



## WHITE PAPER

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# Accelerate Hybrid Cloud Success: Adjusting the IT Mindset

Sponsored by: VMware

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## IDC OPINION

Just as server virtualization has become a standard feature in datacenter environments over the last few years, with virtual machine deployments outnumbering physical server shipments in 2009 for the first time, cloud services are now quickly extending their range and depth, and will become a crucial part of enterprise IT in the coming years. In 2009, IDC estimates that around \$16.5 billion was spent worldwide on cloud services provided by third-party suppliers (including software as a service [SaaS], infrastructure as a service [IaaS], and platform as a service [PaaS]), and expects spending to grow 34% in 2010 to \$22.2 billion and reach \$55.5 billion in 2014.

Virtualization is an evolutionary step in the development of datacenter environments and IT toward cloud computing, which will be significantly different from the infrastructures and processes employed in mainly physical environments. IDC believes that such profound changes are a response to deep structural problems affecting enterprise IT today. These problems stretch from high maintenance costs to poor hardware utilization rates, energy wastage, and above all lack of agility in IT which fails to respond to quickly changing business needs. The new IT delivery models that are evolving address these issues and lead to infrastructures that provide services to the business using private cloud services, public cloud services, and services that are delivered using a combination of public and private models. This new approach is what IDC defines as hybrid clouds.

However, with new models, new challenges for the entire IT infrastructure arise. The top challenges in the era of hybrid clouds typically concentrate around security, performance, and reliability in public cloud and around management and organizational adjustments in private clouds and virtualization deployments. IDC believes that most of these hurdles can be overcome by a careful analysis of the security and importance of each workload, with roadmaps determining which applications will be bound to the public cloud or transformed into a service delivered internally via private cloud.

Additionally, CIOs will have to gradually introduce a change in mindset among their staff, since cloud computing changes the role of IT staff and the skill set needed. The distinction between different functional areas such as application, storage, security, and networking will increasingly blur, forcing much tighter cooperation between different groups. Also, IT organizations will need to be much more business-savvy, becoming a guarantor of the services delivered to end users both internally and externally. CIOs should plan carefully the transition and ideally work on predefining the new roles and responsibilities that each of the high-level IT managers will have in the future hybrid infrastructure.



## IN THIS WHITE PAPER

This IDC White Paper discusses the radical change in datacenter and IT processes brought about by virtualization and by the inception of a cloud- or service-led model for delivery of IT resources to the end users. Perceived risks and organizational hurdles that may slow down adoption of such technologies are analyzed, and guidance is given to CIOs willing to overcome them as they make the journey to the cloud.

The paper is based on a number of primary and secondary sources. These include IDC Worldwide Server and Server Virtualization Trackers, IDC qualitative research, and results from a number of independent end-user surveys conducted by IDC over the last few years. For a detailed list of surveys and for definitions of the key concepts used, in particular regarding the cloud theme, see the appendix at the end of the paper.

## SITUATION OVERVIEW

Enterprise IT is entering a phase of deep technological change. According to IDC, this has been driven by three key factors:

- ☒ **Sprawl of physical servers.** Particularly after the mass penetration of x86 machines in datacenters, with x86 shipments worldwide growing by 64% from 4.7 million to 7.8 million between 2003 and 2008. The consequences of this include energy waste, ballooning capital expenditures (capex), and sprawling maintenance and real-estate costs.
- ☒ **New business requirements.** Ever since the economic crash of 2009, businesses have needed to be much more agile than they used to be, but this requirement often clashes with the traditional, static approach to IT infrastructure, which is typically only able to adapt and change slowly.
- ☒ **Interconnected, diverse client device install base.** The growing number of mobile and non-standard computing devices (smartphones, media tablets, mini-notebooks) used in enterprises means that IT departments need to provide access to a wide array of platforms, anywhere, anytime, in a secure way.

IDC recognizes that these issues are pushing the adoption of innovative technology solutions, which in turn will irreversibly change the way IT departments work over the next few years. Virtualization and the cloud computing model stand out as the most influential.

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## Hybrid Clouds — The IT Delivery Model of the Future

Cloud computing is an IT development, deployment, and delivery model that enables real-time delivery of products, services, and solutions over IT networks (for a detailed definition of the cloud categories used in this paper, please see the appendix). IDC maintains that virtualization and cloud computing are very closely related and virtualization is a key enabler for the new IT service delivery model. In many ways, virtualization is the foundation to create a cloud-like, service-led model.

As virtualization and cloud technologies emerge alongside classical, pre-existing IT delivery models, a new, hybrid type of infrastructure will arise. IDC defines this hybrid

infrastructure as an environment where IT resources (from hardware to application level) are delivered by a combination of approaches, comprising virtualized private clouds on premises, and public cloud resources off premises, purchased from third-party suppliers, be it SaaS vendors or IaaS and PaaS suppliers. According to IDC, portability of applications and software environments between external public and internal, onsite clouds is a key feature of hybrid cloud infrastructures. The ability to move applications onto public clouds when additional hardware resources are needed relies on the presence of a common software frame. At the system level, portability is already fairly extended, and is typically enabled by a virtualization layer that bridges internal and external resources. At higher levels of the IT stack, portability is made possible by expanding open standards, as well as common application middleware and languages (see Essential Guidance).

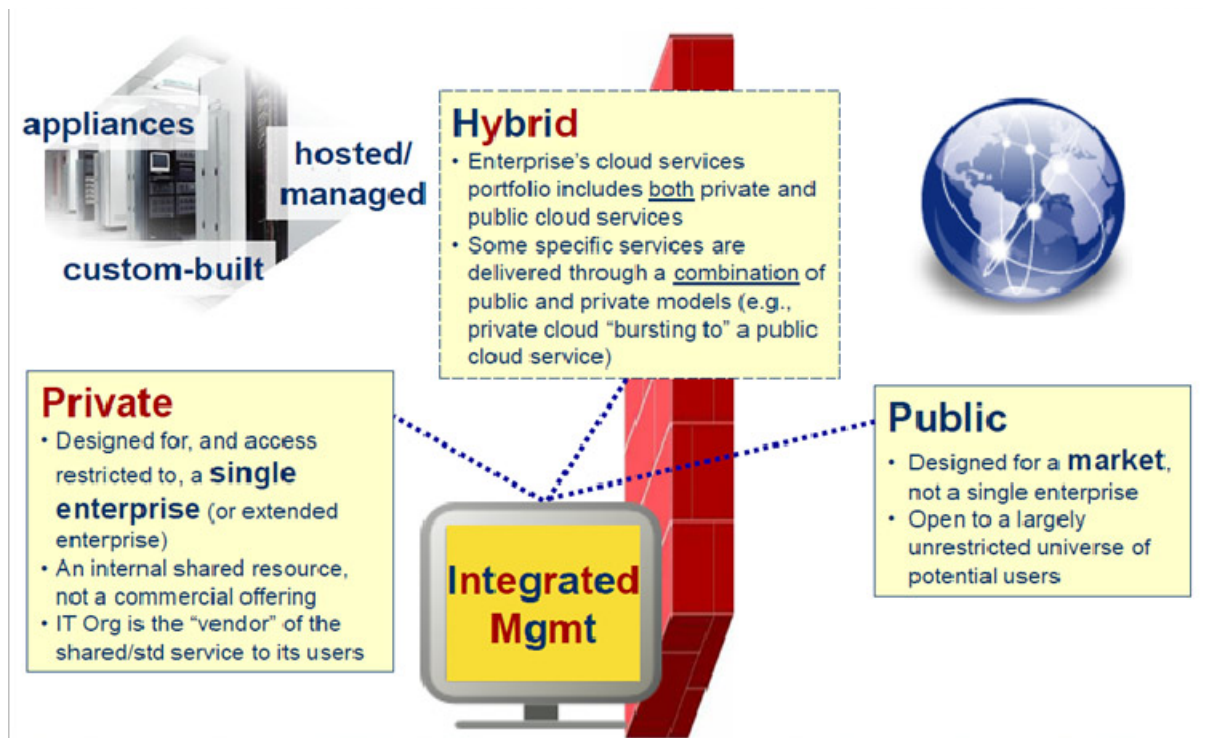
### ***The Push Toward Hybrid Environments***

The first, clear sign that IT delivery models are shifting lies in the end users. In many cases, users or groups of users, rather than IT departments, are the ones introducing public cloud or Web services into the company. Be it "prosumer" mail services offered by Web companies, online backup, computing capabilities on demand (e.g., Google Apps, Amazon WebServices, etc.), or even deployments of online CRM solutions, often it is single users or business units that make the decision — most of the time without even being familiar with the concept of "cloud computing."

IT departments end up losing control, potentially creating a dangerous scenario in which data and applications are neither monitored nor protected by IT staff, simply because IT is unaware of their existence. In addition, IT and end users already use various forms of "cloud services" without actually calling them such. This often leads to misconceptions among various staff levels, from IT management through to C-level, that cloud services are not yet used in the business and as such are treated with mistrust and considered for alternative IT delivery models. In reality in many cases these new delivery models have already been embraced and have lost their aura of being new and untrusted. IDC believes IT needs to regain control over its delivered services and needs to fully understand what and how services are delivered. Only then can an efficient and secure service be delivered back to the business. In this respect, the ability to ensure that applications and workloads run on compatible standards, both internally on virtualized private clouds and externally on datacenters of third-party suppliers, represent a first important step toward improved control over cloud services within enterprises.

**FIGURE 1**

Hybrid IT Environments



Source: IDC, 2010

The quick progression of enterprise IT toward hybrid environments (see Figure 1) is seen in the strong adoption of both external public cloud services and virtualization technologies empowering private clouds, and the even quicker progression that IDC foresees in coming months. The following sections briefly discuss quantitative and qualitative aspects of the penetration of public cloud services and virtualization technologies among businesses across the world.

### Public Cloud Services

The above-mentioned structural problems that clash with traditional IT stacks are the main drivers of public cloud adoption. In particular, IDC identifies two main scenarios for customers embracing this new way of consuming IT resources:

- ☒ **The need for greater flexibility of resource allocation.** Purchasing cloud services, particularly IaaS type services, allows business units and end users to add and subtract compute and storage resources depending on changing business needs. This type of scenario is playing very well with test and development teams and for specific workloads that require disproportionately high resources for short peak times (e.g., CRM and database backends during marketing campaigns or holiday seasons).
- ☒ **Lower capex and opex for non-core parts of the IT infrastructure.** Some organizations are shifting non-business-critical workloads (email, CRM) into the

external cloud and consuming them in an SaaS model in order to cut hardware and ongoing management costs.

The numbers confirm the strength of the shift toward public cloud services. In 2009, IDC estimates that around \$16.5 billion was spent worldwide on cloud services provided by third-party suppliers (including software-as-a-service [SaaS], infrastructure-as-a-service [IaaS], and platform-as-a-service [PaaS]) and expects spending to grow 34% in 2010 to \$22.2 billion and reach \$55.5 billion in 2014. IDC also expects spending on public IT cloud services to be gradually distributed across all major regions, with the U.S. being responsible for 74% of spending in 2009 but only 51% in 2014.

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## Server Virtualization for Private Clouds

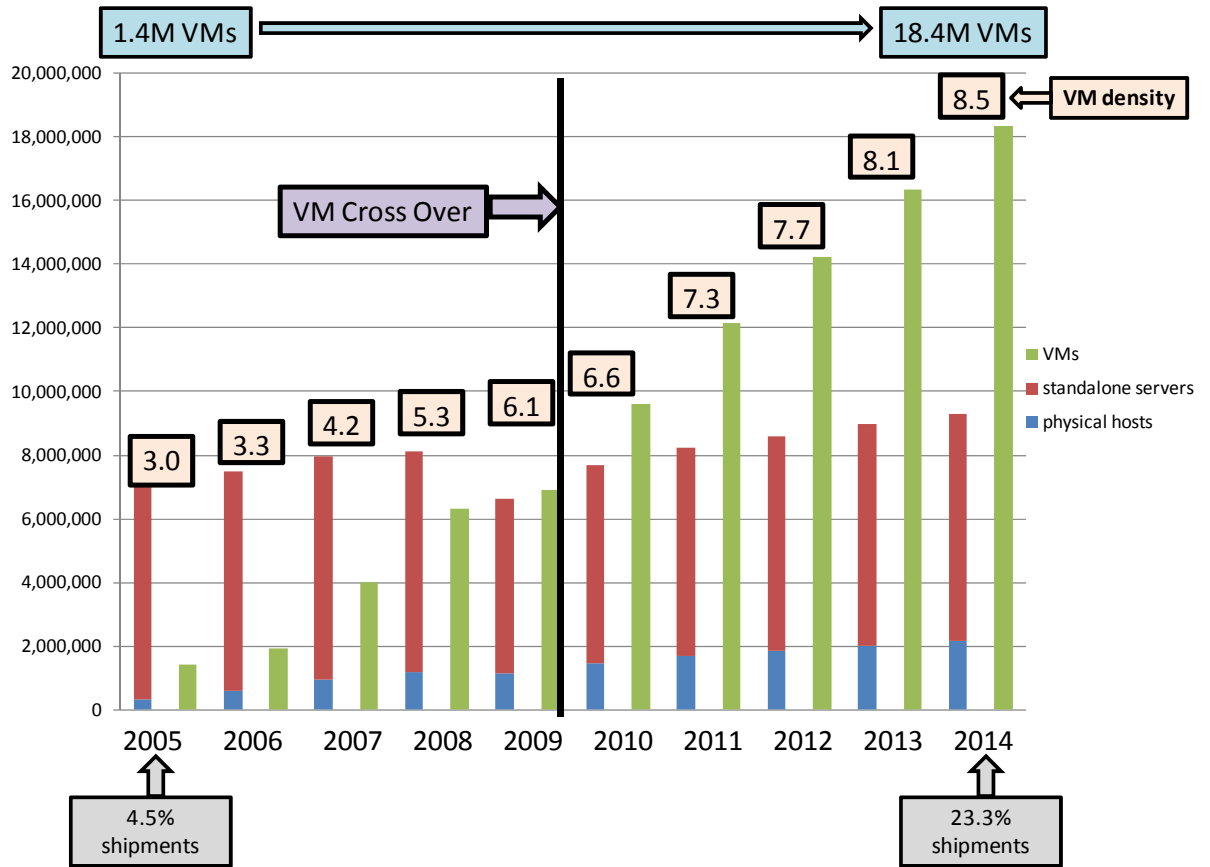
Organizations across the world are embracing server virtualization at different paces, depending on their business model, geographical location, and IT maturity. In general, IDC has observed that businesses tend to move to virtualized infrastructures and then private cloud service models in three different waves:

- ☒ An initial wave in which the strong need for consolidation in the sprawling x86 installed base is the first driver for server virtualization. At this stage, it is primarily large enterprises that use virtualization to reduce the energy cost, footprint, and capital expenditures of their server farms.
- ☒ A second wave, when enterprises and increasingly SMBs embark on virtualization as a means to increase agility and add enhanced infrastructure capabilities that became available through the dynamic capabilities of virtual machines, including instant provisioning, live migration, high-availability, DR, backup, and workload balancing.
- ☒ A third wave, which is seeing x86 virtualization become the engine for the buildout of virtual private clouds, where entire operating systems and application stacks are delivered to end users through self-service portals, optimizing use of resources and accelerating deployment time. Increasing use of automation and policy based management further optimize the datacenter for "lights out" operation.

The first two waves led to a significant event in the dynamics of datacenter environments: in 2009 virtual machine deployments overtook physical server shipments for the first time (see Figure 2), a watershed moment in the way modern IT operates. IDC expects the third wave to further accelerate virtualized server shipments in the coming years.

**FIGURE 2**

Worldwide Virtual Machine Versus Physical Server Deployment Forecast, 2005–2014 (Units)



Source: IDC Worldwide Server Virtualization Forecast, November 2010

### Organizational Challenges

Changes are taking place in the enterprise infrastructure, and they are taking place quickly, driven by end-user and developer requirements on one side and increased efficiency demanded by CFOs on the other. IDC believes that because they are revolutionary steps in the development of IT infrastructure, cloud and virtualization are a response to an unacceptable status quo. Enterprise IT has effectively been crippled by a number of problems, which have continued to grow over the last decade. The main issues are related to the inefficiencies and costs of running datacenters, with management and low hardware utilization rates among the top challenges. As the short-term focus on immediate savings decreases, however, another, even more compelling need emerges: the need to have an agile, efficient infrastructure and operations team that is able to respond and adapt quickly to changing environments.

While public cloud services increase their importance and become integrated in the enterprise IT infrastructure, IDC believes four big shifts will take place:

- ☒ Many tasks will be automated via software tools. The automation process will begin at the hardware allocation and infrastructure level, but will then move up

the scale, reaching application balancing, user rights (e.g., single sign-on to public SaaS and private applications), etc.

- ☒ Error debugging and workload performance analysis will become much more complex, involving networking, server, storage, and even application stacks. This means the boundaries between the traditional silos of IT departments will need to disappear. Only if the different departments work closer together is it possible to establish an efficient modus operandi to tackle such issues.
- ☒ IT processes, workloads, and applications will increasingly be a direct result of changing business needs. In a world where compute resources can be purchased on the spot with a credit card from the public cloud, business will demand similar response times from internal IT as well.
- ☒ Due to the new paradigm that enables the automation of many tasks, IT departments will also need to adapt their focus and mindset to not only look at capital expenditure (capex) savings as primary ways of measuring efficiency but also embrace operation expenditure (opex) savings as important units of measurement. In many cases, opex will become a key performance indicator.

In summary, the IT team will have to become much more business-savvy and be able to transform and deliver IT services that are much more relevant to business needs regardless of existing internal structures.

The necessary changes outlined above will not happen overnight and will also face challenges and barriers that businesses need to address. Some of these will be discussed in the following section.

### ***Requirements and Adjustments Needed***

While the numbers, as seen above, tell us that virtualization and cloud approaches are making clear inroads in the enterprise, there are still challenges that will need to be overcome. IDC believes there are two main areas where organizations still struggle when looking into alternative IT delivery models:

- ☒ **Technology requirements.** Related mainly to performance, availability, management tools, and costs.
- ☒ **Organizational barriers.** Related to the changes in IT and business processes that new delivery models, and particularly external cloud services, require.

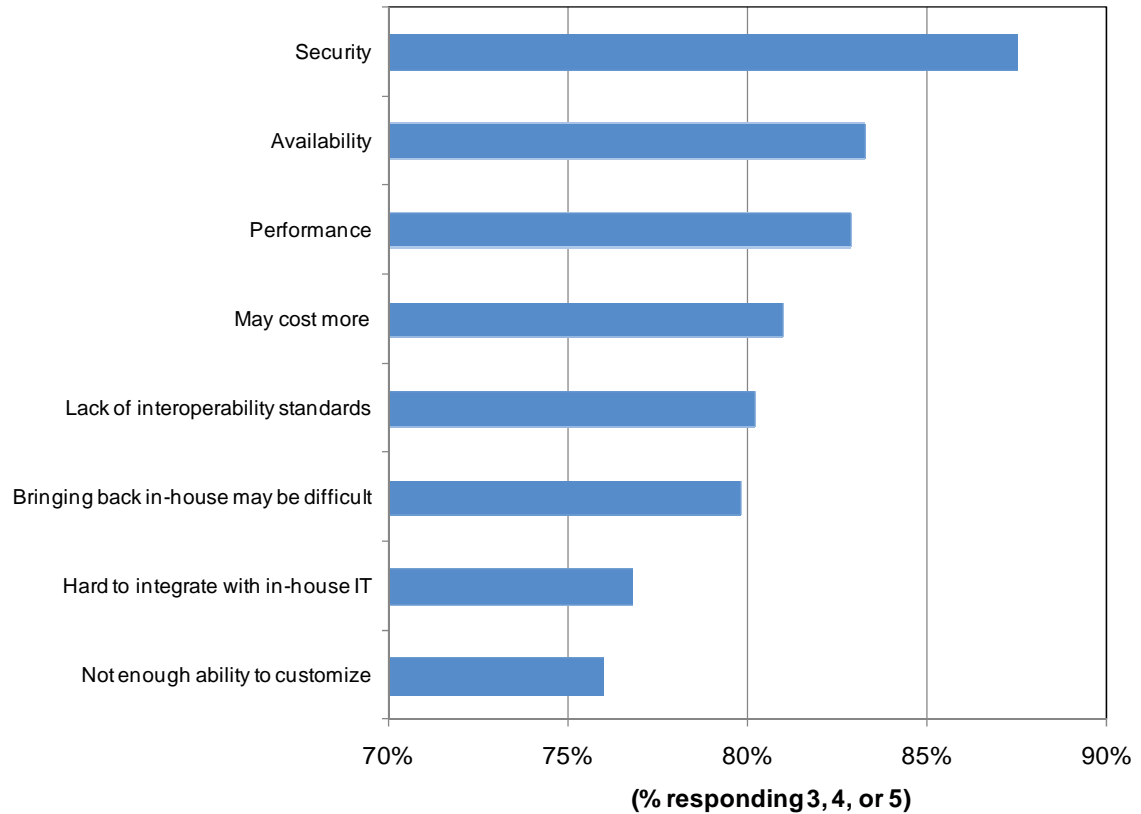
The first area is more easily addressed and vendors are constantly improving their offerings to meet customer expectations. With virtualization and private clouds, most of the technology doubts have already been removed — the technology is relatively mature, independent software vendor (ISV) support has greatly expanded, and system vendors are working to build integrated solutions that ease deployment.

IDC surveys show that security, performance, and availability are the main requirements in terms of technology when it comes to public clouds (see Figure 3). IDC believes these concerns are already easing as service providers enhance their offerings and technology matures.

**FIGURE 3**

**Top Customer Requirements for Public Cloud Environments**

Q. Rate from 1 to 5 the challenges ascribed to the cloud/on-demand model.



Note: n = 263

Source: IDC Enterprise Panel, 3Q09

The fundamental technology requirement, for both the delivery of internal virtualized clouds and external cloud services, remains the management software needed to orchestrate and maintain the new hybrid IT infrastructure. With the creation of hybrid infrastructures, end users typically need management software that encompasses different layers, from hardware/system management orchestration to middleware and governance software to standardize the delivery of applications at the higher level, all having to cross the geographic boundaries of multiple clouds. In this respect, automated processes and the definition of far-reaching policies will be paramount to the buildout of hybrid clouds.

The organizational side presents IT departments with a number of crucial challenges, and IDC advises all companies to carefully analyze and resolve these before embarking on the cloud journey:

- ☒ **Security, security, security.** IDC research and informal discussions with end users confirm that security remains top of mind for the vast majority of IT organizations looking into public cloud delivery models. The topic has both technology and organization/compliance facets, as technical factors define the



security and safety level of data stored in the cloud; at the same time, even in those cases where the third-party datacenter is certified and proofed, and all compliances are cleared, there is still a clear psychological barrier in knowing that data and applications reside physically "somewhere else." IDC believes the best solution here is to create clear service level agreements (SLAs) between the parties. As a first step these SLAs can be used to define internal and separate external cloud delivery models, and eventually enable the shift to push more and more services to an external cloud delivery model if needed.

- ☒ **Confusion on "cloud standards."** The debate on standard application interfaces that allow interoperability between clouds has raged since 2009, and though end users appear to see it now as a secondary hurdle compared with security and performance issues, the lack of a single "cloud interface standard" has often been used as an excuse to postpone cloud projects. IDC believes the presence of one or more "certified" standard institution is not necessarily needed to start adopting cloud delivery models. Organizations should focus on well-defined SLAs and plan to use widely adopted interfaces and languages. The fact that several common standards, such as the open virtualization format (OVF) for virtual machines and portability standards for PaaS (e.g., on Java), have gained market acceptance ensures that a pragmatic openness of clouds will continue to exist and expand going forward.
- ☒ **Opposition from internal IT stakeholders.** Virtualization and, to a larger extent, cloud changes the role of the IT staff. On the one side, IDC is seeing an increasing overlap in the areas of competence of infrastructure administrators, responsible for storage, servers, and networks. On the other side, application infrastructure administrators will have to start delivering support for software that is not run in the company's datacenter but rather somewhere in the cloud. This translates into changes in the status quo and it could lead to groups opposing the new IT model. CIOs should carefully plan the transition and proactively work with group leaders to predefine new roles and responsibilities.
- ☒ **A new consumption model requires different financial planning.** Both internal and external clouds introduce the idea of pay-per-use, increasing the share of "operating costs" at the expense of "allocation/acquisition costs." So, for example, end users requiring new server capacity will be provided with new virtual machines from the virtualization pool, with no hardware acquisition costs — yet they will have to be billed internally on a per-use basis. The same applies externally, where a third-party IaaS provider supplies additional capacity to an enterprise datacenter. Even though technology already enables highly automated chargeback procedures, flexibility in consuming resources will have to be converted into new ways of allocating budget. IDC believes this type of deep organizational transformation will take place gradually over time as companies shift mindset from "resource purchase" to "resource booking" (payment in advance for a predefined resources and amount of time) and finally to pure "resource consumption" (full pay-as-you-go without reservation time).
- ☒ **New processes and governance policies.** In a scenario where the consumption of resources shifts to a partial or full pay-as-you-go model, processes will need to change and be adapted on the governance side too. The use of traditional, static governance methodologies, such as ITIL, will need to be complemented by governance procedure and software that allows IT and business stakeholders to define SLAs — and set up underlying resource access rights — upstream, rather than monitoring their compliance afterward.

- ☒ **A new competitor for IT.** The rise of hybrid clouds is increasingly putting CIOs and IT staff under pressure to deliver IT services that are as effective and cost-efficient as those offered by external cloud providers. The penetration of IaaS offerings, for example, is quickly setting clear cost/performance parameters, with units of measurements such as \$/GB or \$/VM/hour. These are the standards that IT will be increasingly measured against when budgets are allocated, especially in non-core, non-mission-critical areas. IDC believes this challenge can be won only by implementing successful, highly-efficient cloud delivery models.

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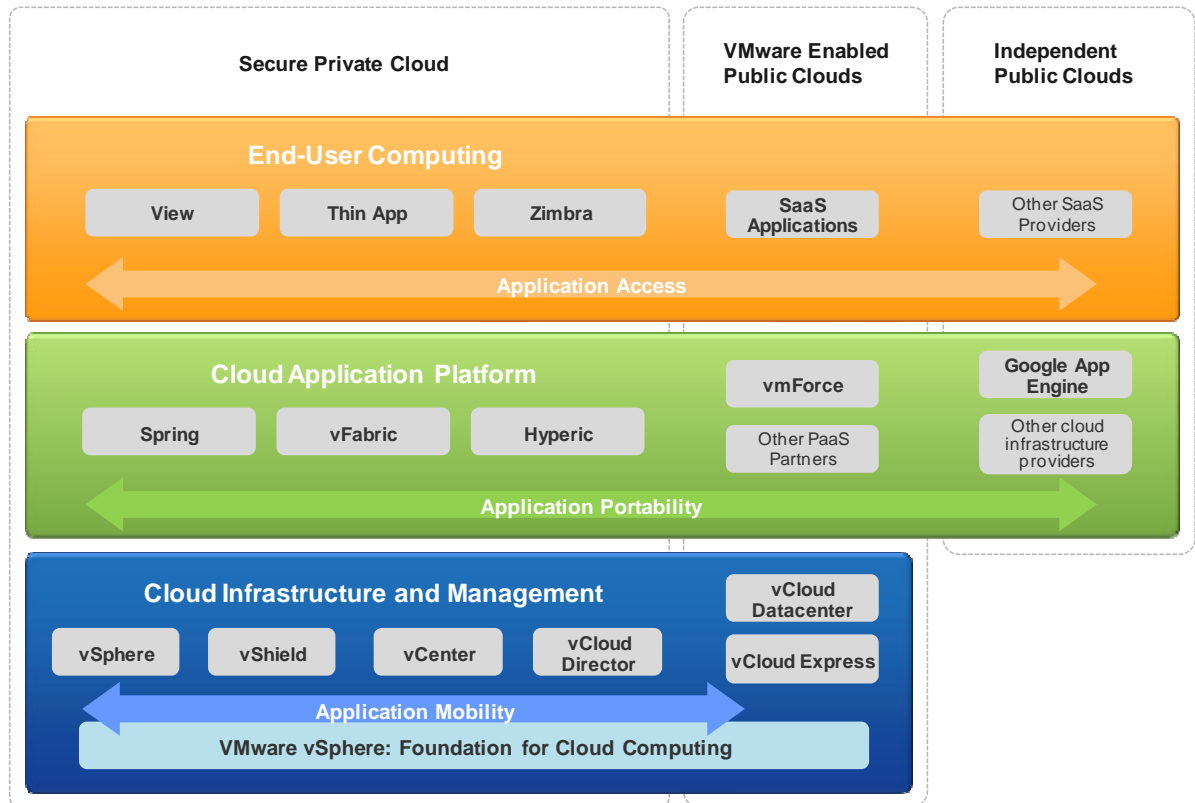
## **VMware's Strategy in Cloud and Virtualization**

With global revenue of \$2.9 billion for the latest full fiscal year ended December 31, 2010, and a healthy 41% year-on-year revenue growth, VMware is one of the largest software companies worldwide. VMware started with software products related to server virtualization, but has significantly expanded its strategy to include cloud infrastructure and management solutions, cloud application platform solutions, and end-user computing solutions in its offerings. Key acquisitions show the degree to which VMware is executing on its cloud vision — SpringSource (whose product line is now included in the VMware vFabric Cloud Application Platform suite for enterprise, Web application development and management) in September 2009, for example, and Zimbra for cloud email and collaboration in February 2010.

According to the latest IDC Worldwide Virtualization Tracker (December 2010), in the first three quarters of 2010 VMware server virtualization software was deployed on 624,273 new server shipments worldwide (up approximately 32% from first three quarters of 2009), covering the majority of new virtualized shipments. Server hardware spending related to VMware-based shipments exceeded \$3.4 billion worldwide for the first three quarters of 2010 and surveys among end users confirm that VMware ESX and VMware Server remain the leading server virtualization platforms among large enterprises as well as SMBs and hosting and cloud service providers.

**FIGURE 4**

VMware's Vision and Portfolio, 2011



Source: VMware, 2011

VMware's vision and offering have significantly broadened over the last few years, and it now offers customers the complete portfolio of cloud infrastructure and management, cloud application platform, and end-user computing solutions, enabling the implementation, management, and security of a cloud computing architecture that is compatible across both private and public clouds. As shown in Figure 4, its technology spans three main layers:

- ☒ Cloud infrastructure and management (foundation for cloud computing and associated management)
- ☒ Cloud application platform (developer frameworks and middleware infrastructure to create PaaS clouds)
- ☒ End-user computing platform (client virtualization technologies, collaboration products)

The offerings for these layers do not stop at internal clouds, but extend to VMware-enabled public clouds and external private clouds.

### ***Security and Management Offerings***

As discussed, security is usually the top concern when it comes to virtualizing and moving to a cloud-based IT model, therefore it is important to highlight the progress VMware has made to address this.

- ☒ From a foundation level the company is ensuring the code is as secure as possible. VMware recently announced that VMware vSphere achieved Common Criteria certification at Evaluation Assurance Level 4 (EAL4+) under the Common Criteria Evaluation and Certification Scheme (CCS). Common Criteria is an international set of guidelines (ISO 15408) that provides a common framework for evaluating security features and capabilities of IT security products, and EAL4+ is the highest assurance level that is recognized globally by all signatories under the Common Criteria Recognition Agreement (CCRA).
- ☒ Legacy security solutions have often been synonymous with keeping things locked down and static: classic examples are static firewall rules, "air-gapped" hardware and software infrastructure for various application zoning needs. This is no longer appropriate in cloud-based models and IT as a service, which require rapid and dynamic reconfiguration of virtual machines across zones and datacenters. Security for cloud-based models cannot stop or prevent change and dynamic movement — it has to embrace it. To support that requirement, VMware announced the VMware vShield product family on August 31, 2010. Its framework secures virtual datacenters and cloud environments at all levels — host, network, application, data, and endpoint — and provides an adaptive security solution that addresses today's dynamic datacenter needs.

Management also typically arises as the focus area for successful deployments of internal virtualized clouds and for the balancing of workloads that run within and outside a company's datacenter. The agility of hybrid cloud infrastructure means the ability to provide each workload the resources it needs now, adjusting as demand changes. The management model therefore needs to evolve from preventing and minimizing change to embracing constant change as the natural state of IT. Recognizing that management is pivotal to efficiently implement new IT delivery models, VMware has been building its portfolio in this area since the very beginning. The vendor now boasts a very comprehensive arsenal in the management field, with tools covering all the most crucial tasks from low, infrastructure-related activities (e.g. VMware Distributed Resource Scheduler for hardware load balancing within VMware vSphere, or vCloud Director for deployment of pre-set blocks of virtualized infrastructure) to business, application, and process-related activities with vCenter Chargeback for implementing new cost models or with vCenter AppSpeed for application performance monitoring.

While the number of suppliers in the cloud area is large and poised to grow in the short term, IDC foresees that consolidation will eventually take place as the market matures. VMware is well positioned to succeed as a supplier of cloud software and services, and given that it continues to execute on its vision, it is likely to emerge as one of the leading players in this area.

## ESSENTIAL GUIDANCE

Just as server virtualization has become standard in datacenter environments over the last few years, leading organizations on the journey to a service-led model, cloud services have quickly extended their range and depth in 2010, and will become a crucial part of enterprise IT in coming years. According to a recent IDC Enterprise Platforms survey, virtualization will be a crucial "on-ramp" to the cloud, with heavy virtualizers (>50%) having approximately 33% higher utilization rates of public cloud than light to non-virtualizers (<15%). In particular, 2010–2012 will be the real turning point for the advent of the cloud computing approach, as organizations worldwide progressively embrace the new paradigm.

IDC believes it is pivotal for organizations embarking on the virtualization and cloud journey to look at the global impact this will have on the configuration of their entire IT architecture, from hardware to applications. Even in those cases where virtualization is used as an ad hoc cure for a specific and very limited issue (e.g., to ensure high availability [HA] for a handful of production servers), a wider consideration of the benefits and potential disruptive effects the technology has on the whole infrastructure is needed.

More practically, IDC advises CIOs that are looking into expanding their virtualization strategy and planning for hybrid environments to consider the following points:

- ☒ Recognize how external economic conditions accelerate "capital efficient" IT strategies such as cloud. Business agility through flexibility in allocating investments will be key in the future.
- ☒ Cloud computing is a paradigm that will gradually change the status quo across your whole organization. This requires the rigid silos between different administrators (application, network, storage, etc.) to be broken down and tighter cooperation is paramount.
- ☒ Evaluate cloud goals in terms of desired economic and business outcomes. Whether business agility or cost savings, clear business objectives must be set in a cloud plan.
- ☒ If you are looking into cloud paradigms for cost savings, be aware of the importance of software license rationalization and IT operational efficiencies.
- ☒ Align business and IT governance around the new delivery models. SLA targets will have to be linked back to virtual and cloud environments, especially at a time where regulatory pressure is reaching new peaks.
- ☒ Create a multiphase plan that recognizes evolution of infrastructure, applications, and management. Legacy workloads, as well as future additional resources, must be inserted in a plan that defines what needs to remain on premises and what can be moved to public clouds.
- ☒ Create a culture of service standardization, where each workload that is currently provided to the end users must be mapped and envisioned as a service. Based on its importance and priority, create a roadmap that specifies how that service will be offered in the future, be it out of the public cloud or the internal cloud.

- ☒ Be prepared to try different options to find best mix. IDC believes most of the mid to large businesses to be best served by some balance of external public cloud services, external private cloud services, and internal cloud resources.

## CONCLUSION

Enterprise IT is quickly turning into a service-led organization delivering solutions based on business needs. An increasing share of services are delivered by external providers, while internal resources become virtualized and supplied in the form of service to internal customers by the IT department. A growing part of private datacenter hardware, middleware, and software stacks will need to be managed in an automated way while integrating with services delivered by third-party cloud providers. IDC research suggests that the hybrid cloud computing approach will become a critical part of the IT strategy for the majority of organizations in the next two to three years.

IDC maintains that while technology requirements such as the need for more performance or interoperability are quickly being fulfilled by suppliers, important organizational adjustments will need to take place within IT organizations if they are to reap the benefits of an on-demand world. Not just technology but also people and processes will have to undergo substantial evaluation and reorganization to keep up with today's business needs. IT managers will have to become real business enablers, administrating and facilitating consumption of resources and services that do not always reside within the company's datacenter.

## APPENDIX

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### Surveys Used

Among the research used, of particular importance is the *Worldwide and Regional Public IT Cloud Services 2010–2014 Forecast* (IDC #223549, June 2010), IDC's first consolidated forecast of public cloud spending by category and region. Other main sources are the IDC Storage End-User Survey (500 Web-based interviews, including major European countries), conducted in early 2010; IT Datacenter Management Survey (300 interviews in France, Germany, and the U.K.), conducted in Europe at the end of 2009; and the IDC Datacenter Automation Survey, an online survey carried out in 2008 involving 164 IT professional in Europe and whose main topic was the perception of datacenter automation and its impact on business output.

### Definitions

For the scope of this research, virtualization is to be understood in its broader sense, as the attempt to break complex and rigid interdependencies among IT resources (OS, applications, hardware components) to deliver a better service to the end user with improved efficiency and reduced costs. While the most evident progress in virtualization is probably still related to x86 server virtualization, this technology has in fact a much wider range of usage areas, including the booming client-related tools space, from virtual desktop infrastructure (VDI) to application streaming.

Whereas virtualization is now an established categorization which is relatively easy to grasp because of its tight link with a specific set of technologies, the term "cloud" can

still be puzzling to many end users willing to understand what it could mean for their own IT operations. IDC articulates the general "cloud concept" in two main ways:

- ☒ **Cloud services.** Consumer and business products, services, and solutions that are delivered and consumed in real time over the Internet.
- ☒ **Cloud computing.** An emerging IT development, deployment, and delivery model, enabling real-time delivery of products, services, and solutions over the Internet (i.e., enabling cloud services).

Cloud services are supplied by what are commonly referred to as cloud service providers. These types of companies, serving external customers, are the ones that primarily put in place the cloud computing paradigm, though large enterprise users may in some cases adopt a similar approach to provide applications to their internal customers. IDC therefore distinguishes between the following:

- ☒ **Public cloud computing.** Approach characterized by being open to a largely unrestricted universe of potential users and designed for a market rather than a single enterprise. In this scenario, cloud services are provided to the end user from offsite by a third-party specialized supplier. Their benefits reside in the fact that they need limited IT skills onsite and that they allow quick provisioning of resources/applications and a far more granular, pay-per-use pricing model.
- ☒ **Private cloud computing.** An infrastructure approach designed for a single enterprise (or extended enterprise), based on a pool of internal shared resources whose consumption remains limited within the supplying organization. In this scenario, IT organizations act as "suppliers" of services to their internal users (business units, single mobile workers, developers, etc.).
- ☒ **Hybrid cloud models.** IT delivery methods used by private businesses where resources (from hardware to application level) are delivered from a combination of sources, comprising a) virtualized private clouds on premises, and b) private/public cloud resources off premises, typically purchased from third-party suppliers in an as-a-service form; and workloads are portable between the two.

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