IBM Perspective on Cloud Computing

The "next big thing" or "another fad"?
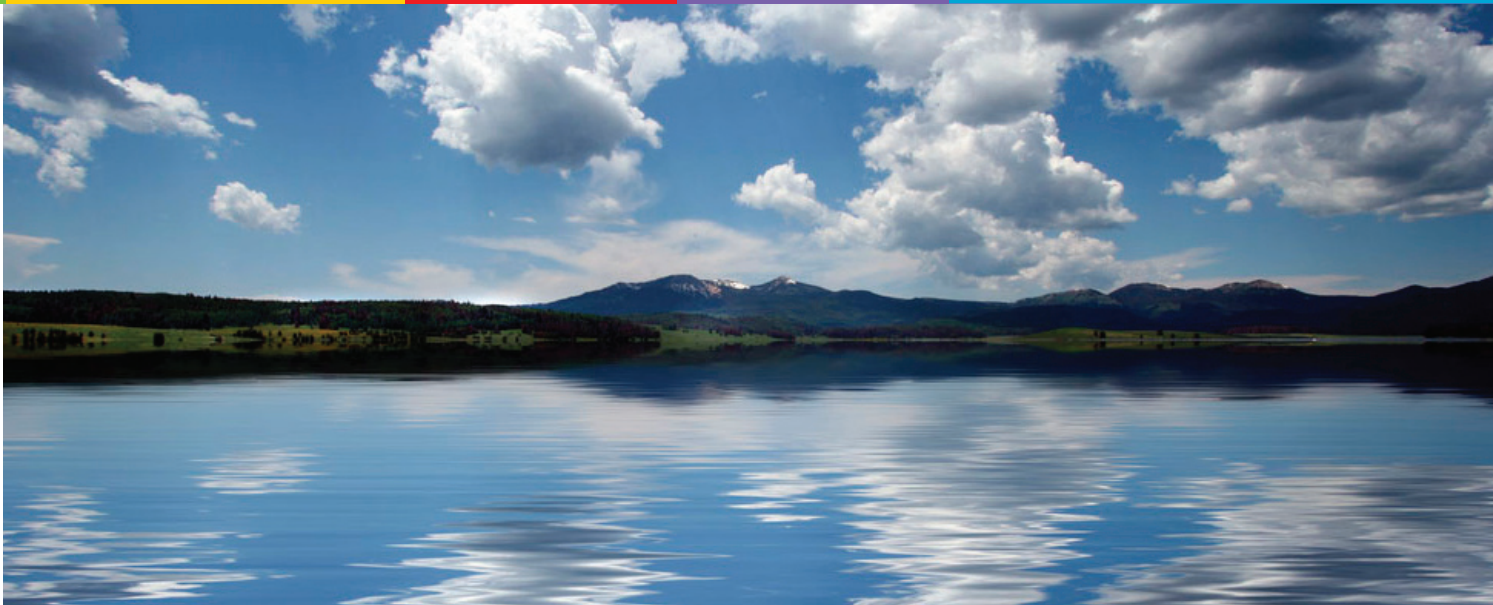
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Today, definitions of cloud computing abound, but the general concept held by the market may be seen in this definition from Wikipedia:

"Cloud computing . . . is a style of computing where IT-related capabilities are provided 'as a service,' allowing users to access technology-enabled services 'in the cloud' without knowledge of, expertise with or control over the technology infrastructure that supports them."

— Wikipedia, the free encyclopedia

Much is being written and spoken about cloud computing, by IT analysts, industry and business leaders and others. Some believe it is a disruptive trend representing the next stage in the evolution of the Internet. Others believe it is hype, as it uses long established computing technologies. So, what is cloud computing? From a user perspective, cloud computing provides a means of acquiring computing services without requiring understanding of the underlying technology. From an organizational perspective, cloud computing delivers services for consumer and business needs in a simplified way, providing unbounded scale and differentiated quality of service to foster rapid innovation and decision making. It is a service acquisition and delivery model for IT resources and, if properly used within an overall IT strategy, can help improve business performance and control the costs of delivering IT resources to the organization.

In a world where almost anyone and anything can connect to the Internet, the exponential increase in the volume of information and connected devices creates a dilemma: IT complexity increases as does demand for simplicity. Organizations are facing accelerating business change, global and domestic competitive pressure and social responsibility demands. They are striving to reach their full potential by rapidly implementing innovative business models while simultaneously lowering the IT barriers to driving innovation and change. These challenges call for a more dynamic computing model that enables rapid innovation for applications, services and service delivery. Cloud computing can be one element of such a model. The underlying technologies associated with cloud computing can also be part of an innovative computing approach focusing on creation of a more dynamic enterprise, as applications and the services they support are no longer locked to a fixed, underlying infrastructure and can adjust quickly to change.

Potential benefits of cloud computing

IBM considers cloud computing to be a potentially cost-efficient model for provision-ing processes, applications and services while making IT management simpler and increasing business responsiveness. In a cost-benefit analysis, a properly imple-mented and leveraged cloud computing model will drive lower cost-of-ownership, responsive delivery of services and higher service quality. Cloud computing can enable rapid business innovation by delivering easy-to-use computing services to users "on demand," regardless of their location or the type of device they are using. The cloud-based service can be "public," "private" or a combination of the two, sometimes referred to as a "hybrid cloud."

Selecting the right use of cloud computing results in lower cost, by taking advantage of economies of scale and automated IT operations while optimizing investment in existing infrastructure. The resulting solution rapidly adjusts the volume of users as workload increases or decreases. Payment or internal chargeback for the services is more flexible and typically occurs on a usage basis.

"Public" and "private" clouds

Most people in the IT world have heard of cloud computing. Most of what has been publicized, however, is about public cloud-based services. In simple terms, public cloud services are characterized as being available to clients from a third party service provider, via the Internet. The term "public" does not always mean free, even though it can be free or fairly inexpensive to use.

The other model of cloud computing, called a "private" cloud-based service, offers many of the benefits of a public cloud computing environment. The difference is that in a private cloud-based service, data and processes are managed within the organization without the restrictions of network bandwidth, security exposures and legal requirements that using public cloud services across open, public networks might entail. In addition, private cloud services can offer the provider and the user

greater control, improving security and resiliency as user access and the networks are restricted and designated.

We also anticipate the development of various business models that include integrating services from different providers (public and private) to support and drive business innovation and IT optimization.

Technology is enabling opportunities for innovation in such disparate areas as high-speed wireless connectivity, social networking, global positioning systems, radio frequency identification (RFID), "intelligent" appliances, utility meters, building control systems, mobile banking, automobiles and even our own homes.

Technology behind cloud computing

Cloud computing, whether public, private or a combination, will typically demonstrate the following technology attributes:

- **Services focused**—Cloud computing is about providing services to any authorized user, anywhere, from any device. For this reason, cloud computing must be built on a service-oriented architecture and deployed with industry best practices for service management. As Irving Wladawsky-Berger, Chairman Emeritus, IBM Academy of Technology has stated, "SOA is to cloud computing as HTML is to the internet."

- **Shared, highly scalable, networked infrastructure**—New IT infrastructure, application and business process services are made available leveraging the *Internet paradigm**. This means standardized, highly efficient, shared, virtualized compute resources (servers, storage, network, data, middleware, applications and business processes) can be rapidly

scaled up and down with elasticity through *automated workload management* in a secure way to deliver high-quality service. Some coin this "massive scalability."

- **Automated service delivery**—*Service Management* is request–driven and strives for near-zero incremental labor costs. Cloud computing supports business processes, applications and IT infrastructure collaboratively and cohesively. It can allocate services, dynamically move and optimize workloads and data across the shared infrastructure and integrate added resources to scale with very little, if any, intervention by the cloud service provider personnel. These same resources are returned to the cloud environment and are immediately made available to others when they are no longer needed. The service management supporting the cloud service also *tracks usage* for purposes of billing or usage chargeback.

- **Enhanced, standardized user experience**—*Easy-to-use interfaces* and straightforward information access are provided to the user to fulfill his or her computing requirement.

IBM Leadership in Cloud Computing

IBM has supported the evolution of cloud-delivered technology through numerous hardware, software and services offerings, and continuing investments in research and development. IBM has created cloud computing environments for clients, for its own use and for the public. Some notable examples include:

Technology incubation cloud computing services

- In the Asia Pacific region, IBM helped a government economic development agency build an application development infrastructure cloud to

Note: Items italicized are generally accepted attributes of cloud computing as described by leading analysts.

stimulate the software development community to innovate and boost exports. Limited IT development platform infrastructure had been a major barrier for many software start-ups in this country. The cloud solution provides virtual computing resources on demand to as many as 200,000 developers. Developers can access the infrastructure cloud from any device with network connectivity, whenever and for however long needed at little to no cost to the developer.

- IBM's Research Division uses cloud computing technologies for its Research Compute Cloud (RC2). This cloud allows researchers to obtain cloud computing infrastructure and application resources on demand for their projects. The resources are allocated and provisioned with software in a matter of minutes. Automated service management has dramatically reduced provisioning time and has improved overall monitoring and management of the project.

Collaborative and Social Networking cloud computing services

- IBM helps ISV vendors to design, build, deliver and market their solutions as cloud enabled services to their end users. IBM provides a portfolio of middleware, hardware and managed hosting services to enable ISVs to adopt this delivery model. Today more than 200 ISVs use IBM technology and services to deliver their cloud enabled services. For example, a healthcare collaboration company assembles and provides patient information on demand from all connected healthcare systems. For their customers this saves time and money, and it helps to avoid inaccurate or duplicative records caused by traditional organizational barriers.

- In another case, IBM enabled an ISV serving the secondary and higher education industry to provide their solution through cloud computing by creating a social network for peer reviews of upcoming published works. This has vastly improved the time to value and the overall quality of the materials being created.

- IBM has a pilot program called "Bluehouse," an innovative and power-fully intuitive set of cloud based business applications designed to meet the essential needs of a business, no matter the size. It delivers a set of integrated collaboration services to dramatically simplify and improve the interactions organizations have with their customers and partners.

- IBM's internal innovation portal, the Technology Adoption Portal, is hosted on a virtualized infrastructure cloud. This "collaboration innovation cloud" has over 80,000 participants within IBM working together to develop new innovations in software, process tools and assets. In 2007, there were more than 70 active innovations, with each innovation collaboration period lasting an average of six months. Fifty percent of those innovations were Web 2.0 projects, and 27 percent became IBM products or solutions that are sold to our customers today. IBM's success with the innovation portal was highlighted in the 20 August 2007 Business Week cover story on global collaboration.

Infrastructure cloud computing services

- Major financial institutions were struggling to provide resources to application developers to keep up with demand for improved, innova-tive services. Increasing costs, manual processes, limited visibility into processes and attempted collaboration via telephone all made it difficult to keep up with and support their organizations' needs. They have now deployed an enterprise cloud to dynamically manage resources and improve utilization of the infrastructure. This solution also features automated provisioning, which has reduced the time required to provision from up to two days to less than one hour.

- IBM's cloud-building services helped a major U.S. university build an infrastructure cloud computing service to share computing resources across as many as 10 campuses, allowing it to optimize computing power,

storage, service and data center labor across the university system, and deliver services across its constituency.

- IBM, through its acquisition of Arsenal Digital Solutions, provides cloud-delivered information protection services. Through a relationship with one of its key telecommunications business partners, Arsenal built an end-to-end cloud-based data protection service that today is available to IBM clients and other business partners. This cloud-based service platform allows end users to purchase and provision the online data backup-and-restore solution for PCs and Servers through a seamless portal interface. As an advantage to the business partner, the Arsenal cloud service provides full management of the data protection vaults, and also delivers integrated monthly billing and reporting as standard components of the service platform. In the event that critical data must be restored, a user can perform a web based recovery of critical files and folders at any time and to any location.

- IBM has more than a dozen cloud computing competency centers, located in places such as Silicon Valley, California; Dublin, Ireland; Beijing, China; Tokyo, Japan; and Johannesburg, South Africa. The centers are designed to showcase IBM cloud-computing infrastructure, applications and services capabilities through specific competency and training solutions—such as product demonstrations, business consulting, customized technical assistance and workshops for designing, testing and piloting cloud computing. In addition, IBM hosts production workloads via IBM® Computing on Demand (CoD). With global public cloud-based centers located in the financial hubs of New York, London and Tokyo, IBM is able to serve clients needing secure, flexible computing resources on an hourly, weekly or yearly basis.

Cloud Computing Considerations

As seen from the examples above, cloud computing can apply to many different situations. That includes organizations ranging from large enterprises looking to transform their data center and optimize IT service delivery, to small and medium
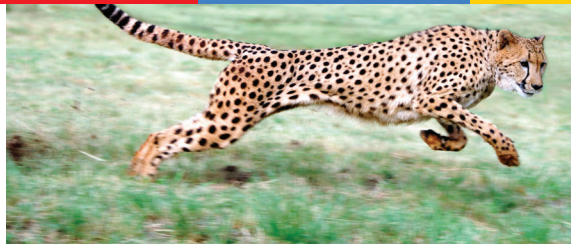
businesses looking for a way to acquire more sophisticated business processes, business services or IT capacity, thereby saving capital-intensive investments to allocate to other growth focused areas of the business. Organizations within emerging markets may want to avoid the time and expense of building an infrastructure. Some companies may simply want the flexibility to scale up and down rapidly. When considering cloud computing, three commonly asked questions are:

1. Will cloud computing help create and deliver innovative business and consumer services to achieve greater competitive differentiation?

Use of cloud computing, public or private, can enable greater innovation through collaboration, rapid deployment and lower costs. This can enable greater levels of "experimentation" with new ideas. In addition, many future innovations will integrate innovative application and information services from others (suppliers, third parties, customers, business partners and government) that, in turn, may be built as cloud-based services.

2. Can cloud computing help to more quickly achieve goals for IT optimization, cost savings and faster time to market?

Cloud computing can provide access to needed, standardized IT resources from a third party provider that can enable you to rapidly deploy new applications, services or computing resources without re-engineering your infrastructure—or, in some cases, without having to have an infrastructure at all. Cloud computing is about the "industrialization" of IT infrastructure, including the data center, to reduce costs while improving quality and time to delivery. Cloud computing provides a set of core services or building blocks that can be rapidly assembled into higher level business services for quick deployment. In some cases, organizations will purchase cloud-based services to augment or replace their existing infrastructure. Other organizations will look for ways to retool their infrastructure to support being a deliverer of cloud-based services.

3. Is competitive advantage gained by using cloud computing?

Organizations taking a leadership role in harnessing the power of cloud computing may gain competitive advantage through more rapid innovation, massive scalability (up and down) to optimize resources and costs and access to resources otherwise not readily available. Speed of implementation and degree of cost savings will be impacted by the degree of customization required by the organization.

The key is an organization's ability to integrate cloud computing into a broader strategy and architected plan to align IT resources closely with overall business goals, objectives and needs. In some cases, cloud computing may be the answer for receiving and/or delivering services. In other cases, leveraging the underlying technologies may be the most appropriate choice.

Why IBM?

IBM is focused on retooling the world's intelligent infrastructure to drive new innovations in a safe, scalable and accessible way. IBM approaches cloud computing from the perspective that you need a trusted foundation on which to build the most secure, efficient and resilient platform for services for your organization, utilizing cloud computing where appropriate. The advances enabling cloud computing evolved from and maximize the benefits of IBM's service management and virtualization offerings, in production today in thousands of organizations around the world. IBM helps integrate cloud computing rapidly, from business processes and middleware to underlying infrastructures, including globally dispersed handheld and wireless devices.

IBM is a leader in both cloud-building and cloud-delivered services. We have demonstrated best practices and a proven history of supporting organizations in their own approach to leveraging new technologies for innovation. As a leader in consulting, SOA, service management, virtualization, security, information on demand, application services and business process management, IBM has been a trusted partner for many in the journey to help IT to better serve individuals, organizations and society.

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