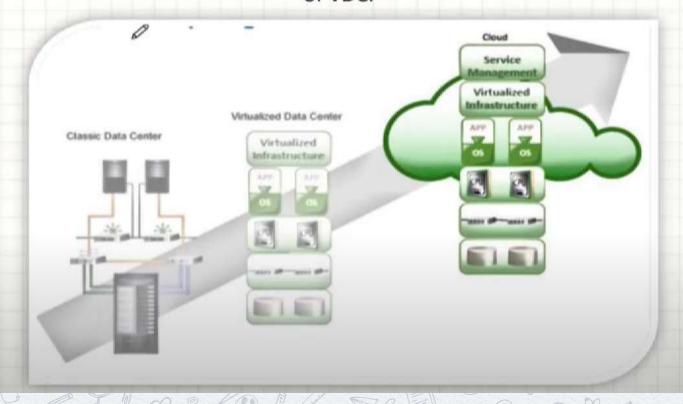


### **Contents**

- Cloud Computing in a Nutshell
- Roots of Cloud Computing
- Layers and Types of Clouds
- Desired Features of a Cloud
- Cloud Infrastructure Management
- •Examining the Characteristics of Cloud Computing

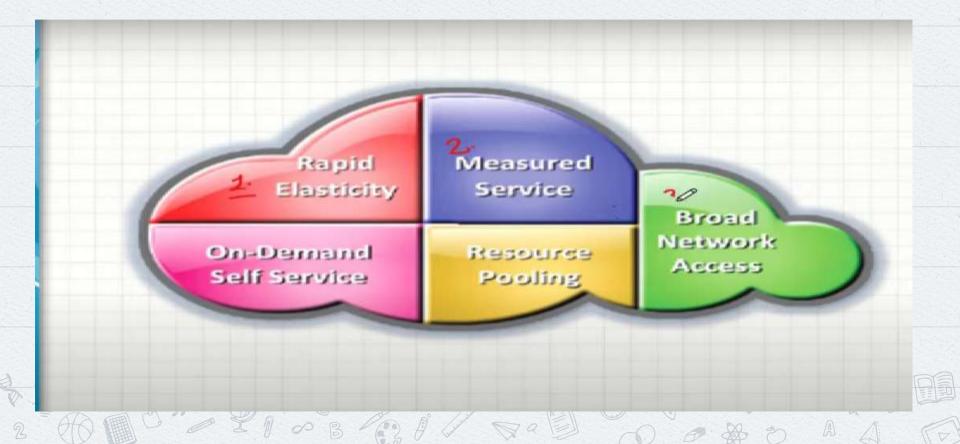
Transforming VDC to Cloud requires a Cloud service management layer on top of VDC.



"Cloud is a parallel and distributed computing system consisting of a collection of inter-connected and virtualized computers that are dynamically provisioned and presented as one or more unified computing resources based on service-level agreements (SLA) established through negotiation between the service provider and consumers."—Raj Kumar Buyya

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

# Characteristics of cloud ( cloud computing id nothing but provide :-)



## **Characteristics of cloud**

#### x On-demand self-services:

The Cloud computing services does not require any human administrators, user themselves are able to provision, monitor and manage computing resources as needed.

#### x Broad network access:

The Computing services are generally provided over standard networks and heterogeneous devices.

#### x Rapid elasticity:

The Computing services should have IT resources that are able to scale out and in quickly and on as needed basis. Whenever the user require services it is provided to him and it is scale out as soon as its requirement gets over.

#### x Resource pooling:

The IT resource (e.g., networks, servers, storage, applications, and services) present are shared across multiple applications and occupant in an uncommitted manner.

#### x Measured service:

The resource utilization is tracked for each application and occupant, it will provide both the user and the resource provider with an account of what has been used. This is done for various reasons like monitoring billing and effective use of resource.

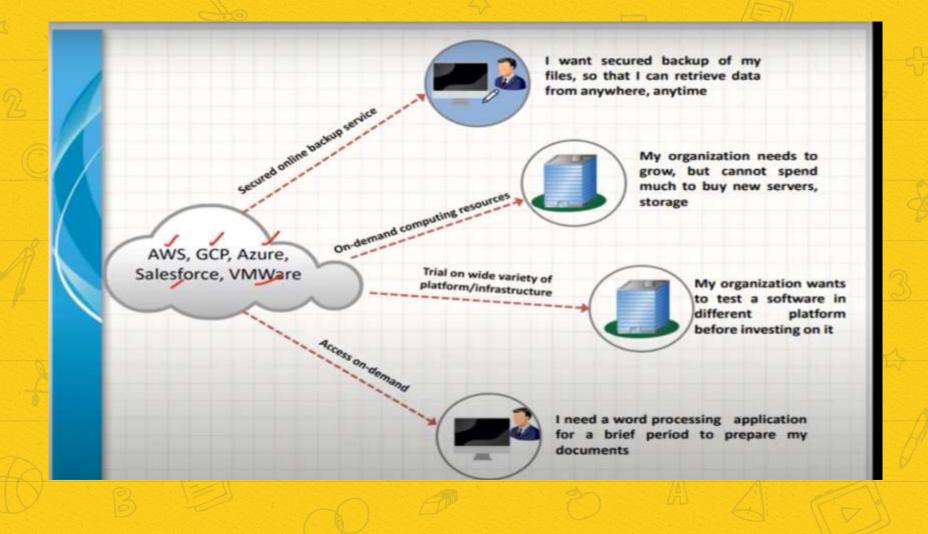
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## Cloud computing in nutshell

- x Technologies such as cluster, grid, and now, cloud computing, have all aimed at allowing access to large amounts of computing power in a fully virtualized manner.
- x Consumers pay providers based on usage ("pay-as-you-go"), similar to the way in which we currently obtain services from traditional public utility services such as water, electricity, gas, and telephony.

- X Cloud computing has been coined as an umbrella term to describe a category of sophisticated on-demand computing services initially offered by commercial providers, such as Amazon, Google, and Microsoft.
- x It denotes a model on which a computing infrastructure is viewed as a "cloud," from which businesses and individuals access applications from anywhere in the world on demand
- x The main principle behind this model is offering computing, storage, and software "as a service."

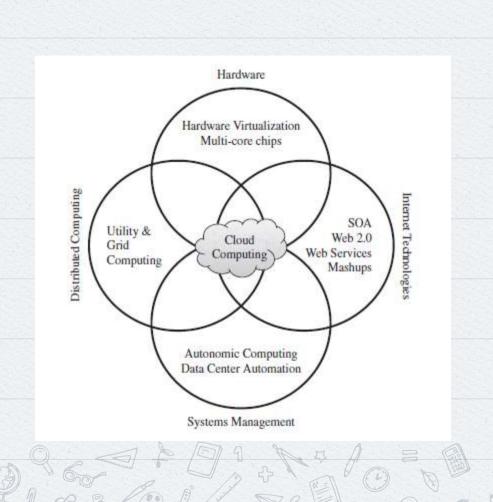
Cloud computing is the result of many years of evolution dating back to the first computers. It is the natural progression from the centralized mainframe era, to the distributed client-server era enabled by the birth of personal computers, to the Internet era where the enterprise was able to connect to the rest of the world through a network of computers that spanned the globe.



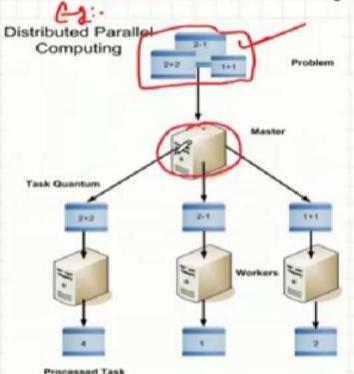
In October 2010, a photo-sharing application called Instagram was launched, and 25,000 people registered on that first day. Three months later, Instagram had 1 million users, and shortly after hit 10 million. At that time, the company only offered an iOS version of its mobile application, so it was only capturing iPhone users. Would it have been possible that a normal traditional server would have supported that kind of traffic?

## ROOTS OF CLOUD COMPUTING

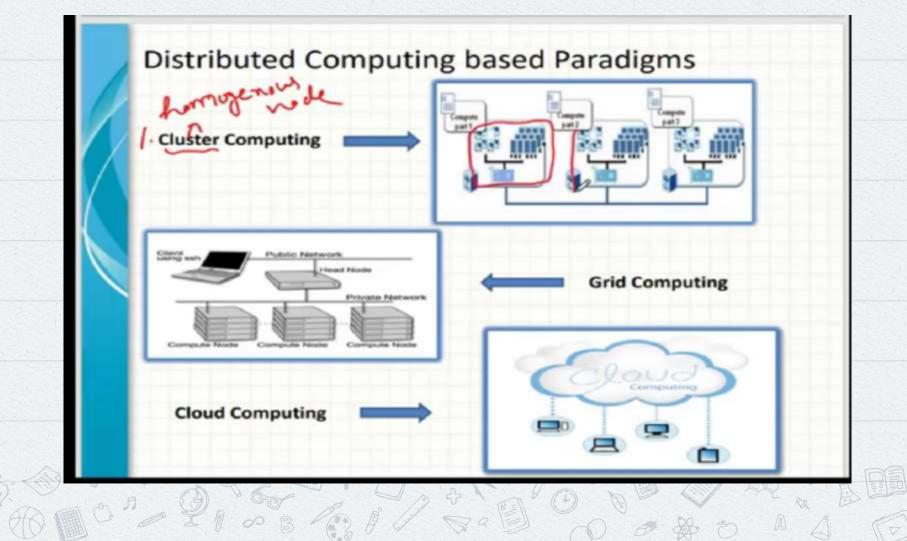
x We can track the roots of clouds computing by observing the advancement of several technologies, especially in hardware (virtualization, multi-core chips), Internet technologies (Web services, service-oriented architectures, Web 2.0), distributed computing (clusters, grids), and systems management (autonomic computing, data center automation).



## **Distributed Computing**



- 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.



x This model brings benefits to both consumers and providers of IT services. Consumers can attain reduction on IT-related costs by choosing to obtain cheaper services from external providers as opposed to heavily investing on IT infrastructure and personnel hiring. The "on-demand" component of this model allows consumers to adapt their IT usage to rapidly increasing or unpredictable computing needs.

- X Web services can glue together applications running on different messaging product platforms, enabling information from one application to be made available to others, and enabling internal applications to be made available over the Internet.
- x The purpose of a SOA is to address requirements of loosely coupled, standards-based, and protocolindependent distributed computing.

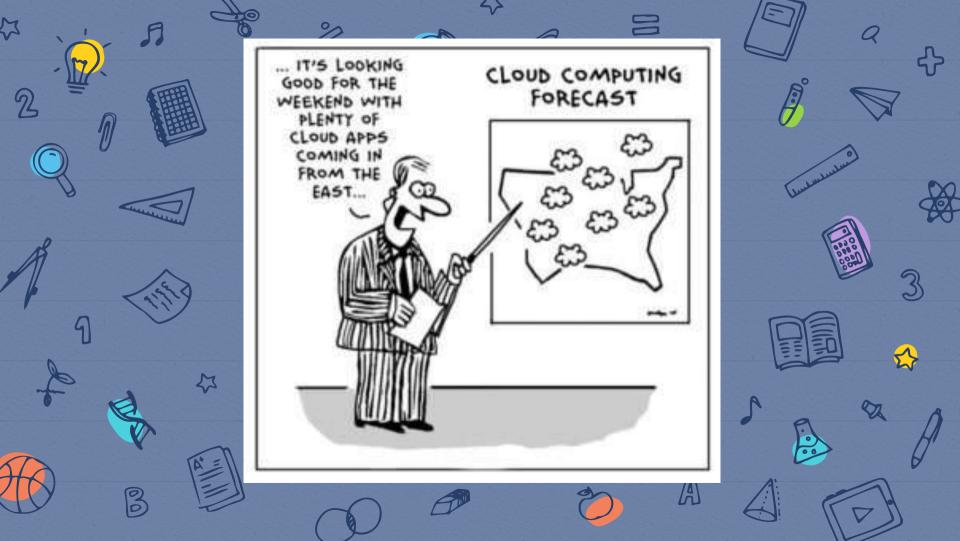
- x In a SOA, software resources are packaged as "services," which are well-defined, self-contained modules that provide standard business functionality and are independent of the state or context of other services. Services are described in a standard definition language and have a published interface.
- x Programmable Web is a public repository of service APIs and mashups currently listing thousands of APIs and mashups.

x In the consumer Web, information and services may be programmatically aggregated, acting as building blocks of complex compositions, called service mashups. Many service providers, such as Amazon, del.icio.us, Facebook, and Google, make their service APIs publicly accessible using standard protocols such as SOAP and REST



X A key aspect of the grid computing services in roots to cloud has been building standard Web services-based protocols that allow distributed resources to be "discovered, accessed, allocated, monitored, accounted for, and billed for, etc., and in general managed as a single virtual system.

- x The idea of virtualizing a computer system's resources, including processors, memory, and I/O devices, has been well established for decades, aiming at improving sharing and utilization of computer systems.
- x The advent of several innovative technologies—multicore chips, paravirtualization, hardware-assisted virtualization, and live migration of VMs—has contributed to an increasing adoption of virtualization on server systems



## Types of cloud

Service Class Main Access & Management Tool

Service content



SaaS

Web Browser

Cloud Applications

Social networks, Office suites, CRM, Video processing



PaaS

Cloud Development Environment Cloud Platform

Programming languages, Frameworks, Mashups editors, Structured data



IaaS

Virtual Infrastructure Manager Cloud Infrastructure

Compute Servers, Data Storage, Firewall, Load Balancer

- X Cloud computing services are divided into three classes, according to the abstraction level of the capability provided and the service model of providers, namely:
- (1) Infrastructure as a Service
- (2) Platform as a Service
- (3) Software as a Service

- x These abstraction levels can also be viewed as a layered architecture where services of a higher layer can be composed from services of the underlying layer.
- X Cloud development environments are built on top of infrastructure services to offer application development and deployment capabilities; in this level, various programming models, libraries, APIs, and mashup editors enable the creation of a range of business, Web, and scientific applications.

## Infrastructure-as-a-service

x laaS is also known as Hardware as a Service (HaaS). It is a computing infrastructure managed over the internet. The main advantage of using laaS is that it helps users to avoid the cost and complexity of purchasing and managing the physical servers.

## Platform-as-a-service

- With Platform as a Service (PaaS), the provider delivers more than infrastructure. It delivers what you might call a solution stack — an integrated set of software that provides everything a developer needs to build an application — for both software development and runtime.
- x PaaS can be viewed as an evolution of Web hosting. In recent years, Webhosting companies have provided fairly complete software stacks for developing Websites.

## **Characteristics of laaS**

- x There are the following characteristics of laaS -
- x Resources are available as a service
- x Services are highly scalable
- x Dynamic and flexible
- x GUI and API-based access
- x Automated administrative tasks
- x Example: DigitalOcean, Linode, Amazon Web
  - Services (AWS), Microsoft Azure, Google
  - Compute Engine (GCE) and Cisco Metacloud.

## Software-as-a-service

- X One of the first implementations of cloud services was Software as a Service (SaaS) — business applications that are hosted by the provider and delivered as a service.
- At the top of the stack is SaaS. SaaS is a complete application delivered as a service to the service consumer. The service consumer has only to configure some application-specific parameters and manage users.

## **Features of cloud**

- x Certain features of a cloud are essential to enable services that truly represent the cloud computing model and satisfy expectations of consumers, and cloud offerings must be
- (i) self-service
- (ii) per-usage metered and billed
- (iii) elastic
- (iv) customizable.

## CLOUD INFRASTRUCTURE MANAGEMENT

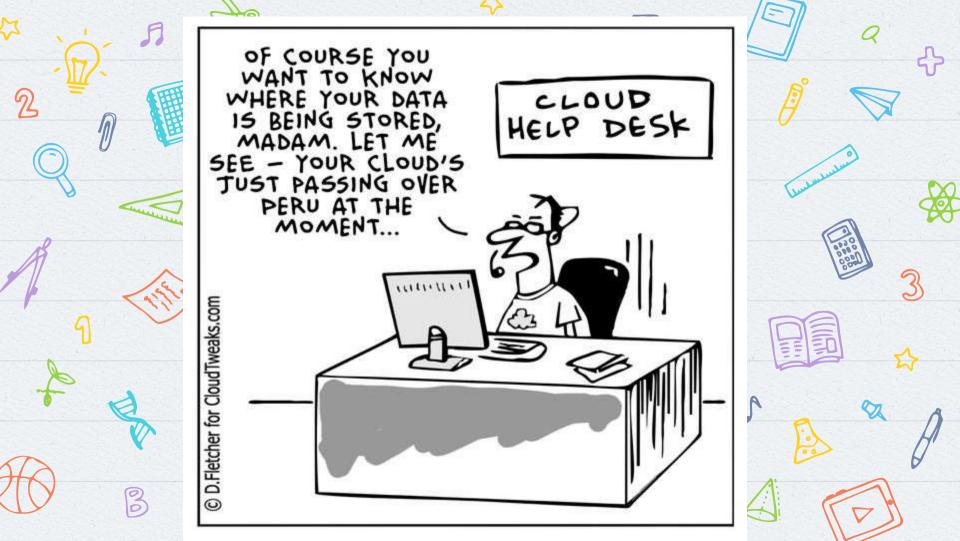
- x A key challenge laaS providers face when building a cloud infrastructure is managing physical and virtual resources, namely servers, storage, and networks
- x The orchestration of resources must be performed in a way to rapidly and dynamically provision resources to applications
- x The software toolkit responsible for this orchestration is called a virtual infrastructure manager.

## Features of infrastructure manager

- x Virtualization Support-The multi-tenancy aspect of clouds requires multiple customers with disparate requirements to be served by a single hardware infrastructure. Virtualized resources (CPUs, memory, etc.) can be sized and resized with certain flexibility.
- X Self-Service, On-Demand Resource Provisioning-Self-service access to resources has been perceived as one the most attractive features of clouds.

- Multiple Backend Hypervisors- Different virtualization models and tools offer different benefits, drawbacks, and limitations. Thus, some virtual infrsatructure managers provide a uniform management layer.
- X Storage Virtualization- Virtualizing storage means abstracting logical storage from physical storage. By consolidating all available storage devices in a data center

- X Dynamic Resource Allocation- Increased awareness of energy consumption in data centers has encouraged the practice of dynamic consolidating VMs in a fewer number of servers.
- X High Availability and Data Recovery- The high availability (HA) feature of VI managers aims at minimizing application downtime and preventing business disruption.



#### **Public Cloud**

Typically have massive amounts of available space, which translates into easy scalability. Recommended for software development and collaborative projects.

#### **Hybrid Cloud**

Combine public clouds with private clouds to allow the two platforms to interact seamlessly. Recommended for businesses balancing big data analytics with strict data privacy regulations.



# Types of Cloud Deployment

#### **Private Cloud**

Usually reside behind a firewall and are utilized by a single organization. Recommended for businesses with very tight regulatory requirements

#### **Community Cloud**

A collaborative, multi-tenant platform used by several distinct organizations to share the same applications. Users are typically operating within the same industry or field.

# Unit-2: Migrating into — cloud —

Here starts the lesson!

CELESCE EN LES

### **Contents**

- Broad Approaches to Migrating into the Cloud
- The Seven-Step Model of Migration into a Cloud VM Migration
- Cloud Middleware and Best Practices
- Concept and Need of Cloud Middleware
- QoS Issues in Cloud
- Data Migration and Streaming in Cloud
- Interoperability

# **Cloud migration**

- Cloud migration is the process of moving a company's digital assets, services, databases, IT resources, and applications either partially, or wholly, into the cloud. Cloud migration is also about moving from one cloud to another.
- Cloud migration is defined as the transfer of digital business processes and workflows to cloud platforms. This process entails moving information, applications, processes, and other digitized business components from an on-premise or existing cloud database to a cloud-based data center

ROYALTY-FREE ILLUSTRATION

# Cloud Migration



Proof of Concept Data Migration

Application Migration Leverage Cloud

Optimization

- · Assess Cost
- · Assess Architecture
- · Assess Security
- · Build Pilot
- ilot Leverage Storage
  Options
  - Migrate

- Migrate
- migrate

- Scale
- Automate
- · Test

- · Monitor
- · Redesign

#### **Understanding a Typical On-Premise to Cloud Migration** MIGRATION PROCESS DECOMISSION IAAS Azure PAAS Hybrid SAAS **Customer Cloud** Partner Cloud 5 Discover customer's Map dependencies Recommend Determine best Provide cloud on-prem footprint and determine cloud computing migration optimization (VMs, networks, network/storage path for service model strategy apps etc.) topology workloads, and plan cost modeling

# **Approaches to migrating**

- It refers to the movement or transfer between different physical machines without any discontinuity.
- What challenges and obstacles clients might have to overcome to tap into the cloud?
- How their management of IT must change to secure and control their new cloud-driven infrastructure?
- When you migrate from a client to the cloud, the issues you will face fall into the following overall categories.

### Security

Security Security is an obvious threshold question, if the cloud is not secure, enterprises will not consider migrating to it fearing their sensitive data will be tampered. For eq Users must ensure that they understand the underlying infrastructure of the cloud to which they migrate from their clients and must also advise clients to include security in their cloud SLAs and terms of service.

**Vendor Management** 

When the user is going migrate with the outsource providers, then the service level agreements and its terms are thoroughly checked. It includes activities such as selecting vendors negitioting contracts controlling costs reducded vendors related riks Ensure service delviery

### **Technical Integration**

Most firms that migrate to the cloud environment in a hybrid model, are keeping certain key elements of their infrastructure inhouse and under their direct control, while outsourcing less susceptible or core components. Integrating internal and external infrastructures can be a technical concern. :- How we are using technology to teach and learn

The Business View

When the user is going migrate with the outsource providers, then the service level agreements and its terms are thoroughly checked. While the whole idea behind cloud computing is to propose a standardized, multi-tenant infrastructure, cloud vendors may not offer the same level of custom SLAs as IT managers

While implementing a cloud, migration expected at replacing on a premise major business application may look like, at times, a simple straightforward implementation. It is burdened with pit falls, which may undermine the true value to the investment, and in fact put enterprises in bad situation than before.

Understanding and planning for these pitfalls is significant for a successful deployment of the solution.

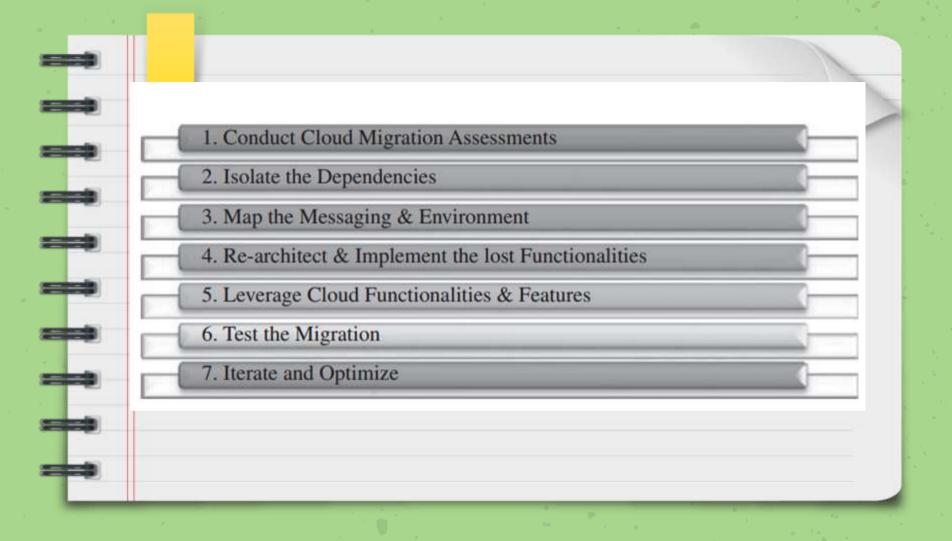
IT and business stakeholders must work together and have to:

- Clearly state business objectives for the cloud migration.
  - Define project scope of the cloud migration.
- Provide a set of guiding principles for all to follow.



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Steps to perform suitable migration



Cloud migration assessments comprise assessments to understand the issues involved in the specific case of migration at the application level or the code, the design, the architecture, or usage levels.

These assessments are about the cost of migration as well as about the ROI that can be achieved in the case of production version.

Isolating all systemic and environmental dependencies of the enterprise application components within the captive data center

# Step 3

Generating the mapping constructs between what shall possibly remain in the local captive data center and what goes onto the cloud.

substantial part of the enterprise application needs to be rearchitected, redesigned, and reimplemented on the cloud.

# Step 5

We leverage the intrinsic features of the cloud computing service to augment our enterprise application in its own small ways.

we validate and test the new form of the enterprise application with an extensive test suite that comprises testing the components of the enterprise application on the cloud as well

# Step 7

Test results could be positive or mixed.

In the latter case, we iterate and optimize as appropriate. After several such optimizing iterations, the migration is deemed successful

### **Process**

#### Assess

- · Cloudonomics
- Migration Costs
- Recurring Costs
- Database data segmentation
- Database Migration
- Functionality migration
- NFR Support

#### Isolate

- Runtime Environment
- · Licensing
- Libraries Dependency
- Applications Dependency
- Latencies
   Bottlenecks

   Performance
- bottlenecks
   Architectural
- Dependencies

#### Map

- Messages mapping: marshalling & de-marshalling
- Mapping Environments
- Mapping libraries & runtime approximations

#### Re-Ai

- Approximate lost functionality using cloud runtime support API
- New Usecases
- AnalysisDesign

#### Augment

- Exploit additional cloud features
- Seek Low-cost augmentations
- · Autoscaling
- Storage
- Bandwidth
- Security

#### Test

- Augment Test Cases and Test Automation
- Run Proof-of-Concepts
- Test Migration strategy
- Test new testcases due to cloud augmentation
- Test for Production Loads

#### Optimize

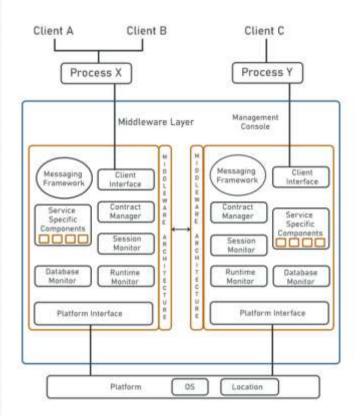
- Optimizerework and iterate
- Significantly satisfy cloudonomics of migration
- Optimize compliance with standards and governance
- Deliver best migration ROI
- Develop roadmap for leveraging new cloud features

# Cloud middleware

middleware is a software platform that sits between an application/device and another application/device. It makes the connection between any two clients, servers, databases or even applications possible; it is not used directly by end users. Cloud middleware. however, is always accessible to the user in the form of remote software platform for communication or management of data.



#### MIDDLEWARE ARCHITECTURE



# Definition of Concepts

Most middleware follows the service-oriented architecture (SOA) design or is designed as a platform-as-a-service (PaaS) solution. SOA is an architectural style that tries to achieve loosely coupled software applications that interact among themselves to run as a whole.

It is adopted by organizations trying to decouple all their business units, depending on integration and reusability for daily operations. SOA allows organizations to use existing application and system investments.

Each of these components must be able to interact with one another and other parts of the system. Apart from some basic components, each type of middleware needs a specific component.

# Components in middleware

Middleware management console

This console provides an overview of events and activities, transactions, configuration management, and contract rules.

• Platform interface
Middleware needs to work
across multiple platforms,
irrespective of where it
resides. This is the interface
that is in direct contact with
the backend servers.

• Common messaging framework Middleware requires messaging services to communicate with services, applications, and platforms. Most of these frameworks rely on existing standards such as simple object access protocol (SOAP), representational state transfer (REST), or Javascript object notation (JSON).



# Configure and control connections and integrations

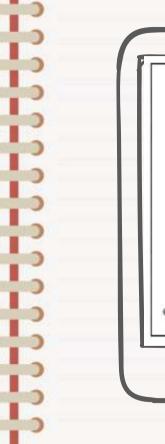
Based on information in a client or front-end application request, middleware can customize the response from the back-end application or service. In a retailer's ecommerce application, middleware application logic can sort product search results from a back-end inventory database by nearest store location, based on the IP address or location information in the HTTP request header.

# Secure connections and data transfer

Middleware typically establishes a secure connection from the frontend application to back-end data sources using Transport Layer Security (TSL) or another network security protocol. And it can provide authentication capabilities, challenging front-end application requests for credentials (username and password) or digital certificates.

# Manage traffic dynamically across distributed systems

When application traffic spikes, enterprise middleware can scale to distribute client requests across multiple servers, on premises or in the cloud. And concurrent processing capabilities can prevent problems when multiple clients try to access the same back-end data source simultaneously.





### Quality of serviceissues in Cloud

Quality of Service refers to the ability of networks to attain maximum bandwidth and handle other network elements like latency, error rate and uptime. Quality of Service include the management of other networks resource by allocating priorities to specific type of data (audio, video and file).

It is a challenge to implement QoS in cloud computing applications. There are many techniques to provide quality of service to the cloud applications. Scheduling, admission control and dynamic resource provisioning are some techniques used to achieve that goal.

# **Challenges**

#### Scheduling:

Cloud service scheduling categorized into two categories: user level and system level. At user level scheduling deals with problems raised by service providing between both service provider and customer. Market based and auction based schedulers are fit for ruling the supply and demand of cloud resources. Market based resource allocation is powerful in cloud computing environment where resources are handed over to user as a service.

The system level scheduling handles with resource management in datacenter. Datacenter contain many physical machines, Million request sent from user's side, scheduling these requests to the physical machines done in datacenter. This scheduling affect the performance of datacenter. Service provisioning in cloud systems based on Service Level Agreement (SLA).

# Challenges

Admission Control: The main purpose of admission control is to provide strong performance. At admission control time, the Infrastructure Provider (IP) must consider the extra requirement along with the fundamental computational and networking necessities that may be required to be added to runtime so it become flexible. In many cases, these flexible requirements may be very large comparing it to the normal requirements. For example, if there are many users are working on cloud application with high divergence, the number of virtual machines are required more and that may be added at runtime many times multiple of the number of the basic ones. So that, the number of flexible requirements plays important role in the total requirements and therefore the cost of hosting the service

# Challenges

Resource provisioning:

Dynamic resource provisioning is the process of assigning available resources to the cloud application. Resource allocation will make services suffer if the allocation not managed in the right way. Resource provisioning will solve this problem by allowing the service providers to manage the resources of modules individually. Resource Allocation Strategy (RAS) is all about integrating service provider services activities to allocate insufficient resources within the limit of cloud environment so that it meets the needs of the cloud application. It need the demand and type of resources for each application to complete the user task. The order and allocation time for resources are inputs for optimal RAS.

# Cloud Interoperability

Cloud interoperability. This term refers to the ability of two or more systems or applications to exchange information and to use the information that has been exchanged together.

There is a strong need for the development of integrated interoperability authentication among all provider

### **Standards**

When consumer wishes to migrate from one cloud Provider to another, interoperability falls into these categories:

Data and Application Portability: It means by running applications and data, consumers should be able to migrate easily from one cloud provider to another without any lock-in issue.

• Platform Portability: It means application development environment or IDE should be capable enough to run over any type of cloud infrastructure.

• Infrastructure Portability: It means virtual server or machine images should have the freedom of portability. They should be able to migrate from one cloud provider to another.