WHITE PAPER

The Pragmatist's Guide to Cloud Computing

An Introduction to The Cloud Computing Adoption Model, a 5-Step Framework for Achieving the Strategic Value of Cloud While Delivering Real ROI Along the Way

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Overview

There is no longer any doubt that cloud computing will soon play a major role in application delivery. Enterprises are starting to see cloud computing as a natural extension of virtualization, and are beginning to explore what cloud computing will mean for existing IT infrastructure. While large-scale adoption of cloud computing is still in the future, it is not too soon to begin planning for its entry into the fabric of enterprise IT.

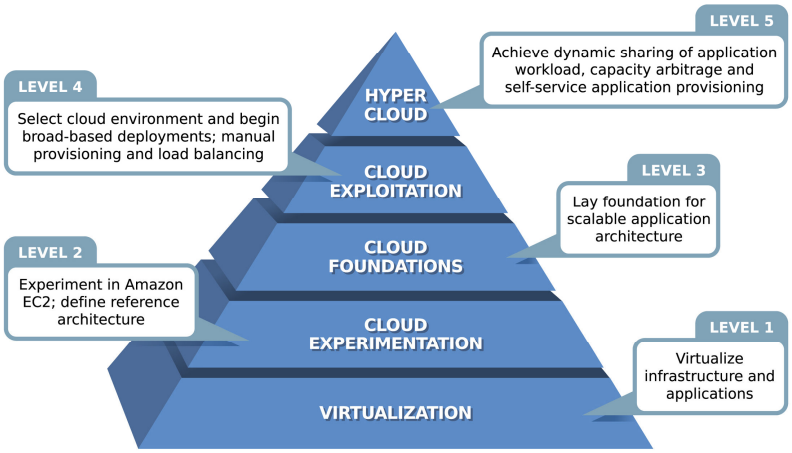
The challenge is that the path to cloud computing isn't particularly clear, and IT transformation can't happen overnight. This sort of change requires an incremental, stepwise progression that yields benefits along the way—without this, stakeholders become fatigued, enthusiasm wanes and projects lose steam. When merchandised effectively, these incremental wins become the kindling that stokes the fire, building the enthusiasm, conviction and confidence required for transformation.

This is the explicit goal of the Cloud Computing Adoption Model: a graduated, stepwise approach for adoption of cloud technologies that allows benefits to be realized incrementally along the way. It helps to cut through the hype and lays out a clear path to cloud without putting projects, budgets and even careers at risk. This progression of technology adoption will make it possible to extract the most value now, while laying the foundation for this emerging technology.

Central to this adoption model is the virtualized application. This is the vehicle that makes it possible for applications to become portable across platforms, scalable to meet dynamic demand and available on-demand. By packaging applications as virtual applications (also known as "virtual appliances" or "virtual machines"), developers ensure that the application will remain relevant and operational throughout the upheavals that are sure to come.

This paper will explore a five-step framework for cloud computing adoption that begins where many organizations are today – at virtualization – and ends with true cloud actualization, which is the end state most organizations ultimately want to achieve.

The Cloud Computing Adoption Model



Level 1 - Virtualization

The foundation for cloud computing adoption is virtualization of applications and infrastructure. Server virtualization in the data center arises mostly from the need to reduce IT operating costs and capital expenditure by consolidating hardware. By effectively insulating applications from the underlying operating system, virtualization enables dramatically increased utilization of server capacity. In turn, more applications running on fewer servers means lower capital expense and lower operating and maintenance costs.

The strategic value of virtualization, however, appears when applications are deployed as coordinated sets of virtual images. These self-contained units consist of the application, database, middleware and other components packaged together with necessary operating system bits – known as just enough operating system (JeOS). Virtual machines enable applications to be deployed on any hypervisor and moved seamlessly from one virtual server to another.

Virtual machines essentially eliminate the barriers to application deployment, such as integration with underlying systems and all the tweaking that goes on to make apps play well with others. Maintaining and updating deployed applications also become easier and faster, again because of the pre-integration of components found in the virtual machine. All this speed and flexibility adds up to dramatically faster deployments, which allow organizations to more rapidly realize application value and increase business responsiveness.

There are several fundamental decisions an organization must make when defining a virtualization strategy. Which virtualization platform (hypervisor) will you select as your standard? There are several established hypervisor vendors in the market today and it is important to make an informed platform selection decision.

Additionally, how will your organization package and manage applications as coordinated sets of virtual machines? Although it is possible to do this manually, it's an onerous process that is not recommended. In the same sense that you've selected a virtualization platform for infrastructure, you must also select a platform for creating, deploying, managing and maintaining virtualized applications. Be forewarned: virtualizing applications has its own set of risks, caused by poorly formed, inconsistent images; an inability to understand and manage impact and dependency relationships; and the need to manually update and maintain what will become a proliferation of virtual machines. The platform you select must encompass the full range of functions needed to manage the virtualized application over its entire lifecycle. Electing to simply "build it and forget it" will only create downstream risks that will compound with volume and scale.

Finally, being locked in to one hypervisor is a potential risk similar to the risk of being locked in to a single hardware platform or operating system. Be sure that the applications you virtualize are able to run on any hypervisor, as well as the external cloud environments you may choose to leverage over time.

Virtualizing your data center and deploying applications as virtual machines yields significant benefits beyond the higher server utilization and lower operating costs promised by hypervisor vendors. Virtualized applications ensure rapid deployment and dramatically improved business responsiveness—the true strategic win with virtualization.

Level 2 – Cloud Experimentation

While cloud computing is the next logical step beyond virtualization, it can't happen without a plan based on real experience. Smaller steps are in order to build knowledge, gain understanding and amass experience. So the next step of the cloud adoption model involves experimentation and laying the groundwork for further cloud initiatives.

Amazon Elastic Compute Cloud (EC2) is a mature and stable cloud infrastructure. At this stage in cloud adoption, we recommend establishing an EC2 account and running a non-mission critical application in the cloud. The team needs to build a base of experience in cloud infrastructure, processes and operations.

While the IT team gains familiarity with the cloud environment, it is also a good time to socialize the idea among enterprise line-of-business departments. Most professionals are comfortable now with the idea of software as a service (SaaS) and will likely see the benefit of running applications in a similar fashion on an internal or external cloud.

It's also a good idea at this stage to get application architects involved in thinking about the reference architecture for cloud computing so that future apps are designed with cloud deployment in mind. EC2 and other external cloud providers are a great test bed for developing an awareness and a context for defining the reference architecture for cloud – enabled apps.

This is also the time to gather baseline metrics. What is the duration between unit test complete and production deployment? Where are the typical bottlenecks in the process and what are they costing in terms of money and productivity? These basic metrics should be understood and quantified at the outset to measure the outcome of an enterprise cloud initiative.

Strong executive sponsorship needs to come online at this point to ensure proper funding is available and a realistic timeline is established. This is a learning and experimenting phase where all the questions should be put on the table. Ideally, the enterprise architect (with the backing of the executive sponsor) should lead a cross-functional team, drive the cloud initiative forward, set objectives and manage expectations.

Benefits at this stage derive mostly from gaining experience with deploying and managing applications in a third-party cloud environment and learning how to design and structure applications to run optimally in that infrastructure. Identifying and measuring business metrics is important at any point, but especially now at the outset of an enterprise-changing initiative.

Level 3 – Cloud Foundations

At this stage, you will lay the foundation for an application architecture that will scale, establish governance and policies, and deploy select applications in a cloud. This is the next logical extension of Level 2, where you take what you have learned on an experimental basis and apply it to a real-life situation.

At this point, you should also document key learning and emerging patterns and good practices in the form of policies and procedures. What was at first a reference architecture should be given more definition, especially with regard to the relationship between "apps" and "ops" for application releases. These policies will help bridge the traditional gap that

occurs between enterprise app developers and enterprise IT when it comes to moving applications into production. You'll discover that virtual appliances deployed in a cloud environment effectively close that gap by ensuring standards are built-in at the outset, instead of being an afterthought.

In Level 3 you should also make a commitment to an application virtualization platform for build and lifecycle management of your virtualized applications. At this phase, a build and lifecycle platform is crucial for the consistency, repeatability and maintainability of virtualized application images. Without one, chaos ensues. While it is generally possible to package an application with just enough operating system, middleware, databases and other components by hand as a one-off, enterprise virtualization and cloud computing is all about scale - and one-offs don't scale. The build tool is the way for you to ensure that the policies you specify make it into the virtualized applications you deploy.

Further, the lifecycle management tool ensures that the updates to those images also meet standards and that they can be pushed to all cloud-deployed units simultaneously. This dramatically reduces the maintenance overhead of cloud-based virtualized applications, while guaranteeing conformance to enterprise standards and specifications.

Don't skip this stage. While you might be tempted to go right from experimentation to full-scale application deployment, you're headed for the abyss if you don't have a firm foundation of procedures, policies and tools. Take your experimental applications and roll them out to a broader group of pilot users in the organization. Work through the process of requisitioning, provisioning and decommissioning apps on demand. Use your lifecycle management system to create, configure and maintain virtualized applications. Get comfortable with all this before going on to Level 4.

Level 4 - Cloud Advancement

In Level 4 you either need to build your own internal cloud or commit to a commercially-available cloud. You and your enterprise are ready for full-scale cloud deployment, albeit without some of the automatic capabilities you'll reach in Level 5. Your application infrastructure should be solid at this stage and implemented across the organization.

Get your virtualized applications into production along with the processes, policies and procedures that you established in Level 3. Fine tune and tweak them as you go along, but if your preparation work was good, these changes should be minimal.

This is a good time to revisit your metrics. There should be enough information about the performance of your cloud-based applications to back up some broad ROI assertions. You should also be noticing first-hand improvement in business agility and flexibility as a result of using cloud-based applications. There should be a significant reduction in departmental charge-backs and corresponding increased profitability from line of business operations.

Take a moment to sit back and congratulate yourself and your team for your accomplishments to date. Enjoy the view from the clouds!

Level 5 - Cloud Actualization: Hypercloud

Before you bask too long in the glory of Level 4, take a look at Level 5 and see what you have left to accomplish. Let's look at each of the main criteria for cloud actualization: dynamic sharing of application workload, capacity arbitrage and self-service application provisioning.

At this point, you'll have the option of deploying apps on internal or external clouds – but which environment for which apps? Traditional load balancing utilities allocate processing across servers – but your servers are now virtual. Never fear. We predict the emergence of dynamic load balancing tools that will automatically detect and determine which environment has the most available compute power for an application at any given time. Dynamic swapping of virtualized applications will be conducted seamlessly according to various thresholds and the need for compute cycles.

This will apply similarly with cost. In some cases, it could be less expensive to run an application in an external cloud – perhaps during time-of-day demand spikes or seasonal fluctuations. Tools will become available that immediately analyze the comparative cost of running apps internally or externally and will dynamically deploy them accordingly.

Self-service application provisioning enables users to request and receive application instances when they need them – no more waiting for hardware, implementation and configuration. What used to take months can now take minutes as a virtualized application can be instantly provisioned to the cloud and made available to the user. When the user is done, the app can be automatically decommissioned to free up compute cycles for the next user.

Although the technology for these activities is not currently available, we believe it is coming and that it will be indispensable to achieving cloud actualization. By the time you get to Level 4, the technology to support Level 5 will be mature. But you need to follow the program.

Conclusion

By Level 5, you'll have seen the transformational effects of cloud computing on your users, IT infrastructure and enterprise profitability. By starting with virtualization and following this model, you'll be laying the foundation for cloud computing adoption while meeting current needs. Throughout the process, you'll accrue benefits at the same time you continue to maximize the value of your applications.

As with any process model, the steps toward cloud computing adoption build on each other. Don't jump ahead or you'll undermine your foundation. Work the program and keep your head firmly on your shoulders while also having it in the clouds.

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Cloud Computing Adoption Model

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Level	Phase	Goal	Readiness Criteria	Actions/Investments	Metrics/Returns	Risk Factors
5	**Cloud Actualization "Hypercloud"**	Achieve dynamic sharing of application workload, capacity arbitrage and self-service application provisioning	- Significant experience delivering production scale cloud applications - Broad and deep cross-functional and management buy-in - Significant organizational change to support a self-service, self-healing environment	- Dynamic provisioning tools that can detect load, capacity, cost and other criteria - Multiple clouds, internal and/or external - Organizational realignments	- Level 1-4 returns, plus - Transformational impact on IT capital and operating expenditures - Material impact on LOB profitability based on cost and revenue	-Level 1-4 risks, plus -Technology readiness -Organizational resistance
4	**Cloud Advancement**	Select a cloud environment and undertake broad-based deployments with manual provisioning and load balancing	- Established governance processes and policies for virtual machine development, deployment and run time management - Experience in production application deployment using this model	- Actively solicit application initiatives for cloud deployment - Merchandise successes to build momentum and demand - Build cross-functional and management support by documenting ROI	- Level 1-3 returns, plus - Material reductions in capital expenditure for IT - Material impact on business responsiveness/agility - Impact on LOB profitability through material reductions in charge-backs	- Level 1-3 risks, plus - As volume scales, lack of governance foundation can actually reverse returns, leading to negative ROI caused by escalating complexity in management and maintenance of virtual machines
3	**Cloud Foundations**	Lay the foundation for an application architecture that will scale; establish governance and policies; deploy select applications in EC2	- Documented roles, processes, reference architecture and business case with sponsorship - Definition of scalable apps/ops architecture	- Deploy build and lifecycle management platform - Work with operations and architecture to define and codify release policies and practices	- Level 1-2 returns, plus - Significant impacts in time to market for new applications - Reductions in LOB charge-backs - Reduction in capital expenditure for IT operations	- Level 1-2 risks, plus - Lack of codified policies and practices can derail deployments - Lack of maintenance automation can lead to escalating support burdens
2	**Cloud Experimentation**	Experiment in Amazon Elastic Compute Cloud (EC2); define reference architecture	- Realization that IT operational bottlenecks and charge-backs are constraining ability to achieve full application value	- Identify and deploy select applications - Document baseline metrics; measure - Define reference architecture for apps and ops - Educate stakeholders and seek sponsorship	- Level 1 returns, plus - Gain experience with a first-class reference architecture for cloud - Baseline metrics and anecdotal returns/ business case for momentum building	- Level 1 risks, plus: - Fear can kill projects – overcome resistance through early education - Lack of business case or sponsorship can stall projects
1	**Virtualization**	Virtualization of Applications and Infrastructure	- Recognize need to deliver applications more rapidly - Want to reduce IT operating costs and capital expenditure	- Select build/ lifecycle system for virtual appliances - Select hypervisor - Document baseline metrics; measure	- Improved server capacity utilization - Improved agility, time to market for new apps - Reduce maintenance and support costs	- Duplications of effort and VM sprawl - VM quality, consistency and control issues impacting app run time experiences - Platform "lock-in"