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Cloud Computing

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Abstract

Reducing costs, accelerating processing and simplifying management are all vital to the success of an effective IT infrastructure. Companies are increasingly turning to more flexible IT environments to help them realize these goals, they are moving to cloud computing. If you are wondering what is so special about the "cloud'' in cloud computing, here is the explanation. Traditionally, developers and architects used a picture of cloud to illustrate a remote resource connected via the web. Eventually cloud became the logical connector between the local and remote resources on internet. Cloud computing is a technology that uses the internet and central remote server to maintain data and application. Cloud computing allows consumers and business to use application without installation and access there personal files at any computer without internet access. This technology allows for much more efficient computing by centralizing storage, memory, processing, and bandwidth. Simple examples of cloud computing are yahoo mail, Gmail. The analogy is "If you only need milk, why would you buy a cow?" That means just to get benefits of usage of software and hardware like sending mails etc., why should a consumer buy it? Just use and pay for that particular time period.

Introduction

Many people are confused as to exactly what cloud computing is, especially as the term can be used to mean almost anything. Roughly, it describes highly scalable computing resources provided as an external service via the internet on a pay-as-you-go basis. The cloud is simply a metaphor for the internet, based on the symbol used to represent the worldwide network in computer network diagrams.

Economically, the main appeal of cloud computing is that customers only use what they need, and only pay for what they actually use. Resources are available to be accessed from the cloud at any time, and from any location via the internet. There's no need to worry about how things are being maintained behind the scenes you simply purchase the IT revise you require as you would any other utility. Because of this, cloud computing has also been called utility computing, or 'IT on demand'.

This new, web-based generation of computing utilizes remote servers housed in highly secure data centers for data storage and management, so organizations no longer need to purchase and look after their IT solutions in-house.

Cloud computing can be visualized as a pyramid consisting of three sections

1. Cloud Application

This is the apex of the cloud pyramid, where applications are run and interacted with via a web browser, hosted desktop or remote client. A hallmark of commercial cloud computing applications is that users never need to purchase expensive software licenses themselves. Instead, the cost is incorporated into the subscription fee. A cloud application eliminates the need to install and run the application on the customer's own computer, thus removing the burden of software maintenance, ongoing operation and support.

2. Cloud Platform

The middle layer of the cloud pyramid, which provides a computing platform or framework as a service. A cloud computing platform dynamically provisions, configures, reconfigures and de-provisions servers as needed to cope with increases or decreases in demand. This in reality is a distributed computing model where many services pull together to deliver an application or infrastructure request.

3. Cloud Infrastructure

The foundation of the cloud pyramid is the delivery of IT infrastructure through virtualization.

Virtualization allows the splitting of a single physical piece of hardware into independent, self governed environments, which can be scaled in terms of CPU, RAM, Disk and other elements. The infrastructure includes servers, networks and other hardware appliances delivered as either Infrastructure "Web Services", "farms" or "cloud centres". These are then interlinked with others for resilience and additional capacity.

Evolution of Cloud Computing

From the initial days of offering basic internet connectivity to offering software as a service, the ISPs have come a long way. ISP 1.0 was all about providing internet access to their customers. ISP 2.0 was the phase where ISPs offered hosting capabilities. The next step was co-location through which the ISPs started leasing out the rack space and bandwidth. By this, companies could host their servers running custom, Line of Business (LoB) applications that could be accessed over the web by its employees, trading partners and customers. ISP 3.0 was offering applications on subscription resulting in the Application Service Provider (ASP) model. The latest Software as a Service or SaaS is a mature ASP model. The next logical step for ISPs would to embrace the Cloud.

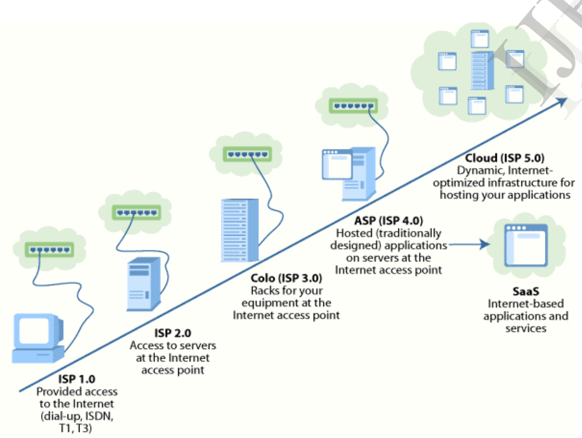

Fig1.Evolution of cloud computing.

Types of clouds

1. Private / Internal Cloud:
A cloud environment which creates a pool of resources behind a company's firewall and includes resource management and dynamic allocation, chargeback and support for virtualization.
2. Public/External Cloud:
A cloud environment which exists outside a company's firewall, offered as a service by a 3rd party vendor (e.g. Amazon EC2, Sun OCP, Google App Engine)
3. Hybrid/Mixed Cloud:
A cloud environment in which external services are leveraged to extend or supplement the internal cloud – simply put, a mixture of both private and public cloud

Services Provided By a Cloud

Most of the developers are familiar with Web Services. Web Services are based on a few simple concepts. Every Web Service accepts a request and returns a response. They are units of code that can be invoked over the web. Typically, Web Services accept one or more input parameters and invoke processing logic which will result in an output. Web Services are a part of web applications that run on a typical stack that has hardware, a Server OS, application development platform. For a while, think how you can expose every layer that is powering your web application as a Web Service.

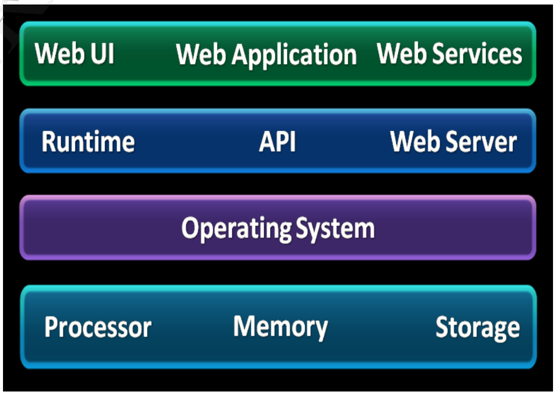

Fig2. Services of Cloud

Cloud OS/infrastructure as a service

Visualize a scenario where the hardware and the Operating System (OS) are exposed as a Web Service over the public internet. Based on the principles of Web Services, we could send a request to this service along with a few parameters. Since the OS is expected to act as an interface to the CPU and the devices, we can potentially invoke a service that accepts a „job that will be processed by the OS and the underlying hardware. Technically, this Web Service has just turned the OS + H/W combination into a „Service. We can start consuming this service by submitting

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CPU intensive tasks to this new breed of Web Service. What do you call an OS that is exposed on the web as a service? May be a Cloud OS?

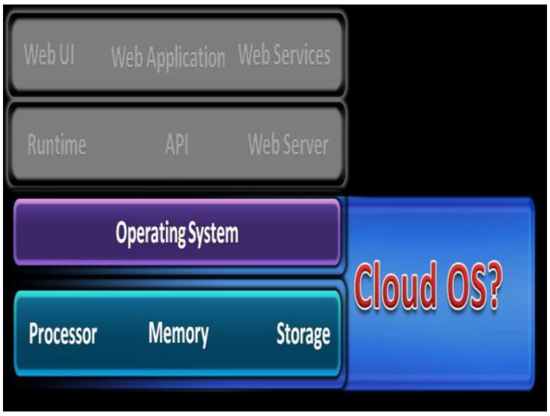

Fig3. Infrastructure as a service.

Cloud FX /Platform as a service

Developers always develop and deploy their applications on the application development platforms. Some of the most popular application development platforms are .NET and Java. In the last scenario, we have seen how the OS + H/W combination is offered as a service. Now, imagine a scenario where the application development platform is offered to you as a service. Through this, you will be able to develop and test your applications on a low end, inexpensive notebook PC but will able to submit my code to run on the most powerful hardware infrastructure. It is the same programming language, SDK and the runtime that runs on your development environment. If the hardware, OS, the language runtime and the SDK are offered to you as a service, what would you call this? A Cloud Platform or may be Cloud FX?

Fig4.Platform as a service

Cloud Application

Today, most of the traditional desktop applications like word processors and spreadsheet packages are available over the web. These new breed of applications just need a browser and offer high fidelity with the desktop software. This fundamentally changes the way software is deployed and licensed. You need not double click setup.exe to install an Office suite on your desktop.

Just subscribe to the applications and the features that you need and only pay for what you use. This is almost equivalent to exposing the application as a service. These applications may be called as Cloud Applications.

Fig5. Applications of cloud

Challenges to be overcome

With any new technology it is important to consider the additional risks that it may bring as well as the benefits. Where cloud computing is concerned this fall in the following key areas:

- **Security**: Whether organizational data sits in a cloud or in a traditional perimeter system, data will still be vulnerable to hacking and other intrusive attacks.
- **Internet resilience and bandwidth**: The public cloud is delivered via the Internet's network and therefore is vulnerable should this become unavailable.
- **Compliance:** Many countries' data protection laws restrict the way in which data can be stored and mandate the way in which it must be protected. Cloud computing usage, especially where it utilizes the public cloud, may place the organization in non-compliance with data protection laws. It is, therefore, important that this is considered both prior to and during cloud computing implementation.

Key features

Agility: improves with users' ability to rapidly and inexpensively re-provision technological infrastructure resources.

Cost: is claimed to be greatly reduced and capital expenditure is converted to operational expenditure. This ostensibly lowers barriers to entry, as infrastructure is typically provided by a third-party and does not need to be purchased for one-time or infrequent intensive computing tasks. Pricing on a utility computing basis is fine-grained with usage-based options and fewer IT skills are required for implementation (in-house).

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

Multi-tenancy: enables sharing of resources and costs across a large pool of users thus allowing for:

- **Centralization** of infrastructure in locations with lower costs (such as real estate, electricity, etc.)
- **Peak-load capacity** increases (users need not engineer for highest possible load-levels)
- **Utilization and efficiency** improvements for systems that are often only 10–20% utilized.[]

Reliability: is improved if multiple redundant sites are used, which makes well designed cloud computing suitable for business continuity and disaster recovery. Nonetheless, many major cloud computing services have suffered outages, and IT and business managers can at times do little when they are affected.

Scalability: via dynamic ("on-demand") provisioning of resources on a fine-grained, self-service basis near real-time, without users having to engineer for peak loads. Performance is monitored and consistent and loosely coupled architectures are constructed using web services as the system interface. One of the most important new methods for overcoming performance bottlenecks for a large class of applications is data parallel programming on a distributed data grid.

Security: could improve due to centralization of data, increased security-focused resources, etc., but concerns can persist about loss of control over certain sensitive data, and the lack of security for stored kernels. Security is often as good as or better than under traditional systems, in part because providers are able to devote resources to solving security issues that many customers cannot afford. Providers typically log accesses, but accessing the audit logs themselves can be difficult or impossible. Furthermore, the complexity of security is greatly increased when data is distributed over a wider area and / or number of devices.

Maintenance: cloud computing applications are easier to maintain, since they don't have to be installed on each user's computer. They are easier to support and to improve since the changes reach the clients instantly.

Metering cloud computing resources usage should be measurable and should be metered per client and application on daily, weekly, monthly, and annual basis. This will enable clients on choosing the vendor cloud on cost and reliability (QoS)

Cloud Storage

Cloud Storage is a model of networked computer data storage where data is stored on multiple virtual servers, generally hosted by third parties, rather than being hosted on dedicated servers. Hosting companies operate large data centers; and people who require their data to be hosted buy or lease storage capacity from them and use it for their storage needs. The data center operators, in the background, virtualizes the resources according to the requirements of the customer and expose them as virtual servers, which the customers can themselves manage. Physically, the resource may span across multiple servers.

The Intercloud

The Intercloud is an interconnected global "cloud of clouds" and an extension of the Internet "network of networks" on which it is based. The term was first used in the context of cloud computing in 2007 when Kevin Kelly stated that "eventually we'll have the intercloud, the cloud of clouds. This Intercloud will have the dimensions of one machine comprising all servers and attendant cloud books on the planet." It became popular in 2009 and has also been used to describe the datacenter of the future.

The Intercloud scenario is based on the key concept that each single cloud does not have infinite physical resources. If a cloud saturates the computational and storage resources of its virtualization infrastructure, it could not be able to satisfy further requests for service allocations sent from its clients. The Intercloud scenario aims to address such situation, and in theory, each cloud can use the computational and storage resources of the virtualization infrastructures of other clouds. Such form of pay-for-use may introduce new business opportunities among cloud providers if they manage to go beyond theoretical framework. Nevertheless, the Intercloud raises many more challenges than solutions concerning cloud federation, security, interoperability, QoS, vendor's lock-ins, trust, legal issues, monitoring and billing.

Should I be concerned about security?

Many companies that are considering adopting cloud computing raise concerns over the security of data being stored and accessed via the internet. What a lot of people don’t realize is that good vendors adhere to strict privacy policies and sophisticated security measures, with data encryption being one example of this. Companies can choose to encrypt data before even storing it on a third-party provider’s servers. As a result, many cloud-computing vendors offer greater data security and confidentiality than companies that choose to store their data in-house. However, not all vendors will offer the same level of security. It is recommended that anyone with concerns over security and access should research vendors' policies before using their services. Technology analyst and consulting firm Gartner lists seven security issues to bear in mind when considering a particular vendor’s services:

Privileged user access:
Enquire about who has access to data and about the hiring and management of such administrators.

1. **Regulatory compliance**:
   Make sure a vendor is willing to undergo external audits and/or security certifications
2. **Data location**:
   Ask if a provider allows for any control over the location of data
3. **Data segregation**:
   Make sure that encryption is available at all stages and that these "encryption schemes were designed and tested by experienced professionals"
4. **Recovery**:
   Find out what will happen to data in the case of a disaster; do they offer complete restoration and, if so, how long that would take
5. **Investigative Support**:
   Inquire whether a vendor has the ability to investigate any inappropriate or illegal activity
6. **Long-term viability**:
   Ask what will happen to data if the company goes out of business; how will data be returned and in what format

Generally speaking, however, security is usually improved by keeping data in one centralized location. In high security data centers like those used by Think Grid, security is typically as good as or better than traditional systems, in part because providers are able to devote resources to solving security issues that many customers cannot afford.

Advantages

•Access your data at all times – not just while in the office
• A physical storage center is no longer needed
• Most have a pay structure that only calls for payment only when used
• Relieves burden on IT Professionals and frees up their time in the office
• easily scalable so companies can add or subtract storage based on their own needs

Disadvantages

• Lost control comes with handing over your data and information
• Depending on third-party to ensure the security and confidentiality of data and information
• If your cloud host disappears, where does your information go?

Conclusion

In today's global competitive market, companies must innovate and get the most from its resources to succeed. This requires enabling its employees, business partners, and users with the platforms and collaboration tools that promote innovation. Cloud computing infrastructures are next generation platforms that can provide tremendous value to companies of any size. They can help companies achieve more efficient use of their IT hardware and software investments and provide a means to accelerate the adoption of innovations. Cloud computing increases profitability by improving resource utilization. Costs are driven down by delivering appropriate resources only for the time those resources are needed. Cloud computing has enabled teams and organizations to streamline lengthy procurement processes.

So the next generation of computing is cloud computing with much benefits for all and we should be ready for that, are you?

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