**UNIT-II**

**Developing Cloud Services**

Most of us approach cloud computing from a user’s perspective, focusing on those web-based applications that owe their existence to the cloud. But cloud computing also offers a lot to software developers, who can now develop web-based applications that take advantage of the power and reach of cloud computing. To this end, many prominent companies—including Amazon. com and Google—are devoting significant resources to cloud services development tools. Read on to learn more about what’s available—and what’s coming.

**Why Develop Web-Based Applications?**

The needs of a typical IT department are daunting: They must deliver adequate computing power and data storage to all users within the company. This must be done, of course, within a set budget, and there is the rub; to meet peak needs or to add capacity for new users can often send an IT budget soaring. For most companies, it is not financially prudent to add capacity that will be used only a small percentage of the time. What the IT department needs is a way to increase capacity or add capabilities without investing in new servers and networking gear, or licensing new software. It is to this need that cloud computing speaks. Cloud services, in the form of centralized web-based applications, also appeal to the IT professional. One instance of an application hosted in the cloud is cheaper and easier to manage than individual copies of similar software installed on each user’s desktop PC. Upgrading a cloud app only has to be done one time, where upgrading traditional software has to be done for each PC on which that software is installed. Then, of course, we have the promise of cloud-enabled collaboration, which just can’t be done with traditional desktop apps. The advantages of cloud services development are particularly notable to smaller businesses, who otherwise wouldn’t have the budget or resources to

develop large-scale applications. By hosting locally developed web applications within the cloud, the small business avoids the cost of purchasing expensive hardware to host similar software. Let’s face it, most small companies don’t have the staff, resources, hardware, or budget to develop and maintain their own applications, or to deal with the rigors of maintaining secure environments. Although they could outsource their software development and hosting, moving those applications to the cloud, companies don’t have to invest in locally hosted systems, freeing up their staff and resources to focus on the day-to-day running of their own businesses.

 In short, there’s a lot to be gained by investing in cloud services development. A company that develops its own web-based applications gains functionality while reducing expenses. The combined power of the cloud is accompanied by lower software purchase and management costs.

**The Pros and Cons of Cloud Service Development**

Why would you choose to develop new applications using the cloud services model? There are several good reasons to do—and a few reasons to be, perhaps, a bit more cautious.

**Advantages of Cloud Development**

One of the underlying advantages of cloud development is that of economy of scale. By taking advantage of the infrastructure provided by a cloud computing vendor, a developer can offer better, cheaper, and more reliable applications than is possible within a single enterprise. The application can utilize the full resources of the cloud, if needed—without requiring a company to invest in similar physical resources.

Speaking of cost, because cloud services follow the one-to-many model, cost is significantly reduced over individual desktop program deployment. Instead of purchasing or licensing physical copies of software programs (one for each desktop), cloud applications are typically “rented,” priced on a per-user basis.

It’s more of a subscription model than an asset purchase (and subsequent depreciation) model, which means there’s less up-front investment and a more predictable monthly expense stream.

 IT departments like cloud applications because all management activities are managed from a central location rather than from individual sites or workstations. This enables IT staff to access applications remotely via the web. There’s also the advantage of quickly outfitting users with the software they need (known as “rapid provisioning), and adding more computing resources as more users tax the system (automatic scaling). When you need more storage space or bandwidth, companies can just add another virtual server from the

cloud. It’s a lot easier than purchasing, installing, and configuring a new server in their data center. For developers, it’s also easier to upgrade a cloud application than with traditional desktop software. Application features can be quickly and easily updated by upgrading the centralized application, instead of manually upgrading individual applications located on each and every desktop PC in the organization. With a cloud service, a single change affects every user running the application, which greatly reduces the developer’s workload.

**Disadvantages of Cloud Development**

Perhaps the biggest perceived disadvantage of cloud development is the same one that plagues all web-based applications: Is it secure? Web-based applications have long been considered potential security risks. For this reason, many businesses prefer to keep their applications, data, and IT operations under

their own control. That said, there have been few instances of data loss with cloud-hosted applications and storage. It could even be argued that a large cloud hosting operation is likely to have better data security

and redundancy tools than the average enterprise. In any case, however, even the perceived security danger from hosting critical data and services offsite might discourage some companies from going this

route.

Another potential disadvantage is what happens if the cloud computing host goes offline. Although most companies say this isn’t possible, it has happened. Amazon’s EC2 service suffered a massive outage on February 15, 2008, that wiped out some customer application data. (The outage was caused by a software deployment that erroneously terminated an unknown number of user instances.) For clients expecting a safe and secure platform, having that platform go down and your data disappear is a somewhat rude awakening. And, if a company relies on a third-party cloud platform to host all of its data with no other physical backup, that data can be at risk.

**Types of Cloud Service Development**

The concept of cloud services development encompasses several different types of development. Let’s look at the different ways a company can use cloud computing to develop its own business applications.

**Software as a Service**

Software as a service, or SaaS, is probably the most common type of cloud service development. With SaaS, a single application is delivered to thousands of users from the vendor’s servers. Customers don’t pay for owning the software; rather, they pay for using it. Users access an application via an API

accessible over the web.

Each organization served by the vendor is called a tenant, and this type of arrangement is called a multitenant architecture. The vendor’s servers are *virtually partitioned* so that each organization

works with a customized virtual application instance. For customers, SaaS requires no upfront

investment in servers or software licensing. For the application developer, there is only one application to maintain for multiple clients. Many different types of companies are developing applications using the SaaS model. Perhaps the best-known SaaS applications are those offered by Google to its consumer base.

**Platform as a Service**

In this variation of SaaS, the development environment is offered as a service. The developer uses the “building blocks” of the vendor’s development environment to create his own custom application. It’s kind of like creating an application using Legos; building the app is made easier by use of these predefined blocks of code, even if the resulting app is somewhat constrained by the types of code blocks available.

**Web Services**

A web service is an application that operates over a network—typically, over the Internet. Most typically, a web service is an API that can be accessed over the Internet. The service is then executed on a remote system that hosts the requested services. This type of web API lets developers exploit shared functionality over the Internet, rather than deliver their own full-blown applications. The result is a customized web-based application where a large hunk of that application is delivered by a third party, thus easing development and bandwidth demands for the custom program.

A good example of web services are the “mashups” created by users of the Google Maps API. With these custom apps, the data that feeds the map is provided by the developer, where the engine that creates the map itself is provided by Google. The developer doesn’t have to code or serve a map application; all he has to do is hook into Google’s web API. As you might suspect, the advantages of web services include faster (and lower-cost) application development, leaner applications, and reduced storage and bandwidth demands. In essence, web services keep developers from having to reinvent the wheel every time they develop a new application. By reusing code from the web services provider, they get a jump-start on the development of their own applications.

**On-Demand Computing**

As the name implies, on-demand computing packages computer resources (processing, storage, and so forth) as a metered service similar to that of a public utility. In this model, customers pay for as much or as little processing and storage as they need. Companies that have large demand peaks followed by much lower normal usage periods particularly benefit from utility computing. The company pays more for their

peak usage, of course, but their bills rapidly decline when the peak ends and normal usage patterns resume.

Clients of on-demand computing services essentially use these services as offsite virtual servers. Instead of investing in their own physical infrastructure, a company operates on a pay-as-you-go plan with a cloud services provider.

 On-demand computing itself is not a new concept, but has acquired new life thanks to cloud computing. In previous years, on-demand computing was provided from a single server via some sort of time-sharing arrangement. Today, the service is based on large grids of computers operating as a single cloud.

**Discovering Cloud Services Development Services and Tools**

As you’re aware, cloud computing is at an early stage of its development. This can be seen by observing the large number of small and start-up companies offering cloud development tools. In a more established industry, the smaller players eventually fall by the wayside as larger companies take center stage.

That said, cloud services development services and tools are offered by a variety of companies, both large and small. The most basic offerings provide cloud-based hosting for applications developed from scratch. The more fully featured offerings include development tools and pre-built applications that developers can use as the building blocks for their own unique web-based applications. So let’s settle back and take a look at who is offering what in terms of cloud service development. It’s an interesting mix of companies and services.

**Amazon**

That’s right, Amazon, one of the largest retailers on the Internet, is also one of the primary providers of cloud development services. Think of it this way: Amazon has spent a lot of time and money setting up a multitude of servers to service its popular website, and is making those vast hardware resources

available for all developers to use.

The service in question is called the Elastic Compute Cloud, also known as EC2. This is a commercial web service that allows developers and companies to rent capacity on Amazon’s proprietary cloud of servers— which happens to be one of the biggest server farms in the world. EC2 enables scalable deployment of applications by letting customers request a set number of virtual machines, onto which they can load any application of their choice. Thus, customers can create, launch, and terminate server instances on demand, creating a truly “elastic” operation. Amazon’s service lets customers choose from three sizes of virtual servers:

\_ Small, which offers the equivalent of a system with 1.7GB of memory, 160GB of storage, and one virtual 32-bit core processor.

\_ Large, which offers the equivalent of a system with 7.5GB of memory, 850GB of storage, and two 64-bit virtual core processors.

\_ Extra large, which offers the equivalent of a system with 15GB of memory, 1.7TB of storage, and four virtual 64-bit core processors.

In other words, you pick the size and power you want for your virtual server, and Amazon does the rest.

EC2 is just part of Amazon’s Web Services (AWS) set of offerings, which provides developers with direct access to Amazon’s software and machines. By tapping into the computing power that Amazon has already constructed, developers can build reliable, powerful, and low-cost web-based applications.

Amazon provides the cloud (and access to it), and developers provide the rest. They pay only for the computing power that they use. AWS is perhaps the most popular cloud computing service to date. Amazon claims a market of more than 330,000 customers—a combination of developers, start-ups, and established companies.

**Google App Engine**

Google is a leader in web-based applications, so it’s not surprising that the company also offers cloud development services. These services come in the form of the Google App Engine, which enables developers to build their own web applications utilizing the same infrastructure that powers Google’s powerful applications.

The Google App Engine provides a fully integrated application environment. Using Google’s development tools and computing cloud, App Engine applications are easy to build, easy to maintain, and easy to scale. All you have to do is develop your application (using Google’s APIs and the Python programming language) and upload it to the App Engine cloud; from there, it’s ready to serve your

users. As you might suspect, Google offers a robust cloud development environment.

It includes the following features:

\_ Dynamic web serving

\_ Full support for all common web technologies

\_ Persistent storage with queries, sorting, and transactions

\_ Automatic scaling and load balancing

\_ APIs for authenticating users and sending email using Google

Accounts

In addition, Google provides a fully featured local development environment that simulates the Google App Engine on any desktop computer. And here’s one of the best things about Google’s offering: Unlike most other cloud hosting solutions, Google App Engine is completely free to use—at a basic level, anyway.

A free App Engine account gets up to 500MB of storage and enough CPU strength and bandwidth for about 5 million page views a month. If you need more storage, power, or capacity, Google intends to offer additional resources (for a charge) in the near future.

**IBM**

It’s not surprising, given the company’s strength in enterprise-level computer hardware, that IBM is offering a cloud computing solution. The company is targeting small- and medium-sized businesses with a suite of cloud-based ondemand services via its Blue Cloud initiative. Blue Cloud is a series of cloud computing offerings that enables enterprises to distribute their computing needs across a globally accessible resource grid. One such offering is the Express Advantage suite, which includes data backup

and recovery, email continuity and archiving, and data security functionality— some of the more data-intensive processes handled by a typical IT department. To manage its cloud hardware, IBM provides open source workload-scheduling software called Hadoop, which is based on the MapReduce software used by Google in its offerings. Also included are PowerVM and Xen virtualization tools, along with IBM’s Tivoli data center management software.

**Salesforce.com**

Salesforce.com is probably best known for its sales management SaaS, but it’s also a leader in cloud computing development. The company’s cloud computing architecture is dubbed Force.com. The platform as a service is entirely on-demand, running across the Internet. Salesforce provides

its own Force.com API and developer’s toolkit. Pricing is on a per log-in basis.

Supplementing Force.com is AppExchange, a directory of web-based applications. Developers can use AppExchange applications uploaded by others, share their own applications in the directory, or publish private applications accessible only by authorized companies or clients. Many applications in the

AppExchange library are free, and others can be purchased or licensed from the original developers.

Not unexpectedly, most existing AppExchange applications are sales related— sales analysis tools, email marketing systems, financial analysis apps, and so forth. But companies can use the Force.com platform to develop any type of application. In fact, many small businesses have already jumped on the

Force.com bandwagon. For example, an April 2008 article in *PC World* magazine quoted Jonathan

Snyder, CTO of Dreambuilder Investments, a 10-person mortgage investment company in New York. “We’re a small company,” Snyder said, “we don’t have the resources to focus on buying servers and developing from scratch. For us, Force.com was really a jump-start.”

**Other Cloud Services Development Tools**

Amazon, Google, IBM, and Salesforce.com aren’t the only companies offering tools for cloud services developers. There are also a number of smaller companies working in this space that developers should evaluate, and that end users may eventually become familiar with. These companies include the following:

* \_ 3tera (www.3tera.com), which offers the AppLogic grid operating system and Cloudware architecture for on-demand computing.
* \_ 10gen (www.10gen.com), which provides a platform for developers to build scalable web-based applications.
* Cohesive Flexible Technologies (www.cohesiveft.com), which offers the Elastic Server On-Demand virtual server platform.
* \_ Joyent (www.joyent.com), which delivers the Accelerator scalable ondemand infrastructure for web application developers, as well as the Connector suite of easy-to-use web applications for small businesses.
* \_ Mosso (www.mosso.com), which provides an enterprise-level cloud hosting service with automatic scaling.
* \_ Nirvanix (www.nirvanix.com), which offers a cloud storage platform for developers, as well as Nirvanix Web Services, which provides file management and other common operations via a standards-based API.
* \_ Skytap (www.skytap.com), which provides the Virtual Lab on-demand web-based automation solution that enables developers to build and configure lab environments using pre-configured virtual machines.
* \_ StrikeIron (www.strikeiron.com), which offers the IronCloud cloudbased platform for the delivery of web services, along with various Live Data services that developers can integrate into their own applications.

In addition, Sun Microsystems has an R&D project, dubbed Project Caroline (www.projectcaroline.net), that provides an open source hosting platform for the development and delivery of web-based applications. Access to Project Caroline’s grid is free to the general public.

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