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Professionals

The Software-Defined Data Center Is The Future Of Infrastructure Architecture

by Richard Fichera, November 12, 2012

KEY TAKEAWAYS

Software-Defined Data Centers Emerge As Both A Product Category And Outcome

In 2012 and into 2013, the SDDC will emerge as a product category from many vendors. Initial product offerings from system vendors will be built on previous converged infrastructure and cloud tools and technologies, while Microsoft and VMware will move with software-only offerings. Expect confusion over exact features, scalability, and interfaces.

The Network Virtualization And Management Model Will Be The Biggest Change

Much of the SDDC stack will be familiar: VMs, virtualized storage presentation, service-composition tools, and self-service portals. The network management stack will represent a major change, and for incumbent Cisco, it will represent a strong control point as well as lever to hinder adoption, if it desires.

As Software-Defined Data Centers Appear, IT Leadership Must Evaluate Their Potential

By integrating legacy IT infrastructure as well as newer VM-centric, cloud, and workload-centric architectures, SDDC will become the defining architectural abstraction for infrastructure architects over the next five years, if the supplying vendors fully implement the vision. I&O and EA organizations must track this emerging trend closely.

The Software-Defined Data Center Is The Future Of Infrastructure Architecture

Vision: The IT Infrastructure Playbook

by Richard Fichera
with Doug Washburn and Eric Chi

WHY READ THIS REPORT

Over the last two decades, IT infrastructure and operations (I&O) teams have been in a race with complexity. As business requirements have mounted, generations of technology have been implemented to try and stem the tide. The result: data centers characterized by complex, static physical configurations, incomplete virtualization efforts, and multiple silos of management. But the emergence of better virtualization management tools, software-defined networks, and converged infrastructure stacks has opened the potential to what Forrester calls the software-defined data center (SDDC) — a comprehensive abstraction of a complete data center. The potential impact of SDDC products is immense, offering an integrated architecture that allows the merger of legacy architectures, cloud computing, and workload-centric architectures into a single manageable domain. To help I&O professionals understand this future vision, this report defines the SDDC, the opportunity, and the emerging vendor landscape.

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Notes & Resources

For this report, Forrester interviewed 13 vendor and user companies, including Advanced Micro Devices (AMD), Avaya, Cisco Systems, Dell, HP, IBM, Intel, Microsoft, Morphlabs, Oracle, Tintri, Virsto, and VMware.

Related Research Documents

Workload-Centric Infrastructure Ignites Software-Defined Networking
November 8, 2012

Optimize IT Infrastructure Around Key Workloads
September 7, 2012

Avoid Tactical, Narrow IT Infrastructure Strategies
June 28, 2012

DATA CENTER MANAGERS HAVE LONGED FOR THE ULTIMATE ABSTRACTION

Since its inception, the world of computer technology has been a search for successively improving abstractions of the underlying resources, which, while powerful, have never been particularly human-friendly and easy to use. The moves from raw machine language to assembly language to procedural languages and from batch- to time-sharing were all usability abstractions. In the late '60s and early '70s, the implementation of virtualization further abstracted the actual machine resources. And by the mid-'70s, the combination of multi-user operating systems (OSes), virtualization, and early software-defined networks transformed the computer into an environment in which programmers with average skills and little understanding of the underlying hardware could produce effective solutions to increasingly difficult business problems.[1]

But by the '80s and into the 21st century, the introduction of cheap x86-based hardware, Ethernet, and the Internet fostered the explosion of distributed system complexity that in many cases outstripped the productivity improvements engendered by improved abstraction layers, cheap virtual machines (VMs), and ubiquitous and (comparatively) painless networking. As a result, the industry was locked into a spiraling complexity and investment model that largely remains in place today.[2] The emerging SDDC has the potential to turn back the clock.

The 'Data Center In A Box' Wasn't Enough

The emergence of converged infrastructure (CI) architectures as early as 2001 ushered in a new chapter in abstractions. For the first time, solutions began to appear that incorporated a combination of virtual servers, virtual networks, and managed presentation of enterprise storage resources.[3] Subsequently, based on licensed software from Terraspring, HP introduced the Utility Data Center (UDC), arguably the first commercial implementation of an SDDC. For a number of reasons, including missing legacy integration and a very idiosyncratic and closed hardware base, the product was not commercially successful, but it did demonstrate the ability to compose services involving multiple servers, networks, and storage from resource pools in the order of 1,000 servers, and to deploy these from a library.

Over the remainder of the decade, CI systems from HP, IBM, and Cisco delivered successively improved abilities to deploy partially virtualized clusters of servers and internally defined network segments, but none addressed the levels of scalability and completeness that would allow us to classify them as an SDDC, although the CloudSystem Matrix/Cloud Maps from HP and IBM's PureApplication System are beginning to approach the threshold for such a designation.

The Emergence Of Piecemeal Virtualization And Cloud Still Leaves Gaps To Bridge

The inflection point in the march to a true abstracted data center was the successful implementation of enterprise-grade server virtualization on commodity platforms by VMware, Xen, Microsoft, and others. What followed were successive improvements in storage virtualization and improved virtual

management capabilities. Post 2006, the improvements in management, the introduction of tools to compose and deploy services, and improvements in storage delivered a set of components that were poised to deliver on a complete data center abstraction.

During the same time, the rise of cloud infrastructure-as-a-service (IaaS) offerings, based on VMs, standardized OS images, and automated provisioning practices, presented another way to abstract both small and massively scaled enterprise services in a cost-effective and flexible manner.

A cloud-centric reading of the tea leaves might conclude that the enterprise data center was a dinosaur and that nothing was needed except some combination of enterprise and public cloud. Unfortunately, that's not the case. There are many gaps to bridge.

The Network And The Legacy Application Mess Perpetuate A Physical World

Networks, due to a combination of the technical difficulties in defining virtual networks, particularly Layer 2 networks at the enterprise level, remained resistant to attempts to virtualize them other than the limited virtual networks introduced by Cisco, VMware, and others.[4] The other significant gap was the legacy mess consisting of applications that were either not easily virtualized or whose owners wanted them on dedicated physical resources. This substantial overhang of unvirtualized resources and legacy applications has led enterprise data centers to in effect bifurcate their management and architectures, leaving large fractions of their infrastructure in two worlds — the virtual and the physical. The result is a combination of deficient network virtualization and the overhang of legacy systems that have left a hole in the ability of current virtualization-oriented service deployment and management tools. To bridge this gap, a more integrated abstraction layer is needed. This is the opportunity Forrester and others have referred to as the software-defined data center.

THE OPPORTUNITY: A SOFTWARE-DEFINED ABSTRACTION OF THE DATA CENTER

The SDDC is at its core a way of flexibly defining, accessing, and controlling existing data center resources. Forrester's concept of the SDDC is generally in agreement with many vendor-defined SDDC concepts but includes a recognition of the need to incorporate legacy physical infrastructure as well. Forrester's formal definition of an SDDC addresses the fundamental requirement for abstraction and does not prescribe implementation technology:

> An SDDC is an integrated abstraction layer that defines a complete data center by means of a layer of software that presents the resources of the data center as pools of virtual and physical resources, and allows them to be composed into arbitrary user-defined services.

Architecture Overview: The SDDC Is Layered On Existing Virtualization Capabilities

The overall architecture of the SDDC will include several layers of functionality on top of existing virtualization capabilities that include (see Figure 1):

- **Virtual resource pools and physical resource pools.** A foundational capability will be the ability to discover and import resources into the SDDC framework and to create and manage the pools of virtual and physical resources.

- **Service design.** The ultimate goal of the SDDC is to facilitate the rapid deployment of services to answer business requirements. The primary interface to the SDDC will be through a services design layer that will specify the workloads, the services that run on the SDDC. The actual implementation of this layer will be an exercise left to the vendors. Forrester expects significant experimentation as the concepts are fleshed out and tested in the market; we expect that the underlying design and deployment engines will be presented with both graphical user interface (GUI)-based as well as script/application programming interface (API)-driven interfaces.

  The services design will be accompanied by a role-based deployment and administrative interface to allow both deployment of services as well as administration of service catalogs, billing, and life-cycle management of the services and underlying resources. Forrester does not expect this layer to be a significant barrier to implementation, as many of the current CI and VM management products incorporate portals that embody many of these functions.

- **Deployment and runtime.** The success of the entire SDDC concept depends on maximum flexibility in allocating resources from predefined pools and in incorporating on-the-fly changes such as resource scaling to accommodate workload changes, HA, and DR operations, so the deployment and supporting runtime will be required to defer actual resource binding until the last possible moment. This late binding will not interfere with the actual execution of the deployed services, because at execution time, the services will execute in their standard runtime environments. An example would be the late binding of media access control (MAC) addresses and IP addresses to processes that will be dynamically relocated.

  The applicability of SDDC technology will succeed or fail based on its incorporation of today's standard runtime components, including (but not limited to) multivendor hypervisors, storage systems, and network components. A key capability that is not currently present in most virtualized management environments today is the ability to incorporate, present, and deploy dedicated physical objects with some level of ID virtualization. While this capability has been implemented by the major systems vendors as part of their CI offerings, there has been an architectural wall between these products and the VM management environments. The ability to integrate and manage physical components with capability will be central to the success of SDDC solutions.

■ **Enterprise management gateway.** The SDDC will have to present and consume information to and from existing legacy enterprise management stacks. Lack of this capability will severely handicap adoption, as legacy enterprise management stacks will need to incorporate data from the SDDC, and legacy monitoring tools must be able to at least view individual components of the SDDC.

To successfully integrate existing CI products, particularly engineered solutions such as Oracle Exadata or one of the VM appliances from HP, IBM, or Dell, the SDDC will be required to expose an API that allows these systems to publish their capabilities and configurations and grant permission to the SDDC layer for selected management operations.

The availability of an API for third-party developers will be critical to efforts to correlate the IT-visible workloads with the physical asset management layers, such as those embodied in modern data center infrastructure management (DCIM) solutions.

Figure 1 Software-Defined Data Center Architecture

SDDC architecture

81941   Source: Forrester Research, Inc.
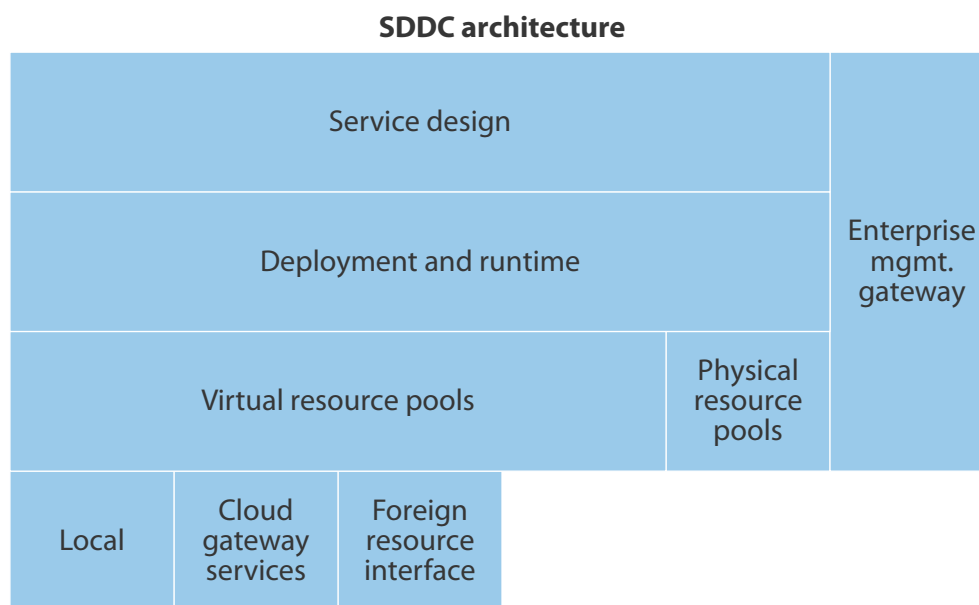
Resource Overview: SDDC Services Are Composed Of Physical And Virtual Resources

The services, which are the workloads deployed in the SDDC, are stored in a catalog and can be deployed either programmatically or via a role-based portal. These services are composed of one or more of the following:

- **Server resources.** VMs are the most mature element and will form the core of the pooled processing resources of the SDDC. However, not all compute resources are encapsulated as VMs, nor will they be for many more years. To be applicable to the largest fraction of the enterprise data center, the SDDC must include selected physical resources. Because of the requirements for pooling and fungibility of basic server IDs, the physical servers included can be limited to systems such as Cisco UCS, HP c-Class BladeSystems, and IBM PureSystems, which have software-defined virtualization of their server IDs, MAC address, fibre channel mappings, and other user IDs, allowing themselves to be managed and reassigned by a pooled resource manager.[5]

- **Storage resources.** The underlying storage resources are presented as pools of virtual storage objects, including conventional LUNs, virtual disks, and other application-specific storage objects. Underlying services such as thin provisioning, deduplication, cloning, snapshotting, and backup can be applied to both the presented virtual objects and the underlying physical resources. As with servers, the SDDC software must also incorporate and present selected physical storage resources as required.

- **Network resources.** The major hurdle for SDDC product offerings will be the presentation of a virtualized network abstraction and interweaving it with physical network components and Layer 4 to Layer 7 solutions. All major network vendors are working on or have delivered versions of software-defined networks (SDNs), and the SDDC product vendors will have to decide which versions to support, as they will not be compatible except for basic functions.[6] Forrester expects that each major SDDC vendor will include its own SDN layer and that interoperability between them will be severely constrained.

COMPARING THE SOFTWARE-DEFINED DATA CENTER TO OTHER TRENDS

The SDDC concept is complementary to two other major trends Forrester has identified in the realm of enterprise infrastructure — converged infrastructure and workload-centric IT infrastructure. Along with the concept of workload-centric architectures, SDDC concepts will have a major impact on future infrastructure architecture and implementation.

The Software-Defined Data Center Versus Workload-Centric IT Infrastructure

Workload-centric infrastructure architecture is an infrastructure architecture that has been optimized around a specific workload and has been cited by Forrester as a major trend.[7] An SDDC is a way of specifying the infrastructure for a given workload and can be used as the overarching tool to define a workload-centric architecture across a portion of the SDDC resource domain. In our hypothetical SDDC, we can define multiple workload-centric architectures simultaneously, all with the appropriate resources and isolation, along with other more general-purpose architectures. In effect, the SDDC becomes an enabler of workload-centric architectures.

The Software-Defined Data Center Versus Converged Infrastructure

Current CI products from vendors such as HP, IBM, and Cisco are relevant to emerging SDDC products from two perspectives:
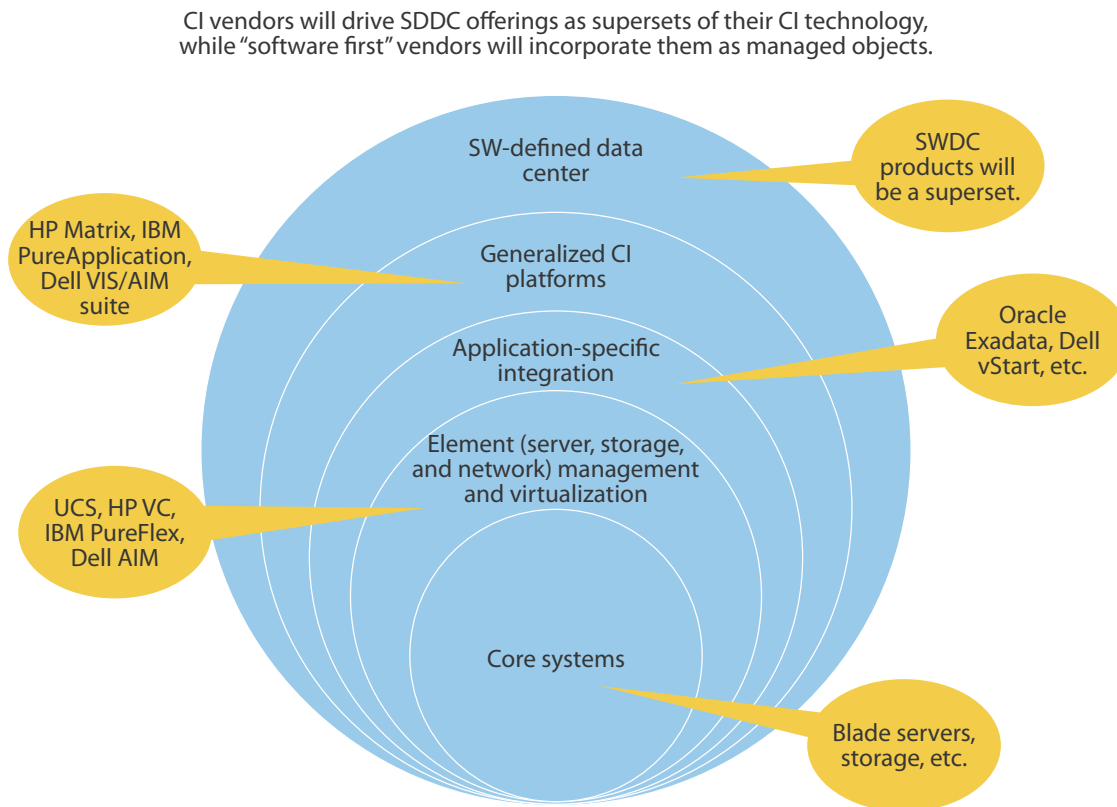
- Forrester anticipates that SDDC products should be able to easily incorporate current and future CI product offerings as a resource, and as these CI products all include facilities for virtualizing critical user interfaces (UIs) such as server name, MAC address, and HBA bindings, they should be easy to incorporate into the SDDC framework.

- Forrester also anticipates that current systems vendors with CI offerings will use their existing CI products as the basis for initial SDDC product offerings. We expect them to increasingly layer additional capabilities around the current CI solutions, as opposed to the major software virtualization players (e.g., Microsoft and VMware) who will use their respective hypervisor and management stacks as the departure point.

  For CI-based SDDC offerings, the vendors will have to interface with the VMware and Microsoft virtualization stack, and an important decision for I&O groups will be whether they want to deal with the likely proliferation of management consoles, as experience has proven that the native hypervisor management tools are almost always still required, no matter how functional the third-party management is.

For current users of CI solutions, the forward migration to a full SDDC solution depends on available skills and how they wish to spend their resources. Some customers will have the skills and wherewithal to construct a fully abstracted and shared resource layer from individual server, storage, and network components, in effect duplicating some of the SDDC value proposition. For customers without these skills, a well-implemented SDDC solution offers the ability to expand the benefits they have already begun to realize from early CI and VM implementations (see Figure 2).

Finally, I&O groups should not read Forrester's endorsement of SDDC as a call to abandon conventional CI implementations. The CI products on the market offer significant benefits for many users across a range of applications and will remain the most rapidly growing segment of the x86 market due to their value proposition.

Figure 2 SDDC And Converged Infrastructure Relationship

CI vendors will drive SDDC offerings as supersets of their CI technology, while "software first" vendors will incorporate them as managed objects.

SW-defined data center

SWDC products will be a superset.

HP Matrix, IBM PureApplication, Dell VIS/AIM suite

Generalized CI platforms

Oracle Exadata, Dell vStart, etc.

Application-specific integration

Element (server, storage, and network) management and virtualization

UCS, HP VC, IBM PureFlex, Dell AIM

Core systems

Blade servers, storage, etc.

81941

Source: Forrester Research, Inc.

SCENARIOS FOR SDDC PRODUCTIZATION

Forrester believes that SDDC is a powerful concept because it is "cloud friendly" in the sense that it will incorporate many of the current IaaS management approaches and will offer compatibility with selected IaaS cloud offerings. Yet by means of its incorporation of existing physical legacy infrastructure, it sidesteps one of the major barriers to cloud adoption — the incompatibility of many legacy architectures and applications with existing cloud environments. By incorporating an inclusion capability for current legacy IT, it will potentially be broadly applicable to more environments. And, to the extent that SDDC offerings include management of physical assets, the more successful they will be as mainstream enterprise products.

Based on multiple conversations with both vendors and users, Forrester believes the underlying requirement is there and that vendors will respond aggressively after the first movers, such as VMware, make their intentions known with initial product announcements. However, there is no current base of SDDC products, nor is there any base of experience except for attempts to promote enterprise private cloud environments, which have not been as successful as the uptake of public cloud solutions.[8]

Forrester expects that SDDC products will be very profitable for technology vendors because they will almost certainly drag along substantial services revenue. The reality is that the ease of use and simplification features that will be exposed to the business users will probably require complex integration, although the vendors who minimize this complexity will have an advantage. For I&O teams evaluating and purchasing SDDC products, Forrester expects that the vendors' initial products will:

- **Be based on the vendors' current cloud, virtualization, or CI portfolio.** Rather than Big-Bang innovation, the initial products will be based on the vendors' current cloud, virtualization, or CI portfolio, with enhancements in the service modeling and deployment capabilities that bring them in line with enterprise IT. Competition and customer feedback will drive further innovation. This means that I&O buyers will have an incremental opportunity to move in the direction of SDDC by means of extended capabilities added to their current environments.

- **Be subject to SDDC-washing.** There will be a wave of SDDC-washing in which products are tagged with the SDDC designation as well as genuine innovation. This will create confusion for I&O and architecture groups and increase the burden on them to track vendors and products.

- **Have many caveats regarding the degree of abstraction and inclusion of legacy infrastructure.** As noted above, Forrester believes that it is reasonable for vendors to support only server components that support the required degree of ID virtualization or to place otherwise reasonable limitations on the physical resources they can incorporate. Forrester believes that differences in the degree to which legacy resources are incorporated and managed will emerge as competitive differences among products.

- **Offer significant benefits to early adopters.** Despite failing to embody the pure model, even the early wave of SDDC products will offer significant benefits to early adopters, including more rapid time-to-solution for complex services, a more unified view and control of enterprise resources leading to reduced opex, and an improved level of insulation from the effects of changing infrastructure technology. Prospective users should note that the full feature sets will take several years to mature, and early implementations will have limited portfolios of supported devices. I&O groups will have to be diligent in assessing the maturity and fit of a particular offering for their environment.

■ **Be highly proprietary products.** While SDDC product offerings will be based on standard software and system components as resources and will support public and standardized protocols and interfaces, they will all be highly proprietary products. While they may offer interoperability across multiple hypervisors, multiple storage and server vendors, and fluid migration onto and off of public or hosted private clouds, they will probably not be in any way interoperable with each other, so a commitment to a vendor is very sticky, and the vendors will be very aware of this stickiness and the probable revenue tail that they will generate.

Expect Your Vendors' Rollouts Of SDDC Products To Be A Multiyear Transition

Despite the nearly infinite number of permutations of potential offerings from not only existing vendors but emerging startups, Forrester believes that SDDC solutions will follow a predictable three- to five-year rollout. Technology buyers should be aware that initial product releases will fall into two basic camps:

■ VMware and Microsoft are the major potential contenders here, with VMware having the first mover advantage. VMware will probably release successively more capable products that focus on virtualized SDDC and with increased R&D to fill in the missing elements such as better storage abstractions.[9]

Subsequent product enhancements will bolster the virtual network capabilities and the unified management of hybrid cloud environments along with service composition tools. Forrester expects that vendors starting from an enhanced hypervisor and tools base will lag in the physical management of the underlying data center infrastructure, although Microsoft probably has more latent capabilities in this area than VMware.

■ Major system vendors, notably HP and IBM, will initially base their SDDC offerings on enhancements of their current CI and related products. The major strategic hurdle these vendors must face is in deciding how much of the VM management responsibility they wish to leave to VMware and where they want to draw a line and add value with the concomitant fight for control with VMware.

The major takeaway for I&O professionals is that this will be a multiyear wave of products rather than a single event, and they will have ample time to plan for a transition.

THE EMERGING VENDOR LANDSCAPE FOR SOFTWARE-DEFINED DATA CENTERS

Forrester believes that the vendor landscape will firm up rapidly from late 2012 through 2013 and that by the end of 2013, all the likely major contenders will have put a stake in the ground for the new category of SDDC products. Forrester expects this to develop into a vigorous competitive arena with vendors initially relabeling and subsequently enhancing product suites that are currently

labeled as private or enterprise cloud as they pursue the prize — a control over the enterprise infrastructure, including incumbent vendors.

The stakes are high enough to motivate serious investment, and Forrester expects that initial offerings will unfold as follows from the following vendors:

- **Cisco.** This company has a unique position in that it owns a substantial asset — the majority of the installed enterprise network customer base. Additionally, Cisco has a rapidly growing CI franchise and has put a stake in the ground that it is interested in a larger slice of the data center services market. As such it has the most to lose from widespread OpenFlow deployment. Forrester expects that Cisco will push to cement its proprietary approach through its strong network market share. Cisco will need to build or acquire IP to bolster its VM and storage capabilities or continue to work through major partners for the VM and storage components of its SDDC offerings, and will probably limit its server support portfolio to its own UCS systems.[10]

- **HP.** The largest blade and CI provider already has a technically viable start to an SDDC environment with its CloudSystem solutions, which could today be considered an SDDC with limited bounds and a very constrained set of objects. HP has the skills and resources to continue to generalize it. HP's major strategic issue is whether to keep attempting to push its HP virtual application network solution or whether to base its SDDC products on OpenFlow, which HP has enabled in its campus switches (but not data center switches). Forrester believes that HP will additionally have to support Cisco's SDN despite the immense commercial tensions between the companies.

- **IBM.** IBM, newly resurgent in CI with its PureFlex System and PureApplication System, which include complex pattern-based deployment capabilities similar to HP's CloudSystem, is well positioned to introduce SDDC products, particularly given its strong services capability. PureApplication patterns, like HP's CloudSystem, can likewise be considered a tightly bound SDDC implementation. In addition, IBM has an SDN strategy that is based on distributed overlay virtual Ethernet (DOVE). IBM offers an SDN-/OpenFlow-enabled switch that it has been co-marketing with several vendors, and is rumored to be launching its own OpenFlow controller. IBM's major challenge, having just introduced a major new cycle of CI that its field is still digesting, will be bandwidth for its marketing efforts. Other than Cisco, IBM is the only hardware vendor that has its virtual switch, 5000v, but IBM struggles to market the new networking division, IBM System Networking, it formed from its acquisition of Blade Network Technologies (BNT) in 2010.[11]

- **Microsoft.** Anchored by its ubiquitous server OS and a growing customer base for its vastly improved Hyper-V technology, rapid growth in its Azure cloud portfolio, and an increasingly competent management stack that provides an ever expanding set of physical and virtual management capabilities, Microsoft is well positioned to be VMware's worst nightmare,

although it will almost certainly be a Windows-mostly nightmare, possibly with limited support for Linux as VM guests. In addition to enhancements to its Hyper-V technology, Forrester believes that Windows Server 2012 will be a major enabler on the road to an SDDC, incorporating a software-defined storage platform as well as network virtualization. The soon-to-be-released System Center 2012 SP1 (currently in customer preview) provides integrated management of hypervisors, storage (both Windows-based and third party), Windows-Server-based virtualized networks, third-party vSwitch extensions, and virtual routing gateways to bridge virtual and physical networks. As a vendor-neutral player in the networking and storage segments and a platform to which ISVs will add considerable value, Microsoft is well positioned to begin to offer SDDC products within 18 to 24 months.

- **Oracle.** Over the last several years, Oracle has been expanding its capabilities as an integrated solution provider with its introduction of the Exa family of engineered systems, investments in its own VM stack and improvements to its management capabilities, and the acquisition of Sun Microsystems. With its recently announced intention to acquire Xsigo Systems, a data center I&O and network virtualization provider, Oracle now has the necessary IP to provide its own data center SDN capabilities and will be in a position to compete with an SDDC offering should it choose to. Forrester believes that Oracle is more likely to offer complete solutions built around its flagship software IP as opposed to general-purpose SDDC products, but it now has a relatively complete suite of IP to compete effectively with HP and IBM.

- **VMware.** Currently having publicly articulated its intent to pursue an SDDC strategy, VMware is in a natural position to lead the industry in this direction. With a dominant position in hypervisors and an expanding portfolio of management tools, including a nucleus of automation and service management products, VMware has the core IP and resources, especially since its acquisition of Nicira and DynamicOps. In addition, as VMware's cloud strategy seems to have been less effective than it expected (Forrester believes this shortfall is at the root of recent management shifts at EMC and VMware), Forrester believes it is inclined to double-down on investments in the enterprise, particularly in light of the apparent momentum of archrival Microsoft. VMware's deficits include a weak track record for dealing with the required legacy physical assets and only adequate networking and storage management.

RECOMMENDATIONS

ASSESS THE IMPACT SDDC WILL HAVE ON YOUR INFRASTRUCTURE

The SDDC promises to offer an integrated architecture that allows the merger of legacy architectures, cloud computing, and workload-centric architectures into a single, manageable architecture. Despite benefits, the emergence of SDDC products will impose a burden on IT I&O teams to understand them and to assess their impacts. To do this, Forrester recommends that you:

- **Get educated immediately and carefully compare SDDC products to existing products.** When SDDC products begin to appear in 2012 and into 2013, I&O and enterprise architecture groups should immediately evaluate them. Customers of HP, IBM, and Cisco should fully understand their vendors' CI road maps, as their SDDC products have a high likelihood of being incremental enhancements of these products. I&O groups should seek clarification of vendor plans for non-CI system elements and heterogeneous vendor support.

- **Reassess applications that are not yet virtualized.** I&O groups should triage their currently nonvirtualized workloads and reassess this rationale in light of recent improvements in hypervisor technologies. Despite the probability that SDDC solutions will selectively include raw physical assets, they will be more capable managing the virtualized portions of their domains.

- **Involve your networking teams, not just server and storage.** Network architecture, management, performance, and reliability will be critical to the success of SDDC products. I&O and architecture groups will need to keep a close eye on both the incumbent vendors and the rise of OpenFlow alternatives.

- **Identify applications to pilot in the SDDC.** In conjunction with their line-of-business customers and other major stakeholders, I&O professionals should prioritize their major applications portfolio and select candidates for initial implementation of a pilot SDDC project. Based on conversations with vendors and prospective buyers, key workloads to consider first include those which may have requirements for rapid scaling or those which may need to be replicated multiple times, or workloads that are only used periodically but require significant resources when they run. Examples might include BI and analytics (scalable and periodic), Exchange (complex and scalable), DR (ability to replicate configurations), and high-volume web applications (scalable).

WHAT IT MEANS

A REVOLUTION: INFRASTRUCTURE MANAGEMENT VERSUS SERVICE DEPLOYMENT

While the timing and staging of solutions is still indeterminate, this will be one of the major shifts in enterprise infrastructure, representing the unification of virtual and physical infrastructure and of cloud and legacy enterprise. Enterprises that do not ride this emerging product wave risk being severely disadvantaged relative to peers who embrace it early.

SUPPLEMENTAL MATERIAL

Companies Interviewed For This Report

AMD	Microsoft
Avaya	Morphlabs
Cisco Systems	Oracle
Dell	Tintri
HP	Virsto
IBM	VMware
Intel	

ENDNOTES

[1] While there is some dispute about the provenance of the first VMs, the first commercially successful computer systems with VM capabilities were from IBM and Xerox Computer Systems.

[2] At the core of the problem is that data volumes, which are a reasonable proxy for overall IT intensity, are doubling approximately every two years, while IT staffing is increasing at best at single-digit rates. The crux of the complexity and consumability problem is that we have fewer people relative to the required processing load every year.

[3] The first viable enterprise CI product was from Egenera, which incorporated what today would be described as physical servers with virtualized IDs. The product provided the ability to present virtual NICs and virtual networks within the confines of the enclosure, as well as the ability to access external SAN storage. The product, positioned by Egenera as a "data center in a box," met with some initial success, and the company is still in business today, attempting to transform itself into a pure software player. Disclosure: The principal author is a former Egenera employee and owns Egenera stock (currently worthless).

⁴ Software Layer 2 network virtualization has been an active field for investment, and larger companies have been acquiring smaller startups, such as VMware's acquisition of Nicira.

⁵ Forrester's belief that a full SDDC implementation must incorporate legacy physical (unvirtualized) resources is probably the most contentious aspect of the SDDC definition. Vendors that are currently focused exclusively on virtualized infrastructure would rather sidestep this aspect of an SDDC, and while they can be quite successful without incorporating physical resources, the solutions will remain incomplete and less useful until these legacy artifacts can be incorporated in the SDDC.

⁶ Infrastructure and operations (I&O) teams are aligning themselves and infrastructure around key workloads to drive greater simplicity and efficiency. In kind, the networking industry has responded by suggesting that networks can provide greater support for this approach using OpenFlow protocol and software-defined networking (SDN) concepts. SDN provides the means to automate networks to better support different workloads, but I&O professionals also need to understand how SDN can support turning networks into a virtual network infrastructure. See the November 8, 2012, "Workload Centric Infrastructure Ignites Software Defined Networking" report.

⁷ The inside-out approach of engineers focused on technology for its own sake must stop: Your business cares about outcomes and holistic services, not server, storage, and network technologies. For too long, I&O has aligned with silos of technology expertise, resulting in complexity, poor communication, low satisfaction, and wasted money. To deliver better business results over the next decade, Forrester advocates that you take a "workload-centric" approach: Design your IT infrastructure on what matters most — your workloads — not the other way around. See the September 7, 2012, "Optimize IT Infrastructure Around Key Workloads" report.

⁸ My colleague James Staten points out that the closest thing to the SDDC concept is vCloud Director's vDC concept, which creates isolated pools of virtual resources from within a vSphere cluster. Private clouds in general do not do this. He also cites Amazon Virtual Private Cloud (Amazon VPC) or how some managed hosting providers offer virtual and physical hosting from a central portal (though often without the automation that SDDCs promise).

⁹ One of the major drawbacks of the current VMware solution is that the virtualized storage abstractions mimic the same presentation of physical SANs, which, while it is faithful to the surrounding environment, is wasteful and adds complexity to the virtual environment, as the VMs want to see simple storage objects, not LUNs. This is the wedge that startups like Tintri and Virsto have used to enter the market with highly efficient and lower-cost VM storage capabilities.

[10] Cisco has a very different approach than do others as to the problem of virtual networks, pointing out that virtual tunnel overlay networks have historically been an option of last resort, introducing an extra layer of abstraction and leaving complex applications vulnerable to significant latency effects as well as being difficult to troubleshoot. Its position is probably partially factual and partially as a proxy for its own SDN efforts, which will be topology-aware virtual networks as it has done in the past — integrating physical and virtual devices so that you don't create topology-agnostic overlays on top of the physical infrastructure.

[11] In considering the relative success of IBM's network business, it is important to understand that IBM's networking exists as part of IBM's larger data center infrastructure and integrated systems plays, with a focus on delivering integrated solutions to clients, rather than as an attempt to compete with Cisco as a volume supplier of network infrastructure, as HP is apparently attempting to do.

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