

# Discovering Private and Hybrid Clouds

- ▶ Defining a private cloud
- ▶ Choosing between public, private, and hybrid cloud environments
- ▶ Investigating private cloud economics
- ▶ Looking at vendor solutions for private and hybrid

While many business executives are attracted to the idea of the public cloud, just as many are interested in achieving the benefits of the cloud but on an internal basis. There are different reasons why companies investigating a cloud might want a private cloud instead of using a public one. The most obvious reason is **privacy and security of data**. Another reason that some companies are considering the private cloud is that they have already invested in a lot of hardware, software, and space and would like to be able to leverage their investments, but in a more efficient manner.

What if you could avoid the security issue by keeping your data *inside* your firewall and still gain public cloud benefits? Then consider a private or a hybrid cloud. Many companies are looking at a situation where they actually see the benefits of using a public cloud for some services, a private cloud for others, a hybrid cloud for some situations, and their traditional data center for the rest. Indeed, the world of IT is complicated. We suspect that most organizations will have a combination of approaches — a hybrid of public and private clouds with traditional data centers included.

In this chapter, we explain what a private cloud is and how it can work in tandem with public clouds. We explain the technology and services vendors are offering, and what happens when companies implement a strategy that combines a private cloud behind the firewall or a virtual private network with public cloud services.

## Pining for Privacy

While it may be clear that a private cloud is private and a public cloud is open to anyone, there are nuances that help make the differences evident.

Here are a few examples that might help:

- ✔ You're a company selling a service to retailers that helps them manage their digital gift cards. You might use a public cloud service to enable the retailers to submit information to you, but you want to make sure that the data you're collecting for them remains confidential and safe. You would, therefore, put that important data in a private cloud behind your company's firewall.
- ✔ You're a healthcare company in France. Your government requires that your patients' data be stored within the country. You'd probably want to keep that data in a private cloud.
- ✔ You're a financial services company that has selected a sales management system based on SaaS. However, you're concerned about the security of your customer data. The SaaS company offers a private cloud version of its service by adding a virtual private network that adds a second layer of security.

## Defining a private cloud



There's confusion — as well as passionate debate — over the definition of a private cloud. When we say *private cloud*, we mean a highly virtualized cloud data center located inside your company's firewall. It may also be a private space dedicated to your company within a cloud vendor data center designed to handle your company's workloads.

The characteristics of the private cloud are as follows:

- ✔ Allows IT to provision services and compute capability to internal users in a self-service manner
- ✔ Automates management tasks and lets you bill business units for the services they consume
- ✔ Provides a well-managed environment
- ✔ Optimizes the use of computing resources such as servers

- ✔ Supports specific workloads
- ✔ Provides self-service based provisioning of hardware and software resources



You might think this sounds a lot like a public cloud! A private cloud exhibits the key characteristics of a public cloud, including elasticity, scalability, and self-service provisioning. (Please refer to Chapter 1 for detailed information on cloud characteristics.) The major difference is *control* over the environment. In a private cloud, you (or a trusted partner) control the service management.

It might help to think of the public cloud as the Internet and the private cloud as the intranet.

If private and public clouds are so similar, why would you develop a private cloud instead of ordering capacity on demand from an Infrastructure as a Service provider or using Software as a Service? Here are several good reasons companies are using a private rather than a public cloud:

- ✔ Your organization has a huge, well-run data center with a lot of spare capacity. It would be more expensive to use a public cloud even if you have to add new software to transform that data center into a cloud.
- ✔ Your organization offers IT services to a large ecosystem of partners as part of your core business. Therefore, a private cloud could be a revenue source.
- ✔ Your company's data is its lifeblood. You feel that to keep control you must keep your information behind your own firewall.
- ✔ You need to keep your data center running in accordance with rules of governance and compliance.
- ✔ You have critical performance requirements, meaning you need 99.9999 percent availability. Therefore, a private cloud may be your only option. This higher level of service is more expensive, but is a business requirement.



Some early adopters of private cloud technology have experienced server use rates of up to 90 percent. This is a real breakthrough, particularly in challenging economic times.

## *Comparing public, private, and hybrid*

We wish we could tell you that there are clear distinctions between private and public clouds. Unfortunately, the lines are blurring between these two approaches. Hybrid approaches also are starting to take hold. For example,

some public cloud companies are now offering private versions of their public clouds. Some companies that only offered private cloud technologies are now offering public versions of those same capabilities.

In this section we offer some issues to consider when you're making your business decision.

### ***Going public***

When is a public cloud the obvious choice? Here are some examples:

- ✓ Your standardized workload for applications is used by lots of people. Email is an excellent example.
- ✓ You need to test and develop application code.
- ✓ You have SaaS (Software as a Service) applications from a vendor who has a well-implemented security strategy.
- ✓ You need incremental capacity (to add compute capacity for peak times).
- ✓ You're doing collaboration projects.
- ✓ You're doing an ad-hoc software development project using a Platform as a Service (PaaS) offering.



Many IT department executives are concerned about public cloud security and reliability. You need to get security right and handle any legal and governance issues, or the short-term cost savings could turn into a long-term nightmare. For more details on security, read Chapter 15; for more on governance, read Chapter 16.



### ***Keeping things private***

In contrast, when would a private cloud be the obvious choice? Here are some examples:

- ✓ Your business is your data and your applications. Therefore, control and security are paramount.
- ✓ Your business is part of an industry that must conform to strict security and data privacy issues. A private cloud will meet those requirements. (See Chapter 16 for more on Governance).
- ✓ Your company is large enough that you have the economies of scale to run a next generation cloud data center efficiently and effectively.

## Amazon and Salesforce.com offer private cloud services

Just as we were finalizing this chapter, both Amazon (see Chapter 10 for more on Amazon's offerings) and Salesforce.com (see Chapter 12 for more on Salesforce.com's SaaS platform) announced that they would be offering private cloud implementations of their public cloud-based services. Both companies are using a VPN, which uses encryption to make the public network or a public cloud work as though it were private.

Amazon has announced what it calls Amazon Virtual Private Cloud (Amazon VPC), which will

provide customers with isolated AWS (Amazon Work Space) compute resources protected by VPN connections. Therefore, customers can use enhanced security features such as multi-factor authentication to protect data. See Chapter 15 for more on security in the cloud.

Salesforce.com is partnering with NTT to offer a VPN to customers that want additional security for their CRM applications. Salesforce.com uses NTT's Comm Network, which incorporates a VPN for enhanced security.



### *Driving a hybrid*

Now add one more choice into the mix: the hybrid cloud. When would you use it? It isn't about making an either/or choice between a public or private cloud. In most situations, we think a hybrid environment will satisfy many business needs. Here are a few examples:

- ✓ Your company likes a SaaS application and wants to use it as a standard throughout the company; you're concerned about security. To solve this problem, your SaaS vendor creates a private cloud just for your company inside their firewall. They provide you with a *virtual private network (VPN)* for additional security. Now you have both public and private cloud ingredients.
- ✓ Your company offers services that are tailored for different vertical markets. For example, you might offer to handle claims payments for insurance agents, shipping services for manufacturers, or credit checking services for local banks. You may want to use a public cloud to create an online environment so each of your customers can send you requests and review their account status. However, you might want to keep the data that you manage for these customers within your own private cloud.



Although private and public cloud environments each have management requirements by themselves, these requirements become much more complex when you need to manage private, public, and traditional data centers all together. You need to add capabilities for **federating** (linking distributed resources) these environments. In addition, your service levels need to focus on how a *service* is working rather than how a *server* is working.

## *Examining the Economics of the Private Cloud*



There isn't one right way to evaluate the economic benefits of public or private clouds. There may be some expenses in the public cloud that only become apparent after you're already in your project.

Before getting started, figure out which option is the most appropriate for

- ✓ Your company's information technology strategy
- ✓ Your security strategy
- ✓ Your budgeting strategy

The economics of cloud computing are complicated. (For more details on the economics of the cloud, see Chapters 5, 6, and 21.)

## *Assessing capital expenditures*

What are your data center and IT operations actually costing you? It isn't a simple question to answer. Most companies divide the area of expenses for IT into two buckets:

- ✓ Capital expenditures are spent on buying equipment (servers, networks, storage systems).
- ✓ Operating expenditures are the normal costs of operating a business day to day (salaries, system maintenance, and research and development).

Sometimes management likes the idea of not paying for equipment or a software package upfront. They may either want to pay in smaller, incremental payments. In this case, they might prefer a cloud platform.

- ✓ **Example 1:** You anticipate some big IT investment expenditures. Public cloud offerings may look economically very attractive (so you can avoid those purchases).
- ✓ **Example 2:** Your very large company has an excess of IT resources. You may want to work with what you have and re-architect as modular services. (For more on service orientation, see Chapter 19.) In addition, you might also want to add service management to support the automation of internal customers' changing workloads. (For additional insight into service management and provisioning, take a look at Chapters 7 and 20.)

Take a look at Chapters 10 through 12 to read how to assess the costs of different types of cloud models.

## *Vendor private cloud offerings*

Understanding what each vendor offers and how they compare can be confusing.

Most of the technology vendors are still working on their cloud strategy as they firm up new products and develop partnerships. In fact, the competitive landscape for the private cloud market is a moving target at this point.



One thing we can say with certainty is that the vendor offerings for private and hybrid clouds will have evolved between the time this book is written and its publication date.

With that caveat, we have organized the vendors into three categories to give you a sense of how different types of companies are approaching the market.

### *Services-led technology*

The services components (internal or partners) of these vendors have developed best practices over thousands of engagements and all this experience is brought to the forefront of each company's cloud strategy.



If your company lacks internal expertise on clouds and needs to implement a specialized set of solutions, a services-led engagement might be a good approach for you. In addition, a services company may have direct experience in your industry that may save you time.

The vendors in this category all have

- ✓ Large customer bases
- ✓ Years of experience working with customers on implementations

- ✓ Service teams working with customers to answer the tough questions around security, governance, cost, and business objectives
- ✓ Enough size to develop a partner ecosystem to deliver on a comprehensive vision for private, public, and hybrid clouds across services, software, hardware, and storage
- ✓ A lot of their own sophisticated technology to use in private clouds (maybe servers, storage systems, service management software, service oriented architecture frameworks and services, security software, and middleware)

### *Systems integrators*

Creating a cloud strategy is a complicated process. A cloud infrastructure needs a well-defined architecture or it can't scale and won't be manageable.



Do you need lots of help with cloud strategy development and implementation, as well as integration services? Systems integrators handle those kinds of customers.

Many systems integrators

- ✓ Have deep knowledge of data center creation
- ✓ Partner closely with technology providers to create practices focused on private and hybrid cloud creation
- ✓ Have specialized knowledge in areas such as security and service orientation

### *Technology enablers*



Just about any technology company that offers solutions for service-oriented architecture (SOA), service management, security, testing, storage, virtualization, and network management (to name but a few) are revamping their offerings so they can be sold for the cloud. Some cynics call this *cloud washing*. The reality is that cloud computing needs all these technologies.

## *Offering Up Key Vendors*

We can't cover all vendors, but in the next section we look at the private (and hybrid) cloud strategies and offerings of some of the key vendors in each category. This should get you started in understanding what's available. The companies we include are IBM, HP, EMC, Unisys, Computer Sciences Corporation, Accenture, VMware, CA, Platform, Rackspace, 3Tera, and Eucalyptus.



## *Services-led technology companies*

All the following vendors are delivering private cloud offerings via an ecosystem of partners. However, services companies' offerings are based on their intellectual property. For example, IBM is focused on specialized software and best practices services, whereas EMC is focused on virtualization and the impact of the cloud on storage requirements. HP, on the other hand, is very focused on implementation services.

### **IBM**

With many of its large enterprise customers determined to transform their data centers to become more efficient, IBM has already done a lot of private and hybrid cloud implementations. While the majority of IBM's initial efforts have been directed toward packaging private and hybrid solutions for enterprise data centers, in the longer term we expect to see a much broader strategy that includes all aspects of the cloud, including public clouds for SaaS, IaaS, and PaaS. IBM has created **a centralized cloud computing organization** with a goal of creating offerings that encompass software, hardware, and services.

IBM anticipates a lot of demand for **solutions to manage the interface between public and private clouds**. For example, IBM's Blue Business platform supports both public and private cloud interfaces. In this scenario, the customer has a physical box on-site in the data center. This way the customer can have a private cloud inside the firewall that also supports the ability to burst out into the public cloud when they need additional compute capacity or storage.

A key element of the IBM private and hybrid cloud strategy is to offer solutions based on varying customer-driven workloads. These solutions are organized together as IBM Smart Business Cloud. IBM private and public cloud strategies offer solutions based on varying customer-centric workloads.

These solutions are delivered via three consumption models:

- ✓ Smart Business on the IBM Cloud (public cloud) is a set of standardized services delivered by IBM on the IBM cloud.
- ✓ Smart Business Cloud (private cloud) provides private cloud services, behind the client's firewall, built and/or managed by IBM.
- ✓ Smart Business Systems (cloud in a box) are preintegrated, workload-optimized systems for clients who want to build their own cloud with hardware **and** software.

In addition, IBM has a packaged private cloud offering. IBM combines the hardware, software, storage, virtualization, networking, and service management components in one package and adds options for services and financing. This package can include some preestablished connections to public cloud services.

As of August 2009, several categories of workload solutions are available for private cloud implementations, including the IBM Smart Analytics System. The following workloads are currently available:

- ✓ **Development and test:** Many organizations have a lot of variation in the demand for test and development resources, making these types of workloads a very practical first step for companies looking to improve data center and IT efficiency and cost-effectiveness. This offering is a private cloud implementation that provides customers with a self-service portal to develop and test on their own. This same service can be implemented inside a customer's firewall. IBM also has a public cloud offering for this area.
- ✓ **Desktop and devices:** End-user connections to desktops and mobile devices are another workload type that IBM has identified as a requirement for private clouds. Companies want their users to access applications from anywhere (at any time) by using thin clients or other Internet-connected devices. This cloud service provides the technology infrastructure for these user environments.
- ✓ **Infrastructure storage:** IBM is offering access to storage on demand in various ways. Customers can install the IBM Smart Business Storage Cloud behind the firewall in the data center. Customers can also buy hardware with the virtual image of hardware and software required for additional storage. IBM also has an option for customers to buy on-demand storage on the IBM public cloud.
- ✓ **Infrastructure compute:** This offering is IBM's version of computing power on demand. This large enterprise offering has shared virtual images on the IBM cloud. IBM has partnered with Amazon and Google to add its middleware Software as a Service model in the Amazon and Google cloud environments.

In keeping with its strategy of providing packaged solutions to help companies get up to speed quickly, IBM also offers its IBM Cloudburst appliance, a family of preintegrated hardware, storage, virtualization, and networking with built-in service management.

### *Hewlett-Packard*

HP has been working on cloudlike implementations with its customers since 2001. These implementations have typically included consulting and integration support and have leveraged HP's extensive collection of technology **management** products.

Based on experiences in these customer engagements, HP has put a special emphasis on helping customers who want to create hybrid cloud environments. The company is leveraging its extensive services teams (including the EDS division) to help educate and lead their customers down an appropriate path to the cloud. EDS has significant experience with vertical *market-managed services* (hosted services specialized for different industries) and HP will leverage this knowledge and *intellectual property (IP)* in its evolving cloud strategy.

HP's teams of business and IT consultants and engineers get involved with the design and implementation of many different types of cloud environments. For example, HP's Infrastructure Design Service will help you design compute, storage, data center, and Infrastructure as a Service implementations. Other teams provide management consulting, business technology optimization, and testing services.

While companies can easily incorporate a CRM software as a service implementation into its IT environment, large-scale adoption of cloud computing requires IT to adopt a services focus; HP is designing some of its consulting services with this in mind. In addition, HP has expanded its cloud environment consulting teams to help companies focus in on the quality of service delivered across all business lines.

HP is packaging its hardware for private cloud implementations. Two key examples:

- ✓ Proliant SL, a scale-out server environment based on commodity servers
- ✓ Blade Matrix, a *cloud in a box* that includes the preintegration of networks, servers, storage, and automation capabilities

## **EMC**

EMC has developed a shared vision for the private cloud along with its key partners like VMware, Cisco, and AT&T. This group sees lots of opportunity in providing technology and services to companies looking for a better approach to managing IT infrastructure.

And although some companies may use private clouds as an entry point and then transition to public clouds, EMC sees the private cloud as much more than just a staging ground for public clouds. EMC and partners want to help you create a flexible set of IT resources by federating your private clouds with external infrastructures provided by third-party providers.

Not surprisingly, EMC's contribution is concentrated on providing storage, backup, archiving, and security (from RSA) to support the data centers in a private cloud environment. When all IT resources (servers, network, and storage) are pooled in the virtualized data center model, many things need to change.

Storage must be designed and managed differently. For example, many EMC products require a dedicated pair of servers, and this requirement won't fly in a virtualized environment. New tools and processes are required to plan and manage IT resources and ensure information security. For example, your company can use EMC's Atmos cloud storage service to build a scalable internal storage cloud, and then tie it to an external cloud storage service. Cisco brings the network and capability of building a scalable network to the mix. VMware's vSphere, as described later in this section, is the cloud operating system.

## *Systems integrators companies*

There is no one answer to the best way to gain data center efficiency and leverage cloud benefits such as elasticity and self-service. Clouds don't come in boxes, so you'll need to work with providers and consultants. This is why companies like IBM and HP lead cloud service engagements with their own internal services teams.

However, there's a lot more work to go around, and companies like Unisys and CSC focus on **security and governance**. Other integrators, such as Accenture, are transforming their existing knowledge of managed services and hosting to provide cloud assistance to customers.



Clearly, it's early for the systems integrators. They will find techniques for participating in this new market, but their service offerings are still emerging.

### *Unisys*

Unisys, a veteran computing company, has focused its cloud strategy on security. Its primary offering is the Unisys Secure Cloud Solution, which is a hosted managed cloud service. Unisys intends to have a version of this available by the end of the year that it will call Cloud-in-a-box. The objective is to make it easier for you to create your own private cloud. The company also intends to offer a hybrid cloud service in 2010. This offering will enable you to have your own private cloud and combine that with hosted cloud services from Unisys.

### *Computer Sciences Corporation*

Computer Sciences is focusing on IT security and reliability for its cloud strategy. While CSC has offered security services on a hosting basis, the company is now launching an Infrastructure as a Service version. CSC will try to differentiate itself by taking into account the physical location of a

company (because different countries have regulations regarding the movement of data). A future service will help these companies securely connect to third-party clouds. CSC intends to build its services on top of Cisco's Unified Computing System.

### ***Accenture***

Accenture offers what it calls its Cloud Computing Suite, which includes the following services:

- ✓ Accenture Cloud Computing Accelerator
- ✓ Accenture Cloud Opportunity Assessment Tool
- ✓ Accenture Cloud Computing Data Processing Solution

Accenture is leveraging its experience with managed services and hosting to move into the cloud market. It also is partnering with many of the software and hardware providers (including EMC, Microsoft, and HP) to provide cloud solutions for its customers.

### ***Savvis, Inc.***

Savvis is primarily an outsourced infrastructure service provider for enterprises. Over the past several years the company has begun providing private cloud solutions for its customers. The company is leveraging its 29 data centers to create cloud services, such as providing virtual lab services for developers and a platform for independent software vendors (ISVs) to offer their SaaS applications. In addition, the company is offering a hybrid cloud service so customers can establish a private cloud environment without one of the Savvis data centers.

## ***Technology enabler companies***



We put these companies together because their cloud offerings are focused on hardware and/or software technology and less on implementation services. For the most part, they have one or more of the key technology components required to build a cloud.

However, as of August 2009, you can't get all the technology you need to build a private cloud from any one of these vendors except Platform. Partnership relationships are understandably very important to these companies to make sure that customers get the most value from the technology they provide.

### **VMware**

VMware's cloud strategy and technology road map is focused on private clouds and providing a way to bridge to external clouds through private clouds. With virtualization as the key underpinning technology enabling cloud infrastructures, VMware has identified three key building blocks for the private cloud:

- ✓ The cloud operating system
- ✓ Service level management
- ✓ Federation and standards

The company can provide a portion of these requirements and relies on partners for the remainder.

VMware provides the cloud operating system for private clouds through its software solution called vSphere. The company refers to this solution as a *cloud operating system* because it manages the data center infrastructure components (CPUs, storage, and networking), just as a computer operating system (like Linux or Windows) manages the components of a computer.

vSphere has two main components:

- ✓ Infrastructure services that transform server, storage, and network hardware into a shared resource
- ✓ Application services that provide built-in service level controls

VMware's acquisition of SpringSource (in August of 2009) lets the company fill in more of these private cloud building blocks with its own technology. SpringSource brings development tools and a management platform to the product mix, moving VMware toward a Platform as a Service offering. Partners like EMC and Cisco provide solutions for the additional critical components of a private cloud. EMC brings storage, management, and security (from RSA) to the mix, while Cisco brings network and scalable network business to the VMware cloud offering.

### **CA**

CA is well positioned to help companies manage the mediation layer between private and public clouds. CA expects that your company will want to take advantage of public cloud services for a portion of your workload, but need to manage these public services into connection with private cloud implementations.



Your company will need a way to manage the combined services from public and private sources in order to take advantage of hybrid cloud services and deliver higher quality IT services at a lower cost.

For example, if you're using a lot of virtualized servers, you need a way to make sure that they're operating efficiently. Also, you must make sure that you can treat internal and external resources as though they were an integrated environment. This requires sophisticated service management. (For more on service management, see Chapter 20.)

CA's strategy is to provide services that help you understand where specific workloads are running (public versus private cloud) and where they should be running for optimal performance and productivity gains. CA can help your company understand and manage the security and provision requirements between private and public cloud workloads. In addition, CA expects to offer its cloud services to service providers as well as directly to businesses, but doesn't plan to be a provider of public clouds like Google or Amazon.

CA has a lot of infrastructure management software that can be applied to cloud environments.

A number of CA's products have been adapted to support VMware's private cloud operating system, vSphere:

- ✓ Spectrum Infrastructure Manager
- ✓ eHealth Performance Manager
- ✓ Spectrum Automation Manager

The solutions all have a common focus: to help you manage private cloud environments with a unified information model and a single-user interface.

### *Platform Computing, Inc.*

Platform Computing is an independent cloud management software company that is well known in the industry for its clusters and grids. With a strong background in high-performance computing, the company has developed all the components required for building a private cloud. Platform's approach is to work with partners to help your company deliver IT as a service by implementing private clouds.

To deliver on this cloud strategy, Platform has developed a close relationship with an ecosystem of partners. Platform is already partnered with system management and virtualization vendors (such as HP, IBM, VMware, RedHat). Other partnerships, such as those with CA and BMC, are in the planning process.

The company's offering for the cloud, Platform ISF, creates a shared computing infrastructure from physical and virtual resources. This shared infrastructure delivers application environments according to specific policies that take into account the various workloads, available resources, and the relationship between them. Platform ISF helps you manage this workload across virtual and physical environments because it looks at the relationship between workloads and resources. For example, because Platform ISF is aware of workload and resource usage, it can help balance resource use among different business units in your company.

### ***Rackspace***

Rackspace is an enterprise-hosting provider with the majority of its customer base in the cloud. The company has three core products that all deliver computing as a service:

- ✓ Rackspace Managed Hosting
- ✓ Rackspace Cloud
- ✓ Rackspace Email and Apps

Rackspace Cloud focuses on hosting Web sites for its customers. It provides storage space, bandwidth usage, and compute cycles. It also has a service for companies that want to gradually move their whole operation into the cloud.

The Rackspace private cloud offering enables your company to run the centrally managed VMware virtualization platform on private dedicated hardware environments in its own data center. It is designed with single-tenant architecture because Rackspace feels that this approach will provide its customers with the level of control and security they demand from the cloud. Companies want control, but they don't want to give up on the scalability, flexibility, and resource optimization they can get from a public cloud. Rackspace's customers are able to quickly provision virtualized server instances and use only what they need.

### ***3Tera***

3Tera's AppLogic is a grid operating system (supporting platform) designed to support cloud computing. It supports middleware and Web applications under this operating system. Therefore, AppLogic is used by 3Tera partners to help virtualize software, which makes for easier management in a cloud environment.

AppLogic works by allowing an application to be put into a "container" as though it were a business service. (See Chapter 19 for more on service orientation.) In this way, an application designed for use on a traditional data center can act as though it were designed for the cloud.



In addition, 3Tera has announced a new offering called Cloudware that's based on AppLogic but expands operating system support to Windows and Solaris. It also adds services to support a service catalog and other service management capabilities. Because it can virtualize traditional applications, it is used in many private cloud implementations.

### *Eucalyptus*

Eucalyptus Systems is an open-source software infrastructure for implementing cloud computing on clusters — a group of computers linked together in a way that allows the group to work as one computer. (And just in case you're wondering where the company got its name, it is the combination of the first letters from the phrase "Elastic Utility Computing Architecture for Linking Your Programs to Useful Systems".) Companies use software from Eucalyptus to build private, public, or hybrid clouds.

You can use Eucalyptus software along with IT resources (servers, networks, storage) to form your own data center into a private cloud. Many companies building private clouds are concerned about the lack of standards in this emerging area. They don't want to make a choice now that will lock them in to a specific vendor and make it hard to switch in the future.

Eucalyptus provides an integrated set of *application programming interfaces (APIs)* that are compatible with Amazon Web Services, including Amazon's Elastic Compute Cloud (EC2), Amazon Simple Storage Service (S3), and Amazon Elastic Block Store (EBS).



Eucalyptus Systems understands it needs to develop a large ecosystem of third-party software solutions to help increase demand for its private cloud platform. So far, Eucalyptus has partnered with some key cloud companies including AppScale, Canonical, CohesiveFT, Rightscale, rPath and Ylastic, providing solutions that extend the usability and accessibility of Eucalyptus. The company's partnership with Canonical has led to some interesting developments with Ubuntu — a community based open-source Linux-based operating system for servers, laptops, and desktops). As we mention earlier in the chapter, many companies begin looking at private clouds because they want to bring the public cloud qualities of elasticity and self-service inside the firewall. The Ubuntu Enterprise Cloud (which is powered by Eucalyptus) allows companies using Amazon's EC2 platform to extend these compute services for use in a private cloud.