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Amritapuri Campus



**22AIE305: CLOUD COMPUTING**





# 1. SaaS – Software as a Service :

**Eg: Google Workspace, Gmail, Office 365, Dropbox, Salesforce, Cisco WebEx, Concur, GoToMeeting**

# 2. PaaS – Platform as a Service :

**Eg: AWS Elastic Beanstalk, Windows Azure, Heroku, Force.com, Google App Engine, Apache Stratos, OpenShift**



# 3. IaaS – Infrastructure as a Service :

**Eg: DigitalOcean, Linode, Rackspace, Amazon Web Services (AWS), VMware, Cisco Metapod, Microsoft Azure, Google Compute Engine (GCE)**



## Infrastructure as a Service (IaaS)

Infrastructure as a Service (IaaS) contains the basic building blocks for cloud IT and typically provide access to networking features, computers (virtual or on dedicated hardware), and data storage space. Infrastructure as a Service vendors can help you with the highest level of flexibility and management control over your IT resources and is most similar to existing IT resources that many IT departments and developers are familiar with today.

[Learn more about IaaS here](#)



## Platform as a Service (PaaS)

Platforms as a service (PaaS) vendors remove the need for organizations to manage the underlying infrastructure (usually hardware and operating systems) and this integration allows you to focus on the deployment and management of your applications. This helps you be more efficient as you don't need to worry about resource procurement, capacity planning, software maintenance, patching, or any of the other undifferentiated heavy lifting involved in running your application.

[Learn more about iPaaS here](#)



## Software as a Service (SaaS)

Software as a Service (SaaS) vendors provide you with software applications that is run and managed by the vendor. In most cases, people referring to Software as a Service are referring to third-party end-user applications. With a SaaS offering you do not have to think about how the service is maintained or how the underlying infrastructure is managed; you only need to think about how you will use that particular piece of software. A common example of a SaaS application is web-based email where you can send and receive email without having to manage feature additions to the email product or maintaining the servers and operating systems that the email program is running on.

[Learn more about SaaS here](#)

# Platform-as-a-Service (PaaS)

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- Allows a cloud user to deploy consumer-created or acquired applications using programming languages and tools supported by the service provider.
- The user:
  - Has control over the deployed applications and, possibly, application hosting environment configurations.
  - Does not manage or control the underlying Cloud infrastructure including network, servers, operating systems, or storage.
- Not particularly useful when:
  - The application must be portable.
  - Proprietary programming languages are used.
  - The hardware and software must be customised to improve the performance of the application.
- Examples: **Google App Engine, Microsoft Azure**

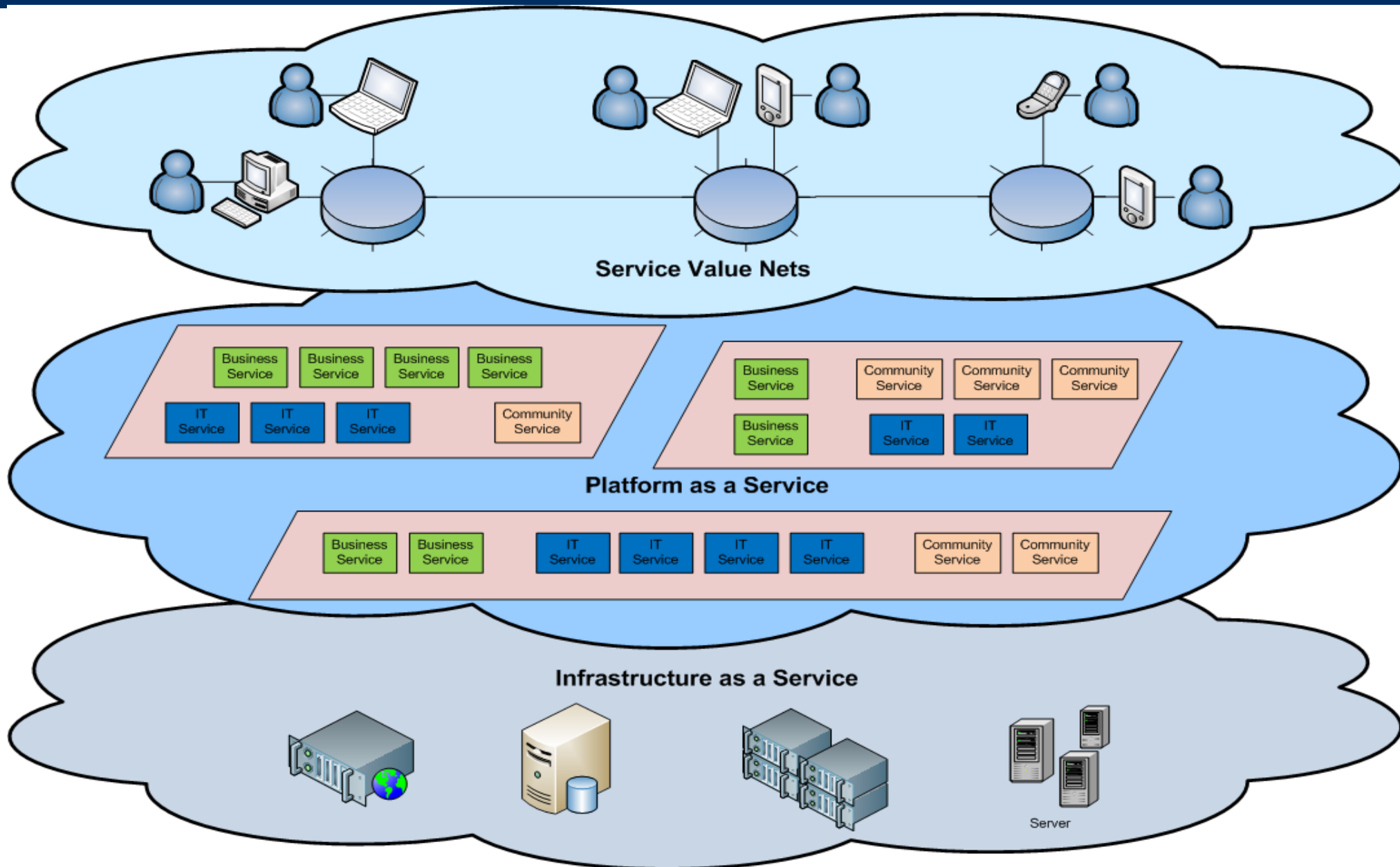
# PaaS

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- 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.
- PaaS can be viewed as an evolution of Web hosting. Webhosting companies have provided fairly complete software stacks for developing Web sites.
- PaaS takes this idea a step farther by providing *lifecycle management*— capabilities to manage all software development stages from planning and design, to building and deployment, to testing and maintenance.
- Some SaaS vendors even enable customization of their product by providing a companion PaaS solution.
- One well-known example is **Heroku**, a PaaS solution for Sales-force.



# Cloud Architecture



# Amazon Simple Storage Service (S3)

- Unlimited Storage.
- Pay for what you use:
  - \$0.20 per GByte of data transferred,
  - \$0.15 per GByte-Month for storage used,
  - Second Life Update:
    - 1 TByte, 40,000 downloads in 24 hours - \$200,



# Utility Computing – EC2

- Amazon Elastic Compute Cloud (EC2):
  - Elastic, marshal 1 to 100+ PCs via WS,
  - Machine Specs...,
  - Fairly cheap!
- Powered by Xen – a Virtual Machine:
  - Different from Vmware and VPC as uses “para-virtualization” where the guest OS is modified to use special hyper-calls:
  - Hardware contributions by Intel (VT-x/Vanderpool) and AMD (AMD-V).
  - Supports “Live Migration” of a virtual machine between hosts.
- Linux, Windows, OpenSolaris
- Management Console/AP



- PaaS involves a third-party–hosted server or operating system. This can also be referred to as a "solution stack," because it typically contains everything a developer needs to build an application.
- PaaS allows businesses to use a platform provided by a third party in order to develop and run applications. The third-party provider supports the platform by eliminating the need to install some on-premise software and hardware.
- PaaS simplifies application development and management because it eliminates a business's need to maintain an onsite infrastructure. In addition, PaaS is scalable and allows for more cost-effective development because it already allows for the use of a solution stack, which contains many of the tools and software apps developers use every day.
- Each of these three cloud computing service delivery models offer their own unique benefits and limitations, as well as varying levels of flexibility and control over the cloud's structure.

Cloud service models also add several new resources for businesses that boost efficiency while lowering costs, especially when scaling operations, as these platforms often eliminate the need for in-house hardware and software. The demand for cloud services is not slowing down any time soon. Eventually, depending on their needs, most businesses will rely on using one or all three models to keep up with the introduction of new technologies. Whether a business is big or small, cloud services are the solution for diversifying service offerings and empowering staff, all while adding more flexibility.

The PaaS delivery model is halfway between infrastructure-as-a-Service (IaaS) and Software-as-a-Service (SaaS). It offers a predetermined cloud environment having already installed, deployed, and configured IT resources. This model offers a platform with built-in software components and tools for the programmers to develop, test, run, customize and manage their applications. The responsibility of managing servers, updating systems, maintaining security patches and backups is on the cloud providers. The consumers have administrative control over the cloud environment to develop applications, while the service providers manage the underlying infrastructures (virtual servers), IT resources (used databases) middleware, and OS maintenance. PaaS is remarkably popular due to its striking following features.



- Platform as a Service is a cloud computing infrastructure that **creates a development environment** upon which applications may be built.
- PaaS provides a model that can be used **to create or augment complex applications** like **Customer Relations Management (CRM)** or **Enterprise Resource Planning (ERP)** systems.
- PaaS offers the benefits of cloud computing and is often componentized and based on a service-oriented architecture.
- PaaS offer their clients everything ranging from OS, databases, spreadsheets, graphics, communication software, analytics, load-balancing, and more.

# Benefits of PaaS

- The primary benefit of PaaS is that it allows customers to build, test, deploy run, update and scale applications more quickly and cost-effectively than they might if they had to build out and manage their own on-premises platform. Other benefits include:
- **Faster time to market:** PaaS enables development teams to spin-up development, testing and production environments in minutes, rather than weeks or months.
- **Low- to no-risk testing and adoption of new technologies:** PaaS platforms typically include access to a wide range of the latest resources up and down the application stack. This allows companies to test new operating systems, languages and other tools without having to make substantial investments in them, or in the infrastructure required to run them.

## Benefits cont'd..

- **Simplified collaboration:** As a cloud-based service, PaaS provides a shared software development environment, giving development and operations teams access to all the tools they need, from anywhere with an Internet connection.
- **A more scalable approach:** With PaaS, organizations can purchase extra capacity for building, testing, staging and running applications whenever they need it.
- **Less to manage:** PaaS offloads infrastructure management, patches, updates and other administrative tasks to the cloud service provider. Local on-site management is bare minimal



# PaaS use-cases

- **API development and management:** With its built-in frameworks, PaaS makes it easier for teams to develop, run, manage and secure APIs for sharing data and functionality between applications.
- **Internet of Things (IoT):** PaaS supports a range of programming languages (Java, Python, Swift and more), tools and application environments used for IoT application development and real-time processing of data from IoT devices.
- **Agile development and DevOps:** PaaS solutions typically cover all the requirements of a DevOps toolchain, and provide built-in automation to support continuous integration and continuous delivery (CI/CD).
- **Cloud-native development and hybrid cloud strategy:** PaaS solutions support cloud-native development technologies—micro-services, containers, Kubernetes, server-less computing—that enable developers to build once, then deploy and manage consistently across private cloud, public cloud and on-premises environments.

# PaaS Disadvantages

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- Platform as a Service offerings usually have some proprietary elements (perhaps the development tools or even component libraries on the Cloud).
- Consequently, you may be ***affixed*** to the vendor's platform and unable to move your applications elsewhere without rewriting them to some degree. This is called "**Vendor-Lockin**".
- If you suddenly become dissatisfied with your Platform as a Service provider, you may face very high expenses when you suddenly need to rewrite the applications to satisfy the requirements of another PaaS vendor.

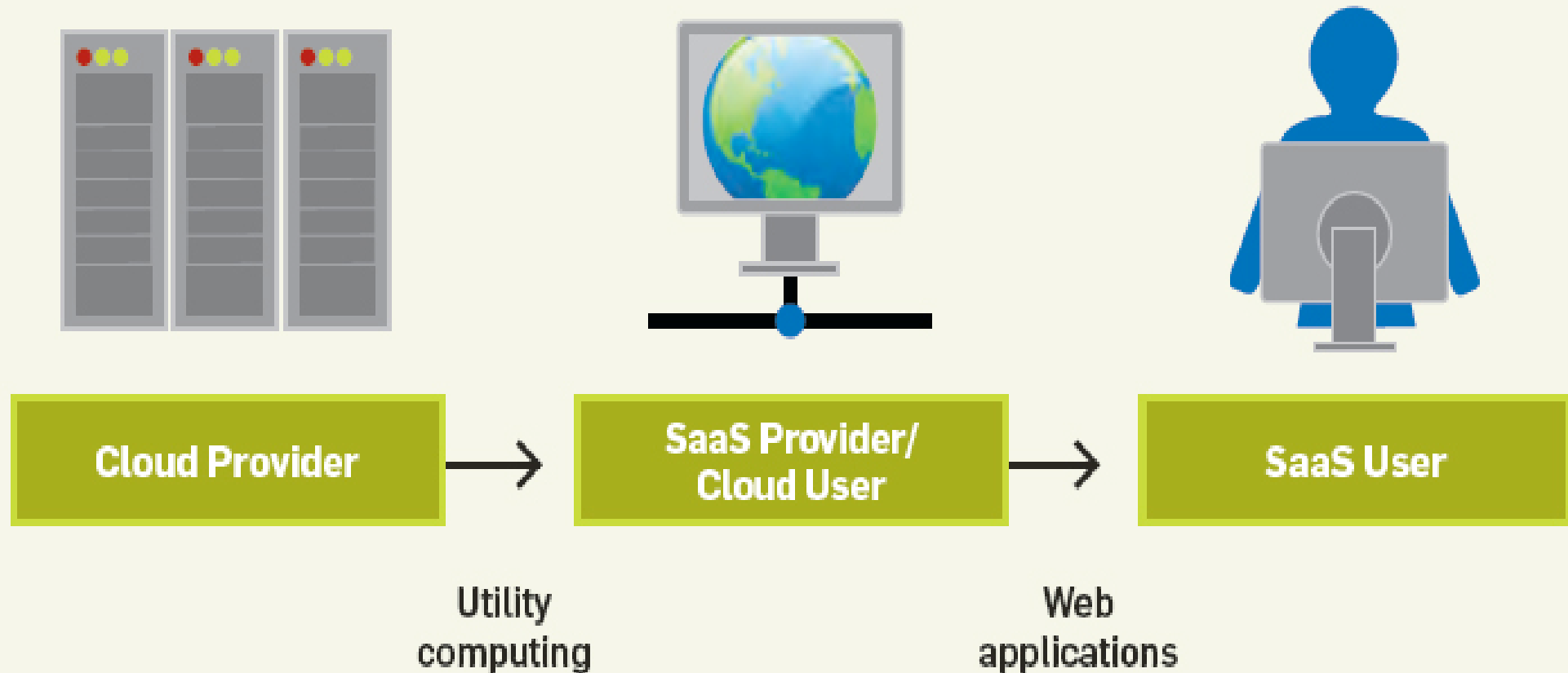
# Benefits of PaaS

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- The primary benefit of PaaS is having software development and deployment capability based entirely on the cloud — hence, no management or maintenance efforts are required for infrastructure.
- Every aspect of software development, from the design stage onward (including source-code management, testing, and deployment) are done on the cloud.
- PaaS is inherently multi-tenant and naturally supports the whole set of Web services standards and is usually delivered with dynamic scaling. In reference to Platform as a Service, *dynamic scaling* means that the software can be automatically scaled up or down. Platform as a Service typically addresses the need to scale as well as the need to separate concerns of access and data security for its customers.



# SaaS user's Interaction



# Software-as-a-Service (SaaS)

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- SaaS represents a hosted application that is universally available over the Internet, usually through a browser.
- Applications are supplied by the service provider.
- The user does not manage or control the underlying Cloud infrastructure or individual application capabilities.
- Services offered include:
  - Enterprise services such as: workflow management, communications, digital signature, customer relationship management (CRM), desktop software, financial management, geo-spatial, and search.
- Not suitable for real-time applications or for those where data is not allowed to be hosted externally.
- Examples: Gmail, Salesforce

# Cloud Service Models

Software as a  
Service (SaaS)

Platform as a  
Service (PaaS)

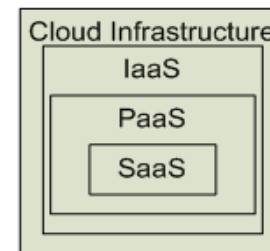
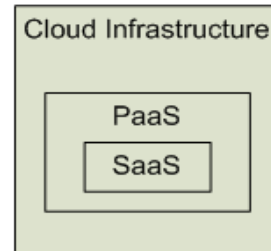
Infrastructure as a  
Service (IaaS)

SalesForce CRM

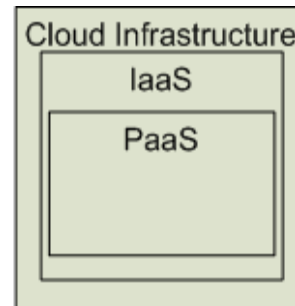
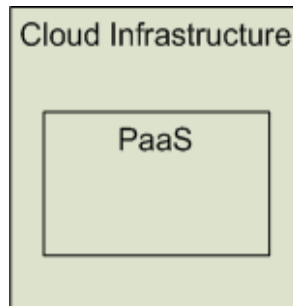
LotusLive



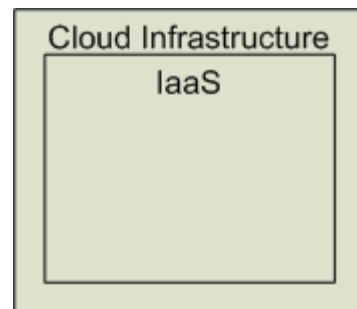
Google  
App



Software as a Service  
(SaaS)  
Providers  
Applications



Platform as a Service (PaaS)  
Deploy customer  
created Applications



Infrastructure as a Service (IaaS)

Rent Processing, storage, N/W  
capacity & computing resources



SaaS has its roots in an early kind of hosting operation carried out by Application Service Providers (ASPs).

The ASP business grew up soon after the Internet began to mushroom, with some companies offering to securely, privately host applications.

Hosting of supply chain applications and customer relationship management (CRM) applications was particularly prominent, although some ASPs simply specialized in running email.

- SaaS is a software distribution model that lets clients interact through web-enabled devices such as laptops, smartphones, and other Internet-enabled devices, making it extremely convenient to access and store cloud data. SaaS represents a hosted application that is universally available over the Internet, usually through a browser.
- SaaS is an alternative to shrink-wrapped software and may replace much of the boxed software that we buy today.
- In house software purchases need more money, has version or incompatibility issues, may need expiry license renewals, etc.
- SaaS is a model of software deployment on the Cloud

- With SaaS, the user interacts directly with the hosted software.
- SaaS may be seen to be an alternative model to that of shrink-wrapped software and may replace much of the boxed software that we buy today.
- Everything-as-a-Service is called **XaaS**
- It is a general term for all services and applications that users can access on the Cloud
- AaaS (Analytics as a Service) for data analytics,  
DaaS (Desktop as a Service) eg: Citrix

Also can be referred to as web-based software, on-demand software, and hosted software.

Benefits of SaaS include increased efficiency, cost-effectiveness, accessibility, and scalability.

SaaS companies are typically either a business-to-business (B2B) or business-to-consumer (B2C) organization.

The most common types of SaaS solutions are Customer Relationship Management (CRM), Enterprise Resource Planning (ERP), Content Management System, (CMS), Project Management Software, Sales, Marketing, e-Commerce

# Different Cloud Computing Layers

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

# Software as a Service (SaaS)

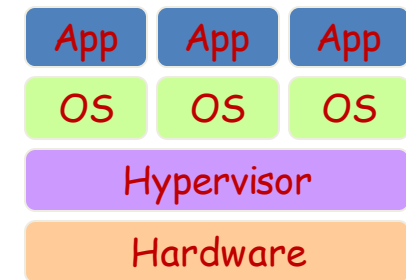
- SaaS is a model of software deployment where an application is hosted as a service provided to customers across the Internet.
- SaaS alleviates the burden of software maintenance/support
  - but users relinquish control over software versions and requirements.
- Terms that are used in this sphere include
  - **Platform as a Service (PaaS)** and
  - **Infrastructure as a Service (IaaS)**

Cloud Delivery Model	Typical Level of Control Granted to Cloud Consumer	Typical Functionality Made Available to Cloud Consumer
SaaS	Use and usage-related configuration	Access to the front-end user interface
PaaS	Limited administrative	Moderate level of administrative control over IT resources relevant to cloud consumer's usage of platform
IaaS	Full administrative	Full access to virtualized infrastructure-related IT resources and, probably, to underlying physical IT resources

Cloud Delivery Model	Common Cloud Consumer Activities	Common Cloud Provider Activities
SaaS	Use and configure cloud service	Implement, manage, and maintain cloud service; Monitor usage by cloud consumers
PaaS	Develop, test, deploy, and manage cloud services and cloud-based solutions	Pre-configure platform and provision underlying infrastructure, middleware, and other IT resources; Monitor usage by cloud consumers
IaaS	Set up and configure bare infrastructure, and install, manage, and monitor any needed software	Provision and manage the physical processing, storage, networking, and hosting; Monitor usage by cloud consumers

# Virtualization

- Virtual workspaces:
  - An abstraction of an execution environment that can be made dynamically available to authorized clients by using well-defined protocols,
  - Resource quota (e.g. CPU, memory share),
  - Software configuration (e.g. O/S, provided services).
- Implement on Virtual Machines (VMs):
  - Abstraction of a physical host machine,
  - Hypervisor intercepts and emulates instructions from VMs, and allows management of VMs,
  - VMWare, Xen, etc.
- Provide infrastructure API:
  - Plug-ins to hardware/support structures

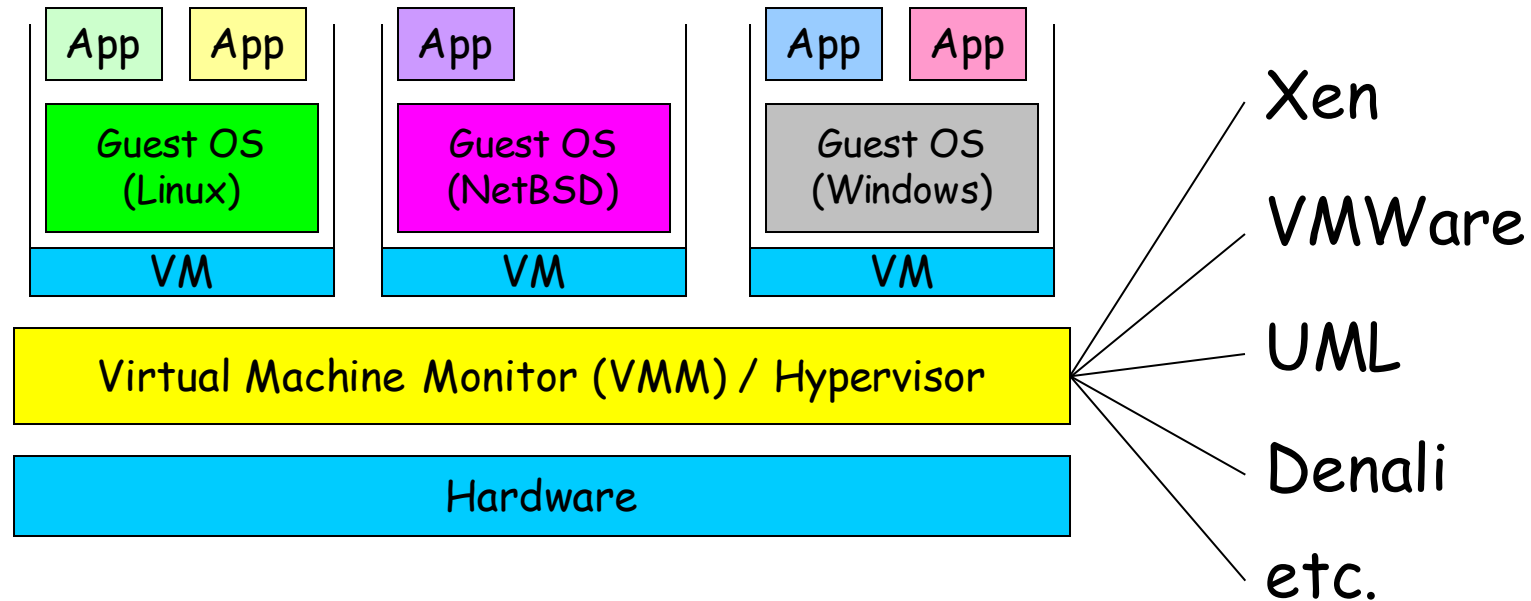


Virtualized Stack



# Virtual Machines

- VM technology allows multiple virtual machines to run on a single physical machine.



*Performance:* Para-virtualization (e.g. Xen) is very close to raw physical performance!

# Subscribing to SaaS

- SaaS allows users to instantly access a collection of applications on the selected Cloud.
- Simply install required software through the cloud-hosting service and then set up access permissions for multiple users in an organization.
- Apps can also be updated automatically, which — for businesses — offers the benefit of not having to manage software applications across multiple platforms.
- Instead, opt to subscribe to an all-in-one service.

# Benefits of SaaS

- The main benefit of SaaS is that it offloads all infrastructure and application management to the SaaS vendor. All a user has to do is to create an account, pay the fee and start using the application. The vendor handles everything else, from maintaining the server hardware and software to managing user access and security, storing and managing data, implementing upgrades and patches, anti-malware and more.
- Minimal risk: Many SaaS products offer a free trial period, or low monthly fees that let customers try the software to see if it will meet their needs, with little or no financial risk.
- Anytime/anywhere productivity: Users can work with SaaS apps on any device with a browser and an internet connection.
- Easy scalability: Adding users is as simple as registering and paying for new seats—customers can purchase more data storage for a nominal charge.

# Three Examples

- **AppEngine** (Google) Build scalable web applications fast. Not for general purpose computing.
- **Azure** (Microsoft) Use .NET and .NET libraries as needed. General purpose computing on a Microsoft platform.
- **EC2** (Amazon) Elastic Compute Cloud (Choose OS and the entire software stack. General purpose computing

# Three Examples

- AppEngine (Google) Least flexible  
Application domain-specific platform  
Automatic scaling and high availability  
Proprietary megastore for data storage
- Azure (Microsoft) Moderately Flexible  
Language independent software development platform
- EC2 (Amazon) Highly Flexible  
Hardware virtual machine  
You build from the kernel upward



# Cloud Taxonomy

## Infrastructure Services

### Storage

- Amazon S3
- Amazon EBS
- CTERA Portal
- Mosso Cloud Files
- Nirvanix

### Compute

- Amazon EC2
- Serve Path GoGrid
- Elastra
- Mosso Cloud Servers
- Joyent Accelerators
- AppNexus
- Flexiscale
- ElasticHosts
- Hosting.com CloudNine
- Terramark
- GridLayer
- iTRiCITY
- LayeredTech

### Services Management

- RightScale
- enStratus
- Scalr
- CohesiveFT
- Kaavo
- CloudStatus
- Ylastic
- Dynect
- CloudFoundry
- NewRelic
- Cloud42

## Cloud Software

### Data

- 10Gen MongoDB
- Oracle Coherence
- Gemstone Gemfire
- Apache CouchDb
- Apache HBase
- Hypertable
- TerraCotta
- Tokyo Cabinet
- Cassandra
- memcached

### Compute

- Globus Toolkit
- Xeround
- Beowulf
- Sun Grid Engine
- Hadoop
- OpenCloud
- Gigaspace
- DataSynapse
- Xeround

### Cloud Management

- 3Tera App Logic
- OpenNebula
- Open.ControlTier
- Enomaly Enomalism
- Altor Networks
- VMware vSphere
- OnPathTech
- CohesiveFT VPN Cubed
- Hyperic
- Eucalyptus
- Reductive Lbs Puppet
- OpenQRM
- Appistry

### Appliances

- PingIdentity
- Symplified
- rPath
- Vordel

### File Storage

- EMC Atmos
- ParaScale
- Zmanda
- CTERA

## CLOUD TAXONOMY

## Platform Services

### General Purpose

- Force.com
- Etelos
- LongJump
- AppJet
- Rollbase
- Bungee Labs Connect
- Google App Engine
- Engine Yard
- Caspio
- Qrimp
- MS Azure Services Platform
- Mosso Cloud Sites

### Business Intelligence

- Aster DB
- Quantivo
- Cloud9 Analytics
- Blink Logic
- K2 Analytics
- LogiXML
- Oco
- Panorama
- PivotLink
- Sterna
- ColdLight Neuron
- Infobright
- Vertica

### Integration

- Amazon SQS
- MuleSource Mule OnDemand
- Boomi
- SnapLogic
- OpSource Connect
- Cast Iron
- Microsoft BizTalk Services
- gnip
- SnapLogic SaaS Solution Packs
- Appian Anywhere
- HubSpan
- Informatica On-Demand

### Development & Testing

- Keynote Systems
- Mercury
- SOASTA
- SkyTap
- Aptana
- LoadStorm
- Collabnet
- Dynamsoft

### Database

- Google BigTable
- Amazon SimpleDB
- FathomDB
- Microsoft SDS

## Software Services

### Billing

- Aria Systems
- eVapt
- OpSource
- Redi2
- Zuora

### Financials

- Concur
- Xero
- Workday
- Beam4d

### Legal

- DirectLaw
- Advologix
- Fios
- Sertifi

### Sales

- Xactly
- LucidEra
- StreetSmarts
- Success Metrics

### Desktop Productivity

- Zoho
- IBM Lotus Live
- Google Apps
- Desktoptwo
- Parallels
- ClusterSeven

### Human Resources

- Taleo
- Workday
- iCIMS

### Content Management

- Clickability
- SpringCM
- CrownPoint

### Backup & Recovery

- JungleDisk
- Mozy
- Zmanda Cloud Backup
- OpenRSM
- Synclplicity

### CRM

- NetSuite
- Parature
- Responsys
- Rightnow
- Salesforce.com
- LiveOps
- MSDynamics
- Oracle On Demand

### Document Management

- NetDocuments
- Questys
- DocLanding
- Aconex
- Xythos
- Knowledge TreeLive
- SpringCM

### Collaboration

- Box.net
- DropBox

### Social Networks

- Ning
- Zemby
- Amitive

# Popular SaaS on the Cloud

- **ClickUp** is one of the leading SaaS tools and the highest-rated project management software in the market today.
- **HubSpot** is a leading cloud-based sales, marketing, and customer relationship management (**CRM**) suite.
- **Salesforce** is a leading SaaS tool specializing in **CRM**. Over 2,50,000 businesses use Salesforce (sales, marketing, and support depts).
- **Slack** is one of the leading companies and a cloud-based workplace communication tool that transforms how organizations communicate
- **DocuSign** is a cloud-based digital signature software that replaces the traditional approach of signing paper documents by enabling organizations to turn every business agreement entirely digital to capture e-signatures

# SaaS on the Cloud cont'd..

- Tableau is one of the leading cloud-based analytics platforms in the world. This data visualization tool and self-service analytics platform is used to get deeper insights
- Crowdcast is a live-streaming software that users can utilize to host webinars
- Editor X is an advanced web creation platform made exclusively for designers and web professionals
- Databox is a business analytics platform that gathers all your business data into one centralized dashboard
- SonarCloud is a source code management tool built to catch bugs and security vulnerabilities in your pull requests and throughout code repositories

# IT Deployment models



## Cloud

A cloud-based application is fully deployed in the cloud and all parts of the application run in the cloud. Applications in the cloud have either been created in the cloud or have been migrated from an existing infrastructure to take advantage of the [benefits of cloud computing](#). Cloud-based applications can be built on low-level infrastructure pieces or can use higher level services that provide abstraction from the management, architecting, and scaling requirements of core infrastructure.



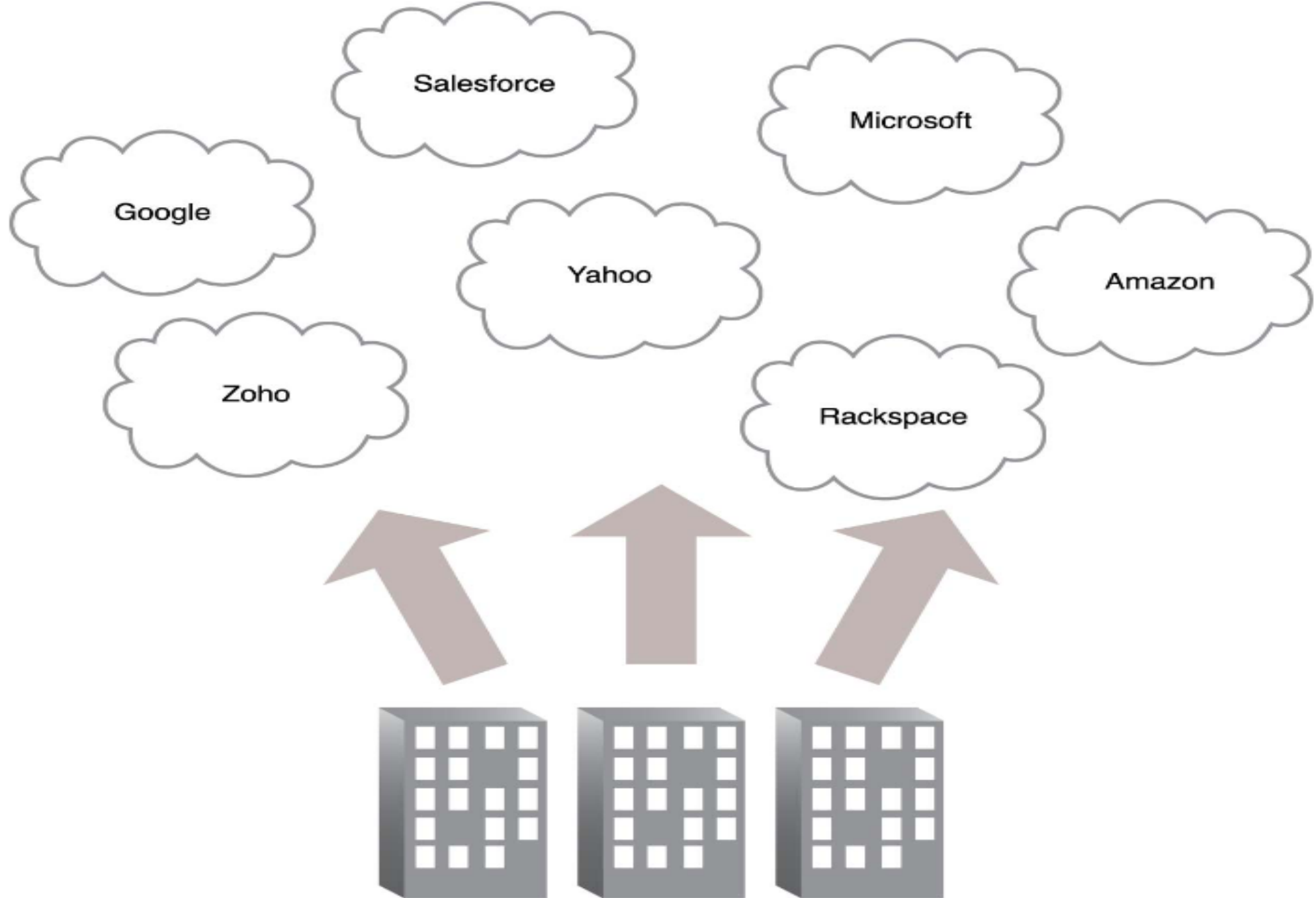
## Hybrid

A please visit hybrid deployment is a way to connect infrastructure and applications between cloud-based resources and existing resources that are not located in the cloud. The most common method of hybrid deployment is between the cloud and existing on-premises infrastructure to extend, and grow, an organization's infrastructure into the cloud while connecting cloud resources to internal system. For more information on how AWS can help you with your hybrid deployment, please visit [our hybrid](#) page.



## On-premises

Deploying resources on-premises, using virtualization and provide resource management tools does not provide many of the benefits of cloud computing but is sometimes sought for its ability to provide dedicated resources. In most cases this deployment model is the same as legacy IT infrastructure while using application management and virtualization technologies to try and increase resource utilization.



# Popular Cloud-Platforms

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- Amazon Web Services (AWS): Best for **Public Cloud**
- Microsoft Azure: Best for **Developer Solutions**
- Salesforce: Best for **CRM Solutions**
- VMWare: Best for **Multi-Cloud Services**
- Alibaba Cloud: Best for **Elastic Computing**
- Oracle Cloud: Best for **Data Management**
- Rackspace: Best for **Cloud Optimization**
- Digital Ocean: Best for **Web Applications**
- ServiceNow: Best for **Enterprise Automation**
- NetApp: Best for **Data Intelligence**
- Google Cloud: Best for **Cloud Computing**
- CloudSigma: Best for **Cloud Hosting**
- IBM Cloud: Best for **Integrated Cloud Experience**
- Cisco Cloud Solutions: Best for **Hybrid Cloud Strategy**
- RedHat Hybrid Cloud: Best for **Edge Architecture**
- Tencent Cloud Best for **Cheap development**
- **Manjrasoft Aneka** ([http://www.manjrasoft.com/manjrasoft\\_downloads.html](http://www.manjrasoft.com/manjrasoft_downloads.html))