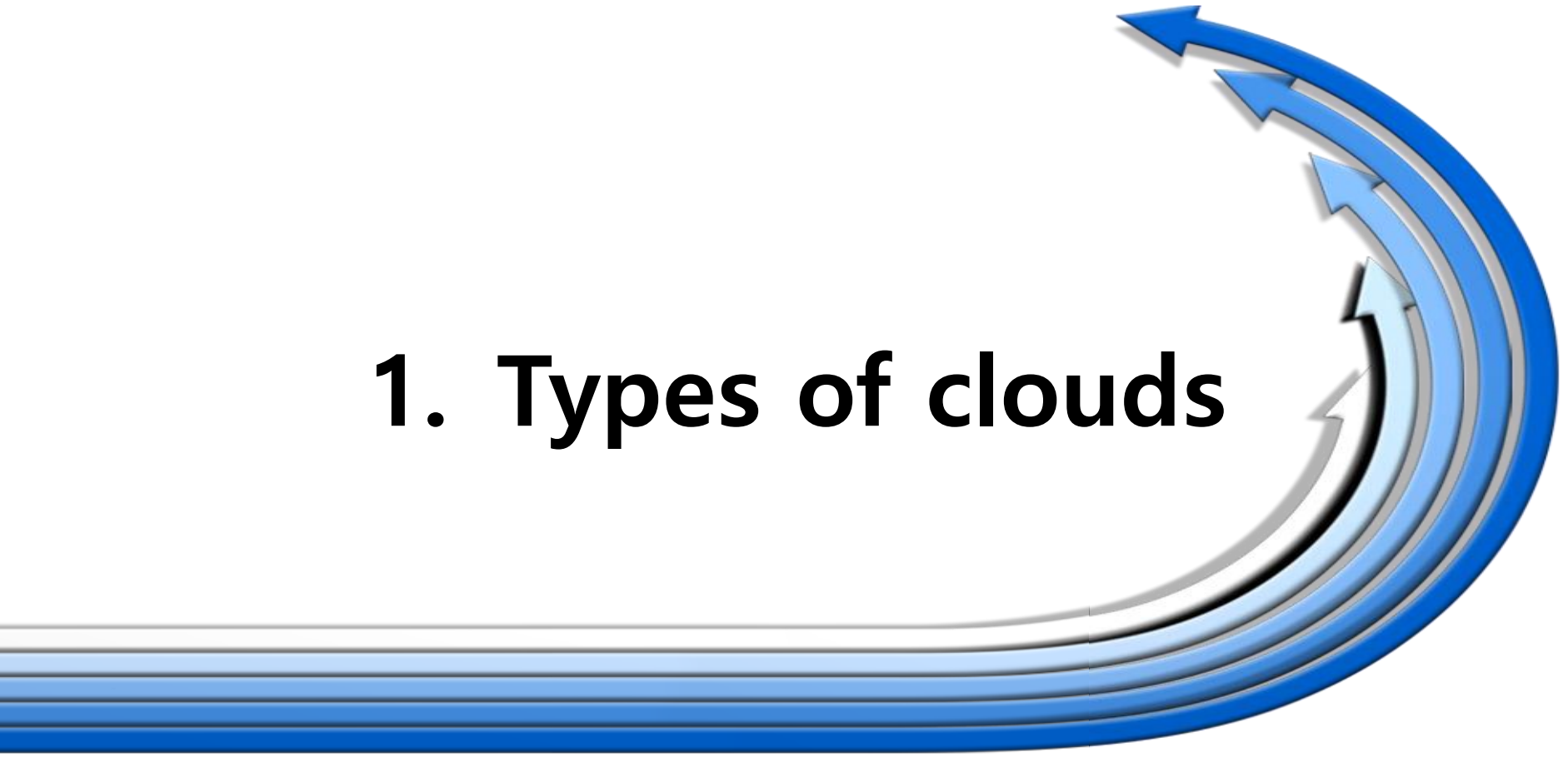


1. Types of clouds



Types of Clouds

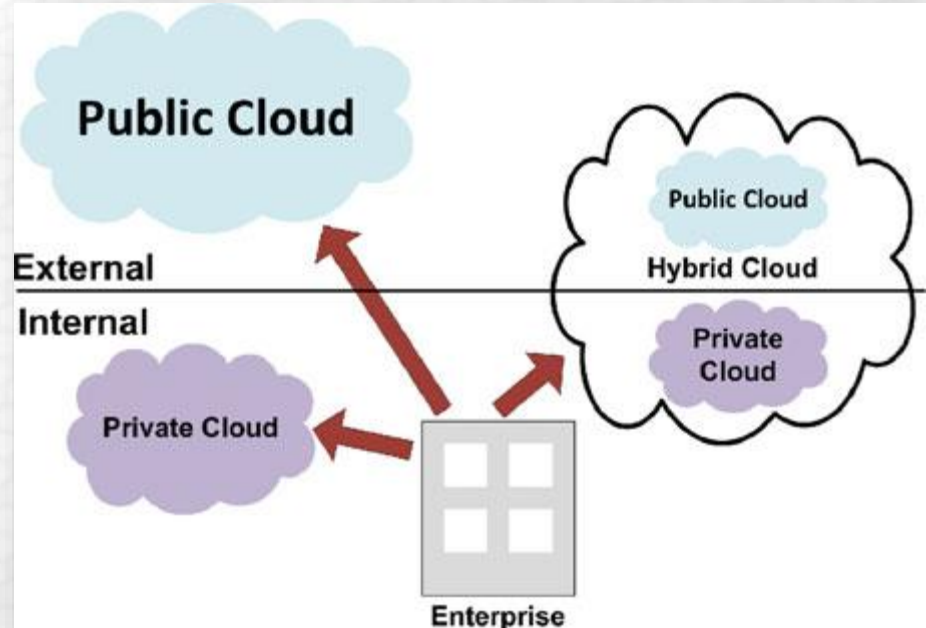
■ Clouds can be classified in terms of who owns and manages the cloud

- Public Clouds
- Private Clouds
- Hybrid Clouds
- Community Clouds

Cloud types:



public, private and hybrid clouds



Public Cloud

A public cloud or external cloud

- are available to the general public in a pay-as-you-go manner

Customers, individual users or enterprises

- access these services over the internet from a third-party provider who may share computing resources with many customers


Security and data governance are the main concern with this approach


Public Cloud


The leading public cloud vendors: Amazon, Microsoft and Google

- have equipped their infrastructure with a vast amount of data centers, enabling users to freely scale and shrink their rented resources with low cost and little management burden



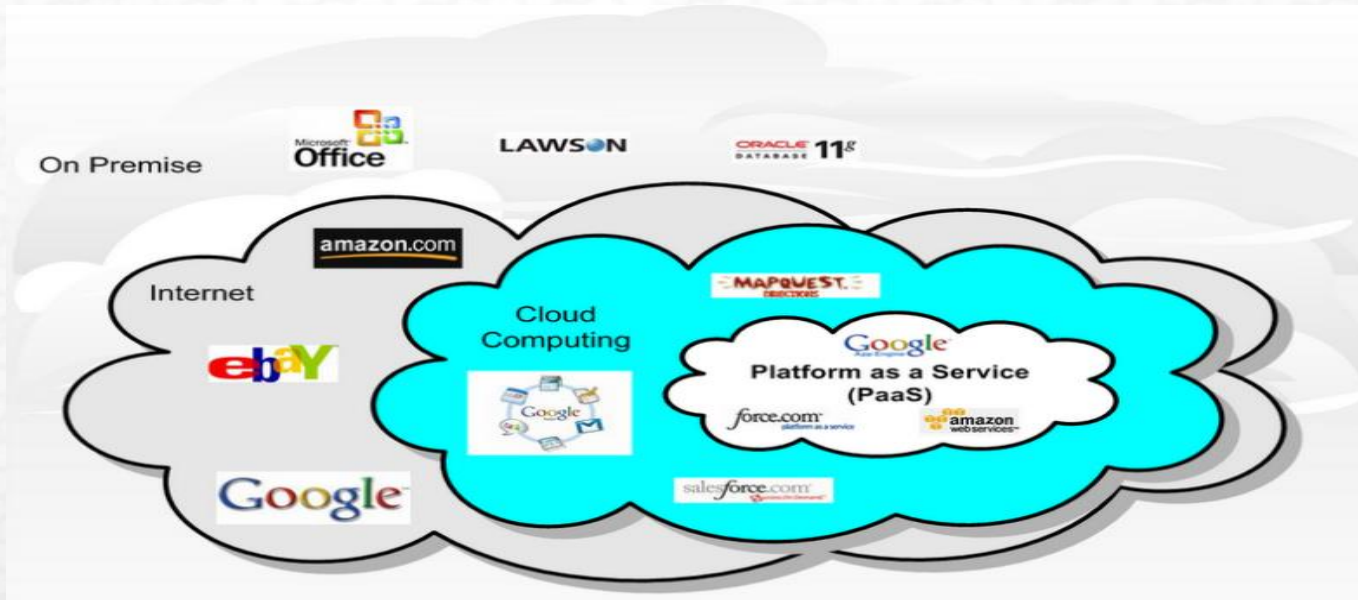
 **Private Clouds use the same base technologies as Public Clouds, but provide more customization to the infrastructure such as specific value-added hardware or software components because Private Clouds run behind the firewall and are located at the Client site or outsourced Service Providers site.**

 **A Private Cloud or Internal cloud**

-  **is used when the cloud infrastructure, proprietary network or data center, is operated solely for a business or organization, and serves customers within the business fire-wall**

Private Cloud

- Most of the private clouds are large company or government departments who prefer to keep their data in a more controlled and secure environment





Public VS. Private cloud

	Public cloud	Private cloud
Infrastructure Owner	Third party (Cloud provider)	Enterprise
Scalability	Unlimited and On-Demand	Limited to the installed Infrastructure
Control and Management	Only manipulate the virtual machines, resulting in less management burden	High level of control over the resources, and need more expertise to manage them.
Cost	Lower cost	High cost including: space, cooling, energy consumption and hardware cost
Performance	Unpredictable multi-tenant environment makes it hard to achieve guaranteed performance	Guaranteed performance
Security	Concerns regarding data privacy	Highly secure



Hybrid Cloud

- A composition of the two types (private and public) is called a Hybrid Cloud
- Where a private cloud is able to maintain high services availability by scaling up their system with externally provisioned resources from a public cloud when there are rapid workload fluctuations or hardware failures
- In the Hybrid cloud, an enterprise can keep their critical data and applications within their firewall, while hosting the less critical ones on a public cloud



Community Cloud

- In a community cloud, several enterprises with similar requirements can share their infrastructures, thus increasing their scale while sharing the cost
- Another form of community cloud may be established by creating a virtual data center from virtual machines instances deployed on underutilized users machines

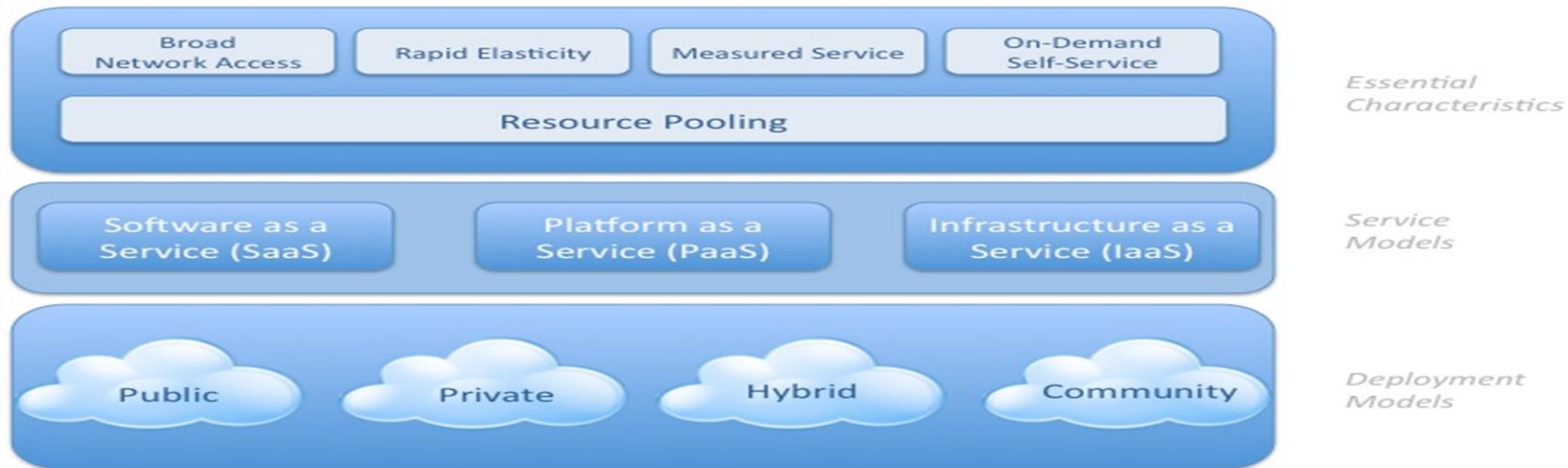


The U.S. National Institute of Standards and Technology (NIST)

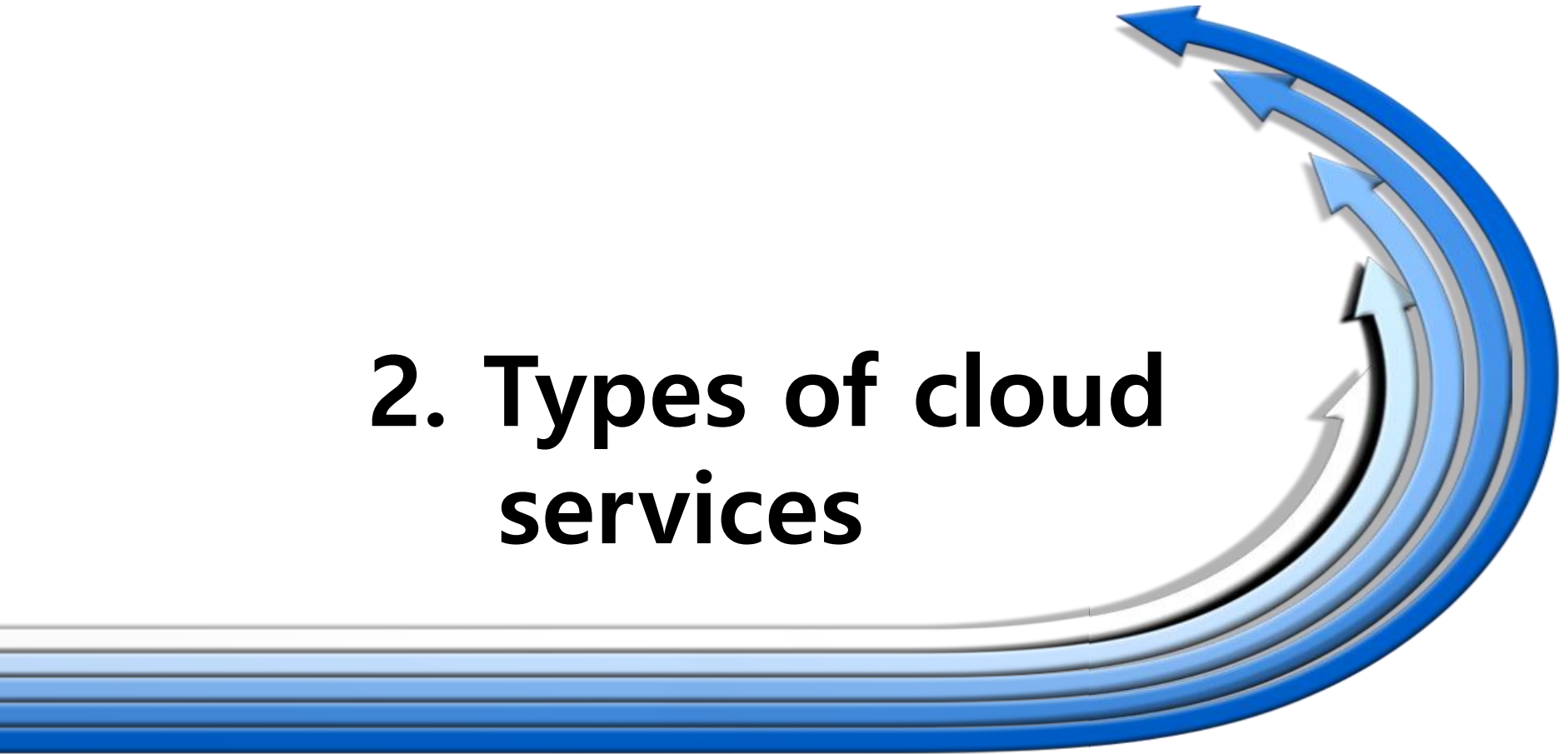
Visual Model of Cloud Computing Definition

Visual Model Of NIST Working Definition Of Cloud Computing


<http://www.csrc.nist.gov/groups/SNS/cloud-computing/index.html>



2. Types of cloud services



Types of Cloud Services

 A Cloud is essentially a class of systems that deliver IT resources to remote users as a service

 The resources encompass hardware, programming environments and applications

 The cloud computing services are falls into three basic types

- Infrastructure as a service (IaaS)
 - Bare mental service on demand
- Platform as a Service (PaaS)
 - Applications and APIs
- Software as a service (SaaS)
 - Internet based development services

SPI Model in Cloud Computing

SaaS



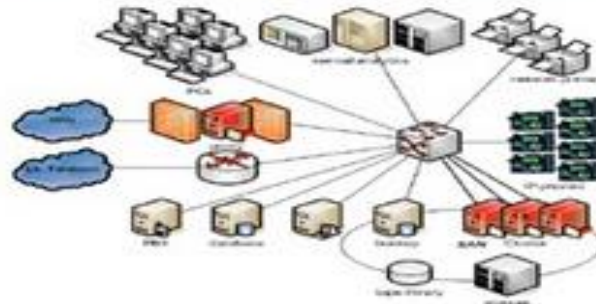
SalesForce.com, Google Apps

PaaS



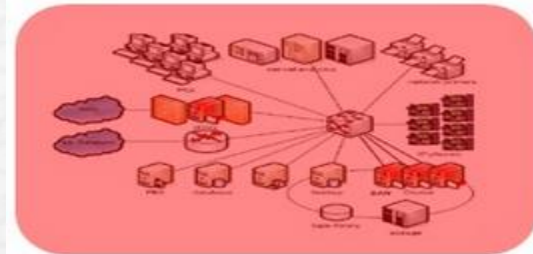
VMForce.com, MS Azure

IaaS

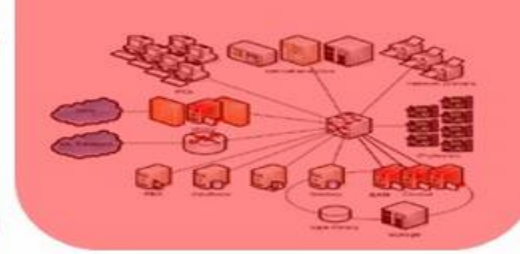
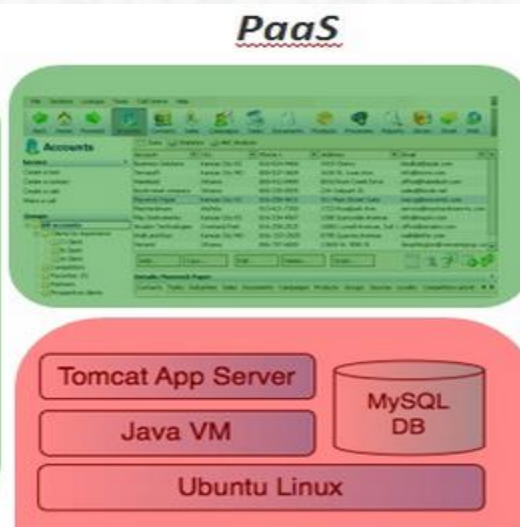


vCloud Express/Datacenter, Amazon EC2

SPI Model in Cloud Computing



Consumer managed



Provider managed



Cloud Services and Cloud Roles

 Different enterprises play different roles in building and using cloud systems

Technology Enablers

Enabling the underlying technologies used to build the cloud, such as hardware technologies, Virtualization technology, web services

Cloud Providers

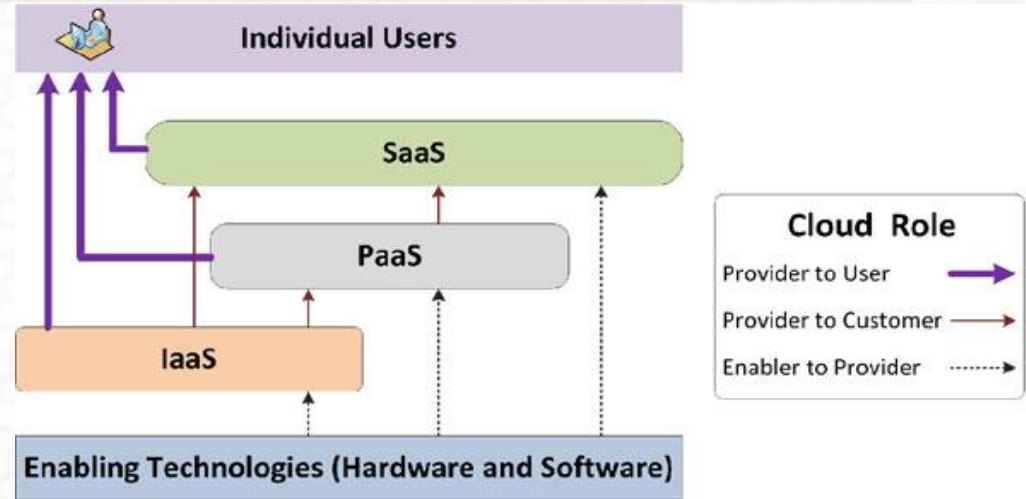
Delivering their infrastructure and platform to customers

Cloud Customers

Using the providers' services to improve their web applications

Users

Who use the web applications



Cloud Services and Cloud Roles



Infrastructure as a Service (IaaS)

 IaaS is one of the “Everything as a Service” (XaaS) trends

 The IaaS is categorized into

- **Computation as a Service (CaaS)**
virtual machine based servers are rented and charged per hour based on the virtual machine capacity
- **Data as a Service (DaaS), in which unlimited storage space is used to store the user’s data regardless of its type**
unlimited storage space is used to store the user’s data regardless of its type, charged per GByte for data size and data transfer

Popular IaaS Systems

Amazon Elastic Compute Cloud (EC2)



- EC2 provides many useful features for customers, including a mature and inexpensive billing system able to charge for computing at a very fine-grained level (memory usage, CPU usage, data transfer, etc.)

GoGrid



- Both EC2 and GoGrid provide basic and common features of cloud computing. The difference between the services they provide mainly derives from their respective business models. For example, GoGrid provides free cloud and persistent storage, slightly different from Amazon

Amazon Simple Storage Service




- The Amazon Simple Storage Service (2010) (S3) is an online storage web service offered by Amazon Web Services.

Widely used CaaS Systems

CaaS	Amazon EC2	GoGrid	Rackspace (cloud server)
Virtualization	Xen	Xen	VMware
OS support	Linux, Windows	Linux, Windows	Linux, Windows
Server RAM	1.7 GB and going up to 68.4 GB	0.5 GB and going up to 8 GB	256 MB and going up to 16 GB
Load Balancer	Amazon Elastic Load Balancer	Free F5 Load Balancer	No
Persistent Block Storage	Yes	Yes	No
Hybrid Hosting	No	Yes	Yes
24/7 Support	No	Yes	Yes
Pricing	Billed \$0.085 – \$3.18 per hour (vary for different Instance and Regions). The Data Transfer rates vary based on where the data goes out to and comes in from with pricing between \$0.00 to \$0.15 per GB transferred.	Billed \$0.19 per GB of deployed RAM per hour and 60 GB of disk, \$0.50 per GB of outbound data transferred, and all inbound data transfer is free.	Billed \$0.06 per GB of deployed RAM per Hour and 40 GB of disk, \$0.05 per GB of inbound data transfer and \$0.22 per GB of outbound data transfer.

Platform as a Service(PaaS)

 PaaS provide a software execution environment that application services can run on

 The environment is not just a pre-installed operating system but is also integrated with a programming-language-level platform, which can be used by users to develop and build applications for the platform



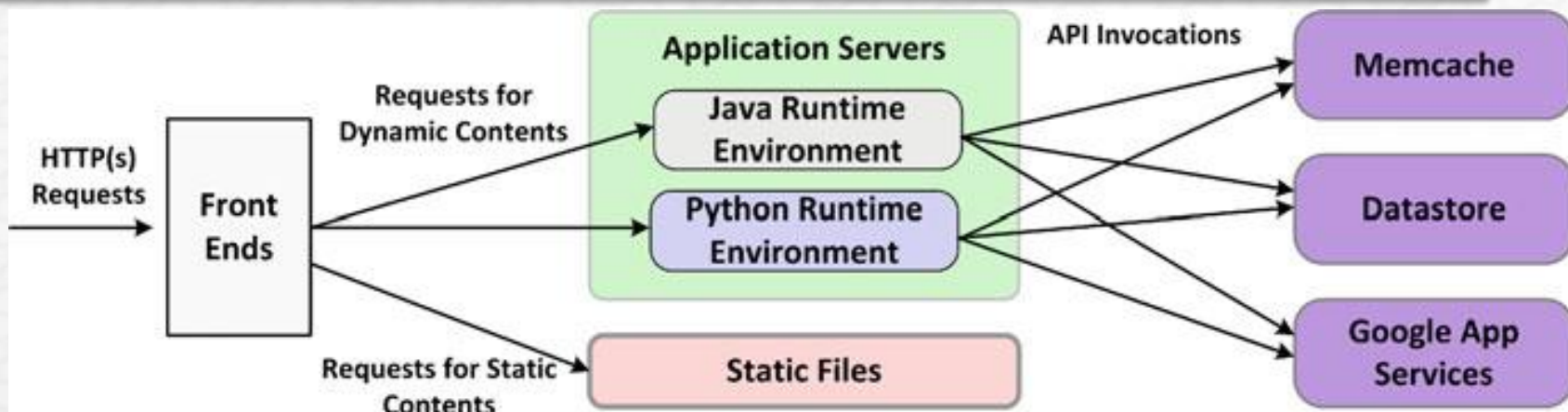
Three Typical PaaS

PaaS provider	Programming environment	Infrastructure	Hosted application
Google	Python and Java	Google Data Center	Socialwok (2010), Gigapan (2010), LingoSpot (2010)
Azure	.Net (Microsoft Visual Studio)	(Virtual Machine Based) Microsoft Data Centers	Microsoft Pinpoint (2010)
Force.com	Apex Programming and Java1	Salesforce Data Center	EA (2010), Author Solutions (2010), The Wall Street Journal (2010)
Heroku (2010)	Ruby	Amazon EC2 and S3	Übermind (2010), Kukori.ca (2010), act.ly (2010), Cardinal Blue (2010)

Google App Engine

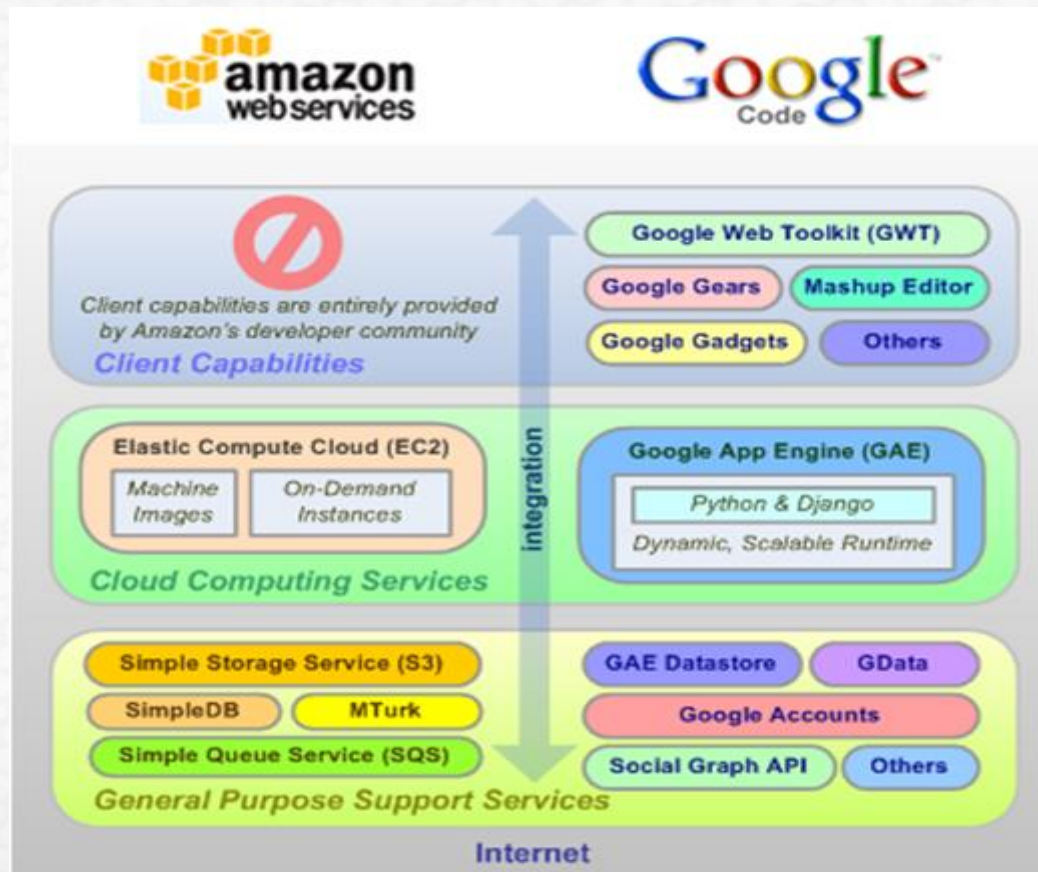
Google App Engine (GAE)'s main goal is to efficiently run users' web applications

As shown in following figure, it maintains Python and Java runtime environments on application servers, along with some simple APIs to access Google services



The Architecture of Google App Engine

Comparing Two of the Leading Software Platforms in The Cloud



Software as a Service (SaaS)

- SaaS is based on licensing software use on demand, which is already installed and running on a cloud platform
- These on-demand applications may have been developed and deployed on the PaaS or IaaS layer of a cloud platform

SaaS Examples

Desktop as a Service

- provides a virtualized desktop-like personal workspace, and sends its image to the user's real desktop
- Access desktop-on-thecloud from different places for convenience, and receive the benefit of SaaS at same time

Google Apps

- Mail, talk, calendar, docs, websites

Salesforce

- a business SaaS cloud platform
- provides customizable applications, mostly Customer Relationship Management (CRM) services

Other Software as Service Examples

- As cloud computing technology spreads, more and more Software as a Service implementations have been released
- The services cover many fields in addition to personal file processing and business administration

SaaS provider	Important services
A2Zapps.com (2010)	Marketing Automation, School Automation (ERP)
Envysion.com (2010)	Video Management
Learn.com (2010)	Training, HR, Online Courses
Microsoft (2010)	Office Live Meeting, Dynamics CRM, SharePoint
OpenID (2010)	Log in Identification
Zoho (2010)	Mail, Docs, Wiki, CRM, Meeting, Business