CHAPTER

APPLICATION MANAGEMENT IN A SOFTWARE-DEFINED DATA CENTER

14

Just as the world changed when isolated networks became the Internet, computing is about to make a quantum leap to 'data centers' abstracted from hardware that may reside in multiple physical locations. This pervasive abstraction will enable us to connect, aggregate, and configure computing resources in unprecedented ways.
Eric Knorr, Editor-in-Chief, *InfoWorld*

Enterprises will be able to use software-defined data centers to innovate with greater utilization, and cost savings on a unified platform for their applications.
Patrick Kerpan, CEO/CTO, CohesiveFT

INTRODUCTION TO THE SOFTWARE-DEFINED DATA CENTER

Enabled by the introduction of virtualization, **software-defined data centers (SDDCs)** are taking the information technology (IT) industry by storm. The goal of the SDDC is to decrease costs and increase agility, policy compliance and **security** by deploying, operating, managing, and maintaining applications. In addition, by providing organizations with their own private **cloud**, SDDCs provide greater flexibility by allowing organizations to have on-demand access to their data instead of having to request permission from their cloud provider.

It is estimated that the market share for SDDCs will grow from the current level of $22 billion to more than $77 billion in the next 5 years. As the use of SDDCs grows at this extraordinary rate, data center managers will be called up to scale their data centers exponentially at a moment's notice. Unfortunately, this is impossible to achieve using the traditional data center infrastructure.

A core belief of the SDDC concept is that the internal and external IT infrastructure must be controlled centrally and aligned with application and service requirements. The use of SDDCs is being driven by business units pressuring IT departments to accelerate their implementation. As a result, developers and application owners are quickly realizing that programming skills and cross-domain capabilities are critical requirements in their IT personnel.

The SDDC extends its focus beyond simply virtualizing servers, storage, and networking to a number of different software applications that contribute to performance improvement and more effective use of data center power use, networking, storage, and hardware. Consequently, in the SDDC, software placement and optimization decisions are based on business logic, not technical provisioning directives, requiring changes in culture, processes, structure, and technology.

Application Performance Management (APM) in the Digital Enterprise. http://dx.doi.org/10.1016/B978-0-12-804018-8.00014-0

The SDDC isolates the application layer from the physical infrastructure layer to facilitate faster and more effective deployment, **management**, and monitoring of diverse applications. This is achieved by finding each enterprise application an optimal home in a public or private cloud environment or draw from a diverse collection of resources.

FUNDAMENTAL RESOURCES OF THE SDDC

The fundamental resources of the SDDC are compute, storage, network, and security. Typically, the SDDC includes limited functionality of service portals, applications, **OS**, VM hardware, **hypervisors**, physical hardware, **software-defined networking (SDN)**, **software-defined storage (SDS)**, security layer, automation and management layers, catalogs, gateway interface module, and third-party plug-ins (Fig. 14.1).

COMPUTE (PHYSICAL AND VIRTUAL)

Traditionally, organizations maintained a combination of physical compute, legacy infrastructure, and virtualized compute nodes to support their core business applications. By stitching together these hardware and virtual components to systematically allocate resources to specific workloads, an overabundance of standalone systems emerged to monitor and manage server farms designed and sized based on projected workload. These infrastructure silos typically lead to resources that become underused, because most organizations using the traditional data center model cannot assess resource availability at a single, unified point because the tools were configured for incompatible legacy applications. As a result, an increasing number of organizations are moving toward developing enterprise-wide infrastructures to more efficiently resolve this issue.

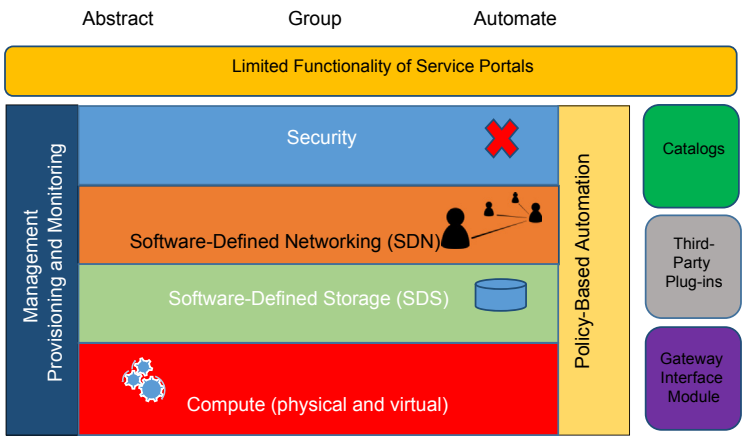

FIGURE 14.1

SDDC infrastructure architecture.

In response to changing workloads and accessibility requirements, the post–hypervisor programming environment and the cloud led to the emergence of **infrastructure as a service (IaaS)**, which offers shared infrastructure services and virtualized compute resources. Using IaaS, **virtualized data centers** can optimize the utilization of compute, storage, and networking through their hypervisors that are programmed to systematically allocate resources for specified applications. Essentially, hypervisors act as an **abstraction software layer** that virtualizes processing resources from physical hardware and integrates resources from a diversity of virtualized software-defined servers (IaaS is discussed at greater length in Chapter 5, "Application Management in the Cloud").

The resulting optimal utilization of resources decreases investment and effort associated with energy use, management overhead, software licenses, and general data center costs. In addition, it extends a data center manager's ability to monitor and create tools to support infrastructure and automation. The efficient and dynamic resource sharing enabled by software-defined server virtualization also results in balanced workloads that meet application requirements. This automatic load-balancing and increased availability is leading to a transition to even greater automation. As automation increases, so does the speed and reliability of compute-related operations and as more resources are abstracted and integrated into a software-defined model, the move to a full SDDC is possible.

SOFTWARE-DEFINED STORAGE

To realize the full benefits of the SDDC, it is necessary to include a **software-defined storage (SDS)** solution as a cost-effective way to gain real value from web-scale IT architectures. In light of unprecedented challenges in managing big data, SDS is quickly becoming an important aspect of a practical, proactive strategy for managing the rapidly increasing volume of enterprise data as organizations strive to gain greater flexibility in their IT architecture. SDS is hardware independent in that it can run on any standard server platform and has a distributed architecture that exceeds the limitations of **network attached storage (NAS)** or **storage area network (SAN)** storage. Ideally, the SDS should support standard data protocols including block, file, and object data services, run application workloads on storage nodes, and have a sophisticated management control plane to streamline and simplify access to the data. Second-generation SDS solutions, becoming available now, integrate **quality of service (QOS)** with storage services such as data protection and tiering. This approach automates QOS and provides the best opportunity for further capacity and performance optimization.

SOFTWARE-DEFINED NETWORKING

Network infrastructure must be abstracted for consumption by workloads in the SDDC. **Software-defined networking (SDN)** emerged as a critical enabler of network within the SDDC. The **Open Networking Foundation (ONF)**, a nonprofit consortium that maintains stewardship over the **OpenFlow** SDN protocol, defines SDN as the separation of the control and data planes in network devices, where the control plane is consolidated within a centralized controller that programs network flow rules into individual data plane devices.[1] In this way, SDN's ability to use a single, logically

[1]What is SDN? https://www.opennetworking.org/sdn-resources/sdn-definition.

isolated computing infrastructure within which discrete networks can easily be created allows organizations to move from production to development to test. Interestingly, decoupling the control plane and data plane was not the most important SDN characteristic identified by respondents to a 2016 Enterprise Management Associates End-User Research Report on the impacts of SDN and network virtualization on network management.[2] Table 14.1 shows the percentage of respondents who identified a variety of defining SDN characteristics that are important to the solutions they implement.

The OpenFlow protocol identified by respondents to the Enterprise Management Associates (EMA) survey was created by the **Open Networking Foundation (ONF)** to standardize critical elements of the SDN architecture and is the first standard interface designed specifically for SDN. The standard is designed to provide high-performance, granular traffic control across the network devices of multiple vendors. Table 14.2 shows the benefits that can be achieved by using the OpenFlow protocol.

OpenFlow began as a Stanford University research project in 2008. Vendors and large enterprises started productizing the technology and implementing SDN in 2011. Data center mega-user Google built its own SDN switches and was the first company to build a global software-driven network. Meanwhile, vendors including Microsoft, VMware, Cisco, and Brocade, released OpenFlow-friendly products, or other SDN technologies, such as software overlays or policy-based networking.

Table 14.1 SDN Defining Characteristics Important to Solution Implementation

SDN Characteristic	Percent (%)
Centralized controller	35
Low-cost hardware	28
Fluid network architecture	25
Open source software	24
Software-only solutions with no hardware refresh	24
OpenFlow protocol	21
Decoupling the control plane and data plane	11

Table 14.2 Benefits of SDN OpenFlow Protocol

Centralized management and control of networking devices from multiple vendors
Improved automation and management
Rapid innovation through new network capabilities and services without the need to configure individual devices or wait for vendor releases
Programmability by operators, enterprises, independent software vendors and users
Increased network reliability and security
More granular network control with ability to apply comprehensive and wide-ranging policies at session, user, device, and application levels
Better end-user experience

Adapted from Software-Defined Networking: The New Norm for Networks, April 13, 2012. Accessible from: https://www.opennetworking.org/images/stories/downloads/sdn-resources/white-papers/wp-sdn-newnorm.pdf.

[2]McGillicuddy, S., 2016. Managing Tomorrow's Networks: The Impacts of SDN and Network Virtualization on Network Management. Enterprise Management Associates.

SECURITY

Overall, the SDDC is considered more secure than a virtualized data center that uses the cloud. The use of an SDN within the SDDC allows organizations to more easily and effectively secure their SDDC by microsegmenting the separate networks. Trying to achieve this with physical components and firewalls would be nearly impossible. A good example of this is a security improvement project undertaken by Starbucks. In the light of high-profile security breaches in companies such as Target, Neiman Marcus, and PF Changs, Starbucks sought tenders to improve the security of its data by segmenting it in an East vs. West fashion. In response, they received bids of at least $10 million and faced the onerous task of purchasing, implementing, and maintaining 90 physical firewalls. This appeared to be an almost impossible task to Starbucks' management, who simply could not justify the cost, time, or expertise it would take. As an alternative, they turned to an SDDC approach. By adopting VMware's NSX software-driven networking tool, they were able to use their existing network, and the total cost of the security improvement was $3 million. By choosing the SDDC approach to deliver automated, high-performance microsegmentation security inside their data center, Starbucks greatly improved their data center security for a fraction of the cost of the proposed $10 million traditional hardware-based approach.

WHY MOVE TO AN SDDC?

From a business perspective, the main reasons for transitioning to the SDDC are increased security, better business alignment of the IT infrastructure, and rapid application provisioning. Traditionally, data centers were characterized by dedicated and isolated hardware plagued by low resource utilization and very limited flexibility. Subsequently, second generation virtualized data centers used consolidated virtualized servers to improve resource utility. The SDDC can create a more flexible environment in which enterprise applications can be reconfigured and supported. The SDDC achieves this by reducing the steps needed to decrease the time it takes to deploy workloads into the production environment. In addition, the SDDC facilitates application definition and the specification of resource needs, including compute, storage, networking, and security by grouping the defined applications and needs to create a simplified application supported by the SDDC. Essentially, converting to the SDDC enables automation and provisions self-service for users by restructuring the data center software and the virtualization administrator's role to provide IaaS. The resulting simplistic application designs enable organizations to achieve greater agility and flexibility in their operations management. This supports and simplifies **application management**.

A software-defined infrastructure also accelerates the use of managed services that perform basic administration and configuration, as well as moving data center staff to performing value-added business services and managing the data created. Software-defined server virtualization enabled organizations to use SDDCs to more efficiently use resources, automate and balance workload, and minimize the need for physical hardware in the data center.

Transitioning to the SDDC enables organizations to achieve optimized utilization of resources, capacity on demand, greater business–IT alignment, improved agility, and flexibility of operations managements and cost savings (Fig. 14.2).

Typically, there are two approaches to implementing the SDDC project. Organizations can either make existing infrastructure more accessible to developers or adopt new infrastructure that offers comprehensive APIs for developer access. Large enterprises tend to add programmability to their existing

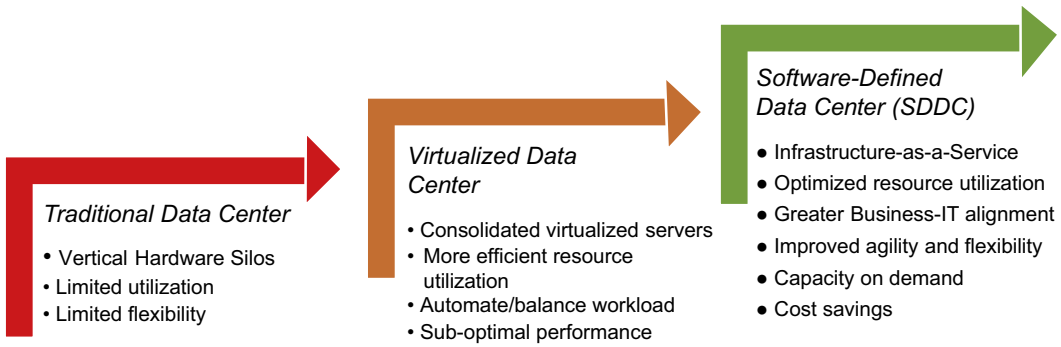

FIGURE 14.2

Data center evolution.

infrastructure while small and medium-sized organizations are more likely to adopt new programmable infrastructure. Very few organizations of any size follow a "rip and replace" approach to building the SDDC; instead, the vast majority gradually replace existing infrastructure and layer new programmable elements on top of legacy data center technologies.

Ultimately, the SDDC requires a change in culture, processes, organizational structure, and technology with a focus on deploying and constantly updating applications in the most efficient and effective manner. This is an ambitious vision that depends on a "logic layer" that is able to make policy-based application placement and management decisions by integrating with traditional IT disciplines, such as performance management, **capacity management**, and lifecycle management. Once the placement decision is made, orchestration and automation capabilities are needed to provision computer, network, and storage resources and the required software in a secure manner. In short, within the SDDC, software placement and optimization decisions are based on business logic instead of technical provisioning instructions.[3]

MANAGING SDDCs

Good management is critical to adopting and operating the SDDC and requires a very different approach from that used to manage a traditional data center. At first glance, the software architecture of the SDDC is easier to interchange than its hardware-based equivalent and might appear to be easier to manage, but that is not the case. There are numerous traps that organizations can fall into when transitioning from a hardware-based to software-defined data center. For example, it is important to verify existing configurations before exposing them to software-defined management because misconfigurations can cause major problems faster and be more difficult to identify in an automated environment.

[3]See part one of the EMA series of four blog posts on the baseline definition of the SDDC: http://blogs.enterprisemanagement.com/torstenvolk/2012/08/16/softwaredefined-datacenter-part-1-4-basics/.

It is also important to remember that traditional hardware-based data centers consist of tightly integrated vertical silos, each of which has a dedicated infrastructure tied to specific applications and has its own management tools, people, and processes. In the SDDC, these integrated vertical silos are transformed into loosely coupled horizontal layers consisting of abstracted infrastructure and applications with their own single set of tools that manage each horizontal layer regardless of the infrastructure or application.

In this type of environment, it is important to recognize that managing the SDDC is not just about managing virtual **CPU** and memory. First, each infrastructure topology layer must be addressed separately and the relationships between them must be understood so that problems across the different layers can be properly correlated and resolved. Next, data must be gathered to help make intelligent operations management decisions, including metric data from devices and element managers on a specific time cycle, logs to identify problems and issues, critical issues including faults, configurations settings to understand the current state, and configuration changes to determine root causes of problems. Finally, intelligent management operations include automating problem identification and resolution, monitoring performance, identifying abnormalities, conducting capacity and change management, managing logs, ensuring the SDDC conforms to best practices and more importantly to the organization's desired configuration and security stance, and, finally, being prepared to troubleshoot by searching the data collected by the software solution used in the SDDC.

The following sections discuss the different application management techniques needed to apply these principles and realize the full potential of the SDDC.

IMPLEMENT CENTRALIZED, POLICY-DRIVEN, AND APPLICATION-CENTRIC MANAGEMENT STYLE

Traditionally, data center managers had to focus on purchasing equipment, managing facilities, and equipment in their own data center and that of third parties. To reap the full benefit of the SDDC, managers have the added burden of carefully monitoring and controlling performance, compliance status, costs, and self-service provisioning for the SDDC users. Consequently, managing infrastructure in a centralized, policy-driven, and application-centric manner is generally regarded as the heart of SDDC management. This type of approach is a strategic shift that requires drastic changes in culture, organization, and processes, not just a change in technology. An application-centric and automated infrastructure is particularly important when addressing the networking component of the SDDC. To achieve this, it is critical to leverage software-defined networking and network virtualization that change the nature of the underlying network that supports SDDC, including the physical network devices and elements using control protocols such as OpenFlow.

CREATE BLENDED TEAMS WITH CROSS-DOMAIN EXPERTISE

As business units exert more and more pressure on their IT department to accelerate the SDDC adoption process, IT application and operations professionals have to obtain new skills such as programming and focusing on the development of **cross-domain expertise**. Consequently, IT managers have

to provide their staff with a more well-rounded set of skills and a greater breadth of knowledge in their new roles.

To be successful, SDDC managers must coordinate diverse groups of people and infrastructure as part of their day-to-day duties. In large organizations, this might include architecture, engineering, integration, operations, and project management teams. A logical blending of teams might be architecture/engineering and integration/operations with a stand-alone project management team to oversee planning, execution, monitoring/controlling, and the ultimate closure of a project.

ORCHESTRATE A HANDS-ON APPROACH

As the blended SDDC teams emerge, it is essential that managers ensure teams are more hands-on than in a traditional data center and assume new responsibilities, such as evaluating partners, providing consistent management and security of all internal and external access points, and finding providers who include software developers on their teams. SDDC managers will also need to focus on ensuring that all teams are functioning and performing efficiently in managing the movement and security of on-site and off-site data, and motivating the newly formed teams to be more aggressive in automating discovery, provisioning, and location tasks with respect to space and power in the SDDC. Needless to say, the difficulty in orchestrating the hands-on approach will vary somewhat depending on the types of organization, and exponentially between organizations of different sizes. For example, upgrading a small number of **virtual machines** in a small–to–medium-sized enterprise can be relatively easy, while the level of complexity involved in upgrading 5000 virtual machines with intricate dependencies in a large Fortune 100 company would be far more difficult.

Temporarily switching staff between teams can be an effective way to achieve this. For instance, each month a small percentage of the architecture/engineering team would be moved to the integration/operations team for a week or two and vice versa, to allow them to appreciate the roles and challenges of the other team. This approach proved to be very effective by proponents of the **DevOps** concept in breaking down barriers between teams of analysts, developers, and operations personnel.

CULTIVATE POLICY-DRIVEN INFRASTRUCTURE PROVISIONING AND MANAGEMENT PROCESS

Although a number of strategically aligned vendors including EMC II, Pivotal, RSA, VCE, Virtustream, and VMware united to form the **EMC Federation** to provide customer solutions and choice for the software-defined enterprise and the cloud, there are currently no central management technologies to control and unify the entire data center and the public cloud. However, an IT operations mindset that focuses on reinventing the infrastructure provisioning and management process in a much more policy-driven manner can lead to successfully implementing the SDDC. Clearly, the SDDC cannot be implemented in the form of a technology project but rather constitutes a concept that describes guidelines that follow the multiyear vision of entirely closing the traditional gap between enterprise IT and the business.

INCREASE CAPACITY MANAGEMENT FOCUS

To preserve the CAPEX and OPEX savings realized by virtualization, the cloud, and the SDDC, the use of capacity management tools must be optimized. Too much guesswork results in overprovisioning, which often fails to deliver desired performance and reliability. As a result, a more intelligent approach needs to be taken in initial placement of applications and the ongoing optimization of application environments.

USE A MULTI-VIRTUALIZATION AND MULTI-CLOUD MANAGEMENT APPROACH

To enhance performance, costs, security, and SLA requirements, application and IT operations teams must assign the most effective selection of physical, virtual, and cloud platforms. Management software such as CSC ServiceMesh, Convirture, ASG Cloud Factor, or IBM SmartCloud Orchestrator provides this type of policy-driven central management capability.

CREATE AND PACKAGE REPEATABLE SOFTWARE AND INFRASTRUCTURE CONFIGURATION

To optimally run an application, configuration management is a critical component in enabling IT teams to consistently provision and manage the various SDDC resources. Configuration management also enables testing or simulating system updates and the consistent and continuous enforcement of policies and best practices across the SDDC, including the semiprivate and public cloud infrastructure. The ability to centrally create and package **repeatable software and infrastructure configuration** for application deployment is a core building block of the SDDC and can be delivered through configuration management software, such as Puppet, Chef, or CSC ServiceMesh. To achieve this, corporate policy must be in place to govern how developers or application administrators publish their applications to an environment of their choice. Only then can an organization take full advantage of all the components of the internal and public infrastructure.

TAKE ADVANTAGE OF IT VENDOR SUPPORT

IT vendors can provide assistance in the form of professional consulting and implementation services in the areas of "legacy infrastructure integration" and improved "IT alignment with business requirements."

CHALLENGES OF MANAGING AN SDDC

Moving to the SDDC is not a simple process. Enterprise architects perceive the SDDC as a strategic direction that consists of a complex web of technical, process, organizational, and cultural challenges. While virtualization facilitated hosting applications and server use, the SDDC further accelerates and

expands this concept by eliminating more IT silos and more thoroughly decoupling IT infrastructure components. These additional changes can be met with resistance. In addition, many of the requisite technology components are still evolving and many organizations' existing IT infrastructures still use legacy products such as mainframes. Despite these challenges, demands for rapid change coupled with the need for organizations to be more agile, particularly in the application layer, are leading to a growth in the number of SDDCs.

In an EMA survey conducted with 235 visionary companies who had extensive experience, skill, and expertise regarding obstacles and priorities on their journey to the SDDC, IT silos and business pressure were identified as two major challenges faced on the SDDC journey.[4]

IT SILOS

Traditional data center silos (i.e., servers, network, storage, applications, and security) represent a key pain point within the context of the SDDC. This leads to security, OPEX, and integration issues. The issues associated with deploying software updates are magnified in large companies, while small companies experience more frequent issues with high OPEX and CAPEX related to the existence of IT silos. Security concerns and integration challenges of IT silos are most prevalent in medium-sized organizations. To satisfy business-driven IT initiatives, data center managers will have to be more project-centric across traditional silos. This will require establishing different priorities, oversight, and organizational and political control, because in most companies, the greater percentage of IT budgets is assigned to silos rather than to projects. Key pain points caused by the IT silos of storage, network, compute, middleware, security, and legacy groups in different-sized organizations are shown in Table 14.3.

Table 14.3 Pain Points Caused Between IT Silos

Pain Point	Percent (%)
Security concerns	38
Increased operating cost	37
Integrating legacy with new technologies	35
Finding/hiring skilled staff	34
Lack of centralized control	34
Slow deployment of software updates	33
Slow provisioning of new application environments	32
Diagnostics and troubleshooting	32
Increased capital cost	30
Increased staff cost	29

Adapted from Volk, T., Frey, J., 2014. Obstacles and Priorities on the Journey to the Software-Defined Data Center: An Enterprise Management Associates (EMA) Research Report. EMA, Boulder, CO.

[4]Volk, T., Frey, J., 2014. Obstacles and Priorities on the Journey to the Software-Defined Data Center: An Enterprise Management Associates (EMA) Research Report. EMA, Boulder, CO.

BUSINESS PRESSURE

The EMA survey reported that business units put tremendous pressure on traditional IT silos, leading to "added responsibilities and skill requirements," the "need for more cross domain knowledge," and IT groups asking for an "increase in staff." The latter applies more to small businesses, while mid-sized organizations are more focused on the cross-domain knowledge requirement to counter the breakdown of traditional IT processes under the load of business requests. Only 9% of study respondents did not see an impact of the SDDC on current infrastructure management, proving that the vast majority of companies (91%) are affected by this new set of challenges.

Table 14.4 shows the increasing number of resource requests from business units and their developers on the traditional roles of network, storage, database, application, and server administrators that were identified by the respondents.

Other challenges caused when transitioning to the SDDC relate to visibility and operations and software licensing.

PERFORMANCE VISIBILITY AND OPERATIONS

The transition to SDDCs and the associated utilization of software-defined networking (SDN), virtualized networks, and virtual firewalls requires new visibility, operations, and integration of networks, storage, servers, and security, all of which require highly integrated operations teams. Consequently, visibility and management across data center silos and across virtual and physical networks are critical.

Tools to address these visibility and operations challenges emerged, including Arkin's Visibility/Operations Platform, SDDC, and Cloud, and to provide end-to-end visibility across underlay and overlay. These tools also extend to **Amazon Web Services** to enable organizations to easily deploy and operate a microsegmentation-based network and security model.

Table 14.4 Impact of Business Requests on Traditional IT Roles

Type of Business Requests	Percent (%)
Added responsibilities and skills required	44
More cross-domain knowledge needed	42
Increase in staff required	41
IT operations staff feels threatened by change	35
Traditional processes are breaking down under the load	34
Business units are bypassing IT and use public cloud services instead	31
Traditional IT roles stay unchanged	26
There is no increase in number of requests coming from business units	3

Adapted from Volk, T., Frey, J., 2014. Obstacles and Priorities on the Journey to the Software-Defined Data Center: An Enterprise Management Associates (EMA) Research Report. EMA, Boulder, CO.

SOFTWARE LICENSING

Licensing can also be extremely challenging when moving to the heavily software-driven infrastructure of the SDDC. In today's highly virtualized world, the majority of software licensing models are still better suited to the traditional hardware/software infrastructure, and in some organizations that operate huge numbers of applications that change frequently, software licenses are too vast to inventory. In the heavily software-driven SDDC infrastructure, it is essential that managers seek efficient, effective, and user-friendly licensing models and monitor and control them in a systematic fashion.

SUMMARY

The SDDC directly addresses the shortcomings of many private and hybrid cloud implementation projects. However, implementing the SDDC should not be viewed as a simple technology challenge. Instead, it is important that it be approached as a comprehensive paradigm shift from a purely technology-centric approach to enterprise IT to one that truly focuses on delivering business solutions.

The SDDC virtualizes and delivers the IT infrastructure—computer, storage, network, and security—as a service. This means that provisioning and operating the IT infrastructure is entirely automated by software to increase its agility and flexibility. SDS and SDN are two critical components of the SDDC. The software-defined approach requires a different method for building networks, binding them with applications, and managing them. These new methods go beyond simply deploying a collection of technologies and processes. For instance, the requisite technology components are still evolving and the current state of many existing IT architectures are not conducive to automated deployment and management. To be successful, the transition needs to be approached as a strategic initiative that involves decision, planning, and execution phases for the provisioning of IT services. Management tools are emerging to assist with this process, including VMware's vCloud Suite and Red Hat's Cloud Infrastructure.

KEY TAKEAWAYS

- Key properties of the SDDC are centralized management, best-practice repeatable configurations of software and infrastructure for workload deployment, orchestration and automation to easily deploy applications across silos, and operational analytics.
- Implementing and operating the SDDC are not just technology challenges. They must be approached as a comprehensive paradigm shift from a purely technology-centric approach to enterprise IT to one that truly focuses on delivering business solutions.
- Management style in the SDDC must be policy driven and application centric.
- Cross-domain expertise and blended teams must be developed and nurtured.
- Implementing and operating the SDDC requires an increased focus on capacity management, **multi-virtualization** and **multi-cloud management**, and configuration management.
- Challenges of transitioning to the SDDC include IT silos, business pressure, performance visibility and operations, and software licensing.
- Vendors are collaborating to produce a fully integrated, engineered, tested, and validated solution to help accelerate organizations as they transition to the SDDC.