Cloud Computing

An Easy Approach

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Wisdom is better than strength

- **Solomon**

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PREFACE

Cloud computing is a vast topic that encompasses many different subjects. To adequately describe what cloud computing offers, we must discuss infrastructure, service-oriented architectures, social networking, and dozens of other topics. Even a large book can address many of these topics in only an introductory manner. However, this book tries to give you at least the basic information you need on all the related topics, as well as pointers to additional information sources.

In this book, I do not make the assumption that you are a particular type of reader, nor do I assume that you are approaching the topic with a fresh view. This is written to serve as the introductory level. But, you can pick up and read this book at any particular chapter because the material doesn't build upon itself.

Many topics in this book are unique to this book and are based on published information that is both current and timely.

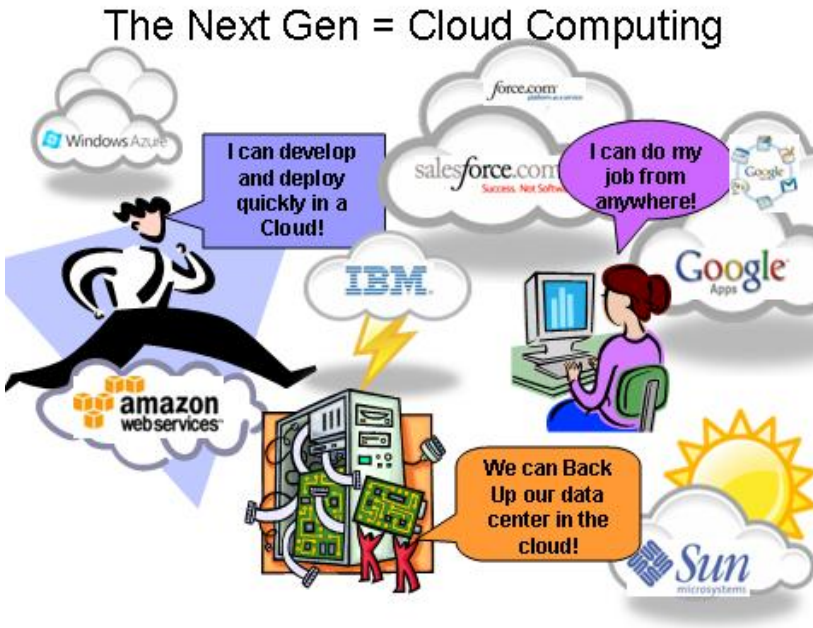
Chapter 1

Definition

Cloud computing is typically defined as a type of computing that relies on sharing computing resources rather than having local servers or personal devices to handle applications.

In cloud computing, the word **cloud** (also phrased as "the cloud") is used as a metaphor for "the Internet," so the phrase cloud computingmeans "a type of Internet-based computing," where different services— such as servers, storage and applications — are delivered to an organization's computers and devices through the Internet.

In short, **Cloud computing** means *on demand delivery of IT resources* via the internet with pay-as-you-go pricing.



The Old World

Before cloud computing, if you wanted some computational power, you had three choices:

You called up one of the big server manufacturers (HP, IBM, Dell, etc.) and ordered a server. When it arrived, you could either install it in your own data center or in colocation space that you had rented from somebody like Switch or Equinix. The responsibility was yours for acquisition, installation, and maintenance.

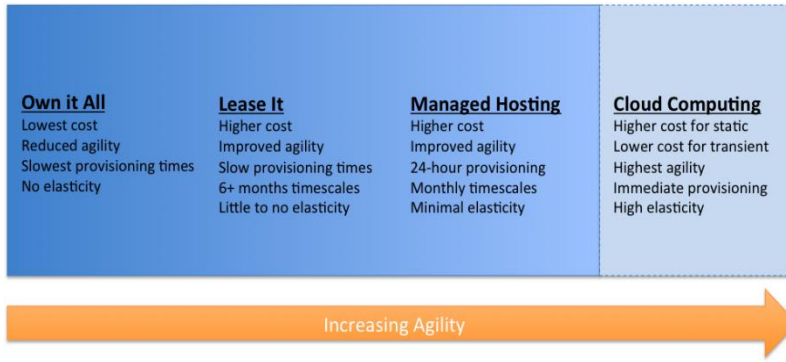
You called up a leasing company and told them you wanted to rent some equipment. You selected from among their stock and they delivered it to your door. Then, just as if you had purchased it yourself, you had the responsibility of installing and configuring it in your data center or colo facility.

You could rent a server from a managed service provider (MSP)(Savvis, Rackspace, Terremark, etc.). The MSP would allocate you a server from their own internal stock, deploy it for you in their data center, and then turn over the keys for you to operate it. The line between the service

provider responsibilities and your responsibilities was flexible. MSPs offered a variety of services (backup and “remote hands” being two popular ones) in addition to simple server rental.

Each of these models has pros and cons. If you bought the equipment, you typically owned it through the full depreciation cycle of three to five years. That might have been the cheapest option, but it was the least flexible. You gained some long-term flexibility when you leased the equipment, but you paid more in trade and you still had all the operations costs. Typically, you wouldn’t lease equipment for less than a 3 month time horizon, and probably at least a year, otherwise the overhead cost of receiving, configuring, and then returning the equipment would be too high. Finally, if you rented the server, you could get something with granular, monthly terms, but you were far more limited in the hardware choices and you couldn’t deploy it in your own data center. The upside was you might be able to have it up and running in as few as 24 hours from the time you placed the order.

These models form a continuum: on one side we have the buy-and-own-everything model; on the other side we have the own-nothing model. In the middle, we have a wide variety of models where some things are owned and others not.



History of Cloud Computing

The idea of an "**intergalactic computer network**" was introduced in the sixties by **J.C.R. Licklider**, who was responsible for enabling the

development of ARPANET (Advanced Research Projects Agency Network) in 1969.

His vision was for everyone on the globe to be interconnected and accessing programs and data at any site, from anywhere, explained Margaret Lewis, product marketing director at AMD. "It is a vision that sounds a lot like what we are calling cloud computing."

Other experts attribute the cloud concept to computer scientist **John McCarthy** who proposed the idea of computation being delivered as a public utility.

Before emerging the cloud computing, there was Client/Server computing which is basically a centralized storage in which all the software applications, all the data and all the controls are resided on the server side.If a single user wants to access specific data or run a program, he/she need to connect to the server and then gain appropriate access, and then he/she can do his/her business.

Then after, distributed computing came into picture, where all the computers are networked together and share their resources when needed.

On the basis of above computing, there was emerged of cloud computing concepts that later implemented.

At around in 1961, John MacCharty suggested in a speech at MIT that computing can be sold like a utility, just like a water or electricity. It was a brilliant idea, but like all brilliant ideas, it was ahead if its time, as for the next few decades, despite interest in the model, the technology simply was not ready for it.

But of course time has passed and the technology caught that idea and after few years we mentioned that:

One of the first milestones in cloud computing history was the arrival of **Salesforce.com** in 1999, **Salesforce.com** *started delivering of applications to users using a simple website*. The applications were delivered to enterprises over the Internet, and this way the dream of computing sold as utility were true.

The next development was Amazon Web Services in 2002, which provided a suite of cloud-based services including storage, computation and even human intelligence through the**Amazon Mechanical Turk** (https://www.mturk.com/mturk/welcome).However, only starting with the launch of the Elastic Compute Cloud in 2006 a truly commercial service open to everybody existed.

In 2009, **Google Apps** *also started to provide cloud computing enterprise applications.*Of course, all the big players are present in the cloud computing evolution, some were earlier, some were later.In 2009, Microsoft launched Windows Azure, and companies like Oracle and HP have all joined the game. This proves that today, cloud computing has become mainstream."The most important contribution to cloud computing has been the emergence of "killer apps" from leading technology giants such as Microsoft and Google. When these companies deliver services in a way that is reliable and easy to consume.

Why Cloud Computing?

Actually, Small as well as some large IT companies follows the traditional methods to provide the IT infrastructure. That means for any IT company, we need a Server Room that is the basic need of IT companies.

In that server room, there should be a *database server*, *mail server*, *networking*, *firewalls*, *routers*, *modem*, *switches*, *QPS* (Query Per Second means how much queries or load will be handled by the server) , configurable system, *high net speed* and the *maintenance engineers*.

To establish such IT infrastructure, we need to spend lots of money. To overcome all these problems and to reduce the IT infrastructure cost, Cloud Computing comes into existence.

Characteristics of Cloud Computing

1. Agility

The cloud works in the **distributed computing environment**. It shares resources among users and works very fast.

2. High availability and reliability

Availability of servers is high and more reliable, because chances of infrastructure failure are minimal.

3. High Scalability

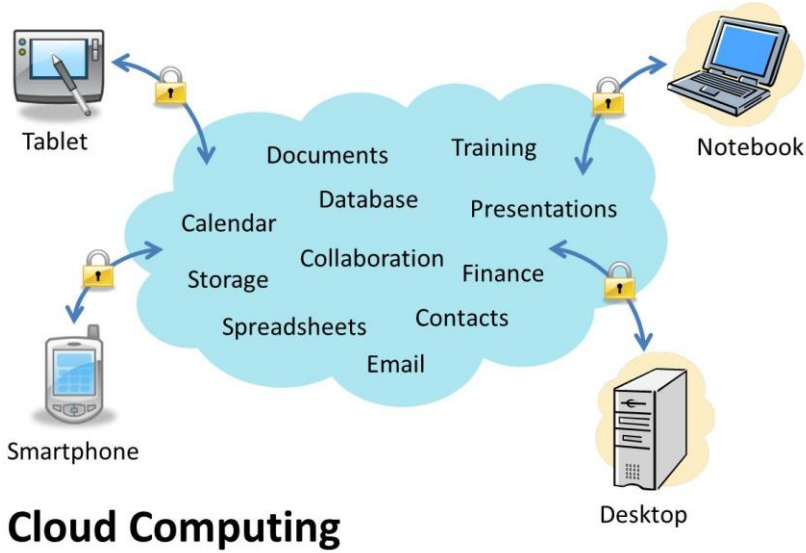
Means **"on-demand"** provisioning of resources on a large scale, without having engineers for peak loads.

4. Multi-Sharing

With the help of cloud computing, **multiple users and applications can work more efficiently** with cost reductions by sharing common infrastructure.

5. Device and Location Independence

Cloud computing enables the users to access systems using a web browser regardless of their location or what device they use e.g. PC, mobile phone etc. As infrastructure is off-site (typically provided by a third-party)and accessed via the Internet, users can connect from anywhere.



6. Maintenance

Maintenance of cloud computing applications is easier, since they do not need to be installed on each user's computer and can be accessed from different places. So, it reduces the cost also.

7. Low Cost

By using cloud computing, the cost will be reduced because to take the services of cloud computing, IT Company need not to set its own infrastructure and pay-as-per usage of resources.Cloud computing does not involve any significant capital expenditure for the organization. Unlike traditional IT infrastructure, in cloud computing organizations just use the computing services without procuring it. In some sense cloud computing involves renting the computing resources instead of buying them. It means unlike traditional computing model, Cloud computing requires no capital expenditure to acquire initial computing resources.

8. Services in pay-per-use mode

Cloud computing uses a "pay-per-use" billing model. Cloud billing model are very different when compared to traditional IT billing techniques. Typical billing models include per user billing, per GB billing or per-use

billing (i.e. an organization is billed on each usage of the computing service).

Before and after Cloud Computing

The significance of cloud computing and what it brings may go unnoticed. Cloud computing and its services are something we use every day, sometimes without notice. Some popular cloud services people use often or daily are, Gmail, YouTube, or Google Docs. Cloud computing and its services bring multiple different components to the people and the internet which are very helpful in today's world. Cloud computing stores your files online, it allows you to get your apps online, also backs up your computer for less, and also get you the latest updates faster. Before cloud computing these things were harder and much more complicated to do. Before cloud computer saving or storing your files was much more complex. To save them you had to first save them on a hard-drive, or personal computer, and to take them with you,and you had to save them to a thumb drive or CD. Now that cloud computing is introduced, you can save them online, and access them not only from your computer, but from anywhere. Before cloud computing, to back up your files you had to buy expensive hardware in order to save them. Now that cloud computing is introduced online backup services (Dropbox, Google Drive, etc...) are now available because of cloud services. Before cloud computing and its services, you had to wait hours with technical people when your applications wasn't working properly. Now that cloud computing is the leading strategic technology service, that isn't an issue anymore. Now cloud apps usually are updated automatically by their provider and also maintained by them as well. As it shown, cloud computing is a very helpful source or tool in today's society. Cloud computing simplifies a lot of daily things we do and use today.

Advantages of Cloud Computing

There are various advantages of cloud computing technology. The important advantages of cloud computing are given below.

1. Lower cost computer for users

In cloud, you don't require a high-powered (and accordingly high-priced) computer to run cloud computing's web based applications because applications run on cloud not on desktop PC or laptop.

2. Lower IT infrastructure cost

By using cloud computing, you need not to invest in larger numbers of more powerful servers, you also need not to require the IT staff for handling such powerful servers.

3. Fewer maintenance cost

The maintenance cost in cloud computing greatly reduces both hardware and software maintenance for organizations of all sizes.

4. Lower Software Cost

It reduces the software cost because you don't need to purchase separate software packages for each computer in the organization.

5. Instant software updates

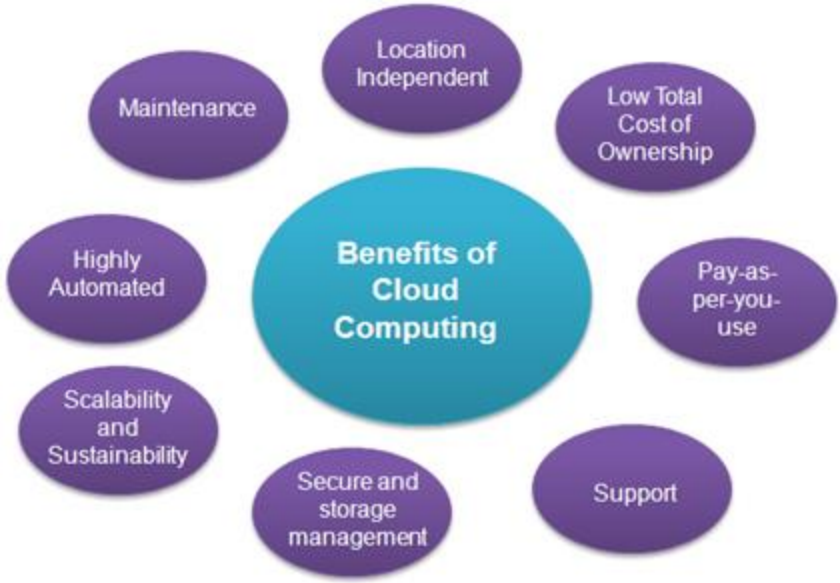
Another software-related advantage in cloud computing is that users don't need to face with the choice between obsolete software and high upgrade costs. If the app is web-based, updates happen automatically and are available next time when the user logs in to the cloud.

6. Increased computing Power

The execution capacity of cloud servers are very high. It processes the application very fast.

7. Unlimited storage capacity

Cloud offers you a huge amount of storage capacity like 2000 GB or more than that if required.



Disadvantages of Cloud Computing

As made clear from the above, cloud computing is a tool that offers enormous benefits to its adopters. However, being a tool, it also comes with its set of problems and inefficiencies. Let's address the most significant ones.

1. Security and privacy in the Cloud

Security is the biggest concern when it comes to cloud computing. By leveraging a remote cloud based infrastructure, a company essentially gives away private data and information, things that might be sensitive and confidential. It is then up to the cloud service provider to manage, protect and retain them, thus the provider's reliability and trust is very critical. Similarly, privacy in the cloud is another huge issue. Companies and users have to trust their cloud service vendors that they will protect their data from unauthorized users.

2. Dependency and vendor lock-in

One of the major disadvantages of cloud computing is the implicit dependency on the provider. This is what the industry calls "vendor lock-in" since it is difficult, and sometimes impossible, to migrate from a

provider once you have rolled with him. If a user wishes to switch to some other provider, then it can be really painful and cumbersome to transfer huge data from the old provider to the new one. This is another reason why you should carefully and thoroughly ponder all options when picking a vendor.

3. Technical Difficulties and Downtime

Certainly the smaller business will enjoy not having to deal with the daily technical issues and will prefer handing those to an established IT company, however you should keep in mind that all systems might face dysfunctions from time to time. Outage and downtime is possible even to the best cloud service providers.Additionally, you should remember that the whole setup is dependent on internet access, thus any network or connectivity problems will render the setup useless.

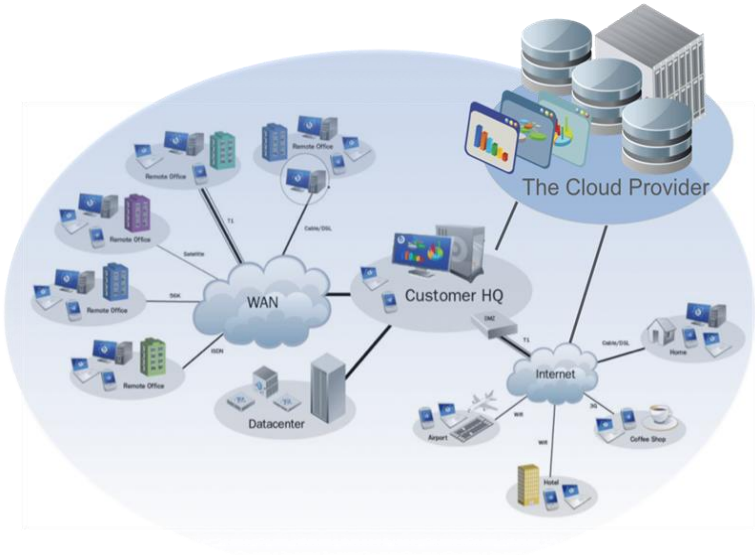
4. Increased Vulnerability

Related to the security and privacy mentioned before, note that cloud based solutions are exposed on the public internet and are thus a more vulnerable target for malicious users and hackers. Nothing on the Internet is completely secure and even the biggest players suffer from serious attacks and security breaches. Due to the interdependency of the system, if there is a compromise one of the machines that data is stored, there might be a leakage of personal information to the world.

5. Require a constant and high speed Internet Connection

Cloud computing is impossible without Internet connection. To access any applications and documents you need a constant Internet connection.Similarly, a low-speed Internet connection makes cloud computing painful at best and often impossible. Web based apps often require a lot of bandwidth to download, as need to download large documents.

Short Light on How Cloud Computing Works



Let's say you're an executive at a large corporation. Your particular responsibilities include making sure that all of youremployees have the right hardware and software they need to do their jobs. Buying computers for everyone isn't enough – you also have to purchase software or software licenses to give employees the tools they require. Whenever you have a new hire, you have to buy more software or make sure your current software license allows another user. It's so stressful that you find it difficult to go to sleep on your huge pile of money every night.

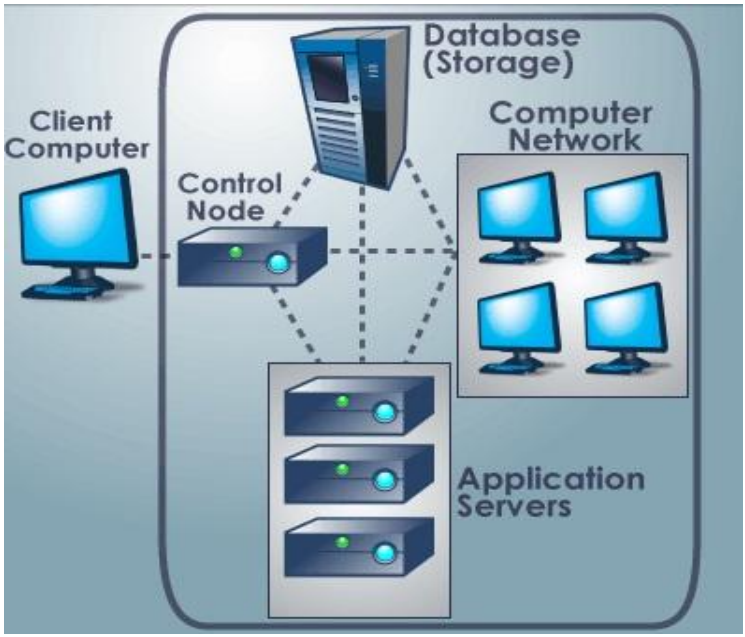
Soon, there may be an alternative for executives like you. Instead of installing a suite of software for each computer, you'd only have to load one application. That application would allow workers to log into aWeb-based service which hosts all the programsthe user would need for his or her job. Remote machines owned by another company would run everything from e-mail to wordprocessing to complex data analysis programs. It's called cloud computing, and it could change the entire computer industry.

In a cloud computing system, there's a significant workload shift. Local computers no longer have to do all the heavy lifting when it comes to running applications. The network of computers that make up the cloud handles them instead. Hardware and softwaredemands on the user's

side decrease. The only thing the user's computer needs to be able to run is the cloud computingsystem's interface software, which can be as simple as a Web browser, and the cloud's network takes care of the rest.

There's a good chance you've already used some form of cloud computing. If you have an e-mail account with a Web-based e-mail service like Hotmail, Yahoo! Mail or Gmail, then you've had some experience with cloud computing. Instead of running ane-mail program on your computer, you log in to a Web e-mail account remotely. The software and storage for your accountdoesn't exist on your computer -- it's on the service's computer cloud.

Cloud Computing Architecture



When talking about a cloud computing system, it's helpful to divide it into two sections: the **front end** and the **back end**. They connect to each other through a network, usually the Internet. The front end is the side the computer user, or client. The back end is the "cloud" section of the system.

The front end includes the client's computer (or computer network) and the application required to access the cloud computing system. Not all cloud computing systems have the same user interface. Services like Web-based e-mail programs leverage existing Web browsers like chrome or Firefox. Other systems have unique applications that provide network access to clients.

On the back end of the system are the various computers, servers and data storage systems that create the "cloud" of computing services. In theory, a cloud computing system could include practically any computer program you can imagine, from data processing to video games. Usually, each application will have its own dedicated server.

A central server administers the system, monitoring traffic and client demands to ensure everything runs smoothly. It follows a set of rules called **protocols** and uses a special kind of software called **middleware**. Middleware allows networked computers to communicate with each other. Most of the time, servers don't run at full capacity. That means there's unused processing power going to waste. It's possible to fool a physical server into thinking it's actually multiple servers, each running with its own independent operating system. The technique is called server virtualization (discussed later in detail). By maximizing the output of individual servers, server virtualization reduces the need for more physical machines.

If a cloud computing, company has a lot of clients, there's likely to be a high demand for a lot of storage space. Some companies require hundreds of digital storage devices. Cloud computing systems need at least twice the number of storage devices it requires to keep all its clients' information stored. That's because these devices, like all computers, occasionally break down. A cloud computing system must make a copy of all its clients' information and store it on other devices. The copies enable the central server to access backup machines to retrieve data that otherwise would be unreachable. Making copies of data as a backup is called **redundancy**.

Cloud Computing Applications

The applications of cloud computing are practically limitless. With the right middleware, a cloud computing system could execute all the programs a normal computer could run. Potentially, everything from generic word processing software to customized computer programs designed for a specific company could work on a cloud computing system.

Why would anyone want to rely on another computer system to run programs and store data? Here are just a few reasons:

Clients would be able to access their applications and data from anywhere at any time. They could access the cloud computing system using any computer linked to the Internet. Data wouldn't be confined to a hard drive on one user's computer or even a corporation's internal network.

It could bring hardware costs down. Cloud computing systems would reduce the need for advanced hardware on the client side. You wouldn't need to buy the fastest computer with the most memory, because the cloud system would take care of those needs for you. Instead, you could buy an inexpensive computer terminal. The terminal could include a monitor, input devices like a keyboard and mouse and just enough processing power to run the middleware necessary to connect to the cloud system. You wouldn't need a large hard drive because you'd store all your information on a remote computer.

Corporations that rely on computers have to make sure they have the right software in place to achieve goals. Cloud computing systems give these organizations company-wide access to computer applications. The companies don't have to buy a set of software or software licenses for every employee. Instead, the company could pay a metered fee to a cloud computing company.

Servers and digital storage devices take up space. Some companies rent physical space to store servers and databases because they don't have it available on site. Cloud computing gives these companies the option of storing data on someone else's hardware, removing the need for physical space on the front end.

Corporations might save money on IT support. Streamlined hardware would, in theory, have fewer problems than a network of **heterogeneous** machines and operating systems.

If the cloud computing system's back end is a grid computing system, then the client could take advantage of the entire network's processing power. Often, scientists and researchers work with calculations so complex that it would take years for individual computers to complete them. On a grid computing system, the client could send the calculation to the cloud for processing. The cloud system would tap into the processing power of all available computers on the back end, significantly speeding up the calculation.

Cloud Computing has its applications in almost all the fields such as business, entertainment, data storage, social networking, management, entertainment, education, art and global positioning system, etc. Some of the widely famous cloud computing applications are discussed here in this tutorial:

Business Applications

Cloud computing has made businesses more collaborative and easy by incorporating various apps such as **MailChimp, Chatter, Google Apps for business**, and **Quickbooks**.

SN	Application Description
1	**MailChimp** It offers an e-*mail publishing platform*. It is widely employed by the businesses to design and send their e-mail campaigns.
2	**Chatter** *Chatter* app helps the employee to share important information about organization in real time. One can get the instant feed regarding any issue.
3	**Google Apps for Business** Google offers *creating text documents, spreadsheets, presentations, etc*., on *Google Docs*which allows the business users to share them in collaborating manner.

4	**Quickbooks** It offers online accounting solutions for a business. It helps in monitoring cash flow, creating VAT returns and creating business reports.

Data Storage and Backup

Box.com, Mozy, Joukuu are the applications offering data storage and backup services in cloud.

SN	Application Description
1	**Box.com** *Box.com* offers drag and drop service for files. It just required to drop the files into Box and access from anywhere.
2	**Mozy** *Mozy* offers online backup service for files during a data loss.
3	**Joukuu** *Joukuu* is a web-based interface. It allows to display a single list of contents for files stored in*Google Docs, Box.net and Dropbox.*

Management Applications

There are apps available for management task such as *time tracking, organizing notes.* Applications performing such tasks are discussed below:

SN	Application Description
1	**Toggl** It helps in tracking time period assigned to a particular project.
2	**Evernote** *Evernote* is an application that organizes the sticky notes and even can read the text from images which helps the user to locate the notes easily.
3	**Outright** It is an accounting app. It helps to *track income, expenses, profits and losses* in real time.

Social Applications

There are several social networking services providing websites such as Facebook, Twitter, etc.

SN	Application Description
1	**Facebook** *Facebook* offers social networking service. One can share photos, videos, files, status and much more.
2	**Twitter** *Twitter* helps to interact directly with the public. One can follow any celebrity, organization and any person, who is on twitter and can have latest updates regarding the same.

Entertainment Applications

SN	Application Description
1	**Audiobox.fm** It offers streaming service, i.e., music can be stored online and can be played from cloud using service's own media player.

Art Applications

SN	Application Description
1	**Moo** It offers art services such as designing and printing *business cards, postcards and minicards.*

Cloud Computing Providers

Various Cloud Computing platforms are available today. The following table contains the popular Cloud Computing platforms:

SN	Platform's Description

1	**Salesforce.com** This is a *Force*.com development platform. This provide a simple user interface and lets users log in, build an app and push it in the cloud.
2	**Appistry** The *Appistry's*CloudQ platform is efficient in delivering a runtime application platform. This platform is very useful to create scalable and service oriented applications.
3	**AppScale** The *AppScale* is an open source platform for Google App Engine applications.
4	**AT&T** The *AT*&T allows access to virtual servers and manages the virtualization infrastructure. This virtualization infrastructure includes network, server and storage.
5	**Engine Yard** The *EngineYard* is a *Rails Application* cloud computing platform.
6	**Enomaly** *Enomaly* provides the Infrastructure-as-a-Service platform.
7	**FlexiScale** The *FlexiScale* offers a cloud computing platform that allows flexible, scalable and automated cloud infrastructure.
8	**GCloud3** The *GCloud3* offers private cloud solution in its gPlatform.
9	**Gizmox** The *Gizmox* Visual *WebGUI* platform is best suited for developing new web apps and modernize the legacy apps based on ASP.net, DHTML, etc.
10	**GoGrid** The *GoGrid* platform allows the users to deploy web and database cloud services.
11	**Google** The *Google'sAppEngine* lets the users build, run and maintain their applications on Google's infrastructure.

12	**LongJump** The *LongJump* offers a Business Application Platform, a platform-as-a-Service (PaaS).
13	**Microsoft** The *Microsoft's Windows Azure* is a cloud computing platform offering an environment to create cloud apps and services.
14	**OrangeScape** *OrangeScape* offers a *Platform-as-a-Service (Paas)* for non-programmers. Building an app is as easy as spreadsheet.
15	**RackSpace** The RackSpace provide servers-on-demand via a cloud-driven platform of virtualized servers.
16	**Amazon EC2** The *Amazon EC2 (Elastic Compute Cloud*) lets the users configure and control computing resources while running them on Amazon's environment.

Summary

Cloud Computing makes computer infrastructure and services available "on-need" basis. The computing infrastructure could include hard disk, development platform, database, computing power or complete software applications. To access these resources from the cloud vendors (cloud computing service providers), organizations (user of cloud computing services) do not need to make any large scale capital expenditures. Organization need to "pay per use" i.e. organization need to pay only as much for the computing infrastructure as they use. The billing model of cloud computing is similar to the electricity payment that we do on the basis of usage.

Chapter 2

Cloud Types

To discuss cloud computing intelligently, you need to define the lexicon (vocabulary) of cloud computing. Most people separate cloud computing into two distinct sets of models:

Deployment models: This refers to the location and management of the cloud'sinfrastructure.

Service models: This consists of the particular types of services that you can access on acloud computing platform.

Deployment models

A deployment model defines the purpose of the cloud and the nature of how the cloud is located. The NIST definition for the four deployment models is as follows:

Public cloud: The public cloud infrastructure is available for public use alternatively for a large industry group and is owned by an organization selling cloud services.

Private cloud: The private cloud infrastructure is operated for the exclusive use of an organization. The cloud may be managed by that organization or a third party. Private clouds may be either on- or off-premises.

Hybrid cloud: A hybrid cloud combines multiple clouds (private, community of public) where those clouds retain their unique identities, but are bound together as a unit. A hybrid cloud may offer standardized or proprietary access to data and applications, as well as application portability.

Community cloud: A community cloud is one where the cloud has been organized to serve a common function or purpose.

It may be for one organization or for several organizations, but they share common concerns such as their mission, policies, security, regulatory compliance needs, and so on. A community cloud may be managed by the constituent organization(s) or by a third party.

Public Cloud

Public clouds are made available to the general public by a service provider who hosts the cloud infrastructure. Generally, public cloud providers like Amazon AWS, Microsoft and Google own and operate the infrastructure and offer access over the Internet. With this model, customers have no visibility or control over where the infrastructure is located. It is important to note that all customers on public clouds share the same infrastructure pool with limited configuration, security protections and availability variances.

Advantages of Public Cloud Model

Low Cost

Public cloud is having low cost as compared to private or hybrid cloud, because it shares same resources with large number of consumer.

Reliable

Public cloud provides large number of resources from different locations, if any of the resource fail, public cloud can employ another one.

Flexible

It is very easy to integrate public cloud with private cloud and hence it gives flexible approach to consumers.

Location Independent

It ensures the independency of location, because public cloud services are delivered through Internet.

High Scalability

Cloud resources are available as per the demand from the pool of resources that means they can be scaled up or down according to the requirement.

Disadvantages of Public Cloud Model

Low security

In public cloud model, data is present off-site and resources are shared publicly. Hence it does not ensure the high level security.

Less customizable

It is less customizable than private cloud.

A public cloud is the obvious choice when:

- Your standardized workload for applications is used by lots of people, such as e-mail.
- You need to test and develop application code.
- You need incremental capacity (the ability to add compute resources for peak times).
- You're doing collaboration projects.

Private Cloud

Private cloud is cloud infrastructure dedicated to a particular organization. Private clouds allow businesses to host applications in the cloud, while addressing concerns regarding data security and control, which is often lacking in a public cloud environment. It is not shared with other organizations, whether managed internally or by a third-party, and it can be hosted internally or externally.

There are two variations of private clouds:

On-Premise Private Cloud: This type of cloud is hosted within an organizations own facility. On-Premise Private Clouds are best used for applications that require complete control and configurability of the infrastructure and security.

Externally Hosted Private Cloud: Externally hosted private clouds are also exclusively used by one organization, but are hosted by a third party specializing in cloud infrastructure. The service provider facilitates an exclusive cloud environment with full guarantee of privacy. This format is recommended for organizations that prefer not to use a public cloud infrastructure due to the risks associated with the sharing of physical resources.

Private clouds are more expensive but also more secure when compared to public clouds. An Info-Tech survey shows that 76% of IT decision-makers will focus exclusively on the private cloud, as these clouds offer the greatest level of security and control.

When is a Private Cloud for you?

- You need data sovereignty but want cloud efficiencies
- You want consistency across services
- You have more server capacity than your organization can use
- Your data center must become more efficient
- You want to provide private cloud services

Advantages of Private Cloud Model

1. High security and privacy

Private cloud resources are shared from distinct pool of resources and hence highly secured.

2. More Control

Private clouds have more control on its resources and hardware than public cloud because it is accessed only within the boundary of an organization.

Disadvantages of Private Cloud Model

1. Restriction

Private cloud is only accessible locally and it is very difficult to deploy globally.

2. More Cost

Cloud is having more cost than public clouds.

3. Inflexible price

In order to fulfill demands, purchasing new hardware is very costly.

4. Less Scalability

Private clouds are scaled only within capacity of internal hosted resources.

Hybrid Cloud

Hybrid Clouds are a composition of two or more clouds (private, community or public) that remain unique entities but are bound together offering the advantages of multiple deployment models. In a hybrid cloud, you can leverage third party cloud providers in either a full or partial manner; increasing the flexibility of computing. Augmenting a traditional private cloud with the resources of a public cloud can be used to manage any unexpected surges in workload.

Here are a couple of situations where a hybrid environment is best:

- Your company wants to use a SaaS application but is concerned about security.
- Your company offers services that are tailored for different vertical markets. You can use a public cloud to interact with the clients but keep their data secured within a private cloud.
- You can provide public cloud to your customers while using a private cloud for internal IT.

Advantages of Hybrid Cloud Model

1. Scalable

It provides both the features of public and private cloud scalability.

2. Flexible and secure

It provides secure resources because of private cloud and scalable resources because of public cloud.

3. Cost effective

It is having less cost as compared to private cloud.

Disadvantages of Hybrid Cloud Model

1. Networking issues

Networking becomes complex because of private and public cloud.

2. Security Compliance

It is necessary to ensure that cloud services are compliant with the security policies of an organization.

Community Cloud

A community cloud is a is a multi-tenant cloud service model that is shared among several or organizations and that is governed, managed and secured commonly by all the participating organizations or a third party managed service provider.

The goal of community clouds is to have participating organizations realize the benefits of a public cloud with the added level of privacy, security, and policy compliance usually associated with a private cloud. Community clouds can be either on-premise or off-premise.

Cloud computing is about shared IT infrastructure or the outsourcing of a company's technology. It is essential to examine your current IT infrastructure, usage and needs to determine which type of cloud computing can help you best achieve your goals. Simply, the cloud is not one concrete term, but rather a metaphor for a global network and how to best utilize its advantages depends on your individual cloud focus.

Service models

In the deployment model, different cloud types are an expression of the manner in which infra-structure is deployed. You can think of the cloud as the boundary between where a client's net-work, management, and responsibilities ends and the cloud service provider's begins. As cloud computing has developed, different vendors offer clouds that have different services associated with them. The portfolio of services offered adds another set of definitions called the service model

Service delivery in Cloud Computing comprises three different service models, namely **Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), and Software-as-a-Service (SaaS).**

You can broadly partition cloud computing into four layers that form a cloud computing ecosystem:

The Application layer forms the basis for Software as a Service (SaaS), while the Platform layer forms the basis for Platform as a Service (PaaS) models that are described in the next two sections. Infrastructure as a Service (IaaS) creates what may be determined to be a utility computing model, something that you can tap into and draw from as you need it without significant limits on the scalability of your deployment. You pay only for what you need when you need it.

Infrastructure as a Service |IaaS

IaaS provides virtual machines, virtual storage, virtual infra-structure, and other hardware assets as resources that clients can provision. The IaaS service provider manages all the infrastructure, while the client is responsible for all other aspects of the deployment. This can include the operating system, applications, and user interactions with the system. IaaS, **earlier called Hardware as a Service** (HaaS), is a cloud computing platform based model.

In traditional hosting services, IT infrastructure was rented out for a specific periods of time, with pre-determined hardware configuration. The client paid for the configuration and time, regardless of the actual use. With the help of IaaS cloud computing platform layer, clients can

dynamically scale the configuration to meet changing requires, and are billed only for the services actually used. IaaS cloud computing platform layer eliminates the need for every organization to maintain the IT infrastructure.

IaaS is offered in three models: public, private, and hybrid cloud. Private cloud implies that the infrastructure resides at the customer-premise. In case of public cloud, it is located at the cloud computing platform vendor's data center; and hybrid cloud is a combination of two with customer choosing the best of both worlds.

Advantages of IaaS cloud computing layer

- You can dynamically choose a CPU, memory and storage configuration as per your needs.
- You easily access the vast computing power available on IaaS cloud platform.
- You can eliminate the need of investment in rarely used IT hardware.
- IT infra will be handled by the IaaS cloud computing platform vendors.

Disadvantages of IaaS cloud computing layer

- There is a risk of IaaS cloud computing platform vendor by gaining the access to the organization’s data. But it can be avoided by opting for private cloud.
- IaaS cloud computing platform model is dependent on internet availability.
- It is also dependent on the availability of virtualization services.
- IaaS cloud computing platform can limit the user privacy and customization options.

Top vendors who are providing IaaS cloud computing platform

Amazon Web Services: The cloud computing platform pioneer, Amazon offers auto scaling, cloud monitoring, and load balancing features as part of its portfolio (Discussed later in detail).

Rackspace: The cloud computing platform vendor focuses primarily on enterprise-level hosting services.

Netmagic Solutions: (Netmagic IaaS Cloud)Netmagic runs from data centers in Mumbai, Chennai, and Bangalore, and a virtual data center in the United States. Plans are underway to extend services to West Asia.

Reliance Communications: (Reliance Internet Data Center)RIDC supports both traditional hosting and cloud services, with data centers in Mumbai, Bangalore, Hyderabad, and Chennai. The cloud services offered by RIDC include IaaS and SaaS.

Tata Communications: (InstaCompute)InstaCompute is Tata Communications' IaaS offering. InstaCompute data centers are located in Hyderabad and Singapore, with operations in both countries

Platform as a Service | PaaS

PaaS cloud computing platform is a developer programming platform which is created for the programmer to develop, test, run and manage the applications. Platforms can be based on specific types of development languages, application frameworks, or other constructs. A PaaS offering provides the tools and development environment to deploy applications on another vendor's application. Often a PaaS tool is a fully integrated development environment; that is, all the tools and services are part of the PaaS service. To be useful as a cloud computing offering, PaaS systems must offer a way to create user interfaces, and thus support standards such as HTLM, JavaScript, or other rich media technologies.

In a PaaS model, customers may interact with the software to enter and retrieve data, perform actions, get results, and to the degree that the vendor allows it, customize the platform involved. The customer takes no responsibility for maintaining the hardware, the software, or the development of the applications and is responsible only for his

interaction with the platform. The vendor is responsible for all the operational aspects of the service, for maintenance, and for managing the product(s) lifecycle.

The one example that is most quoted as a PaaS offering is Google's App Engine platform, which is described later in more detail. Developers program against the App Engine using Google's published APIs. The tools for working within the development framework, as well as the structure of the file system and data stores, are defined by Google. Another example of a PaaS offering is Force.com, Salesforce.com's developer platform for its SaaS offerings, described in the next section.

Force.com is an example of an add-on development environment. A developer might write an application in a programming language like Python using the Google API. The vendor of the PaaS solution is in most cases the developer, who is offering a complete solution to the customer. Google itself also serves as a PaaS vendor within this system, because it offers many of its Web service applications to customers as part of this service model. You can think of Google Maps, Google Earth, Gmail, and the myriad of other PaaS offerings as conforming to the PaaS service model, although these applications themselves are offered to customers under what is more aptly described as the Software as a Service (SaaS) model that is described below. The difficulty with PaaS is that it locks the developer (and the customer) into a solution that is dependent upon the platform vendor. An application written in Python against Google's API using the Google App Engine is likely to work only in that environment. There is considerable vendor lock-in associated with a PaaS solution.

Advantages of PaaS cloud computing layer

1.Simplified Development

Developers can focus on development and innovation without worrying about the infrastructure.

2.Lower risk

No requirements of up-front investment in hardware and software. Developers only need a PC and an internet connection to start building applications.

3.Prebuilt business functionality

Some PaaS vendors also provide already defined business functionality so that users can avoid building everything from very scratch and hence can directly start the projects only.

4.Instant community

PaaS vendors frequently provides online communities where developer can get the ideas, share experiences and seek advice from others.

5.Scalability

Applications deployed can scale from one to thousands of users without any changes to the applications.

Disadvantages of PaaS cloud computing layer

1. Vendor lock-in

One have to write the applications according to the platform provided by PaaS vendor so migration of an application to another PaaS vendor would be a problem.

2. Data Privacy

Corporate data, whether it can be critical or not, will be private so if it is not located within the walls of the company there can be a risk in terms of privacy of data.

3. Integration with the rest of the systems applications

It may happen that some applications are local and some are in cloud. So there will be chances of increased complexity when we want to use data which in the cloud with the local data.

Top vendors who are providing PaaS cloud computing platform

- Google Apps Engine (GAE)
- SalesFroce.com
- Windows Azure

Software as service | SaaS

The most complete cloud computing service model is one in which the computing hardware and software, as well as the solution itself, are provided by a vendor as a complete service offering. It is referred to as the Software as a Service (SaaS) model.

SaaS is a software distribution model in which applications are hosted by a cloud service provider and made available to customers over internet. SaaS is also known as **"On-Demand Software"**.

In SaaS, software and associated data are centrally hosted on the cloud server. SaaS is accessed by users using a thin client via a web browser.

Advantages of SaaS cloud computing layer

SaaS is easy to buy

SaaS pricing is based on a monthly fee or annual fee, SaaS allows organizations to access business functionality at a low cost which is less than licensed applications.

Unlike traditional software which is sold as a licensed based with an up-front cost (and often an optional ongoing support fee), SaaS providers generally pricing the applications using a subscription fee, most commonly a monthly or annually fee.

Less hardware required for SaaS

The software is hosted remotely, so organizations don't need to invest in additional hardware.

Low Maintenance required for SaaS

Software as a service removes the necessity of installation, set-up, and often daily upkeep and maintenance for organizations. Initial set-up cost for SaaS is typically less than the enterprise software. SaaS vendors

actually pricing their applications based on some usage parameters, such as number of users using the application. So SaaS does easy to monitor and automatic updates.

No special software or hardware versions required

All users will have the same version of software and typically access it through the web browser. SaaS reduces IT support costs by outsourcing hardware and software maintenance and support to the IaaS provider.

Software as a Service (SaaS) may be succinctly described as software that is deployed on a hosted service and can be accessed globally over the Internet, most often in a browser. With the exception of the user interaction with the software, all other aspects of the service are abstracted away. Every computer user is familiar with SaaS systems, which are either replacements or substitutes for locally installed software. Examples of SaaS software for end-users are Google Gmail and Calendar, QuickBooks online, Zoho Office Suite, and others that are equally well known. SaaS applications come in all shapes and sizes, and include custom software such as billing and invoicing systems,Customer Relationship Management (CRM) applications, Help Desk applications, Human Resource (HR) solutions, as well as infinite online versions of familiar applications.

Salesforce.com and CRM SaaS: Perhaps the best-known example of Software as a Service (SaaS) is the Customer Relationship Management (CRM) software offered by Salesforce.com whose solution offers sales, service, support, marketing, content, analytical analysis, and even collaboration through a platform called Chatter. Salesforce.com was founded in 1999 by a group of Oracle executives and early adopters of many of the technologies that are becoming cloud computing staples Salesforce.com extended its SaaS offering to allow developers to create add-on applications, essentially turning the SaaS service into a Platform as a Service (PaaS) offering called the Force.com Platform. Applications built on Force.com are in the form of the Java variant called Apex using an XML syntax for creating user interfaces in HTML, Ajax, and Flex. Salesforce.com is the largest SaaS provider of CRM software and a pioneer in this type of cloud computing software.

Identity as a service | Idaas

Let's understand this scenario, Employees in a company require to login into system to perform various tasks. These systems may be based on local server or cloud based. Following are the problems that an employee might face:

Remembering different username and password combinations for accessing multiple servers.

If an employee leaves the company, it's required to ensure that each of the user's account has been disabled. This increases workload on IT staff.

To solve above problems, a new technique emerged which is known as **Identity as a Service (IDaaS)**. IDaaS offers management of identity (information) as a digital entity. This identity can be used during electronic transactions.

Identity refers to set of attributes associated with something and make it recognizable. All objects may have same attributes, but their identity cannot be the same. This unique identity is assigned through unique identification attribute.

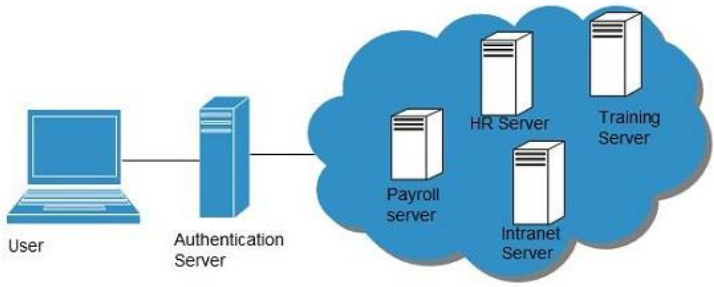
There are several identity services that have been deployed to validate services such as validating web sites, transactions, transaction participants, client, etc. Identity as a Service may include the following:

- Registration
- Authentication Services
- Risk and Event monitoring
- Single sign-on services
- Identity and Profile management

Single Sign-On (SSO)

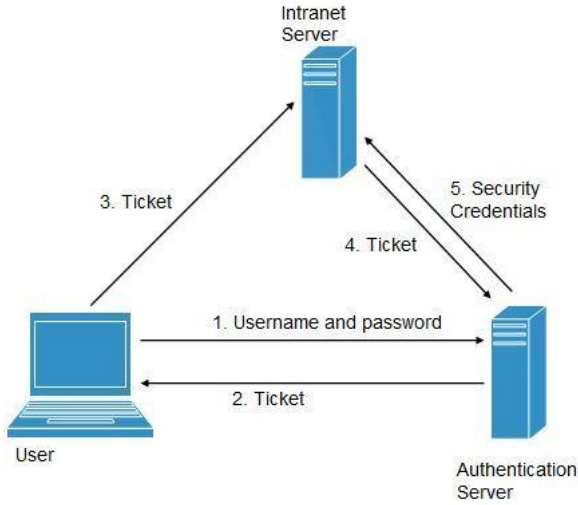
To solve the problem of using different username & password combination for different servers, companies now employ Single Sign-On software, which allows the user to login only one time and manages the user's access to other systems.

SSO has single authentication server, managing multiple accesses to other systems, as shown in the following diagram:



SSO WORKING

There are several implementations of SSO. Here, we will discuss the common working of SSO:



Following steps explain the working of Single Sign-On software:

- User logs into the authentication server using a username and password.
- The authentication server returns the user's ticket.
- User sends the ticket to intranet server.
- Intranet server sends the ticket to the authentication server.

- Authentication server sends the user's security credentials for that server back to the intranet server.
- If an employee leaves the company, then it just required to disable the user at the authentication server, which in turn disables the user's access to all the systems.

OpenID

It offers users to login into multiple websites with single account. Google, Yahoo!, Flickr, MySpace, WordPress.com are some of the companies that support OpenID.

Benefits

- Increased site conversation rates.
- Access to greater user profile content.
- Fewer problems with lost passwords.
- Ease of content integration into social networking sites.

Chapter 3

Virtualization

Virtualization is a technique, which allows to share single physical instance of an application or resource among multiple organizations or tenants (customers). It does so by **assigning a logical name**to a physical resource and providing a **pointer to that physical resource** when demanded.

In other word,**Virtualization** is the "creation of a virtual (rather than actual) version of something, such as a server, a desktop, a storage device, an operating system or network resources".

Concept behind the Virtualization?

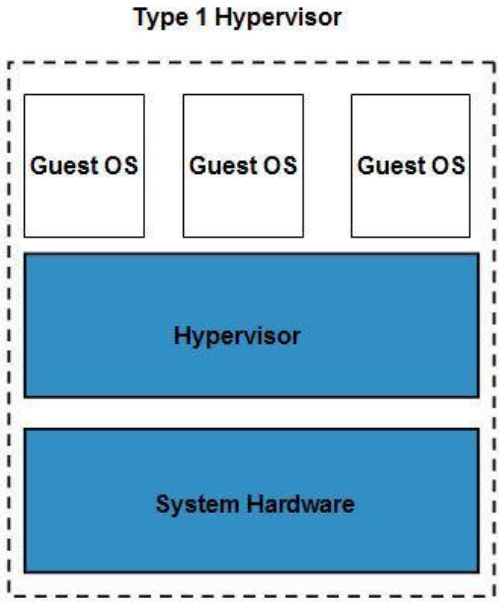
Creation of a virtual machine over existing operating system and hardware is known as Hardware Virtualization. A Virtual machine provides an environment that is logically separated from the underlying hardware.

The machine on which the virtual machine is created is known as **host machine** and **virtual machine**is referred as a **guest machine**. This virtual machine is managed by a software or firmware, which is known as **hypervisor**.

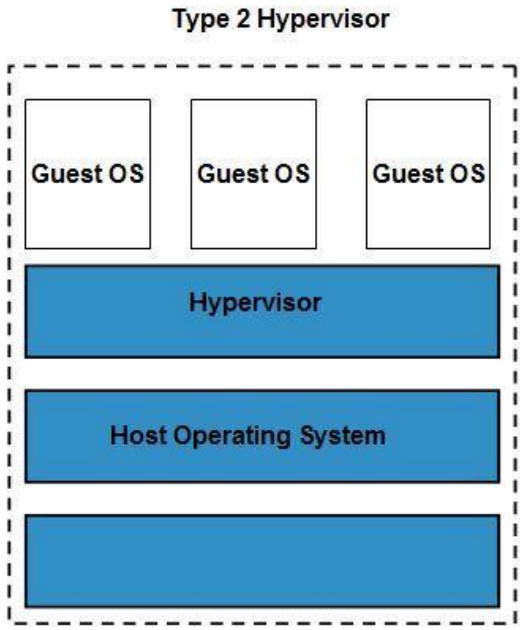
HYPERVISOR

Hypervisor is a firmware or low-level program that acts as a Virtual Machine Manager. There are two types of hypervisor:

Type 1 hypervisor runs on bare system. **LynxSecure, RTS Hypervisor, Oracle VM, Sun xVM Server, VirtualLogic VLX** are examples of Type 1 hypervisor. The following diagram shows the Type 1 hypervisor.



Type 2 hypervisor is a software interface that emulates the devices with which a system normally interacts. **Containers, KVM, Microsoft Hyper V, VMWare Fusion, Virtual Server 2005 R2, Windows Virtual PC** and **VMWare workstation 6.0** are examples of Type 2 hypervisor. The following diagram shows the Type 2 hypervisor.



Types of Virtualization:

- Hardware Virtualization.
- Software virtualization
- Operating system Virtualization.
- Server Virtualization.
- Storage Virtualization.

Hardware Virtualization:

Virtualization means abstraction. Hardware virtualization is accomplished by abstracting the physical hardware layer by use of a hypervisor or VMM (Virtual Machine Monitor).

Previously, there was "one to one relationship" between physical servers and operating system. Low capacity of CPU, memory, and networking requirements were available. So, by using this model, the costs of doing business increased. The physical space, amount of power, and hardware required meant that costs were adding up.

The hypervisor manages shared the physical resources of the hardware between the guest operating systems and host operating system. The physical resources become abstracted versions in standard formats regardless of the hardware platform. The abstracted hardware is represented as actual hardware. Then the virtualized operating system looks into these resources as they are physical entities.

When the virtual machine software or virtual machine manager (VMM) is directly installed on the hardware system is known as hardware virtualization.The main job of hypervisor is to control and monitoring the processor, memory and other hardware resources.After virtualization of hardware system we can install different operating system on it and run different applications on those OS.

Usage:

Hardware virtualization is mainly done for the server platforms, because controlling virtual machines is much easier than controlling a physical server.

Advantages of Hardware Virtualization

The main benefits of hardware virtualization are more efficient resource utilization, lower overall costs as well as increased uptime and IT flexibility.

1. More Efficient Resource Utilization:

Physical resources can be shared among virtual machines. Although the unused resources can be allocated to a virtual machine and that can be used by other virtual machines if the need exists.

2. Lower Overall Costs Because Of Server Consolidation:

Now it is possible for multiple operating systems can co-exist on a single hardware platform, so that the number of servers, rack space, and power consumption drops significantly.

3. Increased Uptime Because Of Advanced Hardware Virtualization Features:

The modern hypervisors provide highly orchestrated operations that maximize the abstraction of the hardware and help to ensure the maximum uptime. These functions help to migrate a running virtual machine from one host to another dynamically, as well as maintain a running copy of virtual machine on another physical host in case the primary host fails.

4. Increased IT Flexibility:

Hardware virtualization helps for quick deployment of server resources in a managed and consistent ways. That results in IT being able to adapt quickly and provide the business with resources needed in good time.

Software Virtualization

Managing applications and distribution becomes a typical task for IT departments. Installation mechanism differs from application to application. Some programs require certain helper applications or frameworks and these applications may have conflict with existing applications.

Software virtualization is just like a virtualization but *able to abstract the software installation procedure and create virtual software installations*. **Virtualized software** is an application that will be "installed" into its own self-contained unit.

Example of software virtualization is ***VMware*** *software,* ***virtual*** *box* etc. In the next pages, we are going to see how to install linux OS and windows OS on VMware application.

Advantages of Software Virtualization

1. Client Deployments Become Easier:

Copying a file to a workstation or linking a file in a network then we can easily install virtual software.

2. Easy to manage:

To manage updates becomes a simpler task. You need to update at one place and deploy the updated virtual application to the all clients.

3. Software Migration:

Without software virtualization, moving from one software platform to another platform takes much time for deploying and impact on end user systems. With the help of virtualized software environment the migration becomes easier.

Operating System Virtualization:

When the virtual machine software or virtual machine manager (VMM) is installed on the Host operating systeminstead of directly on the hardware system is known as operating system virtualization.

With the help of OS virtualization nothing is pre-installed or permanently loaded on the local device and no-hard disk is needed. Everything runs from the network using a kind of virtual disk. This virtual disk is actually a disk image file stored on a remote server, SAN (Storage Area Network) or NAS (Non-volatile Attached Storage). The client will be connected by the network to this virtual disk and will boot with the Operating System installed on the virtual disk.

How does OS Virtualization works?

Components needed for using OS Virtualization in the infrastructure are given below:

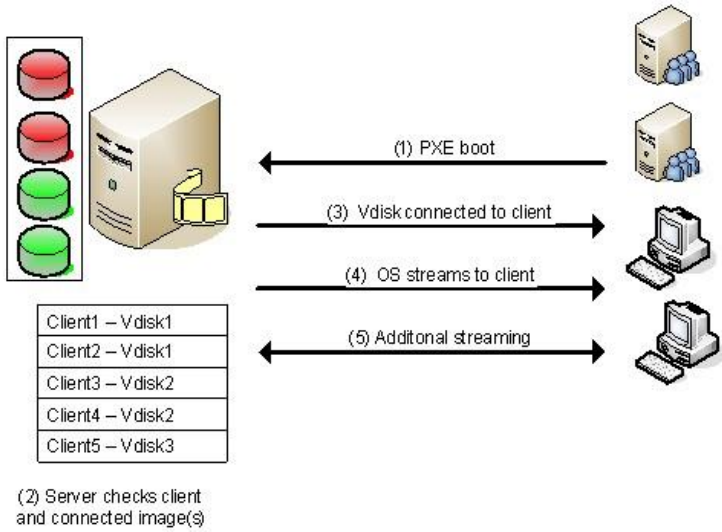
The first component is the OS Virtualization server. This server is the center point in the OS Virtualization infrastructure. The server manages the streaming of the information on the virtual disks for the client and also determines which client will be connected to which virtual disk (using a database, this information is stored). Also the server can host the storage for the virtual disk locally or the server is connected to the virtual disks via a SAN (Storage Area Network). In high availability environments there can be more OS Virtualization servers to create no

redundancy and load balancing. The server also ensures that the client will be unique within the infrastructure.

Secondly, there is a client which will contact the server to get connected to the virtual disk and asks for components stored on the virtual disk for running the operating system.

The available supporting components are database for storing the configuration and settings for the server, a streaming service for the virtual disk content, a (optional) TFTP service and a (also optional) PXE boot service for connecting the client to the OS Virtualization servers.

As it is already mentioned that the virtual disk contains an image of a physical disk from the system that will reflect to the configuration and the settings of those systems which will be using the virtual disk. When the virtual disk is created then that disk needs to be assigned to the client that will be using this disk for starting. The connection between the client and the disk is made through the administrative tool and saved within the database. When a client has a assigned disk, the machine can be started with the virtual disk using the following process displayed in the given below.



1. Connecting to the OS Virtualization server:

First we start the machine and set up the connection with the OS Virtualization server. Most of the products offer several possible

methods to connect with the server. One of the most popular and used methods is using a PXE service, but also a boot strap is used a lot (because of the disadvantages of the PXE service). Although each method initializes the network interface card (NIC), receiving a (DHCP-based) IP address and a connection to the server.

2. Connecting the Virtual Disk:

When the connection is established between the client and the server, the server will look into its database for checking the client is known or unknown and which virtual disk is assigned to the client. When more than one virtual disk are connected then a boot menu will be displayed on the client side. If only one disk is assigned, that disk will be connected to the client which is mentioned in step number 3.

3. VDisk connected to the client:

After the desired virtual disk is selected by the client, that virtual disk is connected through the OS Virtualization server . At the back-end, the OS Virtualization server makes sure that the client will be unique (for example computer name and identifier) within the infrastructure.

4. OS is "streamed" to the client:

As soon the disk is connected the server starts streaming the content of the virtual disk. The software knows which parts are necessary for starting the operating system smoothly, so that these parts are streamed first. The information streamed in the system should be stored somewhere (i.e. cached). Most products offer several ways to cache that information. For examples on the client hard disk or on the disk of the OS Virtualization server.

5. Additional Streaming:

After that the first part is streamed then the operating system will start to run as expected. Additional virtual disk data will be streamed when required for running or starting a function called by the user (for example starting an application available within the virtual disk).

Usage:

Operating System Virtualization is mainly used for testing the applications on different platforms of OS.

Server Virtualization:

Server virtualization is the *partitioning of a physical server into several virtual servers*. It is used to maximize the server resources.

In other words, When the virtual machine software or virtual machine manager (VMM) is directly installed on the Server system is known as server virtualization. Server virtualization is done because a single physical server can be divided into multiple servers on the demand basis and for balancing the load.The server virtualization technology is **mainly used in web servers**. By using virtual web servers, it provides low-cost web hosting services.

Instead of having separate computer for each web server, we can have number of virtual servers on the same computer.

Server virtualization is used:

- to make more efficient use of server resources,
- to improve the server availability,
- to help in disaster recovery,
- development and testing, and
- To centralize the server administration.

Advantages of Server Virtualization

- Each virtual server can be independently rebooted.
- Server virtualization reduces the costs because less hardware is required.

Storage Virtualization:

Storage virtualization is the process of grouping the physical storage from multiple network storage devices so that it looks like a singlestorage device.Storage virtualization is also implemented by using software applications.

As we know that, there has been a strong link between the physical host and the locally installed storage devices. However, that paradigm has

been changing drastically, almost local storage is no longer needed. As the technology progressing, more advanced storage devices are coming to the market that provide more functionality, and obsolete the local storage.

Storage virtualization is a major component for storage servers, in the form of functional RAID levels and controllers. Operating systems and applications with device can access the disks directly by themselves for writing. The controllers configure the local storage in RAID groups and present the storage to the operating system depending upon the configuration. However, the storage is abstracted and the controller is determining how to write the data or retrieve the requested data for the operating system.

Storage virtualization is becoming more and more important in various other forms:

File servers: The operating system writes the data to a remote location with no need to understand how to write to the physical media.

WAN Accelerators: Instead of sending multiple copies of the same data over the WAN environment, WAN accelerators will cache the data locally and present the re-requested blocks at LAN speed, while not impacting the WAN performance.

SAN and NAS: Storage is presented over the Ethernet network of the operating system. NAS presents the storage as file operations (like NFS). SAN technologies present the storage as block level storage (like Fibre Channel). SAN technologies receive the operating instructions only when if the storage was a locally attached device.

Storage Tiering: Utilizing the storage pool concept as a stepping stone, storage tiering analyze the most commonly used data and places it on the highest performing storage pool. The lowest one used data is placed on the weakest performing storage pool.

Usage:

Storage virtualization is mainly done for back-up and recovery purposes.

Advantages of Storage Virtualization

- Data is stored in the more convenient locations away from the specific host. In the case of a host failure, the data is not compromised necessarily.
- The storage devices can perform advanced functions like replication, reduplication, and disaster recovery functionality.
- By doing abstraction of the storage level, IT operations become more flexible in how storage is provided, partitioned, and protected.

How does virtualization work in cloud computing?

Virtualization plays a very important role in the cloud computing technology, normally in the cloud computing, users share the data present in the clouds like application etc, but actually with the help of virtualization users shares the Infrastructure.

The **main usage of Virtualization Technology** is to provide the applications with the standard versions to their cloud users, suppose if the next version of that application is released, then cloud provider has to provide the latest version to their cloud users and practically it is possible because it is more expensive.

To overcome this problem we use basically virtualization technology, By using virtualization, all severs and the software application which are required by other cloud providers are maintained by the third party people, and the cloud providers has to pay the money on monthly or annual basis.

Conclusion

Mainly Virtualization means, running multiple operating systems on a single machine but sharing all the hardware resources. And it helps us to

provide the pool of IT resources so that we can share these IT resources in order get benefits in the business.

Chapter 4

Google Web Service and App Engine

Google is the prototypical cloud computing Services Company, and it supports some of the largest Web sites and services in the world. In this chapter, you learn about Google's applications and services for users and the various developer tools that Google makes available.

At the center of Google's core business is the company's search technology. Google uses automated technology to index the Web. It makes its search service available to users as a standard search engine and to developers as a collection of special search tools limited to various areas of content.

The most important commercial part of Google's activities is its targeting advertising business: AdWords and AdSense. Google has developed a range of services including Google Analytics that supports its targeted advertising business.

Google applications are cloud-based applications. The range of application types offered by Google spans a variety of types: productivity applications, mobile applications, media delivery, social interactions, and many more. The different applications are listed in this chapter. Google has begun to commercialize some of these applications as cloud-based enterprise application suites that are being widely adopted.

Google has a very large program for developers that spans its entire range of applications and services. Among the services highlighted are Google's AJAX APIs, the Google Web Toolkit, and in particular Google's relatively new Google Apps Engine hosting service. Using Google App Engine, you can create Web applications in Java and Python that can be deployed on Google's infrastructure and scaled to a large size.

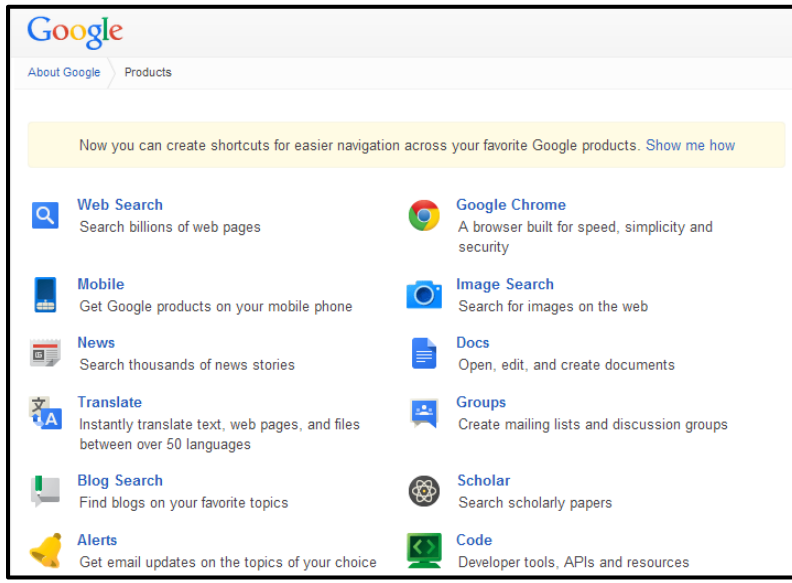
Exploring Google Applications

Few companies have had as much impact on their industries as Google has had on the computer industry and on the Internet in particular. Some companies may have more Internet users (Microsoft comes to mind) or have a stock valuation higher than Google (Apple currently fits that description), but Google remains both a technology and thought leader for all things Internet. For a company whose motto is "Don't be evil," the impact of consumer tracking and targeted advertising, free sourcing applications, and the relentless assault on one knowledge domain after another has had a profound impact on the lives of many people. I call it the Google Effect.

The bulk of Google's income comes from the sales of target advertising based on information that Google gathers from your activities associated with your Google account or through cookies placed on your system using its AdWords system. In 2009, Google's revenue was $23.6 billion, and it controlled roughly 65 percent of the search market through its various sites and services. The company is highly profitable, and that has allowed Google to create a huge infrastructure as well as launch many free cloud-based applications and services that this chapter details. These applications are offered mostly on a free usage model that represents Google's Software as a Service portfolio. A business model that offers cloud-based services for free that are "good enough" is very compelling. While Google is slowly growing a subscription business selling these applications to enterprises, its revenue represents only a small but growing part of Google's current income.

Google's cloud computing services falls under two umbrellas. The first and best-known offerings are an extensive set of very popular

applications that Google offers to the general public. These applications include Google Docs, Google Health, Picasa, Google Mail, Google Earth, and many more. You can access a jump table of Google's cloud-based user applications by following the "More" and "Even More" links on Google's home page to the More Google Products page at http://www.google.com/intl/en/options/ Google's cloud-based applications have put many other vendors' products—such as office suites, mapping applications, image-management programs, and many other categories of traditional shrink-wrapped software—under considerable pressure.



The second of Google's cloud offerings is its Platform as a Service developer tools. In April 2008, Google introduced a development platform for hosted Web applications using Google's infrastructure called the Google App Engine (GAE). The goal of GAE is to allow developers to create and deploy Web applications without worrying about managing the infrastructure necessary to have their applications run. GAE applications may be written using many high-level programming languages (most prominently Java and Python) and the Google App Engine Framework, which lowers the amount of development effort required to get an application up and running. Goggle also allows a certain free level of service so that the application

must exceed a certain level of processor load, storage usage, and network bandwidth (Input/Output) before charges are assessed.

Google Application Portfolio

It is fair to say that nearly all the products in Google's application and service portfolio are cloud computing services in that they all rely on systems staged worldwide on Google's one million plus servers in nearly 30 datacenters. Roughly 17 of the 48 services listed leverage Google's search engine in some specific way. Some of these search-related sites search through selected content such as Books, Images, Scholar, Trends, and more. Other sites such as Blog Search, Finance, News, and some others take the search results and format them into an Aggregation page.

Indexed search

Google's search technology is based on automated page indexing and information retrieval by Web crawlers, also called spiders or robots. Content on pages is scanned up to a certain number of words and placed into an index. Google also caches copies of certain Web pages and stores copies of documents it finds such as DOC or PDF files in its cache.

Google uses a patented algorithm to determine the importance of a particular page based on the number of quality links to that page from other sites, along with other factors such as the use of keywords, how long the site has been available, and traffic to the site or page. That factor is called the PageRank, and the algorithm used to determine PageRank is a trade secret. Google is always tweaking the algorithm to prevent Search Engine Optimization (SEO) strategies from gaming the system. Based on this algorithm, Google returns what is called a Search Engine Results Page (SERP) for a query that is parsed for its keywords. It is really important to understand what Google (and other search engines) offers and what it doesn't offer. Google does not search all sites. If a site doesn't register with the search engine or isn't the target of a prominent link at another site, that site may remain undiscovered. Any site can place directions in their ROBOTS.TXT file indicating whether the site can be searched or not, and if so what pages can be searched.

Google developed something called the Sitemaps protocol, which lets a Web site list in an XML file information about how the Google robot can work with the site. Sitemaps can be useful in allowing content that isn't browsable to be crawled; they also can be useful as guides to finding media information that isn't normally considered, such as AJAX, Flash, or Silverlight media.

Productivity applications and services

These products store your information online in a form that Google can use to build a profile of your activities, and it is unclear how the company uses the information it stores. Google states that your information is never viewed individually by humans, and the company lists its policies in the Privacy Center, which you can find at http://www.google.com/privacypolicy.html . Google has been vigilant in protecting its privacy reputation, but the collection of such a large amount of personal data must give any thoughtful person reason for pause.

List of All Google Products, Services & Tools

Now I'm going to list over 101+ Google products and services that I know of or tried in some way or the other. If you haven't tried any of them then I really suggest you check them out and see if it can make your life easier, better and more productive.

I'm sure that even the Googlers (people who work at Google) won't be able to list the following number of Google services. Even Google's own products page is not listing all their products.

GoogleSearch– Google search is the most popular search engine on the Web.

AdMob – Monetize and promote your mobile apps with ads.

Android – Android is a software stack for mobile devices that includes an operating system , middleware and key applications.

Blogger - A free blog publishing tool for easy sharing of your thoughts with the world.

Dartr – Dart is a brand new programming language developed by Google.

DoubleClick – An ad technology foundation to create, transact, and manage digital advertising for the world's buyers, creators and sellers.

Google.org – Develops technologies to help address global challenges and supports innovative partners through grants, investments and in-kind resources.

Google Aardvark* – A social search engine where people answer each other's questions.

Google Account Activity – Get a monthly summary of your account activity across many Google products.

Google Ad Planner – A free media planning tool that can help you identify websites your audience is likely to visit so you can make better-**informed advertising decisions.**

Google AdSense – Place contextual Google ads on your site – and earn money.

Google AdWords – Advertise online and pay only when people click on your ad.

Google Affiliate Network* – Full-service online marketing company specializing in pay-for-performance media.

Google Alerts – Google Alerts are email updates of the latest relevant Google results (web, news, etc.) based on your choice of query or topic.

Google Analytics (Urchin) – Google Analytics makes it easy to improve your results online.

Google Answers* – Answers allows users to get help from researchers with expertise in online searching.

Google Apps – Software-as-a-service for business email, information sharing and security.

Google App Engine – Run your web applications on Google's infrastructure.

Google Base - Google Base is a place where you can easily submit all types of online and offline content.

Google Blog Search – Blog Search is Google search technology focused on blogs.

Google Body (Now, Zygote Body) – Google Body is a detailed 3D model of the human body.

Google Bookmarks - Google Bookmarks is an online service that lets you save your favorite sites and attach labels and comments.

Google Book Search – Search and preview millions of books from libraries and publishers worldwide.

Google Browser Size – Simple visual tool to show what percentage of web users can see different areas of a website without needing to scroll.

Google Buzz* – Start conversations about the things you find interesting. Share updates, photos, videos and more with your friends.

Google Calendar - Keep track of all your life's important events – birthdays, reunions, and little league games, doctor's appointments – all in one place.

Google Cars – A search engine to get quotes for Cars.

Google Checkout - Buy from stores across the web and track all your orders and shipping in one place.

Google Chrome – A browser that combines a minimal design with sophisticated technology to make the web faster, safer, and easier.

Google Chrome Sync – It's a Google Tool that Syncs your Google Chrome bookmarks across multiple computers.

Google Chromebook – A computer from Google designed to help you get things done faster and easier.

Google Chromebook Pixel – It's a laptop that brings together the best in hardware, software, and design to inspire future innovation.

Google Chromium – The Chromium projects include Chromium and Chromium OS, the open-source projects behind the Google Chrome browser and Google Chrome OS, respectively.

Google Cloud Platform – Enables developers to build, test and deploy applications on Google's highly-scalable and reliable infrastructure.

Google Cloud Print – Google Cloud Print is a new technology that connects your printers to the web.

Google Code - Code is for external developers interested in Google related development.

Google Contacts – Similar to an online address book, the Contact Manager gives you easy access to the people you want to reach.

Google Contact Lens – A smart contact lens project by Google.

Google Correlate – Find search patterns that correlate with real-world data.

Google Cultural Institute – Cultural Institute brings together millions of artifacts from multiple partners, with the stories that bring them to life, in a virtual museum.

Google Currents – A social magazine app by Google.

Google Dashboard – Google Dashboard offers a simple view into the data associated with your Google Account.

Google Desktop* - Search your computer as easily as you search the web with Google.

Google Developers – To inspire developers everywhere.

Google Dictionary – Free online dictionary.

Google Directory – The web organized by topic into categories.

Google Docs – Free web-based word processor and spreadsheet, which allow you to share and collaborate online.

Google Drive – Get 5 GB of Cloud Storage for Free.

Google Earth & Google Mars - Offers maps and satellite images for complex or pinpointed regional searches.

Google Fast Flip* – Read news fast.

Google FeedBurner – Allows bloggers and podcasters to manage their RSS feeds.

Google Fiber – Google Fiber is a broadband internet network that starts with a connection speed 100 times faster than today's broadband.

Google Finance – Offers a broad range of information about stocks, mutual funds, and companies.

Google Flight Search – Choose your flight from a simple list of results, explore destinations on a map, and find travel dates with the lowest fare with Google Flight Search.

Google Fonts – Google Fonts (previously called Google Web Fonts) is an interactive directory of hosted open-source fonts optimized for the web.

Google Fusion Tables – Gather, visualize and share your data online.

Google Friend Connect* – Instantly awakens and strengthens the community that visits your site by enriching it with social features.

Google Gears – A Firefox and Internet Explorer extension that allows to navigate on compatible websites offline and synchronize when going back online.

Google Glass – Google's Project Glass is a research and development program by Google to develop an augmented reality head-mounted display (HMD).

Google Go – Go is an expressive, concurrent, garbage-collected programming language.

Google Grants – In-kind advertising for non-profit organizations.

Google Groups - Where groups of people have discussions about common interests.

Google Hangouts – Hangouts bring your conversations to life with photos, emoji, and group video calls for free.

Google Helpouts – Connects people who need help with people who can give help over live video.

Google Health* - Puts you in charge of your health information.

Google Ideas– Google Ideas connect users, experts and engineers to conduct research and seed new technology-driven initiatives.

Google Image Search & Similar Images - The most comprehensive image search on the web. Google Search Images allows you to search for images using pictures rather than words.

Google In Quotes – Allows you to find quotes from stories linked to Google News.

Google Input Tools – Input Tools makes it easy to type in the language you choose, anywhere on the web.

Google Keep – Quickly create, access and organize your notes, lists and photos with Keep.

Google Knol* - Knol makes it free and easy to create, collaborate on, and publish credible web content.

Google Latitude - See where your friends are on a map.

Google Lively* – A web-based virtual environment by Google.

Google Local Business Center - If you are a business owner Claim your business listing today and let customers find you online!

Google Loon – Loon is a network of balloons traveling on the edge of space, designed to connect people in rural and remote areas, help fill coverage gaps, and bring people back online after disasters.

Google Mail (Gmail) - Gmail is a new kind of webmail, built on the idea that email can be more intuitive, efficient, and useful.

Google Maps & Google Map Maker - Find local businesses, view maps and get driving directions. With Map Maker you can edit the map in

more than a hundred countries and watch your edits go into Google Maps.

Google Mars – Provides a visible imagery view, like Google Moon, as well as infrared imagery and shaded relief (elevation) of the planet Mars.

Google Mobile - Upgrade your phone with free Google products.

Google Moderator - A tool that allows distributed communities to submit and vote on questions for talks, presentations and events.

Google Moon – See the Moon in 3D.

Google Music – Upload your personal music collection and access it instantly on the web or any compatible device without the hassle of wires or syncing.

Google Music Timeline – Music Timeline shows genres of music waxing and waning, based on how many Google Play Music users have an artist or album in their music library, and other data (such as album release dates).

Google Now – An intelligent personal assistant by Google.

Google Offers – Get amazing deals at the best places to eat, shop, and play.

Google One Pass* – A service that lets publishers set their own prices and terms for their digital content.

Google Pack* – Google Pack is a collection of software tools offered by Google to download in a single archive.

Google PageSpeed Insights – Page Speed Online analyzes the content of a web page, then generates suggestions to make that page faster.

Google PageSpeedService –PageSpeed Service makes web pages load faster for your users.

Google Patents – Search the full text of the U.S. patent corpus and find patents that interest you.

Google Person Finder – Google Person Finder by Google.org helps people reconnect with friends and loved ones in the aftermath of natural and humanitarian disasters.

Google Play – Google's digital application distribution platform for Android and an online electronics and digital media store.

Google Plus – Google+ aims to make sharing on the web more like sharing in real life.

Google Postini – Google email security and archiving services, powered by Postini, make your existing email system more secure and compliant.

Google Power Meter – Save Energy. Save Money. Make a Difference.

Google Product Search (Froogle) - Presents photographs of products and links to the stores that sell them online.

Google Profiles – Decide what the world sees when it searches for you. Display the information you care about and make it easy for visitors to get to know you.

Google Public DNS – Google Public DNS is a free, global Domain Name System (DNS) resolution service, which you can use as an alternative to your current DNS provider.

Google Reader* – Web based feed reader to keep up with blogs and news.

Google Related – Google Related is a Chrome Extension that shows you useful, interesting content while you browse the web.

Google Scholar – Provides a search of scholarly literature across many disciplines and sources, including theses, books, abstracts and articles.

Google Scribe – Google Scribe helps you write better documents.

Google Script Converter – Convert text or a webpage.

Google Self-driving Car – Google Driverless Car is a project that involves developing technology for autonomous cars.

Google Sets* – Automatically create sets of items from a few examples.

Google Sites – Google Sites is a free and easy way to create and share web pages.

Google SketchUp - Create, modify and share 3D models.

Google Sky – Google Sky includes a number of different ways to explore the universe.

Google Squared – Takes a category and creates a starter 'square'of information, automatically fetching and organizing facts from across the web.

Google Street View – Explore the world at street level.

Google Store – Official Google Accessories, Apparel Items, Software, Office Equipment.

Google Subscribed Links – Subscribed Links let you create custom search results that users can add to their Google search pages.

Google Suggest - As you type your search, Google offers keyword suggestions in real time.

Google Sync – Synchronize your mail, calendar and contacts.

Google Tag Manager – It lets you add and update your website tags, easily and for free, whenever you want, without bugging the IT folks.

Google Takeout – Google Takeout allows you to download a copy of your data stored within Google products.

Google Talk* – Chat with family and friends over the Internet for free.

Google Tasks – Keep track of what you need to do. Your task list stays up to date no matter how you access it. It's a simple list that's with you everywhere you go.

Google Think – its Google's source for insights, trends and research in digital marketing.

Google Toolbar – Internet Explorer and Firefox Toolbar with Google search.

Google Transit – Plan a trip using public transportation.

Google Transliteration – Google Transliteration allows you to type phonetically using Roman characters.

Google Translate – Free online language translation service instantly translates text and web pages.

Google Trends & Google Insights for Search - Compare the world's interest in your favorite topics. Use Google Insights for Search and see for yourself what the world is searching for.

Google TV – Google TV is a new experience that combines TV, the entire web, and apps — as well as a way to search across them all. Take a tour, learn how it works, and find out how to get it.

Google URL Shortener – Google URL Shortener at goo.gl is used by Google products to create short URLs that can be easily shared, tweeted, or emailed to friends.

Google Ventures – Venture Capital – by Google.

Google Video – Search and watch millions of videos indexed from all over the web.

Google Voice – Google Voice gives you one number for all your phones, voicemail as easy as email, free US long distance, low rates on international calls, and more.

Google Wallet – Save time and money by shopping with Google Wallet — a smart, virtual wallet that stores your payment cards, offers, and more on your phone and online.

Google Wave* – Google Wave is a new online communication and collaboration tool.

Google Web Designer – Create engaging, interactive HTML5-based designs and motion graphics that can run on any device.

Google Web Accelerator – Google Web Accelerator works with your browser to help web pages show up in a snap.

Google Web Elements – Google Web Elements allow you to easily add your favorite Google products to your website.

Google Web Fonts – Get hundreds of free, open-source fonts optimized for the web (hosted on Google Server).

Google Web History - Your web history is stored on Google servers, which means that you can view and manage it from any computer.

Google Web Toolkit – Open source set of tools for building and optimizing complex browser-based applications.

Google Webmaster Tools - Provides you with detailed reports about your pages' visibility on Google.

Google Website Optimizer – Website Optimizer, Google's free website testing and optimization tool, allows you to increase the value of your existing websites and traffic without spending a cent.

Google WiFi – Google WiFi is a free wireless Internet service that Google is offering to the city of Mountain View.

iGoogle– Your personalized Google home page.

Jaiku* - Create your own microblog and connect with your friends.

Orkut– Social networking site designed to make your social life more active and stimulating.

Panoramio– A geolocation-oriented photo sharing website.

Picasa - Helps you organize, edit, and share your photos.

reCAPTCHA– A captcha system that uses successful decodings to helps digitise books for online use.

Schemer – Schemer lets you discover new things to do, share schemes with friends, and make the most of your day.

Textcube - Korean blogging platform.

Waze – It is the world's largest community based traffic and navigation app. You can join other drivers in your area who share real-time traffic and road info, saving everyone time and gas money on their daily commute.

WebP – A new open-source image format by Google that provides 30% better image compression.

WebPageTest– WebPageTest.org is an open source project developed and supported by Google to test a website's performance.

WebRTC – An open source project that enables web browsers with Real-Time Communications (RTC) capabilities.

What Do You Love (WDYL) – Search numerous Google products with one click.

Wildfire – Wildfire is a social media marketing software that provides easy-to-use social media tools for pages, messages, ads, promotions, monitoring, analytics, etc.

YouTube - Share your videos with friends, family, and the world.

Enterprise offerings

As Google has built out its portfolio, it has released special versions of its products for the enterprise. The following are among Google's products aimed at the enterprise market:

Google Commerce Search (http://www.google.com/commercesearch/): This is a search service for online retailers that markets their products in their site searches with a number of navigation, filtering, promotion, and analytical functions.

Google Site Search (http://www.google.com/sitesearch/): Google sells its search engine customized for enterprises under the Google Site Search service banner. The user enters a search string in the site's search, and Google returns the results from that site.

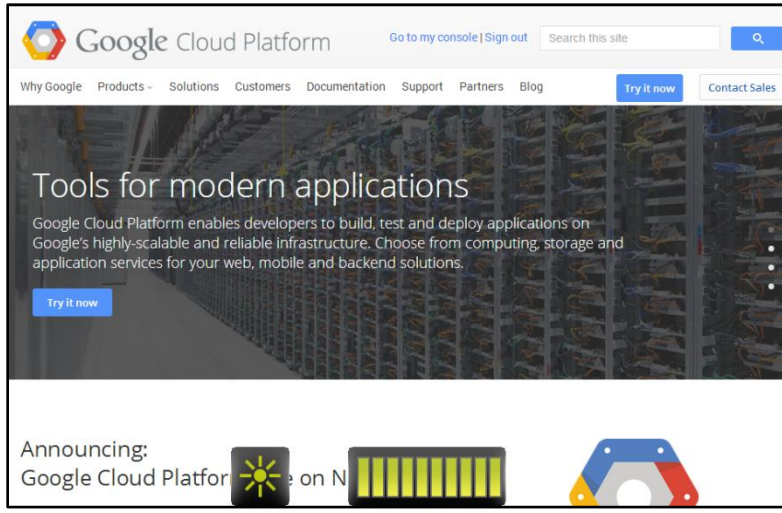
Google Search Appliance (http://www.google.com/enterprise/gsa): This server can be deployed within an organization to speed up both local (Intranet) and Internet searching. The three versions of the Google Search Appliance can store an index of up to 300,000 (GB-1001), 10 million (GB-5005), or 30 million (GB-8008) documents. Beyond indexing, these appliances have document management features, perform

custom searches, cache content, and give local support to Google Analytics and Google Sitemaps.

Google Mini (http://www.google.com/enterprise/mini/): The Mini is the smaller version of the GSA that stores 300,000 indexed documents.

Working with the Google App Engine

Google App Engine (GAE) is a Platform as a Service (PaaS) cloud-based Web hosting service on Google's infrastructure. Figure below shows the GAE home page at https://cloud.google.com/. This service allows developers to build and deploy Web applications and have Google manage all the infrastructure needs, such as monitoring, failover, clustering, machine instance management, and so forth. For an application to run on GAE, it must comply with Google's platform standards, which narrows the range of applications that can be run and severely limits those applications' portability.



GAE supports the following major features:

App Identity	A framework that provides access to the application's identity.

Appstats Analytics	Provides data visualization and analysis pertaining to the utilization of your application.
Blobstore	Allows your application to serve large data objects, such as video or image files, that are too large for storage in the Datastore service.
Capabilities	Detects outages and scheduled maintenance for specific services, so that an application may bypass them or notify users.
Channel	Creates a persistent connection between your application and JavaScript clients, so you can send messages in real time without polling.
Datastore	A schemaless object datastore, with scalable storage, a rich data modeling API, and an SQL-like query language.
Datastore Backup/Restore	Allows you to export or import data to or from your application's Datastore using the Admin Console.
Dedicated Memcache	Provides a fixed cache capacity assigned exclusively to your application.
Go Runtime	Build your application in the Go programming language.
Google Cloud Endpoints	Generates APIs for Android, iOS, and web clients, making it easier to create a web backend for your app.
Google Cloud SQL	A fully-managed web service that allows you to create, configure, and use relational databases that live in Google's cloud.
Google Cloud Storage Client	Read and write to Google Cloud Storage, with internal error handling and retry logic.

Library	
HRD Migration Tool	Migrates application data stored in the Blobstore or the deprecated Master/Slave Datastore into the GA High Replication Datastore.
Images	Manipulate, combine, and enhance images. Converts between image formats, access image metadata such as height and frequency of colors.
Java Runtime	Build your application in the Java programming language.
Logs	Programmatic access to application and request logs from within your application.
Mail	Send email messages on behalf of administrators and users with Google Accounts, and receive mail at various addresses.
MapReduce	An optimized adaptation of the MapReduce computing model for efficient distributed computing over large data sets.
Memcache	A distributed, in-memory data cache that can be used to greatly improve application performance.

Modules	Factor applications into logical components that can share stateful services and communicate in a secure fashion.
Multitenancy	Makes it easy to compartmentalize your data to serve many client organizations from a single instance of your application.
OAuth	Using Google Accounts and the OAuth API, any App Engine application can be an OAuth consumer.
OpenID	An open technology used for authenticating users across various web services.
PageSpeed	A family of tools that automatically optimizes the performance of your application.
Prospective Search	A querying service that allows your application to match search queries against real-time data streams.
PHP Runtime	Build your application in the PHP programming language.
Python Runtime	Build your application in the Python programming language.

Remote	Access App Engine services from any application. For example, access a production datastore from an app running on your local machine.
Scheduled Tasks	Configure tasks that run at defined times or regular intervals.
Search	Perform Google-like searches over structured data such as: plain text, HTML, atom, numbers, dates, and geographic locations.
SendGrid	Use SendGrid's library to send emails from your app and you can see statistics on opens, clicks, unsubscribes, spam reports and more.
Sockets	Supports outbound sockets using the language-specific, built-in libraries.
SSL for Custom Domains	Serve applications via HTTPS and HTTP from a custom domain rather than anappspot.com address.
Task Queue	Allows applications to perform work outside of a user request, using small, discrete tasks, that are executed later.
Task Queue REST API	Enables the use of an App Engine task queue over REST.

Task Queue Tagging	Leases up to a specified number of tasks with the same tag from the queue for a specified period of time.
Traffic Splitting	Routes incoming requests to different versions of your app, allowing you to do A/B testing and roll out new features incrementally.
Twilio	Enables your application to make and receive phone calls, send and receive text messages, and make VoIP calls from any phone, tablet, or browser.
URL Fetch	Uses Google's networking infrastructure to efficiently issue HTTP and HTTPS requests to URLs on the web.
Users	Allows applications to sign in users with Google Accounts or OpenID, and address these users with unique identifiers.
XMPP	Allows an application to send and receive chat messages to and from any XMPP-compatible chat messaging service.

To encourage developers to write applications using GAE, Google allows for free application development and deployment up to a certain level of resource consumption. Resource limits are described on Google's quota page at http://code.google.com/appengine/docs/quotas.html, and the quota changes from time to time.

Google uses the following pricing scheme:

- CPU time measured in CPU hours is $0.10 per hour.
- Stored data measured in GB per month is $0.15 per GB/month.
- Incoming bandwidth measured in GB is $0.10 per GB.
- Outgoing bandwidth measured in GB is $0.12 per GB.
- Recipients e-mailed is $0.0001 per recipient.

The pricing page for Google AppEngine may be found at: https://cloud.google.com/pricing/You can start creating apps using Google App Engine here https://appengine.google.com/start. Many applications have been built and are running on Google App Engine. To get some idea of the range of applications that have been developed, you may want to visit the Google App Engine Gallery. This gallery is found at http://appgallery.appspot.com/ and if you're interested in App Engine happenings, you'll definitely want to regularly check outReddit page: http://www.reddit.com/r/appengine

Summary

In this chapter, you learned about all things Google. The range of applications and services that Google offers is truly impressive; the company is essentially a self-contained ecosystem. Google's empire is built on its highly regarded search engine. The company monetized search technology by attaching target advertising to searches that its users perform. This revenue has allowed Google to create a range of applications and services on the Web that are having real impact in society.

This chapter ended by describing Google App Engine, a Platform as a Service Web-hosting offeringthat allows you to create Web applications and deploy them on Google's own infrastructure.Development anddeployment of these applications are free, as is some basic usage of the application. You can scale your applications on a pay-per-use basis to whatever size you need. At last Google and its service is awesome, that is why you find Google's services on so many of the world's Web sites.

Chapter 5

Amazon web service

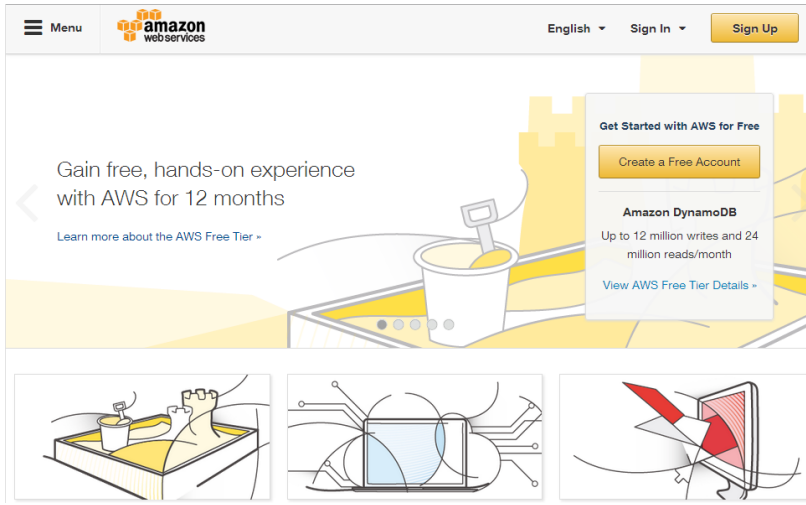
Amazon.com is one of the most important and heavily trafficked Web sites in the world. It provides a vast selection of products using an infrastructure based on Web services. As Amazon.com has grown, it has dramatically grown its infrastructure to accommodate peak traffic times.

Starting in 2006, Amazon.com made its Web service platform available to developers on a usage-basis model.The technologies described in this chapter represent perhaps the best example of Web services achieved through the Service Oriented Architecture (SOA) of components that you learn about in later chapter. Through hardware virtualization on Xen hypervisors, Amazon.com has made it possible to create private virtual servers that you can run worldwide. These servers can be render with almost any kind of application software you might imagine, and they tap into a range of support services that not only make distributed cloud computing applications possible, but make them robust. Some very large Web sites are running on Amazon.com's infrastructure without their client audience being any the wiser.

AWS has a great value proposition: You pay for what you use. While you may not save a great deal of money over time using AWS for enterprise class Web applications, you encounter very little barrier to entry in terms of getting your site or application up and running quickly and robustly. AWS has much to teach us about the future of cloud computing and how virtual infrastructure can be best leveraged as a business asset.

Understanding Amazon Web Services

The Amazon is the world's largest river. Amazon.com is the world's largest online retailer with net sales in $25.59 billion, according to their 2013 annual report. The company is a long way past selling books and records. While Amazon.com is not the earth's biggest retailer (that spot is reserved for Wal-Mart and Alibaba), Amazon.com offers the largest number of retail product SKUs through a large ecosystem of partnerships. By any measure, Amazon.com is a huge business. To support this business, Amazon.com has built an enormous network of IT systems to support not only average, but peak customer demands. Amazon Web Services (AWS) takes what is essentially unused infrastructure capacity on Amazon.com's network and turns it into a very profitable business. Figure below shows the Amazon Web Services home page (http://aws.amazon.com/).



AWS is having enormous impact in cloud computing. Indeed, Amazon.com's services represent the largest pure Infrastructure as a Service (IAAS) play in the marketplace today. It is also one of the best examples of what is possible using a Service Oriented Architecture (SOA), which is described in later Chapter. The structure of Amazon.com's Amazon Web Services (AWS) is therefore highly educational in understanding just how troubled cloud computing can be to traditional fixed asset IT deployments, how virtualization enables a

flexible approach to system rightsizing, and how dispersed systems can impart reliability to mission critical systems.

Amazon Web Service Components and Services

Amazon Web Services is comprised of the following components, listed roughly in their order of importance:

Amazon Elastic Compute Cloud (EC2; http://aws.amazon.com/ec2/), is the central application in the AWS portfolio. It enables the creation, use, and management of virtual private servers running the Linux or Windows operating system over a Xen hypervisor. Amazon Machine Instances are sized at various levels and rented on a computing/hour basis. Spread over data centers worldwide, EC2 applications may be created that are highly scalable, redundant, and fault tolerant. EC2 is described more fully in the next section. A number of tools are used to support EC2 services.

Amazon Simple Storage System (S3; http://aws.amazon.com/s3/) is an online backup and storage system, which is described in "Working with Amazon Simple Storage System (S3)" later in this chapter. A high speed data transfer feature called AWS Import/Export (http: //aws.amazon. com/importexport/) can transfer data to and from AWS using Amazon's own internal network to portable storage devices.

Amazon Elastic Block Store (EBS; http://aws.amazon.com/ebs/) is a system for creating virtual disks (volume) or block level storage devices that can be used for Amazon Machine Instances in EC2.

Amazon SimpleDB(http://aws.amazon.com/simpledb/) is a structured datastore that supports indexing and data queries to both EC2 and S3. SimpleDB isn't a full database implementation, as you learn in "Exploring SimpleDB (S3)" later in this chapter; it stores data in "buckets" and without requiring the creation of a database schema. This design allows SimpleDB to scale easily. SimpleDB interoperates with both Amazon EC2 and Amazon S3.

Amazon Relational Database Service (RDS; http://aws.amazon.com/rds/) allows you to create instances of the

MySQL database to support your Web sites and the many applications that rely on data-driven services. MySQL is the "M" in the ubiquitous LAMP Web services platform (for Linux, APACHE, MySQL, and PERL), and the inclusion of this service allows developers to port applications, their source code, and databases directly over to AWS, preserving their previous investment in these technologies. RDS provides features such as automated software patching, database backups, and automated database scaling via an API call.

Alexa Web Information Service(http://aws.amazon.com/awis/) and Alexa Top Sites (http://aws.amazon.com/alexatopsites/) are two services that collect and expose information about the structure and traffic patterns of Web sites. This information can be used to build or structure Web sites, access related sites, analyze historical patterns for growth and relationships, and perform data analysis on site information. Alexa Top Sites can rank sites based on their usage and be used to structure awareness of site popularity into the structure of Web service you build.

Amazon Cloudfront(http://aws.amazon.com/cloudfront/) is an edge-storage or content-delivery system that caches data in different physical locations so that user access to data is enhanced through faster data transfer speeds and lower latency.

Amazon Associates Web Services (A2S) is the machinery for interacting with Amazon's vast product data and eCommerce catalog function. This service, which was called Amazon E-Commerce Service (ECS), is the means for vendors to add their products to the Amazon.com site and take orders and payments.

Amazon DevPay(http://aws.amazon.com/devpay/) is a billing and account management service that can be used by businesses that run applications on top of AWS. DevPay provides a developer API that eliminates the need for application developers to build order pipelines, because Amazon does the billing based on your prices and then uses Amazon Payments to collect the payments.

Amazon Elastic MapReduce(http://aws.amazon.com/elasticmapreduce/) is an interactive data analysis tool for performing indexing, data mining, file

analysis, log file analysis, machine learning, financial analysis, and scientific and bioinformatics research. Elastic MapReduce is built on top of a Hadoop framework using the Elastic Compute Cloud (EC2) and Simple Storage Service (S3).

Amazon Mechanical Turk (http://aws.amazon.com/mturk/) is a means for accessing human researchers or consultants to help solve problems on a contractual or temporary basis. Problems solved by this human workforce have included object identification, video or audio recording, data duplication, and data research. Amazon.com calls this type of work Human Intelligence Tasks (HITs). The Mechanical Turk is currently in beta.

AWS Multi-Factor Authentication (AWS MFA; http://aws.amazon.com/mfa/) is a special feature that uses an authentication device you have in your possession to provide access to your AWS account settings. This hardware key generates a pseudo-random six-digit number when you press a button that you enter into your logon. This gives you two layers of protection: your user id and password (things you know) and the code from your hardware key (something you have). This multifactor security feature can be extended to Cloudfront and Amazon S3. The Enzio Time Token from Gemalto(http://onlinenoram.gemalto.com/) is available for use with Amazon Web Service; the key costs $12.99. Secure access to your EC2 AMIs is controlled by passwords, Kerberos, and 509 Certificates.

Amazon Flexible Payments Service (FPS; http://aws.amazon.com/fps/) is a payments-transfer infrastructure that provides access for developers to charge Amazon's customers for their purchases. Using FPS, goods, services, donations, money transfers, and recurring payments can be fulfilled.

Amazon Fulfillment Web Services (FWS; http://aws.amazon.com/fws/) allows merchants to fill orders through Amazon.com fulfillment service, with Amazon handling the physical delivery of items on the merchant's behalf. Merchant inventory is prepositioned in Amazon's fulfillment centers, and Amazon packs and ships the items. There is no charge for using Amazon FWS.

Amazon Virtual Private Cloud (VPC; http://aws.amazon.com/vpc/) provides a bridge between a company's existing network and the AWS cloud. VPC connects your network resources to a set of AWS systems over a Virtual Private Network (VPN) connection and extends security systems, firewalls, and management systems to include their provisioned AWS servers. Amazon VPC is integrated with Amazon EC2, but Amazon plans to extend the capabilities of VPC to integrate with other systems in the Amazon cloud computing portfolio.

AWS Premium Support(http://aws.amazon.com/premiumsupport/) is Amazon's technical support and consulting business. Through AWS Premium Support, subscribers to AWS can get help building or supporting applications that use EC2, S3, Cloudfront, VPC, SQS, SNS, SimpleDB, RDS, and the other services listed above. Service plans are available on a per-incidence, monthly, or unlimited basis at different levels of service.

Working with the Elastic Compute Cloud (EC2)

Amazon Elastic Compute Cloud (EC2) is a virtual server platform that allows users to create and run virtual machines on Amazon's server farm. With EC2, you can launch and run server instances called Amazon Machine Images (AMIs) running different operating systems such as Red Hat Linux and Windows on servers that have different performance profiles. You can add or subtract virtual servers elastically as needed; and locate your different servers in different data centers or "zones" throughout the world to provide fault tolerance. The term elastic refers to the ability to size your capacity quickly as needed.

The difference between an instance and a machine image is that an instance is the emulation of a hardware platform such as X86, IA64, and so on running on the Xen hypervisor. A machine image is the software and operating system running on top of the instance. A machine image may be thought of as the contents of a boot drive, something that you could package up with a program such as Ghost, Acronis, or TrueImage to create a single file containing the exact contents of a volume. A machine image should be composed of a hardened operating system

with as few features and capabilities as possible and locked down as much as possible.

Consider a situation where you want to create an Internet platform that provides the following:

- A high transaction level for a Web application
- A system that optimizes performance between servers in your system
- Data driver information services
- Network security
- The ability to grow your service on demand
- Implementing that type of service might require a rack of components that included the following:
- An application server with access to a large RAM allocation
- A load balancer, usually in the form of a hardware appliance such as F5's BIG-IP
- A database server
- Firewalls and network switches
- Additional rack capacity at the ISP

A physical implementation of these components might cost you something in the neighborhood of $25,000 depending upon the scale of your application. With AWS, you might be able to have an equivalent service for as little as $1,000 and have a high level of availability and reliability to boot. This difference may surprise you, but it is understandable when you consider that AWS can run its services with a much greater efficiency than your company would alone and therefore amortize its investment in hardware over several customers. That is the promise and the potential of cloud computing realized and why large Web sites such as Recovery.gov have moved to AWS.

Amazon Machine Images

AMIs are operating systems running on the Xen virtualization hypervisor. Each virtual private server is accorded a size rating called its EC2 Compute Unit, which is pegged to the equivalent of a 1.0–1.2 GHz 2007 Opteron or 2007 Xeon processor. Table below shows the current

set of Instance types and its prices for windows, which broadly fall into the following three classes:

1. **Standard Instances**: The standard instances are deemed to be suitable for standard server applications.

2. High Memory Instances: High memory instances are useful for large data throughput applications such as SQL Server databases and data caching and retrieval.

3**. High CPU Instances**: The high CPU instance category is best used for applications that are processor- or compute-intensive. Applications of this type include rendering, encoding, data analysis, and others.

Pricing models

The pricing of these different AMI types depends on the operating system used, which data center the AMI is located in (you can select its location), and the amount of time that the AMI runs. Rates are quoted based on an hourly rate. Additional charges are applied for:

- The amount of data transferred
- Whether Elastic IP Addresses are assigned
- Your virtual private server's use of Amazon Elastic Block Storage (EBS)
- Whether you use Elastic Load Balancing for two or more servers

Other features

The three different pricing models for EC2 AMIs are as follows:

On-Demand Instance: This is the hourly rate with no long-term commitment.

Reserved Instances: This is a purchase of a contract for each instance you use with a significantly lower hourly usage charge after you have paid for the reservation.

Spot Instance: This is a method for bidding on unused EC2 capacity based on the current spot price. This feature offers a significantly lower

price, but it varies over time or may not be available when there is no excess capacity.

On-Demand Instance Price

	vCPU	ECU	Memory (GiB)	Instance Storage (GB)	Windows Usage
General Purpose - Current Generation					
t2.micro	1	Variable	1	EBS Only	$0.020 per Hour
t2.small	1	Variable	2	EBS Only	$0.050 per Hour
t2.medium	2	Variable	4	EBS Only	$0.100 per Hour
m3.medium	1	3	3.75	1 x 4 SSD	$0.161 per Hour
m3.large	2	6.5	7.5	1 x 32 SSD	$0.322 per Hour
m3.xlarge	4	13	15	2 x 40 SSD	$0.644 per Hour
m3.2xlarge	8	26	30	2 x 80 SSD	$1.288 per Hour
Compute Optimized - Current Generation					
c3.large	2	7	3.75	2 x 16 SSD	$0.238 per Hour
c3.xlarge	4	14	7.5	2 x 40 SSD	$0.477 per Hour
c3.2xlarge	8	28	15	2 x 80 SSD	$0.953 per Hour
c3.4xlarge	16	55	30	2 x 160 SSD	$1.906 per Hour
c3.8xlarge	32	108	60	2 x 320 SSD	$3.813 per Hour
GPU Instances - Current Generation					
g2.2xlarge	8	26	15	60 SSD	$1.160 per Hour
Memory Optimized - Current Generation					
r3.large	2	6.5	15	1 x 32 SSD	$0.323 per Hour
r3.xlarge	4	13	30.5	1 x 80 SSD	$0.646 per Hour
r3.2xlarge	8	26	61	1 x 160 SSD	$1.292 per Hour
r3.4xlarge	16	52	122	1 x 320 SSD	$2.447 per Hour
r3.8xlarge	32	104	244	2 x 320 SSD	$4.600 per Hour
Storage Optimized - Current Generation					
i2.xlarge	4	14	30.5	1 x 800 SSD	$1.169 per Hour
i2.2xlarge	8	27	61	2 x 800 SSD	$2.337 per Hour
i2.4xlarge	16	53	122	4 x 800 SSD	$4.674 per Hour
i2.8xlarge	32	104	244	8 x 800 SSD	$9.348 per Hour

hs1.8xlarge	16	35	117	24 x 2048	$5.901 per Hour

System images and software

You can choose to use a template AMI system image with the operating system of your choice or create your own system image that contains your custom applications, code libraries, settings, and data. Security can be set through passwords, Kerberos tickets, or certificates.

These operating systems are offered:

- Linux
- Windows
- Red Hat Enterprise Linux
- Window with SQL Standard
- Window with SQL Web

Working with Amazon Storage Systems

When you create an Amazon Machine Instance you provision it with a certain amount of storage. That storage is temporal, it only exists for as long as your instance is running. All of the data contained in that storage is lost when the instance is suspended or terminated, as the storage is reassigned to the pool for other AWS users to use. For this and other reasons you need to have access to persistent storage. The Amazon Simple Storage System provides block storage.

Amazon Simple Storage System (S3)

Amazon S3's cloud-based storage system allows you to store data objects ranging in size from 1 byte up to 5GB in a flat namespace. In S3, storage containers are referred to as buckets, and buckets serve the function of a directory or folder, although there is no object hierarchy to a bucket, and you save objects and not files to it. It is important that you do not associate the concept of a file system with S3, because files are not supported; only objects are stored. Additionally, you do not "mount" a bucket as you do a filesystem. The S3 system allows you to assign a name to a bucket, but that name must be unique in the S3

namespace across all AWS customers. Access to an S3 bucket is through the S3 Web API (either with SOAP or REST) and is slow relative to a real-world disk storage system. S3's performance limits its use to no operational functions such as data archiving and retrieval or disk backup. The REST API is preferred to the SOAP API, because it is easier to work with large binary objects with REST.

You can do the following with S3 buckets through the APIs:

- Create, edit, or delete existing buckets
- Upload new objects to a bucket and download them
- Search for and find objects and buckets
- Find metadata associate with objects and buckets
- Specify where a bucket should be stored
- Make buckets and objects available for public access

One tool commonly used to manage data for Amazon S3 is the s3cmd command line client (http://s3tools.org/s3cmd).

Amazon Elastic Block Store (EBS)

Amazon Elastic Block Storage (EBS) provides raw block devices that can be attached to Amazon EC2 instances. These block devices can then be used like any raw block device. In a typical use case, this would include formatting the device with a filesystem and mounting said filesystem. In addition EBS supports a number of advanced storage features, including snapshotting and cloning. As of June 2014, EBS volumes can be up to 1TB in size. EBS volumes are built on replicated back end storage, so that the failure of a single component will not cause data loss.

The EBS product was introduced to the general public by Amazon in August 2008.

The third of Amazon's data storage systems are devoted to Amazon Elastic Block Storage (EBS), which is a persistent storage service with a high operational performance. Advantages of EBS are that it can store file system information and its performance is higher and much more reliable than Amazon S3. That makes EBS valuable as an operational

data storage medium for AWS. The cost of creating an EBS volume is also greater than creating a similarly sized S3 bucket.

EBS is similar in concept to a Storage Area Network or SAN; you create block storage volumes varying in size from 1GB to 1TB and make those volumes available to your machine instances. The performance of a volume is dependent upon the network I/O and therefore varies as a function of the size of your instance (see Table below), as well as the type of disk I/O operations (random, sequential, request size, and READS or WRITE) that are in progress. EBS is a service priced on the amount of storage space used, how long you use it, and the number of I/O requests made to the volume.

CloudFront

Amazon CloudFront is referred to as a content delivery network (CDN), and sometimes called edge computing. In edge computing, content is pushed out geographically so the data is more readilyavailable to network clients and has a lower latency when requested. You enable CloudFrontthrough a selection in the AWS Management Console.

CloudFront servers are located throughout the world—in Europe, Asia, and the United States. As such, CloudFront represents yet another level of Amazon cloud storage. A user requesting data from a CloudFront site is referred to the nearest geographical location. CloudFront supports "geo-caching" data by performing static data transfers and streaming content from one CloudFront location to another.

Direct competitors for CloudFront include Akamai Technologies (http://www.akamai.com/), Edgecast Networks (http://www.edgecast.com/), and Limelight Networks (http://www. limelightnetworks.com/). CloudFront's aggressive pricing model is expected to put pressure on these other services over time. Pricing for CloudFront is based on how much data is transferred to clients, and it doesn't require a service contract. You can estimate CloudFront's costs using the AWS Simple Monthly Calculator (refer to Figure 9.3); costs vary by region. When you create a CloudFront implementation, a CloudFront domain name is registered for your domain name in the form <domainname>.cloudfront.net , and objects in the CloudFront

domain can be mapped to your own domain. You store your source files on CloudNet servers in Amazon S3 buckets and then use the CloudFront API to register the S3 bucket with the CloudNet distribution. Then in your applications, Web pages, and links, you reference the distribution location.CloudFront represents the last of the Amazon Web Services that store and serve objects and files.

EC2 Storage Type Properties

Property	AMI Instance	Amazon Simple Storage Service (S3)	Amazon Elastic Block Storage (EBS)	Amazon CloudFront
Adaptability	Medium	Low	High	Medium
Best usage	Transient data storage	Persistent or archival storage	Operational data storage	Data sharing and large data object streaming
Cost	Low	Medium	High	Low
Ease of use	Low	High	High	High
Data protection	Very Low	Very High	High	Low
Latency	Medium	Low	High	High
Least best used as	Persistent storage	Operational storage	For small I/O transfers	Operational data
Reliability	High	Medium	High	Medium
Throughput	Variable	Slow	High	High

Chapter 6

Microsoft Cloud Services

Microsoft has a very extensive cloud computing portfolio under active development. Efforts to extend Microsoft products and third-party applications into the cloud are centered around adding more capabilities to existing Microsoft tools. Microsoft's approach is to view cloud applications as software plus service

Microsoft calls their cloud operating system the Windows Azure Platform. Microsoft Azure (formerly Windows Azure before 25 March 2014) is a cloud computing platform and infrastructure, created by Microsoft, for building, deploying and managing applications and services through a global network of Microsoft-managed datacenters. It provides both PaaS and IaaS services and supports many different programming languages, tools and frameworks, including both Microsoft-specific and third-party software and systems. Azure was released on 1 February 2010.

You can think of Azure as a combination of virtualized infrastructure to which the .NET Framework has been added as a set of .NET Services. The Windows Azure service itself is a hosted environment of virtual machines enabled by a fabric called Windows Azure AppFabric. You can host your application on Azure and provision it with storage, growing it as you need it. Windows Azure service is an Infrastructure as a Service offering.

Exploring Microsoft Cloud Services

Microsoft CEO SatyaNadella recently said about 75 percent of Microsoft employees were currently working on cloud-related projects and that

the number was expected to rise to about 90 percent within a year. Plans to integrate cloud-based applications and services into the Microsoft product portfolio dominates the thinking at Microsoft and is playing a central role in the company's ongoing product development. The starting place for Microsoft's cloud computing efforts may be found at http://azure.microsoft.com/ or http://www.microsoft.com/enterprise/microsoftcloud/default.aspx

Microsoft has a vast array of cloud computing products and initiatives, and a number of industry leading Web applications. Although services like America Online Instant Messenger (AIM) may garner mindshare in the United States, surprisingly Microsoft Messenger is the market leader in many other countries. Product by product in any category you can name—calendars, event managers, photo galleries, image editors, movie making, and so on—Microsoft has a Web application for it. Some of these products are also-rans, some are good, some are category leaders, and a few of them are really unique. What is also true is that Web apps are under very active development. Microsoft sees its on-line application portfolio as a way of extending its desktop applications to make the company distributive and to extend its products' lives well into the future.

Going forward, Microsoft sees its future as providing the best Web experience for any type of device, which means that it structures its development environment so the application alters its behavior depending upon the device. For a mobile device, that would mean adjusting the user interface to accommodate the small screen, while for a PC the Web application would take advantage of the PC hardware to accelerate the application and add richer graphics and other features. That means Microsoft is pushing cloud development in terms of applications serving as both a service and an application. This duality—like light, both a particle and a wave—manifests itself in the way Microsoft is currently structuring its Windows Live Web products. Eventually, the company intends to create a Microsoft app store to sell cloud applications to users.

Microsoft Live is only one part of the Microsoft cloud strategy. The second part of the strategy is the extension of the .NET Framework and related development tools to the cloud. To enable .NET developers to

extend their applications into the cloud, or to build .NET style applications that run completely in the cloud, Microsoft has created a set of .NET services, which it now refers to as the Windows Azure Platform.

Features and Services

In June 2012, Microsoft Azure released the following new features:

Websites allows developers to build sites using ASP.NET, PHP, Node.js, or Python and can be deployed using FTP, Git, Mercurial or Team Foundation Server.

Virtual machines let developers migrate applications and infrastructure without changing existing code, and can run both Windows Server and Linux virtual machines.

Cloud services - Microsoft's Platform as a Service (PaaS) environment that is used to create scalable applications and services. Supports multi-tier scenarios and automated deployments.

Data management - SQL Database, formerly known as SQL Azure Database, works to create, scale and extend applications into the cloud using Microsoft SQL Server technology. Integrates with Active Directory and Microsoft System Center.

Media services - A PaaS offering that can be used for encoding, content protection, streaming, and/or analytics.

The Microsoft Azure Platform provides an API built on REST, HTTP, and XML that allows a developer to interact with the services provided by Microsoft Azure. Microsoft also provides a client-side managed class library which encapsulates the functions of interacting with the services. It also integrates with Microsoft Visual Studio, Git, and Eclipse.

Defining the Windows Azure Platform

Azure is Microsoft’s Infrastructure as a Service (IaaS) Web hosting service. Azure is a deep blue color, the color of the clear sky onto which you can paint clouds. Taken together as a unit, Windows Azure Platform

becomes a Platform as a Service (PaaS) offering. Hence, you may run into some people calling Azure an infrastructure service and others calling it a platform; in context, both are correct. Compared to Amazon's and Google's cloud services, Azure (the service) is a competitor to AWS. Windows Azure Platform is a competitor to Google's App Engine. Figure below shows the home page of the Windows Azure Platform found at http://www.microsoft.com/windowsazure .

The software plus services approach

Microsoft has a very different vision for cloud services than either Amazon or Google does. In Amazon's case, AWS is a pure infrastructure play. AWS essentially rents you a (virtual) computer on which to run your application. An Amazon Machine Image can be provisioned with an operating system, an enterprise application, or application stack, but that provisioning is not a prerequisite. An AMI is your machine, and you can configure it as you choose. AWS is a deployment enabler.

Google's approach with its Google App Engine (GAE) is to offer a cloud based development plat-form on which you can add your program, provided that the program speaks the Google AppmEngine API and uses objects and properties from the App Engine framework. Google makes it possible to program in a number of languages, but you must write your applications to conform to Google's infrastructure. Google Apps lets you create a saleable cloud-based application, but that application

can only work within the Google infrastructure, and the application is not easily ported to other environments.

Microsoft sees the cloud as being a complimentary platform to its other platforms. The company consider a scenario where a Microsoft developer with an investment in an application wants to extend that application's availability to the cloud. Perhaps the application runs on a server, desktop, or mobile device running some form of Windows. Microsoft calls this approach software plus services.

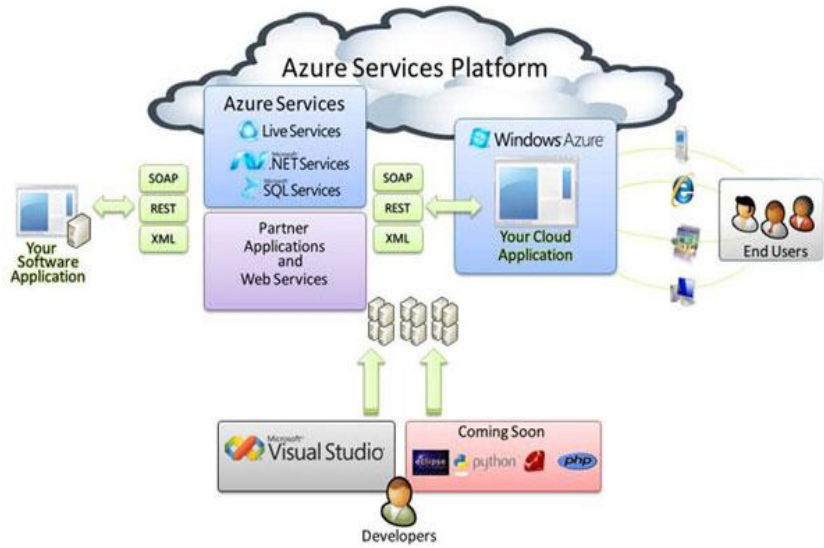
The Windows Azure Platform allows a developer to modify his application so it can run in the cloud on virtual machines hosted in Microsoft datacenters. Windows Azure serves as a cloud operating system, and the suitably modified application can be hosted on Azure as a runtime application where it can make use of the various Azure Services. Additionally, local applications running on a server, desktop, or mobile device can access Windows Azure Services through the Windows Services Platform API.

Given that Microsoft owns the Office application market as well as the desktop OS market, this approach makes lots of sense. It is also quite possible that a hybrid application that can reside either locally or in the cloud will have lots of appeal not only to developers but to users who would prefer more control over their data and more security than the cloud might offer.

The Azure Platform

With Azure's architecture (shown in Figure below), an application can run locally, run in the cloud, or some combination of both. Applications on Azure can be run as applications, as background processes or services, or as both. The Windows Azure service itself is a cloud-based operating system with a fabric infrastructure of virtual machines hosted in Microsoft datacenters. The Azure Windows Services Platform API uses the industry standard REST, HTTP, and XML protocols that are part of any Service Oriented Architecture cloud infrastructure to allow applications to talk to Azure. Developers can install a client-side managed class library that contains functions that can make calls to the Azure Windows Services Platform API as part of their applications.

These API functions have been added to Microsoft Visual Studio as part of Microsoft's Integrated Development Environment (IDE). There are plans to add IPsec connectivity to Azure in the near future. IPsec refers to the Internet Protocol Security protocol suite for creating a secure Internet connection between two endpoints. IPsec provides for authenticated communication using session based negotiation and the exchange of cryptographic keys to enable encrypted communication to be sent and decrypted. IPsec is an IETF standard that is in wide use.



The Azure Service Platform hosts runtime versions of .NET Framework applications written in any of the languages in common use, such as Visual Basic, C++, C#, Java, and any application that has been compiled for .NET's Common Language Runtime (CLR). Azure also can deploy Web-based applications built with ASP.NET, the Windows Communication Foundation (WCF), and PHP, and it supports Microsoft's automated deployment technologies. Microsoft also has released SDKs for both Java and Ruby to allow applications written in those languages to place calls to the Azure Service Platform API to the AppFabric Service.

Elements of Windows Azure Platform

Six main elements are part of Windows Azure:

Application: This is the runtime of the application that is running in the cloud.

Compute: This is the load-balanced Windows server computation and policy engine that allows you to create and manage virtual machines that serve either in a Web role and a Worker role.

A Web role is a virtual machine instance running Microsoft IIS Web server that can accept and respond to HTTP or HTTPS requests. A Worker role can accept and respond to requests, but doesn't run IIS in that virtual machine. Worker roles can communicate with Azure Storage or through direct connections to clients.

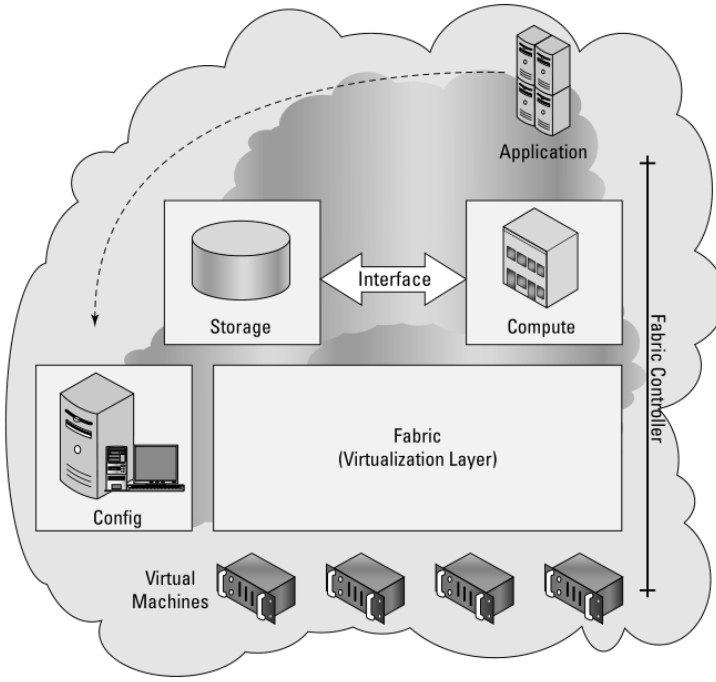
Storage: This is a non-relational storage system for large-scale storage. Azure Storage Service lets you create drives, manage queues, and store BLOBs (Binary Large Objects). You manipulate content in Azure Storage using the REST API, which is based on standard HTTP requests and is therefore platform-independent. Stored data can be read using GET s, written with PUT s, modified with POST s, and removed with DELETE requests.

Azure Storage plays the same role in Azure that Amazon Simple Storage Service (S3) plays in Amazon Web Services.

Fabric: This is the Windows Azure Hypervisor, which is a version of Hyper-V that runs on Windows Server 2008.

Config: This is a management service.

Virtual machines: These are instances of Windows that run the applications and services that are part of a particular deployment.



Window Azure virtual machine sizes and price				
INSTANCE	CPU CORES	RAM	DISK SIZES	PRICE
A0	1	0.75 GB	20 GB	?1.09/hr
A1	1	1.75 GB	40 GB	?4.63/hr
A2	2	3.50 GB	60 GB	?9.26/hr
A3	4	7.00 GB	120 GB	?18.51/hr
A4	8	14.00 GB	240 GB	?37.02/hr

Windows Live services

Windows Live is a collection of cloud-based applications and services, some of which can be used inside applications that run on Windows Azure Platform. Some Windows Live applications run as standalone applications and are available to users directly through a browser.

Others are services that add capabilities to the Windows Azure Platform as part of Microsoft's software plus services strategy.

Microsoft has rolled out Windows Live in sets of releases they describe as four waves. The first wave was a rebranding of several Microsoft MSN applications and services in late 2005. More applications including Windows Mail, Windows Photo Gallery, and Windows Movie Maker were unbundled from Vista and rolled into a downloadable software suite called Windows Live Essentials. There has been continuous development, branding, marketing, and rebranding of the Windows Live portfolio that has had many people scratching their heads. Many Windows Live applications have been rolled into other services or discontinued entirely.

Here's what I believe the current situation is with Windows Live. If an application is bundled as part of an additional download for desktop users, it is part of the Windows Live Essentials package. Some applications that are part of Windows Live are standalone products, while others are extensions of existing Microsoft commercial software. An example of a standalone product would be Windows Live Calendar.

Some parts of the Windows Live portfolio are shared applications and services that are accessible to developers, and those services are the Windows Live Services that are one component of the Windows Azure Platform. Developers access the services for Windows Live Services through a collection of APIs and controls called Windows Live Messenger Connect (previously called Live Services and Windows Live Dev). Using these APIs and controls, developers can add Windows Live Services capabilities and data to their application

Note: To learn more about Window Live Messenger Connect, visit the MSDN site's documentation found at http://msdn.microsoft.com/en-us/library/ff749458.aspx

Messenger Connect was released as part of the Windows Live Wave 4 at the end of June 2010, and it unites APIs such as Windows Live ID, Windows Live Contacts, and Windows Live Messenger Web Toolkit into a single API. Messenger Connect works with ASP.NET, Windows Presentation Foundation (WPF), Java, Adobe Flash, PHP, and Microsoft's

Silverlight graphics rendering technology through four different methods:

- Messenger Connect REST API Service
- Messenger Connect .NET and Silverlight Libraries
- Messenger Connection JavaScript Libraries and Controls
- Web activity feeds, either RSS 2.0 or ATOM

Table below lists the current services that can be used by Windows Live/ Messenger Connect in applications and Web sites.

Window Live Services	
Service	Description
Admin Center	Provides e-mail hosting for web site owners. As of 2014, this service is still using Wave 4 user interface.
Calendar	Time management service that allow users to organize appointments, schedule meetings, set reminders, and share their calendar events.
Outlook.com	Free webmail service using AJAX technology featuring email, People and calendar services.
ID	Identity single sign-on service that allows users to log into various Microsoft products and services. Users can manage their accounts and link multiple IDs together using this service.
People	The address book service, which allows users to keep track and synchronize their contact's information. Allow users to add contacts from other social networks including Facebook, Twitter, LinkedIn, Google, Flickr and soon Sina Weibo and Skype to their Microsoft account.
Plug-ins	A central repository for collections of developer plug-ins for Windows Photo Gallery, Windows Movie Maker, and Windows Live Writer.
Profile	Allow users to manage their profile information and displays information about the particular user, their recent activities, and their relationship with other Windows Live users.
Service	Allow users to get information about the current

Status	performance of Microsoft services, as well as checking the history of service statuses during the past 14 days.
SkyDrive	Password-protected online file storage and sharing, includes management of photos and Office documents. Also allow users to view and edit Microsoft OfficeWord, Excel, PowerPoint and OneNote documents directly in the web browser using Office Web Apps, and allow sharing and co-authoring of these documents with other users.

Microsoft Office 365	It enabled users with domain names to change their domain MX record(s) (mail server records) so that all features of Outlook.com will be available on their own domain names.
Microsoft Tag	2D barcodes that can be used to store information or link to the mobile web.
Skype	Allow users to make PC-to-PC and PC-to-Phone (Voice over Internet Protocol (VoIP)) voice and video calls.
Windows Live Groups Calendar	Manage and plan different types of events and share them with others using Calendar, Spaces and Alerts.
Windows Live Plug-ins	A center for collections of developers' add-ons for Windows Live Messenger, Photo Gallery, Movie Maker, Writer, Toolbar,Spaces, and Live.com, as well as Windows 7 and Windows Vista Sidebar and SideShow gadgets.
Microsoft Answers	Collection of forums and message boards to communicate with other users of Windows Live products.

OneDrive	File sharing and synchronization service based on Folder Share and Live Mesh technologies. Supports PC-to-PC and PC-to-Cloud synchronization, and supports synchronization of program settings such as Internet Explorer and Microsoft Officebetween multiple computers. Also allow users to remotely access their computers via the internet.
Office Online	Offers 5GB of storage space for storing Microsoft Office Word, Excel, PowerPoint, and Outlook documents and lists online and sharing them with others. Office Live Workspace does not offer collaboration or editing capabilities however.
Microsoft Security Essentials	Computer Security Service. Features its own Anti-Virus program, back-up utility, and a software firewall.
Microsoft Safety Scanner	Free PC scanning and health service to help delete viruses and other threats. Includes registry cleaner, disk cleaner and defragmenter, network open port scanner, and comprehensive virus and spyware scanner.
My MSN	An all-in-one home page featuring a customisable RSS aggregator, gadgets and search tools.
Bing Shopping	An online shopping comparison website which allowed users to compare items and prices of over 40 million products from more than 7000 online stores.
Bing Bar	A toolbar which adds itself to Windows Internet Explorer, allowing quick access to a user's Windows Live Spaces, Hotmail,Favorites and Live Search from a button on the toolbar.

MSN Wi-Fi Hotspots	A website which allowed users to locate wireless internet hotspots worldwide and view their positions on a map using Bing Maps.
Agents	Interactive chatterbots through Windows Live Messenger that allow users to get more information about specific topics.
Alerts	Send information updates to the user's email inbox, mobile device or Messenger.
Home	Provides a central location to access Windows Live services, monitor status information, and navigate to other Windows Live sites and services.
Wi-Fi Center	Allow users to search for wireless networks that are available and displays information about them.

Renamed Service

Service type	Service name	Previous name
Account	Microsoft account	Windows Live ID, Passport
Storage	OneDrive	FolderShare, Live Mesh, SkyDrive
Email	Outlook.com	Hotmail
Calendar	Calendar	Hotmail Calendar, Live Calendar

Contacts	People	Live Contacts
Chat	Skype	Live Messenger, MSN Messenger
Web-based chat	Integrated into all services	Web Messenger
Photos/Videos	Integrated into OneDrive	Live Photos

Summary

Microsoft's cloud operating system is called Windows Azure. Windows Azure is a hosted environment of virtualized systems tied together in a fabric using a service called AppFabric. This is offered to developers in the form of an Infrastructure as a Service model similar to Amazon Web Services. To Windows Azure is added a cloud-enabled version of the .NET Framework originally called .NET Services, which are now part of Azure AppFabric. This approach lets developers extend their applications into the cloud using development tools that they already possess with the minimum amount of reconfiguration. Microsoft has added a number of additional services and the entire offering is now a Platform as a Service cloud model that Microsoft calls the Windows Azure Platform.

The other major component of Microsoft's cloud computing strategy is a collection of user applications and related services called Windows Live. Some Windows Live applications are client side applications, many others are Web-based applications, some are mobile apps, and an important subset of these services is available to developers through the Windows Live Messenger Connect APIs.

Chapter 7

Using Mobile Cloud

In this chapter, you learn about mobile phones and their interaction with the cloud. The impact that cellular phone technology has had on civilization is dramatic. The most popular consumer device is the Nokia 1100, and the billionth cell phone that Nokia sold was an 1100 in Nigeria. Cell phones have had nearly universal worldwide adoption.

Cell phones fall into two categories. As this chapter explains, there are feature phones, which are phones with added capabilities, and smartphones that run recognized operating systems, install applications, and have persistent Internet connectivity. Feature phones are being replaced by smartphones, and for many people in the world, smartphones are the only computer that they will ever own.

Cloud services are having a major impact on cellular phone technology, and vice versa. Many smartphones come with native applications that consume Web services, many of which are currently deployed in the cloud. Some of these applications do little more than point a micro-browser at a Web site that has been specifically formatted for mobile phone consumption. Other applications consume RSS feeds, and many more are simply frontends for applications that run in the cloud. Mobile application developers are staging their apps in the cloud, and a number of hosting services provide support for this. Amazon Web Service and the iAWSManager app are provided as an example.

The five major smartphone operating systems to consider are Google's Android, Apple's iOS (iPhone OS), RIM BlackBerry, Symbian, and Windows Mobile Phone. Each of these platforms supports installable

applications, and Android and the iPhone support hundreds of thousands of third-party applications. Many of these applications running in part or fully in the cloud contribute greatly to the value proposition of these leading edge mobile platforms.

Defining the Mobile Market

Here's an astonishing figure to consider. As of 2009, the world's population was 6.8 billion people, and the number of mobile phones estimated to be in use was 4.6 billion units. That means that nearly 68 percent of the people in the world have a cell phone. In some countries people own multiple cell phones and the penetration of phones appears to be more than 100 percent of the population—which is physically impossible, of course.

The top 10 countries and the percentage of their populations with cell phones in 2009 were as follows:

- China, 797 million, 60.8 percent of the population
- India, 635 million, 53.8 percent of the population
- United States, 286 million, 91.0 percent of the population
- Russia, 214 million, 147.3 percent of the population
- Brazil, 187 million, 97.6 percent of the population
- Indonesia, 140 million, 60.5 percent of the population
- Japan, 107 million, 84.1 percent of the population
- Germany, 107 million, 130.1 percent of the population
- Pakistan, 98 million, 59.6 percent of the population
- Italy, 89 million, 147.4 percent of the population

Some experts have contended that the cell phone has done more to bring people out of poverty in the Third World than almost any other invention in history. The idea of grub-staking people with

"40 acres and a mule" in the 21st century needs to be replaced by the phrase: "40 acres, a mule, a cell phone." With a cell phone in hand, a farmer in India or Africa can find out what crops to plant and which buyer to sell to with a phone call.

You may compare these numbers with the estimated number of personal computers in use worldwide in 2010, which according to the Computer Industry Almanac (http://www.c-i a.com/compuseexec.htm) was 1.4 to 1.5 billion units, to judge how much greater the potential impact of cell phones is worldwide. Indeed, for nearly 3.2 billion people, their cell phone is potentially their main computing device, and the trends appear to favor increased cell phone penetration in the future.

Adopting mobile cloud applications

When you consider the term “mobile cloud computing,” you are describing a model where processing is done in the cloud, data is stored in the cloud, and the mobile device serves as the presentation platform or the display. For this model to work, a phone, tablet, or laptop requires a reliable Internet connection and the ability to run a browser (a micro-browser, really) or another viewing application. Currently, most of the computing applications that run on mobile devices run on the local device itself, with a few exceptions. Those exceptions include applications such as Google Earth, Google Maps, the major cloud mail services, and applications that provide navigation, among others. For the most part, though, applications that run on the current generations of smartphones such as Android, iPhones, RIM BlackBerry, and Windows Mobile, among others, are processed locally on the phone. These smartphones are essentially miniaturized computers. In 2009, cell phone sales totaled 1.2 billion units, while smartphones sold 172 million units.

Smartphones currently represent only 14 percent of the overall market. While smartphone sales grew from a level of 139 million units in 2008 versus 1.2 billion sales of cell phones, it is and will remain for a while only a small albeit highly profitable part of the cell phone market.

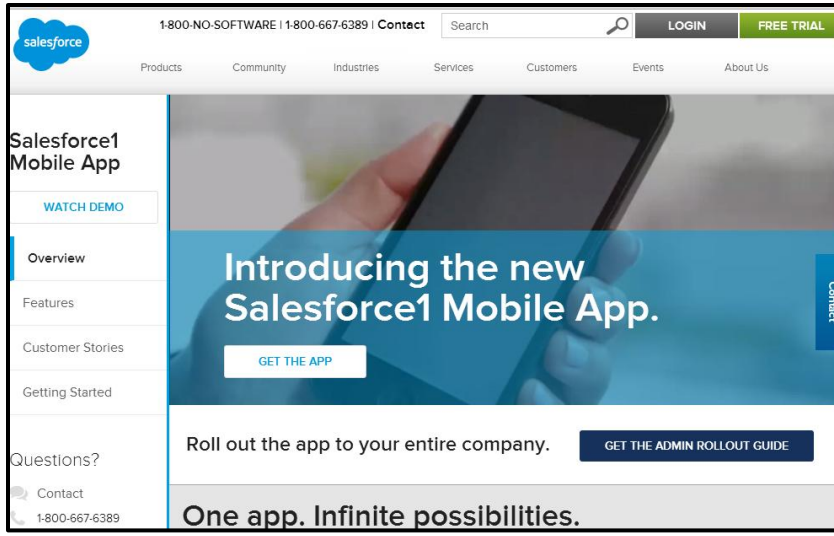
When you live in the United States, Europe, or another affluent society, you tend to view the world through the prism of your own experience. Many readers of this book who are technological cognoscenti have smartphones, but most of the world’s roughly 4.6 billion cell phone users do not; they have what are described as “feature phones.” What cloud computing offers the world’s cell phone users is the potential to

have a smartphone or rich Internet media experience on a cell phone and the potential for smartphones to become technologically “thinner” devices. By thinner, I mean that the devices will require less processing, consume less power, and have better battery life.

Currently, when you want to buy a cell phone or a smart phone, you trundle into a service provider’s store and buy a phone that is supported by that network. To have an application run on the different cell phone types or smartphone operating systems, you need a Nokia developer, a Symbian developer, a RIM developer, an iPhone developer, and so on. When you develop an application for the cloud, you need just one type of developer and then all the connected phones can use that application. This is one of the main reasons why cloud computing represents a disruptive technology for mobile computing and cell phones.

Another reason is the avoidance of vendor lock-in. When you “commit” to a cell phone (particularly a smartphone), many people essentially lease these phones and are trapped in one- or two-year commitments. Worse than that, the data and applications they use are associated with their current phone and platform. Cloud computing frees those huddled cell phone masses yearning to be free from having to migrate their data and apps. If you think mobile service providers aren’t concerned about their customers being free to vote with their feet, think again. The recent “announcement” (http://googlepublicpolicy.blogspot.com/) by Google and Verizon Wireless (with the support of AT&T) that they support a tiered pricing model for content transferred over wireless networks is nothing more than an attempt to control Web applications on their network and for Google to retain unrestricted access (for a cost) on willing carriers.

With such a large audience relying more and more on mobile technologies, and cell phones in particular, it is necessary for software developers to think about extending their applications to the mobile space. What better way to do so than to build a cloud application?Salesforce.com’s Mobile Lite and its app (http://www.salesforce.com/mobile/overview/) illustrates an important trend in software to extend its products as cloud services for mobile access.



Feature phones and the cloud

Feature phones have nowhere near the resolution that the current smartphones do, nor is it likely that they will in the near future. A feature phone is more capable than a “dumb phone,” but often it has a screen that is limited to text or very low-end graphics. Feature phones own 83 percent ofthe cell phone market in the U.S. as of 2009, and they are categorized by having lower prices,longer battery lives, and simpler APIs. Of the top 10 bestselling phones listed on Wikipedia (http://en.wikipedia.org/wiki/List_of_best-selling_mobile_phones), only the Nokia 5230, which runs Symbian OS v9.4, is a smartphone:

- Nokia 1100 (250 million)
- Nokia 1110 (250 million)
- Nokia 5230 (150 million)
- Nokia 1200 (150 million)
- Motorola RAZR V3 (130 million)

As feature phones go upscale and smartphones extend their market downscale, the industry is beginning to add to inexpensive feature phones the capability to run lightweight operating systems such as Oracle’s (nee Sun’s) Java Platform Micro Edition (Java ME; http://www.oracle.com/technetwork/java/javame/index.html) or

Qualcomm's Binary Runtime Environment for Wireless (BREW; http://brew.qualcomm.com/brew/en/). This gives feature phones the capability to run applications such as browsers that make cloud computing on these phones more attractive. Qualcomm is slated to add both the Opera Mini 5 and Opera Mobile 10 browsers to the Brew mobile platform. There's little uniformity in the features and interoperability in the micro-browser arena, but that could change quickly. While carriers have been quick to offer us repackaged games like Atari on feature phones, the race is on to move to Web applications at service providers like AT&T where a new messaging service has just been added for a number of their feature phones that provides access to e-mail, Facebook, and other services.

Feature phones were worldwide leaders yesterday, but rapidly overtaken by smartphones as the price of smartphones decline. In Europe, where Nokia's Symbian S60 phones once dominated, their share has fallen to 7 percent, while Android and iOS dominate with a 16 percent and 73 percent market share, respectively. Smartphones move roughly 30 times the data that feature phones do because of smartphone's use of applications.

The conclusion you can reach from this data is that phones are getting cheaper, and as smartphones become cheap enough, they replace feature phones. As feature phones are retired, newer lightweight operating systems are being added to lower-end phones to give them smartphone capabilities. Access to the cloud where data and processing are outsourced and the phone is a display platform will tend to level the playing field, making feature phones appear to be smarter and all phones cheaper.

Using Smartphones with the Cloud

There are many different ways in which you can define a smartphone, but the essential characteristics are:

- A smartphone has a specific operating system.
- It can run installable applications.

- It offers advanced calling features such as video calls or conferencing.
- Smartphone offers messaging features.
- A smartphone comes with a touchscreen; the bigger the touchscreen the smarter the phone.
- Every smartphone offers keyboard entry, either physically or virtually.
- A smartphone has a persistent Internet connection.

So my definition of smartphones goes like this:

"**Smartphones are small computers on which you can make phone calls, send messages, and access Internet data in real time**."

So much for smartphones, but what about the cloud? Consider what we haven't seen yet in smartphones that clouds can offer. If you move smartphone execution to a virtual machine running in the cloud, smartphones are no longer constrained by their processing power, memory, or storage capacity. The only two factors of importance are network bandwidth and display quality. You have to think that someone will build the equivalent of a thin client/terminal service using the cloud.

One thing that smartphones have made perfectly clear is that people love apps. On the mobile platforms each vendor has an application marketplace. Each vendor also puts lots of effort into getting third-party applications written for its platform. Many of the applications using Web services are doing so through sites that are specially formatted for a particular platform. Nearly every major Web site or service has a version that is optimized for mobile computing and accessed using a mobile URL. When you point a micro-browser at one of these sites, you get a smartphone-optimized cloud-based experience.

Android

Android (http://www.android.com/) is the mobile device operating system originally developed by Android Inc., purchased and further developed by Google, and supported by the industry working group called the Open Handset Alliance (http://www.openhandsetalliance.com/). Android is based on Linux and

GNU software. The software is licensed to OEMs under the Apache license. The current version of the OS is 4.1- 4.3.1 and is called jellybean. The next two versions coming are KitKat(4.4-4.4.4) and Lollipop(5.0), which will be released sometime in 2014 .

Phones using the Android operating system were first sold by Google, branded as the Nexus One, and manufactured by HTC. A long list of these phones is maintained at http://en.wikipedia.org/wiki/List_of_NFC-enabled_mobile_devices , but many people will recognize current market leaders such as the HTC, Samsung, Hero, and Incredible, the LG Optimus, the Motorola Droid and Droid X, and Sony Ericsson XPERIA, among others on this list.

Android was built to serve as a mobile platform for Internet computing and, by extension, as a consumer or client for cloud computing services. The Android software is based on Java and runs in a Dalvik virtual machine.

As of 2013, Android was the leading smartphone OS worldwide, and it sells worldwide at a run rate of 5-8 million phones per month. It has been remarked that as Windows was to Macintosh, Android is to the iPhone.

An advantage of Android and Windows Mobile is that they have their own dedicated infrastructure on which developers can host their applications, if they want to. For Google, that hosting service is the Google AppEngine (described in chapter 4) and Google's infrastructure; for Microsoft, that hosting service is the Windows Azure Platform (described in chapter 6) and Microsoft's infrastructure.

Mobile Web Service

Performing Synchronization

Data synchronization is an important Web service for mobile devices. Contact, calendar, and information on devices often need to be synchronized between multiple systems. The most commonly used standard for performing synchronization is SyncML (Synchronization Markup Language).

All or some the following data types may be synchronized by SyncML:

- Bookmarks
- Calendar
- Contacts
- E-mail
- Files
- Memos
- Music
- Photos
- SMS
- Tasks
- Video

SyncML is implemented using a SyncML server or alternatively as a SyncML hosted service. The client portion of SyncML is either a browser plug-in or client connector software. Different servers and clients allow for the synchronization of different data types. Some backup software also uses SyncML. The standard is an open platform-independent protocol maintained by the Open Mobile Alliance as part of the Data Synchronization and Device Management group (http: //www. openmobilealliance.org/Technical/DS.aspx).

Mobile Cloud Computing

According to the latest study from Juniper Research, the number of mobile cloud computing subscribers is expected to grow rapidly in the next five years. Cloud-based mobile market will generate annual revenue of $9.5 billion in 2014 from $400 million in 2009, at an average annual increase of 88%.

This phenomenal growth is driven by new web standard HTML5, increased mobile broadband coverage and the need for always-on collaborative services for the enterprise.

Cloud Apps in Your Mobile

Google's Gmail and Google Voice for iPhone are just two of the well-known mobile cloud apps. Mobile cloud computing is referred to as the

infrastructure where both the data storage and the data processing happen outside of the mobile device. From a consumer's point-of-view, a cloud-based mobile application is similar to an app purchased or downloaded from a mobile application store like iTunes, where the processing power is driven not from the handheld device, but from the cloud. When launched from the iPhone home screen, the apps perform like any other app on the iPhone.

HTML5: Mobile Computing Revolution

ABI Research (ABI Research is a market research and market intelligence firm based in New York) released a major study in mobile Cloud computing which insight how HTML5 technology, mobile applications and mobilized enterprises will lead the growth.

Juniper Research believes that enterprise applications will account for the bulk of mobile cloud app revenues. HTML5, the core language used to create the web, will bring about a dramatic revolution. HTML5 is the proposed standard for next version web markup language. The cloud based apps offer improved offline data caching, where the apps will still work even if Internet connection is down. HTML5-enabled apps also reduce server load demand which will make cloud-based mobile connectivity as a means to improve access of nations and locales with poor coverage.

The Power of the Cloud

Juniper Report notes that the key to mobile's future depends on the processing power of the cloud itself. Cloud-based mobile apps can scale beyond the capabilities of any smartphone. Cloud apps have the power of a server-based computing infrastructure accessible through an app's mobile interface. It does not only allow non-smartphone owner to access the same mobile applications, but allows the apps themselves to become more powerful.

Cloud Apps and the Mobile Marketplace

Earlier this year, Gartner researchers estimated that $7 billion will be generated by the app store businesses and would reach $29.5 billion by 2013. This would grow even more by 2014 when the mobile cloud-based application market is expected to near $9.5 billion. From these comparisons, it appears that in the near future, there will be more

growth for both traditional, device-based apps and mobile cloud-based apps.

Four Reasons to Care About Mobile Cloud Computing

There are ongoing efforts to standardize cloud computing (Open Cloud Manifesto) but they seem to lack use cases about mobile computing. Cloud computing becomes mobile when a mobile device tries to access a shared pool of computing resources on-demand. There are at least 5 reasons why mobile cloud computing is important for free and open source software.

1. Mobile cloud computing is big in size

At the end of 2013, mobile phones were five billion. By 2014, that number is projected to grow to 6 billion. That is many times the number of personal computers. And when we start including in the mobile world other Internet capable devices, like eBook readers, photo frames, printers, photo and video cameras, personal navigators, the numbers go way up. Small portable devices that can access information are already part of everyday life for hundreds of millions of people in the developed world. Also, many hints point to the fact that developing countries will be using the mobile cloud before they get to the 'regular' one. Just as Free/Libre Open Source Software played a major role in the growth of the Internet and cloud computing, sparking issues about openness and freedom, the Free Software movement has the potential to provide a similar yet different impact on mobile cloud computing.

2. Mobile cloud computing is a need – form factor and other needs

By definition, mobile devices that access the Internet are performing mobile cloud computing: handsets need to borrow storage and computing power from the cloud because of their limited resources or because it makes more sense. For example, consider modern wireless car navigators, like the Dash: these devices not only can store locally the maps and calculate routes, but they rely on the cloud to get real time information about traffic conditions and plan the routes

accordingly.Accessing data in the cloud from mobile devices is becoming a basic need.

3. Mobile cloud needs interoperability

Mobile cloud services are largely dominated by vendor specific walled gardens, and debate is not as intense as one would expect given the numbers of cell phone users. Probably this is due to the fact that not only Free Software powered mobile phones are still a minority, but also installing new software on phones was not an option for the mass market until recently. After iPhone and Android, with more and more 'application stores' emerging, the issue of mobile users' freedom is showing up. Users of one handset, for example, may want to get their email from a provider but sync pictures with another. Or if they buy music from a digital store from the desktop computer, they want to sync their playlists with any phone. A minimum requirement is interoperable services2 implementing open standards, because users' data must be preserved at all costs. Proprietary walled gardens create small monopolies that sometimes grow big and take away personal data from the users. Consider these recent cases that demonstrate that users of mobile cloud services are exposed to serious problems.

Palm Pre owners cannot access the music that they bought and stored in Apple's iTunes: Apple still wants to own the music it sold its users and keep their data hostage. Similar risks are run by owners of Amazon Kindle, who had their purchased books deleted too easily by Amazon from the devices.

The recent fiasco with Microsoft losing people's data is the opening act of how we've all learned that data is not necessarily safe in a proprietary cloud. If one of the world's premier software companies cannot be trusted to keep people's data safe, who can be trusted? Furthermore, do people really want Microsoft, Google to access all their data? With the cloud in general and in particular, the mobile cloud (because you want your mobile data backed up), it is more important than ever that people have the full ability to access and preserve their data, which means the open mobile cloud. These are just visible signals of proprietary services battling to own user data. If iTunes and Microsoft used interoperable and open standards, which could be safely

implemented in free/libre open source software, their users would not face these problems.

4. Mobile cloud is an opportunity for free software providers

With so many new mobile devices hitting the market, billions of new users have the issue of freedom for the software on the device and freedom in the mobile cloud. The Free Software community has the opportunity to participate in the mobile cloud debate and shape this new environment. Ignoring the issues posed by the mobile cloud risks excluding a large number of digital citizens from the benefits that free software has brought to other computer users. The mobile cloud is an open territory where many vendors3 are already fighting to lock-in users.

Resting on the cloud and network services, free and open source software should rely on licenses that prevent abuse. Fortunately, the Free Software Foundation has contributed a very good tool to bring freedom to the cloud. By extending its reach to interaction over a network, the Affero GPL v3 is very effective at bringing copyleft to the services offered by cloud computing. Some people have had the chance to use open source software to offer services to the public, without returning anything to the community. That's taking open source software as free beer. It is just not being honest with the community, to the people who sweat to write the code to see someone running away with it and not contributing anything. Using the AGPLv3 for all software that can be used over a network is a smart way to start building a mobile cloud that respects user's freedom.

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