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Cloud Computing: An Emerging Application in Web-Technology

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Abstract: Cloud computing has become a major force for change in how web design, configure, provision, and manage IT infrastructure. Instead of custom-provisioning individual systems or clusters, an architect or administrator is expected to have hundreds, or even thousands of resources under their control! A variety of approaches have emerged to do this. On one hand, services such as Amazon's SimpleDBor Google's App Engine completely abstract the infrastructure away from the developer, outsourcing it to Amazon and Google respectively. On the other hand, Amazon's Elastic Compute Cloud (EC2) provides a raw interface to provisioning and managing Linux instances. The reason for such disparity and confusion is that the Cloud is multi-disciplinary. It straddles the areas of virtualization, IT management, clustering, Services-Oriented Architecture (SOA), and Web Architecture, with the overall goal of providing easily accessible interfaces for using and manipulating infrastructure. This overview gives the basic concept, defines the terms used in the industry, and outlines the general architecture and applications of Cloud computing. It gives a summary of Cloud Computing and provides a good foundation for understanding.

Introduction

Cloud Computing," to put it simply, means "Internet Computing." The Internet is commonly visualized as clouds; hence the term "cloud computing" for computation done through the Internet. With Cloud Computing users can access database resources via the Internet from anywhere, for as long as they need, without worrying about any maintenance or management of actual resources. Besides, databases in cloud are very dynamic and scalable. Cloud computing is unlike grid computing, utility computing, or autonomic computing. In fact, it is a very independent platform in terms of computing. The best example of cloud computing is Google Apps where any application can be accessed using a browser and it can be deployed on thousands of computer through the Internet.
Some generic examples include:
• Amazon's Elastic Computing Cloud (EC2) offering computational services that enable people to use CPU cycles without buying more computers
• Storage services such as those provided by Amazon's Simple Storage Service (S3)
• Companies like Nirvanix allowing organizations to store data and documents without adding a single on-site server
• SaaS companies like Salesforce.com delivering CRM services, so clients can manage customer information without installing specialized software

Concept of Cloud Computing

Cloud computing is a technology that uses the internet and central remote servers to maintain data and applications. Cloud computing allows consumers and businesses to use applications without installation and access their personal files at any computer with internet access. This technology allows for much more efficient computing by centralizing storage, memory, processing and bandwidth. A simple example of cloud computing is Yahoo email or Gmail etc. You dont need a software or a server to use them. All a consumer would need is just an internet connection and you can start sending emails. The server and email management software is all on the cloud (internet) and is totally managed by the cloud service provider Yahoo , Google etc. The consumer gets to use the software alone and enjoy the benefits. The analogy is , 'If you only need milk , would you buy a cow ?' All the users or consumers need is to get the benefits of using the software or hardware of the computer like sending emails etc. Just to get this benefit (milk) why should a consumer buy a (cow) software /hardware ? Cloud computing is broken down into three segments: "applications," "platforms," and "infrastructure." Each segment serves a different purpose and offers different products for businesses and individuals around the world. In June 2009, a study conducted by Version One found that 41% of senior IT professionals actually don't know what cloud computing is and two-thirds of senior finance professionals are confused by the concept, highlighting the young nature of the technology. In Sept 2009, an Aberdeen Group study found that disciplined companies achieved on average an 18% reduction in their IT budget from cloud computing and a 16% reduction in data center power costs.

Cloud computing

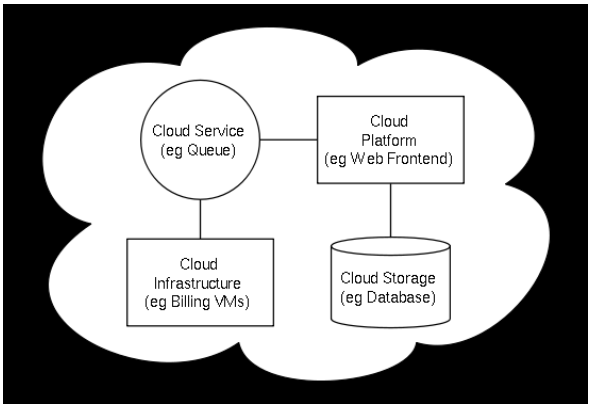
Cloud computing is computation, software, data access, and storage services that do not require end-user knowledge of the physical location and configuration of the system that delivers the services. Parallels to this concept can be drawn with the electricity grid where end-users consume power resources without any necessary understanding of the component devices in the grid required to provide the service. Cloud computing comes into focus only when you think about what IT always needs: a way to increase capacity or add capabilities on the fly without investing in new infrastructure, training new personnel, or licensing new software. Cloud computing encompasses any subscription-based or pay-per-use service that, in real time over the Internet, extends IT's existing capabilities. Cloud computing is at an early stage, with a motley crew of providers large and small delivering a slew of cloud-based services, from full-blown applications to storage services to spam filtering. Yes, utility-style infrastructure providers are part of the mix, but so are SaaS (software as a service) providers such as Salesforce.com. Today, for the most part, IT must plug into cloud-based services individually, but cloud computing aggregators and integrators are already emerging. InfoWorld talked to dozens of vendors, analysts, and IT customers to tease out the various components of cloud computing. Based on those discussions, here's a rough breakdown of what cloud computing is all about.

Characteristics:

The key characteristic of cloud computing is that the computing is "in the cloud" i.e. the processing (and the related data) is not in a specified, known or static place(s). This is in contrast to a model in which the processing takes place in one or more specific servers that are known. All the other concepts mentioned are supplementary or complementary to this concept.

Architecture:

Cloud architecture, the systems architecture of the software systems involved in the delivery of cloud computing, typically involves multiple cloud components communicating with each other over application programming interfaces, usually web services and 3-tier architecture. This resembles the Unix philosophy of having multiple programs each doing one thing well and working together over universal interfaces. Complexity is controlled and the resulting systems are more manageable than their monolithic counterparts.



Architecture of Cloud Computing

The two most significant components of cloud computing architecture are known as the front end and the back end. The front end is the part seen by the client, i.e. the computer user. This includes the client's network (or computer) and the applications used to access the cloud via a user interface such as a web browser. The back end of the cloud computing architecture is the 'cloud' itself, comprising various computers, servers and data storage devices.

History:

The underlying concept of cloud computing dates back to the 1960s, when John McCarthy opined that "computation may someday be organized as a public utility." Almost all the modern-day characteristics of cloud computing (elastic provision, provided as a utility, online, illusion of infinite supply), the comparison to the electricity industry and the use of public, private, government and community forms was thoroughly explored in Douglas Parkhill's 1966 book, The Challenge of the Computer Utility.

The actual term "cloud" borrows from telephony in that telecommunications companies, who until the 1990s primarily offered dedicated point-to-point data circuits, began offering Virtual Private Network(VPN) services with comparable quality of service but at a much lower cost. By switching traffic to balance utilization as they saw fit,

they were able to utilize their overall network bandwidth more effectively. The cloud symbol was used to denote the demarcation point between that which was the responsibility of the provider from that of the user. Cloud computing extends this boundary to cover servers as well as the network infrastructure.[16] The first scholarly use of the term "cloud computing" was in a 1997 lecture by Ramnath Chellappa.

Amazon played a key role in the development of cloud computing by modernizing their data centers after the dot-com bubble, which, like most computer networks, were using as little as 10% of their capacity at any one time, just to leave room for occasional spikes. Having found that the new cloud architecture resulted in significant internal efficiency improvements whereby small, fast-moving "two-pizza teams" could add new features faster and more easily, Amazon initiated a new product development effort to provide cloud computing to external customers, and launched Amazon Web Service (AWS) on a utility computing basis in 2006.

In 2007, Google, IBM and a number of universities embarked on a large scale cloud computing research project. In early 2008, Eucalyptus became the first open source AWS API compatible platform for deploying private clouds. In early 2008, OpenNebula, enhanced in the RESERVOIR European Commission funded project, became the first open source software for deploying private and hybrid clouds and for the federation of clouds.]In the same year, efforts were focused on providing QoS guarantees (as required by real-time interactive applications) to Cloud-based infrastructures, in the framework of the IRMOS European Commission funded project. By mid-2008, Gartner saw an opportunity for cloud computing "to shape the relationship among consumers of IT services, those who use IT services and those who sell them" and observed that "organisations are switching from company-owned hardware and software assets to per-use service-based models" so that the "projected shift to cloud computing ... will result in dramatic growth in IT products in some areas and significant reductions in other areas."

Key Characteristics:

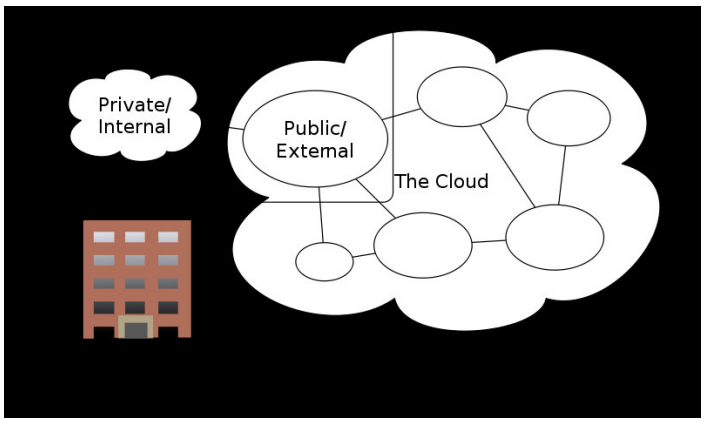
Agility improves with users' ability to rapidly and inexpensively re-provision technological infrastructure resources.

- Application Programming Interface (API) accessibility to software that enables machines to interact with cloud software in the same way the user interface facilitates interaction between humans and computers. Cloud Computing systems typically use REST-based APIs.
- Cost is claimed to be greatly reduced and in a public cloud delivery model 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 phone). 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. 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 of cloud computing applications is easier, 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 means that cloud computing resources usage should be measurable and should be metered per client and application on a daily, weekly, monthly, and yearly basis.

Types of deployment cloud models :

Public cloud
Public cloud or external cloud describes cloud computing in the traditional mainstream sense, whereby resources are dynamically provisioned on a fine-grained, self-service basis over the Internet, via web applications/web services, from an off-site third-party provider who bills on a fine-grained utility computing basis.[26]

Community cloud
A community cloud may be established where several organizations have similar requirements and seek to share infrastructure so as to realize some of the benefits of cloud computing. With the costs spread over fewer users than a public cloud (but more than a single tenant) this option is more expensive but may offer a higher level of privacy, security and/or policy compliance. Examples of community cloud include Google's "Gov Cloud".[47]
Hybrid cloud and hybrid IT delivery. The main responsibility of the IT department is to deliver services to the business. With the proliferation of cloud computing (both private and public) and the fact that IT departments must also deliver services via traditional, in-house methods, the newest catch-phrase has become “hybrid cloud computing.” Hybrid cloud is also called hybrid delivery by the major vendors including HP, IBM, Oracle and VMware who offer technology to manage the complexity in managing the performance, security and privacy concerns that results from the mixed delivery methods of IT services.
A hybrid storage cloud uses a combination of public and private storage clouds. Hybrid storage clouds are often useful for archiving and backup functions, allowing local data to be replicated to a public cloud. Another perspective on deploying a web application in the cloud is using Hybrid Web Hosting, where the hosting infrastructure is a mix between cloud hosting and managed dedicated servers - this is most commonly achieved as part of a web cluster in which some of the nodes are running on real physical hardware and some are running on cloud server instances.[citation needed]



Combined cloud
Two clouds that have been joined together are more correctly called a "combined cloud". A combined cloud environment consisting of multiple internal and/or external providers "will be typical for most enterprises". By integrating multiple cloud services users may be able to ease the transition to public cloud services while avoiding issues such as PCI compliance.

Private cloud
Douglas Parkhill first described the concept of a "private computer utility" in his 1966 book The Challenge of the Computer Utility. The idea was based upon direct comparison with other industries (e.g. the electricity industry) and the extensive use of hybrid supply models to balance and mitigate risks.
Private cloud and internal cloud have been described as neologisms, however the concepts themselves pre-date the term cloud by 40 years. Even within modern utility industries, hybrid models still exist despite the formation of reasonably well-functioning markets and the ability to combine multiple providers.
Some vendors have used the terms to describe offerings that emulate cloud computing on private networks. These (typically virtualization automation) products offer the ability to host applications or virtual machines in a company's own set of hosts. These provide the benefits of utility computing -shared hardware costs, the ability to recover from failure, and the ability to scale up or down depending upon demand.

Private clouds have attracted criticism because users "still have to buy, build, and manage them" and thus do not benefit from lower up-front capital costs and less hands-on management, essentially "[lacking] the economic model that makes cloud computing such an intriguing concept". Enterprise IT organizations use their own private cloud(s) for mission critical and other operational systems to protect critical infrastructures.

Conclusion

Cloud Computing holds a lot of promise and we believe that it is likely to be a major influence on hosting and application development. SmarterTools is preparing all of our products for potential Cloud compatibility in the future because we have confidence that the incumbent issues will be satisfactorily. Cloud Computing is a another means of using the wheel without re-inventing it. Lot of organisations already have well-established, stable resources like Database Systems, Web Servers etc. which can be used as a co-locator for medium or small-scale business oriented organisations who need not invest their time and resources establishing the set-up but can instead focus on developing service-oriented applications, which in turn can be used globally. For Example, BioInformatics applications, I would suggest, is a service-area, where lot of subject oriented work is involved. Instead of re-inventing the entire set-up again, several existing processes may be used either directly, as they are or with slight modifications wherever required. The botheration of maintenance may be handled by the experts in Computers, and subject related task may be managed by the Subject-experts.

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