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Are Converged Infrastructures Good For IT?

by James Staten
for Infrastructure & Operations Professionals



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New Unified Solutions Strive To Accelerate Virtualization Maturity

by **James Staten**

with Christopher Voce, Galen Schreck, Andrew Reichman, and Ben Echols

EXECUTIVE SUMMARY

IT pros have most of the basic ingredients to cook up their own cloud-like infrastructure — but there's no recipe, and many ingredients just don't combine well. Complicating the story are the traditional infrastructure silos around servers, networks, and storage that must work together in a new, truly integrated way. Vendors like Cisco, Dell, EMC, HP, and IBM know you need packaged solutions that just work, but until recently they left too much of the burden on their customers. Recent integrated solutions take a big step toward delivering complete virtual infrastructures in a box, but to effectively use them, you must assess your own virtualization maturity, start small with development and test workloads, and consider whether you really need to run it yourself.

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Forrester interviewed several vendor and user companies, including Cisco, Dell, Egenera, HP, and IBM.

Related Research Documents

["Assess Your Infrastructure Virtualization Maturity"](#)
July 10, 2009

["The Forrester Wave™: Blade Server Systems, Q2 2009"](#)
May 28, 2009

["10 GbE: Its Time Is Coming"](#)
May 16, 2008

DO-IT-YOURSELF INFRASTRUCTURE SOLUTIONS REQUIRE TOO MUCH IT ATTENTION

Infrastructure innovation marches on — but not always in ways that deliver better overall efficiency. Often, innovations in server, storage, or networking are out of step with each other, driving up complexity. When we asked infrastructure and operations professionals in our 2009 hardware survey about their motivations for adopting server virtualization, many said that their organizations were driven by greater efficiency and sharing of the IT infrastructure.¹ But frankly, that hasn't happened. Perhaps most contentious have been innovations in blade systems and hypervisors, that have shifted some traditional storage and network admin functions into the hands of the server administrator, causing overlaps in functionality, duplication of efforts, and territorial issues. As a result, IT now faces the fact that:

- **Server virtualization alone isn't the answer.** Hypervisors and virtualization management tools give administrators the means to consolidate workloads and dramatically lower the costs of disaster recovery and resiliency. But server virtualization doesn't solve broader infrastructure challenges like ensuring simplified, flexible networking, consistent storage assignment, and high utilization of non-server resources.
- **Unifying networks doesn't create administrative harmony.** The arguments over whether data, storage, and management traffic could or should be combined over a common network — 10 GbE — are mostly moot at this point.² Protocol squabbles, such as Fibre Channel over Ethernet versus iSCSI, and whether 10 GbE can technically deliver quality of service delineation based on traffic type, have mostly been resolved; however, when and how to implement this continues to be debated inside enterprise IT shops. A key part of this battle is who gets administrative rights over what, for what functions, and who delegates authority to whom and in what circumstances. For example, does the virtual server administrator get the right to create logical unit numbers (LUNs) and subnets?
- **Consistent implementations and operations are, well, inconsistent.** Deploying new workloads to your virtual environment should be science, not art. Yet we continue to see admins failing to share best practices, inconsistently following standardized workflows, and reinventing the wheel based on variations in the requests from the business. Do we really need four different server types, three flavors of storage, and three different disaster recovery methods in our virtual pools? Triage time for an outage or performance problem is when we really feel this pain.
- **And, as a result, the business still isn't happy.** Although the virtual server admin can provision a VM in minutes, he still needs to have the network and storage resources properly assigned, and this coordination (assuming it's a coordinated effort and resources are available in all three silos) drags out deployment times. Thus the promise of being more responsive to the business, more often than not, isn't the end result. Bottom line: I&O still hasn't realized the potential savings and flexibility that has been promised, and business owners continue to complain that IT can't deliver what they need to grow the business.³

TIGHTLY COUPLED VENDOR SOLUTIONS CAN EASE THE PAIN

Over the years, vendors have tried to help solve these issues by providing factory-integrated solutions that were built, tested, and supported as a single solution aimed at solving these and other specific purposes. Solutions like the Egenera BladeFrame, Oracle Exadata, and others are examples of a tightly coupled set of server, storage, and network components with a unified management stack. However, their highly proprietary nature makes them closed solutions with narrow use cases that leave you at the mercy of one vendor's road map. As a result, these solutions have met with only moderate success — particularly in greenfield environments. While customers of these solutions praise the benefits of this approach, initial acquisition costs of these proprietary systems is in the hundreds of thousands of dollars (versus thousands for each of the piece parts), and the degree of lock-in they present has prevented them from going mainstream. The *idea* of a converged, standardized, and unified infrastructure, however, is spot-on.

Chapter two of this story has now begun, and its prospects are much greater, as these solutions are focused on helping customers create virtual infrastructure pools, and the abstracted nature of virtualization widens the applicability of the solution. And, rather than deliver proprietary solutions, HP, IBM, Cisco, a resurgent Egenera, and most recently, Dell, are delivering prepackaged server, storage, network, and management solutions that use a preselected best-of-breed approach. Integrated although more loosely coupled, yet still providing many of the same benefits, these solutions:

- **Let you take the next step with virtualization.** Whereas standalone virtualization solutions let you quickly provision, deploy, and easily move a specific component of the infrastructure, they don't do this in concert across infrastructure silos very well. Server virtualization by itself lets you dynamically move instances around, but not necessarily in concert with storage and networks. Coordinating the storage and network resources supporting VMs in an efficient way is still difficult. Fully integrated solutions ensure that this coordination happens by providing a unified approach that integrates management tools and element managers to complete the request through the entire system.
- **Drive consistency in deployment, performance, and ease of administration.** Condensing the I/O of servers into a single shared or virtual fabric greatly simplifies hardware provisioning by converging multiple traffic types. Switches and adapters are fixed but virtualized so that when you need to make changes, it's a software configuration exercise to modify virtual adapters and addresses, not a significant physical recabling effort. And you don't have to buy into 10 GbE to achieve these benefits — although doing so makes this simpler.
- **Ease support, monitoring, and TTR.** From a support standpoint, you can reduce headaches from both a technical and relationship perspective. These solutions pre-integrate and pretest the configuration of multiple software and hardware elements, then unify the support behind

a single organization. There's no finger-pointing between different vendors — there's only one vendor. Or in the case of the Cisco/EMC/VMware solution described below, there is a unified support team in place to provide the same effect.

- **Create an easier path to internal cloud.** If you want to accelerate the transformation of your virtualized infrastructure into an internal cloud, these solutions provide all the basic building blocks, already pre-integrated for you. They include the automation solutions for deployment, management, and monitoring; the unified virtual infrastructure; and even the self-service portal for deployment requests. These solutions provide most of the core elements of a cloud infrastructure.

Five Vendor Stacks Have Emerged

The leading vendors with solutions in the market today include the usual suspects of Dell, HP, and IBM, and newcomer Cisco (see Figure 1 and see Figure 2).⁴ All vendors but Dell rely heavily on VMware's vCenter for virtual server management. There are two solutions using Dell infrastructure components: one led by partner Egenera, the other created by Dell itself and based on Scalent Systems' Scalent Infrastructure Manager. Dell, HP, and IBM built their solutions from mostly their own broad product portfolios, while Cisco relies heavily on its partners VMware and EMC. The leading solutions in the market today are:

- **Cisco, EMC, VMware Vblock.** This integrated solution is built around the Cisco family of blade servers — the Unified Compute System (UCS). UCS consolidates all I/O from and between the blade servers over a 10 GbE fabric.⁵ The management software, UCS Manager, can provision and segment the I/O as needed.⁶ Additionally, you can still use your Fibre Channel-based SAN via an external gateway appliance. The virtualization solution centers on a VMware vSphere foundation and incorporates select EMC software elements, mainly from the Ionics acquisition, to complete the solution. And to make support more seamless, the three vendors, through their jointly funded VCE Coalition, have combined forces behind a unified support center — providing a single phone call to a jointly staffed and funded support facility.⁷ And earlier this month, the Coalition announced the formation of a new company, Acadia, headed by former Compaq CEO Michael Capellas, which will provide integration services and support of the Vblock solution.
- **Dell Virtual Integrated System.** Dell's offering, announced in March 2010, is based around its PowerEdge M1000e blade system and unified through its new Dell Advanced Infrastructure Manager (Dell AIM), which leverages technologies from Scalent Technologies, Symantec, and Dell. VIS gives the customer choice around networking components but in doing so forgoes I/O virtualization functions. The solution supports VMware vSphere by default, but Hyper-V and Xen are options. Dell packages EqualLogic by default but supports FC-based Dell|EMC storage as well.

- **Egenera PAN Datacenter-in-a-Box.** Egenera took the software inside its BladeFrame system — PAN Manager — and essentially rebuilt the solution using off-the-shelf components from the Dell catalog, including the Dell PowerEdge M1000e blade system and iSCSI-based Dell EqualLogic or FC-based EMC storage. Although Dell-branded, this is a Dell-supported but partner-led solution. PAN is adept at automating and coordinating the provisioning of resources for each virtual machine deployed and has a proven track record for providing resiliency and automated failover between virtual and physical systems. Note, however, that this system is built around the open source Xen hypervisor, which is common in public clouds, rather than the more enterprise-standard VMware vSphere — both VMware and Microsoft Hyper-V are optionally supported, the company said.
- **HP BladeSystem Matrix.** This HP Converged Infrastructure solution represents the unification of HP's different data center initiatives over the years — Insight Management, Virtual Connect, Insight Dynamics, Thermal Logic, and others, all wrapped around its BladeSystem.⁸ HP supports multiple hypervisors and nonvirtualized workloads, with default virtualization management conducted through Insight Dynamics.⁹ HP provides guidance and templates for common enterprise workloads and configurations like Oracle RAC, Microsoft Exchange Server, and SAP, to name a few. HP's packaged solution does include on-site professional services integration to aid in setup and knowledge transfer. Also of note, HP gives customers the option of using their existing storage or purchasing HP StorageWorks components such as the iSCSI-based LeftHand solution, or its FC EVA solutions.
- **IBM CloudBurst.** Like HP, IBM incorporated learning and features from its data center initiatives over the years into a single package. Since its initial release in mid-2009, which closely mirrored HP BladeSystem Matrix, IBM this year released a new configuration designed to be an internal cloud test and development setup. CloudBurst caters to this important and often first-use case with common management for this on-premises solution and the company's similarly named public cloud (in beta), and tight integration with the Rational Development platform. IBM also targets an area of great pain in internal cloud deployments: chargeback. This has been addressed by the recent integration of metering and accounting capabilities directly into the offering. Like HP, IBM includes setup and knowledge transfer assistance as part of the packaged offering. On the storage front, IBM supports both FC and iSCSI storage.

Figure 1 Converged Infrastructure Base Configurations

Vendor	Base configuration	Price
Cisco/EMC/ VMware Vblock	<ul style="list-style-type: none"> • UCS blade system w/16 server blades (10 GbE only) • Two-blade chassis Fabric Manager server • Nexus 1000v MDS switches • EMC Celerra Unified Storage 	\$196,000
Dell VIS	<ul style="list-style-type: none"> • Dell PowerEdge M1000e blade chassis w/15 blades (Ethernet switch modules) • Fifteen Dell M610 servers • One M610 management server • 2 PowerConnect 6220M blade switches • One PowerConnect 6224 24-port switch • One Dell EqualLogic PS6000X iSCSI SAN 	\$152,688
Egenera PAN DCIB	<ul style="list-style-type: none"> • Dell PowerEdge M1000e blade chassis w/15 blades (Ethernet switch modules) • Two redundant R710 management servers • One PowerEdge 2410 rack • 4TB iSCSI storage 	\$150,000
HP BladeSystem Matrix	<ul style="list-style-type: none"> • C7000 blade chassis w/15 blades (Virtual Connect Flex 10 & FC switch modules) • BL460c management blade • HP 10000 G2 rack • EVA storage rack (3.6 TB) • Implementation service 	\$207,500
IBM CloudBurst	<ul style="list-style-type: none"> • BladeCenter H w/3 HS22 blades (Ethernet & FC switch modules) • 3650M2 management server • HS22 CloudBurst management blade • DS3400 FC storage • Implementation service 	\$200,000

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Source: Forrester Research, Inc.

Figure 2 Breaking Down The Vendor Stacks

	Cisco/EMC/ VMware Vblock	Dell VIS	Egenera PAN DCIB	HP BladeSystem Matrix	IBM CloudBurst
Blades supported	16 (two chassis required)	16 (one mgmt. blade)	16 (single chassis)	16	14 (one mgmt blade)
Storage included	Yes	Yes	Optional	Yes	Yes
VM environment (hypervisor)	VMware	VMware	Xen (VMware, Hyper-V optional)	VMware, Hyper-V	VMware, KVM
VM deployment tool	EMC Ionix Unified Infrastructure Manager (UIM)	Dell Advanced Infrastructure Manager (AIM)	PAN Builder	HP Insight Dynamics	Tivoli Provisioning Manager
Self-service deployment portal	No	Optional — not included in base configuration	No	Yes	Yes
Unified physical/virtual server management	No (API interface to VMware)	AIM/Dell Management Console	PAN Builder	HP Insight Dynamics	Yes
Physical server management	Ionix UIM	Dell Management Console	PAN Builder	HP Insight Dynamics	Systems Director
Virtual server management	VMware vCenter	AIM, VMware vCenter (requires additional licenses)	PAN Builder	HP Insight Dynamics, vCenter (for VMware environments; requires additional licenses)	Systems Director VM Control, VMware vCenter (requires additional licenses)
I/O management	Cisco Fabric Manager	Chassis Controller, AIM	PAN Builder	VirtualConnect Enterprise Manager (VCEM)	BladeCenter Open Fabric Manager (BOFM)
Hardware provisioning	UCS Manager	AIM	PAN Builder	HP Insight Dynamics	Tivoli Provisioning Manager
Software provisioning	Ionix	AIM	PAN Builder	HP Insight Dynamics	Tivoli Provisioning Manager
Out-of-band management	Ionix UIM	iDRAC	iDRAC	HP iLO	IBM Remote Supervisor Adapter, Advanced Management Module

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Source: Forrester Research, Inc.

Figure 2 Breaking Down The Vendor Stacks (Cont.)

	Cisco/EMC/ VMware Vblock	Dell VIS	Egenera PAN DCIB	HP BladeSystem Matrix	IBM CloudBurst
Hardware monitors	Ionix UIM	DMC, iDRAC, EQL SAN HQ	DMC, iDRAC, EQL SAN HQ	HP Insight Control	Systems Director
OS/ application monitors	Ionix UIM	Optional — Vizioncore not included in base configuration	PAN Builder	Insight Dynamics, can augment with HP SiteScope (not included in base configuration)	Tivoli Monitoring
Availability: HA (physical)	Cluster software (e.g., Veritas)	AIM	PAN Server Portability	Insight Control, VCEM	Systems Director, BOFM, Tivoli Systems Automation (TSA)
Availability: HA (virtual)	UCS-M API, VMware HA	AIM, VMware HA (requires additional licenses)	PAN Server Portability	HP Insight Control, VMware HA (requires additional licenses)	TSA, VMware HA (requires additional licenses)
Availability: DR (physical)	UCS-M API plus third party	AIM	PAN Server Portability	HP Insight Dynamics	BOFM
Availability: DR (virtual)	VMware SRM	AIM	PAN Server Portability	HP Insight Dynamics, VMware SRM (not included in base configuration)	TSA
Configuration management	Ionix UIM	Dell Management Console	Optional — Dell Management Console/Altiris not included in base configuration	HP Insight Dynamics	Tivoli Provisioning Manager, BOFM, TSA
IO virtualization	Nexus 1000v	PlexAddress	PAN Builder	HP Virtual Connect	BOFM
Device failover	EMC Powerpath	EqualLogic multipath DSM	PAN Builder	HP Insight Dynamics	BOFM, System Director

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Source: Forrester Research, Inc.

Figure 2 Breaking Down The Vendor Stacks (Cont.)

	Cisco/EMC/ VMware Vblock	Dell VIS	Egenera PAN DCIB	HP BladeSystem Matrix	IBM CloudBurst
Device pooling	UCS Manager	AIM	PAN Builder	HP Insight Dynamics	Systems Director, BOFM, Virtual Fabric
Server pooling	UCS Manager	AIM	PAN Builder	VCEM, HP Insight Dynamics	Systems Director, BOFM, Virtual Fabric
Energy management	None	AIM	PAN Builder	HP Insight Dynamics	ITM for Energy Management, Systems Director

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Source: Forrester Research, Inc.

These Solutions Could Fuel Your Transition To IP Storage

Many of these product bundles include options for Ethernet storage, mainly with iSCSI-enabled arrays. If you have a Fibre Channel environment but are interested in the fabric convergence, simplicity, and cost reduction potential of storage on Ethernet, a bundle such as one of these could represent a good starting point. Best practices for SAN design in Ethernet have not been widely understood, but using a pre-architected bundle from vendors that are committed to the success of these solutions can be a good way to gain experience with iSCSI storage without having to figure everything out yourself. Keep in mind that another concern with Ethernet is organizational, with ownership falling in a gray zone between storage and IP network teams. Make sure that you designate an owner, encourage cooperation among disciplines, and pay attention to best practices such as virtual or physical traffic separation between SAN and LAN data streams.

Although Marketed As Clouds In A Box, These Solutions Won't Make You A Cloud Overnight

Just because you can now buy a solution that is the vendor's interpretation of what is an internal cloud infrastructure doesn't mean this interpretation meets *your* specific needs or maps to *your* operational processes or that *your* organization is even ready to accept the solution as delivered. You have likely standardized on a collection of tools for monitoring, provisioning, managing, and configuring your environments that doesn't map to the products they have chosen to implement. Are you willing to switch to their selections?

Likewise, your organization may not be as standardized in your operational and maintenance procedures as these solutions require or assume. Are you willing to give up on the processes you have built and switch to theirs? The same is true for automation. These solutions incorporate a significant amount of automation, particularly for deployment of new workloads, done in most of these solutions via a developer-facing self-service portal. Are you really ready and trusting that the way they are approaching automation is right for you?

Because of the above caveats, it may be best simply to view these solutions as reference implementations or blueprints of where you want to get, rather than practical solutions you're ready to consume.

While most vendors are touting the merits of converged infrastructures and marketing solutions that take the work out of cobbling together infrastructure stacks, many are simply providing reference architectures rather than truly integrated solutions that take away the pain of infrastructure configuration. Along this same spectrum the definition of openness is traded off (see Figure 3). More fully integrated solutions such as those highlighted here are built from industry standard piece parts, and yes, you could break them apart and swap out components from vendors you might favor more, but doing so takes away all the benefit of the integration work done by the vendor. At this end of the spectrum, open mostly means these integrated systems integrate openly with other infrastructure you put around them. At the other end of the spectrum openness means far less integration and more of a reference architecture for suggested means of integration. Here openness means you can build this architecture with your best-of-breed components. It's more work and slower time-to-market but can preserve your existing standards more easily. So which way should infrastructure and operations teams lean? Depends on whether you prioritize time-to-market and operational efficiency over preservation of choice.B

But A Unified Infrastructure Can Provide A Greenfield Opportunity

Although you may be evolving your existing infrastructure toward an efficient virtualized environment that builds off a toolset you have more experience and knowledge of, that journey may take longer than you want. An alternative approach with one of these tightly coupled infrastructure solutions would be to start anew, accept the best practices in these implementations, and leave the evolution of your existing infrastructure for slower transformation.

Several customers of these solutions that Forrester spoke with said that is exactly what they are doing. They're leveraging these solutions to build fresh environments targeting new workloads coming from the business that require rapid deployment and don't require connectivity to legacy systems. Over time, they will integrate the older systems and operational procedures with this fresh-start infrastructure as a means of transformation.

RECOMMENDATIONS

RECOGNIZE THAT TECHNOLOGY IS ONLY PART OF THE SOLUTION

These unified infrastructure solutions are promising offerings, but for you to consume and derive the greatest benefit from them you have to prepare your organization for their implications. Perhaps the biggest challenge will be to bring together your server, storage, and network administrators, who will have to agree to how these solutions operate in their respective areas. Although there will be a strong temptation to swap out parts of these solutions for tools your administrators are more familiar with, doing so negates the pre-integration work and diminishes the value of these solutions. Thus, before implementing these infrastructures, Forrester recommends that you:

- **Assess your virtualization maturity.** This is necessary to determine if your organization is truly ready to consume these types of solutions. If your group isn't experientially ready to standardize how workloads are deployed, agree to standard practices for monitoring and management, and trust automation to a great extent, you aren't ready for these types of converged infrastructures.¹⁰ Take the Forrester virtualization maturity assessment to see where you stand, identify the gaps, and plan the best next steps.
- **Start down the path with test lab resources.** Just as you did with server virtualization initially, you can accelerate your learning on how to operate a converged infrastructure by proving it with noncritical functions. This is also a great way to relieve I&O teams from the constantly changing burdens of lab setup, teardown, and maintenance. Curiously, however, only one of the unified infrastructure vendors, IBM, has built a specific test lab configuration of its solution.¹¹
- **Resist trying to outsmart the vendors by breaking this apart.** One of the biggest benefits of pre-established bundles such as these is the reduction in variability of configuration they

bring to the table. While you may be inclined to customize and substitute known products, it will only dilute the value and make it harder to support down the road. Your time is better spent on consolidation, high-level architecture, and process consistency within your environment than figuring out which products interoperate with others and cabling and testing custom solutions. If you choose to buy such a bundle, accept it for what it is — a reference architecture for a whole simplified solution set. Let the vendors figure out which products work best together and trust in their decisions.

- **Consider having someone else manage it for you.** If you find that your organization isn't ready to administer a unified infrastructure and is simply too far away from being ready for the automation, self-service, and standardized deployment methods these solutions bring, but you want to give this value to your business now, you have another option. You can ask a managed services provider to operate these solutions on your behalf. The fastest and simplest path to this approach is of course with the vendor's own managed outsourcing groups, but several third-party MSPs can operate these infrastructures for you as well.¹²

WHAT IT MEANS

STOP TINKERING WITH INFRASTRUCTURE, AND FOCUS ON RAISING BUSINESS VALUE

When is the last time you built a PC? Unless you just love to tinker in this fashion, it's probably been a while. And there's a reason for this. The PC manufacturers have proven that they can build them faster, more reliably, and for less than you can. The same has mostly held true for servers for some time. Now, this trend is now moving up the stack.

These integrated solutions are a step in the right direction of delivering higher-order infrastructure solutions so that you don't have to. They remove the unnecessary art of cobbling together your own stacks. Yes, you give up some control and some ability to use familiar and well-loved components, but the long-term value comes in not having to troubleshoot everything individually.

Are these solutions and this trend a threat to the infrastructure architect? If you define your value to the organization as the guy who can make disparate pieces fit together on a custom basis, then maybe so. But a greater value to the business comes from architecting processes and solutions that enable the business to grow faster, more cheaply, and more flexibly. There's still plenty of work to be done toward this end, and letting vendors determine which nuts and bolts fit best under the hood will free you up to do work that enables greater value like understanding business requirements, refining processes, and rationalization and consolidation of workloads — things that no one technology vendor can do for a given company. Take advantage of this standardization of technology components and spend your time innovating business technology solutions instead of troubleshooting technology components.

SUPPLEMENTAL MATERIAL

Companies Interviewed For This Document

Cisco	HP
Dell	IBM
Egenera	

ENDNOTES

- ¹ Source: Enterprise And SMB Hardware Survey, North America And Europe, Q3 2009.
- ² Ten gigabit per second Ethernet (10 GbE) represents the next level of enterprise network bandwidth, with vendors hyping it as the next great capability. The per-port pricing gap between 10 GbE and alternate network options is narrowing rapidly as more vendors increase the competitive pressure on pricing for related components. See the May 16, 2008, "[10 GbE: Its Time Is Coming](#)" report.
- ³ Through Forrester inquiries clients have told us they are cutting an average of 20% from new capital expenditures by increasing the utilization of resources while deploying new applications in record time. Many used to measure application deployment in weeks but do so now in hours — but clearly are still not done. See the November 18, 2009, "[Driving Multitenancy In Your Virtual Environments](#)" report.
- ⁴ Please note that the base configurations and pricing provided are for the listed configurations in Figure 1. These specific configurations are not directly correlated to the feature table in Figure 2; pricing for configurations vary with feature set desired.
- ⁵ Cisco's Unified Computing System (UCS) is essentially a blade server system that is integrated with Cisco's 10 GbE networking and virtualized I/O capabilities. It also delivers integrated fabric, adapter, and hardware management, as well as high performance and density, especially for virtualized workloads. See the March 16, 2009, "[Cisco's Big Blade Server Bet](#)" report.
- ⁶ The UCS Manager software management tool directs I/O virtualization. Those settings are then managed by two elements of the system: Fabric Manager, which manages network links, and the Nexus 1000v, which manages virtual network assignments in the vSphere world.
- ⁷ It should be noted that Cisco and VMware have also teamed with NetApp on a similar integrated stack solution that swaps out the EMC storage and storage management components for those from NetApp. Source: "Cisco, NetApp and VMware Collaborate to Deliver New Capabilities for the Dynamic Data Center," NetApp press release, January 26, 2010 (<http://www.netapp.com/us/company/news/news-rel-20100126-cisco-vmware.html>).
- ⁸ HP, earlier this year, unified several management tools into a more streamlined family — Insight Management and Insight Dynamics. Virtual Connect, Virtual Connect Enterprise Manager and Integrated Lights Out (iLO) are still separate tools, however. Source: HP Insight Dynamics (<http://h18000.www1.hp.com/products/solutions/insightdynamics/overview.html>).

- ⁹ HP recently announced that BladeSystem Matrix supports HP-UX workloads on Integrity blades. Configurations can be set up containing both ProLiant and Integrity blades in the same system. Source: High Availability servers: HP Integrity Itanium-based enterprise servers (<http://h20341.www2.hp.com/integrity/w1/en/systems/integrity-systems-overview.html?var=tab2>).
- ¹⁰ Why are most organizations not achieving more with infrastructure virtualization? They just aren't ready to. Through more than 200 enterprise interviews, correlated with survey data, Forrester has identified four clear stages of infrastructure virtualization maturity that dictate readiness for various management and automation technologies, process improvements that must be made, and standardizations that have to be realized to achieve greater gains. See the July 10, 2009, "[Assess Your Infrastructure Virtualization Maturity](#)" report.
- ¹¹ IBM Smart Business Development and Test Cloud helps you assess, plan, design, and implement a flexible development and testing private cloud environment to help save capital and operating costs as well as reduce test cycle times, complexity, and risks. A self-service test platform, which is designed for ease of use, combines service request management, automated provisioning, and configuration management, providing you with on-demand provisioning of physical and virtualized test resources — including IBM and non-IBM components such as operating systems, middleware, storage, network, images, and data. Source: Smart Business Development and Test Cloud, IBM (<http://www-935.ibm.com/services/us/index.wss/offering/middleware/a1030965>).
- ¹² Cloud computing platforms are more than just shared, multitenant infrastructures on the public Internet. There are actually three infrastructure-as-a-service cloud deployment options available to enterprises today, each with unique characteristics and economics that can help optimize application and service deployment objectives. See the April 13, 2009, "[Which Cloud Computing Platform Is Right For You?](#)" report.

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