

AN OVERVIEW OF THE VIRTUALIZATION AND HYBRID CLOUD MARKET VENDOR LANDSCAPE FOR SMALL AND MIDSIZE BUSINESSES

JULY 2014



In this paper, Taneja Group presents an evaluation of the virtualization and hybrid cloud solution market for small and midsize business (SMB) users (companies with less than 1000 employees). Our objective is to evaluate virtualization, software defined infrastructure, management and automation, and hybrid cloud capabilities from leading vendors, to enable senior decision makers in SMB organizations to decide which vendors in the market offer the best solutions.

We evaluated four of the leading virtualization and cloud solution vendors and scored their offerings in four categories: virtualization architecture, software defined infrastructure, management and automation, and hybrid cloud. All vendors were required to have solutions in one or more categories that were generally available as of April 2014. To assess the competitive offerings, we looked at between 6 and 11 differentiating factors in each of the four categories, which we believe small and midsize business customers should use to qualify virtualization and hybrid cloud solutions and services. As a final step, we reviewed the vendors' solutions, services and overall virtualization and hybrid cloud strategy, and – using the leading vendor as the baseline – explored how competitive solutions compare favorably and unfavorably against that vendor's solutions.

SMB Virtualization/Cloud Market: Ranking Solutions & Services

(4 = Highest Score; 0 = Lowest Score. Harvey Ball scores rounded down to nearest whole number.)

Roll-Up Scores	VMW	MSFT	AMZN	CTXS
Virtualization Architecture	3.9	3.1	2.4	2.3
Software-Defined Infrastructure	3.5	2.0	1.5	1.0

Roll-Up Scores	VMW	MSFT	AMZN	CTXS
Management & Automation	3.5	2.2	1.5	2.0
Hybrid Cloud Capabilities	3.4	2.5	2.6	2.4

Legend: VMW=VMware, MSFT=Microsoft, AMZN=Amazon, CTXS=Citrix

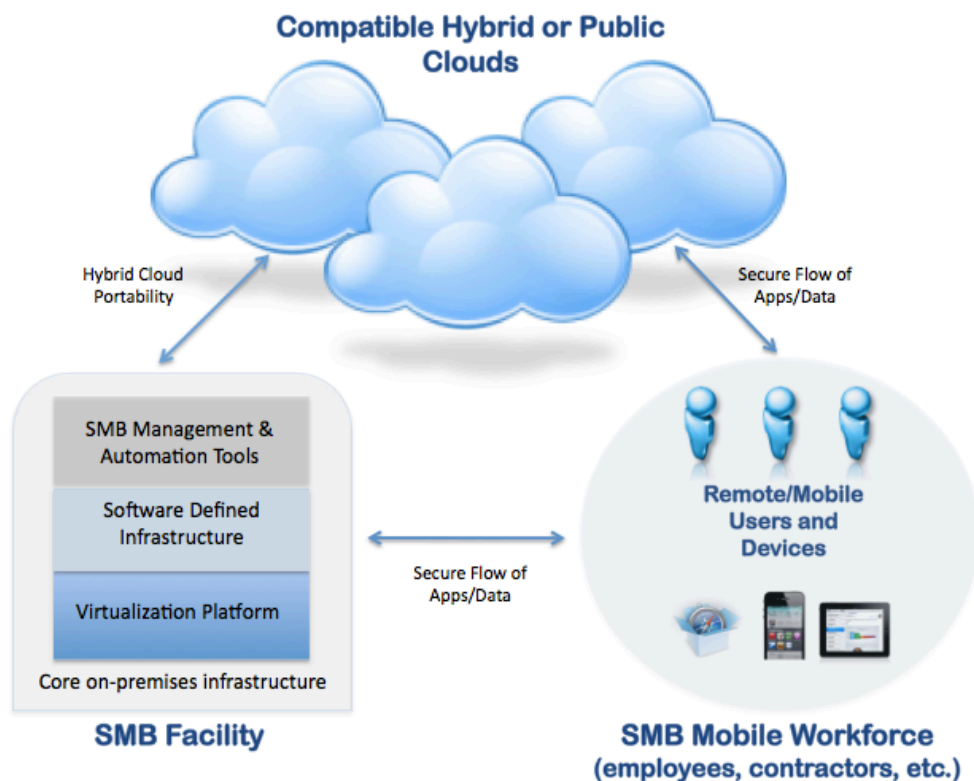
To assess each vendor's virtualization architecture and software-defined infrastructure, we evaluated factors such as virtualization platform, scaling efficiency, business continuity, security, service-level assurance and software-defined storage and availability capabilities. To assess management and automation offerings, we looked at factors including virtualization planning and deployment tools, patching solutions, infrastructure operations and hybrid cloud management. Finally, to evaluate hybrid cloud capabilities, we focused on attributes such as network extensibility between data center and hybrid cloud, broad OS and application support, workload compatibility between on- and off-premises, consistency of HA and security frameworks, catalog and template synchronization, and the ability to offer both dedicated and virtual private cloud infrastructure to customers.

Taneja Group Opinion

Overall, VMware stands out as the virtualization, software-defined infrastructure, management and automation, and hybrid cloud leader for SMB customers – due to the reliability, strength and maturity of the vSphere virtualization platform; the functional breadth and depth of its software-defined infrastructure solutions; SMB tools for getting started with, deploying and managing virtualization; and the seamless and integrated approach VMware provides to extend the benefits of on-premises virtualization to the hybrid cloud. No other vendor reviewed in our assessment is yet executing as effectively and simultaneously along all of these dimensions.

VMware is also unique in offering SMB organizations a proven and well-defined growth path to becoming a software-defined enterprise (see Figure 1), including a combination of virtualization-enabled software defined infrastructure, hybrid cloud, and end-user mobility solutions that are designed to work and scale together. Though end-user mobility solutions are beyond the scope of this report, they have in a few short years become an essential element of every SMB organization's IT playbook, and should be viewed as an integral part of an overall cloud and virtualization solutions architecture.

Figure 1: SMB Cloud and Virtualization Solutions Landscape

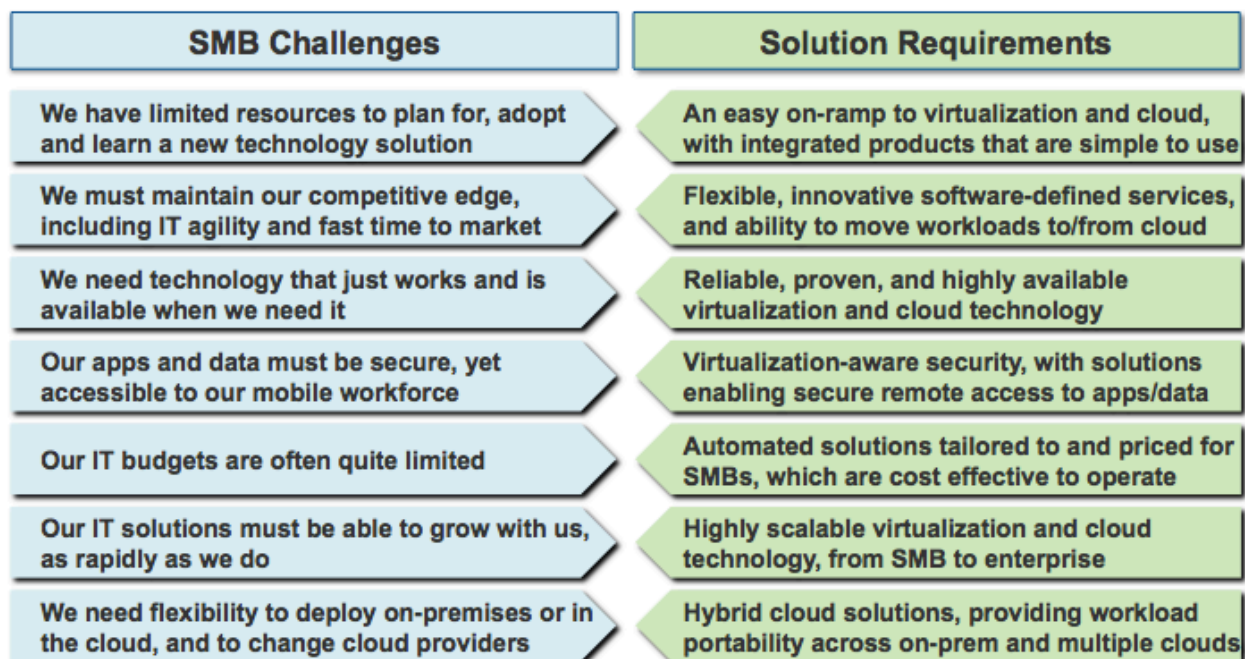


SOURCE: TANEJA GROUP

As we went through our assessment of the SMB solutions landscape, we kept in mind a set of challenges (summarized in Figure 2) that SMBs tell us they face in evaluating and selecting new technology solutions. These, in turn, suggest a series of top-level requirements (also listed in Figure 2) that we believe SMB buyers should demand in their chosen virtualization, software defined infrastructure, and hybrid cloud vendor/solutions.

Of the four vendors in our comparative study, VMware's solutions come closest to matching the set of top-level requirements that address SMB customers' most common challenges. VMware today provides an integrated solutions family spanning on-premises virtualization, software defined infrastructure, management and automation, and hybrid cloud. As we'll see in our detailed analysis, VMware provides a rapid path for SMBs to virtualization and cloud via a set of easy to deploy and manage offerings, built on the foundation of a reliable, advanced, and widely deployed hypervisor platform. VMware's virtualization-aware security and business continuity capabilities surpass those of the other vendors in our study, and unlike its rivals, VMware provides cost-effective, packaged, OS-independent solutions tailored to SMBs. VMware also provides SMBs with a non-disruptive, highly scalable growth path to protect their virtualization/cloud investments, and ensures that customers will not be locked in to a single vendor's cloud solution. As one of the leaders in virtualization and cloud infrastructure, VMware is not only a *safe* choice, but also the *best* choice, for SMBs.

Figure 2: SMB Challenges and Solution Requirements



SOURCE: TANEJA GROUP

With this context in mind, we have developed a series of key takeaways that will help guide your evaluation of virtualization and cloud solutions and services, and enable you to select the best vendor and solution for your growing small or midsize business.

Key Takeaways for Small and Midsize Business Decision Makers

- **In evaluating cloud solutions, go beyond just “kicking the tires”.** The cloud market is still emerging, and vendors continue to overpromise and under-deliver. As a buyer, you must check out whether the various offerings perform as advertised. We recommend hands-on, proof-of-concept engagements that put the offerings through their paces, and test and exercise key capabilities.
- **Start with a solid foundation.** We believe the fastest and surest route to a successful solution deployment is to choose a robust and proven underlying platform. Ask vendors and serv-

ice providers about the maturity, reliability and availability of their virtualization and cloud infrastructure as a service (IaaS) stacks, and their experience in running customers' business-critical workloads.

- **Insist on virtual security.** Security is one of the most critical requirements for virtualization and cloud solutions. Look for solutions that offer *virtualization-aware* security, versus approaches that graft existing physical infrastructure security solutions into a virtualized environment. Work with the vendor to understand their security framework, and validate that the framework addresses each layer of the virtualization and cloud stack.
- **Free your organization from the constraints of hardware-driven infrastructure.** The industry is rapidly moving to software-defined infrastructure, to bring the advantages of virtualization and independent, software-based control to storage, networking, security and availability. Choose a vendor with a strong virtualization track record that is committed to making storage, networking and security resources as flexible, fungible and cost effective as virtualized compute and memory resources are today.
- **Look for solutions that are simple to deploy and manage, but don't force compromises in efficiency, data protection, or quality of service.** Dynamic cloud environments require a new approach to management – one that is as agile and flexible as the underlying virtual infrastructure. Ask to see SMB-friendly tools for setting up and managing a virtualization environment, and for simply and efficiently backing up and patching VM workloads. Prioritize solutions that have high levels of automation and policy-based service assurance.
- **Automate for increased efficiency, agility and reliability.** Traditional manual provisioning and management processes are typically cumbersome and error-prone, resulting in a less than optimal allocation of both IT and infrastructure resources. To avoid these issues, look for a vendor that offers policy-based automation and dynamic resource allocation, to ensure that business critical applications are prioritized and your IT team can meet service-level objectives. Automation can also speed your time to market for new business initiatives and free up your already stretched IT staff to focus on higher value activities.
- **Make sure your apps are portable between on- and off-premises.** As shown in Figure 1, your virtualization/cloud provider will offer much less value if your applications can't move back and forth effortlessly between on- and off-premises. Insist on a solution that enables you to freely move and manage workloads between on-premises and hybrid or public clouds.
- **Invest in hybrid clouds to gain the dual advantages of on- and off-premises computing.** The most effective solutions will marry the security, quality of service and control of on-premises infrastructure, with the agility and compelling economics of a hybrid or public cloud. As you evaluate solutions, focus on vendors that provide the security, hybrid cloud management, standards-based workload portability and interoperability required to bridge on- and off-premises deployments.

Why VMware?

The most successful on-premises infrastructure and hybrid cloud solutions will be built on the foundation of an enterprise-grade virtualization technology. Of the vendors we have evaluated, VMware offers the most mature, widely used, and functionally capable virtualization platform. Virtualization technology is bringing major improvements to storage and availability, by reducing or eliminating hardware dependencies and allowing control to be exerted in software. While several vendors in the study have emerging virtualized and/or software-defined storage and availability offerings, we judged VMware's solutions to be the strongest, based on features such as hardware independence, dynamic and policy-based resource allocation, and VM/app centric capabilities.

VMware scored highest in the management solutions category, with the best combination of planning and deployment tools, intelligent operations management, and heterogeneous management capabilities. Though the hybrid cloud market is still in its early stages, several suppliers in the study are now shipping offerings designed for business or enterprise customers. Of those vendors, we found that VMware solutions come closest to meeting business-level requirements, with features such as workload compatibility and migration, catalog and template synchronization, and consistent high availability and security frameworks between environments on- and off-premises.

We recommend, as always, that customers carefully evaluate the respective vendors' offerings, ideally including some hands-on experience, before making a purchase decision.

GUIDE TO OUR LANDSCAPE ASSESSMENT

Our comparative evaluation of the virtualization, software-defined infrastructure and hybrid cloud solutions landscape for SMBs is divided into the following six sections:

- **Market Definition, Drivers and Vendor Landscape.** We define each of the three principal markets addressed in our landscape research, discuss primary market drivers, and then briefly describe the solution vendor landscape covered in our analysis.
- **Virtualization/Cloud Vendors and Solutions Evaluated.** Here we define each of the four solution categories, our vendor selection criteria, and the vendors and solutions we have evaluated across the four categories.
- **Evaluation Methodology and Criteria.** This section details our evaluation methodology and the specific factors we used in each of the four solution categories to comparatively assess each vendor's solution.
- **Virtualization Architecture Competitive Landscape.** This is the first of four sections, corresponding to each solution area, in which we comparatively score the vendor offerings for each specific evaluation factor, and then discuss our rationale for the scores we have given, in a sub-section entitled "Taneja Group Opinion". This first section details the scores and rationale for SMB-oriented virtualization platform solutions.
- **Software Defined Infrastructure Competitive Landscape.** In this second of four sections focused on each of the solution areas, we comparatively score SMB-oriented software defined infrastructure offerings, and provide our rationale for these scores.
- **Management and Automation Competitive Landscape.** In this third of four sections devoted to each of the solution areas, we comparatively score SMB-oriented management and automation offerings, and provide our rationale for these scores.
- **Hybrid Cloud Competitive Landscape.** In this fourth and final section, we comparatively score SMB-oriented hybrid cloud solution capabilities, and provide our rationale for these scores.

MARKET DEFINITION, DRIVERS, AND VENDOR LANDSCAPE

Virtualization Market Definition and Drivers

In this report we focus on the virtualization market for Type 1 (bare metal) Hypervisors, running on native x86 commodity server hardware (including both 32-bit and 64-bit variants). This is the market pioneered by VMware in 2001, and is the sweet spot for SMB virtualization efforts today. Based on our ongoing research, including regular discussions with SMB users, the three primary drivers for SMB adoption of virtualization today are reducing costs (both CAPEX and OPEX) through consolidation, improving business continuity (via the disaster recovery and high availability capabilities inher-

ent in virtualization), and increasing IT and business agility (in conjunction with a desire to move to the cloud). Together, these factors can bring SMBs considerable benefits, enabling them to accelerate business growth, enhance competitiveness and boost profitability.

Also included in this market category are virtual infrastructure management and automation solutions, with capabilities such as infrastructure operations management (tying in both capacity and performance); SMB tools to plan, deploy and manage virtualization; and patch and asset management features, including software license management. These types of management tools are particularly critical for SMB organizations that are just beginning to virtualize their IT environments, since they accelerate time to productivity and give IT managers the confidence to expand their virtualization footprint. Unfortunately, however, such tools and capabilities are far too often neglected in vendor offerings and/or delivered as an afterthought by third parties.

Software-Defined Infrastructure Market Definition and Drivers

Though this is a newly emerging market, we feel it is important to call it out in this study, since it holds great promise for SMBs who are looking to extend the benefits of compute virtualization to other parts of their infrastructure, such as storage and availability. Traditional array-based storage solutions have been a fixture in virtual infrastructures for more than ten years, and while they bring a familiar storage approach to virtual server workloads, they also bring some disadvantages, including management complexity and high cost. Based on Taneja Group studies, storage has in fact been the most costly infrastructure component in most virtualized environments for many years, and has in some cases made server virtualization less attractive to SMBs from both a CAPEX and OPEX standpoint. While a number of promising virtualization-specific storage technologies have been introduced in recent years, most fall short of providing the level of administrative simplicity and cost effectiveness that SMBs are looking for. Software-defined storage solutions promise to take the storage value proposition in server virtualization environments to the next level, by enabling SMBs to abstract and pool storage resources, so that they can be dynamically allocated to the most critical business applications and controlled and managed in software. By removing storage hardware dependencies and streamlining management, such solutions have the potential to reduce both storage CAPEX and OPEX costs, which will further increase their appeal to SMB customers.

In addition to storage, software defined availability and business continuity solutions promise to strengthen the resilience of SMBs' virtual infrastructures, without the cost and complexity inherent in traditional hardware approaches. Ultimately, in the not-too-distant future, we expect that all elements of an SMB's IT environment, including networking and security, will be designed to run as software-defined infrastructure, bringing the cost and simplification benefits full circle.

Hybrid Cloud Market Definition and Drivers

Cloud computing takes many forms and is rapidly evolving from a broad range of pre-existing and new vendor technologies. The essential characteristics of any cloud computing solution are generally agreed and most understand them to include: broad network access on demand, via a self-service interface, to a pool of shared IT resources which exhibit rapid elasticity and are consumed as a measured (pay-per-use) service. Above this baseline, however, delivery and deployment models vary widely.

The major delivery models are Infrastructure-as-a-Service (IaaS, for compute, memory, storage, and network resources), Platform-as-a-Service (PaaS, for application development tools and runtime services) and Software-as-a-Service (SaaS, for applications delivered as a service). The primary deployment models include on-premises (private cloud), off-premises (public cloud), or a mix of both (hybrid cloud). In this report, we focus on *hybrid* IaaS clouds, and not PaaS or SaaS clouds. While applications vary widely among SMBs, depending on factors such as their industry and type of business, infrastructure tends to be common across SMB organizations. A majority of SMBs today want to

maintain control over the management and deployment of their infrastructures, and we therefore believe that SMBs should look first at IaaS clouds, rather than PaaS or SaaS clouds. A *hybrid* IaaS cloud provides the benefits of cloud agility and economics, enabling SMB users to move workloads as needed between on-premises and the cloud and oversee these environments from a single cloud management platform, without requiring the larger investment in in-house resources needed to build and operate an on-premises, private cloud.

What are the primary drivers for SMBs moving to hybrid IaaS clouds? It turns out they are very similar to the primary motivators that lead SMBs to adopt virtualization: lowering costs, increasing workload deployment flexibility, and enabling greater IT agility. In fact, the majority of SMBs we speak with believe that virtualization and cloud go hand in hand, and that virtualization is an essential technology for IaaS clouds.

Solution Vendor Landscape

Virtualization, software-defined infrastructure, management and automation, and hybrid cloud computing solutions are offered from a wide range of vendors, but only a select group of vendors have broad portfolios of solutions that have achieved significant adoption and usage among SMBs. In the virtualization space, these players are the hypervisor vendors – including VMware, Microsoft, and Citrix – which have purchased and/or developed functionally rich virtualization platforms offering management capabilities and supporting a wide range of business applications and solutions. These vendors also have or are developing software-defined infrastructure and hybrid cloud technologies, which often complement and enhance their SMB virtualization solutions.

In addition to the virtualization players, one other company is increasingly appearing on SMB organizations' radar: Amazon. As the leading public cloud provider, Amazon Web Services (AWS) offers customers virtualized compute and associated storage and networking infrastructure as a service. AWS is rapidly enhancing the software-defined capabilities of its massive public cloud infrastructure, and already offers a range of management services. In addition, AWS is attempting to bring hybrid cloud-like functionality to customers, so that they can selectively develop and/or deploy workloads in the AWS public cloud while maintaining their on-premises IT environments.

VIRTUALIZATION/CLOUD VENDORS AND SOLUTIONS EVALUATED

Vendor Comparative Categories

To organize our analysis and facilitate accurate comparisons with VMware's virtualization architecture, software defined infrastructure, management and automation, and hybrid cloud offerings, we have grouped competitive solutions into four main comparative categories in order to call out each vendor's pre-existing areas of expertise as well as their current virtualization and cloud strategies:

- **Virtualization Architecture Solutions Category.** Includes solutions that offer compute virtualization (hypervisor platform) capabilities and a scale-efficient architecture, along with the business continuity and security features required to support production applications. In addition, this category includes API accessibility to provide users with the flexibility to programmatically orchestrate and manage software-defined capabilities.
- **Software-Defined Infrastructure Solutions Category.** This category captures policy-based automation and dynamic resource allocation features that enable resources to be prioritized for business-critical applications. In addition, the category includes emerging software-defined storage and availability solutions.
- **Management and Automation Solutions Category.** Encompasses solutions that offer IT operations management, heterogeneous management across multiple hypervisors and public clouds, and hybrid cloud workload migration and management capabilities. This category also

includes solutions that provide SMBs with a fast on-ramp to virtualization, along with SMB-specific IT planning, deployment and management tools.

- **Hybrid Cloud Solutions Category.** Solutions in this category offer infrastructure, tools and services that allow SMB customers to extend their data centers into a public/hybrid cloud. Capabilities include network extensibility between data center and cloud, workload and storage compatibility between on- and off-premises infrastructure, consistent high availability and security approaches, and support for both dedicated physical and virtual private cloud infrastructure.

Vendor Selection Criteria

Since our goal is to paint a picture of the vendor landscape for SMB solutions, we have selected four of the top vendors – in terms of SMB adoption, market share, and quality of offerings – across the four solution categories. As a baseline, all vendors were required to have solutions in one or more categories that were generally available in April 2014. We primarily included already available solutions in our head-to-head comparisons, though we did consider a few strategic offerings that were deep into beta testing or customer preview as of this date. In addition, we took into account significant upcoming offerings in our evaluation of vendor strategy and the key takeaways that we’ve offered as a result of assessing vendor solutions in each category.

Vendors and Solutions Evaluated

Three of the four vendors selected for this study – VMware, Microsoft and Citrix – are leading hypervisor players, offering virtualization platforms and associated management and automation capabilities based on vSphere/ESX, Hyper-V, and Xen technologies, respectively. These vendors actively compete in the market for SMB virtualization solutions. Also included is Amazon Web Services (AWS), the leading public cloud provider, which offers a compute infrastructure as a service (IaaS) and associated management capabilities.

In addition to their compute virtualization/IaaS and management portfolios, these four vendors are investing to varying degrees in bringing software-defined infrastructure and hybrid cloud solutions to market. We have listed for each vendor the solutions evaluated across the four categories in the table below.

Vendor	Solution(s) Evaluated
VMware (VMW)	vSphere with Operations Management Enterprise Plus 5.5 suite (including vSphere 5.5 + vCenter Server Standard), Virtual SAN, vCloud Hybrid Service (vCHS) 1.0, vCenter Converter, vCloud Connector 2.5 Advanced
Microsoft (MSFT)	Windows Server 2012 R2 Standard (including Hyper-V, Hyper-V Replica, Storage Spaces), System Center 2012 R2 Standard, System Center Essentials 2010, Windows Azure Services, Azure Files, Azure Site Recovery, ExpressRoute, Virtual Machine Servicing Tool 2012, Storage Simple Cloud-Integrated Storage
Amazon (AWS)	Amazon Web Services Elastic Compute Cloud (EC2), Elastic Block Storage (EBS), Elastic Load Balancing (ELB), Identity and Access Management (IAM), CloudWatch, OpsWorks, AWS Direct Connect, Amazon Virtual Private Cloud (VPC), AWS Storage Gateway, VM Import/Export, Management Portal for vCenter
Citrix (CTXS)	XenServer 6.2 (with XenCenter), Apache CloudStack 3 IaaS, CloudPlatform 4, CloudBridge

EVALUATION METHODOLOGY AND CRITERIA

Methodology

Taneja Group performed independent research in Q1 2014, augmenting our experience with and knowledge of SMB requirements and vendor solutions with additional briefings and, where possible, demos and interviews. For each comparative solution category, we established a set of evaluation factors based on required virtualization architecture, software-defined infrastructure, management and automation and hybrid cloud features and our opinion of the importance of each to the SMB buyer interested in such solutions. For each factor, we scored vendor solutions on a sliding scale: 0 = none or inadequate capabilities; 1-2 = basic, limited, or immature capabilities; 3-4 = feature-rich, broad or mature capabilities. Roll-up scores are based on a 5-point Harvey Balls scale and were calculated by averaging each factor score, then weighted by our analysis of each vendor's SDDC and hybrid cloud focus, expertise, level of investment, and publicly-announced solution strategies and product directions. The visual scores reflected in the Harvey Balls are rounded down to the nearest whole number.

Evaluation Factors

Following is a detailed description of the criteria we used to comparatively assess solutions in each of the four categories: Virtualization Architecture, Software-Defined Infrastructure, Management and Automation, and Hybrid Cloud. We recommend that small and midsize business customers use these factors to qualify, compare and contrast the functionality and capabilities of competing solutions and services.

Virtualization Architecture Factors:

Factor	Solution Features Evaluated
Runs on Commodity Hardware	Supported on any x86 commodity hardware platform. No special/custom hardware required. Full control of software defined capabilities in software.
Compute Virtualization	Virtualization capabilities, maturity, market penetration, hypervisor architecture. Guest OS's and apps supported. Bare metal hypervisor, independent of OS. Purpose-built to protect against security vulnerabilities. Minimal patching requirements. Advanced virtualization features (mobility, HA/DR, optimizations, etc.).
Scale Efficient Architecture	Scales to 100's or 1000's of VMs while maintaining performance. Supports high levels of VM density for maximum efficiency. Proven ability to manage large-scale infrastructures.
Business Continuity and Disaster Recovery	Monitoring and detection of hardware, OS and application failures. Migration of VMs for continuing availability. Zero-downtime due to hardware crashes, workload migration, and IT admin tasks. Standalone replication, auto failover/failback. Non-disruptive DR testing. Simple VM backup and recovery.
Security for Virtualized Environments	Virtualization-aware security. Logical firewalls that enforce network settings at VM level. Comprehensive security management framework. Application firewall between VMs to protect against network-based threats. Non-disruptive anti-virus model (e.g. via hypervisor-level introspection).
API Accessibility	Easy programmatic access for set-up, reconfiguration, management and orchestration of software-defined capabilities.

Software-Defined Infrastructure Factors:

Factor	Solution Features Evaluated
Service Level Assurance for Business-Critical Apps	Policy-based automation and dynamic resource allocation. Profile-driven configurations of virtual hosts and associated storage. Resource prioritization for business-critical SMB applications.

Software-Defined Storage and Availability	Application-centric, software defined storage and HA capabilities, ideally integrated with the hypervisor for better performance. Simple provisioning from pooled compute and storage resources. Resilient against hardware failures. Supports shared storage including both server disks (HDDs) and flash. Policy-based management to enable and maintain specific storage capacity, performance and availability levels per VM. Allows dynamic scaling of performance and/or capacity. Data services such as thin provisioning, snapshots, clones, replication and multi-site DR. Simple to buy and deploy.
---	---

Management and Automation Factors:

Factor	Solution Features Evaluated
Tools to Plan, Deploy, and Manage Virtualization	Guided assessment to plan for virtualization. Wizard-based VM install, set-up and management capabilities. Built-in physical-to-virtual conversion and workload migration to VMs. Proactive recommendations for improving infrastructure reliability. Easy to deploy virtual infrastructure.
Infrastructure Operations Management	Automated performance monitoring and management. Purpose-built for virtualized environments, ideally including tight integration with the hypervisor. Full operations dashboard, including rich visualization. Dynamic performance thresholds. Self-learning performance analytics. Metering of capacity usage. Correlation of performance and change events. Application visibility and awareness. Recommendations for resource and capacity optimization.
Patch & Asset Management	Automated inventory and management of hardware assets. Software license management. Ability to automatically scan, deploy, and manage patches from multiple software publishers. Single pane of glass to manage physical and virtual IT assets.
Hybrid Cloud Management	Cross-cloud management tools and interfaces. One management tool to monitor and manage on- and off-premises workloads. Ability to provision across multiple resource pools, based on-premises and/or in one or more public clouds. Consistent set of tools and interfaces for monitoring and managing VMs, events and support issues. Support for open cloud standards (e.g. OVF). Solution elements purpose-built for cloud.
Ease of Migration and Cost of Exit	Ability to easily and flexibly migrate workloads from one vendor's public cloud to another. Minimal cost and effort required to exit public cloud, to avoid vendor lock-in.
Heterogeneous Management Capabilities	Support for a variety of public clouds and hypervisors. Unified management spanning multi-vendor public clouds and virtualization environments.

Hybrid Cloud Factors:

Factor	Solution Features Evaluated
Network Extensibility Between Data Center and Hybrid Cloud	Ability to extend corporate network to hybrid cloud without need for new infrastructure or network management. Manage/control data center and hybrid cloud network from same interface.
Workload Compatibility and Migration Between On- and Off-Premises Infrastructure	Ability to manage and easily migrate workloads, using a single management interface, to and from on-premises infrastructure and public clouds, enabling a hybrid IT approach.
Support for Both Legacy and Cloud Enabled Workloads	Run existing applications without rewrites or conversion. Support for REST-based API and next-generation frameworks.
Broad OS and Application Support	Comprehensive support of Windows and Linux operating systems. Support for major commercial and vertical applications.
Storage Compatibility Between On- and Off-Premises Infrastructure	Support for a common virtual disk format across on- and off-premises environments.
Consistent High Availability Approach Between On- and Off-Premises Environments	Consistent, infrastructure-driven high availability capabilities across on- and off-premises environments. Ability to live migrate and auto-restart VMs without disruption. No need to design resiliency into the application.

Data Protection	Automated, policy-based backup and recovery to protect cloud-based workloads. Agentless support for file and image based backups. Integrated pre-backup deduplication to reduce storage and data transfer loads. OS and application agnostic.
Consistent Security Framework	Consistent security and identity management framework between on- and off-premises, including VPN, NAT, DHCP and firewalls. Role-based access, providing cloud/IT admins with accountable control and oversight over on-premises and cloud environments.
Catalog and Template Synchronization	Ability to take approved templates from on-premises environment and place them in hybrid cloud catalog, to ensure the use of corporate-blessed images.
Support for Dedicated Cloud Infrastructure	Ability to place applications on segregated (single-tenant) physical infrastructure for performance purposes.
Support for Virtual Private Cloud	Ability to run applications in a multi-tenant virtual private cloud, with logically isolated compute, networking and storage resources.

VIRTUALIZATION ARCHITECTURE COMPETITIVE LANDSCAPE

Virtualization Architecture Factors	VMW	MSFT	AMZN	CTXS
Runs on Commodity Hardware	●	●	●	●
Compute Virtualization	●	◐	◐	◐
Scale Efficient Architecture	●	◐	◐	◐
Business Continuity and Disaster Recovery	●	◐	◐	◐
Security for Virtualized Environments	●	◐	◐	◐
API Accessibility	◐	●	◐	◐
OVERALL SCORES:	3.9	3.1	2.4	2.3

Taneja Group Opinion

- Virtualization is an essential foundation technology for both software-defined infrastructure and the cloud.** To support business-critical applications, software-defined infrastructure and hybrid cloud offerings must begin with a strong underlying virtualization platform. A virtualization platform abstracts hardware resources and pools them into aggregate capacity, enabling automation to efficiently and securely allocate those resources as needed for applications. Through virtualization, business-critical workloads are decoupled from the physical infrastructure, consolidated, and optimized for availability, flexibility, and deployment, either on premises or in a public cloud. VMware's market-leading set of advanced virtualization capabilities, together with its strong 12+ year track record and experience in serving both SMB and enterprise customers, gives the vendor a significant advantage over other players in this category.

Microsoft has increased market share in recent years and expanded its virtualization platform capabilities, but vSphere still far outpaces Hyper-V in terms of customer adoption and deployed production workloads. Hyper-V is available either as part of Microsoft Windows Server 2012 R2 or as a standalone hypervisor. As of today, the hypervisor supports approxi-

mately 35 Windows and Linux guest operating systems, and while this represents steady growth, it is still a fraction of the nearly 100 guests supported on vSphere. Microsoft has added important new features in the past couple of Windows Server 2012 releases, including Hyper-V Extensible Virtual Switch and Hyper-V Replica, but Hyper-V continues to have some fundamental architectural weaknesses, such as reliance on a parent OS, which compromises security and can increase downtime for patching and maintenance activities. The dependency on Windows Server also results in a multi-year cycle for major releases, which limits the rate at which Microsoft can bring new virtualization capabilities to market.

Amazon Web Services (AWS), the industry's largest public cloud, runs a highly customized version of Xen as its virtualization platform, which now has roughly 8 years of market maturity and supports an estimated 2+ million users via the AWS Elastic Compute Cloud (EC2). AWS has steadily added virtualization capabilities over the years, though many of these, such as Elastic Load Balancing and Auto Scaling, are offered as separate, add-on services. Like Hyper-V, AWS compute virtualization is based on a DOM 0 architecture, meaning it is dependent on a general-purpose OS (in this case, Linux), and the security vulnerabilities that go along with it. AWS lacks the robustness, availability and quality-of-service controls of enterprise offerings like vCloud.

Citrix XenServer is based on the open source Xen hypervisor technology, which Citrix purchased in late 2007. Citrix open-sourced the baseline version of XenServer two years later, but still sells a more advanced version of the product. As with Hyper-V, the Xen architecture is domain-based, relying on a Linux OS parent partition. By increasing the attack surface, this Dom 0 architecture opens up XenServer to security vulnerabilities and adds to patching requirements. XenServer supports just shy of 40 guest operating systems, more than Hyper-V but significantly fewer than vSphere. XenServer market share today is in the single digits, and the hypervisor has only limited use in supporting production applications. In fact, Citrix has been removing and deprecating features in the last couple of XenServer 6.x releases, rather than adding new ones. As a result, XenServer lacks some of the advanced features that vSphere delivers, such as live storage migration, load balancing based on storage use, and storage and network IO controls.

While total solution cost should be on every SMB's short list of key qualifying criteria, the set of features and capabilities that make up each solution will be an equally important determinant of value. As we evaluated the virtualization solutions against our checklist of key capabilities, we noted that VMware provides a packaged set of vSphere Essentials and Essentials Plus and vSphere with Operations Management Acceleration Kits that are tailored to and priced for SMB users. Microsoft offers SMB buyers Windows Server 2012 R2 Essentials, but it is restricted to 25 users and a single virtual machine instance, so small and midsize businesses that are serious about virtualization and the cloud will want to invest in Windows Server 2012 R2 Standard. Microsoft also offers System Center Essentials 2010, which includes some virtualization management capabilities, but does not support Windows Server 2012 R2. SMB customers that require Windows Server 2012 R2 support will need to license the more functional but also more costly System Center 2012 R2. Neither Citrix nor Amazon provides SMB-specific virtualization offerings.

- **Business continuity is as essential for the SMB as it is for the enterprise.** Your virtualization solution should contain built-in high availability and disaster recovery features, to minimize downtime in the event of an unplanned system failure or outage. The solution should provide offsite or cloud backup, replication, and automated recovery capabilities, so that you can recover from a disaster that disables your primary site. In addition, the virtualization so-

lution should enable you to non-disruptively migrate your VMs (running or idle) and virtual server storage, to prevent application downtime due to planned maintenance activities.

Microsoft Windows Server 2012 R2 with Hyper-V provides a robust HA offering, primarily via Failover Clustering, including failure detection and non-disruptive, live VM and virtual disk migration. However, Failover Clustering is a “one size fits all” approach that applies to all Windows apps and services, so it’s not optimized for virtual machines. Azure Site Recovery, which went into preview in June 2014 and provides a functional superset of the former Hyper-V Recovery Manager, provides SMB customers with automated failover and failback of VMs running on-premises to an Azure cloud or secondary site. Users can apply Azure Site Recovery protection to any workload, and can also use the service to perform non-disruptive DR testing. App-aware, VSS snapshots can be replicated at a choice of three time intervals – every 30 seconds, 5 minutes or 15 minutes – and Azure can monitor the health of VMs and automatically launch failover when required. Failover and recovery are orchestrated in Azure, to ensure VMs recover in the proper order and with little to no manual intervention.

Citrix XenServer provides HA features, including automated live VM migration in the event of host failures, but not in the event of guest OS or application failures. XenServer prevents VM downtime due to planned maintenance activities, but cannot offer this for virtual disks, since live storage migration is not supported. Amazon provides the minimal business continuity features you would expect to find in a public cloud, such as basic failure monitoring and detection, but because AWS EC2 cannot take automated actions to alleviate or prevent such failures, AWS outages are quite common.

VMware, with its vSphere and vCloud Hybrid Service offerings, has the most complete set of capabilities in this category for SMBs, spanning high availability, fault tolerance and disaster recovery, through features such as VMware vSphere HA, vMotion, Storage vMotion, Fault Tolerance and the vCloud Hybrid Service – Disaster Recovery offering. To protect against unplanned downtime, and minimize downtime when it occurs, vSphere HA provides automated restart of applications within minutes in response to hardware and OS failures, while the integrated vSphere App HA (available in vSphere Enterprise Plus) does the same for application failures. For a higher level of protection, vSphere Fault Tolerance delivers continuous availability, preventing both downtime and data loss for critical applications. vSphere also helps to minimize planned downtime due to server or storage maintenance, through features such as vMotion and Storage vMotion, which enable live migration of VMs and virtual machine disks, respectively, without impacting users or running applications. To facilitate recovery in the event of an extended outage, the built-in vSphere Replication feature supports a wide range of recovery point objectives, and is the underlying replication engine for vCloud Hybrid Service. The vCloud Hybrid Service – Disaster Recovery offering provides hardware-agnostic, self-service disaster recovery protection for virtual machines, with support for a variety of recovery point and recovery time objectives as well as non-disruptive testing of automated failover scenarios. SMB customers can also license VMware Site Recovery Manager, if needed, for an additional fee.

- **To be effective, security must be built in – versus bolted on – to the virtual infrastructure.** Security is consistently cited among SMB customers’ top concerns about moving to virtualization and the cloud. While many vendors adapt existing physical security features and tools to their virtualization offerings, we believe the best approach is to design those capabilities in from the beginning, so that the security is virtualization aware. In this category, we evaluated solutions based on whether they offer a comprehensive security framework, along with logical firewalls that operate at a virtual network interface card (vNIC) level and protec-

tion for VM-based applications from network-based threats. We also looked for non-disruptive approaches to anti-virus scanning.

VMware gets a high overall mark here, with its virtualization-aware security and comprehensive security management framework, including logical firewalls that enforce network settings at a VM level and application firewalls between VMs to protect against network-based threats. vShield Endpoint is also available to SMBs in all editions of vSphere, including the baseline vSphere Standard edition.

Offerings from Microsoft and Citrix tend to employ OS-driven approaches and best practices to try to secure the virtualized environment (e.g. Microsoft with Windows, Citrix with Linux). Microsoft Windows Server 2012 R2 with Hyper-V, with its built-in parent OS and lack of security at the logical boundaries between VMs and applications, cannot provide the level of virtualization-aware security that VMware does. Microsoft is now extending anti-malware protection to Azure VMs with the preview of Microsoft Antimalware for Azure, and is working with third parties such as Symantec and Trend Micro on additional security capabilities.

Citrix XenServer provides limited built-in security, but it requires hardware firewalls, as well as separate tools and management interfaces. As a result, users running XenServer must protect each VM as they would a physical machine; there are no logical firewalls that enforce network settings at the VM level.

Amazon AWS provides multiple layers of security, including host level, guest level and a mandatory inbound firewall to protect tenants and applications. However, AWS security is largely not virtualization aware, and has some significant limitations, such as a lack of logical firewalls that enforce and maintain network security settings at a VM level.

- **Organizations grow and so must their virtualization solutions.** Before investing in a virtualization and cloud platform, SMB buyers should be certain that the underlying architecture will enable the platform to scale efficiently, and grow cost-effectively as their business grows. Scaling efficiency in a data center virtualization architecture includes several important elements. The most visible of these is support for large configurations (e.g. of virtual CPU/memory resources per VM, or hosts/VMs per cluster), which is a prerequisite for a highly elastic infrastructure. Another is resource pooling capabilities, i.e. the ability to create hierarchical pools of CPU and memory resources that scale across hosts in a cluster and allow for resource isolation or sharing between pools. A highly efficient architecture will also support high levels of VM density per host, without significantly impacting application performance. Finally, a scale-efficient virtualization architecture must deliver management platforms that can scale to support large production environments, consisting of 1000+ VMs for SMBs and 10,000+ VMs for enterprises, with both low overhead and high reliability.

VMware vSphere satisfies all of these scaling requirements. vSphere spans and scales across multiple host clusters, and can expand to new clusters and VMs on demand. Based on a series of Taneja Group hands-on validation tests, the vSphere architecture has demonstrated the ability to support large numbers of VMs per host, with the VMs running varying mixes of business-critical workloads (e.g. some CPU-intensive, some memory-intensive, etc.). vSphere efficiency and advanced memory management capabilities both contributed to the high VM density levels we observed in practice. From a management perspective, both vCenter Server and vCenter Operations Manager can scale to manage very large infrastructures, as evidenced by many different VMware customer installations today that are running 1000+ or in some cases 10,000+ VMs.

Microsoft Hyper-V has over the past few releases closed much of the former “configurability gap” versus vSphere, and has leapfrogged VMware (at least for now) in a few areas. Still, ar-

architectural limitations prevent Hyper-V from scaling the way that vSphere can. For example, Hyper-V lacks logical resource (CPU, memory, networking, and storage) pool management, forcing customers to use dedicated host clusters to guarantee tenant VM performance and mitigate noisy neighbor effects. All the controls that are available to tune tenant performance work on a per-VM basis. VM density has improved, removing previous limitations around VMs per host and per cluster. Hyper-V running on Windows Server 2012 R2 is now supporting some large customer installations, and System Center VMM (SCVMM) 2012 provides management support for such large-scale infrastructures.

Citrix XenServer has also increased configuration limits and scalability in recent 6.x releases. For example, XenServer 6.2 achieved a reduction in the amount of traffic between a VM and the control domain (Dom0), and also enabled automatic scaling of Dom0 memory and vCPUs based on physical memory and CPU capacity on the host. While this increased the number of supported VMs per host to 500-650 (depending on OS), consolidation ratios are still constrained by the limited memory overcommit capability, giving vSphere a density advantage.

Amazon AWS EC2 runs on a highly scale-efficient architecture, and with the addition of CloudWatch and Auto Scaling, allows users to automatically scale capacity (the number of running EC2 instances) up or down, based on pre-defined conditions or policies. As a “hands-off” public cloud infrastructure, AWS does not publish VM scalability or density numbers, so it is difficult to compare AWS scaling efficiency with that of the other landscape vendors. EC2 does not support hierarchical resource pools that scale across hosts in a cluster, with a choice of resource isolation or sharing, so it cannot match vSphere in that dimension, which is a key enabler of scaling efficiency for enterprise-critical applications.

SOFTWARE DEFINED INFRASTRUCTURE COMPETITIVE LANDSCAPE

Software Defined Infrastructure Factors	VMW	MSFT	AMZN	CTXS
Service Level Assurance for Business Critical Applications				
Software Defined Storage and Availability				
OVERALL SCORES:	3.5	2.0	1.5	1.0

Taneja Group Opinion

- **You cannot afford to gamble with your business-critical applications.** You would never leave quality of service to chance in your physical infrastructure, and you shouldn't in your virtual one, either. To provide service-level assurance in a virtual infrastructure, the hypervisor must provide dynamic allocation of CPU, memory, storage and networking from a set of logical resource pools, so that VMs running business-critical applications will not be starved for these resources when they are most needed. Dynamic resource allocations can be managed and implemented through policy-based automation capabilities. Host and storage I/O profile capabilities enable you to standardize configurations of new virtual hosts and datastores, to help ensure that the resources are available to meet service-level needs of high-priority applications.

VMware vSphere with Operations Management Enterprise Plus edition sets the standard for service-level assurance, with features such as Distributed Resource Scheduler (DRS) and Storage DRS, which enable IT resources to be dynamically load balanced, and features like Storage I/O Control and Network I/O Control, which allow administrators to set policies that

govern how resources are allocated to competing VMs. vSphere also provides robust isolation of resource consumption. A number of the vSphere resource management capabilities go beyond an individual host, and apply at the cluster level.

Microsoft Windows Server 2012 R2 with Hyper-V does not provide logical resource pools across host clusters, and CPU and memory resources are assigned at the VM level, rather than at the logical pool or tenant level. Windows Server 2012 R2 does provide good visibility into resource usage at an application level, but that is not always enough to assure service levels for critical applications. While Storage QoS can help mitigate the impact of storage intensive workloads on other VMs running on the same host (with no datastore awareness), the Microsoft offering cannot dynamically allocate storage resources to critical VMs.

Citrix XenServer offers basic resource sharing, but does not provide policy-based automation or the ability to dynamically allocate storage or networking resources to high-priority VMs. As a result, SMB users cannot be sure that their critical, high-priority applications will get the resources they need to meet service-level requirements. Microsoft and Citrix also do not provide host or storage I/O profile capabilities.

AWS does not offer shared IT resource pools or the ability to dynamically allocate storage or IO resources to critical VM-based applications. As a consequence, SMB customers will want to think twice before moving their critical applications to an AWS EC2 public cloud environment.

- **Make the most of your virtual infrastructure storage investment by moving to software-defined storage.** Though software-defined storage is a newly emerging technology, it has the potential to deliver a storage solution that is fully complementary and tailored to virtual servers. Software-defined storage will ideally be application-centric, enabling simple provisioning from pooled compute and storage resources and integrated with the hypervisor for optimal performance. The solution should support shared storage, featuring both server HDDs and flash. Built-in high-availability capabilities, also defined in software, will increase the resilience of the solution, without imposing the cost or complexity of hardware approaches. The combined software-defined storage and availability solution will include policy-based management to allow users to specify and maintain specific storage performance, capacity and availability levels per VM, and dynamically scale performance and/or capacity as needed. To promote data protection and business continuity, an ideal offering should also support data services such as snapshots, replication, and multi-site DR.

VMware's recently introduced Virtual SAN offering is well positioned to satisfy these requirements. Just a few clicks are needed to initially provision shared storage, speeding and streamlining deployment. A virtual server administrator does not need to wait for a storage admin to provision LUNs; rather, he can rapidly create a Virtual SAN datastore to meet application storage needs. Users can define capacity, performance and availability policies on a per-VM or per-virtual disk basis, and scale performance and/or capacity on demand by adding hosts on the fly or hot-adding disks to existing server nodes. The solution is tightly integrated with the vSphere kernel to minimize latency, and takes advantage of vSphere services such as snapshots, clones and replication. Though the storage hardware compatibility list (HCL) is still a bit limited and the solution is still relatively new, Virtual SAN has already received several industry awards and is rapidly being adopted by vSphere users.

Microsoft has two offerings that fit roughly into this category. The first is Storage Spaces, which virtualizes storage by grouping physical disks into pools, and then creating virtual disks from the available pooled capacity. Storage Spaces is integrated with Microsoft Failover Clustering for high availability (providing a hardware RAID alternative) and with Cluster Shared Volumes (CSV) for scale-out deployments. With Storage Spaces, users can control re-

siliency levels and take advantage of features such as storage tiering and a write-back cache. The second offering is Scale-Out File Servers (SOFS), which creates scale-out file shares to provide active/active storage to application servers, using cluster supported storage such as a SAN (or direct attached shared storage running Storage Spaces). For example, Hyper-V can store VM files on SMB 3.0 file shares enabled by SOFS. Both Storage Spaces and SOFS were originally introduced in Windows Server 2012 (with enhancements to Storage Spaces made in R2), and they therefore have a slight edge over Virtual SAN in terms of maturity and proven reliability. However, Storage Spaces and SOFS are Windows Server features, and do not offer hypervisor-level integration for the best possible performance. Also unlike with Virtual SAN, users cannot define and manage policies at a VM level of granularity. In addition, when customers are ready to expand storage in Storage Spaces, they will need to add more hardware running Windows Server, which means they will be increasing their physical infrastructure rather than reducing it.

Citrix XenServer does not provide app-centric, software-defined storage and HA capabilities (i.e. a Virtual SAN equivalent), nor does it enable simplified provisioning from pooled compute and storage resources. StorageLink, the focal point for shared storage support in XenServer, provides access to third party storage arrays that support both server disks (HDDs) and flash, but not in a software-defined way. The StorageLink feature has been deprecated, and so will not be further enhanced or supported in future XenServer releases.

AWS also does not provide the equivalent of a VMware Virtual SAN offering today, including features such as app-centricity, built-in resiliency, provisioning from pooled compute and storage resources, and a policy-based mechanism to enable and maintain specific capacity, performance and availability levels per VM. Amazon is enlisting third parties to deliver software-defined storage, such as virtual private storage arrays and similar solutions on AWS.

MANAGEMENT AND AUTOMATION COMPETITIVE LANDSCAPE

Management and Automation Factors	VMW	MSFT	AMZN	CTXS
Tools to Plan, Deploy and Manage Virtualization				
Infrastructure Operations Management				
Patch and Asset Management				
Hybrid Cloud Management				
Ease of Migration and Cost of Exit				
Heterogeneous Management Capabilities				
OVERALL SCORES:	 3.5	 2.2	 1.5	 2.0

Taneja Group Opinion

- **Virtualizing shouldn't be a trial-and-error exercise.** One of the frustrations we hear from SMBs is that their virtualization supplier did not provide them with enough help and guidance upfront, so that they could readily identify the best candidates for virtualization from among their physical server workloads, and easily install, set up and manage their virtualization environment. These SMBs had to read through detailed technical documentation, and in some

cases, resort to trial-and-error approaches to get their environments working. To address this requirement, we believe that virtualization providers should include sufficient tools to automate workload discovery, selection and conversion, as well as wizards to enable IT generalists to set up and manage the initial deployment.

VMware has recently simplified the vSphere installation experience, and offers a variety of planning and deployment tools that facilitate and streamline SMBs' first steps toward virtualization. The online VMware Virtualization Advisory Tool provides SMBs with a guided assessment to plan for virtualization, while the vCenter Server Appliance (VCSA) includes wizard-based VM install, set-up and management capabilities, via a vCenter Server Simple Install. Standalone (and free-of-charge) vCenter Converter provides P2V, V2V, and other workload migration features. vCenter Guided Consolidation (also free) and VMware Capacity Planner (for a fee) assess current and projected usage of an IT infrastructure so SMBs can plan ahead. In addition, VMware enables cross-cloud migration with its vCloud Connector offering.

Microsoft provides an array of virtualization planning and deployment capabilities in System Center Essentials 2010 and System Center 2012 R2. System Center Essentials offers discovery and inventory management features, as well as wizard-based VM installation, set-up and management. However, System Center Essentials does not provide a guided assessment or the ability to recommend virtualization candidates, and it also does not offer recommendations for improving infrastructure reliability. System Center Essentials also does not support Windows Server 2012 R2.

Citrix XenServer delivers an easy-to-deploy infrastructure, and promises 10-minute installation and set-up. But Citrix does not provide SMB-specific tools to guide a virtualization assessment or to identify app candidates for virtualization. In addition, Citrix no longer offers XenConvert for P2V conversion and other workload migration needs (having retired the tool in the 6.2 release).

Virtualization is built in to Amazon's public cloud offering, which reduces the need for installation tools, but Amazon does provide a series of white papers and checklists to help customers decide what types of workloads are best suited for AWS. Amazon also offers documentation and tools to facilitate the deployment of Amazon Machine Images (AMIs), but no wizard-based image install, set-up or management capabilities. Though AWS enables migration of workloads via the VM Import/Export tool, it does not offer P2V conversion of existing physical workloads.

- **Strive to put your virtual infrastructure on auto-pilot.** It takes a strong and well-integrated management toolset to keep a virtual infrastructure running smoothly and effectively. But beyond that, it takes built-in intelligence and automation, since an SMB customer will typically have only limited time and expertise to master and play a hands-on role in day-to-day management. For this reason, we looked for built-in performance monitoring, capacity metering, and operations dashboards as we assessed each solution. Since a virtualization deployment is never static, we also checked for features such as dynamic performance thresholding and self-learning analytics, as well as the ability to correlate performance with change events. Finally, since users really care most about how their own applications are performing, we evaluated solutions for application visibility and awareness.

Against this set of criteria, Microsoft gets partial credit, since System Center 2012 R2 provides many of these management features. The latest System Center release is designed to work across physical and virtual environments as well as Microsoft private and public clouds, and all seven System Center modules are available via a single license. However, the legacy of System Center, which relies heavily on scripting and rules-based management, can make it diffi-

cult for SMB customers to productively manage their virtualized and cloud environments. Since the various System Center product modules are only loosely integrated, Microsoft customers will in some cases need to buy add-on management packs, integration packs and/or connectors to enable specific modules to work together. Recently announced System Center Advisor, which enables SaaS monitoring of on-premises System Center deployments, is designed to provide admins with greater management flexibility, but it also requires a number of other System Center components to work effectively. A number of System Center 2012 R2 components are not purpose-built for Hyper-V environments, and System Center does not offer an integrated operations dashboard across the various modules. System Center Operations Manager (SCOM) offers the most detailed virtual infrastructure operational metrics, but they are still only a fraction of the metrics available in vCenter. System Center Virtual Machine Manager (SCVMM) and SCOM provide partial event and incident management, and dynamic performance thresholds and self-learning performance analytics are only supported through the use of third-party plug-ins.

Citrix XenCenter was purpose built for virtualized environments, and provides monitoring of compute, memory and network performance, though it is not as tightly integrated with XenServer as vCenter Operations Manager (vCOPs) is with vSphere. XenCenter is also not as comprehensive as vCOPs, lacking features such as capacity usage metering, correlation of performance with change events, dynamic performance thresholds and self-learning performance analytics. Amazon CloudWatch delivers resource utilization monitoring, as well as visibility into application performance and system health. Static, but not dynamic, performance thresholds can be set. AWS does not provide unified event and incident management, correlation of performance/change events, self-learning performance analytics, or integrated configuration management.

VMware, with its vCenter Operations Management Standard, available to SMBs in all editions of the vSphere with Operations Management suite, is able to deliver all of these operations management capabilities.

- **SMB customers cannot afford expensive add-ons for essential patching and asset management functions.** As you evaluate competing virtualization solutions, it pays to look closely to see whether they include basic administrative functions that you likely take for granted in your physical infrastructure. For example, does the virtualization solution enable you to inventory and manage your hardware assets? Does it allow you to easily manage your software licenses? How about patching? Do you have the ability to scan for, schedule and deploy software patches for both Windows and third party applications, for either virtual or physical devices? Are all of these management capabilities for your physical and virtual devices accessible from a single management console?

Based on our assessment, you'll likely find a varying degree of coverage for these capabilities among the four vendors' solutions. Citrix provides hardware inventory and software license management, but only via XenCenter plug-ins to third party packages. Citrix does not offer users the ability to automatically scan, schedule and deploy patches; users must manually keep track of patch availability, and then manually download patches and install them. The lack of an integrated guest OS update engine means that SMB administrators will have to take on patch management responsibilities.

Microsoft provides automated hardware asset inventorying and management as well as single-pane-of-glass visibility in System Center Essentials 2010. System Center Essentials also allows users to manage and schedule updates of Microsoft and third party software, but does not support Windows Server 2012 R2. For asset and patch management in Windows Server

2012 R2, SMB users will have to turn to System Center 2012 R2. Customers can use Windows Server Update Services to patch virtual machines, and Virtual Machine Servicing Tool 2012 to keep offline VMs, templates and virtual hard disks (VHDs) up to date.

AWS OpsWorks can automate patch management for guest OSs and applications running on EC2, but it takes DevOps expertise to develop and operationalize this capability for an SMB customer's own application set. Alternatively, AWS recommends manual patching or the use of existing on-site tools. Several third party products provide inventory and management of digital hardware assets and software license management capabilities.

VMware offers the most comprehensive and cost effective set of patch and asset management solutions for the SMB customer. vCenter Server Essentials provides automated inventorying of hardware assets, while vSphere Update Manager automates patch management of vSphere hosts and virtual machines. Users can gain visibility into the patch status across their virtual infrastructure with a patch compliance dashboard, and stage and schedule patching for remote sites. For software license management and compliance, SMB users can turn to one of several third party solutions.

- **Extend your on-premises management to the hybrid cloud.** To make a hybrid cloud deployment most productive, small and midsize business users require a consistent management approach and toolset across their on- and off-premises environments. The solution should allow them to provision against multiple resource pools and monitor and manage workloads between on-premises and one or more public clouds.

VMware has a relatively complete offering here, though its vCloud Hybrid Service (vCHS) has been on the market only since August 2013. vCHS provides a single tool to deploy and manage on- and off-premises workloads, and to allocate and provision pooled resources where they are most needed. Together, vSphere with Operations Management Enterprise Plus and vCHS enable full isolation and security of workloads in a multi-tenant environment. vCHS is integrated with other VMware tools such as vCenter Server and vCenter Operations Management to enable consistent monitoring and management of VMs, events and support issues. For these reasons, we have given VMware a high score in hybrid cloud management.

The Microsoft hybrid cloud combines Windows Azure, Windows Server and Microsoft System Center. System Center 2012 R2 provides a common toolset to manage on-premises and Azure public cloud environments, and a number of System Center tools (e.g. App Controller, VMM) support cross-cloud operations. However, Microsoft lacks the ability to provision across multiple resource pools that span on- and off-premises, and cannot provide full isolation and security of workloads in a multi-tenant environment.

AWS does not provide a hybrid cloud option today, nor does it offer the kind of cross-cloud management tools we were looking for here. AWS also lacks the ability to provision across multiple logical resource pools and (without dedicated cloud infrastructure) to provide the full isolation and security required for multi-tenant, enterprise workloads. As a result, AWS received the lowest score in this category.

To enable a hybrid cloud, Citrix provides CloudBridge, a virtual or physical appliance that resides on-premises and gives customers a secure, transparent way to connect to third party clouds. CloudPlatform (and the Apache CloudStack offering on which it is based) does not provide the ability to provision across multiple logical resource pools, based on-premises and in one or more public clouds. CloudPlatform supports basic usage metering and event/audit logs, but full VM and event monitoring and management capabilities are only available through third party solutions. For these reasons, Citrix scored below VMware in this category.

HYBRID CLOUD COMPETITIVE LANDSCAPE*

Hybrid Cloud Factors	VMW	MSFT	AMZN	CTXS
Network Extensibility Between Data Center and Hybrid Cloud	●	◐	◐	◐
Workload Compatibility and Migration Between On- and Off-Premises	●	◐	◐	◐
Support for Both Legacy and Cloud-Enabled Workloads	◐	◐	◐	◐
Broad OS and Application Support	●	◐	◐	◐
Storage Compatibility Between On- and Off-Premises Infrastructure	●	◐	◐	◐
Consistent High Availability Approach Between On- and Off-Premises Environments	●	◐	○	◐
Data Protection	◐	◐	◐	◐
Consistent Security Framework	●	◐	◐	◐
Catalog and Template Synchronization	●	◐	◐	◐
Support for Dedicated Cloud Infrastructure	◐	◐	◐	◐
Support for Virtual Private Cloud	●	◐	●	◐
OVERALL SCORES:	3.4	2.5	2.6	2.4

* Note: this category is focused on business-oriented hybrid cloud capabilities, rather than general public cloud features. We have given vendors with public cloud offerings (e.g. Amazon) credit for their public cloud capabilities, in the context of (and to the extent they add value to) a business-oriented hybrid cloud solution.

Taneja Group Opinion

- **Very few true business-capable hybrid cloud solutions exist today.** With the exception of VMware, vendors scored fair to poor on most of the hybrid cloud evaluation factors, primarily because their hybrid cloud offerings do not have full capabilities and/or are not that far along. Most small and midsize organizations will not invest in a hybrid cloud unless the solution is held to the same standard as their on-premises environment. This means a high level of security and availability, on-premises to cloud interoperability, and unfettered workload portability.

With its vCloud Hybrid Service (vCHS), vCloud Connector, and advanced vSphere virtualization capabilities, VMware is the only vendor offering a true hybrid cloud model, including cross-cloud security, management, interoperability, and workload portability. VMware offers seamless network connectivity between on-premises (private) and public clouds, proven virtualization-aware security, and certified support for 96+ guest OSs and more than 5,000 applications. vCHS provides support for a multi-tenant virtual private cloud, as well as dedicated cloud infrastructure for those applications that require it for performance purposes. VMware has also launched several business solutions based at least in part on vCHS, including vCHS-Disaster Recovery (DR as a service) and Horizon DaaS (virtual desktops as a service).

Microsoft hybrid cloud, which combines Windows Azure, Windows Server and Microsoft System Center, enables on-premises to public cloud network extensibility via Azure ExpressRoute. ExpressRoute private, high-speed links are provided to customers by large network service providers. The secure, high-performance link enables high-volume data transfers and hybrid application use cases, though it does not simplify management of data center and hybrid cloud networks. Microsoft's hybrid cloud solution lacks virtualization-aware security, and the security frameworks are inconsistent between Windows Azure and Windows Server. Windows Azure provides broad Windows OS support, but is still catching up in terms of Linux support. The hybrid cloud solution supports both legacy and cloud-enabled apps.

Though Amazon does not offer on-premises, private clouds, it does provide the ability to extend customers' on-premises networks into the AWS public cloud, via an AWS Direct Connect dedicated network connection. The AWS public cloud provides weaker security than VMware does in its hybrid cloud offering. Though it is not a true hybrid cloud solution, AWS supports major Windows and Linux OSs, major commercial apps, and both legacy and cloud-enabled workloads. AWS is still trailing VMware and Microsoft in support for legacy workloads. Also to its credit, AWS goes beyond most vendors' offerings by supporting both dedicated cloud infrastructure (via Dedicated Instances) and an AWS Virtual Private Cloud.

Citrix's hybrid cloud offering is based primarily on CloudPlatform, which provides an orchestration and management platform for private, public and hybrid clouds. Another component of the solution is the CloudBridge appliance, which enables customers to securely extend their on-premises network to the hybrid cloud. CloudPlatform delivers a fairly robust security offering, including support for VPN, NAT, DHCP and firewalls, and role-based access (offering a choice of three roles). However, Citrix does not appear to offer a consistent security and identity management framework across on-premises XenServer and off-premises CloudPlatform environments. On the other hand, the HA approach is relatively consistent. Citrix does a good job of supporting both traditional and new cloud-enabled workloads; CloudPlatform APIs are well documented and extensible, and include support for AWS EC2 and S3.

- **Demand full workload portability between on-premises and the cloud.** To be attractive to enterprise users, a hybrid cloud must provide simple and painless portability of workloads between on-premises, hybrid and public clouds. Customers should be able to manage workload migration across clouds from a single interface. In addition, clouds should not impose an "exit tax" on users who decide to move their workloads to a different cloud.

Microsoft System Center App Controller enables customers to move workloads between on-premises Microsoft private clouds (and clouds in which Xen or ESXi/vSphere virtualization hosts are being managed by System Center VMM) and Windows Azure public clouds, from a single interface. While it was formerly quite difficult to move workloads between on-premises and Windows Azure environments, the portability of workloads in and out of Azure has improved considerably, as long as the workloads are running in Windows Azure Virtual Machines. Still, Microsoft has published detailed migration guides that provide users with step-by-step migration guidelines, so the migration process is far from trivial, especially for business-critical applications. Complex legacy applications are often still quite difficult to move into Azure. Core infrastructure such as security, availability and resource management services differ between Windows Azure and Windows Server/Hyper-V, so customers will also need to take this into account as they plan which apps to migrate. Once in the cloud, workloads can be migrated among Azure public cloud data centers (16 of them so far), as long as customers are willing to pay the relatively nominal data transfer charge. The data transfer costs of exiting the Azure public cloud to another vendor's cloud are in the range of \$50-120 per TB, but any associated workload conversion costs could end up being much higher.

Amazon AWS enables fairly easy and straightforward importing of apps (via VMs) from other clouds (e.g. OpenStack, vCloud), but it is more difficult to export those EC2 instances from AWS to other clouds. Similarly, Amazon is also encouraging VMware SMB customers to migrate on-premises apps to AWS via the AWS Management Portal for vCenter, and then continue to manage them in vCenter. Customers that take AWS up on this offer will lose the ability to automate and orchestrate their workloads across private and public clouds, as well as the ability to enforce policy-based governance across multiple clouds. Just as importantly, once the migration to AWS takes place, SMB customers will find it very difficult to move their workloads back on-premises or to a different public cloud. Specifically, users will need to be prepared to set up their servers from scratch if they decide to move their apps out of EC2. In practice, depending on the investment a customer has made in building a server farm with AWS server images (AMIs), and auto scaling and/or custom scripting workload operation, the switching cost can be significant. Third party cross-cloud management solutions from vendors such as RightScale or Scalr can reduce the cost, but the required effort is far from plug and play.

Citrix CloudBridge allows on-premises XenServer-based workloads to be migrated to a CloudPlatform-based cloud and run without modification or conversion. In addition, workloads can also be migrated between CloudPlatform driven private (or virtual private) clouds and public clouds using CloudBridge. Citrix also supports workload migration across heterogeneous virtualization platforms. The migration story is a bit more problematic in the case of CloudStack: customers may find themselves locked in to CloudStack because (as of yet) there are relatively few CloudStack public cloud deployments and often not a simple way to move workloads between different providers' environments.

VMware has a strong offering in this category: vCloud Connector, which facilitates workload migration and management. Using the vCloud Connector management interface, customers can migrate existing workloads – vApps, VMs or templates – between on-premises infrastructure, vCHS hybrid clouds and vCloud-based public clouds. Customers can also employ vCloud Connector to move workloads to other public clouds, such as AWS EC2. Migration from vCloud to other supported public clouds generally involves minimal effort and cost.

- **Choose a vendor that offers full on-premises to hybrid cloud compatibility.** To be business ready, and support use cases such as cloud bursting and DR as a service, a hybrid cloud solution must enable a compatible and consistent infrastructure between on- and off-premises environments for running and protecting production applications. This means a consistent security framework, as well as a consistent high availability approach that prevents customers from having to design resiliency into their applications. It means data protection and replication schemes that work seamlessly across on-premises and public clouds. Full hybrid cloud compatibility also means a common virtual disk format to enable storage compatibility across on- and off-premises. In our minds, compatibility should additionally extend to provisioning and deployment processes, such as catalog and template synchronization to ensure the use of corporate-blessed application images.

VMware scores well in all of these compatibility dimensions. The vCHS platform delivers a consistent security framework, and VMware HA and vMotion capabilities are supported on- and off-premises, avoiding the need for customers to build availability services into their applications. vCHS-Data Protection provides policy-based backup and recovery for virtual machine data and content, and vCHS-Disaster Recovery enables recovery as a service based on the vSphere Replication engine. VMDK virtual disk format is supported across on- and off-premises VMware environments, as well as in other providers' public clouds (e.g. AWS). vCHS and vCloud Connector Advanced Edition extend the scope of compatibility to provisioning

and deployment, by allowing approved on-premises templates to be synchronized between on-and off- premises cloud service catalogs.

Microsoft falls short in providing a consistent security framework between on- and off-premises environments. Windows Azure lacks the HA and live migration features of Hyper-V, so cannot offer a consistent HA approach between on-premises and the public cloud. As a result, customers must design resiliency into their applications. Microsoft does provide a common VHD virtual disk format between on and off premises, though VHDX formatted virtual disks on Windows Server must be converted down to VHD to run on Windows Azure. The company also provides compatible hybrid cloud storage, via its StorSimple cloud-integrated storage solution, which provides customers with local (on-premises) storage control and consistent performance, coupled with the pay-as-you-grow advantages of a public cloud. To protect data in the event of a disaster or prolonged outage, customers can utilize the Geo-Replication for Azure Storage feature, which allows Azure Blobs and Tables to be replicated to and recovered from a data center in a different geographic region. The new Azure Site Recovery capability will enable automated failover and failback of VMs between on-premises and the Azure cloud. Microsoft hybrid cloud does not appear to offer an out-of-the-box capability to synchronize templates between on-premises and public cloud service catalogs.

Amazon does not support its own on-premises environment, and so cannot provide a consistent security framework between on- and off-premises. AWS offers relatively weak HA guarantees in the public cloud, and its infrastructure driven HA capabilities are not available on-premises. To facilitate storage compatibility between on and off premises, Amazon provides the AWS Storage Gateway, which offers users the ability to connect on-premises storage (accessed via an iSCSI interface) with in-cloud storage in AWS S3. This service provides application compatibility and no need to change on-premises disk formats. Again, without an on-premises footprint, Amazon cannot deliver catalog and template synchronization between on-and off-premises.

Citrix provides a robust security offering, but does not offer a consistent security framework between on-premises XenServer and off-premises CloudPlatform (or CloudStack) environments. The company offers relatively consistent high availability capabilities, but while VM workloads will continue to run in the event of a host failure, that is not necessarily the case in the event of guest OS or application failures. As a result, customers will want to consider designing resiliency into their business-critical applications. CloudPlatform does not support automated, policy-based backup and recovery to protect cloud-based workloads (though manual snapshots are supported), and Citrix relies on third party solutions for replication. Citrix claims CloudPlatform is storage agnostic, meaning that it can orchestrate over block, file and object storage irrespective of the underlying storage technologies and protocols. However, Citrix is dependent on third parties to provide compatible storage between on- and off-premises. CloudPlatform today enables users to import a template from an on-premises environment and launch VMs based on that template in the cloud, but it's not clear how catalogs are synchronized (if at all).

VENDOR SNAPSHOTS

VMWARE

VMware is the virtualization market leader, and at the forefront in software-defined infrastructure, hybrid cloud and end user computing/mobility solutions. vSphere is far and away the industry's leading virtualization platform, in terms of maturity, advanced capabilities, breadth of guest OS and application support, and market adoption. Together, vCenter Operations Management (vCOPs) and vCloud Automation Center (vCAC) suites deliver comprehensive provisioning, automation and management capabilities for virtualized and cloud infrastructures.

VMware has built the most comprehensive software defined infrastructure offering, leveraging both its virtualization strengths and acquired technologies to bring to market Virtual SAN software-defined storage and NSX network virtualization solutions. The company has developed a vCloud-based, enterprise capable hybrid cloud platform, which can connect on-premises virtualization and private cloud environments with vCloud-Powered public clouds. The platform is also the basis for vCloud Hybrid Service (vCHS), which is primarily a VMware-operated public cloud service focused on enabling VMware-based hybrid clouds. vCHS provides a single tool to deploy and manage workloads between on-premises and multiple public clouds (vCloud, AWS, etc.).

Competitive Advantages

- The virtualization technology and market leader, with proven solutions being used by more than 500,000 customers.
- Advanced management and automation capabilities tailored to virtual and cloud infrastructures.
- Strong uptake in the company's software-defined infrastructure offerings, including award-winning Virtual SAN, which is already gaining significant market momentum.
- The most secure hypervisor and cloud IaaS platforms, available in private, hybrid and public cloud offerings, with virtualization aware security and a consistent framework across on- and off-premises environments. VMware delivers security at multiple layers of the cloud IaaS stack, including host, network, application, data and endpoint.
- VMware's hybrid cloud (vCHS) offering, which effectively bridges on-premises and off-premises environments, and delivers enterprise-class enablers such as workload portability and interoperability leveraging common platform, management, and security layers.
- vSphere with Operations Management Enterprise Plus suite provides the industry's most powerful and functional virtualization platform for small and midsize organizations
- An extensive global partner network, including 75,000+ channel partners and 11,000+ service provider partners.

Competitive Disadvantages

- With vCloud Hybrid Service still early in its adoption cycle, VMware is playing a bit of catch-up in the market for hybrid cloud solutions.
- Fairly or unfairly, VMware still has the reputation of being a high-priced provider of virtualization and cloud solutions, offering good value but not necessarily aggressive pricing.

MICROSOFT

Microsoft is the world's leading provider of server and desktop operating systems, and one of the top commercial application vendors as well. In the virtualization and private cloud space, Microsoft offers Windows Server 2012 R2 with Hyper-V for on-premises and private clouds, along with System Center 2012 R2 management solutions. Windows Azure is the company's IaaS and PaaS public cloud offering. Microsoft's hybrid cloud solution combines all three of these components (Windows Server, System Center, and Windows Azure). Microsoft Hyper-V occupies a solid #2 position among commercial hypervisors, second only to ESX/vSphere in terms of maturity, advanced features, and market adoption. System Center was originally designed for use in on-premises physical Windows environments, but it has gradually been enhanced over the years to also address virtualization and cloud management needs.

Microsoft is building out its software-defined infrastructure offerings. Storage Spaces, which comes closest to a software-defined storage offering, enables storage virtualization and resource pooling, but is not application or VM centric today, and requires dedicated servers. Azure Site Recovery provides SMB customers with automated failover and failback of VMs running on-premises to an Azure cloud or secondary site. The company also delivers cloud-integrated enterprise storage through its StorSimple solution. The Microsoft hybrid cloud offering is still a work in progress, with much improved workload portability between on-premises and off-premises, but still incompatible security and availability frameworks.

Competitive Advantages

- While under competitive pressure on multiple fronts, Microsoft's Windows franchise is still enormous, with hundreds of millions of enterprise, business and professional users.
- Playing at nearly every level of the cloud market, including IaaS, PaaS, and SaaS offerings, and is investing considerable money and effort to brand itself as a cloud leader to business customers. The company has laid out a "Cloud OS" vision, which encompasses its full virtualization and cloud portfolio, and has announced its intention to become a leading hybrid cloud supplier.
- Investing heavily in training, equipping, and motivating its vast array of channel partners to win in cloud opportunities.
- The Hyper-V virtualization platform continues to offer more enterprise-level functionality, and its market share continues to expand, both in traditional Windows accounts and as a second hypervisor to VMware.

Competitive Disadvantages

- Though the company's strategy is based on moving customers to a cloud-enabled OS, the foundation of Hyper-V virtualization and Windows Azure cloud solutions continues to be architecturally tied to Windows. This impacts the pace of innovation and time to market for new releases.
- Despite the strength of Microsoft System Center in traditional Windows environments, the suite is still being adapted to serve virtualization and cloud management needs, and remains complex to deploy and administer.
- Though hybrid cloud workload portability is improving, there are still challenges here for customers, particularly in migrating workloads from Azure to other public clouds.
- Microsoft has achieved limited uptake of Windows Server with Hyper-V and System Center among service providers, given providers' reluctance to partner with a company that might compete directly with them in the public cloud.
- Existing and would-be Microsoft customers are concerned about the potential for lock-in to the proprietary elements of Microsoft's cloud offerings.

AMAZON

Amazon is the world's largest online retailer, and Amazon Web Services (AWS) is the world's largest public cloud. The company was a pioneer in commodity cloud computing and has the largest market share among public cloud providers, with eight years' experience in delivering cloud compute services. Amazon is continuing to expand use cases for AWS, and is increasingly orienting the public cloud to business users. AWS includes both IaaS and PaaS offerings, but this landscape study is focused on infrastructure services, such as AWS EC2 compute, Elastic Block Store (EBS) and Simple Storage Service (S3). AWS EC2 is based on a highly customized version of the Xen hypervisor, and provides basic virtualization capabilities, but lacks the robustness, availability and quality-of-service controls of enterprise offerings like vSphere and vCloud. AWS does not provide app-centric, software-defined storage and networking offerings based on virtualized and pooled resources.

Amazon CloudWatch provides visibility into the operational health, resource utilization, and application performance of each EC2 instance. Amazon also offers a series of security services, including AWS Identity and Access Management (IAM). AWS does not provide a formal hybrid cloud option today, nor does it offer cross-cloud management tools. However, AWS Direct Connect allows users to extend their on-premises environment into the AWS public cloud, and the AWS Storage Gateway enables users to pay for AWS storage as they grow, while providing fast access to frequently accessed data on-premises. In addition, the AWS Virtual Private Cloud (VPC) offering enables users to provision a private, isolated section of the AWS cloud for applications that require additional security, privacy or performance.

Competitive Advantages

- Leading public cloud IaaS offering, in terms of market share and brand presence.
- Wide appeal among developers, who write many next-gen apps specifically for the AWS cloud.
- Broad products and services portfolio, offering one or more use cases for nearly every type of workload and customer.
- Strong track record of innovation and being first to market with new public cloud solutions.
- Premium technical support services that make AWS more attractive to business customers.
- Pricing leadership among public cloud providers.

Competitive Disadvantages

- Lack of enterprise-grade business continuity and security capabilities, particularly compared to VMware offerings.
- SLAs that are targeted at the needs of developers and non-critical applications, rather than business customers and critical workloads (availability guarantees are particularly weak).
- No true hybrid cloud offering, since AWS cannot offer an on-premises cloud. In addition, AWS does not provide cross-cloud management and interoperability.
- Business and corporate customers generally have to re-architect their existing (legacy) applications to run them in the EC2 cloud, and then those apps are no longer portable to on-premises infrastructure or other public clouds.

CITRIX

Citrix is a pioneer in end user computing, and provides server, application and desktop virtualization solutions along with networking and cloud computing technologies to SMB and enterprise customers. Citrix's market coverage has grown dramatically in recent years, from a primary focus on server-based multi-user computing just 12 years ago, to a diversified set of virtualization, cloud and networking solutions today. Citrix has been a technology partner with Microsoft since the mid-1990's, and in recent years that relationship has expanded to include some reciprocal sales and joint marketing efforts. Citrix offers SMBs XenServer 6.2 for server virtualization, including both open source and commercially supported versions. The Xen architecture is domain-based, relying on a Linux OS parent partition, which increases its vulnerability to security issues. XenServer provides both basic and advanced virtualization functionality, but Citrix has been deprecating and discontinuing features in recent releases, which puts the future roadmap for the product in question. XenServer lacks some of the advanced resource control and load balancing features available in vSphere, and has relatively limited use today in supporting production applications among SMB and enterprise customers. XenServer also does not provide app-centric, software-defined storage and HA capabilities.

The accompanying XenCenter offering delivers basic resource monitoring capabilities, but lacks a number of key management features included in VMware vCenter Operations Manager. Citrix's hybrid cloud offering is based primarily on CloudPlatform, which is powered by Apache CloudStack and provides an orchestration and management platform for private, public and hybrid clouds. The CloudBridge appliance enables customers to securely extend their on-premises network to the hybrid cloud. Citrix CloudBridge allows on-premises XenServer-based workloads to be migrated to a CloudPlatform-based cloud and run without modification. However, the CloudStack service provider ecosystem is still in the very early stages of development, and customers may find themselves locked in to CloudStack because (as of yet) there are relatively few CloudStack public cloud deployments.

Competitive Advantages

- Citrix has a strong presence and large installed base among SMB customers, with its traditional server-centric multi-user computing (aka session virtualization) offerings (now part of XenApp, but formerly under the MetaFrame brand).
- XenServer and the underlying Xen hypervisor benefit from the innovation of the open source developer community.
- Xen has a leading market share among open-source hypervisors, and the open sourcing of XenServer in 2013 has helped to increase its adoption among small and midsize business customers.
- Citrix CloudPlatform and the associated CloudBridge appliance can help SMBs to effectively and non-disruptively extend their on-premises environments into the cloud.

Competitive Disadvantages

- Citrix has de-emphasized XenServer as a commercial offering over the past couple of years, and has been deprecating and discontinuing features over the past few releases.
- Citrix is a distant third in terms of market share and presence in the server virtualization space, and therefore SMB customers may not regard XenServer as a safe or comfortable choice.
- Citrix XenServer lags VMware vSphere in a number of functional areas, including security and quality of service controls.
- Citrix XenCenter is relatively weak among the field of virtual infrastructure management solutions.
- The CloudStack public cloud ecosystem is developing only slowly, which limits SMB customers' choice and flexibility as they begin to move business-critical workloads to the cloud.

THIS REPORT WAS SPONSORED BY VMWARE

ABOUT TANEJA GROUP

Taneja Group's mission is to deliver best-in-class technology analysis and consulting for the storage, server, virtualization, cloud and big data markets to enable our clients to convert technology into business. We are a boutique firm of operational experts with both broad and deep expertise in storage systems and technologies, server and desktop hardware and software, virtualization platforms and appliances, cloud software and services, and physical and virtual infrastructure management solutions.

For more information, please visit www.tanejagroup.com.

NOTICE: THE INFORMATION CONTAINED HEREIN HAS BEEN OBTAINED FROM SOURCES BELIEVED TO BE ACCURATE AND RELIABLE, AND INCLUDES PERSONAL OPINIONS THAT ARE SUBJECT TO CHANGE WITHOUT NOTICE. TANEJA GROUP DISCLAIMS ALL WARRANTIES AS TO THE ACCURACY OF SUCH INFORMATION AND ASSUMES NO RESPONSIBILITY OR LIABILITY FOR ERRORS OR FOR YOUR USE OF, OR RELIANCE UPON, SUCH INFORMATION. COMPANY, BRAND AND PRODUCT NAMES REFERENCED HEREIN MAY BE TRADEMARKS OF THEIR RESPECTIVE OWNERS.