PDHonline Course E268 (3 PDH)

Cloud Computing

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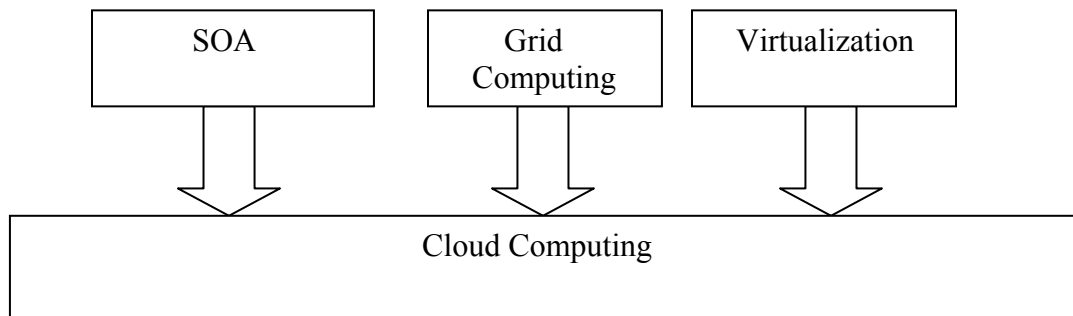www.PDHonline.com

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Cloud Computing

Warren T. Jones, Ph.D. P.E.

Course Content

Module #1: What is Cloud Computing?

Cloud computing is a term that is being applied to the confluence of several technologies within the context of the Internet. There seems to be no consensus definition of the term but one expression that is credited to Sun Microsystems a number of years ago comes to mind and captures the idea as completely as any definition. That expression is "The Network is the Computer". Important converging technologies that are making cloud computing possible include software as a service, virtualization and grid computing.

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Software as a service (SaaS), sometimes called service-oriented architecture (SOA), is a software deployment approach in which an application is hosted as a service to customers through the Internet. With this approach, the need for purchase, installation and maintenance of the application on the customer's computer is eliminated. The cost to use the service becomes an ongoing expense.

Virtualization is related to the older concept of partitioning in which a single physical server is divided into many logical servers. Each of these logical servers can run an operating system and applications independently. Virtualization has become the "gotta have it" technology of the day for IT shops, primarily as part of a server consolidation strategy. Money can be saved by reducing the number and types of servers that support business applications. In addition, storage virtualization can logically consolidate physical storage devices on networks so that they appear to be one single device and network virtualization can combine computing resources in a network by dividing the

available bandwidth into independent channels that can be assigned to a specific server or device in real time.

Grid computing is all about cycle sharing among groups of computers distributed throughout a network. This grid of shared computers can be scaled up to create a virtual machine of vast computational power. Applications that require the supercomputing level of power can make use of this grid approach. Two examples of projects that are using this approach to computational resources are the mathematical problem of factoring large numbers into their prime number components and the SETI@home project to search for intelligent life in outer space. Other more recent examples are the huge server farms of Google and Amazon.com.

None of the three technologies of SOA, virtualization or grid computing is new on the scene. However, as they are all maturing in the context of the increasing bandwidth network systems of the Internet, the converging of the three is now being recognized more as a single technology and is labeled cloud computing.

It should also be noted here that cloud computing is also seen as the next step in collaboration. Cloud-based documents and services are now becoming commonplace. Many feel that in the future this functionality will be extended to any device that has Internet connectivity such as smart phones, portable music players as well as automobiles and televisions sets. [1]

Module #2: Advantages and Disadvantages of Cloud Computing

Any new technology has an upside and downside. In this section we review the advantages and disadvantages of cloud computing.

Advantages

- Lower cost for desktop clients since the applications are running in the cloud. This means clients with smaller hard drive requirements and possibly even no CD or DVD drives.

- Peak computing needs of a business can be off loaded into cloud applications saving the funds normally used for additional in-house servers.

- Lower maintenance costs. This includes both hardware and software cost reductions since client machine requirements are much lower cost and software purchase costs are being eliminated altogether for applications running in the cloud.

- Automatic application software updates for applications in the cloud. This is another maintenance savings.

- Vastly increased computing power availability. The scalability of the server farm provides this advantage.

- The scalability of virtual storage provides unlimited storage capacity.

Disadvantages

- Requires an "always on" Internet connection.

- There are clearly concerns with data security. e.g. questions like: "If I can get to my data using a web browser, who else can?"

- Concerns for loss of data.

- Reliability. Service interruptions are rare but can happen. Google has already had an outage.

Module #3 Who Should Use Cloud Services?

Small to medium size businesses are seeing cloud computing as a very important opportunity and are seen as the early adopters of this technology. It is also true that large businesses are beginning to move into their use as well. Let's sharpen this question of who should be using cloud services by mentioning who should <u>not</u> be using them.
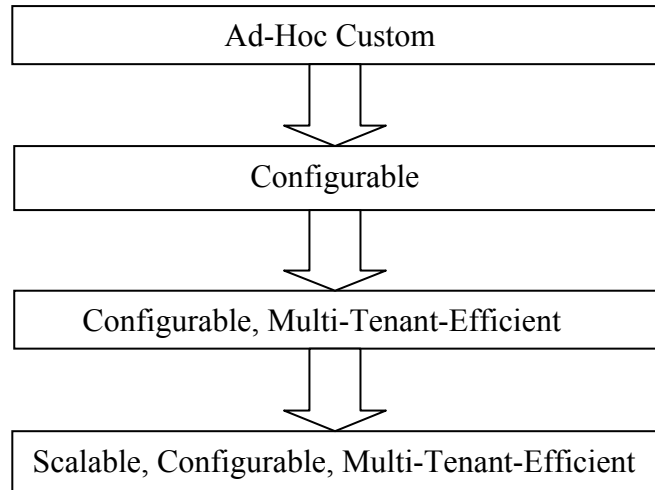
- Clearly if the internet services available are slow or if workers are moving from office to office where there is no guarantee of internet access, then cloud computing is not an option.

- If the information involved contains confidential or proprietary data, it would probably not be a good idea to consider cloud-based applications. Security is a major concern with cloud services. Not that they are considered insecure, but being outside the control of the owners is an understandable concern.

- Format incompatibility of documents in the cloud with documents in the user's organization can be a problem. Specifically, there can be issues with Microsoft documents. Test for compatibility before signing up for the cloud.

Moving on to those who should be using the cloud, it should be noted that Google Docs (http://www.docs.google.com) is a good example to illustrate what can be done with cloud services. Word processing, spreadsheet and presentation applications are available. The changes made by one user are automatically visible to other collaborators. Since applications being accessed are physically located in the cloud, the user has the convenience of accessing from anywhere and at anytime. Oft cited benefactors of using cloud services are the following:

- Those who travel in their work have the convenience of accessing their applications from any machine at any time without having to take it on a laptop hard drive or even on flash.

- Those who are part of a group who needs to collaborate on the development of a document or presentation can benefit by working in the cloud since face-to-face meetings are difficult to schedule because of schedule conflicts and geography. And of course geography today means global.

- Those who are operating with budgets that have severe constraints will be attracted to cloud services for the cost savings. For example, an organization might opt for using the cloud rather than some of Microsoft Office products. Use of the cloud can reduce desktop hardware system requirements to thin inexpensive clients. Cost-conscious IT shops will be interested in the low-up-front costs, scalability up and down and IT resource flexibility afforded by cloud services.

Module #4 Cloud Services Maturity Levels

According to Microsoft, software as a service architectures can be categorized into one of four maturity levels. Each level is distinguished from the previous by the addition of the attributes configurability, multi-tenant-efficiency and scalability.

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              │  Scalable, Configurable, Multi-Tenant-Efficient │
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- Ad-Hoc Custom: Each user has their own customized version of the hosted application and runs their own instance of the application on the host server.

- Configurable: The cloud vendor hosts a separate instance of the application for each customer.

- Configurable, Multi-Tenant-Efficient: Every user uses the same instance of the application on the host server.

- Scalable, Configurable, Multi-Tenant-Efficient: A load-balanced farm of identical instances are hosted for multiple users. This is the ultimate maturity level since the number of servers and instances can be scaled up to match demand. Moreover, patches and upgrades can be made available to the entire user community as easily as to a single user.

Module #5: Cloud Service Providers

It is fair to say that cloud computing is an emerging technology. Therefore, the landscape of vendor providers is wide ranging in their capabilities and offerings. In this section we review some of the major players. If you are not already familiar with the cloud computing scene, you may be surprised by some of those in the list.

Amazon

Amazon is a household word for one of the largest retailers on the Internet. However, the essence of Amazon is not selling books or even retailing. Amazon is basically a technology company and has recently decided to leverage this technological infrastructure as cloud services and has become one of the major service providers, Amazon Web Services (AWS).   Amazon recognized an opportunity to provide alternatives to CIOs who are looking for alternatives to spending more money on their own IT infrastructure. Around-the-clock phone support and enterprise-level service agreements are now available. Even though AWS itself does not offer software-as-a-service, other vendors are doing so using AWS resources. The four core services offered by AWS are the following:

- Simple Storage Service (S3)
- Elastic Compute Cloud (EC2)
- Simple Queuing Service
- SimpleDB

Google

As everyone knows, the Google search engine is one of the largest online applications in the world. Leveraging this foundational IT infrastructure, Google is now a cloud services provider with Google App Engine that provides developers with the resources to write Python-based applications and host them on Google server farms. There is also Google Apps that supports productivity tools such as word processing, spreadsheets and presentation software. It has partnered with Salesforce.com to integrate Salesforce CRM and Google Apps. Google is also working with IBM to provide cloud resources to university students and researchers. Recognizing that cloud users may sometimes need to work off line, Google has introduced the Google Gears browser plug-in. The original goal was a consumer cloud but recent moves have been made to attract IT department users. According to Google, the primary defining difference between a consumer and enterprise cloud is the security issue.

Salesforce

Salesforce is best known for its highly successful software-as-a-service application for sales force automation. Its platform-as-a-service offering is called Force.com and provides the resources for other companies to build their own software services. These resources include a relational database, user interface, business logic and an integrated development environment called Apex. A sandbox is available for testing and completed code can be offered on the AppExchange directory. Salesforce Content supports enterprise content management allowing users to store, classify and share information. Google Apps can also be accessed from within a Salesforce application.

IBM

IBM has announced it will soon be creating clouds with its Blue Cloud offerings. Resources in Blue Cloud include virtual Linux servers, parallel workload scheduling and the IBM Tivoli management software. Its first commercial cloud computing data center will be located in Wuxi in southern China to support the region's chip-making companies.

Microsoft

Not surprisingly, Microsoft does not promote the idea of most IT resources of the future being in the cloud. Their vision is described as "software plus services". The planned enterprise offerings are

- Dynamics CRM Online
- Exchange Online
- Office Communications Online
- Share Point Online

Consumer cloud offerings planned include the following:

- Windows Live
- Office Live
- Xbox Live

SUN Microsystems

SUN is focusing on making cloud computing easy to use and sees public clouds as spillover points for enterprises. They are assuming that companies will not be willing to put their critical applications in the cloud but will see IT departments pulling in some extra computing nodes to get work done. Two cloud projects have been initiated at SUN described as follows:

- Network.com is a group of grid-based applications that can serve as a "virtual on-demand data center" that will be available in real time to meet variable demands.

- Project Caroline is intended to make cloud-based resources available to developers of web-based applications. Java, Perl, Python, Ruby and PHP are supported.

Oracle

Given Oracle's highly successful on-premises software license business, moving toward a subscription model has been relatively slow. The official word for the transition process is a "stair-step approach to the cloud". The 2005 acquisition of Siebel Systems with their on-demand CRM applications moved the company into the cloud landscape. The new Oracle On Demand includes the company's well-known database.

AT & T

Given the AT&T experience in managed network services it is not surprising that their cloud services entry point is announced to be managed computing, networking, security and storage service with the target being large companies. The cloud service is called Synaptic Hosting and will support companies hosting Windows Server, Linux server and web applications inside AT&T data centers. The targeted companies are those whose IT requirements vary seasonally or unpredictably.

Module #6: Popular Cloud Applications

The goal of this section is to give some examples to provide a sense of the large number of cloud applications that are available.

Calendars

 In an increasingly mobile work and personal world, having a calendar that can be accessed from any Internet connection by spouse, supporting office staff and collaborating colleagues is becoming a nobrainer. There are many choices for cloud-based calendars and many are free. As you would expect, calendars are all very much the same in functionality, but there are differentiating features in the various products. The following list is a sample of what is available.

- Google Calendar (http://www.calendar.google.com) is said to be the most popular calendar on the web. It free and many featured. You can create several different calendars for different purposes and then view all of them on a single calendar page with color codes for each calendar. For example, a separate calendar for business, personal, community group activities, etc.

- Yahoo! Calendar (http://www.calendar.yahoo.com) allows you to add tasks and due dates on the calendar.

- Windows Live Calendar (http://www.mail.live.com/mail/calendar.aspx)

- Apple MobileMe Calendar (http://www.me.com) also includes contacts, photo gallery and file storage. It is designed to be accessible from the Apple iPhone. It allows creation of multiple calendars and their display on a color-coded single calendar page.

Scheduling

Scheduling in the cloud can take much of the frustration out of scheduling meetings for either small or large groups. Here are some examples:

- Presdo (http://www.presdo.com) provides support for scheduling meetings with anyone with an email address.

- Schedulebook (http://www.schedulebook.com) offers three categories of scheduling services.

  o Schedulebook Professionals – business-oriented
  o Schedulebook Office – targets shared resources such as meeting rooms

o   Schedulebook Aviation – designed specifically for scheduling aircraft, flight training and other similar services

- hitAppoint (http://www.hitappoint.com) is designed to target organizations that require client appointments.

Planning and Task Management

There are cloud services that support a range of planning and task management functions. This range is broad and encompasses the simple to-do lists all the way to complex task management. Some examples follow:

- iPrioritize (http://www.iprioritize.com) can be used for family, community or business activities. You can subscribe to changes via RSS and view your lists on your mobile phone.

- TaskTHIS (http://www.taskthis.darthapo.com) provides the ability to add extended notes to any task entered. You can also use RSS to share with others on the web.

- Vitalist (http://www.vitalist.com) uses the Getting Things Done (GTD) workflow methodology developed by David Allen, a management consultant.

- TracksLife (http://www.trackslife.com) is data-base oriented and each entry track is implemented as a separate database that makes use of columns of money, numbers, text and yes and no responses. The system also sends out reminders of important events by email or RSS.

Event Management

There are cloud-based apps designed to assist in carrying out the details of large-scale events such as conferences, trade shows and seminars. Examples of the activities involved are listed below. Cloud-based collaborative tools in support of these functions can clearly be to great advantage.

- Marketing
- Calendar of events
- Scheduling of facilities needed
- Registration and payment
- Event budget management

Several cloud-based apps are available to support event management activities. They range from full-featured systems for large-scale events to low-end systems for much less complex activities such as registration and payment. Four representative examples of these type systems are presented below:

- Conference.com (http://www.conference.com) – an example which supports large-scale events but can also be used for small ones as well.

- Event Wax (http://www.eventwax.com) – designed for small in-house events such as company meetings or open house activites.

- RegOnline (http://www.regonline.com) – provides event registration and payment services and related activities such as printing of name tags, room signs, etc.

- Tendenci (http://www.tendenci.com) – has the unique feature of connecting a calendar app to the registration and payment process.

Contact Management

 Contact management is an important part of the everyday life of everyone, whether friends, family or business contacts. In the business and technical communities contact management can become much more important and is often formally called customer relationship management (CRM). Important functions of a CRM include the following:

- Storage of all data relating to a customer
- Analysis of customer data
- Report generation of analytics

Some examples of cloud-based contact-management systems are:

- Salesforce (http://www.salesforce.com) – Arguably the most popular cloud-based CRM. Its full-featured functionality can be extended by third party apps and individual customization.

- BigContacts (http://www.bigcontacts.com) – Targets work groups in a size range from two to 2,000

- PipelineDeals (http://www.pipelinedeals.com) – designed to support the consummation of business deals and features the ability to attach all relevant data using documents and spreadsheets needed for a pending deal.

Module #7: Private Clouds

With all the interest in cloud computing as a service, there is also an emerging concept of private clouds. It is a bit reminiscent of the early days of the Internet and the importing that technology into the enterprise as intranets. The concerns for security and reliability outside corporate control are very real and troublesome aspects of the otherwise attractive technology of cloud computing services. The IT world has not forgotten about the eight hour down time of the Amazon S3 cloud server on July, 20, 2008.

Private clouds means that the cloud technology must be bought, built and managed within the corporation. But didn't we say earlier not having to do this was one of the major attractions of cloud services? But wait, maybe we can have the best of both worlds. How about buying cloud technology that we can use inside the enterprise for development of cloud applications that can have the flexibility of running on the private cloud or outside on the public clouds? This "hybrid environment" is in fact the direction that some believe the enterprise community will be going and some of the products that support this approach are listed below.

- Elastra (http://www.elastra.com) is developing a server that can be used as a private cloud in a data center. Tools are available to design applications that will run in both private and public clouds.

- 3Tetra (http://www.3tetra.com) is developing a grid operating system called ParaScale that will aggregate disk storage.

- Cassatt(http://www.cassatt.com)will be offering technology that can be used for resource pooling.

- Ncomputing (http://www.ncomputing.com) has developed standard desktop PC virtualization software system that allows up to 30 users to use the same PC system with their own keyboard, monitor and mouse. Strong claims are made about savings on PC costs, IT complexity and power consumption by customers in government, industry and education communities.

Module #8: Impact on Smart Phones

Mobility is being increasingly expanded by technology trends. For example, recently more laptops were sold annually than desk top systems. Are the fixed PC systems going the way of the diskette? We are all now keenly aware of the new wireless world of cell phones and the increasing numbers of high end smart phones. The often heard word "blackberry" is no longer the fruit of my favorite cobbler. There is already serious speculation that some form of smart phone will begin to replace the laptop in the near future [2]. Even the smart phone of today is a complete general purpose computer. Its only limitations are physical form factor for carrying and the power limitations on its performance. In spite of power limitations, one smart phone producer already has multicore hardware architectures built into laboratory prototypes.

Forward-looking organizations are already pushing for a broader use of smart phones to include real-time access to enterprise apps that can drill down into sales, financial, project management and business intelligence information. This means that we will see increasing use of smart phones in the role of cloud services access in the future. (See PDHOnline course E241 for more details on Smart Phone Technologies)

Module #9: Critical Success Factors for SOA

Whether an organization is considering moving toward a private or public cloud, there are issues that must be addressed if a successful transition is to be made. In spite of all the positive hype about cloud computing, there is also a very real undercurrent of concerns that are emerging from the SOA user community. It is not unusual for transition to SOA to be considered a project failure. The following list of factors that are seen as very important to SOA project success has been assembled and published in a recent issue of CIO magazine [5]. These factors may be more relevant to the development of private clouds but also addresses many concerns related to corporate culture shift to SOA regardless of where SOA resources are located.

- Make sure that the project beginning point is one or more business problems and not technology issues.

- A goal should be to create an organizational-change management plan that describes what will change and why.

- Support from the executive levels of the enterprise is essential.

- Budget what is needed to do a quality job. The financial justification should include a case for the ROI or the most important corporate financial indicators.

- Make sure that there is SOA experience on staff.

- Success at this transformational initiative will require top level project management talent.

- Collaborative teamwork across the enterprise will be needed for success.

- Start small, deliver value often and build on it.

- Design for reuse, flexibility and agility so that the system becomes more cost-effective over time.

- Work out your own requirements before you talk with vendors. Contact vendor references and other companies that have implemented SOA.

Not surprisingly, many of these factors bear strong resemblance to the same concerns for any complex software systems development and implementation project. (See PDHOnline course E145 for more details on software development process concepts.) However, Internet-based systems have moved IT complexity to another level and the cloud-based system is a good example of a category of systems at this new level.

One of the most fascinating new ways to view complex systems design issues is presented in a book by Stuart Robbins entitled <u>Lessons in Grid Computing: The System is a Mirror</u> [7]. It is not a short book, but it is a great weekend read. It is not also what you might expect. A collection of fictional stories communicate the notion that our systems replicate our social relationships and that managing either can be improved by learning from the other. His central proposition is that: Information systems mirror the people who build them. He posits the following corollaries:

- The systems will not "talk to each other" if the people are not "talking to each other".

- The relationships between systems reflects the relationships between the people who build and support them.

- To correct problems in our information systems we must first address the problems among the people that build them.

- We must transform ourselves to the same degree that we want to transform our systems.

The underlying observation made by Robbins is that "the greatest handicap observed in any technical organization, large or small, corporate or private, is the nearly universal inability of technologists to explain themselves adequately to their executives, their customers and their spouses". It is his hope that the fictional stories will provide a bridge.

The above quote might seem to be extreme to some readers. However, anyone who has been responsible for establishing the system requirements for a complex software system for a customer knows the magnitude of this challenge.

Course Summary

This course introduces the concept of cloud computing services and its advantages and disadvantages. The types of individuals and organizations that will benefit for cloud services are also discussed. Several cloud service providers are described and the categories of maturity levels of services that can be offered. Examples of popular cloud applications are presented and the rationale for the emergence of private clouds. Finally, the role of smart phones for cloud access and critical success factors in the development of cloud service systems are discussed.

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10. Plaszczak, Pawel and Richard Wellner, "Grid Computing: The Savvy Manager's Guide", Elsevier, 2006.
11. Marks, Eric A. and Michael Bell, "Service-Oriented Architectures (SOA): A Planning and Implementation Guide for Business and Technology", John Wiley and Sons, Inc., 2006.

Selected Web Resources

Cloud Computing Expo
http://cloudcomputingexpo.com

Desktop virtualization software
http://www.ncomputing.com

Cloud Summit Executive
http://www.cloudsummit.com
Conference with mission statement: To explore the impact of the cloud ecosystem and the web as a platform.

Twenty Experts Define Cloud Computing.
http://cloudcomputing.sys-con.com/read/612375_p.htm

Cloud Computing Seen as the Next Wave for Technology Investors
http://www.financialpost.com/money/story.html?id=562877

Amazon Elastic Compute Cloud (EC2)
http://www.amazon.com/ec2/

Google App Engine
http://appengine.google.com

Microsoft Live Mesh
http://www.mesh.com

Grid Management Theory by Stuart Robbins
http://www.srobbinsconsulting.com/docs/