SAVVIS

WHITE PAPER: Cloud Computing

The Relevance of Cloud Infrastructure to Enterprise Challenges

Bryan Doerr
Chief Technology Officer, Savvis

Table of Contents

Introduction: Cloud Computing as IT Catalyst

Even stripped of all the marketplace buildup and buzz, cloud computing services are undeniably changing IT options in meaningful ways. Still, cloud computing is neither a fundamentally new concept nor an IT outsourcing panacea, but is instead the result of the continuous evolution of hosting services to increase customer appeal and adoption of outsourced infrastructure. Further dissected, cloud computing essentially combines shared platform economics and rich Web-based interfaces to enhance user control — either programmatically or through a graphical user interface.

So why is cloud computing currently one of the most talked-about phenomena in IT? There are a number of converging factors that have given rise to cloud computing's emergence as a new IT service delivery option. Today's shared hosting platform economics reflect continued resource infusion at the compute processor, memory, and bandwidth levels. Without this expanded capacity, the abstraction levels necessary to effectively isolate customers wouldn't be possible. Moreover, as IT research and advisory firm Gartner has observed, the combined influences of increased adoption of virtualization technologies, service-oriented architectures (SOAs), and ubiquitous computing standards have expanded the availability of lower-cost and massively scalable computing-related services.[1] Additionally, feature-rich user interfaces are now easily developed and deployed, while low-cost, widespread access options (usually Internet-based) ensure immediate connectivity.

Although a simple model, cloud computing is nonetheless powerful because of the customer's transference of risk when using managed services to deliver IT infrastructure functions. In my conversations with IT executives, the words may differ, but a common thread regarding the decision to outsource IT functions is the valid concern that the service provider will not deliver as expected. This limits adoption of what is otherwise a clear choice when viewed from an organizational core competency perspective. In short, outsourcing infrastructure makes sense, but only when IT executives envision compelling, tangible rewards that far outweigh perceived risks. Because of its improved customer control model, cloud computing can help tip the scale of this analysis in favor of outsourcing for those executives. Consequently, IT decision makers who think most creatively about how to leverage cloud today are examining how their cost, control, and end-user experience metrics will benefit from various types of cloud offerings — often in combination with traditional managed services — and are starting to experiment with these options. Clearly, by viewing IT as a strategic tool, these executives recognize that to maneuver for competitive advantage in today's rough economic currents, testing the cloud waters is a necessity rather than a luxury.

Managed services providers (MSPs), and in particular IT Infrastructure-as-a-Service (IaaS) providers, that offer a variety of service types and service grades — both *in-the-cloud* and traditional managed services — are effectively best positioned to satisfy the range of enterprises' application requirements. These requirements will naturally vary from those that "keep the lights on" to those that support limited business functionality, and will reflect the inherent value of systems that operate across the application lifecycle (i.e., development, staging, testing, and production). To meet these requirements fully, IaaS providers must

[1] Daryl C. Plummer, Thomas J. Bittman, Tom Austin, David W. Cearley, David Mitchell Smith, June 17, 2008, Cloud Computing: Defining and Describing an Emerging Phenomenon, Gartner, Inc.

offer integrated cloud-based and traditional managed compute, storage, network, and security services — each with a range of features, performance service level agreements (SLAs), support levels, and corresponding price points.

This white paper reviews the evolution of data center outsourcing, and introduces cloud offerings within this historical framework. To help clarify the playing field, it presents a high-level overview of various cloud service types, narrowing the focus to infrastructure cloud offerings, and, more to the point, to those services in this market targeted to enterprise buyers.

Evolution of Data Center Outsourcing Solutions

Outsourcing IT has been an option available to IT managers for many years. Early on, IT outsourcing meant completely divesting the enterprise of IT assets, people, and application development responsibilities. These types of relationships were established with systems integrators who assumed all IT responsibilities and associated capital outlays in exchange for an initial monetization of IT assets and an ongoing operational expense.

This early outsourcing was limited to an all-or-nothing approach, in part due to the complexities involved in developing and maintaining applications that performed satisfactorily. Without complete ownership of the solution — from implementation of the software to the data center operations and network facilities management — the systems integrator couldn't be accountable for meeting application performance, cost savings, and reliable SLAs. These arrangements were typically long in duration, owing to the cost and complexity associated with the change and with the service provider's need to optimize and recoup its investment over time. At a time when IT was generally viewed quite narrowly as an accounting function and only in relatively few instances as a strategic asset, these types of decisions made sense for many organizations.

More recently, IT outsourcing has evolved to support more granular choices, essentially enabling more selective outsourcing of IT functions. Many enterprises embraced the emerging model of outsourcing IT *infrastructure* services related to facilities, storage, network, compute, and security functions because it enabled them to maintain more direct control of *core* enterprise applications and IT-based development capabilities while shedding undifferentiating, capital-intensive *context* functions. The result empowered enterprises to more fully and affordably leverage IT as a competitive weapon.

The increasing standardization of the architectural components used to build IT applications has unquestionably enabled this more granular approach to outsourcing. More mature application programming interfaces (APIs), standards, operating system interfaces, hardware abstractions, and software encapsulation support in development tools have contributed to minimizing integration complexity and enterprises' subsequent reliance on systems integrator contracts. The market responded to these opportunities with a wide variety of offerings. These were typically differentiated by the managed service providers' financial strength and scale of operations, as well as the degree of sharing, operations support, SLAs, and architectural variation inherent in their services.

Within this context, cloud-type services have emerged. Cloud hosting, considered here as a combination of shared platforms, virtualization, and user-directed integrated management tools, offers something that its hosting services predecessors could not: a high level of customer control over the provisioned IT infrastructure in combination with a flexible cost model. In fact, this customer control of hosted infrastructure — defined by immediate addition/deletion of service; granular, usage-based billing; and lack of fixed costs — characterizes the *cloud experience*. This experience is altering the IT services landscape by lowering customer risk perceptions and raising customer reward realities.

The *cloud experience* is changing the IT services landscape by lowering customer risk perceptions and raising customer reward realities.

Distinguishing Among Types of Cloud Services

The cloud experience, as described earlier, can be applied to a variety of underlying IT services. This has led to considerable confusion about just what cloud computing is and when it is useful. Addressed here are four types of services that, when combined with a cloud user-control experience, demonstrate the benefits of cloud computing.

Infrastructure Clouds

Infrastructure clouds provide components that are the building blocks of typical applications. As such, these types of clouds are focused on delivering basic infrastructure services (e.g., servers, disk storage, LAN connectivity, load balancing, and firewalls).

In their most basic form, infrastructure cloud services are typified by domain registrars, who, for a credit card payment, will host a URL within a running conventional Web server package and provide an administrator login to upload and configure a Web site. More interesting examples of infrastructure clouds include the dynamic creation (and destruction) of dedicated virtual servers, support for various types of operating systems, and in some cases, SLAs related to availability and support. In all cases, the common cloud characteristics are manifested in the direct user control of the provisioned environment, a high degree of flexibility to change this environment, and the granular charging policies that ensure infrastructure capacity can be adapted as needed to changing requirements. Amazon Web Services™ is the most recognizable cloud provider in this category. Savvis also offers these types of cloud services, targeted specifically to the enterprise market.

Platform Clouds

Also delivering basic infrastructure, platform cloud components are generally less explicitly managed by the end users. Instead, developers are supported by automated capacity management related to their application's demand profile. The platform cloud may consist of a hosted version of common Web application technologies in a prepackaged deployment architecture. Customers upload Web applications to this environment and pay for services according to transaction count and/or the total capacity of compute, storage, and network services consumed to deliver the application within specific intervals. Generally, resources in platform cloud solutions are shared but not guaranteed, and application technologies limited to those hosted on the platform. Still, the benefit of automatic capacity expansion and contraction enables effective cost management. An example of a provider in this category of cloud services is Mosso, the cloud division of Rackspace®.

API Clouds

Application programming interface (API) clouds deliver all of the services of a platform cloud as well as programming environments that simplify not just the delivery of infrastructure, but also the actual implementation of the application for cloud deployment. APIs support common application functions — from gaining access to resources and inter-process/inter-application communication services to database and caching functions. Theoretically, most application lifecycle activities are simplified by services embedded in the API cloud. One potential disadvantage of this style of platform is the lack of portability. The APIs hosted in these clouds do not generally conform to any industry standards, and therefore, any need to migrate away from the initially selected cloud will likely require re-implementation of the application. Salesforce.com's Force.com platform is one of the more familiar provider offerings in this category of cloud services.

Software-as-a-Service (SaaS) Clouds

SaaS cloud services are hosted applications, where the customer is not contracting for infrastructure component services, but instead access to business logic functions licensed by the end user. SaaS solutions are now available for many common business application functions, including email, collaboration and community, sales force automation (SFA), customer relationship management (CRM), enterprise resource planning (ERP), financial and human resource (HR) functions, enterprise content management (ECM), and a host of IT-related services such as lab management, load testing, and performance monitoring. These solutions are often labeled *cloud computing* because, from the customer's perspective — for whom the ultimate goal is flexible access to application functions for end users — this form of service delivers the cloud experience directly at the application service level. Users can be provisioned and de-provisioned easily while eliminating overhead costs related to managing the deployed application, such as those presented when the application is self-hosted.

Although the lines of distinction that separate these cloud categories are frequently blurred, the above overview is an attempt to provide a broad categorization rather than an explicit taxonomy. The important point is that there are a range of services available under the cloud moniker, all of which have a common user experience model that enables higher levels of direct user control to achieve increased flexibility in adapting services to actual and changing needs.

Design Considerations in Deploying Infrastructure Cloud Services

The market of service providers offering infrastructure cloud services is growing rapidly in response to the belief that the cloud experience will provide compelling value to those who have previously remained on the outsourcing sidelines. If this belief holds true, the result will likely spur truly remarkable growth in the managed infrastructure services marketplace. For the enterprise, this provides a real opportunity to change the equation of the internal IT cost/benefit analysis.

However, there is more to consider than price and flexibility when designing infrastructure for IT applications. Infrastructure architects must also be mindful of countless requirements affecting infrastructure design and the suitability of services to satisfy these requirements:

- Application architectural requirements
- Security design
- Compliance reporting requirements

- End-user performance sensitivity and correlation to resource demands
- Data protection and recovery times and points
- Capacity planning
- Uptime requirements

When outsourcing alternatives present viable options, managed services provider solutions must also address these requirements. This is no less the case when considering cloud-based outsourcing solutions. In fact, cloud-based solutions, unlike traditional solutions that have well-understood properties in many of the above outlined areas, may introduce new complexities as well as opportunities.

Following is a list of requirements categories that must be addressed by cloud infrastructure providers before cloud infrastructure platforms will be adopted for mainstream enterprise applications.

Complex Application Architectures
As an example of this requirement, applications are usually deployed in a multi-tier configuration, with aspects of the solution encapsulated in each tier to improve overall performance, reliability, and security. Network connectivity between tiers, in addition to being limited to application-specific traffic to minimize congestion and latency, is also a point of access control. A cloud-based infrastructure must preserve the ability to build this classic architecture from the infrastructure components it delivers.

Many organizations will desire a combination of cloud-based and dedicated resources to satisfy the breadth of their applications requirements. These hybrid solutions are ideal matches for applications that have bursty usage levels. In these instances, a managed services provider's holistic solution that offers the full complement of integrated services will provide clear value to enterprises that otherwise overspend through over-built infrastructures.

Resource Commitments
Today, applications are generally written without awareness of resources. That is because in dedicated infrastructure deployments, the resources available to the application are dictated by the capacity of the infrastructure components — no more and no less. This approach to infrastructure and application design has in many cases led to a lack of awareness related to resource requirements. Frequently, application troubleshooting gets started by first understanding needs and normal behavior, and then catching abnormal conditions and correcting the problem. The source of these abnormal conditions might be a poorly performing section of code in an application server or database, or it might be a normal load increase, in which case the correction will be to scale up or out one or more tiers. In any event, the problem and its solution are confined to the application and its infrastructure.

In shared platform cloud solutions lacking the equivalent of guaranteed resources (where required), application performance troubleshooting can assume a new level of complexity. In this environment, conditions unrelated to the application must be considered when diagnosing application performance problems. These are generally very difficult problems to solve. A better approach is to design the shared platform to enable resource guarantees where necessary, while still allowing for resource burstiness when this is beneficial.

Security
Security and related compliance concerns exist in two somewhat independent dimensions of infrastructure sometimes referred to as management and data planes. Generally speaking, security requirements in both of these planes are trickier to satisfy in cloud environments than in dedicated environments.

In the data plane of cloud-based infrastructures, we first need to duplicate the application security functions that have matured over the past several years in dedicated environments. This starts with including traditional firewalls, application firewalls, and intrusion detection functions as *part of the cloud* provisioning environment. This will ensure that in place of physical devices, virtual devices are configured and deployed according to security best practices (and also benefit customers with the same cloud attributes deemed desirable in compute and storage resources). However, in addition to these classic services, new services are needed to address the new threats present in a virtual environment, such as virtual switches and hypervisor (or virtual machine monitor) vulnerabilities.

In the management plane, the challenges are no less significant. Virtualization adds complexity to segregation of duties by combining previously separate physical functions into shared, cross-functional platforms. In multi-tenant cloud environments, roles and access permissions are even less strictly controllable. As a result, more people have access to administrative logins than in traditional dedicated environments where physical and application segregation provide natural points of entitlement control. In response to this less restrictive setting, managed services providers should optimally architect the management plane of cloud infrastructure to address these security concerns. Both provider and customer dimensions must be considered when designing access control mechanisms related to support, maintenance, and troubleshooting.

Advanced Services
One way to view the move toward cloud computing is as a migration away from *box-level* infrastructure design to *environment-level* infrastructure design. In this case, *environment* isn't referencing the relative *greenness* of the solution (although a case can likely be made for this as well), but rather the idea that the application is operating within a complete, service-rich platform suitable to many applications, not custom designed for one. The advantage for the entire IT industry is a higher level of infrastructure design abstraction and a higher level of standardization. This elevated level of standardization allows more cloud-based functionality to be embedded in standard form in the cloud platform. This results in more feature-rich infrastructure services than enterprises have typically built for themselves and at attractive price points not usually achievable.

As an example, data management functions — from storage area network (SAN) snapshots, to geographic data replication and information lifecycle management that minimize storage costs — are usually custom "bolt-on" designs added as collective ad hoc technologies and processes within the typical enterprise application and data center (or frequently not present at all). In appropriately designed cloud platforms, the service will go beyond simply providing data storage, to include standard solutions for these more advanced functions as well. Because of the higher degree of standardization, these functions will be available more inexpensively and consequently more widely adopted. The result is an overall improvement in IT performance.

Other advanced services are also vital for complete adoption of cloud-based solutions. Managed services providers must include full application-level SLAs, maintenance downtime-free instances, full 24/7 support, security patching, and comprehensive disaster recovery options. All of these can and must be offered to ensure cloud deployment relevancy to all application types and business requirements, either alone or in combination with other deployment services.

Lifecycle Process Support

Selecting a service provider for any sort of outsourced infrastructure has significant impact on organizational processes. This is no less the case in the shift to cloud-based infrastructure. By delivering services to the enterprise, the managed services provider becomes intrinsically part of an interlocked business-to-business relationship involving time and business-critical processes related to provisioning and repair of business systems. In cloud-based solutions, which depend on significant provider automation of internal processes, this entails understanding best-practice processes and working closely with customers to recreate their former internal processes as a bridge across both organizations.

Conclusion

The march toward the virtual data center is well underway. Indeed, as industry research firm Forrester has recognized, "cloud computing looks very much like the instantiation of many vendors' visions of the data center for the future; it's an abstracted, fabric-based infrastructure that enables dynamic movement, growth, and protection of services that is billed like a utility."[2] Cloud solutions, with their contribution to customer control, flexibility, and resource optimization, promise to raise the bar of IT performance and value within the enterprise.

Because of these benefits, and because developing virtual platforms that incorporate the latest virtualization technologies and automation is not something easily justified in a typical, non-IT-driven company, the emergence of cloud platforms can also pave the way for large-scale adoption of outsourced managed data center services. Nevertheless, this enterprise market acceptance will take place only if cloud-based offerings address the full range of application deployment requirements found across the IT spectrum — from occasional to business-critical use, and from development to production.

When considering all the variables in IT outsourcing decision making, cloud computing is not a replacement for existing traditional managed IT infrastructure services. Nevertheless, it does offer compelling opportunities to further establish IT as a strategic weapon and may even persuade others to reassess the value versus risk in selective outsourcing of non-core IT functions.

SAVVIS

[2] James Staten, March 7, 2008, Is Cloud Computing Ready for the Enterprise, Forrester Research, Inc.

About the Author

Bryan Doerr is Chief Technology Officer at Savvis. Bryan provides technology leadership for infrastructure and product development, M&A support, and next-generation platform evaluation. Before joining Savvis, he held positions in management, software technology research, and software development at Bridge Information Systems, Boeing, and the Applied Physics Laboratory. Bryan holds a Masters Degree in Electrical Engineering from Johns Hopkins University in Baltimore, Maryland and a Masters Degree in Information Management from Washington University in St. Louis, Missouri.

About Savvis

Savvis, Inc. (NASDAQ:SVVS) is an outsourcing provider of managed computing and network infrastructure for IT applications. By outsourcing to Savvis, enterprises can focus on their core business while Savvis ensures the quality of their IT infrastructure. Leading IT organizations around the world have selected Savvis to help them improve their service levels, reduce capital expense, and deal with the rising costs of bandwidth, energy, real estate, staff, and expertise. As a pioneer in utility computing, Savvis understands and harnesses the latest advances in technology like virtualization, cloud computing, and support process automation.

For more information about Savvis, visit www.savvis.net or call 1.800.SAVVIS.1 (1.800.728.8471).

EMEA
Savvis UK Limited
Tel +44 (0)118 322 6000

ASIA PACIFIC
Savvis Singapore
Company Pte Ltd
Tel +65 6768 8000

JAPAN
Savvis Communications K.K.
Tel +81.3.5214.0151

SAVVIS