

Unit 1

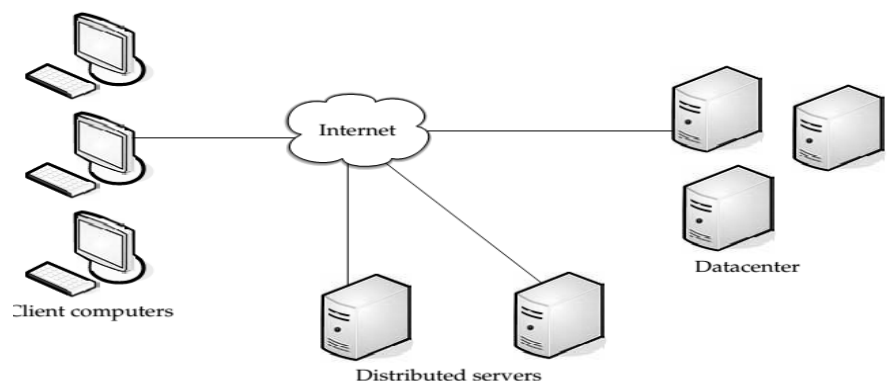
Definition:

Cloud computing is the delivery of computing as a service rather than a product, whereby shared resources, software, and information are provided to computers and other devices as a utility over a network (Internet).

Cloud Computing definition from National Institute of Standards and Technology(NIST), “Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction”.

Cloud Components:

Client Computers, Distributed Servers and Data Centers are the three components of Cloud Computing.



Three components make up a cloud computing solution.

1. Client Computers:

The following are different types of Clients in Cloud Computing.

- **Mobile** Mobile devices include PDAs or smartphones, like a Blackberry, Windows Mobile Smartphone, or an iPhone.
- **Thin** Clients are computers that do not have internal hard drives, but rather let the server do all the work, but then display the information.
- **Thick** This type of client is a regular computer, using a web browser like Firefox or Internet Explorer to connect to the cloud.

The advantages of Thin Clients are

1) Lower hardware costs 2) Lower IT costs 3) Security 4) Data security 5) Less power consumption.

2. Data Center:

The *datacenter* is the collection of servers where the application to which you subscribe is housed. It could be a large room in the basement of your building or a room full of servers on the other side of the world that you access via the Internet.

A growing trend in the IT world is vitalizing servers. That is, software can be installed allowing multiple instances of virtual servers to be used. In this way, you can have half a dozen virtual servers running on one physical server.

3. Distributed Servers:

But the servers don't all have to be housed in the same location. Often, servers are in geographically disparate locations. But to you, the cloud subscriber, these servers act as if they're humming away right next to each other.

This gives the service provider more flexibility in options and security. For instance, Amazon has their cloud solution in servers all over the world. If something were to happen at one site, causing a failure, the service would still be accessed through another site.

Virtualization:

Virtualization enables multiple operating systems and applications to run concurrently and in isolation on a single physical host machine, and multiple virtual machines to share in the resources of the physical host machine ensuring better utilization, optimization and resource efficiency.

VMware defines a virtual machine as “ a representation of a real machine using software that provides an operating environment which can run or host a guest operating system”.

In the context of hardware virtualization, the software abstraction that separates the operating system from the hardware is called the hypervisor (or virtual machine monitor).

The hypervisor creates a virtual platform onto which operating system instances may be executed. This allows the hardware platform to be shared by multiple operating systems and application sets, making it more cost effective.

Host Machine is a “physical machine running the virtualization software”. The virtual machines utilize the physical resources (i.e. memory, hard disk space and CPU) and other resources (i.e. network access) implemented on the host machine. The host machine is therefore the physical machine (server), containing the physical resources (hardware), on which the virtual machine(s) reside.

Guest Operating System is “an operating system running in a virtual machine environment that would otherwise run directly on a separate physical system”. The guest operating system therefore resides within the virtual environment utilising the host operating system resources. The host operating system is the operating system software installed on the physical host machine. The virtualization service runs on top of the standard operating system (host). The host operating system is the layer on top of the physical infrastructure layer.

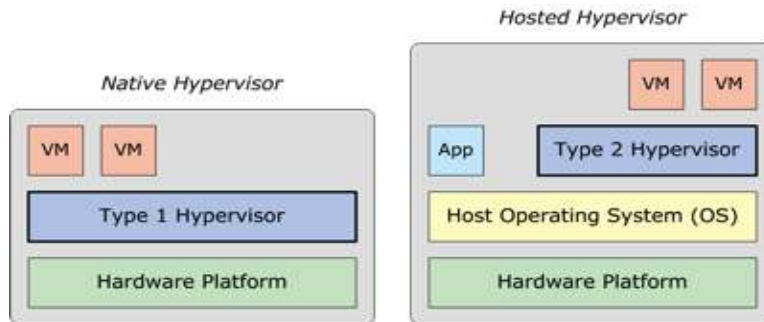
VMware Inc. defines VMM as “software that runs in a layer between a hypervisor or host operating system and one or more virtual machines that provides the virtual machine abstraction to the guest operating systems.

With full virtualization, the virtual machine monitor exports a virtual machine abstraction identical to a physical machine, so that standard operating systems (e.g. Windows 2000, Windows Server 2003, Linux, etc.) can run just as they would on physical hardware”.

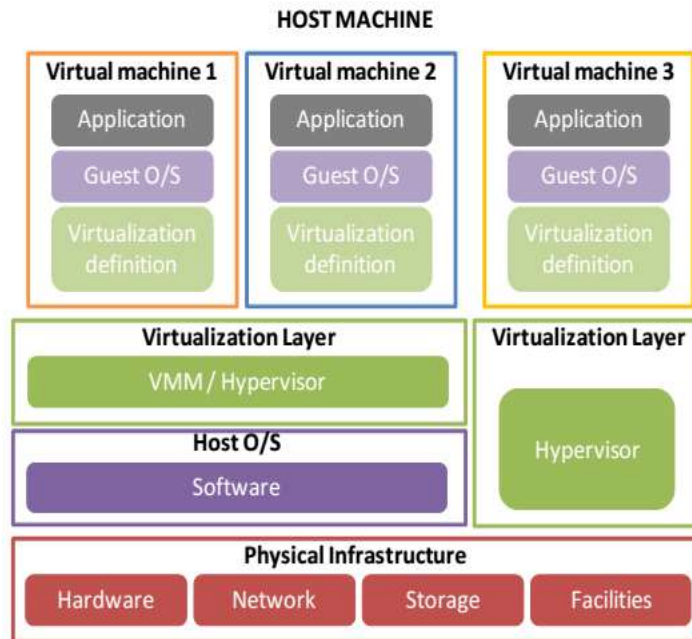
A virtual machine monitor is the software solution that implements virtualization to run in conjunction with the host operating system. The virtual machine monitor virtualizes certain hardware resources, such as the CPU, memory and physical disk, and creates emulated devices for virtual machines running on the host machine.

Hypervisor runs directly on the hardware without any intervening help from the host operating system to provide access to hardware resources. The hypervisor is directly responsible for hosting and managing.

VMware Inc. defines the hypervisor as a thin layer of software, running directly on the hardware but underneath the higher-level virtualization service, and provides virtual partitioning capabilities and is sometimes referred to as a ‘bare metal’ approach.



The above diagram depicts Structure of Native Hypervisor and Hosted Hypervisor. In native hypervisor VM are running on Type 1 Hypervisor and its intern run on Hardware Platform. In Hosted Hypervisor Host Operating System is in between Hypervisor and Hardware Platform. In broad way the following figure shows the structure of VM execution and its underlying support from Hypervisor or Host Operating System.



Para Virtualization:

VMware Inc. defines para-virtualization as “a virtualization approach that exports a modified hardware abstraction which requires operating systems to be explicitly modified and ported to run”. Para-virtualization uses hypercalls to communicate directly with the virtualization layer hypervisor and therefore requires the host and guest operating systems to be modified and recompiled.

Full Virtualization:

Full Virtualization is a combination of binary translation and direct execution. The guest operating system is not aware it is being virtualized and requires no modification. Full-virtualization is the only option that requires no hardware assist or operating system assist to virtualize sensitive and privileged instructions. Full-virtualization makes use of binary translation and direct execution, and does not require any operating system modifications. The following table shows the comparison of Virtualization overhead and System Processing requirement between Full Virtualization and Para Virtualization.

Virtualization Type	Guest Instances	Virtualization Overhead	System Processing Needs	Total
Full Virtualization	5	10% (50% total)	10% (50% total)	100%
Paravirtualization	8	2% (16% total)	10% (50% total)	96%

Processor Power Used in Full Virtualization and Paravirtualization

Services :

The term services in cloud computing is the concept of being able to use reusable, fine grained components across a vendor's network. This is widely known as "as a service."

Offerings with as a service as a suffix include traits like the following:

- Low barriers to entry, making them available to small businesses
- Large scalability
- Multitenancy, which allows resources to be shared by many users
- Device independence, which allows users to access the systems on different hardware

NIST (National Institute of Standards and Technology) broadly divided cloud services into three categories or service models.

- Infrastructure-as-a-Service (IaaS): Includes the entire infrastructure stack i.e. servers, software, datacentre space, virtualization platforms and network equipment.
- Platform-as-a-Service (PaaS): Sits on top of IaaS and adds an additional layer with application development capabilities, and programming languages and tools supporting the complete lifecycle of building and delivering applications and services over a cloud infrastructure.

- Software-as-a-Service (SaaS): Builds upon IaaS and PaaS and provides a self-contained operating environment delivering presentation, application and management capabilities.

Software as a Service:

Software as a Service (SaaS) is the model in which an application is hosted as a service to customers who access it via the Internet. The provider does all the patching and upgrades as well as keeping the infrastructure running.

Costs can be sort of a double-edged sword. On the one hand, costs for accessing the software can be an ongoing thing. Rather than pay for it once and be done with it, the more you use it, the more you'll be billed. On the other hand, in some cases you don't have to pay as much up front and you are only billed based on your use of the application. There are many types of software that lend themselves to the SaaS model. Typically, software that performs a simple task without much need to interact with other systems makes them ideal candidates for SaaS.

There are many types of software that lend themselves to the SaaS model. Typically, software that performs a simple task without much need to interact with other systems makes them ideal candidates for SaaS. Customers who are not inclined to perform software development but have need of high-powered applications can also benefit from SaaS. Some of these applications include.

- Customer resource management (CRM)
- Video conferencing
- IT service management
- Accounting
- Web analytics
- Web content management

Benefits of SaaS:

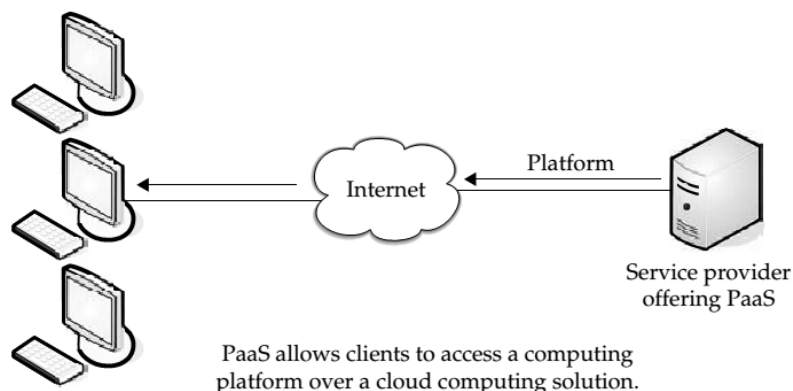
One of the biggest benefits of SaaS is, of course, costing less money than buying the application outright. The service provider can offer cheaper, more reliable applications than organizations can by themselves. Some other benefits include the following:

- **Familiarity with the World Wide Web** Most workers have access to a computer and know how to use it on the World Wide Web. As such, the learning curve for using external applications can be much smaller.
- **Smaller staff** IT systems require the overhead of salaries, benefits, insurance, and building space. The ability to farm out applications reduces the need for as much IT staff.
- **Customization** Older applications were difficult to customize and required tinkering with the code. SaaS applications are much easier to customize and can give an organization exactly what they want.
- **Better marketing** A provider who had developed an application for a very narrow market might have had problems marketing that application. However, with SaaS, the entire world is open to the providers.
- **Web reliability** We talked earlier about how the World Wide Web can be seen as a source of failure. And while that is sporadically true, the fact of the matter is that the Web is generally quite reliable.

Platform as a Service (PaaS):

PaaS is another application delivery model. PaaS supplies all the resources required to build applications and services completely from the Internet, without having to download or install software.

PaaS is also known as cloudware.



PaaS, services include application design, development, testing, deployment, and hosting. Other services include team collaboration, web service integration, database integration, security, scalability, storage, state management, and versioning.

PaaS generally offers some support to help the creation of user interfaces, and is normally based on HTML or JavaScript. Because PaaS is expected to be used by many users simultaneously, it is designed with that sort of use in mind, and generally provides automatic facilities for concurrency management, scalability, failover, and security.

PaaS also supports web development interfaces such as Simple Object Access Protocol (SOAP) and Representational State Transfer (REST), which allow the construction of multiple web services, sometimes called mashups.

PaaS Options PaaS is found in one of three different types of systems:

- **Add-on development facilities** These allow existing SaaS applications to be customized. Often, PaaS developers and users are required to purchase subscriptions to the add-on SaaS application.
- **Stand-alone environments** These environments do not include licensing, technical, or financial dependencies on specific SaaS applications and are used for general developments.
- **Application delivery-only environments** These environments support hosting level services, like security and on-demand scalability. They do not include development, debugging, and test capabilities.

Infrastructure as a Service (IaaS) or Hardware as a Service (HaaS):

Hardware as a Service (HaaS) is the next form of service available in cloud computing. Where SaaS and PaaS are providing applications to customers, HaaS doesn't. It simply offers the hardware so that your organization can put whatever they want onto it.

HaaS allows you to "rent" such resources as

- Server space
- Network equipment
- Memory
- CPU cycles
- Storage space

Additionally, the infrastructure can be dynamically scaled up or down, based on the application resource needs. Further, multiple tenants can be on the equipment at the same time. Resources are typically billed based on a utility computing basis, so providers charge by how many resources are consumed.

HaaS involves several pieces:

- Service level agreements This is an agreement between the provider and client, guaranteeing a certain level of performance from the system.
- Computer hardware These are the components whose resources will be rented out. Service providers often have this set up as a grid for easier scalability.
- Network This includes hardware for firewalls, routers, load balancing, and so on.
- Internet connectivity This allows clients to access the hardware from their own organizations.
- Platform virtualization environment This allows the clients to run the virtual machines they want.
- Utility computing billing Typically set up to bill customers based on how many system resources they use.

Service level agreement: This is an agreement between the provider and client, guaranteeing a certain level of performance from the system.

Cloud Computing Applications:

The most common cloud computing application are Storage and Database.

Storage

Somewhat similar to HaaS, one of the uses for cloud computing is simply storage. The benefits are in line with the general benefits of cloud computing.

Database

Distributed databases, like Amazon's Simple DB, spread information among physically dispersed hardware. But to the client, the information seems to be located in one place.

The advantages of such a database include the following:

- **Improved availability** If there is a fault in one database system, it will only affect one fragment of the information, not the entire database.
- **Improved performance** Data is located near the site with the greatest demand and the database systems are parallelized, which allows the load to be balanced among the servers.
- **Price** It is less expensive to create a network of smaller computers with the power of one large one.
- **Flexibility** Systems can be changed and modified without harm to the entire database.

Database Services

Another "as a service" offering that is becoming prevalent in the world of cloud computing is Database as a Service (DaaS). The idea behind DaaS is to avoid the complexity and cost of running your own database.

DaaS offers these benefits:

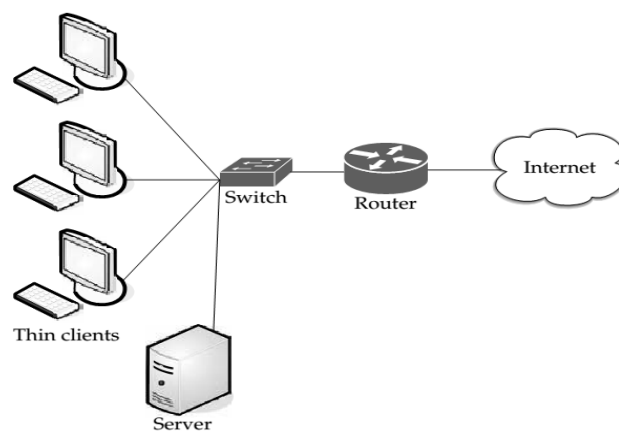
- **Ease of use:** There are no servers to provision and no redundant systems to worry about. User don't have to worry about buying, installing, and maintaining hardware for the database.
- **Power:** The database isn't housed locally, but that doesn't mean that it is not functional and effective. Depending on vendor, user can get custom data validation to ensure accurate information.

- **Integration:** The database can be integrated with end user and other services to provide more value and power. For instance, you can tie it in with calendars, email, and people to make your work more powerful.
- **Management:** Because large databases benefit from constant pruning and optimization, typically there are expensive resources dedicated to this task. With some DaaS offerings, this management can be provided as part of the service for much less expense.

Intranets and the Cloud:

Some organizations use cloud computing to deliver their corporate intranet. Intranets are customarily used within an organization and are not accessible publicly. That is, a web server is maintained in-house and company information is maintained on it that others within the organization can access. However, now intranets are being maintained on the cloud. To access the company's private, in-house information, users have to log on to the intranet by going to a secure public web site.

There are two main components in client/server computing: servers and thin or light clients. The servers house the applications your organization needs to run, and the thin clients (which do not have hard drives) display the results. The following diagram shows client/server computing deployment



A client/server computing deployment consists of servers and thin clients.

Thin clients use an application program to communicate with an application server. Most of the processing is done down on the server, and sent back to the client. Some thin clients require an application program or a web browser to communicate with the server. However, others require no add-on applications at all.

First Movers in the Cloud

There are scores of vendors who offer cloud services.

Amazon

Amazon was one of the first companies to offer cloud services to the public, and they are very sophisticated. Amazon offers a number of cloud services, including

- Elastic Compute Cloud (EC2) Offers virtual machines and extra CPU cycles for your organization.
- Simple Storage Service (S3) Allows you to store items up to 5GB in size in Amazon's virtual storage service.
- Simple Queue Service (SQS) Allows your machines to talk to each other using this message-passing API.
- SimpleDB A web service for running queries on structured data in real time. This service works in close conjunction with Amazon Simple Storage Service (Amazon S3) and Amazon Elastic Compute Cloud (Amazon EC2), collectively providing the ability to store, process, and query data sets in the cloud.

Google

In stark contrast to Amazon's offerings is Google's App Engine. Google offers online documents and spreadsheets, and encourages developers to build features for those and other online software, using its Google App Engine. Google reduced the web applications to a core set of features, and built a good framework for delivering them. Google also offers handy debugging features.

Microsoft

Microsoft's cloud computing solution is called Windows Azure, an operating system that allows organizations to run Windows applications and store files and data using Microsoft's datacenters. It's also offering its Azure Services Platform, which are services that allow developers to establish user identities, manage workflows, synchronize data, and perform other functions as they build software programs on Microsoft's online computing platform.

Key components of Azure Services Platform include

- Windows Azure Provides service hosting and management and low-level scalable storage, computation, and networking.
- Microsoft SQL Services Provides database services and reporting.
- Microsoft .NET Services Provides service-based implementations of .NET Framework concepts such as workflow.
- Live Services Used to share, store, and synchronize documents, photos, and files across PCs, phones, PC applications, and web sites.
- Microsoft SharePoint Services and Microsoft Dynamics CRM Services Used for business content, collaboration, and solution development in the cloud.

When You Can Use Cloud Computing

The following factors are considered to take a decision to use cloud computing or not.

- Cost/benefit ratio
- Speed of delivery
- How much capacity will use
- Whether data is regulated
- Organization's corporate and IT structure

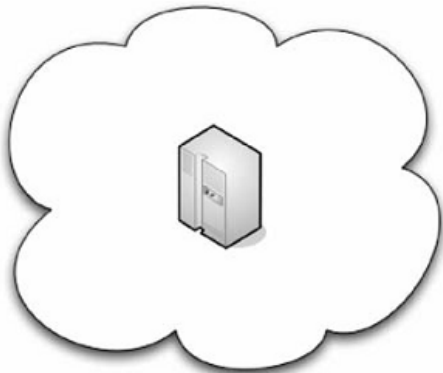
The following are three solutions are used generally based on the user requirements

Compute Clouds

Compute clouds allow access to highly scalable, inexpensive, on-demand computing resources that run the code that they're given.

Three examples of compute clouds are

- Amazon's EC2
- Google App Engine
- Berkeley Open Infrastructure for Network Computing (BOINC)

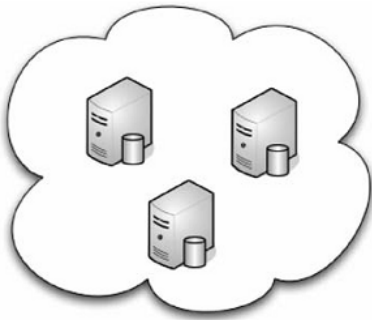


Compute clouds allow you to access applications maintained on a provider's equipment.

These applications are good for any size organization, but large organizations might be at a disadvantage because these applications don't offer the standard management, monitoring, and governance capabilities that these organizations are used to. Enterprises aren't shut out, however. Amazon offers enterprise-class support and there are emerging sets of cloud offerings like Terremark's Enterprise Cloud, which are meant for enterprise use.

Cloud Storage:

One of the first cloud offerings was cloud storage and it remains a popular solution. Cloud storage is a big world. There are already in excess of 100 vendors offering cloud storage. This is an ideal solution if you want to maintain files off-site. Security and cost are the top issues in this field and vary greatly, depending on the vendor you choose. Currently, Amazon's S3 is the top vendor.



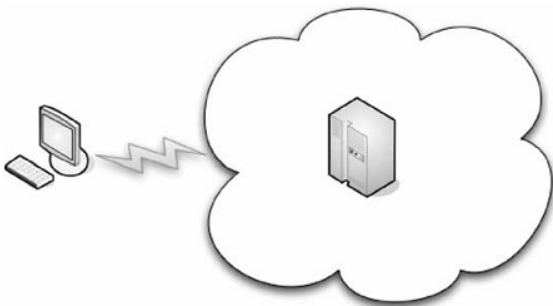
Cloud storage allows you to store your data on a vendor's equipment.

Cloud Applications

Cloud applications differ from compute clouds in that they utilize software applications that rely on cloud infrastructure. Cloud applications are versions of Software as a Service (SaaS) and include such things as web applications that are delivered to users via a browser or application like Microsoft Online Services. These applications offload hosting and IT management to the cloud.

Some cloud applications include

- Peer-to-peer computing (like BitTorrent and Skype)
- Web applications (like MySpace or YouTube)
- SaaS (like Google Apps)
- Software plus services (like Microsoft Online Services)

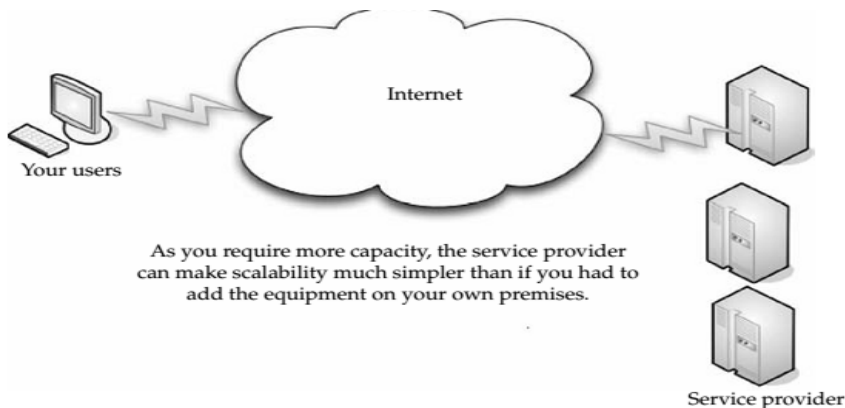


Cloud applications deliver applications that depend on the infrastructure of the Internet itself.

Benefits

The following are the benefits of using cloud computing.

If we are anticipating a huge upswing in computing need, cloud computing can help us to manage. Rather than having to buy, install, and configure new equipment, we can buy additional CPU cycles or storage from a third party. Since our costs are based on consumption, we likely wouldn't have to pay out as much as if we had to buy the equipment.



Simplicity:

Using cloud computing we no need to buy and configure new equipment allows us and our IT staff to get right to our business. The cloud solution makes it possible to get our application started immediately, and it costs a fraction of what it would cost to implement an on-site solution.

Knowledgeable Vendors:

The first comers to the cloud computing party are actually very reputable companies. Companies like Amazon, Google, Microsoft, IBM, and Yahoo! have been good vendors because they have offered reliable service, plenty of capacity.

Security:

There are plenty of security risks when using a cloud vendor, but reputable companies strive to keep us safe and secure. Vendors have strict privacy policies and employ stringent security measures, like proven cryptographic methods to authenticate users. Further, we can always encrypt our data before storing it on a provider's cloud. In some cases, between our encryption and the vendor's security measures, our data may be more secure than if it were stored in-house.

It is often said that this generation of web services got its start from LAMP. LAMP is a stack of simple, powerful web technologies that power a lot of popular, smaller web sites. LAMP stands for the following popular items:

- **Linux** An open-source operating system
- **Apache** An open-source web server
- **MySQL** An open-source Structured Query Language (SQL) relational database for web servers
- **Perl** A programming language

LAMP is widely used because it is very simple. Because of its ease of use, you can get an application up and running very quickly.

Limitations

Some cases are there where cloud computing does not suit for our organization.

Sensitive Information

Consider an example that financial planner is using Google Spreadsheets to maintain a list of employee social security numbers. Now the financial planning company isn't the only one who should protect the data from hackers and internal data breaches. In a technical sense, it also becomes Google's problem. However, Google may absolve itself of responsibility in its agreement with you. So, it's no less complicated a task to sort out how sensitive information is genuinely secured.

The best way is to encrypt your data before you send it to a third party. Programs like PGP (www.pgp.com) or open-source TrueCrypt (www.truecrypt.org) can encrypt the file so that only those with a password can access it. Encrypting your data before sending it out protects it. If someone does get your data, they need the proper credentials or all they get is gibberish.



Encrypting your data before it is sent to the service provider ensures that if the provider's security measures are breached, your data is still secure.

Applications Not Ready

In some cases the applications themselves are not ready to be used on the cloud. They may have little quirks that prevent them from being used to their fullest abilities, or they may not work whatsoever. First, the application might require a lot of bandwidth to

communicate with users. Remember, since cloud computing is paid based on how much you use, it might turn out to be less expensive in the long run to simply house the application locally until it can be rewritten or otherwise modified to operate more efficiently.

Security Concerns, Regulatory Issues

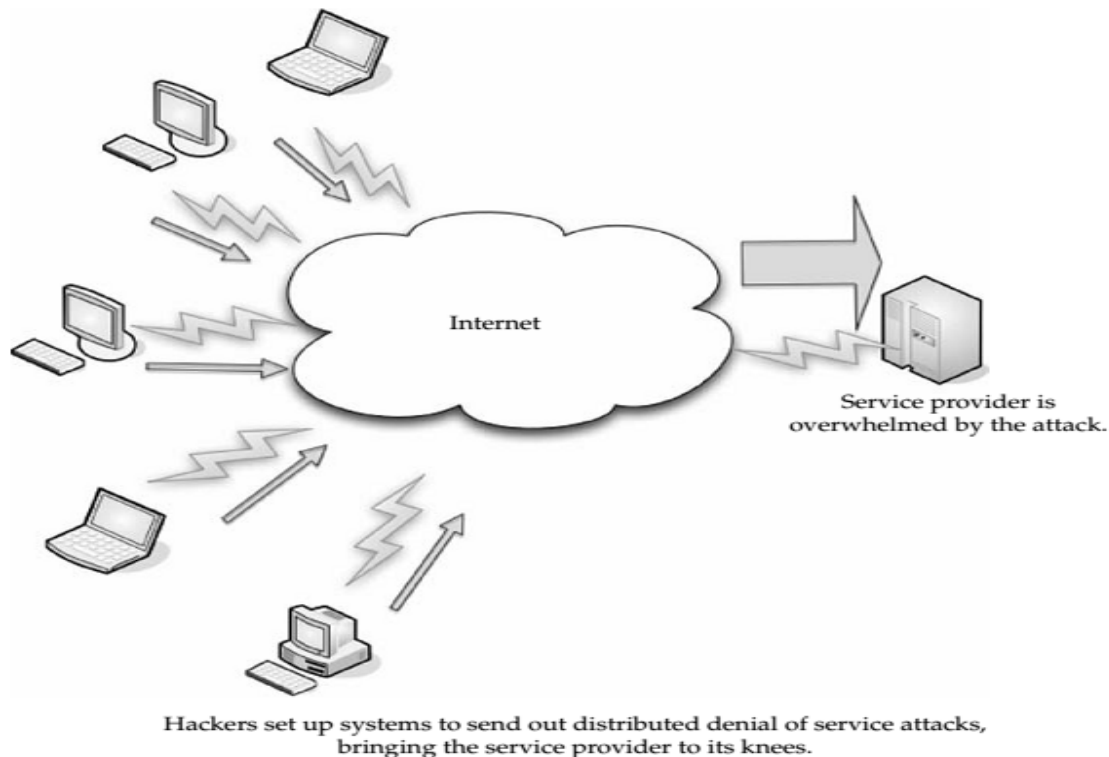
As with so many other technical choices, security is a two-sided coin in the world of cloud computing.

Privacy Concerns with a Third Party

The first and most obvious concern is for privacy considerations. That is, if another party is housing all our data, how do we know that it's safe and secure? we really don't. As a starting point, assume that anything we put on the cloud can be accessed by anyone. There are also concerns because law enforcement has been better able to get at data maintained on a cloud, more so than they are from an organization's servers.

Cloud providers should take care of the following persons for security concerns.

1. Hackers
2. Bot Attackers



Cloud Providers are taking more care of security concerns toward the data and its security for end users. The security Benefits are

1. Centralized Data

There are some good security traits that come with centralizing your data.

2. Reduced Data Loss:

More than 12,000 laptops are lost in American airports every year. It's bad enough to lose your data, but it's especially bad for companies who lose proprietary data or other mission-critical information. Also, how many laptops employ really strong security measures, like whole-disk data encryption? If the laptop can be effectively compromised, the information will be in the hands of the

thief. By maintaining data on the cloud, employing strong access control, and limiting employee downloading to only what they need to perform a task, cloud computing can limit the amount of information that could potentially be lost.

3. Monitoring If your data is maintained on a cloud, it is easier to monitor security than have to worry about the security of numerous servers and clients

4. Logging

In the cloud, logging is improved. Logging is usually thought of late in the game, and issues develop with storage space. For instance, a C2 audit trail can be employed. This is generally rarely used because of the performance hit your network would take. However, in the cloud, you can reach that level of granularity

Regulatory Issues

In the case of cloud computing, however, regulation might be exactly what we need. Without some rules in place, it's too easy for service providers to be unsecure or even shifty enough to make off with our data.

Currently there is no existing regulation, but there should be. In September 2008, the United States government took control of Washington Mutual. It was viewed as the greatest bank failure in American history to date. It reminds us that no matter how huge a company is, it can still come tumbling down. Look at a company like Google, for instance. It's a big one and recently valued at \$107 billion. That size and value would seem to make them bulletproof. But WaMu was worth \$307 billion when it failed.

There are also questions about whether government agencies will store their data on the cloud. Procurement regulations will have to change for government agencies to be keen on jumping on the cloud. The General Services Administration is making a push toward cloud computing, in an effort to reduce the amount of energy their computers consume. Hewlett-Packard and Intel produced a study that shows the federal government spends \$480 million per year on electricity to run its computers.

Cloud Computing with the Titans

Google is one of the big cloud vendor.

1. GoogleAppEngine

Google App Engine enables developers to build their web apps on the same infrastructure that powers Google's own applications.

Features

Leveraging Google App Engine, developers can accomplish the following tasks:

- **Write code once and deploy** Provisioning and configuring multiple machines for web serving and data storage can be expensive and time-consuming. Google App Engine makes it easier to deploy web applications by dynamically providing computing resources as they are needed. Developers write the code, and Google App Engine takes care of the rest.
- **Absorb spikes in traffic** When a web app surges in popularity, the sudden increase in traffic can be overwhelming for applications of all sizes, from startups to large companies that find themselves re-architecting their databases and entire systems several times a year. With automatic replication and load balancing, Google App Engine makes it easier to scale from one user to one million by taking advantage of Bigtable and other components of Google's scalable infrastructure.
- **Easily integrate with other Google services** It's unnecessary and inefficient for developers to write components like authentication and email from scratch for each new application. Developers using Google App Engine can make use of

built-in components and Google's broader library of APIs that provide plug-and-play functionality for simple but important features.

Cost
Google enticed developers by offering the App Engine for free, when it launched, but after a few months slapped on some fees. As of this writing, developers using Google App Engine can expect to pay:

2. EMC

EMC Corporation is the world leader in products, services, and solutions for information storage and management that help organizations extract value from their information. They have their fingers in all sorts of different cloud computing and virtualization pies.

Technologies

But EMC's reach goes far beyond virtualized datacenter management. Their other fields of expertise include

- **Archiving** Creating accessible online archives that offer a reduced operational cost by shrinking backup windows and making restores faster.
- **Backup and recovery** Different tools combine EMC's recovery management offerings, backup technologies, and management strategies to ensure that you have a solid backup and recovery practice.
- **Enterprise content management** Content-enabled solutions help mitigate risk without imposing overly complex technologies on your organization.
- **Intelligent information management** Using various technologies allows organizations to discover, store, and act on information in intelligent ways.
- **IT management** IT management is simplified and its cost reduced through automation, virtualization, and process efficiencies.
- **Replication** Data protection and remote replication technologies provide disaster recovery options.
- **Security** Organizations can deploy products with capabilities for access control, data protection, and auditing.

3. NetApp

NetApp is an organization that creates storage and data management solutions for their customers. Their goal is to deliver cost efficiency and accelerate business breakthroughs. In 1992 they introduced the world's first networked storage device. The company continues to introduce new technologies that reduce the costs of IT. NetApp claims they can cut your IT costs in half, use up to 80 percent less storage, hold off on datacenter expansion, and speed up your time to market.

Offerings

NetApp was one of the first companies in the cloud, offering datacenter consolidation and storage services, as well as virtualization. Their products include a platform OS, storage services, storage security, software management, and protection software. Their solutions run the gamut from Microsoft SQL Server and SharePoint Services to seismic processing and reservoir development to desktop and server virtualization.

Microsoft

Microsoft offers a number of cloud services for organizations of any size—from enterprises all the way down to mom-and-pop shops or individuals. A good portion of Microsoft's cloud offerings are cloud variants of products that people already use, so cloud versions aren't that difficult to use.

Azure Services Platform: The cornerstone of Microsoft's offerings is the Azure Services Platform. The Azure Services Platform is a cloud computing and services platform hosted in Microsoft datacenters. The Azure Services Platform supplies a broad range of functionality to build applications to serve individuals or large enterprises, and everyone in between. The platform offers a cloud operating system and developer tools. Applications can be developed with

industry standard protocols like REST and SOAP. Azure services can be used individually or in conjunction with one another to build new applications or to enhance existing ones. Let's take a closer look at the Azure Services Platform components.

Windows Azure

Windows Azure is a cloud-based operating system that enables the development, hosting, and service management environment for the Azure Services Platform. Windows Azure gives developers an on-demand compute and storage environment that they can use to host, scale, and manage web applications through Microsoft datacenters. To build applications and services, developers can use the Visual Studio skills they already have. Further, Azure supports existing standards like SOAP, REST, and XML.

Windows Azure can be used to

- Add web service capabilities to existing applications
- Build and modify applications and then move them onto the Web
- Make, test, debug, and distribute web services efficiently and inexpensively
- Reduce the costs of IT management

SQL Services

Microsoft SQL Services extends SQL Server capabilities to the cloud as web-based services. This allows the storage of structured, semi-structured, and unstructured data. SQL Services delivers a set of integrated services that allow relational queries, search, reporting, analytics, integration, and synchronization of data. This can be done by mobile users, remote offices, or business partners.

.NET Services

Microsoft .NET Services are a set of Microsoft-hosted, developer-oriented services that provide the components required by many cloud-based and cloud-aware applications. .NET Services are similar to the .NET Framework, providing high-level class libraries that make development much more robust. .NET Services can help developers focus more on their end product than on building and deploying their own cloud-based infrastructure. .NET Services are also available to other development technologies through the use of industry-standard protocols, like REST, SOAP, and HTTP.

Windows-Live

Windows Live is an integrated set of online services that makes it easier and more fun for consumers to communicate and share with others. The new generation of Windows Live includes updated experiences for photo sharing, email, and instant messaging, as well as integration with multiple third-party sites.

4. Amazon

Amazon may be the most widely known cloud vendor. They offer services on many different fronts, from storage to platform to databases. Amazon seems to have their finger in a number of cloud technologies.

Amazon Elastic Compute Cloud (Amazon EC2)

Amazon Elastic Compute Cloud (Amazon EC2) is a web service that offers resizable compute capacity in the cloud and is designed to make web scaling easier for developers. Amazon EC2 provides a simple web interface that allows you to obtain and configure capacity with little difficulty. It allows you control of your computing resources. Amazon EC2 cuts the time it takes to obtain and boot new server instances to a few minutes, allowing you to change scale as your needs change. For instance, Amazon EC2 can run Microsoft Windows Server 2003 and is a way to deploy applications using the Microsoft Web Platform, including ASP.NET, ASP.NET AJAX, Silverlight, and Internet Information Server (IIS).

Amazon SimpleDB:

For database services, Amazon offers its Amazon SimpleDB. It provides core database functions of data indexing and querying. This service works closely with Amazon Simple Storage Service (Amazon S3) and Amazon EC2. This provides the ability to store, process, and query data sets in the cloud.

Amazon Simple Storage Service (Amazon S3)

Amazon Simple Storage Service (Amazon S3) is Amazon's storage solution for the Internet. It is designed to make web-scale computing easier for developers. Amazon S3 utilizes a simple web services interface that can be used to store and retrieve any amount of data from anywhere on the Web. It gives developers access to the same data storage infrastructure that Amazon uses to run its own retail empire.

AmazonCloudFront

Amazon CloudFront is a web service for content delivery. It works in conjunction with other Amazon Web Services to give developers and businesses an easy way to distribute content to clients. Amazon promises low latency, high data transfer speeds, and no commitments.

Amazon Simple Queue Service (Amazon SQS)

Amazon Simple Queue Service (Amazon SQS) offers a scalable, hosted queue for storing messages as they travel between computers. Developers can move data between distributed components of their applications that perform different tasks, without losing messages or requiring each component to be always available. Amazon SQS allows an automated workflow to be created and works closely with Amazon EC2 and other Amazon Web Services.

5. Salesforce.com

Salesforce.com made its name with the success of its flagship Salesforce.com automation application. Today, the company has three primary areas of focus:

- **The Sales Cloud** The popular cloud computing sales application
- **The Service Cloud** The platform for customer service that lets companies tap into the power of customer conversations no matter where they take place
- **Your Cloud** Powerful capabilities to develop custom applications on its cloud computing platform, Force.com

The company has made its platform available to other companies as a place to build and deploy their software services. Force.com offers

- A relational database
- User interface options
- Business logic
- Apex, an integrated development environment
- Workflow and approvals engine
- Programmable interface
- Automatic mobile device deployment
- Web services integration
- Reporting and analytics

Using Apex, programmers can test their applications in Force.com's Sandboxes and then offer the finalized code on Salesforce.com's site. Developers initially used Force.com to create add-ons to the Salesforce CRM, but now it is possible to develop applications that are unrelated to Salesforce.com's offerings.

Salesforce.com is into other cloud services, as well. In April 2007 it moved into enterprise content management with Salesforce.com Content. This makes it possible to store, classify, and share information in a manner similar to Microsoft SharePoint.

Force.com

Force.com is Salesforce.com's on-demand cloud computing platform—billed by Salesforce .com as the world's first PaaS. Force.com features Visualforce, a technology that makes it much simpler for end customers, developers, and independent software vendors (ISVs) to design almost any type of cloud application for a wide range of uses. The Force.com platform offers global infrastructure and services for database, logic, workflow, integration, user interface, and application exchange.

PaaS

Force.com delivers PaaS, a way to create and deploy business apps that allows companies and developers to focus on what their applications do, rather than the software and infrastructure to run them.

Visualforce

As part of the Force.com platform, Visualforce provides the ability to design application user interfaces for practically any experience on any screen. Visualforce uses HTML, AJAX, and Flex, for business applications. Visualforce provides a page-based model, built on standard HTML and web presentation technologies, and is complemented with both a component library for implementing common user interface elements, and a controller model for creating new interactions between those elements.

Visualforce features and capabilities include

- **Pages** Enables the design definition of an application's user interface.
- **Components** Provides the ability to create new applications that automatically match the look and feel of Salesforce.com applications or easily customize and extend the Salesforce.com user interface to specific requirements.
- **Logic Controllers** The controller enables customers to build any user interface behavior.

Salesforce.com CRM

Salesforce.com is a leader in cloud computing customer relationship management (CRM) applications. Its CRM offering consists of the Sales Cloud and the Service Cloud and can be broken down into five core applications:

- **Sales** Easily the most popular cloud computing sales application, Salesforce.com says that CRM Sales is used by more than 1.1 million customers around the world. Its claim to fame is that it is comprehensive and easy to customize. Its value proposition is that it empowers companies to manage people and processes more effectively, so reps can spend more time selling and less time on administrative tasks.
- **Marketing** With Salesforce.com CRM Marketing, marketers can put the latest web technologies to work building pipeline while collaborating seamlessly with their sales organization. The application empowers customers to manage multichannel campaigns and provide up-to-date messaging to sales. And since the application is integrated with the Salesforce.com CRM Sales application, the handoff of leads is automated.
- **Service** The Service Cloud is the new platform for customer service. Companies can tap into the power of customer conversations no matter where they take place. Because it's on the Web, the Service Cloud allows companies to instantly connect to collaborate in real time, share sales information, and follow joint processes. Connecting with partners is made to be as easy as connecting with people on LinkedIn: companies instantly share leads, opportunities, accounts, contacts, and tasks with their partners.
- **Collaboration** Salesforce.com CRM can help an organization work more efficiently with customers, partners, and employees by allowing them to collaborate among themselves in the cloud. Some of the capabilities include
 - Create and share content in real time using Google Apps and Salesforce.com
 - Track and deliver presentations using Content Library
 - Give your community a voice using Ideas and Facebook
 - Tap into the collective wisdom of the sales team with Genius

- **Analytics** Force.com offers real-time reporting, calculations, and dashboards so a business is better able to optimize performance, decision making, and resource allocation.
- **Custom Applications** Custom applications can be quickly created by leveraging one data model, one sharing model, and one user interface.

6. IBM

IBM offers cloud computing services to help businesses of all sizes take advantage of this increasingly attractive computing model. IBM is applying its industry-specific consulting expertise and established technology record to offer secure services to companies in public, private, and hybrid cloud models.

Some of their features include

- **Industry-specific business consulting services for cloud computing** IBM Global Business Services uses an economic model for assessing the total cost of ownership for building private clouds, and/or moving data and applications off-site in a public or hybrid cloud model.
- **Technology consulting, design, and implementation services** IBM Global Technology Services offers services to help clients install, configure, and deliver cloud computing inside the datacenter.
- **Cloud security** Spanning IBM Systems, Software, Services and IBM's Research and X-Force arms, this effort is aimed at re-architecting and redesigning technologies and processes, to infuse security and shield against threats and vulnerabilities in the cloud.

Hardware and Infrastructure

Clients:

The clients are the end users who interact with the cloud providers to get their services.

There are different types of clients that can link to the cloud, and each one offers a different way for the user to interact with users data and applications. Depending on the organization and its needs, end users are using any combination of these devices.

1, Mobiles:

Mobile clients run the gamut from laptops to PDAs and smartphones, like an iPhone or BlackBerry. Mobile clients, of course, have security and speed concerns.

2. Thin Clients

Thin clients are client computers that have no hard drives, no DVD-ROM drives, and simply display what's on the server.. There's also a high level of security, because no data is stored on the thin client. All the data resides in our datacenter or on the cloud, so the risk of a physical breach is small.

3. Thick Clients:

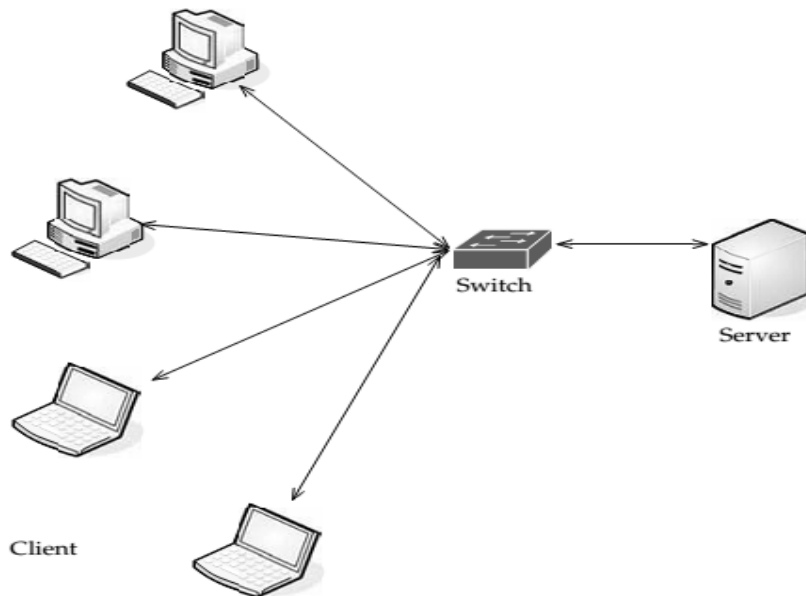
Thick clients are the clients already use and are likely to use to connect to applications in the cloud, and likely already have applications installed on end users' machines. These machines can certainly still connect to a virtualized server, and if we don't want to spend any more money for clients, just use the machines that we already have. Thick clients are good choices if users need to maintain files on their own machines or run programs that don't exist on the cloud. Security-wise, thick clients are more vulnerable to attack than thins. Since data is stored on the machine's hard drive, if the machine is stolen then the data could be compromised. There's also an issue of reliability.

Security :

Security is very important in Cloud computing because third party is storing the data on Cloud.

Data Leakage

The biggest benefit is the centralization of data. Organizations have an issue with asset protection, in no small part because of data being stored in numerous places, like laptops and the desktop. Thick clients are apt to download files and maintain them on the hard drive, and there are plenty of laptops out there with non encrypted files. Using thin clients creates a better chance for centralized data storage. As such, there's less chance for data leakage.



Data store on local server with clients that store data has more opportunity for data leakage than clients that maintain no permanent storage.

Logging

Logging is also improved. It's something that, in-house, usually gets the short end of the stick. But in the virtualized world of cloud computing, providers can add as much memory as they need to extend logging.

Forensics

If there is a breach, the cloud provider can respond to the incident with less downtime than if we had to investigate the breach locally. It is easy to build a forensic server online, and it costs almost nothing until it comes into use. If there is a problem, the virtual machine can be cloned for easy offline analysis.

Auditing

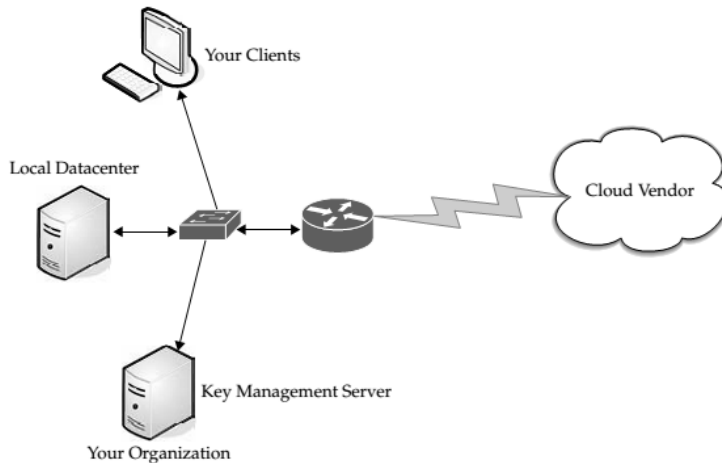
As an IT professional, we already know the headache of securing our own local network. But when we send our data to the cloud, a whole new set of issues arise. This is largely because our data is being stored on someone else's equipment.

VPNs

With applications being moved to the cloud, it makes it possible for each and every worker to be a telecommuter.

Key Management:

With cloud storage, be sure to protect it cryptographically as well. This includes encrypting the data we store and ensuring that data is set up to be destroyed when the storage key is destroyed.



The above diagram shows the key management in cloud computing. With cloud storage, be sure to protect it cryptographically as well. This includes encrypting the data we store and ensuring that data is set up to be destroyed when the storage key is destroyed.

Keys on the server include

- Transport keys
- Authentication keys
- Authorization tokens
- File encryption keys
- Hardware storage keys
- Revocation keys
- Certificates

Network:

Basic Public Internet: The first option is the pipe most of us have coming into our office or homes. The public Internet is the most basic choice for cloud connectivity. This is the type of access that we buy from an Internet service provider (ISP) and connect with via broadband or dial-up, based on our location.

This model has the following advantages:

- There's a large audience. Anyone with Internet access can use this solution.
- It's highly fault tolerant.
- Many provider options are available.
- Secure Sockets Layer (SSL)–based, Hypertext Transport Protocol Over Secure Sockets Layer (HTTPS), encrypted access provides confidentiality.
- It's cost-effective.

Optimized Internet Overlay

An optimized Internet overlay approach allows customers to access the cloud via the public Internet, but enhancement occurs on the provider's cloud. Enhancements at these points of presence (POP) include

- Optimized real-time routing. This helps avoid slowdowns, helping to make SLAs easier to attain.
- An SSL session can be stopped so that protocols and payload can be optimized and re-encrypted.
- Some of the application logic can reside on the POP. This allows for better scalability, fault tolerance, and response time, usually in excess of 80 percent.
- Content that is frequently accessed can be delivered from local caches.

Connection Method	Description	Examples of Use
Basic public internet	Anyone can use it Fault tolerant Multiple providers Cost-effective Performance issues for globally delivered applications	Consumer applications Advertising supported services Applications where "best effort" service is sufficient
Accelerated internet	Improved end-user performance Inconsistent performance, based on provider and ISP configuration Low cost	Best for cost-sensitive service where improved response times and bandwidth are necessary
Optimized overlay	Consistent performance Ability to have strong SLAs Expensive Limited provider options Provider risk	Business-critical applications that require SLAs delivering promised response times and bandwidth
Site-to-site VPN	Ability to have strong SLAs Site-specific delivery Consistent performance Lowest latency Limited reach	Business-critical applications, including server-to-server traffic

SERVICES

They are different types of services provided by cloud vendors.

Identity:

No matter where an application runs (in-house or on the cloud), it needs to know about its users. To accomplish this, the application asks for a digital identity—a set of bytes—to describe the user. Based on this information, the application can determine who the user is and what he or she is allowed to do. In-house applications rely on services like Active Directory to provide this information. Clouds, however, have to use their own identity services. For instance, if we sign on to Amazon cloud services, we have to sign on using an Amazon-defined identity. Google's App Engine requires a Google account, and Windows uses Windows Live ID for use with Microsoft's cloud applications.

OpenID authentication is used by many organizations, including:

- Google
- IBM
- Microsoft
- Yahoo

Integration

Applications talking among themselves have become highly common. Vendors come up with all sorts of on-premises infrastructure services to accomplish it. These range from technologies like message queues to complex integration servers. Integration is also on the cloud and technologies are being developed for that use, as well. For example, Amazon's Simple Queue Service (SQS) provides a way for applications to exchange messages via queues in the cloud.

Mapping

Maps are becoming more and more popular in web applications. For instance, hotel and restaurant web sites show their locations on their web sites and allow visitors to enter their addresses to get customized directions.

Payments

Another cloud service that you might want to plan for and configure your hardware appropriately for is payments. Depending on your organization, you may or may not want to accept online payments from customers. Luckily, there is no lack of ways to get paid online.

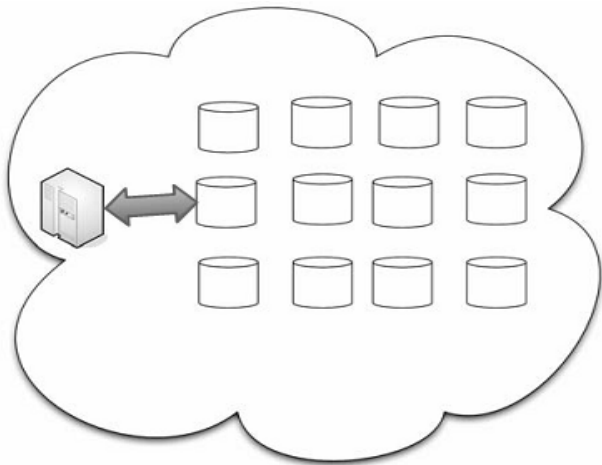
Search

The ability to embed search options in a web site is certainly nothing new, but it is a rich feature that you might want to employ in your own web or application development. Microsoft's Live Search allows on-site and cloud applications to submit searches and then get the results back.

Cloud Storage:

Cloud storage is nothing but storing our data with a cloud service provider rather than on a local system, as with other cloud services, we can access the data stored on the cloud via an Internet link. Cloud storage has a number of advantages over traditional data storage. If we store our data on a cloud, we can get at it from any location that has Internet access.

At the most rudimentary level, a cloud storage system just needs one data server connected to the Internet. A subscriber copies files to the server over the Internet, which then records the data. When a client wants to retrieve the data, he or she accesses the data server with a web-based interface, and the server then either sends the files back to the client or allows the client to access and manipulate the data itself.



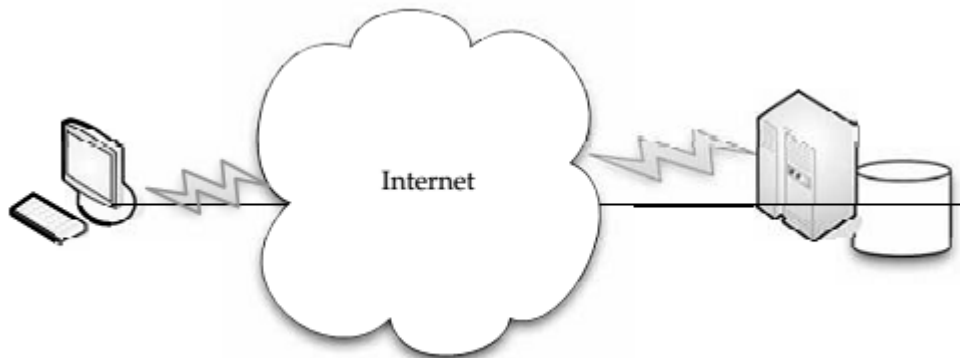
A cloud service provider can simply add more commodity hard drives to increase the organization's capacity.

Cloud storage systems utilize dozens or hundreds of data servers. Because servers require maintenance or repair, it is necessary to store the saved data on multiple machines, providing redundancy. Without that redundancy, cloud storage systems couldn't assure clients that they could access their information at any given time. Most systems store the same data on servers using different power supplies. That way, clients can still access their data even if a power supply fails.

Storage as a Service

The term Storage as a Service (another Software as a Service, or SaaS, acronym) means that a third-party provider rents space on their storage to end users who lack the budget or capital budget to pay for it on their own. It is also ideal when technical personnel are not available or have inadequate knowledge to implement and maintain that storage infrastructure. Storage service providers are nothing new, but given the complexity of current backup, replication, and disaster recovery needs, the service has become popular, especially among

small and medium-sized businesses. Storage is rented from the provider using a cost-per-gigabyte-stored or cost-per-data-transferred model. The end user doesn't have to pay for infrastructure; they simply pay for how much they transfer and save on the provider's servers.



Clients rent storage capacity from cloud storage vendors.

A customer uses client software to specify the backup set and then transfers data across a WAN. When data loss occurs, the customer can retrieve the lost data from the service provider.

Providers

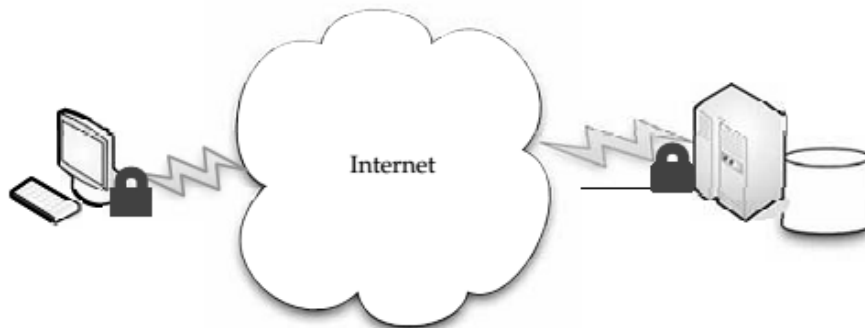
They are hundreds of cloud storage providers on the Web, and more seem to be added each day. Not only are there general-purpose storage providers, but there are some that are very specialized in what they store.

- Google Docs allows users to upload documents, spreadsheets, and presentations to Google's data servers. Those files can then be edited using a Google application.
- Web email providers like Gmail, Hotmail, and Yahoo! Mail store email messages on their own servers. Users can access their email from computers and other devices connected to the Internet.
- Flickr and Picasa host millions of digital photographs. Users can create their own online photo albums.
- YouTube hosts millions of user-uploaded video files.
- Hostmonster and GoDaddy store files and data for many client web sites.
- Facebook and MySpace are social networking sites and allow members to post pictures and other content. That content is stored on the company's servers.
- MediaMax and Strongspace offer storage space for any kind of digital data.

Security:

To secure data, most systems use a combination of techniques:

- **Encryption** A complex algorithm is used to encode information. To decode the encrypted files, a user needs the encryption key. While it's possible to crack encrypted information, it's very difficult and most hackers don't have access to the amount of computer processing power they would need to crack the code.
- **Authentication processes** This requires a user to create a name and password.
- **Authorization practices** The client lists the people who are authorized to access information stored on the cloud system. Many corporations have multiple levels of authorization. For example, a front-line employee might have limited access to data stored on the cloud and the head of the IT department might have complete and free access to everything.



Encryption and authentication are two security measures you can use to keep your data safe on a cloud storage provider.

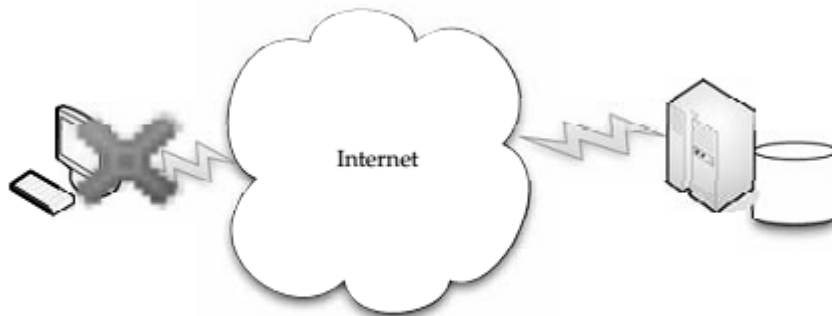
Reliability

Most cloud storage providers try to address the reliability concern through redundancy, but the possibility still exists that the system could crash and leave clients with no way to access their saved data.

Advantages

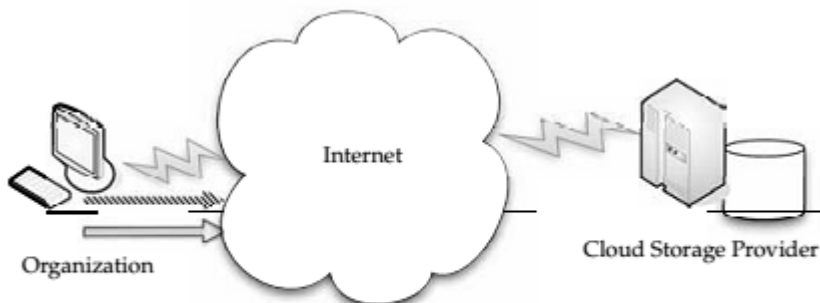
Cloud storage is becoming an increasingly attractive solution for organizations. That's because with cloud storage, data resides on the Web, located across storage systems rather than at a designated corporate hosting site. Cloud storage providers balance server loads and move data among various datacenters, ensuring that information is stored close to where it is used. Storing data on the cloud is advantageous, because it allows us to protect our data in case there's a disaster. We may have backup files of our critical information, but if there is a fire or a hurricane wipes out our organization, having the backups stored locally doesn't help. Amazon S3 is the best-known storage solution, but other vendors might be better for large

enterprises. For instance, those who offer service level agreements and direct access to customer support are critical for a business moving storage to a service provider.



If there is a catastrophe at your organization, having your files backed up at a cloud storage provider means you won't have lost all your data.

A lot of companies take the “appetizer” approach, testing one or two services to see how well they mesh with their existing IT systems. It’s important to make sure the services will provide what we need before we commit too much to the cloud.



Many companies test out a cloud storage vendor with one or two services before committing too much to them. This “appetizer” approach ensures the provider can give you what you want.

Cloud Storage Providers

Amazon and Nirvanix are the current industry top storage providers.

Amazon Simple Storage Service (S3)

The best-known cloud storage service is Amazon’s Simple Storage Service (S3), which launched in 2006.

Amazon S3 is designed to make web-scale computing easier for developers. Amazon S3 provides a simple web services interface that can be used to store and retrieve any amount of data, at any time, from anywhere on the Web. It gives any developer access to the same highly scalable data storage infrastructure that Amazon uses to run its own global network of web

sites. The service aims to maximize benefits of scale and to pass those benefits on to developers.

Amazon S3 is intentionally built with a minimal feature set that includes the following functionality:

- Write, read, and delete objects containing from 1 byte to 5 gigabytes of data each. The number of objects that can be stored is unlimited.
- Each object is stored and retrieved via a unique developer-assigned key.
- Objects can be made private or public, and rights can be assigned to specific users.
- Uses standards-based REST and SOAP interfaces designed to work with any Internet-development toolkit.

Design Requirements

Amazon built S3 to fulfill the following design requirements:

- **Scalable** Amazon S3 can scale in terms of storage, request rate, and users to support an unlimited number of web-scale applications.
- **Reliable** Store data durably, with 99.99 percent availability. Amazon says it does not allow any downtime.
- **Fast** Amazon S3 was designed to be fast enough to support high-performance applications. Server-side latency must be insignificant relative to Internet latency. Any performance bottlenecks can be fixed by simply adding nodes to the system.
- **Inexpensive** Amazon S3 is built from inexpensive commodity hardware components. As a result, frequent node failure is the norm and must not affect the overall system. It must be hardware-agnostic, so that savings can be captured as Amazon continues to drive down infrastructure costs.
- **Simple** Building highly scalable, reliable, fast, and inexpensive storage is difficult. Doing so in a way that makes it easy to use for any application anywhere is more difficult. Amazon S3 must do both.

Design Principles

Amazon used the following principles of distributed system design to meet Amazon S3 requirements:

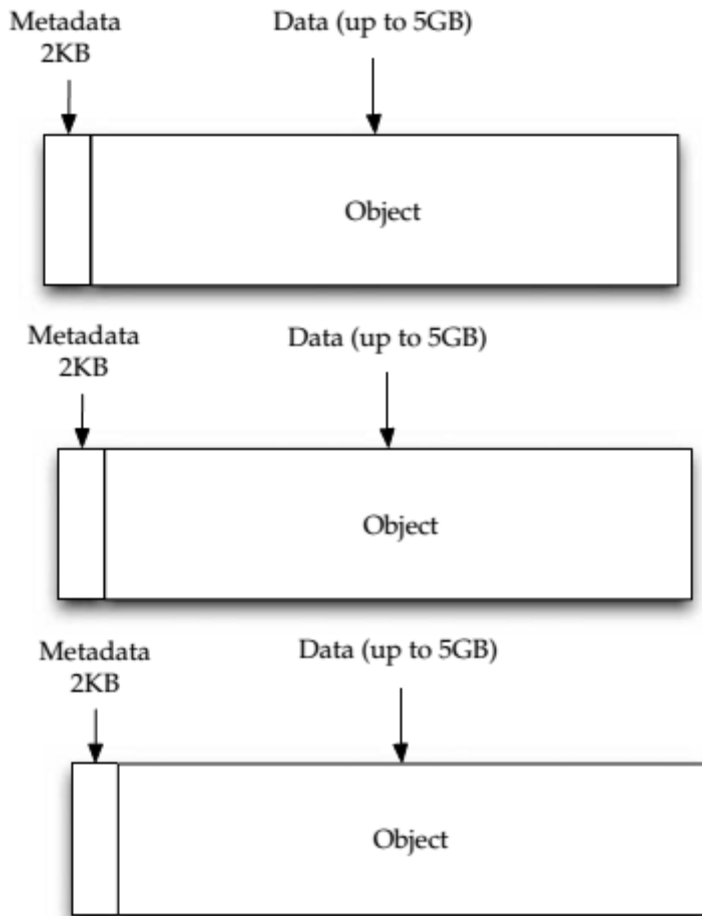
- **Decentralization** It uses fully decentralized techniques to remove scaling bottlenecks and single points of failure.
- **Autonomy** The system is designed such that individual components can make decisions based on local information.
- **Local responsibility** Each individual component is responsible for achieving its consistency; this is never the burden of its peers.
- **Controlled concurrency** Operations are designed such that no or limited concurrency control

is required.

- **Failure toleration** The system considers the failure of components to be a normal mode of operation and continues operation with no or minimal interruption.
- **Controlled parallelism** Abstractions used in the system are of such granularity that parallelism can be used to improve performance and robustness of recovery or the introduction of new nodes.
- **Small, well-understood building blocks** Do not try to provide a single service that does everything for everyone, but instead build small components that can be used as building blocks for other services.
- **Symmetry** Nodes in the system are identical in terms of functionality, and require no or minimal node-specific configuration to function.
- **Simplicity** The system should be made as simple as possible, but no simpler.

How S3 Works

S3 stores arbitrary objects at up to 5GB in size, and each is accompanied by up to 2KB of metadata. Objects are organized by *buckets*. Each bucket is owned by an AWS account and the buckets are identified by a unique, user-assigned key.



Multiple objects are stored in buckets in Amazon S3.

Buckets and objects are created, listed, and retrieved using either a REST-style or SOAP interface. Objects can also be retrieved using the HTTP GET interface or via BitTorrent.

An access control list restricts who can access the data in each bucket. Bucket names and keys are formulated so that they can be accessed using HTTP. Requests are authorized using an access control list associated with each bucket and object, for instance:

Nirvanix

Nirvanix uses custom-developed software and file system technologies running on Intel storage servers at six locations on both coasts of the United States. They continue to grow, and expect to add dozens more server locations. SDN Features Nirvanix Storage Delivery Network (SDN) turns a standard 1U server into an infinite capacity network attached storage (NAS) file accessible by popular applications and immediately integrates into an organization's existing archive and backup processes.

Nirvanix has built a global cluster of storage nodes collectively referred to as the Storage Delivery Network (SDN), powered by the Nirvanix Internet Media File System (IMFS). The SDN intelligently stores, delivers, and processes storage requests in the best network location, providing the best user experience in the marketplace.

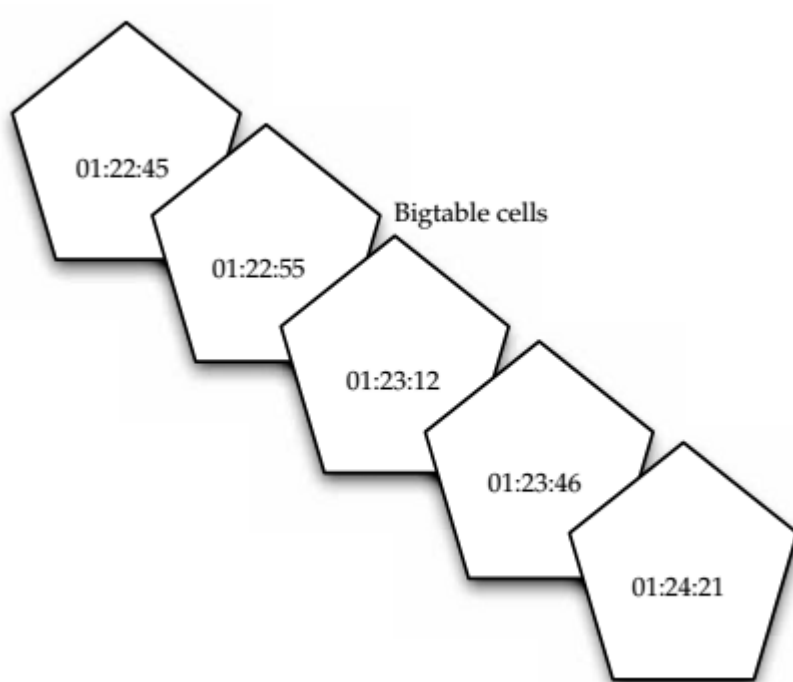
Benefits of CloudNAS: The benefits of cloud network attached storage (CloudNAS) include

- Cost savings of 80–90 percent over managing traditional storage solutions
- Elimination of large capital expenditures while enabling 100 percent storage utilization
- Encrypted offsite storage that integrates into existing archive and backup processes
- Built-in data disaster recovery and automated data replication on up to three geographically dispersed storage nodes for a 100% SLA
- Immediate availability to data in seconds, versus hours or days on offline tape

Google Bigtable:

Datastore In cloud computing, it's important to have a database that is capable of handling numerous users on an on-demand basis. To serve that market, Google introduced its Bigtable. Google started working on it in 2004 and finally went public with it in April 2008. Bigtable was developed with very high speed, flexibility, and extremely high scalability in mind. A Bigtable database can be petabytes in size and span thousands of distributed servers. Bigtable is available to developers as part of the Google App Engine, their cloud computing platform.

Google describes Bigtable as a fast and extremely scalable DBMS. This allows Bigtable to scale across thousands of commodity servers that can collectively store petabytes of data. Each table in Bigtable is a multidimensional sparse map. That is, the table is made up of rows and columns, and each cell has a timestamp. Multiple versions of a cell can exist, each with a different timestamp. With this stamping, we can select certain versions of a web page, or delete cells that are older than a given date and time.



In Google Bigtable, multiple copies of a cell exist, each with a different timestamp.

Standards

Standards make the World Wide Web go around, and by extension, they are important to cloud computing. Standards are what make it possible to connect to the cloud and what make it possible to develop and deliver content.

Applications

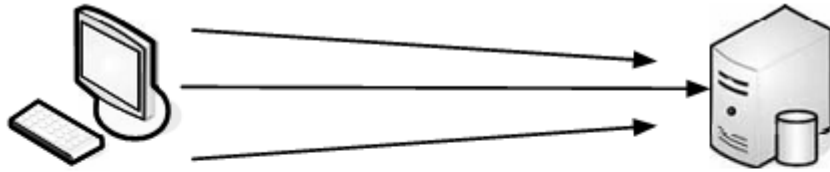
A cloud application is the software architecture that the cloud uses to eliminate the need to install and run on the client computer. There are many applications that can run, but there needs to be a standard way to connect between the client and the cloud.

HTTP

To get a web page from our cloud provider, we will likely be using the Hypertext Transfer Protocol (HTTP) as the computing mechanism to transfer data between the cloud and our organization. HTTP is a stateless protocol. This is beneficial because hosts do not need to retain information about users between requests, but this forces web developers to use alternative methods for maintaining users' states. HTTP is the language that the cloud and our computers use to communicate.

XMPP

The Extensible Messaging and Presence Protocol (XMPP) is being talked about as the next big thing for cloud computing.



HTTP requires multiple polling events to update status from the web browser.



XMPP maintains a connection between the client and the web server.

The Problem with Polling When we wanted to sync services between two servers, the most common means was to have the client ping the host at regular intervals. This is known as polling. This is generally how we check our email. Every so often, we ping our email server to see if we got any new messages. It's also how the APIs for most web services work.

SSL is the standard security technology for establishing an encrypted link between a web server and browser. This ensures that data passed between the browser and the web server stays private. To create an SSL connection on a web server requires an SSL certificate. When our cloud provider starts an SSL session, they are prompted to complete a number of questions about the identity of their company and web site. The cloud provider's computers then generate two cryptographic keys—a public key and a private key.



1. The browser checks the web site's certificate to ensure that the site you are connecting to is the real site and not someone else intercepting and spoofing the site.
2. The browser and web site decide on what type of encryption to use.
3. The browser and server send each other unique codes to use when encrypting information to be sent.
4. The browser and server use the encryption to start talking.
5. The browser shows the encrypting icon, and web pages are passed as secured.

Standards – Client

HTML

DHTML

There are four parts to DHTML:

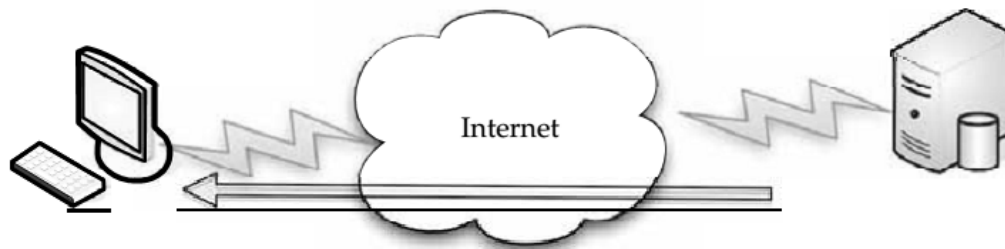
- Document Object Model (DOM)
- Scripts
- Cascading Style Sheets (CSS)
- XHTML

JavaScript

Infrastructure

Infrastructure is a way to deliver virtualization to our cloud computing solution.

Virtualization: Whenever something new happens in the world of computing, competitors duke it out to have their implementation be the standard. Virtualization is somewhat different, and major players worked together to develop a standard.



In a virtualized environment, applications run on a server and are displayed on the client. The server can be local or on the other side of the cloud.

VMware, AMD, BEA Systems, BMC Software, Broadcom, Cisco, Computer Associates International, Dell, Emulex, HP, IBM, Intel, Mellanox, Novell, QLogic, and Red Hat all worked together to advance open virtualization standards. VMware says that it will provide its partners with access to VMware ESX Server source code and interfaces under a new program called VMware Community Source. This program is designed to help partners influence the direction of VMware ESX Server through a collaborative development model and shared governance process.

These initiatives are intended to benefit end users by

- Expanding virtualization solutions The availability of open-standard virtualization interfaces and the collaborative nature of VMware Community Source are intended to accelerate the availability of new virtualization solutions.
- Expanded interoperability and supportability Standard interfaces for hypervisors are expected to enable interoperability for customers with heterogeneous virtualized environments.
- Accelerated availability of new virtualization-aware technologies Vendors across the technology stack can optimize existing technologies and introduce new technologies for running in virtual environments.

Open Hypervisor Standards

Hypervisors are the foundational component of virtual infrastructure and enable computer system partitioning. An open-standard hypervisor framework can benefit customers by enabling innovation across an ecosystem of interoperable virtualization vendors and solutions.

VMware contributed an existing framework of interfaces, called Virtual Machine Hypervisor Interfaces (VMHI), based on its virtualization products to facilitate the development of these standards in an industry-neutral manner.

Community Source

The Community Source program provides industry partners with an opportunity to access VMware ESX Server source code under a royalty-free license. Partners can contribute shared code or create binary modules to spur and extend interoperable and integrated virtualization solutions. The idea is to combine the best of both the traditional commercial and open-source development models. Community members can participate and influence the governance of VMware ESX Server through an architecture board.

OVF

As the result of VMware and its industry partners' efforts, a standard has already been developed called the Open Virtualization Format (OVF). OVF describes how virtual appliances can be packaged in a vendor-neutral format to be run on any hypervisor. It is a platform-independent, extensible, and open specification for the packaging and distribution of virtual appliances composed of one or more virtual machines.

VMware developed a standard with these features:

- Optimized for distribution
- Enables the portability and distribution of virtual appliances
- Supports industry-standard content verification and integrity checking
- Provides a basic scheme for the management of software licensing
- A simple, automated user experience
- Enables a robust and user-friendly approach to streamlining the installation process
- Validates the entire package and confidently determines whether each virtual machine should be installed

- Verifies compatibility with the local virtual hardware
- Portable virtual machine packaging
- Enables platform-specific enhancements to be captured
- Supports the full range of virtual hard disk formats used for virtual machines today, and is extensible to deal with future formats that are developed
- Captures virtual machine properties concisely and accurately
- Vendor and platform independent
- Does not rely on the use of a specific host platform, virtualization platform, or guest operating system
- Extensible
- Designed to be extended as the industry moves forward with virtual appliance technology
- Localizable
- Supports user-visible descriptions in multiple locales
- Supports localization of the interactive processes during installation of an appliance
- Allows a single packaged appliance to serve multiple market opportunities

Service

A web service, as defined by the World Wide Web Consortium (W3C), “is a software system designed to support interoperable machine-to-machine interaction over a network” that may be accessed by other cloud computing components. Web services are often web API’s that can be accessed over a network, like the Internet, and executed on a remote system that hosts the requested services.

Data

Data can be stirred and served up with a number of mechanisms; two of the most popular are JSON and XML.

JSON

JSON is short for JavaScript Object Notation and is a lightweight computer data interchange format. It is used for transmitting structured data over a network connection in a process called serialization. It is often used as an alternative to XML.

JSON Basics JSON is based on a subset of JavaScript and is normally used with that language. However, JSON is considered to be a language-independent format, and code for parsing and generating JSON data is available for several programming languages. This makes it a good replacement for XML when JavaScript is involved with the exchange of data, like AJAX.

XML vs. JSON: JSON should be used instead of XML when JavaScript is sending or receiving data. The reason for this is that when we use XML in JavaScript, we have to write scripts or use libraries to handle the DOM objects to extract the data our need. However, in JSON, the object is already an object, so no extra work needs to be done.

Example The following is a sample JSON representation of an object describing a person:

```
{
  "firstName": "Johnny",
  "lastName": "Johnson",
  "address": {
    "streetAddress": "123 Main Street",
    "city": "Minneapolis",
    "state": "MN",
    "postalCode": 55102
  },
  "phoneNumbers": [
    "612 555-9871",
    "952 555-1598"
  ]
}
```

XML

Extensible Markup Language (XML) is a standard, self-describing way of encoding text and data so that content can be accessed with very little human interaction and exchanged across a wide variety of hardware, operating systems, and applications. XML provides a standardized way to represent text and data in a format that can be used across platforms. It can also be used with a wide range of development tools and utilities.

HTML vs XML

- Separation of form and content HTML uses tags to define the appearance of text, while XML tags define the structure and the content of the data. Individual applications will be specified by the application or associated style sheet.
- XML is extensible Tags can be defined by the developer for specific application, while HTML's tags are defined by W3C.

Benefits of XML include:

- **Self-describing data** XML does not require relational schemata, file description tables, external data type definitions, and so forth. Also, while HTML only ensures the correct presentation of the data, XML also guarantees that the data is usable.
- **Database integration** XML documents can contain any type of data—from text and numbers to multimedia objects to active formats like Java.
- **No reprogramming** if modifications are made Documents and web sites can be changed with XSL Style Sheets, without having to reprogram the data.
- **One-server view of data** XML is exceptionally ideal for cloud computing, because data spread across multiple servers looks as if it is stored on one server.
- **Open and extensible** XML's structure allows us to add other elements if we need them. We can easily adapt our system as our business changes.
- **Future-proof** The W3C has endorsed XML as an industry standard, and it is supported by all leading software providers. It's already become industry standard in fields like healthcare.
- **Contains machine-readable context information** Tags, attributes, and element structure provide the context for interpreting the meaning of content, which opens up possibilities for development.
- **Content vs. presentation** XML tags describe the meaning of the object, not its presentation. That is, XML describes the look and feel of a document, and the application presents it as described.

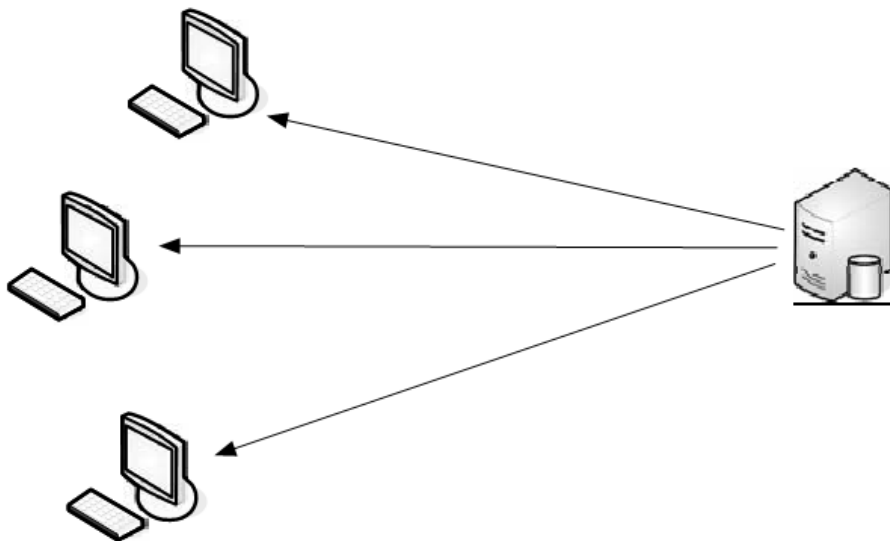
Web Services

Web services describe how data is transferred from the cloud to the client.

REST

Representational state transfer (REST) is a way of getting information content from a web site by reading a designated web page that contains an XML file that describes and includes the desired content.

For instance, REST could be used by our cloud provider to provide updated subscription information. Every so often, the provider could prepare a web page that includes content and XML statements that are described in the code. Subscribers only need to know the uniform resource locator (URL) for the page where the XML file is located, read it with a web browser, understand the content using XML information, and display it appropriately.



Clients send a request to the web server for information, using the same URL. The web site has updated its content, and uses REST to send the information back to the clients.

REST is similar in function to the Simple Object Access Protocol (SOAP), but is easier to use. SOAP requires writing or using a data server program and a client program (to request the data). However, SOAP offers more capability. For instance, if we were to provide syndicated content from our cloud to subscribing web sites, those subscribers might need to use SOAP, which allows greater program interaction between the client and the server.

Benefits REST offers the following benefits:

- It gives better response time and reduced server load due to its support for the caching of representations.
- Server scalability is improved by reducing the need to maintain session state.
- A single browser can access any application and any resource, so less client-side software needs to be written.
- A separate resource discovery mechanism is not needed, due to the use of hyperlinks in representations.
- Better long-term compatibility and evolvability characteristics exist than in RPC.

This is due to:

- The ability of documents, like HTML, to evolve with both forward- and backward-compatibility.
- Resources can add support for new content types as they are defined, without eliminating support for older content types.

SOAP

Simple Object Access Protocol (SOAP) is a way for a program running in one kind of operating system (such as Windows Vista) to communicate with a program in the same or another kind of an operating system (such as Linux) by using HTTP and XML as the tools to exchange information.

Procedure Calls Often, remote procedure calls (RPC) are used between objects like DCOM or COBRA, but HTTP was not designed for this use. RPC is a compatibility problem, because firewall and proxy servers will block this type of traffic. Because web protocols already are installed and available for use by the major operating systems, HTTP and XML provide an easy solution to the problem of how programs running under different operating systems in a network can communicate with each other.

SOAP describes exactly how to encode an HTTP header and an XML file so that a program on one computer can call a program in another computer and pass it information. It also explains how a called program can return a response.

SOAP was developed by Microsoft, DevelopMentor, and Userland Software.

One of the advantages of SOAP is that program calls are more likely to get through firewalls that normally screen out requests for those applications. Because HTTP requests are normally allowed through firewalls, programs using SOAP can communicate with programs anywhere.

Sample When you look at the following SOAP example, you can see how it is based on HTTP. In fact, the first line in the request is nearly identical to a standard HTTP request. Here is the request fully written out:

```
POST /InStock HTTP/1.1
Host: www.example.org
Content-Type: application/soap+xml; charset=utf-8
Content-Length: nnn

<?xml version="1.0"?>
<soap:Envelope
xmlns:soap="http://www.w3.org/2001/12/soap-envelope"
soap:encodingStyle="http://www.w3.org/2001/12/soap-encoding">

  <soap:Body xmlns:m="http://www.example.org/stock">
    <m:GetStockPrice>
      <m:StockName>IBM</m:StockName>
    </m:GetStockPrice>
  </soap:Body>
</soap:Envelope>
```

And like a standard HTTP response, a SOAP response follows the similar format. Here is a sample SOAP response:

```
HTTP/1.1 200 OK
Content-Type: application/soap+xml; charset=utf-8
Content-Length: nnn

<?xml version="1.0"?>
<soap:Envelope
xmlns:soap="http://www.w3.org/2001/12/soap-envelope"
soap:encodingStyle="http://www.w3.org/2001/12/soap-encoding">

  <soap:Body xmlns:m="http://www.example.org/stock">
    <m:GetStockPriceResponse>
      <m:Price>34.5</m:Price>
    </m:GetStockPriceResponse>
  </soap:Body>

</soap:Envelope>
```

Standards are extremely important, and something that we take for granted these days. For instance, it's nothing for us to email Microsoft Word documents back and forth and expect them to work on our computers.

The Business Case for Going to the Cloud

An organization will be benefited far better by using cloud computing in their business. Users business will be profitable by using the following services from Cloud Computing.

1. Infrastructure as a Service:

We may use a virtualized server and running software on it. One of the most prevalent is Amazon Elastic Compute Cloud (EC2). Another player in the field is GoGrid.

Amazon EC2:

EC2 is a web service that provides resizable computing capacity in the cloud. Amazon EC2's simple web service interface allows businesses to obtain and configure capacity with minimal friction. It provides control of computing resources and lets organizations run on Amazon's computing environment. Amazon EC2 reduces the time required to obtain and boot new server instances to minutes, allowing quick scaling capacity, both up and down, as computing requirements change. Amazon EC2 changes the economics of computing by allowing you to pay only for capacity that you actually use.

Windows and SQL Server Support for Amazon EC2 Customers can employ Amazon EC2 running Windows Server or SQL Server with all of the benefits of Amazon EC2. Windows with Amazon EC2 has been a common request of AWS customers since the service launched. Amazon EC2 provides an environment for deploying ASP.NET web sites, high performance computing clusters, media transcoding solutions, and many other Windows based applications.

Amazon EC2 Service Level Agreement With over two years of operation Amazon EC2 exited its beta into general availability and offers customers a Service Level Agreement (SLA). The Amazon EC2 SLA guarantees 99.95 percent availability of the service within a region over a trailing 365-day period, or customers are eligible to receive service credits back. The Amazon EC2 SLA is designed to give customers additional confidence that even the most demanding applications will run dependably in the AWS cloud.

Recent Features of AWS EC2:

- Load balancing Enables customers to balance incoming requests and distribute traffic across multiple Amazon EC2 compute instances.
- Auto-scaling Automatically grows and shrinks usage of Amazon EC2 compute capacity based on application requirements.
- Monitoring Enables customers to monitor operational metrics of Amazon EC2, providing even better visibility into usage of the AWS cloud.
- Management Console Provides a simple, point-and-click web interface that lets customers manage and access their AWS cloud resources.

GoGrid

GoGrid is a service provider of Windows and Linux cloud-based server hosting, and offers 32-bit and 64-bit editions of Windows Server 2008 within its cloud computing infrastructure. Parent company ServePath is a Microsoft Gold Certified Partner, and launched Windows Server 2008 dedicated hosting. GoGrid becomes one of the first Infrastructure as a Service (IaaS) providers to offer Windows Server 2008 "in the Platform as a Service

Platform as a Service (PaaS):

Platform as a Service (PaaS) is a way to build applications and have them hosted by the cloud provider. It allows you to deploy applications without having to spend the money to buy the servers on which to house them. The following are the vendors which provides PaaS.

1. RightScale

RightScale entered into a strategic product and partnership, broadening its cloud management platform to support emerging clouds from new vendors, including FlexiScale and GoGrid, while continuing its support for Amazon's EC2. RightScale is also working with Rackspace to ensure compatibility with their cloud offerings, including Mosso and CloudFS. RightScale offers an integrated management dashboard, where applications can be deployed once and managed across these and other clouds.

2. Salesforce.com

Salesforce.com offers Force.com as its on-demand platform. Force.com features breakthrough Visualforce technology, which allows customers, developers, and ISVs to design any app, for any user, anywhere with the world's first User Interface-as-a-Service. The Force.com platform offers global infrastructure and services for database, logic, workflow, integration, user interface, and application exchange.

Software as a Service:

Software as a Service (SaaS) is the model in which an application is hosted as a service to customers who access it via the Internet. The provider does all the patching and upgrades as well as keeping the infrastructure running.

Salesforce for Google Apps is a combination of essential applications for business productivity (email, calendaring, documents, spreadsheets, presentations, instant messaging) and CRM (sales, marketing, service and support, partners) that enables an entirely new way for business professionals to communicate, collaborate, and work together in real time over the Web. Salesforce for Google Apps offers a complete way for businesses to harness the power of cloud computing without the cost and complexity of managing hardware or software infrastructure.

How Cloud Computing Help for Business:

Cloud computing offers a number of benefits for any organization to build and run their business in profitable way

Operational Benefits:

1. **Reduced cost:** Since technology is paid incrementally, your organization saves money in the long run.
2. **Increased storage:** we can store more data on the cloud than on a private network. Plus, if we need more it's easy enough to get that extra storage.
3. **Automation:** Our IT staff no longer needs to worry that an application is up to date—that's the provider's job. And they know they have to keep it up to date or they'll start losing customers.
4. **Flexibility:** We have more flexibility with a cloud solution. Applications can be tested and deployed with ease, and if it turns out that a given application isn't getting the job done, we can switch to another.
5. **Better mobility:** Users can access the cloud from anywhere with an Internet connection. This is ideal for road warriors or telecommuters—or someone who needs to access the system after hours.
6. **Better use of IT staff:** IT staff no longer has to worry about server updates and other computing issues. They can focus on duties that matter, rather than being maintenance staff.

Economic Benefits

- **People:** Man power can be reduced and the cost can be less towards staffing.
 - **Hardware:** With the exception of very large enterprises or governments, major cloud suppliers can purchase hardware, networking equipment, bandwidth, and so forth, much cheaper than a “regular” business. That means if we need more storage, it’s just a matter of upping our subscription costs with your provider, instead of buying new equipment.
 - **Pay as you go:** Think of cloud computing like leasing a car. Instead of buying the car outright, we pay a smaller amount each month. It’s the same with cloud computing—we just pay for what we use. But, also like leasing a car, at the end of the lease we don’t own the car.
-
- **Time to market** One of the greatest benefits of the cloud is the ability to get apps up and running in a fraction of the time we would need in a conventional scenario. Let’s take a closer look at that and see how getting an application online faster saves our money. Before the cloud, launching a startup meant using either an underpowered or inflexible host or an overpriced self-host.

Staffing Benefits to the customers:

The consumer benefits from cloud computing in a number of ways, for example:

- **No software installation or maintenance** That means no more 1,000-page planning and implementation guides.
- **Shorter deployment time** It takes only a few minutes to spin up a new server, rather than the months it would normally take to plan, prepare, test, and deploy.
- **Worldwide availability** By using a cloud, your users can access data and applications from anywhere they have Internet access.
- **Service Level Agreement (SLA) adherence** If you have an SLA, then we are guaranteed that level of service. And if we report any bugs, the vendor will fix them, but we don’t have to hassle.

Deleting Your Datacenter:

It is very easy to move our data and application to move to the cloud from desktop or from our computer center. If we want to exit from cloud environment to our own systems is difficult.

Desktop applications are one of the areas perfect for a move to the cloud. What drives such a move is the lower costs for both large and small companies. Moving to the cloud allows companies to realize the benefits of economies of scale that come with managing several desktops. Those who specialize in desktop management are going to get the best economies of scale.

A key component in making desktops cloud capable and helping client virtualization go mainstream is the introduction of so-called bare metal hypervisors for clients. These hypervisors allow the desktop to run locally without network access to take advantage of the Pac’s computing power, rather than just relying on the server.

In this process we don’t want to lose our important data and also downtime in this process of transferring.

AppZero provides a set of tools for creating Virtual Application Appliances (VAAs). This approach to provisioning and deploying applications on physical or virtual servers running anywhere is designed for the cloud environment and for movement of server applications and datacenter to cloud, hosting environment, or cloud to cloud.

Thomas Reuters

Thomson Reuters is a company that provides information to a wide range of clients—lawyers, accountants, scientists, reporters, and a host of others. For the most part, they have nothing in common but the need to get information. Providing that information is what Thomson Reuters is all about. Thomson Reuters calls itself “the world’s leading provider of ‘intelligent information’ for businesses and professionals.”

Thomson Reuters wanted to give its customers a better, more intelligent way to search for information than they were providing at the time. Their solution was to adopt a Microsoft Software-plus-Services solution. They integrated Microsoft Live Search with their own search engines and databases. When information is requested, both Live Search and Thomson Reuters’s databases are scanned for the information, and Thomson Reuters analyzes the results to return the best information to the client.

The system works this way:

1. A customer accesses the Thomson Reuters information service, which can be a web application or a Windows-based application.
2. Once a search is initiated, that request is passed to the Thomson Reuters intranet to the Thomson Reuters Web Plus service layer.
3. The service layer begins two actions concurrently: It applies its custom business logic to the request, culling relevant information from it.
4. The service layer returns the information to the client.

Salesforce.com

Salesforce.com offers SaaS with a host of different applications, many of which are created and shared by other Salesforce customers. According to salesforce point of view the following are advantages of cloud environment. Because the vendor is running the applications, they’re constantly tuned and improved on the business.

Thomson Reuters

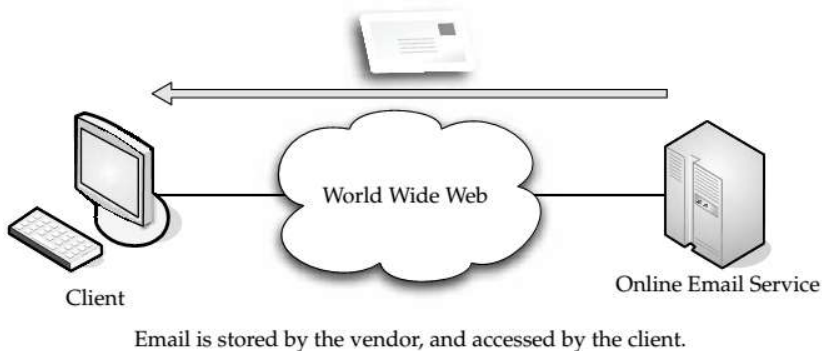
Thomson Reuters is a company that provides information to a wide range of clients like lawyers, accountants, scientists, reporters, and a host of others. For the most part, they have nothing in common but the need to get information. Providing that information is what Thomson Reuters is all about. Thomson Reuters calls itself “the world’s leading provider of ‘intelligent information’ for businesses and professionals.” To live up to that billing, they need to do more than simply deliver search engine results, a lot more. They pull distributed information together; they analyze the information first to ensure it is what the customer wants; and they provide methods of data delivery and retrieval that help their customers get what they want.

Software as a Service

SaaS (Software as a Service) is an application hosted on a remote server and accessed through the Internet.



An easy way to think of SaaS is the web-based email service offered by such companies as Microsoft (Hotmail), Google (Gmail), and Yahoo! (Yahoo Mail). Each mail service meets the basic criteria: the vendor (Microsoft, Yahoo, and so on) hosts all of the programs and data in a central location, providing end users with access to the data and software, which is accessed across the World Wide Web.



SaaS can be divided into two major categories:

- Line of business services These are business solutions offered to companies and enterprises. They are sold via a subscription service. Applications covered under this category include business processes, like supply-chain management applications, customer relations applications, and similar business-oriented tools.
- Customer-oriented services These services are offered to the general public on a subscription basis. More often than not, however, they are offered for free and supported by advertising. Examples in this category include the aforementioned web mail services, online gaming, and consumer banking, among others.

Advantages

- There's a faster time to value and improved productivity, when compared to the long implementation cycles and failure rate of enterprise software.
- There are lower software licensing costs. • SaaS offerings feature the biggest cost savings over installed software by eliminating the need for enterprises to install and maintain hardware, pay labor costs, and maintain the applications.
- SaaS can be used to avoid the custom development cycles to get applications to the organization quickly.
- SaaS vendors typically have very meticulous security audits. SaaS vendors allow companies to have the most current version of an application as possible. This allows the organization to spend their development dollars on new innovation in their industry, rather than supporting old versions of applications.

SaaS, on the other hand, has no licensing. Rather than buying the application, you pay for it through the use of a subscription, and you only pay for what you use. If you stop using the application, you stop paying.



You only pay for the applications when you use them.

Vendor Advantages

SaaS is advantage to Vendors also.

And financial benefit is the top one—vendors get a constant stream of income, often what is more than the traditional software licensing setup. Additionally, through SaaS, vendors can fend off piracy concerns and unlicensed use of software.

Vendors also benefit more as more subscribers come online. They have a huge investment in physical space, hardware, technology staff, and process development. The more these resources are used to capacity, the more the provider can clear as margin.

Virtualization Benefits

Virtualization makes it easy to move to an SaaS system. One of the main reasons is that it is easier for independent software vendors (ISVs) to adopt SaaS is the growth of virtualization. The growing popularity of some SaaS vendors using Amazon’s EC2 cloud platform and the overall popularity of virtualized platforms help with the development of SaaS.

Companies Offering SaaS

Intuit

QuickBooks has been around for years as a conventional application for tracking business accounting. With the addition of QuickBooks online, accounting has moved to the cloud. QuickBooks Overview QuickBooks Online (www.qboe.com) gives small business owners the ability to access their financial data whether they are at work, home, or on the road. Intuit Inc. says the offering also gives users a high level of security because data is stored on firewall-protected servers and protected via automatic data backups.

There is also no need to hassle with technology—software upgrades are included at no extra charge.

For companies that are growing, QuickBooks Online Plus offers advanced features such as automatic billing and time tracking, as well as the ability to share information with employees in multiple locations.

QuickBooks Online features include

- The ability to access financial data anytime and from anywhere. QuickBooks Online is accessible to users 24 hours a day, seven days a week.
- Automated online banking. Download bank and credit card transactions automatically every night, so it’s easy to keep data up to date.
- Reliable automatic data backup. Financial data is automatically backed up every day and is stored on Intuit’s firewall-protected servers, which are monitored to keep critical business information safe and secure. QuickBooks Online also supports 128-bit Secure Sockets Layer (SSL) encryption.
- No software to buy, install, or maintain and no network required. The software is hosted online, so small business users never have to worry about installing new software or upgrades. QuickBooks Online remembers customer, product, and vendor information, so users don’t have to re-enter data.
- Easy accounts receivable and accounts payable. Invoice customers and track customer payments. Create an invoice with the click of a button. Apply specific credits to invoices or apply a single-customer payment to multiple jobs or invoices. Receive bills and enter them into QuickBooks Online with the expected due date.
- Write and print checks. Enter information in the onscreen check form and print checks.

Google

Google's SaaS offerings include Google Apps and Google Apps Premier Edition.

Google Apps, launched as a free service in August 2006, is a suite of applications that includes Gmail webmail services, Google Calendar shared calendaring, Google Talk instant messaging and Voice over IP, and the Start Page feature for creating a customizable home page on a specific domain.

Google also offers Google Docs and Spreadsheets for all levels of Google Apps. Additionally, Google Apps supports Gmail for mobile on BlackBerry handheld devices.

Google Apps Premier Edition has the following unique features:

- Per-user storage of 10GBs Offers about 100 times the storage of the average corporate mailbox.
- APIs for business integration APIs for data migration, user provisioning, single sign-on, and mail gateways enable businesses to further customize the service for unique environments.
- Uptime of 99.9 percent Service level agreements for high availability of Gmail, with Google monitoring and crediting customers if service levels are not met.
- Advertising optional Advertising is turned off by default, but businesses can choose to include Google's relevant target-based ads if desired.
- Low fee Simple annual fee of \$50 per user account per year makes it practical to offer these applications to select users in the organization.

Microsoft

Microsoft Office Live Small Business offers features including Store Manager, an e-commerce tool to help small businesses easily sell products on their own web site and on eBay; and E-mail Marketing beta, to make sending email newsletters and promotions simple and affordable.

The following features are available in Microsoft Office Live Small Business:

- Store Manager is a hosted e-commerce service that enables users to easily sell products on their own web site and on eBay.
- Custom domain name and business email is available to all customers for free for one year. Private domain name registration is included to help customers protect their contact information from spammers. Business email now includes 100 company-branded accounts, each with 5GB of storage.
- Web design capabilities, including the ability to customize the entire page, as well as the header, footer, navigation, page layouts, and more.
- Support for Firefox 2.0 means Office Live Small Business tools and features are now compatible with Macs.
- A simplified sign-up process allows small business owners to get started quickly. Users do not have to choose a domain name at sign-up or enter their credit card information.
- Domain flexibility allows businesses to obtain their domain name through any provider and redirect it to Office Live Small Business. In addition, customers may purchase additional domain names.
- Synchronization with Microsoft Office Outlook provides customers with access to vital business information such as their Office Live Small Business email, contacts, and calendars, both online and offline.
- E-mail Marketing beta enables users to stay connected to current customers and introduce themselves to new ones by sending regular email newsletters, promotions, and updates.

IBM

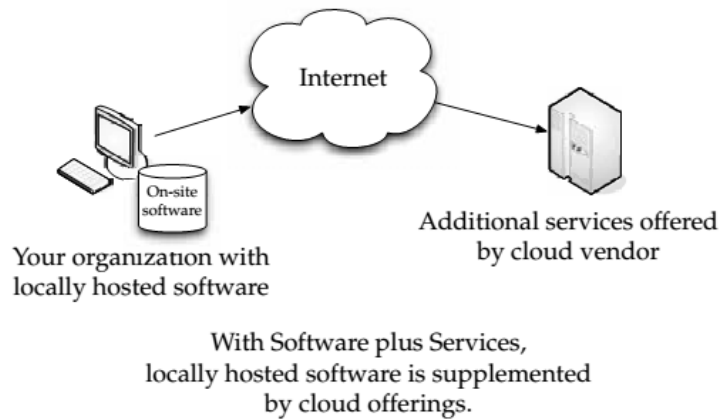
Big Blue—IBM offers its own SaaS solution under the name “Blue Cloud.”

Blue Cloud is a series of cloud computing offerings that will allow corporate datacenters to operate more like the Internet by enabling computing across a distributed, globally accessible fabric of resources, rather than on local machines or remote server farms.

Blue Cloud is based on open-standards and open-source software supported by IBM software, systems technology, and services. IBM's Blue Cloud development is supported by more than 200 IBM Internet-scale researchers worldwide and targets clients who want to explore the extreme scale of cloud computing infrastructures.

Software plus Services

Software plus Services takes the notion of Software as a Service (SaaS) to complement packaged software. Here are some of the ways in which it can help the client organization.



- **User experience:** Browsers have limitations as to just how rich the user experience can be. Combining client software that provides the features we want with the ability of the Internet to deliver those experiences gives us the best of both worlds.
 - **Working offline** Not having to always work online gives us the flexibility to do our work, but without the limitations of the system being unusable. By connecting occasionally and syncing data, we get a good solution for road warriors and telecommuters who don't have the same bandwidth or can't always be connected.
 - **Privacy worries:** No matter how we use the cloud, privacy is a major concern. With Software plus Services, we can keep the most sensitive data housed on-site, while less sensitive data can be moved to the cloud.
 - **Marketing:** Software plus Services gives vendors a chance to keep their names in front of clients. Since it's so easy to move from vendor to vendor, providing a part software/part-Internet solution makes it easier to sell our product to a client.
 - **Power:** More efficiency is realized by running software locally and syncing to the cloud as needed.
 - **Flexibility:** Vendors can offer software in different sizes and shapes—whether onsite or hosted. This gives customers an opportunity to have the right-sized solution.
- Software plus Services offerings that prevalent companies have.
- **Microsoft** Microsoft offers Dynamics CRM, Microsoft Outlook, Windows Azure, and Azure Services Platform. Windows Azure is a collection of cloud-based services, including Live Framework, .NET Services, SQL Services, CRM Services, SharePoint Services, and Windows Azure Foundation Services for compute, storage, and management.
 - **Adobe** Adobe Integrated Runtime (AIR) brings Flash, ActionScript, and MXML/Flex to the PC. Using AIR, vendors can build desktop applications that access the cloud.
 - **Salesforce.com** Salesforce.com's AppExchange is a set of APIs that vendors can use to create desktop applications to access salesforce data and run on the desktop of an end user.

- Apple offers a number of cloud-enabled features for its iPhone/iPod touch. Not only does it come with an integrated Safari web browser, but they also offer a software developer's kit (SDK) that allows software to be created for the iPhone/ iPod touch. Vendors can build their own applications, and on-the-go users can access cloud offerings with those applications.
- Google's mobile platform is called "Android" and helps vendors build software for mobile phones. Google also offers its Google Apps and the Google Chrome browser, which also installs Google Gears software on the desktop. This allows offline and online solutions.

Mobile Device Integration:

How Mobile Device Integration is done. How Microsoft Online provides this?

A key component of Software plus Services is the ability to work in the cloud from a mobile device.

Google Android:

A broad alliance of leading technology and wireless companies joined forces to develop Android, an open and comprehensive platform for mobile devices. Google Inc., T-Mobile, HTC, Qualcomm, Motorola, and others collaborated on the development of Android through the Open Handset Alliance, a multinational alliance of technology and mobile industry leaders.

Open Handset Alliance:

Thirty-four companies have formed the Open Handset Alliance, which aims to develop technologies that will significantly lower the cost of developing and distributing mobile devices and services. The Android platform is the first step in this direction—a fully integrated mobile "software stack" that consists of an operating system, middleware, and user-friendly interface and applications. This alliance include major companied like,

- Google (www.google.com)
- HTC (www.htc.com)
- Intel (www.intel.com)
- LG (www.lge.com)
- Marvell (www.marvell.com)
- Motorola (www.motorola.com)
- NMS Communications (www.nmscommunications.com)
- NTT DoCoMo Inc. (www.nttdocomo.com)
- Qualcomm (www.qualcomm.com)
- Samsung (www.samsung.com)

Etc...

Providers:

The following development solutions we may consider for creating our own Software plus Services deployments.

Adobe AIR:

Adobe Systems offers its Adobe Integrated Runtime (AIR), formerly code-named Apollo. Adobe AIR is a cross-operating-system application runtime that allows developers to use HTML/CSS, AJAX, Adobe Flash, and Adobe Flex to extend rich Internet applications (RIAs) to the desktop.

Lecture Notes 6

For its popular iPhone and iPod touch devices, Apple offers its iPhone Software Development Kit (SDK) as well as enterprise features such as support for Microsoft Exchange ActiveSync to provide secure, over-the-air push

email, contacts, and calendars as well as remote wipe, and the addition of Cisco IPsec VPN for encrypted access to private corporate networks.

App Store:

The iPhone software contains the App Store, an application that lets users browse, search, purchase, and wirelessly download third-party applications directly onto their iPhone or iPod touch. The App Store enables developers to reach every iPhone and iPod touch user. Developers set the price for their applications (including free) and retain 70 percent of all sales revenues. Users can download free applications at no charge to either the user or developer, or purchase priced applications with just one click. Enterprise customers can create a secure, private page on the App Store accessible only by their employees.

Microsoft Online:

Microsoft provides Software plus Services offerings, integrating some of its most popular and prevalent offerings, like Exchange. Not only does Microsoft's Software plus Services offering allow a functional way to serve our organization, but it also provides a means to function on the cloud in simple way.

Hybrid Model

With Microsoft services like Exchange Online, SharePoint Online, and CRM 4.0, organizations big and small have more choices in how they access and manage enterprise from entirely web-based, to entirely on-premise solutions, and anywhere in between. Having a variety of solutions to choose from gives customers the mobility and flexibility they need to meet constantly evolving business needs. To meet this demand, Microsoft is moving toward a hybrid strategy of Software plus Services, the goal of which is to empower customers and partners with richer applications, more choices, and greater opportunity through a combination of on-premise software, partner-hosted software, and Microsoft-hosted software. As part of this strategy, Microsoft expanded its Microsoft Online Services which includes Exchange Online and SharePoint Online to organizations of all sizes. With services like Microsoft Online Services and Microsoft Dynamics CRM 4.0, organizations will have the flexibility required to address their business needs.

Exchange Online and SharePoint Online

Exchange Online and SharePoint Online are two examples of how partners can extend their reach, grow their revenues, and increase the number to sales in a Microsoft-hosted scenario. In September 2007, Microsoft initially announced the worldwide availability of Microsoft Online Services—which includes Exchange Online, SharePoint Online, Office Communications Online, and Office Live Meeting—to organizations with more than 5,000 users. The extension of these services to small and mid-sized businesses is appealing to partners in the managed services space because they see it as an opportunity to deliver additional services and customer value on top of Microsoft-hosted Exchange Online or SharePoint Online. Microsoft Online Services opens the door for partners to deliver reliable business services such as desktop and mobile email, calendaring and contacts, instant messaging, audio and video conferencing, and shared workspaces—all of which will help increase their revenue stream and grow their businesses.

Microsoft Dynamics CRM 4.0:

Microsoft Dynamics CRM 4.0, released in December of 2007 which provides a key aspect of Microsoft's Software plus Services strategy. The unique advantages of the new Microsoft Dynamics CRM 4.0, which can be delivered on-premise or on-demand as a hosted solution, make Microsoft Dynamics CRM an option for solution providers who want to rapidly offer a solution that meets customer needs and maximizes their potential to grow their own business through additional services.

I Developing Applications

Explain how we can develop the Cloud Computing Applications?

In cloud computing we can develop our own applications to cater the needs of our business. A simple example is developing an app using Android to meet our business using Google App Engine and deploy in App Store. Similarly we may use Intuit's QuickBase which allows you us to develop financial-based cloud apps.

1. Google:

To develop an app on the cloud, the Google App Engine is the perfect tool to use to make this dream become reality. In essence, we will write a bit of code in Python, tweak some HTML code, and then we have our app built, and it only takes a few minutes. Using Google App Engine we can develop our applications without worry about buying servers, load balancers, or DNS tables. Salesforce.com struck up a strategic alliance with Google with the availability of Force.com for Google App Engine. Force.com for Google App Engine is a set of tools and services to enable developer success with application development in the cloud. The offering brings together Force.com and Google App Engine, enabling the creation of entirely new web and business applications. Force.com for Google App Engine builds on the relationship between Salesforce.com and Google, spanning philanthropy, business applications, social networks, and cloud computing.

Google Gears: Another development tool that Google offers is Google Gears, an open-source technology for creating offline web applications. This browser extension was made available in its early stages so that the development community could test its capabilities and limitations and help Google improve upon it. Google's long-term hope is that Google Gears can help the industry as a whole move toward a single standard for offline capabilities that all developers can use.

2. Microsoft:

Microsoft's Azure Services Platform is a tool provided for developers who want to write applications that are going to run partially or entirely in a remote datacenter. The Azure Services Platform (Azure) is an Internet-scale cloud services platform hosted in Microsoft datacenters, which provides an operating system and a set of developer services that can be used individually or together. Azure can be used to build new applications to run from the cloud or to enhance existing applications with cloud-based capabilities, and it forms the foundation of all Microsoft's cloud offerings. Its open architecture gives developers the choice to build web applications, applications running on connected devices, PCs, servers, or hybrid solutions offering the best of online and on premises.

Microsoft also offers cloud applications ready for consumption by customers such as Windows Live, Microsoft Dynamics, and other Microsoft Online Services for business such as Microsoft Exchange Online and SharePoint Online. The Azure Services Platform lets developers provide their own unique customer offerings by offering the foundational components of compute, storage, and building block services to author and compose applications in the cloud. Azure utilizes several other Microsoft services as part of its platform, known as the Live Mesh platform.

Live Services:

Live Services is a set of building blocks within the Azure Services Platform that is used to handle user data and application resources. Live Services provides developers with a way to build social applications and

experiences across a range of digital devices that can connect with one of the largest audiences on the Web.

Microsoft SQL Services : Microsoft SQL Services enhances the capabilities of Microsoft SQL Server into the cloud as a web-based, distributed relational database. It provides web services that enable relational queries, search, and data synchronization with mobile users, remote offices, and business partners.

Microsoft .NET Services :

Microsoft .NET Services is a tool for developing loosely coupled cloud-based applications. .NET Services includes access control to help secure applications, a service bus for communicating across applications and services, and hosted workflow execution. These hosted services allow the creation of applications that span from on-premises environments to the cloud.

Microsoft SharePoint Services and Dynamics CRM Services:

Microsoft SharePoint Services and Dynamics CRM Services are used to allow developers to collaborate and build strong customer relationships. Using tools like Visual Studio, developers can build applications that utilize SharePoint and CRM capabilities.

Microsoft Azure Design

Azure is designed in several layers, with different things going on under the hood.

Layer Zero

Layer Zero is Microsoft's Global Foundational Service. GFS is akin to the hardware abstraction layer (HAL) in Windows. It is the most basic level of the software that interfaces directly with the servers.

Layer One

Layer One is the base Azure operating system. It used to be code-named "Red Dog," and was designed by a team of operating system experts at Microsoft. Red Dog is the technology that networks and manages the Windows Server 2008 machines that form the Microsoft hosted cloud.

Red Dog is made up of four pillars:

- Storage (a file system)
- The fabric controller, which is a management system for deploying and provisioning
- Virtualized computation/VM
- Development environment, which allows developers to emulate Red Dog on their desktops

Layer Two

Layer Two provides the building blocks that run on Azure. These services are the aforementioned Live Mesh platform. Developers build on top of these lower-level services when building cloud apps.

SharePoint Services and CRM Services are not the same as SharePoint Online and CRM Online. They are just the platform basics that do not include user interface elements.

Layer Three

At Layer Three exist the Azure-hosted applications. Some of the applications developed by Microsoft include SharePoint Online, Exchange Online, Dynamics CRM, and Online. Third parties will create other applications.

3. Intuit QuickBase:

Intuit Inc.'s QuickBase launched its new QuickBase Business Consultant Program. The program allows members to use their expertise to create unique business applications tailored specifically to the industries they serve—without technical expertise or coding. This helps members expand their reach into industries formerly served only by IT experts. Using QuickBase, program members will be able to easily build new on-demand business applications from scratch or customize one of 200 available templates and resell them to their clients.

Quickbase is a browser accessed database building application. It allows users to build relational data structures with limited previous experience and has reporting functions built in. For many users it replaces the need for multi-user spreadsheets that are difficult to update. Quickbase charges a monthly fee based on users and storage. Any browser can access quickbase, uptime is very good and security seems to be good as well.

Using Intuit Quickbase we have the following advantages

- Integrated with Your Existing Data
- Cost Effective
- Product Support
- Professional Services
- Safe and Secure
- Scalable and Adaptable
- Accepted by Corporate IT

4. Cast Iron Cloud:

Cast Iron Systems introduced its development platform, the Cast Iron Cloud. Cast Iron offers the choice of a completely cloud-based integration service or an on-premise integration appliance as an organization's application ecosystem evolves.

As SaaS usage expands from departmental silos into the extended enterprise, integration of data and applications is even more critical to productivity and success. Cast Iron and its partners can deliver the most widely used solution for connecting SaaS and enterprise applications through the simplicity and speed of Integration as a Service (IaaS). The Cast Iron Cloud leverages the company's delivery of completed integration projects quickly and also eliminates the need for customers to invest in integration infrastructure or deep middleware expertise.

Cast Iron is transforming the integration experience using the Cast Iron Cloud. The company is introducing a cloud-based library of preconfigured Template Integration Processes (TIPs) for the most common SaaS business processes.

5. Bungee Connect:

Bungee Labs offers its Bungee Connect web application development and hosting platform. Developers use Bungee Connect to build desktop-like web applications that leverage multiple web services and databases, and then deploy them on Bungee's multitenant grid infrastructure. Bungee Connect provides development, testing, deployment, and hosting in a single, on-demand platform.

Bungee Connect includes the following features:

- A single, on-demand environment for developing, testing, deploying, and hosting
- Interaction delivered entirely via browser with no download or plug-in for developers or end users
- Delivery of highly interactive user experience without compromising accessibility and security
- Automated integration of web services (SOAP/REST) and databases (MySQL/PostgreSQL)
- Built-in team collaboration and testing and Built-in scalability, reliability, and security
- Deep instrumentation of end-user application utilization for analytics
- Utility pricing model based on end-user application use

II Development :

There are three different, popular platforms: the Google App Engine, Salesforce.com, and Microsoft Azure.

1. **Google App Engine:**

To work on Google app engine first we have to download and install the App Engine SDK. This way developed on Python

dev_appserver.py The development web server

appcfg.py Used to upload our app to App Engine

App Engine applications communicate with the web server using the CGI standard. When the server receives a request for your application, it runs the app with the request data in environment variables and on the input stream. When it responds, the app writes the response to the output stream and includes HTTP content.

After developing an app in Google app engine we have to upload the app and register this app by getting an unique id.

2. **Salesforce.com**

Salesforce has two ways to create an application using

- 1) point-and-click methods
- 2) command line

- Create an Account

The first step is to create our Salesforce account.

- Create an Object

The next step is to create an object that will hold the data

- Add Fields to the Object:

Next step is we have to add fields to the object

- Make an App & test it out

At this stage we have to create an app and then test it.

Local Cloud and Thin Clients

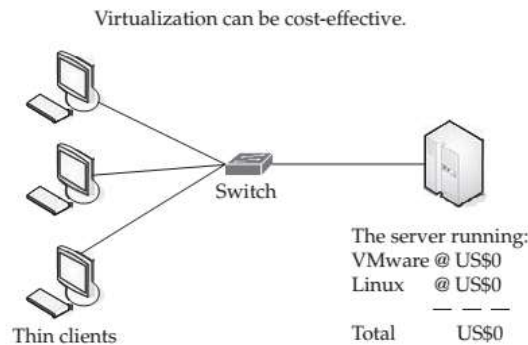
1. Local Clouds

Every organization cannot move to the cloud for their IT needs, one best way is to become familiar with cloud computing concepts and benefits without the outsourcing commitment is to bring the cloud as close as possible by building our own cloud for our business. With a local cloud, we keep your server in-house and clients connect to it.

Virtualization in our Organization:

Virtualization can help companies maximize the value of IT investments, decreasing the server hardware footprint, energy consumption, and cost and complexity of managing IT systems while increasing the flexibility of the overall environment.

- **Server virtualization:** This is a method of partitioning a physical server computer into multiple servers so that each has the appearance and capabilities of running on its own dedicated machine. An example of this is VMware or Hyper-V.
- **Application virtualization:** This is a method that describes software technologies that separate them from the underlying operating system on which they are executed. A fully virtualized application is not installed in the traditional sense, although it still executes as though it were. The application is tricked at run time to believe that it is directly interfacing with the original OS and the resources it manages.
- **Presentation virtualization:** This method isolates processing from the graphics and I/O, which makes it possible to run an application in one location (the server) but be controlled in another (the thin client). In this method, a virtual session is created and the applications project their interfaces onto the thin clients. It can either run a single application or present an entire desktop.



The advantages are

- A centralized console allows quicker access to servers.
- CDs and DVDs can be quickly mounted using ISO files.
- New servers can be quickly deployed.
- New virtual servers can be deployed more inexpensively than physical servers.
- RAM can be quickly allocated for disk drives.
- Virtual servers can be moved from one server to another.

Microsoft Hyper-V:

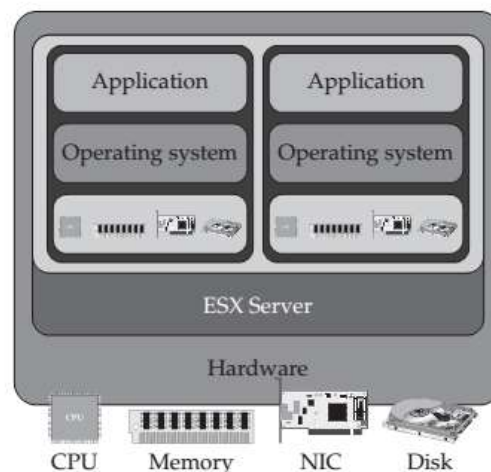
Microsoft Server 2008 Hyper-V (Hyper-V) is a hypervisor-based virtualization technology that is a feature of select versions of Windows Server 2008. Microsoft's strategy and investments in virtualization help IT professionals and developers implement Microsoft's Dynamic IT initiative, whereby they can build systems with the flexibility and intelligence to automatically adjust to changing business conditions by aligning computing resources with strategic objectives.

VMware :

VMware offers its VMware Server, a free entry-level hosted virtualization product for Linux and Windows servers.

VMware Server is feature-packed with the following market-leading capabilities:

- Support for any standard x86 hardware
- Support for a wide variety of Linux and Windows host operating systems, including 64-bit operating systems
- Support for a wide variety of Linux, NetWare, Solaris x86, and Windows guest operating systems, including 64-bit operating systems
- Support for Virtual SMP, enabling a single virtual machine to span multiple physical processors
- Quick and easy, wizard-driven installation similar to any desktop software
- Quick and easy virtual machine creation with a virtual machine wizard
- Virtual machine monitoring and management with an intuitive, user-friendly remote console



In the above figure VMware ESX Server allows different virtual servers to use their portion of system resources as if they were their own.

2. Thin Clients

Desktop and mobile thin clients are solid-state devices that connect over a network to a centralized server where all processing and storage takes place, providing reduced maintenance costs and minimal application updates, as well as higher levels of security and energy efficiency. Thin clients can be up to 80 percent more power-efficient than traditional desktop PCs with similar capabilities.

Sun: Sun's thin client solution is called Sun Ray, and it is an extremely popular product.

Hewlett Packard: Hewlett Packard (HP) is certainly a well-known technology company, and their products extend into the world of thin clients. In fact, HP is the leading manufacturer of thin clients.

HP made another effort to ensure they continue their thin client strides. In early 2009, HP announced that its entire line of thin clients is certified for VMware View, making the products even easier for customers to deploy in VMware environments. The certification, which covers the Microsoft Windows CE, Windows XP Embedded, and Linux operating systems, includes rigorous testing and quality assurance with VMware View for enhanced reliability and ease of deployment.

Dell: Another well-known player in the world of client development is Dell offers thin client OptiPlex. The OptiPlex systems feature new technologies in serviceability, manageability, security, and power consumption to help simplify day-to-day operations while reducing operating expenses. The OptiPlex portfolio is designed to reduce costs in four key areas:

- **Management:** Remote system maintenance; designed for easy serviceability; Dell ProSupport offerings.
- **Security:** Automated data security with full disk encryption and solid state drives for added data protection on select systems; improved chassis intrusion prevention; Dell Control Point security management, smart card authentication; remote patching and isolation.
- **Stability:** Factory-built, preconfigured, and delivered to customer specifications; up to 36-month product life cycle; global standard platforms available on select systems.
- **Environmental Responsibility:** Energy-efficient design; post-consumer recycled plastics on select systems; recyclable packaging; leading power-supply efficiency on select systems.

OptiPlex 960: The OptiPlex 960 offers these features:

- Up to 43 percent less power consumption to reduce energy costs over previous generation of OptiPlex desktops
- Up to 89 percent recyclable packaging
- At least 10 percent post-consumer recycled plastic on small form factor
- An average of 28 percent faster service time than a comparable system from HP and 43 percent faster than a Lenovo
- Optional QuietKit technology reduces noise by as much as 60 percent
- Available in three chassis styles (mini-tower, desktop, and small form factor), the OptiPlex 960 starts at \$ 863.

3. Case Study: McNeilus Steel:

Benefits:

Different companies chose virtualization for different reasons. A steel distributor company **McNeilus Steel** has taken cloud computing as IT Infrastructure for reliability. Before deciding on virtualization, McNeilus considered eight-way servers. The problem with that solution was that every server had just one backup. By using blade servers, if the system fails, it is instantly switched over to a new blade.

Equipment & Software:

In terms of hardware, McNeilus switched from Hewlett Packard servers to an IBM 4700 Fiber SAN with Expansion Bay, IBM Blade Center Chassis with HS20 and HS21 IBM Blade Server, and Cisco C9020 Fiber Switches. On the software side, they are using VMware ESX Servers, which include high availability and VMotion options.

Making Move and Doing New Things:

VMware tool called P2V (Physical-to-Virtual) that allowed them to copy their server images onto the blades. Then it was an issue of physically schlepping client computers to the new building. McNeilus has been able to change the way the company works for the better. When they want to test a new application, it's simply a matter of spinning up an identical virtual server, installing the application there, and testing it. If there are problems, they don't deploy the application to the main image.

Migrating to the Cloud

4. Cloud Services for Individual:

In Cloud there are a growing number of popular applications out there, and they tend to be free or offered at a very low cost for individual of very small organizations.

Example :

1. **Gmail** is a free application on cloud for individuals
2. **Apple Mobile Me** (<http://www.me.com/>) This service synchronizes emails, photos, and contacts among multiple devices. Your computer, laptop, and mobile devices can remain in sync as long as they have access to Apple's cloud servers.
3. **Google Docs** (<http://docs.google.com/>) Providing an intuitive interface, Google Docs provides applications that you normally associate with the desktop—a word processor, spreadsheet, and presentation designer. Documents can be saved to the cloud or locally. Multiple users can collaborate on the same document from different computers with changes taking effect instantly.
4. **Microsoft Live Search** (<http://www.live.com/>) Microsoft's mobile phone search engine uses heavy cloud processing to bring detailed searches to handheld devices.

Skytap Solution:

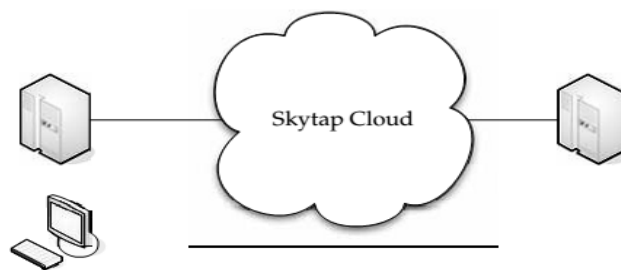
Skytap offers a virtual lab in the cloud. And to help you move your efforts from your local environment, they offer an API to help mount a solid migration. Cloud-based virtualization solution company Skytap (formerly known as illumita) offers Skytap Virtual Lab, a virtual lab automation solution available as an on-demand service over the Web

Customers using Skytap are able to access the following:

- **Virtual infrastructure on-demand:** Virtually unlimited hardware, software, and storage available from any location and any browser. Skytap Virtual Lab scales up and down with software project demands and requires no upfront investment.
- **Automated setup and tear-down of environments:** A web-based virtual lab automation application that eliminates manual setup and tear-down tasks and enables the rapid provisioning and replication of multimachine production environments for development and testing.
- **Skytap Library:** A prepopulated software library that includes major operating systems, databases, and applications in multiple languages that dramatically reduces media installation tasks and enables construction of lab environments by dragging and dropping preconfigured virtual machines.
- **Collaboration in a virtual environment:** The capability to instantly collaborate on software issues and defects in a virtualized environment. Entire multimachine lab environments can be suspended and shared with distributed, global team members to enable reproduction and diagnosis of software bugs and issues.

Skytap Migration API:

The Skytap API enables customers to blend Skytap's cloud-based Virtual Lab platform with their existing on-site IT infrastructure. Rather than using cloud resources in a silo, Skytap's Web Services API and one-click VPN functionality allows organizations to create a "hybrid" IT model whereby cloud resources can be used as an extension of existing on-site IT environments.



The Skytap solution involves accessing their cloud and running lab services at your own site.

5. Cloud Services Aimed at the Mid-Market:

Force.com

The Force.com Migration Tool is a Java/Ant-based command-line utility for moving metadata between a local directory and Force.com. The Force.com Migration Tool is especially useful in these scenarios:

- **Development projects:** When we need to populate a test environment with large amounts of setup changes. If you were to make these changes using a web interface, it would take a large amount of time.
- **Multistage release processes:** Most development processes run in iterative cycles of building, testing, and staging before they are released to a production environment. Scripted retrieval and deployment of your components makes this process easier and cleaner.
- **Repetitive deployment using the same parameters:** we can retrieve all your organization's metadata, make changes as needed, and deploy that metadata. If you need to do it again, you just have to call the same deployment target.

Enterprise-Class Cloud Offerings:

MS Exchange :

Many enterprises are using Microsoft Exchange service for email. Microsoft now offers Exchange Online and Microsoft SharePoint Online for businesses of all sizes. These subscription services offer businesses a new way to purchase, deploy, and manage the industry-leading email and calendaring solution, and the industry-leading solution for portals and collaboration.

VMotion:

VMware says that VMotion is used for Migration which leverages the complete virtualization of servers, storage, and networking to move an entire running virtual machine instantaneously from one server to another.

VMware vCenter Converter:

VMware offers its vCenter Converter to migrate physical servers to virtual servers. The application can be run on a number of different types of hardware and supports most versions of Microsoft Windows operating systems.

Hyper-V Live Migration: Microsoft Server 2008 Hyper-V makes migration a very clean affair, although it is used for moving virtual servers around to different machines. Live Migration is a tool part of Windows Server 2008 R2. Live migration utilizes the integrated hypervisor technology and high-availability features of the server operating system so that customers can move running applications between servers to accommodate changing, dynamic computing needs across a datacenter.

5. Migration:

Migration of IT of an organization from existing infrastructure to Cloud is an important task. Identifying which applications are to be migrated to cloud is a challenging process and they may change from organization to organization.

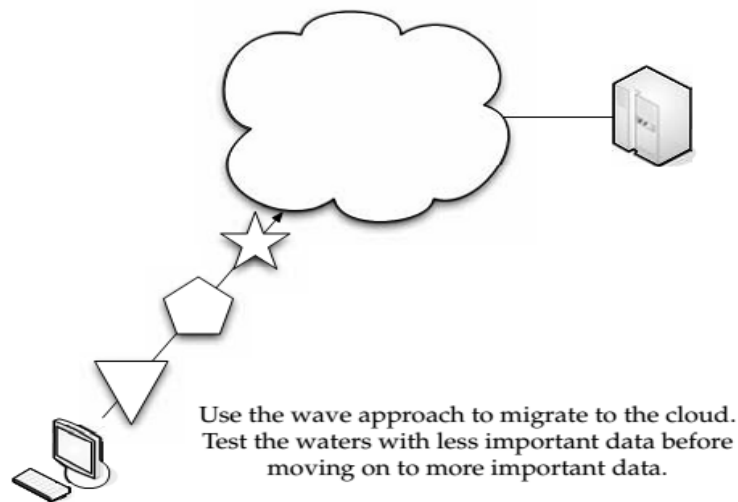
Sending Existing data to cloud:

We can send the data and files to cloud from our IT infrastructure. Symantec Online Backup is used to protect business records while reducing the time and money spent managing backups. With Symantec's Software-as-a-Service (SaaS) online backup application, small and mid-sized businesses can ensure their data is protected against catastrophic loss while remaining easily recoverable.

Use of Wave Approach:

The best way to migrate your data to the cloud is by following the same steps you would when rolling out a new operating system to our organization.

Start with small data that is of low importance. Then, as we add more data, send more important stuff. Now, if we start with the data of least importance, we aren't going to see the performance that you will when more important data moves to the cloud. That just makes sense, because the lowpriority data isn't accessed all that much to test the cloud. But, starting small gives us a place to start.



When we use a phased-in approach, it gives you a chance to see how the data fits on the cloud. Rather than throw everything over at once, we get a chance to see how things are going. If it turns out things aren't going well, we can take corrective action to fix it, or just pull the plug and walk away.

6. Best Practices and the Future of Cloud Computing

Analyze Your Service

Once we opt for a cloud vendor, we should perform some tests and make sure we are still getting what we are paying for agreement. We have to check for the following.

- **Connection speed:** The speed at which we connect to the vendor's cloud.
- **Datastore delete time:** How long it takes to delete the datastore.
- **Datastore read time:** How long it takes to read data.
- **Deployment latency:** The amount of latency between when an application is posted and ready to use.
- **Lag time:** How slow the system is.

Best Practices:

We have to follow the following measures while moving towards cloud.

Finding the Right Vendor:

Apart from the available vendors we have to choose the vendor who support cloud with minimum cost and satisfies our needs.

Performance:

Measuring performance is also an approach while selecting a vendor.

Spread of Service:

Sometimes we can deploy our applications in two or more vendors like Amazon and Salesforce such that there is NO downtime.

Data & Data Flow:

Make sure that our vendor(s) provide customizable data views and reporting. This allows us to get to the data you need quickly. Also, make sure we can get our data back from the vendor. Also our vendors should support us to do our business workflow.

How Cloud Computing Might Evolve.

Gartner sees cloud computing as an evolution of business that is no less influential than e-business. Gartner maintains that the very confusion and contradiction that surrounds the term “cloud computing” signifies its potential to change the status quo in the IT market. Gartner defines cloud computing as a style of computing where massively scalable IT-related capabilities are provided “as a service” using Internet technologies to multiple external customers.

Phase 1: 2007 to 2011 — Pioneers and Trailblazers

This will largely be a market development phase as we have seen in IT Industry.

Phase 2: 2010 to 2013 — Market Consolidation

Gartner predicts that by 2012, the SEAP(Service Enabled Application Software’s) market will become overcrowded with a broad range of solutions from large and small vendors, and competitive pressure will drive many weaker players from the market, resulting in acquisition activity.

Phase 3: 2012 to 2015 and Beyond — Mainstream Critical Mass and Commoditization

In 2013, a small number of large SEAP providers will dominate the market, providing de facto standards.