# CS528
# Introduction to Cloud

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# **Outline**

- What is Cloud Computing?

- (HPC, Data Center, Grid) Vs Cloud

- Virtualization

- Advantage of Cloud System : User Prospects

- Dis-advantage of Cloud System : User Prospects

# HPC/Grid Vs Cloud

- Grid/HPC : Self owned
  - Too costly : CAPEX (Capital Expenditure)
  - IITG HPC Example: 10.6 Crores, 3800 J cores
  - OPEX : Operational cost, AC, electricity, AMC
- Cloud : User and Owner are Separated
  - Lets of VC own the HPC but users uses as RENT
  - User get cheaply at need time
  - Owner get a lots of demand for USE
  - Win-Win for Both,   Example Public BUS
- OLA, UBER, Any Taxi Service
  - Get a CAR and used for Taxi

# Utility Model

- Do we require to own a car to ride?
- Rent a CAR for 1 month (schedule your self how you will use)
- Rent a CAR for 1 Day (schedule your self how you will use)
- Use Pickup or Drop service, personalized
  - Src-Dst defined
- Use shared services: Piggy back with others

# Utility Computing
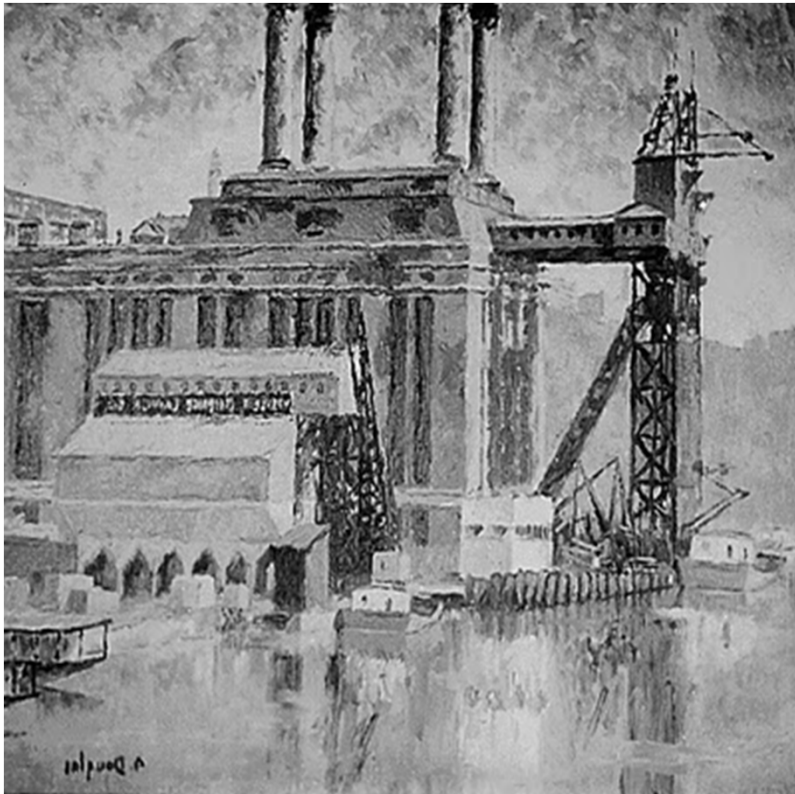


- Long been a vision
- Grid computing failed to really catch on
- Technology advances as well as a viable business model have helped Cloud Computing catch on
- Cloud Computing allows for fuller utilization of hardware
- Energy consumption is turning into a major issue

# Cloud Computing Economic Benefits

- Most identifiable economic benefit of cloud computing is
  - direct cost savings, which occur from changes within the organization and the data centers that house the IT infrastructure.
  - Supply Side – Large scale data centers lower cost due to superior buying power

# Cloud Computing Economic Benefits

- Other economic benefit of cloud
  - Demand Side – Allowing multiple users across varying industries regions & time zones allowing for server utilization
  - Multi-user efficiency – Increasing # of users lowers server cost per tenant
  - Data center efficiency – Advanced data center designs reduce power loss and improved cooling

# 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

# What is Cloud Computing?

- 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).
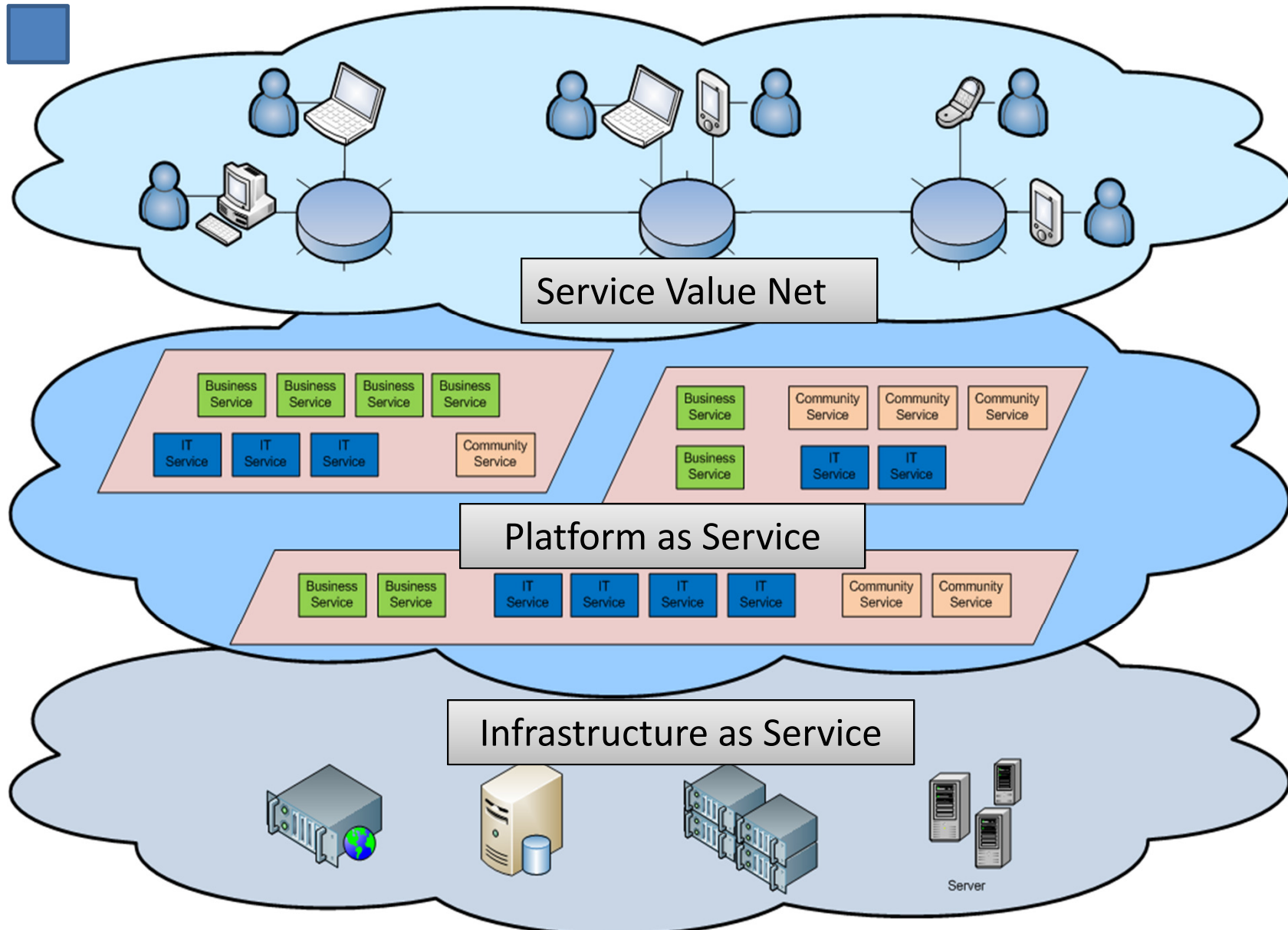
# What is Cloud Computing?

- 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 H/W and S/W services are available to
  - general public, enterprises, corporations and businesses markets

# Cloud Summary

- Cloud computing : 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
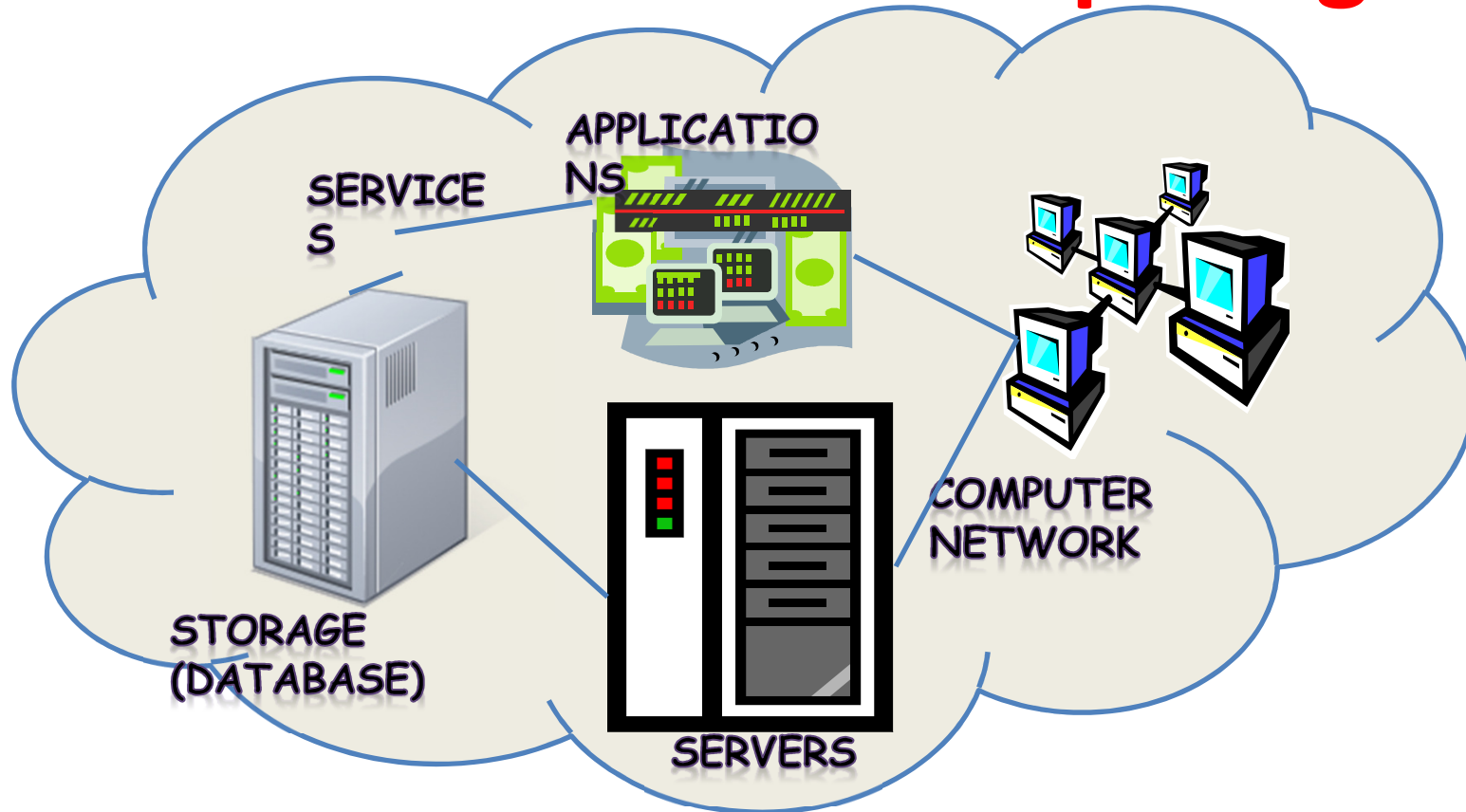


- Shared pool of configurable computing resources
- On-demand network access
- Provisioned by the Service Provider

# 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 Computing Characteristics

- **Scalability** Infrastructure capacity allows for traffic spikes and minimizes delays.

- **Resiliency** Cloud providers have mirrored solutions
  - To minimize downtime in the event of a disaster.
  - This type of resiliency can give businesses the sustainability they need during unanticipated events.

- **Homogeneity**: No matter which cloud provider and architecture an organization uses
  - An open cloud will make it easy for them to work with other groups,
  - even if those other groups choose different providers and architectures.

# Cloud Computing Characteristics

- *On-demand self-service:* A consumer can unilaterally provision computing capabilities
  - Such as server time and network storage,
  - as needed automatically without requiring human interaction with each service's provider.
- *Broad network access.* Capabilities are available over the network and
  - Accessed through standard mechanisms
  - promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, laptops, PDAs).

# Cloud Computing Characteristics

- *Resource pooling:* **Multi-tenant model**
  - There is a sense of location independence in that
  - The customer generally has no control or knowledge over the exact location of the provided resources
  - but may be able to specify location at a higher level of abstraction (e.g., country, state, or datacenter).
  - Examples of resources include storage, processing, memory, network bandwidth, and virtual machines.
- *Rapid elasticity.* **Capabilities can be rapidly and elastically provisioned**
  - In some cases automatically
  - To quickly scale out and rapidly released to quickly scale in.
  - To the consumer, the capabilities available for provisioning often appear to be unlimited
  - can be purchased in any quantity at any time.

# Cloud Computing Characteristics

- *Measured Service*
  - Cloud systems automatically control and optimize resource use
  - by leveraging a metering capability at some level of abstraction appropriate to the type of service
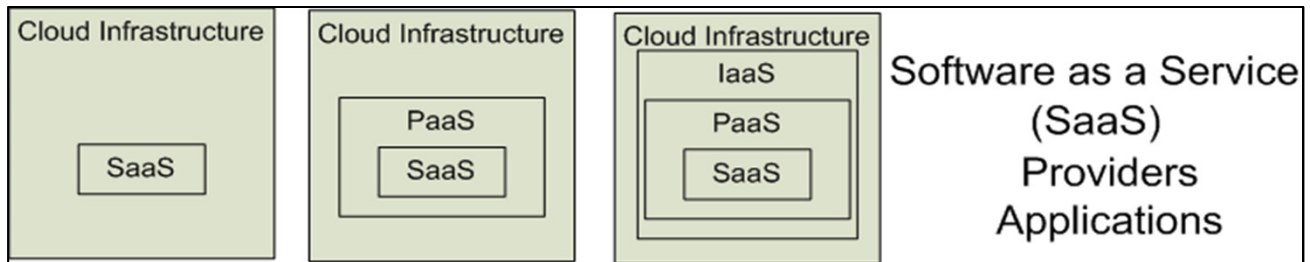  - E.g., storage, processing, bandwidth, and active user accounts

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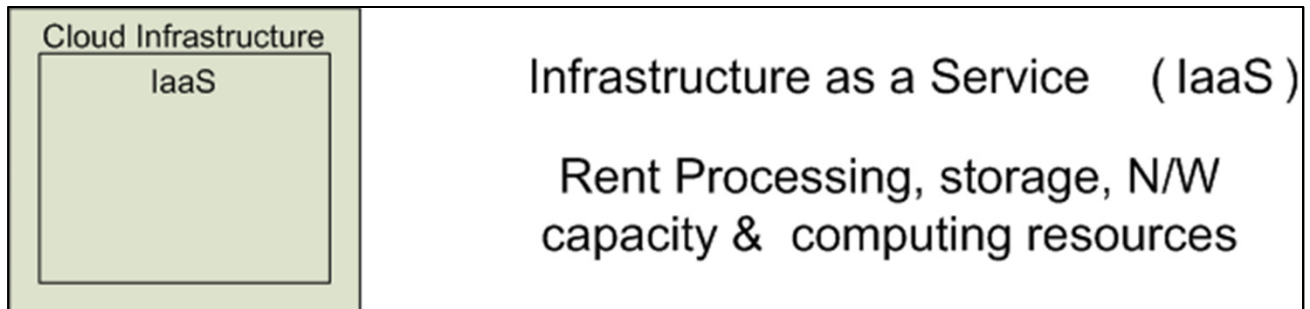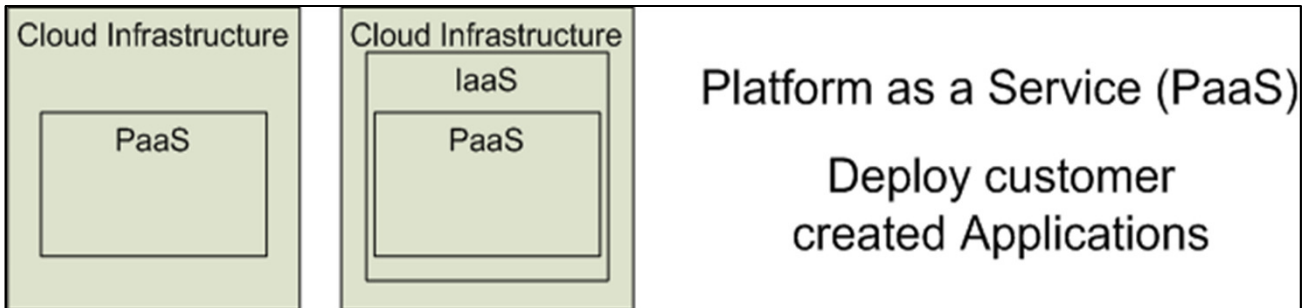
| Software as a Service (SaaS) | Platform as a Service (PaaS) | Infrastructure as a Service (IaaS) |

**SalesForce CRM**

**LotusLive**

Google App

Windows Azure
The Future Made Familiar

amazon webservices™

Rackspace HOSTING

| Cloud Infrastructure | Cloud Infrastructure | Cloud Infrastructure | |
|---|---|---|---|
| SaaS | PaaS / SaaS | IaaS / PaaS / SaaS | Software as a Service (SaaS) Providers Applications |

| Cloud Infrastructure | Cloud Infrastructure | |
|---|---|---|
| PaaS | IaaS / PaaS | Platform as a Service (PaaS) Deploy customer created Applications |

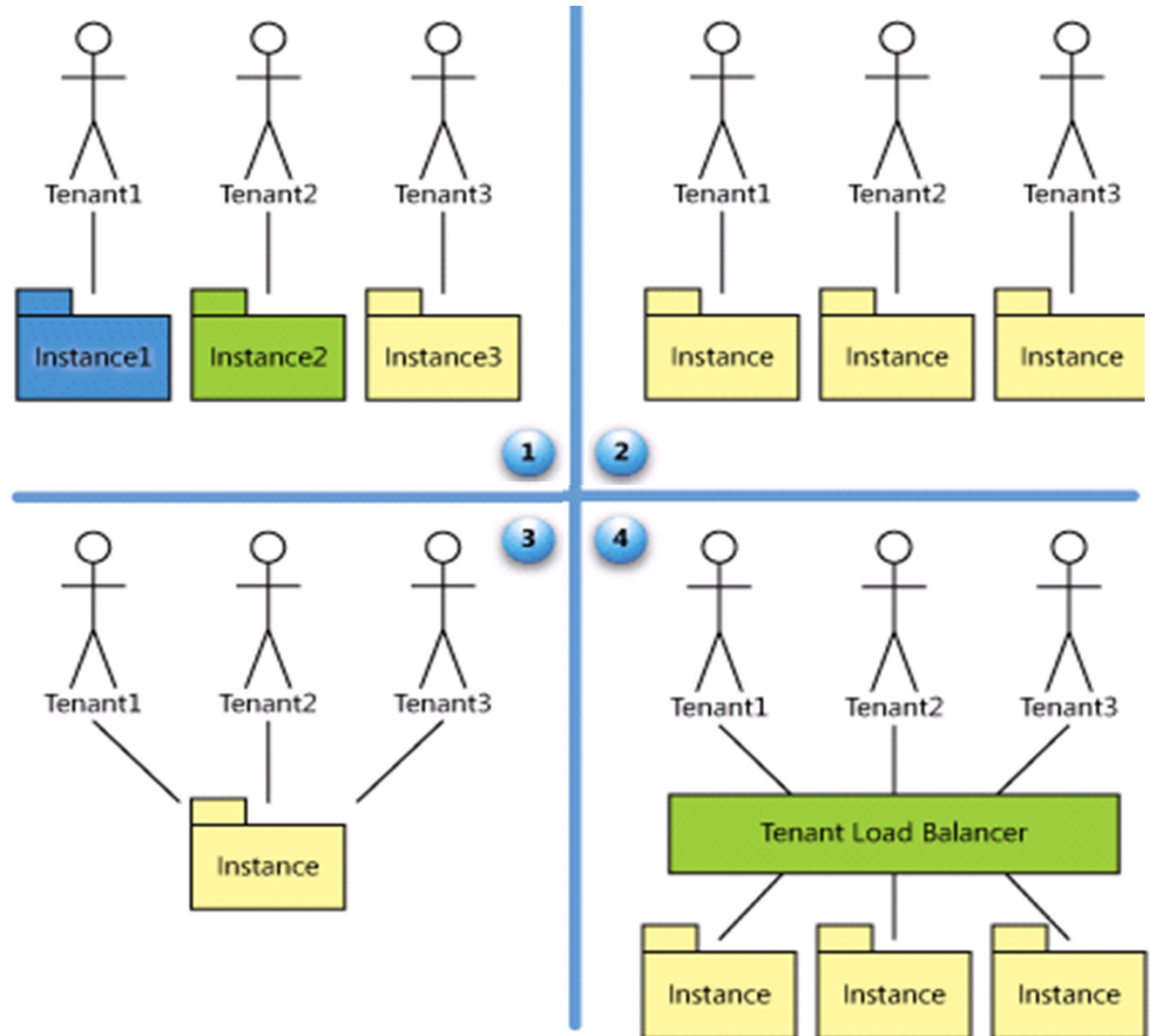| Cloud Infrastructure | |
|---|---|
| IaaS | Infrastructure as a Service ( IaaS ) Rent Processing, storage, N/W capacity & computing resources |

# 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 |
|---|---|
| **Services** | **Services – Complete business services such as PayPal, OpenID, OAuth, Google Maps, Alexa** |
| **Application** | **Application–Cloud based S/W that eliminates local installation: Google Apps, MS Online** |
| **Development** | **Development – S/W Dev. platforms used to build custom cloud based applications (PAAS & SAAS) such as SalesForce** |
| **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.** |

**App. Focused**

**Infra. Focused**

# 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.

# Software as a Service (SaaS)

- SaaS is a model of software deployment where an application is hosted as a service provided to customers across the Internet.

- Saas alleviates the burden of software maintenance/support
  - but users relinquish control over software versions and requirements.

- Terms that are used in this sphere include
  - **Platform as a Servic**e (PaaS) and
  - **Infrastructure as a Service** (IaaS)

Cloud computing model where software applications are provided over the internet as a service, rather than being installed and run locally on a user's computer. In a SaaS model, the software application is hosted by a third-party provider and made available to customers on a subscription basis.