The Mandate for a Highly Automated IT Function

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Introduction

The traditional IT operational model is highly manual and very hardware centric. As a result, IT infrastructure services have historically been both expensive to provide and slow to respond to new requirements. Over the last few years, the pressure that virtually all IT organizations have felt to reduce cost and be more responsive to new requirements has driven both the adoption of new technologies, such as server virtualization, and the adoption of new ways of delivering IT services, such as cloud computing. The relentless pressure to reduce cost and be more responsive continues to drive the IT operational model to change. For example, that pressure is driving companies to make additional use of both virtualization and cloud computing and to explore alternative approaches to delivering IT services, such as Software Defined Data Centers (SDDCs) and Software Defined Networking (SDN).

This white paper is part of a five-part series of white papers and webinars that describe the journey that IT organizations must take to go from the traditional highly manual, hardware centric IT operational model to an operational model that is highly automated and software centric. This white paper will describe the limitations of the current IT operational model and will discuss some of the factors that are forcing IT organizations to adopt a new operational model.

The Traditional IT Operational Model

This section will discuss some of the key characteristics of the traditional IT infrastructure that cause the infrastructure to be both expensive and slow to respond to new requirements. Those characteristics include that the traditional IT environment:

- Is hardware centric;
- Focuses on dedicated servers and appliances;
- Is comprised of equipment from myriad vendors and of varying vintages;
- Relies on inadequate automation tools.

Is Hardware Centric

The key components of the infrastructure (i.e., compute, storage, networking) are hardware centric. Using networking as an example, network components (switches, routers, WAN optimization controllers (WOCs), Application Delivery Controllers (ADCs)) have traditionally been based on dedicated appliances and each appliance was itself based on dedicated hardware such as ASICs.

Some of the implications of this approach to developing network appliances are that:

- The ASICs that provide the network functionality evolve slowly;
- The evolution of ASIC functionality is under the control of the provider of the appliance;
- The appliances are proprietary;
- Each appliance is configured individually;
- Tasks such as provisioning, change management and de-provisioning are very time consuming and error prone.

Focuses on Dedicated Servers and Appliances

In the traditional data center design, functionality such as servers, storage, LAN switches, firewalls and load balancers are typically dedicated to a single service or application. This approach results in stranded capacity and hence an increase in the overall cost of the data center. It also increases the time it takes to deploy a new service or application since new infrastructure must be designed, procured, installed and tested before a new service or application can go into production.

Is Highly Heterogeneous

There are several factors that drive heterogeneity in the IT infrastructure. The result of that heterogeneity is that there is little if any commonality in terms of how the components of the traditional IT infrastructure are configured and managed.

One factor that drives heterogeneity is that that the key components of the infrastructure (i.e., compute, storage, networking) have traditionally been provided by different vendors. Another factor is that there typically is significant diversity within a given component of the infrastructure. Using networking as an example, the majority of IT organizations use networking equipment from multiple vendors. Even if an IT organization were to use only a single networking vendor such as Cisco, they would likely have network elements that utilized different Cisco operating systems and hence displayed some of the same diversity as if the network elements came from different vendors.

Another factor that drives heterogeneity is that virtually all IT environments are comprised of both state-of-the art and legacy components. One of the reasons for this is the fact that purchasing decisions accumulate over time and existing systems may be too costly or too critical to replace. Alternatively, an IT organization may have spent large amounts of money on the current infrastructure and won't replace it until it is either fully depreciated or has reached the end of its functional life.

Relies on Inadequate Automation Tools

IT organization use automation as a way to more quickly respond to new requirements or changes in the environment and the most common approach that IT organizations take relative to automation is to use scripts. Unfortunately there are four key issues relative to the use of scripts that minimize the value of this approach to automation.

One issue is that scripts are both difficult and time consuming to maintain because scripts typically are long and complex. Another side effect of being long and complex is that scripts tend to break when there is a change in the environment. Maintaining and/or fixing scripts require programmers and the vast majority of IT infrastructure organizations don't have the funding to hire a sufficient number of programmers.

The fact that most IT infrastructures tend to be very dynamic combined with the fact that scripts tend to break when there is a change in the environment means that an unacceptably high percentage of the IT infrastructure organization's scarce pool of programmers is consumed maintaining the existing set of scripts. As a result, another issue with the heavy reliance on scripts is that it is difficult, if not impossible, to scale the use of scripts and hence it is difficult, if not impossible, to significantly increase the amount of infrastructure automation.

The heavy reliance on scripts introduces unnecessary risk and it limits the productivity of the infrastructure team. The root cause of this issue is the scarce pool of programmers that are available to create and/or maintain scripts. One impact of this scarcity is that programmers become a bottleneck that can either delay the introduction of new functionality, or result in new functionality being introduced with little if any supporting automation. Another impact is that in virtually all instances, the majority of the infrastructure organization isn't programmers and the work of the majority of the infrastructure organization is often dependent on the work of a small set of programmers. That situation typically leads to throttling the productivity of the non-programmers.

The fourth issue is that a script-based approach to automation results in little, if any, systematic, reusable intelligence. In most IT organizations, the majority of intelligence about the existing set of scripts is entirely contained in the heads of the programmers. This further increases the risk that was discussed in the preceding paragraph because it creates the risk that this intelligence will disappear when one or more of the programmers leave the organization. It also makes it impossible to effectively search the existing set of scripts to locate functionality that can be re-used or re-purposed.

The Emerging IT Operational Model

As mentioned in the introduction, a few years ago IT organizations began to evolve away from the traditional highly manual, hardware centric IT operational model and head to an IT operational model that is highly automated and software centric. This section of the white paper will discuss some of the initiatives that IT organizations are either currently implementing, or are likely to soon implement, that are shaping the emerging IT operational model.

Virtualization

The first form of virtualization to significantly impact IT organizations was server virtualization. As pointed out in The 2013 Application and Service Delivery Handbook[1], in the current environment the majority of IT organizations have already virtualized the majority of their data center servers and the penetration of server virtualization is expected to increase. For most IT organizations, the implementation of server virtualization was their first major step to move away from an environment that was both hardware centric and comprised of dedicated servers and appliances.

One of the key factors driving the broad adoption of server virtualiztion is that server virtualization allows significant savings in the both CAPEX (i.e., costs of server hardware) and OPEX; i.e., server management labor expense, plus facility costs such as power, cooling, and floor space. Another key factor driving adoption is that server virtualization enables IT organizations to move a production virtual machine (VM) between physical servers, which helps to:

- Streamline the provisioning of new applications
- Improve backup and restoration operations

[1] http://www.webtorials.com/content/2013/06/2013-application-service-delivery-handbook.html

- Enable zero-downtime maintenance

While server virtualization was the first form of virtualization to significantly impact IT organizations, today most IT organizations have implemented additional forms of virtualization including the virtualization of appliances such as WOCs and ADCs. In addition, the European Telecommunications Standards Institute (ETSI) has formed an Industry Specifications Group for Network Functions Virtualization (NFV ISG). The goal of NFV ISG is to enable telecommunications service providers to greatly simplify their operations and reduce capital expense by having all of the network functions they use available as virtual appliances that can be easily provisioned and integrated regardless of the vendor who provided the appliance or the hypervisor(s) on which it runs.

Cloud Computing

One measure of the large and growing adoption of cloud computing is that according to industry analysts, the global cloud computing market will grow to $241 billion in 2020[2]. As pointed out in The 2013 Application and Service Delivery Handbook, the two primary factors driving IT organizations to utilize applications and services from a Software-as-a-Service (SaaS) or Infrastructure-as-a-Service (IaaS) provider are to:

- Lower cost;
- Reduce the amount of time it takes to implement an application or add capacity.

The 2013 Application and Service Delivery Handbook also pointed out that three of the characteristics that are commonly associated with cloud computing are:

- Virtualization;
- Automation;
- Self-service.

The significant adoption of cloud computing demonstrates how much influence the drivers listed above have on the evolution of IT infrastructure organizations. That adoption also demonstrates how critical the characteristics listed above are to the emerging IT operational model.

Although the adoption of cloud computing offers many benefits, it also presents some very significant challenges. One of the primary challenges IT organizations face as they expand their use of cloud computing is ensuring that the use of cloud computing doesn't negatively impact their ability to provide an acceptable level of application performance. For example, IT organizations need to ensure that as they migrate an application to an IaaS provider or they implement more of the characteristics of private cloud computing, that application performance isn't negatively impacted.

Software Defined Data Center (SDDC)

As noted, IT organizations are currently making significant use of virtualization and cloud computing. Few if any IT organizations have currently implemented an SDDC. SDDC is an emerging concept that is being advocated by a number of vendors and which provides clear direction in terms of how the IT operational model is changing.

[2] http://www.zdnet.com/blog/btl/cloud-computing-market-241-billion-in-2020/47702

The two primary characteristics of an SDDC are virtualization and automation. In particular, in an SDDC:

- Compute virtualization, network virtualization and software-defined storage deliver abstraction, pooling and automation of the compute as well as network and storage infrastructure.

- Automated management delivers a framework for policy-based management of data center application and services.

While it's true that few if any IT organizations have currently implemented an SDDC, it's also true that the steps that the majority of IT organizations have already taken to implement virtualization and private cloud computing are key steps on the path to implementing an SDDC. However, in order to continue down the path to implementing an SDDC, IT organizations need the ability to perform self-service automation of a heterogeneous, multi-generational IT infrastructure.

Software Defined Networking (SDN)

Similar to the situation with an SDDC, few IT organizations have already implemented SDN. However, The 2013 Guide to Network Virtualization and Software Defined Networking[3] contains market research data that indicates the great interest that IT organizations have in SDN.

The Open Networking Foundation (ONF) is the group that is most associated with the development and standardization of SDN. According to the ONF[4], "Software-Defined Networking (SDN) is an emerging architecture that is dynamic, manageable, cost-effective, and adaptable, making it ideal for the high-bandwidth, dynamic nature of today's applications. This architecture decouples the network control and forwarding functions enabling the network control to become directly programmable and the underlying infrastructure to be abstracted for applications and network services. The OpenFlow™ protocol is a foundational element for building SDN solutions."

According to the ONF, the SDN architecture is:

- **Directly programmable**: Network control is directly programmable because it is decoupled from forwarding functions.

- **Agile**: Abstracting control from forwarding lets administrators dynamically adjust network-wide traffic flow to meet changing needs.

- **Centrally managed**: Network intelligence is (logically) centralized in software-based SDN controllers that maintain a global view of the network, which appears to applications and policy engines as a single, logical switch.

- **Programmatically configured**: SDN lets network managers configure, manage, secure, and optimize network resources very quickly via dynamic, automated SDN programs.

Similar to virtualization, cloud computing and SDDC, SDN is one more factor driving the IT organization to change their operational model to have much more of a focus on software, automation and self-provisioning.

[3] http://www.webtorials.com/content/2013/10/2013-guide-to-software-defined-networking-network-virtualization.html
[4] https://www.opennetworking.org/sdn-resources/sdn-definitions

Summary and Next Steps

Because the traditional IT operational model has been highly manual and very hardware centric, IT infrastructure services have historically been both expensive to provide and slow to respond to new requirements. While being expensive and slow has never been acceptable, having an IT infrastructure with these qualities is rapidly becoming unacceptable for virtually all IT organizations because it places the company at a significant competitive disadvantage.

The broad adoption of server virtualization was the first major step that IT organizations took towards adopting an IT operational model that can respond quickly to new requirements and which is relatively inexpensive. Subsequent steps that most IT organizations have already taken include the adoption of additional forms of virtualization as well as the adoption of cloud computing. These steps, combined with the great interest that IT organizations are showing in both SDDCs and SDN indicate that the emerging IT operational model will increasingly be characterized as being software-based and highly automated.

In order to head down a path to a software-based, highly automated operational model, IT organizations need to develop a strategy for how they will implement self-service automation of what is today, and likely always will be, a heterogeneous, multi-generational IT infrastructure. In order to be successful, the strategy that IT organizations adopt must have both a technology and an organizational component. Future white papers and webinars in this series will describe those components in detail.

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