GIGAOM RESEARCH

A field guide to the software-defined data center

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a cloud report

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The changing focus from hardware-based infrastructure products to software-based solutions is spawning a new ideology in the data center. Backed by virtualization technologies, hardware abstraction, and the quest for instant scalability, IT leaders are looking to build data centers that are abstracted from legacy hardware.

Early users are finding that software-defined data center (SDDC) technologies are introducing flexibility into their enterprise while reducing operational and management costs and also fueling the drive toward the cloud. SDDC can bring benefits to the modern data center, including reduced total cost of ownership (TCO) and the ability to repurpose or rescale in a matter of moments. Other benefits include reduced operational and management costs, as well as the ability to more quickly adapt to new technologies, speed integration projects, and launch new services.

Simply put, SDDC may become one of the most disruptive technologies to impact enterprise data centers, and it has the potential to rapidly change the market landscape as well as change the way data centers are funded, designed, provisioned, and managed. That disruption is driven by many factors, ranging from economic concerns to efficiency initiatives and furthered by data center operators seeking to leverage economies of scale while creating more-secure and adaptable environments, which are more manageable and less complex.

The potential impact of SDDC products should not be underestimated. These technologies offer an integrated architecture, which allows the consolidation of legacy hardware, cloud computing, and workload-driven architectures into a single manageable domain. Nevertheless, SDDC still has a long way to go before it is fully viable as a wholesale replacement for legacy data centers.

Current market overview

Today the SDDC market is still in its infancy, and therefore forecasts of its size should be taken with a grain of salt. However, VMware's $1.2 billion acquisition of Nicira (a software-defined networking, or SDN, startup with minimal current revenues) speaks volumes about the potential market size. GigaOM Research predicts that the enterprise SDN market (as defined by this report) will reach $320 million in 2014 and grow to $2.45 billion by 2018. This is just a slice of the overall SDDC market. It would not be impossible to foresee the total SDDC market reach between $5 billion and $10 billion within five years.

Multiple large vendors have dipped their toes into the SDDC market already, mostly as a way to move their existing virtualization and hardware abstraction products higher up into the management chain of the data center. Those same vendors are looking to leverage an opportunity where they are able to unify their existing server, storage, and network virtualization technologies into a more comprehensive, singularly managed infrastructure with the ultimate goal of gaining market share by replacing legacy hardware, software, and management tools. The major players that have the most to gain here include VMware and EMC, already formidable players in virtualization and hardware abstraction technologies.

However, VMware and EMC are not the sole players in the market. Other large companies such as Cisco, Microsoft, and HP are all eyeing the SDDC market and are currently providing some of the software and infrastructure components that make SDDC a reality. With leading vendors anticipating that the SDDC market could grow by billions in the next few years, many startups and smaller vendors are joining the scene, trying to establish a foothold into a potentially huge market. Some are starting off with SDN or SDDC foundation technologies to establish viability and ultimately become competitive.

Those vendors, such as Big Switch Networks, Jeda Networks, Hotlink, Pluribus Networks, Midokura, Ravello Systems, SimpliVity, and Intigua could potentially challenge the industry giants by leveraging open-source or proprietary technologies that may shift some of the ideologies about SDDC and what the technology should ultimately accomplish.

That said, there are some significant challenges for vendors looking to leverage SDDC for market share, one being the nebulous nature of SDDC, which stems from the lack of a concrete definition.

The term "software-defined data center" is not defined by an existing standards body (such as the IETF, ITU, or NIST) but rather is a forward-looking vision of how data center environments will evolve to increase flexibility and respond to business demands. Industry pundits and vendors have come to agree that SDDC builds on the abstraction that server virtualization has created, as well as the virtualization of storage and networking technologies. What's more, automation and unified management are expected to play a major role. That gives a more concrete definition to SDDC, which helps to advance the technology. Nevertheless, the market may see multiple variations of the SDDC ideology, which could redefine some of the elements that make up an SDDC solution as the market matures.

SDDC in depth

For vendors and potential buyers, understanding the technology and the evolution of the SDDC market are critical prerequisites before entry. That said, SDDC can trace its roots back to a multitude of already established technologies, making SDDC the next logical step for unification of those technologies for the reinvention of the traditional data center.

The primary concept of SDDC revolves around bringing enhanced flexibility and automation to three major infrastructure components of a data center (compute, networking, and storage) and becoming less dependent on the underlying proprietary and physical hardware. Ideally, a properly executed SDDC solution will create a pool of available resources that can automatically adapt to changing workloads and ensure that the right resources are available whenever and wherever needed. Of course, those major infrastructure components also need to be managed effectively, and unified management driven by automation and policies will be critical to the success of any SDDC implementation. Let's take a closer look at the primary data center elements impacted by the virtualization and hardware abstraction requirements of SDDC.

Server and compute virtualization

Virtualization (and hardware abstraction) of the data center's server and compute segment has already been established for the most part, and with the adoption of that technology, there came significant changes as to how applications and services are deployed, creating a disruptive element for the server market. The dominant force behind server virtualization has been and currently remains VMware. Although VMware has established itself as the market leader, offerings from other industry giants such as Microsoft, Citrix, and Red Hat are gaining sizable market share. With a majority of today's workloads running on virtualized servers, server virtualization is the most evolved component of the software-defined data center.

Network virtualization

Software-defined networking (SDN) is poised to replace traditional networking hardware in the data center. Although relatively new, SDN technology has made some inroads in the enterprise, thanks to the OpenFlow movement. OpenFlow is a standards-based protocol for network virtualization that can be implemented by any vendor for either open-source or commercial products. However, OpenFlow is not the only delivery mechanism to bring virtualization and hardware abstraction to the networking space. VMware is betting on its $1.26 billion acquisition of Nicira to bring an SDN solution to the market. Nicira was involved with the OpenStack Quantum project and the Open vSwitch project, both of which are open-source offerings focused on network virtualization. Nicira's involvement has led to the company's creating its commercial network virtualization platform (NVP) offering.

Network hardware vendors are starting to see the writing on the wall. Take, for example, Cisco, which has long dominated the network hardware market and is now facing new competition from companies like Nicira (now owned by VMware) and Big Switch Networks, which have designed their products for today's virtualized IT environment. Cisco intends to pursue the market and challenge competitors with its $100 million investment in Insieme, a Cisco spin-in company that is creating SDN products, which will give Cisco a portfolio of products for network virtualization.

The importance of SDN and NVP solutions as part of an SDDC should not be underestimated, as evidenced by the significant amount of attention garnered in the IT industry. A number of major tech players including Google, Facebook, Microsoft, Yahoo, and Verizon worked together back in March of 2011 to create the Open Networking Foundation. The ONF's primary goal is to drive innovation around SDN and push for continued development of OpenFlow. Startups like Arista Networks are developing SDN products, while Cisco, HP, and other traditional networking leaders are looking to incorporate OpenFlow capabilities into their hardware switches. However, SDN is evolving and for the most part has not yet achieved the levels of market adoption and maturity that server virtualization has — a situation that may have a major impact on the viability of the SDDC as a whole.

Storage virtualization

Storage is a key component of the data center and has proved one of the most difficult elements to effectively virtualize. Storage has been one of the most volatile elements of the data center, with competing solutions, differing ideologies, and increasing demand setting the tone. Nevertheless, the storage layer proves to be a critical element of SDDC, especially since all of the software that defines SDDC relies heavily on the storage layer. To date, large vendors such as EMC, NetApp, HP, and IBM have had a stranglehold on the data center storage market, leaving little room for startups to gain market share and, most importantly, the venture capital to challenge the industry leaders.

However, thanks to applying virtualization technologies to the storage equation and the arrival of cost-effective flash technology, innovation has reentered the storage market and startups are looking to leverage new techniques, which help to abstract traditional storage hardware from the equation. That ideology has given birth to a new acronym, SDS (software-defined storage). Although SDS is really little more than a marketing term, it effectively describes how virtualized storage fits into the SDDC ideology.

The speed offered by flash and the flexibility of SDS has led to new startups that are looking to leverage the ideologies of software-defined platforms (SDDC, SDN, SDS), where commodity hardware can be used to orchestrate large-scale storage systems, which use high-speed flash drives to reduce latency while bringing on-the-fly provisioning (and reprovisioning) strategies to what was once a relatively static storage silo. In one sense, flash has paved the way for dozens of new vendors to enter the enterprise storage market. However, the adoption of flash technology has brought with it complexity and data-management issues, which legacy storage-management technologies are ill-equipped to handle. That problem stems from the fact that most major storage vendors designed their product architectures before virtualization was considered a possibility for enterprise storage. In other words, those architectures were originally built for a physical world, one where application workloads were isolated, known, and predictable. Exacerbating that problem is that many startups have continued to use similar architectures, although with faster flash storage rather than spinning disks, and they have left much of the storage virtualization ideology to software vendors.

Nevertheless, vendors have come to bat to deliver virtualization at the storage level. For example, EMC is pushing its ViPR product as a companion product for SDDC. As a software-defined storage (SDS) solution, ViPR primarily functions by presenting multiple types of storage while segmenting the control plane from the data plane. In addition, ViPR acts as a head end, fronting traditional storage arrays as an automation and control point. ViPR does not require the replacement of arrays; however, it does make access to those arrays simpler and more flexible, driving the ideology of an SDDC. EMC has been able to effectively demonstrate that SDS is a primary component of SDDC. VMware is also pursuing this market with Virsto, which the company defines as a storage hypervisor. Although Virsto has its roots in virtual desktop infrastructure (VDI), VMware positions the technology to improve storage performance.

Management

Management tools have long been an overlooked element for consolidating data center designs. To date, many data center operators rely on individually managed silos to provide the services needed out of the data center. That style of partitioning is the antithesis of what SDDC is all about. Unified management remains one of the biggest challenges to effective SDDC adoption. That said, a plethora of software vendors are incorporating SDDC compatible controls into their management platforms.

Companies such as SolarWinds, Cloud Sidekick, RightScale, Spiceworks, and Puppet Labs (see disclosure) are incorporating virtualization-management components into their management products, which will ultimately lead to fully SDDC-aware toolsets. Although those vendors currently focus on network and application performance, as well as troubleshooting, those management components will become a key factor for maintaining and managing SDDC implementations. However, those vendors are faced with specific challenges resulting from the lack of industry standards and governing body certifications. This situation forces management platform vendors to partner with SDDC solution vendors to create custom unified management platforms that are able to interface with proprietary SDDC elements.

For example, some software-management vendors have come to rely on selling add-on modules to deal with a particular virtualization vendor's platform. SolarWinds offers several different extensions to its virtualization-management platforms that address particular vendor products. Puppet Labs brings a declarative, model-based approach to network management, enabling automation that is applicable to SDDC environments, however the management engine requires the use of configuration modules, from which there are over 600 to choose. Cloud Sidekick recently announced a partnership with VMware to craft automation support for vSphere and vCenter using Cloud Sidekick's Cato Cloud Automation Platform and Maestro Enterprise Orchestration products. Although Cloud SideKick's products are aimed at cloud services, strong ties into VMware's SDDC solutions will most likely be incorporated into the company's offerings.

Larger virtualization vendors such as VMware and Citrix are building management suites that are destined to control SDDC implementations in a unified fashion, with the most important element being policy-driven automation. Arguably, the most important element of an SDDC management platform is the ability to introduce automation into the environment, automation driven by administrator-crafted policies. That in turn requires a robust policy scripting and design capability, where data center administrators can define triggers and rules for an automated action to take place, such as spinning up additional virtual compute resources, provisioning additional storage, or even redefining network paths to handle variable traffic patterns.

Disclosure: *Puppet Labs is backed by True, a venture capital firm that is an investor in the parent company of GigaOM. Om Malik, the founder of GigaOM, is also a venture partner at True.*

SDDC in the real world

Building an effective SDDC solution requires the integration of virtualized resources, including the compute, network, and storage layers. That integration must be both manageable and compatible with policy-based automation techniques that can speed reconfiguration of the virtualized data center, with little or no administrator involvement. What's more, SDDC must work in a unified fashion, eliminating the traditional silos of compute, storage, and network management to deliver the anticipated savings on hardware, management, and support costs.

What works in theory may not always work in practice, an observation that proves highly applicable to SDDC and its associated components. For the most part, SDDC technology is still in its infancy, and few tangible case studies or success stories exist in the public domain. However, examples abound around the success of the individual elements that make up the SDDC ideology. For example, VMware has published dozens of case studies where server-compute virtualization has proved its viability over and over again. In the storage space, vendors such as Hitachi, NetApp, BlueArc, Accelra, EMC, HP, Dell, and many others provide ample evidence of the financial benefits and management prowess offered by virtualized storage in the enterprise.

The final virtualization component of SDDC and the newest entry into the virtualization pool is networking, which still lags behind, at least when it comes to adoption rates, market share, and IT priorities. Even so, success behind open-source projects (OpenStack, OpenFlow, FlowVisor, Indigo, and many others) has demonstrated the viability of SDN, to the extent that major switch vendors including Cisco, HP, and IBM are incorporating SDN support into their hardware devices. The success of those individual virtualization tiers indicate that SDDC is destined for success, at least on a technological level.

Trends to watch

There is no doubt that SDDC technology will take hold in many data centers; however, there is still much work to be done before SDDC becomes the de facto standard of data center design. Vendors are attempting to jump-start adoption and are beginning to push ideologies out into enterprises in the hopes of fueling new trends in data center design.

Cloud initiatives. Many vendors are trying to latch SDDC to cloud ideologies, where all processes are abstracted via software and applications are transformed into services. Although SDDC may prove to be an excellent platform for deploying cloud-based solutions, the nebulous nature of the term "the cloud" may actually weaken the argument to adopt SDDC, which should derive its strength from the ability to abstract hardware, network, and storage into a software layer.

Mergers and acquisitions. Currently the virtualization industry is in a state of flux, with multiple vendors partnering to develop SDDC solutions. The sharing of intellectual property among those vendors may lead to more open standards or could lead to closed systems that will be controlled through mergers and acquisitions of companies.

Scalability. Vendors are highlighting the ability to scale as needed as a key driver for SDDC technologies, meaning that solutions that can scale data center operations will become interchangeable with SDDC products.

Resiliency. Some vendors are incorporating DR and BC technologies into SDDC solutions, bringing resiliency to the forefront of the technology. The instant provisioning and virtualized nature of SDDC lends itself well to business-continuity objectives, but it will surely increase adoption costs.

Staggered deployment. Vendors are starting to illustrate that SDDC does not have to be an all-or-nothing proposition, for example by layering the approach, such as deploying the various virtualization technologies in sequence. Data center operators can first deploy compute virtualization, then add storage virtualization and then incorporate network virtualization before attempting to manage the three elements as a single entity.

Flexibility. Vendors are stressing the importance of flexible provisioning capabilities, where core ideologies of the cloud such as instant scale, redefinable compute resources, and application resiliency are well supported by SDDC technology.

Portability. By its very nature, SDDC brings data center portability to the forefront of operations. As a virtualized resource, SDDC can move its core components across physical entities and even be transitioned into hosted services. All of this enables data center operators to move core elements of the data center to different resources, without severe interruptions in service.

Vendors are well aware of the trends that they are fashioning and are feverously developing proof of concepts, new virtualization ideologies, and management scenarios to associate SDDC with the best-practices trends of enterprise cloud development.

Over the next few months, expect more SDDC purveyors to stress the importance of cloud enablement via SDDC and to launch products that ease the transition to enterprise clouds while leveraging the ideologies of hardware abstraction and virtualization.

Another trend driving the evolution of SDDC comes in the form of API adoption, where APIs are able to remove the physical walls surrounding virtual silos. Simply put, APIs expose the various virtualization layers to one another and the management tools needed to orchestrate SDDC.

The Open Grid Forum (OGF) technical reference model pictured above has been around for some time, and it illustrates that each of the physical silos — storage, compute, and network — already had virtualization layers. In fact those virtualization layers have been around for decades. Now that APIs have been developed, those once siloed resources can now be addressed via a unified management methodology, creating what has evolved into the SDDC concept.

Without those APIs, SDDC would not be possible. The trend today is to create more APIs and make them more easily accessible, which will help to extend the SDDC ideology into data centers.

Of course some organizations have had SDDC for a little while already. Google and Amazon were the pioneers here, cutting out their own ways and means to manage infrastructure at scale (and selling it on to those wanting access on demand). Others have followed, creating their own cloud platforms and more recently open-sourcing them with efforts like OpenStack and CloudStack. In 2006 it took a lot of effort and imagination to make a software-defined data center and sell it as a cloud. Now anybody can download the basics for free.

OpenStack might let you download your own software-defined data center, but software-defined shouldn't have to mean software-implemented. There are still serious performance gains to be had by using the right hardware for networking and storage, and that hardware needs to be properly integrated into the appropriate APIs (such as OpenStack Quantum and Cinder). This can be done by the user, but there's a marketplace opening up for preintegrated (turnkey) systems.

Companies to watch

Perhaps no other technology in recent memory has created the same level of entrepreneurial excitement as virtualization. Numerous startups and open-source projects have come about via the promise of what virtualization can deliver to compute, storage, and networking resources. The majority of those startups have focused on making virtualization work better, either via management tools, provisioning solutions, or scale-on-demand offerings. While a robust market exists for the various types of virtualization solutions, the companies to watch in the SDDC segment are those that have figured out how to unify the management stack across compute, storage, and networking stacks while abstracting the hardware from primary data center operations.

Industry leaders

VMware. The company has extensive expertise in the virtualization space and has successfully mastered server-compute virtualization as well as its management. VMware has been able to strengthen its SDDC offerings via acquisitions and partnerships, which extend proprietary technologies into a more cohesively managed virtualized data center offering. Current market concerns include licensing issues, pricing, and support as well as cross-platform compatibility.

Citrix. Rumored as an acquisition target for Cisco, Citrix has extensive experience with application virtualization, desktop virtualization, and the management elements surrounding those concepts. What's more, Citrix has experience with application delivery and WAN optimization, giving the company the core competencies to develop SDDC solutions. However, Citrix's ideology lends itself more toward cloud enablement for the data center and soft-IT solutions, which muddy the waters of a clearly defined SDDC platform.

HP. Hewlett-Packard has a large portfolio of data center products and has acquired vendors that specialize in combining virtualization with proprietary hardware. The company's biggest challenge comes from maximizing the concept of SDDC without negatively impacting its hardware sales. That said, the company has built a strong partnership with VMware to forward its SDDC and soft-IT initiatives.

Startups and specialized vendors

Embotics. Embotics specializes in virtualization and cloud management, and it offers tools that automate the management of complex virtualized systems. With its basis in automation and management, Embotics has the potential to bring those services to SDDC implementations, and it already has the compute virtualization-management component in place.

CloudBolt Software. Through its recently launched C2 product line, CloudBolt brings life cycle management, metered billing, self-service IT, and optimization to virtualized environments. With a focus on Infrastructure as a Service, C2 could potentially become a management platform for SDDC solutions.

Cloud Sidekick. Maestro, the primary application from Cloud Sidekick, is a management-automation engine designed to bring template-based provisioning to VMware/vCloud, Eucalyptus, AWS, and other virtual server environments. Self-service application delivery may become an important part of SDDC, and Cloud Sidekick may be able to deliver that capability to cloud-enabled SDDC implementations.

Puppet Labs. This is yet another company that specializes in IT automation for the data center. Puppet Labs is working with VMware to automate the provisioning of VMware vSphere Virtual Machines as well as automate private cloud application delivery with VMware's vFabric Application Director. As the technology matures, Puppet Labs may very well become the go-to add-on for VMware's SDDC ideology.

(Disclosure: Puppet Labs is backed by True, a venture capital firm that is an investor in the parent company of GigaOM. Om Malik, the founder of GigaOM, is also a venture partner at True.)

SimpliVity. OmiCube from SimpliVity is touted as a "data center in a box." Sold as a stackable appliance, OmniCube incorporates virtualization technology to create an offering that is very similar to an SDDC implementation. Expect SimpliVity to extend its proprietary technology and include more management, automation, and virtualization technologies to become an SDDC in a box-type offering.

As SDDC continues to evolve over the next several quarters, expect to see more startups come out from under stealth mode and established vendors to be quickly enhancing product matrixes to address the growing interest in SDDC.

Potential inhibitors to adoption

As with any new or emerging technology, obstacles can be a major concern, and SDDC is no different. While the technological ideology of SDDC seems valid and the emerging products seem to be more than capable of spurring data center transformations, there are still some perceived concerns that may derail adoption or, at the very least, bring it to a crawl.

Silos. Many enterprise networks have embraced the siloed approach of provisioning and managing data centers. This ideology creates tiers in the data center, which are managed separately by IT managers. Although silos are an inefficient way to share resources, many organizations have become dependent on independently managed resources that share a defined hierarchy and are less likely to switch over to a unified data-center-management approach.

Disruption. Transitioning to new technology often comes at the cost of services interruption. Many enterprises strive for the five nines of availability, and introducing a new architectural IT design can cause service outages. Many data center managers fear that transitioning networking and storage over to virtual entities concurrently will result in unpredictable service delivery.

Legacy hardware. Most data centers have a significant investment in proprietary hardware and the associated service contracts. A rip and replace of systems incompatible with SDDC solutions could prove to be very costly.

Operational overhead. Transitioning to new data center architecture incurs ancillary costs, such as training, support contracts, and consultants, meaning that budgets will have to grow, at least temporarily to incorporate SDDC into a data center.

ROI concerns. Business IT decisions are often based on demonstrable return on investment, which can be very difficult to calculate when dealing with a disruptive technology such as SDDC.

Support. With some SDDC implementations relying on heterogeneity and multiple vendor products, support may be a complex issue, which could significantly increase costs.

Although the future looks bright for SDDC, legacy hardware issues, costs, and design concerns could potentially delay the wholesale adoption of the technology.

About Frank Ohlhorst

Frank J. Ohlhorst is an award-winning technology journalist, professional speaker, and IT business consultant with more than 25 years of experience in the technology arena. He has worked with all major technologies and accomplished several high-end integration projects in a range of industries, including federal and local governments as well as Fortune 500 enterprises and small businesses.

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