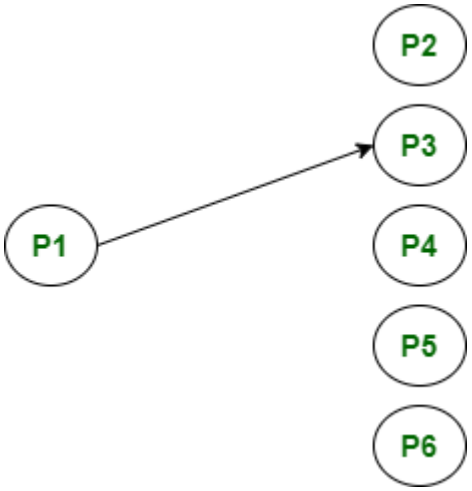
Multicast Communication :

- When the host process tries to communicate with a designated group of processes in a distributed system at the same time.
- This technique is mainly used to find a way to address problem of a high workload on host system and redundant information from process in system.



Unicast Communication :

- When the host process tries to communicate with a single process in a distributed system at the same time.
- Although, same information may be passed to multiple processes.
- This works best for two processes communicating as only it has to treat a specific process only.
- It leads to overheads as it has to find exact process and then exchange information/data.



Video Content / Details of website for further learning (if any):
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LECTURE HANDOUTS

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II / III

Course Name with Code :**CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **I - Distributed Systems**

Date of Lecture: 26.08.2021

Topic of Lecture: Coordination in Group Communication

Introduction :

- The coordination part of a distributed system handles the communication and cooperation between processes.
- It forms the glue that binds the activities performed by processes into a whole (Gelernter and Carriero, 1992).

Prerequisite knowledge for Complete understanding and learning of Topic:

- Group Communication.
- Distributed Systems.
- System Model.

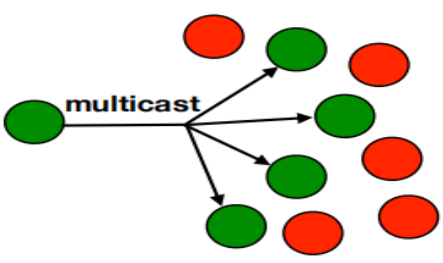
Detailed content of the Lecture:

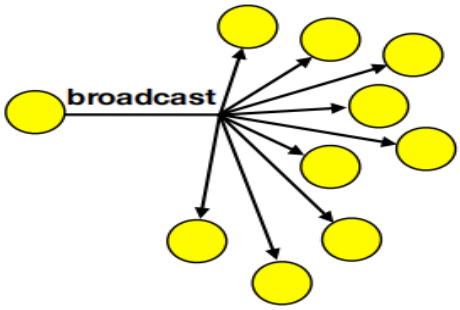
Coordination in Group Communication:

- Cabri et al. (2000) provide a taxonomy of coordination models for mobile agents that can be applied equally to many other types of distributed systems.
- Adapting their terminology to distributed systems in general, we make a distinction between models along two different dimensions, temporal and referential.

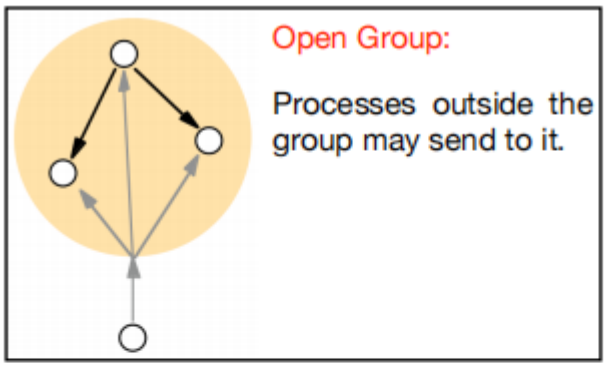
Multicast VS Broadcast:

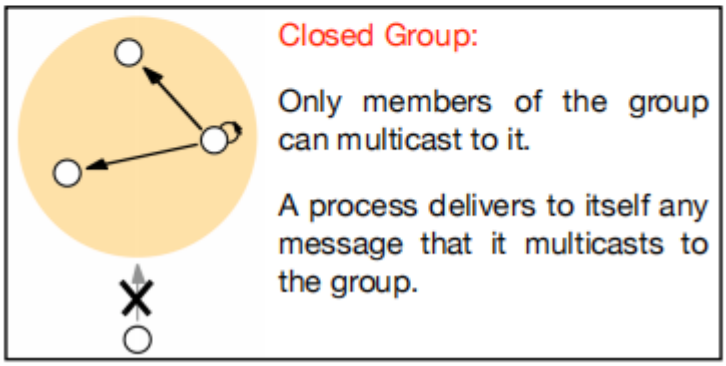
- Communication to all processes in the system, as opposed to a sub-group of them, is known as broadcast.





Open VS Closed Group:





System Model:

- Processes may fail only by crashing
- Processes are members of groups, which are the destinations of messages sent with the multicast operation

Communication primitives:

- **multicast(g, m) :** sends a message m to all members of the group g
- **deliver(m) :** delivers a message sent by multicast to the calling process

Video Content / Details of website for further learning (if any):
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Important Books/Journals for further learning including the page nos.:
Distributed and Cloud computing,From Parallel Processing to the Internet of Things-Kai Hwang, Geoffrey C. Fox & Jack G. Dongarra,Morgan Kaufmann Publishers,First Edition, 2012.
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LECTURE HANDOUTS

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II / III

Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **I - Distributed Systems**

Date of Lecture: 28.08.2021

Topic of Lecture : Ordered Multicast , Time Ordering

Introduction :

- One dedicated "sequencer" that orders all messages – Everyone else follows.
- Similar to having a sequencer, but the responsibility is distributed to each sender.
- Total order multicast is a primitive that sends messages to a set of destinations and enforces a total order on the delivery of those messages (i.e., all messages are delivered in the same order).

Prerequisite knowledge for Complete understanding and learning of Topic:

- Distributed Systems.
- System Model.
- FIFO

Detailed content of the Lecture:

Ordered Multicast , Time Ordering:

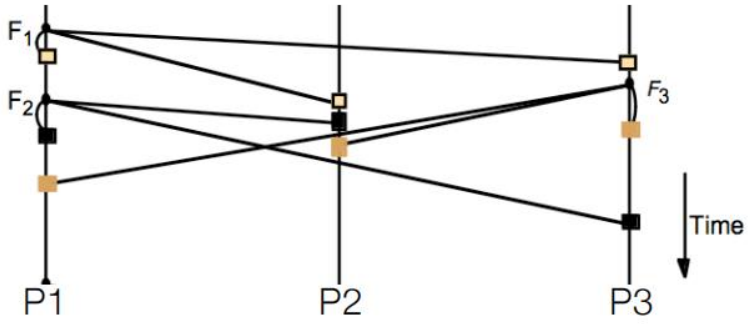
- The B- and R- multicast algorithms deliver messages to processes in an arbitrary order, due to arbitrary delays in the 1-to-1 send operations

Common ordering requirements:

- **FIFO ordering:** if a correct process issues multicast(g, m) and then multicast(g, m') multicast(g, m) $\rightarrow_i$ multicast(g, m')), then every correct
- process that delivers m' will deliver m before m'; partial relation
- **Causal ordering:** multicast(g, m) $\rightarrow$multicast(g, m'), then any correct process that delivers m' will deliver m before m'; partial relation
- **Total ordering:** if a correct process delivers message m before it delivers m', then any other correct process that delivers m' will deliver m before m'.
- N.B.: causal ordering implies FIFO ordering

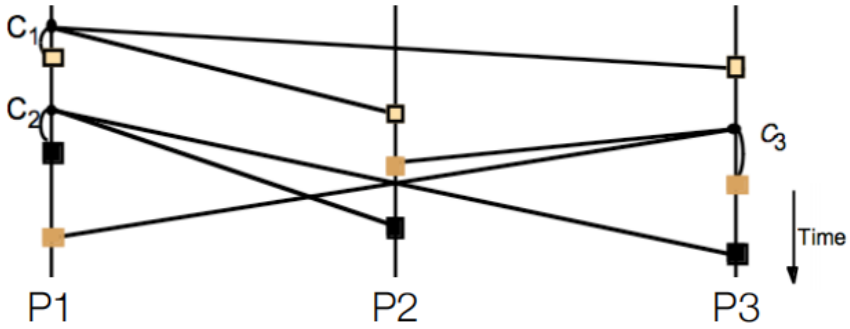
FIFO Ordering:

- If a correct process pi issues multicast(g, m) and then multicast (g, m') (multicast(g, m) $\rightarrow_i$ multicast(g, m')), then every correct process that delivers m' will deliver m before m'



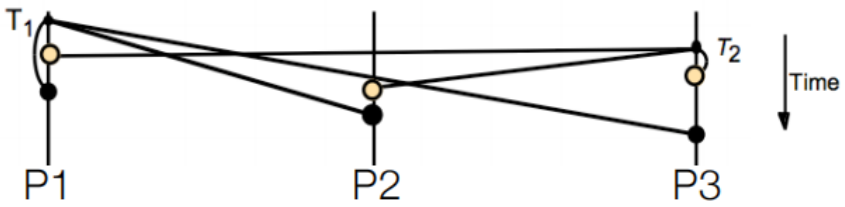
Causal ordering:

- multicast(g, m) →multicast(g, m'), then any correct process that delivers m' will deliver m before m'



Total ordering:

- If a correct process delivers message m before it delivers m', then any other correct process that delivers m' will deliver m before m'



Video Content / Details of website for further learning (if any):
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LECTURE HANDOUTS

MCA

II / III

Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **I - Distributed Systems**

Date of Lecture: 01.09.2021

Topic of Lecture: Physical Clock Synchronization

Introduction :

- .Synchronization in distributed systems is achieved via clocks.
- The physical clocks are used to adjust the time of nodes.
- Each node in the system can share its local time with other nodes in the system.
- It is used as a reference and the nodes in the system can set and adjust their time accordingly

Prerequisite knowledge for Complete understanding and learning of Topic:

- FIFO.
- Client.
- Server.
- Distributed Systems.

Detailed content of the Lecture:

Physical Clock Synchronization :

- Distributed System is a collection of computers connected via the high speed communication network.
- In the distributed system, the hardware and software components communicate and coordinate their actions by message passing.
- Each node in distributed systems can share their resources with other nodes. So, there is need of proper allocation of resources to preserve the state of resources and help coordinate between the several processes.
- To resolve such conflicts, synchronization is used. Synchronization in distributed systems is achieved via clocks.

The clock synchronization can be achieved by 2 ways:

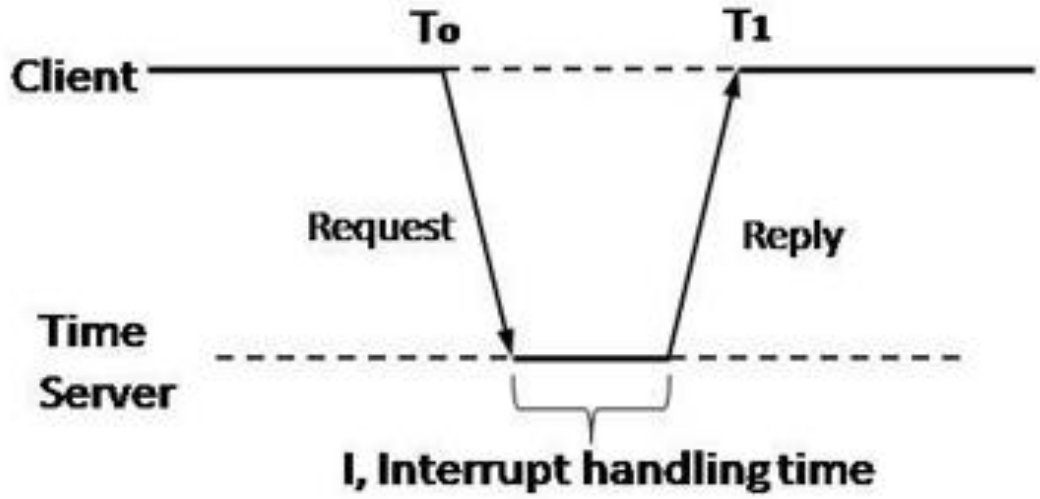
External and Internal Clock Synchronization:

1. **External clock synchronization** is the one in which an external reference clock is present. It is used as a reference and the nodes in the system can set and adjust their time accordingly.
2. **Internal clock synchronization** is the one in which each node shares its time with other nodes and all the nodes set and adjust their times accordingly.

There are 2 types of clock synchronization algorithms:

Centralized and Distributed:

- **Centralized** is the one in which a time server is used as a reference.
- The single time server propagates its time to the nodes and all the nodes adjust the time accordingly. It is dependent on single time server so if that node fails, the whole system will lose synchronization. Examples of centralized are- Berkeley Algorithm, Passive Time Server, Active Time Server etc.
- **Distributed** is the one in which there is no centralized time server present.
- Instead the nodes adjust their time by using their local time and then, taking the average of the differences of time with other nodes.
- Distributed algorithms overcome the issue of centralized algorithms like the scalability and single point failure.
- Examples of Distributed algorithms are – Global Averaging Algorithm, Localized Averaging Algorithm, NTP (Network time protocol) etc.



Video Content / Details of website for further learning (if any):

https://www.youtube.com/watch?v=aiJTAqu4gxs

Important Books/Journals for further learning including the page nos.:

Distributed and Cloud computing,From Parallel Processing to the Internet of Things-Kai Hwang, Geoffrey C. Fox & Jack G. Dongarra,Morgan Kaufmann Publishers,First Edition, 2012.
(Page No : 117 - 121)

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LECTURE HANDOUTS

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II / III

Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **I - Distributed Systems**

Date of Lecture: 02.09.2021

Topic of Lecture: Logical Time and Logical Clocks.

Introduction :

- A logical clock is a mechanism for capturing chronological and causal relationships in a distributed system.
- Distributed systems may have no physically synchronous global clock, so a logical clock allows global ordering on events from different processes in such systems.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Client.
- Server.
- Distributed Systems.

Detailed content of the Lecture:

Logical Time and Logical Clocks:

- Logical Clocks refer to implementing a protocol on all machines within your distributed system, so that the machines are able to maintain consistent ordering of events within some virtual time span.

Algorithm:

- Lamport timestamps, which are monotonically increasing software counters.
- Vector clocks, that allow for partial ordering of events in a distributed system.
- Version vectors, order replicas, according to updates, in an optimistic replicated system.
- Matrix clocks, an extension of vector clocks that also contains information about other processes' views of the system.

- Knowing the ordering of events is important • not enough with physical time.
- Two simple points [Lamport 1978] • the order of two events in the same process the event of sending message always happens before the event of receiving the message.
- Happened-before relations: partial order, Æ • HB1, HB2 • HB3 means happened-before relation is transitive

Lamport's logical clocks:

- It is a monotonically increasing software counter.
- It need not relate to a physical clock
- Each process pi has a logical clock Li •
- LC1: Li is incremented by 1 before each event at process pi •
- LC2: (a) when process pi sends message m, it piggybacks t = Li
- (b) when pjreceives (m,t), it sets Lj := max(Lj , t) and applies LC1 before time stamping the event receive (m)
- $e \rightarrow e' \Rightarrow L(e) < L(e')$ but not vice versa □
- **Example:** event b and event e □ shortcoming of Lamport's clock e.

Vector clocks (Mattern [1989] and Fidge [1991]) :

- Fix the problem in Lamport's clock ˆ
- **Vector clock:** an array of N integers for a system with N processes. Each process Pi has its own local vector clock Vi. ˆ

Rules for updating clocks: •

- VC1:initially Vi [j] = 0 for i, j = 1, 2, …N •
- VC2:before pi timestamps an event it sets Vi [i] := Vi [i] +1
- VC3: pi piggybacks t = Vi on every message it sends •
- VC4: when pi receives (m,t) it sets Vi [j] := max(Vi [j] , t[j]) j = 1, 2, …N (then adds I to its own element using VC2)

Merge operation :

- E.g. at p2, (0, 0, 0) -> (0, 1, 0) -> (0, 2, 0) -> (0, 3, 0) … -> (1, 4, 3)

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LECTURE HANDOUTS

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II / III

Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **II - Introduction To Cloud Computing**

Date of Lecture: 03.09.2021

Topic of Lecture: Cloud Computing Basics , Desired features of Cloud Computing

Introduction :

- Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources

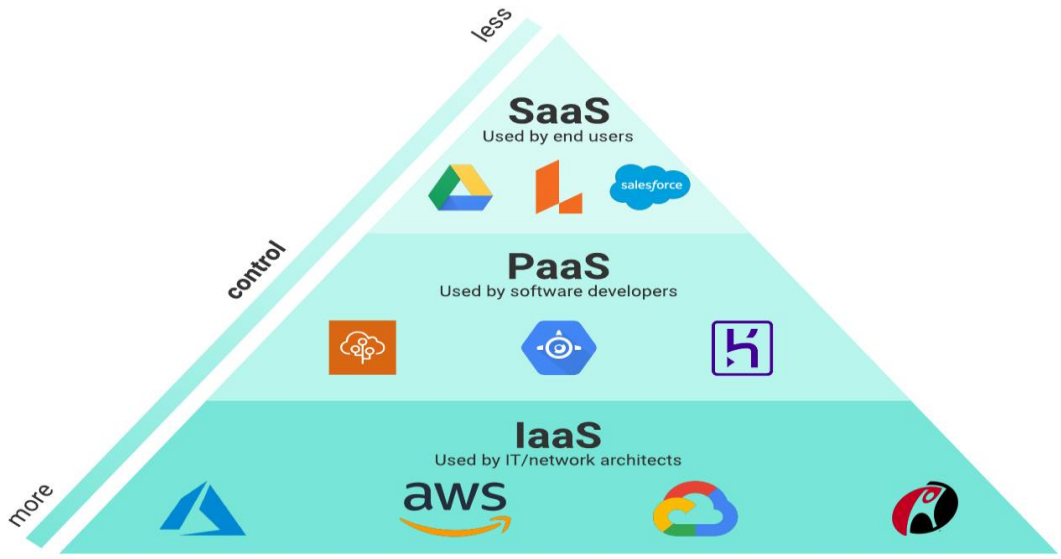
Prerequisite knowledge for Complete understanding and learning of Topic:

- Distributed Systems.
- Cloud Services.
- Network Access.

Detailed content of the Lecture:

<u>Cloud Computing Basics:</u>

- Cloud solutions come in three primary service models:
- Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS).



Desired features of Cloud Computing :

RESOURCES POOLING:

- Resource pooling is one of the essential characteristics of Cloud Computing.
- Resource pooling means that a cloud service provider can share resources among several clients, providing everyone with a different set of services as per their requirements.

ON-DEMAND SELF-SERVICE:

- It is one of the significant and essential features of Cloud Computing. It enables the client to constantly monitor the server uptime, abilities, and allotted network storage.

EASY MAINTENANCE:

- This is one of the best cloud characteristics. The servers are effortlessly maintained, and the downtime remains low or absolutely zero sometimes.

SCALABILITY AND RAPID ELASTICITY:

- A key characteristic and benefit of cloud computing is its rapid scalability. This cloud characteristic enables cost-effective running of workloads that require a vast number of servers but only for a short period.

ECONOMICAL:

- This cloud characteristic helps in reducing the IT expenditure of the organizations. In Cloud Computing, the client needs to pay the administration for the space they have used.

MEASURED AND REPORTING SERVICE:

- Reporting services are one of the many cloud characteristics that make it the best choice for organizations. Measuring & reporting service is helpful for both cloud providers and their clients.

SECURITY:

- Data security is one of the best characteristics of Cloud Computing. Cloud services create a copy of the data that is stored to prevent any form of data loss. If one server loses the data by any chance, the copy version is restored from the other server.

AUTOMATION:

- Automation is an essential characteristic of cloud computing. The ability of cloud computing to automatically install, configure, and maintain a cloud service is known as automation in cloud computing. In simple terms, it is the process of making the most of technology and reducing manual effort.

RESILIENCE:

- Resilience in cloud computing means the ability of the service to quickly recover from any disruption. A cloud's resilience is measured by how fast its servers, databases, and network system restarts and recovers from any kind of harm or damage.

LARGE NETWORK ACCESS:

- A big part of the cloud characteristics is its ubiquity. The client can access the cloud data or transfer the data to the cloud from any place just with a device and internet connection.

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Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **II - Introduction To Cloud Computing**

Date of Lecture: 06.09.2021

Topic of Lecture : Elasticity in Cloud , Ondemand provisioning

Introduction :

- In cloud computing, elasticity is defined as "the degree to which a system is able to adapt to workload changes by provisioning and de-provisioning resources in an autonomic manner.
- On-demand computing is a delivery model in which computing resources are made available to the user as needed. The resources may be maintained within the user's enterprise, or made available by a cloud service provider.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Cloud Services.
- Network Access.
- Cloud Provider.

Detailed content of the Lecture:

Elasticity in Cloud:

- Public cloud providers such as Amazon Web Services (AWS) and Google Cloud support rapid elasticity.
- The quicker a cloud provider can allocate varying resources to dynamic customer demands, the more elastic its cloud services.
- Cloud elasticity enables a “pay as you go” cost model, in which you're only charged for the resources that you actually consume.
- For example, Amazon claims that customers who use the AWS Instance Scheduler with Amazon EC2 (Elastic Compute Cloud) .
- Cloud elasticity is the process by which a cloud provider will provision resources to an enterprise's processes based on the needs of that process.
- Cloud provides have systems in place to automatically deliver or remove resources in order to provide just the right amount of assets for each project.
- The relational algebra is a Procedure Query Language
- It consist of a set of operations that take one or two relations as input and produce a new relation as the result.

Implement elasticity:

- Identify the workloads that have variable load.

- Identify the workload load range. That is, is there enough variability to warrant adding or removing resources?
- Identify the application limitations (sessions, long initialization, licensing, etc.) that may limit elasticity.
- Identify if the increase in demand can be met by automatic scaling, or if it needs to be in place before (for events, launches, etc.).
- Identify applications that can use Amazon Athena or Amazon Aurora Server less

Ondemand Provisioning :

- The on-demand model was developed to overcome the common challenge to an enterprise of being able to meet fluctuating demands efficiently.
- Because an enterprise's demand on computing resources can vary drastically from one time to another, maintaining sufficient resources to meet peak requirements can be costly. Conversely, if an enterprise tried to cut costs by only maintaining minimal computing resources, it is likely there will not be sufficient resources to meet peak requirements.
- The on-demand model provides an enterprise with the ability to scale computing resources up or down with the click of a button, an API call or a business rule.
- The model is characterized by three attributes: scalability, pay-per-use and self-service.
- Whether the resource is an application program that helps team members collaborate or additional storage for archiving images, the computing resources are elastic, metered and easy to obtain.

Advanced Cloud Provisioning:

- Also known as "post-sales cloud provisioning," customers get the resources upon contract or service sign up.
- They sign formal contracts with the cloud service provider. The provider then prepares and delivers the agreed-upon resources or services. The customers are charged a flat fee or billed every month.

Dynamic Cloud Provisioning:

- Also referred to as "on-demand cloud provisioning," customers are provided with resources on runtime. In this delivery model, cloud resources are deployed to match customers' fluctuating demands.
- Deployments can scale up to accommodate spikes in usage and down when demands decrease. Customers are billed on a pay-per-use basis. When this model is used to create a hybrid cloud environment, it is sometimes called "cloud bursting."

User Cloud Provisioning:

- In this delivery model, customers add a cloud device themselves. Also known as "cloud self-service," clients buy resources from the cloud service provider through a web interface or portal. The model usually involves creating a user account and paying for resources with a credit card.

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Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **II - Introduction To Cloud Computing**

Date of Lecture: 08.09.2021

Topic of Lecture : Applications , Benefits

Introduction :

- Software-as-a-Service (SaaS) is probably the most well-known application for cloud computing. Essentially, SaaS products distribute data online, and are accessible from a browser on any device, which allows those companies to continue to host the software.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Network Access.
- Cloud Provider.
- Data Warehouse.

Detailed content of the Lecture:

Applications:

- Cloud computing is driven by a network of physical data warehouses hardware, software and services that run on the Internet (the "cloud") instead of on a local device (like your computer).
- With the cloud, VMware CEO Paul Maritz has said, it's about "how you do computing, not where you do computing." And these days, it's all the rage.
- A cloud application simply refers to any software application that is deployed in a cloud environment rather than being hosted on a local server or machine.
- A private cloud environment acts as a private network, creating a secure environment for applications, services and users.
- SQL can create schema, delete them and change them.
- It can also put data into schema and remove data.
- It is a data handling language but it is not a programming language.

- **Private cloud** - private cloud infrastructure is used exclusively by a single organization. Its resources are not shared by other organizations, and access to these systems is not available for the public.
- **Public cloud** - public clouds can offer low rates for data storage capacity and flexible computing power due to economies of scale.
- **Hybrid cloud** - hybrid cloud environments use API technology to combine public and private clouds together into a single environment. With a hybrid cloud environment.

Benefits :

- Cost saving, scalability, mobile storage, anytime anywhere access, better security, energy saving, environment benefits are some of benefits of the cloud computing. computing to the cloud computing and organizations and individuals are benefiting from it.

Scalability:

- The scale up or scale down your operation and storage needs quickly to suit your situation, allowing flexibility as your needs change. Rather than purchasing and installing expensive upgrades yourself, your cloud computer service provider can handle this for you. Using the cloud frees up your time so you can get on with running your business.

Business continuity:

- Protecting your data and systems is an important part of business continuity planning. Whether you experience a natural disaster, power failure or other crisis, having your data stored in the cloud ensures it is backed up and protected in a secure and safe location. Being able to access your data again quickly allows you to conduct business as usual, minimising any downtime and loss of productivity.

Collaboration efficiency:

- Collaboration in a cloud environment gives your business the ability to communicate and share more easily outside of the traditional methods. If you are working on a project across different locations, you could use cloud computing to give employees, contractors and third parties access to the same files. You could also choose a cloud computing model that makes it easy for you to share your records with your advisers.

Flexibility of work practices:

- Cloud computing allows employees to be more flexible in their work practices. For example, you have the ability to access data from home, on holiday, or via the commute to and from work (providing you have an internet connection). If you need access to your data while you are off-site, you can connect to your virtual office, quickly and easily.

Access to automatic updates:

- Access to automatic updates for your IT requirements may be included in your service fee. Depending on your cloud computing service provider, your system will regularly be updated with the latest technology. This could include up-to-date versions of software, as well as upgrades to servers and computer processing power.

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Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **II - Introduction To Cloud Computing**

Date of Lecture:09.09.2021

Topic of Lecture: Cloud Components: Clients, Data centers & Distributed Servers

Introduction :

- Distributed Servers Clients are the devices that users use to interact with to manage the information on the cloud.
- Data center: is the collection of servers where the application to which customers subscribe are housed.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Cloud Provider.
- Data Center.
- Distributed Server.

Detailed content of the Lecture:

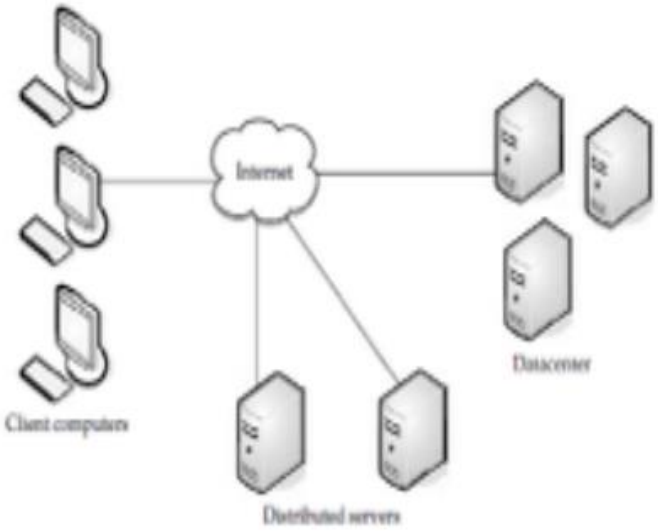
Clients, Data centers & Distributed Servers:

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

The cloud components are:

- Clients
- Data Center
- Distributed Servers

- **Clients** are the devices that users use to interact with to manage the information on the cloud.
- **Datacenter:** is the collection of servers where the application to which customers subscribe are housed. It could be a large room of servers that are accessed through Internet.
- **Distributed Servers:** The servers need not be housed in the same location. The servers can be at geographically disparate locations.



Core Components of a data center :

- Data center design includes routers, switches, firewalls, storage systems, servers, and application delivery controllers. Because these components store and manage business-critical data and applications, data center security is critical in data center design.

Data centers important to business:

- Email and file sharing
- Productivity applications
- Customer relationship management (CRM)
- Enterprise resource planning (ERP) and databases
- Big data, artificial intelligence, and machine learning
- Virtual desktops, communications and collaboration services.

Video Content / Details of website for further learning (if any):
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II / III

Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **II - Introduction To Cloud Computing**

Date of Lecture: 13.09.2021

Topic of Lecture: Characterization of Distributed Systems , Distributed Architectural Models

Introduction :

- A distributed system is one in which components located at networked computers communicate and coordinate their actions only by passing messages.
- A distributed system consists of a collection of autonomous computers linked by a computer network and equipped with distributed system software.
- There are several technology frameworks to support distributed architectures, including . NET, J2EE, CORBA, . NET Web services, AXIS Java Web services, and Globus Grid services.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Data Center.
- Distributed Server.
- Web Services.

Detailed content of the Lecture:

<u>Characterization of Distributed Systems:</u>

- A distributed system is one in which components located at networked computers communicate and coordinate their actions only by passing messages.
- A distributed system consists of a collection of autonomous computers linked by a computer network and equipped with distributed system software.
- This software enables computers to coordinate their activities and to share the resources of the system hardware, software, and data.
- Cluster - "A type of parallel or distributed processing system, which consists of a collection of interconnected stand-alone computers cooperatively working together as a single, integrated computing resource" .

Characterization of a Distributed System:

4. **Concurrency of components** - different system components do work at once and handle communication (ex. retrieving results or sending data) by passing messages.
5. **Lack of global clock** - in distributed systems each system has its own clock. Systems might somewhat synchronize their clocks sometimes but they most likely will not have the same time.
6. **Independent failures of components** - in a distributed system one component might fail due to some unforeseen (or foreseen) circumstances. Dependant on how the distributed system is

managed, the other components may keep on running or fail as well.

Types of Distributed Operating System:

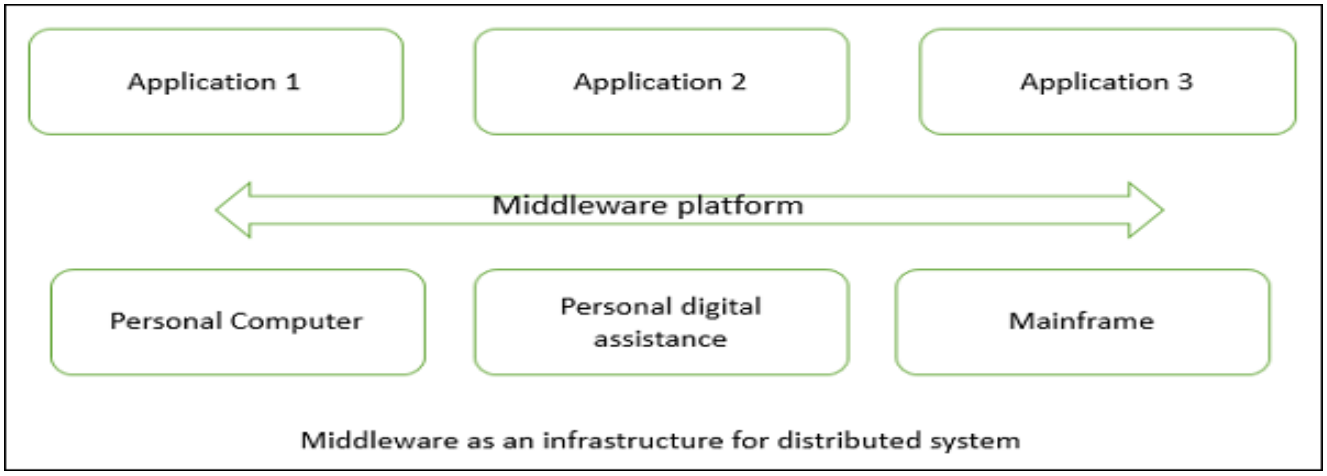
- Client-Server Systems.
- Peer-to-Peer Systems.
- Middleware.
- Three-tier.
- N-tier.

Key characteristics of distributed systems:

- Resource sharing.
- Openess.
- Concurrency.
- Scalability.
- Fault Tolerance.
- Transparency.

Distributed Architectural Models:

- In this architecture, information processing is not confined to a single machine rather it is distributed over several independent computers.
- A distributed system can be demonstrated by the client-server architecture which forms the base for multi-tier architectures; alternatives are the broker architecture such as CORBA, and the Service-Oriented Architecture (SOA).
- There are several technology frameworks to support distributed architectures, including .NET, J2EE, CORBA, .NET Web services, AXIS Java Web services, and Globus Grid services.
- Middleware is an infrastructure that appropriately supports the development and execution of distributed applications. It provides a buffer between the applications and the network.
- It sits in the middle of system and manages or supports the different components of a distributed system. Examples are transaction processing monitors, data convertors and communication controllers etc.
- The basis of a distributed architecture is its transparency, reliability, and availability.



Middleware as an infrastructure for distributed system

Advantages

- **Resource sharing** − Sharing of hardware and software resources.
- **Openness** − Flexibility of using hardware and software of different vendors.
- **Concurrency** − Concurrent processing to enhance performance.
- **Scalability** − Increased throughput by adding new resources.
- **Fault tolerance** − The ability to continue in operation after a fault has occurred.

Disadvantages

- **Complexity** − They are more complex than centralized systems.
- **Security** − More susceptible to external attack.
- **Manageability** − More effort required for system management.
- **Unpredictability** − Unpredictable responses depending on the system organization and network load.

Video Content / Details of website for further learning (if any):
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Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **II - Introduction To Cloud Computing**

Date of Lecture: 15.09.2021

Topic of Lecture : Principles of Parallel and Distributed computing

Introduction :

- In parallel computing multiple processors performs multiple tasks assigned to them simultaneously. Parallel computing provides concurrency and saves time and money.
- Parallel computing is using multiple processors in parallel to solve problems more quickly than with a single processor, or with less energy consumption.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Distributed Computing.
- Web Services.
- Parallel Computing.

Detailed content of the Lecture:

Principles of Parallel and Distributed computing :

Parallel Computing:

- In parallel computing multiple processors performs multiple tasks assigned to them simultaneously. Memory in parallel systems can either be shared or distributed. Parallel computing provides concurrency and saves time and money

- **Bit-level parallelism:** increases processor word size, which reduces the quantity of instructions the processor must execute in order to perform an operation on variables greater than the length of the word.
- **Instruction-level parallelism:** the hardware approach works upon dynamic parallelism, in which the processor decides at run-time which instructions to execute in parallel; the software approach works upon static parallelism, in which the compiler decides which instructions to execute in parallel
- **Task parallelism:** a form of parallelization of computer code across multiple processors that runs several different tasks at the same time on the same data
- **Superword - level parallelism:** a vectorization technique that can exploit parallelism of inline code.
- Parallel applications are typically classified as either fine-grained parallelism, in which subtasks will communicate several times per second; coarse-grained parallelism

Distributed Computing:

- In distributed computing we have multiple autonomous computers which seems to the user as single system. In distributed systems there is no shared memory and computers communicate with each other through message passing. In distributed computing a single task is divided among different computers.
- Distributed computing refers to solve a problem over distributed autonomous computers and they communicate between them over a network. It is a computing technique which allows to multiple computers to communicate and work to solve a single problem.
- A distributed system allows resource sharing, including software by systems connected to the network.
- **Examples of distributed systems / applications of distributed computing :** Intranets, Internet, WWW, email. Telecommunication networks: Telephone networks and Cellular networks.
- Cloud computing and distributed computing is that the cloud computing provides hardware, software and other infrastructure resources over the internet while the distributed computing divides a single task among multiple computers that are connected via a network .
- A distributed computer system consists of multiple software components that are on multiple computers, but run as a single system. ‘
- The computers that are in a distributed system can be physically close together and connected by a local network, or they can be geographically distant and connected by a wide area network.

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II / III

Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **II - Introduction To Cloud Computing**

Date of Lecture: 16.09.2021

Topic of Lecture : Applications of Cloud computing

Introduction :

- Cloud service providers provide various applications in the field of art, business, data storage and backup services, education, entertainment, management, social networking, etc.

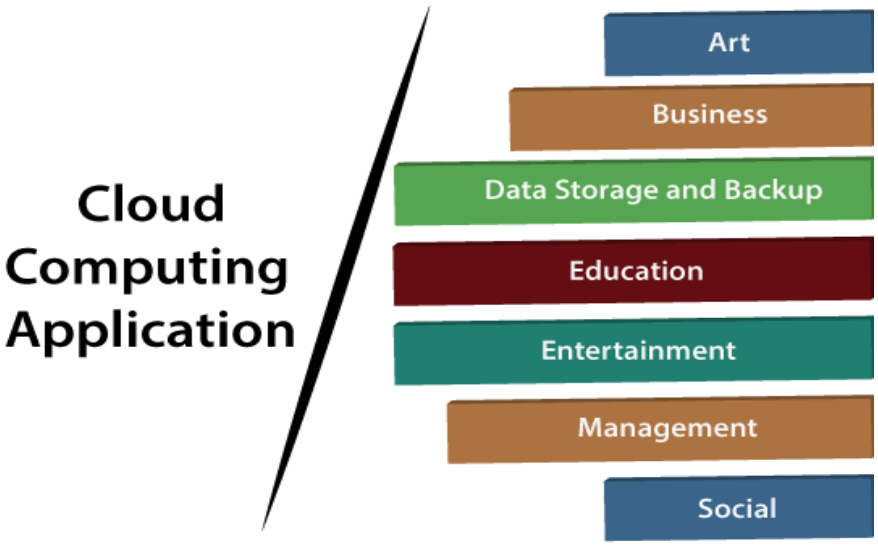
Prerequisite knowledge for Complete understanding and learning of Topic:

- Parallel Computing.
- Cloud Provider.
- Recovery.

Detailed content of the Lecture:

<u>Applications of Cloud computing:</u>

- Cloud computing allows us to store information (data, files, images, audios, and videos) on the cloud and access this information using an internet connection.
- As the cloud provider is responsible for providing security, so they offer various backup recovery application for retrieving the lost data.



Art Applications:

- Cloud computing offers various art applications for quickly and easily design attractive cards, booklets, and images. Some most commonly used cloud art applications

Business Applications:

- Business applications are based on cloud service providers. Today, every organization requires the cloud business application to grow their business. It also ensures that business applications are 24*7 available to users.

Data Storage and Backup Applications:

- Cloud computing allows us to store information (data, files, images, audios, and videos) on the cloud and access this information using an internet connection.

Education Applications:

- Cloud computing in the education sector becomes very popular. It offers various online distance learning platforms and student information portals to the students. The advantage of using cloud in the field of education is that it offers strong virtual classroom environments,

Entertainment Applications:

- Entertainment industries use a multi-cloud strategy to interact with the target audience. Cloud computing offers various entertainment applications such as online games and video conferencing.

Management Applications:

- Cloud computing offers various cloud management tools which help admins to manage all types of cloud activities, such as resource deployment, data integration, and disaster recovery.

Social Applications:

- Social cloud applications allow a large number of users to connect with each other using social networking applications such as Facebook, Twitter, Linkedln, etc.

Video Content / Details of website for further learning (if any):
https://www.youtube.com/watch?v=sVbUXVh7Nx0

Important Books/Journals for further learning including the page nos.:
Distributed and Cloud computing,From Parallel Processing to the Internet of Things-Kai Hwang, Geoffrey C. Fox & Jack G. Dongarra,Morgan Kaufmann Publishers,First Edition, 2012.
(Page No : 207 - 218)

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LECTURE HANDOUTS

II / III

MCA

Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **II - Introduction To Cloud Computing**

Date of Lecture: 18.09.2021

Topic of Lecture: Benefits , Cloud services

Introduction :

- Cloud computing represents range of different cloud computing services enabling organizations and individuals to choose where, when, and how they can use cloud computing.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Cloud Provider.
- Cloud Models.
- Cloud Infrastructure.

Detailed content of the Lecture:

Benefits:

- The Remote Desktop Session Host (RDSH) used for creating multiple cloud desktops on a Windows based machine is one of the best examples offering more benefits than traditional computing.
- It is session based deployment whereby multiple cloud desktop sessions are used on a single Microsoft Windows Server saving application licensing cost and offering more productivity.
- There are different options for using the Storage as a Service (STaaS), for example, public and private service.
- The private service offers dedicated environment inside the organization's environment and the public service is offered by different vendors.
- The STaaS is highly scalable and easy to manage storage becoming popular choice as cloud computing storage.
- Small companies and individuals can enjoy cost saving and scalability benefit of Storage as a Service (STaaS).
- The Platform as a Service (PaaS) is used to rent computing infrastructure.
- For example, organizations and individuals can rent or subscribe cloud computing infrastructure for applications accessible via Internet.
- Using PaaS service, vendors can provide customized solutions on affordable cost leading them to generate more revenue compared to customized traditional computing based solutions.

Cloud Services:

- Cloud services are infrastructure, platforms, or software that are hosted by third-party providers and made available to users through the internet.
- Users can access cloud services with nothing more than a computer, operating system, and internet connectivity or virtual private network (VPN).
- All infrastructure, platforms, software, or technologies that users access through the internet without requiring additional software downloads can be considered cloud computing services including the following as-a-Service solutions.

Cloud Infrastructure:

- When supplying users with a cloud infrastructure, cloud services providers detach computing capabilities from hardware components, such as separating:
- Processing power from central processing units (CPUs)
- Active memory from random access memory (RAM) chips
- Graphics processing from the graphics processing units (GPUs)
- Data storage availability from datacenters or hard drives

Video Content / Details of website for further learning (if any):

https://www.youtube.com/watch?v=K6JTSoL5Lvc

Important Books/Journals for further learning including the page nos.:

Distributed and Cloud computing,From Parallel Processing to the Internet of Things-Kai Hwang, Geoffrey C. Fox & Jack G. Dongarra,Morgan Kaufmann Publishers,First Edition, 2012.
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Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **II - Introduction To Cloud Computing**

Date of Lecture: 20.09.2021

Topic of Lecture: Open source Cloud Software: Eucalyptus, Open Nebula, Openstack, Aneka, Cloudsim

Introduction :

- The first open-source version of OpenNebula in March 2008, we have been involved in many presentations, discussions and meetings where people wanted to know how OpenNebula compares with the rest of open-source Cloud Management Platforms (CMPs), mostly with Eucalyptus and OpenStack.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Cloud Infrastructure.
- Cloud Software.
- Cloud Models.
- Data Center.

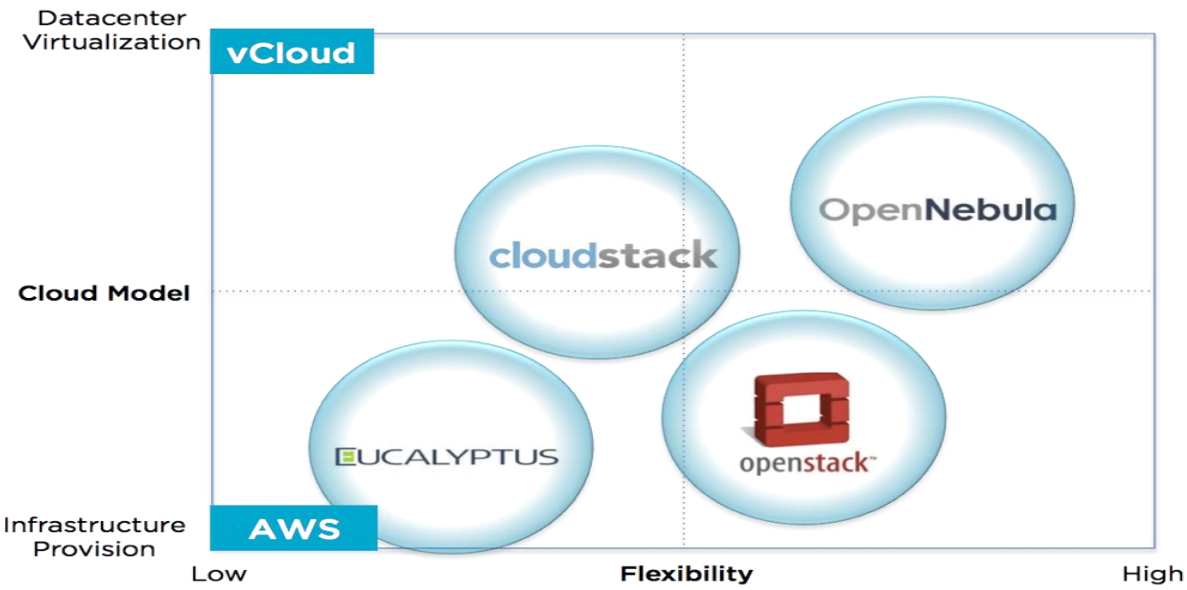
Detailed content of the Lecture:

Open source Cloud Software:

- Open-source cloud is any cloud service or solution that is built using open-source software and technologies.
- This includes any public, private or hybrid cloud model providing SaaS, IaaS, PaaS or XaaS built and operated entirely on open-source technologies.

Two Different Cloud Models:

- Although there are as many ways to understand cloud computing as there are organizations planning to build a cloud, they mostly fall between two extreme cloud models:
- **Data center Virtualization**: On one side, there are businesses that understand cloud as an extension of virtualization in the datacenter; hence looking for a vCloud-like infrastructure automation tool to orchestrate and simplify the management of the virtualized resources.
- **Infrastructure Provision**: On the other side, there are businesses that understand cloud as an AWS-like cloud on-premise; hence looking for a provisioning tool to supply virtualized resources on-demand.



Some important clarifications:

- We are not suggesting that one position (read "tool") in the chart is better than other, only that some of the CMPs are so different that cannot be compared, they are on completely different tracks (read "zones in the Quadrant").
- The chart does not represent absolute values, the relevant information is in the relative positions of the CMPs with respect to their "Cloud Model" and "Flexibility".
- The openness of the software is orthogonal to this chart, you can also use it to compare proprietary CMPs.
- Any CMP can be used to build either public or private clouds, all of the CMPs in the Quadrant implement cloud APIs.
- And last, but not least, this map is not static, the different CMPs will move right, left, up or down over time, but they cannot be simultaneously in different places. There is not a single perfect solution for every possible scenario.

Video Content / Details of website for further learning (if any):

https://opennebula.io/eucalyptus-cloudstack-openstack-and-opennebula-a-tale-of-two-cloud-models/

Important Books/Journals for further learning including the page nos.:

Distributed and Cloud computing,From Parallel Processing to the Internet of Things-Kai Hwang, Geoffrey C. Fox & Jack G. Dongarra,Morgan Kaufmann Publishers,First Edition, 2012.
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II / III

Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **III -Cloud Infrastructure**

Date of Lecture: 22.09.2021

Topic of Lecture: Cloud Architecture and Design

Introduction :

- Cloud architecture defines the technology components that are combined to build a cloud, where resources are pooled through virtualization technology and shared across a network.
- A front-end platform (the client or device used to access the cloud) One or more back-end platforms (servers and storage).

Prerequisite knowledge for Complete understanding and learning of Topic:

- Cloud Models.
- Data Center.
- Cloud Architecture.

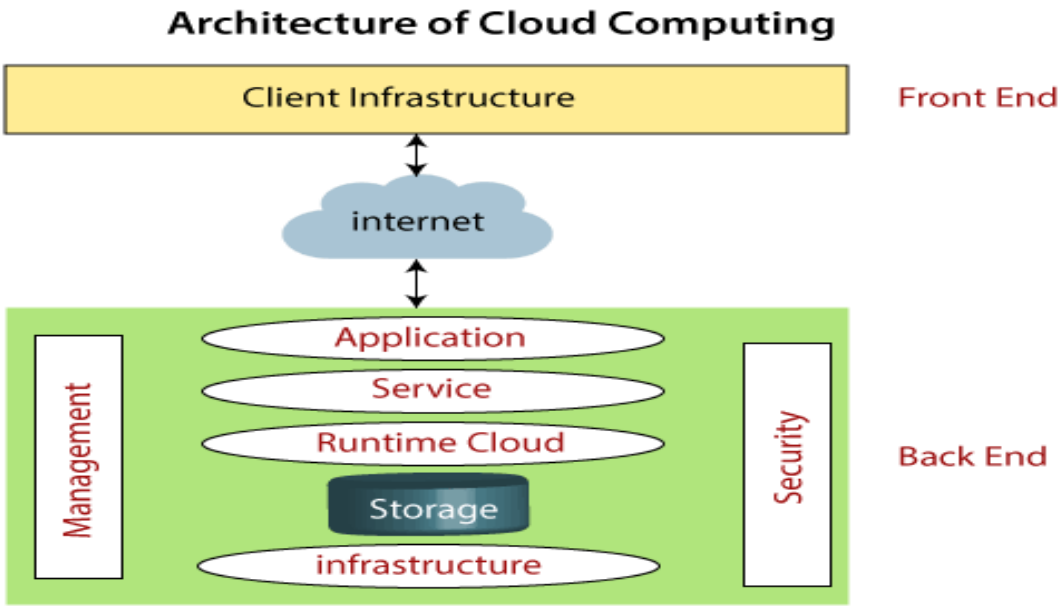
Detailed content of the Lecture:

Cloud Architecture and Design:

- Cloud-Based Design (CBD) refers to a networked design model that leverages cloud computing, service-oriented architecture (SOA), Web 2.0 (e.g., social network sites), and semantic web technologies to support cloud-based engineering design services in distributed and collaborative environments.

Steps to building a cloud-ready application architecture:

- Design the application as a collection of services.
- Decouple the data.
- Consider communications between application components.
- Model and design for performance and scaling.
- Make security systemic within the application.



Data Center Hardware:

- At the foundation of any cloud is the data center hardware on which workloads run servers, storage, and networking. Depending on the workloads you're supporting, your hardware may also include accelerators, such as FPGAs.
- These are especially helpful where specialized workloads, such as deep learning applications, are involved.

Virtualization Layer:

- Next, a virtualization layer abstracts your compute, storage, and networking hardware. Virtualization allows for the creation of virtual machines (VMs). To drive optimal utilization, many different applications, each on its own VM, can run on the same data center hardware.

- Additionally, each VM can run its own operating system such as Linux, Ubuntu, or a Windows operating system—for greater flexibility in how you provide cloud services.

Applications and Services Layer:

- The applications and services layer on the back end of your cloud supports the user interface that's displayed on the front end. Here, end user requests are coordinated with available back-end resources.

Video Content / Details of website for further learning (if any):
https://www.youtube.com/watch?v=X43KVeWVkSY

Important Books/Journals for further learning including the page nos.:
Cloud Computing, Concept,Technology & Architecture-Thomas Erl, ZaighamMahood& Ricardo Puttin, Prentice Hall, SecondEdition, 2013 **(Page No : 143 - 152)**

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Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **III -Cloud Infrastructure**

Date of Lecture: 23.09.2021

Topic of Lecture: Architectural design challenges

Introduction :

- Cloud Computing is an emerging paradigm of computing that replaces computing as a personal service by computing as a public utility. Cloud services are often compared in their nature to utility services such as gas or electricity.
- In fact, cloud computing services as a public utility as the use of electricity (instead of building generators) and also as the use of telecommunications service call (instead of building and working our own cell tower)

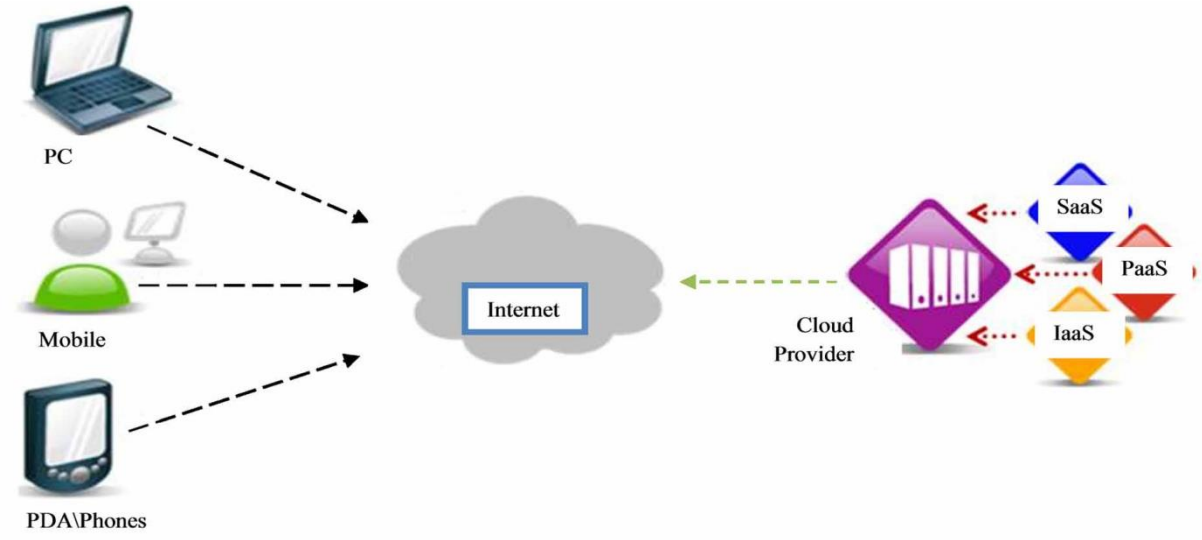
Prerequisite knowledge for Complete understanding and learning of Topic:

- Cloud Architecture.
- Distributed Systems.
- Internet.

Detailed content of the Lecture:

Architectural design challenges:

- Cloud computing systems provide computing resources (such as processor compute time and data storage) on demand via a service provider rather than maintaining your own hardware and software environment.
- The resources are dynamically provisioned over the internet and invoices its subscribers based on the use of computing resources.
- Cloud computing is a subscription-based service where you can obtain networked storage space and computer resources.
- A Distributed System consists of multiple autonomous computers that communicate through a computer network.
- The computers interact with each other in order to achieve a common goal. Distributed computing also refers to the use of distributed systems to solve computational problems.



- The cloud computing adoption is increased last years. In fact, Cloud computing has particular characteristics that distinguish it from classical resource and service provisioning environments
- Infinitely (more or less) Scalable
- Cost saving/less capital expenditure
- Higher resource utilization
- Business agility
- Disaster recovery and Back up

Advantages of cloud computing:

- Lower Cost
- More Performance
- More Efficiency
- Less Maintenance
- Unlimited Storage Capacity
- Convenience

Disadvantages of cloud computing:

- Dependency on Internet Connectivity
- Loss of Control
- Unpredictable Cost.

Video Content / Details of website for further learning (if any):
https://www.youtube.com/watch?v=X43KVeWVkSY

Important Books/Journals for further learning including the page nos.:
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Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **III -Cloud Infrastructure**

Date of Lecture: 27.09.2021

Topic of Lecture: Technologies for Network based system

Introduction :

- Network Technology involves the use of data systems to manage and deliver digital resources over a computer network.
- A variety of industries use computer hardware and system software that maintains a network, creating a need for specialists to manage them.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Distributed Systems.
- Graphics Card.
- CPU Processor.

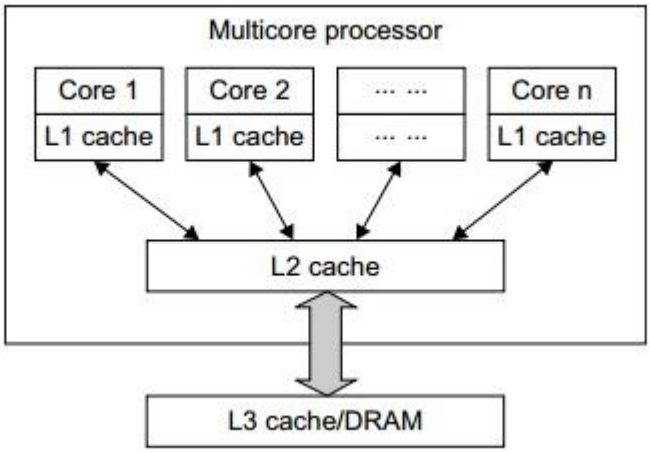
Detailed content of the Lecture:

Technologies for Network based system:

- Cloud computing systems use many technologies, of which the programming model, data management, data storage, virtualization are the key technologies. Virtualization is a method of deploying computing resources.

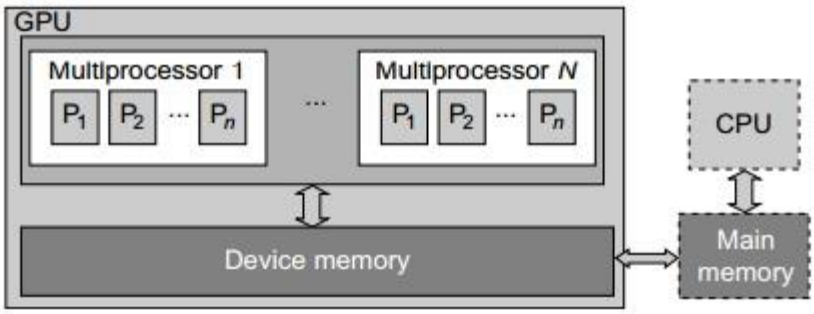
Multicore CPUs and Multithreading Technologies:

- Consider the growth of component and network technologies over the past 30 years.
- They are crucial to the development of HPC and HTC systems processor speed is measured in millions of instructions per second (MIPS) and network bandwidth is measured in megabits per second (Mbps) or gigabits per second (Gbps). The unit GE refers to 1 Gbps Ethernet bandwidth.
- Advances in CPU Processors
- Multicore CPU and Many-Core GPU Architectures
- Multithreading Technology



GPU Computing to Exascale and Beyond:

- A GPU is a graphics co-processor or accelerator mounted on a computer's graphics card or video card.
- A GPU offloads the CPU from tedious graphics tasks in video editing applications.
- How GPUs Work
- GPU Programming Model
- Power Efficiency of the GPU



Memory, Storage, and Wide-Area Networking

- The disk storage growth in 7 orders of magnitude in 33 years.
- The rapid growth of flash memory and solid-state drives (SSDs) also impacts the future of HPC and HTC systems.

Video Content / Details of website for further learning (if any):
https://www.youtube.com/watch?v=X43KVeWVkSY

Important Books/Journals for further learning including the page nos.:
Cloud Computing, Concept,Technology & Architecture-Thomas Erl, ZaighamMahood& Ricardo Puttin, Prentice Hall, SecondEdition, 2013 **(Page No : 171 - 178)**

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Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **III -Cloud Infrastructure**

Date of Lecture:29.09.2021

Topic of Lecture:NIST Cloud computing Reference Architecture

Introduction :

- The NIST cloud computing reference architecture focuses on the requirements of "what" cloud services provide, not a "how to" design solution and implementation.
- The reference architecture is intended to facilitate the understanding of the operational intricacies in cloud computing.

Prerequisite knowledge for Complete understanding and learning of Topic:

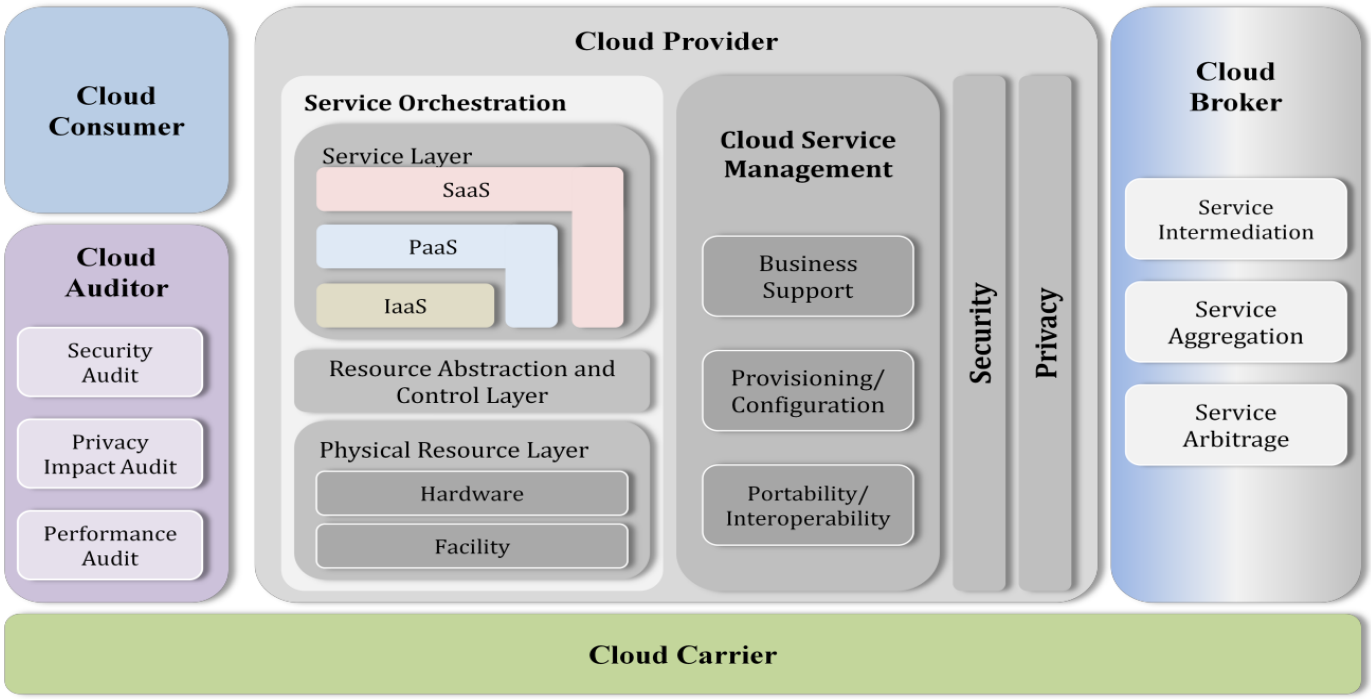
- Graphics Card.
- CPU Processor.
- Cloud Provider.

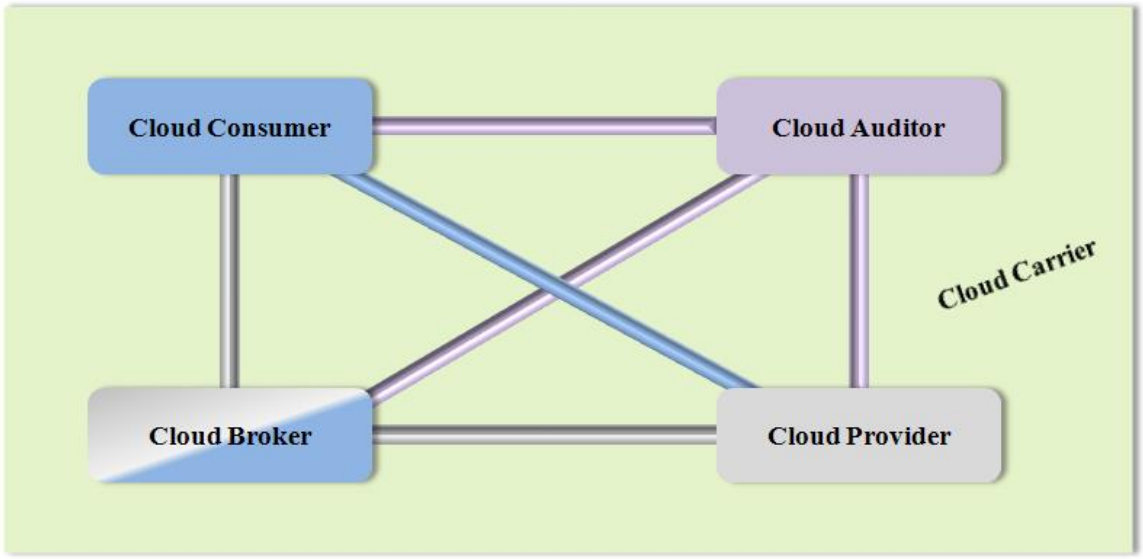
Detailed content of the Lecture:

NIST Cloud computing Reference Architecture :

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

Actor	Definition
Cloud Consumer	A person or organization that maintains a business relationship with, and uses service from, *Cloud Providers*.
Cloud Provider	A person, organization, or entity responsible for making a service available to interested parties.
Cloud Auditor	A party that can conduct independent assessment of cloud services, information system operations, performance and security of the cloud implementation.
Cloud Carrier	An intermediary that provides connectivity and transport of cloud services from *Cloud Providers* to *Cloud Consumers*.





Cloud Consumer :

- The cloud consumer is the principal stakeholder for the cloud computing service. A cloud consumer represents a person or organization that maintains a business relationship with, and uses the service from a cloud provider.

Cloud Provider :

- A cloud provider is a person, an organization; it is the entity responsible for making a service available to interested parties.
- A Cloud Provider acquires and manages the computing infrastructure required for providing the services, runs the cloud software that provides the services, and makes arrangement to deliver the cloud services to the Cloud Consumers through network access.

Cloud Auditor :

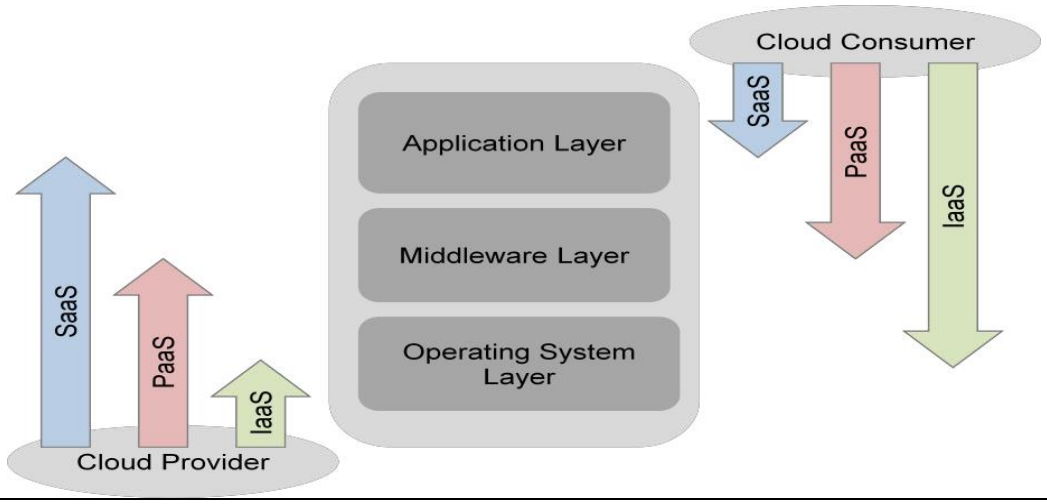
- A cloud auditor is a party that can perform an independent examination of cloud service controls with the intent to express an opinion thereon. Audits are performed to verify conformance to standards through review of objective evidence.

Cloud Broker :

- As cloud computing evolves, the integration of cloud services can be too complex for cloud consumers to manage. A cloud consumer may request cloud services from a cloud broker, instead of contacting a cloud provider directly.

Cloud Carrier :

- A cloud carrier acts as an intermediary that provides connectivity and transport of cloud services between cloud consumers and cloud providers. Cloud carriers provide access to consumers through network, telecommunication and other access devices.



Video Content / Details of website for further learning (if any):
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Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **III -Cloud Infrastructure**

Date of Lecture: 30.09.2021

Topic of Lecture: Public, Private and Hybrid clouds

Introduction :

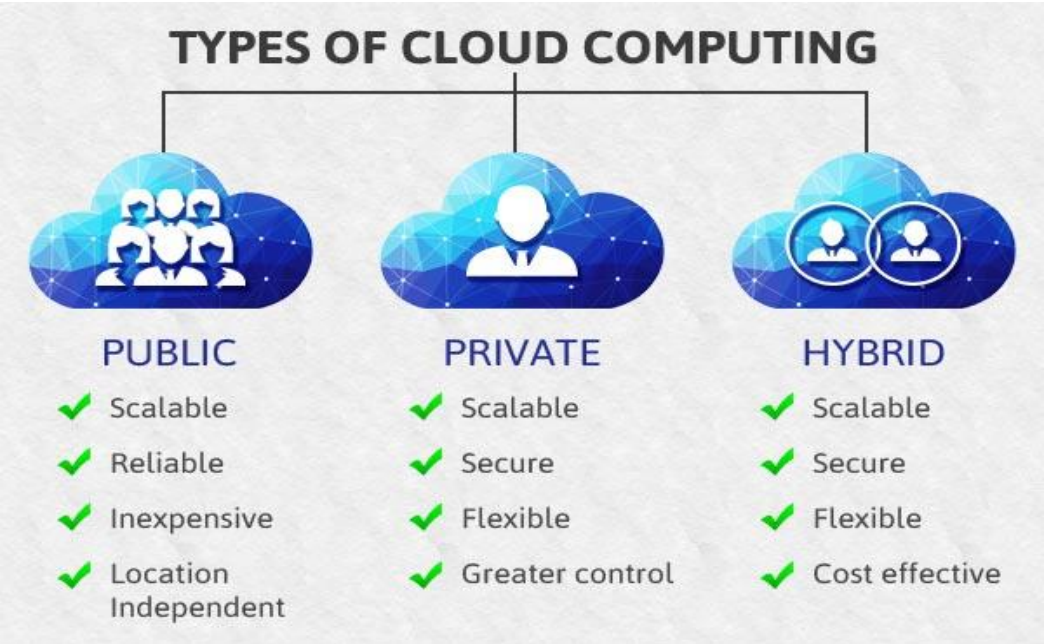
- Public cloud is cloud computing that's delivered via the internet and shared across organizations.
- Private cloud is cloud computing that is dedicated solely to your organization.
- Hybrid cloud is any environment that uses both public and private clouds.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Cloud Provider.
- Cloud Models.
- Web Services.

Detailed content of the Lecture:

Public, Private and Hybrid clouds :



PUBLIC CLOUDS:

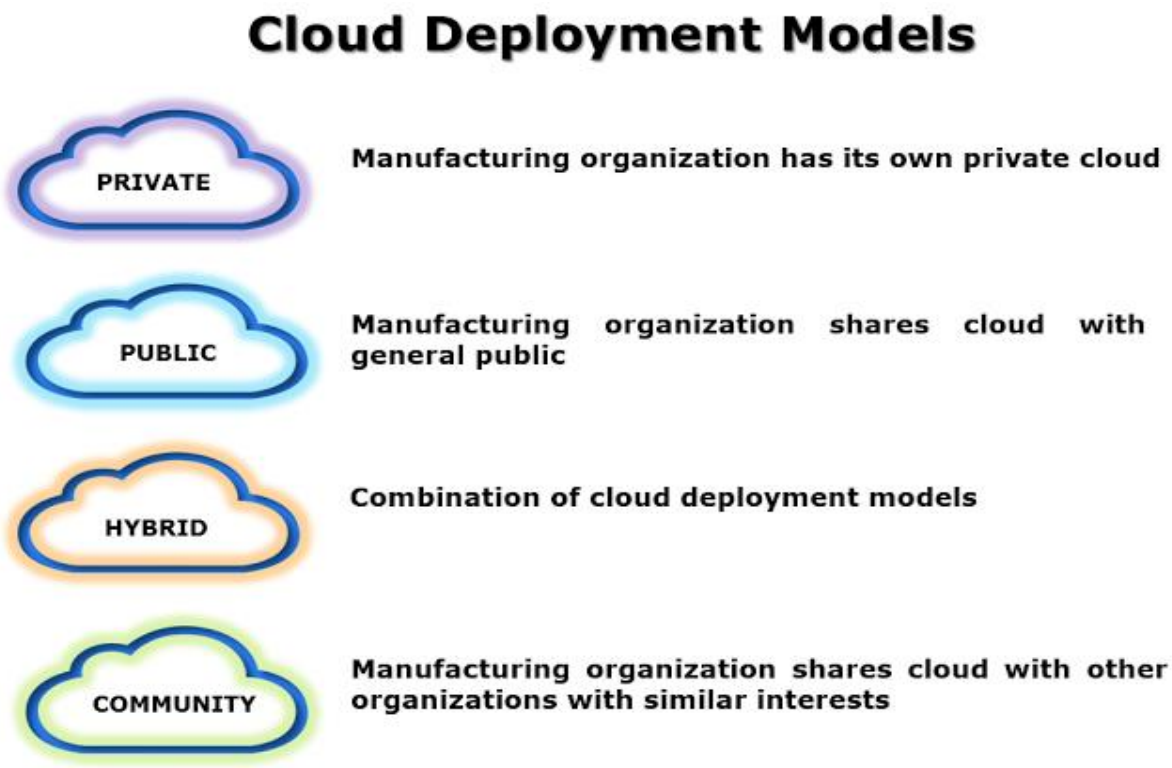
- A public cloud is one in which the services and infrastructure are provided off- site over the internet.
- This cloud offers the greatest level of efficiency in shared resources.
- It also reduces the CAPEX since all hardware resides in the cloud and is managed either by the customer or the cloud service provider.
- This topology requires a constant connection to the internet.
- The three major public cloud services are: Amazon Web Services (AWS), Google Cloud Platform (GCP), and Microsoft's Azure.

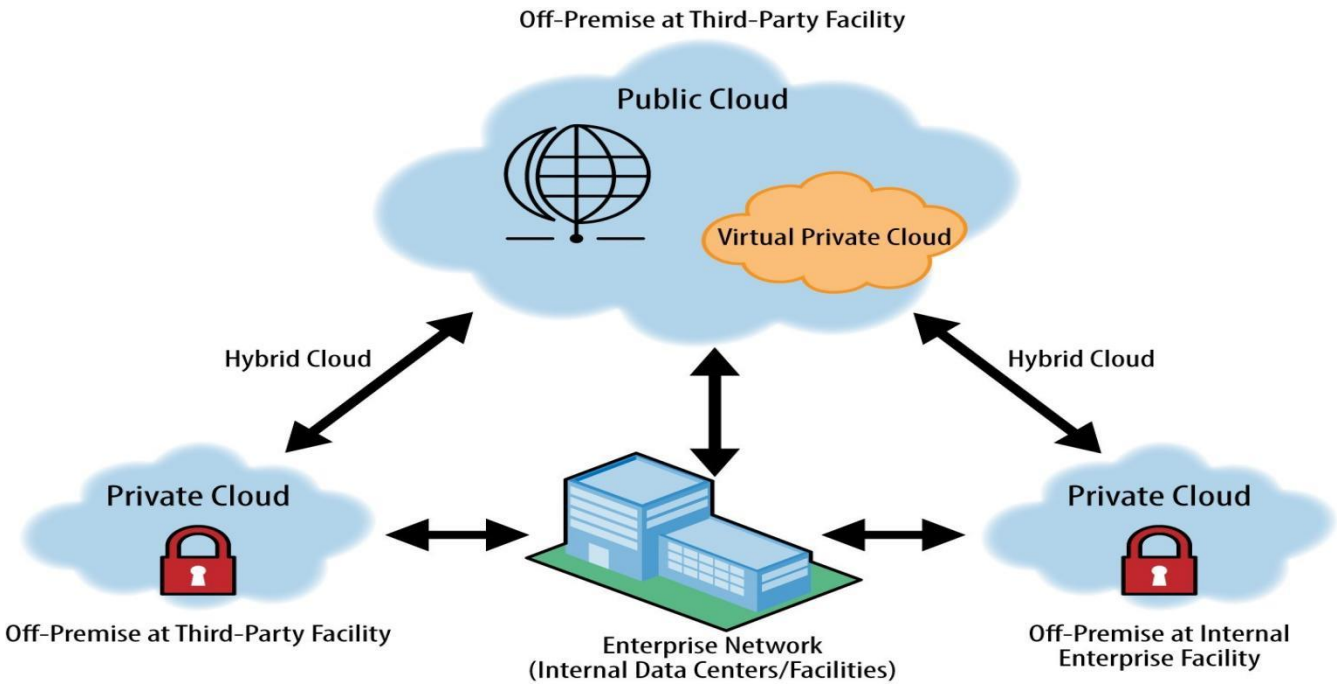
PRIVATE CLOUDS:

- A private cloud is one in which the services and infrastructure are maintained on a private network.
- This cloud offers the greatest level of security and control, but requires the company to still purchase and maintain all the software and infrastructure, reducing the cost-savings.
- This setup allows for connectivity without always having to be online.

HYBRID CLOUDS:

- A hybrid cloud includes a variety of public and private options with multiple providers.
- By spreading things out over a hybrid cloud, you keep each aspect of your business in the most efficient environment possible.
- The downside is that you have to keep track of multiple different security platforms and ensure that all aspects of your business can communicate with each other.





- Hybrid cloud refers to a mixed computing, storage, and services environment made up of on-premises infrastructure, private cloud services, and a public cloud such as Amazon Web Services (AWS) or Microsoft Azure with orchestration among the various platforms.

Video Content / Details of website for further learning (if any):
https://www.youtube.com/watch?v=1BMO7YkwR6Y

Important Books/Journals for further learning including the page nos.:
Cloud Computing, Concept,Technology & Architecture-Thomas Erl, ZaighamMahood& Ricardo Puttin, Prentice Hall, SecondEdition, 2013 **(Page No : 191 - 198)**

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Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **III -Cloud Infrastructure**

Date of Lecture: 04.10.2021

Topic of Lecture: Cloud Models : IaaS, PaaS and SaaS

Introduction :

- IaaS: cloud-based services, pay-as-you-go for services such as storage, networking, and virtualization. PaaS: hardware and software tools available over the internet. SaaS: software that's available via a third-party over the internet. On-premise: software that's installed in the same building as your business.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Cloud Models.
- Web Services.
- Networks.

Detailed content of the Lecture:

Cloud Models : IaaS, PaaS and SaaS:

- Infrastructure as a Service (IaaS)
- Platform as a Service (PaaS)
- Software as a Service (SaaS)

Infrastructure as a Service (IaaS):

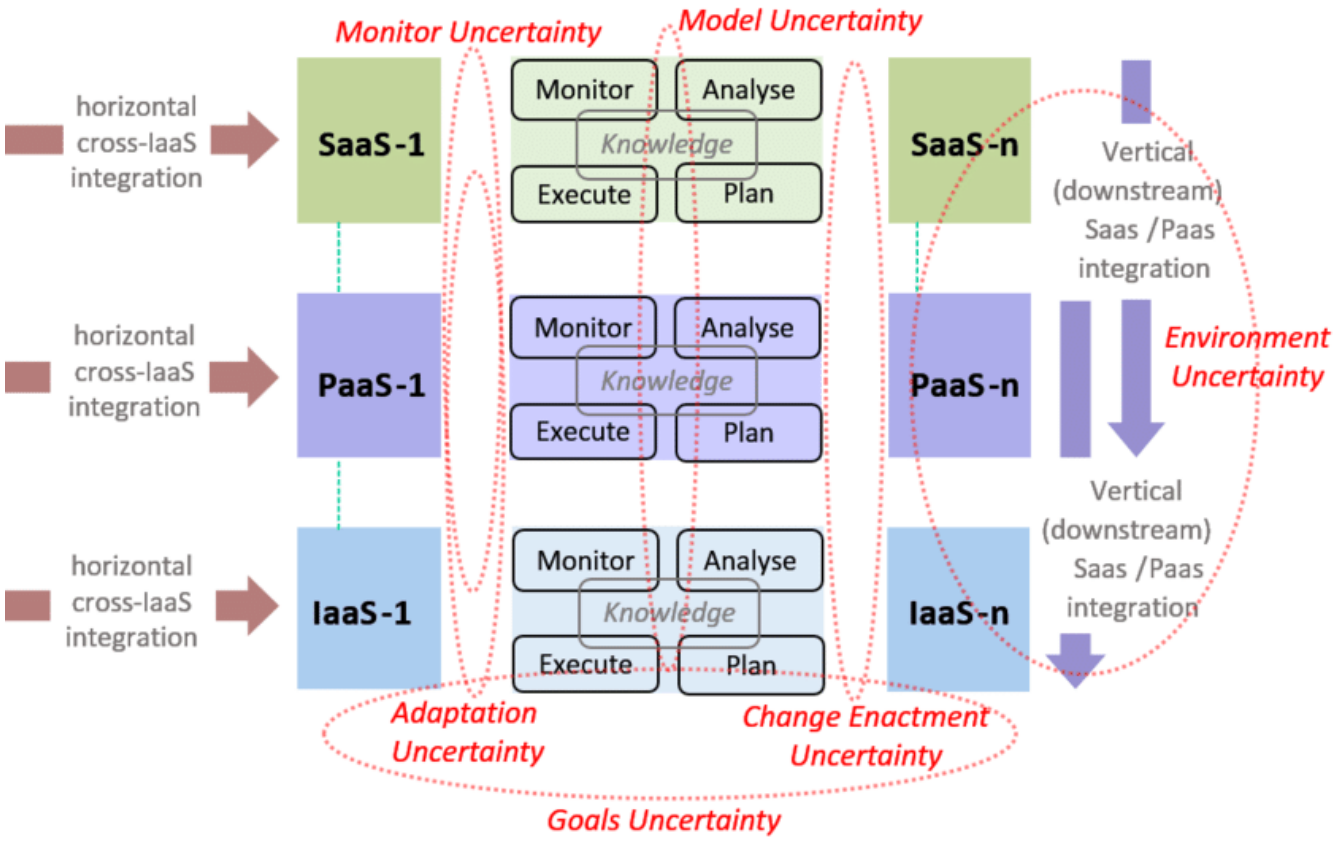
- Infrastructure as a Service (IaaS) is a self-service model for managing remote data center infrastructures. IaaS provides virtualized computing resources over the Internet hosted by a third party such as Amazon Web Services, Microsoft Azure or Google. Instead of an organization purchasing hardware, companies purchase IaaS based on a consumption model. It is like buying electricity.

Platform as a Service (PaaS):

- Platform as a Service (PaaS) allows organizations to build, run and manage applications without the IT infrastructure. This makes it easier and faster to develop, test and deploy applications.

Software as a Service (SaaS):

- Software as a service (SaaS) replaces the traditional on-device software with software that is licensed on a subscription basis. It is centrally hosted in the cloud.



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Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **III -Cloud Infrastructure**

Date of Lecture: 06.10.2021

Topic of Lecture: Cloud storage providers

Introduction :

- Cloud computing is a hot topic in recent research and applications. Up to now, Google, Microsoft, IBM, Amazon and some other famous companies have proposed their cloud computing application, and put cloud computing as one of the most important strategy in the future. Cloud storage is the lower layer of cloud computing system which supports the service of the other layers above it. In addition, it is an effective way to save and manage heavy data. So it focused even more attentions from some researchers.

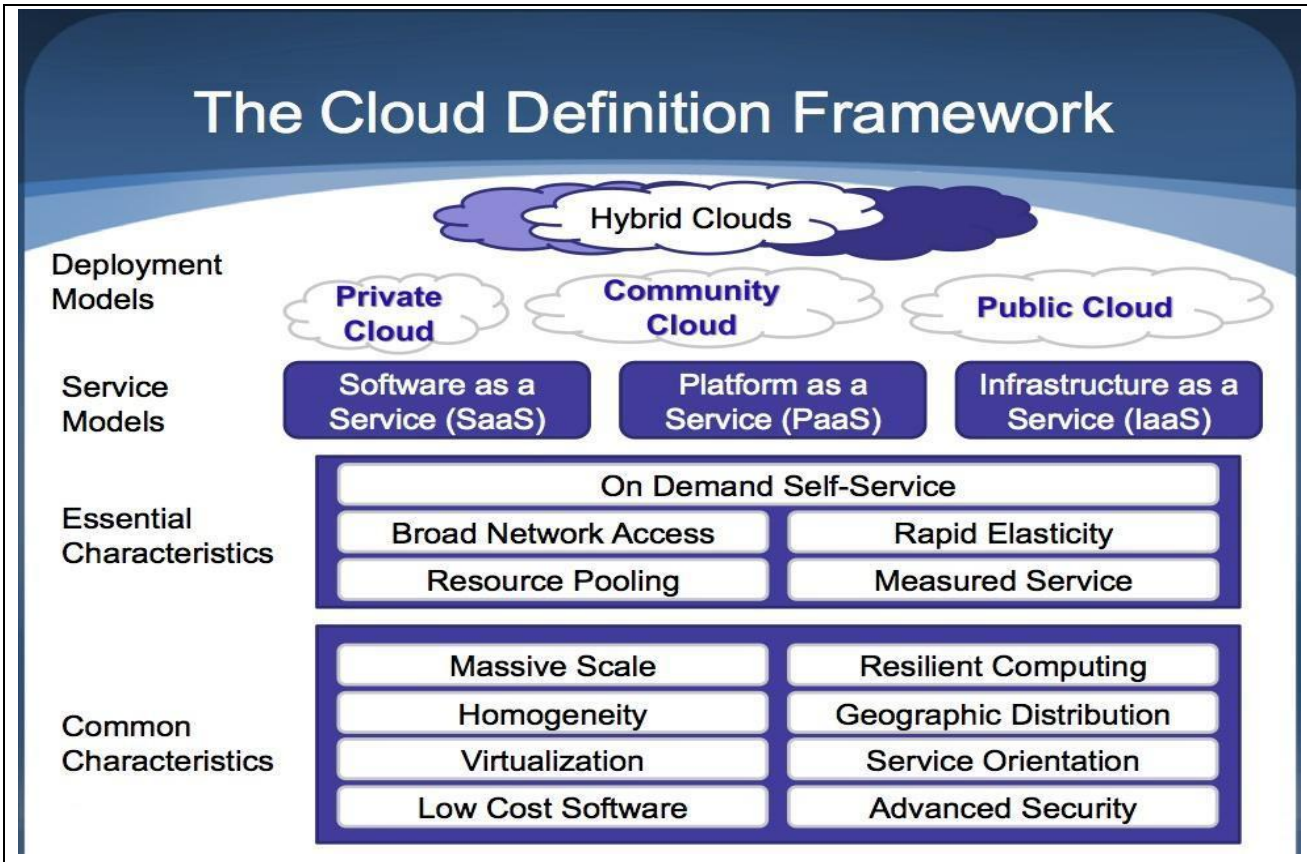
Prerequisite knowledge for Complete understanding and learning of Topic:

- Cloud computing.
- Cloud storage.
- Storage virtualization.
- Distributed extend.
- Data protection.

Detailed content of the Lecture:

Cloud storage providers :

- Cloud storage is still not very accurate, many people think that cloud storage is the network disk like Dropbox, Google Drive. But the network disk is just one of the forms of the cloud storage which is the closest expression to the public. It stores the user's file data to the network that achieve data storage and backup. It meet user’s purpose of data storage, using, sharing and protection.
- Some people think that cloud storage is a kind of document network storage, such as Evernote notes storage services.
- cloud storage should have the following two parts. First one is that in the service oriented aspects of the user, it provides on-demand service application model, users can connect to the
- cloud through the network, to save user’s data in cloud storage anytime, anywhere.
- Secondly, in terms of build cloud storage service, it achieves massive, resilient, low-cost, low-power shared storage sources through the distributed, virtualized, intelligent configuration and other technologies.



Cloud storage features:

- Cloud storage is one of the best ways to keep business's important data safe and accessible. Many small and midsize businesses are turning to cloud storage services to keep files and documents backed up and available from any Internet-connected device even when those files contain sensitive company and client data. (Loomis 2010.)

Comparison of cloud storage with traditional storage :

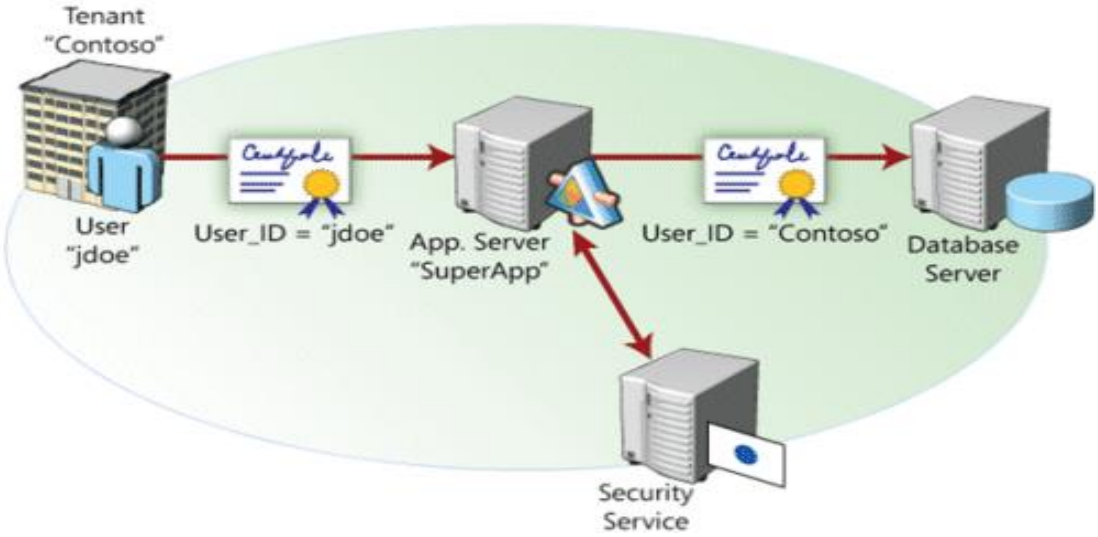
- Because cloud storage is a new product in the field of storage, it will inevitably lead to a comparison with the traditional storage.
- There are many differences between them. The comparison of cloud storage and traditional storage

Storage virtualization :

- The most popular understanding of storage virtualization is a performance of abstract storage hardware resources.
- It means that integrate one (or more) targets services or functions with other additional features integrating, unified comprehensive features to provide useful service. (Joseph 2014.)
- Typical virtualization includes the following scenarios, Shielding the complexity systems, Adding or integrate new features, emulating, integrating or breaking down existing service functions.

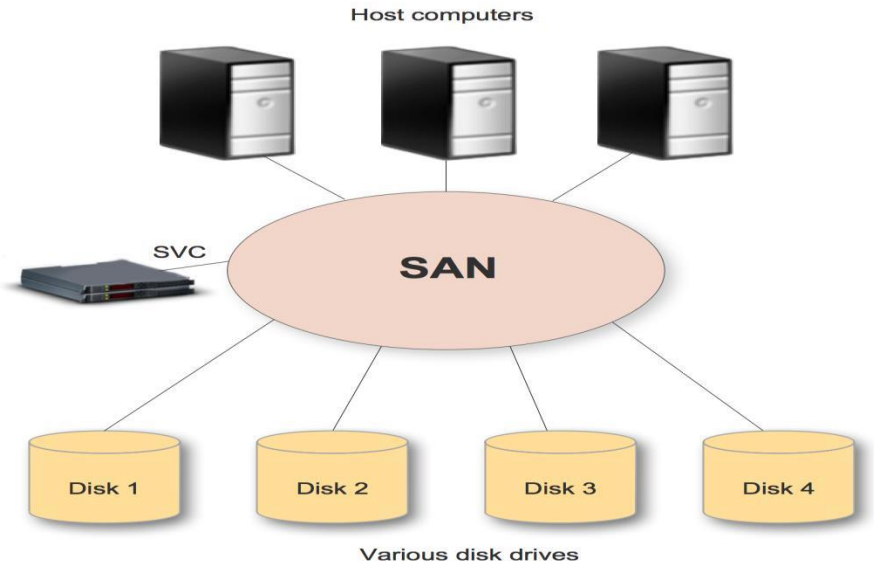
Multi-Tenancy :

- Multi-tenancy (Multi-Tenancy) can be regarded as a very new concept, however, this concept has been around for a long time.
- When the earliest, the concept of a multi-tenant refers to a separate instance of the software that can serve multiple organizations, and multiple organization services called multi-tenants.



Virtualization implementation

- Depending on the location of the virtualization implementation, storage virtualization can also be vided into host-based, storage-based, and network-based virtualization.
- Storage virtualization can be implemented at three different levels. n



Video Content / Details of website for further learning (if any):
https://www.youtube.com/watch?v=-exhrtTmpWQ

Important Books/Journals for further learning including the page nos.:
Cloud Computing, Concept,Technology & Architecture-Thomas Erl, ZaighamMahood& Ricardo Puttin, Prentice Hall, SecondEdition, 2013 **(Page No : 213 - 219)**

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LECTURE HANDOUTS

II / III

MCA

Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **III -Cloud Infrastructure**

Date of Lecture: 07.10.2021

Topic of Lecture: Enabling Technologies for the Internet of Things

Introduction :

- Technologies and protocols of IoT are RFID, NFC, low-energy Bluetooth, low-energy wireless, low-energy radio protocols, and LTE-A.
- These technologies support the specific networking functionality needed in an IoT system in contrast to a standard uniform network of common systems.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Cloud computing.
- Cloud storage.
- Storage virtualization.
- Internet of Things.

Detailed content of the Lecture:

Enabling Technologies for the Internet of Things :

- Managing millions of heterogeneous connected devices via the Internet requires a flexible, layered architecture.
- There are various IoT architectural models, namely, Internet of Things Architecture (IoT-A), Industrial Internet Reference Architecture (IIRA), Reference Architecture Model Industrie 4.0 (RAMI 4.0), and Cisco's Internet of Things Reference Model. However, no standard reference architecture has been adopted.

Enabling Technologies :

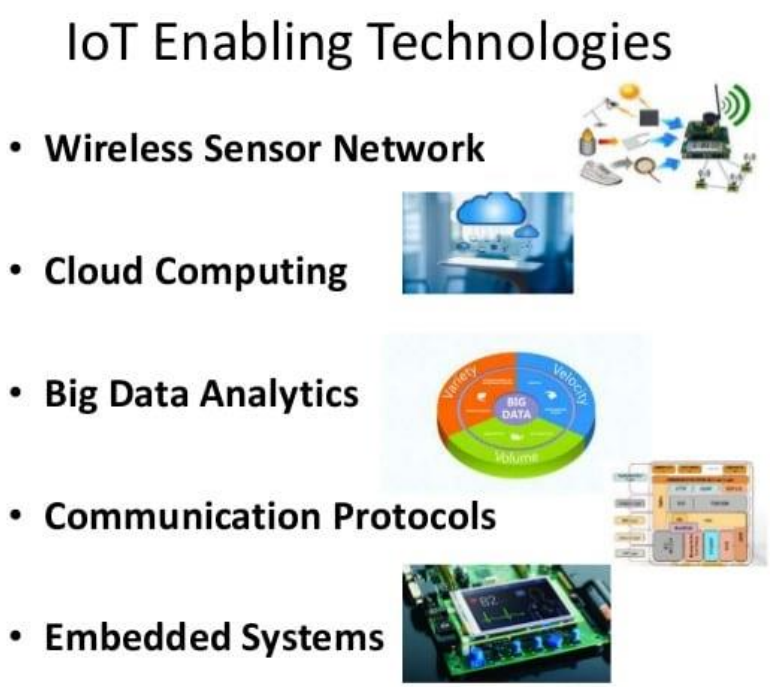
- IoT enabling technologies vary depending on the domain and scenario.
- **For example,** smart transportation requires flexible technologies that ensure the connectivity of a vast number of mobile nodes. In contrast, the focus in healthcare is reliability and integrity.

Internet of Things (IoT) Enabling Technologies:

IoT(internet of things) enabling technologies are:

- Wireless Sensor Network(WSN)
- Cloud Computing
- Big Data Analytics

- Communications Protocols
- Embedded Systems



Context Sensing :

- One of the ways an application can perform more effectively is through context awareness.
- Sensing what is around a host device (and its user) and the context in which it is used allows an app to adapt how data is presented and filtered.
- **For example,** a local map application that automatically shows the user's current position.

Actions and control:

- As a complement to sensing, the IoT offers us a way to control the physical world through displays, actuators, and switches.
- Many modern systems benefit from remote control because it simplifies physical interaction design and extends capabilities.

Privacy and security:

- One of the primary challenges for the future will be avoiding the darker consequences of a world with globally connected devices.
- The Physical Web could enable hackers to control our devices unless precautions are taken.

Video Content / Details of website for further learning (if any):
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Important Books/Journals for further learning including the page nos.:
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Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **III -Cloud Infrastructure**

Date of Lecture: 18.10.2021

Topic of Lecture: Innovative Applications of the Internet of Things.

Introduction :

- The Internet of Things (IoT) is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

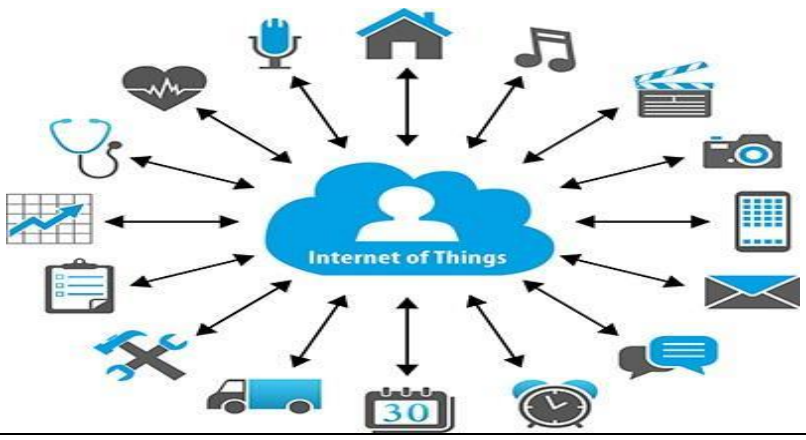
Prerequisite knowledge for Complete understanding and learning of Topic:

- Cloud computing
- IoT
- Future computing

Detailed content of the Lecture:

Innovative Applications of the Internet of Things:

- IoT has evolved with the greater generation of data.
- Internet of Things Cloud Service creates excessive communication between inexpensive sensors in the IoT which means even greater connectivity.
- Billions of connected devices and machines will soon join human-users.
- IoT generates lots of data while on the other hand, cloud computing paves way for this data to travel.



- Enter cloud computing- an on-demand delivery of computing power, database storage, applications and IT resources. It enables organizations to consume a compute resource, like a virtual machine (VM) instead of building a computing infrastructure on premise.

Sensor networks:

- With cloud provides a new opportunity in collecting sensor data it also hinders the progress because of security and privacy issues. Sensor networks have amplified the benefits of IoT.

Enables inter-device communication:

- Cloud Cache and Dropstr are enabled by cloud communications, allowing easy linking to smartphones.
- This eases devices to talk to each other and not just us, which essentially is the tenet of IoT cloud

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II / III

Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **IV - Cloud Enabling Technologies**

Date of Lecture: 20.10.2021

Topic of Lecture : Service Oriented Architecture

Introduction :

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

Prerequisite knowledge for Complete understanding and learning of Topic:

- Future computing
- Services Provider.
- SOA.

Detailed content of the Lecture:

Service Oriented Architecture:

- Service orientation is the core reference model for cloud computing systems.
- This approach adopts the concept of services as the main building blocks of application and system development.
- A service is supposed to be loosely coupled, reusable, programming language independent, and location transparent.

SOA roles:

Service provider:

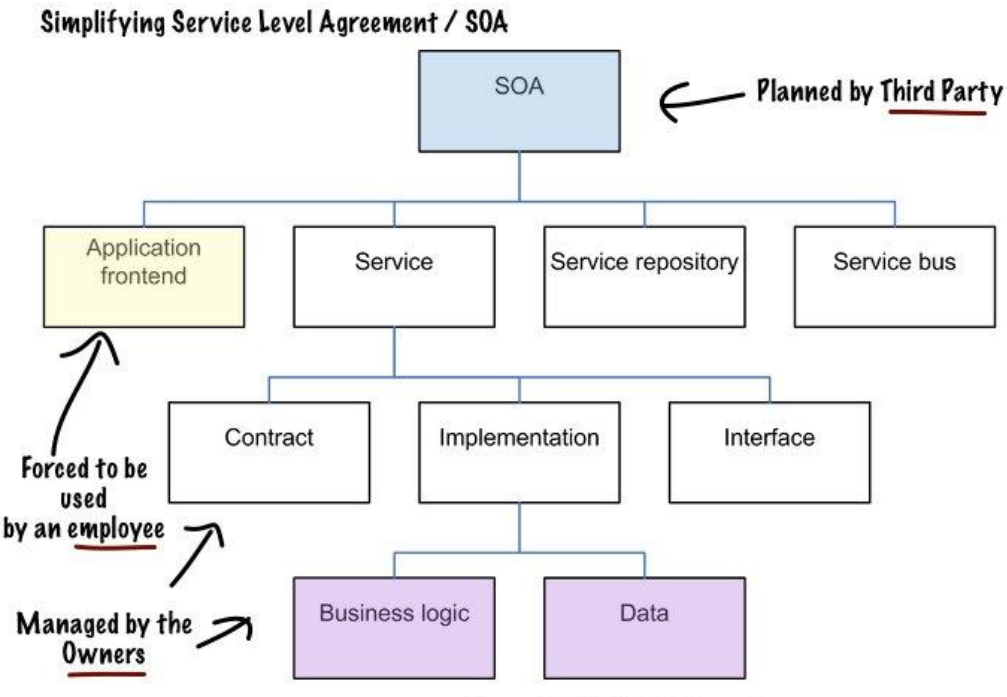
- A service provider creates web services and provides them to a service registry.
- The service provider is responsible for the terms of use of the service.

Service broker or service registry:

- A service broker or service registry is responsible for providing information about the service to a requester. A broker may be public or private.

Service requester or service consumer:

- A service requester finds a service in a service broker or service registry and then will connect with the service provider to receive the service.



- SOA provides a translation and management layer within the cloud architecture that removes the barrier for cloud clients obtaining desired services.
- SOA provides access to reusable Web services over a TCP/IP network, which makes this an important topic to cloud computing going forward.

SOA Architecture :

SOA architecture is viewed as five horizontal layers. These are described below:

- **Consumer Interface Layer:** These are GUI based apps for end users accessing the applications.
- **Business Process Layer:** These are business-use cases in terms of application.
- **Services Layer:** These are whole-enterprise, in service inventory.
- **Service Component Layer:** are used to build the services, such as functional and technical

libraries.

- **Operational Systems Layer:** It contains the data model.

Elements Of SOA:

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Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **IV - Cloud Enabling Technologies**

Date of Lecture: 21.10.2021

Topic of Lecture: Web Services , Basics of Virtualization

Introduction :

- Web services are the tools that allow users to interact with software over the Internet. Cloud services are the servers that store the data, security and other infrastructure pieces needed to allow Web services to provide unique value as Web-accessible applications.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Cloud Services.
- Web Services.
- Virtualization

Detailed content of the Lecture:

Web Services:

- web services include any software, application, or cloud technology that provides standardized web protocols (HTTP or HTTPS) to interoperate, communicate, and exchange data messaging usually XML (Extensible Markup Language) throughout the internet.
- Web services are XML-centered data exchange systems that use the internet for A2A (application-to-application) communication and interfacing. These processes involve programs, messages, documents, and/or objects.

Types of Web Services:

- Web template.
- JSON-RPC.
- JSON-WSP.
- Web Services Description Language (WSDL)
- Web Services Conversation Language (WSCL)
- Web Services Flow Language (WSFL)
- Web Services Metadata Exchange (WS-MetadataExchange)
- XML Interface for Network Services (XINS)

SOAP Web Services:

- SOAP is defined as Simple Object Access Protocol.

- This web service protocol exchanges structured data using XML and generally HTTP and SMTP for transmission. SOAP also uses WSDL (Web Services Description Language) documents to distribute a web service description model.
- This describes how the SOAP requests (client-side) and responses (server-side) must appear. Additionally, SOAP web Services have standards for security and addressing.

Web services uses:

- Web services are XML-based information exchange systems that use the Internet for direct application-to-application interaction.
- These systems can include programs, objects, messages, or documents.
- A web service is a collection of open protocols and standards used for exchanging data between applications or systems.

Components of Web Services:

The basic web services platform is XML + HTTP. All the standard web services work using the following components:

- SOAP (Simple Object Access Protocol)
- UDDI (Universal Description, Discovery and Integration)
- WSDL (Web Services Description Language)
- All these components have been discussed in the Web Services Architecture

Basics of Virtualization :

- Virtual machines are decoupled from the underlying physical hardware, virtualization allows you to consolidate physical computing resources such as CPUs, memory, storage, and networking into pools of resources. These resources can be dynamically and flexibly made available to virtual machines.

Three Types of Virtualization:

- According to a Research and Markets report, client virtualization is expected to drive continual growth in the IT sector.
- Virtual Desktop Infrastructure (VDI)
- Application virtualization

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II / III

Course Name with Code :**CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **IV - Cloud Enabling Technologies**

Date of Lecture: 25.10.2021

Topic of Lecture: Emulation , Types of Virtualization

Introduction :

- Emulation Cloud is an open application development environment that helps customers and third-party developers create, test, and fine-tune customized applications in a completely virtual environment.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Web Services.
- Virtualization
- Hash Table.

Detailed content of the Lecture:

Emulation:

- Emulation Cloud is an open application development environment that helps customers and third-party developers create, test, and fine-tune customized applications in a completely virtual environment.
- The Emulation Cloud also functions as a virtual lab, enabling the emulation of products to test code and scripts.

Hash Table:

- A hash table , or a hash map, is a data structure that associates keys with values.

Types of Virtualization:

- The context of cloud computing, virtualization is a technique that makes a virtual ecosystem of storage devices and the server OS. In that case, virtualization enables users to use various machines that share one particular physical instance of any resource.

Types of Virtualization in Cloud Computing:

- Network Virtualization.
- Storage Virtualization.
- Server Virtualization.
- Data Virtualization.
- Desktop Virtualizing.
- Application Virtualization.

Network Virtualization:

- Network virtualization in cloud computing is a method of combining the available resources in a network by splitting up the available bandwidth into different channels, each being separate and distinguished.

Storage Virtualization:

- Using this technique gives the user an ability to pool the hardware storage space from several interconnected storage devices into a simulated single storage device that is managed from one single command console.

Data Virtualization:

- This kind of cloud computing virtualization technique is abstracting the technical details usually used in data management, such as location.

Desktop Virtualization:

- As compared to other types of virtualization in cloud computing, this model enables you to emulate a workstation load, rather than a server.

Application Virtualization:

- Software virtualization in cloud computing abstracts the application layer, separating it from the operating system. This way the application can run in an encapsulated form without being dependant upon the operating system underneath.

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Course Name with Code :**CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **IV - Cloud Enabling Technologies**

Date of Lecture:28.10.2021

Topic of Lecture : Implementation levels of Virtualization

Introduction :

- Common virtualization layers include the instruction set architecture (ISA) level, hardware level, operating system level, library support level, and application level

Prerequisite knowledge for Complete understanding and learning of Topic:

- Web Services.
- Virtualization.
- Operating System.

Detailed content of the Lecture:

Implementation levels of Virtualization:

Instruction Set Architecture Level:

- At the ISA level, virtualization is performed by emulating a given ISA by the ISA of the host machine.
- For example, MIPS binary code can run on an x86-based host machine with the help of ISA emulation. With this approach, it is possible to run a large amount of legacy binary code writ-ten for various processors on any given new hardware host machine.

Hardware Abstraction Level:

- Hardware-level virtualization is performed right on top of the bare hardware. On the one hand, this approach generates a virtual hardware environment for a VM.
- On the other hand, the process manages the underlying hardware through virtualization.

Operating System Level:

- This refers to an abstraction layer between traditional OS and user applications. OS-level virtualization creates isolated containers on a single physical server and the OS instances to utilize the hard-ware and software in data centers.

Library Support Level:

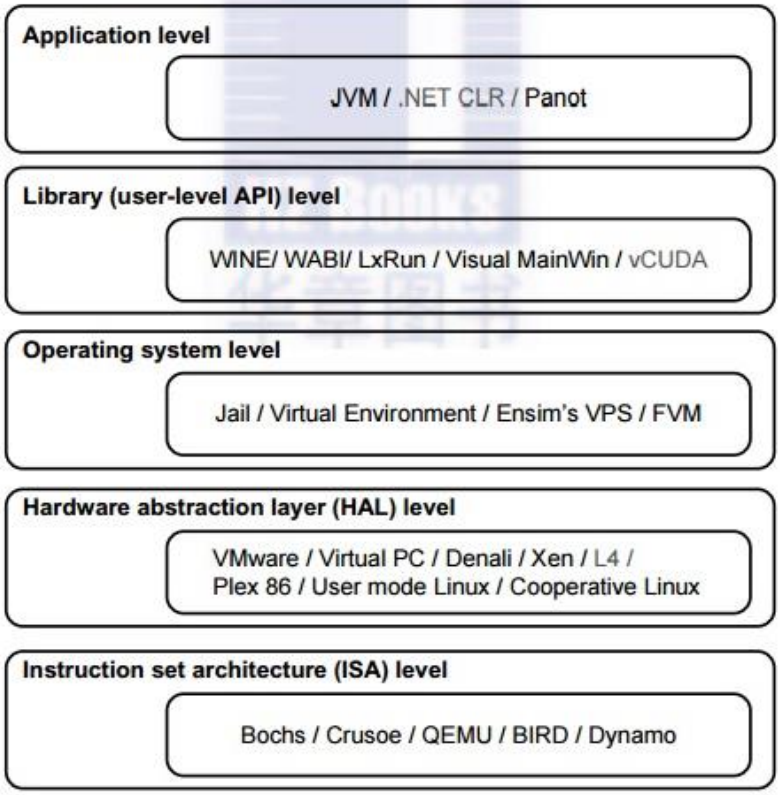
- Most applications use APIs exported by user-level libraries rather than using lengthy system calls by the OS. Since most systems provide well-documented APIs, such an interface becomes another candidate for virtualization.

User-Application Level:

- Virtualization at the application level visualizes an application as a VM. On a traditional OS, an application often runs as a process. Therefore, application-level virtualization is also known as process-level virtualization.

Relative Merits of Different Approaches:

- "Higher Performance" and "Application Flexibility" are self-explanatory. "Implementation Complexity" implies the cost to implement that particular virtualization level.
- "Application Isolation" refers to the effort required to isolate resources committed to different VMs.



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Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **IV - Cloud Enabling Technologies**

Date of Lecture:08.11.2021

Topic of Lecture : Virtualization Structures

Introduction :

- virtualization, different user applications managed by their own operating systems (guest OS) can run on the same hardware, independent of the host OS.
- This is often done by adding additional software, called a virtualization layer

Prerequisite knowledge for Complete understanding and learning of Topic:

- Virtualization.
- Operating System.
- Virtual Machine.

Detailed content of the Lecture:

Virtualization structures:

- Virtualization deploys software that makes an abstraction layer across computer hardware, letting the hardware components such as processors, memory, storage etc of a particular computer to be segmented into several virtual elements (also known as virtual machines).
- Virtualization deploys software that makes an abstraction layer across computer hardware, letting the hardware components such as processors, memory, storage etc of a particular computer to be segmented into several virtual elements (also known as virtual machines).

Some terminologies associated with Virtualization:

- **Hypervisor:** It is an operating system, performing on the actual hardware, the virtual counterpart is a subpart of this operating system in the form of a running process. Hypervisors are observed as Domain 0 or Dom0.
- **Virtual Machine (VM):**It is a virtual computer, executing underneath a hypervisor.
- **Container:** Some light-weighted VMs that are subpart of the same operating system instance as its hypervisor are known as containers. They are a group of processes that runs along with

their corresponding name space for process identifiers.

- **Virtualization Software:** Either be a piece of a software application package or an operating system or a specific version of that operating system, this is the software that assists in deploying the virtualization on any computer device.
- **Virtual Network:** It is a logically separated network inside the servers that could be expanded across multiple servers.

Characteristics of Virtualization:

- **Resource Distribution:** Either be a single computer or a network of connected servers, virtualization allows users to make a unique computer environment from one host machine that lets users to restrict the participants as active users, scale down power consumption and easy control.
- **Isolation:** Virtualization software involves self-contained virtual machines, these VMs give guest users (not an individual but a number of instances as applications, operating systems, and devices) an isolated online, virtual environment.
- **Availability:** Virtualization software provides various number of features that users won't obtain at physical servers, these features are beneficial in increasing uptime, availability, fault tolerance, and many more.
- **Aggregation:** Since virtualization allows several devices to split resources from a single machine, so it can be deployed to join multiple devices into a single potent host.
- **Authenticity and security:** At ease, virtualization platforms assure the continuous uptime by balancing load automatically that runs an excessive number of servers across multiple host machines in order to prevent interruption services.

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II / III

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Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **IV - Cloud Enabling Technologies**

Date of Lecture: 10.11.2021

Topic of Lecture : Tools &Mechanisms

Introduction :

- The technology is enhanced rapidly day by day. With the expansion of the computer system, the virtual machine has been originated to be the major research topic by researchers.
- By utilizing the virtual machinery, the computer scheme can combine all forms of data assets or resources, software assets, and hardware assets.

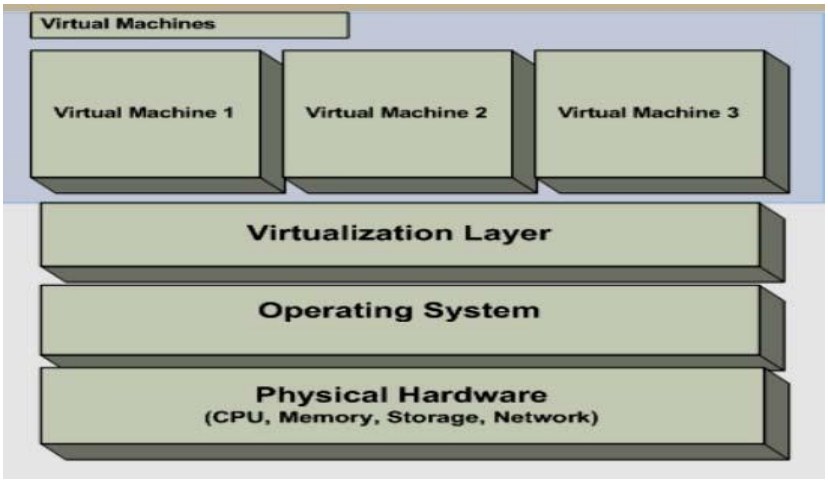
Prerequisite knowledge for Complete understanding and learning of Topic:

- Operating System.
- Virtual Machine.
- Web Services.

Detailed content of the Lecture:

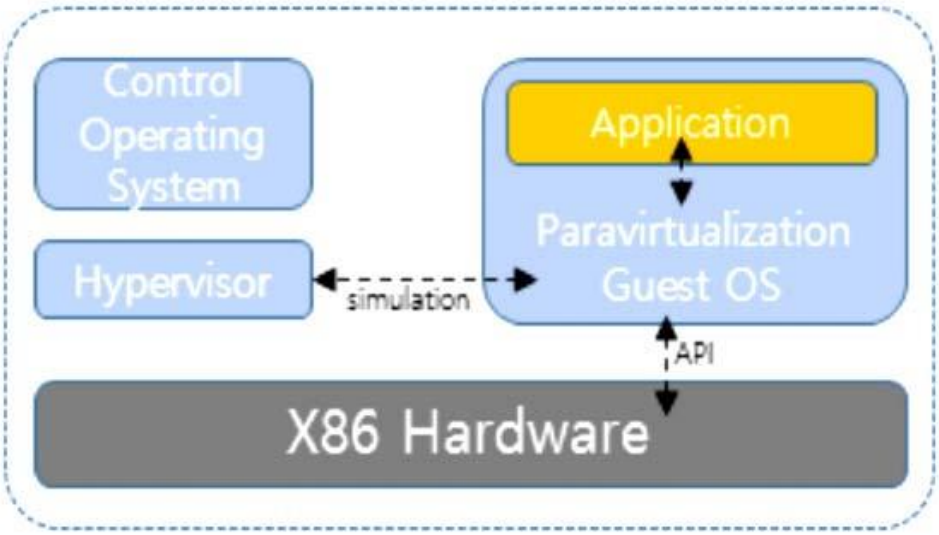
Tools &Mechanisms:

- The most common mechanisms of virtualization like Full-Virtualization, Para-Virtualization, and Desktop-Virtualization have been discussed in about the widely utilized virtualization tools like VMware, OpenVZ, and Xen.
- A comparison has been done between the virtualization tools is drawn in section.



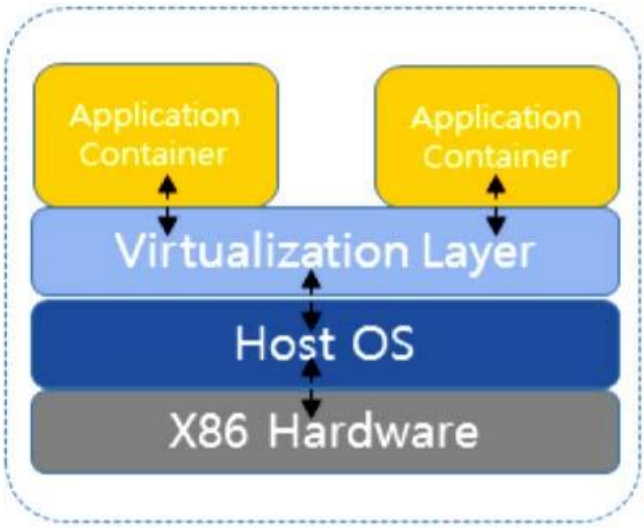
Para Virtualization:

- Needs to modify the guest OS para-virtualization attempts to reduce the virtualization overhead, and thus improve performance by modifying only the guest OS kernel.



Operating System-Level virtualization 'OSLV' :

- This kind was known as that the kernel of an OS permitted several separate User-Space instances.
- These instances track over the top of OS hosted system, worked with a group of libraries that interact with applications, and allowing them to run on a machine devoted to its utilize.



Application Virtualization 'AV':

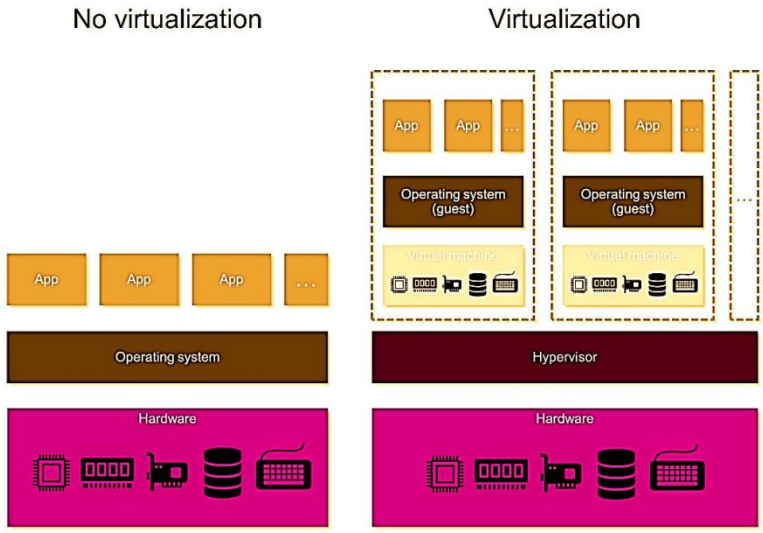
- In this type of virtualization, an end-user is allowed to run an application of the server locally with the assist of native assets without requiring the installation of the complete application on the computer scheme.

Desktop Virtualization 'DV' :

- It was the conception of splitting the logical desktop from the physical appliance.
- It was enumerated as hardware virtualization. Virtual Desktop Infrastructure 'VDI' was the main sub-type of this form.

Network Virtualization 'NV':

- It had been utilized to unite both hardware 'HW' and software 'SW' assets into a Virtual Network as a distinct group of assets.
- It assisted in obtaining superior infrastructure utilization in terms of reutilizing a logical or physical asset for several other network assets like hosts, virtual machines 'VMs', and routers, etc.



Video Content / Details of website for further learning (if any):
https://www.youtube.com/watch?v=RWgW-CgdIk0

Important Books/Journals for further learning including the page nos.:
Distributed and Cloud computing, From Parallel Processing to the Internet of Things-Kai Hwang, Geoffrey C. Fox & Jack G. Dongarra, Morgan Kaufmann Publishers, First Edition, 2012.
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LECTURE HANDOUTS

MCA

II / III

Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **IV - Cloud Enabling Technologies**

Date of Lecture: 11.11.2021

Topic of Lecture: Virtualization of CPU, Memory & I/O Devices

Introduction :

- Modern operating systems and processors permit multiple processes to run simultaneously.
- If there is no protection mechanism in a processor, all instructions from different processes will access the hardware directly and cause a system crash.

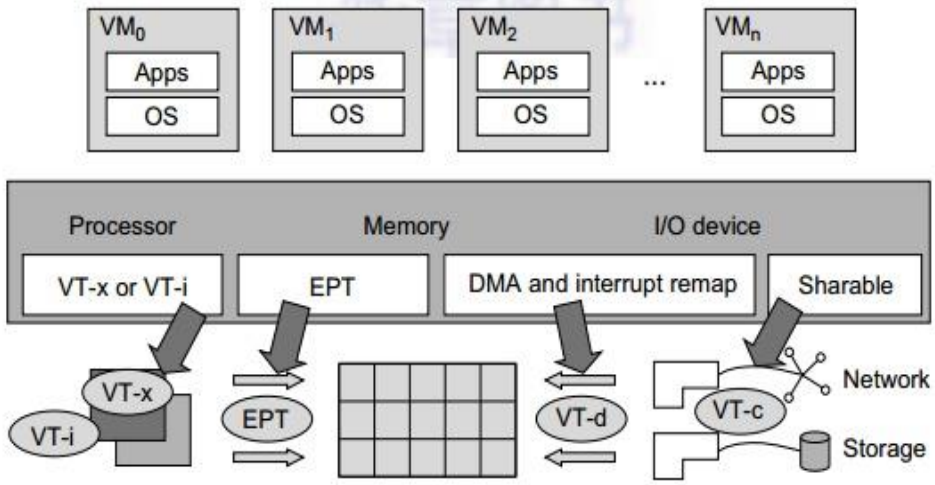
Prerequisite knowledge for Complete understanding and learning of Topic:

- Virtual Machine.
- Virtualization of CPU.
- Kernel.

Detailed content of the Lecture:

Virtualization of CPU, Memory & I/O Devices:

- OS can run on top of the hypervisor. KVM (Kernel-based Virtual Machine) is a Linux kernel virtualization infrastructure.
- KVM can support hardware-assisted virtualization and para virtualization by using the Intel VT-x or AMD-v and Virt IO framework, respectively.

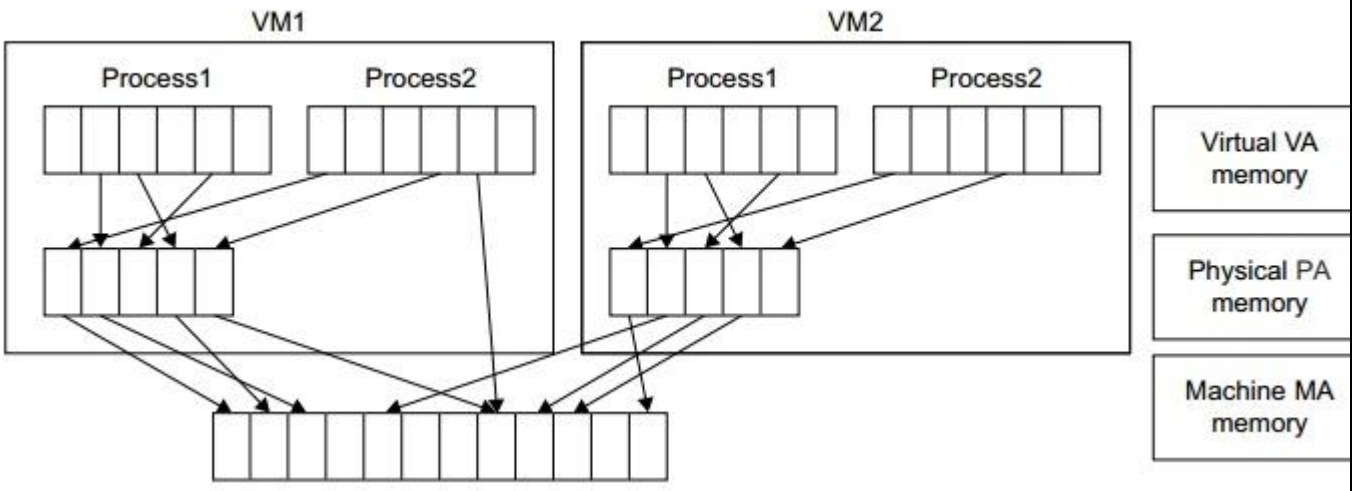


CPU Virtualization:

- A VM is a duplicate of an existing computer system in which a majority of the VM instructions are executed on the host processor in native mode.
- Thus, unprivileged instructions of VMs run directly on the host machine for higher efficiency. Other critical instructions should be handled carefully for correctness and stability.

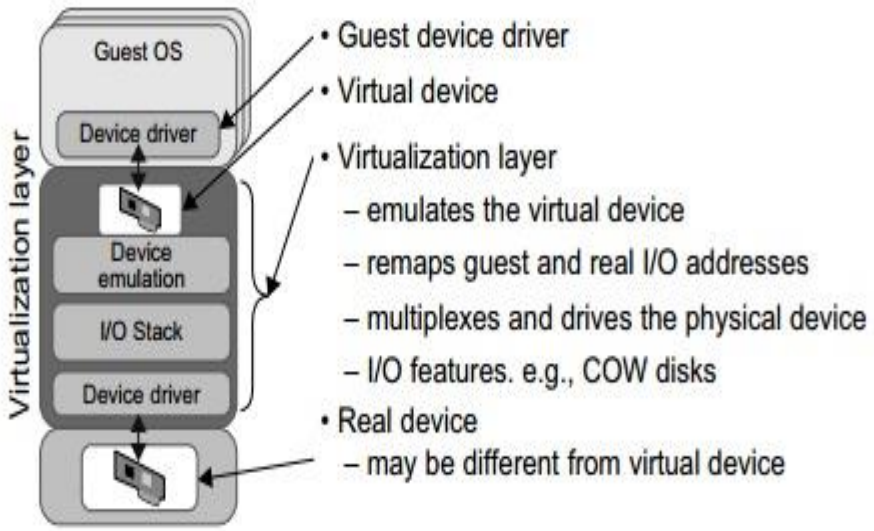
Memory Virtualization:

- Virtual memory virtualization is similar to the virtual memory support provided by modern operating systems.
- In a traditional execution environment, the operating system maintains mappings of virtual memory to machine memory using page tables, which is a one-stage mapping from virtual memory to machine memory.



I/O Virtualization

- I/O virtualization involves managing the routing of I/O requests between virtual devices and the shared physical hardware.
- At the time of this writing, there are three ways to implement I/O virtualization: full device emulation, para-virtualization, and direct I/O. Full device emulation is the first approach for I/O virtualization. Generally, this approach emulates well-known, real-world devices.
- All the functions of a device or bus infrastructure, such as device enumeration, identification, interrupts, and DMA, are replicated in software.
- This software is located in the VMM and acts as a virtual device. The I/O access requests of the guest OS are trapped in the VMM which interacts with the I/O devices.



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Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **IV - Cloud Enabling Technologies**

Date of Lecture: 22.11.2021

Topic of Lecture: Desktop Virtualization , Server Virtualization

Introduction :

- Desktop virtualization is technology that lets users simulate a workstation load to access a desktop from a connected device. It separates the desktop environment and its applications from the physical client device used to access it.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Virtualization of CPU.
- Kernel.
- Data Virtualization.

Detailed content of the Lecture:

Desktop Virtualization:

- Desktop virtualization is technology that lets users simulate a workstation load to access a desktop from a connected device. It separates the desktop environment and its applications from the physical client device used to access it.
- Desktop virtualization is a key element of digital workspaces and depends on application virtualization.

Virtual Desktop Infrastructure (VDI):

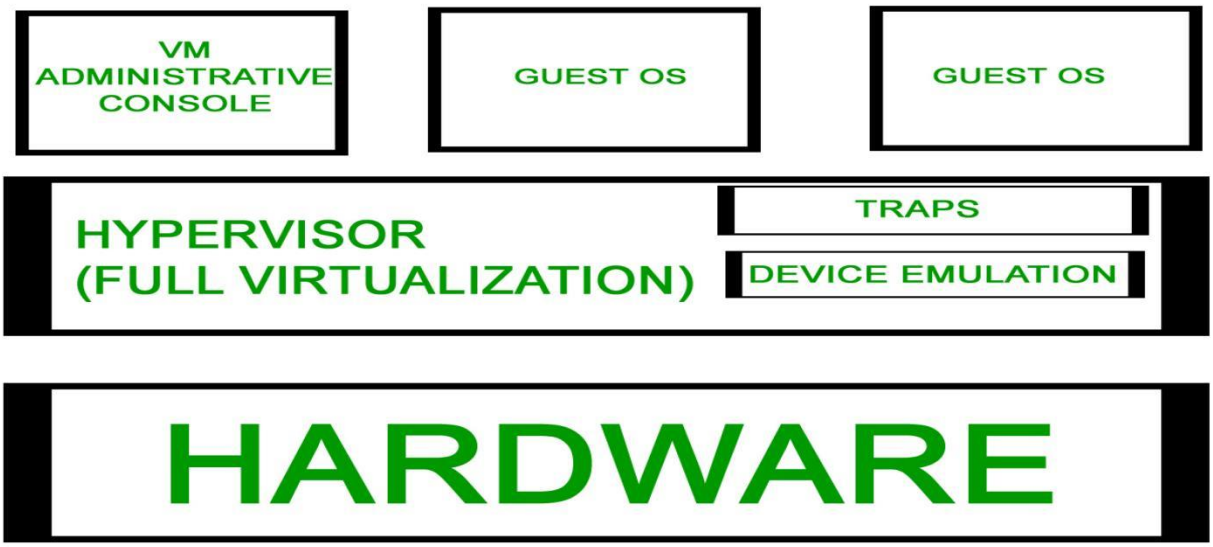
- A popular type of desktop virtualization is virtual desktop infrastructure (VDI). VDI is a variant of the client-server model of desktop virtualization, which uses host-based virtual machines (VMs) to deliver persistent and non persistent virtual desktops to all kinds of connected devices.
- With a persistent virtual desktop, each user has a unique desktop image they can customize with apps and data, knowing it will be saved for future use.
- A non persistent virtual desktop infrastructure allows users to access a virtual desktop from an identical pool when they need it; once the user logs out of a non persistent VDI, it reverts to its unaltered state.
- Some of the advantages of virtual desktop infrastructure are improved security and centralized desktop management across an organization.

Benefits of desktop virtualization:

- Security
- Resource Management
- Remote work

Server Virtualization :

- Server virtualization is the process of dividing a physical server into multiple unique and isolated virtual servers by means of a software application. Each virtual server can run its own operating systems independently.
- If all virtual servers must share the same copy of operating system it is system level virtualization and if different servers can have different operating system it is server virtualization.
- **Examples:** FreeVPS, Linux Vserver and OpenVZ



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Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **IV - Cloud Enabling Technologies**

Date of Lecture: 24.11.2021

Topic of Lecture: Google App Engine, Amazon AWS ,Federation in the Cloud

Introduction :

- App Engine is a fully managed, server less platform for developing and hosting web applications at scale. You can choose from several popular languages, libraries, and frameworks to develop your apps, and then let App Engine take care of provisioning servers and scaling your app instances based on demand.

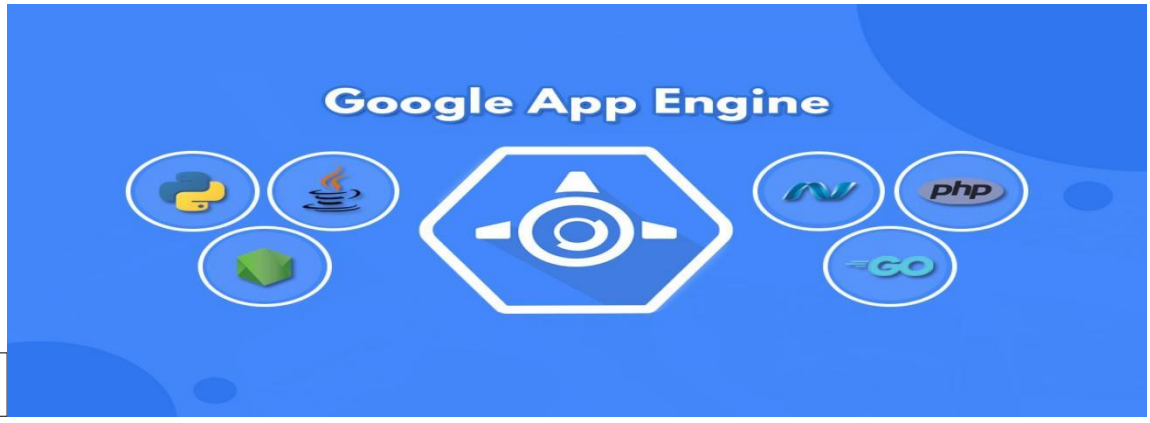
Prerequisite knowledge for Complete understanding and learning of Topic:

- Kernel.
- Data Virtualization.
- AWS.

Detailed content of the Lecture:

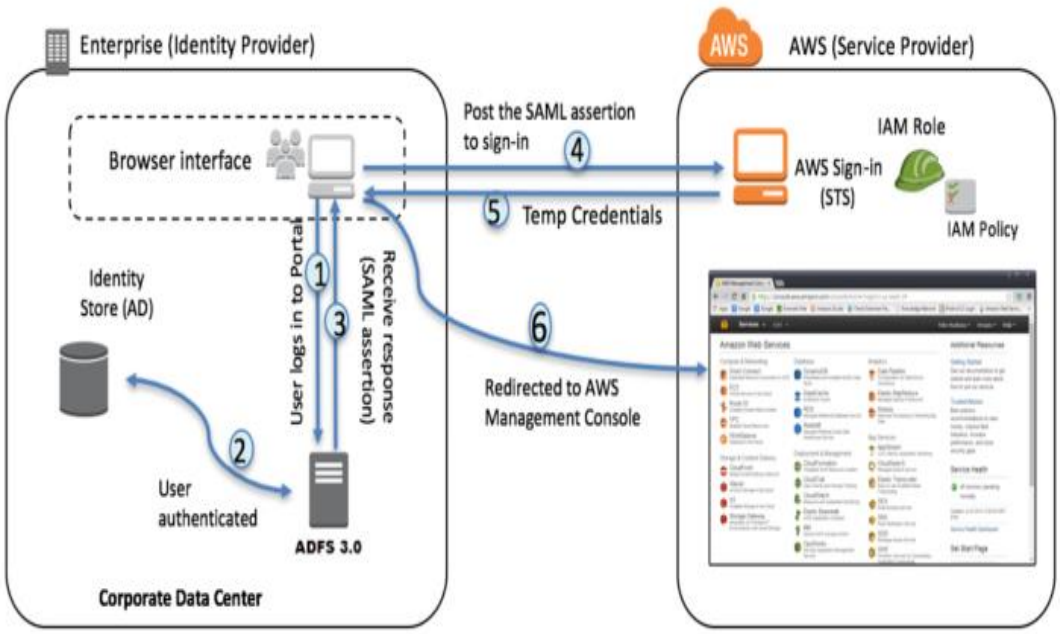
Google App Engine:

- Apps in the standard environment have a free tier for App Engine resources.
- Any use of App Engine resources beyond the free tier incurs charges as described in this section.
- To estimate costs for App Engine resources in the standard environment, use the pricing calculator.



Amazon AWS ,Federation in the Cloud:

- Identity federation is a system of trust between two parties for the purpose of authenticating users and conveying information needed to authorize their access to resources.
- To streamline the administration of user access in AWS, organizations can utilize a federated solution with an external directory, allowing them to minimize administrative overhead.
- Benefits of this approach include leveraging existing passwords and password policies, roles and groups.



Video Content / Details of website for further learning (if any):
https://aws.amazon.com/what-is-aws/

Important Books/Journals for further learning including the page nos.:
Distributed and Cloud computing, From Parallel Processing to the Internet of Things-Kai Hwang, Geoffrey C. Fox & Jack G. Dongarra, Morgan Kaufmann Publishers, First Edition, 2012.
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Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **V -Microservices And Devops**

Date of Lecture: 25.11.2021

Topic of Lecture : Defining Microservices , Emergence of Microservice Architecture

Introduction :

- Microservices architecture, is an approach to application development in which a large application is built from modular components or services.

Prerequisite knowledge for Complete understanding and learning of Topic:

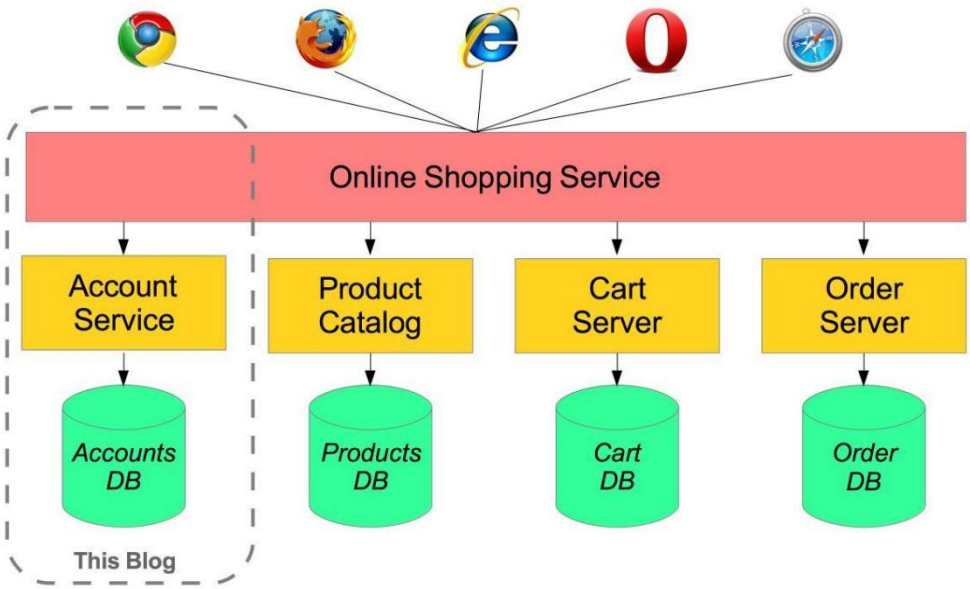
- Microservices.
- Web Services.
- SOA.

Detailed content of the Lecture:

Defining Microservices:

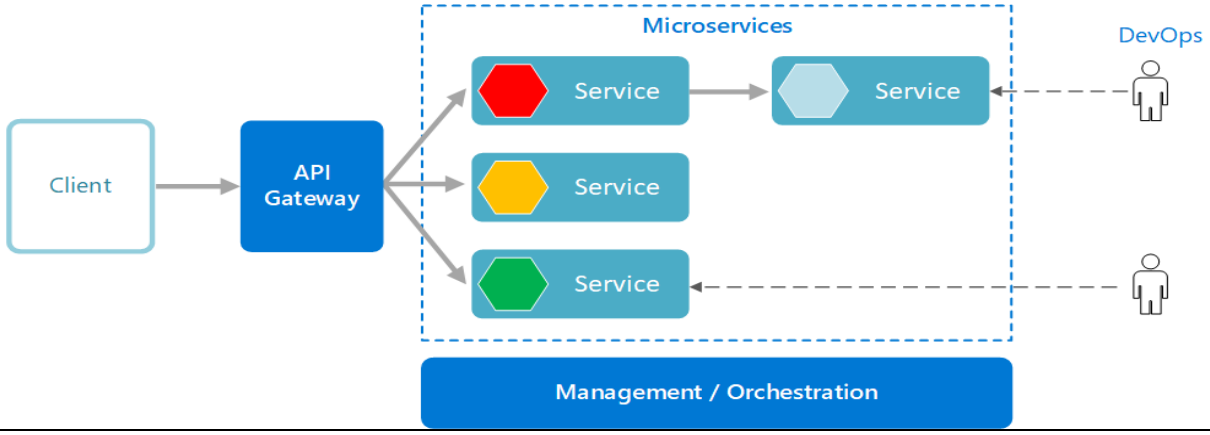
- Microservices - also known as the microservice architecture - is an architectural style that structures an application as a collection of services that are
- Highly maintainable and testable
- Loosely coupled
- Independently deployable
- Organized around business capabilities
- Owned by a small team
- The microservice architecture enables the rapid, frequent and reliable delivery of large, complex applications. It also enables an organization to evolve its technology stack.

- Microservices is a service-oriented architecture pattern wherein applications are built as a collection of various smallest independent service units.
- It is a software engineering approach that focuses on decomposing an application into single-function modules with well-defined interface.



Emergence of Microservice Architecture:

- A microservice attempts to address a single concern, such as a data search, logging function, or web service function. This approach increases flexibility.
- **Example:** Updating the code of a single function without having to refactor or even redeploy the rest of the microservices architecture.
- The microservice architectural style is an approach to developing a single application as a suite of small services, each running in its own process and communicating with lightweight mechanisms, often an HTTP resource API.



Video Content / Details of website for further learning (if any):
https://www.youtube.com/watch?v=L4aDJtPYI8M

Important Books/Journals for further learning including the page nos.:
Hands-On Microservices with Spring Boot and Spring Cloud: Buildand deploy microservices using spring cloud, Istio and kubernetes-Magnus Larsson,Packt Publishing Ltd, First Edition, September, 2019 **(Page No : 54- 59)**

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Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **V -Microservices And Devops**

Date of Lecture: 29.11.2021

Topic of Lecture: Design patterns of Microservices , The Mini web service architecture

Introduction :

- The API Gateway pattern defines how clients access the services in a microservice architecture.
- The Client-side Discovery and Server-side Discovery patterns are used to route requests for a client to an available service instance in a microservice architecture.

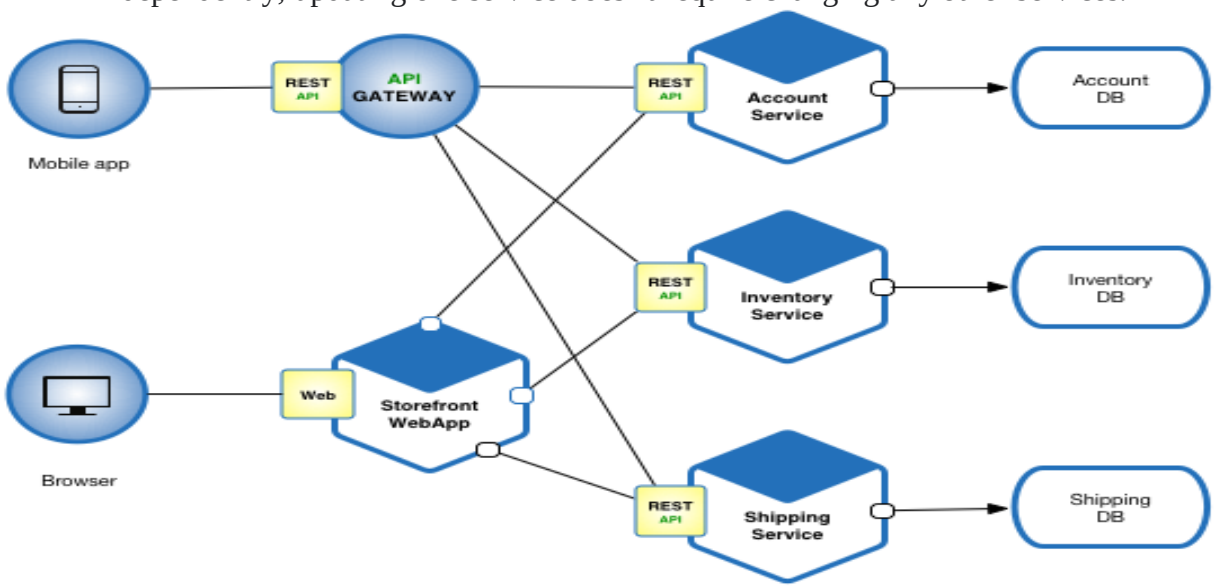
Prerequisite knowledge for Complete understanding and learning of Topic:

- SOA.
- Microservices.
- Gateway.

Detailed content of the Lecture:

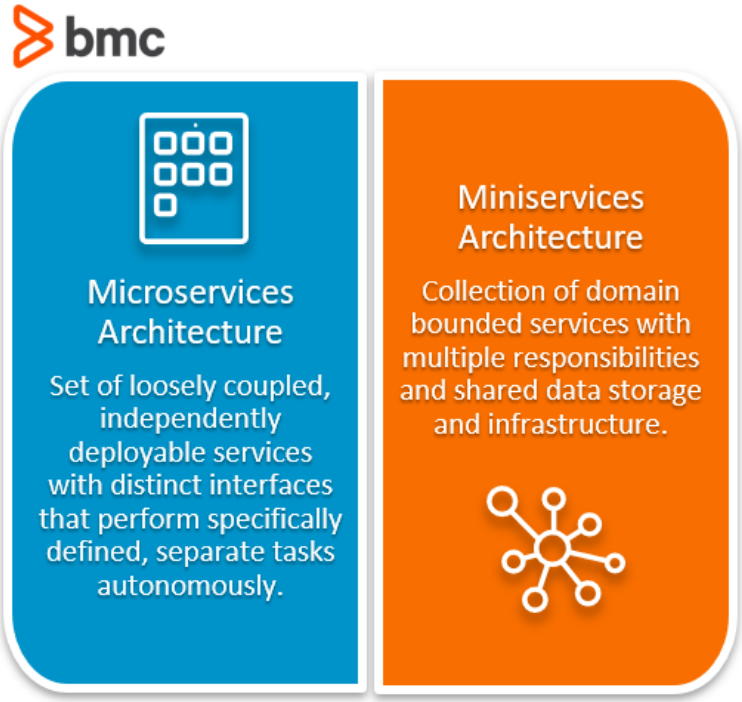
Design patterns of Microservices :

- A microservices architecture as a service-oriented architecture composed of loosely coupled elements that have bounded contexts. Loosely coupled means that you can update the services independently; updating one service doesn't require changing any other services.

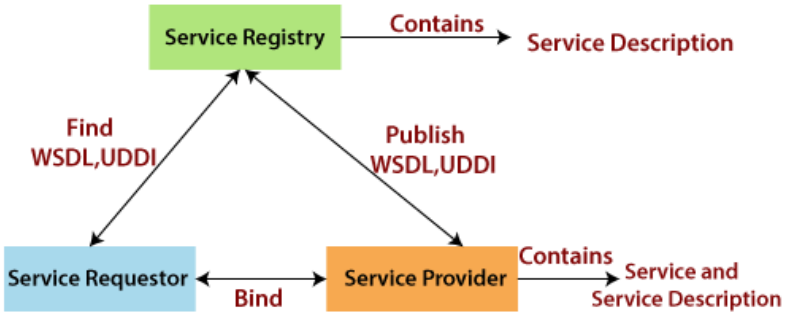


The Mini web service architecture :

- The miniservices architecture is an architectural framework that has a collection of domain bounded services with multiple responsibilities and shared data stores.
- Unlike microservices with a complete de-coupling of services and their implementation details, miniservices can share libraries and databases.



- A miniservice takes the pragmatic approach to microservices, but enables users to take a simpler integration technique between services without having to learn new integration patterns.
- The purist notion of a microservice follows a very specific model. It should really be an event driven architecture.
- Web application architecture is a pattern of interaction between the web application components.
- The way this interaction is planned out determines the resilience, performance, and security of a future web application.



Web Service Roles, Operations and Artifacts

- The differences between microservices and web services deal with different concepts in modern application design.
- A microservice is a small, independent, application that performs a highly focused service as well as possible.
- A web service is an internet-based interface that makes the “services” of one application available to applications running on different platforms.
- A miniservice takes the pragmatic approach to microservices, but enables users to take a simpler integration technique between services without having to learn new integration patterns.
- The purist notion of a microservice follows a very specific model. It should really be an event driven architecture.

Video Content / Details of website for further learning (if any):
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Important Books/Journals for further learning including the page nos.:
Hands-On Microservices with Spring Boot and Spring Cloud: Buildand deploy microservices using spring cloud, Istio and kubernetes-Magnus Larsson,Packt Publishing Ltd, First Edition, September, 2019 **(Page No : 61- 66)**

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Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **V -Microservices And Devops**

Date of Lecture: 01.12.2021

Topic of Lecture: Microservice dependency tree , Challenges with Microservices , SOA vs Microservice

Introduction :

- A circular dependency is defined as a relationship between two or more application modules that are codependent.
- Circular dependencies in a microservices-based application can hurt the ability of services to scale or independently deploy, as well as violate the Circular Dependencies Principle.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Microservices.
- SOA.
- HTTP.

Detailed content of the Lecture:

Microservice dependency tree :

- The communication between microservices should be done only by propagating data asynchronously, but try not to depend on other internal microservices as part of the initial service's HTTP request/response operation.

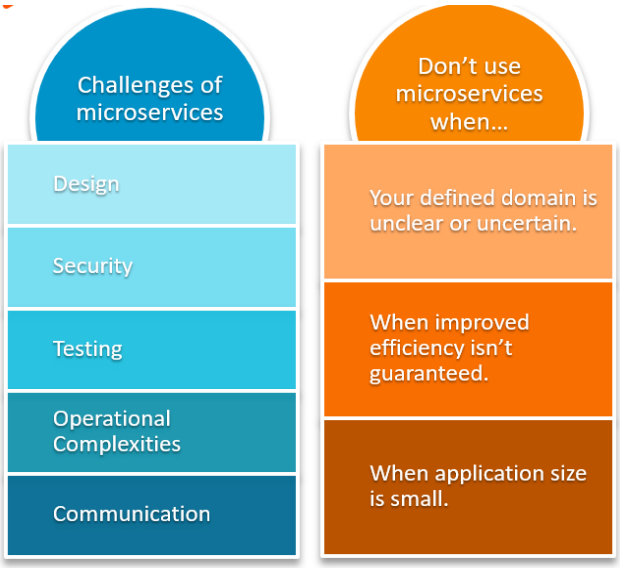
Challenges with Microservices:

- **Inter Service Communication** – MicroServices will rely on each other and they will have to communicate. A common communication channel needs to be framed using HTTP/ESB etc.
- **Health Monitoring** – There are more services to monitor which may be developed using different programming languages.

Challenges of microservices architectures:

- Design.
- Security.
- Testing.
- Increased operational complexity.
- Communication.

- Your defined domain is unclear/uncertain.
- Improved efficiency isn't guaranteed.
- Application size is small or uncomplex.



SOA vs Microservice:

SERVICE ORIENTED ARCHITECTURE	MICROSERVICES ARCHITECTURE
Maximizes application service reusability	Focused on decoupling
A systematic change requires modifying the monolith	A systematic change is to create a new service
DevOps and Continuous Delivery are becoming popular, but are not mainstream	Strong focus on DevOps and Continuous Delivery
Focused on business functionality reuse	More importance on the concept of "bounded context"
For communication it uses Enterprise Service Bus (ESB)	For communication uses less elaborate and simple messaging systems
Supports multiple message protocols	Uses lightweight protocols such as HTTP, REST or Thrift APIs
Use of a common platform for all services deployed to it	Application Servers are not really used, it's common to use cloud platforms
Use of containers (such as Docker) is less popular	Use of containers (such as Docker) is less popular
SOA services share the data storage	Each microservice can have an independent data storage
Common governance and standards	Relaxed governance, with greater focus on teams collaboration and freedom of choice

Video Content / Details of website for further learning (if any):
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Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **V - Microservices And Devops**

Date of Lecture:02.12.2021

Topic of Lecture: Microservice and API, Deploying and maintaining Microservices

Introduction :

- A microservice is a small, single service offered by a company.
- The microservice can then be delivered through an application programming interface (API).
- An API is a method of communication between a requester and a host, most often accessible through an IP address.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Microservices.
- API.
- Web Services.

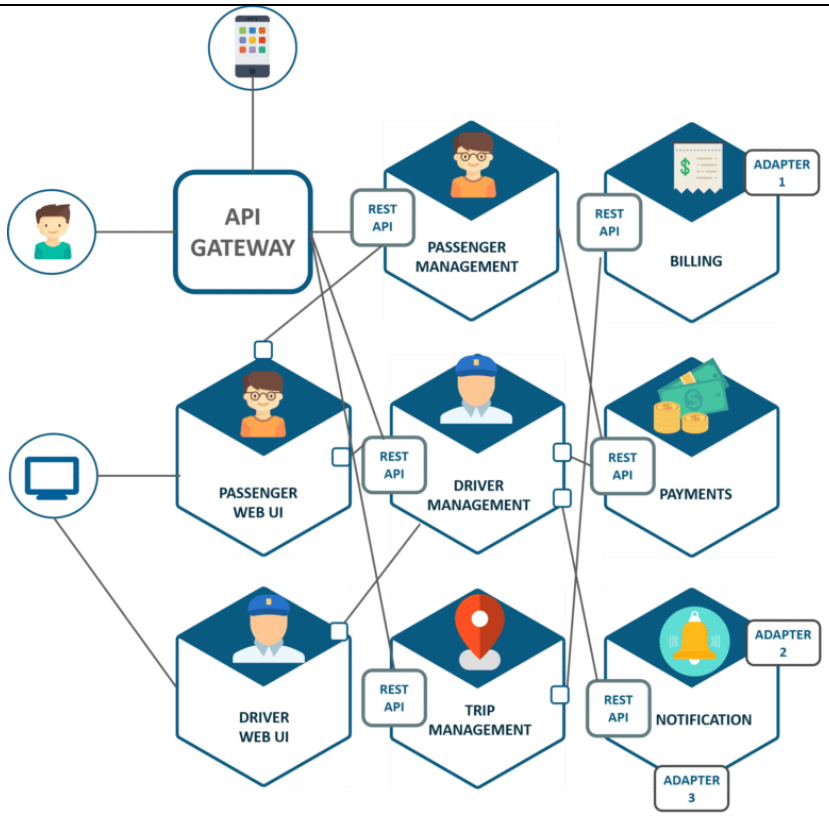
Detailed content of the Lecture:

Microservice and API:

- Microservices are very simple. Simplicity is a primary goal. They can be thought of as roles in a company; one microservice serves a very particular role and has just one job to do.
- DZone put together an excellent graph of different microservices that Uber offers, communicating with one another through APIs and performing different tasks.

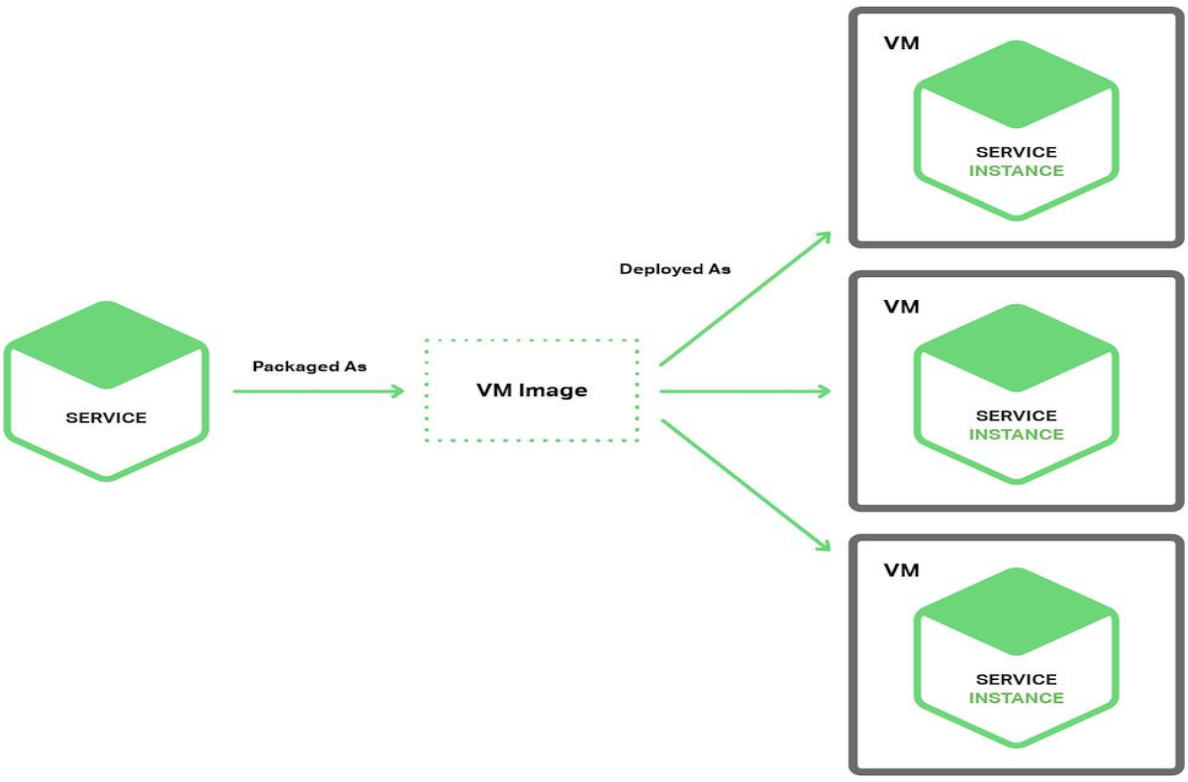
User builds different services for each task:

- Passenger management
- Passenger web UI
- Billing
- Driver management
- Driver web UI
- Payment
- Trip management
- Notifications



Deploying and maintaining Microservices:

- One way to deploy your microservices is to use the Multiple Service Instances per Host pattern.
- When using this pattern, you provision one or more physical or virtual hosts and run multiple service instances on each one. In many ways, this the traditional approach to application deployment.



key points of Microservices:

- Keep communication between services simple with a RESTful API.
- Divide your data structure.
- Build your microservices architecture for failure.
- Emphasize monitoring to ease microservices testing.
- Embrace continuous delivery to reduce deployment friction.

Microservices Deployment Strategies:

- Multiple Service Instances per Host (Physical or VM) This is one of the most traditional a widely used approach to deploy an application in the Multiple Service Instances per Host pattern.
- Service Instance Per Host (Physical or VM)
- Service Instance per Container.
- Server-less Deployment.

Video Content / Details of website for further learning (if any):
https://www.youtube.com/watch?v=zs_QyRTIpDM

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Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **V - Microservices And Devops**

Date of Lecture:03.12.2021

Topic of Lecture: Reason for having DevOps, Overview of DevOps , History of DevOps

Introduction :

- DevOps is important because it's a software development and operations approach that enables faster development of new products and easier maintenance of existing deployments.

Prerequisite knowledge for Complete understanding and learning of Topic:

- DevOps.
- Microservices.
- Software Development.

Detailed content of the Lecture:

Reason for having DevOps :

- DevOps is the combination of cultural philosophies, practices, and tools that increases an organization's ability to deliver applications and services at high velocity evolving and improving products at a faster pace than organizations using traditional software development and infrastructure management processes.

DevOps and its benefits:

- DevOps engineers can exploit real-time data into the performance of their systems to quickly understand the impact of application changes.
- And resolution times are faster because team members don't need to wait for a different team to troubleshoot and fix the problem.

Overview of DevOps :

- DevOps is a set of practices, tools, and a cultural philosophy that automate and integrate the processes between software development and IT teams.
- It emphasizes team empowerment, cross-team communication and collaboration, and technology automation.
- DevOps is about removing the barriers between traditionally siloed teams, development and operations
- Under a DevOps model, development and operations teams work together across the entire software application life cycle, from development and test through deployment to operations.

History of DevOps:

- The concept of DevOps emerged out of a discussion between Andrew Clay and Patrick Debois in 2008.
- They were concerned about the drawbacks of Agile and wanted to come up with something better.
- The idea slowly began to spread and after the DevOpsDays event held in Belgium in 2009, it became quite a buzzword.
- DevOps (development and operations) is an enterprise software development phrase used to mean a type of agile relationship between development and IT operations.

DevOps invented:

- The DevOps movement started to coalesce some time between 2007 and 2008, when IT operations and software development communities raised concerns what they felt was a fatal level of dysfunction in the industry.

Video Content / Details of website for further learning (if any):
https://www.youtube.com/watch?v=o7-IuYS0iSE

Important Books/Journals for further learning including the page nos.:
DEVOPS: A complete beginner's guide to DevOps best practices-Jim Lewis, ISBN-13:978-1673259148, ISBN-10: 1673259146, First Edition,2019 **(Page No : 45- 49)**

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Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **V - Microservices And Devops**

Date of Lecture: 07.12.2021

Topic of Lecture: Concepts and terminology in DevOps , Core elements of DevOps , Life cycle of DevOps

Introduction :

- DevOps is an IT mindset that encourages communication, collaboration, integration, and automation among software developers and IT operations in order to improve the speed and quality of delivering software.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Software Development.
- DevOps.
- Collaboration.

Detailed content of the Lecture:

Concepts and terminology in DevOps:

- DevOps is a collaboration between Development and IT Operations to make software production and deployment in an automated & repeatable way.
- DevOps helps to increase the organization's speed to deliver software applications and services.
- The word 'DevOps' is a combination of two words, 'Development' and 'Operations.'

DevOps used:

- DevOps allows Agile Development Teams to implement Continuous Integration and Continuous Delivery. This helps them to launch products faster into the market.

Other Important reasons are:

1. Predictability: DevOps offers significantly lower failure rate of new releases

2. Reproducibility: Version everything so that earlier version can be restored anytime.

3. Maintainability: Effortless process of recovery in the event of a new release crashing or disabling

the current system.

4. Time to market: DevOps reduces the time to market up to 50% through streamlined software delivery. This is particularly the case for digital and mobile applications.

5. Greater Quality: DevOps helps the team to provide improved quality of application development as it incorporates infrastructure issues.

6. Reduced Risk: DevOps incorporates security aspects in the software delivery lifecycle. It helps in reduction of defects across the lifecycle.

7. Resiliency: The Operational state of the software system is more stable, secure, and changes are auditable.

8. Cost Efficiency: DevOps offers cost efficiency in the software development process which is always an aspiration of IT companies' management.

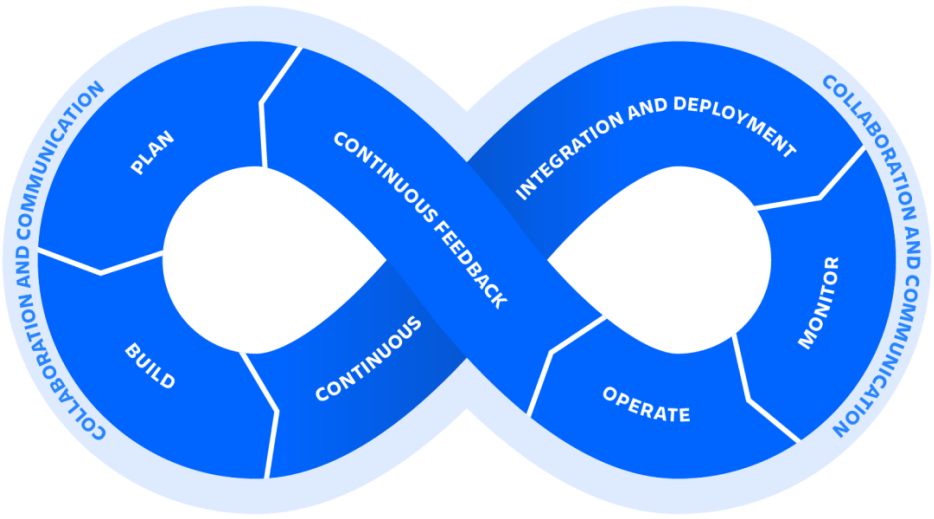
9. Breaks larger code base into small pieces: DevOps is based on the agile programming method. Therefore, it allows breaking larger code bases into smaller and manageable chunks.

Core Elements of DevOps :

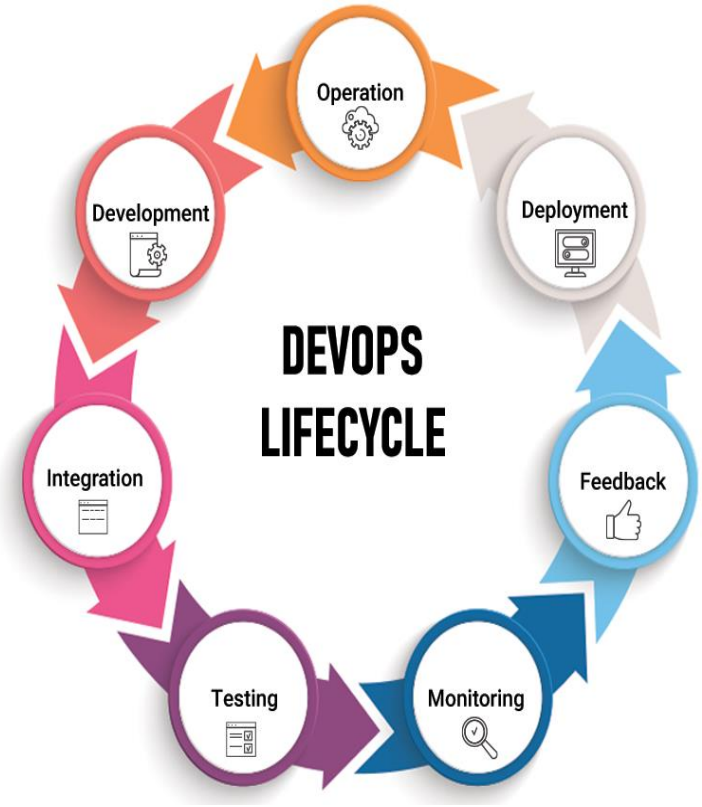
- Continuous Integration.
- Continuous Delivery.
- Microservices.
- Infrastructure as Code.
- Monitoring and Logging.
- Communication and Collaboration.

The DevOps lifecycle:

- Because of the continuous nature of DevOps, practitioners use the infinity loop to show how the phases of the DevOps lifecycle relate to each other.
- Despite appearing to flow sequentially, the loop symbolizes the need for constant collaboration and iterative improvement throughout the entire lifecycle.



- The DevOps lifecycle optimizes development processes from start to end and engages the organization in continuous development, resulting in faster delivery times. This process mainly consists of the following seven stages.



Video Content / Details of website for further learning (if any):
https://www.youtube.com/watch?v=Y-rj4vFc1Q8

Important Books/Journals for further learning including the page nos.:
DEVOPS: A complete beginner's guide to DevOps best practices-Jim Lewis, ISBN-13:978-1673259148, ISBN-10: 1673259146, First Edition,2019 **(Page No : 51- 58)**

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LECTURE HANDOUTS

MCA

II / III

Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **V - Microservices And Devops**

Date of Lecture: 08.12.2021

Topic of Lecture: Adoption of DevOps , DevOps Tools

Introduction :

- Adopting DevOps allows you to streamline your software delivery lifecycle and to be able to deliver better software faster.
- The reason why organizations are interested in adopting DevOps is to streamline their software delivery lifecycle and to be able to deliver better software faster.

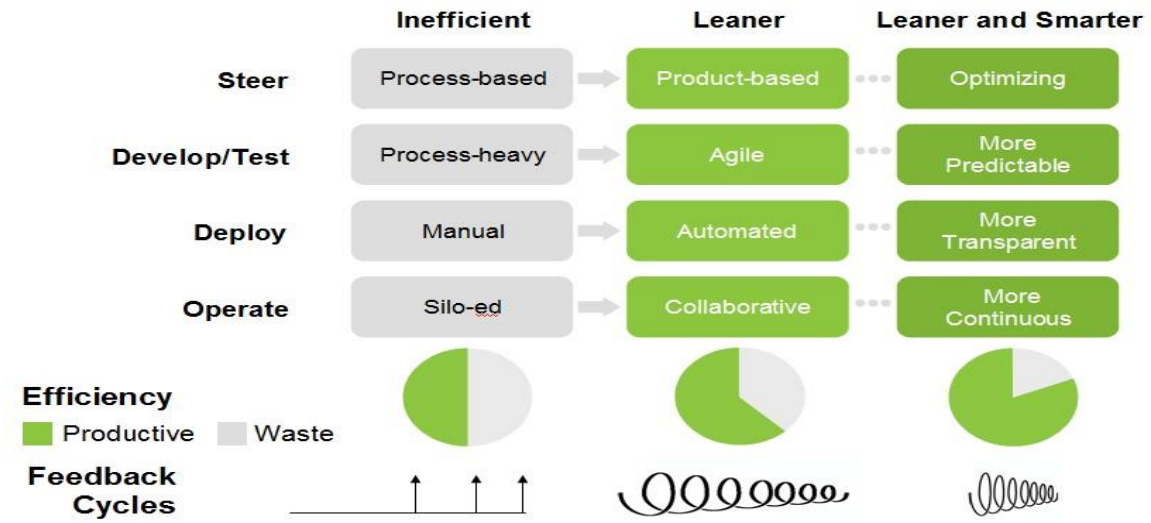
Prerequisite knowledge for Complete understanding and learning of Topic:

- Web Services.
- DevOps Tools.
- Cloud Services.

Detailed content of the Lecture:

Adoption of DevOps :

- DevOps Adoption Model. IBM has defined a DevOps adoption model to help organizations incrementally adopt DevOps capabilities and measurably improve effectiveness and efficiency.
- There are 4 adoption paths represented by the 4 rows: Steer, Develop/Test, Deploy and Operate.



DevOps Tools:

List of DevOps Tools:

- Version Control tools.
- Container Management tools.
- Application Performance Monitoring tools.
- Deployment & Server Monitoring tools.
- Configuration Management tools.
- CI / Deployment Automation tools.
- Test Automation tools.
- Artifact Management tools.
- DevOps is the combination of cultural philosophies, practices, and tools that increases an organization's ability to deliver applications and services at high velocity evolving and improving products at a faster pace than organizations using traditional software development and infrastructure management processes.

Video Content / Details of website for further learning (if any):
https://www.youtube.com/watch?v=B3M0XFRK9vY

Important Books/Journals for further learning including the page nos.:
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LECTURE HANDOUTS

II / III

MCA

Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **V - Microservices And Devops**

Date of Lecture: 13.12.2021

Topic of Lecture: Build, Promotion and Deployment in DevOps

Introduction :

- A developer commits code to a software repository.
- A deployment automation tool, such as Jenkins or Ansible, will see the new code and trigger a series of tests.
- In this stage the application is deployed to production and available to users.

Prerequisite knowledge for Complete understanding and learning of Topic:

- Binary Code.
- Continuous Integration
- Packages.

Detailed content of the Lecture:

Build in DevOps :

- Build automation is the process of automating the retrieval of source code, compiling it into binary code, executing automated tests, and publishing it into a shared, centralized repository
- Build automation is critical to successful DevOps processes.
- Build means to Compile the project.
- Deploy means to Compile the project & Publish the output.
- For web applications no need to deploy or nothing need to do at client side except simple browser with url.

5 Benefits of Build Automation:

Increases Productivity:

- Build automation ensures fast feedback. This means your developers increase productivity.
- They'll spend less time dealing with tools and processes and more time delivering value.

Accelerates Delivery:

- Build automation helps you accelerate delivery. That's because it eliminates redundant tasks

and ensures you find issues faster, so you can release faster.

Improves Quality:

- Build automation helps your team move faster. That means you'll be able to find issues faster and resolve them to improve the overall quality of your product and avoid bad builds.

Maintains a Complete History:

- Build automation maintains a complete history of files and changes. That means you'll be able to track issues back to their source.

Saves Time and Money:

- Build automation saves time and money. That's because build automation sets you up for CI/CD, increases productivity, accelerates delivery, and improves quality.

Automate the build process:

1. Write the code.
2. Commit code to a shared, centralized repository such as Perforce Helix Core.
3. Scan the code using tools such as static analysis.
4. Start a code review.
5. Compile code and files.
6. Run automated testing.

Promotion and Deployment in DevOps :

- DevOps resources. Deployment automation is what enables you to deploy your software to testing and production environments with the push of a button. Automation is essential to reduce the risk of production deployments.

An automated deployment process has the following inputs:

- Packages created by the continuous integration (CI) process (these packages should be deployable to any environment, including production).
- Scripts to configure the environment, deploy the packages, and perform a deployment test (sometimes known as a smoke test).
- Environment-specific configuration information.

Video Content / Details of website for further learning (if any):
https://www.youtube.com/watch?v=SrYCkrlpwzs

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LECTURE HANDOUTS

II / III

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Course Name with Code : **CLOUD COMPUTING TECHNOLOGIES - 19CAC11**

Course Faculty : **Mrs. R.Pavithra**

Unit : **V - Microservices And Devops**

Date of Lecture: 15.12.2021

Topic of Lecture: DevOps in Business Enterprises

Introduction :

- Enterprise DevOps is the application of DevOps values in an environment that contains any of the following: Many inter-dependent and related systems and sub systems, software and teams that rely on each other.
- Workflows that are mostly manual and error prone across multiple teams or stakeholders.

Prerequisite knowledge for Complete understanding and learning of Topic:

- DevOps.
- Hardware.

Detailed content of the Lecture:

DevOps in Business Enterprises:

- Enterprise DevOps is the application of DevOps values in an environment that contains any of the following:
- Many inter-dependent and related systems and sub systems, software and teams that rely on each other
- Monolithic systems and/or static software/hardware environments
- Lengthy Approval Gates or change control processes
- Security, financial medical or other compliance requirements
- Lengthy waterfall based processes among multiple teams and stake holders
- Workflows that are mostly manual and error prone across multiple teams or stakeholders
- In order to create a pipeline-centered organization that is able to seize opportunities in the marketplace quickly.

What is DevOps?

- DevOps is a culture that drives and enables the following behaviors:
- Treating Infrastructure and code as the same thing: Software

- That Software is built and deployed to achieve fast feedback cycles
- Those feedback cycles are achieved through continuous delivery pipelines
- Those pipelines contain the automated coded policy of the organization
- Those pipelines are as human free as possible
- Humans share knowledge and work creatively with work centered around pipelines
- Knowledge silos are broken in favor of supporting a continuous pipeline flow
- DevOps is the Agile operating model of modern IT, and is centered around the idea of a continuous delivery pipeline as the main building block of an Agile organization.

- The DevOps model is a process for improving the collaboration and visibility between IT operations and software developers creating a lifecycle for continuous delivery and integration (CI/CD) of highly resilient systems. ... The core tenets of DevOps facilitate an organizational culture focused on continuous improvement.

Video Content / Details of website for further learning (if any):
https://www.youtube.com/watch?v=ltU4FkHu0Nk

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