Technical Report

Managing NetApp FlexPod with Cisco UCS Director

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Abstract

As the adoption of virtualization and private cloud deployments continues to increase, data center complexity and data storage growth become more of an issue. The NetApp® FlexPod® integrated infrastructure combines compute, network, and storage into a unified platform with prevalidated configurations. This solution reduces deployment time and operational complexity. Combining FlexPod with Cisco Unified Computing System™ (Cisco UCS®) Director provides a single application to monitor, plan, and execute infrastructure management tasks.

This paper describes how Cisco UCS Director fits into your data center management tool set and how to create workflows in Cisco UCS Director for two use cases, tenant onboarding and tenant application provisioning.

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1 Audience

The target audience for this paper is storage administrators, technical sales engineers, and private cloud architects. This information is also useful for anyone who wants to gain a better understanding of converged infrastructure management, especially in a private cloud environment.

2 Current Situation

Over the past 15 years, since the rise of mainstream x86 virtualization, companies have been converging more and more of the stacks in their data centers. Server virtualization enabled many server workloads to be consolidated onto a single compute resource. Around the same time, network virtualization in the form of virtual LANs (VLANs; IEEE 802.1Q) allowed multiple network broadcast domains to be shared on one physical switch. Today, more changes are occurring at the network layer through new technologies such as Data Center Bridging (DCB; IEEE 802.1Qaz) and software-defined networking (SDN). Figure 1 shows an example environment that has a siloed compute, network, and storage infrastructure.

Figure 1) Siloed compute, network, and storage infrastructure.

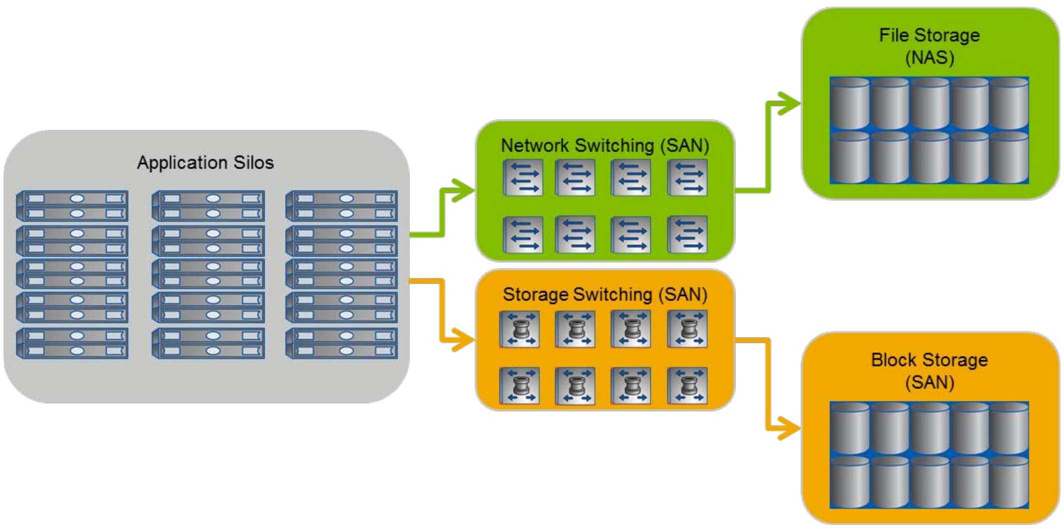
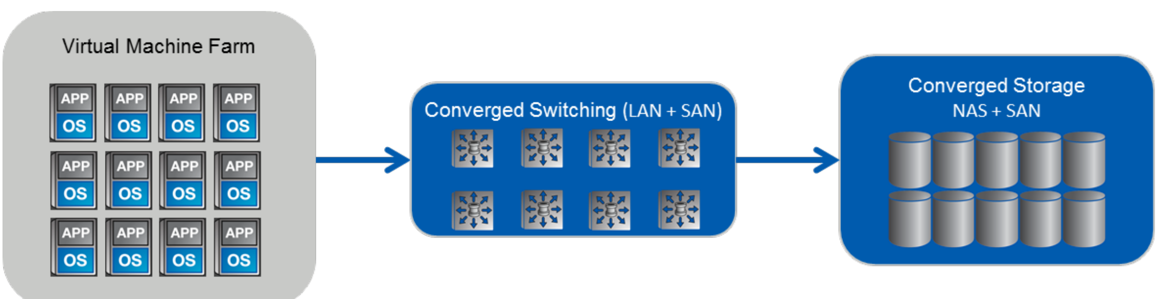


Figure 2 shows an environment that has virtualized compute and network resources and converged storage.

Figure 2) Virtualized compute and network with converged storage.

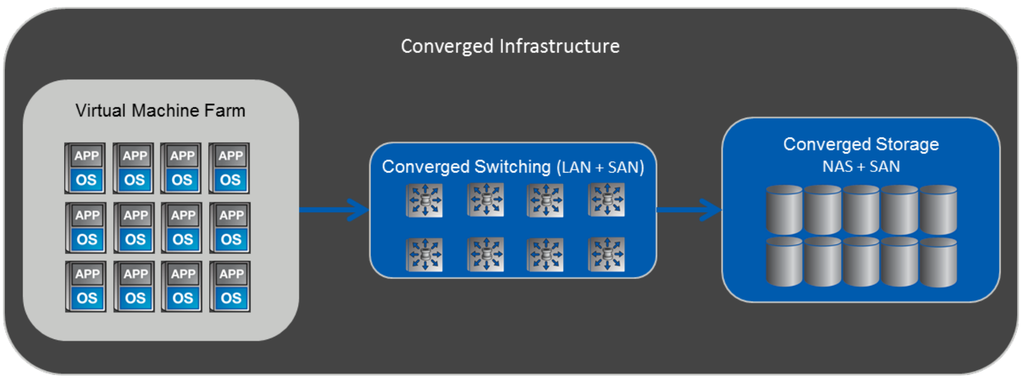


Each of these abstractions has caused shifts in IT operations toward what is known today as cloud computing. The National Institute of Standards and Technology (NIST) defines cloud computing as a model that uses pooled resources and ubiquitous network connectivity to allow IT resources to be rapidly provisioned and deprovisioned with little human interaction.[1]

However, because of the rapid growth of these virtualized environments, the simplification that virtualization once provided has made large data center management more complex, with layers of abstraction and complex interdependencies between the compute, network, and storage resources. Although the logical layers have been coming together, for most companies the physical infrastructure is still managed as distinct silos, impeding the expected gain in efficiency. Furthermore, according to the International Data Corporation (IDC), the amount of data generated and stored by enterprises has been growing at a rate of greater than 50% per year[2], which places more of a burden on IT operations.

In 2010, NetApp created the FlexPod converged infrastructure to reduce data center infrastructure complexity. As shown in Figure 3, this solution combines the fundamental building blocks of compute, network, and storage into prevalidated architectures that are designed for various workloads. FlexPod configurations can be scaled out (by adding more pods) or up (by adding more compute or storage resources in each pod) to meet evolving data center growth requirements.

Figure 3) Compute, network, and storage integrated in a converged infrastructure.



3 Complication

Although the FlexPod converged architecture provides a robust platform for running enterprise workloads, the components of the FlexPod configuration are often still managed as separate stacks with compute, network, and storage each maintained by their respective teams. These divisions of labor are based on good reasons, the biggest of which is that each of these areas requires a specific and specialized skill set. However, without a simplified management system in place, the benefits of a converged infrastructure will not be fully realized.

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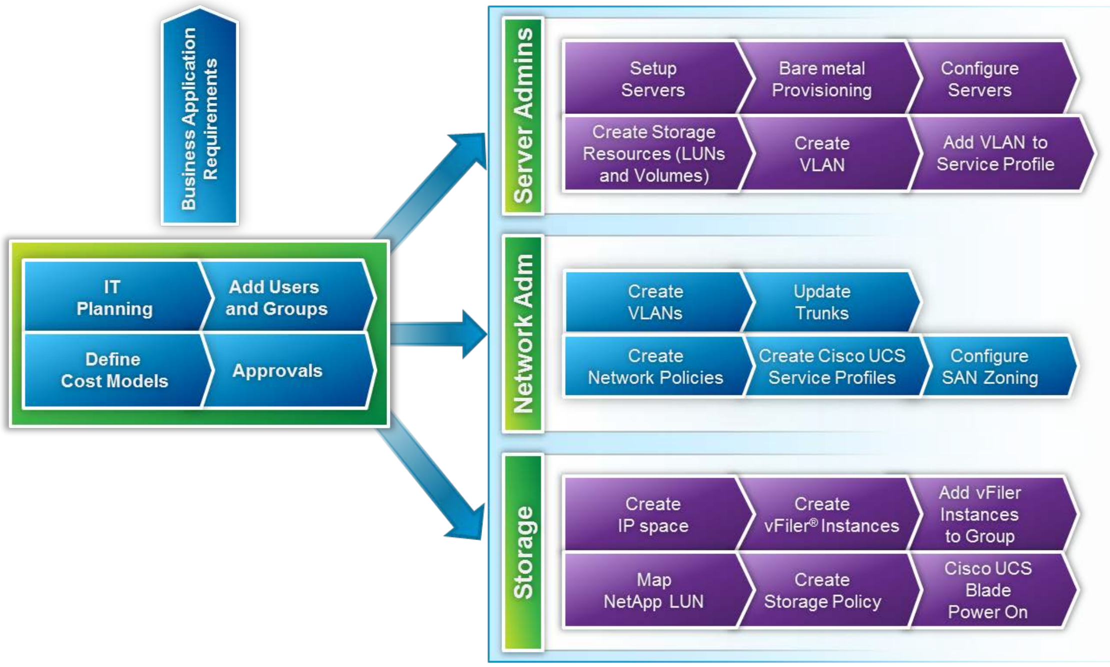
[1] “The NIST Definition of Cloud Computing,” September 2011; available from http://csrc.nist.gov/publications/nistpubs/800-145/SP800-145.pdf; Internet; accessed April 2014.
[2] “Big Data Drives Big Demand for Storage,” April 16, 2013, available from https://www.idc.com/getdoc.jsp?containerId=prUS24069113; Internet; accessed April 2014.

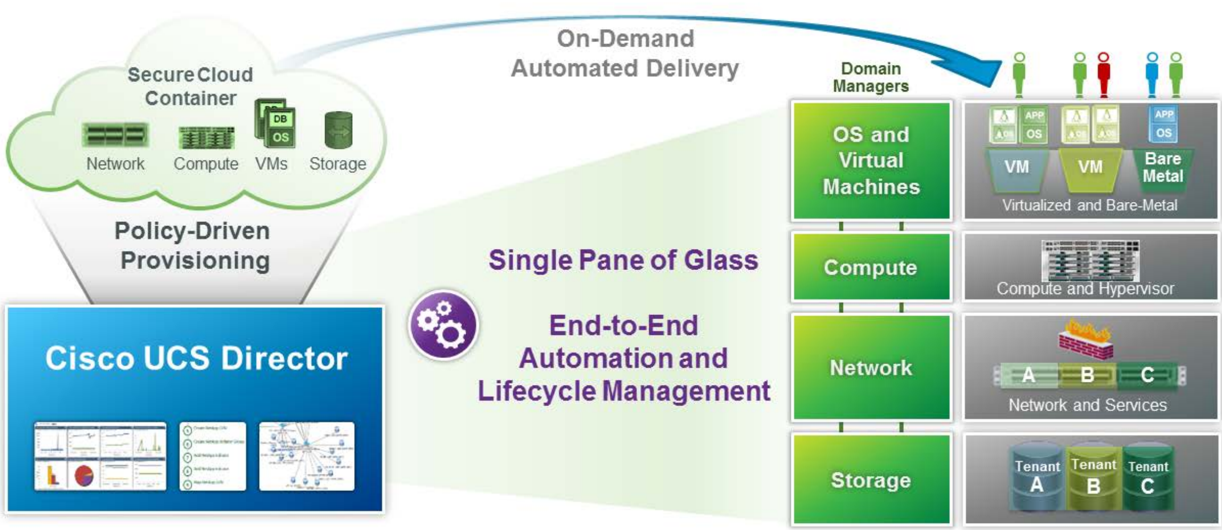
Figure 4) Business requirements map to multiple IT teams with distinct infrastructure management points.



4 How Cisco UCS Director Provides Unified Management Interface

Cisco UCS Director provides a single application to monitor, plan, and execute infrastructure management tasks on the FlexPod converged infrastructures in a data center. With built-in workflow components for NetApp Data ONTAP®, Cisco Nexus® switches, Cisco UCS compute, VMware vSphere®, and Microsoft® Hyper-V®, Cisco UCS Director has end-to-end capabilities.

Figure 5) Cisco UCS Director provides a single management interface for the complete infrastructure stack.



Cisco UCS Director can perform the following operations on systems running clustered Data ONTAP:

- Create, read, update, and delete operations on aggregates, CIFS servers, shares, access control lists (ACLs), Snapshot™ policies, and schedules
- Restore files
- Manage licensing
- Manage iSCSI initiators
- Manage quotas on volumes and qtrees
- Configure Fibre Channel Protocol (FCP)
- Manage igroups
- Clone LUNs
- Configure DNS, NFS, LIF, and cluster nodes
- Provision virtual machines (VMs) through VSC storage
- Configure single-instance storage (SIS)
- Configure and manage NetApp SnapMirror®
- Configure storage virtual machine (SVM; formerly called Vserver) peering and cluster peering

Additionally, Cisco UCS Director has out-of-the-box tasks for NetApp Data ONTAP operating in 7-Mode, NetApp OnCommand®, and NetApp Virtual Storage Console (VSC) for VMware®. All of these tasks are built on the Cisco UCS Director Open Automation Software Development Kit (SDK), which enables integration with technology partners such as NetApp.

After the desired configuration has been defined and appropriate workflows have been created, Cisco UCS Director takes the newly deployed FlexPod configurations and brings them to a fully configured application-ready state with a single click. Because of this capability, organizations can reduce operational costs and time to deployment for each FlexPod configuration deployed in the environment. See the "Examples" section of this document for detailed information on two use cases: tenant onboarding and tenant application provisioning. Cisco UCS Director can also be used with a FlexPod configuration to configure networks, provide data replication by using NetApp SnapMirror, and complete other administrative tasks.

Cisco UCS Director has connectors both to infrastructure components below it (referred to as "southbound") and to higher level management tools above it (referred to as "northbound") such as Cisco® Intelligent Automation for Cloud (IAC) and OpenStack. These connectors enable Cisco UCS Director to focus on the infrastructure layer and to easily integrate into existing cloud and data center management stacks such as portals or ticketing systems. Its northbound interface is through a representational state transfer (REST) API, and most actions available in the graphical user interface (GUI) can be performed through the API. Figure 6 shows an overview of Cisco UCS Director. For more information, see the Cisco UCS Director REST Developer Guide.

Figure 6) Cisco UCS Director.

5 Cisco UCS Director Addresses Market Gap and Is Positioned as Primary Tool for FlexPod Management

The market provides many products for customers to consider for managing their IT process, infrastructure, and operations. Available products focus on aligning IT operations to business process management and managing cloud platforms, virtualization, and individual components. Cisco UCS Director addresses a major gap in the market with its capabilities to collectively manage across the underlying physical infrastructure that supports these higher level platforms. Cisco UCS Director reduces the complexity involved with the cross-component configuration necessary to deliver IT resources. This layer of foundational infrastructure is the most complex and specialized domain in the data center; therefore, it is by far the most time-consuming to manually operate and most prone to human error.

As the market shifts to continuous and more complex on-demand IT service delivery, comprehensive automation to dynamically provision and manage IT resources is essential to satisfy this demand. Data centers that cling to manual procedures increasingly suffer from inefficiency and outages and are unable to keep pace with the ever-increasing demand and complexity. The market offers many options to automate and manage higher levels of service delivery, facilitated by the standardization and programmability of those layers; however, the market does not address automating the underlying infrastructure due to the diversity in components and configuration. The NetApp FlexPod architecture reduces the scope of complexity in data center design, and Cisco UCS Director delivers cohesive management for the NetApp FlexPod portfolio. Cisco UCS Director can serve as an infrastructure administrator’s primary tool for unified FlexPod management and as a unified FlexPod integration interface for higher level data center management systems.

6 Examples

FlexPod provides industry-leading technology to deliver highly secure, yet flexible, multi-tenancy and workload environments. Cisco UCS Director can leverage the advanced features of clustered Data ONTAP within a FlexPod configuration to provide customers with a broad range of shared, secured, or fully isolated resources to best suit their business, application, or regulatory requirements. Clustered Data ONTAP is uniquely capable of delivering this flexibility and security from a small to a very large scale as business needs grow. The following examples detail how Cisco UCS Director enables secure, flexible customer tenant environments and workload-specific resources that can leverage the unique capabilities of NetApp FlexPod and clustered Data ONTAP. To download working implementations of these examples, see the “References” section of this document.

6.1 FlexPod Secure Tenant Onboarding with NetApp VM Storage

Providers of IT services worldwide enjoy how the unique capabilities of NetApp FlexPod and clustered Data ONTAP enable them to consolidate many varied workloads and IT consumers onto a common data center infrastructure platform with extreme flexibility in resource management. The term “tenant” is commonly used to define groupings across the consumption and/or separation of IT resources. A tenant organization can represent various forms of grouping: for example, the entirety of a business organization; a subset of IT consumers with special requirements; or isolation of particular applications or workloads due to design, business, or regulatory requirements. In such a multi-tenant environment, a prerequisite to delivering IT services is to create a dedicated environment to host the tenant resources. Depending on the provider’s preferences, this initial tenant environment can consist of a variety of standardized resources that establish a baseline for delivering IT services. This process is commonly referred to as “tenant onboarding.” The unique technologies within FlexPod and clustered Data ONTAP provide many degrees of isolation, security, performance, scalability, and data protection, all at fine granularity, to best suit the preferences of a provider’s approach to service delivery toward fulfilling the particular business or technology requirements of a tenant environment.

This example illustrates how Cisco UCS Director can prepare an initial tenant environment across a NetApp FlexPod infrastructure. In this scenario, the provider’s approach to tenant onboarding includes the deployment of a dedicated NetApp SVM within clustered Data ONTAP to securely isolate the storage to be delivered to this tenant. Within this SVM, the tenant onboarding process also deploys a storage volume to provide a dedicated, secured VMware datastore to host tenant VM files. In this scenario, the provider needs complete separation of tenant resources, including the network, so the process also includes deploying a dedicated VM datastore network attaching the SVM-isolated storage to the desired VMware cluster hosting the tenant VMs.

Example Procedure: FlexPod Tenant Onboarding with Secure Datastore

Complete the following prerequisites within Cisco UCS Director:

- Create a VLAN pool policy for provisioning tenant datastore networks.
- Create a static IP pool policy for provisioning tenant datastore network IP addresses.

To onboard a FlexPod tenant with secure datastore, complete the following steps:

1. In Cisco UCS Director, create a new group for this tenant.
2. In NetApp clustered Data ONTAP:
    a. Create an SVM for the tenant environment.
    b. Create a load-sharing mirror of the SVM root volume across all cluster nodes.
3. In Cisco UCS Director:
    a. Assign the SVM to the tenant group.
    b. Reserve a VLAN ID for the tenant datastore network.
    c. Assign the VLAN ID to the tenant group.
4. In Cisco UCS Manager, add the tenant datastore VLAN to the Cisco UCS fabric interconnect.
5. On the first Cisco Nexus switch:
    a. Add the tenant datastore VLAN.
    b. Update the trunks to allow the tenant datastore VLAN.
6. On the second Cisco Nexus switch:
    a. Add the tenant datastore VLAN.
    b. Update the trunks to allow the tenant datastore VLAN.
7. In VMware vSphere, create a virtual switch port group to contain the virtual network attachments for the tenant.
8. In Cisco UCS Director, assign the vSphere port group to the tenant.
9. In VMware vSphere, add a virtual adapter to the tenant port group to attach the tenant datastore VLAN.
10. In NetApp clustered Data ONTAP:
    a. Create a VLAN interface on one node to attach the tenant datastore VLAN.
    b. Create a VLAN interface on the high-availability (HA) partner node to attach the tenant datastore VLAN.
    c. Create a failover group across the VLAN interfaces.
11. In Cisco UCS Director, reserve an IP address for the tenant SVM logical network interface.
12. In NetApp clustered Data ONTAP:
    a. Create the tenant SVM logical network interface.
    b. Create an export policy to contain the NFS export rules for the tenant datastore.
    c. Create an export rule to permit the vSphere host virtual adapters to attach to the tenant datastore.
    d. Create the NetApp flexible volume to contain the tenant datastore.

  e. Define the storage path that the vSphere hosts will use to access the tenant datastore flexible volume.

13. In VMware vSphere, attach the desired vSphere hosts to the tenant datastore flexible volume.

6.2 FlexPod Secure Service Container with NetApp Application Storage

A key feature of Cisco UCS Director is its ability to create “secure service containers” to isolate a particular application or IT service deployment. A secure service container is a group of compute and storage resources that are provisioned onto private networks and isolated by a secure network gateway. Cisco UCS Director deploys service containers from templates defined by the service provider in order to support many instances of the service. The network, compute, and storage resources are defined as part of the service container template, and the compute and storage resources can be physical, virtual, or both. The applications or services within the container are accessed through a network gateway that provides both network address translation (NAT) and rule-based firewall support on behalf of the resources within the container. The container gateway can be configured with either a Cisco ASA or a Linux® IP-tables VM appliance.

NetApp clustered Data ONTAP delivers advanced tenancy capabilities that dramatically enhance the value of Cisco UCS Director secure service containers. This example illustrates how a Cisco UCS Director secure service container can be extended to include application storage secured within a NetApp SVM, providing for the isolation of resources while continuing to deliver the flexibility and efficiency benefits of shared infrastructure.

Example Procedure: FlexPod Secure Service Container with NetApp Application Storage

Complete the following prerequisites within Cisco UCS Director:

- Complete the steps in the previous tenant onboarding with secure datastore procedure to define a tenant and provision a NetApp SVM for that tenant.
- Create a secure service container template, include a container network to attach the storage to the desired application VM within that container, and provision an instance of that template.

To extend a secure service container to include application storage, complete the following steps:

1. In Cisco UCS Director, fetch the VLAN information for the service container instance.
2. In VMware vSphere, create a port group for the service container’s storage attachment VLAN.
3. In Cisco UCS Manager, add the container’s storage VLAN ID to the Cisco UCS fabric interconnect.
4. In Cisco UCS Director, assign the container’s storage VLAN ID to the tenant group.
5. On the first Cisco Nexus switch:
    a. Add the container’s storage VLAN.
    b. Update the trunks to allow the container’s storage VLAN.
6. On the second Cisco Nexus switch:
    a. Add the container’s storage VLAN.
    b. Update the trunks to allow the container’s storage VLAN.
7. In NetApp clustered Data ONTAP:
    a. Create a VLAN interface on one node to attach the container’s storage VLAN.
    b. Create a VLAN interface on the HA partner node to attach the container’s storage VLAN.
    c. Create a failover group across the VLAN interfaces.
8. In Cisco UCS Director, reserve an IP address for the tenant SVM logical network interface for the container’s storage attachment.
9. In NetApp clustered Data ONTAP:

a. Create the tenant SVM logical network interface for the container's storage attachment.
b. Create an export policy to contain the export rules for the application storage.
c. Create an export rule to permit VM interfaces on the container storage network to attach to the application storage.
d. Create the NetApp flexible volume to contain the application data.
e. Define the storage path that the container VMs will use to access the application data.

7 References

This report references the following documents and resources:

- The NIST Definition of Cloud Computing," September 2011; available from http://csrc.nist.gov/publications/nistpubs/800-145/SP800-145.pdf; Internet; accessed April 2014.
- "Big Data Drives Big Demand for Storage," April 16, 2013, available from https://www.idc.com/getdoc.jsp?containerId=prUS24069113; Internet; accessed April 2014.

To download the workflows associated with this document, see the following website:

- https://communities.cisco.com/community/technology/datacenter/ucs_management/content?filterID=contentstatus%5Bpublished%5D%7Ecategory%5Bucs-director%5D

Refer to the Interoperability Matrix Tool (IMT) on the NetApp Support site to validate that the exact product and feature versions described in this document are supported for your specific environment. The NetApp IMT defines the product components and versions that can be used to construct configurations that are supported by NetApp. Specific results depend on each customer's installation in accordance with published specifications.

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