IBM Global Services
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Cloud computing: defined and demystified

Explore public, private and hybrid cloud approaches to help accelerate innovative business solutions

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Executive summary

Predicted to transform IT over the next decade, cloud computing is an emerging trend that provides rapid access to dynamically scalable and virtualized IT resources. IBM is fully embracing the potential of all types of cloud-based solutions rooted in industry-based standards: Our goal is to collaborate with organizations around the world to help create dynamic IT infrastructures through virtualization technologies and new cloud management techniques that enable a simplified "anywhere, anytime" self-service approach for the delivery and consumption of IT services. Because they provision and allocate services on demand, cloud-based technologies can provide unlimited scalability and a higher-quality, more efficient infrastructure while simultaneously fostering rapid innovation. In this white paper, the term cloud computing is defined, along with the distinguishing attributes of the types of cloud deployments, their advantages and disadvantages, and the approach that best aligns with the needs of your enterprise.

Introduction

While the concept of cloud computing becomes more mainstream within the IT universe, its precise definition—and potential application—remains ambiguous for many people. Cloud computing is still an emerging technology that will continue to evolve over the next few years, so understanding its precise meaning will probably depend on who is using the term and in what way. The purpose of this white paper is to define and clarify cloud computing from IBM's perspective, focusing on the various ways it can be deployed—from public to private to hybrid clouds—while covering the potential technical and business implications of each in a vendor-agnostic way. With a clear understanding of how each type of cloud deployment is set up and the advantages and disadvantages of each as they relate to your enterprise, you are more fully equipped to make informed decisions about which cloud computing approach is most appropriate for your enterprise.

Overview of cloud computing

Cloud computing is a simplified way to deliver IT services to your business, allowing you to choose from a menu of virtualized applications, software, hardware, and networking services that are housed in an Internet "cloud," either owned privately by an enterprise or owned, hosted, and managed by a third-party service provider. Unlike a traditional corporate client-server data center where you own and actively manage the infrastructure and its resources, a public cloud computing model enables you to "lease" these resources. Depending on the pricing agreement, you can pay a monthly fee (similar to a subscription) or pay for services as you use them, both options potentially freeing you from the large capital expenses typically associated with developing innovative technology solutions. A private cloud is, or provides access to, a highly virtualized data center that allows your IT staff to provision services and capacity to internal end users on a self-service basis while automating management tasks and using a chargeback billing system to lines of business. The services in a cloud computing model are highly scalable, so you can flexibly adapt to changing business requirements by easily adding new services or removing those you no longer need.

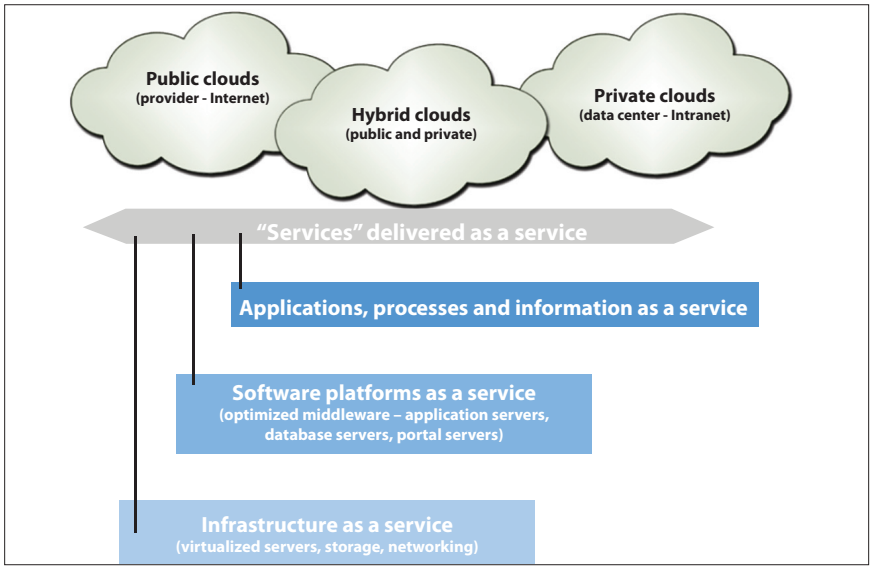


Figure 1. Cloud computing deployments and services

Defining cloud computing

Cloud computing is a smart acquisition and delivery model that provides continuous access and availability to computing services and IT resources from any location, using virtually any device. A self-service approach allows consumers to acquire services as needed, for as long as they need them, through the Internet or an intranet, while making the technology beyond the user device almost invisible. As a result, this service delivery model is highly scalable and can help to rapidly develop, deploy and deliver services in a simplified way to cost-effectively support innovative business solutions.

So how exactly does it work? The user accesses the cloud to select the desired consumer or business products, services or solutions, which are delivered and consumed in real time using the Internet or Internet-based technology. Depending on your needs, the cloud can provide access to interoperable and interchangeable software or hardware components, networking capabilities as well as management and monitoring capabilities.

Cloud computing provides:

- Standardized, consumable, Web-based deliverable services
- Elastic scaling
- Flexible pricing
- Metering and billing capability
- Advanced virtualization
- Rapid provisioning of resources

A cloud computing platform combines the modular components of a service-oriented architecture and an Internet protocol-based convergence of networks and devices within a high-performance pool of virtualized computer hardware and software resources. With easy access to an easy-to-use service request catalog that hides the complexity of the underlying infrastructure, the end user is able to select and access standardized,

preconfigured and pretested solutions, services and resources. Delivered at a granular level of billing and metering, this workload standardization can help measure, monitor and lower the cost of your services while easing complexity of your IT infrastructure.

This on demand approach allows for greater scalability and enables your organization to take advantage of innovative technology, without having to spend time, resources and money on development and implementation to provide similar services to the business users.

Benefits of cloud computing

Cloud computing implementations are designed for rapid delivery of computing resources, providing a cost-efficient model for provisioning processes, applications and services while making IT management easier and more responsive to the needs of the business. Services (resources and applications) are made available by highly efficient, virtualized compute resources that can be rapidly scaled up and down in a flexible yet secure way to deliver a high quality of service. Business or consumer services—from computation services, storage services, networking services, whatever is needed—are rapidly delivered and made available dynamically, in an "on demand," simplified way, regardless of the user's location or type of device. With this model comes unbounded scale, differentiated quality, and a user focus designed to foster rapid, innovation that enables organizations to quickly and cost-effectively deploy new solutions for use inside and outside the company—creating greater business agility and allowing you to do more with fewer resources. With rapid access to new combinations of services and leading-edge technologies supported by more efficient decision making and a highly optimized, end-to-end process, a cloud-based approach enables your IT team to shift its focus to innovation while creating significant economies of scale—all to provide differentiating value propositions for your enterprise at lower costs and in a shorter timeframe. If properly used within an overall IT strategy, cloud computing can help improve business performance and control the costs of delivering IT resources to your organization.

Benefits include:

- A dynamic infrastructure that can help improve service, reduce cost and manage risk
- Simplified delivery of services, resulting in significantly less IT maintenance and development costs
- Greater scalability and flexible, adaptable, extendable systems
- A cost-efficient, pay-as-you-grow model
- More rapid recovery and restore capabilities (including e-mail and data on laptops and desktops), for improved business resiliency
- The ability to reach and drive user communities and consumers of new cloud services (such as social networking)
- Accelerate innovative projects that can lead to new revenue by bringing cloud services for access by users on a global scale, increasing your competitive advantage
- Enhanced governance capabilities and improved risk and compliance
- Flexible data and process location options
- Greater cost transparency transparency, visibility and control
- Increased return on investment of existing assets, freeing capital to deploy strategically
- Allow IT to deliver more standardized applications and outsource commodities
- Acquire and release computing services while making the technology virtually invisible to the user
- Enforce the integrated visibility, control and automation across the cloud services lifecycle
- Ease user adoption and empowerment through self-service provisioning
- Provide a simple, effective and creative service delivery model
- Deliver services in a less costly and higher-quality business model, while providing service access ubiquity
- Utilize an acquisition and delivery model of IT services, within an overall IT strategy, to improve business performance and control the costs of delivering IT resources to the organization

To sum it up, you can lower both your capital and operating expenses with less IT purchases, expenditures, staff, and through optimization, which occurs from physical consolidation, application infrastructure virtualization, system virtualization and better IT management.

Types of clouds

Current cloud computing models are available in three main implementation options: private, public and hybrid. To be technically precise, the services reside within the cloud but, like the Internet and an intranet, the cloud can be private or public to the enterprise or a mix of both. This section explains the difference between each, their potential benefits and drawbacks, as well as the technical and business objectives that align with each model.

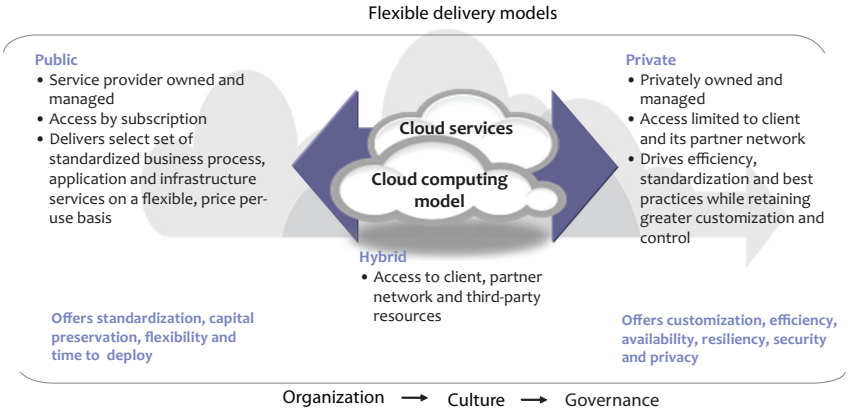


Figure 2. Cloud computing delivery models: public, private and hybrid

Highlights

A cloud computing environment that is open for use to the general public, including individuals, corporations or other types of organizations

Public clouds

Public (or external) clouds deliver a select set of dynamically provisioned, standardized business process, application and infrastructure services and resources using Internet-based technologies on a flexible, variable payment and self-service basis. Typically owned and managed by an offsite, third-party provider, the billing is provided on a fine-grain utility computing basis and accessed by subscription. Examples of public clouds are Google Apps, iPhone apps and Amazon's Elastic Compute Cloud (EC2). (IBM is collaborating with Amazon to enable software developers to quickly build preproduction applications based on IBM software within the Amazon EC2 environment.) As enterprises and service providers become more experienced with the cloud architecture model and gain confidence in the security and access-control technologies that are available, it is expected that many service providers will deploy externally facing cloud services.

Advantages: Public clouds often cost less than private clouds to initially set up, and move IT spending from a capital-expense-based to an operating-expense-based model. They can offer the fastest route to adopting cloud technology, since services can immediately be accessed, often through the use of a credit card. The shared resource pool for public clouds is often larger than that of private clouds, which makes the resources more elastic.

Disadvantages: Public clouds may be vulnerable to security threats and their services can be less flexible and robust than a private cloud. Availability and service levels can also vary widely with public cloud providers. Public clouds are often fairly fixed and controlled environments, offering a set of services that may or may not meet sophisticated enterprise requirements. Legal ownership of data and privacy information is often not well documented.

Works best if you need:

- Fast access to standardized cloud services
- No capital outlay to provide new services
- Experimenting with cloud computing
- Limited commitment to a service provider

Highlights

A cloud computing environment maintained on your own IT infrastructure using a private network or hosted by a service provider

Private clouds

Private (or internal) clouds provide security-rich on demand access to business process, application and infrastructure services and resources, and is managed within the organization. Private clouds can be delivered through a data center or an intranet, with access limited to your users and partner networks. A layer of new technologies will typically be added—virtualization management, cloud infrastructure, self-service portals, chargeback systems, and more—to existing data center systems and processes.

Advantages: Private clouds have many of the benefits of traditional data centers and public clouds, including access to a large resource pool that offers new choices for running workloads internally or externally or in dynamic combination. These types of clouds are often not burdened by public network bandwidth and availability issues or potential security exposures that can be associated with public clouds. Private clouds allow the provider and user greater control and customization, security and resilience while driving efficiency, standardization and best practices in development and deployment processes. They are readily auditable and can provide a more secure environment with high availability. In addition, private clouds provide a potentially smoother migration path from a traditional IT infrastructure models to a cloud-based one with more control and security. Many companies are experimenting with a private cloud, with the goal of migrating various workloads to a private or hybrid cloud environment.

Disadvantages: Private clouds can be more costly at the outset than public clouds, but are still more cost-efficient and flexible than traditional IT delivery environments.

Works best if you need:

- An intranet-like implementation for employees, customers, partners, suppliers
- Customization and flexibility
- Auditing and compliance

Highlights

- Security and privacy
- Data protection
- Service delivery within a virtual private network (VPN)
- Availability and service levels
- Control over the environment

Private clouds can be implemented as an:

- On-site, managed cloud
- Off-site, hosted cloud – dedicated resources

A cloud computing model that combines public and private models, with your enterprise owning parts of the cloud and sharing other parts, in a highly controlled way

Hybrid clouds

Part public cloud service and part internal private cloud, a hybrid cloud model can be set up in several ways; for example, using an outside provider's hardware (such as cloud appliances) onsite that is designed to provide cloud-based services. The hybrid is ideal for a private cloud user that has demand peaks that require resource elasticity, but the cost of permanently acquiring that asset far outweighs on demand access costs, even at a premium price. IBM demonstrated a hybrid type approach earlier in 2009 that enables companies to move application processing from an internal cloud to a public cloud facility, while keeping all data stored within the private cloud. This type of hybrid cloud approach may work well for companies that cannot otherwise use a public cloud for security or regulatory reasons.

Advantages: Hybrid clouds provide the scaling advantages of an on demand, externally provisioned cloud while also increasing security, privacy and auditability. An enterprise can decide which services are offered through public or private clouds and at what service levels, selecting the most optimal delivery methods at a flexible cost structure. Flexible use of hybrid clouds can offer enterprise cost-effective IT service delivery options to meet dynamic business requirements and at the same time, still meet strict security and service level agreements for critical services.

Disadvantages: Added complexity of distributed applications across different environments that can increase management and monitoring requirements within the environment.

Highlights

To address specific challenges, such as return on investment, capacity and availability issues, many organizations are adopting cloud computing models for their testing environments.

Works best if you need:

- Support for simple stateless applications that don't require complex databases
- Optimal flexibility, scalability and service levels combined with the need for highly innovative environments that require rapid availability of new services
- Advantages of both types of cloud implementations for an optimal price compared against your need for flexibility, security and ability to meet service level agreements

Workload considerations for cloud implementation options

With so much information and chatter surrounding cloud-based solutions, determining the right approach for your enterprise can be challenging. As cloud computing evolves, so does its capabilities, which means not all your workloads are currently appropriate for a cloud-based model. By providing examples of workloads that are both appropriate and not appropriate for cloud migration, the following sections can help you get started in determining the best approach for your enterprise.

Workloads that can take advantage of public clouds

- Test systems and environments
- Single virtual appliance workloads
- Preproduction systems and environments
- Mature packaged offerings, like e-mail and collaboration
- Software development environments
- Batch processing jobs with limited security requirements
- Isolated workloads where latency between components is not an issue
- Storage solutions (including storage as a service)
- Backup solutions (including backup and restore as a service)
- Data-intensive workloads if the provider has a cloud storage offering linked to the cloud compute offering

Workloads more appropriate for private clouds

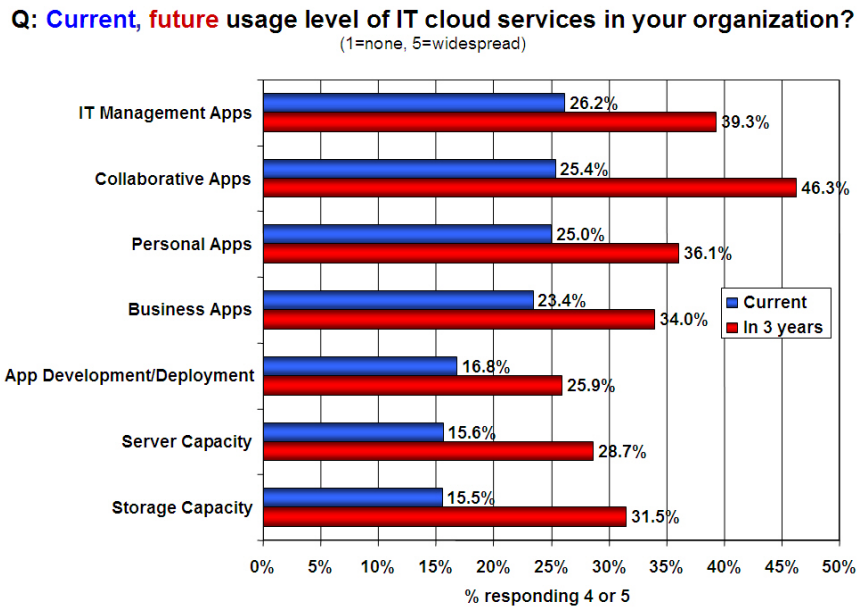
- Employee information or other sensitive data typically restricted to the enterprise
- Workloads composed of multiple, co-dependent services
- High throughput online transaction processing
- Workloads based on third-party software that does not have a virtualization or cloud-aware licensing strategy
- Workloads requiring customization

Forecast: The future of cloud computing

In the early days of the Internet, many people were skeptical about its future. No one doubted that it facilitated better communication and the sharing of information, but few people possessed the vision to foresee that the Internet, and intranets, could—and would—so dramatically transform the way we interact, learn, connect and do business. IBM anticipates that like the Internet, cloud computing technology will go through a similar evolution that, over time, will allow access to many more transformational tools and capabilities.

Many industry analysts foresee cloud computing as an approach that will transform businesses as it matures. *The Economist* recently reported that "Clouds will transform the information technology (IT) industry… and profoundly change the way people work and companies operate." [1]
A senior analyst at Forrester predicts that, "Clouds are going to become less of a work in progress…and become more of a mature reality, in terms of how enterprises acquire functionality, how they acquire applications and platforms." [2]

The following IDC survey[3] shows that usage level of IT cloud services are predicted to rise over the next three years. "The survey results suggest we're entering a period of accelerating IT cloud services adoption, with the portion of organizations exhibiting significant adoption moving from 15 to 25 percent today to 25 to 45 percent in three years." [3]



Source: IDC Enterprise Panel, August 2008 n=244

Implementing a cloud computing solution

Now that you've explored the ways that various types of cloud implementations can potentially benefit your organization, your next step should be to evaluate how you might be able to transition from a traditional onsite client-server and data center model to an IT infrastructure where applications, compute, storage and business processes are all delivered as cloud-based services.

You will need a trusted partner to help you decide how and where to start in making that transition. IBM is an industry leader in contributing to and establishing cloud reference architectures while developing and delivering cloud-enabling technologies and products to companies around the world. Our deep data center expertise is based on vast experience in managing multiple, global next-generation cloud computing centers and refined through thousands successful implementations and projects.

Backed by this expertise, IBM is able to create and deliver cost-effective and energy-efficient IT resources for your business. Equipped with deep industry expertise, IBM can help you develop cloud solutions tailored to your specific business needs.

Using a vendor-neutral, comprehensive open standards approach, IBM works with you to assess your needs and then design, implement and deploy a cloud computing solution tailored to meet your unique business requirements. If you want to start small with a private test cloud, a typical on-ramp to cloud adoption, IBM Implementation Services for cloud computing – design and implementation for test environments provides the expertise as well as support for the automated provisioning and management of IBM WebSphere® Application Server virtual images with the new WebSphere CloudBurst appliance. If you need an enterprise-ready public cloud, IBM's proven expertise combined with industry-leading technology—including multivendor hardware and software, processes, networking capabilities and services—enable us to collaborate with you to deliver a robust cloud solution that's right for your organization.

For more information

For more information about cloud computing, please contact an IBM representative or visit: www.ibm.com/cloud

Additionally, IBM Global Financing can tailor financing solutions to a customer's specific IT needs. For more information on rates, flexible payment plans and loans, and asset buyback and disposal, visit:

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1 The Economist (print edition) special report, interview with Ludwig Siegele, October 23, 2008 http://www.economist.com/specialreports/displaystory.cfm?story_id=12411882

2 "2009 predictions for IT, SOA, cloud and BI," podcast, citing Jim Kobielus, senior analyst, Forrester Research

3 IDC eXchange, IT Cloud Services User Survey, pt 1: Crossing the Chasm, http://blogs.idc.com/ie/?p=205 September 29, 2008

www.economist.com/specialreports/displaystory.cfm?story_id=12411882

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