Cloud Computing

Oya Sanli

Trainer Consultant, MCT, MCAS, MCTS, Business Management Solution Specialist and Owner of PayDeg Corporation
Istanbul, Turkey

Abstract

In my opinion Information Technology is in evolution, transformation and in a change nowadays.

The concept of cloud computing has spread rapidly through the information technology industry. The ability of organizations to tap into computer applications and other software via the cloud and thus free themselves from building and managing their own technology infrastructure seems potentially irresistible.

Cloud computing is seen by many as the next wave of information technology for individuals, companies and governments. In addition to reducing operational costs, cloud technologies have become the basis for radical business innovation and new business models and for significant improvements in the effectiveness of anyone using information technology – which, these days, increasingly means most of the world.

At the beginning to answer the question; "What is Cloud Computing?" I would like to give NIST's (National Institute of Standards and Technology) definition;

Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model promotes availability and is composed of five essential **characteristics,** three **service models**, and four **deployment models**.

Essential Characteristics:

On-demand self-service. A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service's provider.

Broad network access. Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, laptops, and PDAs).

Resource pooling. The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. There is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or datacenter). Examples of resources include storage, processing, memory, network bandwidth, and virtual machines.

Rapid elasticity. Capabilities can be rapidly and elastically provisioned, in some cases automatically, to quickly scale out and rapidly released to quickly scale in. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be purchased in any quantity at any time.

Measured Service. Cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts). Resource usage can be monitored, controlled, and reported providing transparency for both the provider and consumer of the utilized service.

Service Models:

Cloud Software as a Service (SaaS). The capability provided to the consumer is to use the provider's applications running on a cloud infrastructure. The applications are accessible from various client devices through a thin client interface such as a web browser (e.g., web-based email). The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific application configuration settings.

Cloud Platform as a Service (PaaS). The capability provided to the consumer is to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming languages and tools supported by the provider. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly application hosting environment configurations.

Cloud Infrastructure as a Service (IaaS). The capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications. The consumer does not

manage or control the underlying cloud infrastructure but has control over operating systems, storage, deployed applications, and possibly limited control of select networking components (e.g., host firewalls).

Cloud as a service. It covers all other services. It is built for a market, for a group of customers, turnkey offering and integrates required resources, self-service – may require some on-board support. In moment of a necessity it is fast scalable.

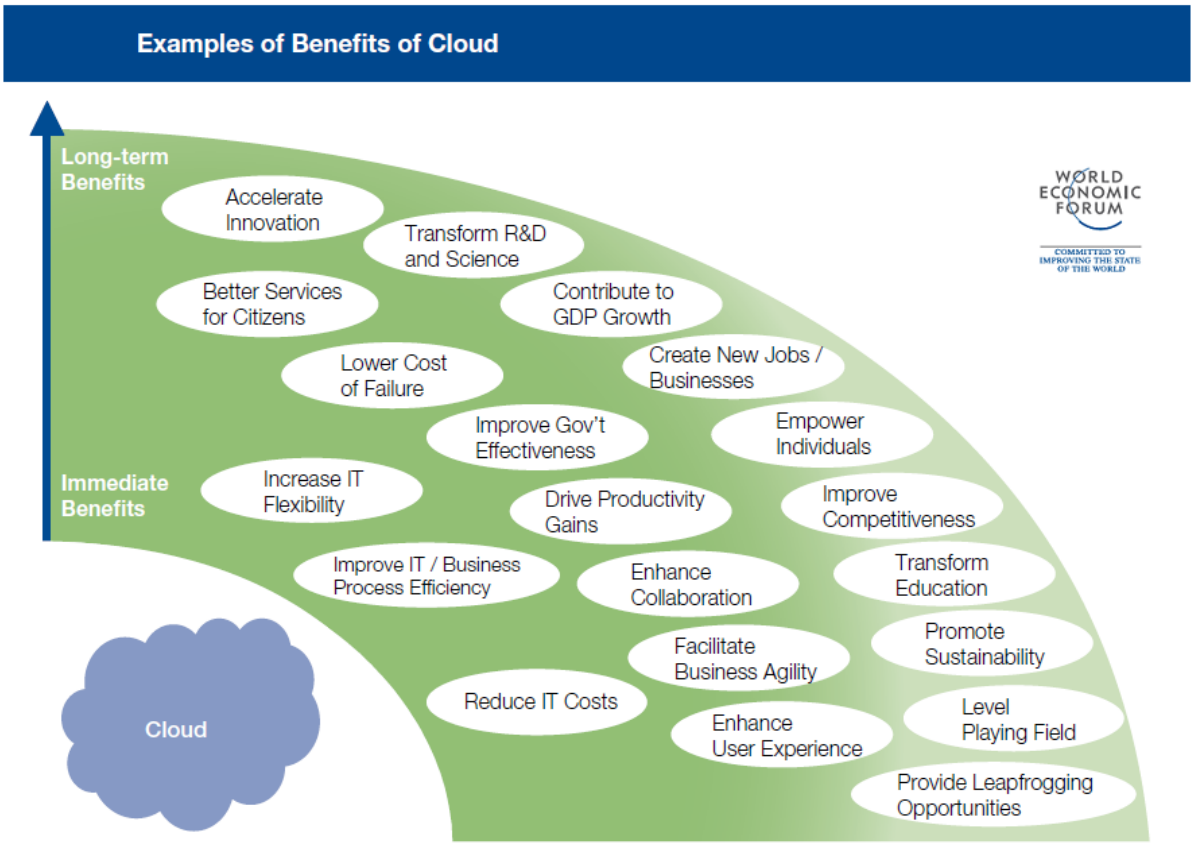
Deployment Models:

Private cloud. The cloud infrastructure is operated solely for an organization. It may be managed by the organization or a third party and may exist on premise or off premise.

Community cloud. The cloud infrastructure is shared by several organizations and supports a specific community that has shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be managed by the organizations or a third party and may exist on premise or off premise.

Public cloud. The cloud infrastructure is made available to the general public or a large industry group and is owned by an organization selling cloud services.

Hybrid cloud. The cloud infrastructure is a composition of two or more clouds (private, community, or public) that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load-balancing between clouds).



Benefits

Benefits for End Users

With today's economic uncertainty, cloud-based computing services present an attractive alternative to traditional enterprise-owned IT infrastructures. The cloud provides cost efficiency, business efficiency, business agility and flexibility when compared with the static IT infrastructure.

Key benefits for end users of cloud-based services include:

- Price: This is by far the top driver for end users exploring cloud. With cloud, companies can pay only for the computing capacity they actually use – avoiding the need to invest in hardware to meet peak demand periods. In short, companies can still meet their computing needs without buying more hardware. . "based on these case studies, there are significant cost savings associated with various cloud computing migrations. Depending on the scope and timing of the migration, reliance on public versus private clouds, the need for privacy and security, the number of file servers before and after migration, the extent of labor savings, and file server storage utilization rates, savings generally average between 25 and 50 percent." – Darrel M West Vice President and Director of Governance Studies at the Brookings Institution.

- Competitive edge: Tapping into cloud services gives end users a drives competitive advantage by increasing IT resource efficiency and capacity that can be added in a matter of minutes.

• Time to market: To remain competitive, companies need to find ways to bring products to market faster – even short delays in a product release can dramatically reduce profitability. This means removing complexity and ensuring computing needs are met as quickly as possible. Cloud enables this by abstracting the infrastructure away from the end user and ensuring that resources are avail-able transparently and on demand.

• Efficiency and flexibility: Companies with static compute resources have to consistently grapple with the tradeoffs related to under and over provisioning of in-house compute capacity. Having access to a cloud service offering lets companies be more flexible about how they meet their internal computing needs – with the ability to fl ex out to a cloud service, companies enjoy faster deployment times and move closer to achieving a truly dynamic data center.

Benefits for Service Providers

The core benefits that service providers receive from moving to a cloud platform fall into these primary categories:

• Revenue Growth: Through the more sophisticated pricing model described above, as well as the increase in customer volume brought about by competitive differentiation, service providers who adopt a cloud strategy can maximize revenues.

• Reduced Costs: By reducing hardware footprint and streamlining IT management via intelligent, SLA-focused automation, companies can save big on both CAPEX and OPEX.

• Improved Customer Satisfaction and Retention: Because cloud services enable providers to offer better performance guarantees (and live up to them), customers will be happier and more likely to stay with that service.

Multi-tenant model

Multi-tenant has been used to describe application architectures designed to support multiple users or “tenants”.

To provide “secure” multi-tenancy and address the concerns of cloud skeptics, a mechanism to enforce separation at one or more layers within the infrastructure is required:
• **Application layer.** A specially written, multi-tenant application or multiple, separate instances of the same application can provide multi-tenancy at this level.
• **Server layer.** Server virtualization and operating systems provide a means of separating tenants and application instances on servers and controlling utilization of and access to server resources.
• **Network Layer.** Various mechanisms, including zoning and VLANs, can be used to enforce network separation. IP security (IPsec) also provides network encryption at the IP layer (application independent) for additional security.
• **Storage Layer.** Mechanisms such as LUN masking and SAN zoning can be used to control storage access. Physical storage partitions segregate and assign resources (CPU, memory, disks, interfaces, etc.) into fixed containers.

Is Cloud Computing revolution or evolution ?

I think there are three main factors for the interests in Cloud Computing:

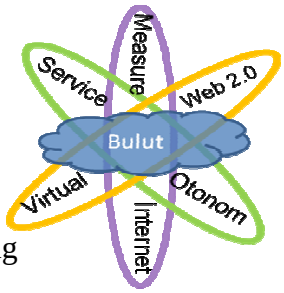
1) rapid decrease in hardware cost and increase in computing power and storage capacity, and the advent of multi-core architecture and modern supercomputers consisting of hundreds of thousands of cores;

2) the exponentially growing data size in scientific instrumentation/simulation and Internet publishing and archiving; and 3) the wide-spread adoption of Services Computing and Web 2.0 applications. Cloud Computing not only overlaps with Grid Computing, it is indeed evolved out of Grid Computing and relies on Grid Computing as its backbone and infrastructure support.

Cloud Computing actually is not a revolution, it is an evolution..It uses many known technologies behind it.

Main Technologies behind Cloud Computing

- Virtualization
- Grid technology
- Service oriented Architecture(SOA)
- Distributed computing
- Wide area
- Browser as Platform
- Free and open source



Other Technologies behind Cloud Computing

- Otonomic systems
- Web 2.0
- Web application frameworks
- SLA

Cloud computing, combined with virtualization, simplifies provisioning, application services, and business continuity, and helps increase availability and reduce environmental impact.

Virtualization is software technology which uses a physical resource such as a server and divides it up into virtual resources called virtual machines (VM's). Virtualization allows users to consolidate physical resources, simplify deployment and administration, and reduce power and cooling requirements. Whilevirtualization technology is most popular in the server world, virtualization technology is also being used in data storage such as Storage Area Networks, and inside of operating systems such as Windows Server 2008 with Hyper-V.

With virtualization, since many servers may run on one machine there may be significant cost savings. Less power consumption, both from the servers themselves and the facilities' cooling systems, and fuller use of existing, underutilized computing resources translate into a longer life for the data center and a fatter bottom line. And a smaller server footprint is simpler to manage.

It provides high accessibility and recover data at failure, while one server fails it prevents others to fail.

Virtualization provides the right to use of system resources. Lets us say you have a server which runs many services and one of the service suddenly needed all of the resources and used all. In that condition other services will be affected negatively. However, with virtualization they may run on same machine and do not affect eachother negatively.

I may say virtualization has 3 cathegories;

Storage virtualization; Virtualization is the pooling of physical storage from multiple network storage devices into what appears to be a single storage device that is managed from a central console.

Network virtualization; is the process of combining hardware and software network resources and network functionality into a single, software-based administrative entity. Servers which are connected to virtual networks may communicate each other like they were connected a phisycal network.

Server virtualization; is the masking of server resources, including the number and identity of individual physical servers, processors, and operating systems, from server users**.**

Grid computing enables or facilitates the conduct of virtual organizations-geographically and institutionally distributed projects and such organizations have become essential for tackling many projects in commerce and research.

“Grid is a type of parallel and distributed system that enables the sharing, selection, and aggregation of services of heterogeneous resources distributed across "multiple" administrative domains based on their availability, capability, performance, cost, and users' quality-of-service requirements”.

Cloud computing is quite similar to grid computing but it is a more powerful, hybrid and a safer computing arena. Cloud computing can be defined as a set of virtual servers working in tandem over the internet. The applications are easily accessible through the internet and these applications use large data centers and powerful servers that host web applications and services. Grid computing involves dividing large tasks into smaller tasks and running those in a number of parallel systems. In contrast cloud computing architecture is a collection of resources which are managed dynamically and can be provisioned, de-provisioned, monitored and maintained at any point of time.

Service Oriented Architecture (SOA) is a business-centric IT architectural approach that supports integrating your business as linked, repeatable business tasks, or services .

A service-oriented architecture is essentially a collection of services. These services communicate with each other. The communication can involve either simple data passing or it could involve two or more services coordinating some activity. Some means of connecting services to each other is needed.

SOA establishes an architectural model that aims to enhance the efficiency, agility, and productivity of an enterprise **.**

Service-orientation requires *loose coupling*- is an approach to interconnecting the components in a system or network so that those components, also called elements, depend on each other to the least extent practicable. Coupling refers to the degree of direct knowledge that one element has of another. - of services with operating systems, and other technologies that underlies applications. SOA separates functions into distinct units, or services, which developers make accessible over a network in order to allow users to combine and reuse them in the production of applications. These services and their corresponding consumers communicate with each other by passing data in a well-defined, shared format, or by coordinating an activity between two or more services.

A great example is a retailer deciding whether to issue a credit card to a customer. It could use the technology to tap different sources and pull together information on a customer's credit worthiness and buying habits.

A bank can use the same computing services to handle account transfer requests, whether they are coming from a teller, an ATM, or a Web application, avoiding the need for multiple applications. SOAs have proven to help companies realize greater efficiencies, cost savings, and productivity.

With Soa you may have:

- Process oriented
- Platform free
- Independent components
- Collaborative working
- Services
- Repeatedly usage
- Modularity
- Standardization

Distributed computing is a science which solves a large problem by giving small parts of the problem to many computers to solve and then combining the solutions for the parts into a solution for the problem.

A distributed system consists of multiple autonomous computers that communicate through a computer network. The computers interact with each other in order to achieve a common goa, solving the problem.

Let me give you a link http://www.distributedcomputing.info this site is designed for non-technical people who are interested in learning about, and participating in, public distributed computing projects which apply distributed computing science to solving real-world problems.

To define fast internet services generally the word **"Broadband**" is used. In telecomunications refers to a signaling method that includes or handles a relatively wide range (or band) of frequencies which may be divided into channels or *frequency bins.* It is

pertaining to or denoting a type of high-speed datatransmission in which the bandwidth is shared by more than one simultaneous signal. Widely used broadbands are cable, DSL(digital subscriber line), ISDN(Integrated Services Digital Network) and satellite connections.

According to the "Broadband report prepared by Telkoder (Turkish competitive telco Operators association), development in Turkey depends on Turkish telecom's Adsl policies. According to the OECD*(Organisation for Economic Co-operation and Development) reportin 28 OECD countries Turkey is the 27th one in using broadband. For cloud computing* to become widespread we need to move up our bandwith rates.

We all are using browsers like Internet Explorer, Google Chrome, Firefox or safari or other, in our dalily life so for cloud computing our browser is a platform, since we reach the cloud srvices via our browsers.

The term ***open source*** describes practices in production and development that promote access to the end product's source materials.

Some consider open source a philosophy, others consider as a methodology. With the rise of internet open source means open the computing source code to public.

Opening the source code enabled a self-enhancing diversity of production models, communication paths, and interactive communities. Subsequently, the new phrase " open-source software" was born to describe the environment that the new copyright, licencing, domain, and consumer issues created.

A main principle and practice of open source software development is peer production by bartering (takas) and collaboration with the end-product, source material and documentation available at no cost to the public.

There are some criters to call a software as **"open source":**

- First of all licencing should not restrict the distribution of the software freely and never forced anyone to distribute the software.
- Licencing must support editing, modifying and derivating..
- Licencing must waranty that the source code with its patches will always be accessible and useable
- Licencing must give any one any type of privileges and never tie downs other softwares
- Licence should be neutral on technology side and it should never support any technology or any interface.

Autonomic computing is an initiative started by IBM in 2001. And its goal is is to develop computer systems capable of self-management. Autonomic computing refers to the self-managing characteristics of distributed computing resources, adapting to unpredictable changes whilst hiding intrinsic complexity to operators and users.

An autonomic system makes decisions on its own, using high-level policies; it will constantly check and optimize its status and automatically adapt itself to changing conditions. Autonomic system, system manages themself is the administrator's goals. In a automic system administartor does not directly control the system but determines the general rules and policies that serve as an input for the self-management process.

For this process, IBM has defined the following four functional areas:

- Self-Configuration: Automatic configuration of components;
- Self-Healing: Automatic discovery, and correction of faults;
- Self-Optimization: Automatic monitoring and control of resources to ensure the optimal functioning with respect to the defined requirements;
- Self-Protection: Proactive identification and protection from arbitrary attacks.

The term **Web 2.0** is associated with web applications that facilitate participatory information sharing, interoperability, user-centered design,and collaboration on the World Wide Web.

Web 2.0 websites allow users to do more than just retrieve information. By increasing what was already possible in "Web 1.0", they provide the user with more user-interface, software and storage facilities, all through their browser. This has been called "Network as platform" computing. Users can provide the data that is on a Web 2.0 site and exercise some control over that data.These sites may have an "Architecture of participation" that encourages users to add value to the application as they use it. **Web 2.0** offers all users the same freedom to contribute. While this opens the possibility for rational debate and collaberation, it also opens the possibility for "spamming" and "trolling" by less rational users.

Some of the examples of Web 2.0 are: social-networking sites, blogs, wikis,video-sharing sites, hosted services, web applications, mashups and folksonomies.

Web 2.0 websites include the following features and techniques: (Andrew McAfee used the acronym SLATES to refer to them)

- **Search ;** Finding information through keyword search**.**
- **Links ;** Connects information together into a meaningful information ecosystem using the model of the Web, and provides low-barrier social tools.
- **Authoring ;** The ability to create and update content leads to the collaborative work of many rather than just a few web authors. In wikis, users may extend, undo and redo each other's work. In blogs, posts and the comments of individuals build up over time.
- **Tags ;** Categorization of content by users adding "tags" - short, usually one-word descriptions — to facilitate searching, without dependence on pre-made categories. Collections of tags created by many users within a single system may be referred to as "folksonomies" (i.e., folk taxonomies).

- **Extensions ;** Software that makes the Web an application platform as well as a document server. These include software like Adobe Reader, Adobe Flash player, Microsoft Silverlight, ActiveX, Oracle Java, Quicktime, Windows Media, etc.
- **Signals ;** The use of syndication technology such as RSS to notify users of content changes

If we compare web 1.0 with web 2.0 we may endup with this table

Web 1.0	**Web 2.0**
DoubleClick	--> Google AdSense
Ofoto	--> Flickr
Akamai	--> BitTorrent
Mp3.com	--> Napster
Britannica Online	--> Wikipedia
Personal websites	--> blogging
Evite	--> upcoming.org and EVDB
Domain name speculation	--> search engine optimization
Page views	--> cost per click
Screen scraping	--> web services
Publishing	--> Participation
content management systems	--> wikis
directories (taxonomy)	--> tagging ("folksonomy")
stickiness	--> syndication

Web 2.0 ensures 6 points;

1. Rich user experience
2. Usable on many devices -pcs, mobiles exct- Software above the level of a single device
3. Innovation in assembly-- A new service like housingmaps.com was built simply by snapping
4. Together two existing services.
5. Lightweight programming models - RSS has become perhaps the single most widely deployed web service because of its simplicity,
6. End of the software release cycle- Users must be treated as co-developers, in a reflection of open source development practices

Web services components provide processing services from a server to other applications over the internet, and it is marvellous technology which one can share data using different softwares in the web pool. For example; combining one Windows application for desktops with a java application for web is easy whith web services..

“cloud has legal issues rather then technical”

SLA - Are the techno-commercial agreement between the Cloud Consumer and the Cloud Provider. It ensures the services provided by the Service (Cloud) provider.

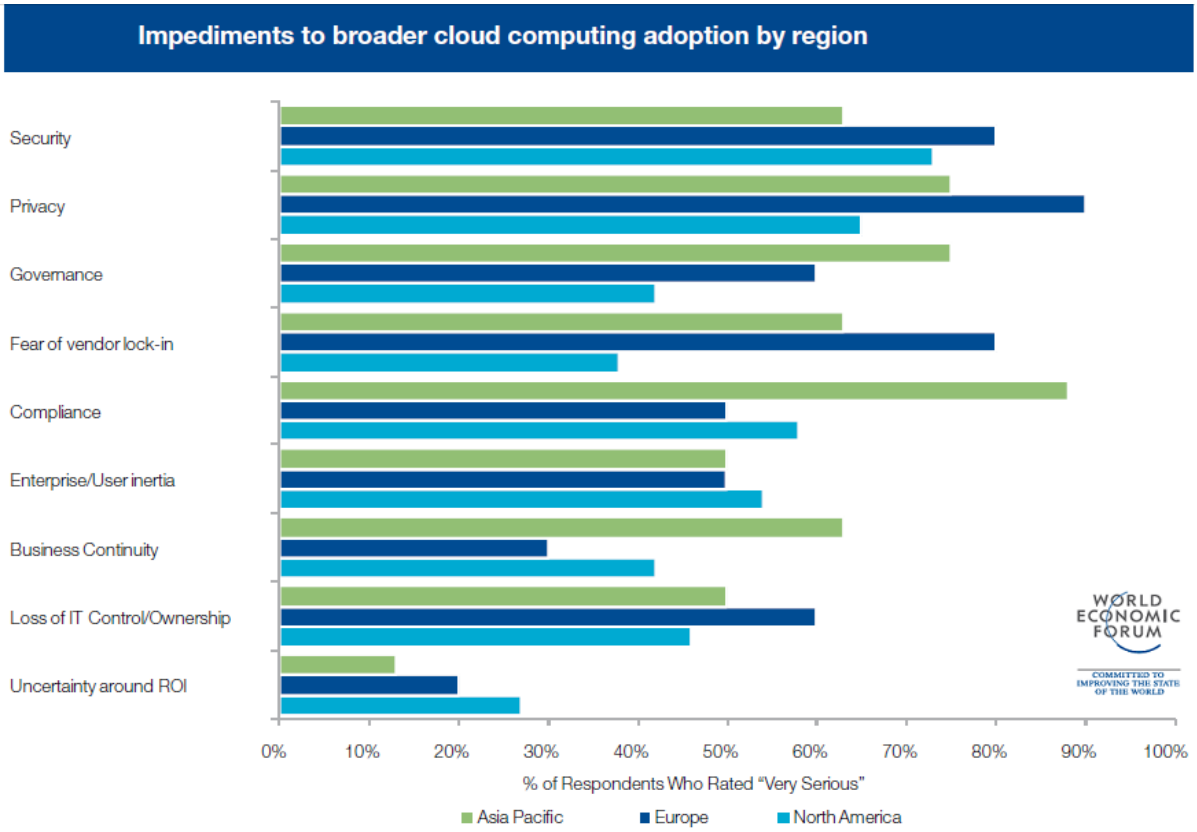
SLAs are meant for Quality of Service (QoS), what cloud provider may provide to the user. if you consider it from the technical perspective, consumers are allowed the"due care" to the extend that a normal network can provide the information or process it. Then there are some technological controls which are not in the power of cloud provider or user, for example the broadband excess, routing, network confidentiality, these things should be considered while designing SLAs. Pricing is related to the terms of the SLA. And it needs to address things like functionality, availability, capacity, security continuity (aka DR), and maintainability, support and response, etc. However, each of these need to be quantifiable and have associated metrics.

Before preparing SLA analyzing customer expecation pattern is essential and has several advantages; First the service provider would have done the necessary homework to understand the appropriate value and tiers; second with this understanding, it's possible to create SLAs combined with a corresponding pricing model; and third packages provide a level of confidence to customers that they'll get what they pay for, aren't paying too much, etc.

While preparing an SLA

Simplicity is important. There should be a section which describes the service, and a section for how and by whom it is going to be measured and a section about describing the customers recourse when the guaranteed services are not met. It is not enough to present reports depicting adherence or otherwise to SLAs. IT needs to build an actionable approach to reporting, i.e. what happened, what IT did, how IT will ensure it doesn’t impact again and how IT are working to improve service delivery generally.

What's holding cloud computing back?



Source: Cloud Computing Survey 2009, World Economic Forum and Accenture

Security is a key concern of companies moving to cloud computing. A few companies can internally match the security available from service providers. When you look at organizations small to mid-size businesses, if someone wanted to get at their data, they'd be able to, because we are by no means the experts on security and data storage. But Google is an expert in data security. That's what Google does—they make sure your security is top-notch and your data is available.

Your company can be a two-person operation or a 200,000-person operation. [With cloud computing], you're going to get the same features, the same performance, the same scalability and reliability, and the same global solution. And whether you have folks based in the U.S. or in China, you get the same solution in the language of that country, all managed by an organization like Google. And the different languages that apply to different locations also apply to Google Apps.

In conclusion; Cloud Computing is not revolution but with all the technologies behind it it is evolution at IT arena. It is a new business model wrapped around a set of technologies—such as server virtualization—that reduce the cost of using information technology resources. . Cloud computing takes advantage of Web based mechanisms that allow scalable, virtualized IT resources to be provided as a service over a network.

One of the big payoffs of cloud computing for an organization is that it freed up a lot of the time used to spend managing hardware. Redirection of the time to managing the data and

information that feeds our business applications has a much bigger impact on the effectiveness of day-to-day business operations.

Cloud computing isn't just about cost cutting. It's also about using IT to drive innovation and respond to changes in the business. A more flexible infrastructure, whether hosted internally or externally, encourages more experimentation and iteration, which in turn lets businesses introduce new Technologies and services more quickly and more often.

We see many types of clouds and delivery models for the simple reason that not all customers are alike. They have different security and compliance requirements, which may even be mandated by the government. They have different levels of IT skills. A given application may be more or less central to their core business. They may be large or small. They may have big, sophisticated IT departments, or IT could be a part-time job for one person.

- **Just 11 percent of enterprises plan to implement cloud computing in the coming 12 months.**
- **75 percent prefer the private cloud, with 52 percent implementing both on-premises and off-premises cloud.**
- **Approximately 70 percent of enterprises rate IT automation disciplines as highly important to cloud computing.**

Source: "The Responsible Cloud," Enterprise Management Associates, 2010

In the final, cloud computing is not just about data center technology. It is about streamlining business processes to make organizations and people more strate-gic, more responsive to change and more oriented to service delivery.

CIOs are making the move to cloud computing to reduce costs, increase productivity and simplify IT.

References

Websites: **NIST's cloud section** http://csrc.nist.gov/groups/SNS/cloud-computing

http://go.gogrid.com
www.virtualizationtechnology.com
http://www.techrepublic.com
http://www.cio.com
http://whitepapers.zdnet.com
http://www.cloudleadershipforum.com
http://www.boozallen.com/publications/article/42656904
http://finance.brighttalk.com/node/736
http://www.ibm.com/developerworks/websphere/techjournal/0904_amrhein/0904_amrhein.html
http://gladinet.blogspot.com/2010/10/cloud-storage-strategy-iii-public-vs.html
http://www.ama-assn.org/amednews/2010/10/18/bisa1018.htm?utm_campaign=Cloud+Computing+-+Google+News&utm_medium=Twitter&utm_source=SNSanalytics
http://blog.eaglegenomics.com/?p=300
http://www.powerhomebiz.com/
http://searchcloudcomputing.techtarget.com/

http://www.enterpriseitplanet.com/article.php/3921246/Report-Cloud-Computing-Has-Room-to-Grow.htm

Whitepapers:

Benefits of cloud computing - Dynamic InfrastructureJuly 2009, IBM
Banking on the Cloud – Accenture
Red Hat Cloud Foundations: Cloud 101
Creating Information Advantage in a Cloudy World –EMC
Cloud Security - Info World
Economics of Cloud – Gartner Ras Core research note G00168554
Capacity Management for Infrastructure Clouds- BRYAN SEMPLE, CMO Vkernel

Events:

CloudCamp – www.cloudcamp.org
ALM Expo 2010 - http://events.unisfair.com/index.jsp?eid=431&seid=2135&id=2583

Groups:
cloud-computing@googlegroups.com

http://www.linkedin.com/groups/CloudCamp-Turkey-Cloud-Computing-unconference-2787278?mostPopular=&gid=2787278

http://www.linkedin.com/groups/Roll-Out-Cloud-3873305?mostPopular=&gid=3873305

http://www.linkedin.com/groups?mostPopular=&gid=122638&trk=myg_ugrp_ovr

WebTv: http://bit.ly/RollOutCloud