BEYOND THE DESKTOP : AN INTRODUCTION TO CLOUD COMPUTING

In a world that sees new technological trends bloom and fade on almost a daily basis, one new trend promises more longevity. This trend is called cloud computing, and it will change the way you use your computer and the Internet. Cloud computing portends a major change in how we store information and run applications. Instead of running programs and data on an individual desktop computer, everything is hosted in the "cloud"a nebulous assemblage of computers and servers accessed via the Internet. Cloud computing lets you access all your applications and documents from anywhere in the world, freeing you from the confines of the desktop and making it easier for group members in different locations to collaborate.

The emergence of cloud computing is the computing equivalent of the electricity revolution of a century ago. Before the advent of electrical utilities, every farm and business produced its own electricity from freestanding generators. After the electrical grid was created, farms and businesses shut down their generators and bought electricity from the utilities, at a much lower price (and with much greater reliability) than they could produce on their own.

Look for the same type of revolution to occur as cloud computing takes hold. The desktop-centric notion of computing that we hold today is bound to fall by the wayside as we come to expect the universal access, 24/7 reliability, and ubiquitous collaboration promised by cloud computing. It is the way of the future

Cloud Computing: What It Isand What It Isn't

With traditional desktop computing, you run copies of software programs on each computer you own. The documents you create are stored on the computer on which they were created. Although documents can be accessed from other computers on the network, they can't be accessed by computers outside the network. The whole scene is PC-centric. With cloud computing, the software programs you use aren't run from your personal computer, but are rather stored on servers accessed via the Internet. If your computer crashes, the software is still available for others to use. Same goes for the documents you create; they're stored on a collection of servers accessed via the Internet. Anyone with permission can not only access the documents, but can also edit and collaborate on those documents in real time. Unlike traditional computing, this cloud computing model isn't PCcentric, it's document-centric. Which PC you use to access a document simply isn't important. But that's a simplification. Let's look in more detail at what cloud computing isand, just as important, what it isn't.

What Cloud Computing Isn't

First, cloud computing isn't network computing. With network computing, applications/documents are hosted on a single company's server and accessed over the company's network. Cloud computing is a lot bigger than that. It encompasses multiple companies, multiple servers, and multiple networks. Plus, unlike network computing, cloud services and storage are accessible from anywhere in the world over an Internet connection; with network computing, access is over the company's network only. Cloud computing also isn't traditional outsourcing, where a company farms out (subcontracts) its computing services to an outside firm. While an outsourcing firm might host a company's data or applications, those documents and programs are only accessible to the company's employees via the company's network, not to the entire world via the Internet. So, despite superficial similarities, networking computing and outsourcing are not cloud computing.

What Cloud Computing Is

Key to the definition of cloud computing is the "cloud" itself. For our purposes, the cloud is a large group of interconnected computers. These computers can be personal computers or network servers; they can be public or private. For example, Google hosts a cloud that consists of both smallish PCs and larger servers. Google's cloud is a private one (that is, Google owns it) that is publicly accessible (by Google's users). This cloud of computers extends beyond a single company or enterprise. The applications and data served by the cloud are available to broad group of users, cross-enterprise and cross-platform. Access is via the Internet. Any authorized user can access these docs and apps from any computer over any Internet connection. And, to the user, the technology and infrastructure behind the cloud is invisible. It isn't apparent (and, in most cases doesn't matter) whether cloud services are based on HTTP, HTML, XML, JavaScript, or other specific technologies.

It might help to examine how one of the pioneers of cloud computing, Google, perceives the topic. From Google's perspective, there are six key properties of cloud computing:

Cloud computing is user-centric

Once you as a user are connected to the cloud, whatever is stored theredocuments, messages, images, applications, whateverbecomes yours. In addition, not only is the data yours, but you can also share it with others. In effect, any device that accesses your data in the cloud also becomes yours.

Cloud computing is task-centric

Instead of focusing on the application and what it can do, the focus is on what you need done and how the application can do it for you., Traditional applicationsword processing, spreadsheets, email, and so onare becoming less important than the documents they create.

Cloud computing is powerful.

Connecting hundreds or thousands of computers together in a cloud creates a wealth of computing power impossible with a single desktop PC.

Cloud computing is accessible.

Because data is stored in the cloud, users can instantly retrieve more information from multiple repositories. You're not limited to a single source of data, as you are with a desktop PC.

Cloud computing is intelligent.

With all the various data stored on the computers in a cloud, data mining and analysis are necessary to access that information in an intelligent manner.

Cloud computing is programmable.

Many of the tasks necessary with cloud computing must be automated. For example, to protect the integrity of the data, information stored on a single computer in the cloud must be replicated on other computers in the cloud. If that one computer goes offline, the cloud's programming automatically redistributes that computer's data to a new computer in the cloud.

And also Microsoft says ,We believe cloud computing represents the platform for the next generation of business. Cloud Computing is driving the transformation of the IT industry across the entire stack:

- **Hardware Model**Incredibly powerful and efficient hardware at a fraction of the cost.
- **Applications Model**Developers can rapidly create highly available, secure cloud applications.
- **Operations Model**Operations can keep cloud applications available 24x7 with "9-to-5" management.

These trends can offer dramatic improvements in **business agility**, **operational efficiency** and **IT maturity** with significant **cost savings**. Customers recognize this and are adopting private and/or public cloud deployments for many usage scenarios.

How Microsoft Will Deliver Cloud Innovation

Microsoft is committed to bring in learning's from building and running public cloud services (like Windows Azure) to the enterprise datacenter. We will use the following approaches to lead innovation in the cloud:

- Invest in the entire cloud stackinfrastructure, platforms, applicationswith a service centric focus.
- Ensure applications run consistently across on-premises (private cloud) and off-premises (public cloud).
- Provide unified management for applications/services across on-premises and off- premises.
- Similar flexibility and agility across cloud environments whether you're using your own assets, working with service providers (hosting partners), or deploying into Microsoft's datacenters (e.g. Windows Azure).

Cloud Computing: The Next Step in Collaboration

With the growth of the Internet, there was no need to limit group collaboration to a single enterprise's network environment.Users from multiple locations within a corporation, and from multiple organizations, desired to collaborate on projects that crossed company and geographic boundaries. To do this, projects had to be housed in the "cloud" of the Internet, and accessed from any Internet-enabled location.
The concept of cloud-based documents and services took wing with the development of large server farms, such as those run by Google and other search companies. Google already had a collection of servers that it used to power its massive search engine; why not use that same computing power to drive a collection of web-based applicationsand, in the process, provide a new level of Internet-based group collaboration?

That's exactly what happened, although Google wasn't the only company offering cloud computing solutions. On the infrastructure side, IBM, Sun Systems, and other big iron providers are offering the hardware necessary to build cloud networks. On the software side, dozens of companies are developing cloud-based applications and storage services.Today, people are using cloud services and storage to create, share, find, and organize information of all different types. Tomorrow, this functionality will be available not only to computer users, but to users of any device that connects to the Internetmobile phones, portable music players, even automobiles and home television sets.

The Network Is the Computer: How Cloud Computing Works

Sun Microsystems's slogan is "The network is the computer," and that's as good as any to describe how cloud computing works. In essence, a network of computers functions as a single computer to serve data and applications to users over the Internet. The network exists in the "cloud" of IP addresses that we know as the Internet, offers massive computing power and storage capability, and enables widescale group collaboration. But that's the simple explanation. Let's take a look at how cloud computing works in more detail.

Understanding Cloud Architecture

The key to cloud computing is the "cloud"a massive network of servers or even individual PCs interconnected in a grid. These computers run in parallel, combining the resources of each to generate supercomputing-like power. What, exactly, is the "cloud"? Put simply, the cloud is a collection of computers and servers that are publicly accessible via the Internet. This hardware is typically owned and operated by a third party on a consolidated basis in one or more data center locations. The machines can run any combination of operating systems; it's the processing power of the machines that matter, not what their desktops look like.As shown in Figure 1, individual users connect to the cloud from their own personal computers or portable devices, over the Internet. To these individual users, the cloud is seen as a single application, device, or document. The hardware in the cloud (and the operating system that manages the hardware connections) is invisible.

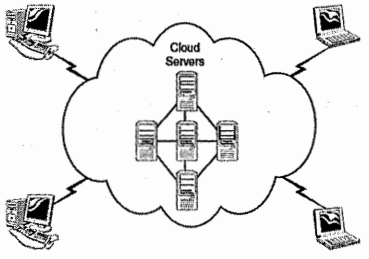

Figure 1 How user's Connect to the Cloud

This cloud architecture is deceptively simple, although it does require some intelligent management to connect all those computers together and assign task processing to multitudes of users. As you can see in Figure 2, it all starts with the front-end interface seen by individual users. This is how users select a task or service (either starting an application or opening a document). The user's request then gets passed to the system management, which finds the correct resources and then calls the system's appropriate provisioning services. These services carve out the necessary resources in the cloud, launch the appropriate web application, and either creates or opens the requested document. After the web application is launched, the system's monitoring and metering functions track the usage of the cloud so that resources are apportioned and attributed to the proper user(s).

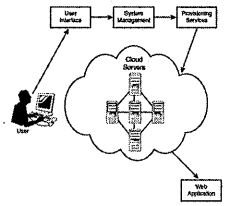

Figure 2 ***The architecture behind a cloud computing system.***

Understanding Cloud Storage

One of the primary uses of cloud computing is for data storage. With *cloud storage*, data is stored on multiple third-party servers, rather than on the dedicated servers used in traditional networked data storage.

When storing data, the user sees a *virtual server*that is, it appears as if the data is stored in a particular place with a specific name. But that place doesn't exist in reality. It's just a pseudonym used to reference virtual space carved out of the cloud. In reality, the user's data could be stored on any one or more of the computers used to create the cloud. The actual storage location may even differ from day to day or even minute to minute, as the cloud dynamically manages available storage space. But even though the location is virtual, the user sees a "static" location for his dataand can actually manage his storage space as if it were connected to his own PC.

Cloud storage has both financial and security-associated advantages. Financially, virtual resources in the cloud are typically cheaper than dedicated physical resources connected to a personal computer or network. As for security, data stored in the cloud is secure from accidental erasure or hardware crashes, because it is duplicated across multiple physical machines; since multiple copies of the data are kept continually, the cloud continues to function as normal even if one or more machines go offline. If one machine crashes, the data is duplicated on other machines in the cloud.

Understanding Cloud Services

Any web-based application or service offered via cloud computing is called a *cloud service*. Cloud services can include anything from calendar and contact applications to word processing and presentations. Almost all large computing companies today, from Google to Amazon to Microsoft, are developing various types of cloud services.

With a cloud service, the application itself is hosted in the cloud. An individual user runs the application over the Internet, typically within a web browser. The browser accesses the cloud service and an instance of the application is opened within the browser window. Once launched, the web-based application operates and behaves like a standard desktop application. The only difference is that the application and the working documents remain on the host's cloud servers.

Cloud services offer many advantages. If the user's PC crashes, it doesn't affect either the host application or the open document; both remain unaffected in the cloud. In addition, an individual user can access his applications and documents from any location on any PC. He doesn't have to have a copy of every app and file with him when he moves from office to home to remote location. Finally, because documents are hosted in the cloud, multiple users can collaborate on the same document in real time, using any available Internet connection. Documents are no longer machine-centric. Instead, they're always available to any authorized user.

Companies in the Cloud: Cloud Computing Today

We're currently in the early days of the cloud computing revolution. Although many cloud services are available today, more and more interesting applications are still in development. That said, cloud computing today is attracting the best and biggest companies from across the computing industry, all of whom hope to establish profitable business models based in the cloud.As discussed earlier in this article, perhaps the most noticeable companies currently embracing the cloud computing model is Microsoft and Google. Google offers a powerful collection of web-based applications, all served via its cloud architecture. Whether you want cloud-based word processing (Google Docs), presentation software (Google Presentations), email (Gmail), or calendar/scheduling functionality (Google Calendar), Google has an offering. And best of all, Google is adept in getting all of its web-based applications to interface with each other; their cloud services are interconnected to the user's benefit.

Other major companies are also involved in the development of cloud services. Microsoft, for example, offers its Windows Live suite of web-based applications, as well as the Live Mesh initiative that promises to link together all types of devices, data, and applications in a common cloud-based platform. Amazon has its Elastic Compute Cloud (EC2), a web service that provides cloud-based resizable computing capacity for application developers. IBM has established a Cloud Computing Center to deliver cloud services and research to clients. And numerous smaller companies have launched their own webbased applications, primarily (but not exclusively) to exploit the collaborative nature of cloud services.

Why Cloud Computing Matters

Why is cloud computing important? There are many implications of cloud technology, for both developers and end users.For developers, cloud computing provides increased amounts of storage and processing power to run the applications they develop. Cloud computing also enables new ways to access information, process and analyze data, and connect people and resources from any location anywhere in the world. In essence, it takes the lid off the box; with cloud computing, developers are no longer boxed in by physical constraints.

For end users, cloud computing offers all those benefits and more. A person using a web-based application isn't physically bound to a single PC, location, or network. His applications and documents can be accessed wherever he is, whenever he wants. Gone is the fear of losing data if a computer crashes. Documents hosted in the cloud always exist, no matter what happens to the user's machine. And then there's the benefit of group collaboration. Users from around the world can collaborate on the same documents, applications, and projects, in real time. It's a whole new world of collaborative computing, all enabled by the notion of cloud computing.

And cloud computing does all this at lower costs, because the cloud enables more efficient sharing of resources than does traditional network computing. With cloud computing, hardware doesn't have to be physically adjacent to a firm's office or data center. Cloud infrastructure can be located anywhere, including and especially areas with lower real estate and electricity costs. In addition, IT departments don't have to engineer for peak-load capacity, because the peak load can be spread out among the external assets in the cloud. And, because additional cloud resources are always at the ready, companies no longer have to purchase assets for infrequent intensive computing tasks. If you need more processing power, it's always there in the cloud and accessible on a cost-efficient basis.

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