1
CHAPTER

Cloud Computing Basics

Cloud computing is everywhere. Pick up any tech magazine or visit almost any IT website or blog and you'll be sure to see talk about cloud computing. The only problem is that not everyone agrees on what it is. Ask ten different professionals what cloud computing is, and you'll get ten different answers. And is cloud computing even worth all the hype? Some people don't think so. In fact, in 2008 Oracle CEO Larry Ellison chastised the whole issue of cloud computing, saying that the term was overused and being applied to everything in the computer world.

"The computer industry is the only industry that is more fashion-driven than women's fashion," he said to a group of Oracle analysts.

So let's talk about what cloud computing is and tighten up our definition and understanding of this implementation.

Cloud Computing Overview

In this first section, we'll talk about what cloud computing is, and how it is developed and deployed. We'll clear up some misconceptions and make sure we all have a common understanding of the topic.

Disambiguation—Just What Is Cloud Computing?

Cloud computing gets its name as a metaphor for the Internet. Typically, the Internet is represented in network diagrams as a cloud, as shown in Figure 1-1. The cloud icon represents "all that other stuff" that makes the network work. It's kind of like "etc." for the rest of the solution map. It also typically means an area of the diagram or solution that is someone else's concern, so why diagram it all out? It's probably this notion that is most applicable to the cloud computing concept.

NOTE *Applications run on hosted servers* as a service. *We'll define that term later in this chapter, and discuss the different types of "as a service" applications that are prevalent.*

Cloud computing promises to cut operational and capital costs and, more importantly, let IT departments focus on strategic projects instead of keeping the datacenter running.

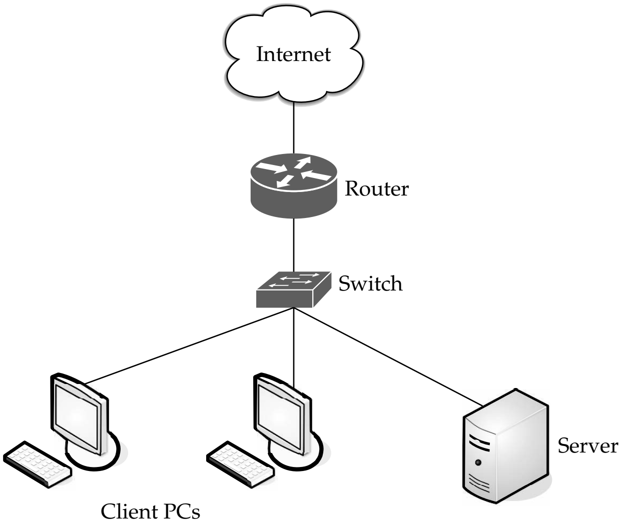


Figure 1-1 A cloud is used in network diagrams to depict the Internet.

What Works

But there's more going on under the hood than to simply equate cloud computing to the Internet. In essence, cloud computing is a construct that allows you to access applications that actually reside at a location other than your computer or other Internet-connected device; most often, this will be a distant datacenter. There are many benefits to this. For instance, think about the last time you bought Microsoft Word and installed it on your organization's computers. Either you ran around with a CD- or DVD-ROM and installed it on all the computers, or you set up your software distribution servers to automatically install the application on your machines. And every time Microsoft issued a service pack, you had to go around and install that pack, or you had to set up your software distribution servers to distribute it. Oh, and don't forget the cost of all the licenses. Pete down the hall probably uses Word once a month, but his license cost just as much as everyone else's.

The beauty of cloud computing, as shown in Figure 1-2, is that another company hosts your application (or suite of applications, for that matter). This means that they handle the costs of servers, they manage the software updates, and—depending on how you craft your contract—you pay less for the service.

Don't forget the equipment that you won't need to buy—which will result in fewer capital expenditures—thereby causing the CFO to actually smile when she sees you. By having someone else host the applications, you need not buy the servers nor pay for the electricity to power and cool them.

It's also convenient for telecommuters and traveling remote workers, who can simply log in and use their applications wherever they are.

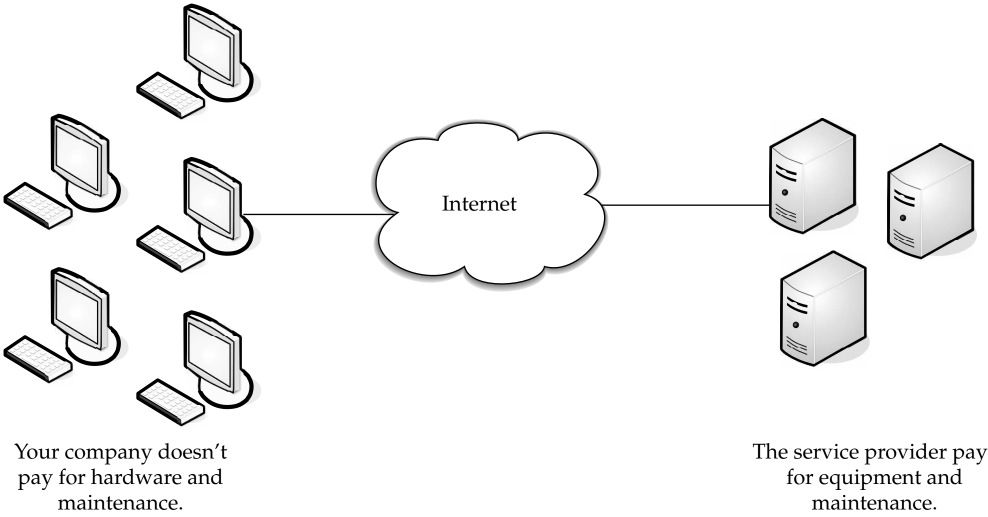
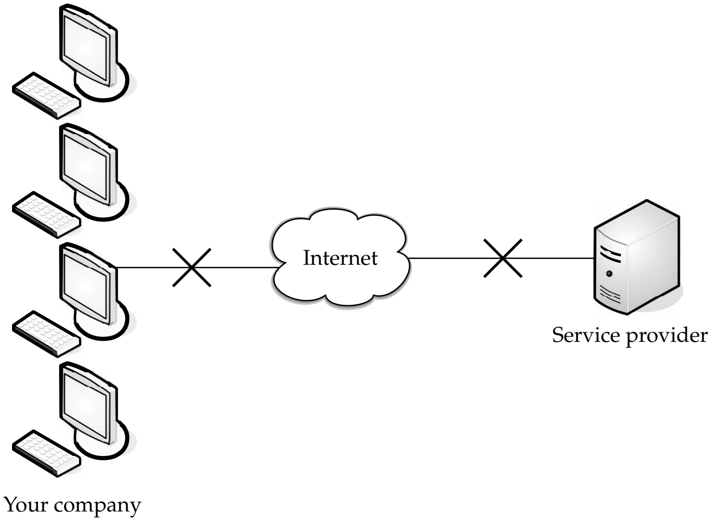

Internet
Your company doesn't pay for hardware and maintenance.
The service provider pays for equipment and maintenance.

FIGURE 1-2 With cloud computing, other companies host your applications.

Weak Links

So it all sounds great, right? Not so fast. As with everything in IT, there are pros and cons. Cloud computing is not exempt. Let's take a quick look at a few areas of potential trouble. The following illustration shows potential points of failure.



While an Internet outage or problems with your Internet service provider (ISP) are rare, you may not be able to access your applications and do your work. Not that everyone sits in one office much anymore, but if you currently have the application on your own local servers, and all those who access it are not remote, you'd be at least somewhat assured that an Internet outage wouldn't affect your application.

But it isn't your connection to the Internet that can be prone to outages. What if the site you're accessing has problems? It's happened already. In July 2008, Amazon's S3 cloud storage service went down for the second time that year. A lot of applications were hosted by the company and all those services could not be accessed until techs could fix the problem. Some applications were down for eight hours.

Also, there may simply be applications or data that you want located on-site. If you have sensitive or proprietary information, your IT security group may simply mandate that you not store it on someone else's machines.

Application Integration Issues

You might also find that it's more difficult to integrate your applications if they are geographically dispersed. That is, it is easier to manage and access your data if it is nearby, and not under someone else's control.

For instance, if you need two applications to exchange information, it's easier to do if they both reside in the same place. If you have one application in-house and it has to contact another application on the cloud, it becomes far more complicated, and more prone to failure.

Cloud Components

In a simple, topological sense, a cloud computing solution is made up of several elements: clients, the datacenter, and distributed servers. As shown in Figure 1-3, these components make up the three parts of a cloud computing solution.

Each element has a purpose and plays a specific role in delivering a functional cloud-based application, so let's take a closer look.

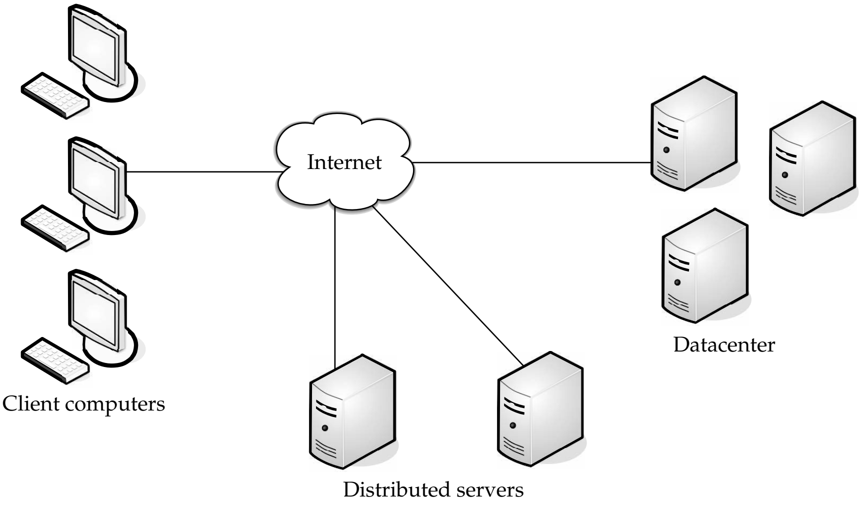


FIGURE 1-3 Three components make up a cloud computing solution.

Clients

Clients are, in a cloud computing architecture, the exact same things that they are in a plain, old, everyday local area network (LAN). They are, typically, the computers that just sit on your desk. But they might also be laptops, tablet computers, mobile phones, or PDAs—all big drivers for cloud computing because of their mobility.

Anyway, clients are the devices that the end users interact with to manage their information on the cloud. Clients generally fall into three categories:

- **Mobile** Mobile devices include PDAs or smartphones, like a Blackberry, Windows Mobile Smartphone, or an iPhone.
- **Thin** Clients are computers that do not have internal hard drives, but rather let the server do all the work, but then display the information.
- **Thick** This type of client is a regular computer, using a web browser like Firefox or Internet Explorer to connect to the cloud.

Thin clients are becoming an increasingly popular solution, because of their price and effect on the environment. Some benefits to using thin clients include

- **Lower hardware costs** Thin clients are cheaper than thick clients because they do not contain as much hardware. They also last longer before they need to be upgraded or become obsolete.
- **Lower IT costs** Thin clients are managed at the server and there are fewer points of failure.
- **Security** Since the processing takes place on the server and there is no hard drive, there's less chance of malware invading the device. Also, since thin clients don't work without a server, there's less chance of them being physically stolen.
- **Data security** Since data is stored on the server, there's less chance for data to be lost if the client computer crashes or is stolen.
- **Less power consumption** Thin clients consume less power than thick clients. This means you'll pay less to power them, and you'll also pay less to air-condition the office.
- **Ease of repair or replacement** If a thin client dies, it's easy to replace. The box is simply swapped out and the user's desktop returns exactly as it was before the failure.
- **Less noise** Without a spinning hard drive, less heat is generated and quieter fans can be used on the thin client.

Datacenter

The *datacenter* is the collection of servers where the application to which you subscribe is housed. It could be a large room in the basement of your building or a room full of servers on the other side of the world that you access via the Internet.

A growing trend in the IT world is virtualizing servers. That is, software can be installed allowing multiple instances of virtual servers to be used. In this way, you can have half a dozen virtual servers running on one physical server.

NOTE *The number of virtual servers that can exist on a physical server depends on the size and speed of the physical server and what applications will be running on the virtual server.*

Distributed Servers

But the servers don't all have to be housed in the same location. Often, servers are in geographically disparate locations. But to you, the cloud subscriber, these servers act as if they're humming away right next to each other.

This gives the service provider more flexibility in options and security. For instance, Amazon has their cloud solution in servers all over the world. If something were to happen at one site, causing a failure, the service would still be accessed through another site. Also, if the cloud needs more hardware, they need not throw more servers in the safe room—they can add them at another site and simply make it part of the cloud.

Infrastructure

Cloud computing isn't a one-size-fits-all affair. There are several different ways the infrastructure can be deployed. The infrastructure will depend on the application and how the provider has chosen to build the cloud solution. This is one of the key advantages for using the cloud. Your needs might be so massive that the number of servers required far exceeds your desire or budget to run those in-house. Alternatively, you may only need a sip of processing power, so you don't want to buy and run a dedicated server for the job. The cloud fits both needs.

Grid Computing

Grid computing is often confused with cloud computing, but they are quite different. Grid computing applies the resources of numerous computers in a network to work on a single problem at the same time. This is usually done to address a scientific or technical problem. A well-known example of this is the Search for Extraterrestrial Intelligence (SETI) @Home project. In this project, people all over the world allow the SETI project to share the unused cycles of their computers to search for signs of intelligence in thousands of hours of recorded radio data. This is shown in Figure 1-4.

Another well-used grid is the World Community Grid—Berkeley Open Infrastructure for Network Computing (BOINC; see www.worldcommunity grid.org). Here you can dedicate as much or as little of your idle CPU processing power as you choose to help conduct protein-folding experiments in an effort to create better and more durable rice crops to feed the world's hungry. I bet you didn't know you could feed the needy with your computer.

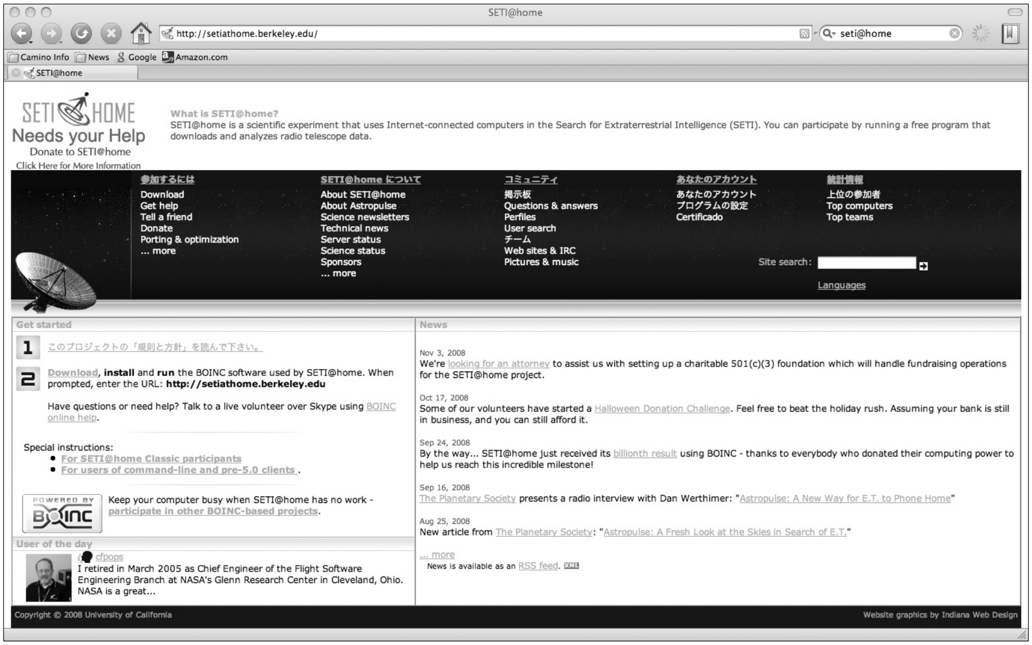
Grid computing necessitates the use of software that can divide and then send out pieces of the program to thousands of computers. It can be done throughout the computers of an organization, or it can be done as a form of public collaboration.

Sun Microsystems offers Grid Engine software that allows engineers at companies to pool the computer cycles on up to 80 workstations at a time.

Grid computing is appealing for several reasons:

- It is a cost-effective way to use a given amount of computer resources.
- It is a way to solve problems that need a tremendous amount of computing power.
- The resources of several computers can be shared cooperatively, without one computer managing the other.

So what do grid computing and cloud computing have to do with one another? Not much directly, as they function in fundamentally different ways. In grid computing, a large project is divided among multiple computers to make use of their resources. Cloud computing does just the opposite. It allows multiple smaller applications to run at the same time.



What is SETI@home?
SETI@home is a scientific experiment that uses Internet-connected computers in the Search for Extraterrestrial Intelligence (SETI). You can participate by running a free program that downloads and analyzes radio telescope data.

Get started

1 このプロジェクトの「規則と方針」を読んで下さい。

2 Download, **install** and **run** the BOINC software used by SETI@home. When prompted, enter the URL: **http://setiathome.berkeley.edu**

Have questions or need help? Talk to a live volunteer over Skype using BOINC online help.

Special instructions:

- For SETI@home Classic participants
- For users of command-line and pre-5.0 clients .

Keep your computer busy when SETI@home has no work - participate in other BOINC-based projects.

User of the day

cfpops
I retired in March 2005 as Chief Engineer of the Flight Software Engineering Branch at NASA's Glenn Research Center in Cleveland, Ohio. NASA is a great...

News

Nov 3, 2008
We're looking for an attorney to assist us with setting up a charitable 501(c)(3) foundation which will handle fundraising operations for the SETI@home project.

Oct 17, 2008
Some of our volunteers have started a Halloween Donation Challenge. Feel free to beat the holiday rush. Assuming your bank is still in business, and you can still afford it.

Sep 24, 2008
By the way... SETI@home just received its billionth result using BOINC - thanks to everybody who donated their computing power to help us reach this incredible milestone!

Sep 16, 2008
The Planetary Society presents a radio interview with Dan Werthimer: "Astropulse: A New Way for E.T. to Phone Home"

Aug 25, 2008
New article from The Planetary Society: "Astropulse: A Fresh Look at the Skies in Search of E.T."

... more
News is available as an RSS feed.

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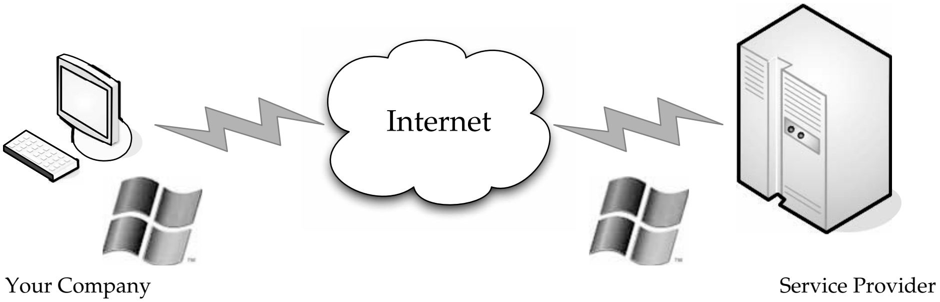
FIGURE 1-4 SETI@Home is a well-known use of grid computing.

Full Virtualization

Full virtualization is a technique in which a complete installation of one machine is run on another. The result is a system in which all software running on the server is within a virtual machine.



In a fully virtualized deployment, the software running on the server is displayed on the clients.

NOTE *Full virtualization dates back to 1967 with IBM's CP-40 research system.*

This sort of deployment allows not only unique applications to run, but also different operating systems.

Virtualization is relevant to cloud computing because it is one of the ways in which you will access services on the cloud. That is, the remote datacenter may be delivering your services in a fully virtualized format.

In order for full virtualization to be possible, it was necessary for specific hardware combinations to be used. It wasn't until 2005 that the introduction of the AMD-Virtualization (AMD-V) and Intel Virtualization Technology (IVT) extensions made it easier to go fully virtualized.

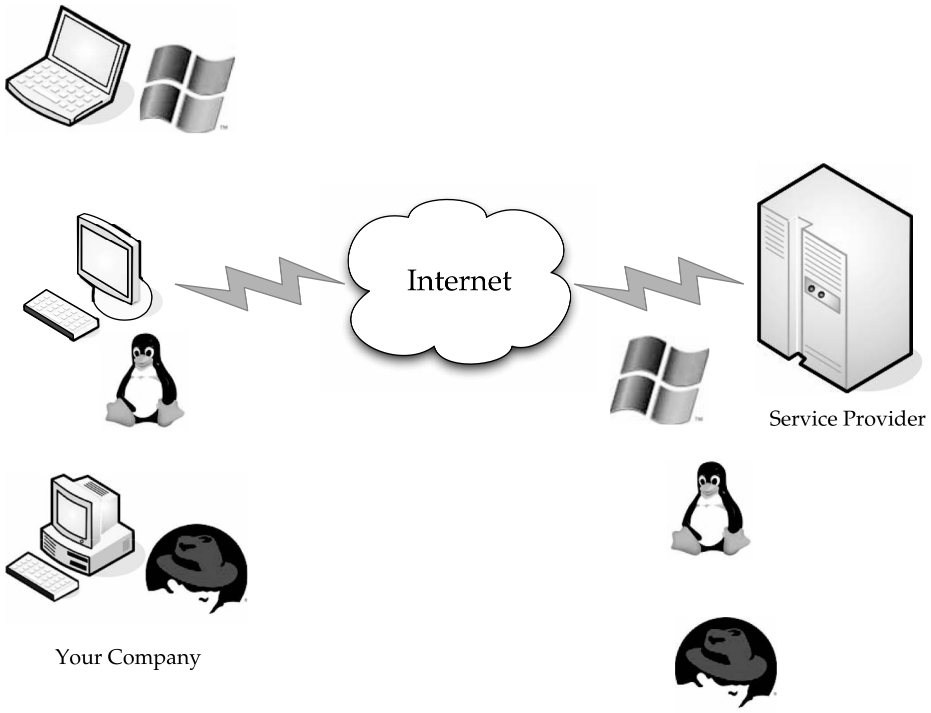
Full virtualization has been successful for several purposes:

- Sharing a computer system among multiple users
- Isolating users from each other and from the control program
- Emulating hardware on another machine

Paravirtualization

Paravirtualization allows multiple operating systems to run on a single hardware device at the same time by more efficiently using system resources, like processors and memory.

In full virtualization, the entire system is emulated (BIOS, drive, and so on), but in paravirtualization, its management module operates with an operating system that has been adjusted to work in a virtual machine. Paravirtualization typically runs better than the full virtualization model, simply because in a fully virtualized deployment, all elements must be emulated.



In a paravirtualized deployment, many different operating systems can run simultaneously.

Virtualization Type	Guest Instances	Virtualization Overhead	System Processing Needs	Total
Full Virtualization	5	10% (50% total)	10% (50% total)	100%
Paravirtualization	8	2% (16% total)	10% (50% total)	96%

Table 1-1 Processor Power Used in Full Virtualization and Paravirtualization

The trade-off is reduced security and flexibility. For instance, flexibility is reduced because a particular OS or distribution may not be able to work. For example, a new Windows deployment may not be available as a guest OS for the solution. Security can be at risk because the guest OS has more control of the underlying hardware, and there is a risk of impacting the hardware and all the guest systems on the host.

Paravirtualization also allows for better scaling. For example, if a fully virtualized solution requires 10 percent of processor utilization, then five systems are about the most that could be run on a system before performance takes a hit. Paravirtualization requires only 2 percent of processor utilization per guest instance and still leaves 10 percent of the guest OS available. This is illustrated in Table 1-1.

Paravirtualization works best in these sorts of deployments:

- **Disaster recovery** In the event of a catastrophe, guest instances can be moved to other hardware until the equipment can be repaired.
- **Migration** Moving to a new system is easier and faster because guest instances can be removed from the underlying hardware.
- **Capacity management** Because of easier migrations, capacity management is simpler to implement. It is easier to add more processing power or hard drive capacity in a virtualized environment.

Services

The term services in cloud computing is the concept of being able to use reusable, fine-grained components across a vendor's network. This is widely known as "as a service."

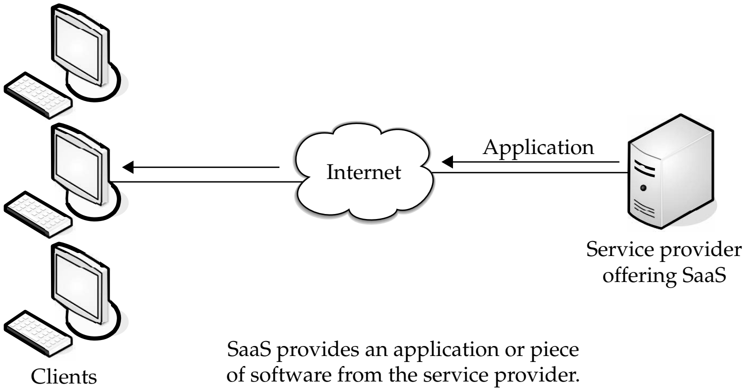
Offerings with *as a service* as a suffix include traits like the following:

- Low barriers to entry, making them available to small businesses
- Large scalability
- Multitenancy, which allows resources to be shared by many users
- Device independence, which allows users to access the systems on different hardware

Software as a Service

Software as a Service (SaaS) is the model in which an application is hosted as a service to customers who access it via the Internet. When the software is hosted off-site, the customer doesn't have to maintain it or support it. On the other hand, it is out of the customer's hands when the hosting service decideds to change it. The idea is that you use the software out of the box as is and do not need to make a lot of changes or require integration to other systems.

The provider does all the patching and upgrades as well as keeping the infrastructure running.



SaaS provides an application or piece of software from the service provider.

Costs can be sort of a double-edged sword. On the one hand, costs for accessing the software can be an ongoing thing. Rather than pay for it once and be done with it, the more you use it, the more you'll be billed. On the other hand, in some cases you don't have to pay as much up front and you are only billed based on your use of the application.

For vendors, SaaS has the appeal of providing stronger protection of their intellectual property as well as creating a continuous stream of income.

There are many types of software that lend themselves to the SaaS model. Typically, software that performs a simple task without much need to interact with other systems makes them ideal candidates for SaaS. Customers who are not inclined to perform software development but have need of high-powered applications can also benefit from SaaS. Some of these applications include

- Customer resource management (CRM)
- Video conferencing
- IT service management
- Accounting
- Web analytics
- Web content management

SaaS applications differ from earlier distributed computing solutions in that SaaS was developed specifically to use web tools, like the browser. This makes them web-native. It was also built with a multitenant back end in mind, which enables multiple customers to use an application.

SaaS provides network-based access to commercially available software. Since the software is managed at a central location, customers can access their applications wherever they have web access.

As we'll discuss in the next section—PaaS—SaaS is often used in conjunction with other software. When used as a component of another application, this is known as a *mashup* or a *plugin*.

Benefits One of the biggest benefits of SaaS is, of course, costing less money than buying the application outright. The service provider can offer cheaper, more reliable applications than organizations can by themselves. Some other benefits include the following:

- **Familiarity with the World Wide Web** Most workers have access to a computer and know how to use it on the World Wide Web. As such, the learning curve for using external applications can be much smaller.
- **Smaller staff** IT systems require the overhead of salaries, benefits, insurance, and building space. The ability to farm out applications reduces the need for as much IT staff.
- **Customization** Older applications were difficult to customize and required tinkering with the code. SaaS applications are much easier to customize and can give an organization exactly what they want.
- **Better marketing** A provider who had developed an application for a very narrow market might have had problems marketing that application. However, with SaaS, the entire world is open to the providers.
- **Web reliability** We talked earlier about how the World Wide Web can be seen as a source of failure. And while that is sporadically true, the fact of the matter is that the Web is generally quite reliable.
- **Security** Secure Sockets Layer (SSL) is widely used and trusted. This allows customers to reach their applications securely without having to employ complex back-end configurations, like virtual private networks (VPNs).
- **More bandwidth** Bandwidth has increased greatly in recent months and quality of service improvements are helping data flow. This will allow organizations to trust that they can access their applications with low latencies and good speeds.

Obstacles Like anything, SaaS faces obstacles to its implementation and use. The first is that an organization that has a very specific computational need might not be able to find the application available through SaaS. In that case, they may discover that they need to buy the software and install it on their local machines. That said, companies with unique needs may be able to find some of the components in a SaaS.

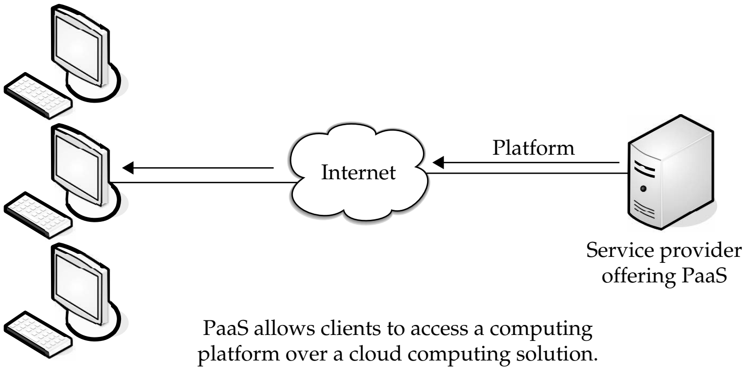
There is also an element of "lock-in" with vendors. That is, the customer might pay a provider to use an application, but once they do, they may be unable to port that application to a new vendor. Or, it might be possible to move to a new vendor, but the old vendor might charge a hefty moving fee.

Finally, SaaS also faces challenges from the availability of opensource applications and cheaper hardware. If companies are so inclined, they can put their open source applications on hardware that performs better and costs less than it used to.

Platform as a Service

Following on the heels of SaaS, Platform as a Service (PaaS) is another application delivery model. PaaS supplies all the resources required to build applications and services completely from the Internet, without having to download or install software.

NOTE *PaaS is also known as* cloudware.



PaaS allows clients to access a computing platform over a cloud computing solution.

PaaS services include application design, development, testing, deployment, and hosting. Other services include team collaboration, web service integration, database integration, security, scalability, storage, state management, and versioning.

A downfall to PaaS is a lack of interoperability and portability among providers. That is, if you create an application with one cloud provider and decide to move to another provider, you may not be able to do so—or you'll have to pay a high price. Also, if the provider goes out of business, your applications and your data will be lost.

NOTE *This was the case with the provider Zimki. The company started in 2006 and by mid-2007 was out of business, causing applications and client data they hosted to be lost.*

PaaS generally offers some support to help the creation of user interfaces, and is normally based on HTML or JavaScript.

Because PaaS is expected to be used by many users simultaneously, it is designed with that sort of use in mind, and generally provides automatic facilities for concurrency management, scalability, failover, and security.

PaaS also supports web development interfaces such as Simple Object Access Protocol (SOAP) and Representational State Transfer (REST), which allow the construction of multiple web services, sometimes called mashups. The interfaces are also able to access databases and reuse services that are within a private network.

PaaS Options PaaS is found in one of three different types of systems:

- **Add-on development facilities** These allow existing SaaS applications to be customized. Often, PaaS developers and users are required to purchase subscriptions to the add-on SaaS application.
- **Stand-alone environments** These environments do not include licensing, technical, or financial dependencies on specific SaaS applications and are used for general developments.

- **Application delivery-only environments** These environments support hosting-level services, like security and on-demand scalability. They do not include development, debugging, and test capabilities.

Trends Toward Adoption PaaS faces the same sorts of factors in its adoption as SaaS did, as it is in its early phase. Some other factors influencing adoption include

- The ability of geographically isolated development teams to work together
- The ability to merge web services from multiple sources
- The ability to realize cost savings from using built-in infrastructure services for security, scalability, and failover, rather than having to obtain and test them separately
- The ability to realize cost savings from using higher-level programming abstractions

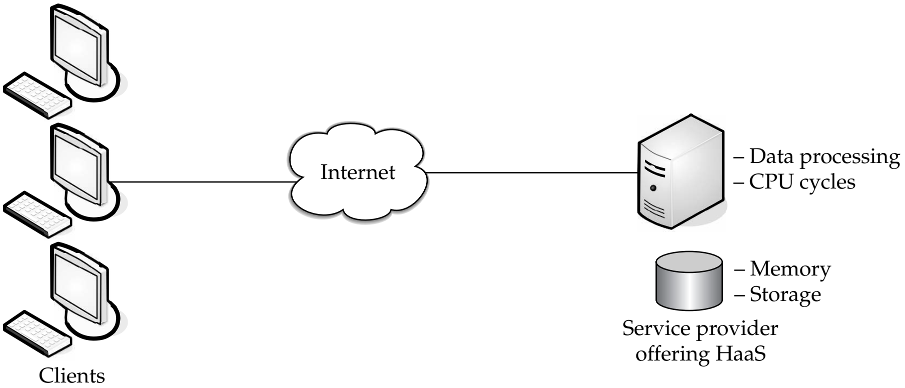
Hurdles There are two main obstacles that developers face when considering PaaS.

Because vendors use proprietary services or development languages, some developers are afraid of being locked into a single provider. The vendor may allow the application to be brought to a different provider; however, the costs are typically higher as compared to moving applications between conventional hosts.

Hardware as a Service

Hardware as a Service (HaaS) is the next form of service available in cloud computing. Where SaaS and PaaS are providing applications to customers, HaaS doesn't. It simply offers the hardware so that your organization can put whatever they want onto it.

NOTE *HaaS is sometimes also called Infrastructure as a Service (IaaS).*



HaaS allows service providers to rent hardware resources.

Rather than purchase servers, software, racks, and having to pay for the datacenter space for them, the service provider rents those resources.

HaaS allows you to "rent" such resources as

- Server space
- Network equipment
- Memory
- CPU cycles
- Storage space

Additionally, the infrastructure can be dynamically scaled up or down, based on the application resource needs.

Further, multiple tenants can be on the equipment at the same time.

Resources are typically billed based on a utility computing basis, so providers charge by how many resources are consumed.

HaaS involves several pieces:

- **Service level agreements** This is an agreement between the provider and client, guaranteeing a certain level of performance from the system.
- **Computer hardware** These are the components whose resources will be rented out. Service providers often have this set up as a grid for easier scalability.
- **Network** This includes hardware for firewalls, routers, load balancing, and so on.
- **Internet connectivity** This allows clients to access the hardware from their own organizations.
- **Platform virtualization environment** This allows the clients to run the virtual machines they want.
- **Utility computing billing** Typically set up to bill customers based on how many system resources they use.

Applications

So now we get to the question—what does cloud computing actually do? Well, we have applications running on our laptops, servers, phones and the like. Cloud computing either has them too or has the potential to bring them to you. So cloud computing brings you applications, a way of viewing, manipulating, and sharing data. Like their desktop brethren, many "staple" applications exist in cloud computing, but what will differ for you is how you interact with those applications. The most common are storage and database. In this section, we'll take a closer look at storage and database functionality.

NOTE *We'll talk about developing your own interfaces to work with storage and databases in Chapter 6.*

Storage

Somewhat similar to HaaS, one of the uses for cloud computing is simply storage. The benefits are in line with the general benefits of cloud computing—if you lease storage space from a vendor, you are not responsible to buy equipment, pay to run it, and pay to cool it. That's all on the vendor.

But there are different options when it comes down to cloud storage.

Database

Databases (which we will talk more about later in this chapter) are repositories for information with links within the information that help make the data searchable.

Distributed databases, like Amazon's SimpleDB, spread information among physically dispersed hardware. But to the client, the information seems to be located in one place.

The advantages of such a database include the following:

- **Improved availability** If there is a fault in one database system, it will only affect one fragment of the information, not the entire database.
- **Improved performance** Data is located near the site with the greatest demand and the database systems are parallelized, which allows the load to be balanced among the servers.
- **Price** It is less expensive to create a network of smaller computers with the power of one large one.
- **Flexibility** Systems can be changed and modified without harm to the entire database.

Naturally there are disadvantages, including

- **Complexity** Database administrators have extra work to do to maintain the system.
- **Labor costs** With that added complexity comes the need for more workers on the payroll.
- **Security** Database fragments must be secured and so must the sites housing the fragments.
- **Integrity** It may be difficult to maintain the integrity of the database if it is too complex or changes too quickly.
- **Standards** There are currently no standards to convert a centralized database into a cloud solution.

Synchronization

Synchronization, as with Microsoft's Live Mesh or Apple's MobileMe, allows content to be refreshed across multiple devices. For instance, if you have a spreadsheet on your computer and then upload it to the storage service, the next time you check your PDA, that file will be downloaded onto it.

Database Services

Another "as a service" offering that is becoming prevalent in the world of cloud computing is Database as a Service (DaaS). The idea behind DaaS is to avoid the complexity and cost of running your own database.

DaaS offers these benefits:

- **Ease of use** There are no servers to provision and no redundant systems to worry about. You don't have to worry about buying, installing, and maintaining hardware for the database.
- **Power** The database isn't housed locally, but that doesn't mean that it is not functional and effective. Depending on your vendor, you can get custom data validation to ensure accurate information. You can create and manage the database with ease.
- **Integration** The database can be integrated with your other services to provide more value and power. For instance, you can tie it in with calendars, email, and people to make your work more powerful.
- **Management** Because large databases benefit from constant pruning and optimization, typically there are expensive resources dedicated to this task. With some DaaS offerings, this management can be provided as part of the service for much less expense. The provider will often use offshore labor pools to take advantage of lower labor costs there. So it's possible that you are using the service in Chicago, the physical servers are in Washington state, and the database administrator is in the Philippines.

There are a number of providers out there, but let's take a closer look at two of the biggest players.

MS SQL

Anyone who has worked with databases is no stranger to Microsoft's premier offering, SQL Server. They announced the cloud extension of that tool in the spring of 2008 by introducing Microsoft SQL Server Data Services (SSDS). It is expected to be in a public beta by spring 2009.

SSDS looks very similar to Amazon's SimpleDB, with a straightforward, schema-free data storage, SOAP or REST APIs, and a pay-as-you-go payment system. It is also able to start small and scale larger as needed.

While it looks similar to SimpleDB, it varies greatly. First, one of the main selling points of SSDS is that it integrates with Microsoft's Sync Framework, which is a .NET library for synchronizing dissimilar data sources.

Microsoft wants SSDS to work as a data hub, synchronizing data on multiple devices so they can be accessed offline.

There are three core concepts in SSDS:

- **Authority** An *authority* is both a billing unit and a collection of containers.
- **Container** A *container* is a collection of entities and is what you search within.
- **Entity** An *entity* is a property bag of name and value pairs.

SSDS is based on SQL Server, but it is not a simple retooling of it. Microsoft built it with large-scale deployment in mind.

SSDS is a bit of a twist because it backsteps from being more complex, rather being simple and flexible.

Oracle

In the fall of 2008 Oracle introduced three services to provide database services to cloud users. Customers can license

- Oracle Database 11*g*
- Oracle Fusion Middleware
- Oracle Enterprise Manager

The products are available for use on Amazon Web Services' Elastic Compute Cloud (Amazon EC2). Oracle delivered a set of free Amazon Machine Images (AMIs) to its customers so they could quickly and efficiently deploy Oracle's database solutions.

Developers can take advantage of the provisioning and automated software deployment to rapidly build applications using Oracle's popular development tools such as Oracle Application Express, Oracle JDeveloper, Oracle Enterprise Pack for Eclipse, and Oracle Workshop for WebLogic. Additionally, Oracle Unbreakable Linux Support and AWS Premium Support is available for Oracle Enterprise Linux on EC2, providing seamless customer support.

"Providing choice is the foundation of Oracle's strategy to enable customers to become more productive and lower their IT costs—whether it's choice of hardware, operating system, or on demand computing—extending this to the Cloud environment is a natural evolution," said Robert Shimp, vice president of Oracle Global Technology Business Unit. "We are pleased to partner with Amazon Web Services to provide our customers enterprise-class Cloud solutions, using familiar Oracle software on which their businesses depend."

Additionally, Oracle also introduced a secure cloud-based backup solution. Oracle Secure Backup Cloud Module, based on Oracle's premier tape backup management software, Oracle Secure Backup, enables customers to use the Amazon Simple Storage Service (Amazon S3) as their database backup destination. Cloud-based backups offer reliability and virtually unlimited capacity, available on demand and with no up-front capital expenditure.

The Oracle Secure Backup Cloud Module also enables encrypted data backups to help ensure complete privacy in the cloud environment. It's fully integrated with Oracle Recovery Manager and Oracle Enterprise Manager, providing users with familiar interfaces for cloud-based backups.

For customers with an ongoing need to quickly move very large volumes of data into or out of the AWS cloud, Amazon allows the creation of network peering connections.

Intranets and the Cloud

While your operation is not big as Amazon S3 cloud computing, you can use the same sorts of principles within your organization to develop your IT infrastructure. By setting up thin clients to run applications and services on a local server, rather than on their desktops, you ease the costs of deployment and maintenance, as well as reducing power costs.

Note *Ironically, some organizations use cloud computing to deliver their corporate intranet. Intranets are customarily used within an organization and are not accessible publicly. That is, a web server is maintained in-house and company information is maintained on it that others within the organization can access. However, now intranets are being maintained on the cloud. To access the company's private, in-house information, users are having to log on to the intranet by going to a secure public web site.*

In this section we'll talk about the merits of developing your own in-house "cloud" and what is used in its composition.

Components

There are two main components in client/server computing: servers and thin or light clients. The network map in Figure 1-5 shows how they are deployed.

The servers house the applications your organization needs to run, and the thin clients—which do not have hard drives—display the results.

Hypervisor Applications

Applications like VMware or Microsoft's Hyper-V allow you to virtualize your servers so that multiple virtual servers can run on one physical server.

These sorts of solutions provide the tools to supply a virtualized set of hardware to the guest operating system. They also make it possible to install different operating systems on the same machine. For example, you may need Windows Vista to run one application, while another application requires Linux. It's easy to set up the server to run both operating systems.

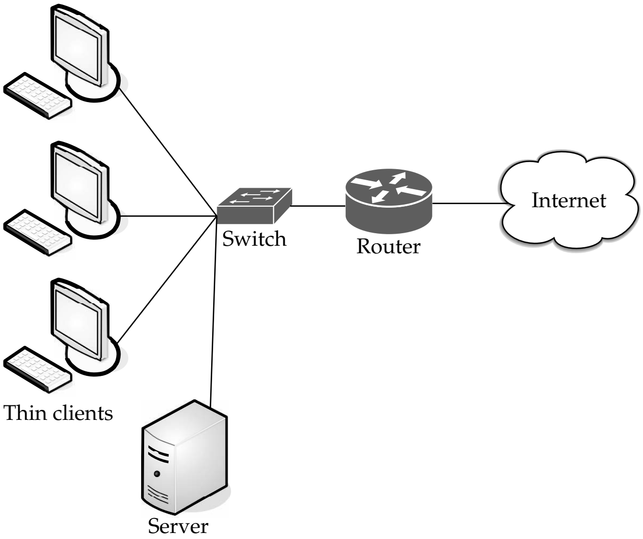


Figure 1-5 A client/server computing deployment consists of servers and thin clients.

Thin clients use an application program to communicate with an application server. Most of the processing is done down on the server, and sent back to the client.

There is some debate about where to draw the line when talking about thin clients. Some thin clients require an application program or a web browser to communicate with the server. However, others require no add-on applications at all. This is sort of a discussion of semantics, because the real issue is whether the work is being done on the server and transmitted back to the thin client.

First Movers in the Cloud

There are scores of vendors who offer cloud services. What they have to offer varies based on the vendor and their pricing models are different, as well. Let's take a look at some of the big names in the world of cloud computing and talk, briefly, about what they have to offer.

NOTE *We'll talk about them in greater detail in Chapter 11.*

Cloud computing is a growing field, and there will likely be new players in the market in the foreseeable future. For now, let's look at the names you already know: Amazon, Google, and Microsoft.

Amazon

Amazon was one of the first companies to offer cloud services to the public, and they are very sophisticated. Amazon offers a number of cloud services, including

- **Elastic Compute Cloud (EC2)** Offers virtual machines and extra CPU cycles for your organization.
- **Simple Storage Service (S3)** Allows you to store items up to 5GB in size in Amazon's virtual storage service.
- **Simple Queue Service (SQS)** Allows your machines to talk to each other using this message-passing API.
- **SimpleDB** A web service for running queries on structured data in real time. This service works in close conjunction with Amazon Simple Storage Service (Amazon S3) and Amazon Elastic Compute Cloud (Amazon EC2), collectively providing the ability to store, process, and query data sets in the cloud.

These services can be difficult to use, because they have to be done through the command line. That said, if you are used to working in a command-line environment, you shouldn't have much trouble using the services.

Amazon's virtual machines are versions of Linux distributions, so those who are experienced with Linux will be right at home. In fact, applications can be written on your own machine and then uploaded to the cloud.

Amazon is the most extensive cloud service to date. You can see more about Amazon's cloud services at http://aws.amazon.com.

Google

In stark contrast to Amazon's offerings is Google's App Engine. On Amazon you get root privileges, but on App Engine, you can't write a file in your own directory. Google removed the file write feature out of Python as a security measure, and to store data you must use Google's database.

Google offers online documents and spreadsheets, and encourages developers to build features for those and other online software, using its Google App Engine. Google reduced the web applications to a core set of features, and built a good framework for delivering them. Google also offers handy debugging features.

Groups and individuals will likely get the most out of App Engine by writing a layer of Python that sits between the user and the database. Look for Google to add more features to add background processing services.

It can be found online at code.google.com/appengine/.

Microsoft

Microsoft's cloud computing solution is called Windows Azure, an operating system that allows organizations to run Windows applications and store files and data using Microsoft's datacenters. It's also offering its Azure Services Platform, which are services that allow developers to establish user identities, manage workflows, synchronize data, and perform other functions as they build software programs on Microsoft's online computing platform.

Key components of Azure Services Platform include

- **Windows Azure** Provides service hosting and management and low-level scalable storage, computation, and networking.
- **Microsoft SQL Services** Provides database services and reporting.
- **Microsoft .NET Services** Provides service-based implementations of .NET Framework concepts such as workflow.
- **Live Services** Used to share, store, and synchronize documents, photos, and files across PCs, phones, PC applications, and web sites.
- **Microsoft SharePoint Services and Microsoft Dynamics CRM Services** Used for business content, collaboration, and solution development in the cloud.

Microsoft plans the next version of Office to offer a browser-based option so that users can read and edit documents online as well as offer the ability for users to collaborate using web, mobile, and client versions of Office.

Microsoft is a little late to the cloud party and isn't a leader in cloud computing. That honor goes to Google and Amazon, and more and more companies are offering cloud services, so if Microsoft wants to stay competitive, they're going to have to pick up the pace.

Microsoft's cloud offerings can be found online at www.microsoft.com/azure/default.mspx.

For some, the term "cloud computing" is simply hype. But for others who want to embrace it, cloud computing is a great way for IT professionals to focus less on their datacenters, and more on the work of information technology.