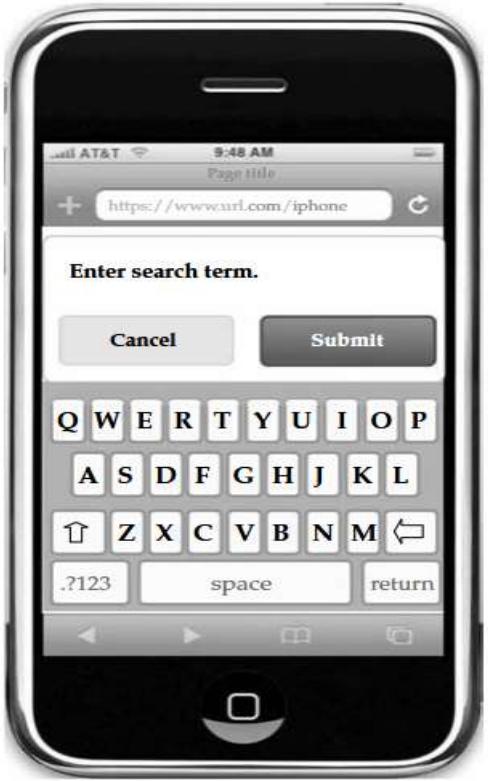
Clients:

- The clients on your end users' desks are how you will interact with the cloud.
- There are different types of clients that can link to the cloud, and each one offers a different way for you to interact with your data and applications.
- Depending on your organization and its needs, you may find yourself using any combination of these devices.
- How you interact with your data based on these clients will be a combination of factors what your needs are and the benefits and limitations of these client types.

Mobile :

- Mobile clients run the gamut from laptops to PDAs and smartphones, like an **iPhone or BlackBerry.**
- You're not likely to utilize a particularly robust application on a **PDA or smartphone, but laptop** users can connect to the cloud and access applications just as if they were sitting at their desk.
- Mobile clients, of course, have security and speed concerns. Because the clients will be connecting to the cloud from various locations that may not have an optimized connection, as in a hotel, you can't expect the speed that a desk-bound client will achieve.

- All applications need speedy connections, and mobile users probably aren't inputting gigabytes worth of data into a database.
- You can create your own applications in the cloud, they can be crafted with a mobile client in mind.
- While a mobile user won't put tons of information into a database, an application can still be developed to let them access it.
- Security is a major concern, but it's a two-sided issue. On the one hand, it's easier to lose or misplace a laptop, and whatever information is on it could be compromised.
- On the other hand, if data is maintained on the cloud and the user only has select files on his or her laptop, if the laptop were to be stolen, only a minimal set of data would be compromised.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Thin:

- Thin client computers that have **no hard drives, no DVD-ROM drives, and simply display what's on the server.**

- Thins may have a role in your organization, but likely only if you have an in-house cloud. Of course, it depends on what applications and services you're accessing on the cloud.

- If a client only needs to access cloud-based services or is accessing a Virtualized server, then thin clients are a great option. They're less expensive than thick clients, are much less expensive to maintain, and use less energy.

- There's also a high level of security, because no data is stored on the thin client. All the data resides in your data centre or on the cloud, so the risk of a physical breach is small.

Thick:

- Thick clients are the clients you already use and are likely to use to connect to applications in the cloud.
- You likely already have applications installed on your end users' machines.
- While you can offload some of your applications to the cloud, chances are there are still going to be some mission-critical applications that simply need to stay in-house.
- These machines can certainly still connect to a virtualized server, and if you don't want to spend any more money for clients, just use the machines that you 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.

Thick:

- 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. If a thin client fails, all it takes is for another thin to get plugged in and the user's work environment is right there.
- If a thick client fails, whatever data is stored on the machine, including the operating system and all the configuration settings, is lost and a new computer will have to be configured for the user.

Security

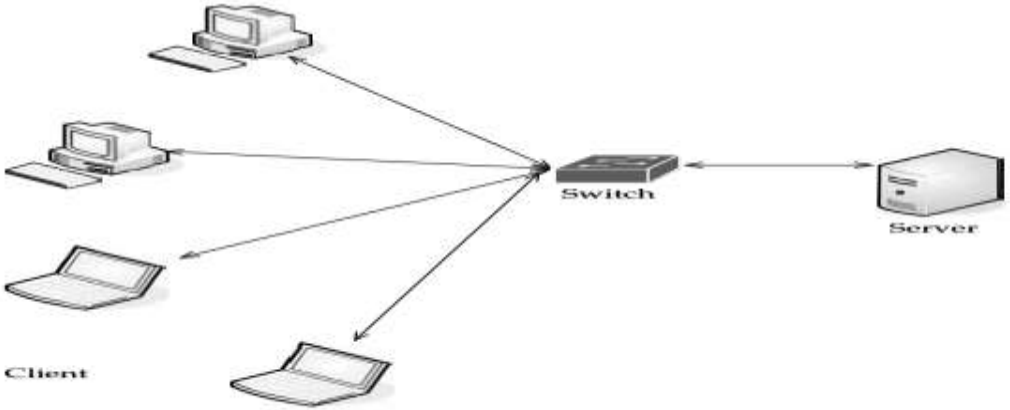
- Security is the number one issue when it comes to cloud computing, and that only makes sense.
- Third party stores your data, you don't know what's going on with it. It's easy to worry about the security risks of a cloud solution, but let's not overlook the inherent security benefits, as well.

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.

- Thin clients creates a better chance for centralized data storage. 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.

Offloading Work :

- Another security benefit isn't so much a technology, but the fact that you don't have to do it yourself. It's up to the cloud provider to provide adequate security.

- The fact of the matter is that your cloud provider might offer more security features than you had before. Many clients are paying allows cloud providers to have beefier security.

- Simply because of the economy of scale involved. That is, there are many paying clients so the provider is able to do more, because there is more money in the pot. additionally, it's to the provider's benefit to offer more, because they want to get a good reputation.

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 you 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. Further, many companies don't have a dedicated in-house incident response team.

- If there is a problem, IT staff have to quickly figure out their new job of taking the server down, quickly investigating, and getting it back online for minimal production downtime.

Development

- Even more good news is that security vendors aren't in the dark about this whole cloud thing. They are actively developing products that can apply to virtual machines and the cloud.

- Security vendors also have a unique opportunity in the cloud. Since it's new ground, there are new opportunities for the vendors who are open-minded enough to imagine them.

Auditing

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

Compliance

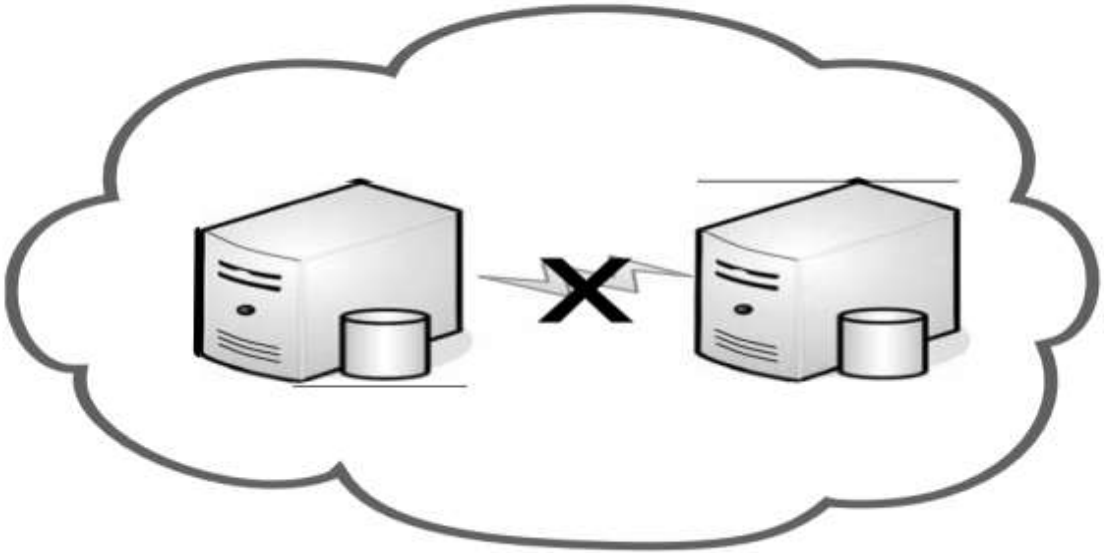
- The same security issues that your organization deals with are the sorts of issues that SaaS providers face—securing the network, hardware issues, applications, and data.

- But compliance adds another level of headache. Regulations like Sarbanes-Oxley (SOX), Gramm-Leach-Bliley (GLBA), and HIPAA, and industry standards like the Payment Card Industry Data Security Standard (PCI DSS) make things particularly challenging.

Prior to SaaS, compliance could be managed by a few tasks:

- Identify users and access privileges
- Identify sensitive data
- Identify where it's located
- Identify how it is encrypted
- Document this for auditors and regulators
- SaaS makes these steps even more complicated. If you store compliance-sensitive data with an SaaS provider, it is difficult to know where the data is being stored.
- It could be on the provider's equipment, or it could even be on the equipment of one of the provider's partners.

Requirement A.1.1—Unauthorized Exposure The first subsection requires that each client of the provider only has access to their own data. The important question to ask is how the SaaS provider's system architecture prevents the unauthorized exposure of data to other subscribers using the same service.



Appendix A.1.1 of PCI Requirement 12.8 mandates
that no entity other than your organization be able to view your data.

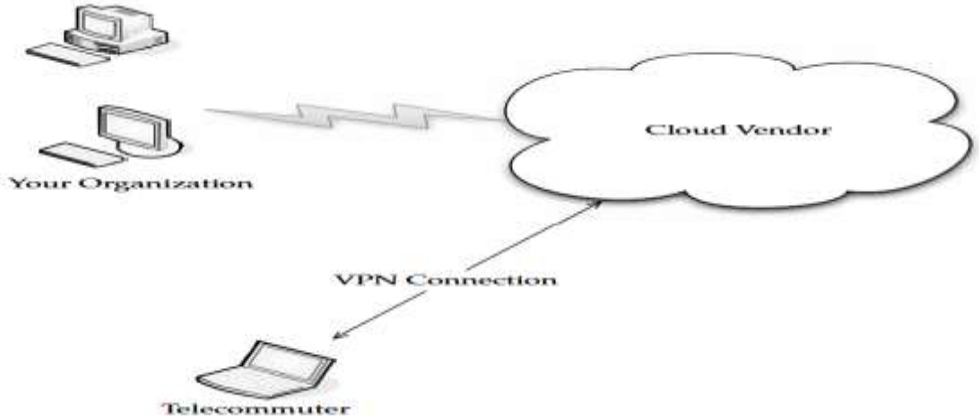
Web Application Breaches

- Service providers use so many web connections, they should be asked about the security of their web applications.
- This should include whether they follow Open Web Application Security Project (OWASP) guidelines for secure application development.
- This is similar to Requirement 6.5 of PCI, which requires compliance with OWASP coding procedures.
- When dealing with a provider, you should seek out those who are able (willing) to talk about how they handle breaches among their staff as well as where data is stored.
- Given the wide range of server deployment, your data could be sitting on a server in Brazil, Germany, or Thailand.

VPNs

- With applications being moved to the cloud, it makes it possible for each and every worker to be a telecommuter. Thus, the organization doesn't have to lease as much space, pay as much for utilities, and those stupid holiday parties can be eliminated.

- Your organization might not lend itself to telecommuting simply by the work you do, or maybe you like those holiday parties and warm bodies in chairs. But the more applications get offloaded to the cloud, the fewer things you have to worry about in-house.



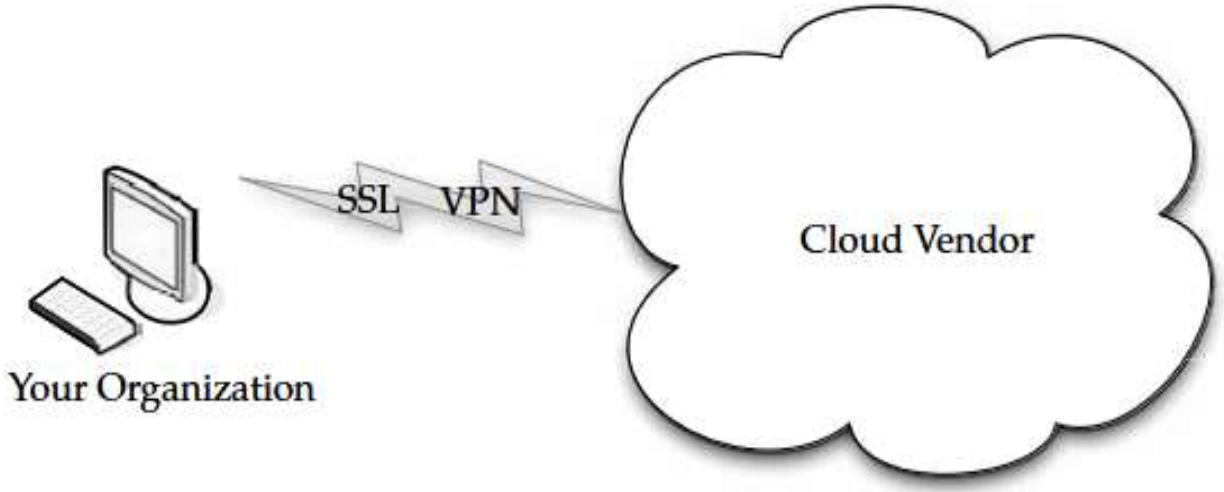
- There is certainly more to your datacenter than web applications. You have file storage, email, productivity applications, and anything else that doesn't lend itself to being web-based.

- But in any event, whether your employees access the cloud across the public Internet or from your office, you need a secure remote access solution, like an SSL VP.

- **What SSL Is An SSL VPN (Secure Sockets Layer virtual private network)** is a VPN that can be used with a standard web browser.

- As compared to the traditional IPsec (Internet Protocol Security) VPN, an SSL VPN does not require you to install specialized client software on end users' computers.

- SSL is a protocol for managing the security of message transmission on the Internet. SSL is included as part of popular web browsers and most web server products. It employs a public and private key encryption system from RSA.



SSL VPNs use an established protocol to connect to the cloud securely.

- An SSL VPN cloud computing connection between your data center and the cloud provider secures your data without a lot of the Public Key Infrastructure (PKI) overhead that comes from an IPsec-based VPN solution.

- Most SSL VPN gateways provide an on-demand client, so there's very little management overhead on the client side and it's easy for the end user to use.

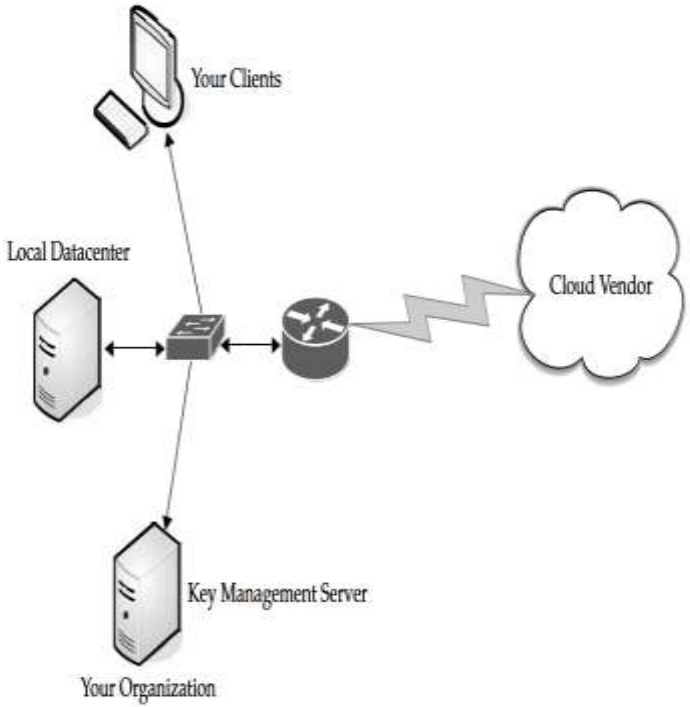
- Better Security Practices An SSL VPN also makes sure that end users are compliant with your organization's security policies through the use of endpoint security.

Those measures include

- Requiring antivirus software to be running
- Verifying that OS patches have been installed
- Checking to see if malware or bots are running
- The SSL VPN is a great security solution because it secures access to your applications in a simple, inexpensive, and efficient way.
- If you were so inclined, you can offer your employees more chance to telecommute.

Key Management

- With your data stored off-site, there's certainly opportunity for your data to be compromised. Your applications, compute cycles, and storage are not under your direct control, so while cloud vendors aspire to keep your data safe, you can never really be 100 percent sure that it's not at risk.
- Add to that the possibility that there may just be an accident that causes your data to be seen by others. Further, when you are done with data and try to purge it, there's no guarantee that it will be eradicated.
- Many cloud services simply do not erase freed storage and some do not even initialize storage when they assign it to you. In the event of a hardware or software failure, some cloud providers may not destroy data on failed machines.
- There are also concerns stemming from man-in-the-middle attacks. The point here is not to scare you away from cloud computing, but to remind you that safeguards must be taken and the tough questions asked.
- It's imperative that you cryptographically authenticate remote services and servers. This is accomplished through client and server certificates that let you know you are connecting securely to your cloud assets.
- Remote services must also be cryptographically protected. You use an authorization infrastructure, like Kerberos, to ensure that you are properly authenticated.



Cloud computing key management diagram

- With cloud storage, be sure to protect it cryptographically as well.
- This includes encrypting the data you store and ensuring that data is set up to be destroyed when the storage key is destroyed.
- This process will make your data more secure, but it also requires a lot of keys. Keys on the server include
- Transport keys
- Authentication keys
- Authorization tokens
- File encryption keys
- Hardware storage keys
- Revocation keys
- Certificates

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 you buy from an Internet service provider (ISP) and connect with via broadband or dial-up, based on your location.
- There are no extras like Transmission Control Protocol (TCP) acceleration, advanced compression, or application-specific optimization.

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.

Disadvantages:

- Lack of end-to-end quality of service (QoS), thus making end-to-end service-level agreements (SLAs) difficult to reach.
- Probability of poor response over high-latency connections. This is worsened by protocol inefficiencies in TCP, HTTP, and web services, Downtime that might be out of your control.

The Accelerated Internet

- Employing advanced application delivery features on top of your Internet connection can benefit both the service provider and the client.
- Cloud improvement can increase by 20 percent to 50 percent by offloading network-related functions from the server.
- SSL termination and TCP connection management remove a significant amount of processing from the front-line servers.
- Additionally, dynamic caching, compression, and prefetching results in better than a 50 percent performance increase for end users.

Some providers offering this service include

- AT&T Hosting
- Citrix NetScaler
- F5's WebAccelerator

- Organizations opting for this method of connectivity should look at SLAs and monthly bandwidth charges, rather than worry about what acceleration methods the service provider is adding.

- At the cloud, this method of acceleration requires the installation of a server-side appliance. At the end user, it normally requires the installation of a downloadable client.

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.
- Disadvantages of this method include
- It is costlier than public Internet connectivity, sometimes as much as four times as much.
- There is a strong vendor lock-in if the application is distributed into the carrier's network.

Site-to-Site VPN

- The fourth option is to connect to the service provider directly using a private wide area network (WAN) (normally an MPLS/VPN connection). This setup allows confidentiality, guaranteed bandwidth, and SLAs for availability, latency, and packet loss.

- MPLS can also scale to meet changing bandwidth needs, and QoS can also be written into the SLAs. On the downside, private WANs are not normally more reliable than Internet connections, especially redundant connections to multiple ISPs.

Cloud Providers

- Cloud providers that use services dispersed across the cloud need a robust connection method. Private tunnels make sure that bandwidth, latency, and loss aren't as likely to affect performance. Encryption and strong authentication offer another benefit.

- Cloud providers that are growing might face big costs as network bandwidth charges increase. This traffic is from traffic both to and from clients as well as traffic among provider sites. Big providers, like Google, are able to sidestep these charges by building their own WANs with multiple peering points with major ISPs.

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

Features of Connectivity Options

Cloud Consumers

- Large companies can build their own scalable distributed IT infrastructure in which datacenters are connected with their own private fiber optic connections.
- This depends on distance, bandwidth requirements, and budgets.
- Clients located at major sites normally access applications over the corporate WAN.
- For smaller offices or mobile workers, VPN connections across optimized and accelerated
- Internet services provide a more robust solution.
- VPN tunnels across the Internet are best as a primary link only when high performance is not crucial.

Pipe Size

- Bandwidth is, simply put, the transmission speed or throughput of your connection to the Internet.
- There are three factors that are simply out of your control when it comes to how much bandwidth you need:
- The Internet bandwidth between your organization and the cloud
- The round-trip time between your organization and the cloud
- The response time of the cloud

Upstream/Downstream

- Another factor to consider is whether it is okay for the transfers to be symmetric or asymmetric. If your connection with the cloud is symmetric, then that means you are sending and receiving data at the same rate.

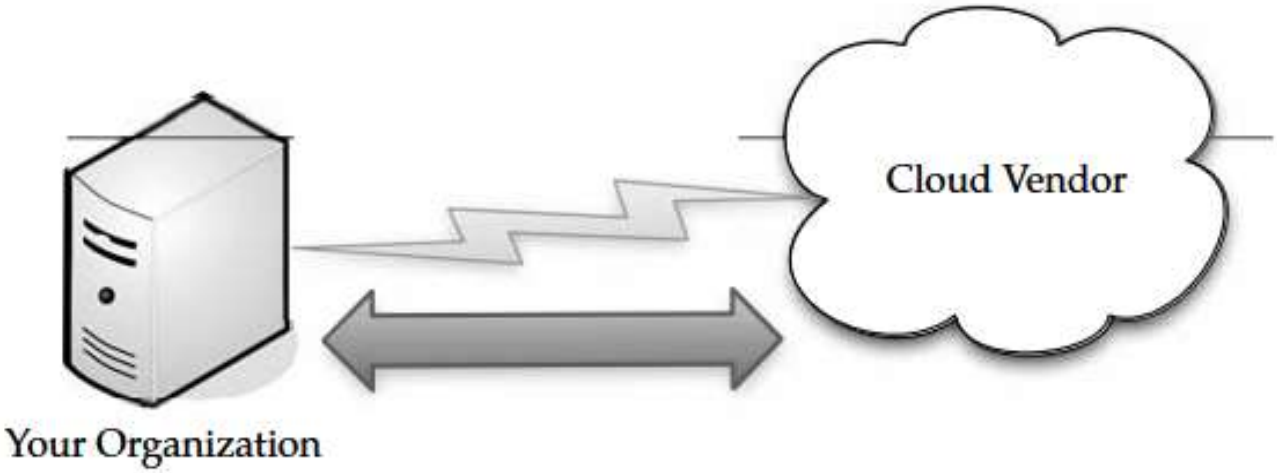
- If your connection is asymmetric, then data is sent from your organization at a slower rate than you're receiving it. For instance, ADSL connections send and receive data at different rates. The "A" in ADSL stands for asymmetric. Depending on what service we're talking about, data can be received at 1.5Mbps while it is sent at 750Mbps.

- Your organization is likely connecting to its ISP using something more robust than DSL, and in most cases those connections are symmetrical.

- Consider also that the Internet changes from one moment to the next in ways that are impossible to predict. Data moves through different routers and network appliances.

- Your speed will vary from time to time. It may not be noticeable, but it does fluctuate. As such, even though you're paying for a T1 line, don't call the phone company to complain right away there's always a delay somewhere.

- The best rule of thumb is that if you are consistently measuring 85 percent of your nominal bandwidth, then you're doing okay. Perform an Internet connection test several times a day. Try it first thing in the morning,



Be cognizant of how fast data is able to be sent
in addition to how fast you are able to receive data.

How Much Do We Need?

- How much data will be moving in and out of the cloud at any given time, and then decide how big of a pipe you need to move that data.
- Chances are good that you have a beefy enough Internet connection to make cloud computing viable.
- However, realize that the more you do on the cloud, the more demand will be placed on your Internet connection. If you do not have enough capacity, then everyone will experience a slowdown.
- Take the time to figure out how much capacity you'll use, and make sure you have enough resources to accommodate that need.
- It's important to secure an SLA that meets your bandwidth requirements. This not only ensures that you are getting the speed that you need, but if the ISP fails to meet those levels, there can be some sort of remediation in it for you.

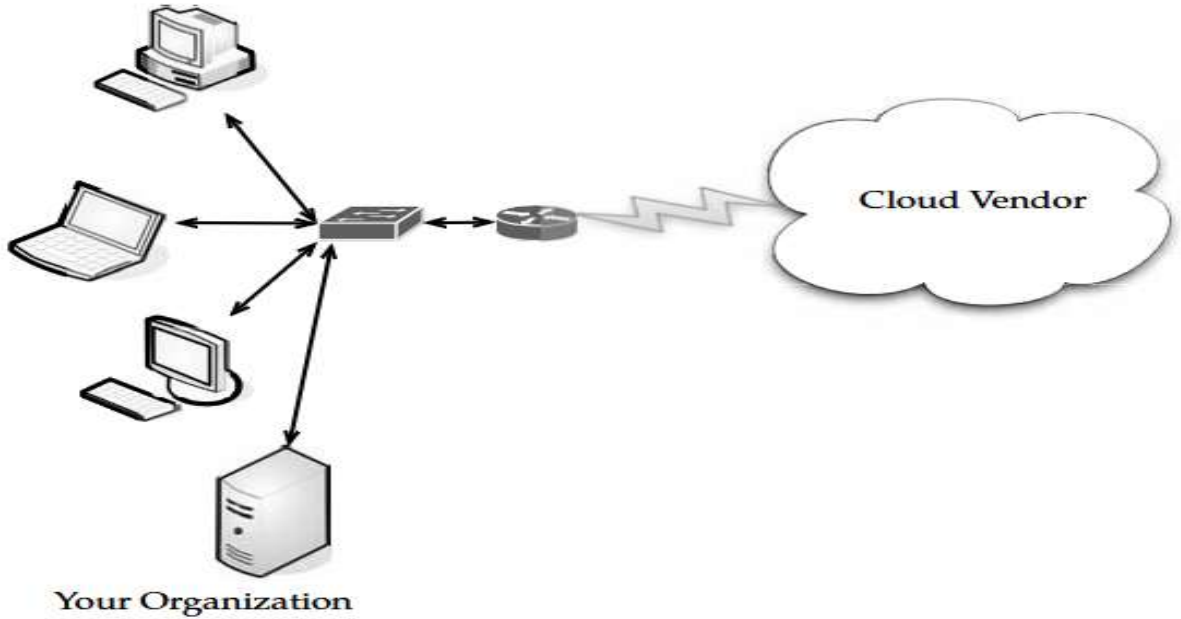
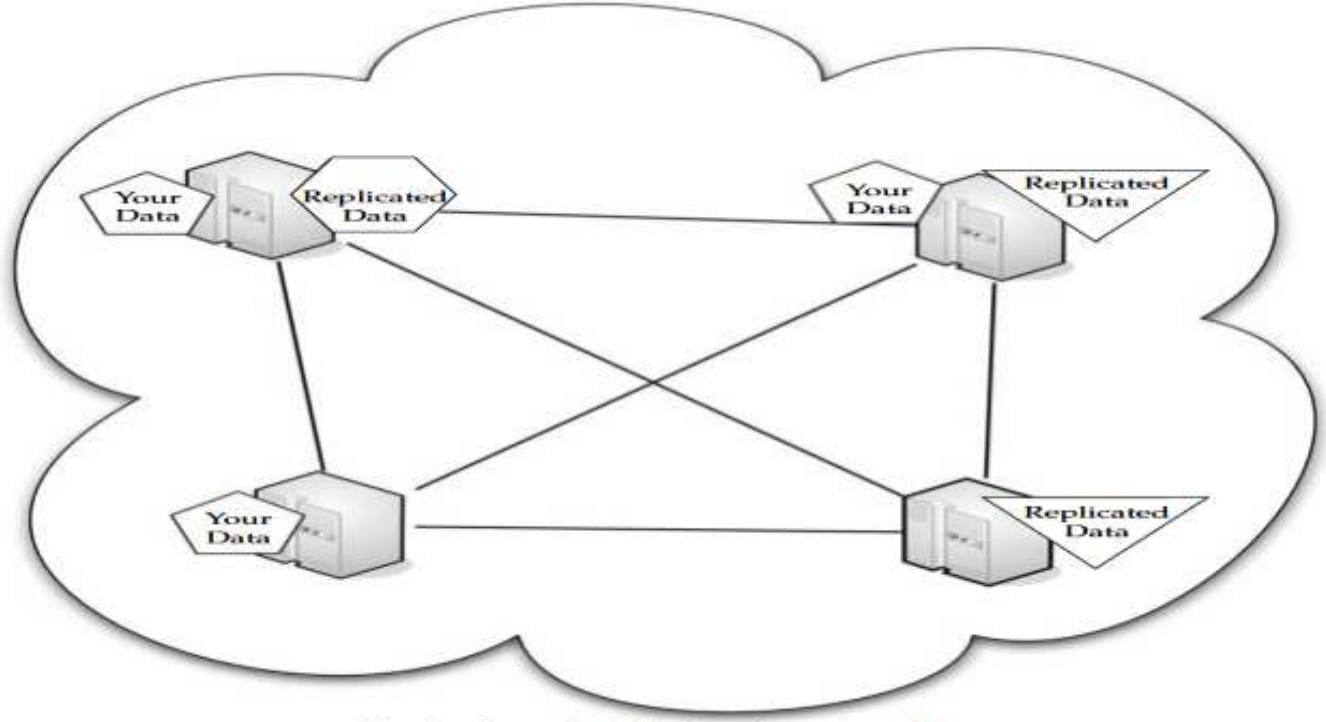


Figure out how much capacity all your clients will use when accessing the cloud, and ensure you have a big enough pipe to accommodate that need.

Redundancy

- When formulating your cloud infrastructure, be sure to consider the issue of reliability and uptime and ask your service provider to configure your computing infrastructure for redundancy and failover.
- Redundancy used to mean that another server or two were added to the data center in case there was a problem.
- These days with virtualization, redundancy might mean a virtual server being cloned onto the same device, or all the virtual servers of one machine being cloned onto a second physical server.
- It becomes more complex in the cloud. While you may think of your server being hosted at the datacenter of your cloud provider, it's not as easy to nail down.
- Parts of your data may be housed in one location and other parts scattered throughout the country.
- When the provider adds a redundant system, again the data is scattered throughout their cloud. So it's not an issue of the service provider wheeling in a new server to provide redundant services. Rather, they simply reallocate resources to give you a redundant system.



The cloud vendor is likely to have your data and its redundant clone in geographically dispersed locations.

Services :

- There are different services you will need to run, depending on your cloud provider and what your organization does. Also, these services will likely affect how your cloud infrastructure is deployed.

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 you sign on to Amazon cloud services, you 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.

- Identity services need not be proprietary. OpenID is an open, decentralized, single sign-on standard that allows users to log in to many services using the same digital identity.

- An OpenID is in the form of a uniform resource locator (URL) and does not rely on a central authority to authenticate a user's identity.

- Since a specific type of authentication is not required, nonstandard forms of authentication may be used, including smart cards, biometric, or passwords.

OpenID authentication is used by many organizations, including:

- Google
- IBM
- Microsoft
- Yahoo

OpenID is a means to keep login information consistent across several sites.

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.
- SQS replicates messages across several queues, so an application reading from a queue may not see all messages from all queues on a given request. SQS also doesn't guarantee in-order delivery.
- In fact it's these simplifications that make SQS more scalable, but it also means that developers must use SQS differently from on-premises messaging. Instead of using queuing, BizTalk Services utilizes a relay service in the cloud, allowing applications to communicate through firewalls.
- Cloud-based integration requires communicating through different organizations, the ability to tunnel through firewalls is an important problem to solve.

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.

- The guy who developed the web site likely didn't have the time or money to make his own mapping database. Enough organizations want this functionality, however, so it is offered as a cloud application.

- Google Maps and Microsoft's Virtual Earth provide this cloud-based function, allowing developers to embed maps in web pages.

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.

- You can simply sign up with a service to accept credit cards, or you can go the route of PayPal. With an online payment service, customers can send money directly to your organization.

These services are really just additions to existing web sites.

Search :

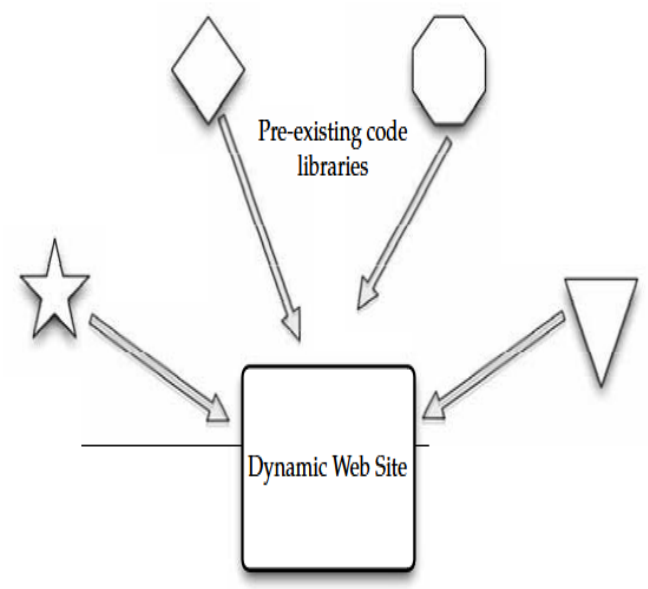
- The ability to embed search options in a web site is certainly nothing new, but it is rich feature that you might want to employ in your own web or application development.
- Microsoft's Live Search allows on-site and cloud applications to submit searches and then get the results back.
- Searching is limited only to the organization and what it does. For instance, a company might develop an application that does both.
- For instance, let's say a company has a database of movie information.
- By typing in the name of the movie, you can search its own database as well as a search of the Internet to give you two types of results what's stored in the company database as well as what's on the entire Web.
- If you were to use a single computer to access the cloud, the requirements are pretty minimal all you need is a computer and an Internet connection.

Accessing the Cloud

Web Application Framework :

- A web application framework is used to support the **development of dynamic web sites, web applications, and web services.**
- The point of a framework is **to reduce the overhead** that comes with common activities in web development.
- For instance, frameworks provide libraries that are already written so the developer doesn't have to reinvent the wheel every time a web site is developed.
- Early in the Web's life, hypertext was mostly hand-coded **Hypertext Markup Language (HTML)** that was published on Web servers.
- If a published page needed to be changed, it had to be done by the page's author. As the Web grew up, it became more dynamic with the addition of the **Common Gateway Interface (CGI).**
- This allowed external applications to interface with web servers.

Accessing the Cloud



Pre-existing libraries can be used to create web applications.

AJAX

- **Asynchronous JavaScript and XML (AJAX)** is a group of web development techniques used for creating interactive web applications.
- Using AJAX, **web applications can retrieve data from the server asynchronously.**
- It is being done in the background, it won't interfere with the display and behaviour of the current page.

Accessing the Cloud

Technologies :

- AJAX is a term that represents a **wide range of web technologies** that can be used to help **web applications communicate with a server,** but without interfering with the current state of that page.
- AJAX refers to these technologies: **Extensible Hypertext Markup Language (XHTML) and Cascading Style Sheets (CSS) for presentation.**
- The Document Object Model for dynamic display of and interaction with data XML and **Extensible Style Sheet Language Transformations (XSLT)** for the interchange and manipulation of data, respectively.
- The **XML Http Request object for asynchronous communication** JavaScript to bring these technologies together.
- AJAX continues to evolve. For instance, while JavaScript claims a place in the acronym for AJAX, it is not the only client-side language that can be used for developing an AJAX application.
- **JavaScript Object Notation (JSON) is a widely used alternative**. HTML and plain text can also be used.

Advantages of AJAX :

- Multiple pages on a web site contain the same information. If those pages were coded by hand, the same content would have to be written into each and every page.
- AJAX allows a web application to simply retrieve new information and adjust how the content is presented. This is very efficient and reduces the amount of bandwidth consumed and reduces load times.
- Using asynchronous requests allows the client's web browser to be more interactive and respond quickly to user inputs. The user may even perceive the application to be faster.
- Connections to the server are reduced, because scripts and style sheets need only be downloaded once.

Disadvantages to AJAX :

- Dynamically created web pages do not show up in the browser's history engine, so clicking on the Back button would not re-create the last seen page.
- It is difficult to bookmark a dynamically created web page.
- If a browser does not support AJAX or if JavaScript is disabled, AJAX functionality cannot be used.
- There is no standards body behind AJAX, so there is no widely adopted best practice to test AJAX applications.

Accessing the Cloud

Python Django :

- **Django is an open-source web application framework written in Python**. Originally it was created to manage news sites for The World Company and released publicly under a BSD license in July 2005.
- In June 2008 it was announced that the Django Software Foundation will be the authority for Django.
- **Django was developed to ease the creation of database-driven web sites and uses reusability of components**. Django utilizes the principle of DRY (Don't Repeat Yourself).
- It also uses an administrative CRUD (create, read, update, and delete) interface that is dynamically generated.

Included in the core framework are :

- A lightweight, stand-alone web server for development and testing.
- A caching framework, which can use any of several cache methods.
- An internal dispatcher system that allows an application's components to communicate using predefined signals.
- An internationalization system that translates Django's components into multiple languages.
- A scheme for extending the capabilities of the template engine.

Accessing the Cloud

Web Hosting Service :

- A web hosting service that will allow you to store your data and applications.
- Some web hosting services include Amazon Elastic Compute Cloud and Mosso.

Amazon Elastic Compute Cloud (EC2) :

- **Amazon Elastic Compute Cloud (http://aws.amazon.com/ec2)** is a web service that provides resizable compute capacity in the cloud. Amazon EC2's web service interface allows you to obtain and configure capacity with minimal friction.
- It provides complete control of your computing resources and lets you run on Amazon's computing environment. Amazon EC2 reduces the time required to obtain and boot new server instances to minutes, allowing you to quickly scale capacity, both up and down, as a client's computing requirements change.
- Amazon EC2 changes the economics of computing by allowing you to pay only for capacity that you actually use.

Accessing the Cloud

Amazon Elastic Compute Cloud (EC2) :

- EC2 uses Xen virtualization. Each virtual machine, called an instance, is a virtual private server and can be one of three sizes: small, large, or extra large.
- Instances are sized based on EC2 Compute Units, which is the equivalent CPU capacity of physical hardware.
- One EC2 Compute Unit equals a 1.0–1.2GHz 2007 Opteron or 2007 Xeon processor.
- The service initially offered Sun Microsystems OpenSolaris and Solaris Express Community Edition. In October 2008, EC2 added the Linux and Windows Server 2003 operating systems to its offerings.

Mosso :

- Mosso is the home of The Hosting Cloud and CloudFS, providing enterprise-grade hosting and storage services.
- Mosso provides an easily managed interface so that developers, designers, and IT managers can deploy reliable web applications quickly and easily as well as a high-performance cloud-based storage service.

Accessing the Cloud

Instance Size	Small	Large	Extra Large	High CPU–Medium	High CPU–Extra Large
EC2 Compute Units	1	4	8	5 (two virtual cores with 2.5 Compute Units each)	20
Memory	1.7GB	7.5GB	15GB	1.7GB	7GB
Storage	160GB	850GB	1,690GB	350GB	1,690GB
Platform	32-bit	64-bit	64-bit	32-bit	64-bit

There are three components to Mosso's offering:

• Cloud Sites Advertised as "the fastest way to put sites on the cloud"; runs Windows or Linux applications across hundreds of servers.

• Cloud Files Provides unlimited online storage for media (examples include backups, video files, user content), which is served out via Limelight Networks' Content Delivery Network.

• Cloud Servers Able to deploy from one to hundreds of cloud servers instantly and creates advanced, high-availability architectures.

Accessing the Cloud

Proprietary Methods

- Microsoft and Force.com are two examples of companies that have designed their own infrastructure for connecting to the cloud.

Azure

- The Azure Services Platform is Microsoft's cloud solution that spans from the cloud to the enterprise datacenter. Further, it delivers content across the PC, web, and phone.
- The platform combines cloud-based developer capabilities with storage, computational, and networking infrastructure services, all hosted on servers operating within Microsoft's global datacenter network.
- This provides developers with the ability to deploy applications in the cloud or on-premises and enables experiences across a broad range of business and consumer scenarios.
- The Azure Services Platform provides developers with the ability to create applications while taking advantage of their existing skills, tools, and technologies such as the Microsoft .NET Framework and Visual Studio.

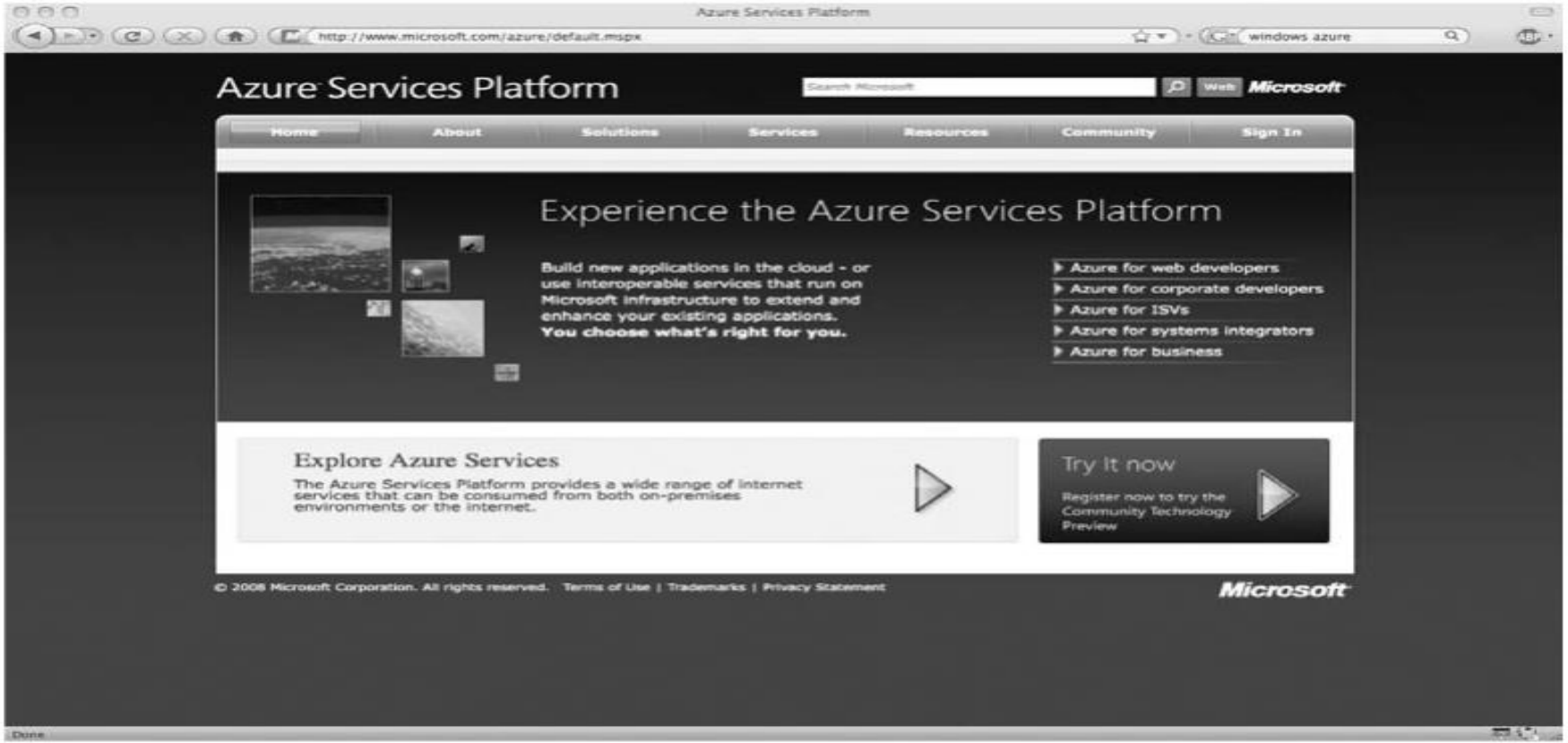
Accessing the Cloud

- Developers also can choose from a broad range of commercial or open-source development tools and technologies, and access the Azure Services Platform using a variety of common Internet standards including HTTP, representational state transfer (REST), and Atom Publishing Protocol (AtomPub).

Key components of the Azure Services Platform include the following:

- Windows Azure for service hosting and management, low-level scalable storage, computation, and networking
- Microsoft SQL Services for a wide range of database services and reporting
- Microsoft .NET Services, which are service-based implementations of familiar .NET Framework concepts such as workflow and access control.
- Live Services for a consistent way for users to store, share, and synchronize documents, photos, files, and information across their PCs, phones, PC applications, and web sites.
- Microsoft SharePoint Services and Microsoft Dynamics CRM Services for business content, collaboration, and rapid solution development in the cloud As a key part of their cloud offering.
- Microsoft has built datacenters to deliver online services. Microsoft has opened major datacenters in Quincy, Washington, and San Antonio, Texas, with additional centers scheduled to open in Chicago and in Dublin, Ireland.

Accessing the Cloud



Force.com

- Force.com, a PaaS from Salesforce.com, is another way to create and deploy business applications. By replacing the complexity of software platforms with a complete, scalable service, Force.com provides developers a fast path to turn ideas into business impact.

- Force.com Features Force.com PaaS provides the building blocks necessary to build any kind of business application, and automatically deploy them as a service to small teams or entire enterprises.

- The Force.com platform gives customers the ability to run multiple applications within the same Salesforce.com instance, allowing all of a company's Salesforce.com applications to share a common security model, data model, and user interface.

- The multitenant Force.com platform encompasses a complete feature set for the creation of business applications such as an on-demand operating system.

- The ability to create any database on demand, a workflow engine for managing collaboration between users, the Apex Code programming language for building complex logic, the Force.com Web Services API for programmatic access, mashups, and integration with other applications and data, and now Visualforce for a framework to build any user interface.

Accessing the Cloud

- Visualforce As part of the Force.com platform, Visualforce gives customers the ability to design application user interfaces for any experience on any screen.

- Using the logic and workflow intelligence provided by Apex Code, Visualforce offers the flexibility to meet the requirements of applications that feature many different types of users on a variety of devices.

- Visualforce uses HTML, AJAX, and Flex for business applications. Visualforce enables the creation and delivery of any user experience, offering control over an application's design and behavior.

- 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. This enables developers to create new pages using standard web technologies including HTML, AJAX, and Flex. Pages allows developers to create any user experience with standard web technologies.

Accessing the Cloud

- **Components** Provides the ability to create new applications that automatically match the look and feel of Salesforce applications or easily customize and extend the Salesforce user interface to specific customer and user requirements
- Customers can create a user experience by assembling existing user interface elements.
- **Logic Controllers** Enables customers to build any user interface behavior.
- Customers can use Visualforce to quickly create a new look and feel that leverages existing application functionality. The standard controller gives customers the ability to inherit and reuse any standard Salesforce UI behavior like new, edit, and save.

Accessing the Cloud

Accessing the Cloud

Web sample Applications :

- Different companies offer different things, but for the sake of understanding the market, let's take a closer look at cloud giant Google and their offerings.
- They have a slate of apps that are targeted right toward your enterprise. Following this link (http://www.google.com/apps/intl/en/business/index.html) will take you to their apps.
- 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

• Start Page for creating a customizable home page on a specific domain

Accessing the Cloud

- More than 100,000 small businesses and hundreds of universities now use the service.
- "So much of business now relies on people being able to communicate and collaborate effectively," said Gregory Simpson, CTO for General Electric Company.
- "GE is interested in evaluating Google Apps for the easy access it provides to a suite of web applications, and the way these applications can help people work together.
- Given its consumer experience, Google has a natural advantage in understanding how people interact together over the web." Google also offers a premium service called Google Apps Premier Edition.

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, eliminating the need to frequently delete email.
- 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.

Accessing the Cloud

• 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.

• Support for critical issues 24/7 Includes extended business hours telephone support for administrators.

• 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 and affordable annual fee (US$50 per user account per year) makes it practical to offer these applications to everyone in the organization.

In addition to Gmail, Google Calendar, Google Talk and Start Page, all editions of Google Apps also include :

• Google Docs and Spreadsheets With this addition, teams can collaborate on documents and spreadsheets without the need to email documents back and forth.

Multiple employees can securely work on a document at the same time. All revisions are recorded for editing, and administrative controls allow organizations to define limits on document sharing.

Accessing the Cloud

• Gmail for mobile devices on BlackBerry Gmail for mobile devices provides the same Gmail experience—such as search, conversation view, and synchronization with desktop version—on BlackBerry handheld devices for users of

Google Apps.

- Gmail for mobile devices joins a list of other mobile options for Google Apps and BlackBerry users that already includes a Google Talk client and a variety of calendar sync tools.
- Application-level control Allows administrators to adapt services to business policies, such as sharing of calendars or documents outside of the company.
- To provide more options and value to customers of Google Apps Premier Edition, Google Enterprise Professional partners like Avaya and Postini are developing a variety of solutions based on Google's APIs.
- Including email gateways, enhanced security, Google Calendar synchronization, and third-party integration with Google Talk, as well as offering deployment, migration, and additional support services.
- Google-hosted applications are available in many languages, such as French, Italian, German, Spanish, Chinese, Japanese, and Korean. You can find more information at http://www.google.com/ .

Accessing the Cloud

- Different cloud providers use different APIs.

What Are APIs?

- An application programming interface (API) is a set of programming instructions and standards for accessing a web-based program. Software companies release their APIs to the public so that other software developers can design products that are powered by its service.
- For example, Amazon released its own API so that web site developers could more easily access information maintained at the Amazon web site.
- By using Amazon's API, a third-party web site can directly link to products on the Amazon site.
- APIs allow one program to speak with another. They are not user interfaces. Using APIs, programs can speak to each other without the user having to be involved.

Accessing the Cloud

- For instance, when you buy something at Amazon and enter your credit card information, Amazon uses an API to send your credit card information to a remote application that verifies whether your information is correct. As a user, all you saw was the place to enter your credit card information, but behind the scenes, APIs were getting the job done.

- An API is similar to Software as a Service (SaaS), because software developers don't have to start from scratch every time they write a program. Rather than build one program that does everything (email, billing tracking, and so forth), the application can farm out those duties to other applications that do it better.

An API works in between two pieces of software to exchange information.

Accessing the Cloud

How APIs Work :

- An API is (as the acronym says) an interface that defines the way in which two things will communicate. With APIs, the calls back and forth are managed by web services.

- Web services are a collection of standards including XML, the programming language that allows applications to communicate over the Internet. XML is a general-purpose markup language.

The structured data in a way that both humans and computers can read and write.

- The API is a piece of software code written as a series of XML messages, like the one for the Google Maps API shown here:
- <script type="text/javascript“ , src="http://www.google.com/jsapi?key=ABCDEFG"></script>
- <script type="text/javascript"> , google.load("maps", "2.x"); // Call this function when the page has been loaded
- function initialize() {
- var map = new google.maps.Map2(document.getElementById("map"));
- map.setCenter(new google.maps.LatLng(37.4419, -122.1419), 13); }
- google.setOnLoadCallback(initialize); </script>

Accessing the Cloud

- Programmers can use APIs by programming new or existing applications to generate the right XML messages to utilize remote applications.
- For instance, if you wanted to archive emails on the cloud, you could use an API to automatically send emails from your inboxes to the cloud archive.
- Companies that release their API usually do so as part of a larger software development kit (SDK) that includes the API, programming tools, and documentation.
- APIs and web services are invisible to your users as they access the cloud. Their whole purpose is to run silently in the background, doing the job for which they were created.
- XML isn't the only standard that makes APIs work. Other standards include; SOAP (Simple Object Access Protocol) SOAP encodes XML messages so that they can be received and understood by any operating system over any type of network protocol.
- UDDI (Universal Description, Discovery, and Integration) UDDI is an XML based directory that allows businesses to list themselves, find each other, and collaborate using web services.
- WSDL (Web Services Description Language) WSDL is the SOAP of UDDI. WSDL is the XML-based language that businesses use to describe their services in the UDDI.

Accessing the Cloud

API Creators

- There are many different APIs you can use to link your organization with your cloud applications
- You might have to create your own APIs.
- Google Gadgets
- Google Gadgets are a desktop search application that enables users to search their email, files, web history, and chats. Called Google Desktop Search, this new application makes it possible for users to find information on their computers as fast and easily as they can search the Web with Google.

The Google Gadgets API is composed of three languages:

- XML This is the language you use to write gadget specifications. A gadget is just an XML file, placed on the Web somewhere where Google can find it.

Accessing the Cloud

- The XML file contains the instructions on how to process and render the gadget. The XML file can contain all the data, or it can have reference URLs where the data can be found.
- HTML HTML is the markup language used to format the pages on the web. It is generally responsible for the static portions of your web pages.
- HTML and XML look similar, but HTML is used to format web documents, whereas XML is used to describe structured data.
- JavaScript JavaScript is the scripting language you can use to add dynamic behavior to your gadgets.
- Google Desktop Search is a lightweight, free, downloadable application that brings
- Google search to information on your computer. The application operates locally on the user's computer, where it provides the following capabilities:

Accessing the Cloud

- System-wide search Users can search across their email and a wide range of files and information such as email in Microsoft Outlook and Outlook Express; files in Microsoft Word, Microsoft Excel,
- Microsoft PowerPoint, and text; web site history in Internet Explorer; and instant message chats in AOL Instant Messenger.
- High search speed Google.com can search billions of web pages in a fraction of a second. Google Desktop Search is built with the same technology, and it can search a single hard drive in even less time.
- Easy access to desktop results via Google.com Google Desktop Search enables users to search both their computer and the Web simultaneously.
- When users search through Google.com (either from the home page or the Google Toolbar), Google Desktop Search runs the same search in parallel on the user's computer.

Accessing the Cloud

- If Google Desktop Search finds relevant results, those results are added to the Google.com search results page. This means that users don't need to decide before they search whether to search the Web or their computer.

- Dynamic results Unlike traditional computer search software that updates once a day, Google Desktop Search updates continuously for most file types.

- When a user downloads a new email in Outlook, for example, it can be found within seconds using Google Desktop Search. Google Desktop Search is available at http://desktop.google.com.

Google Data APIs

- The Google Data APIs provide a simple standard protocol for reading and writing data on the Web. They encompass a broad range of business functions that can be used to link your applications within and outside of the cloud.

- Description These REST-style APIs are based on the Atom Publishing Protocol (AtomPub), and use the Atom syndication format to represent data and HTTP to handle communication.

Accessing the Cloud

The Google Data APIs include

- Google Apps APIs
- Google Base Data API
- Blogger Data API
- Google Book Search Data API
- Google Calendar Data API
- Google Code Search Data API
- Google Contacts Data API
- Google Documents List Data API
- Google Finance Portfolio Data API
- Google Health Data API
- Google Notebook Data API
- Picasa Web Albums Data API
- Google Spreadsheets Data API
- Webmaster Tools Data API
- YouTube Data API

Accessing the Cloud

- Partnership Salesforce.com partnered with Google, making it easier for developers to create applications for cloud computing.

- The Force.com Toolkit for Google Data APIs provides a set of tools and services to allow developers to take advantage of Google Data APIs, a common set of standard APIs for interacting with data in Google services, within their applications and projects on Force.com.

- The APIs are freely available at http://developer.force.com/ and http://code.google.com/ p/apex-google-data/.

- The alliance between Salesforce.com and Google gives developers a multicloud computing platform for building and running applications.
- The Force.com PaaS and Google's open APIs and technologies enable the creation of powerful applications delivered on the Web.
- Additionally, the Force.com Toolkit for Google Data APIs creates new opportunities for developers and ISVs to extend the widely adopted Salesforce for Google Apps.

- The toolkit gives developers and partners the ability to create business applications that extend salesforce for Google Apps as well as build entirely new applications to help customers run their business in the cloud.

Accessing the Cloud

GoGrid

- GoGrid's API is a web service that allows developers to control their interaction with GoGrid's cloud hosting infrastructure.

- The GoGrid API provides two-way communication for controlling GoGrid's control panel functionality. Typical uses for the API include
- Auto-scaling network servers
- Listing assigned public and private IP addresses
- Deleting servers

Listing billing details

- GoGrid's REST-like API Query interface is designed for individuals who want to programmatically control their cloud hosting infrastructure over the Internet.
- The GoGrid API requires you to be a GoGrid customer and to have technical knowledge and programming skills.
- **The GoGrid API supports these languages:**
- Java
- PHP
- Python
- Ruby

Accessing the Cloud

Apex

- The Apex Web Services API is one of the world's most widely used enterprise web services, handling more than 50 percent of Salesforce.com's 3.7 billion service transactions.
- The Apex Web Services API makes it possible to access and manage complex data relationships—such as a set of information about an account, all the products they have bought, and all of their contacts—in a single request.
- This capability, analogous to database JOIN functionality, enhances both the speed and simplicity of integrations, and will be unique to the Apex API.
- Development Platform Apex is a development platform for building Software as a Service (SaaS) applications on top of Salesforce.com's customer relationship management (CRM) functionality.
- By using Apex, developers can access Salesforce.com's back-end database and client-server interfaces to create SaaS applications.
- This API allows developers to use common SaaS components, like web widgets or a multitenant database, without the need to develop much of the infrastructure traditionally associated behind SaaS programs.

Accessing the Cloud

The Apex platforms consist of three tools:

• Apex Builder An on-demand component allowing easy drag-and-drop customization with a limited set of features.

• Apex API A method of retrieving raw data from Salesforce.com's servers. The API is used by programs that are external to Salesforce.com, like Java applications that need access to information on a client's Salesforce.com account.

• Apex Code A programming language that is executed on Salesforce.com's servers. The Apex Code offers flexibility in developing by using the Apex API while reducing the number of calls between the client and server.

Sample Code The following is an example of an Apex API. The code defines a system that prevents duplicate records, based on email address, from being entered into the system.

```
trigger blockDuplicates_tgr on Lead bulk(before insert, before update) {
/** begin by building a map which stores the (unique) list of leads * being inserted/updated, using email address as the key. */
Map<String, Lead> leadMap = new Map<String, Lead>();
for (Lead lead : System.Trigger.new) {
if (lead.Email != null) { // skip null emails /* for inserts OR * updates where the email address is changing
* check to see if the email is a duplicate of another in  this batch, if unique, add this lead to the leadMap*/
```

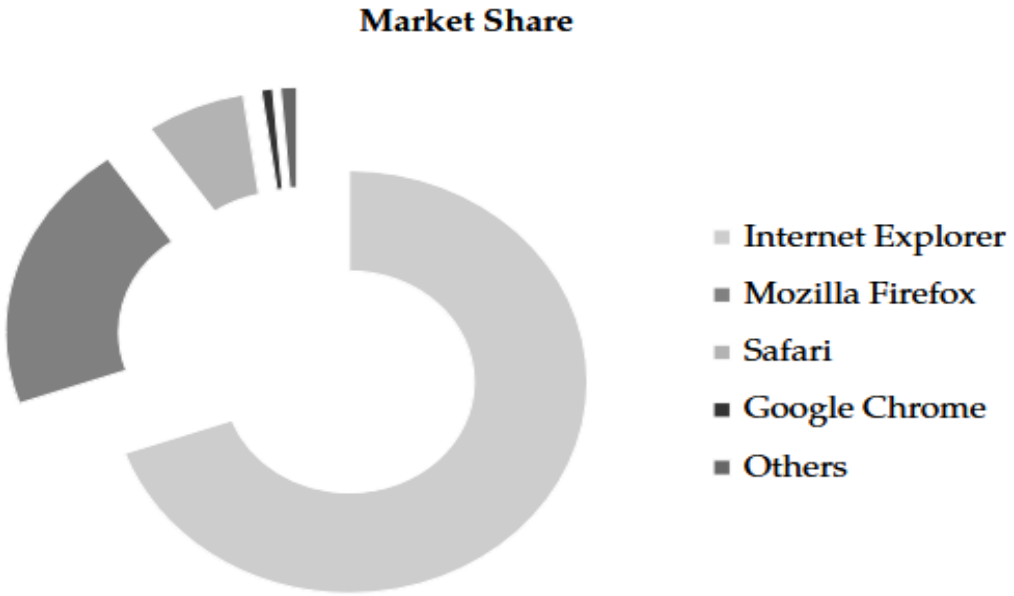
```
if ( System.Trigger.isInsert ||
(System.Trigger.isUpdate &&
lead.Email !=
System.Trigger.oldMap.get(lead.Id).Email)) {
if (leadMap.containsKey(lead.Email)) {
lead.Email.addError('Another new lead has the
same email address.');
} else {
leadMap.put(lead.Email, lead);
}}}}
/* Using the lead map, make a single database query,
* find all the leads in the database that have the same email address.
* as any of the leads being inserted/updated.
*/ for (Lead lead : [select Email from Lead where Email IN
:leadMap.KeySet()]) {
Lead newLead = leadMap.get(lead.Email);
newLead.Email.addError('A lead with this email address already
exists.');}}
```

Accessing the Cloud

Web Browsers :

- To connect to the cloud, most likely you and your users will utilize a web browser. Which one should you use?
- Internet Explorer enjoys the highest market share of browser usage—69.77 percent (according to a December 2008 study released by the web metrics firm Net Applications).
- You can attribute that dominance to the fact that Internet Explorer is included with Windows, the dominant operating system in the world.
- Mozilla's Firefox accounts for 20.78 percent, Apple's Safari represents 7.13 percent, while Google Chrome accounts for less than 1 percent of the market at .98 percent.
- The remaining almost 2 percent of browsers include products like Camino, Opera, and others. Of course these numbers are moving targets, but the market shares have been more or less the same over the months.

Accessing the Cloud



Microsoft Internet Explorer represented almost 70 percent of the web browser market at the end of 2008.

Accessing the Cloud

Internet Explorer :

- Windows Internet Explorer 8 for Windows Vista, XP, and Windows 7 is the latest version of the popular web browser.

IE 8 Features

- Internet Explorer 8 delivered a new look and enhanced capabilities that made everyday tasks—such as searching, browsing multiple sites, and printing—simple and fast.

- The big change in IE 8 is its rendering modes. The progressive evolution of the Web has necessitated that browsers such as Internet Explorer include multiple content-rendering modes both supporting strict interpretation of certain web standards and also supporting behaviors designed to maintain compatibility with existing web sites.

- Web site designers generally have the ability to specify which mode they are designing for; in the absence of specific instructions from a web site, browsers are preset to use one of the modes by default.

- Internet Explorer 8 has been designed to include three rendering modes: One that reflects Microsoft's implementation of current web standards.

- A second reflecting Microsoft's implementation of web standards at the time of the release of Internet Explorer 7 in 2006 A third based on rendering methods dating back to the early Web

Accessing the Cloud

- The newest rendering mode is forward-looking and preferred by web designers, while the others are present to enable compatibility with the myriad sites across the Web that are currently optimized for previous versions of Internet Explorer.
- Internet Explorer 8 includes important end-user advancements, it was also designed with developers and IT managers in mind.
- Microsoft engineered Internet Explorer 8 for compatibility with existing web sites by adhering to some of the most important standards for web site development.
- Internet Explorer 8 also features improved manageability for enterprises through the enhanced support of Active Directory Group Policy.
- It enables IT managers to easily deploy and centrally manage the browser on each of the desktops in their network.

Accessing the Cloud

Microsoft's Internet Explorer 8 is the most current version of the popular web browser.

Accessing the Cloud

Firefox :

- In June 2008 Mozilla released Firefox 3, a major update to its popular, free, open-source web browser. Firefox 3 is the culmination of three years of efforts from thousands of developers, security experts,localization and support communities, and testers from around the globe.

- Available in approximately 50 languages, Firefox 3 is two to three times faster than its predecessor and offers more than 15,000 improvements, including the revolutionary smart location bar, malware protection, and extensive under-the-hood work to improve the speed and performance of the browser.

User Experience :

- The enhancements to Firefox 3, smart location bar, affectionately known as the “Awesome Bar.” It learns as people use it, adapting to user preferences and offering better-fitting matches over time.

- The Firefox 3 Library archives browsing history, bookmarks, and tags, where they can be easily searched and organized.

- One-click bookmarking and tagging make it easy to remember, search, and organize web sites. The new full-page zoom displays any part of a web page, up close and readable, in seconds.

Accessing the Cloud

Firefox 3 was released in August 2008, and runs two to three times faster than its predecessor.

Firefox Performance :

- Firefox 3 is built on top of the Gecko 1.9 platform, resulting in a safer, easier-to-use, and more personal product. Firefox 3 uses less memory while it's running than previous releases, and its redesigned page rendering and layout engine means that users see web pages two to three times faster than with Firefox 2.

Security :

- Firefox 3 raises the bar for security. The new malware and phishing protection helps protect from viruses, worms, trojans, and spyware to keep people safe on the Web.

- Firefox 3's one-click site ID information allows users to verify that a site is what it claims to be. Mozilla's open-source process leverages the experience of thousands of security experts around the globe.

Customization :

- Firefox 3 lets users customize their browser with more than 5,000 add-ons. Firefox add-ons allow users to manage tasks like participating in online auctions, uploading digital photos, seeing the weather forecasts, and listening to music, all from the convenience of the browser.

- The new Add-ons Manager helps users to find and install add-ons directly from the browser.

Accessing the Cloud

Safari :

- Apple claims that Safari 3.1 is the world's fastest web browser for Mac and Windows PCs, loading web pages 1.9 times faster than Internet Explorer 7 and 1.7 times faster than Firefox 2.

- Safari also runs JavaScript up to six times faster than other browsers, and is the first browser to support the latest innovative web standards needed to deliver the next generation of highly interactive Web 2.0 experiences. Safari 3.1 is available as a free download at www.apple.com/safari for both Mac OS X and Windows.

- "Safari 3.1 for Mac and Windows is blazingly fast, easy to use and features an elegant user interface," said Philip Schiller, Apple's senior vice president of Worldwide Product Marketing. "And best of all, Safari supports the latest audio, video and animation standards for an industry-leading Web 2.0 experience."

Safari Performance :

- Safari features an intuitive browsing experience with drag-and-drop bookmarks, easy-to-organize tabs, an integrated Find capability that shows the number of matches in a page, and a built-in RSS reader to quickly scan the latest news and information.

Accessing the Cloud

- Safari 3.1 is the first browser to support the new video and audio tags in HTML 5 and the first to support CSS Animations. Safari also supports CSS Web Fonts, giving designers limitless choices of fonts to create stunning new web sites.

System Requirements :

- Safari 3.1 for Mac OS X requires Mac OS X Leopard or Mac OS X Tiger version 10.4.11 and a minimum of 256MB of memory and is designed to run on any Intel-based Mac or a Mac with a PowerPC G5, G4, or G3 processor and built-in FireWire.

- Safari 3.1 for Windows requires Windows XP or Windows Vista, a minimum of 256MB of memory, and a system with at least a 500MHz Intel Pentium processor.

Accessing the Cloud

Safari is the number three most popular web browser and is available for both Mac and PC platforms.

Accessing the Cloud

Chrome :

- Chrome is Google's foray into the open-source browser market. In the early days of the Internet, web pages were frequently little more than text.
- The Web has evolved into a powerful platform that enables users to collaborate with friends and colleagues through email and other web applications, edit documents, watch videos, listen to music, manage finances, and much more.
- Google Chrome was built for today's Web and for the applications of tomorrow.
- "We think of the browser as the window to the web—it's a tool for users to interact with the web sites and applications they care about, and it's important that we don't get in the way of that experience," said Sundar Pichai, vice president of product management, Google Inc.
- "Just like the classic Google homepage, Google Chrome has a simple user interface with a sophisticated core to enable the modern web

Accessing the Cloud

Chromium is an open-source derivation of the Google Chrome web browser.

Accessing the Cloud

Chrome Features :

- Google Chrome was designed to make it easy for users to search and navigate the Web for the content they're looking for.

Features include

- A combined search and address bar quickly takes users where they want to go.
- When users open a new tab in Google Chrome, they'll see a page that includes snapshots of their most-visited sites, recent searches, and bookmarks, making it easier to navigate the Web.
- Each browser tab operates as a separate process; by isolating tabs, if one tab crashes or misbehaves, others remain stable and responsive, and users can continue working without having to restart Google Chrome.
- Google also built a new JavaScript engine, V8, which not only speeds up today's web applications, but enables a whole new class of web applications that couldn't exist on today's browsers.

Accessing the Cloud

Open Source :

- "Google Chrome was built upon other open source projects that are making significant contributions to browser technology and have helped to spur competition and innovation."
- To further advance the openness of the Web, Google Chrome is being released as an open-source project under the name Chromium.
- The intent is that Google will help make future browsers better by contributing the underlying technology in Google Chrome to the market, while continuing to develop additional features.

Chrome Cloud :

- There's a lot of buzz around Chrome being a great tool for cloud computing. It extends the cloud into your organization's computer, and vice versa. This is mainly because of the power of the V8 JavaScript engine and built-in Google Gear.

Accessing the Cloud

- Google Gears are also open source, and they enable powerful web applications by adding new features to the web browser. Major API components to Gears include
- A database module that can store data locally
- A WorkerPool module that provides parallel execution of JavaScript code
- A LocalServer module that caches and serves application resources (like HTML, JavaScript, images, and so on)
- A Desktop module that lets web applications interact more naturally with the desktop
- A Geolocation module that lets web applications detect the geographical location of their users

Accessing the Cloud

- Chrome will allow desktop and web applications to merge, putting everything into the cloud so that you won't even have to think about both terms.
- Chrome is an application virtual machine for both on and offline web applications.
- Google Chrome can be downloaded at www.google.com/chrome. Google Chrome for Mac and Linux users is still in the works.
- Chromium, visit www.chromium.org.
- There are a number of ways to connect to the cloud. The way you opt to do so will depend on a number of factors including your or your programmers' skills, which computing platform you use, and what your vendor offers.

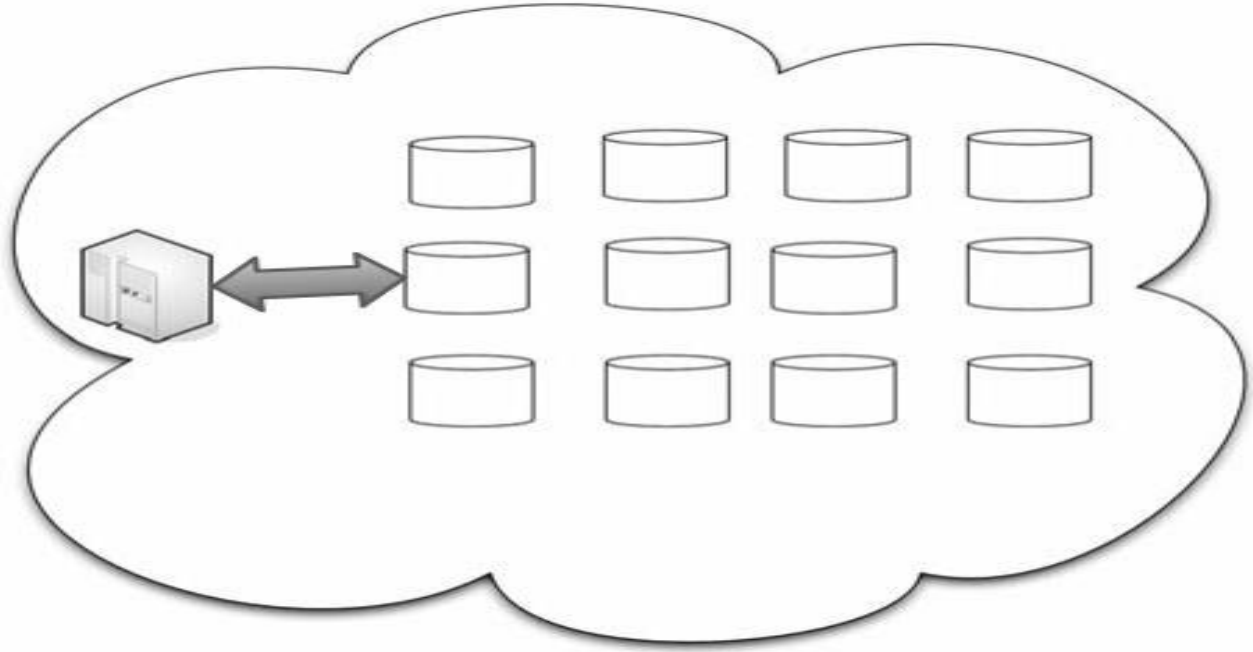
Cloud Storage

- Cloud storage has a number of advantages over traditional data storage. If you store your data on a cloud, you can get at it from any location that has Internet access.
- Workers don’t need to use the same computer to access data nor do they have to carry around physical storage devices.
- There are hundreds of different cloud storage systems, and some are very specific in what they do. Some are niche-oriented and store just email or digital pictures, while others store any type of data.
- Some providers are small, while others are huge and fill an entire warehouse.
- 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.

Cloud Storage

- 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.
- Many clients use cloud storage not because they’ve run out of room locally, but for safety. If something happens to their building, then they haven’t lost all their data.

Cloud Storage

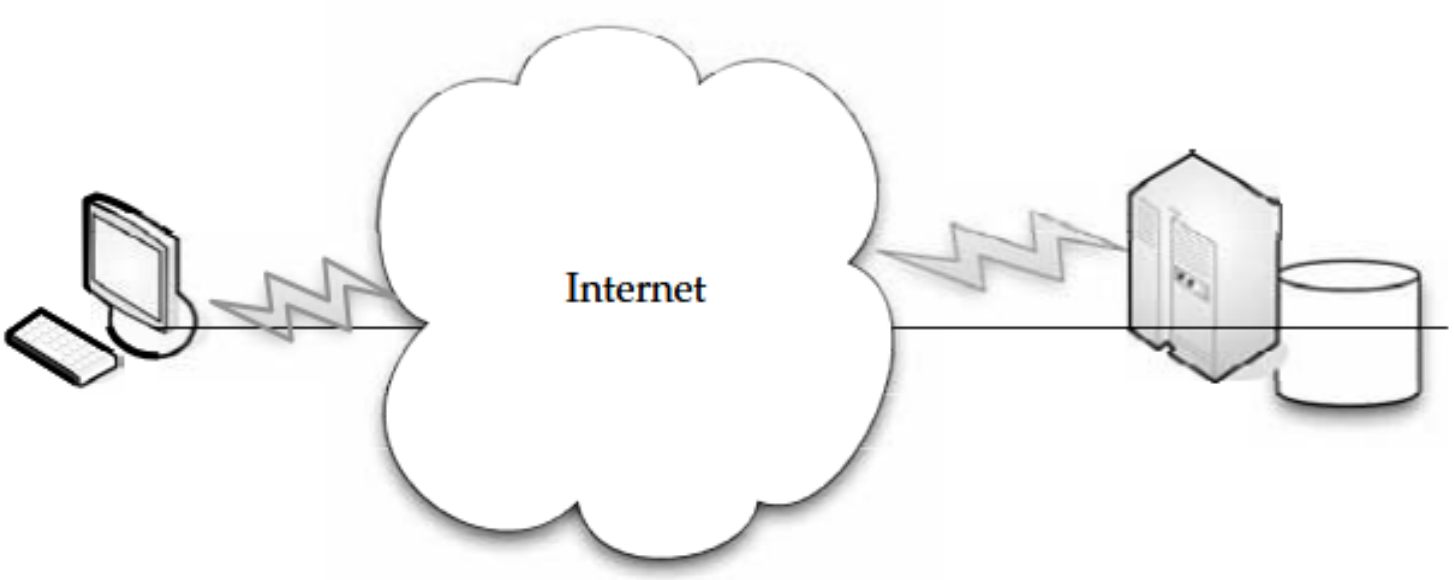


A cloud service provider can simply add more commodity hard drives to increase the organization's capacity.

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

Cloud Storage



Clients rent storage capacity from cloud storage vendors.

Cloud Storage

Providers :

- There 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

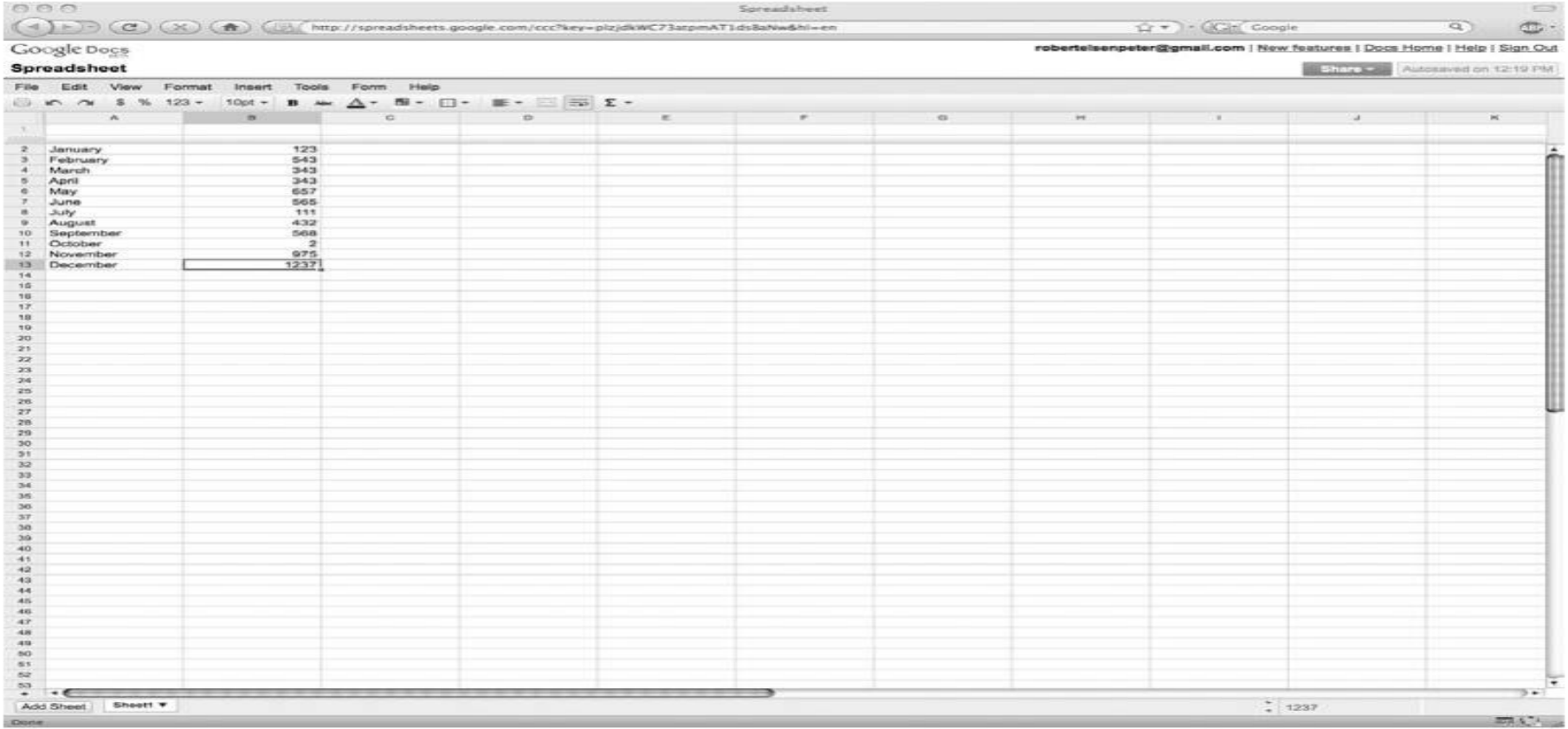
- Google Docs allows users to upload documents, spreadsheets, and presentations to Google's data servers. Those files can then be edited using a Google application.

- 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.
- Many of these services are provided for free, but others charge you per stored gigabyte and by how much information is transferred to and from the cloud. More and more providers offer their services, prices have tended to drop, and some companies offer a certain amount for free.

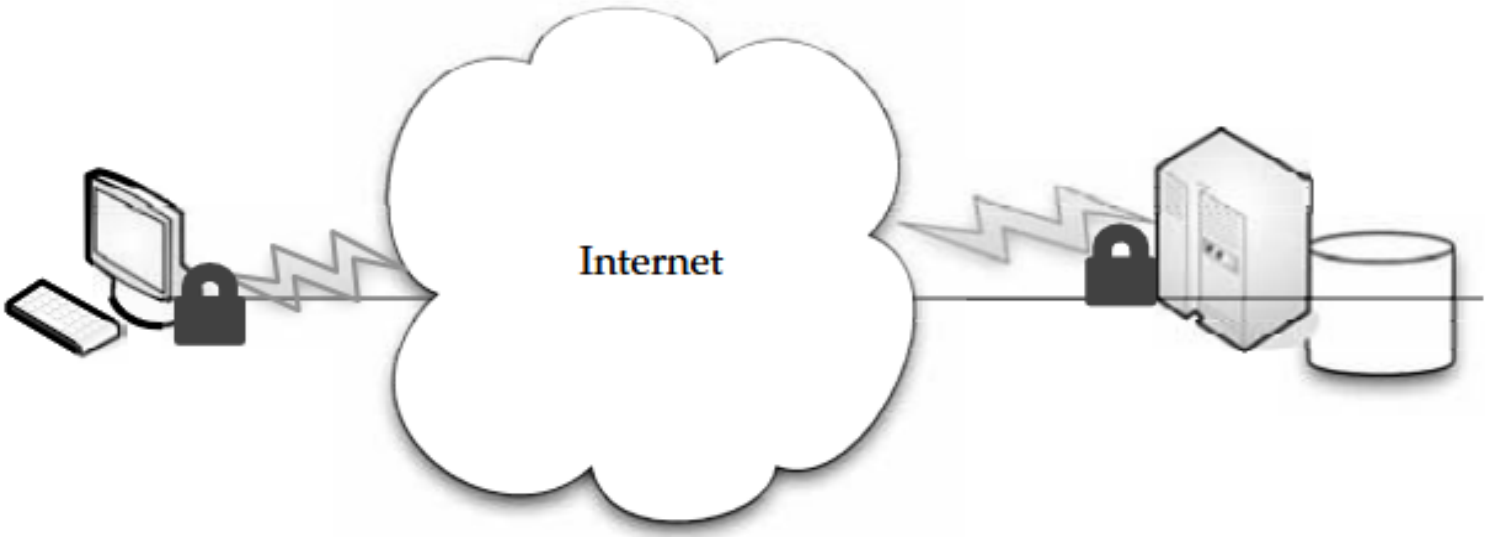
Cloud Storage



Security :

- 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.
- There are still concerns that data stored on a remote system is vulnerable. There is always the concern that a hacker will find a way into the secure system and access the data. Also, a disgruntled employee could alter or destroy the data using his or her own access credentials.

Cloud Storage



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

Cloud Storage

Reliability :

- The other concern is reliability. If a cloud storage system is unreliable, it becomes a liability. No one wants to save data on an unstable system, nor would they trust a company that is financially unstable.
- 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.
- Reputation is important to cloud storage providers. If there is a perception that the provider is unreliable, they won't have many clients. And if they are unreliable, they won't be around long, as there are so many players in the market.

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 and thereby available quickly to where it is used.

Cloud Storage

- Storing data on the cloud is advantageous, because it allows you to protect your data in case there's a disaster. You may have backup files of your critical information, but if there is a fire or a hurricane wipes out your organization, having the backups stored locally doesn't help.

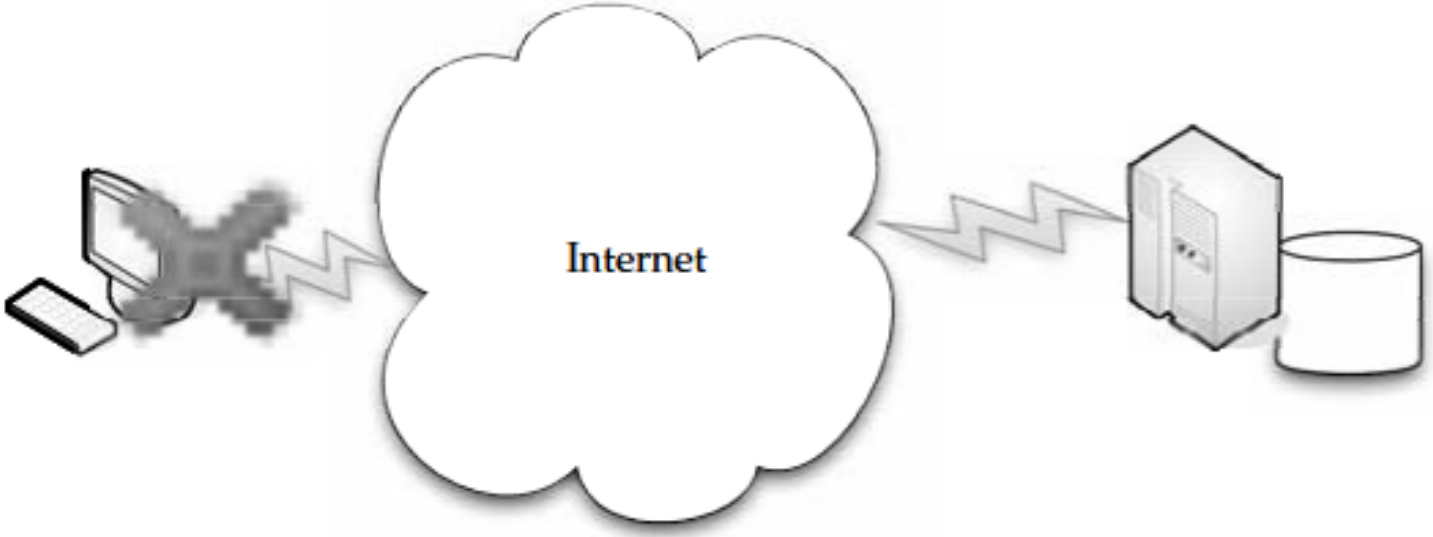
- Having your data stored off-site can be the difference between closing your door for good or being down for a few days or weeks.

- Storage vendor to go with can be a complex issue, and how your technology interacts with the cloud can be complex.

- For instance, some products are agent-based, and the application automatically transfers information to the cloud via FTP. But others employ a web front end, and the user has to select local files on their computer to transmit.

- 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.

Cloud Storage



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.

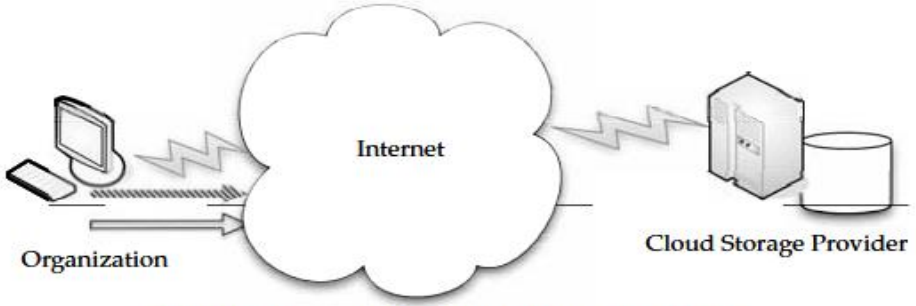
Cloud Storage

Cautions :

- A mixed approach might be the best way to embrace the cloud, since cloud storage is still immature. That is, don't commit everything to the cloud, but use it for a few, noncritical purposes.
- Large enterprises might have difficulty with vendors like Google or Amazon, because they are forced to rewrite solutions for their applications and there is a lack of portability.
- A vendor like 3tera, however, supports applications developed in LAMP, Solaris, Java, or Windows.NET.
- The biggest deal-breakers when it comes to cloud storage seem to be price and reliability.
- This is where you have to vet your vendor to ensure you're getting a good deal with quality service. One mistake on your vendor's part could mean irretrievable 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 you need before you commit too much to the cloud.

Cloud Storage

- Legal issues are also important. For instance, if you have copyrighted materially like music or video that you want to maintain on the cloud, such an option might not be possible for licensing reasons.
- Vendors offer different assurances with the maintenance of data. They may offer the service, but make sure you know exactly what your vendor will or will not do in case of data loss or compromise.
- The best solution is to have multiple redundant systems: local and offsite backup; sync and archive.



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

Outages :

- Further, organizations have to be cognizant of the inherent danger of storing their data on the Internet. Amazon S3, for example, dealt with a massive outage in February 2008.
- The result was numerous client applications going offline. Amazon reports that they have responded to the problem, adding capacity to the authentication system blamed for the problem.
- They also note that no data was lost, because they store multiple copies of every object in several locations.
- The point remains, however, that clients were not able to access their data as they had intended, and so you need to use caution when deciding to pursue a cloud option.

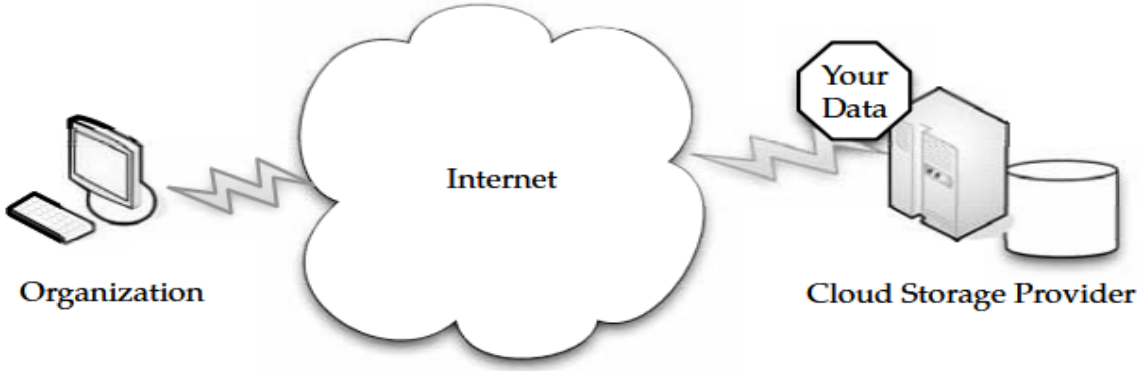
Theft :

- You should also keep in mind that your data could be stolen or viewed by those who are not authorized to see it. Whenever your data is let out of your own datacenter, you risk trouble from a security point of view.

Cloud Storage

- Storage providers put everything into one pot. Your company's data could be stored next to a competitor's, and the risk of your competition seeing your proprietary information is real.

- If you do store your data on the cloud, make sure you're encrypting data and securing data transit with technologies like SSL.



Whenever you let your data out of your organization, you give up a measure of security.

Cloud Storage Providers :

- There are hundreds of them and new players every day. This is simply a listing of what some of the big players in the game have to offer, and you can use it as a starting guide to determine if their services match your needs.

- Amazon and Nirvanix are the current industry top dogs, but many others are in the field, including some well-known names. Google is ready to launch its own cloud storage solution called GDrive.

- EMC is readying a storage solution, and IBM already has a number of cloud storage options called Blue Cloud.

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.

Cloud Storage

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.

Cloud Storage

- 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.

- A forcing function for the design was that a single Amazon S3 distributed system must support the needs of both internal Amazon applications and external developers of any application.

- This means that it must be fast and reliable enough to run Amazon.com's web sites, while flexible enough that any developer can use it for any data storage need.

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.

Cloud Storage

- 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 :

- Amazon keeps its lips pretty tight about how S3 works, but according to Amazon, S3's design aims to provide scalability, high availability, and low latency at commodity costs.

- 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.

- 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:

Cloud Storage

- http://s3.amazonaws.com/examplebucket/examplekey
- http://examplebucket.s3.amazonaws.com/examplekey

- The Amazon AWS Authentication tools allow the bucket owner to create an authenticated URL with a set amount of time that the URL will be valid.

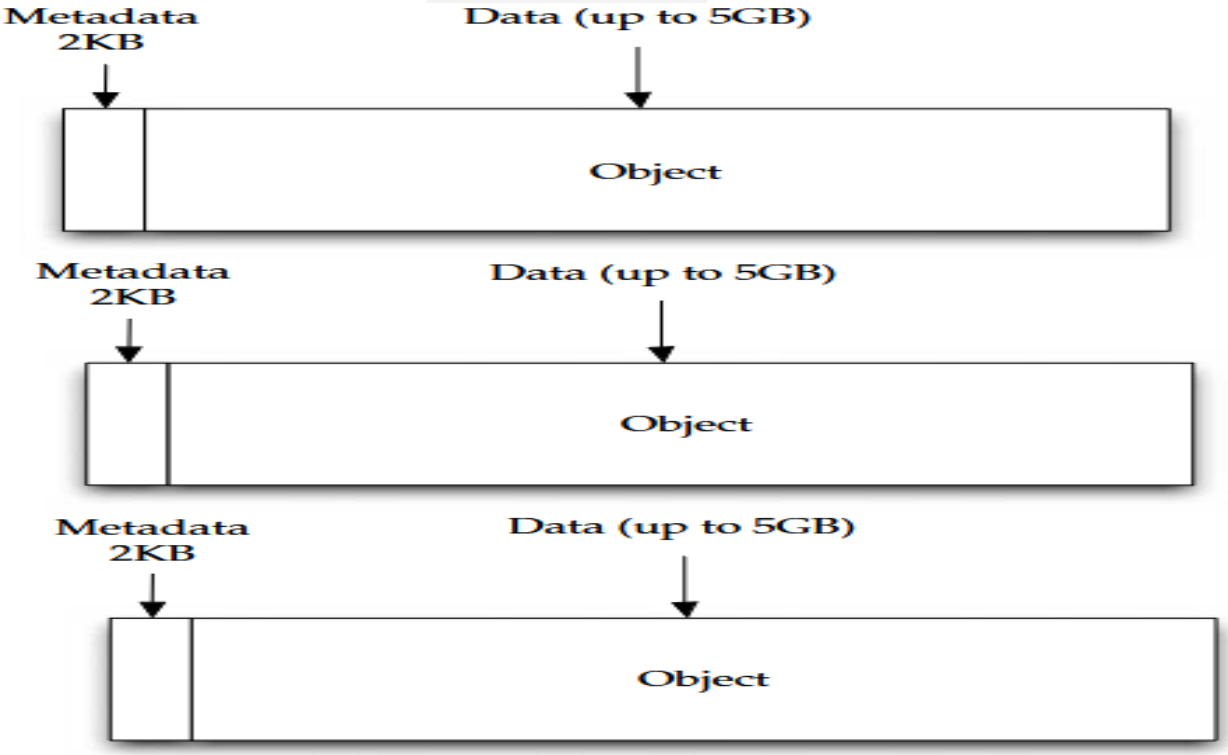
- For instance, you could create a link to your data on the cloud, give that link to someone else, and they could access your data for an amount of time you predetermine, be it 10 minutes or 10 hours.

- Bucket items can also be accessed via a BitTorrent feed, enabling S3 to act as a seed for the client. Buckets can also be set up to save HTTP log information to another bucket.

- This information can be used for later data mining. “Amazon S3 is based on the idea that quality Internet-based storage should be taken for granted,” said Andy Jassy, vice president of Amazon Web Services.

- “It helps free developers from worrying about where they are going to store data, whether it will be safe and secure, if it will be available when they need it, the costs associated with server maintenance, or whether they have enough storage available.
- Amazon S3 enables developers to focus on innovating with data, rather than figuring out how to store it.”

Cloud Storage



Multiple objects are stored in buckets in Amazon S3.

Cloud Storage

Early S3 Applications :

- The science team at the University of California Berkeley responsible for NASA's "Stardust@Home" project (http://stardustathome.ssl.berkeley.edu/) is using Amazon S3 to store and deliver the 60 million images that represent the data collected from their dust particle aerogel experiment.

- These images will be delivered to 100,000 volunteers around the world who scan the images looking for dust particles from comet Wild2.

- "We quickly ran into challenges when we started the project using our own infrastructure," said Andrew Westphal, project director of Stardust@Home. "Using Amazon S3 has allowed us to proceed without having to worry about building out the massive storage infrastructure

- The fact that Amazon S3 is an Internet-connected storage service is particularly useful to us as we expect the data examination phase of the project to take only a few months. We can quickly ramp up and back down again without a huge investment."

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 location.

Cloud Storage

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.
- "Up until recently, cloud storage has primarily served as an on-tap back end for application developers," said Adam Couture, principal analyst at Gartner.
- "Today, we're starting to see enterprises begin to consider cloud storage as a low-cost storage tier for selective applications such as backup and archiving."
- 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.

Cloud Storage

- With the ability to store multiple file copies in multiple geographic nodes, the SDN enables unparalleled data availability for developers, businesses, and enterprises.
- The Nirvanix CloudNAS for Linux mounts the Nirvanix Storage Delivery Network as a virtual drive that can be accessed via NFS, CIFS, or FTP.
- After installation, storage administrators can apply standard file, directory, or access permissions, and users on the network can then access the Nirvanix-mapped drive from their existing applications or storage processes.
- Additionally, storage administrators get access to the robust Nirvanix SDN functionality such as automated policy-based file replication, single global namespace that scales to petabytes, and storage of secure, encrypted data on one or more of Nirvanix's globally clustered storage nodes.

Cloud Storage

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 percent SLA Immediate availability to data in seconds, versus hours or days on offline tape Nirvanix

- CloudNAS is aimed at companies that maintain repositories of archival, backup, or unstructured data that requires long-term, secure storage, or organizations that use automated processes to transfer files to mapped drives.

- Example use cases include long term archiving of data leveraging an established backup/archival solution; departments using a centralized, shared data repository; disk-to-disk-to-cloud replacing tape for archival of data; and simple backup of all computers within a department.

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.

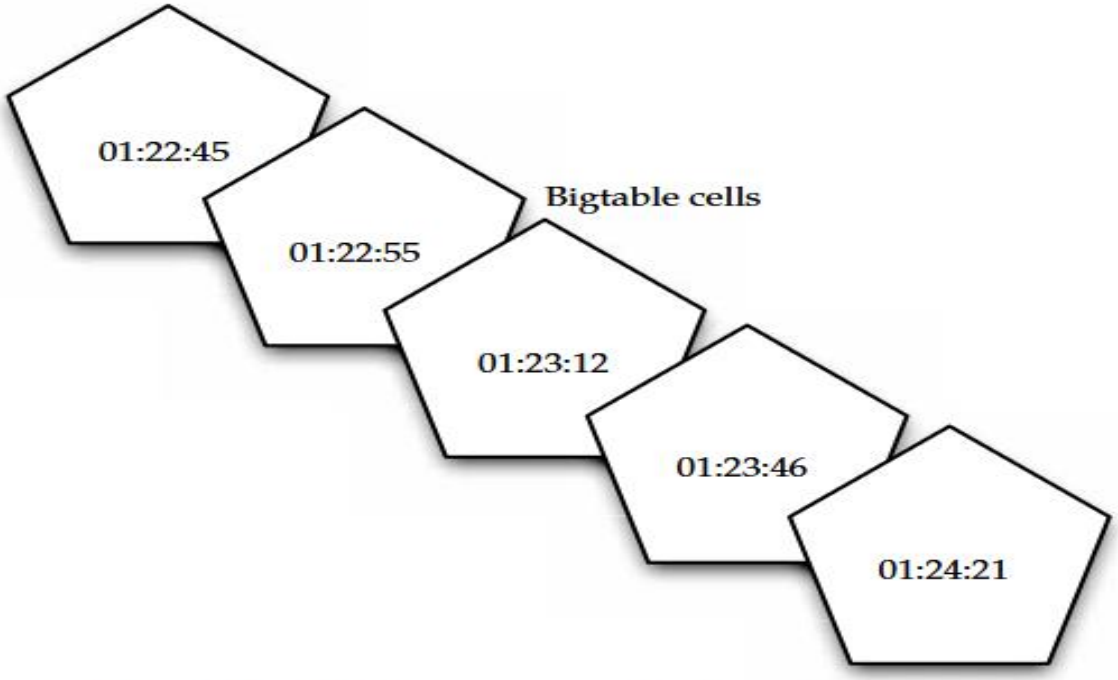
How Bigtable Works :

- Bigtable is a complex offering that is not easy to understand. If you have trouble sleeping, they offer a very technical explanation at http://labs.google.com/papers/bigtable-osdi06.pdf. 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, you can select certain versions of a web page, or delete cells that are older than a given date and time.

Cloud Storage

- The tables are so large, Bigtable splits them at row boundaries and saves them as tablets. Each tablet is about 200MB, and each server houses 100 tablets.
- Given this, data from a database is likely to be stored in many different servers—maybe not even in the same geographic location.
- This architecture also allows for load balancing. If one table is getting a lot of queries, it can remove other tablets or move the busy table to another machine that is not as busy.
- Also, if a machine fails, since the tablet is spread to different machines, users may not even notice the outage.
- When a machine fills up, it compresses some tablets using a Google-proprietary technique. On a minor scale, only a few tablets are compressed. On a large scale, entire tablets are compressed, freeing more drive space.
- Bigtable tablet locations are stored in cells, and looking them up is a three-tiered system. Clients point to the META0 table. META0 then keeps track of many tables on META1 that contain the locations of the tablets. Both META0 and META1 make use of prefetching and caching to minimize system bottlenecks.

Cloud Storage



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

Cloud Storage

Issues :

- While Bigtable is a robust tool, developers have been cautious about using it. Because it is a proprietary system, they get locked into Google. That is also the case with Amazon's Web Services and other cloud providers.
- On the other hand, Google App Engine and Bigtable are affordable, costing about the same as Amazon's S3.

Costs are as follows:

- • $0.10–$0.12 per CPU core-hour
- • $0.15–$0.18 per GB-month of storage
- • $0.11–$0.13 per GB of outgoing bandwidth
- • $0.09–$0.11 per GB of incoming bandwidth

Cloud Storage

MobileMe :

- MobileMe is Apple's solution that delivers push email, push contacts, and push calendars from the MobileMe service in the cloud to native applications on iPhone, iPod touch, Macs, and PCs. MobileMe also provides a suite of ad-free web applications that deliver a desktop like experience through any modern browser.

- MobileMe applications (www.me.com) include Mail, Contacts, and Calendar, as well as Gallery for viewing and sharing photos and iDisk for storing and exchanging documents online.

MobileMe Features :

- With a MobileMe email account, all folders, messages, and status indicators look identical whether checking email on iPhone, iPod touch, a Mac, or a PC. New email messages are pushed instantly to iPhone over the cellular network or Wi-Fi, removing the need to manually check email and wait for downloads.

- Push also keeps contacts and calendars continuously up to date so changes made on one device are automatically pushed up to the cloud and down to other devices.

Cloud Storage

- Push works with the native applications on iPhone and iPod touch, Microsoft Outlook for the PC, and Mac OS X applications, Mail, Address Book, and iCal, as well as the MobileMe web application suite.
- MobileMe web applications provide a desktop-like experience that allows users to drag and drop, click and drag, and even use keyboard shortcuts.
- MobileMe provides anywhere access to Mail, Contacts, and Calendar, with a unified interface that allows users to switch between applications with a single click, and Gallery makes it easy to share photos on the Web in stunning quality.
- Gallery users can upload, rearrange, rotate, and title photos from any browser; post photos directly from an iPhone; allow visitors to download print-quality images; and contribute photos to an album.
- MobileMe iDisk lets users store and manage files online with drag-and-drop filing and makes it easy to share documents too large to email by automatically sending an email with a link for downloading the file.
- MobileMe includes 20GB of online storage that can be used for email, contacts, calendar, photos, movies and documents.

Pricing and Requirements :

- MobileMe is a subscription-based service with 20GB of storage for US$99 per year for individuals and US$149 for a Family Pack, which includes one master account with 20GB of storage and four Family Member accounts with 5GB of storage each.
- A free, 60-day MobileMe trial at www.apple.com/mobileme and current Mac members will be automatically upgraded to MobileMe accounts.
- MobileMe subscribers can purchase an additional 20GB of storage for US$49 or 40GB of storage for US$99 annually.
- Using an iPhone or iPod touch with MobileMe requires iPhone 2.0 software and iTunes 7.7 or later. For use with a Mac, MobileMe requires Mac OS X Tiger 10.4.11 or the latest version of Mac OS X Leopard.
- For a PC, MobileMe requires Windows Vista or Windows XP Home or Professional (SP2), and Microsoft Outlook 2003 or later is recommended. MobileMe is accessible on the Web via Safari 3, Internet Explorer 7, and Firefox 2 or later.

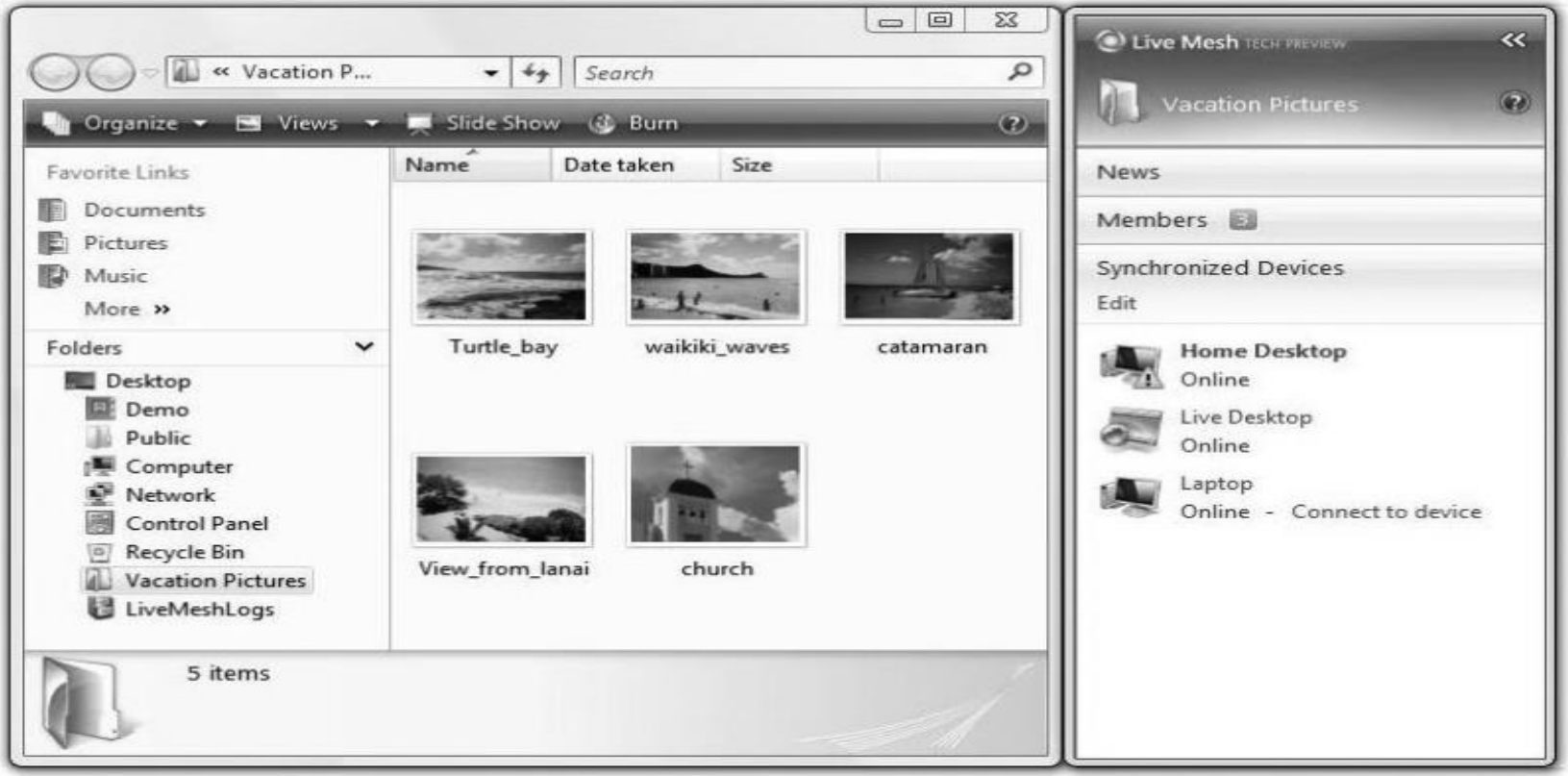
Live Mesh :

- Live Mesh is Microsoft's "software-plus-services" platform and experience that enables PCs and other devices to be aware of each other through the Internet, enabling individuals and organizations to manage, access, and share their files and applications seamlessly on the Web and across their world of devices.

Live Mesh has the following components:

- A platform that defines and models a user's digital relationships among devices, data, applications, and people made available to developers through an open data model and protocols.
- A cloud service providing an implementation of the platform hosted in Microsoft datacenters.
- Software, a client implementation of the platform that enables local applications to run offline and interact seamlessly with the cloud.
- A platform experience that exposes the key benefits of the platform for bringing together a user's devices, files and applications, and social graph, with news feeds across all of these.
- Microsoft promises an open data model, and developers will be able to help Live Mesh grow through the development of additional applications and services.

Cloud Storage



Cloud Storage

- The Live Mesh software, called Mesh Operating Environment (MOE), is available for

- Windows XP
- Windows Vista
- Windows Mobile
- Mac OS X

- The software is used to create and manage the synchronization relationships between devices and data. Live Mesh also incorporates a cloud component, called Live Desktop.

- This is an online storage service that allows synchronized folders to be accessible via a web site.

- It also includes remote desktop software called Live Mesh Remote Desktop, which can be used to remotely connect and manage any of the devices in the synchronization relationship.

- Live Mesh Remote Desktop allows you to control your devices from the Live Mesh application, as well as from any other PC connected to the Internet.

Live Framework :

- For developers, there is a development component consisting of a protocol and APIs known as Live Framework. Live Framework is a REST-based API for accessing the Live Mesh services over HTTP.
- Live Framework differs from MOE in that MOE simply lets folders be shared. The Live Framework APIs can be used to share any data item between devices that recognize the data.
- The API encapsulates the data into a Mesh Object, which is the synchronization unit of Live Mesh. It is then tracked for changes and synchronization.
- A Mesh Object consists of data feeds, which can be represented in Atom, RSS, JSON, or XML. The MOE software also creates Mesh Objects for each Live Mesh folder so they can be synchronized.
- Like cloud computing itself, cloud storage takes its fair share of knocks for being used as a trendy term. If the term is used too often, it could wind up referring to any type of Internet-accessible storage.
- Organizations should think of cloud computing as scalable IT capabilities that are delivered to external customers using the Web.

Cloud Standards

Application :

- 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 :

- The Hypertext Transfer Protocol (HTTP) as the computing mechanism to transfer data between the cloud and your 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.
- When a host needs to customize the content of a web site for a user, the web application must be written to track the user's progress from page to page. The most common method for solving this problem is sending and receiving cookies.

Cloud Standards

- HTTP is the language that the cloud and your computers use to communicate. This language isn't hard to understand, and you've probably seen it before.

- Say your browser wants to get a given web page. The browser initiates it by "saying"
- GET/HTTP/1.0
- Host: www.velte.com
- The server responds with
- HTTP/1.0 200 OK
- Content-Type: text/html
- <head>
- <title>Thank you for visiting Velte Publishing. </title>
- {The rest of the Velte Publishing web page appears here}
- </body>

- The first line of the browser's request, GET/HTTP/1.0, tells us that the browser wants to see the site's home page and that it is using version 1.0 of HTTP.

- The second line, Host:www.velte.com, says which web site the browser wants to see.

Cloud Standards

- HTTP 1.1 This example used HTTP 1.0, but current browsers use 1.1. The request and response would include a bit more information, but the differences are not distinct enough to go into.
- The primary difference between the two is that originally, web browsers made separate HTTP requests like this for each page, each image, and every other component on the page.
- Using HTTP 1.1, a browser and server can negotiate to leave the connection open and transfer all the page's components without hanging up and opening new sessions.
- Requests HTTP defines eight methods to describe how the desired action is to be performed on the server.
- This server presents—whether pre-existing data or dynamically generated data depends on the implementation of the server.
- HTTP is the most common way you will connect your browsers with the cloud. A protocol that is brewing is the XMPP.

Cloud Standards

Request	Description
HEAD	Asks for the response identical to the one that would correspond to a GET request, but without the response body. This is good for retrieving metainformation in the response headers, but without transporting the entire content.
GET	Requests information from a server.
POST	Submits data to be processed to the server. The data is included in the body of the request. The result of the request might be the creation of the resource or updating the existing resource.
PUT	Uploads a representation of the resource.
DELETE	Deletes the specified resource.
TRACE	Echoes the request back to the browser so that the client can see which servers are adding or changing in the request.
OPTIONS	Returns HTTP methods that the server supports for the given URL. This can be used to check the functionality of a web server.
CONNECT	Converts the request connection to a transparent TCP/IP tunnel. It's usually used to facilitate SSL-encrypted communication through an unencrypted HTTP proxy.

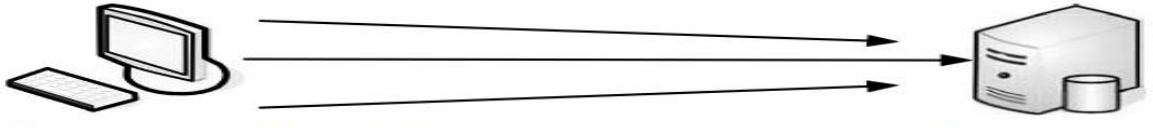
The Different Requests in HTTP

Cloud Standards

XMPP :

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

- The SOAP and other HTTP-based protocols are all one-way information exchanges. This means that clouds do not operate in real time and might have difficulties clearing a firewall. XMPP allows for two-way communication and eliminates polling.

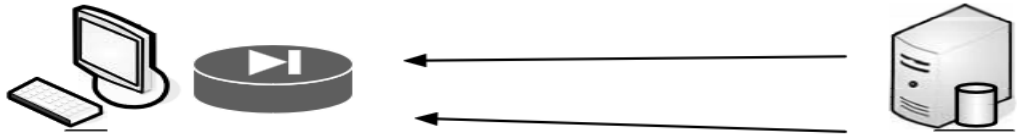


HTTP requires multiple polling events to update status from the web browser.

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

Cloud Standards

- The Problem with Polling When you 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.
- The web site High Scalability reported in 2008 that Twitter was reporting an average of 200 to 300 connections per second, with spikes that rose as high as 800 requests per second.
- During the Macworld keynote, the service went down because of so many polls. Some companies are trying to address the polling problem with existing protocols, but it is difficult.
- Salesforce.com tries to do this by sending notifications back to your web service to avoid polling. That's difficult for developers, and your firewall has to be configured to allow the messages back through.



Responses to polling requests
might be blocked by your organization's firewall.

Cloud Standards

- **Not Ready** XMPP's biggest problem is that it's not HTTP. There's a thought that anything new needs to be based on existing web standards, and while HTTP serves well, it's not perfect, especially for cloud computing.
- XMPP was developed for instant messaging and presence, and it is widely used in those circles. It includes the following features:
- XMPP allows for easy two-way communication, eliminating the need for polling.
- It is XML-based and easily extensible, which makes it ideal for cloud services.
- It is efficient and able to scale to millions of concurrent users on a single service.
- XMPP will gain in prevalence, but hopefully cloud vendors will make the move sooner rather than later.

Security

- Securing your cloud sessions can be accomplished via encryption and authentication. The most prevalent means of web encryption comes standard on every browser. Authentication is another matter, with several options open to you.

Secure Sockets Layer (SSL) :

- 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 your 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 key a public key and a private key.
- The public key does not need to be secret and is placed into a Certificate Signing Request (CSR). This is a file that contains your details. You then submit the CSR.
- During the SSL certificate application process, the certification authority will validate your details and issue an SSL certificate, containing your details, allowing you to use SSL.
- The cloud provider will then match your issued SSL certificate to your private key. Your web browser will be able to establish an encrypted link between your computer and the cloud provider.

Cloud Standards

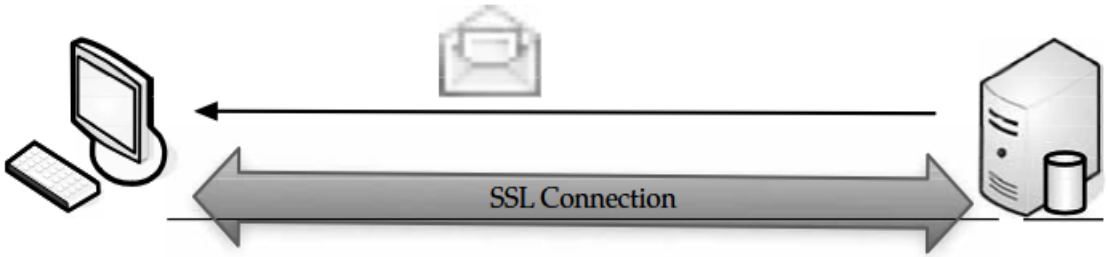
1. The browser checks the web site's certificate to ensure that the site you are connecting to is the real site and not someone else intercepting and spoofing the site.

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.



Cloud Standards

- The only difference you are likely to see is that the page takes a little longer to load because of all the behind the-scenes certificate passing.
- The SSL certificate will contain your cloud provider's domain name, company name, address, city, state, and country.
- It will also contain the expiration date of the certificate and details of the certification authority responsible for issuing the certificate.
- When a browser tries to connect securely to the cloud, it will retrieve the site's SSL certificate and check that it has not expired and that it is being used by the web site for which it was issued.
- It also checks to see if the certificate was issued by an authority that the browser trusts. If it fails any of these checks, the browser lets the user know that the site is not secured by SSL.

OpenID :

- OpenID is an open-source solution for the problem of needing a unique username and password for access to different web sites, thus making your life simpler.
- This allows you to choose the OpenID provider that best meets your need and that you trust. Also, OpenID can stay with you no matter which provider you move to.
- Best of all, OpenID is free. This is good for businesses, because it means a lower cost for password and account management.
- OpenID is still in the adoption phase and is becoming more popular as big names like AOL, Microsoft, Sun, and Novell begin to accept and provide OpenIDs.
- OpenID is a product of the open-source community to solve problems that were not easily solvable by existing technology.
- OpenID is a lightweight way to authenticate users, using the same technology that is used to identify web sites. Anyone can be an OpenID user or provider for free.

Cloud Standards

PCI DSS :

- **Payment Card Industry Data Security Standards (PCI DSS)** requirement 2.2.1 is a nebulous area for many, especially as it relates to cloud computing.
- The requirement states that an organization can “implement only one primary function per server.” But does that mean one physical server?
- The short answer is “no.” You can have multiple systems that are virtualized; you just have to ensure that they are segmented and isolated from each other.
- Virtualization is an emerging technology, and technology changes everything. In the past, copyright law was written to prevent you from making copies of movies and music.
- At the time, no one dreamed that there would be a day when copyrighted materials could be saved on a computer or an iPod.
- The copyright laws are written in such a way that all the bases are covered, no matter what technology throws at them. Expect PCI DSS rules to be changed as well.

How HTML Works :

- HTML is a series of short codes typed into a text file by the author or created by web page design software. These short codes are called tags.
- The text is then saved as an HTML file and viewed through a browser, like Internet Explorer or Mozilla Firefox. The browser reads the file and translates the text into the form the author wanted you to see.
- Writing HTML can be done using a number of methods, with either a simple text editor or a powerful graphical editor.

Tags :

- Tags are written between <angle brackets>. Tags are what allow things like tables and images to appear in a web page. Different tags perform different functions. The tags don't appear when you view the page through a browser, but they affect how the browser behaves.
- For instance: This text will appear in bold. But this text won't. In this example, the tags were wrapped around some text, which will appear bold when viewed through an ordinary web browser.

Cascading Style Sheets in HTML :

- Cascading Style Sheets (CSS) are used to control how pages are presented, and make pages more accessible. Basic special effects and interaction are provided by JavaScript, which adds a lot of power to basic HTML.

Dynamic HTML

- Dynamic HTML (DHTML) is not a new specification of HTML, but rather a different way of looking at and controlling the standard HTML codes and commands.

- When a regular HTML page loads, it will not change until another request comes to the server. DHTML gives you more control over the HTML elements, allowing them to change without returning to the web server.

There are four parts to DHTML:

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

DOM :

- The Document Object Model (DOM) is what allows you to access your web page and make changes with DHTML. The DOM specifies every part of a web page, and provides consistent naming conventions, allowing you to access your web pages and change their properties.

Scripts :

- The most common scripting languages in DHTML are JavaScript and ActiveX. Scripts are used to control the objects specified in the DOM.

Cascading Style Sheets in DHTML :

- CSS is used in DHTML to control the look and feel of the web page. Style sheets list the colors and fonts of text, the background colors and images, and the placement of objects on the page. Using scripting and the DOM, you can change the style of various elements.

XHTML :

- DHTML web pages are actually written in XHTML or HTML 4.x. DHTML is also used to build the elements for the CSS and the DOM to work on.

DHTML has four Features :

- Changing the tags and properties
- Real-time positioning
- Dynamic fonts
- Data binding

- Changing the Tags and Properties One of the most common uses of DHTML is changing the qualities of an HTML tag, depending on an event outside of the browser. You can use this to preload information onto a page, but not display it until the user clicks a specific link.

- Real-Time Positioning Real-time positioning allows objects, images, and text to move around the web page. Normally, this is used for interactive games, but it is a feature you may program into your cloud pages on the basis of organizational need.

- Dynamic Fonts Dynamic fonts are a Netscape-only feature. Netscape developed this to avoid the problem designers had with not knowing which fonts would be on a reader’s system.

- Fonts are encoded and downloaded with the page so that the page always looks the way the designer intended. Data Binding Data binding is an Internet Explorer only feature.

- Microsoft developed the feature to allow easier access to databases and web sites. It is similar to using CGI to access a database, but uses an ActiveX control to function.

JavaScript :

Basic HTML does only basic stuff. It's when you use JavaScript to write functions that are embedded in the HTML pages and interact with the DOM that you start adding pizzazz and specific user-entered data that adds functionality to your web pages.

Examples of the uses of JavaScript:

• Opening or popping up new windows, and having control of the size and attributes of the Window.

- Validating web form input values to ensure that they will be accepted before submitting them to the server.

• Changing images as the cursor rolls over them

Cloud Standards

- JavaScript is a scripting language used for client-side web development. JavaScript was influenced by many languages and was designed to look like Java but be easier for non programmers to work with.
- It is best known for its use in web sites, it is also being used to enable scripting access to objects embedded in other applications.
- It has very little to do with the Java programming language, although both use the common C syntax and JavaScript uses many Java names and naming conventions.
- It would appear to be a “lite” version of the Java programming language. The name comes from a marketing agreement between Sun and Netscape in exchange for Netscape bundling Sun’s Java Runtime with the then-dominant browser.
- JavaScript runs locally on a user’s browser rather than on the server, so it responds quickly to user actions. Further, JavaScript code can detect user action, which HTML cannot, like sensing individual keystrokes. Web browsers use the public API to create host objects, which are responsible for reflecting the DOM into JavaScript.
- A JavaScript web server would house the host objects representing an HTTP request and response, then a JavaScript program could manipulate the data to dynamically generate a web page.

A sample JavaScript program:

```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01//EN"
"http://www.w3.org/TR/html4/strict.dtd">
<html>
<head><title>simple page</title></head>
<body>
<script type="text/javascript">
document.write('Hello World!');
</script>
<noscript>
<p>Your browser either does not support JavaScript, or you have
JavaScript turned off.</p>
</noscript>
</body>
</html>
```

Cloud Standards

Infrastructure :

- Infrastructure is a way to deliver virtualization to your cloud computing solution. We talked about virtualization before, both across the Internet and locally.

Virtualization :

- Virtualization is somewhat different, and major players worked together to develop a standards.
- 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.

Cloud Standards

- "Virtualization is gaining widespread adoption due to its indisputable customer benefits. It is an area rich in opportunities and the ecosystem will develop most fully with open standards.
- VMware is thus taking our industry-leading products, opening up the APIs and providing shared governance and source access to them," said Diane Greene, president of VMware.
- It is the best possible way to give customers the ability to realize the full potential of the x86 virtualization layer."

These initiatives are intended to benefit end users by the following :

- 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.

Cloud Standards

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.

- Consistent adoption of open interfaces is expected to facilitate interoperability and supportability across heterogeneous virtualized environments.

- Collaboration around open hypervisor standards is expected to focus on the following areas of interoperability and performance optimization for virtualized environments:
- Cross-platform frameworks that govern the standardized operation and management of stand-alone virtual machine environments as well as highly dynamic, data center-scale deployment of virtualized systems
- Cooperative virtualization APIs between hypervisors and guest operating systems
- Virtual machine formats that enable virtual machine migration and recovery across platforms

Cloud Standards

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.
- This approach will help drive open collaboration while still preserving the ability of partners to build differentiated, intellectual property protected solutions.
- For customers, the VMware Community Source program is expected to yield a richer and broader set of partner solutions that are well integrated with VMware virtual infrastructure products.
- For partners, the source access and development model allows them to efficiently deliver complementary solutions or differentiated product capabilities around the VMware ESX Server code base.

Cloud Standards

- Red Hat applauds the efforts of technology partners like VMware who are working to establish open, standards-based solutions," said Paul Cormier, executive vice president of engineering at Red Hat.

- "VMware, partners and the community to offer customers virtualization as a key component of their open source architectures."

OVF :

- 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.

- OVF gives customers and developers the choice to select any hypervisor based on price, preference, or functionality, and it prevents vendor lock-in.

- This standard packaging and distribution format for virtual appliances will be important in accelerating the adoption of virtual appliances.

Vmware 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

Cloud Standards

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

- It seems logical that VMware would take the lead in the development of the standard, as they are one of the most dominant forces in the world of virtualization.

- It is also encouraging that they opened their own code to partners to make the standard a true industry-developed standard

Cloud Standards

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 APIs 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.

- Both are based on leading industry standards HTML and JavaScript. to help deliver and present data.

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.
- 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 you use XML in JavaScript, you have to write scripts or use libraries to handle the DOM objects to extract the data you need.

- In JSON, the object is already an object, so no extra work needs to be done. This reduces the amount of overhead, CPU use, and the amount of code you or your programmers have to write.

- 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.

- XML Basics XML is very similar to HTML so those who already know HTML will find it easy to pick up 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.

Cloud Standards

- **Functionality** XML makes database use much easier for your organization.
- Relational database systems cannot meet all the demands of electronic business because they process data independently from its context.
- They are also unable to handle rich data, like audio, video, or nested data structures, which are common in cloud environments.
- Traditional databases are usually retrofitted to deal with XML, but the conversion process is prone to error and there's a lot of overhead, especially with greater transaction rates and document complexity.
- XML databases smooth out this process because they store XML natively in structured, hierarchical form.
- Queries can be resolved much more quickly because there is no need to map the XML data tree to relational database tables.

Benefits of XML :

- **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 you to add other elements if you need them. You can easily adapt your system as your 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.

Cloud Standards

- **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 and SOAP work, and which would be best for your cloud needs.

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.

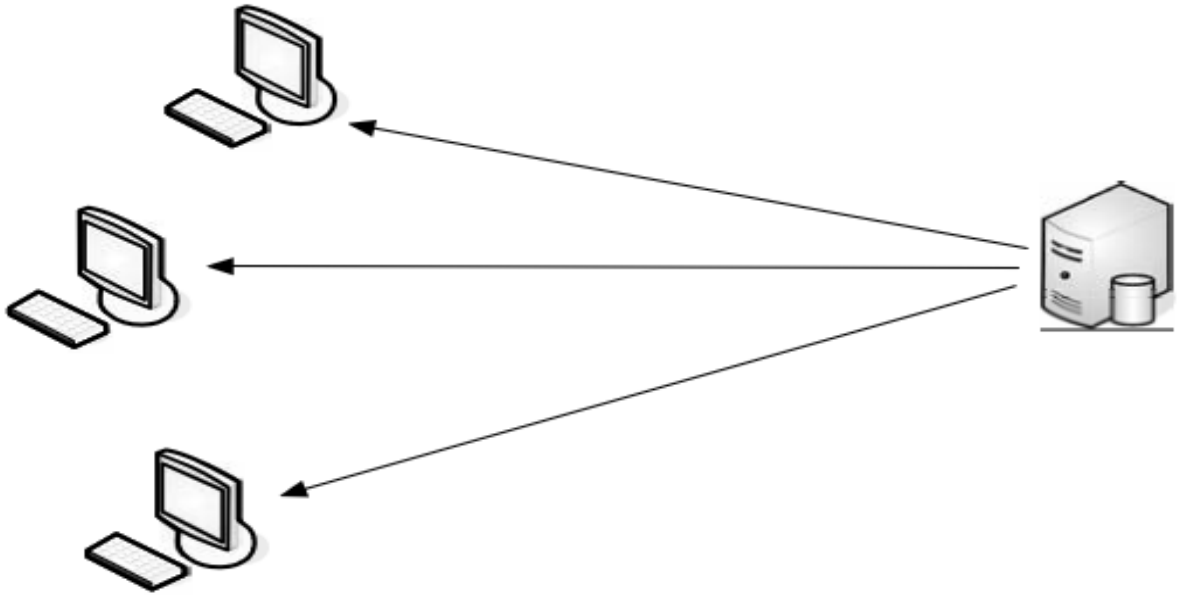
- For instance, REST could be used by your cloud provider to provide updated subscription information. The provider could prepare a web page that includes content and XML statements that are described in the code.

- 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.

Cloud Standards

- REST was developed in a PhD dissertation by Roy Fielding, and he calls it an “architectural style.” He says REST exploits existing technology and protocols of the Web including HTTP and XML.
- 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. However, SOAP offers more capability.
- For instance, if you were to provide syndicated content from your cloud to subscribing web sites, those subscribers might need to use SOAP, which allows greater program interaction between the client and the server.
- REST uses the same publishing approach that many sites use with RDF Site Summary (RSS). RSS uses the Resource Description Framework (RDF), which is a standard way to describe a web site.
- **Resources** are sources of specific information and each one is referenced by a global identifier, like a URL in HTTP. To manipulate these resources, network components communicate via a standard interface and exchange representations of the resources.
- For instance, a resource, which is a triangle, might be described as a polygon with three sides of equal length. It may also combine three points that are connected in a comma separated list.

Cloud Standards



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.

Benefits REST :

- 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.
- 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.
- A benefit when using RESTful applications on the cloud is that REST allows users to bookmark specific queries and allows those queries to be sent to others via email or instant messaging.
- This “representation” of a path or entry point into an application becomes very portable.

Cloud Standards

SOAP :

- Simple Object Access Protocol (SOAP) is a way for a program running in one kind of operating system 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.
- 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.

Cloud Standards

- 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.

- 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>