CLOUD COMPUTING-(18MCA43C)

UNIT – I

INTRODUCTION TO CLOUD COMPUTING

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SYLLABUS

UNIT I:

Introduction: Cloud computing in a nutshell, Layers and types, Features, Deployment models, Challenges and tasks, Migration into a cloud.

UNIT II:

Cloud Services: Web based applications, Pros and Cons of cloud services: Platform as a service Infrastructure as a service - service - software as a service, Discovering cloud services, development services and tools, cloud maturity levels, clouds.

UNIT III:

Virtual Machines: Provisioning and manageability, migration, provisioning in the cloud context, Management of VM Anatomy of cloud infrastructures - Scheduling techniques.

UNIT IV:

Map Reduce Paradigms: Introduction, GFS Architecture, HDFS Architecture, Hbase, Google big Tables, Amazon's key value pair storage and Microsoft's Azure infrastructure, Map reduce programming model and implementations.

UNIT V:

Monitorzing And Management: Federated cloud computing, SLA Management: Types - Lifecycle - Automated policy management in cloud. Cloud Computing Framework: Amazon EC3, S3 storage services, Aneka framework, Google App Engine, Eucalyptus cloud computing platform, IBM Bluemix.

TEXT BOOKS: 1. Rajkumar Buyya, James Broberg and Andrzej Goscinskj, "Cloud Computing: Principles and Paradigms", John willey and Sons, New Delhi, 2011.

REFERENCE BOOKS: 1. Judith Hurwitz, Marcia Kaufman, Fern Halper and Daniel Kirsch," Hybird Cloud for Dummies", Willey Publications, New Delhi,2012.

UNIT-I

- What is Cloud Computing ?
  - Different perspectives
  - Properties and characteristics
  - Benefits from cloud computing
- Deployment models
  - Four deployment models

Cloud Computing in a nutshell

- Analogy to electricity use

- 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, by aggregating resources and offering a single system
- view

- Utility computing describes a business model for on-demand delivery of computing power; consumers pay providers based on usage.

- 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

Cloud Computing in a nutshell

- **BUYYA**
- "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."

- **NIST**
- 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."

Cloud Computing in a nutshell

- While there are countless other definitions, there seems to be common

  characteristics between the most notable ones listed above, which a cloud should have: (

(i) pay-per-use (no ongoing commitment, utility prices);

(ii) elastic capacity and the illusion of infinite resources;

(iii) self-service interface

(iv) resources that are abstracted or virtualised.

Roots of Cloud Computing

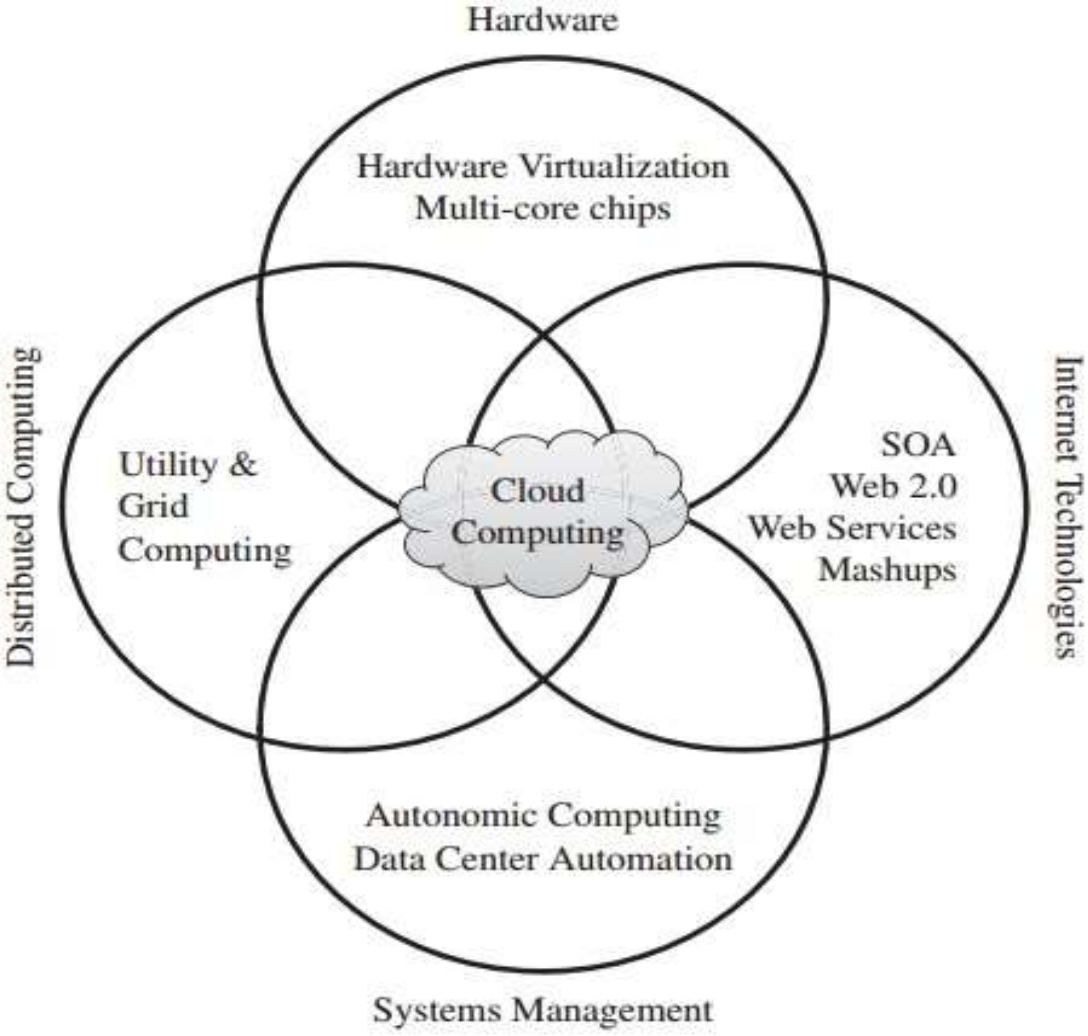


FIGURE 1.1. Convergence of various advances leading to the advent of cloud computing.

Roots of Cloud Computing

- (i) Mainframe to cloud
- (ii) SOA, Web Services, Web 2.0 and Mashups
- (iii) Grid Computing
- (iv) Utility Computing
- (v)Hardware Virtualization
- (vi)Virtual Appliance and OVF
- (vii) Autonomic Computing

From Mainframe to cloud

- currently experiencing a switch in the IT world, from in-house generated computing power into utility-supplied computing resources delivered over the Internet as Web services

- Computing delivered as a utility can be defined as “on demand delivery of infrastructure, applications, and business processes in a security-rich, shared, scalability based computer environment over the Internet for a fee”

- Advantage to both consumer and providers

- Earlier provided timeshared mainframes , declined due to advent of fast and inexpensive microprocessors

SOA, Web Services, Web 2.0 and Mashups

- 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.

- The purpose of a SOA is to address requirements of loosely coupled, standards-based, and protocol-independent distributed computing

- Services such user authentication, e-mail, payroll management, and calendars are examples of building blocks that can be reused and combined in a business solution in case a single, ready-made system does not provide all those features

Grid Computing

- **Grid computing** is the collection of **computer** resources from multiple locations to reach a common goal. The **grid** can be thought of as a distributed system with non-interactive workloads that involve a large number of files.

- A key aspect of the grid vision realization has been building standard Web services-based protocols that allow distributed resources to be "discovered, accessed, allocated, monitored, accounted for, and billed for..

- **Issues:**
- QOS, Avaibility of resource with diverse software configuration
- Soln: virtualisation

Utility Computing

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

- In utility computing environments, users assign a “utility” value to their jobs, where utility is a fixed or time-varying valuation that captures various QoS constraints (deadline, importance, satisfaction).

- The service providers then attempt to maximize their own utility, where said utility may directly correlate with their profit.

Hardware Virtualisation

- Hardware virtualization allows running multiple operating systems and software stacks on a single physical platform

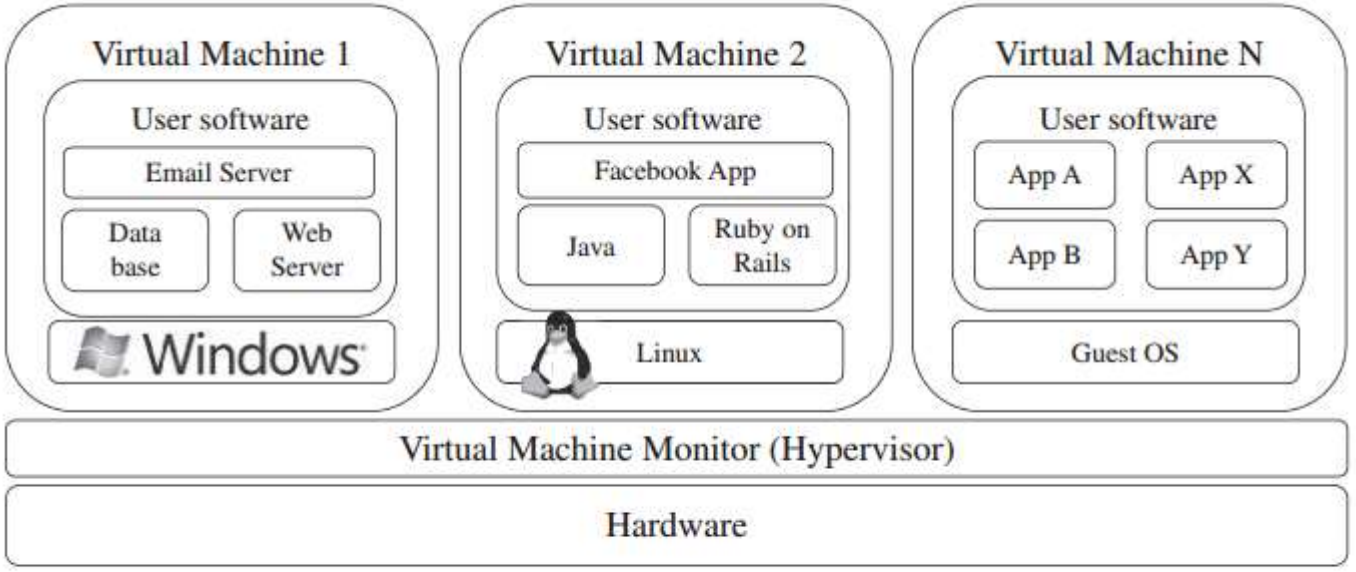


FIGURE 1.2. A hardware virtualized server hosting three virtual machines, each one running distinct operating system and user level software stack.

- **3 basic capabilities related to management of workload: isolation, Consolidation and Migration**

- A number of VMM platforms exist that are the basis of many utility or cloud computing environments.

VMWare ESXi :

- pioneer in virtualisation, bare metal hypervisor,
- provides advanced virtualization techniques of processor, memory, and I/O. Especially, through memory ballooning and page sharing, it can overcommit memory,

Xen:

- open-source project
- It has pioneered the para-virtualization concept, on which the guest operating system, by means of a specialized kernel, can interact with the hypervisor, thus significantly improving performance

KVM:

- kernel-based virtual machine (KVM) is a Linux virtualization subsystem
- Is has been part of the mainline Linux kernel since version 2.6.20, thus being natively supported by several distributions.
- In addition, activities such as memory management and scheduling are carried out by existing kernel
- KVM leverages hardware-assisted virtualization, which improves performance and allows it to support unmodified guest operating systems

Virtual Appliance and OVF(open virtual format)

- An application combined with the environment needed to run it (operating system, libraries, compilers, databases, application containers, and so forth) is referred to as a "virtual appliance."

- In a multitude of hypervisors, where each one supports a different VM image format and the formats are incompatible with one another, a great deal of interoperability issues arises.

- For instance, Amazon has its Amazon machine image (AMI) format, made popular on the Amazon EC2 public cloud. Other formats are used by Citrix XenServer, several Linux distributions that ship with KVM, Microsoft Hyper-V, and VMware ESX

Autonomic Computing

- The increasing complexity of computing systems has motivated research on autonomic computing, which seeks to improve systems by decreasing human involvement in their operation

- Autonomic, or self-managing, systems rely on monitoring probes and gauges (sensors), on an adaptation engine (autonomic manager) for computing optimizations based on monitoring data, and on effectors to carry out changes on the system.

What is Cloud Computing?

- **Cloud Computing** is a general term used to describe a new class of network based computing that takes place over the Internet,
  - basically a step on from Utility Computing
  - a collection/group of integrated and networked hardware, software and Internet infrastructure (called a platform).
  - Using the Internet for communication and transport provides hardware, software and networking services to clients
- These platforms hide the complexity and details of the underlying infrastructure from users and applications by providing very simple graphical interface or API (Applications Programming Interface).

What is Cloud Computing?

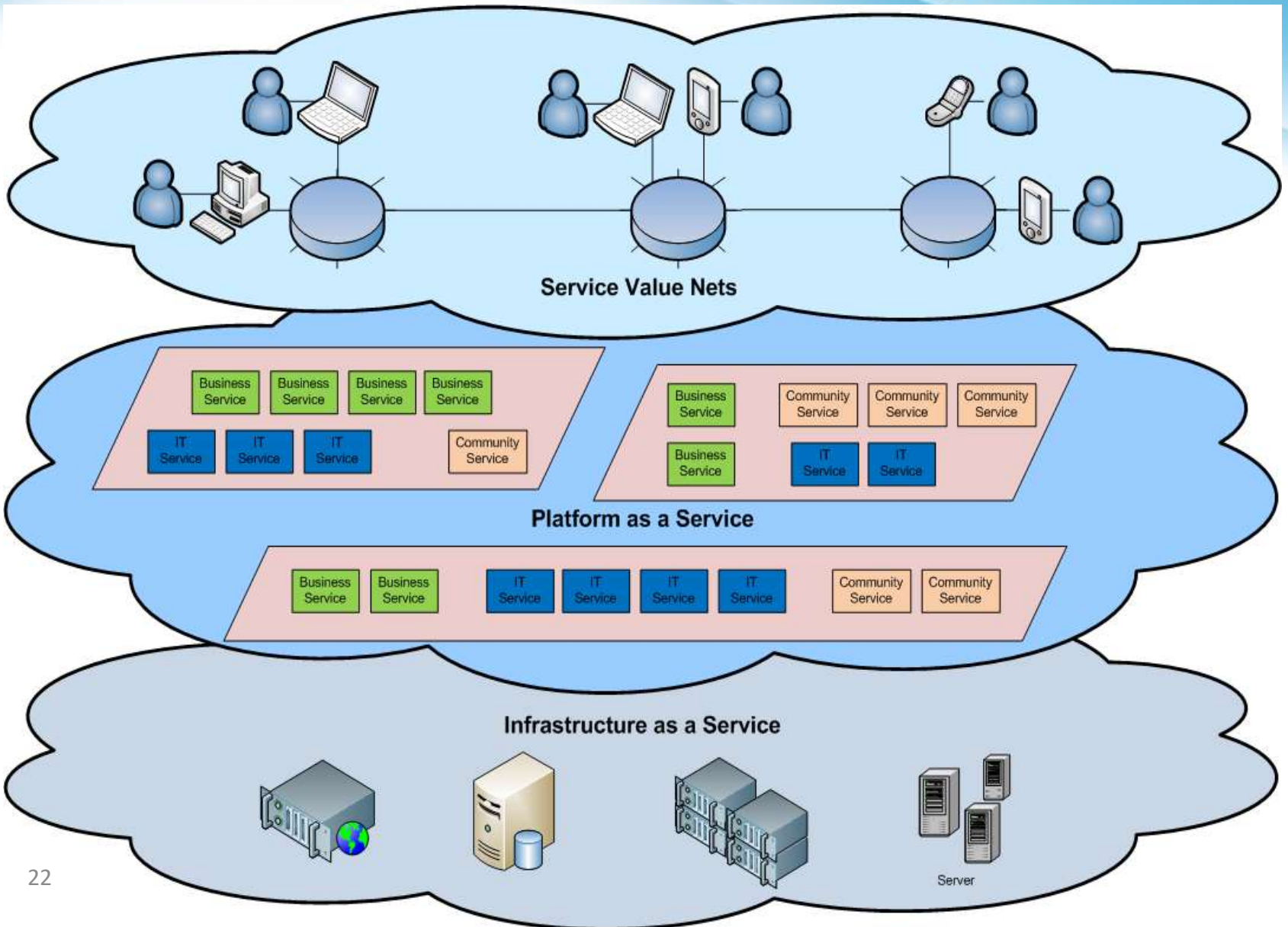
- In addition, the platform provides on demand services, that are always on, anywhere, anytime and any place.
- Pay for use and as needed, elastic
  - scale up and down in capacity and functionalities
- The hardware and software services are available to
  - general public, enterprises, corporations and businesses markets

Cloud Summary

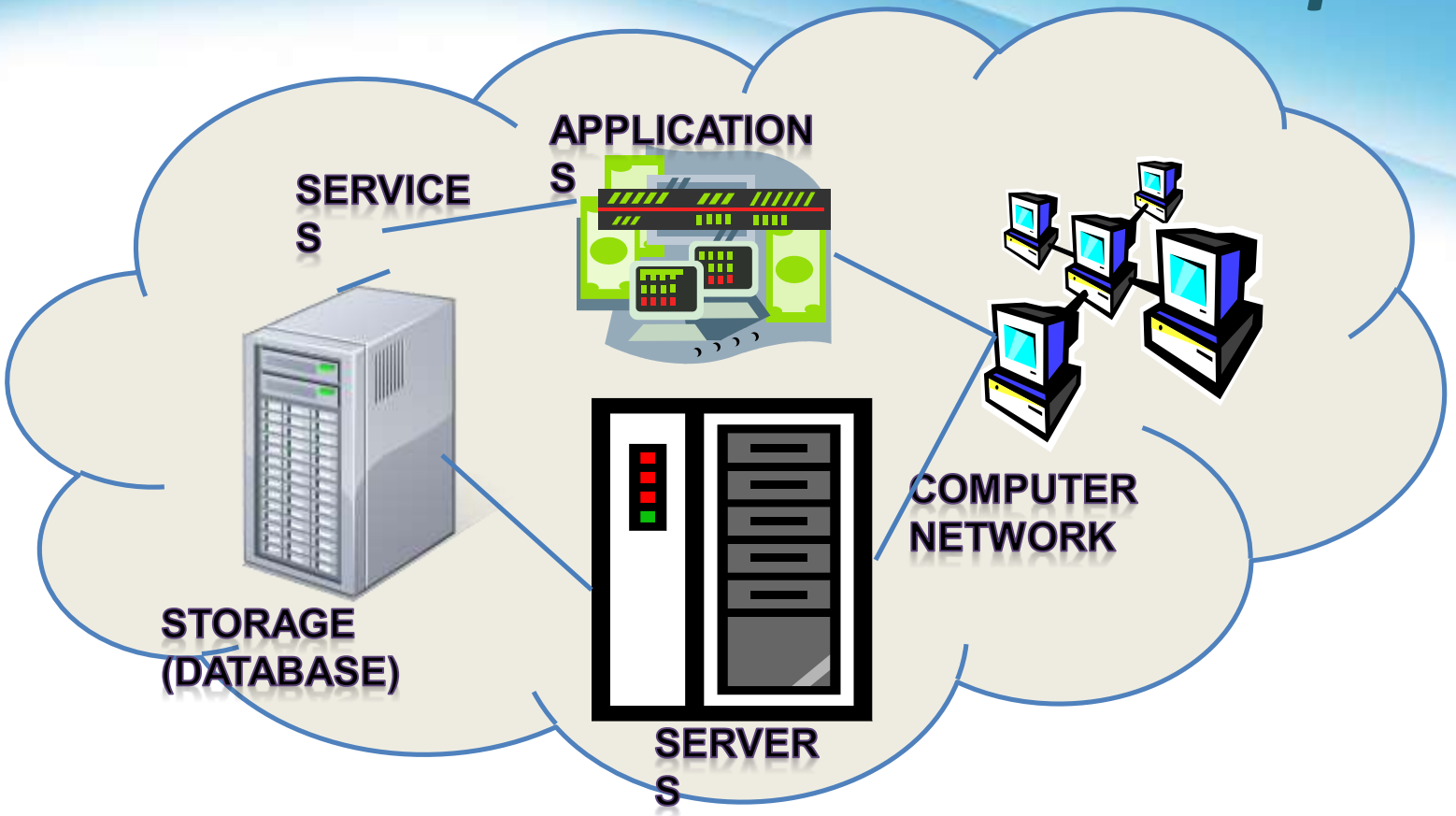
- Cloud computing is an umbrella term used to refer to Internet based development and services

- A number of characteristics define cloud data, applications services and infrastructure:
  - **Remotely hosted**: Services or data are hosted on remote infrastructure.
  - **Ubiquitous**: Services or data are available from anywhere.
  - **Commodified**: The result is a utility computing model similar to traditional that of traditional utilities, like gas and electricity - you pay for what you would want!

Cloud Architecture



What is Cloud Computing



- Shared pool of configurable computing resources
- On-demand network access
- Provisioned by the Service Provider

Cloud Computing Characteristics

Common Characteristics:

- Massive Scale
- Resilient Computing
- Homogeneity
- Geographic Distribution
- Virtualization
- Service Orientation
- Low Cost Software
- Advanced Security

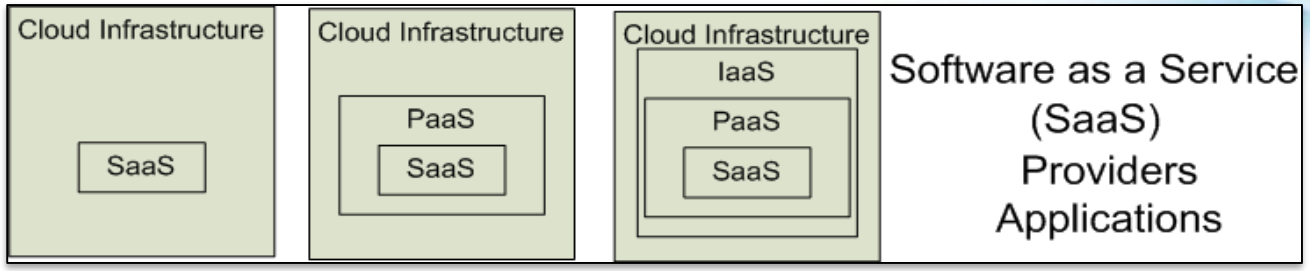
Essential Characteristics:

- On Demand Self-Service
- Broad Network Access
- Rapid Elasticity
- Resource Pooling
- Measured Service

Cloud Service Models

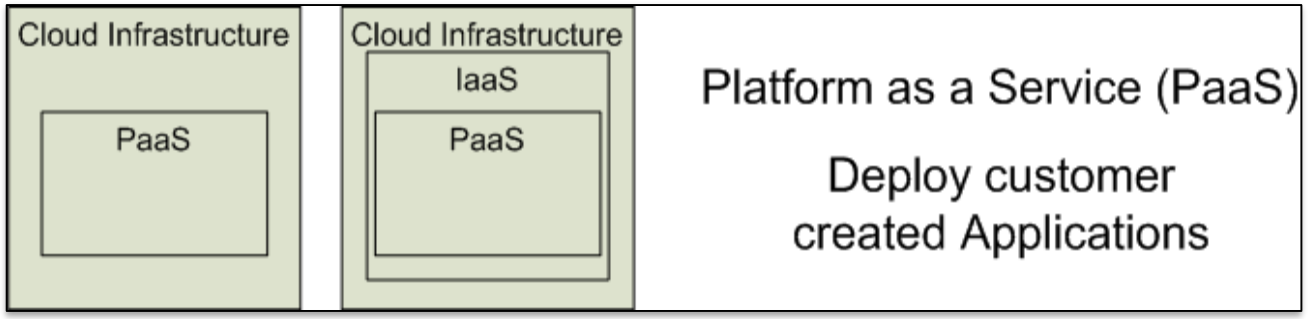
Software as a Service (SaaS) | Platform as a Service (PaaS) | Infrastructure as a Service (IaaS)

SalesForce CRM
LotusLive



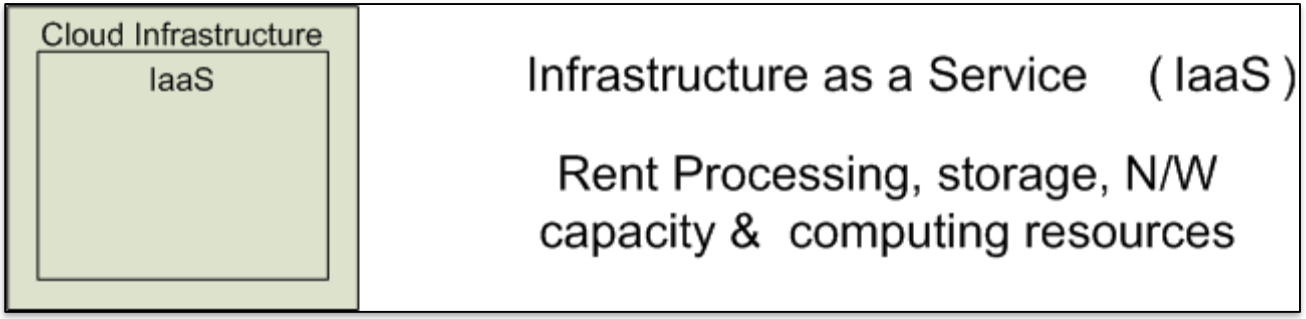
Google App Engine

Windows Azure
The Future Made Familiar



amazon web services™

rackspace HOSTING



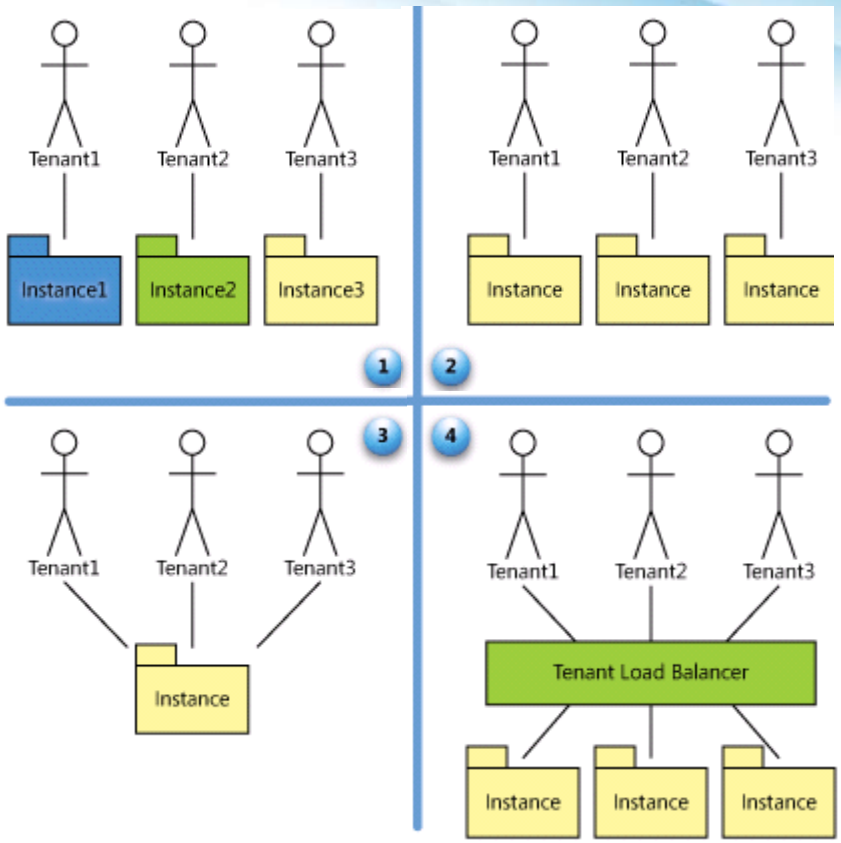
SaaS Maturity Model

Level 1: Ad-Hoc/Custom – One Instance per customer

Level 2: Configurable per customer

Level 3: configurable & Multi-Tenant-Efficient

Level 4: Scalable, Configurable & Multi-Tenant-Efficient



Different Cloud Computing Layers

Application Service (SaaS)	MS Live/ExchangeLabs, IBM, Google Apps; Salesforce.com Quicken Online, Zoho, Cisco
Application Platform	Google App Engine, Mosso, Force.com, Engine Yard, Facebook, Heroku, AWS
Server Platform	3Tera, EC2, SliceHost, GoGrid, RightScale, Linode
Storage Platform	Amazon S3, Dell, Apple, ...

Cloud Computing Service Layers

	Services	Description
Application Focused	Services	Services – Complete business services such as PayPal, OpenID, OAuth, Google Maps, Alexa
	Application	Application – Cloud based software that eliminates the need for local installation such as Google Apps, Microsoft Online
	Development	Development – Software development platforms used to build custom cloud based applications (PAAS & SAAS) such as SalesForce
Infrastructure Focused	Platform	Platform – Cloud based platforms, typically provided using virtualization, such as Amazon ECC, Sun Grid
	Storage	Storage – Data storage or cloud based NAS such as CTERA, iDisk, CloudNAS
	Hosting	Hosting – Physical data centers such as those run by IBM, HP, NaviSite, etc.

Basic Cloud Characteristics

- The "**no-need-to-know**" in terms of the underlying details of infrastructure, applications interface with the infrastructure via the APIs.
- The "**flexibility and elasticity**" allows these systems to scale up and down at will
  - utilising the resources of all kinds
    - CPU, storage, server capacity, load balancing, and databases
- The "**pay as much as used and needed**" type of utility computing and the "**always on!, anywhere and any place**" type of network-based computing.

Basic Cloud Characteristics

- Cloud are transparent to users and applications, they can be built in multiple ways
  - branded products, proprietary open source, hardware or software, or just off-the-shelf PCs.
- In general, they are built on clusters of PC servers and off-the-shelf components plus Open Source software combined with in-house applications and/or system software.

How to deploy a cloud system ?

DEPLOYMENT MODELS

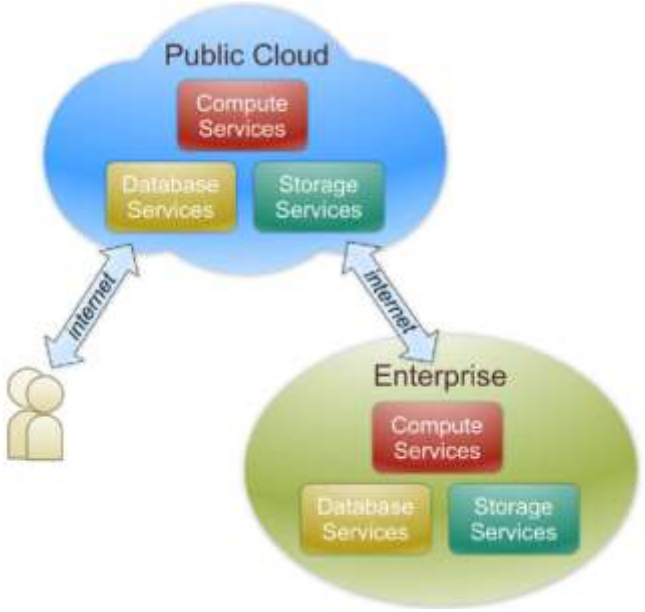
Deployment Model

- There are four primary cloud deployment models :
  - Public Cloud
  - Private Cloud
  - Community Cloud
  - Hybrid Cloud

- Each can exhibit the previously discussed characteristics; their differences lie primarily in the scope and access of published cloud services, as they are made available to service consumers.

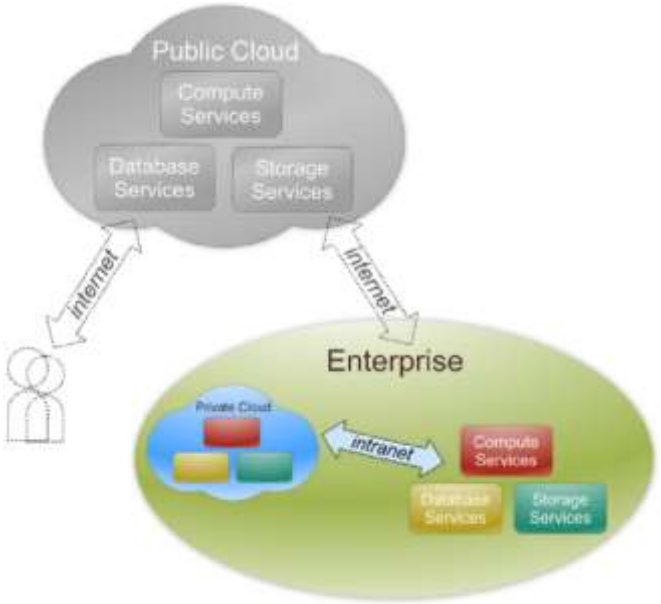
Public Cloud

- Public cloud definition
  - The cloud infrastructure is made available to the general public or a large industry group and is owned by an organization selling cloud services.
  - Also known as external cloud or multi-tenant cloud, this model essentially represents a cloud environment that is openly accessible.
  - Basic characteristics :
    - Homogeneous infrastructure
    - Common policies
    - Shared resources and multi-tenant
    - Leased or rented infrastructure
    - Economies of scale



Private Cloud

- Private cloud definition
  - The cloud infrastructure is operated solely for an organization. It may be managed by the organization or a third party and may exist on premise or off premise.
  - Also referred to as internal cloud or on-premise cloud, a private cloud intentionally limits access to its resources to service consumers that belong to the same organization that owns the cloud.
  - Basic characteristics :
    - Heterogeneous infrastructure
    - Customized and tailored policies
    - Dedicated resources
    - In-house infrastructure
    - End-to-end control



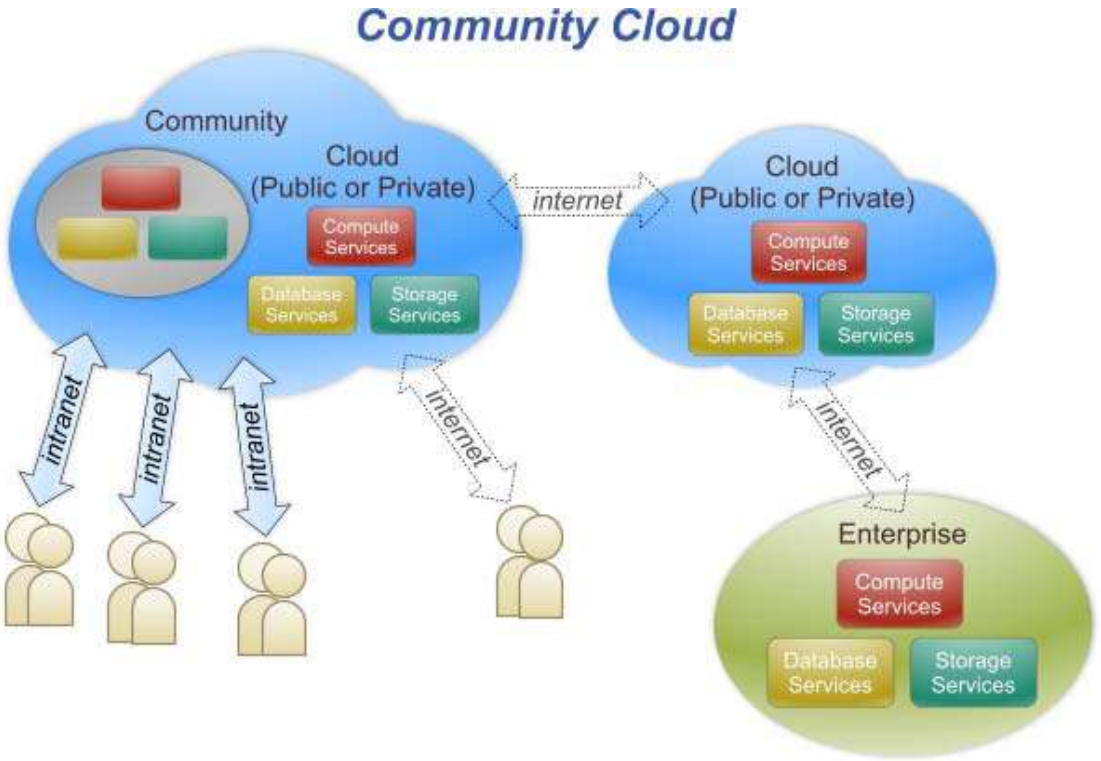
Public vs. Private

- Comparison :

	Public Cloud	Private Cloud
Infrastructure	*Homogeneous*	*Heterogeneous*
Policy Model	*Common defined*	*Customized & Tailored*
Resource Model	*Shared & Multi-tenant*	*Dedicated*
Cost Model	*Operational expenditure*	*Capital expenditure*
Economy Model	*Large economy of scale*	*End-to-end control*

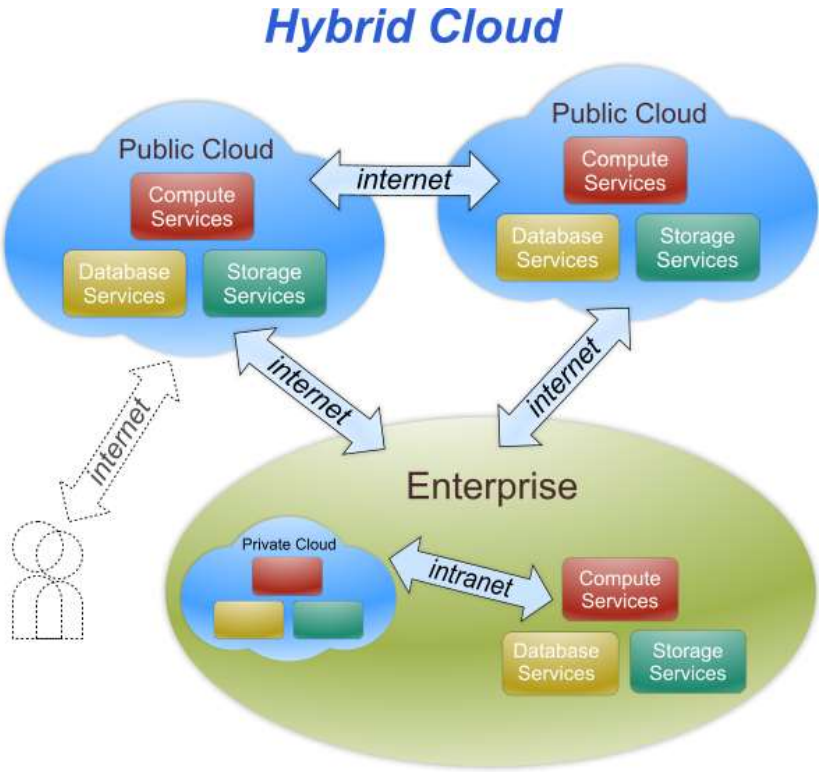
Community Cloud

- **Community cloud definition**
  - The cloud infrastructure is shared by several organizations and supports a specific community that has shared concerns (e.g., mission, security requirements, policy, and compliance considerations).

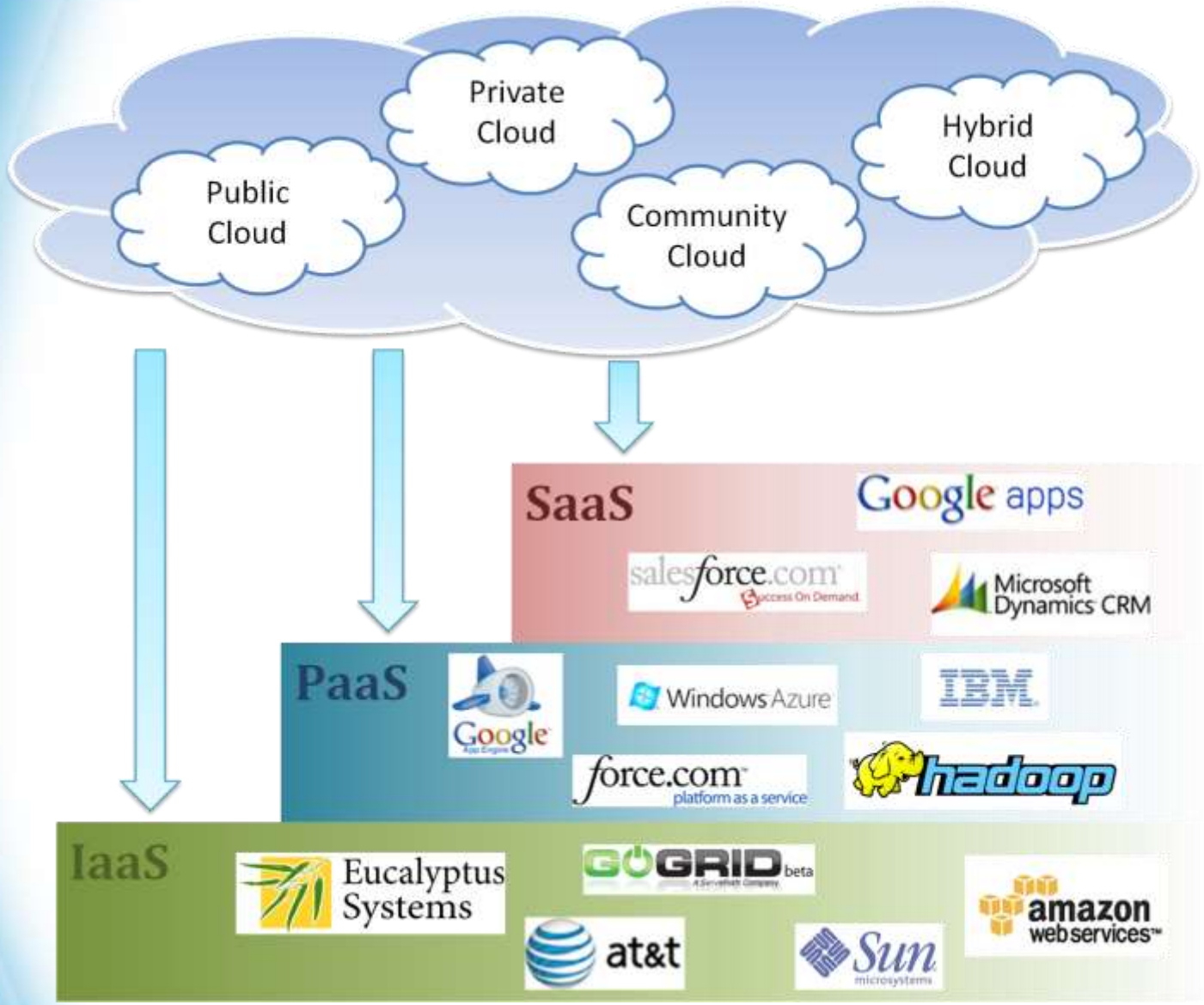


Hybrid Cloud

- Hybrid cloud definition
  - The cloud infrastructure is a composition of two or more clouds (private, community, or public) that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load-balancing between clouds).



Cloud Ecosystem



Summary

- What is cloud computing in your mind
  - Clear or Cloudy?

- Cloud computing is a new paradigm shift of computing
- Cloud computing can provide high quality of properties and characteristics based on essentially central ideas

- Service models and deployment models provide services that can be used to
  - Rent fundamental computing resources
  - Deploy and develop customer-created applications on clouds
  - Access provider's applications over network (wired or wireless)

Migration

- when and how to migrate one's application into a cloud ?
- what part or component of the IT application to migrate into a cloud and what not to migrate into a cloud ?
- what kind of customers really benefit from migrating their IT into the cloud ?

The Seven-Step Model of Migration into a Cloud

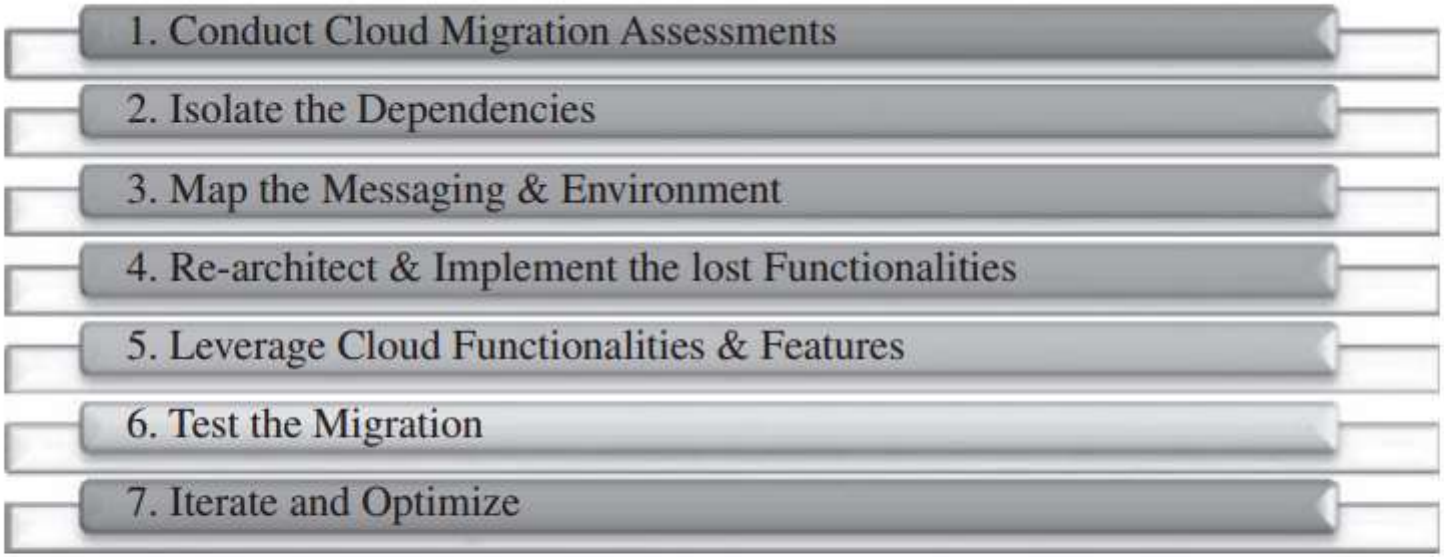


FIGURE 2.4. The Seven Step Model of Migration into the Cloud. (*Source:* Infosys Research.)

The Seven-Step Model of Migration into a Cloud

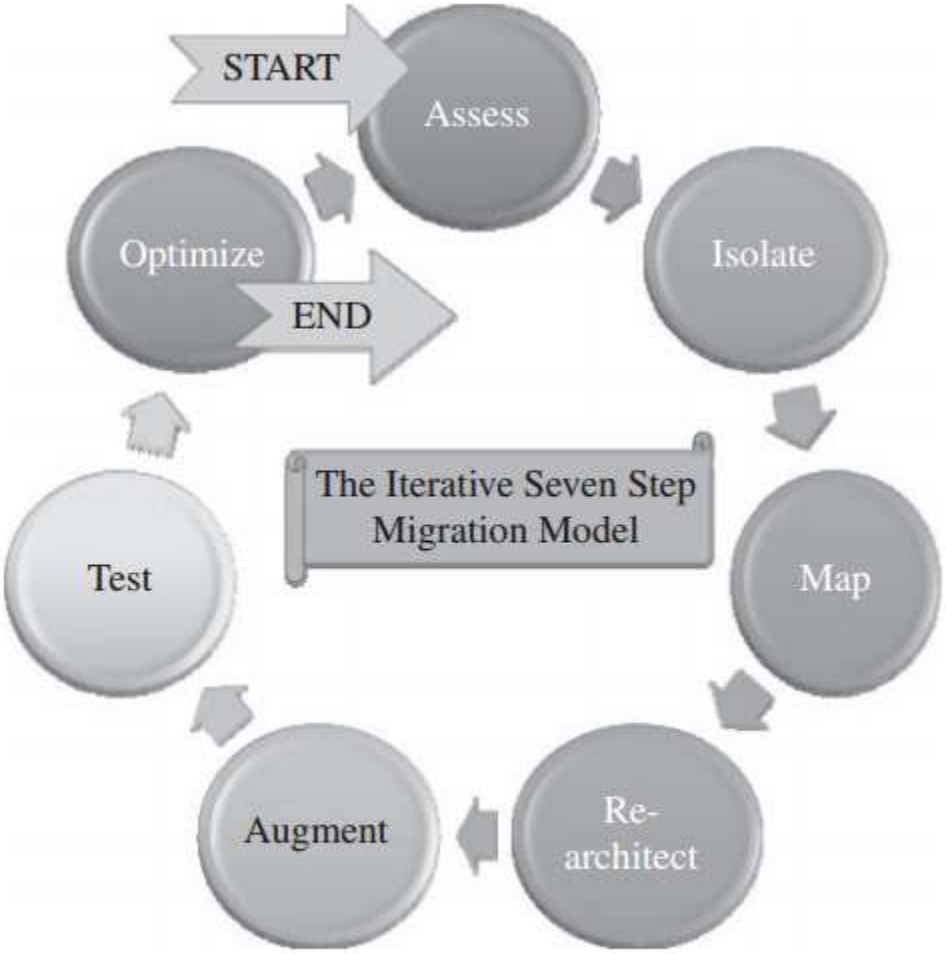


FIGURE 2.5. The iterative Seven step Model of Migration into the Cloud. (*Source:* Infosys Research.)

The Seven-Step Model of Migration into a Cloud

Step 1

- 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.

Step 2

- 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.

The Seven-Step Model of Migration into a Cloud

Step 4

- 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.

Step 6

- 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

The Seven-Step Model of Migration into a Cloud

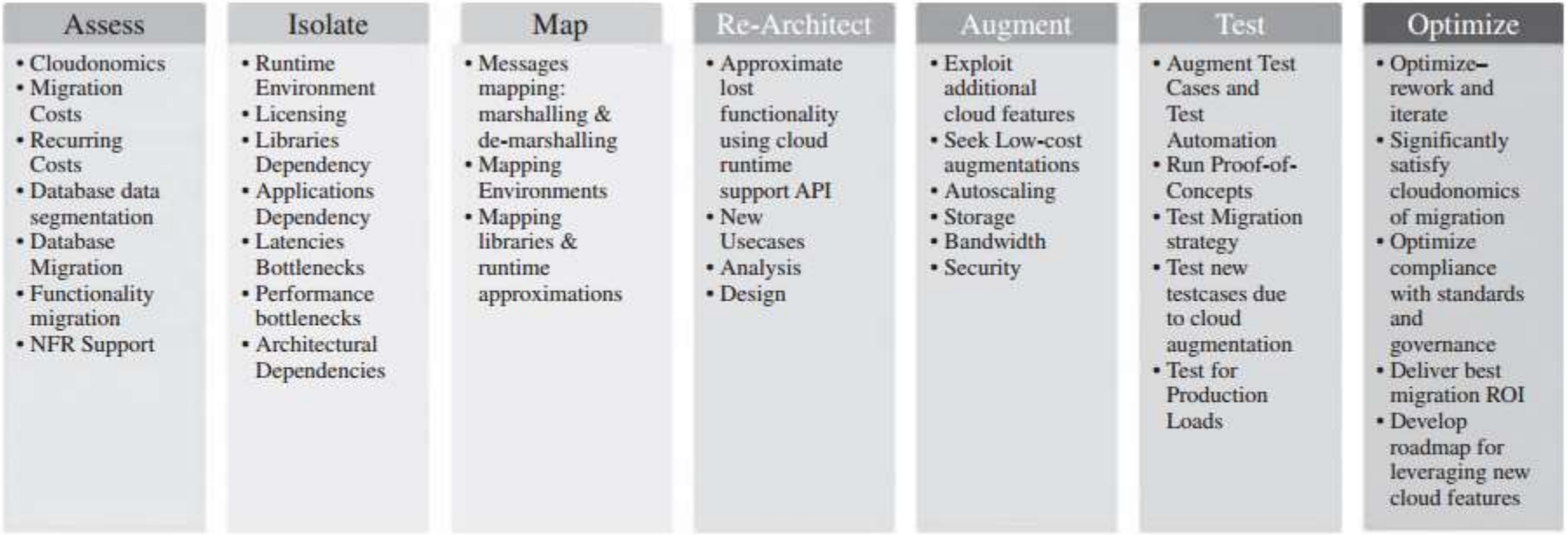


FIGURE 2.6. Some details of the iterative Seven Step Model of Migration into the Cloud.

Thank you

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