NetApp Verified Architecture

**FlexPod Datacenter with SolidFire All-Flash Array Add-On**

NVA Deployment

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1 Program Summary

FlexPod® Datacenter is a predesigned, best practice data center architecture that is built on the Cisco Unified Computing System (Cisco UCS), Cisco Nexus family of switches, and NetApp® fabric-attached storage (FAS) systems. FlexPod is an ideal platform for running a variety of virtualization hypervisors and enterprise workloads. FlexPod can be scaled up for greater performance and capacity by adding compute, network, or storage resources individually as needed. It can also be scaled out for both virtualized and nonvirtualized environments that need multiple consistent deployments by rolling out additional FlexPod stacks. FlexPod delivers not only a baseline configuration, but also the flexibility to be sized and optimized to accommodate many different use cases.

2 Solution Overview

This solution describes the procedure for adding a SolidFire® all-flash storage system into any existing FlexPod Datacenter environment, with an emphasis on multi-tenant workloads demanding minimum performance guarantees. The hardware components included in the design include Cisco compute and networking, NetApp FAS, and SolidFire all-flash block storage system.

2.1 Solution Technology

Figure 1 shows the FlexPod Datacenter with NetApp FAS and SolidFire components and the network connections for a configuration with iSCSI-based storage. This design uses the Cisco Nexus 5000/9000 switches, Cisco UCS C-Series and B-Series servers with the Cisco UCS virtual interface card (VIC), the NetApp FAS family of storage controllers, and SolidFire storage nodes connected in a highly available design by using Cisco virtual port channels (vPCs).

Figure 1 shows the technical components of the solution, and Figure 2 shows the detailed cabling diagram.
Figure 1) FlexPod Datacenter components.

Cisco UCS
C220 M4 C-Series Servers

Cisco UCS
5108 B-Series Blade Chassis
2208XP Chassis FEX Modules
B200 M4 B-Series Blades

Cisco UCS
6248UP Fabric Interconnects

Cisco Nexus
9372PX or 5548UP
Switches

NetApp FAS8040
Storage Controllers

NetApp
DS2246 Disk Shelves

SolidFire 2405

Converged
10GbE Only
Note: The SF2405 1GbE ports are connected to the management switch.

Figure 2) FlexPod Datacenter cabling diagram.

2.2 Use Case Summary

The primary use case for this solution is to provide a scale-out storage option for block-based iSCSI workloads within the FlexPod Datacenter environment using SolidFire all-flash array. This use case also provides multitenant workloads with guaranteed, minimum performance service-level agreements (SLAs) that are required through SolidFire quality of service (QoS).

This document assumes the FlexPod Datacenter environment is configured as per any of our CVD best practices and describes only the deployment procedures and best practices to add a SolidFire all-flash block storage system in an existing FlexPod Datacenter environment. The server operating system is VMware vSphere ESXi, and a VMware vCenter Server is installed to manage the ESXi instances. The document leverages any existing FlexPod Datacenter environment for both and existing workloads.

3 Technology Requirements

Cisco, NetApp, and VMware have interoperability matrices that must be referenced to determine support for any specific implementation of FlexPod. The “FlexPod Datacenter Technical Specifications” document details the hardware and configuration requirements for FlexPod.

For more information, see the following links:

- [NetApp Interoperability Matrix Tool (IMT)](#)
- [Cisco UCS Hardware and Software Interoperability Tool](#)
- [TR-4036: FlexPod Datacenter Technical Specifications](#)
3.1 Hardware Components

Table 1 lists the hardware components used for this solution validation. However, any supported FlexPod hardware component or SolidFire node component can be used in this solution.

Table 1) Hardware components.

<table>
<thead>
<tr>
<th>Layer</th>
<th>Hardware</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compute</td>
<td>Cisco UCS 5108 chassis</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Cisco UCS B200 M4 blades with VIC 1240</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Cisco UCS C220 M4 rack-mount servers</td>
<td>2</td>
</tr>
<tr>
<td>Network</td>
<td>Cisco Nexus 9372PX</td>
<td>2</td>
</tr>
<tr>
<td>Storage</td>
<td>FAS8040</td>
<td>HA pair</td>
</tr>
<tr>
<td></td>
<td>Disk shelf: DS4246 with 24x900GB disks</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>SolidFire 2405</td>
<td>4</td>
</tr>
</tbody>
</table>

3.2 Software Components

Table 2 lists the software components used for this solution validation. However, any supported software component can be used in this solution.

Table 2) Software components.

<table>
<thead>
<tr>
<th>Layer</th>
<th>Software</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compute</td>
<td>Cisco UCS infrastructure software bundle</td>
<td>2.2(6)</td>
</tr>
<tr>
<td></td>
<td>Cisco UCS server bundle</td>
<td>2.2(6)</td>
</tr>
<tr>
<td>Network</td>
<td>Cisco Nexus switch software (system and kick start)</td>
<td>NX-OS 7.0(3)I1(3)</td>
</tr>
<tr>
<td>Storage</td>
<td>NetApp clustered Data ONTAP®</td>
<td>8.3.2</td>
</tr>
<tr>
<td></td>
<td>SolidFire Element OS</td>
<td>8.4</td>
</tr>
<tr>
<td>Hypervisor</td>
<td>VMware vSphere ESXi</td>
<td>6.0</td>
</tr>
<tr>
<td></td>
<td>VMware vCenter</td>
<td>6.0</td>
</tr>
<tr>
<td></td>
<td>Enic and fnic drivers</td>
<td>2.1.2.42 (enic)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.6.0.5 (fnic)</td>
</tr>
</tbody>
</table>

Table 3 lists the VLANs used for this solution validation.

Table 3) VLANs.

<table>
<thead>
<tr>
<th>VLAN Name</th>
<th>VLAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>NATIVE-VLAN</td>
<td>2</td>
</tr>
<tr>
<td>IB-MGMT-VLAN</td>
<td>3317</td>
</tr>
<tr>
<td>iSCSI-STORAGE-VLAN</td>
<td>3318</td>
</tr>
</tbody>
</table>
### 4 Cabling Details for SolidFire Nodes

Figure 3 shows the cabling diagram for Cisco Nexus switches and SolidFire nodes.

Figure 3) Cabling diagram for Cisco Nexus switch and SolidFire nodes.

<table>
<thead>
<tr>
<th>VLAN Name</th>
<th>VLAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>iSCSI-VLAN-ID_TENANT_1</td>
<td>3342</td>
</tr>
</tbody>
</table>

- **Cisco Nexus 9372 - A**
- **Cisco Nexus 9372 - B**
- **Solidfire 2405 – Node 1**
- **Solidfire 2405 – Node 2**
- **Solidfire 2405 – Node 3**
- **Solidfire 2405 – Node 4**

- Used 10G port
- Used 1G port
5 Deployment Procedures

This document assumes that the FlexPod Datacenter environment is already configured. This document provides detailed steps for attaching SolidFire nodes into an existing FlexPod Datacenter environment.

Deploying the solution involves the following tasks:

- Cisco UCS configuration
- Cisco Nexus switch configuration
- SolidFire node configuration

Note: NetApp recommends configuring Bond1G ports to a 1G management switch for SolidFire node management. This procedure is not covered in this document.

5.1 Cisco UCS Configuration

Follow any existing FlexPod Datacenter documentation to create service profiles and other Cisco UCS configurations. No additional configurations are required to add SolidFire nodes to an existing FlexPod Datacenter environment except the addition of the iSCSI tenant VLAN in vNIC A and vNIC B of a service profile.

5.2 Cisco Nexus Switch Configuration

The procedures in this section describe how to extend the switch configuration to add SolidFire nodes in a FlexPod Datacenter environment. This document assumes that the global configuration, license feature, and vPC are already configured. For more details, see any existing FlexPod Datacenter documentation.

Create iSCSI VLANs

This document covers only the iSCSI-related configuration. If your iSCSI VLANs are already configured, skip this step. To create iSCSI VLANs, complete the following step:

1. From the global configuration mode, run the following commands:

```
vlan <<iSCSI-VLAN-ID_TENANT_1>>
name iSCSI-VLAN-TENANT-1
```

Add Individual Port Descriptions

To add individual port descriptions for troubleshooting activity, complete the following steps:

**Cisco Nexus 9000 A**

1. From the global configuration mode, run the following commands:

```
interface Eth1/31
   description SF1:eth1
exit

interface Eth1/32
   description SF2:eth1
exit

interface Eth1/33
   description SF3:eth1
exit

interface Eth1/34
   description SF4:eth1
exit
```
Cisco Nexus 9000 B

1. From the global configuration mode, run the following commands:

```plaintext
interface Eth1/31
description SF1:eth2
exit
interface Eth1/32
description SF2:eth2
exit
interface Eth1/33
description SF3:eth2
exit
interface Eth1/34
description SF4:eth2
exit
```

Create Port Channels

To create the necessary port channels between devices, complete the following step on both switches:

Cisco Nexus 9000 A and Cisco Nexus 9000 B

1. From the global configuration mode, run the following commands:

```plaintext
interface Po1
description SF1:Bond10G
exit
interface Eth1/31
cchannel-group 1 mode active
exit
interface Po2
description SF2:Bond10G
exit
interface Eth1/32
cchannel-group 2 mode active
exit
interface Po3
description SF3:Bond10G
exit
interface Eth1/33
cchannel-group 3 mode active
exit
interface Po4
description SF4:Bond10G
exit
interface Eth1/34
cchannel-group 4 mode active
exit
```

Configure Port Channel Parameters

To configure port channel parameters, complete the following step on both switches:

Cisco Nexus 9000 A and Cisco Nexus 9000 B

1. From the global configuration mode, run the following commands:

```plaintext
int Po1
switchport mode trunk
switchport trunk native vlan <<NATIVE-VLAN>>
switchport trunk allowed vlan <<iSCSI-STOREGE-VLAN>>, <<iSCSI-VLAN-ID_TENANT_1>>, spanning-tree port type edge trunk
mtu 9216
vpc 1
int Po2
switchport mode trunk
```
Note: This document assumes that the VPCs are already configured in the FlexPod Datacenter environment.

Note: If new tenant is created, make sure to modify the allowed VLAN in the previous configuration.

5.3 SolidFire Node Configuration

This document assumes that your SolidFire hardware is racked, cabled, and powered on. The SolidFire cluster hardware must be appropriately installed and cabled so that network communications and configuration management communications can be established. Instructions for setting up the SolidFire hardware are provided in the hardware box in which it was shipped. For more cabling information, see Figure 3.

Configure SolidFire Bond1G and Bond10G Network Using Terminal User Interface

To configure the SolidFire nodes using the terminal user interface (TUI), complete the following steps:

1. Using the USB and VGA ports on the back side of the SolidFire node, attach the keyboard and monitor to the node.
2. Power on the node.
3. The TUI displays on the tty1 terminal with the Network Settings tab. Make sure that the static IP address is configured for the SolidFire nodes.
   Note: A node with a DHCP-assigned IP address cannot be added to a cluster.
4. Set the 1G interface settings as follows:
   a. Enter <<var_solidfire_node01_mgmt_ip>> in the IP Address field.
   b. Enter <<var_solidfire_mgmt_mask>> in the Subnet Mask field.
   c. Enter <<var_solidfire_mgmt_gateway>> in the Gateway Address field.
   d. Leave the other settings at the default.
   e. Press S to save the settings. Enter Y to confirm.
5. Set the 10G interface settings as follows:
   a. Enter `<<var_solidfire_node01_storage_ip>>` in the IP Address field.
   b. Enter `<<var_solidfire_storage_mask>>` in the Subnet Mask field.
   c. Enter `<<var_solidfire_storage_gateway>>` in the Gateway Address field.
   d. Enter `9000` in the MTU field.
   e. Enter `LACP` in the Bond Mode field.
   f. Enter `<<var_iscsi_default_vlan_id>>` in the Virtual Network Tag field and press S to save.
   g. Leave the other settings at the default.

**Note:** The gateway address is optional in a basic configuration of the 10G interfaces. Virtual Network Tag is optional and is only required if it is the primary network for SolidFire.
Configure SolidFire Cluster

To configure the SolidFire clusters complete the following steps:

1. From the TUI, press C to navigate to Cluster Settings.
2. Enter <<var_solidfire_node01>> in the Hostname field.
3. Enter <<var_solidfire_cluster>> in the Cluster field.  
   **Note:** Use the same cluster name on all the SolidFire nodes.
4. Leave the other fields at the default.
5. Press S to save the settings and then press Y to accept and save the settings. This operation may take a few minutes to complete.
6. Perform steps 1-5 on all SolidFire nodes using their respective values.

**Note:** SolidFire requires a minimum of four nodes.

### Create SolidFire Cluster by Using Web UI

You can create a cluster from any node. Creating a new cluster initializes a node as the communications owner for a cluster and establishes network communications for each node in the cluster.

To create a cluster by using the web UI, complete the following steps:

1. In a browser window, enter any node management IP (MIP) address. The Create a New Cluster page appears automatically.
2. All of the nodes are automatically displayed in the Nodes pane.
3. Configure the following fields:
   - Management VIP: <<MVIP address>>
   - iSCSI (Storage) VIP: <<SVIP address>>
   - Create User Name: <<username>>
   - Create Password: <<password>>
   - Repeat Password: <<password>>

4. Select the I Agree checkbox. Click Create Cluster.

5. Type the <<var_solidfire_cluster_mgmt_ip>> address in a web browser and enter the authentication credentials.

6. When prompted to add your available drives, click Add Drives.
7. Select Cluster and click the Nodes tab to verify that all four nodes are active.

![Node Status Table](image)

Configure Cluster Full Settings and NTP

To configure the cluster full settings and NTP, complete the following steps:

1. Open a web browser and navigate to the cluster MVIP address.
2. Navigate to Cluster > Settings.
3. Click Cluster.
4. In the Cluster Full Settings section, enter 3 and click Save Changes.
5. Click Back to Settings.
6. In the Network Time Protocol Settings section, click the Broadcast Client option.
7. In the Server field, enter the desired NTP address.
8. Click Save Changes.
Tenant accounts are billable accounts that have access to the storage resources on a SolidFire storage cluster. These accounts enable access to volumes on the cluster through an iSCSI connection and require a Challenge-Handshake Authentication Protocol (CHAP) identification and authorization before a connection can be made.

To create a new tenant account, complete the following steps:

1. Open a web browser and navigate to the cluster MVIP address.
2. Navigate to Management > Accounts.
3. Click Create Account.
4. Enter a new user name.
5. In the CHAP Settings section, enter the initiator secret and target secret passwords for CHAP node session authentication.
   
   **Note:** Leave the fields blank to autogenerate the passwords. Although Volume Access Groups do not use CHAP authentication, the volume creation still requires an account to be assigned.
6. Click Create Account.
Create Volume

To create a new volume, complete the following steps:

1. Open a web browser and navigate to the cluster MVIP address.
3. Click Create Volume.
4. Enter the volume name.
   
   **Note:** In the Volume Name field, you can enter letters, digits, or dashes (-).
5. Click the Account drop-down list and select the tenant account that is to have access to the volume.
6. Enter the total size of the volume.
7. Select whether or not to enable the 512k block emulation.
   
   **Note:** This option is necessary to support operating systems that do not recognize native 4k drives, such as VMware ESX. By default, this option is selected.
8. Set the Quality of Service Settings values or accept the default values.
9. Click Create Volume.
To create new volume, complete the following steps:

1. Open a web browser and navigate to the cluster MVIP address.
3. Click Active Volumes.
4. Under Actions, click Settings and then select Snapshot.
5. In the Create Snapshot of Volume page:
   a. Enter a name for the Snapshot copy.
   b. In the Retention section, select your desired option.
   c. In the Schedule section, select Create Snapshot Schedule.
   d. Enter the schedule name and select Schedule Type.
6. Click Create Schedule.
Create Snapshot of Volume

Volume Details
ID: 1  Name: SF-infra-datastore1
Account: infra_account1
Slice Count: 1  512e: Yes
IQN: iqn.2010-01.com.solidfire:u051.sf-infra-datastore1.1

General
New Snapshot Name
snapshot-SF-infra-datastore1

Include Snapshot in Replication When Paired

Retention
Keep Forever
Set Retention Period

Schedule
Take Snapshot Now
Create Snapshot Schedule

New Schedule Name
Weekly

Schedule Type
Days of Week
Recurring Schedule

Create Snapshot every

Time of Day (UTC)
12:00 AM

Create Schedule  Cancel
Create Volume Access Group and Attach Volumes

To create a new volume access group, complete the following steps:

1. Open a web browser and navigate to the cluster MVIP address.
3. Click Create Access Group.

4. In the Create a New Access Group page:
   a. Enter a name for the volume access group.
   b. Click the Create Initiator link.
   c. Enter an IQN in the Initiators text box and click Create.
   d. After creating the initiator, select the initiator and click Add Initiator.

   **Note:** To gather the vNIC iSCSI qualified name (IQN) information, launch the Cisco UCS Manager GUI. In the navigation pane, select the Servers tab. Expand Servers > Service Profiles > root. Click each service profile and then click the iSCSI vNICs tab on the right. The initiator name is displayed at the top of the page under Service Profile Initiator Name.

   e. Click Add Initiator.
   f. In the Attach Volumes section, select the volume from the Volumes drop-down list and click Attach Volume.
5. Click Create Access Group.
To create a new VLAN, complete the following steps:

1. Open a web browser and navigate to the cluster MVIP address.
3. Click Create New VLAN.
4. Configure the following fields:
   - VLAN Name: ESX-iSCSI-VLAN-Tenant-1
   - VLAN Tag: \(<<iSCSI-VLAN-ID\_TENANT\_1>>\)
   - SVIP: \(<<IP\_address>>\)
   - Netmask: \(<<IP\_netmask>>\)
5. In the IP Address blocks section, enter the starting IP address and size.
6. Click Create VLAN.
Connect VMware vSphere to SolidFire

To connect the VMware vSphere environment to SolidFire, complete the following steps:

**Create VMkernel Adapters**

Make sure that the following prerequisites are met:

- One vSphere vSwitch or vSphere distributed switch with at least two physical network uplinks.
- One or more network connections between the ESXi host and SolidFire storage.

To create the VMkernel adapters, complete the following steps:

1. Log in to VMware vCenter using the VMware vSphere Client.
2. From the home page, navigate to Hosts and Clusters.
3. On the right pane, click Manage > Networking > VMkernel adapters.
4. Click the add ( ) button.
5. In the Add Networking wizard, select the following options:
   a. Select VMkernel Network Adapter for the Connection type.
   b. Select the target device as vSwitch or Virtual Distributed Switch.
   c. In Port Properties, enter the network label and VLAN ID.
   d. In IPV4 settings, enter the static IP and subnet mask.
6. Click Finish.
7. (Optional) Create another VMkernel adapter in the same subnet.

### Configure iSCSI Multipathing

A VMkernel interface should be configured for each physical network interface to be included in the multipathing configuration. By default, all uplinks are active for each port group. Configure each port group used for iSCSI and its VMkernel interface to override the vSwitch physical interface failover order to configure a single active uplink per iSCSI port group.

1. Log in to VMware vCenter using the VMware vSphere Web Client.
2. From the home page, navigate to Hosts and Clusters.
3. On the right pane, click Manage > Networking > Virtual Switches.
4. Select the desired vSwitch and VMkernel interfaces.
5. Click the Edit settings ( ) button.
6. In the VMkernel Edit settings pane, select Teaming and failover.
7. Select Override under Failover Order.
8. Move one of the VMNICS to Unused adapters and click OK.
9. Repeat steps 1-8 for the other VMkernel adapter.

**Note:** vmnic1 is unused adapter for VMkernel-iSCSI-A-Tenant-1 and vmnic0 is unused adapter for VMkernel-iSCSI-B-Tenant-1.

**Binding VMkernel Interfaces to the iSCSI Adapter**

1. Log in to VMware vCenter by using the VMware vSphere Web Client.
2. From the home page, navigate to Hosts and Clusters.
3. Select the ESXi host to which you want to add the SolidFire iSCSI datastore.
4. Select the Manage tab.
5. Select the Storage tab.

6. In the left pane, click Storage Adapters.
7. Select the adapter under iSCSI Software Adapter.
8. Under Adapter Details, select the Targets tab.
9. Click Static Discovery.
10. Click Add.

11. In the iSCSI Server field, enter the SVIP.
12. In the iSCSI Target Name field, enter the volume IQN.
   
   **Note:** The IQN value can be retrieved from the SolidFire Element UI by selecting the Modify Volume option.

13. If you are using a one-way CHAP, complete the following steps:
   a. Select Use Unidirectional CHAP if required by target from the Authentication Method drop-down list.
   b. In the CHAP Name field, enter the CHAP user name for the SolidFire tenant account that you previously created.
   c. In the CHAP Secret field, enter the SolidFire initiator secret that you previously created.
   d. Click OK.
14. Click the Network Port Binding tab and add the VMkernel interfaces using the + button.

15. Rescan the storage adapter.

16. In the left pane, select Storage Devices and check for the new storage device.
17. From SolidFire Cluster user interface, make sure the iSCSI sessions are created for both VMkernel interfaces.

18. Repeat steps 1 to 17 for all of the ESXi hosts in the cluster.

**Mount Datastore**

To mount the datastore, complete the following steps:

1. In the VMware vSphere Web Client, open the ESXi host.
2. Select the Related Objects tab.
3. Select the Datastore tab.
4. Click the Add Datastore ( pudding icon) button.
5. Select the VMFS type and click Next.

6. In the Datastore Name field, enter a datastore name, select the storage device from the list, and click Next.
7. From the Partition Configuration drop-down list, select your partition layout and click Next.

8. Review the datastore information and click Finish.
Acknowledgements

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- Dave Derry, NetApp
- Bhavin Shah, NetApp
- Chad Smith, NetApp

References

This report references the following documents and resources:

- FlexPod Datacenter with VMware vSphere 6.0:  
- VMware vSphere and vSphere with Operations Management:  
  http://www.vmware.com/in/products/vsphere
- SolidFire Active Support:  
  http://www.solidfire.com/platform/support
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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