Session no. 1

Cloud Computing

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Course Objectives

The course aims at:

CO1	Students will learn the fundamental ideas behind Cloud Computing, the evolution of the paradigm, its applicability; benefits, as well as current and future challenges;
CO2	Students will learn the basic idea and principles in Cloud infrastructure management
CO3	Students will learn about cloud components Compute, Storage and Networking technologies
CO4	Students will learn a variety of programming models and develop working experience

Modular Structure

Module #	Module name
1	Introduction to Cloud Computing
2	Virtualization Techniques and Types
3	Infrastructure as a Service
4	Platform as a Service and SaaS
5	Managing Virtual Resources on the Cloud: Provisioning and Migration
6	Capacity management and Scheduling in cloud computing
7	Issues and Challenges : Availability, Multi-Tenancy, Security and SLA
8	Application Development and Deployment

Evaluation Scheme

Item	Name	Type	Duration	Weight	Day, Date, Session, Time
EC-1	Quiz – 1 & 2 (5 marks each)	Online	2 days	10 Marks	TBA
	Experiential learning Assignment-I	Take Home	15-20 days	30 Marks	TBA
EC-2	Mid-Semester Test (Topics in Session Nos. 1 to 8)	Open Book	~2 hours	30 Marks	Per Programme schedule
EC-3	Comprehensive Exam (All topics (Session Nos. 1 to 16))	Open Book	~3 hours	30 Marks	Per Programme schedule

Pedagogy

| Sl No	Name	Type	Duration	No. of Sessions
1	Class lectures	Online	2.00 hr	16 (as per calendar)

Introduction to Cloud Computing, services and deployment models

- Agenda
  - Introduction to Cloud Computing – Origins and Motivation
  - 3-4-5 rule of Cloud Computing
  - Types of Clouds and Services
  - Cloud Infrastructure and Deployment

Distributed Computing

In distributed computing a program is split up into parts that run simultaneously on multiple computers communicating over a network
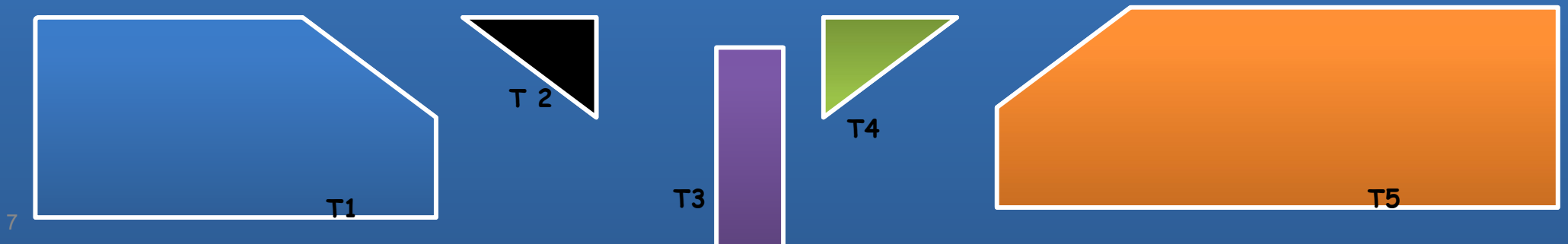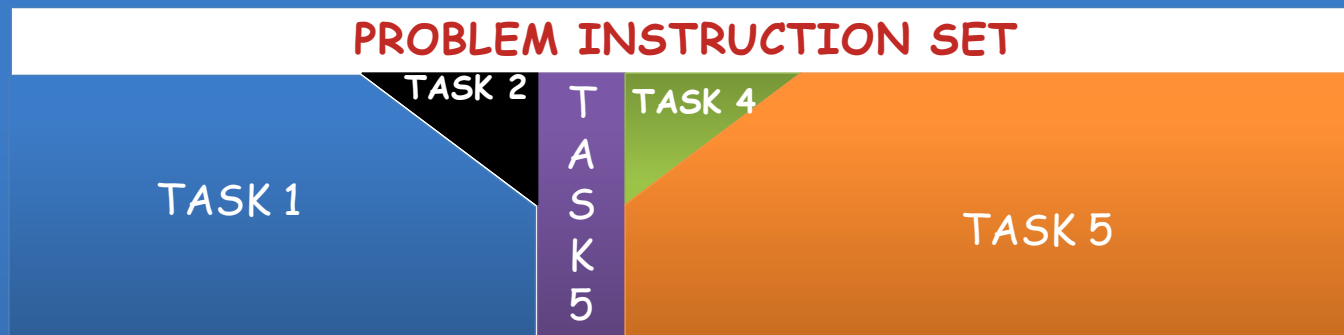
Distributed Computing

Consider If There Are **n** Systems Connected In A Network, Then We Can Split One Program Into **n** Different Tasks And Compute Them Concurrently.

Why do we need Distributed Computing?

- Computation requirements are ever increasing

- Silicon based (sequential) architectures reaching their limits in processing capabilities (clock speed) as they are constrained by.

- Significant development in networking technology is paving a way for network-based cost-effective parallel computing.

- The parallel processing technology is mature and is being exploited commercially.

Distributed computing models
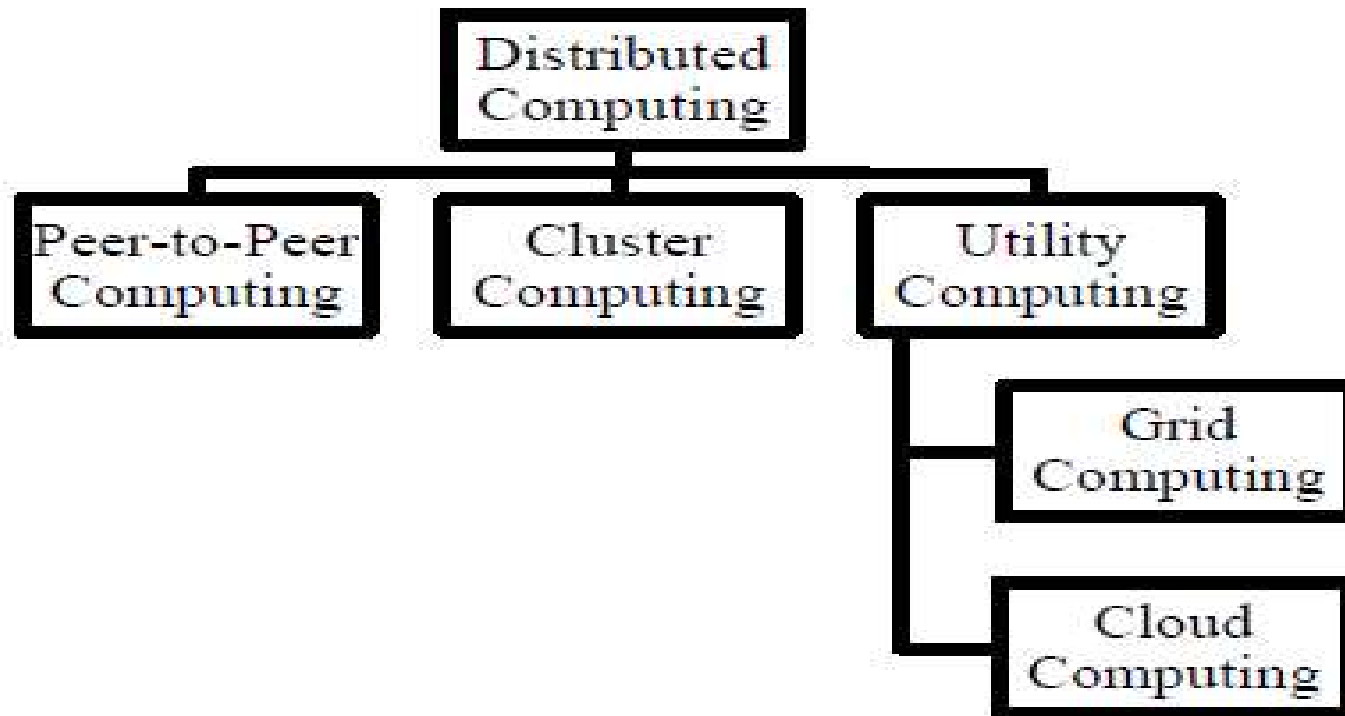
Peer-to-peer computing

In a P2P system,

- Every node acts as both a client and a server, providing part of the system resources.
- Peer machines are simply client computers connected to the Internet.
- All client machines act autonomously to join or leave the system freely.
- This implies that no master-slave relationship exists among the peers.
- No central coordination or no central database is needed.

Cluster computing

In a cluster computing,

- comprises a set of independent or stand-alone computers and a network interconnecting them.
- It works cooperatively together as a single integrated computing resource.
- A cluster is local in that all of its component subsystems are supervised within a single administrative domain, usually residing in a single room and managed as a single computer system
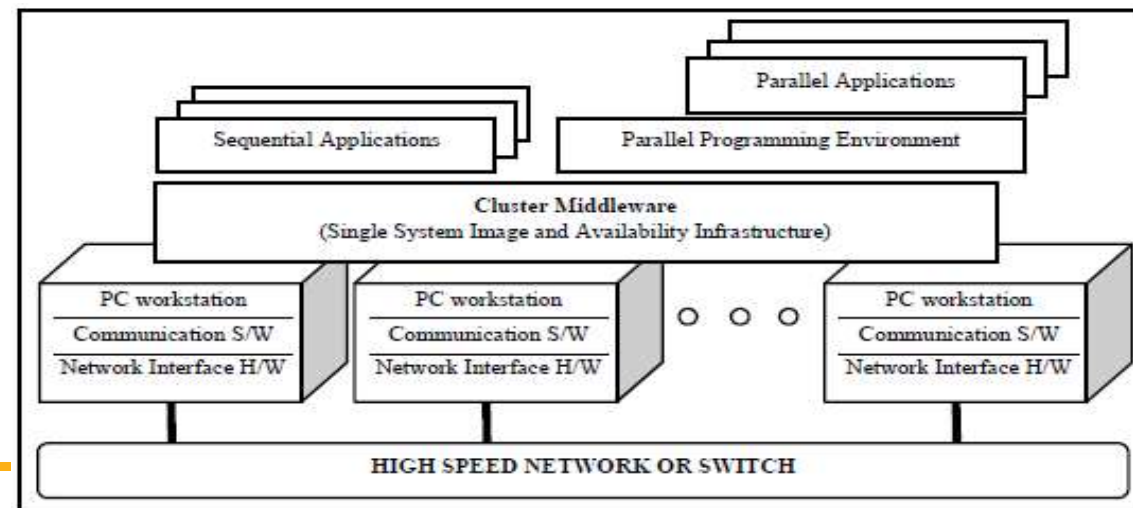
Utility computing

- Based on a service provisioning model, where users (consumers) pay providers for using computing power only when they need to.

- Utility computing focuses on a business model, by which customers receive computing resources from a paid service provider.

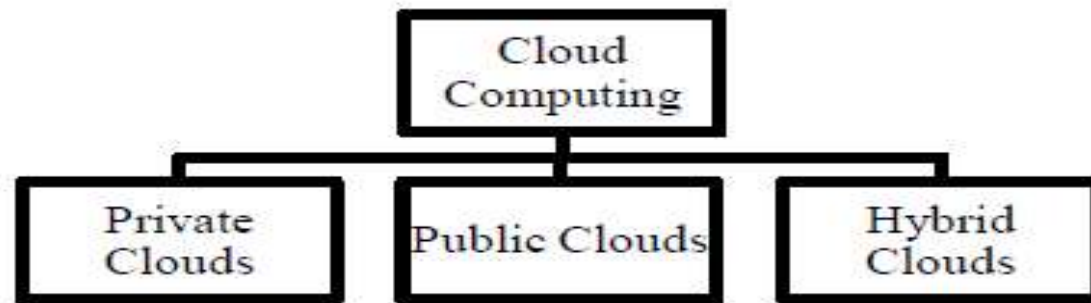- All grid/cloud platforms are regarded as utility service providers

Grid computing

Grid computing enables coordinated resource sharing and problem solving in dynamic, multi-institutional virtual organizations.
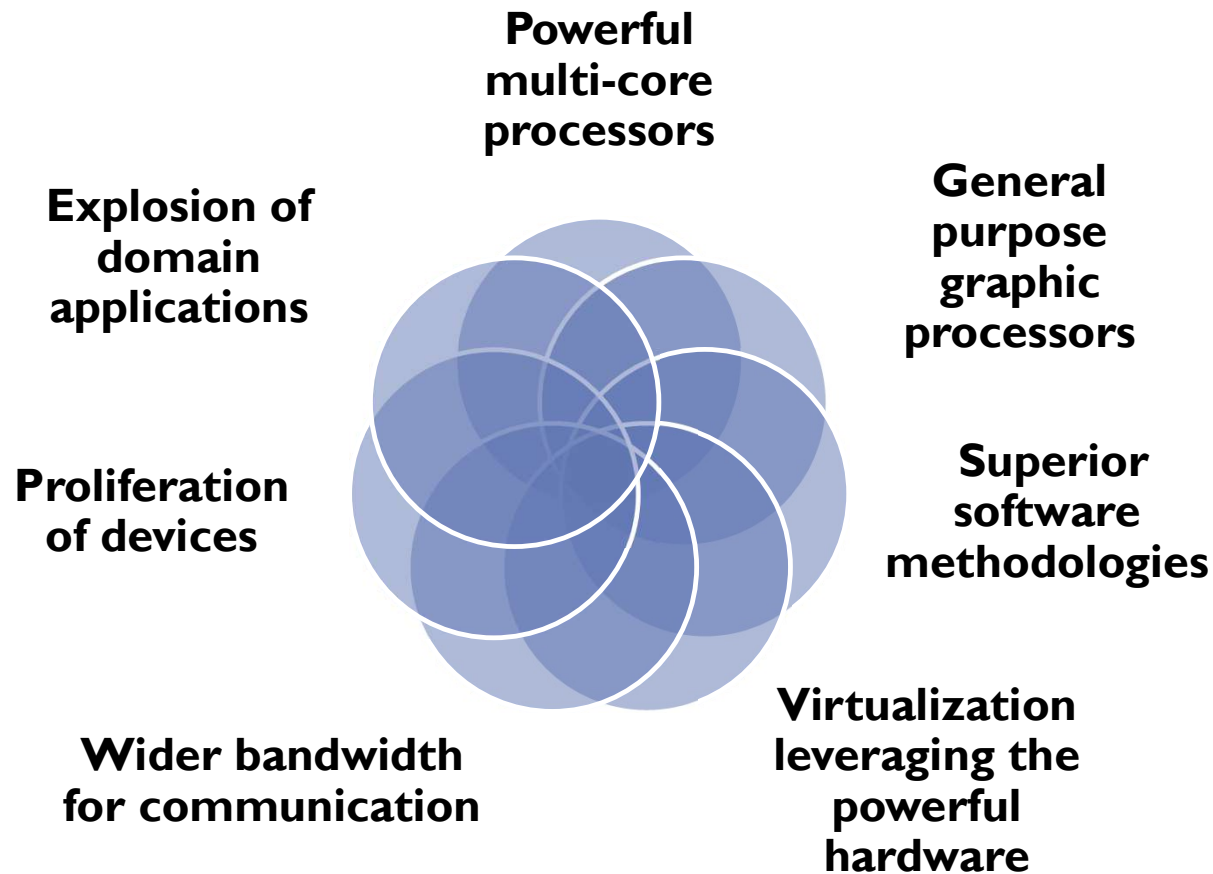
Grid is often constructed across LAN, WAN, or Internet backbone networks at regional, national, or global scales. Enterprises or organizations present grids as integrated computing resources.

Cloud computing

Cloud computing is a computing paradigm that involves outsourcing of computing resources with the capabilities of expendable resource scalability, on-demand provisioning with little or no up-front IT infrastructure investment costs.

Motivation

Explosion of domain applications

Powerful multi-core processors

General purpose graphic processors

Proliferation of devices

Superior software methodologies

Wider bandwidth for communication

Virtualization leveraging the powerful hardware

1. Web Scale Problems
2. Web 2.0 and Social Networking
3. Information Explosion
4. Mobile Web

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,
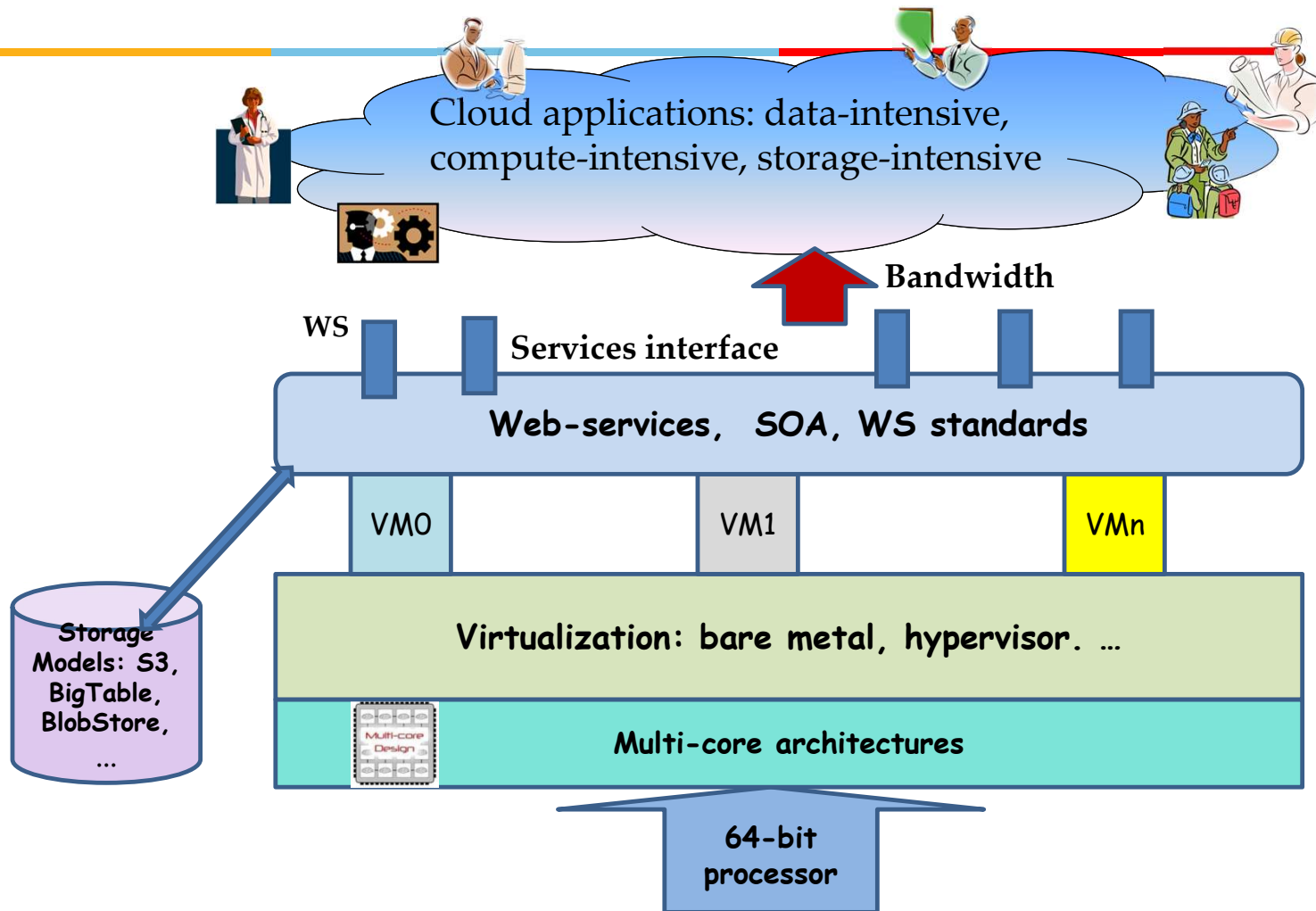
- basically a step on from Utility Computing
- a collection/group of integrated and networked hardware, software and Internet infrastructure (called a platform).
- Using the Internet for communication and transport provides hardware, software and networking services to clients

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 cont....

- Self-service
- Commodity pricing
- Transparent scalability
- Shared infrastructure

Technology Advances

Cloud applications: data-intensive, compute-intensive, storage-intensive

Bandwidth

WS

Services interface

Web-services, SOA, WS standards

VM0

VM1

VMn

Storage Models: S3, BigTable, BlobStore, ...

Virtualization: bare metal, hypervisor. ...

Multi-core architectures

Multi-core Design

64-bit processor

Evolution of Computing

Mainframe — Centralized 1960-1970
Client-Server — Distributed 1980-2000
Mobile-Cloud
Edge Intelligence — Distributed 2020-

Generational Shift of Computing Platform

Technology	Economic	Business
Centralized compute & storage, thin clients	Optimized for efficiency due to high cost	High upfront costs for hardware and software
PCs and servers for distributed compute, storage, etc.	Optimized for agility due to low cost	Perpetual license for OS and application software
Large DCs, commodity HW, scale-out, devices	Order of magnitude better efficiency and agility	Pay as you go, and only for what you use

http://blogs.technet.com/b/yungchou/archive/2011/03/03/chou-s-theories-of-cloud-computing-the-5-3-2-principle.aspx

Cloud computing is the on-demand delivery of IT resources over the Internet with pay-as-you-go pricing. Instead of buying, owning, and maintaining physical data centers and servers, you can access technology services, such as computing power, storage, and databases, on an as-needed basis from a cloud provider like Amazon Web Services (AWS). – **AMAZON**

Cloud computing is on-demand access, via the internet, to computing resources—applications, servers (physical servers and virtual servers), data storage, development tools, networking capabilities, and more—hosted at a remote data center managed by a cloud services provider (or CSP). The CSP makes these resources available for a monthly subscription fee or bills them according to usage. – **IBM**

Simply put, cloud computing is the delivery of computing services—including servers, storage, databases, networking, software, analytics, and intelligence—over the Internet ("the cloud") to offer faster innovation, flexible resources, and economies of scale. You typically pay only for cloud services you use, helping you lower your operating costs, run your infrastructure more efficiently, and scale as your business needs change. – **MICROSOFT**

Cloud computing is the act of running workloads within clouds—which are IT environments that abstract, pool, and share scalable resources across a network. Neither cloud computing nor clouds are technologies unto themselves.

Cloud computing is an act—the function of running a workload in a cloud.

Clouds are environments—places where applications run.

Technologies are things—software and hardware used to build and use clouds. **- REDHAT**

Cloud Computing: Definition

The US National Institute of Standards (NIST) defines cloud computing as follows:
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.

3-4-5 rule of Cloud Computing

NIST specifies 3-4-5 rule of Cloud Computing

3 cloud service models or service types for any cloud platform

4 deployment models

5 essential characteristics of cloud computing infrastructure